Is It Working?

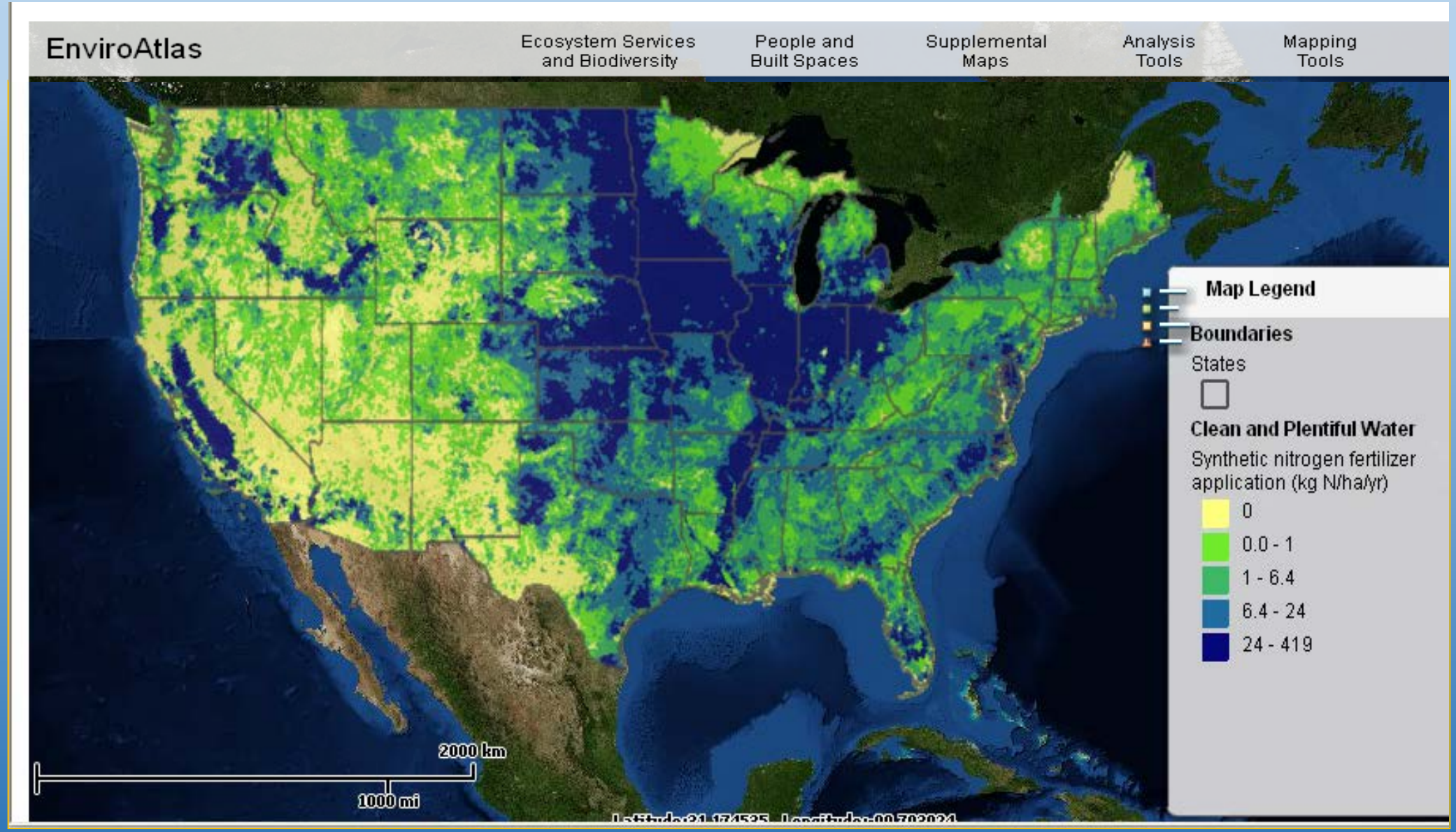
Changes in nitrate leaching over time in the Southern Willamette Valley Groundwater Management Area

Jana Compton, US EPA Western Ecology Division

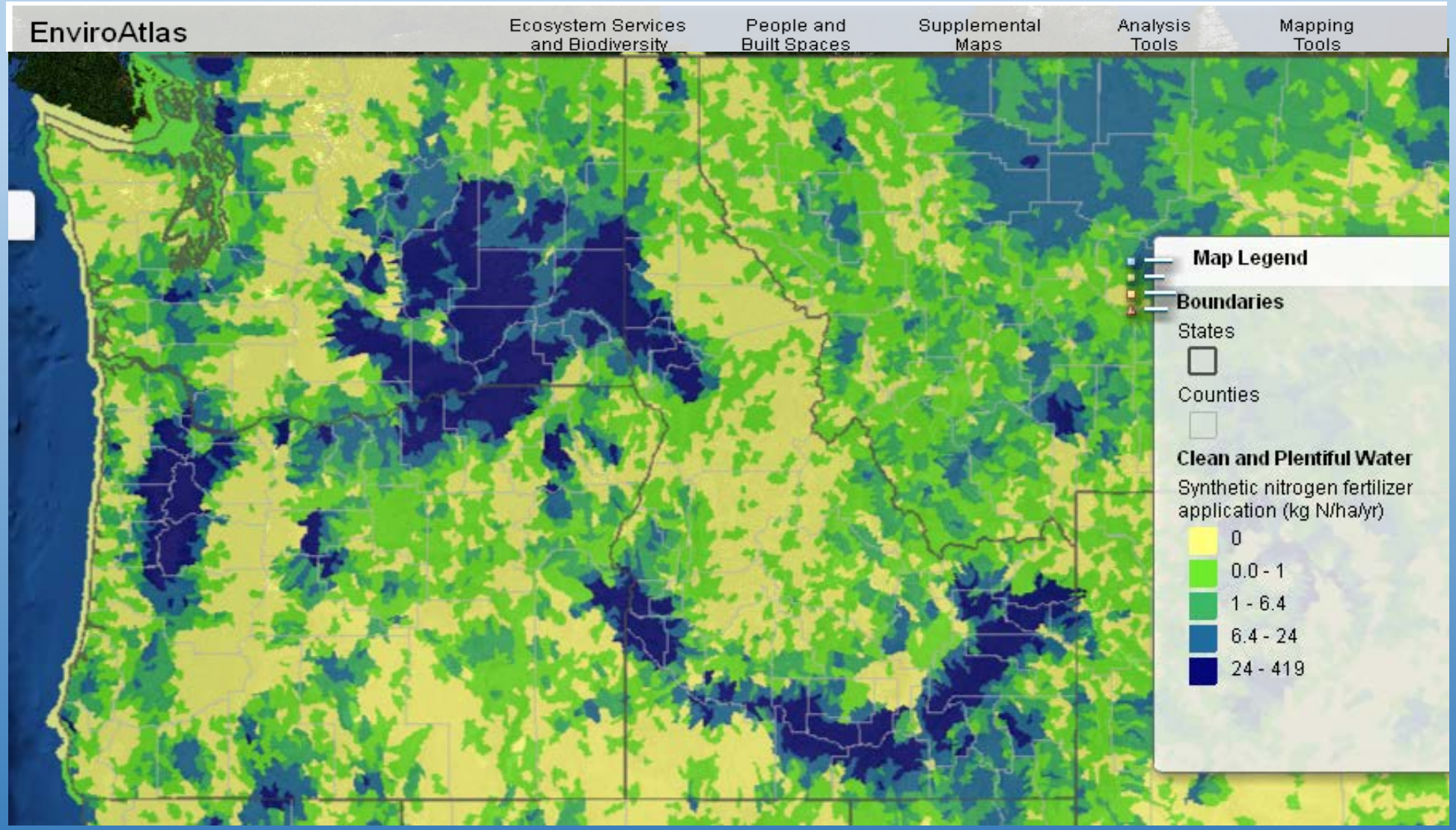
Susanna L. Pearlstein, ORISE Fellow

FRRCC Meeting March 16, 2016

US Synthetic Fertilizer N Inputs, 2006

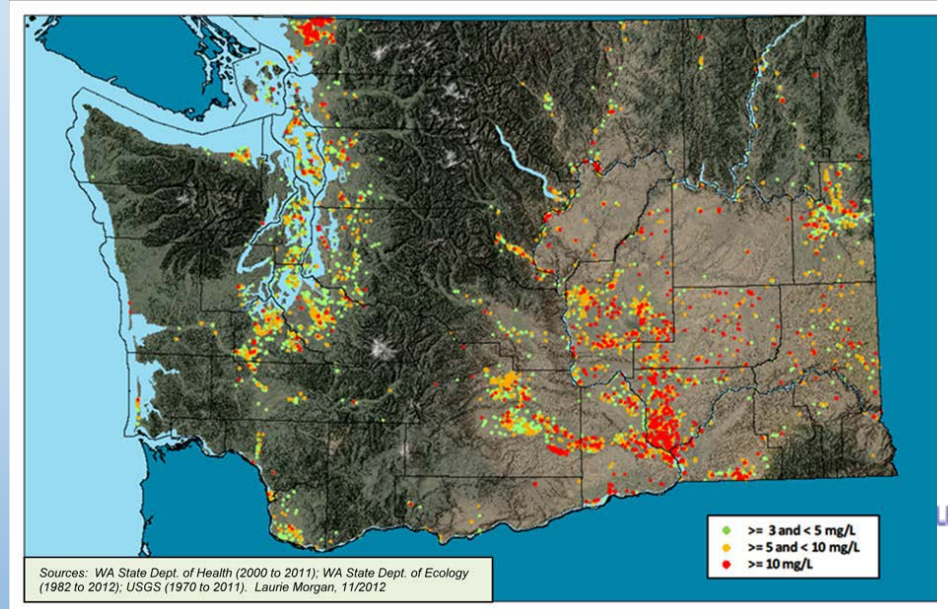


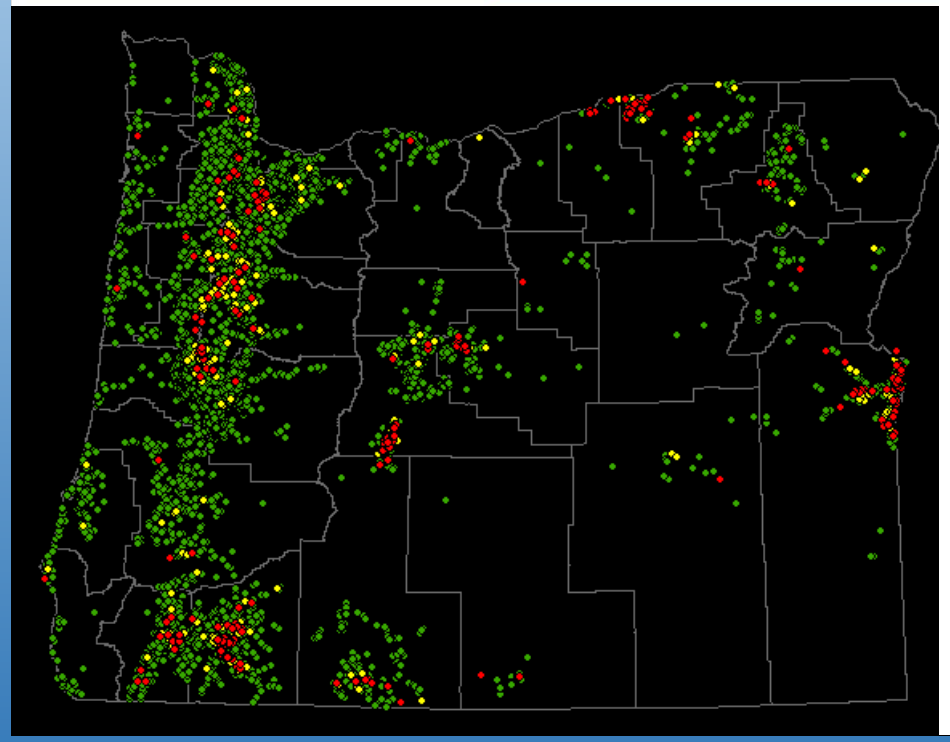
PNW Nitrogen Fertilizer N Inputs, 2006

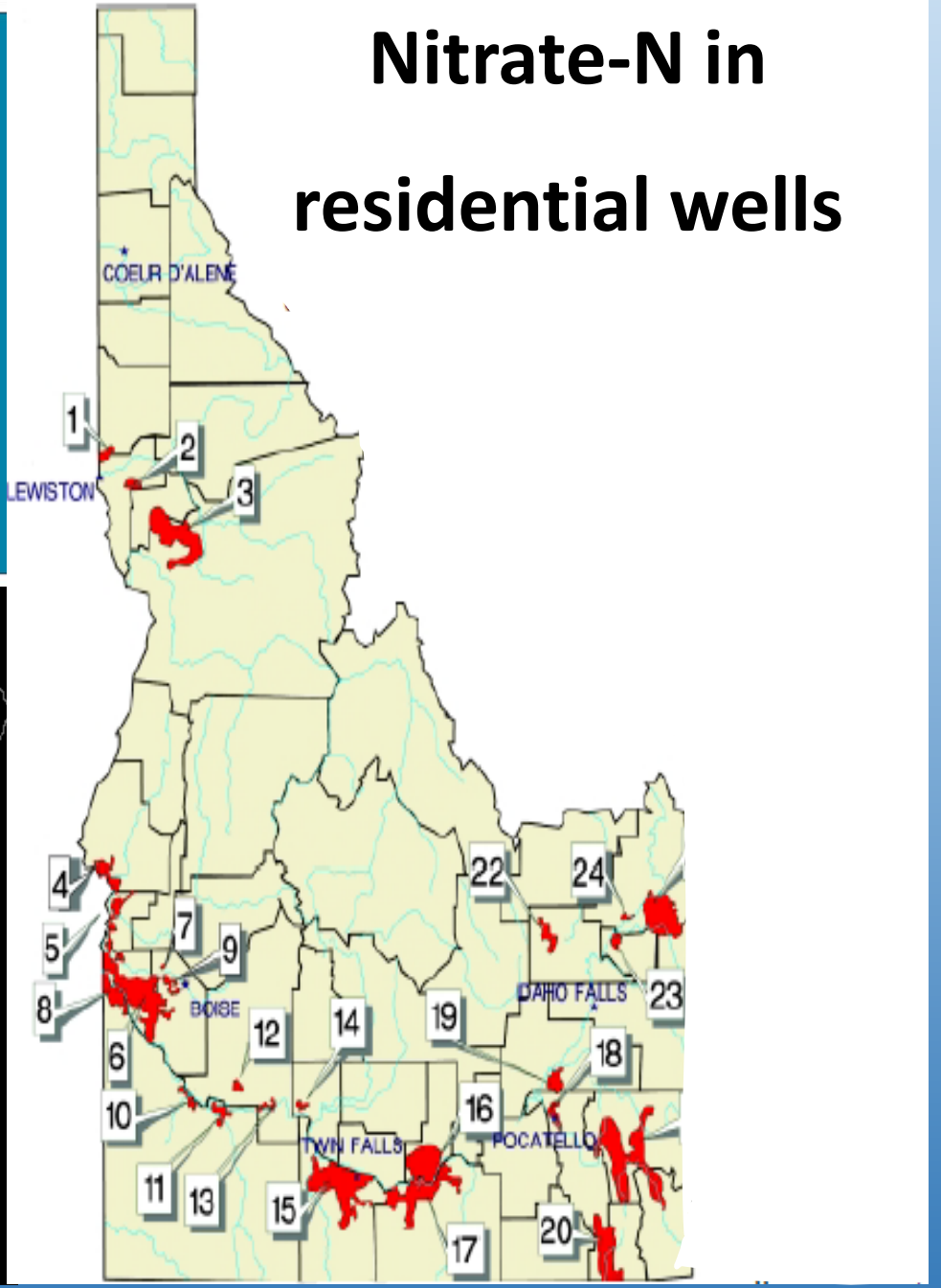


http://enviroatlas.epa.gov/enviroatlas/atlas.html

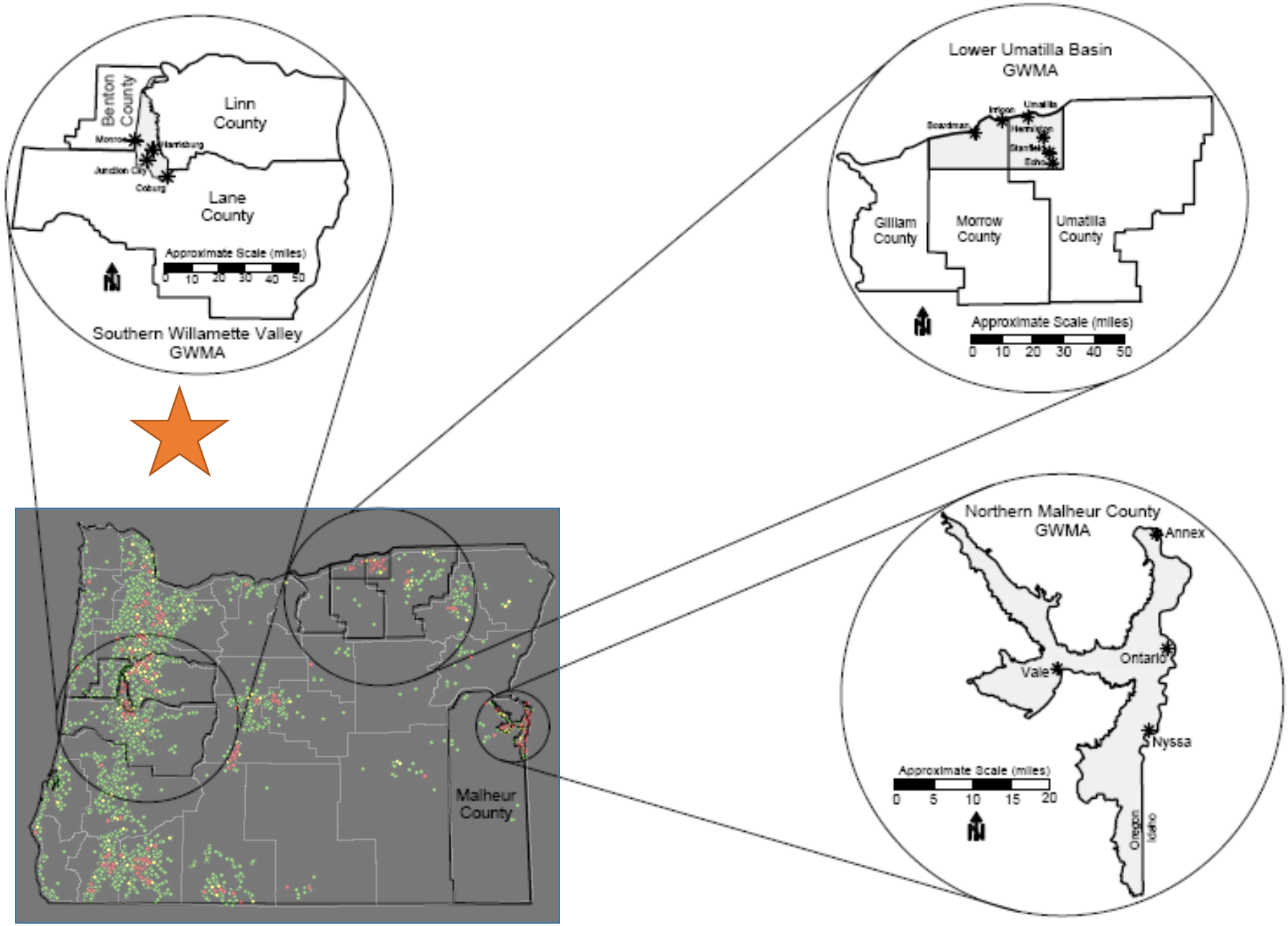
Nitrate-N in residential wells







Location of Oregon's Groundwater Management Areas



Southern Willamette Valley Groundwater Management Area

- 20% wells > 7 mg/L nitrate-N (2000-2001)
- GWMA declared in 2004
  - At least 8,000 people live in SWV GWMA
- N fertilizer is main source of nitrogen to GWMA
- Outreach activities and changing management practices from 1990s

Partnership to Improve Nutrient Efficiency (PINE):
Setting the social and management stage for water quality improvements in the Southern Willamette Valley

RARE
Regionally Applied Research Effort Grant Program
ENVIRONMENTAL PROTECTION AGENCY

Project team:
Alan Henning, US EPA Region 10
Jana Compton, US EPA-ORD
Audrey Eldridge, Oregon DEQ, GWMA lead
Susanna Pearlstein, ORISE
J. Renée Brooks, US EPA-ORD
Donna Schmitz, Benton SWCD
Teresa Matteson, Benton SWCD
Kevin Seifert, Linn SWCD
Dave Downing, Upper Willamette SWCD
Tom Snyder, USDA NRCS
Paul Measles, Oregon Dept. of Agriculture
Carrie Sanneman, Willamette Partnership
Bobby Cochran , Willamette Partnership
Denise Kalakay, Lane Council of Governments
John Selker, Oregon State University
Blake Hatteberg, Dynamac Inc.

Project support:
EPA – Field sampling, isotope analysis
DEQ – Chemistry analysis in-kind
ODA Fertilizer Fund – Equipment, Soils
SWCD – Soil health
NRCS, SWCS, GWMA, Land owners – Sites
WP – Modeling edge-of-field loss
LCOG – Outreach, Expert Panel

Project Team Members

Oregon Department of Agriculture
DEQ State of Oregon Department of Environmental Quality
WILLAMETTE PARTNERSHIP
LCOG LANE COUNCIL OF GOVERNMENTS
TiAER Texas Institute for Applied Environmental Research Tarleton State University
Oregon State University Extension Service
Linn Soil & Water Conservation District
EPA
BENTON SOIL AND WATER CONSERVATION DISTRICT
Upper Willamette Soil and Water Conservation District

Objective of the PINE Project

Provide a tool that will help managers
quantify water quality benefits of management practices.

Partnerships from PINE project

- Landowners - 11 local farmers agree to study their working fields
- Additional grower interest – soil testing protocol in RARE 2016
- Influential industry partners – crop advisers, fertilizer reps
- SWCDs, DEQ and ODA integral in support
- USDA national effort – APEX modeling and testing of the Nutrient Tracking Tool for use by farmers

Timeline for PINE project

2013	2014	2015	2016	2017

RARE grant 2013

RARE PINE grant 2016

Landowner agreements

Grower interviews

Outreach, Expert Panel

Grower interviews

Grower interviews

Lysimeter study

RARE funding PLUS DEQ in-kind analyses and ODA grant

Rapid soil test for farms
RARE funding

Nutrient Model Calibration & Scenarios - Willamette partnership RARE funding

Workshop Irrigation ODA funding

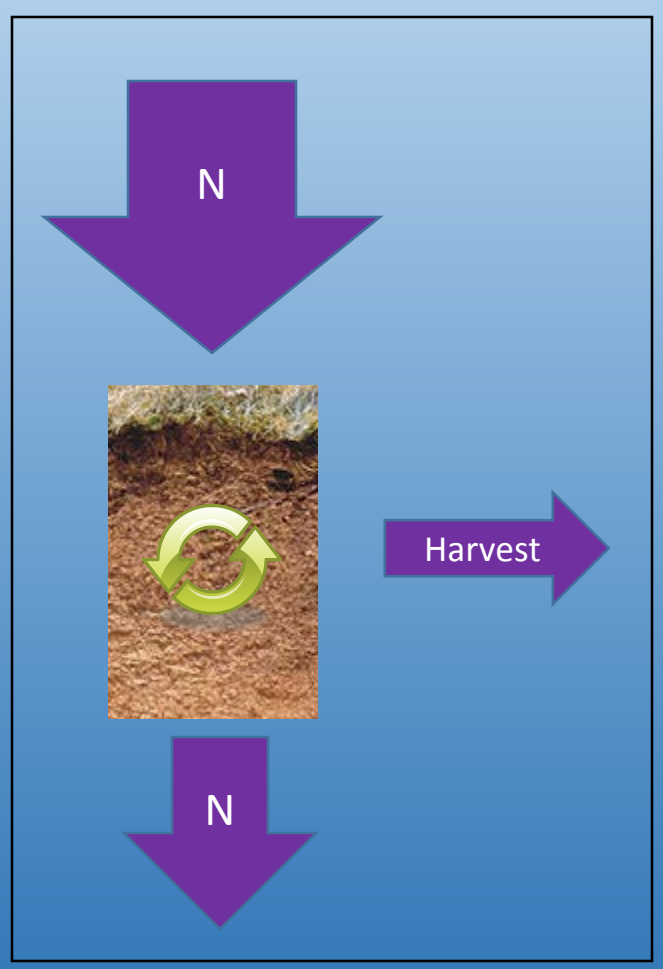
Workshop Cover Crops ODA funding

Workshop N management ODA funding

Reports, Publications, Communication

Lysimeter study expectations based on changing practices

1990s study



Improvements

Irrigation Practices

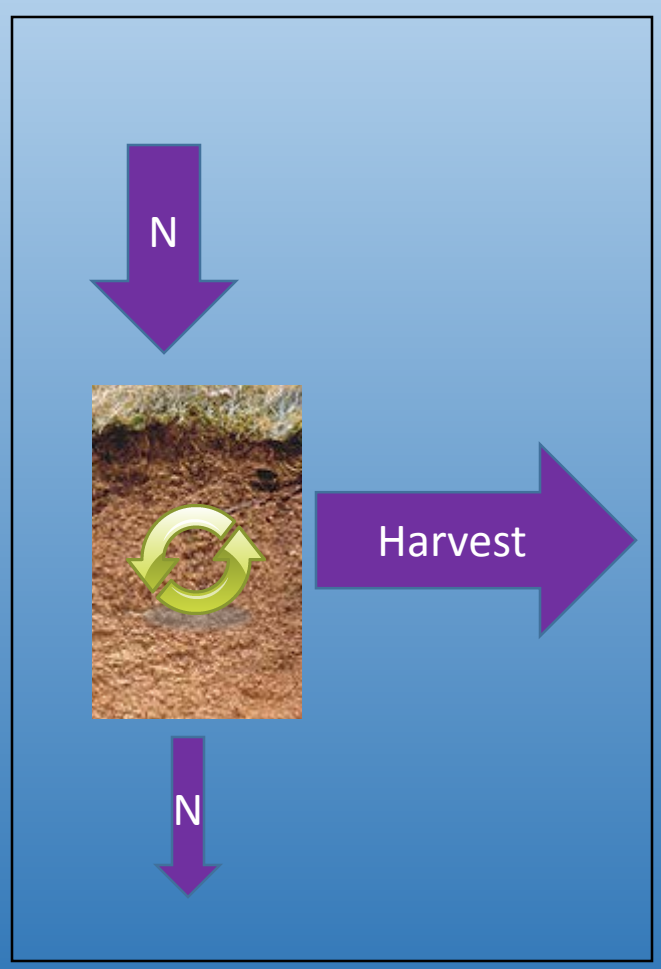
Breeding, Production

Fertilizer management

- ✓Right source
- ✓Right rate
- ✓Right time
- ✓Right place

Legacy nitrate issue

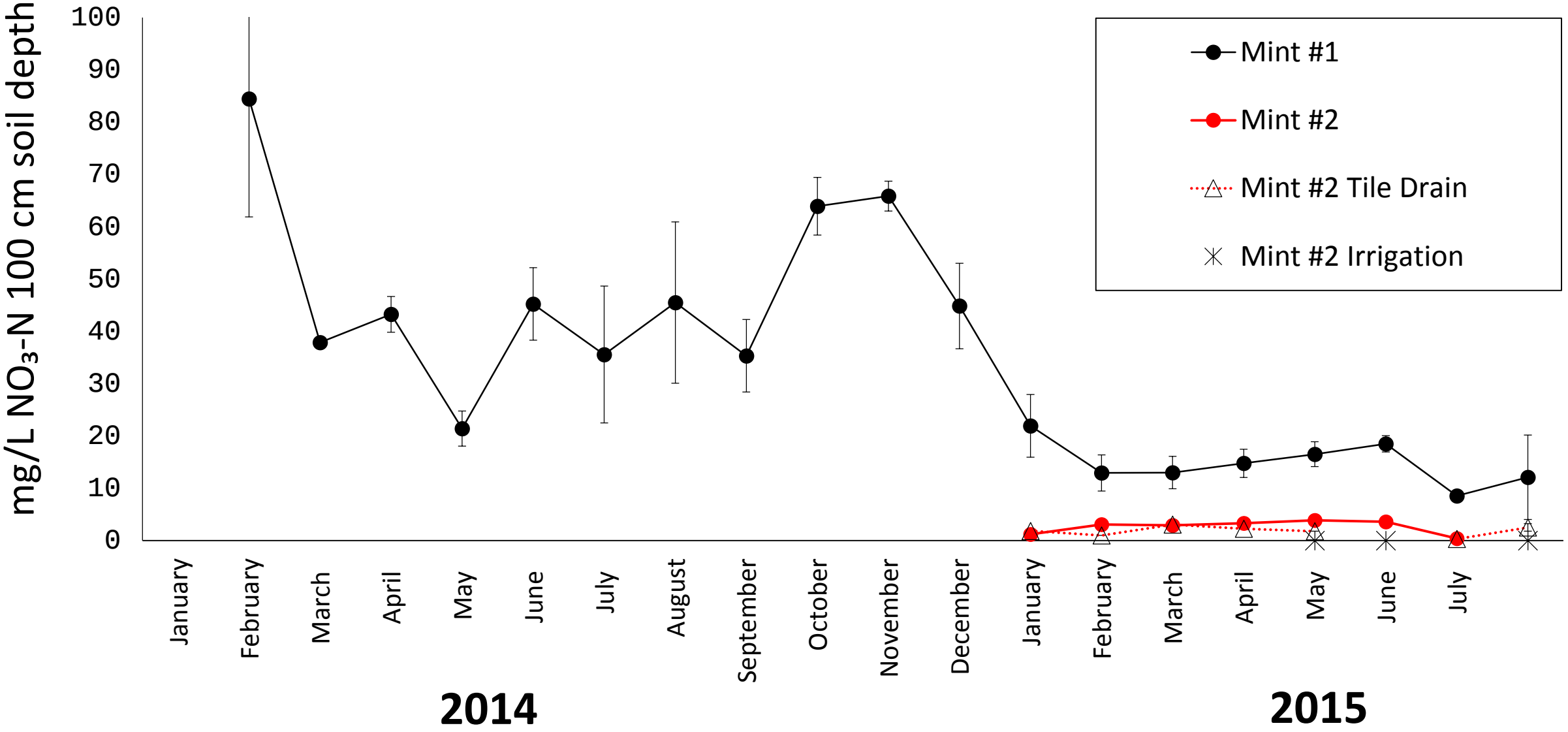
Current study



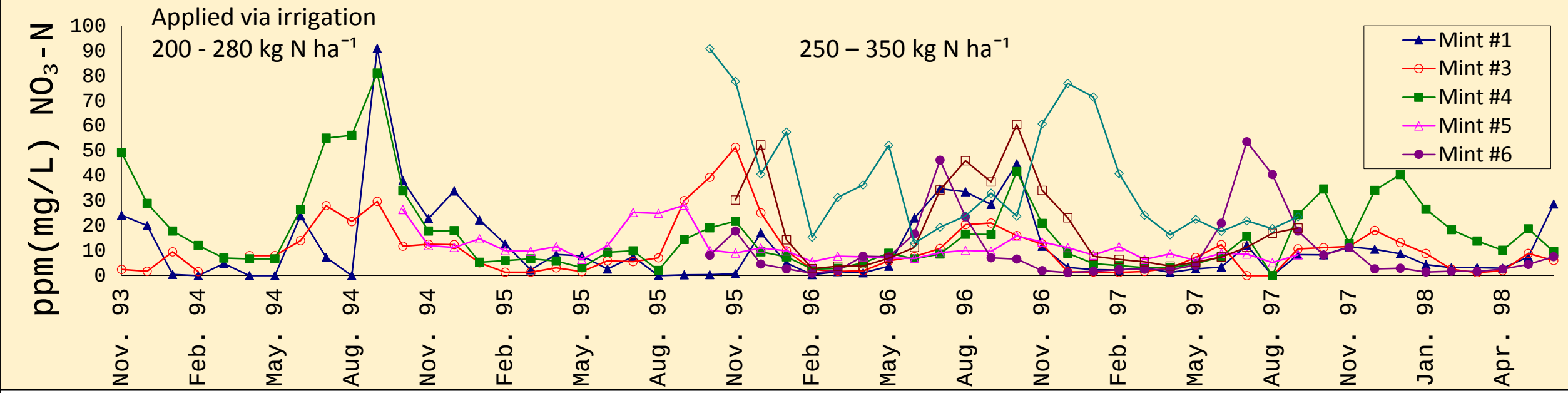
Results - Peppermint

Photo: S. Pearlstein

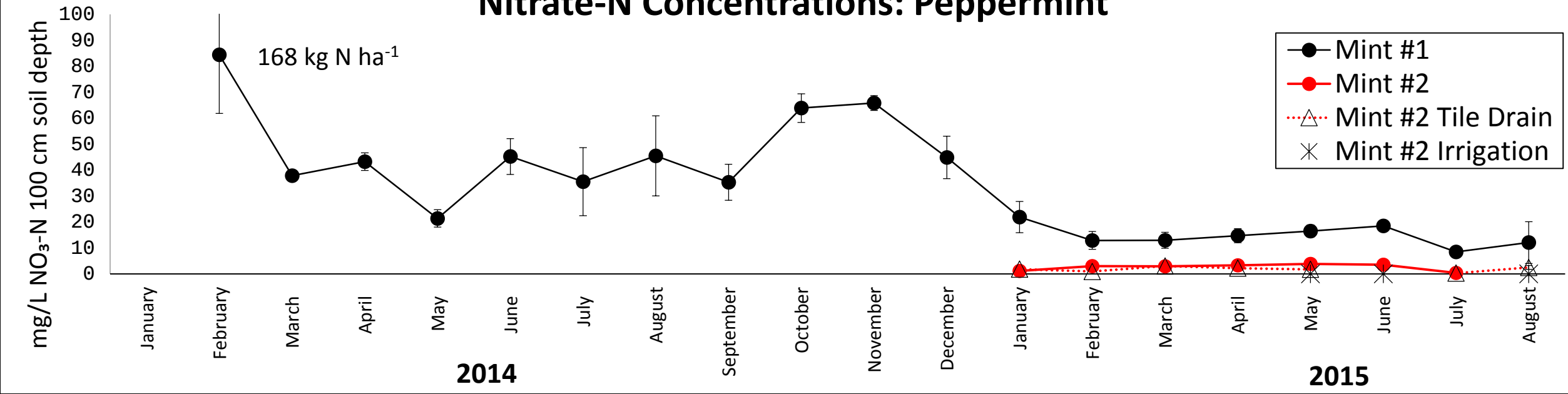
Nitrate Concentrations: Peppermint



Nitrate-N in 1990s PCAPs: Peppermint



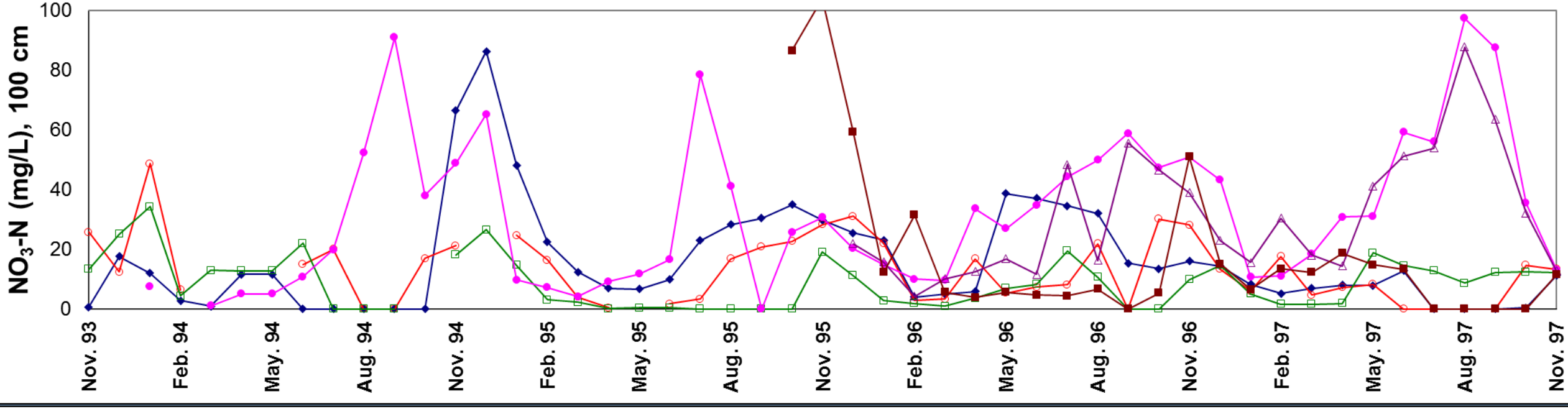
Nitrate-N Concentrations: Peppermint



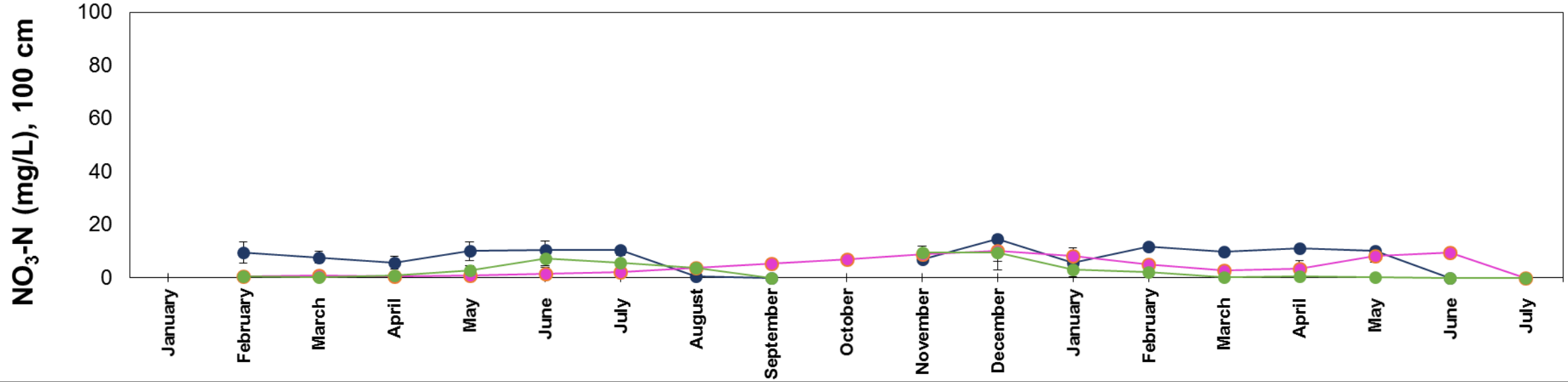
Results - Row Crops

Photo: S. Pearlstein

1993-1997 Data - Row Crops



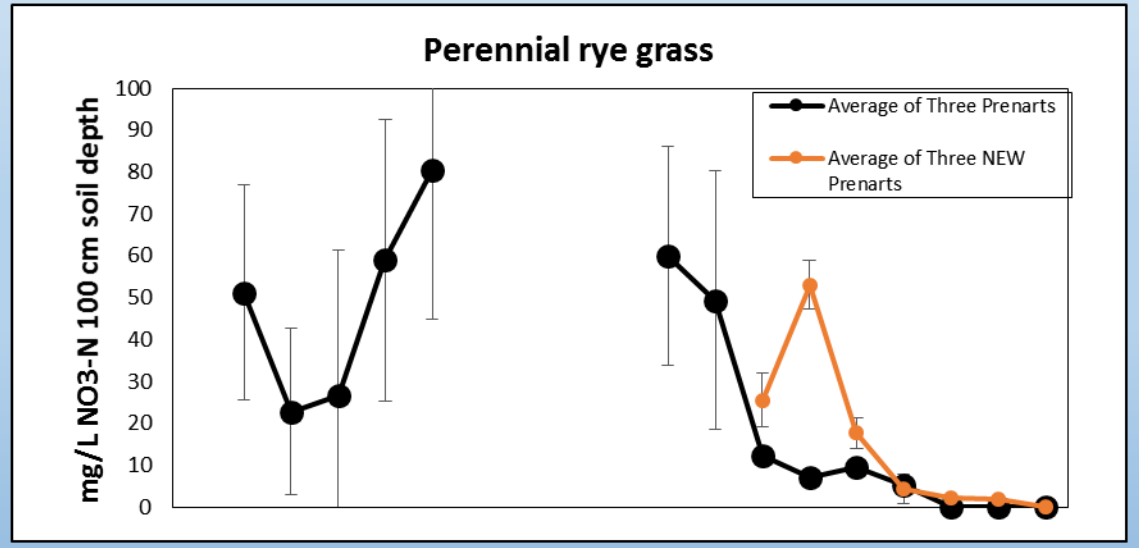
2014-2015 Data - Row Crops



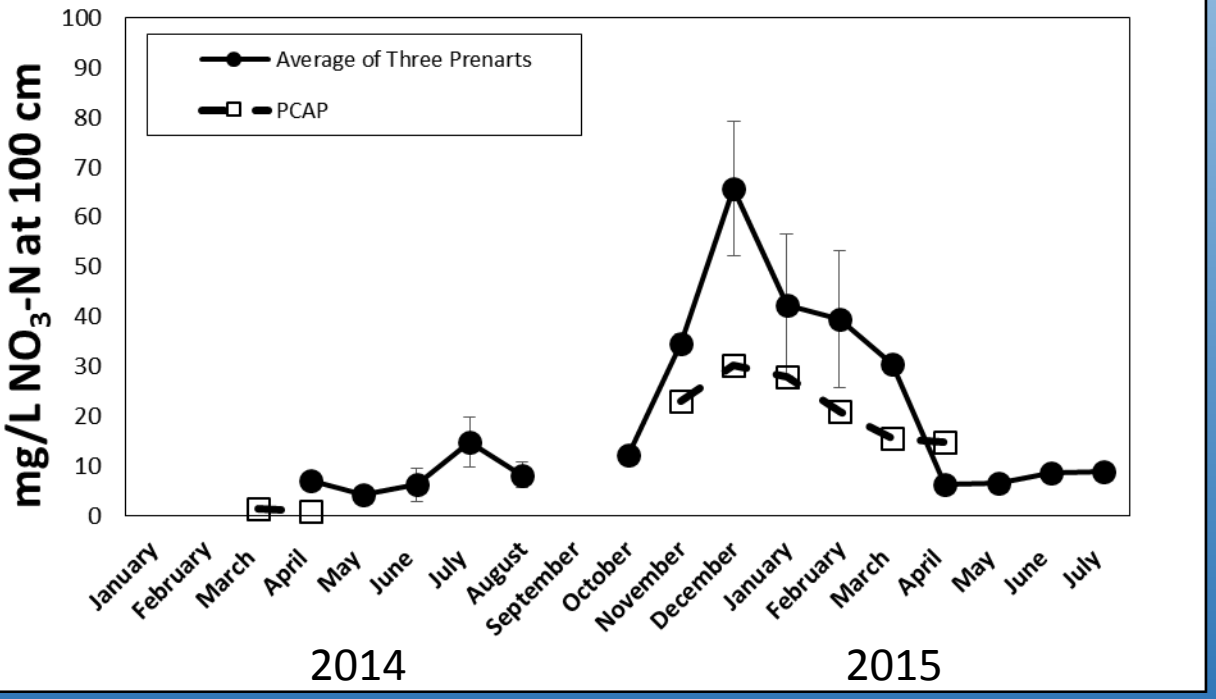
Results - Grass seed

Tall fescue

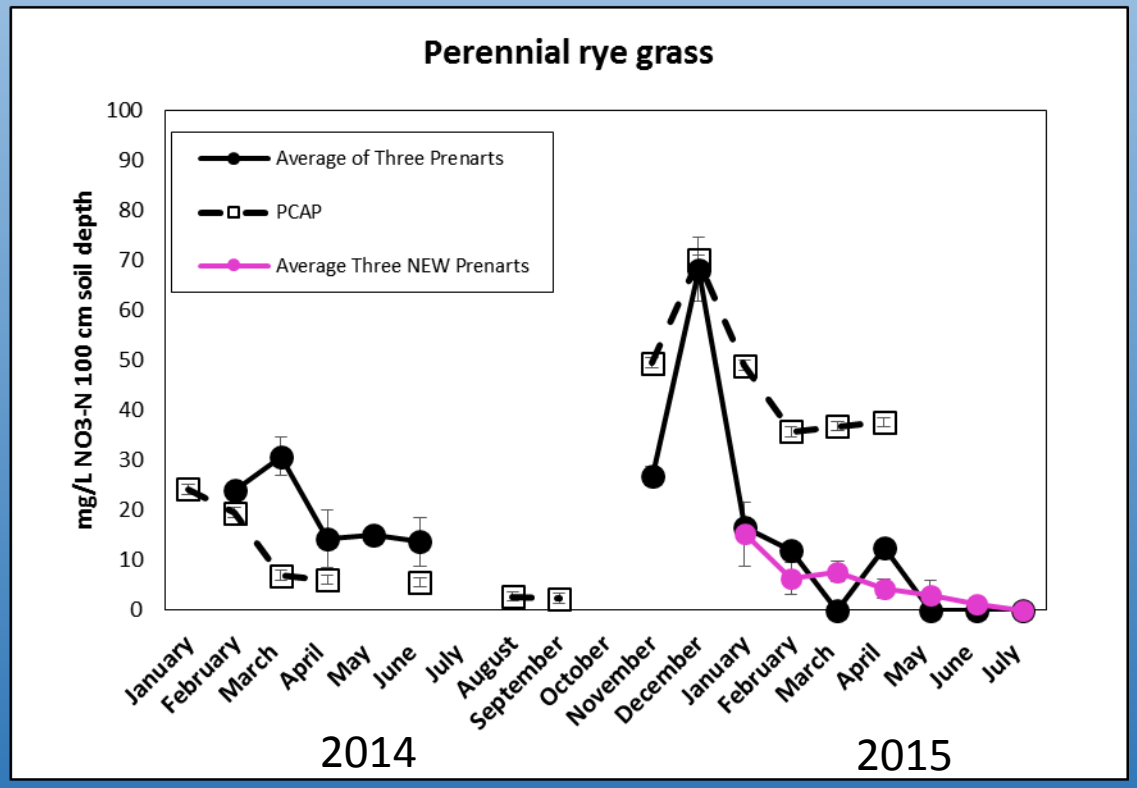
Perennial rye grass



Annual Rye grass



Perennial rye grass



Individual Grower Data Sharing

Preliminary Nitrate Data for Field RARE L001

Install Date	Current Crop	Previous Crop	Soil Type	PCAP Lysimeter (1990)	Prenart Lysimeter (2014)	Shallow Groundwater Well	Farmer Interview Conducted
Feb 5, 2014	Wheat	Tall Fescue	Malabon silty clay	Yes	Yes	Yes	Yes

The February – September 2014 lysimeter nitrate-Nitrogen (NO_3-N) data has been processed by Oregon Department of Environmental Quality lab. Results for your field are shown in the graph below and have been flow-weighted for each month meaning we combine samples collected from the same lysimeter over the three week collection period into one, 500 mL bottle. The Maximum Contaminant Level (MCL) in drinking water is 10 mg/L of nitrate-Nitrogen. The measurements taken by the lysimeters are not groundwater, they are sampling below the root zone of the crop. For this field, the older Passive Capillary (PCAP) lysimeters show higher levels than the newer Prenart lysimeters but both leachate values are below the MCL.

Three more Prenart lysimeters were installed on May 12, 2014 in the field by the irrigation riser. These lysimeters did not start pulling data until December, 2015. Prenart data represented here is only from the three Prenart lysimeters at the edge of the field.

+

Figure 1. Google Earth image of sampling site L001. Yellow push pins indicate locations of the 6 Prenart Lysimeters that were installed in 2014. The three in the center of the field were installed at the landowner's request. The PCAP is next to a Prenart represented by the yellow pin in the far upper right hand corner.

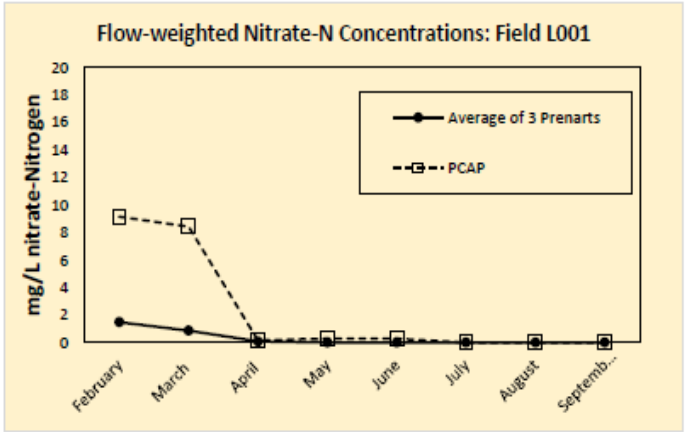


Figure 2. Preliminary data for L001 Wheat field. Dotted line represents the Passive Capillary lysimeters that were installed by John Selker in the 1990's. The solid black line represents the Prenart lysimeters that were installed in 2014.

Year 1 Factsheet

Nutrient Tracking for Surface and Groundwater Protection

Innovative Research for a Sustainable Future

RARE
Regionally Applied Research Effort Grant Program
ENVIRONMENTAL PROTECTION AGENCY

A project to examine nutrient management to improve surface and groundwater quality in the southern Willamette Valley Groundwater Management Area (GWMA)

Water quality trading:
An innovative approach to achieve water quality goals more efficiently. Trading is based on the fact that sources in a watershed can face very different costs to control the same pollutant. Trading programs allow those facing higher pollution control costs to meet regulatory obligations by purchasing environmentally equivalent (or superior) pollution reductions from another source at lower costs, achieving the same water quality improvement at lower overall cost.

Goal

To assess the effectiveness of current fertilizer management practices in the GWMA for reducing nitrate contamination of groundwater, and to test models that can support nutrient and ecosystem services trading to improve surface and groundwater quality.

The Nutrient Tracking Tool (NTT) and Agricultural Policy/Environmental Extender (APEX) are models used by USDA and others to quantify reductions in nitrogen and phosphorus leaving the field. This project makes the link between improvements in fertilizer management and groundwater improvements.

Approach

Over a two year period, the Project Team will collect samples from existing and newly placed lysimeters in the GWMA. Water samples will be analyzed to determine levels of nitrate leaching below rooting zones in crops using precision agriculture and other innovative fertilizer management practices. Measurements of soil parameters will be used to determine the influence of practices on soil quality. Results will be used to calibrate and validate the APEX for the GWMA, and compare those methods and results to the NTT. The NTT model could be used to support ecosystem service trading and improving surface water and groundwater quality in the GWMA and elsewhere in the nation.

2009 NRCS CIG
Soil Quality Project

Teresa Matteson
tmatteson@bentonswcd.org

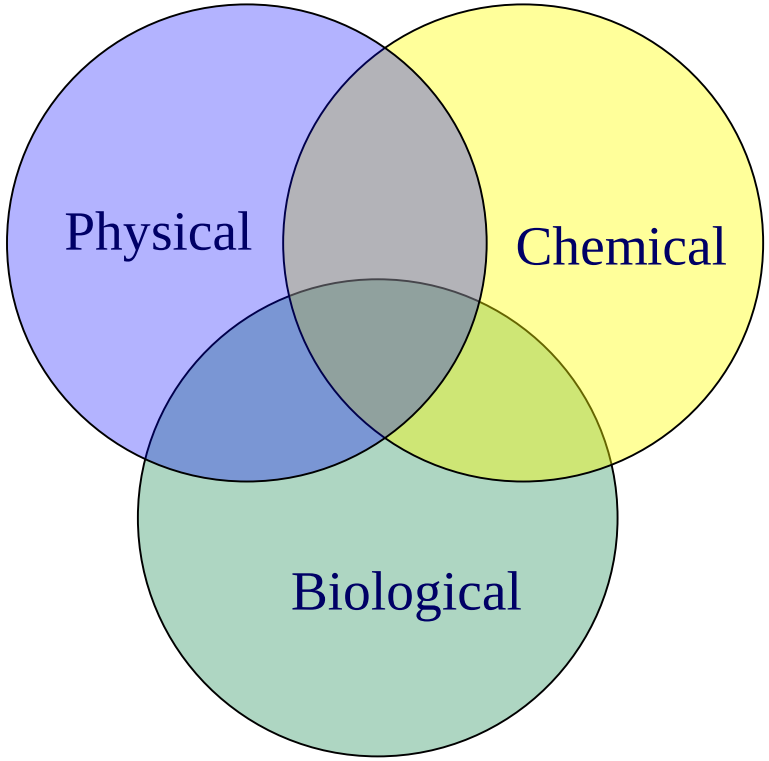
Benton Soil and Water
CONSERVATION DISTRICT

Soil Quality Project
Mission Statement

To provide farmers
with an assessment package
that describes on-farm soil quality
to guide future management decisions.

Benton Soil and Water
CONSERVATION DISTRICT

Indicators of Soil Quality:
The soil quality assessment package



“Beyond N, P, and K, what is the condition of my soil’s physical and biological health?”

Cornell Soil Health Assessment Training Manual

B.K. Gugino, O.J. Idowu, R.R. Schindelbeck, H.M. van Es,
D.W. Wolfe, B.N. Moebius-Clune, J.E. Thies, and G.S. Abawi

Soil quality data

Soil Quality Parameter Data for Field RARE L001

Below are the Soil Quality Parameters (SQP) from the L001 Wheat field in 2014 and the Tall Fescue in 2015. This work was conducted by Teresa Matteson from Benton Soil & Water Conservation District. In 2014 soil samples were taken in the proximity of the lysimeters. One soil sample (6-8 inches deep) was taken around each lysimeter. The nitrate-N results are in Table 1.

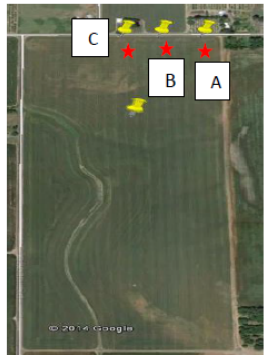


Figure 1: Google Earth image of L001. Yellow push pins indicate locations of the 3 Prenart Lysimeters on the edge and in the middle of the field. The PCAP is next to the A Prenart. Red stars show soil sample locations for the A, B and C lysimeters.

Table 1: 2014 Soil Nitrate-N results

	NO3-N (ppm)
A	7.1
B	5.3
C	3.0

We hope you find this information helpful!
More information on the SQP can be found at
http://www.bentonswcd.org/programs/soil-quality/soil-quality-assessment/
Teresa can be contacted at (541) 753-7208.

Summary Sheet Prepared by Susanna Pearlstein (541) 754-4534

Table 2: SQP Results for 2014-2015

	2014	2015
Crop/field condition at time of sampling	**Wheat**	**Fresh plow/plant to grass**
Aggregate Stability (%)	7	45
Field Gravimetric Moisture (%)	0.29	0.29
Surface Hardness (psi)	156.50	179
Subsurface Hardness (psi)	325	357
OM (LECO C *(1/0.58) (%)	4.3	
OM LOI (%)		4.8
Active Carbon (ppm)	405	347
Aerobic PMN	0.4	0.5
pH	6.2	5.8
Extractable Phosphorus Bray-P (ppm)	108	140
Extractable Potassium (ppm)	328	401
Magnesium (ppm)	426	634.4
Magnesium (meq)		5.2
Calcium (ppm)	2414	3700
Calcium (meq)		18.5
Sand	25	28
Silt	40	59
Clay	35	14
Textural class	Clay loam	Silt loam

Successes

- All farmers who started with us in 2014 are still participating
- Benton SWCD conducted two years of soil quality sampling on all fields. Shared results with farmers.
- Added rapid soil sampling protocol to the 2016-2017 sampling years. (10 additional fields)
- >30 presentations to local stakeholders, regional, state and federal agencies and at national meetings.

Lessons Learned

- Trust, credibility, communication and consistency are key factors.
- Working with SWCDs and extension to connect to farmers. Not everyone wants to work directly with EPA.
- Working with university extension is key in the credibility column.
- Partnerships with the state DEQ and ODA have been invaluable.
- Monthly team meetings keeps us on track.
- Presence at community meetings has increased visibility and interest.
- Farmers want the data, it helps them see how they are doing.

Project Impact

- Voluntary collaborative effort of the GWMA has built trust with growers
- Increased interest from other farmers
- Assessment of Best Management Practices in working farms, rapid sharing of data
- Tools and workshops for landowners

About the Project:
"One of the most exciting things about working at DEQ is seeing different interests come together to solve environmental problems. This is an incredible and innovative example of that."
Oregon DEQ Director Dick Pedersen