Summary Report

Idaho Nitrate Symposium: Working together to protect Idaho's Drinking Water Sources
December 4, 2014
Twin Falls, Idaho

Introduction

Ground water supplies drinking water to more than 200 Idaho cities and towns and 95% of Idaho households. Although the quality of ground water in Idaho is generally good, several areas in Idaho show elevated levels of Nitrate.

- Nearly 7% of the wells sampled in Idaho have nitrate concentrations above the federal drinking water standard of 10 mg/L and 46% have nitrate concentrations above background levels of 2 mg/L.
- Approximately 400,000 Idahoans live in Nitrate Priority Areas where 25% of the wells have nitrate concentrations greater than or equal to 5 mg/L.
- Within some Nitrate Priority Areas 50% or more of the wells have nitrate concentrations greater than or equal to 10 mg/L.

This localized degradation negatively impacts water quality and threatens domestic water supplies, aquaculture, and other beneficial uses of ground water.

The Idaho Nitrate Symposium was held on December 4, 2014 in Twin Falls, Idaho to address nitrate degradation in the state and the resulting concerns. The intent of the symposium was to increase awareness of the impacts of nitrate contamination on drinking water sources, recognize potential partners, and identify effective solutions to better protect Idaho's drinking water sources. Approximately 90 participants attended the one day event. The symposium included presentations and discussion on the risks of nitrate in drinking water, how nitrate moves through the soil, and successful examples of nitrate reduction and community involvement (see agenda in Appendix A).

Symposium Background

The Idaho Department of Environmental Quality became aware of potential funding available from EPA to promote state source water protection collaborative efforts. Since Idaho already established a state source water protection collaborative, DEQ discussed other workshop options with EPA and their contractor Cadmus Group, Inc. Examples of workshops conducted at other states were discussed, including Iowa, who held workshops that focused on nitrates and source water protection. Iowa held a source water protection partnership workshop to reach producers and share an effective message regarding nitrate. As a result, the Iowa collaborative developed a nutrient reduction strategy and, by leveraging several programs, they were able to implement BMPs to reduce nitrates in ground water serving a public water system.

DEQ, EPA and Cadmus decided that hosting a symposium on the effects of nitrate on source water in Idaho would be valuable. The intent of the symposium was to increase awareness of the

impacts of nitrate contamination on drinking water sources, recognize potential partners, and identify strategies for implementation aimed at improving ground water quality. The Twin Falls region was chosen to host the symposium because there are four nitrate priority areas (Twin Falls, Minidoka, Marsh Creek, Bliss) in the area, and there are several active ground water quality advisory groups that have successful examples to highlight.

Members of the source water collaborative (www.protectthesource.org) and other key stakeholders were invited to participate in a planning committee for the symposium. The planning committee was tasked with identifying and commenting on potential topics and speakers, and providing feedback on the logistics of the symposium (registration fee, locations, etc.).

Planning committee members included staff from Idaho Department of Environmental Quality, U.S. Environmental Protection Agency, The Cadmus Group, Inc., USDA Natural Resource Conservation Service, University of Idaho, Idaho Water Resource Research Institute, USDA Agricultural Research Service, Idaho State Department of Agriculture, Idaho Soil and Water Conservation Commission, Cassia County Ground Water Advisory Group, Twin Falls County Ground Water Advisory Group, Middle Snake Regional Water Resource Commission, Idaho Rural Water Association, South Central District Health Department, Idaho Department of Health and Welfare, and the City of Boise (Public Works).

The target audience for the symposium focused on local service providers who work directly with producers and land owners, including: conservation districts, certified crop advisors, nutrient management planners, ground water advisory committee members, and local government officials and staff. Postcards and emails were sent inviting them to participate. A $30 registration fee was charged to cover the cost of the meeting facility and lunches.

Meeting Summary

Approximately 90 people attended the symposium (see registration list in Appendix B).

Certified Crop Advisor	12
Nutrient Management Planner	1
Soil & Water Conservation District	1
Local Government	16
State Government	20
Federal Government	12
University	4
Other	13
No response	9

The symposium was broken down into three segments:

1. What is the water quality? This section included an overview of Idaho's aquifers and ground water vulnerability, where nitrate is occurring in high levels (nitrate priority areas and source water protection areas), and why nitrate is a health concern for both humans and livestock.

2. What does the data show? This section included an overview of nitrogen in the soil, effects of irrigation on nitrogen movement and examples of post-harvest nitrate tests to determine the level of nitrogen movement in the soil.
3. What are the solutions? This section included several examples of successful nitrate reduction projects including habitat restoration in Iowa, implementation of various BMPs in Idaho, and deep nitrate testing to encourage community involvement in the Columbia Basin. The final session of the symposium included a collaborative learning session to allow participants to discuss potential solutions and ways to work together in the future.

Presentations are available online at http://www.deq.idaho.gov/nitrate-symposium. A summary of each presentation in also included in Appendix C and speaker biographies and abstracts are included in Appendix D and E. In addition to the presentations, the following posters were displayed:

- Idaho's Nitrate priority area map and ranking (DEQ)
- Idaho's Source Water Assessment Website (DEQ)
- Community Source Water Protection (DEQ)
- Numerical Model Simulations of Nitrate Concentrations in Groundwater Using Various Nitrogen Input Scenarios, Mid-Snake Region, South-Central Idaho (USGS)
- Soil Health 101 (NRCS)
- CAFO Siting Team (ISDA and DEQ)
- Subsurface/NP Evaluations (DEQ)
- Source Water Protection and Ground Water Guardian display (IRWA, City of Boise)
- Private Well Testing display (DEQ)
- Water Facts (DEQ- NGWA source)
- Yakima Clinician Training Program/Resources (EPA)

Feedback:

Approximately 43% of the participants completed evaluations. Of those, 48% rated the overall workshop as excellent and 51% rated the overall work shop as good. All participants who completed an evaluation answered that the topics discussed at the symposium were useful to them. Of the evaluations received, 97% of participants answered that they would like to see more of these workshops in the future. The majority of those thought future workshops should be a full day (74%) held annually (67%) and focus on regional (38%) and/or local issues (27%). Suggestions of future topics included soil sampling, water quality, regulations, BMPs and innovative technologies, and source water protection. See Appendix F for the complete evaluations.

Follow-up and Future Actions:

Participants: The collaborative learning session included an exercise that broke participants into small groups to discuss potential solutions and ways to work together in the future. Each person

in the small group was given two minutes to share promising ideas, identify action items and how to measure success, and then report back as a group to the larger group. This exercise helped get participants thinking of ways they can make changes to have an impact and improve water quality. Some of the common themes that were identified included: educating and raising awareness, improving communication and partnerships to learn from each other and build trust, and assessing alternative mechanisms, technologies and best management practices to identify win-win strategies. A summary of the responses are included in Appendix C.

The evaluation form then asked participants what actions they planned to take as a result of this workshop. Some of those actions included:

- sample to greater depths to look for residual nitrate
- revisit source water protection ordinance
- test for nitrates in future well depth study
- update source water protection plan, ordinance, and impact area agreement
- review Iowa example, investigate soil conservation measures, and review Yakima EPA dairy consent order
- follow up on expertise and reference materials provided at symposium

See Appendix F for evaluation responses.

DEQ: In an effort to build on the momentum of the symposium, DEQ has scheduled a follow-up meeting with the planning team to discuss next steps. Two proposed actions that will be discussed with the planning team include:

- A proposal to develop a collaborative working group to establish recommendations for nitrogen reduction strategies. Suggestions of opportunities to improve nitrogen reduction were identified through the planning process as well as at the symposium. The idea of creating a workgroup would be to capture and prioritize those ideas which could be used to identify potential project and partnership opportunities, or potentially used to develop a statewide nitrogen reduction strategy.
- Identify an on the ground project to reduce nitrates in a source water protection area. The Iowa and Columbia Basin examples made in impact on participants at the symposium and Idaho would like to try to replicate their efforts. A local advisory group would be established to select the location and type of project. DEQ would help set the criteria for selecting the location. Local partners would be identified and funding acquired (including source water protection funds). The project could be used as a local case study specific to Idaho that would be shared to promote source water protection through nitrate reduction.

Acknowledgements:

DEQ would like to thank EPA for the support and funding provided that made the symposium possible. Because of the funding EPA provided, excellent speakers from other areas were able to participate and share success examples from other states. We would also like to thank all the

speakers. There were several comments from participants on the excellent presentations that provided valuable information. We would also like to thank those who provided posters and displays and we appreciate all the hard work from the planning team members who helped organize and plan the event.

Appendices:

- Appendix A: Symposium Agenda
- Appendix B: Registration List
- Appendix C: Summary of Presentations
- Appendix D: Abstracts
- Appendix E: Speaker Bios
- Appendix F: Evaluations

APPENDIX A

Nitrate Symposium – Working Together to Protect Idaho's Drinking Water

December 4, 2014
Twin Falls, Idaho

Agenda

8:30 – 8:45 **Welcome** (Terry Kramer, Twin Falls County Commissioner)

Part 1: What is the quality of Idaho's Drinking Water?

8:45 – 9:05 **Idaho's Aquifers**: Overview of Idaho's Aquifer Systems and Southern Idaho's Unique Hydrogeology (Michael McVay, Idaho Department of Water Resources)

9:05 – 9:30 **Water Quality Concerns:** Nitrate Priority Areas and Source Water in Idaho (Toni Mitchell, Idaho Department of Environmental Quality)

9:30 – 9:50 **Health Effects of Nitrate in Drinking Water**: Human and livestock concerns from nitrate. (Jeff Fromm, Idaho Department of Environmental Quality)

9:50 – 10:15 **Break/ Poster Session**

Part 2: What does the data show?

10:15 – 11:15 **Nitrogen in the Soil: Current Studies** (Amber Moore – University of Idaho, Dave Bjorneberg and David Tarkalson – USDA Agricultural Research Service)

11:15 – 11:35 **Irrigation Management: How Irrigation Effects Nitrogen Movement**: Tools to measure and determine application rates. (Howard Neibling, University of Idaho)

11:35 – 11:55 **Nitrogen Movement Below Root Zone:** Post-harvest nitrate tests in Yakima (Eric Winiecki, EPA Region 10)

11:55 – 12:45 **Lunch (provided)**

Part 3: What are the solutions?

12:45 – 1:15	**Sustainable Source Water Protection through Habitat Restoration at Remsen, Iowa** (Chi Ho Sham, Cadmus Group, Becky Ohrtman, Iowa Department of Natural Resources)
1:15 - 2:05	**Best Management Practices to Improve Ground Water Quality: Implementation Efforts in Idaho and Beyond** (Carolyn Firth, Idaho Soil and Water Conservation Commission)
2:05 – 2:15	**Break**
2:15– 2:45	**Deep Nitrate Tests in Columbia Basin: How to get the community engaged?** (Paul Stoker, Columbia Basin Ground Water Management Area)

Part 4: Where do we go from here?

2:45 – 3:15	**Facilitated Panel Discussion** (Chi Ho Sham, Cadmus Group)
3:15 – 4:30	**Collaborative Learning** (Chi Ho Sham, Cadmus Group)
4:30 –4:45	**Wrap-up**

APPENDIX B – Registration List

	First Name	Last Name	Company	Position	City	State
1	Aaron	Aggeler	City of Shohsone	Maintenance	Shoshone	ID
2	David	Anderson	DEQ	Regional Administrator	Twin Falls	ID
3	Jay	Barlogi	Twin Falls Canal Company	Field Supervisor	Twin Falls	ID
4	Mike	Barnum	US/DOI/BLM/ID	Rng Mgmt Spec	Greenleaf	ID
5	Phyllis	Beard			Filer	ID
6	Britt	Beene	Helena Chemical Company	Location Manager	Paul, Idaho	ID
7	Terik	Birch			Saint Anthony	ID
8	Dave	Bjorneberg	USDA Ag Research Service		Kimberly	ID
9	Robert	Bohling	City of Twin Falls	Water Superintendent	Twin Falls	ID
10	Melody	Bowyer	South Central Public Health District	Environmental Health Div Directo	Twin Falls	ID
11	Eugene	Brown	City of Hazelton	Public Works Supervisor	Hazelton	ID
12	Jason	Brown	City of Twin Falls	Environmental Engineer	Twin Falls	ID
13	Michael	Brown	Department of Environmental		Twin Falls	ID
14	Dee	Carlson	NRCS		Pocatello	ID
15	Randy	Clark	City of Buhl	Planning and Zoning Administrato	Buhl	ID
16	Jeff	Cook	City Of Glenns Ferry	Public Works Director	Glenns Ferry	ID
17	Ian	Crawford			Twin Falls	ID
18	Dean	Delorey			Boise	ID
19	Katie	Dennis	NRCS		Pocatello	ID
20	Kevin	Dugan	Camas Conservation District	Supervisor	Fairfield	ID
21	Richard (Rick)	Dunn	Twin Falls County		Twin Falls	ID
22	Kathryn	Elliott	Idaho Department of Environmental Quality		Boise	ID
23	Bob	Erickson	South Central Public Health District	Environmental Health Specialist	Bellevue	ID
24	Carolyn	Firth	ID Soil & Water Conservation Commission	Ag Program Specialist	Burley	ID
25	Ralph	Fisher	US Environmental Protection Agency	Nutrient Managment Specialist	Boise	ID
26	Jeff	Fromm			Boise	ID
27	Jeff	Gabardi	USDA Forest Service	Mining Engineer	Twin Falls	ID

28	Robert	Goss	Bigham	Public Works Supervisor	Aberdeen	ID
29	Ed	Hagan	Idaho DEQ		Boise	ID
30	Joanna	Hahn			Boise	ID
31	Flint	Hall	DEQ	Environmental Scientist	Idaho Falls	ID
32	Melinda	Harper	Idaho Rural Water Association	Technician	Boise	ID
34	Tom	Hepworth	DEQ	Engineering Manager	Pocatello	ID
35	Micheal	Hill			Rupert	ID
36	George	Hitz	Soil and Water Conservation Commission			
37	Colton	Holden	Landview			
38	Ray	Hollist	Hollist Crop Consulting, Inc.		Shelley	ID
39	Candice	Hopkins	USGS	Hydrologist	Boise	ID
40	Rob	Howarth	Central District Health Department	Division Director	Boise	ID
41	Adrianna	Hummer	Idaho Rural Water Association	Source Water Protection	Boise	ID
42	Patti	Hurley	NRCS		Pocatello	ID
43	Kelly	Hurst			Blackfoot	ID
44	Brett	Huse	Bio West Ag Solutions		American Falls	ID
45	Ron	Jones	Ecolotree	CFO	Twin Falls	ID
46	Terry	Kramer	Twin Falls County	Commissioner	Twin Falls	ID
47	AMANDA	LARESE	BANNOCK COUNTY PLANNING & DEVELOPMENT		Pocatello	ID
48	Rene	LeBlanc	South Central Public Health District (PHD V)		Twin Falls	ID
49	Charles	Lenkner			Twin Falls	ID
50	John	Lind				ID
51	Sam	Lusk	Boyle Fertilizer		St. Anthony	ID
52	Greg	Mansfield			Chubbuck	ID
53	Sheila	McAtee			Lewiston	ID
54	Kerry	McMurray	Cassia County	Administrator	Burley	ID
55	Michael	McVay			Boise	ID
56	William	Mills	Idaho Dept. of Water Resources		Boise	ID
57	Tonia	Mitchell			Boise	ID
58	Amber	Moore	University of Idaho	Soil Fertility Specialist	Twin Falls	ID
59	Irene	Nautch	DEQ, Twin Falls Regional Office		Twin Falls	ID
60	Ken	Neely			Boise	ID
61	Marsha	Neibling	Mrs.		Kimberly	ID
62	W.	Neibling	University of Idaho		Kimberly	ID
63	John	O'Connor	Farm Management Inc	President/	Buhl	ID

				Owner		
64	Brian	Oakey			Boise	ID
65	Rebecca	Ohrtman	Iowa DNR	SWP Program Coordinator	Ankeny	IA
66	Nicholas	Peak			Boise	ID
67	Chuck	Pentzer	ISWCC		Twin Falls	ID
68	Brian	Petersen	J.R. Simplot Company		Boise	ID
69	John	Peyman	City of Shohsone		Shoshone	ID
70	Courtney	Richards	Idaho State University	Student	Pocatello	ID
71	Daniel	Romano	NRCS		Pocatello	ID
72	TIM	SHURTLIFF	BANNOCK COUNTY PLANNING & DEVELOPMENT	ENGINEER	Pocatello	ID
73	Megan	Satterwhite	University of Idaho		Twin Falls	ID
74	Chi Ho	Sham	The Cadmus Group, Inc.	Senior Scientist	Waltham	MA
75	Kenneth	Skinner	U.S. Geological Survey	Hydrologist	Boise	ID
76	Christopher	Smith	Crop Production Services	Salesman	Wendell	ID
77	Steven	Smith			Pocatello	ID
78	Paul	Stoker			Othello	WA
79	LINDA	TIGERT	BANNOCK COUNTY PLANNING & DEVELOPMENT	PLANNING DIRECTOR	Pocatello	ID
80	John	Taberna	Western Labs	Agronomist	Blackfoot	ID
81	David	Tarkalson	USDA-ARS	Cropping Systems Agronomist	Kimberly	ID
82	Craig	Tesch	Idaho Dept. of Water Resources		Boise	ID
83	K	Wells		Cassia Ground Water Committee	Oakley	ID
84	Amy	Williams	Idaho Department of Environmental Quality		Boise, Idaho	ID
85	Eric	Winiecki			Seattle	WA
86	Dennis	Wright			Buhl	ID
87	Mario	de Haro-Marti	University of Idaho	Extension Educator	Gooding	ID
88	robert	todd			nampa	ID

APPENDIX C: Presentation Summaries

Please note that note taking responsibilities at the symposium were divided among several volunteers with various note taking styles. Below are the notes.

Welcome (Terry Kramer, Twin Falls County Commissioner)

Mr. Kramer described how land use development over the last century has created a "false" unnatural aquifer due to irrigation from surface water. The water table has risen closer to the surface and become more vulnerable to contamination. He suggested that the Twin Falls Nitrate Priority Area has a decreasing nitrate trend for economic reasons. He thought the higher cost of nitrogen based fertilizers coupled with better irrigation efficiency was responsible for the lower nitrates in ground water. He wrapped by encouraging attendees to share information from the symposium with their neighbors and friends.

Idaho's Aquifers (Mike McVay, IDWR)

An overview of factors contributing to vulnerability contained in the DRASTIC model of potential contamination was provided. These factors include Depth to water, net Recharge, Aquifer media, Soil media, Topography, Impact of vadose zone media, and hydraulic Conductivity of aquifer. The most significant factors associated with ground water degradation were generally depth to water and soil media. He provided examples from selected aquifers in Nitrate Priority Areas (NPAs), around the areas state including the Bear River Aquifer NPAs, Eastern Snake Plain Aquifer, and the Mountain Home Aquifer to illustrate that NPAs are predominantly located in shallow unconfined aquifers with permeable soils.

Water Quality Concerns (Toni Mitchell, DEQ)

An overview of nitrate occurrence in Idaho was presented along with information on potential nitrate sources. The Idaho Nitrate Priority Area process was described and the 2014 NPA ranking was provided. A brief description of public water systems in Idaho was provided which showed that 97% of the public water sources in Idaho are ground water wells or springs. The Idaho Source Water Assessment process includes delineations, an inventory of potential contaminant sources, a susceptibility analysis, and a summary report. A variety of source water protection plans can be implemented to protect public water supplies.

Health Effects of Nitrate in Drinking Water (Jeff Fromm DEQ)

The health effects of nitrate were discussed. The most concerning impact associated with elevated nitrates in drinking water is methemoglobinemia (blue baby syndrome) which occurs in infants under 6 months of age due to physiological reasons unique to infants. There are few reported cases in the United States. However, methemoglobinemia may be under reported. There is some debate whether methemoglobinemia may be entirely caused by nitrates and may

be associated with gastrointestinal infection. High levels of nitrate may be associated with numerous cancers due to nitrosamine formation. The synergistic impacts of nitrates with pesticides are uncertain.

Nitrogen in the Soil: Current Studies (Amber Moore – University of Idaho, Dave Bjorneberg and David Tarkalson – USDA Agricultural Research Service)

Dave Bjorneberg (ARS)

Information on nitrate concentrations in surface water were presented which showed nitrate concentrations in Twin Falls Canal Company return flows have approximately doubled from 1 mg/L to slightly more than 2 mg/L since 1970. However, the nitrate concentrations in the main canal have decreased to almost non-detectable levels. This information indicates the water running off the fields contains lower nitrate than the water moving into ground water. So nitrate is coming from the soil. Nitrate concentrations in ground water vary significantly over short distances and seasonally. Sources of nitrate include cropland and cows. Cows produce about 150 lbs of ammonia per cow per year, of which about 50 lbs are transported to the atmosphere.

Amber Moore (U of Idaho)

The timing and amount of nitrate in manure that is available to plants varies by animal species and the form of manure (composted or wet). Comparisons with manure from poultry, swine, beef, and dairy were shown. Nitrification was shown to increase with temperature. At warmer temperatures nitrate is more available to plant. Manure takes several years to release as nitrate, while inorganic fertilizer is much more susceptible leaching and can release nitrate within days or weeks depending on temperature. Therefore, soil testing is necessary to ensure appropriate nutrient application.

David Tarkalson (ARS)

Research has led to increasing crop yields with decreased nitrogen use. Additional research is needed to better understand mineralization processes to predict nitrate soil availability. Examples of the response of corn and sugar beets to nitrogen were presented. The impacts of conventional fertilizer and manure applications frequency was illustrated by showing that a field with annual manure applications for six years had more than 450 lbs of nitrogen available in the top two feet of soil in the spring of 2014.

Irrigation Management: How Irrigation Effects Nitrogen Movement (Howard Niebling, Ph.D, University of Idaho)

Summary: Good irrigation water management can reduce nitrate movement toward ground water and will reduce demand on the aquifer. Irrigation water management depends on factors such as soil type, soil properties, root zone depth, moisture content, field capacity, and wilting point. Weather data, soil moisture sensing, and water budgeting are tools that can be used to determine

water storage capacity in the root zone and appropriate application rates and methods. Irrigation water management is not simple and considerations should be made for potential reductions in recharge, but we can be more efficient by putting the right amount of water at the right time.

Note: presentations are available for reference at http://www.deq.idaho.gov/nitrate-symposium.

Slide 2

- As season advances there is a deeper root zone.
- If you aren't paying attention to soil types, too much water can be added.

Slide 3

- Water budgeting requires evaluating many factors including water storage and water application methods.

Slide 6

- Cross section of soil from the Mackay area.

Slide 7

- Capillary forces hold water in soil.

Slide 8-13

- There are two different measures that can be used in the lab to determine water storage capacity.
- Different soils have different amounts of water storage capacity. For example, sandy soils have low storage/ft capacity where silt, clay, or loam soils have high storage/ft capacity.

Slide 14-28

- Soil moisture sensing can help minimize potential for deep nitrate leaching.

Slide 29

- Irrigation water management is not simple, but we can be more efficient by putting the right amount of water at the right time.

Yakima AOC Dairies, Draft Data, Yakima Valley, Washington
Eric Winiecki, US EPA

Summary:
The presentation covered details of EPA's Administrative Order on Consent ("Consent Order" or AOC) with several dairies in the Lower Yakima Valley, Washington and the work that has begun

to control nitrate sources, including soil and ground water sampling. The presentation summarized the data that has been collected so far, with a focus on soil.
Ground water data was also shared to show the relationship.

Note: presentations are available for reference at http://www.deq.idaho.gov/nitrate-symposium.

Slide 2 (The Dairies):
The black line is the footprint of the diaries; pink line includes the area of sampled wells and provision of treatment/alternative water supply (a few of the things the dairies agreed to when signing the AOC).

Slide 5 (Figure)
This is the conceptual site model developed by the diaries' consultant.

Slide 6 (Monitoring Wells)
Monitoring wells were installed by EPA in the winter of 2013. Dairies installed more (16). If they can't find/show a decreasing trend, then they will isolate those wells and work to address.

Slide 7 (Monitoring Well Sample Results)
Graph of 2013 third quarter ground water monitoring data. The data is sorted lowest to highest. Upgradient wells (in blue) are at or below the MCL. Most downgradient wells exceed the MCL. The monitoring wells are screened in the first 15 feet of the water table (shallow aquifer).

Slide 8 (Nitrate Concentrations in Shallow Monitoring Wells: 2014 Second Quarter (map))
A map of the concentrations. Gradient is shown by the arrow. As the water moves under the dairies, the concentration increases.

Slide 9 (Map – Yakima Valley Dairies Nitrate Concentrations)

Slide 10 (Presentation Overview)
All solid waste is exported. Land in footprint receives liquid waste/wastewater.

Slide 12 (Soil Nitrate Levels in Application Fields (graph)
This is a graph of concentrations of nitrate in soil at a depth of 2 feet, fall post-harvest. The goal is 45ppm. A lot exceeded the 45ppm target by a significant amount.

Slide 13 (Soil Data Summary)
As a footnote, larger fields had higher nitrate concentrations at the 2-foot depth.

Slide 15 (Average Soil Nitrate Concentration by Crop Type)
Weighted averages (based on size of field). 99 is fairly high (pointing out the 99 ppm in the 1-foot and 3-foot samples of triticale/silage corn).

Slide 16 (Pounds of Nitrate per Acre)
Multiply (the ppm results (from slide 15)) by 4 to get the pounds per acre.

Slide 17 (Root Zone Nitrate)

The WSU guidelines are 150 lbs for corn, 137 for Alfalfa (?), 287 for double crop (?). You can see they have an excess.

Slide 18 (Fall 2013 Soil Summary)
This is all nitrogen (not just organic nitrogen), post-harvest. All in the soil profile, vulnerable to leaching. The nitrate at 3-foot level has left the root zone and is available to leach to ground water.

Slide 20 (Proposed management changes)
Proposed shifting 10 fields to alfalfa. They would cut it/not plow it up. Some fields would get more than one treatment (management change).

Slide 24 (Lagoons to be Assessed)
Will evaluate lagoons to determine if standards are met. If can't show in the field, they'll line the lagoons.

Slide 25 (Provisions of Water Treatment)
The 61% is of those that were home to do it.

Questions from Audience:

- Are they applying animal waste? Yes, although they are reducing (amount?) on 5 fields.
- Depth to water? Soils? Varies across the site; northern end – 200 feet (bgs), southern end 40 feet (bgs). Soil class – silt loam at surface, lots of sand/sandy loam soils.
- How long have the diaries been in the area? Based on historic photos/aerials – 70's early 80's. At least one has been there since the 60's.

Sustainable Source Water Protection through Habitat Restoration at Remsen, Iowa
Becky Ohrtman, Iowa Department of Natural Resources (DNR)

Summary:
The presentation included a brief background on DNR's Source Water Protection (SWP) program, messages on the importance of partnerships and good, local planning teams for implementation. The majority of the presentation was on the successful collaborative source water protection efforts in Iowa (Remsen, Sioux Center, Elliott, and Griswold) to resolve high nitrate concentrations in ground water. The collaborative approach to SWP using land use management/acquisition, agricultural BMPs, and habitat restoration under a partnership with the agricultural community has been demonstrated to be an effective and sustainable approach to improving the quality of drinking water supplies.

DNR has been creating SWP plans since 1998 but no implementation was occurring. Historically, SWP lacked partnerships and with ~90,000 farms, ~3,000+ PWSs and one 'Becky' (running a voluntary program), partnerships were needed. Becky began developing local partnerships to help achieve SWP goals. This has been instrumental in implementation of SWP.

Remsen, Iowa Example:

The city of Remsen, with its wells showed significant nitrate contamination (since 2005), was facing installation of expensive treatment to maintain their water supply in the future. After forming a team and conducting a site investigation (fields with over application of manure were identified as a major source of nitrate), developed a work plan (using a template) to address the nitrate issue. A partnership was formed and funding was sought for implementation. A combination of grants and loans (0% interest loan with a SWP plan) were used to purchase land. The land was converted to native grasses through the help of partners like Pheasants Forever. The main objective was to lower nitrate concentration (to avert expensive treatment options) and the data is showing a reduction in nitrate concentrations.

Sioux Center, Iowa Example:
Sioux Center is a city in Sioux County, Iowa which is the county with the highest livestock production in Iowa. More manure is produced that the amount of acreage needed for disposal. In this case, a project to install native grasses wouldn't work since the land is needed to feed the cattle so field trials were initiated (to address nutrient/nitrate loading issues) and the landowner changed farming rotations. Partnerships were very important in this project.

Elliott, Iowa Example:
The town of Elliott, Iowa is a little town with economic challenges. The PWS had two wells with high nitrate concentrations (from contaminated soil). Denitrification facility was not a viable option for the city. The city had a great mayor that helped to create a great planning team that was able to facilitate land acquisition through land donations (from the school) and the other land owners within the area of interest. The acquired land was converted to a wetland/environmental education center. A collaborative approach and strong partnerships (with the landowners, Pheasants Forever, NRCS, the local Soil and Water Conservation District, next door county, FWF, and National Parks, etc.) were essential in the success of the project.

Griswold, Iowa Example:
The Griswold project involved a conservation innovation grant for cost sharing for cover crops. Two monitoring wells were installed to evaluate impacts (on the aquifer) from the addition of the cover crops.

Best Management Practices To Improve Ground Water Quality: Implementation Efforts in Idaho and Beyond (Carolyn Firth, Idaho Soil and Water Conservation Commission)

Summary: Agricultural production statistics appear to closely mirror the 2014 nitrate priority areas. Agriculture can voluntarily address nitrate problems through the implementation of best management practices and becoming involved with education and outreach. Agricultural best management practices have been implemented within Nitrate Priority Areas all across Idaho. Numerous projects were mentioned, and a few projects were discussed in detail including Ashton 319 Project, Burley/Marsh Creek 319 and WQPA Ground Water Project, Rupert NPA, Bliss Ground Water Improvement 319 Project, Camas Ground Water Improvement 319 Project, and the Weiser River SCD Ground water Improvement 319 Projects. All projects achieved success through various best management practices such as nutrient management, irrigation water

management, precision agriculture, soil sampling, soil moisture monitoring, using cover crops, and no-till practices. Soil health should be a consideration when implementing best management practices to create the most favorable habitat possible for the soil food web. Outreach and education are needed to gain support and share successes.

Note: presentations are available for reference at http://www.deq.idaho.gov/nitrate-symposium.

Slide 2

- The Cassia County NPA was renamed in 2014 to Marsh Creek NPA because the boundaries of the NPA don't encompass the entire county.
- In 2008 Twin Falls NPA was ranked number one, but in 2014 Marsh Creek NPA is ranked number one.

Slide 3

- Image shows the 2011 agricultural production statistics by county. The darker the color the higher the county is contributing to agricultural production. It is interesting to compare the map to the NPA map.

Slide 4

- Table shows agricultural production in Idaho versus neighboring states. Note the pounds of milk produced in Idaho.

Slide 10

- The picture of this field illustrates how sandy the soils can be in southeast Idaho

Slide 11

- The Ashton Ground Water Protection 319 project was a pioneer project because it was the first time 319 funds were used for ground water protection

Slide 15

- The project also worked with NRCS and the Conservation Security Program in addition to 318.

Slide 18

- Phase II of the Ashton Ground Water project focused on low pH problems in the area. The low pH prevented soils from utilizing nitrogen, so the grant will entail lime application.
- The city of Ashton repeatedly had problems with nitrate exceedances so they had to put in an ion exchange system.

Slide 19-21

- The Burley/Marsh Creek project was funded by 319 and SWCC provided WQPA funding.
- The project identified areas that needed treatment.
- The Springdale area had a hotspot of 20-40 mg/L for nitrate.
- A source water protection grant was used to test for personal care products and pharmaceuticals, but the test was inconclusive in determining the source of nitrate.
- Grower workshops were held, and placemats and pamphlets were disseminated.

Slide 26-28

- Graphs compare yield versus fertilizer applied above recommended rates.
- Conclusion: excess nitrogen did not increase yield or if it did it was only slight.

Slide 31-39

- Worked with the University of Idaho to conduct soil moisture monitoring using telephone wire.
- Tested pivot, wheeline, and gravity systems

Slide 40

- The Rupert/Minidoka NPA area received $2 million in congressional appropriations and since that time the NPA ranking has decreased.

Slide 45

- This flyer summarizes reductions achieved through the Weiser River Soil Conservation District 319 projects.

Slide 47

- Mini-Cassia project ordered no-till drills for farmers to rent and provided funding to help plant cover crops

Slide 48

- Graph shows nitrogen efficiency is decreasing for sugar crops. Projects are needed that will increase the efficiency of crops.

Slide 49

- Precision agriculture can help apply inputs where they are needed rather than uniformly across the field. Using EC mapping can identify soil type groupings.

Slide 50-54

- Electrical conductivity tool is useful because conductivity is a natural property of the soil and can be used to map up to ten years if the conditions are right. However, there is more variability in electrical conductivity than soil type.

Slide 64

- Picture showing the freeway closure due to blowing dust. There are many consequences to poor soil health. Numerous soil health videos are available on YouTube.

Deep Nitrate Tests in Columbia Basin: How to get the community engaged?
(Paul Stoker, Columbia Basin Ground Water Management Area)

Summary:
The presentation included a brief background on the creation/development of the Columbia Basin Ground Water Management Area (GWMA), the implementation plan and an overview of the deep soil testing program.

By 1998, the Board of County Commissioners was heavily involved in creating a GWMA (as an alternative to EPA's proposed Sole Source Aquifer designation). Advisory committees were established shortly after the creation of the GWMA. The committees spent two years (1998-2000) creating a plan to address ground water quality. The expectation of the plan was to slow down nitrate leaching or stop it if possible. Another priority of the plan was to implement irrigation water management on as many acres as possible.

Deep Soil Sampling Program:
The farmers in the area didn't want to admit they were part of the problem. So the committee put together a voluntary (deep) soil sampling program that would ultimately be used as an opportunity to educate the farming community (on the nitrate contamination concerns). The program involved collecting nitrate samples at every foot for 10 feet (where possible). Initially, no one would sign up. There was fear among the growers that if the results were "bad", then "bad" things would happen. The committee went to leaders of the commodity group for their participation. They were successful in enrolling them in the program, after being promised the results wouldn't be shared. The first results (from samples of the leaders' fields) were 'good' and those growers started bragging at the local coffee shop. Credibility (of the program and advisory committee) started going up and more growers started participating. Paid consultants/professional soil samplers took the samples. Confidentiality was maintained throughout the project.

Through implementation of this program, a few things were learned. Though there were some "bad players" (folks with high soil nitrate concentrations), there were some "good players" too (folks with low soil nitrate concentrations). The purpose of the project was education. The design was to go to engage the agricultural growers, then the community. Deep soil sampling allowed the farmers and ultimately the community, to be involved in the plan.

The committee has also implemented an Irrigation Water Management subsidy program, testing (private water samples for nitrate) at grocery stores, a program for schools about leaching, and have worked to identify recharge pathways (through the development of a ground water model of the GWMA). They also created graphics to train/education the Legislature and local officials (they were successful in educating them).

Advice from Paul. Create a plan, involve influential partners and implement the plan. Make the plan simple so you can go on to build something better. Create a four-minute story for elected officials (to sell your program/plan).

Collaborative Learning Session (Chi Ho Sham, Ph.D, The Cadmus Group, Inc.)

Collaborative learning is a way to engage a variety of experts to identify promising ideas and actions for success. Questions to ask and information to consider during collaborative learning exercise:

- Do we have a vision?
- What do we want to see in Idaho?
- How can we help audiences see impact?
- Who are we including or reaching?
- How do we come up with solutions that are a win/win/win?
- Do we find the source of the problem or do we just treat the symptoms?
- Can we find a preventative approach to minimize the impact?
- What can we do to protect our drinking water?
- Science and research is getting better but there is always uncertainty.
- There are regional or local differences, how can we capitalize on those differences?
- Can we understand and convey the value of water?

There are several recent examples that demonstrate the value of water ("whiskey is for drinking, water is for fighting"). 90% of California is in extreme drought conditions, so a statute was passed to regulate ground water withdrawals. Recent spills in West Virginia and Toledo show that water is not 100% reliable. Everyone has a role in maintaining the objective.

Activity: As a table, each person was given two minutes to share promising ideas, identify action items, and how to measure success and report back as a group. Below is a summary of the responses:

Group 1:

- Need to identify a way to communicate with landowners regarding testing of their water wells and septic systems
- Need to make sure the landowners are comfortable with the tests and gain confidence with government agencies and other partners

Group 2:

- Need to found a way to get data on well water (sampling), wellhead protection area, ground water flow path – i.e., use data and science to demonstrate the extent of problems
- Working with farming communities to build trust so work cannot be carried out on best management practices and nutrient analyses
- Use independent party to conduct testing

Group 3:

- Assessment of alternatives mechanisms to distribute animal wastes (e.g., extraction of nitrogen in addition to phosphorus; gasification of waste to recover energy)
- Gain understanding of long-term mineralization of nitrogen in the soil after years of animal waste application

Group 4:

- Better advertisement to generate more public involvement
- Develop approaches to better organize interest among partners and the public (e.g., the use of aquifer protection district or committee) to integrate best management practices to protect ground water

Group 5:

- Provide additional and comprehensive public education regarding the drinking water resources in Idaho (e.g., how the management of animal waste at dairy operations can be beneficial to the protection of drinking water resources)
- Conduct testing of private wells – e.g., through Idaho Rural Water Association at no cost

Group 6:

- Place appropriate individuals (from various partners) in communities to educate the public and elected officials and to communicate the importance of collaboration in solving drinking water problems by working with agriculture partners

Group 7:

- Increase the use of technologies to help monitoring and dissemination of information (e.g., monitoring and sharing of water quality data and impacts of various nutrient application rates)
- Deploy technologies to help convince people to be a part of the solution

Group 8:

- Provide education to the public

- Look at way to break the public from the "shock jock" phenomenon and identify "tipping point" to raise awareness among the public regarding the value of water and how the agriculture sector can be a partner

Group 9:

- Move animal feedstock away from the dependency on corn (e.g., using other crops that are less dependent on high nutrient inputs)

Group 10:

- Provide education to the appropriate partners (e.g., Certified Crop Advisers)
- Use the knowledge and experience of Certified Crop Advisers to assess efficiency of crop uptake of applied nutrients and status of soil health

Group 11:

- Education of landowners, service providers, and other partners on the nature of problems and how to get on board to help solve the problems
- Use economics as incentive
- Bring partners from various communities (e.g., university, industry, community, government agencies, and landowners) to explore and implement win-win strategies

Group 12:

- Putting the partners together to learn from each other (e.g., the symposium is a great example)
- Develop demonstration projects on drinking water to show results to farmers (i.e., by selecting area of manageable scale for demonstration projects)
- Provide support to landowners especially with increasing fertilizer price and variable animal waste

Group 13:

- Look beyond nitrate in water issues for other problems such as blowing dust because of poor earth health
- Assess and address the challenges associated with soil and water management over thousands of acres by implementing appropriate best management practices

Group 14:

- Revisit the passage of 1989 Ground Water Quality Protection Act in Idaho and evaluate the various current challenges on ground water protection
- Identify influential champion to promote ground water protection through the use of tools such as precision farming, improving soil health, and the formation of aquifer protection district (at a larger scale)

Appendix D: Abstracts

Overview of Idaho's Aquifer Systems and Southern Idaho's Unique Hydrogeology (Michael McVay, IDWR)

Abstract: The hydrology section at IDWR is responsible for characterizing and monitoring Idaho's water resources, which includes identifying and modeling both the physical characteristics and water use in aquifers around the state. An aquifer's vulnerability to non-point source contamination is a combination of physical setting and anthropogenic activities. Therefore, information gathered for water-resource modeling can be used to assess nitrate vulnerability, and an overview of southern Idaho's unique hydrogeology will include a comparison of assessment criteria and nitrate priority areas.

Water Quality Concerns: Nitrate Priority Areas and Source Water in Idaho (Toni Mitchell, IDEQ)

Abstract: Nitrate is the most common, widespread contaminant in Idaho. The presentation will provide a brief introduction what nitrate is, the sources of and estimated nitrogen loading amounts from fertilizer, animal operations, plow-down residuals, industrial, precipitation and domestic land uses within the Snake River Aquifer of Idaho.
A brief overview of Ground Water Quality Rules and Statues in Idaho and a discussion of Idaho's DEQ Policy for Addressing Areas with Degraded Ground Water Quality will be provided. The policy provides the agency with a procedure to follow that has been used to establish Nitrate Priority Areas in Idaho. Topics include how degraded areas are identified, the sources of data used to identify, tools used to spatially analyze with geostatistical software, geology and hydrogeology; 2) the criteria used to determine how areas are prioritized including population, water quality percentages, number of public water systems/source water assessments, nitrate concentration trends over time and beneficial uses; 3) management or improvement strategies development; 4) implementation of strategies; 5) an evaluation of strategies; and 6) priority re-designation. Changes in priority within some specific areas over three ranking cycles in 2002, 2008, and 2014 have been observed and will be discussed. In order to improve defensibility of the process several how changes in the identification and prioritization methodology have been implemented. A majority of the Nitrate Priority Areas are located within the Snake River Aquifer.

Sole Source Aquifers will be introduced with the designations established by the EPA in Idaho with the spatial relationships to the nitrate priority areas. Currently 2 of the 3 sole source aquifers in Idaho intersect with the 2014 Nitrate Priority Areas, including the Snake River Aquifer.

Public water systems will be described along with the regulatory difference from private water systems. In 1996, amendments to the Safe Drinking Water Act required states to delineate

drinking water sources of a public water system, inventory potential contaminant sources within the delineated area and to assess the system by determining the susceptibility to contamination based on system construction, soil types, land uses and contaminant sources. Protection plans are developed on a volunteer basis by communities within delineated areas to implement protective measures to drinking water.

Health Effects of Nitrate in Drinking Water: Human and Livestock Concerns from Nitrate. (Jeff Fromm, IDEQ)

Abstract: Adverse health effects associated with nitrate exposure will be discussed, focusing on methemoglobinemia (blue baby syndrome), but also other potential effects that have been investigated. Nitrate effects on livestock health will be covered, as well. Nitrate as an indicator of other potential water quality problems will also be addressed.

Nitrogen in the Soil: Current Studies (David L. Bjorneberg Ph.D. and David Tarkalson, USDA ARS, Amber Moore Ph.D., University of Idaho)

Abstract: This session will include information about nitrogen losses from agricultural production and data from several research studies to determine nitrogen uptake by crops and changes in the soil with different fertilizer rates, manure applications, or previous crop history. The nitrogen cycle will also be discussed in terms of what we know and don't know about managing nitrogen in agricultural soils.

Nitrogen Movement Below Root Zone: Post-harvest nitrate tests in Yakima, Washington (Eric Winiecki, EPA)

In March 2013, EPA signed an Administrative Order on Consent ("Consent Order") with several dairies in the Lower Yakima Valley, Washington, to address sources of nitrate contamination in ground water near and downgradient of the dairies' facilities. The dairies have begun work to control nitrate sources, collect soil and ground water data, and monitor the quality of the ground water to assess the effectiveness of the source control actions. This presentation will summarize the data that the dairies have collected so far, with a focus on the soil data.

Irrigation Management: How Irrigation Effects Nitrogen Movement (Howard Neibling Ph.D. University of Idaho)

This presentation will cover the following:

- How much water can root zones with different soil textures hold before drainage?
- How much water is typically applied per irrigation with pivot and set systems?
- What is the resulting potential for deep percolation (and soluble N movement)?
- How can we better schedule irrigation timing and amount to minimize deep percolation?
    - Web-based water budget tool
    - Web-access soil moisture sensor tools

Sustainable Source Water Protection through Habitat Restoration at Remsen, Iowa (Becky Ohrtman, Iowa Department of Natural Resources)

Abstract: The community of Remsen relies on a number of shallow alluvium municipal wells as a part of its water supply. These wells had shown significant nitrate contamination since 2005. On the basis of the increasing nitrate concentration trend, Remsen will most likely need to install expensive denitrification treatment to maintain their water supply in the near future. With assistance from the Iowa Department of Natural Resources (DNR) Contaminated Sites Section, potential areas of concerns were identified and investigated using ground water flow models and ground water sampling in 2008 and 2009. A specific plot of land where over-application of manure had been practiced was identified to a major source of nitrate to the shallow alluvium wells. Through a partnership effort with the Remsen Source Water Protection Community Planning Team, the Remsen Utilities Board and City Council, Plymouth County U.S. Department of Agriculture - Natural Resources Conservation Service, Sioux River Resource Conservation and Development Council, Iowa DNR Source Water Protection Program and Contaminated Sites Section staff, Iowa DNR Clean Water State Revolving Fund, State Watershed Improvement Review Board, USDA Agricultural Research Service, and Plymouth County Pheasants Forever Chapter, a combination of loan and grant were used to purchase land of the well field where Pheasants Forever prepared seedbed and plant most of the acquired areas for restoration to prairie in the Spring of 2009. Additional ground water modeling and ground water sampling have shown that the prairie habitat restoration has gradually and continuously lowering the nitrate concentration in the shallow aquifer. The collaborative source water protection program through land use management and habitat restoration, with partnership with the agriculture community, has been demonstrated to be an effective and sustainable approach to improve the quality of water supply sources.

Best Management Practices to Improve Ground Water Quality: Implementation Efforts in Idaho and Beyond (Carolyn Firth, Idaho Soil and Water Conservation Commission)

Abstract: Agricultural Best Management Practices (BMPs) have been implemented within Nitrate Priority Areas (NPAs) all across Idaho, and the results appear promising. Soil testing prior to applying fertilizer and using soil test results in conjunction with University of Idaho Fertilizer guides to determine application rates are simple, but important practices as initial efforts in the implementation of nutrient management. Additionally, irrigation water management using soil moisture monitoring, planting cover crops, and residue and tillage management are effective practices in reducing leaching of nitrogen compounds into ground water. Real life examples of producers using these practices from 1999-2014 include those within almost half of Idaho's designated NPAs, ranging from Ashton to Weiser and other communities located along the Snake River, and as far north as the Clearwater Plateau near Lewiston. The USDA-NRCS has been aggressively promoting soil health BMPs nationwide, such as cover crops and tillage management as ways to not only increase organic matter in soils, but also to decrease the amount of fertilizer required to produce crops with optimal yields. Farmers from Montana to Florida are successfully implementing soil health BMPs. Nutrient management is being refined by precision agriculture using GPS guided variable rate application

of fertilizer and other soil amendments, including lime to increase pH. Outreach and education are also important components of strategies to improve ground water quality. Some of these activities include free water testing of private wells, grower workshops, and working with schools to integrate water quality awareness activities into science curricula.

Deep Nitrate Tests in Columbia Basin: How to get the community engaged? (Paul Stoker, Columbia Basin Ground Water Management Area)

In 1997, EPA issued the "*Support Documentation for Consideration of the Eastern Columbia Plateau Aquifer System as a Sole Source Aquifer (SSA)*" based on 1) the aquifer is the sole or principal source of drinking water, and 2) contamination of the aquifer would create a significant hazard to public health.

As an attractive alternative to the SSA designation, the Boards of County Commissioners passed resolutions to Washington State Department of Ecology to designate Adams, Franklin, and Grant Counties as a Ground Water Management Area (GWMA). The GWMA calls for the appointment of local ground water advisory committees to provide for effective and coordinated local management of the ground water resource. Over 100 citizens formed committees representing suspected sources of nitrate in ground water. Six local Conservation Districts and three health districts lead the planning, research and implementation of the plan. Six state and federal agencies signed an agreement to support the GWMA efforts with funding and technical assistance.

One component in the Plan was to encourage agricultural producers to implement activities that reduce nitrate movement downward through the soil to the ground water in the aquifer. Such activities included irrigation water management and deep soil testing, well below the crop root zone. A first phase of this educational program was conducted in the spring of 2000. Seventy-three growers provided 373 fields that were sampled in this program. By 2004, 195 growers participated in this program covering 59,280 acres for irrigation water management. This presentation will discuss how the community became engaged in the program which led to increased participation and successful implementation.

Panel Discussion (Chi Ho Sham, Ph.D., The Cadmus Group, Inc.)

This session will include a facilitated discussion with a panel of speakers who provided presentations earlier on case studies examples of nitrate reduction strategies and best management practices. Each speaker will provide information on lessons learned from their case studies and participants will be able to ask questions of the panel.

Collaborative Learning Session (Chi Ho Sham, Ph.D., The Cadmus Group, Inc.)

Collaborative learning is a process that engages various experts and stakeholders involved in an issue to share ideas in order to identify the most promising ideas to explore and identify actions for success. Participants at the symposium represent a wide variety of expertise including university researchers, federal and state regulators, technical assistance providers, planners, crop advisors, policy makers, and others. This facilitated process will draw on this expertise by dividing the participants into small groups (for 15 minutes) to discuss nutrient reduction strategies, outcomes of each strategy, actions needed to implement each strategy, partners needed, and existing assumptions. The most promising ideas identified by the small groups will be brought to the larger group. The facilitator will lead the group through a discussion to identify action items and measures of success. The goal will be to identify next steps to develop strategies to reduce nutrients in ground water through partnerships and the promotion of best management practices that encourage sustainable agriculture.

Appendix E: Speaker Biographies

Mike McVay, P.G.

Mike McVay is a technical hydrogeologist at the Idaho Department of Water Resources. He earned a Bachelor's of Science in Geologic Engineering and a Master's of Science in Hydrology from the University of Idaho. Mike is currently employed at the Idaho Department of Water resources and specializes in aquifer characterization and ground water modeling. Mike is also registered as both a Professional Geologist and a Professional Engineer in the State of Idaho.

Qualifications

- Bachelor of Science degree in Geologic Engineering – University of Idaho, 2003.
- Employed as Environmental/Geological Engineer in Wyoming, 2003-2004.
- Masters of Science degree in Hydrology – University of Idaho, 2007.
- Employed as Hydrogeologist/Civil Engineer at the Idaho Department of Environmental Quality, 2006-2008.
- Employed as a Hydrogeologist/Civil Engineer at the Idaho Department of Water Resources, 2008-present.
- Registered Professional Geologist in the State of Idaho.
- Registered Professional Engineer in the State of Idaho.

Tonia Spiker Mitchell, P.G.

Tonia has been an environmental hydrogeologist at DEQ since 1998. She has managed the Nitrate Priority Area Delineation and Ranking Process since 2001 and has been heavily involved with ground water quality evaluations related to nutrients and inorganic constituents. She has also been heavily involved with agency coordination in regards to managed recharge, mining point of compliance development, guidance preparation, and negotiated rulemaking. Prior to DEQ Tonia has worked for 15 years in the private sector, and other government agencies in the fields of geotechnical engineering, environmental compliance, GIS, mine planning, operation and reclamation. Tonia has a Bachelor of Science in Geology from Boise State University and 28 graduate level credits with an emphasis on Hydrogeology. Tonia is a registered Professional Geologist in Idaho.

Jeff Fromm, Ph.D.

Jeff Fromm, Ph.D. has an educational background in biology, environmental toxicology, biochemistry and ecology. He has been with DEQ for twenty-one years, providing toxicological support to the agency and specializing in the evaluation of exposure to chemical and radiological contaminants for both ecological and human health risk assessment. He also serves frequently as a liaison to the IDHW Division of Health, reviewing and providing assistance with health consultations and public health assessments, and serving on advisory committees such as the

Cancer Cluster Analysis Work Group and the Idaho Fish Consumption Advisory Program committee. Previously he has worked for the U.S. EPA and taught a variety of college courses in the biological sciences as a faculty member at Washburn University and the University of Kansas.

David L. Bjorneberg, Ph.D.

Supervisory Research Agricultural Engineer
USDA ARS Northwest Irrigation and Soils Research Laboratory - Kimberly, ID

Responsible for planning and conducting research with a team of scientists to develop practices and technologies that address production and environmental problems associated with irrigated crop and dairy production.

Education:

- South Dakota State University, Brookings, SD. B.S. Agricultural Engineering. 1987.
- South Dakota State University, Brookings, SD. M.S. Agricultural Engineering. 1989.
- Iowa State University, Ames, IA. PhD. Agricultural & Biosystems Engineering. 1995.

Experience:

- 2008-present: Supervisory Research Agricultural Engineer, USDA-ARS, Northwest Irrigation and Soils Research Laboratory, Kimberly, ID.
- 1995-2008: Research Agricultural Engineer, USDA-ARS, Northwest Irrigation and Soils Research Laboratory, Kimberly, ID.

Amber Moore, Ph.D.

Amber Moore has been a Soil Fertility Specialist with the University of Idaho at the UI Twin Falls Research and Extension Center for 7 years. In Idaho, Amber has worked on dairy manure field applications, organic production, specialty fertilizers, strip-tillage, nitrogen mineralization, potatoes, barley, sugar beets, corn, beans, and various cover crops. Amber grew up in Tennessee and received her Masters and Doctorate in Soil Science from North Carolina State University and Bachelor's in Environmental Science from Auburn University.

Eric Winiecki

Eric Winiecki works in the Drinking Water Unit, in the Office of Water and Watersheds, of the U.S. Environmental Protection Agency (EPA). Since 1990 he has contributed to EPA's mission to protect human health and the environment through work involving enforcement coordination, source water protection coordination, grants management in support of the Columbia Basin Ground Water Management Area, hazardous waste site cleanup management, policy analysis, and strategic planning. Past work experience includes state government and private consulting. He earned a BA degree in international economics from the University of Illinois at Urbana-

Champaign, and a MPA degree from the Evans School of Public Affairs at the University of Washington.

William Howard Neibling, Ph.D.

Education
- Ph.D., Agricultural Engineering, Purdue University, 1984
- M.S., Agricultural Engineering, Kansas State University, 1976
- B.S., Agricultural Engineering, Kansas State University, 1974

Academic experience (all full time)
- Univ. Idaho, Associate Professor/Extension Water Management Engineer, 5/97-present
- Univ. Idaho, Assistant Professor/Extension Water Management Engineer, 2/92-5/97
- Univ. Missouri-Columbia, Assistant Professor, Agric. Engineering Dept., 8/87-2/92
- University of Wyoming, Assistant Professor, Agric. Engineering Dept., 3/85-8/87
- Purdue University, Adjunct Assistant Professor & member of graduate faculty, Agricultural Engineering Dept.,9/84-3/85

Non-academic experience (full time)
- USDA-ARS, Agricultural Engineer, National Soil Erosion Laboratory, Purdue University, W. Lafayette, IN, 1976-1985

Certifications or professional registrations**:** Idaho PE #7407

Becky Ohrtman

Rebecca Ohrtman received her Bachelor of Science degree in Agriculture from Iowa State University. She has worked in water quality programs for USDA-NRCS, Iowa Department of Agriculture and Land Stewardship and most recently for the past eight years has coordinated the Iowa Department of Natural Resources statewide SWP program for Targeted Community Water Supplies.

Carolyn Firth

For almost 10 years, Carolyn Firth has served as the Ground Water Agricultural Program Specialist for the Idaho Soil and Water Conservation Commission. Prior to that, she worked as a Water Quality Resource Conservationist for the Idaho Association of Soil Conservation Districts, focusing on developing and implementing plans to address surface water quality issues on private land. In her work as Ground Water Quality Specialist, Carolyn has been actively involved in developing Ground Water Management Plans for communities located within Nitrate Priority Areas. She has also worked directly with numerous producers to help them implement nutrient management and irrigation water management on their farms. She grew up on a farm and has assisted her husband in operating a small farming and ranching operation in Minidoka

County. Carolyn earned a B.S. degree in Earth Science Education and a M.S. degree in Geology. She worked 10 years in the petroleum industry as a production geologist.

Paul Stoker

Paul Stoker was raised in Othello, Washington where he helped his father level and prepare the family farm to receive the first irrigation water from the federal project in 1958. He attended Brigham Young University for 1968 to 1972. He owned and operated a large irrigated farm in Othello from 1972 to 2001. He became politically active in 1994 and organized and chaired the Columbia Basin Groundwater Management Area. He discontinued full time farming in 2001 and became the Executive Director of the CBGWMA from 2001 to present.

Chi Ho Sham, Ph.D.

Chi Ho Sham has over two decades of consulting experience, mainly in the areas of drinking water protection, water quality analysis, and underground injection control. Currently, he works at The Cadmus Group, Inc. He is an active member of the American Water Works Association (AWWA) – serving many councils, divisions, and committees. He served as the lead author of the Operational Guide to AWWA Standard G300: Source Water Protection and as a co-Principal Investigator of the "Development of a Source Water Protection Vision and Roadmap for U.S. Drinking Water Utilities" project sponsored by the Water Research Foundation. He is a Research Fellow of the George Perkins Marsh Institute and an adjunct professor at Clark University in Worcester, Massachusetts. Chi Ho received his Ph.D. and M.A. from the University at Buffalo and his B.A. from the University of Regina in Canada. His research interests include effective source water protection strategies, impacts of wildfires and extreme events on water utilities, and management of hydraulic fracturing and underground injection activities.

Appendix F: Evaluations

(Contact DEQ for complete evaluation results)

Question	Number of Responses
How would you rate the overall workshop?	
Excellent	19
Good	20
Fair	0
Poor	0
	39
How would you rate the facility?	
Excellent	15
Good	21
Fair	3
Poor	0
How would you rate the quality of the lunch and snacks?	
Excellent	7
Good	27
Fair	4
Poor	0
How would you rate the networking and poster time?	
Excellent	6
Good	25
Fair	8
Poor	0
How would you rate the collaborative learning session?	
Excellent	9
Good	17
Fair	8
Poor	0

Were the topics discussed useful to you?	
Yes	39
No	0
Would you like to see more workshops like this in the future?	
Yes	29
No	1
If so, how often?	
annual	22
biennial	11
If so, what should it focus on?	
statewide	8
regional	14
local issues	10
all	5
If so, how long should it be?	
1/2 day	5
Full day	24
two day	2