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Best Management Practices to Improve Ground Water Quality: Implementation Efforts in Idaho and Beyond

Presented to Idaho Nitrate Symposium
Twin Falls, Idaho
December 4, 2014

by Carolyn Firth

Ag Program Specialist – Ground Water
Idaho Soil & Water Conservation Commission

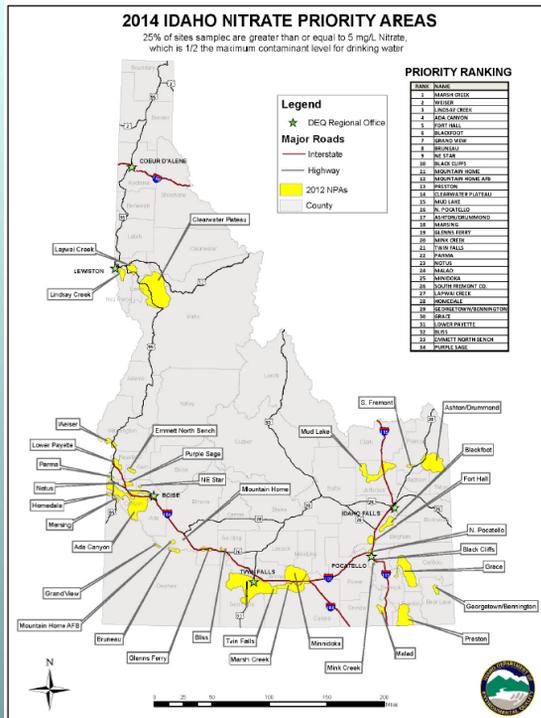


SOIL & WATER
CONSERVATION COMMISSION

Conservation the Idaho Way. Sowing the Seeds of Stewardship



2014 Delineation of Nitrate Priority Areas (Idaho DEQ)





2011 Idaho Agricultural Production Statistics

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Comparison of Idaho & Neighboring States' Agricultural Production for 2011

State	Principal Crops: acres harvested	Potatoes acres	Corn (grain and silage) acres	Wheat & Wheat Durum acres	Pounds of milk produced
Montana	8,489,000	11,500	74,000	5,360,000	288 million
Idaho	4,219,000	319,000	345,000	1,412,000	13 billion
Washington	3,685,000	160,000	195,000	2,345,000	6 billion
Oregon	2,200,000	39,900	82,000	982,000	2 billion
Wyoming	1,483,000	0	95,000	130,000	123 million
Utah	1,014,000	0	84,000	144,000	2 billion
Nevada	470,000	0	8,000	12,000	666 million

Source: USDA National Ag Statistics Service. Data as of 5/14/2012

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Protecting Ground Water Through Best Management Practices (BMPs)

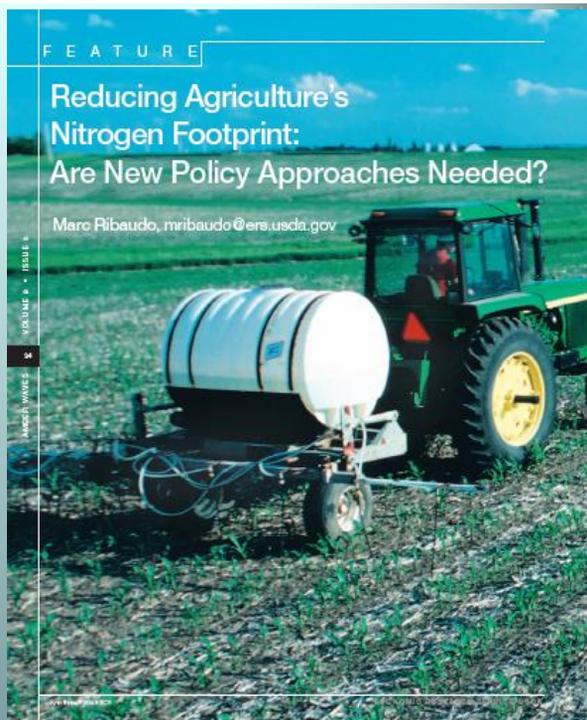
- ❖ **Water Quality and Quantity Resource Concerns**
 - Degraded ground water
 - Aquifer Overdraft & its Effect on Surface Water
 - ~ 20 % of irrigated area of the U.S. is supplied by ground water pumped in excess of recharge (Tilman, 2002)

- ❖ **Soil Quality Concerns**
 - Soils with Low pH
 - Soils with Low Organic Matter

- ❖ **Current Issues**
 - Possible Regulation of Fertilizer Use
 - Possible curtailment of irrigation water in dry years

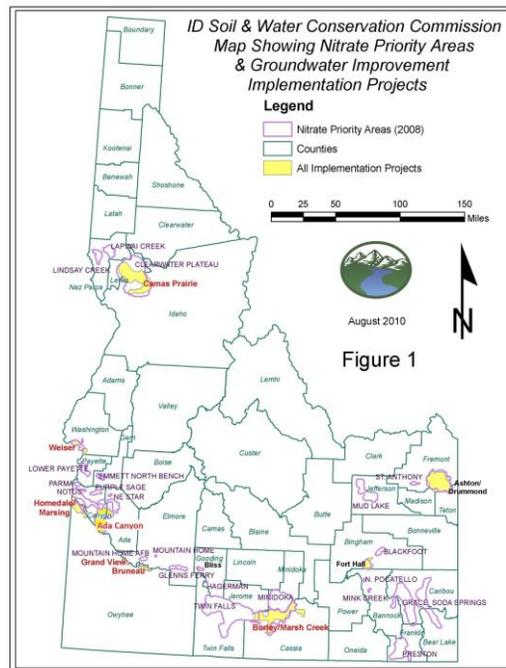
USDA Economic Research Service
Article published September 2011

“...agriculture is the single largest source of nitrogen compounds entering the environment in the U.S., contributing 73% of nitrous oxide emissions, 84% of ammonia emissions, & 54% of nitrate emissions...Nitrogen applied in excess of crop needs has the greatest risk of leaving the field & degrading air & water resources... Only reducing the amount of nitrogen applied assures a reduction of all nitrogen compounds...”



How can the agricultural community voluntarily address the nitrate problem?

- ❖ Implement Best Management Practices
- ❖ Become involved with Education and Outreach



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Each Nitrate Priority Area (NPA) is Unique

- **Ashton/Drummond NPA**
 - Well-drained soils and fractured bedrock
 - Shallow aquifers
 - High winter precipitation
 - Varied mineralization rates of soils
- **Cassia County NPA**
 - Canals and agricultural-related holding ponds may change local seasonal ground water flow directions
 - Shallow (perched) aquifer is susceptible to land use practices
 - Complex geology from the Albion Mountains to the Snake River Plain impacts rate of ground water movement
- **Twin Falls NPA – complicated by drain tunnels**
- **Mountain Home Air Force Base – very little agricultural influence**
- **Minidoka NPA**
 - Shallow aquifer is susceptible to land use practices
 - In the past, irrigation return water was injected into the deep aquifer
- **Mud Lake NPA**
 - Very sandy soils

Potato Field in Hamer Area (NW of Idaho Falls)



Ashton Ground Water Protection 319 Project

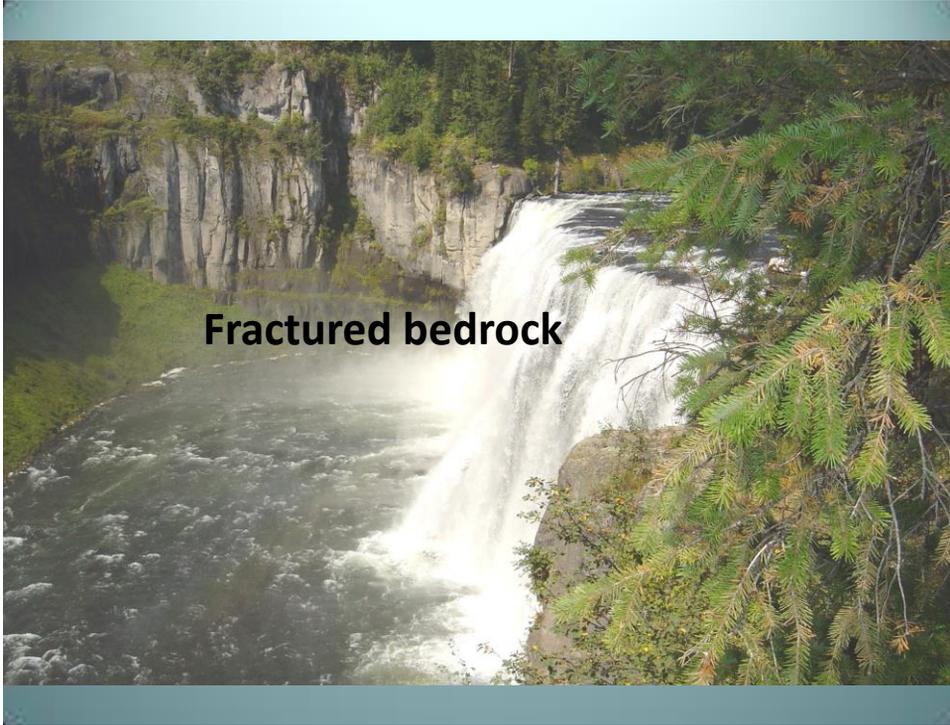
**Sponsored by Yellowstone Soil
Conservation District**

with technical assistance provided by
**Natural Resources Conservation Service
ID State Department of Agriculture
ID Soil & Water Conservation
Commission**

Why this area?

- **Well drained soils**
- **Fractured bedrock**
- **Shallow aquifers**
- **High winter precipitation**
- **Varied mineralization rates (soils' ability to convert organic matter to nitrogen)**

**Combination of these factors makes this area
extremely vulnerable to spring nitrate leaching!**



History of Project

Project Began in 2001

Best Management Practices (BMPs) Implemented:

1. Soil Testing – Many farmers were not soil testing prior to applying fertilizer.
2. Following University of Idaho fertilizer recommendations

**These practices constitute Nutrient
Management**

Acres with Nutrient Management

<i>Year</i>	<i>Amount (acres)</i>
2001	80
2002	160
2003	479
2004	4,756
2005	18,381
2006	34,441
2007	45,276
Total Project Acres:	76,924

Farmers using Nutrient Management reduced their nitrogen application by an average of 14 pounds per acre or 18%.

Total Pounds of Nitrogen Not Applied:

<i>Year</i>	<i>Pounds</i>
2001	1,120
2002	2,240
2003	6,700
2004	66,500
2005	262,000
2006	482,000
2007	634,000

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Other Implementation Projects – Ashton/Rexburg Area

- ❖ **Ashton Ground Water Protection Phase II**
 - Correct soil pH with variable rate application of lime
 - 3-year project started in 2010
 - 54 farms participated, involving 19,693 acres
- ❖ **Egin Bench Cover Crop Project to address wind erosion**
 - 24 farms participating, involving 4844 acres
- ❖ **Rexburg Bench Energy & Ground Water Conservation Project**
 - Installation of VFD motors on pumps
 - 4-year project started in 2011
 - 33 farms participating, involving 17,659 acres

Conservation the Idaho Way. Sowing the Seeds of Stewardship

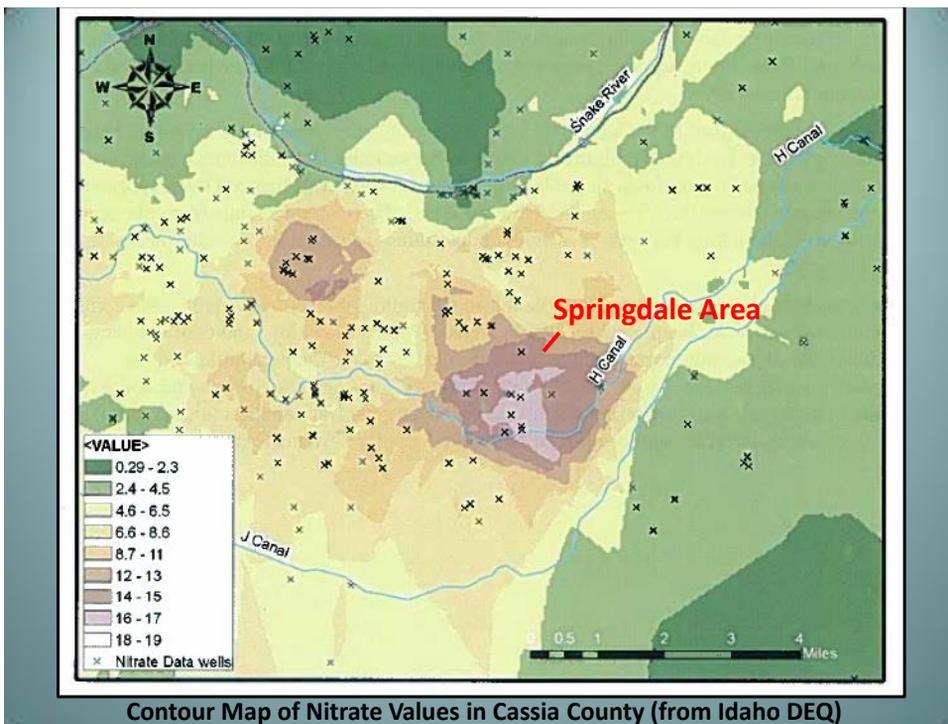


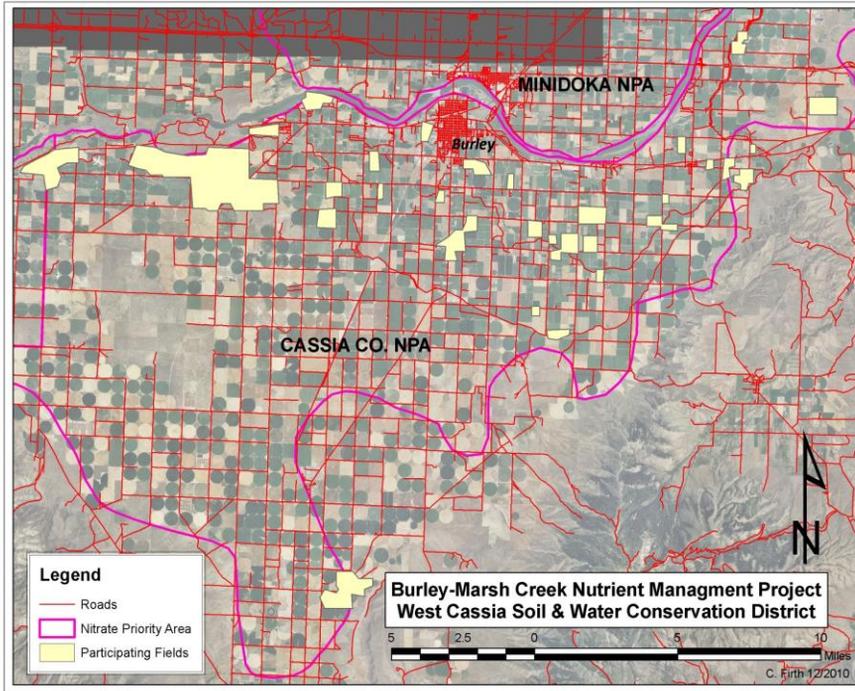
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Burley/Marsh Creek 319 and WQPA Ground Water Project

- Project began in 2006 and concluded in 2011
- 16 farmers who operate approximately 8000 acres participated in nutrient management and irrigation water management
- Farmers reduced nitrogen application by an average of 10 pounds per acre

Conservation the Idaho Way: Sowing the Seeds of Stewardship





Project Objectives

- Reduce nitrate leaching below the active crop root zone by implementing nutrient and irrigation water management with cooperating producers.
- Use information gained as an educational tool for all producers to demonstrate the feasibility and advantages of nutrient management and increased water application efficiencies.

Criteria for Good Nitrogen Management Practices, aka The 4 R's

- **Rate** – apply only the amount the crop needs
- **Source** – apply the appropriate fertilizer for the crop being grown
- **Timing** – apply nitrogen in the spring when the crop needs it (and not before)
- **Placement** – inject or incorporate nitrogen into the soil (rather than leaving it on the soil surface)

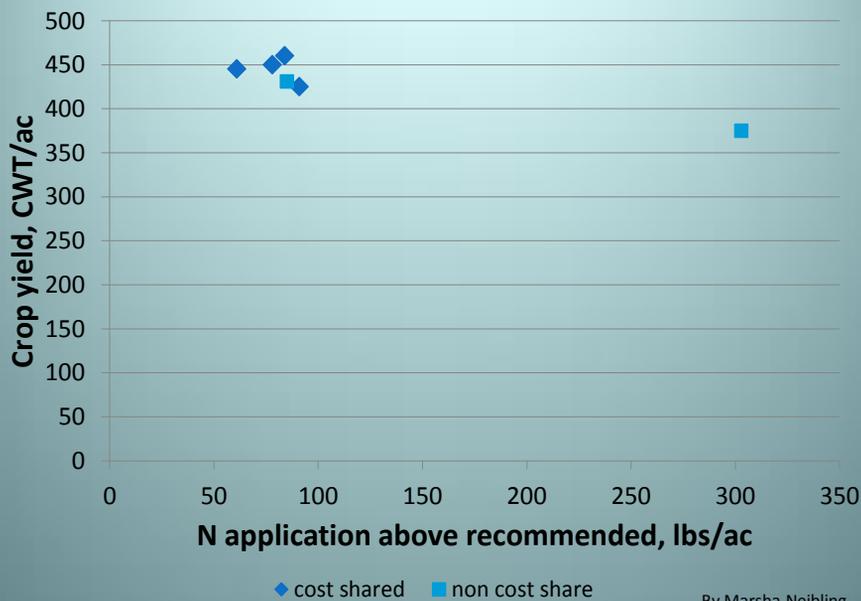
Nutrient Management Goals

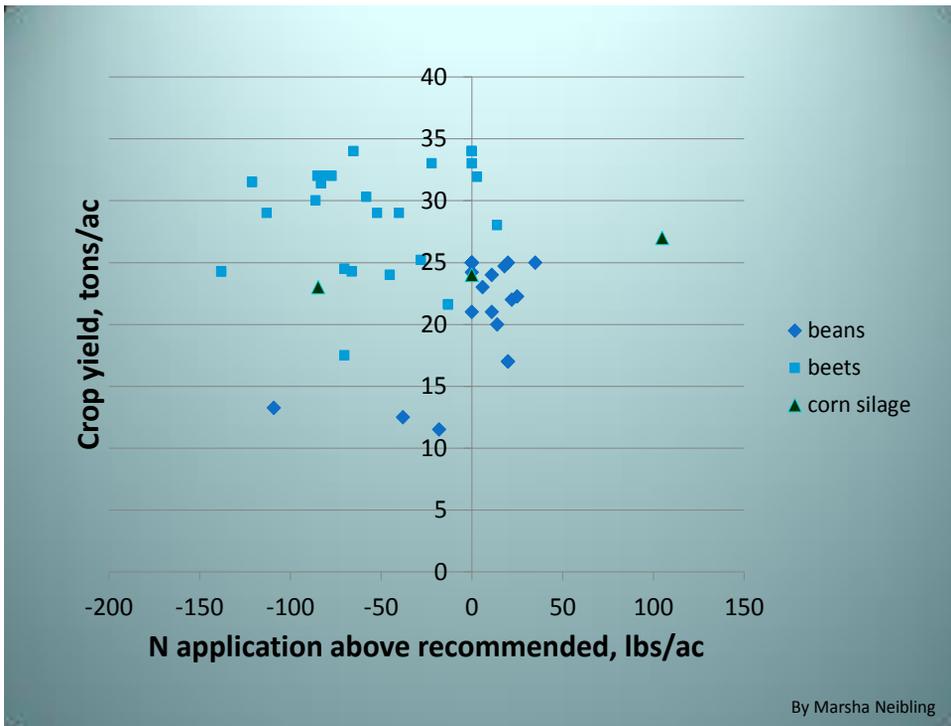
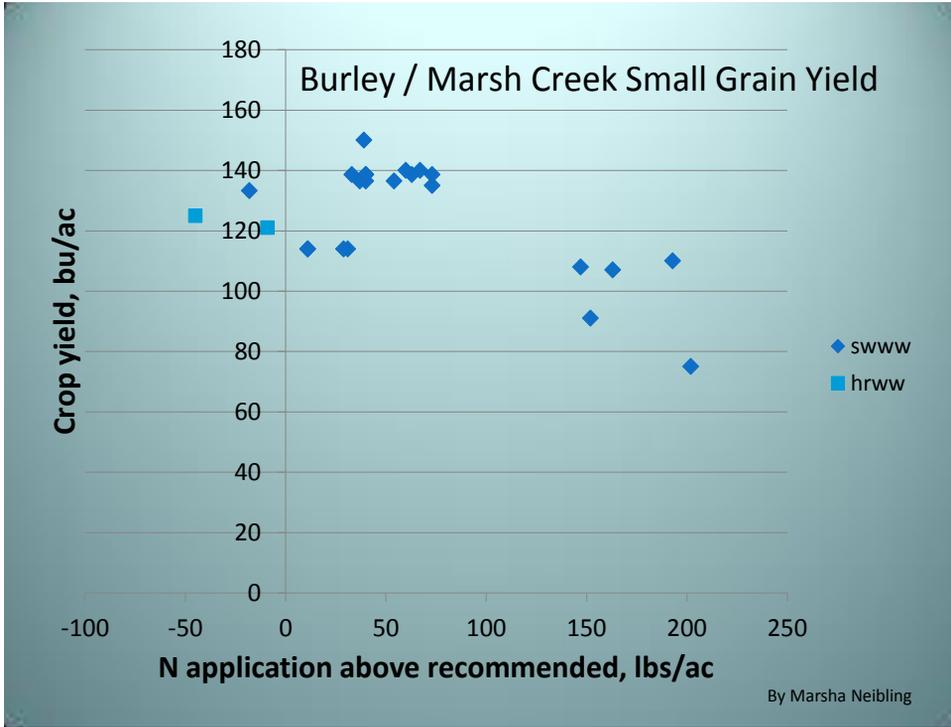
- **Optimize crop yield and quality while minimizing nutrient and water inputs**
 - **Must provide acceptable crop yield and quality**
 - **Minimize excess N in root zone (this reduces N leaching potential and input costs)**
 - **Minimize opportunity for "excess" water to leach nutrients (reduces irrigation costs and loss of nutrients)**

Operational Nutrient Management

- Spring soil sample to 2-ft depth (119 fields)
- Input soil test results and other information into USDA NRCS Nutrient Management Spreadsheet
 - Crop rotation (previous & current crop)
 - Current crop yield goal
 - Tillage practices (influence N mineralization)
- Spreadsheet outputs
 - UI fertilizer guides used to recommend N, P, K
 - based on soil available N and probable N mineralized during growing season
- Fall soil test and/or tissue test in case of over-application or manure application
 - NRCS allows a variation of 40N-20P-40K; starter P rates of 30-40# for corn, 40-80# for potatoes, & 30-40# for sugar beets is allowed

Burley / Marsh Creek 2010 Potato Yield





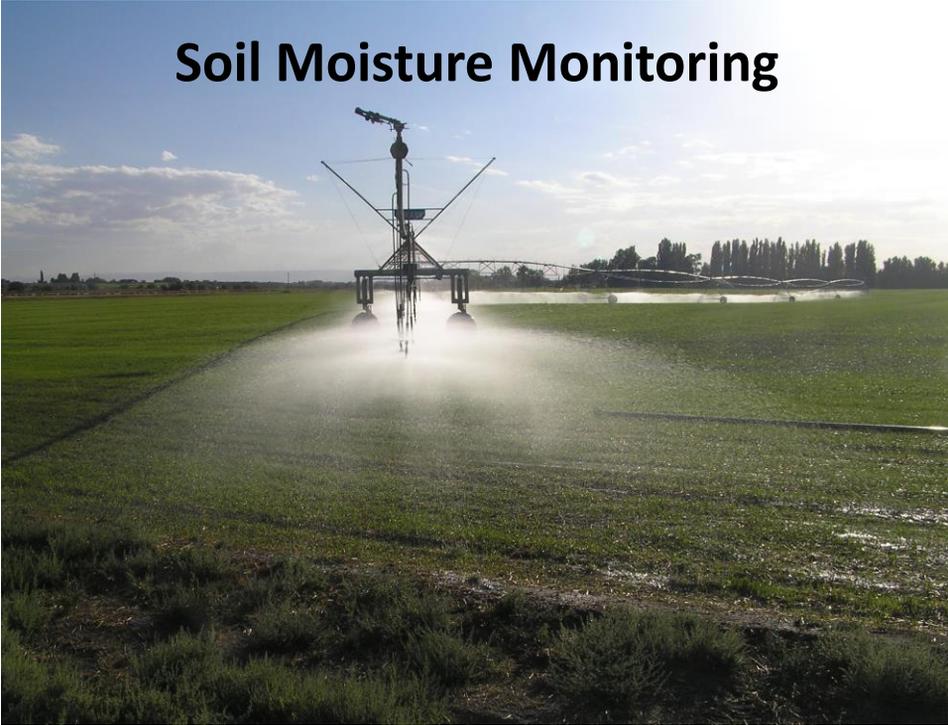
2010 Overview

- Most soil N levels in the fall were lower or equal to spring levels. Exceptions:
 - Potatoes where N above UI recommendation was added. Some additional N accumulated in both the top foot and the second foot of soil depth. **Excess N did not increase yield**
 - Corn silage where 105 lb/ac N was applied above the recommended rate. **Excess N increased yield slightly**
 - Dry beans where yield was less than half of planned yield

2010 Overview Cont.

- **On all crops, N added in excess of program recommendations either maintained or reduced crop yield.**
 - Corn silage yield was slightly higher with extra N
 - Grain yields were equal or lower with extra N
- **Therefore, significant N can be saved without reducing crop yield by following program N rate recommendations**

Soil Moisture Monitoring



**Irrigation Water
Management
using gypsum
block soil
moisture
probes &
Hansen Data
Loggers**





Laminated sheets with soil texture, water holding capacity, and crop information were placed inside each data collector. With the push of a button, operators could view their soil moisture history over a period of several days.

Watermark Readings (7/03)

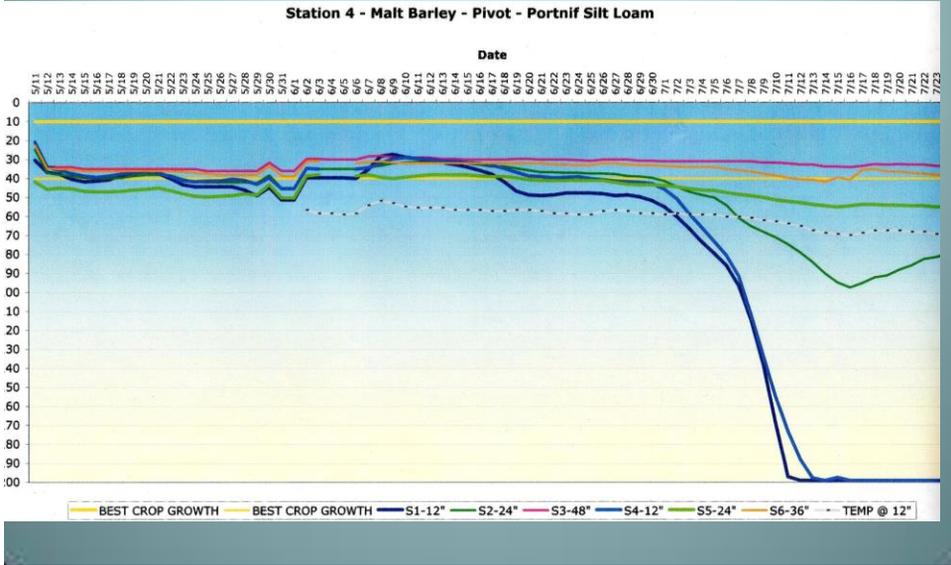
Light-Textured Silt Loam (1.97 in/ft):
(Potatoes, Mint, Onions, Dry Beans)

- 0 Saturated soil
- 0-10 Leaching Possible
- 10-25 Best Crop Growth
- >25 Crop Water Stress

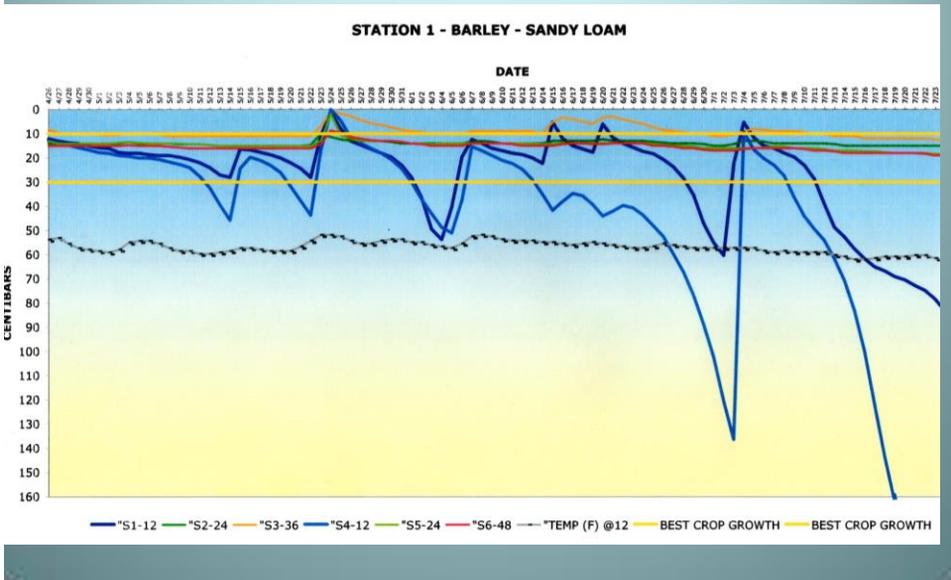
Percent Available Soil Water	Water-mark Reading cbars	Inches to refill 1 ft of soil pivot or linear	Inches to refill 1 ft of soil hand or wheel line
100	10	0	0
85	15	0.37	0.42
80	17	0.49	0.56
75	20	0.62	0.70
70	22	0.74	0.84
65	25	0.86	0.98
60	30	0.98	1.13
55	35	1.11	1.27
50	40	1.23	1.41
40	62	1.48	1.69
30	119	1.72	1.97

Howard Neibling - University of Idaho

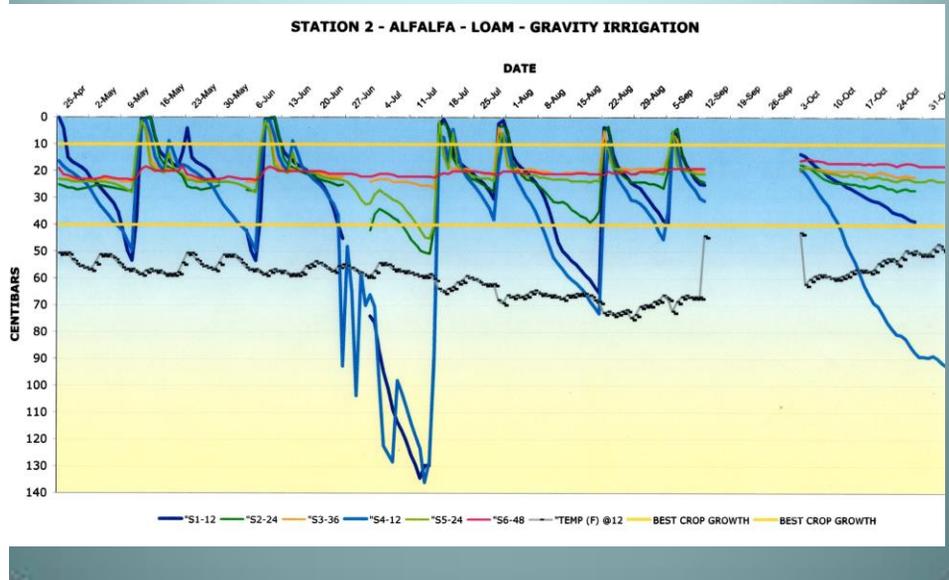
Pivot



Wheeline



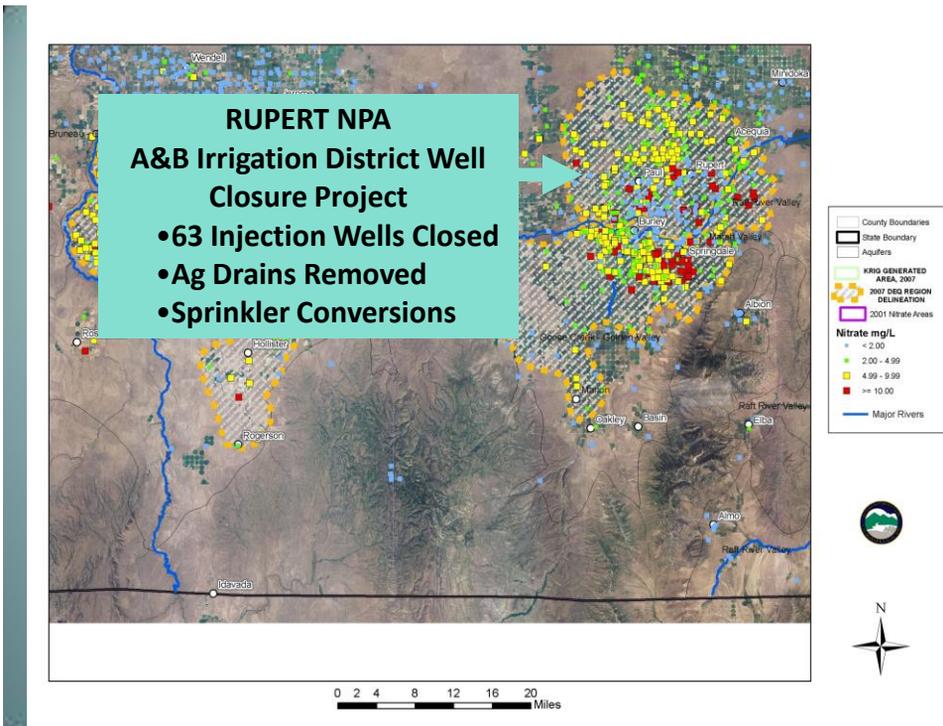
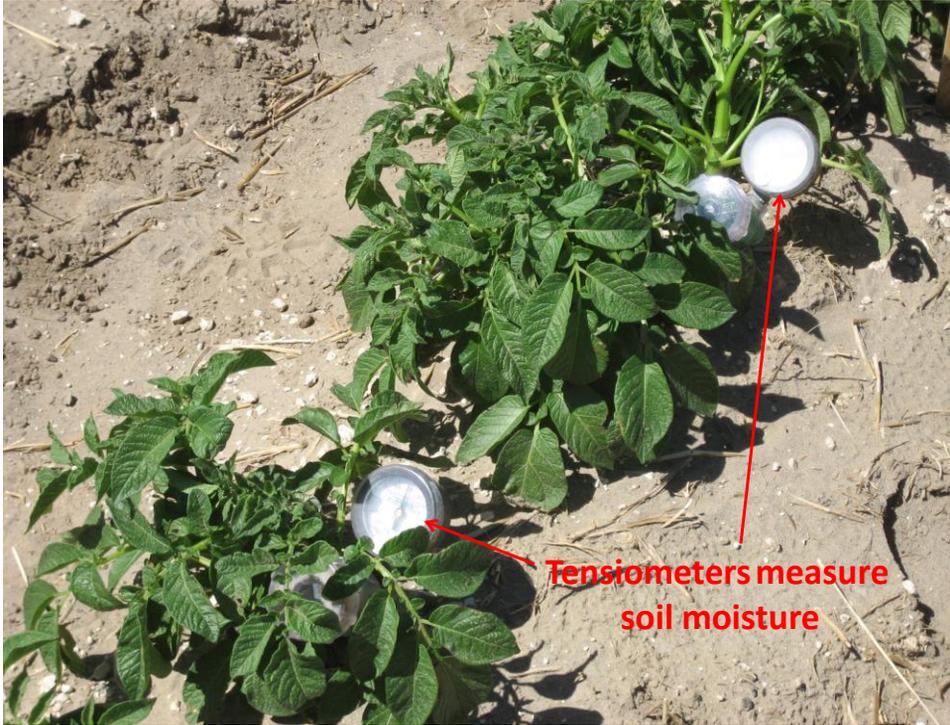
Gravity



Irrigation Water Management

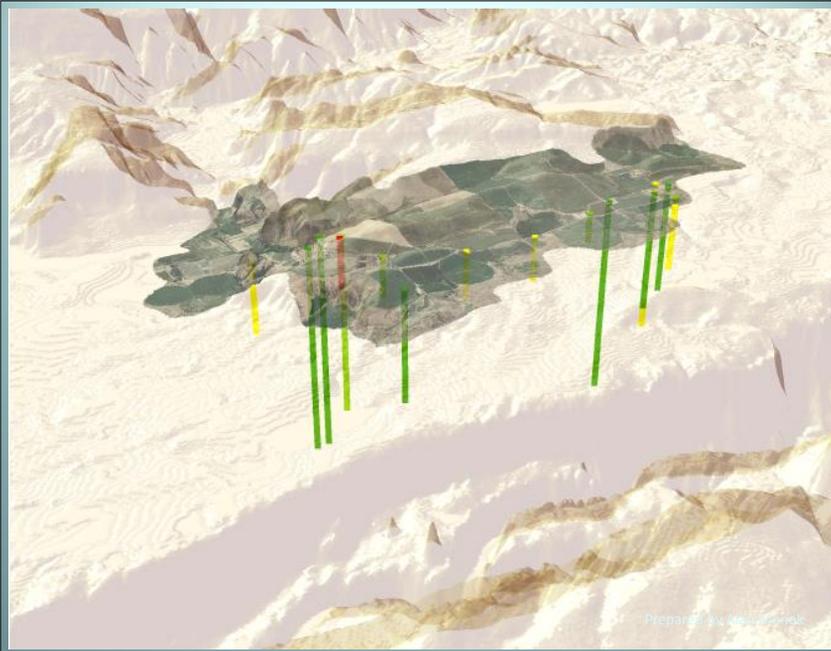
Alternative/additional methods to soil moisture meters:

- NRCS “Check Book” Method of Irrigation Scheduling
 - Record crop water use using AgriMet or similar database website
 - Record irrigation applications
 - Keep track of soil water levels, analogous to withdrawals and deposits of money in a checking account
 - Use an irrigation guide for reference
 - Develop an Irrigation Water Management (IWM) Plan that is tailored for your fields and crops
- Use “feel and appearance” guide for soil moisture
 - Contact your local NRCS office or check NRCS website for help



Bliss Groundwater Improvement 319 Project

- Soil Testing
- Soil Moisture Monitoring
- Well Monitoring & Surface Water Monitoring



3 Dimensional View of Monitoring Wells in Bliss Project Area

Southwest Idaho Soil Conservation Districts & NRCS Previous & On-Going Ground Water Projects

- **Homedale/Marsing 319 - 2266 acres Nutrient & Irrigation Water Management**
- **Grandview/Bruneau 319 - 8178 acres Nutrient & Irrigation Water Management**
- **Gem SWCD 319 - Sprinkler Conversion Project (Pivot)**
- **Ada SWCD - No-till Drill Rental**
- **Canyon SWCD 319 - Drip Irrigation, Sprinkler Conversions, & Constructed Wetlands**

Weiser River SCD Groundwater Improvement 319 Projects

- **Crops grown include onions, sugar beets, peas, beans, wheat, and barley**
- **Nutrient Management (soil sampling & adjusting fertilizer rates accordingly) 35 ac-test plots**
- **Surge or drip irrigation systems installed**
- **Soil Moisture Monitoring**
- **Lysimeters**
- **Filter Strips**
- **Sediment Basins**
- **Automated Irrigation Head Gates**

Weiser River SCD Wetland Project on the Lower Pavette Ditch

Weiser River Soil Conservation District
Project Load Reductions to date

Weiser Flat Water Quality Demonstration Project-Phase I (2003-2006)
Nitrogen reduced by 37,699 pounds
Phosphorus reduced by 405 pounds
Sediment reduced by 180 tons

Weiser Flat Water Quality Demonstration Project-Phase II (2007-2009)
Nitrogen reduced by 7,850 pounds

Pavette Ditch Wetland Discharge Treatment Project (2010-2012)
Suspended Sediment Concentration reduced by 570 tons/year
Total Phosphorus reduced by 1,045 tons/year

Cove Creek Wetland Project (2012-2016)
Estimated sediment reduction is 724 tons/year
Estimated phosphorus reduction is 1044 pounds/year
Estimated nitrogen reduction is 1951 pounds/year

Galloway/Warm Springs Wetland Project (proposed 2014-2016)
Estimated sediment reduction is 1452 tons/year
Estimated phosphorus reduction is 4.2 tons/year
Estimated nitrogen reduction is 3.3 tons/year

Smith/Hermesway/Grimmet Wetland Project (proposed 2014-2016)
Estimated sediment reduction is 871 tons/year
Estimated phosphorus reduction is 2.5 tons/year
Estimated nitrogen reduction is 2.0 tons/year

Weiser Irrigation Automated Head Gate Project (2014)
Estimated sediment reduction is 2057 tons/year
Estimated phosphorus reduction is 8.1 tons/year
Estimated nitrogen reduction is 20.5 tons/year

TOTAL REDUCTIONS
Phosphorus: 16.57 tons Sediment: 5,054 tons Nitrogen: 49.53 tons
wetland & head gate reductions are per year
March 31, 2014

Drip Irrigation

Soil Sampling

Digging wells for water quality monitoring

Planting willows with the Water Jet Sprayer

Spraying the roadsides for jointed goat grass

Weiser River Soil Conservation District
847 East 0th Street, Weiser, ID 83072
(208)549-4250
wcdi.lukshart@id.nadnet.net
<http://weiseriverscd.weebly.com>

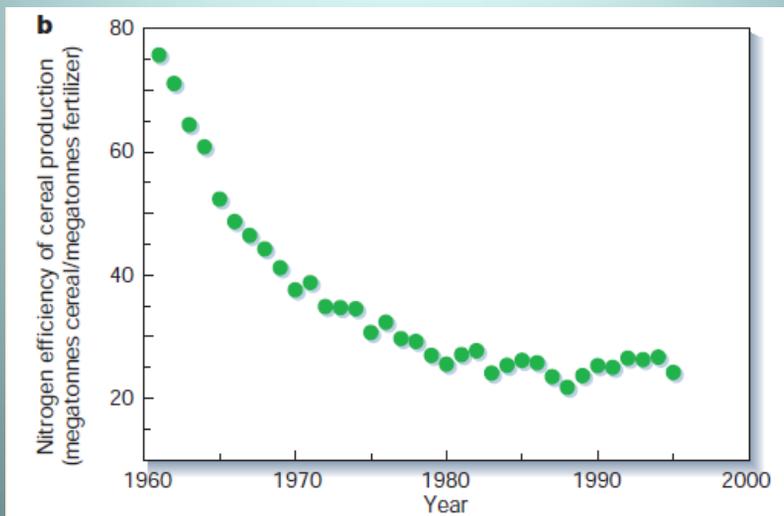
Camas Groundwater Improvement 319 Project

- BMPs implemented on 7423 acres
- Nutrient Management, including split applications of fertilizer
- Direct Seeding/No till practice has reduced soil loss from 6.5 tons/ac/yr to 1 ton/ac/yr
 - 80 % of farmers in Lewis County & 45 % in Idaho County have converted to no till.
- Lime applied to 2500 acres
- Cover crops planted on 1600 acres
- Filter Strips

On-going & New Ground Water Projects

- West Cassia, East Cassia, Minidoka, Balanced Rock, Twin Falls, and Snake River SWCDs were awarded Cooperative Conservation Partnership Initiative (CCPI) grants from NRCS to implement high intensity nutrient management, precision ag, and irrigation water management
- Twin Falls Drain Tunnel mapping & monitoring project
- Twin Falls & Magic Valley Soil Health Cover Crop Project
- Farm Service Agency Conservation Reserve Enhancement Program (CREP)
- Mini-Cassia Direct Seed & Cover Crop Project (NRCS Conservation Innovation Grant)

N efficiency decreasing

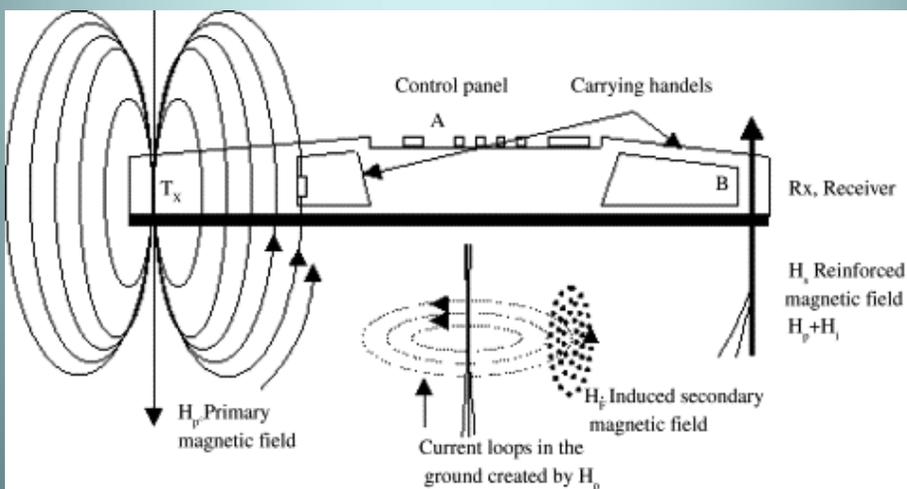


Tilman et al, 2002

Using EC Mapping to Generate Soil type grouping



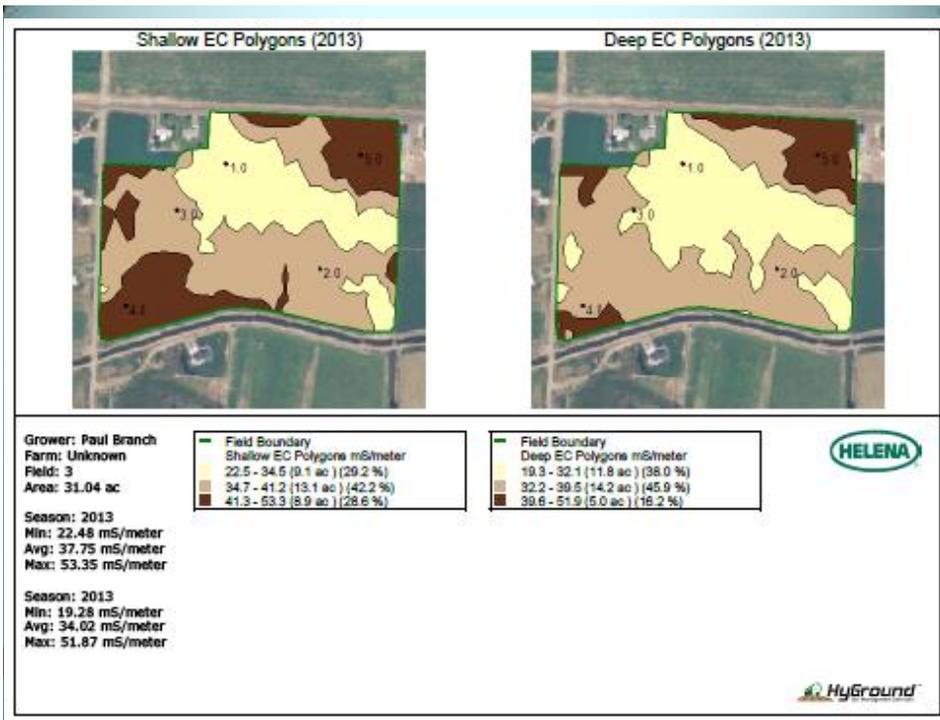
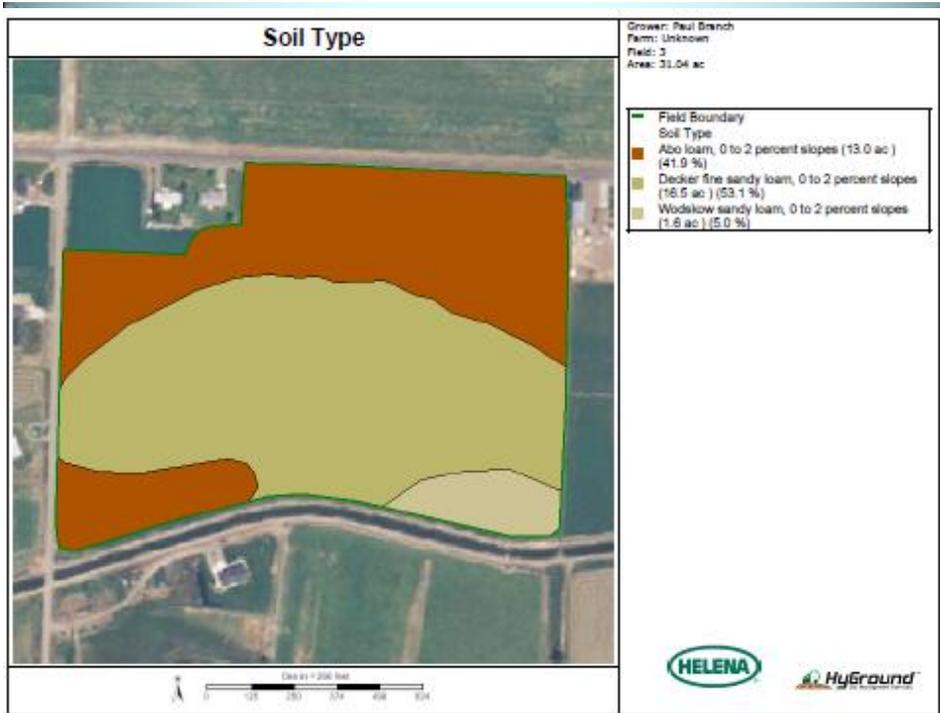
Electrical Conductivity Mapping Tool





Simplot Electrical Conductivity Tool





Cover Crop Demonstration Project

The Twin Falls Soil and Water Conservation District is partnering with the University of Idaho Cooperative Extension Service on a two-year cover crop demonstration project.

The project consists of eight satellite sites that range in size from 2 acres to 15 acres. These sites are located across the Magic Valley to capture different soil types, elevations, climate and management systems. Cooperators were asked to use their own equipment to plant, most chose to follow a spring grain crop to get the cover crop planted as early as possible. Some chose to plant at a heavier rate to utilize the cover crop as a winter feed for cattle or sheep, some chose to plant at a lighter rate solely for the wind erosion or soil health benefits. Species in the mix include radish, turnips, four kinds of pea, red clover, triticale, winter wheat and vetch.

Cassia County — 1 site
Jerome County — 2 sites
Lincoln County — 2 sites
Minidoka County — 1 site
Twin Falls County — 2 sites

There is also a main site in Twin Falls County where more replicated strips are providing more information about soil till, grazing benefits and tillage methods.

Because this is the first fall, we don't have a lot of data. Forage samples were taken on the sites where cooperators planned to graze. Those numbers haven't been crunched yet.



This is the main site near Kimberly. Replicated strips were planted using both conventional and no-till drills. The site did not receive consistent irrigation and production suffered, with plots ranging from one-third to 1 ton of dry matter per acre.



Site on the Salmon Tract that was planted in mid-August and received less than 2 inches of water. The cover crop mix was planted at approximately 40 pounds per acre with a no-till drill.



Site in western Twin Falls County that was planted in mid-August at the rate of 150 pounds per acre with the intention of being grazed. Seed was broadcast with fertilizer as a carrier. This site was well irrigated.



This site is located in southern Jerome County. It was planted in mid-August with a no-till drill and received about 6 inches of irrigation water. It will be grazed.

This site is near Malta. Seed was planted with a no-till drill at 150 pounds per acre on Aug. 3, 2013 and received about 10 inches of irrigation water. This field has been no-tilled for approximately 5 years and was very mellow. You can see a worm casing on the soil surface in the photo below.

The cooperator plans to graze sheep on the cover crop this fall and then will green chop it next June, followed by sudangrass.



Summary of BMPs to address elevated nitrates

- **Nutrient management & precision ag**
- **Irrigation water management, including VFDs**
- **Convert to sprinkler, surge, or drip irrigation to minimize the risk of leaching nitrates**
- **Apply lime to increase pH in acidic soils**
- **Be aware of the importance of good well construction and maintenance and septic system maintenance (see ISDA Home*A*Syst Program)**
- **Adjust crop rotations to utilize nitrogen from legume crops such as alfalfa**
- **Plant cover crops to improve soil health**
- **Implement no-till or minimum tillage practices**



SOIL & WATER CONSERVATION COMMISSION

Resource Conservation & Range Development Loan Program

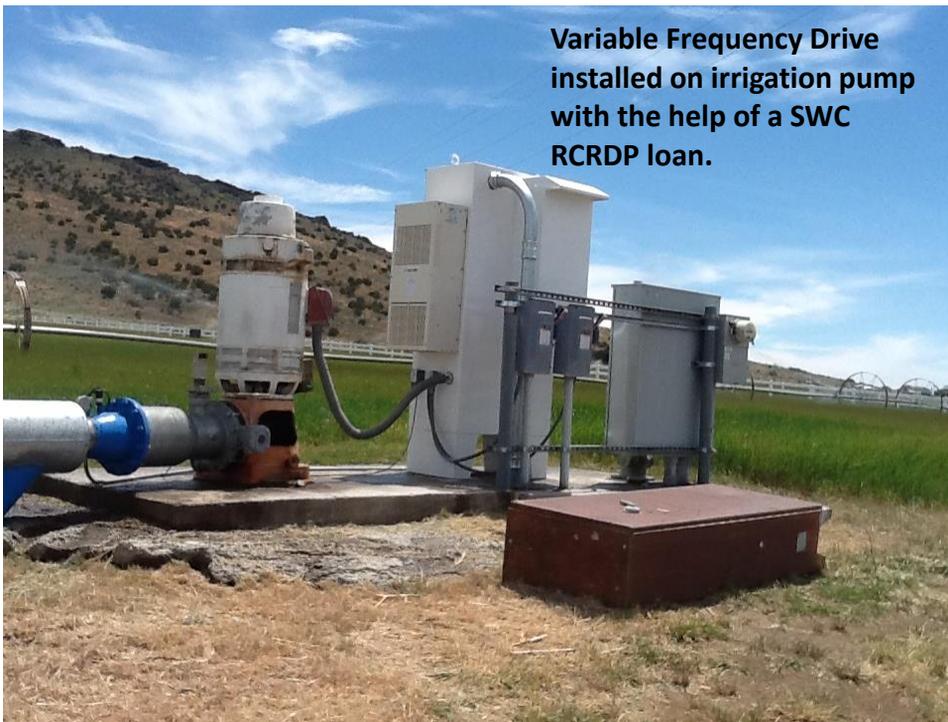
The Conservation Commission invites landowners to apply for low-interest loans to install conservation measures on private property. Eligible projects address soil and water issues, like improving riparian areas or enhancing fish and wildlife habitat.

A partial list of eligible projects includes:

- Irrigation equipment
- No-till drills
- Animal feeding operation improvements
- Livestock fencing
- Stream bank protection

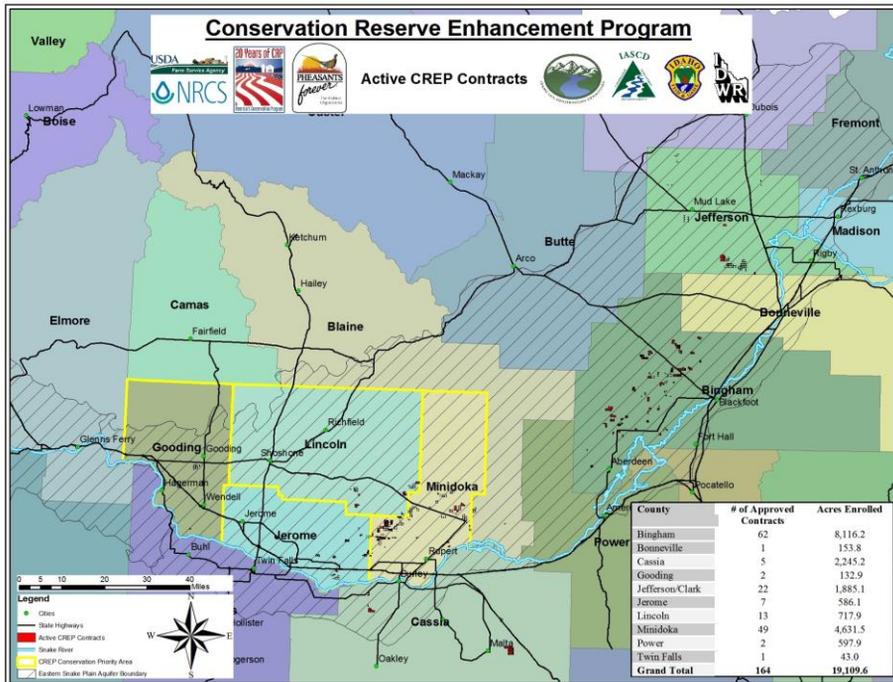
Currently, there is a single loan limit of \$200,000 and \$300,000 maximum for any individual borrower. Loan rates are:

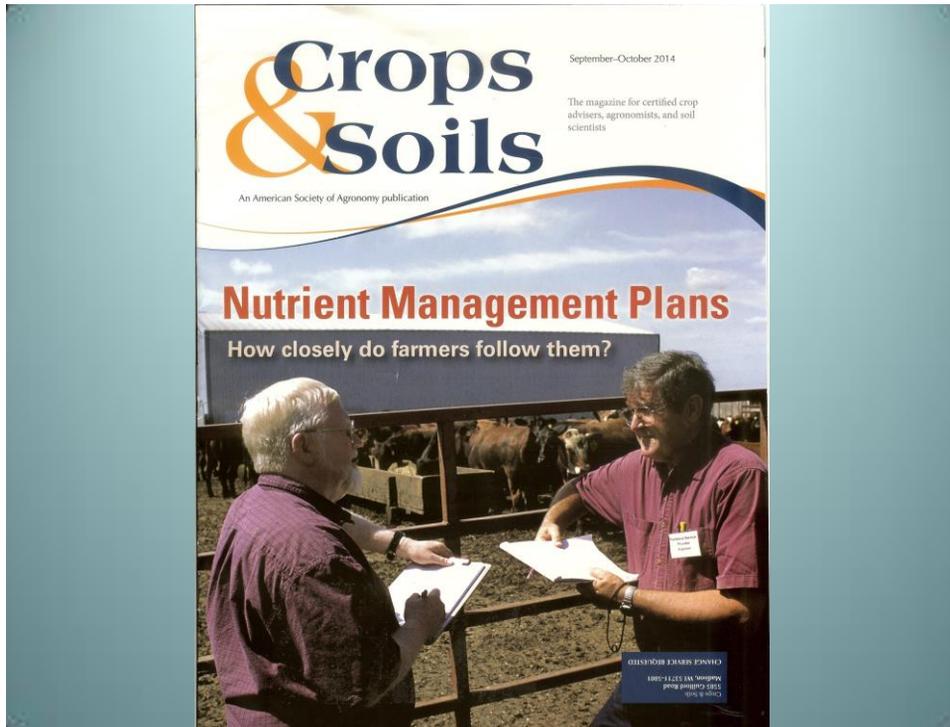
- 2.5% for a 1- to 7-year term
- 3% for an 8- to 12-year term
- 3.5% for a 13- to 15-year term



**Variable Frequency Drive
installed on irrigation pump
with the help of a SWC
RCRDP loan.**

Using a no till/direct seed drill helps conserve water and improve soil tilth, thus decreasing the likelihood of nutrients leaching into the groundwater.





Soil Health: What is It?

The continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals, and humans

- Nutrient cycling
- Water (infiltration & availability)
- Filtering and Buffering
- Physical Stability and Support
- Habitat for Biodiversity

Soil Health Planning Principles

- **Manage more by Disturbing Soil Less**
- **Use Diversity of Plants to add diversity to Soil Micro-organisms**
- **Grow Living Roots Throughout the year**
- **Keep the Soil Covered as Much as Possible**

Goal: To create the most favorable habitat possible for the soil food web

**Interstate 15 Near Roberts/Osgood Area
(Northwest of Idaho Falls).
Freeway was closed because of blowing dust.
Picture taken 4/22/2014.**



November 29, 2014 - 9 vehicles involved in chain reaction crash due to zero visibility caused by blowing dust. Both sides of I-15 near Roberts (NW of Idaho Falls) shut down for 7 hours

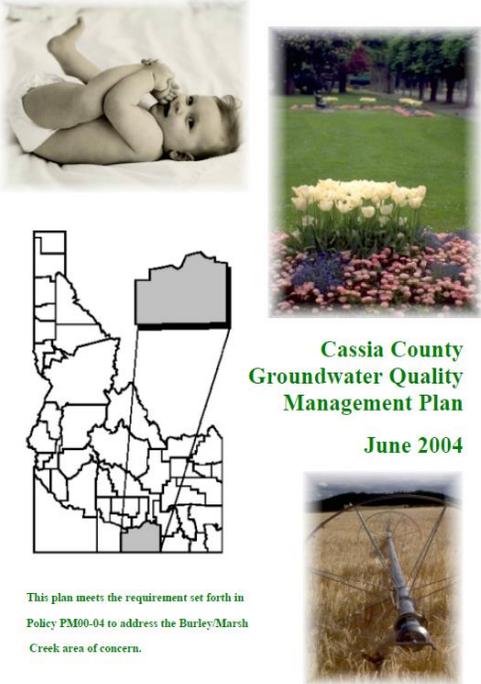
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Outreach and Education

- Water Fairs/Free Water Testing
- Brochures, Placemats
- Grower Workshops
- Newsletters
- Ground Water Improvement Planning Committees
- Work with schools to integrate water testing activities into science curriculum
- Displays at county fairs and ag expos

Conservation the Idaho Way: Sowing the Seeds of Stewardship





Completed Ground Water Management Plans in Idaho (and year completed):

- Ada County 2010
- Bliss NPA 2007
- Lower Boise/Canyon County 2005
- Bruneau/Grand View 2008
- Camas Prairie NPA 2008
- Cassia County 2004
- Elmore County 2014
- Gem County 2014
- Minidoka NPA 2008
- Owyhee County 2010
- Payette County 2012
- Twin Falls County 2001, updated in 2009
- Weiser Area 2003

Cassia County Groundwater Quality Management Plan
June 2004

This plan meets the requirement set forth in Policy PM00-04 to address the Burley/Marsh Creek area of concern.



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High nitrates in your water?

A Public Meeting & Free Nitrate Screening for
the Ashton-Drummond Nitrate Priority Area

Saturday, Oct. 17 • 10 am – 2 pm
Ashton Community Center, 714 Main Street, Ashton

MEETING GOALS:

- Update the public of the status of the draft Ground Water Quality Improvement Plan, and
- encouraging residents impacted by high nitrates to be part of the solution;
 - be part of the team that will decide on the solutions and
 - volunteer to be included in the follow-up sampling of high-nitrate wells identified in the most recent monitoring events

*The public meeting portion will begin at 10 am,
and the nitrate screening will continue until 2 pm.*

*Questions? Flint Hill—Idaho DEQ, 528-2650
Cathy Stegelmier—City of Ashton, 652-3987*

Carolyn.Firth@swc.idaho.gov

