Natural Resources Conservation Service
359 East Park Drive, Suite 2
Harrisburg, PA 17111

State Technical Committee

AGENDA

Thursday, January 19, 2023

This meeting will be conducted via Microsoft Teams internet conferencing as well as in person at our State Office, which is located at 359 East Park Drive,(USDA Conference Room),Harrisburg, PA . The meeting link and a call-in telephone number is provided at the end of this document. Handouts for subjects listed on the attached Agenda may be accessed on our website by using the following link: https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/pennsylvania/pennsylvania-state-technical-committee-0

1:00 pm Welcome – Denise Coleman, NRCS State Conservationist

1:05 pm Presentation: PA 4R Nitrogen Modeling CIG Project
Brooke and Eric Rosenbaum, Executive Directors

1:35 pm **Technical Reports**

- Engineering – Tim Peters, State Engineer
- Ecological Sciences – Dan Ludwig, State Resource Conservationist
- Soils – Yuri Plowden, State Soil Scientist

2:05 pm **Partnerships and Easement Programs Report**

- Partnerships and Outreach Updates- Susan Parry ASTC for Partnerships
- Urban Ag Subcommittee Report- Chair, Dimka Braswell
- Agricultural Conservation Easements Programs (ACEP) – Melissa Hanner, Easement Program Manager

2:30 pm **Financial Program Reports**

- Update – Jared Shippey, Assistant State Conservationist for Programs

- Environmental Quality Incentives Program (EQIP) – Ryan Cornelius, EQIP Program Manager
- National Water Quality Initiative (NWQI), Conservation Stewardship Program (CSP), and Conservation Innovation Grants (CIG) – Melissa Erdman, Acting CSP Manager
- Conservation Reserve Enhancement Program (CREP) – Jim Gillis, FSA
- Regional Conservation Partnership Program (RCPP) – Adam Dellinger, Regional Conservation Partnership Program Coordinator

3:45 pm Committee Input

Do the State Technical Committee members have any suggestions for topics or agenda items for future meetings?

Dates for future State Technical Committee Meetings:

Thursday, April 20, 2023
Wednesday, July 19, 2023
Thursday, October 19, 2023

Microsoft Teams meeting

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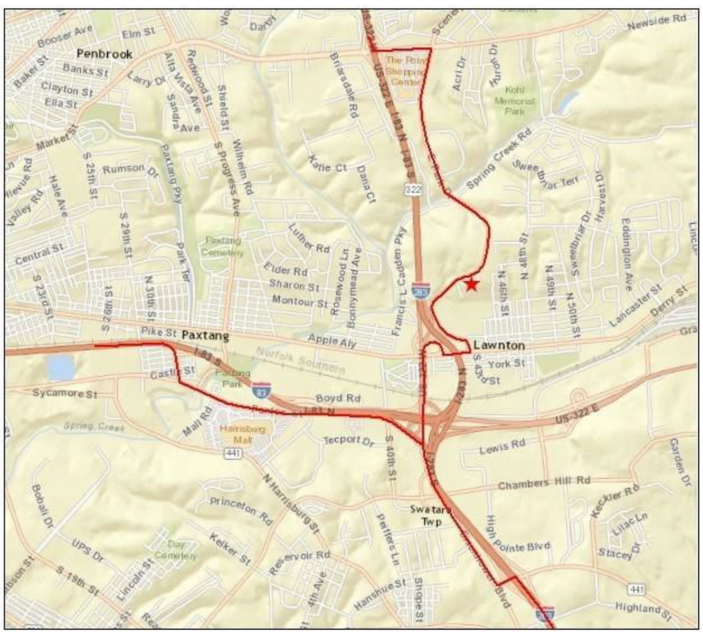
Please note: You can also attend this State Technical Committee Meeting in Person. It will be held in the NRCS Conference Room in our office (Suite 2) located at 359 East Park Drive in Harrisburg, PA. 17111. The map and directions to our office location are provided below:

United States Department of Agriculture

Directions to the NRCS Pennsylvania State Office

USDA-NRCS
359 East Park Drive, Suite 2
Harrisburg, PA 17111
NRCS is located on the east corner of the building
Telephone: 717-237-2100
Fax: 717- 237-2238
Building hours are: 8:00 AM to 4:30 PM
If arriving outside of building hours please arrange for someone to meet you at the west building entrance to allow access to the building.

Driving Directions



From Washington, DC: Take MD-295 N. - toward BALTI- MORE; Merge onto MD-295 N via the exit; Merge onto I-95 N toward; BALTIMORE/COLLEGE PARK; Merge onto I- 695 N/BALTIMORE BELTWAY INNER LOOP via exit number 49B- on the left- toward I-70/I83/TOWSON; Merge onto I-83 N via exit number 24 toward TIMONIUM/YORK PA.; Continue on I83 N to exit number 45 toward Paxton Street; merge onto S 32nd Street; turn left onto Capital Area Greenbelt/Parkview Lane; turn left onto Capital Area Green- belt/City Park Drive and continue to follow Capital Area Greenbelt; take the 1st right onto Derry Street; turn left onto East Park Drive and travel approximately 0.6 mile.
Destination will be on the right.

From Philadelphia: Take exit 247 to merge onto I- 283 N toward PA-283/Harrisburg/Hershey; take exit 2 for PA-441 N; turn left onto PA-441 N/Lindle Road; turn right onto Eisenhower Boule- vard; continue onto US-322 W; keep right at the fork, follow signs for Derry Street; keep left at the fork, follow signs for Lawnton; turn left onto Derry Street; Take the 1st left onto East Park Drive and travel approximately 0.6 mile.
Destination will be on the right.

From Pittsburgh: I-76 E/Pennsylvania Turnpike East; Take exit 236 toward U.S. 15 N/Harrisburg; continue on the ramp and merge onto US-15 N; Take the exit onto PA-581 E toward I-83/ Harrisburg/Hershey; Merge onto I-83 N; take exit 45 toward Pax- ton Street; Merge onto S 32nd Street; turn left onto Capital Area Greenbelt/Parkview Lane; turn left onto Capital Area Greenbelt/City Park Drive and continue to follow Capital Area Green- belt; take the 1st right onto Derry Street; turn left onto East Park Drive and travel approximately 0.6 mile.

Destination will be on the right.

From State College: Merge onto US-322E via the ramp to Lewistown; Merge onto US-22/US-322; Take the exit onto I- 81N/US-322E toward Hershey; Continue on US-322 E, follow signs for I- 83S/Hershey York; Continue onto I-83S/US-322E; Take Exit 48 for Union Deposit Road; Turn left onto Union Deposit Road; Turn right onto East Park Drive and travel approximately 0.6 mile.

Destination will be on the right.

Pennsylvania State Technical Committee Meeting

January 19, 2023

The Pennsylvania State Technical Committee Meeting was held in the USDA Conference Room at the NRCS State Office.

Denise Coleman (NRCS) (Natural Resources Conservation Service) opened the meeting at 1 PM. Denise welcomed everyone to the second quarterly STC meeting as there was one in October. She began by introducing Dan Ludwig and explaining that from there, they will go around and introduce themselves in order. They started with NRCS staff and following their introductions, the non NRCS employees introduced themselves as well. After the greetings, Eric Rosenbaum is introduced, and he begins with his presentation.

00/09/13 - Eric Rosenbaum (Conservation Innovation Grants), PA 4R Nitrogen Modeling CIG Project, Assistant Executive Director, was introduced and presented information on what he has learned from the conservation innovation grants that he has. (See attached Handouts) Eric Rosenbaum is an agronomist with Rose Tree Consulting. He is grateful to have gotten the APA Conservation Innovation Grant to do some work on cover crops and advanced nitrogen management. He thanks NRCS for their involvement, but specifically Mark Goodson, who is integral in their ability to put together programming and push it out to different stakeholders within the state, and particularly as it pertains to this project. Eric also thanks Dan for the guidance that he had given over the past year and a half to bring the project to fruition. He moves on to begin the summary portion of this presentation. He says that what they were after in this project is to be able to look within the CSP activity E 590 DB to figure out if there were other tools that could be added to that particular enhancement to allow farmers to use nitrogen modeling and other subfield zoned developed tools to get a nitrogen rate. They also wanted to look at how to incorporate cover crop contributions into determining what the correct rate of nitrogen fertilizer was. There were two main components to this project, #1 cover crop evaluation and modeling to determine cover crop contributions and #2 system modeling to compare a nitrogen modeling platform to a NRCS 590 level of an nutrient management plan. For the cover cropping, there were 20 farms that volunteered to participate in the program and for the system modeling and there were 83 fields that eric used for comparison. The purpose was to compare a nutrient management plan using the ACT 38 template. So, there was enough confidence to provide NRCS with in modifying the E 590 modeling as a cost shareable tool for farmers to use for whole field and subfield management. His next slide lays out missed opportunities that he felt occurred with the E 590 program. They were: not integrating real time data into those nitrogen recommendations, not identifying active lost nitrogen pathways that occur within farms, and not quantifying the total loss from each pathway and being modifying the initial plan based off in season decisions. All in all, he says, the E 590 program is great, and it allows farmers to come in and manage nutrients on a field and subfield basis. However, when it comes to nitrogen, there are some missed opportunities that a nitrogen modeling program being brought in could fix. Eric would like to introduce a teaching tool. Everybody should have a copy of this teaching tool and should feel comfortable using this teaching tool for it to be able to go out to their clientele and provide information on cover crop modeling and nitrogen contributions. Eric jumps to a slide that shows the mass calculation calculator. It shows double crop carryover, manure history, and legume history, which are all well balanced in the calculator. What needs to be worked on is soil organic matter contributions and cover crop nitrogen contributions. The next couple of slides deal with granular agronomy as he wanted to spend a little bit of time talking about what they do and what their service is. They have two services that they offer to Eric and his team. One is a crop modeling service and the other is to be able to use their nitrogen modeling tool. Two things to consider when using this tool are: #1 to be certified as a TSP to write nutrient management plans and understand state level nutrient management guidelines. Following with #2, which is to be well educated on the model. On Eric's final slide, he goes over the cover crop biomass sampling project. For this project, they did 20 sites throughout the state of Pennsylvania on multiple different soil types, multiple geographies from southern Franklin County to northern Columbia

County, and very different cover cropping strategies. He goes on to show three examples of the cover crops on the slides and how the tool is helpful and manageable in various situations. Eric ends the presentation by thanking everyone for their time and encourages everyone to use the tool and spread the information shared.

LEARNING FROM HISTORY

Nitrogen Modeling Platforms Put Lessons of the Past to Work for the Future

Nitrogen modeling gives visibility to the nitrogen loss pathways we experience in the field.

Nitrogen modeling utilizes a daily time-step deterministic crop growth model that takes inputs of soil, weather, management and crop genetics and simulates both below and above ground dynamics, including nitrification, leaching, mineralization, germination, root development, crop nitrogen uptake and target grain yield. Modeling platforms utilize many years of research and development, tested and validated from hundreds of field trials, and backed up with sources through literature reviews and other scientific efforts.

More Information

To learn more about Nitrogen Modeling Platforms and the technical and financial assistance available contact your local NRCS office. To find your local NRCS office, visit **farmers.gov/service-center-locator**.

Good Information In = Good Information Out

Users can add site specific soil nitrate sample results to the model to establish their baseline nitrogen levels. These programs can also model both organic and inorganic sources of nitrogen, including common commercial fertilizers as well as organic residues from previous crops. An operation's manure analysis can be added to provide site specific nitrogen availability from the manure source(s) applied.

The accuracy of baseline information (manure analysis, pre-season soil nitrate levels rotation/cover crop history, planting date) is key for the accuracy of the model's outputs. Application dates are also critical for the success of the model. It is recommended that operations work with a trained advisor to ensure data is entered correctly and provides most accurate outputs.

Dynamic to weather

Each year's weather is different, so having the ability to make adjustments of nitrogen rates in-season is important. While modeling platforms cannot predict the weather, utilizing 20 prior years of weather history is useful to understand what could occur. Connecting this with the weather that has already occurred, a model can develop a simulation of what has occurred and what could likely happen.

Flexible with management

Because a modeling platform simulates the growth of a crop, management of the growing of that plant are necessary inputs. This includes planting date, seeding density, crop maturity rating, as well as key nitrogen information, such as rates, dates, forms of nitrogen and methods of application. A modeling platform simulates nitrogen uptake by the corn plant based on seeding parameters and adjusts potential N uptake based on maturity and seeding density. A model also simulates the conversion and movement of both commercial fertilizer and organic sources that are based on soil moisture and temperature estimations from weather.

Simulations of difficult-to-measure outputs

A modeling platform simulates many sub-processes that may be difficult to measure and quantify in most situations. These processes include the nitrogen loss pathways of nitrification, denitrification, leaching, mineralization, volatilization, and immobilization. Simulations are based on controlled lab measurements and modeling and are leveraged across individual field environments. These simulated outputs can be useful for quantifying the amount of nitrogen losses that may take place under various management programs and environments, helping farmers, planners, researchers and policy makers provide proper guidance to farmers to ensure that the environment is considered while still helping the farmer produce to the best of their abilities.

Fostering conversation, learning and changes to on-farm nitrogen management

The reports generated by a modeling platform provide growers and their trained advisors with data around the most prevalent loss pathways in a field. While the data provided may not always be able to be used to facilitate changes during the current growing season, it does provide a platform for trained advisors and farmers to have a conversation around on-farm management strategies and to modify 4R (source, rate, time and place) nitrogen decisions for the future growing season that will benefit Nitrogen Use Efficiency (NUE), yield and profitability and reduce potential negative impacts to water quality.

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4RMidAtlantic.com

The following education and outreach events were performed as part of NRCSNR202D37XXXXG003, "Utilizing Nitrogen Modeling to Determine Soil Health Contributions to Nitrogen Fertility."

Date	Event	Attendance
3/17/21	PA No Till Alliance Annual Meeting @ Hershey Farms	35
7/19/21	Field Day @ Hoover Ag	94
7/28/21	Soil Health Coalition Field Day @ Scattered Acres Farm	67
8/25/21	Field Day @ the Mill	120
1/21/22	PA Agronomic Education Society (PAES) Annual Conference	65
8/25/22	PA4R Webinar on CIG findings	34
9/20/22	PA4R Field Day @ Milton Hershey School Farm	55

In addition to presentations, copies of the final report was made available at the 20SEP22 Field Day at the Milton Hershey School Farm and a copy was mailed to all CIG farmer participants.

Utilizing Nitrogen Modeling to Determine Soil Health Contributions to Nitrogen Fertility

A PA4R Alliance project funded through an NRCS Conservation Innovation Grant

Eric Rosenbaum

Executive Director, PA4R Alliance

Project Objective

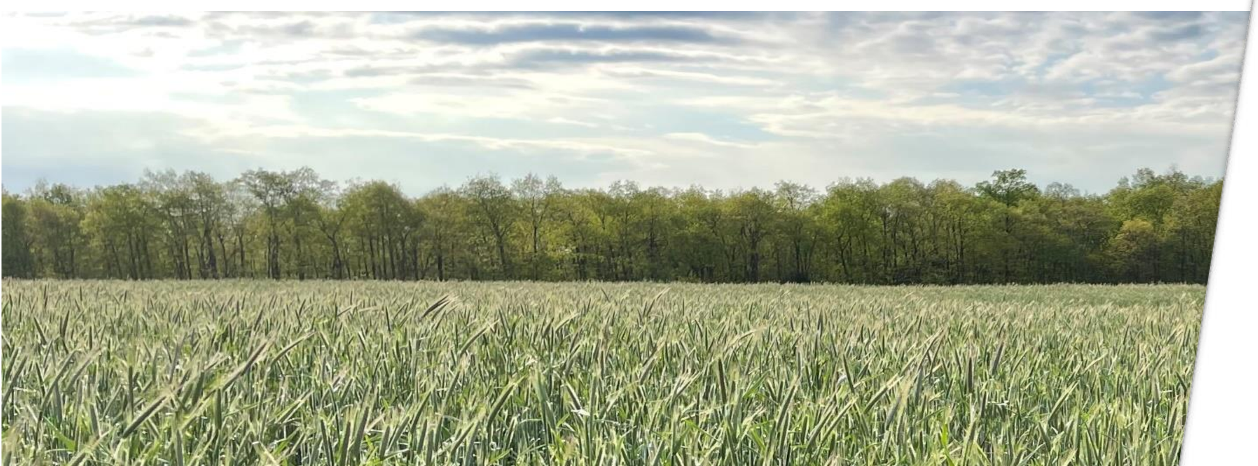
Demonstrate that nitrogen modeling can be considered within CSP activity enhancement E590B as a precision agriculture technology that can be used to reduce risks of nutrient loss to surface water at the same level of confidence that current nutrient management tools provide.

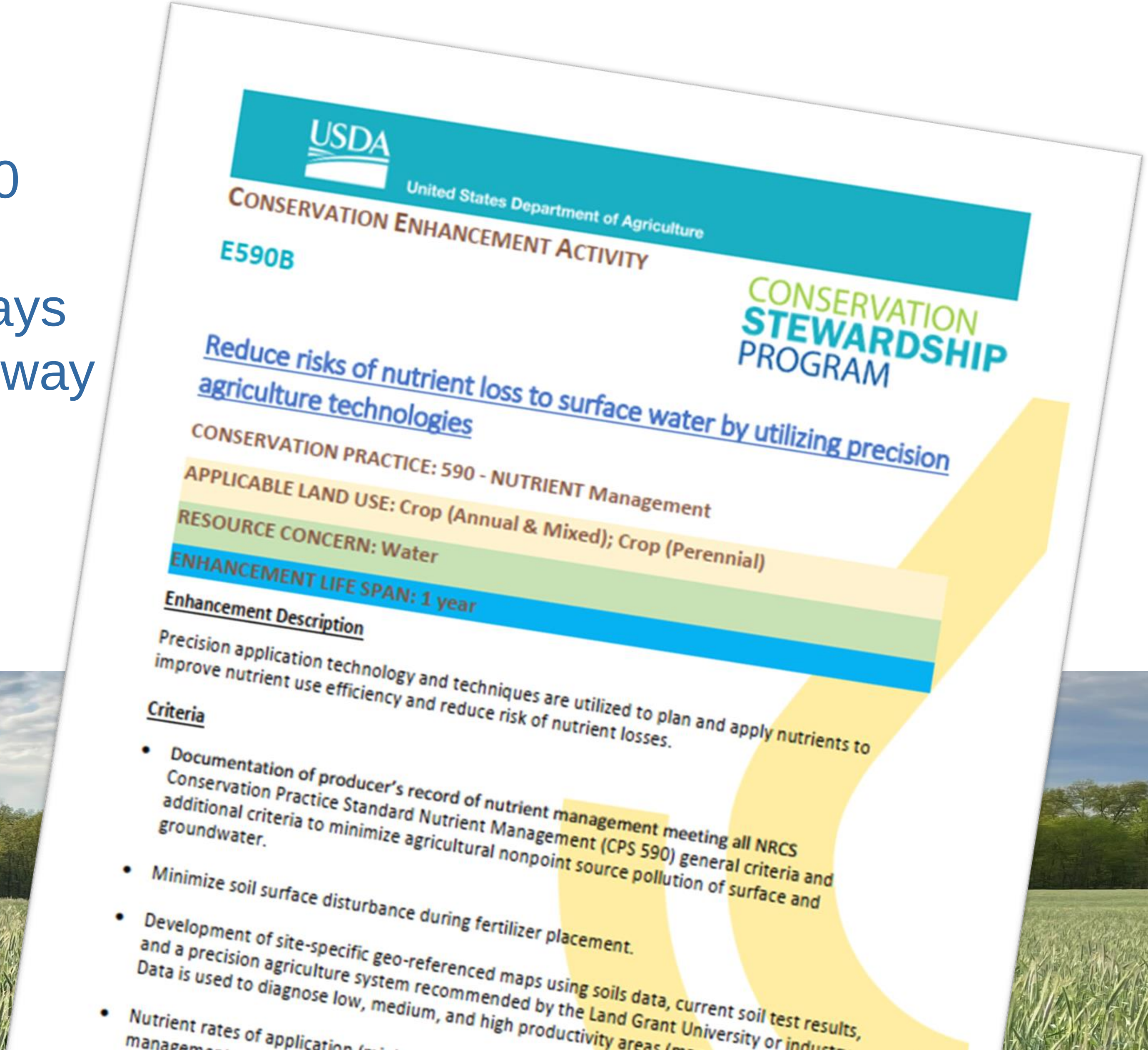
- Cover Crop Evaluation & Modeling to determine cover crop contributions
- System Modeling to compare MMP/NMP vs model predicted needs

Conservation Stewardship Program – E590B

Missed Opportunities?

- Soil Health Contributions in CPS 590
- Integrating Real-Time Data
- Identify Active Nitrogen Loss Pathways
- Quantify Total Loss From Each Pathway
- In-Season Decisions & Plan Modifications





USDA United States Department of Agriculture

CONSERVATION ENHANCEMENT ACTIVITY

E590B

CONSERVATION STEWARDSHIP PROGRAM

Reduce risks of nutrient loss to surface water by utilizing precision agriculture technologies

CONSERVATION PRACTICE: 590 - NUTRIENT Management

APPLICABLE LAND USE: Crop (Annual & Mixed); Crop (Perennial)

RESOURCE CONCERN: Water

ENHANCEMENT LIFE SPAN: 1 year

Enhancement Description

Precision application technology and techniques are utilized to plan and apply nutrients to improve nutrient use efficiency and reduce risk of nutrient losses.

Criteria

- Documentation of producer's record of nutrient management meeting all NRCS Conservation Practice Standard Nutrient Management (CPS 590) general criteria and additional criteria to minimize agricultural nonpoint source pollution of surface and groundwater.
- Minimize soil surface disturbance during fertilizer placement.
- Development of site-specific geo-referenced maps using soils data, current soil test results, and a precision agriculture system recommended by the Land Grant University or industry. Data is used to diagnose low, medium, and high productivity areas
- Nutrient rates of application

Thank you to all our project partners & collaborators

PA4R Alliance

NRCS
Natural Resources Conservation Service

Granular

PennState Extension

FS
GROWMARK FS

4R MID-ATLANTIC

The Mill™

Pennsylvania SCC
State Conservation Commission

The Nature Conservancy

Rosetree Consulting
Agricultural • Environmental

The Why…

With new technologies & practices come new observations and questions.

"So much has changed in my soil through No-till & Cover Crops. I can see the difference. How are these changes affecting the soil's ability to produce, capture and cycle nitrogen? How are we going to take advantage of it??"

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Connecting Soil Health to Nutrient Management

In the past 25 years…

No-Till Production has taken over

Cover Cropping has Increased

Planting Green is Possible

We Measure SLAN, VAST & CO2 Burst

But the way we calculate nitrogen needs hasn't adapted to these changes.

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Connecting Soil Health to Nutrient Management

In the past 25 years average corn yields in PA have increased

40+ Bushels / Acre

- Genetic Improvements
- Improved Soil Health
- 4R Nutrient Stewardship Strategies
- Increased Equipment Capability
- Introduction of Data Management

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But the way we calculate nitrogen needs remains the same.

Mass Balance Calculations –
a trusted tool, but can we do better?

App. 4: Crop Yrs. 2019	FB2		
CMU/Field ID			
Acres	15.2		
Soil Test Report Date	October 5, 2018		
Laboratory Name	Spectrum Analytic		
Soil Test Levels (Mehlich-3 P & K) (Show conversions to ppm in Appendix 10)	ppm P	ppm K	pH
	225	183	6.1
P Index Part A Evaluation	Soil Test P		
Part A Result	Part B		
Crop	Corn for Grain		
Planned Yield	180 bu/A		
PSU Soil Test Recommendation (lb/A)	**N**	**P2O5**	**K2O**
	190	0	0
User Soil Test Recommendation (lb/A)			
Other Nutrients Applied (lb/A) (Nutrients applied regardless of manure)			
P Index Application Method			
Double Crop CarryOver N (lb/A)	0		
Manure History Description Residual Manure N (lb/A)	35	Continuously - Summer Crop	
Legume History Description Residual Legume N (lb/A)	50	Soybeans, 50 bu/A	
Manure Group	Fall Applied Dairy Slurry		
Application Season: Management (Incorporation, cover crops, etc.)	Early Fall 1.2-15: next summer use by a summer crop following a harvested winter crop or no winter crop		
Availability Factors (Total N or NH4-N & Organic N)	**Total N**	**NH4-N**	**Org. N**
		0.00	0.35
P Index Application Method	April - Oct: No incorp or incorp > 1 wk.		
N Balanced Manure Rate (ton; gal/A)	41,176 gal/A		
P Removal Balance Manure Rate (ton or gal/A; If required by P Index)	8,955 gal/A		
	Crop P Removal (lb/A) 72.0		
P Index Value	70		
Planned Manure Rate (ton or gal/A)	**9000 gal/A**		
Nutrients Applied at Planned Manure Rate (lb/A)	23	72	153
Nutrient Balance after Manure	82	-72	-153
Supplemental Fertilizer (lb/A)	**82**	0	0
P Index Application Method			
Final Nutrient Balance (lb/A)	**0**	**-72**	**-153**

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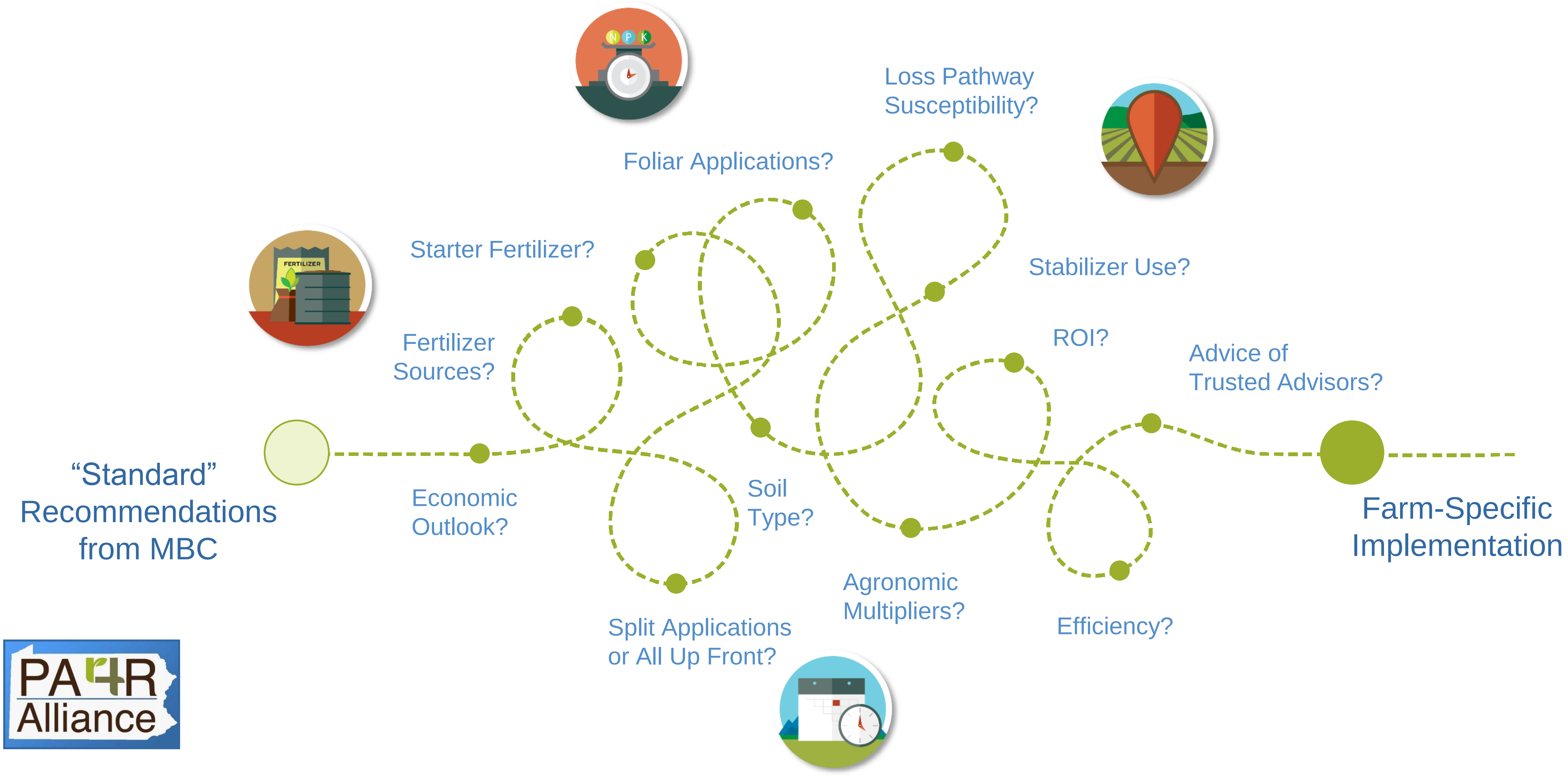
Soil Nitrogen – Generalized Contributions

Double Crop CarryOver N (lb/A)	0	
Manure History Description Residual Manure N (lb/A)	35	Continuously - Summer Crop
Legume History Description Residual Legume N (lb/A)	50	Soybeans, 50 bu/A
Soil Organic Matter N (lb/A)	?	~ 20 lbs/%SOM
Non-Legume & Multi-Species Cover Crop N (lb/A)	?	+/-

- How do we improve calculations used to determine soil contributions?
- Can we account for the effect soil characteristics & weather have on this contribution in real time?

Today's Farm Specific Implementation



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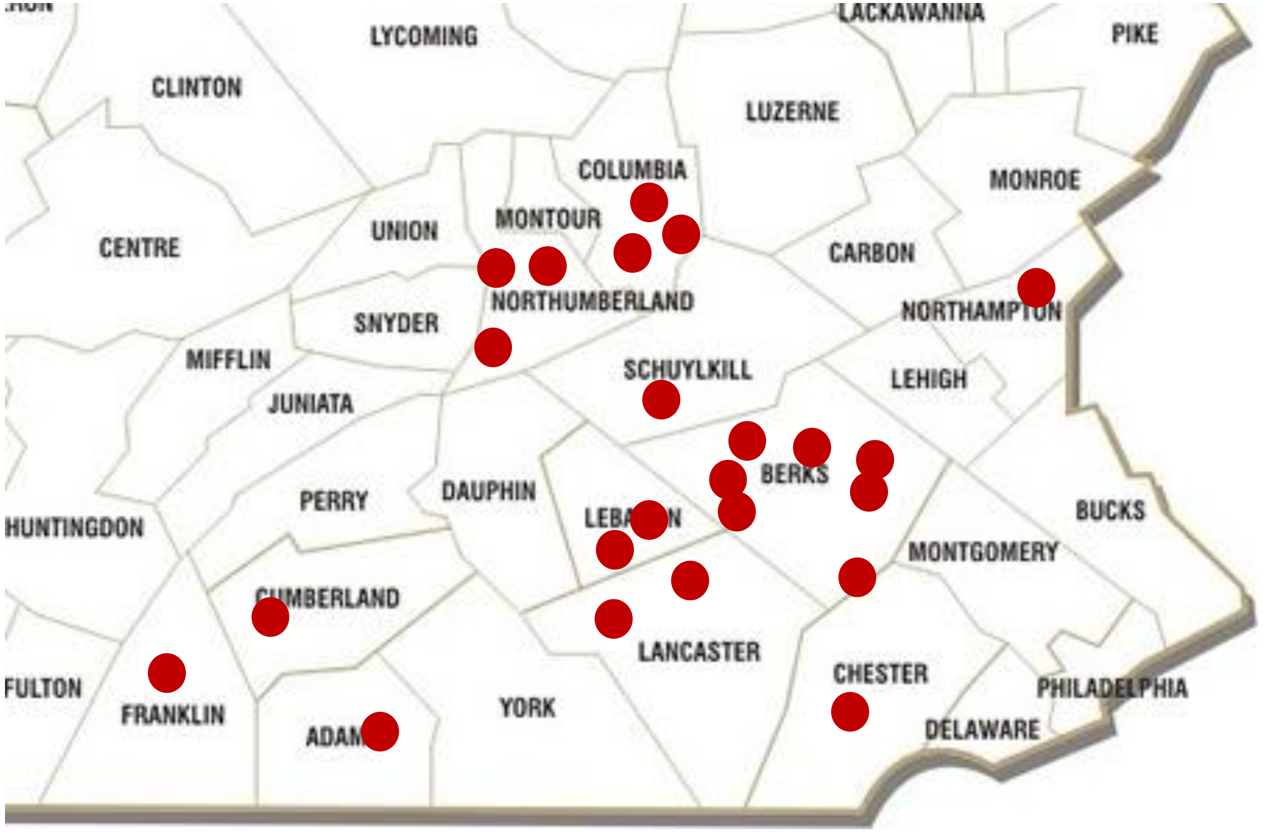
Project Overview



Participant Breakdown

All farms had a nutrient plan

All farms utilized manure in their rotation

All farms implemented soil health practices
- 4 continuous no till (No cover crop)
- 5 continuous no till w/ harvested cover crop
- 14 continuous no till w/ green manure cover

All sites compared nutrient management plan recommendations to model recommendations

20 locations, from the 14 no till + cover crop participants, were modeled for cover crop mineralization

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Granular Agronomy Nitrogen Service

Granular Agronomy Nitrogen Service

The Granular Crop Model (GCM) is a daily time-step deterministic crop growth model that takes inputs of soil, weather, management, and crop genetics in as inputs and simulates both below and above ground dynamics, including nitrification, leaching, mineralization, germination, root development, crop N uptake, and grain yield. GCM can model both organic and inorganic sources of nitrogen, including common commercial fertilizers as well as organic residues from previous crops and manure.

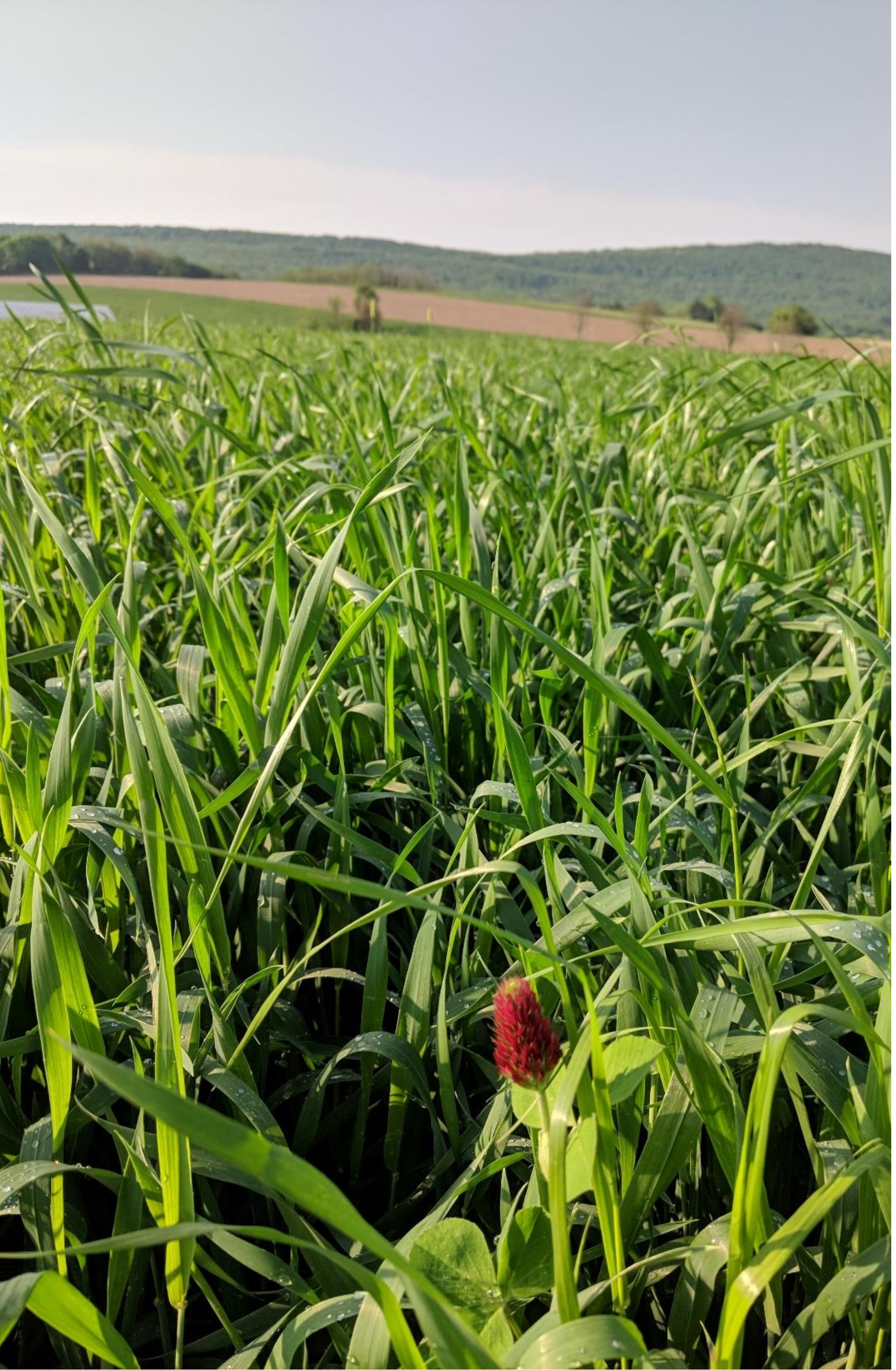
A median estimation of soil nitrogen levels across multiple years is used as guidance of nitrogen to be applied.

GCM vs Mass Balance Calculations

Granular Crop Model is:

- Dynamic to weather
- Flexible with management
- Allows measured inputs
- Provides simulation of difficult-to-measure outputs
- Fosters site specific conversation of nitrogen loss pathways and alternative strategies

2021 Cover Crop Biomass Sampling Project



Things to Keep in Mind

- Nitrogen Production is only one cover crop goal
- Nitrogen Scavenging may be a separate cover crop goal
- Total Cover Crop *uptake* of nitrogen does not equal the total nitrogen *contribution* of the cover crop
- Calculating cover crop contributions are site specific
- Cover crop species, planting rate, planting date
- Soil characteristics
- Management Interactions

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2021 Cover Crop Biomass Sampling Project

1. Find *average area* of the field using satellite imagery
2. Measure 1 square meter and mark with flags
3. Harvest all biomass & weigh it
4. Obtain a representative sample of harvested material for forage analysis
5. Obtain soil tests for soil nitrate, total carbon, active carbon, soil texture

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Key Metrics for Cover Crop Contributions to Nitrogen Fertility

Nitrogen Contribution Depends on…

Dry Matter Production
More mass = more nitrogen – to a point

Nitrogen Content
Crude Protein * 6.25

Carbon Pools
Non-Fiber Carbohydrate
Cellulose
Lignin

Carbon : Nitrogen Ratio

Small Grain Cover Crop

<12” tall

Attribute	Value
Date Sampled	4/26/2021
Species	Triticale
Dry Matter, lbs/ac	4,959
Crude Protein %	14.9
Nitrogen %	2.384
Non-Fiber Carbohydrates %	28.7
Cellulose %	69.2
Lignin %	2.2
C:N Ratio	21.3

Small Grain Cover Crop
Heading

Attribute	Value
Date Sampled	5/7/2021
Species	Rye
Dry Matter, lbs/ac	5,206
Crude Protein %	14.2
Nitrogen %	2.272
Non-Fiber Carbohydrates %	11.6
Cellulose %	82.6
Lignin %	5.9
C:N Ratio	22.2

Small Grain Cover Crop
Late Planting

Attribute	Value
Date Sampled	5/5/2021
Species	Triticale
Dry Matter, lbs/ac	1,535
Crude Protein %	10.8
Nitrogen %	1.728
Non-Fiber Carbohydrates %	19.0
Cellulose %	77.0
Lignin %	4.0
C:N Ratio	29.31

Small Grain Cover Crop
Comparing Termination Stages

Attribute	Vegetative	Heading
Date Sampled	4/26/2021	5/7/2021
Species	Triticale	Rye
Dry Matter, lbs/ac	4,959	5,206
Crude Protein %	14.9	14.2
Nitrogen %	2.384	2.272
Non-Fiber Carbohydrates %	28.7	11.6
Cellulose %	69.2	82.6
Lignin %	2.2	5.9
C:N Ratio	21.3	22.2

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Nutrient Uptake by Grass Covers

Operation/Farm/Field	Nitrogen	Phosphorus (P_2O_5)	Potassium (K_2O)	Calcium	Magnesium
Small Grain 12” Lancaster County	118.2	56.8	233.4	12.9	6.5
Small Grain – Heading Adams County	118.3	44.1	236.3	13.0	4.2
Small Grain – Later Planting Franklin County	26.5	10.2	56.3	5.2	1.4

Simulated Additional Mineralization (Lbs/Ac) from Above Ground Cover Crop Biomass – Grass Cover Crops

Operation/Farm/Field	Details	By Silking	By Black Layer	By End of Year
Small Grain – 12" Lancaster County	High N High NFC	42.7 ($32.03/ac)	52.6	58.8
Small Grain – Heading Adams County	High N Low NFC	33.2 ($24.90/ac)	45.0	52.4
Small Grain – Late Planting Franklin County	Lowest CP	8.3 ($6.23/ac)	10.8	12.3

- Simulation using Granular Crop Model
- Values were generated using site specific soil info + 20 years of weather
- Above ground contributions only – does not include any contribution from roots
- Economic data calculated using 30% UAN price of $450/ton

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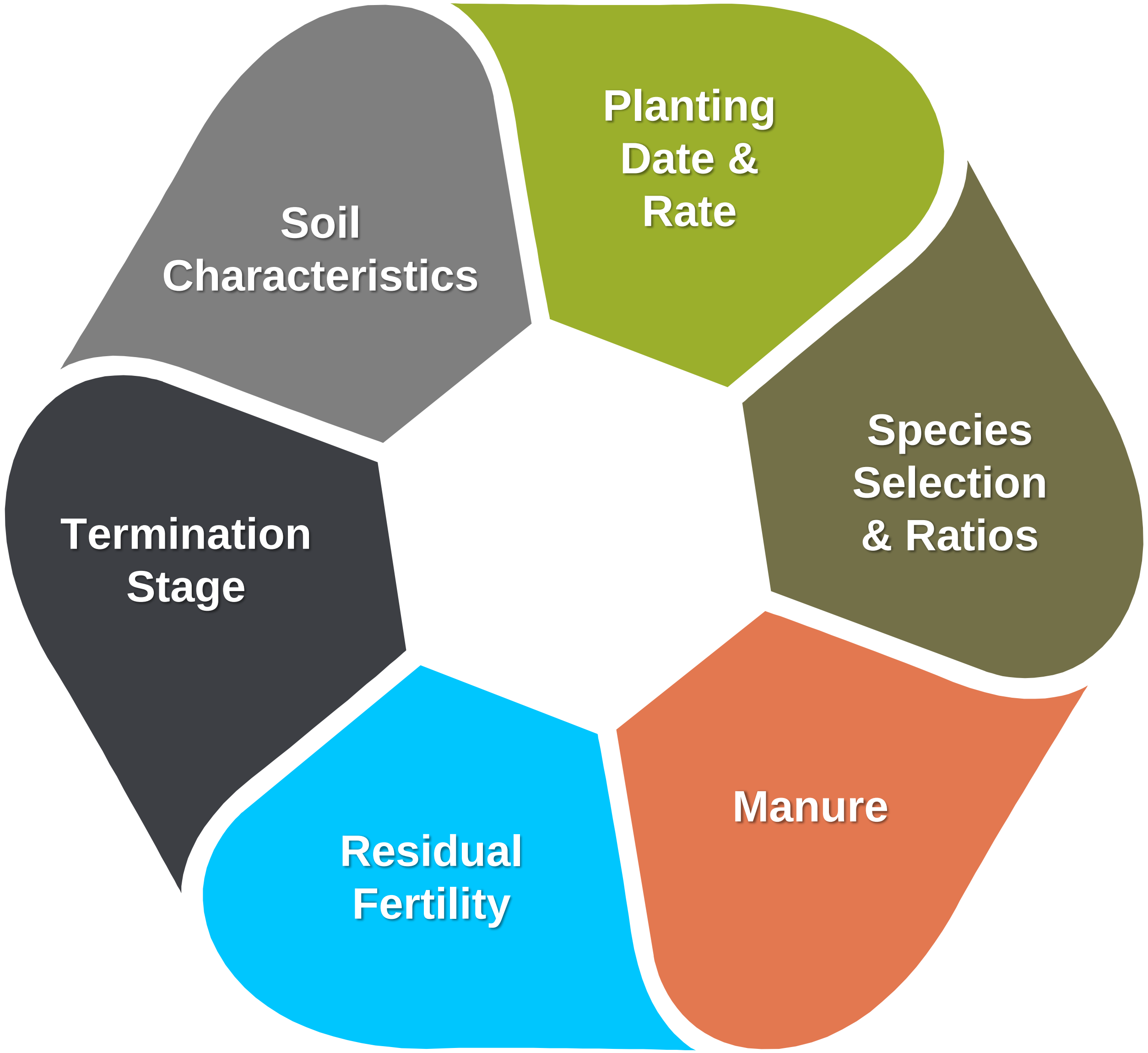
Factors Affecting Cover Crop Contributions to Nitrogen Fertility



4Rs of Nutrient Stewardship

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What We've Learned

Species, species ratio, planting density, planting date, termination date, farm management all affect N contributions to fertility.

Grass based cover crops *can* provide nitrogen, especially when manure is applied

Late plantings are hard to cash flow (from a N perspective)

What Questions Remain

Explain the difference between total N uptake & N mineralization. What happened to the rest of the N?

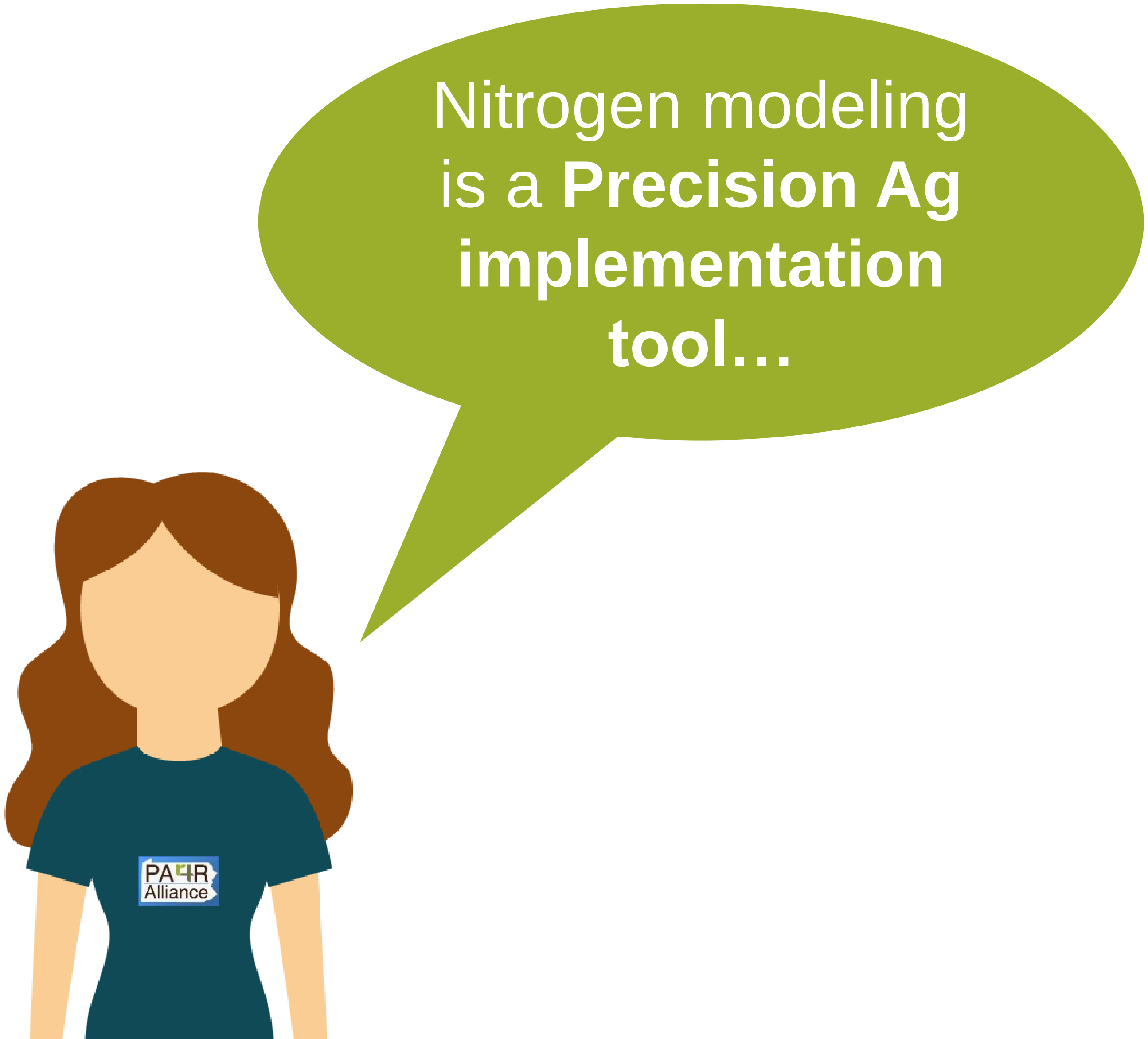
What contributions are the below ground portions of a cover crop contributing?

Does long term cover cropping affect nutrient uptake due to increased nutrient stratification?

How much do we need to plant?

Nitrogen Modeling as a Nutrient Management Tool

Nitrogen Modeling 101



…it combines NMP inputs like planned manure, fertilizer applications, rotation history, yield goals with advanced management strategies, fertilizer stabilization products, variety information, soil characteristics and weather to calculate nitrogen needs and nitrogen loss on a field or sub-field basis.

How a Nitrogen Model Works

01

Decision Zone Development
Field Boundary | Soil Maps | LiDar Maps | Yield Maps | Remote Sensing Imagery | EC Maps

02

Background Data
Yield Goal | Past Manure Applications | Crop History | Soil Test Data | Soil Texture Sample

03

In-Season Data
Soil Nitrate Sample | Planned Manure Applications & Dates | Planned Fertilizer & Application Dates | Hybrid Relative Maturity & Planting Date

04

Weather
In-season weather | 8 day forecasted weather | 20 years of historic data

Weekly updates on nitrogen loss, nitrogen uptake & season N availability predictions

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Case Study
Cumberland County

Field Establishment

Step 1

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Case Study
Cumberland County

Field Establishment — Step 1

Decision Zone Creation — Step 2

Do I need decision zones?

What's the confidence level in a decision zone?

Case Study
Cumberland County

Field Establishment — Step 1

Decision Zone Creation — Step 2

Site Specific Information — Step 3

Fields	Yield Goal (bu/ac)	Variety	Initial N (lbs N/ac)	Soil Depth (in)	Planting Date	Projected N
W7A 8 ac | *Weingarten Farm*	175	CRM105	03/01/21 - 66	18	05/03/2021	+ 7 →

10/01/2020 — Flat Rate	05/03/2021 — Flat Rate	05/03/2021 — Flat Rate	06/21/2021 — Variable Rate
Nitrogen Swine: Finisher - Slurry, wet or dry feeders, Broadcast Incorporated (0-4 in)	**Starter** UAN (28-0-0), Surface Banded (0-2 in)	**Planting** CRM105	**Nitrogen** UAN (28-0-0), Broadcast Incorporated (0-4 in)
Product Rate 1079 gal/ac **N Rate** 50 lbs N/ac	**Product Rate** 20 gal/ac **N Rate** 60 lbs N/ac	**Rate** 32000 seeds/ac	**Product Rate** 48 gal/ac **N Rate** 144 lbs N/ac

Case Study

- **Field Establishment** — Step 1
- **Decision Zone Creation** — Step 2
- **Site Specific Information** — Step 3
- **Monitoring & Analysis** — Step 4

PA4R Alliance

Projected N

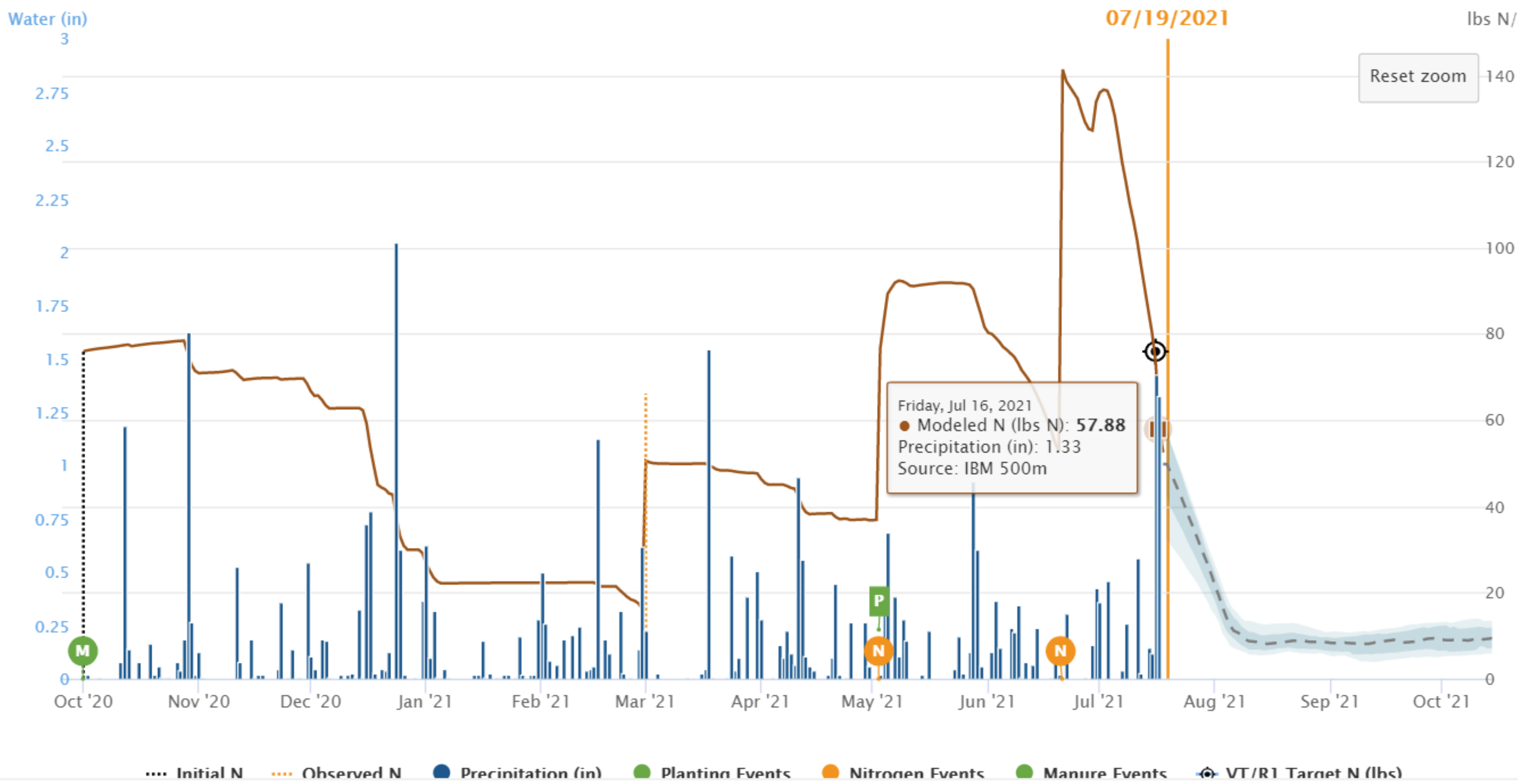
+ 7 →

W7A
8 ac | *Weingarten Farm* | 175 | CRM105 | 03/01/21 - 66 | 18 | 05/03/2021 | + 7 →

10/01/2020 — Flat Rate	05/03/2021 — Flat Rate	05/03/2021 — Flat Rate	06/21/2021 — Variable Rate
N **Nitrogen**	N **Starter**	**Planting**	N **Nitrogen**
Swine: Finisher - Slurry, wet or dry feeders, Broadcast Incorporated (0-4 in)	UAN (28-0-0), Surface Banded (0-2 in)	CRM105	UAN (28-0-0), Broadcast Incorporated (0-4 in)
Product Rate 1079 gal/ac; **N Rate** 50 lbs N/ac	**Product Rate** 20 gal/ac; **N Rate** 60 lbs N/ac	**Rate** 32000 seeds/ac	**Product Rate** 48 gal/ac; **N Rate** 144 lbs N/ac

Case Study

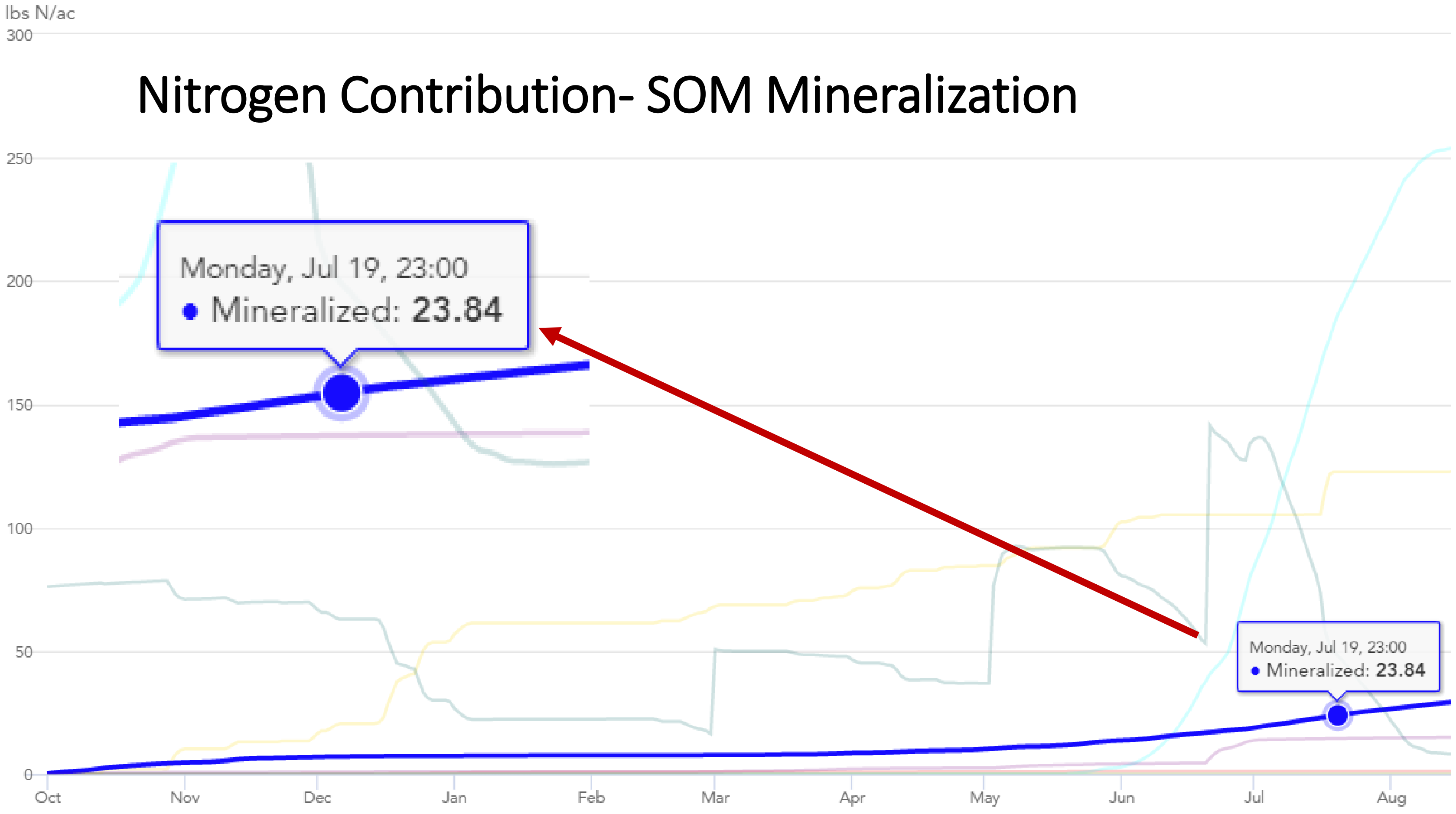
Monitoring & Analysis Step 4



Case Study

Monitoring & Analysis Step 4

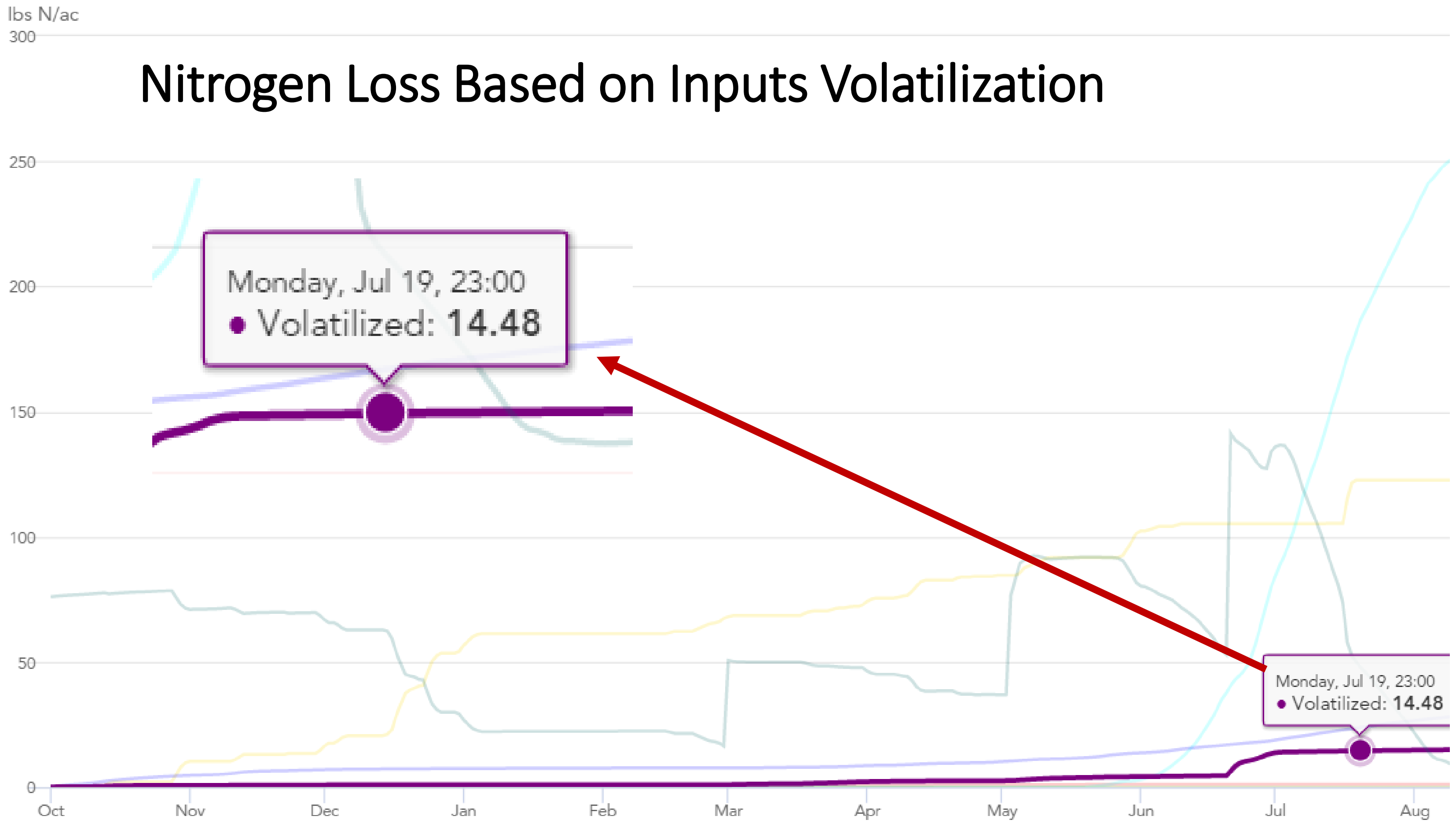
Nitrogen Contribution- SOM Mineralization



Case Study

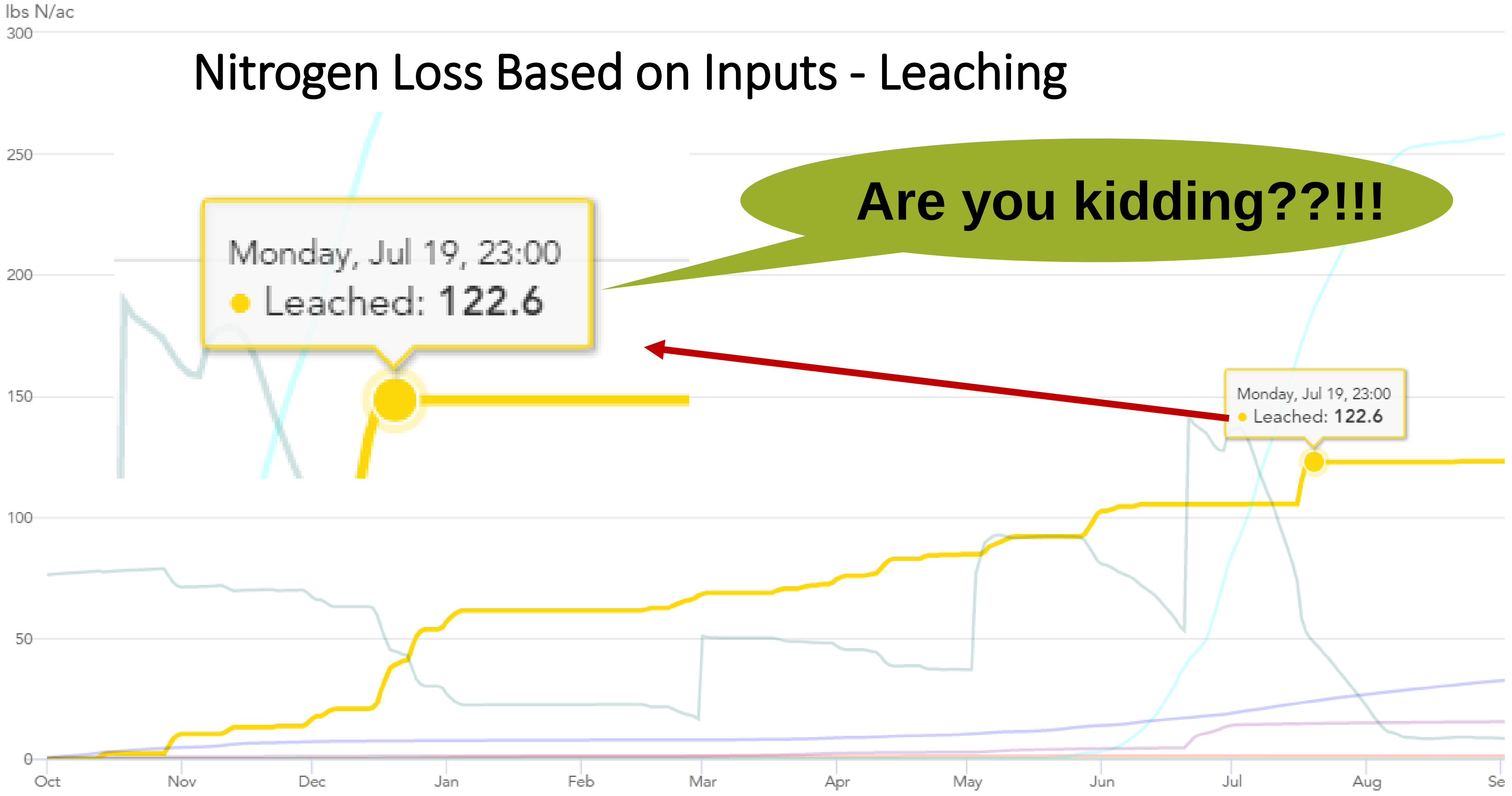
Monitoring & Analysis

Step 4



Case Study

Monitoring & Analysis Step 4



Using Nitrogen Models – Tips for Success

- Do site specific background data collection
- Use Actual Manure Analysis & Application Rates
- Get Nitrogen Source, Rate, Timing & Placement Correct
- Dates are Important!
- Check it regularly & modify parameters as needed (yield, rooting depth, etc.)

PA4R Alliance

Modeling is one more tool for fine tuning manure & soil contributions to adjust fertilizer management. It can help to preserve yield, address N loss, and manage input costs.

Questions?

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PA4R Alliance

NRCS NR202D37XXXXG003 Final Report

Mid Atlantic 4R Nutrient Stewardship Association

Utilizing Nitrogen Modeling to Determine Soil Health Contributions to Nitrogen Fertility

Executive Summary

This study looked at site specific implementation of nutrient management plans on farms implementing soil health practices (continuous no-till, cover crops, green planting). The goal of the project was to demonstrate that nitrogen modeling tools should be considered within CSP activity enhancement E590B as a Precision Agriculture Technology that can be used to reduce risks of nutrient loss to surface water.

- Comparison of the Granular Agronomy Nitrogen Service model (the crop model) to the current mass balance nitrogen calculation approach used by advisers and regulatory agencies in Pennsylvania resulted in a 10% improvement of nitrogen use efficiency on acres utilizing the crop model vs acres utilizing a mass balance calculation (See Part A of this report)

- The crop model has the ability to quantify soil nitrogen contributions from soil sources, manure applications, and fertilizer applications. It also has the ability to track nitrogen loss through leaching, immobilization, volatilization and denitrification based on soil characteristics and user inputs. This provided an opportunity to talk with farmers about reducing nitrogen loss caused by specific loss pathways active in their fields through 4R Nutrient Stewardship Source, Place and Timing practices as well as cover cropping.

- Soil Health contributions to nitrogen fertility were looked at in two ways. First, pre-season soil nitrate samples were obtained in fields to determine the size of the soil nitrogen "pool." Second, 20 locations with cover crop were simulated using the crop model to project average site-specific nitrogen mineralization rates from the above ground portion of a cover crop based on soil type, cover crop characteristics, and weather. See Part B of this report for in-depth discussion on cover crop nitrogen contributions.

- Both currently accepted mass balance calculations and nitrogen modeling platforms have limits on their ability to improve water quality by reducing nitrogen loss. Soil conditions, drought, excessive rainfall, and other unplanned incidents will always exist to reduce nitrogen use efficiency and increase the risk of nitrogen loss. Advisors, trained in both state nutrient management regulations and nitrogen modeling platforms, are necessary to achieve the highest benefit to water quality.

Multiple nitrogen modeling services provide similar platforms in this space. During the conceptualization of the project, Granular was the platform that had the ability and interest to become a project cooperator and provide match for this project. Their match, in the form of reduced product cost and staff time contributions, was an important aspect of this project. It allowed the intimate use of their product, in-depth conversations into the working of the model with product developers, and for the cover crop analysis. Other nitrogen services offered in the marketplace may provide a similar level of modeling. This report does not constitute an endorsement of the Granular Agronomy Nitrogen Service above other services.

Table of Contents

Introduction

This project, titled *Utilizing Nitrogen Modeling to Determine Soil Health Contributions to Nitrogen Fertility*, is a project funded through a PA NRCS Conservation Innovations Grant (CIG). The PA4R Alliance is the project lead, with Alliance partners Granular and Rosetree Consulting providing not only match for project implementation, but also technical support and analysis.

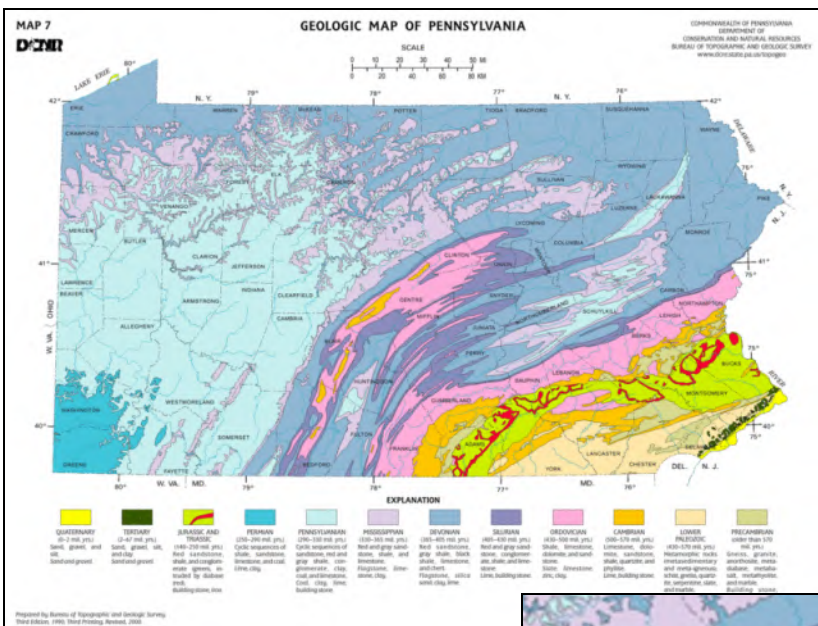
The objective of this project was to demonstrate that nitrogen modeling can be considered within CSP activity enhancement E590B as a precision agriculture technology that can be used to reduce risks of nutrient loss to surface water at the same level of confidence that current nutrient management tools provide. To achieve this objective, the project focused on the following items:

1. Farms currently implementing a nutrient management plan meeting either the PA Act 38 of 2005 program or NRCS 590 practice standard. Both nutrient management plans are based on a mass balance nitrogen calculation, allowing a direct comparison in the supplemental fertilizer recommendations produced by the crop model. All participants needed to have a fully implemented nutrient management plan.
2. Farms implementing soil health practices like continuous no-till, cover crops, and/or planting green. These practices are influential in producing nitrogen, scavenging nitrogen, and cycling nitrogen. There are no tools within the current mass balance regulatory frameworks (Act 38 & NRCS 590) to quantify the nitrogen contributions from soil health. All participating farms needed to have at least one soil health practice (continuous no-till, cover crops, planting green) implemented.
3. Farms willing to split-apply supplemental nitrogen fertilizer. Split application, a recognized 4R nutrient stewardship BMP, is used to reduce nitrogen loss, reduce excess application, maximize yield, and improve overall nitrogen use efficiency through focusing applications at the Right Time for maximum uptake and minimal loss, at the Right Place for easy uptake into plants, and at the Right Rate to meet realistic yield goals. Participating farms needed to have the ability and willingness to delay all or a portion of their supplemental nitrogen fertilizer to around the V8 growth stage.

General Methodology:

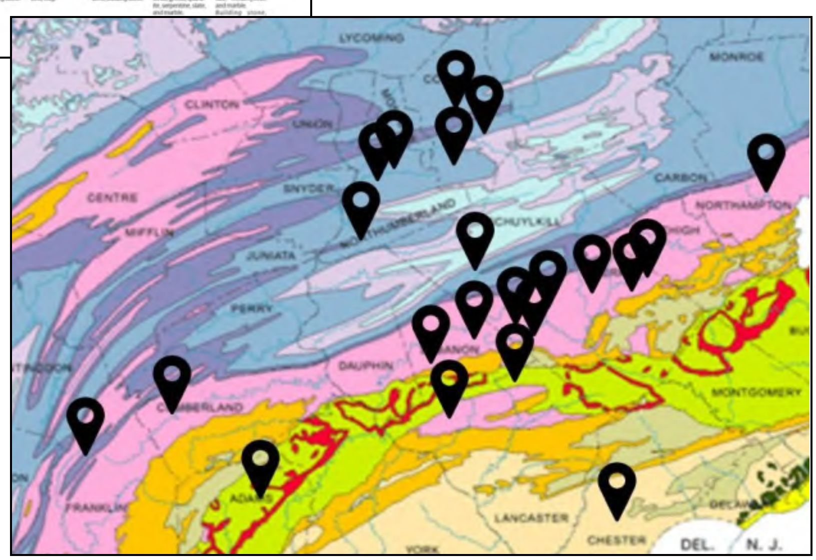
This project utilized a Nitrogen Modeling program (Granular Agronomy Nitrogen Service) on 22 operations / 83 fields (totalling ~4,000 corn acres) in order to compare this site-specific method of nitrogen management to the operations' Nutrient Management plan's mass balance calculation. A deep dive of the data on 13 geographically diverse and data representative fields is included in this report. All 22 cooperating farms utilized nitrogen modeling on half of the corn acres enrolled in the project, making nitrogen applications based on model outcomes. The remaining half of their enrolled corn acres were managed to align with the supplemental fertilizer rates calculated in their Nutrient Management Plans (Act 38 or NRCS 590).

Evaluating data across a diverse geography was an important part of this project. This project focused on ensuring a "fair trial" by including many of the state's predominant agricultural soils as well as enough geographic diversity to capture weather variations that can influence model outputs. The following maps show the locations of participating farms and the geological diversity those farms represent.



(Left) ***Soils Map of Pennsylvania***

(Below) ***Locations of participants in the project. 22 operations (83 fields) participated, representing the predominant agricultural soil types within the state.***



Overview of the Granular Agronomy Nitrogen (Modeling) Service:
The Granular Agronomy Nitrogen Service, delivered through trained advisors, utilizes a corn growth model to estimate crop nitrogen availability and uptake during a growing season. The Granular Crop Model (GCM) is a daily time-step deterministic crop growth model that takes inputs of soil, weather, management, and crop genetics in as inputs and simulates both below and above ground dynamics, including nitrification, leaching, mineralization, germination, root development, crop N uptake, and grain yield. This model is based upon many years of research and development, trained and validated from hundreds of field trials, and backed up with sources through literature reviews and other scientific efforts.

Positioned in the Granular Agronomy Nitrogen Service, both current and historical weather (20 prior years) are inputted into the GCM to simulate the effects of weather that has already occurred in the growing season and the potential weather based on prior years. A median estimation of soil nitrogen levels across those multiple years is used for guidance of nitrogen to be applied. Users can also add site specific soil nitrate sample results to the model. The GCM can model both organic and inorganic sources of nitrogen, including common commercial fertilizers as well as organic residues from previous crops and manure.

At the time of these simulations the Granular Agronomy Nitrogen Service did not have an input for cover crops. However, new efforts for the 2022-23 growing season will enable the simulation of cover crops including plant development, water and N uptake, available N at termination and the effects they have on subsequent corn crops in that season. The cover crop data collected through this project is being used for this update and will help the model better quantify soil health contributions to nitrogen fertility.

The comparative differences between a regulatory mass-balance calculation to a crop growth model like the Granular Crop Model for estimating target nitrogen rates for corn are:

- **Dynamic to weather** - Each year's weather is different, so having the ability to make adjustments of nitrogen rates in-season is important. While a crop model cannot predict the weather, utilizing 20 prior years of weather history is useful to understand what could occur. Connecting this with the weather that has already occurred, a crop model can develop a simulation of what has occurred and what could likely happen. A mass-balance calculation used for regulatory nutrient management planning does not have the ability to adjust to current or future potential weather.
- **Flexible with management** - Because a crop model simulates the growth of a corn plant, management of the growing of that plant are necessary inputs. This includes planting date, seeding density, crop maturity rating, as well as key nitrogen information, such as rates, dates, forms of nitrogen and methods of application. A crop model simulates nitrogen uptake by the corn plant based on seeding parameters and adjusts potential N uptake based on maturity and seeding density. A crop model also simulates the conversion and movement of both commercial fertilizer and organic sources that are based on soil moisture and temperature estimations from weather. A mass-balance calculation used for regulatory nutrient management planning doesn't consider these dynamic effects due to management.

- **Simulations of difficult-to-measure outputs** - A crop model simulates many sub-processes that may be difficult to measure and quantify in most situations. These processes include the nitrogen loss pathways of nitrification, denitrification, leaching, mineralization, volatilization, and immobilization. Crop model simulations are based on controlled lab measurements and modeling and are leveraged across individual field environments. These simulated outputs can be useful for quantifying the amount of nitrogen losses that may take place under various management programs and environments, helping farmers, planners, researchers and policy makers provide proper guidance to farmers to ensure that the environment is considered while still helping the farmer produce the best to their abilities.
- **Fostering conversation, learning and changes to on-farm nitrogen management** - A crop model provides growers and their trained advisors with data around the most prevalent loss pathways in a field. While the data provided may not always be able to be used facilitate changes during the current growing season, it does provide a platform for trained advisors and farmers to have a conversation around on-farm management strategies and to modify 4R (source, rate, time and place) nitrogen decisions for the future growing season that will benefit NUE, yield and profitability and reduce impacts to water quality.

Part A: Selected Field Results

2021 Field Result Analysis

Project enrollment: 24 participants / 83 fields / ~4,000 corn acres

For the purposes of this deep-dive / analysis, 13 fields were selected for comparison. These 13 fields provide geographic & soil type diversity, as well as the adoption of varying soil health practices to enable a representative, deep-dive comparison between mass balance calculations and nitrogen modeling.

Nitrogen Use Efficiency Analysis

Operation/Farm/Field	Mass Balance NUE	Granular Model NUE
Adams County Site 1	1.24	1.17
Adams County Site 2	1.27	1.33
Adams County Site 3	1.02	1.1
Berks County Site 1	0.76*	1.1*
Berks County Site 2	0.77*	0.95*
Chester County Site 1	0.99	0.93
Chester County Site 2	1.08	1.08
Cumberland County Site 1	1.34	0.76
Cumberland County Site 2	1.78	0.94
Columbia County Site 1	1.09	1.05
Northumberland County Site 1	1.29	1.45
Lancaster County Site 1	1.08	0.68
Berks County Site 3	1.28	1.22
MEAN NUE Values		

NUE, or Nitrogen Use Efficiency, is calculated by dividing estimated yield by total nitrogen contributions, and represents the pounds of nitrogen needed to produce a bushel of corn. Lower NUE numbers represent a greater use efficiency – less nitrogen to produce a bushel of corn. While the NUE for modeled acres is 10% lower, indicating better use efficiency, the difference may not be a statistical one.

Interpreting Results from Selected Sites

Utilizing any crop modeling platform starts with establishing field boundaries. Once boundaries are complete, the system automatically creates a SSURGO soils data layer. The soils map is included in each of the comparisons in this report. Soils data like texture and depth are used to calculate nitrogen contributions, loss and availability. Users have the option to combine this SURGO layer with other layers (LiDar, yield maps, etc.) to create sub-field zones for variable rate applications and for discerning differences in N loss within a field. This project did not look at subfield management of nitrogen, but rather whole field management consistent with current regulatory nutrient management frameworks.

Once boundaries are established users can begin entering manure, fertilizer, planting and other information into the model. It is imperative that users accurately enter the site-specific and farm specific data like manure analysis, pre-season soil nitrate levels, and rotation/cover crop history. Application dates are also critical for the success of the model. Farms should work with a trained professional to ensure background information is accurately entered into the model.

Once all applications are entered into a crop model, the model will calculate "real-time" nitrogen levels and alert the user if nitrogen is needed. Additionally, the Granular Crop model specifically creates 2 graphs - a "Season Events & Nitrogen Availability Chart" and "In-Season Nitrogen Losses Chart." It is important to note that each field within the project should have different graphs based on soil type, farm management and environmental interactions.

- The Events & Availability Chart presents available nitrogen as influenced by precipitation, crop uptake and management choices. All entered events are identified on this graph. The Season Events Chart also provides a target for the amount of soil nitrogen that should be present at tassel for users to reach their chosen yield goal.
- The Nitrogen Losses vs Contributions vs Uptake Chart quantifies nitrogen loss from the major nitrogen loss pathways (denitrification, leaching, volatilization, immobilization) and graphs it against mineralization and crop uptake. This graph is a visual key for users to see what loss pathways are most active in their fields. From there, users can develop BMPs to address nitrogen loss pathways.

Users have the ability, throughout the season, to change parameters (application rate, application source, application time, application placement, use of nitrogen stabilizer, etc.) and re-run the model to compare uptake & loss outcomes.

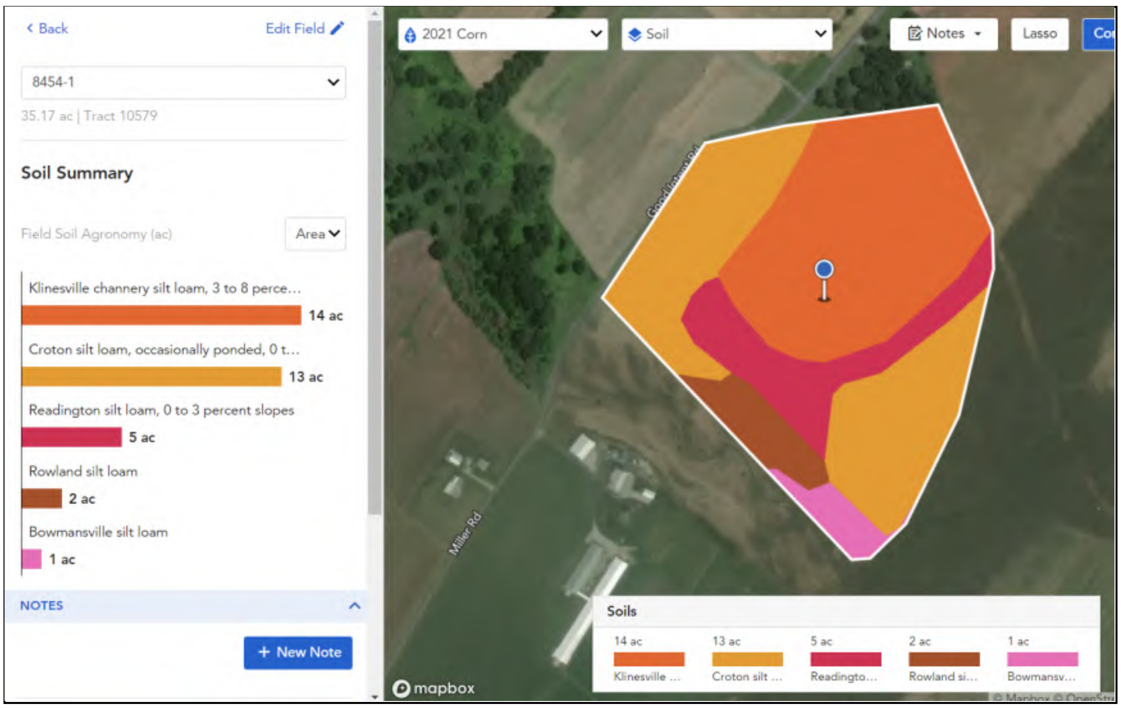
In-depth discussion is provided for site 1 to allow readers to interpret results for the remaining sites.

Adams County Site 1 - 35.17 Acres

Dominant Soil Types: Klinesville channery silt loam, 3 to 8 percent slopes
Croton silt loam, occasionally ponded, 0 to 3 percent slopes
Soil Health Practices In Place:
Continuous No-Till, Unharvested Cover Crops, Planting Green

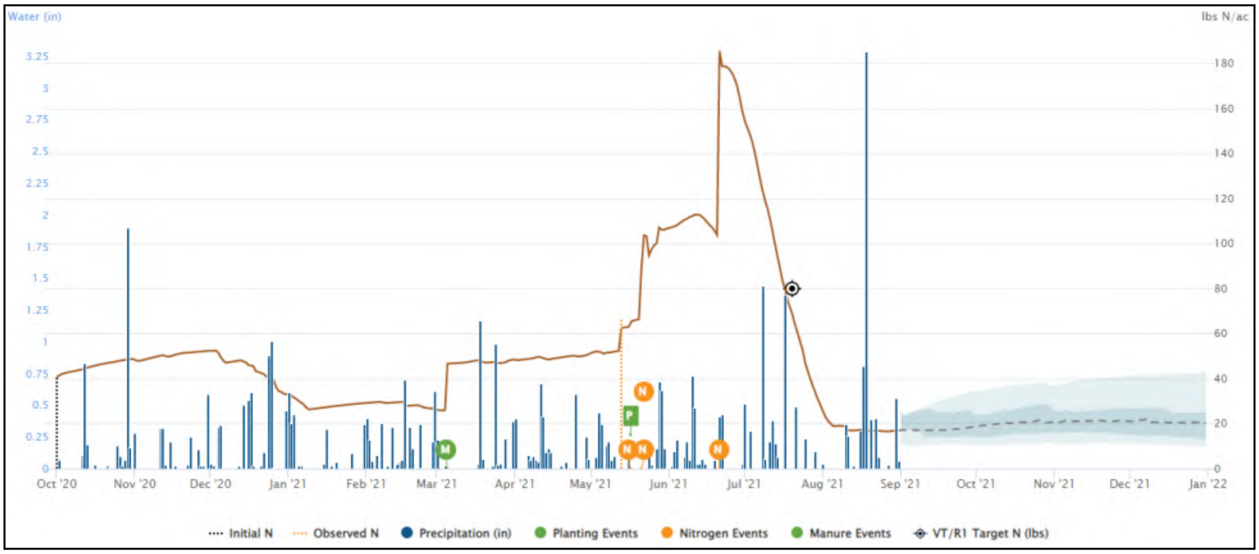
Adams County Sites 1, 2 & 3 are the same operation. Each field has a different dominant soil type. It is a family poultry operation that implements a 2-3 year rotation. Poultry manure is focused on corn acres. The farm has a long history of cover crops.

Soils Map: Adams County Site 1



SURGO soils data layer established after creating field boundaries. A user developing a soils map through NRCS's Web Soil Survey would create an identical map. Additional layers like LiDar and yield maps can be added to create "Decision Zones" within a field. Decision Zones can be treated like individual fields within a field for the purposes of creating variable rate nitrogen prescriptions. This project did not use Decision Zones or VR technology, although some cooperators had enough data to create them and had the equipment to implement them.

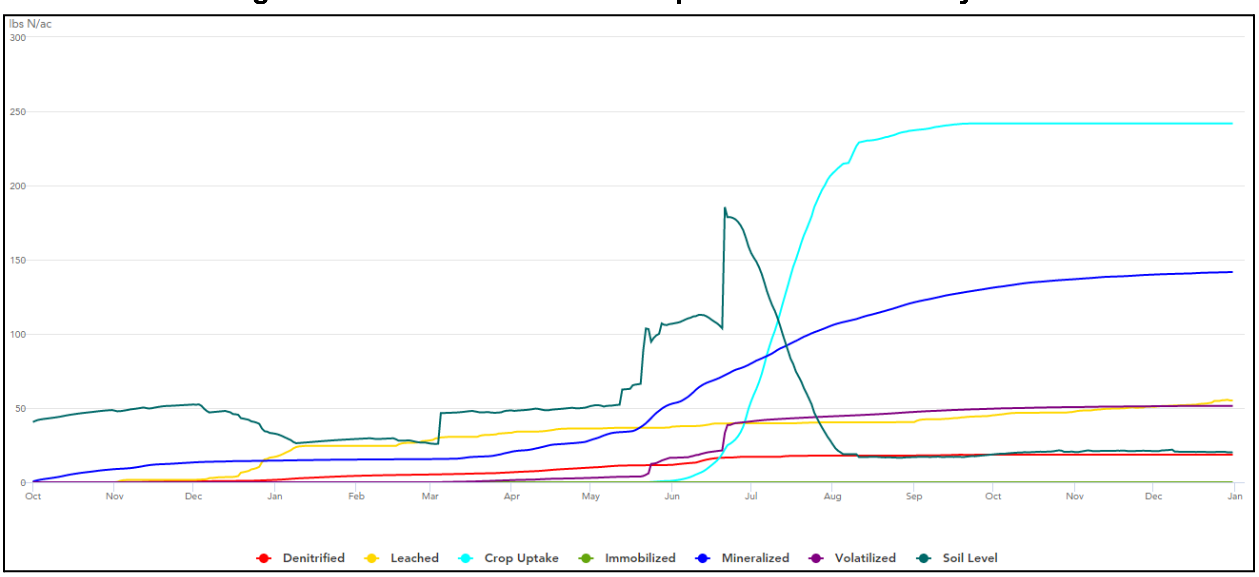
Events & Nitrogen Availability: Adams County Site 1



With a quick glance at both graphs readers can see the soil nitrogen line is the same. Also, notice the model begins calculating nitrogen loss on October 1. Farms that would have applied manure for the 2021 crop year prior to October 1, 2020 use a default date of October 1, 2020.

Initial N on October 1 is calculated by the model, based on user inputs and model assumptions. *Observed N* is the incorporation by the model of the pre-season nitrate sample, taken on May 12 for this site. The model will recalibrate based on a user-entered soil nitrate sample result. All manure applications, nitrogen fertilizer events, and planting events are shown on the graph, as is the target soil nitrogen level needed at tassel to achieve the set yield goal. The screenshot of this graph was taken in early September 2021 - events prior to that date show calculated nitrogen levels while time after that date is modeled as a range of outcomes.

Nitrogen Loss vs Contribution vs Uptake: Adams County Site 1



The four major nitrogen loss pathways are quantified in this chart, based on soil characteristics, precipitation and farm management activities. Readers can see that overall nitrogen losses in this field were around 25 lbs – around 5 lbs from denitrification and 10 lbs each from volatilization and leaching. Low losses can, in part, be attributed to farm management practices. Manure was applied in the spring to a growing cover crop and nitrogen fertilizer applications were split to reduce loss. Notice the “steps” in the volatilization line - they match application events where no nitrogen stabilizer effective on reducing volatilization was used.

The mineralized nitrogen line estimates nitrogen mineralized from various sources like soil organic matter, legumes, cover crops and organic manure nitrogen. Total mineralized nitrogen for this site is calculated at 140 lbs/acre.

Another interesting line is the total nitrogen uptake line. Notice the 240 lb uptake projection does not match the 172 bu/A yield goal. There is not enough information in the model to assess this difference, but it could be partially related to plant density, % of plants contributing to yield and inherent variety differences.

Readers will be able to identify nitrogen loss concerns on participating farms through these graphs, and be able to formulate possible alternatives for reducing that loss through 4R BMPs that focus on manure and fertilizer use efficiency.

Mass Balance vs. the Model: Adams County Site 1

	Mass Balance	Granular Nitrogen Model
Pre Season Nitrate Soil Test	NA	62 lbs N/ac
Yield Goal	185 bu/ac	185 bu/ac
Manure Application	2 tons turkey manure spring	2 tons turkey manure 3/5/21
Available N from manure	81 lbs N/ac	(54) lbs N/ac
Residual Manure N	20 lbs N/ac	0 lbs N/ac
Residual Legume N	0 lbs N/ac	0 lbs N/ac
At Planting Fertilizer Nr	15 lbs N/ac	15 lbs N/ac 5/15/21
Pop up/in-furrow Fertilizer N	2 lbs N/ac	2 lbs N/ac 5/15/21
Pre-Emerge Fertilizer N	30 lbs N/ac	33 lbs N/ac 5/17/21
Side-dress Fertilizer N	33 lbs N/ac	90 lbs N/ac 6/20/21
Total Applied N	183 lbs N/ac	202 lbs N/ac
Pre-Harvest Field Measured Yield	147 bu	172 bu
Calculated Nitrogen Use Efficiency	1.24 lbs N/bu	1.17 lbs N/bu
Precipitation 10/1/2020 - 10/1/2021		46 inches
Precipitation Planting - 10/1/2021		21 inches

The green highlighted cell shows the calculation with the best nitrogen use efficiency.

The chart above shows the different factors each tool, mass balance calculation and Granular Nitrogen, account for when calculating nitrogen fertilizer needs.

Pre-Season Nitrate Test: A crop model typically allows for users to take a nitrate soil test around the time of planting, before commercial nitrogen fertilizer is applied, to calibrate the model to historic field conditions like previous manure, legume nitrate, mineralized nitrogen from organic matter, etc. There are significant differences between participating sites in the amount of mineralized nitrogen present at planting. The timing of the Pre-Season Nitrate Test will influence what sources can be additionally credited. For instance, Adams County Site 1 had manure applied in March, and the soil nitrate sample was taken in May. A portion of the soil nitrate measured in May is the manure nitrogen applied in March. As such, source contributions will need to be modified based on the pre-season nitrate sample date. It is unclear how the model modifies manure & residual contributions based on timing of the sample.

Yield Goal: Same for both products

Manure Application: Both tools account for a 2-ton application. Granular accounts for the application date because the model will begin calculating loss and mineralization on March 5. The version of Granular used for this project did not account for the influence of existing cover crops present at the time of application. The goal of future models is to allow users to enter cover crop data.

Availability of manure nitrogen can be different for a manure application, depending on how a user enters the data into the model. Users can create farm specific manure analysis and enter availability factors. Even with those options, users may need to adjust the application rate to make available nitrogen match a nutrient management plan. For instance, fall applied dairy manure on a rye forage cover crop at 6,000 gal/A would have a limited nitrogen contribution to the corn planted following rye harvest. The current mass balance calculation used in PA provides an availability factor for this situation. The model does not. Instead, users would need to reduce the application rate to around 2,400 gal/A to have the model calculate the equivalent contribution.

One issue we faced in this project centered around manure nitrogen availability. Both Rosetree Consulting's certified nutrient management plan writers and Granular's Pro-Services staff (individuals certified to assist farms with modeling and yield data management) worked to enter data on the 83 fields. The Pro-Services staff was not familiar with PA regulations and availability factors which led to calculated nitrogen contributions not matching PA nutrient management plans. This error was not caught in time to correct the model. It highlights the need for local professionals familiar with regulatory policies to provide oversight to farms that are using the model in cost share programs or regulatory programs.

Residual Legume and Manure N: This is a major difference between a mass balance calculation and the version of the Granular model used in this project. Mass balance calculations provide a specific nitrate contribution for residual manure and legumes. The crop model did not directly account for nitrate contributions from legume or past manure applications, but rather, partially accounted for these contributions in the pre-season soil nitrate sample. The 2023 version of Granular Agronomy Nitrogen Service will allow users to select these sources for higher visibility of the residual source.

Fertilizer Applications: A crop model will account for the Time, Source, and Placement of fertilizer materials to calculate availability and loss. Accurate entry of application dates & methods are very important for this “real-time” calculation. For instance, 150 lbs of nitrogen called for in a nutrient plan is applied with burndown herbicides. The field receives a 1 inch rain 24-hours after application and a total of 4 inches of rain before the corn is waist high. The model can account for the movement of this nitrogen through loss pathways, while the mass balance calculation cannot. If the farmer split applies his 150 lbs, applying 50 at planting and 100 lbs as a sidedress, the mass balance calculation does not give credit to split applied nitrogen, a 4R Timing practice recognized for improving nitrogen use efficiency. The model takes this into account when calculating available nitrogen and contributions to yield.

Precipitation: Precipitation is the driver not only for nitrogen loss pathways, but also for mineralization of soil sources. In the previous example, 5 inches of precipitation can lead to significant leaching and runoff losses, leaving the crop potentially deficient in nitrogen & unable to maximize yield. Another impact of precipitation is to mineralization rates. Soil moisture in the top layer of the soil is critical for microbial degradation of organic materials. Too little soil moisture in the top layer can reduce mineralization rates of the soil, resulting in less contributions from sources like legumes, cover crops, and organic manure fractions. Mass balance calculations are static, unable to adapt to in season changes in conditions. Nitrogen models can account for some of these interactions when calculating available nitrogen.

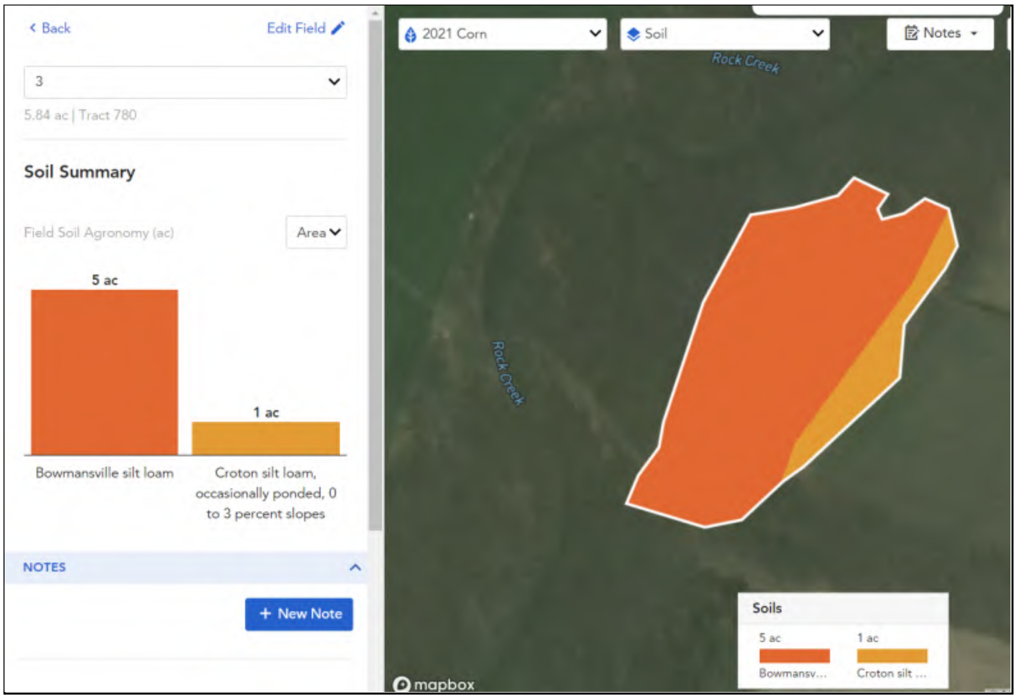
Calculated Nitrogen Use Efficiency: This is the estimated yield divided by the total amount of nitrogen accounted for. It was not the goal of this project to provide a statistical analysis of the results to identify what constitutes a statistical difference. Rather, it was the goal to compare commercially available modeling tools with trusted mass balance calculations to determine if they can provide the same level of confidence to a grower and a water quality regulating agency for site specific management of nitrogen.

Adams County Site 2 - 5.84 Acres

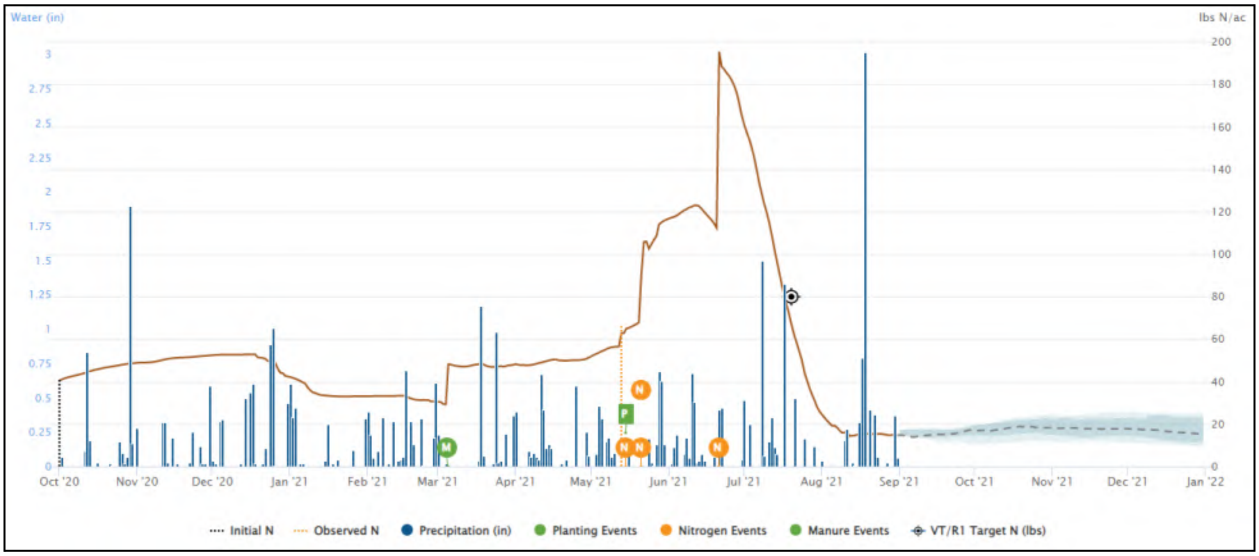
Dominant Soil Type: Bowmansville silt loam
Soil Health Practices In Place: Continuous No-Till, Cover Crops, Planting Green

Adams County Sites 1, 2 & 3 are the same operation. Each field has a different dominant soil type. It is a family poultry operation that implements a 2-3 year rotation. Poultry manure is focused on corn acres. The farm has a long history of cover crops.

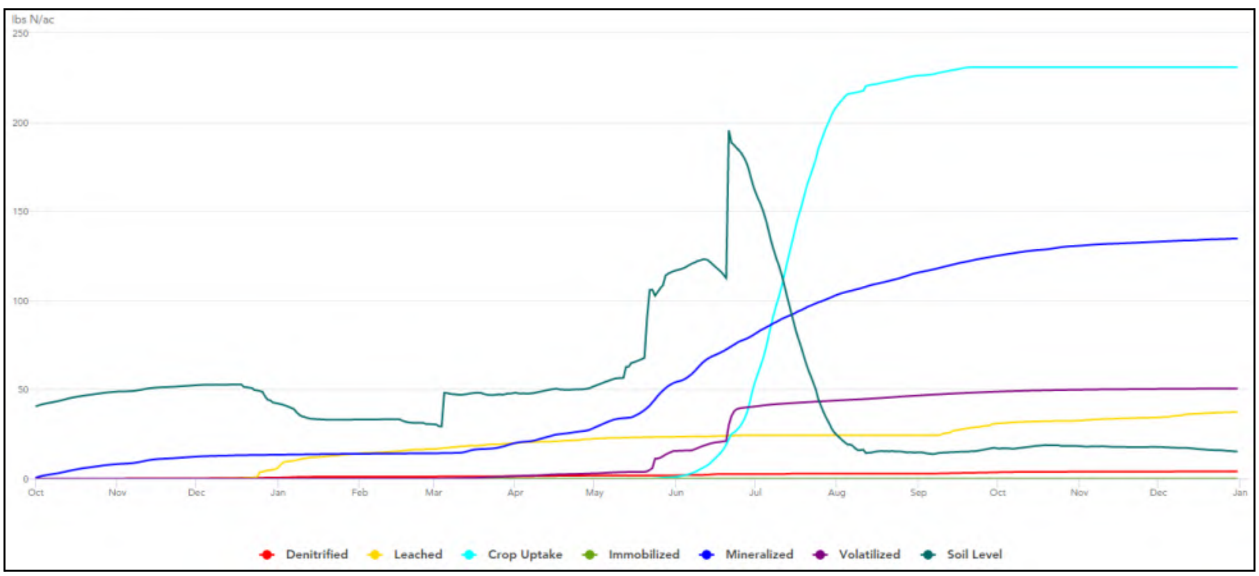
Soils Map: Adams County Site 2



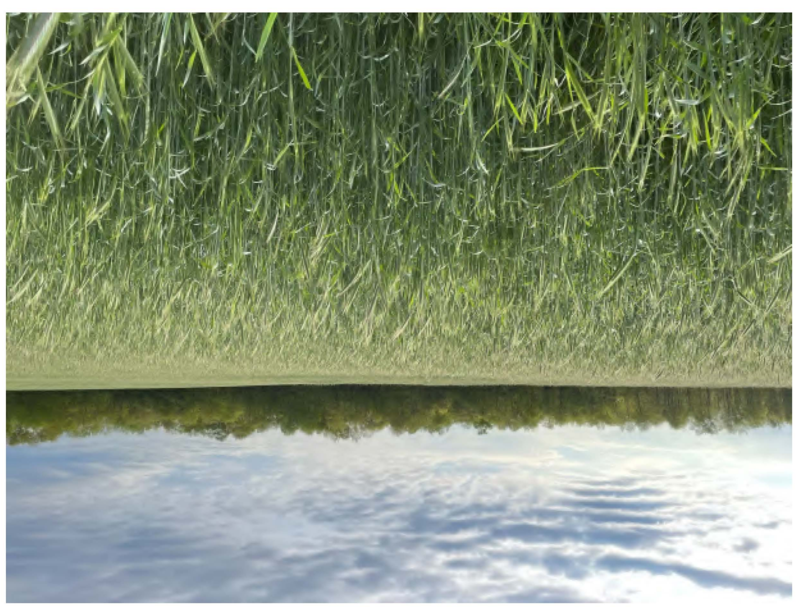
Events & Nitrogen Availability: Adams County Site 2



Nitrogen Loss vs Contribution vs Uptake: Adams County Site 2



Volatilization losses from fertilizer applications are noticeable in the graph. The version of the Granular model used for this project did not identify any immobilization losses due to presence of a high biomass cover crop. The Adams County farm used for sites 1, 2, & 3 is the “Small Grain Headed” cover crop scenario presented in Part B of this report. The site was modeled to show site specific nitrogen contributions from the cover crop. A picture of the cover crop is below.



Mass Balance vs. the Model: Adams County Site 2

	Mass Balance	Granular Nitrogen Model
Pre Season Nitrate Soil Test	NA	62 lbs N/ac 5/12/21
Yield Goal	185 bu/ac	185 bu/ac
Manure Application	2 tons turkey manure	2 tons turkey manure 3/5/21
Available N from manure	81 lbs N/ac	(54) lbs N/ac
Residual Manure N	20 lbs N/ac	0 lbs N/ac
Residual Legume N	0 lbs N/ac	0 lbs N/ac
At Planting	15 lbs N/ac	15 lbs N/ac 5/16/21
Pop up/in-furrow	2 lbs N/ac	2 lbs N/ac 5/16/21
Pre-Emerge	30 lbs N/ac	33 lbs N/ac 5/18/21
Side-dress	33 lbs N/ac	90 lbs N/ac 6/20/21
Total Applied N	181 lbs N/ac	202 lbs N/ac
Pre-Harvest Field Measured Yield	142 bu	152 bu
Calculated Nitrogen Use Efficiency	1.27 lbs N/bu	1.33 lbs N/bu
Precip 10/1/2020 - 10/1/2021		46 inches
Precip Planting - 10/1/2021		20 inches

The Granular model calculated lower nitrogen availability from the manure application due to PA availability factors given to manure applied on a growing cover crop. The model may have captured some of this difference in the soil nitrate sample taken on 5/12/21.

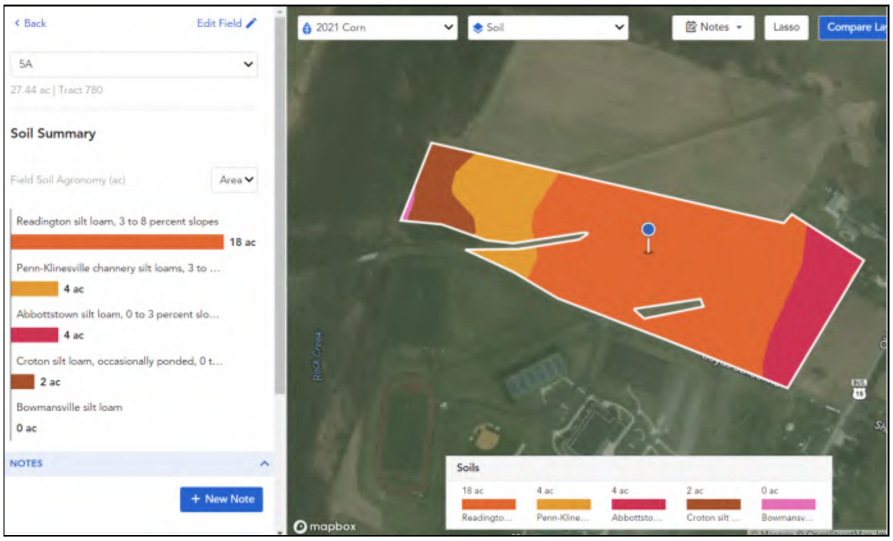
Note that the 62 lbs of measured nitrate is not included in the total applied N calculation. This 62 lbs includes nitrogen available from the manure source + any legume residual + soil sources. To include this 62 lbs in the total applied N calculation would be “double dipping.” It is interesting to note that this soil was supplying 62 lbs of nitrate when the rye cover crop was in full head and rye was near its highest demand for nitrogen. Overall nitrogen rates are higher for the modeled acres, but higher yield results in a better NUE. The increased yield of 10 bu/A also results in increased phosphorus removal of 4 lbs/A.

Adams County Site 3 - 27.44 Acres

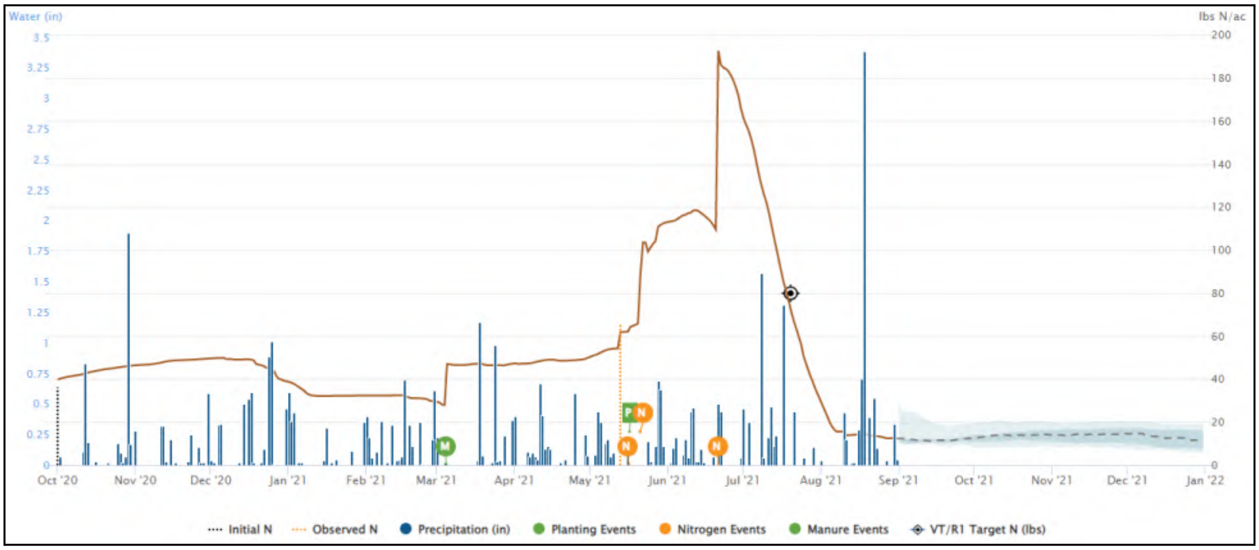
Dominant Soil Type: Readington silt loam, 3 to 8 percent slopes
Soil Health Practices In Place: Continuous No-Till, Cover Crops, Planting Green

Adams County Sites 1, 2 & 3 are the same operation. Each field has a different dominant soil type. It is a family poultry operation that implements a 2-3 year rotation. Poultry manure is focused on corn acres. The farm has a long history of cover crops.

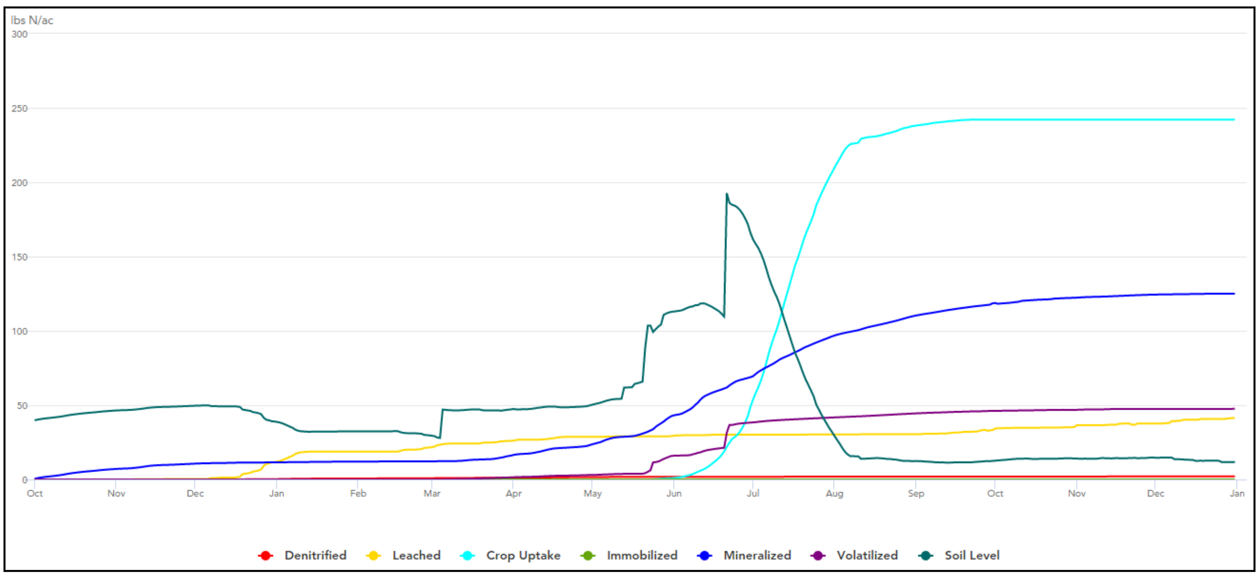
Soils Map: Adams County Site 3



Events & Nitrogen Availability: Adams County Site 3



Nitrogen Loss vs Contribution vs Uptake: Adams County Site 3



Volatilization losses from fertilizer applications are noticeable in the graph. The version of the Granular model used for this project did not identify any immobilization losses due to presence of a high biomass cover crop. The Adams County farm used for sites 1, 2, & 3 is the “Small Grain Headed” cover crop scenario presented in Part B of this report. The site was modeled to show site specific nitrogen contributions from the cover crop.

Mass Balance vs. the Model: Adams County Site 3

	Mass Balance	Granular Nitrogen Model
Pre Season Nitrate Soil Test	NA	62 lbs N/ac 5/12/21
Yield Goal	185 bu/ac	185 bu/ac
Manure Applications	2 tons turkey manure	2 tons turkey manure 3/5/21
Available N from manure	81 lbs N/ac	(54) lbs N/ac
Residual Manure N	20 lbs N/ac	0 lbs N/ac
Residual Legume N	0 lbs N/ac	0 lbs N/ac
At Planting	15 lbs N/ac	15 lbs N/ac 5/16/21
Pop up/in-furrow	2 lbs N/ac	2 lbs N/ac 5/16/21
Pre-Emerge	30 lbs N/ac	33 lbs N/ac 5/18/21
Side-dress	0 lbs N/ac	90 lbs N/ac 6/20/21
Total Applied N	148 lbs N/ac	202 lbs N/ac
Pre-Harvest Field Measured Yield	145 bu/a	184 bu/a
Calculated Nitrogen Use Efficiency	1.02 lb N/bu	1.1 lb N/bu
Precip 10/1/2020 - 10/1/2021		46 inches
Precip Planting - 10/1/2021		20 inches

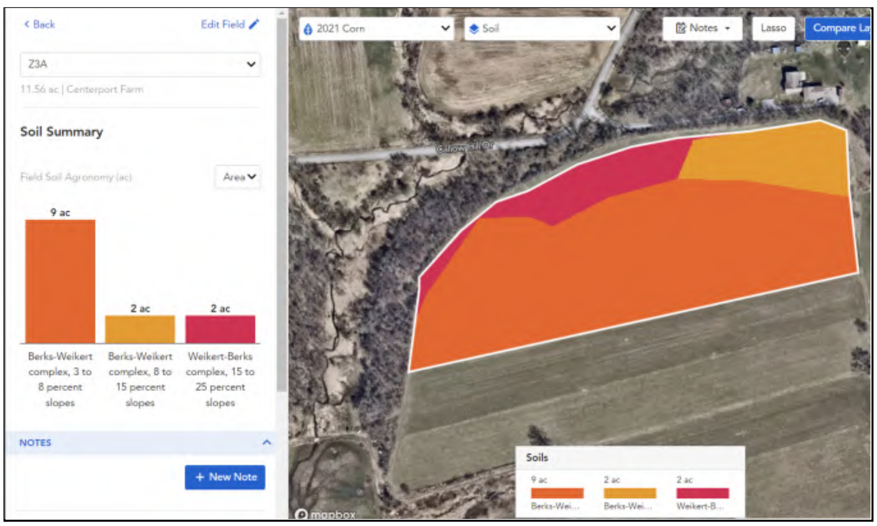
Much of the comments are the same for Adams County site 3 as were made for Adams County site 2 pertaining to residual nitrogen contributions. The higher sidedress rate for this field may be due to a different dominant soil type - Readington. Klinesville and Croton soils were the dominant soil types in sites 1 & 2, respectively.

Berks County Site 1 - 11.56 Acres

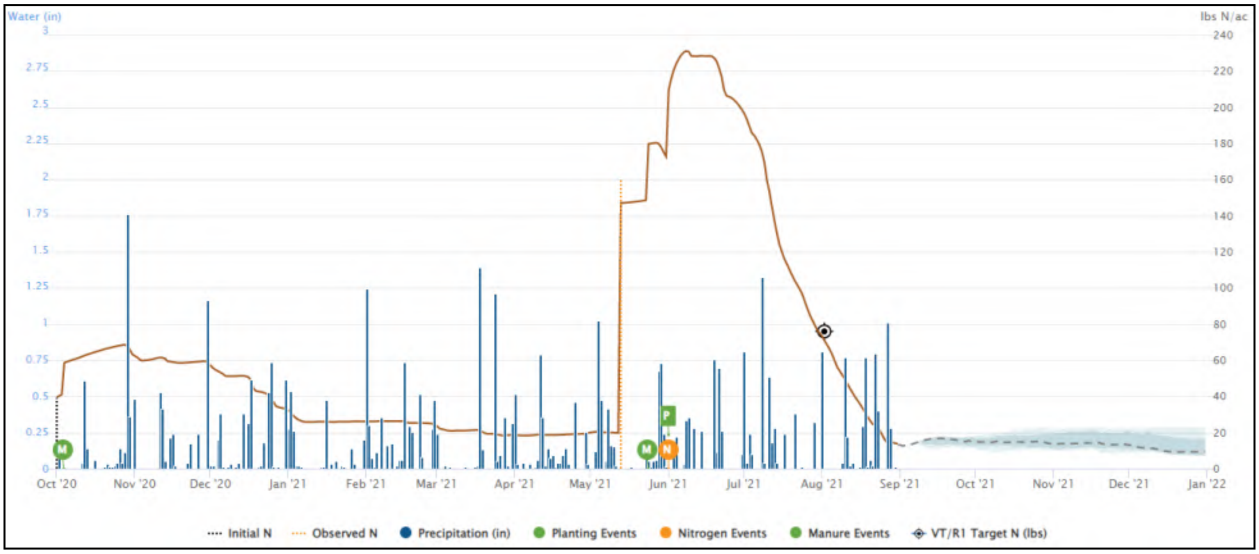
Dominant Soil Type: Berks-Weikert complex, 3 to 8 percent slopes
Soil Health Practices In Place: Continuous No till, Forage Cover Crop

Berks County Sites 1 & 2 are at the same dairy farm. The farm implements a 1-year corn silage / small grain silage rotation and has a long history of 2-3 manure applications annually and traditionally does not apply all the nitrogen called for in their nutrient management plan. Sites 1 & 2 are the same Berks Weikert soil, but site 1 is a northern field on a 3-8% slope, while site 2 is a southern facing field with a 8-15% slope.

Soils Map: Berks County Site 1

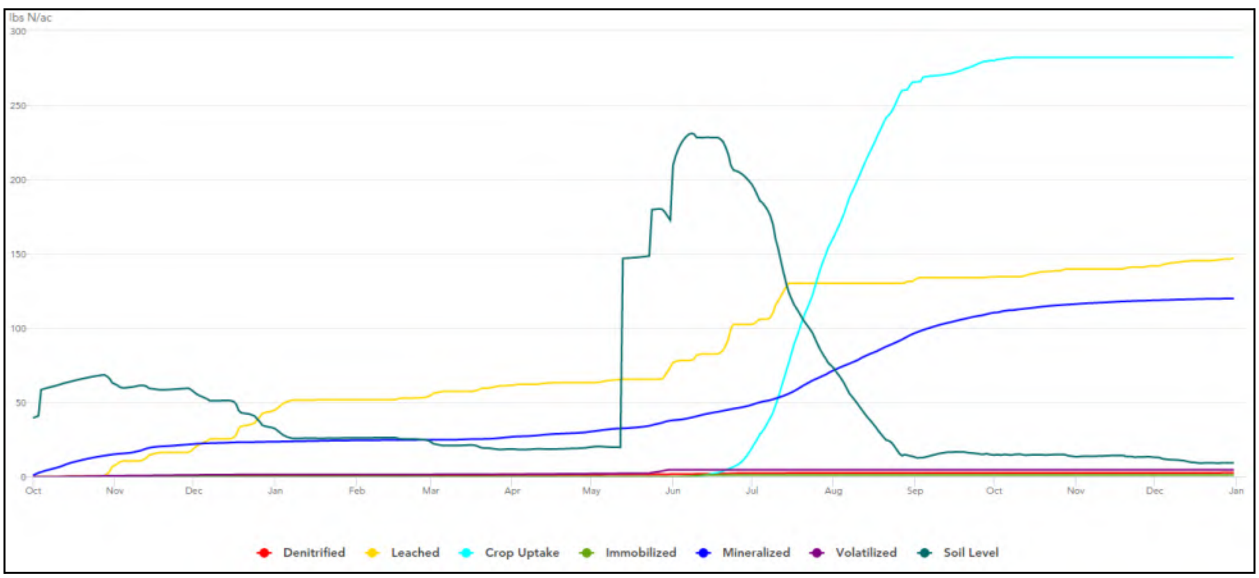


Events & Nitrogen Availability: Berks County Site 1



Note the Observed N date of 5/12 - 160 lbs of available nitrogen was present in the field *before* manure and at-planting nitrogen was applied.

Nitrogen Loss vs Contribution vs Uptake: Berks County Site 1



Leaching losses are higher than expected from a field with nitrogen fertilizer banded sub-surface at planting and no additional fertilizer applied. The steps in the leaching line match well with rainfall events, indicating that the soil type has a high propensity for leaching.

Mass Balance vs. the Model: Berks County Site 1

	Mass Balance	Granular Nitrogen Model
Pre Season Nitrate Soil Test	NA	160 lbs N/ac (Sample date: 5/12/21)
Yield Goal	175 bu/ac	175 bu/ac
Manure Applications	7k dairy early fall 7k dairy spring	7k dairy 10/1/20 7k dairy 5/24/21
Available N from manure	68 lbs N/ac	35 lbs N/ac
Residual Manure N	24 lbs N/ac	0 lbs N/ac
Residual Legume N	0 lbs N/ac	0 lbs N/ac
At Planting	60 lbs N/ac	60 lbs N/ac 5/27/21
Pop up/in-furrow	0 lbs N/ac	0 lbs N/ac
Pre-Emerge	0 lbs N/ac	0 lbs N/ac
Side-dress	(23) lbs N/ac	0 lbs N/ac
Total Applied N	175 lbs N/ac	255 lbs N/ac
Pre-Harvest Field Measured Yield	230 bu/A	230 bu/A
Calculated Nitrogen Use Efficiency	0.76 lbs N/bu*	1.1 lbs N/bu*
Precip 10/1/2020 - 10/1/2021		46 inches
Precip Planting - 10/1/2021		17 inches

*No sidedress was made to these fields, so no comparison of NUE can be made. The mass balance part of the field should have received an additional 23 lbs of nitrogen, while the model would not have called for additional fertilizer to be applied. The 23 lbs is presented as applied and calculated in the NUE number.

The amount of soil nitrate measured in this field, 160 lbs/A, explains the very low calculated nitrogen use efficiency for the mass balance calculation. The N Model's nitrate sample was taken prior to the spring manure application, so the fall manure contributions + residual manure + soil sources are captured in the nitrate sample. Spring manure applications were not. Total nitrogen applied for the model closely reflect expected overall NUE, indicating that the pre-season nitrate sample was effective at capturing soil contributions.

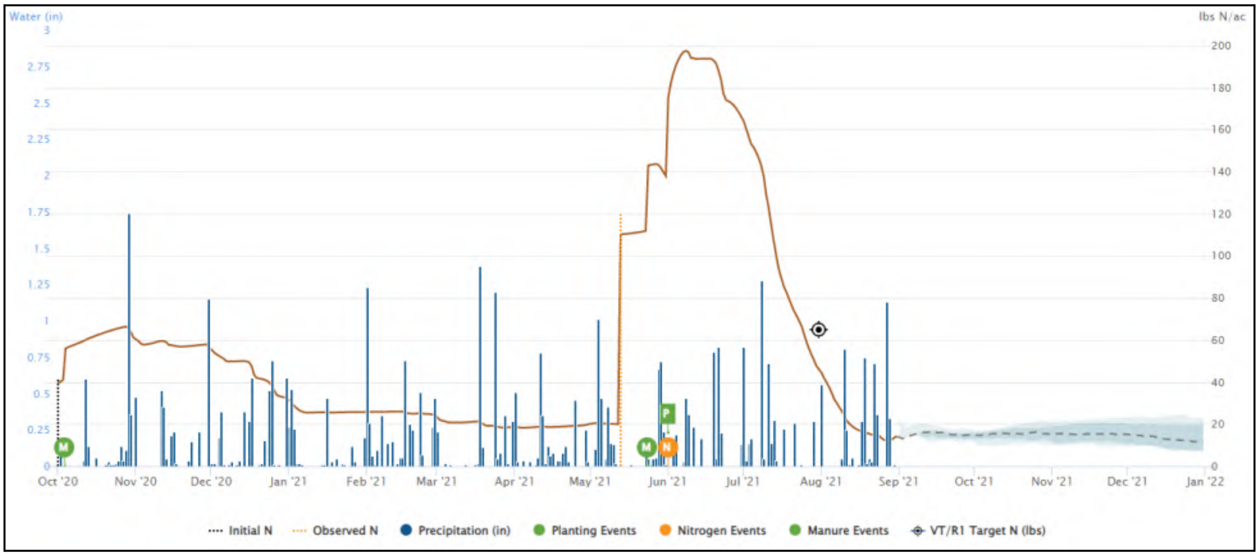
Berks County Site 2 - 7.36 Acres

Dominant Soil Type: Berks-Weikert complex, 8 to 15 percent slopes
Soil Health Practices In Place: Continuous No Till, Forage Cover Crop

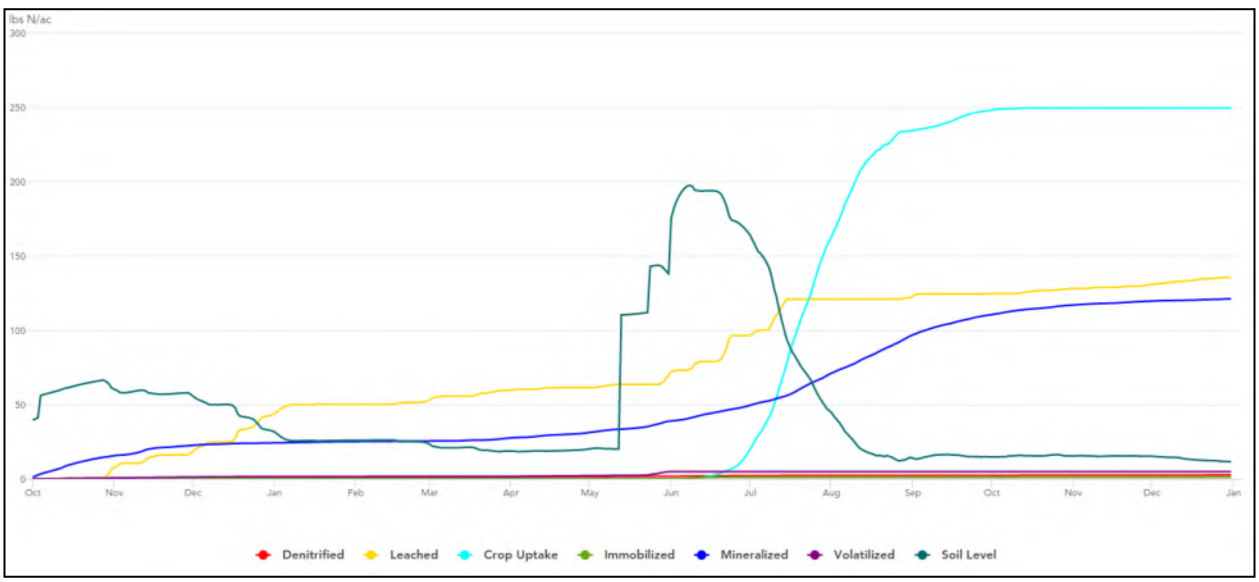
Berks County Sites 1 & 2 are at the same dairy farm. The farm implements a 1-year corn silage / small grain silage rotation and has a long history of 2-3 manure applications annually and traditionally does not apply all the nitrogen called for in their nutrient management plan. Sites 1 & 2 are the same Berks Weikert soil, but site 1 is a northern field on a 3-8% slope, while site 2 is a southern facing field with a 8-15% slope.

Soils Map: Berks County Site 2

Events & Nitrogen Availability: Berks County Site 2



Nitrogen Loss vs Contribution vs Uptake: Berks County Site 2



Leaching losses are higher than expected from a field with nitrogen fertilizer banded sub-surface at planting and no additional fertilizer applied. The steps in the leaching line match well with rainfall events, indicating that the soil type has a high propensity for leaching.

Mass Balance vs. the Model: Berks County Site 2

	Mass Balance	**Granular Nitrogen Model**
Pre Season Nitrate Soil Test	NA	120 lbs N/ac (Sampled on: 5/13/21)
Yield Goal	175 bu/ac	175 bu/ac
Manure Applications	7k dairy early fall 7k dairy spring	7k dairy 10/1/20 7k dairy 5/24/21
Available N from manure	68 lbs N/ac	35 lbs N/ac
Residual Manure N	24 lbs N/ac	0 lbs N/ac
Residual Legume N	0 lbs N/ac	0 lbs N/ac
At Planting	60 lbs N/ac	60 lbs N/ac 5/28/21
Pop up/in-furrow	0 lbs N/ac	0 lbs N/ac
Pre-Emerge	0 lbs N/ac	0 lbs N/ac
Side-dress	(23) lbs N/ac	0 lbs N/ac
Total Applied N	175 lbs N/ac	215 lbs N/ac
Pre-Harvest Field Measured Yield	227 bu/a	227 bu/a
Calculated Nitrogen Use efficiency	0.77 lbs N/bu*	0.95 lbs N/bu*
Precip 10/1/2020 - 10/1/2021		46 inches
Precip Planting - 10/1/2021		16 inches

*No sidedress was made to these fields, so no comparison of NUE can be made. The mass balance part of the field should have received an additional 23 lbs of nitrogen, while the model would not have called for additional fertilizer to be applied. The 23 lbs is presented as applied and calculated in the NUE number.

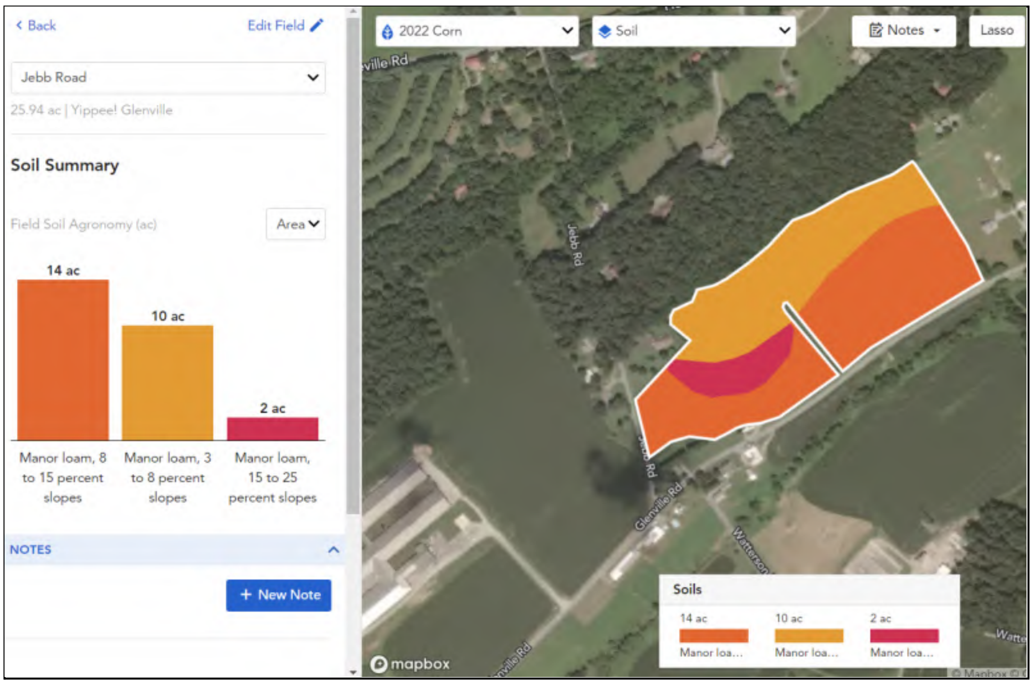
The amount of soil nitrate measured in this field, 120 lbs/A, explains the very low calculated nitrogen use efficiency for the mass balance calculation. The N Model's nitrate sample was taken prior to the spring manure application, so the fall manure contributions + residual manure + soil sources are captured in the nitrate sample. Spring manure applications were not. Total nitrogen applied for the model closely reflect expected overall NUE, indicating that the pre-season nitrate sample was effective at capturing soil contributions.

Chester County Site 1 - 25.94 Acres

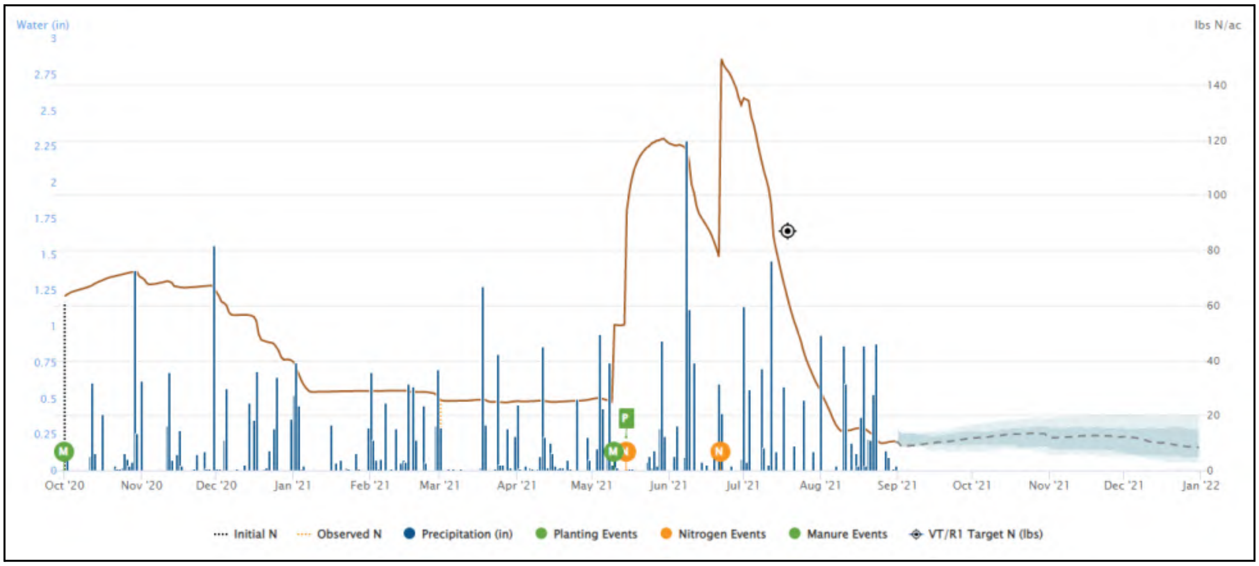
Dominant Soil Types: Manor Loam, 8 to 15 percent slopes & 3 to 8 percent slopes
Soil Health Practices In Place: Continuous No-till, Forage Cover Crop

Chester County Sites 1 & 2 are at the same dairy farm. The farm implements a 1-year corn silage / small grain silage rotation and has a long history of 3+ manure applications annually. Site 1 is a Manor soil type, while Site 2 is a Chester soil type.

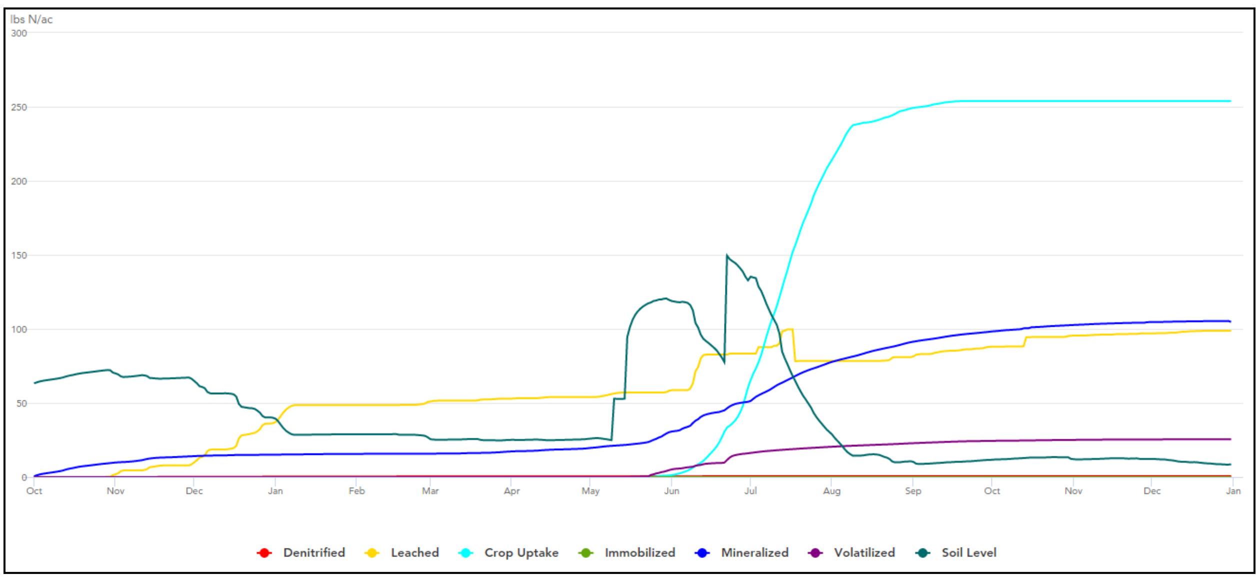
Soils Map: Chester County Site 1



Events & Nitrogen Availability: Chester County Site 1



Nitrogen Loss vs Contribution vs Uptake: Chester County Site 1



Note the leaching losses occurring in December & January. This may be an omission in the current Granular program for not recognizing the presence of a cover crop.

Notice the leaching losses that occurred in mid June following the single rain event. The model was able to capture this leaching loss and reflect it in a higher sidedress rate.

Mass Balance vs. the Model: Chester County Site 1

	Mass Balance	Granular Nitrogen Model
Pre Season Nitrate Soil Test	NA	26 lbs N/ac (Sampled on: 5/13/21)
Yield Goal	220 bu/ac	220 bu/ac
Manure App	12k dairy early fall 12k dairy spring	12k dairy 10/1/20 12k dairy 5/20/21
Available N from manure	76 lbs N/ac	61 lbs N/ac
Residual Manure N	24 lbs N/ac	0 lbs N/ac
Residual Legume N	0 lbs N/ac	0 lbs N/ac
At Planting	60 lbs N/ac	60 lbs N/ac 5/24/21
Pop up/in-furrow	0 lbs N/ac	0 lbs N/ac
Pre-Emerge	0 lbs N/ac	0 lbs N/ac
Side-dress	60 lbs N/ac	101 lbs N/ac 6/23/21
Total Applied N	220 lbs N/ac	231 lbs N/ac
Pre-Harvest Field Measured Yield	223 bu/a	248 bu/a
Calculated Nitrogen Use Efficiency	0.99 lbs N/bu	0.93 lbs N/bu
Precip 10/1/2020 - 10/1/2021		51 inches
Precip Planting - 10/1/2021		23 inches

The amount of soil nitrate measured in this field, 26 lbs/A, is low in comparison to Berks 1 & 2. One major difference is the solids content of the manure for each site - it is much higher for the Berks County farm.

Notice the rainfall event in mid-June and the corresponding increase in leaching losses. This event prompted a higher sidedress rate that eventually resulted in higher yields. The increased yield of 25 bu/A resulted in an additional 10 lbs/A of phosphorus removal.

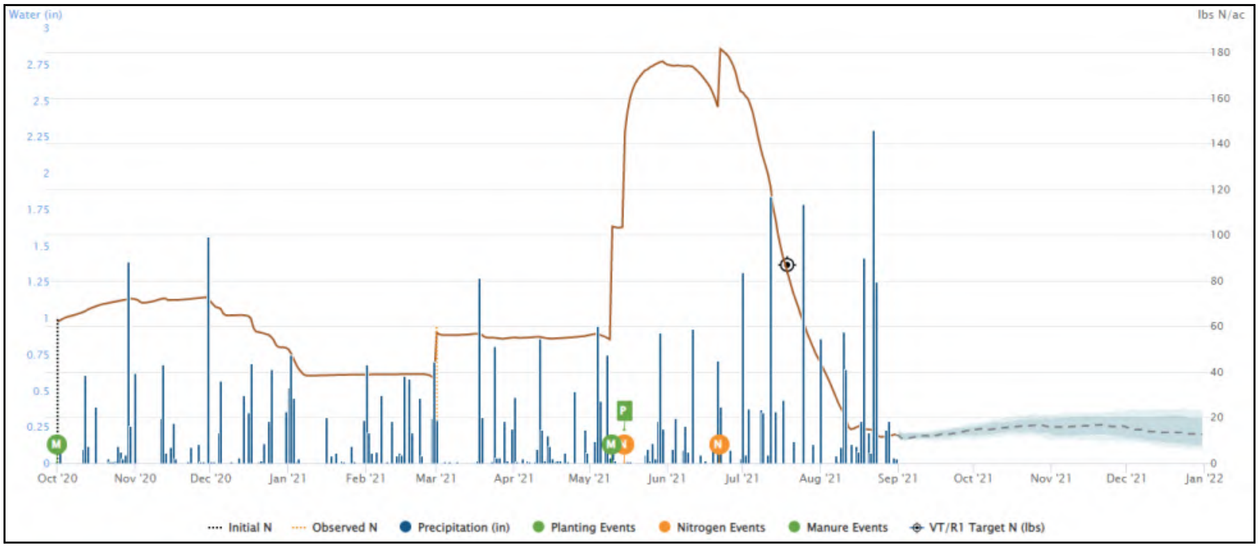
Chester County Site 2 - 36.10 Acres

Dominant Soil Types: Glenelg silt loam, 8 to 15 percent slopes
Chester silt loam, 3 to 8 percent slopes
Chester silt loam, 0 to 3 percent slopes
Soil Health Practices In Place: Continuous No-Till, Forage Cover Crop

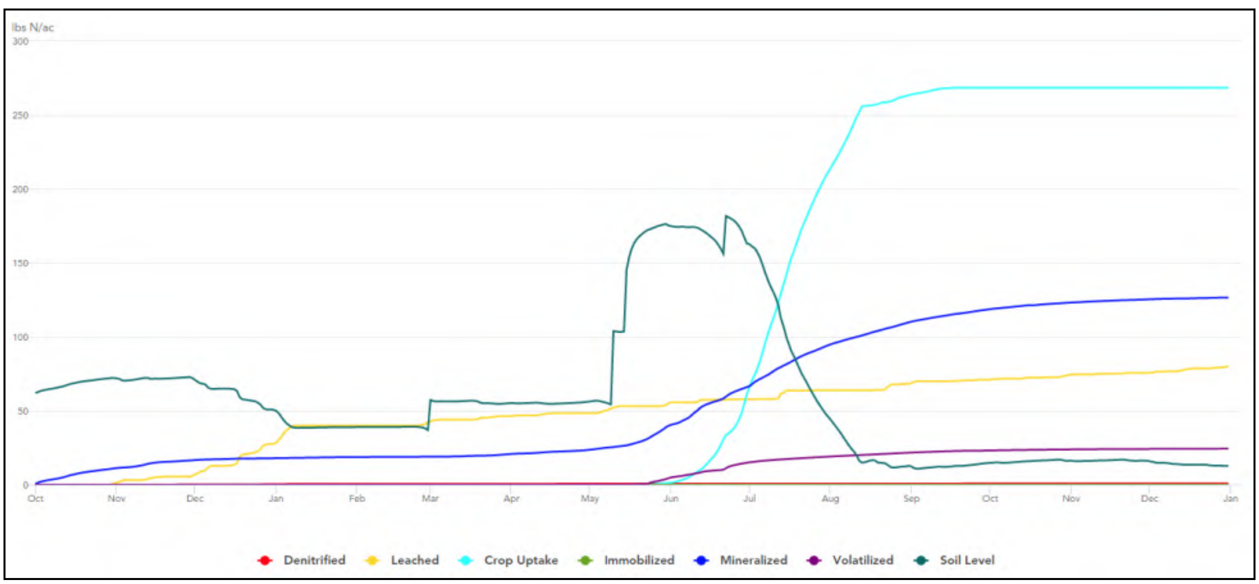
Chester County Sites 1 & 2 are at the same dairy farm. The farm implements a 1-year corn silage / small grain silage rotation and has a long history of 3+ manure applications annually. Site 1 is a Manor soil type, while Site 2 is a Chester soil type.

Soils Map: Chester County Site 2

Events & Nitrogen Availability: Chester County Site 2



Nitrogen Loss vs Contribution vs Uptake: Chester County Site 2



Again, the leaching losses of December and January are likely due to the model not recognizing a cover crop was present. Rainfall at this site was different from the rainfall at Chester 1, so the model adjusted sidedress rates accordingly.

Mass Balance vs. the Model: Chester County Site 2

	Mass Balance	Granular Nitrogen Model
Pre Season Nitrate Soil Test	NA	60 lbs N/ac (Sampled on: 5/13/21)
Yield Goal	220 bu/ac	220 bu/ac
Manure App	12k dairy early fall 12k dairy spring	12k dairy 10/1/20 12k dairy 5/20/21
Available N from manure	76 lbs N/ac	61 lbs N/ac
Residual Manure N	24 lbs N/ac	0 lbs N/ac
Residual Legume N	0 lbs N/ac	0 lbs N/ac
At Planting	60 lbs N/ac	60 lbs N/ac 5/23/21
Pop up/in-furrow	0 lbs N/ac	0 lbs N/ac
Pre-Emerge	0 lbs N/ac	0 lbs N/ac
Side-dress	60 lbs N/ac	40 lbs N/ac
Total Applied N	220 lbs N/ac	221 lbs N/ac
Pre-Harvest Field Measured Yield	203 bu	203 bu
Calculated Nitrogen Use Efficiency	1.08 lbs N/bu	1.08 lbs N/bu
Precip 10/1/2020 - 10/1/2021		52 inches
Precip Planting - 10/1/2021		25 inches

The amount of soil nitrate measured in this field, 26 lbs/A, is higher than site 1, but low in comparison to Berks 1 & 2. Manure solids content difference between the Berks & Chester farms may be part of the difference. Soils differences between Chester 1 & Chester 2 may also be part of the difference.

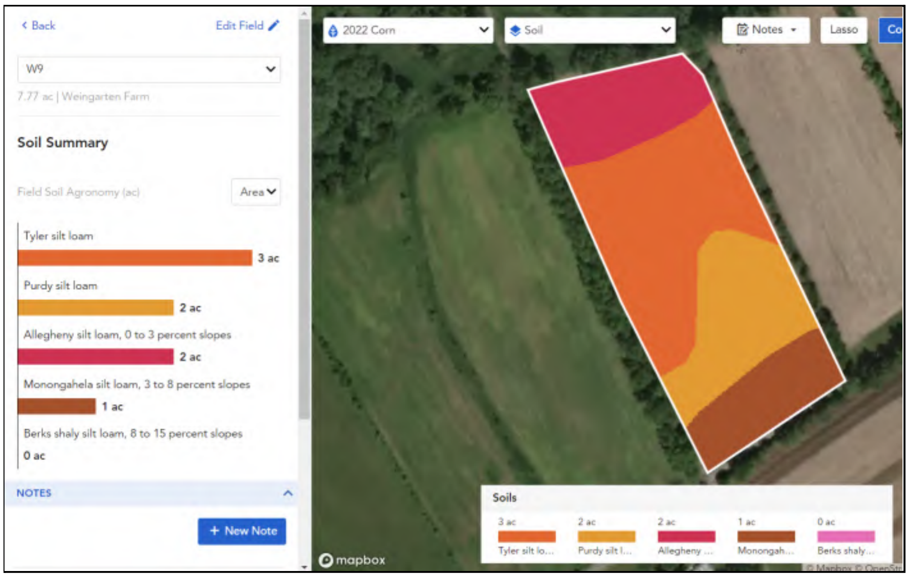
The model calculated less of a sidedress need than the mass balance calculation. NUE were identical for the comparisons.

Cumberland County Site 1 - 7.77 Acres

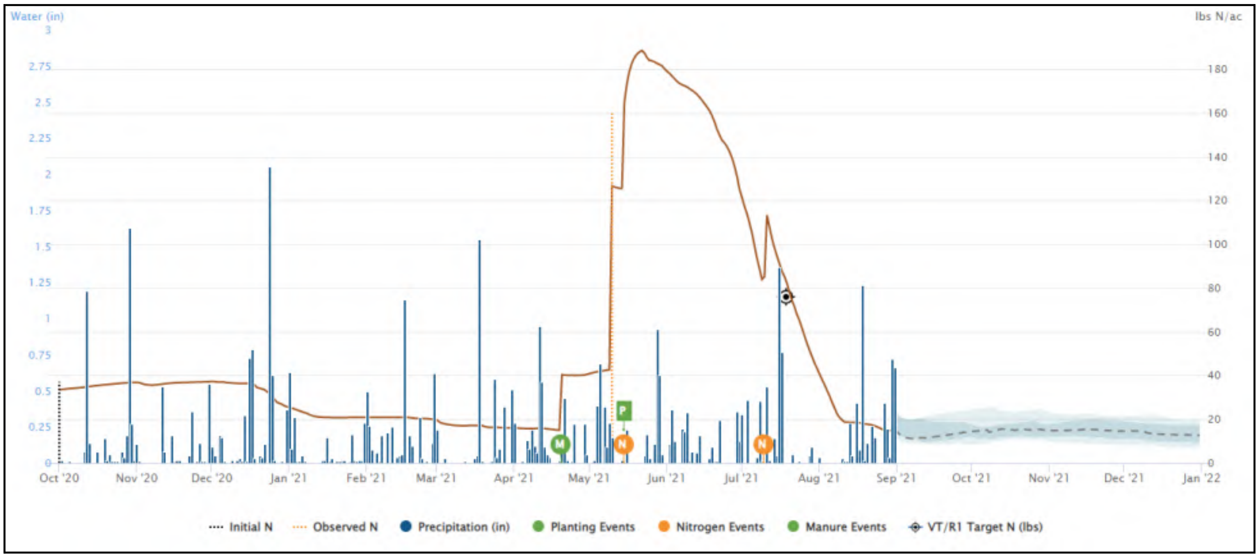
Dominant Soil Type: Tyler silt loam
Soil Health Practices In Place:
Continuous No-Till, Multi-Species Cover Crop, Green Planting

Cumberland County Sites 1 & 2 are at the same hog farm. The farm implements a 2-year corn and wheat/multi-species cover crop rotation and applied hog manure to the cover crop in fall. Site 1 is a Tyler Silt Loam while Site 2 is a Monongahela Silt Loam.

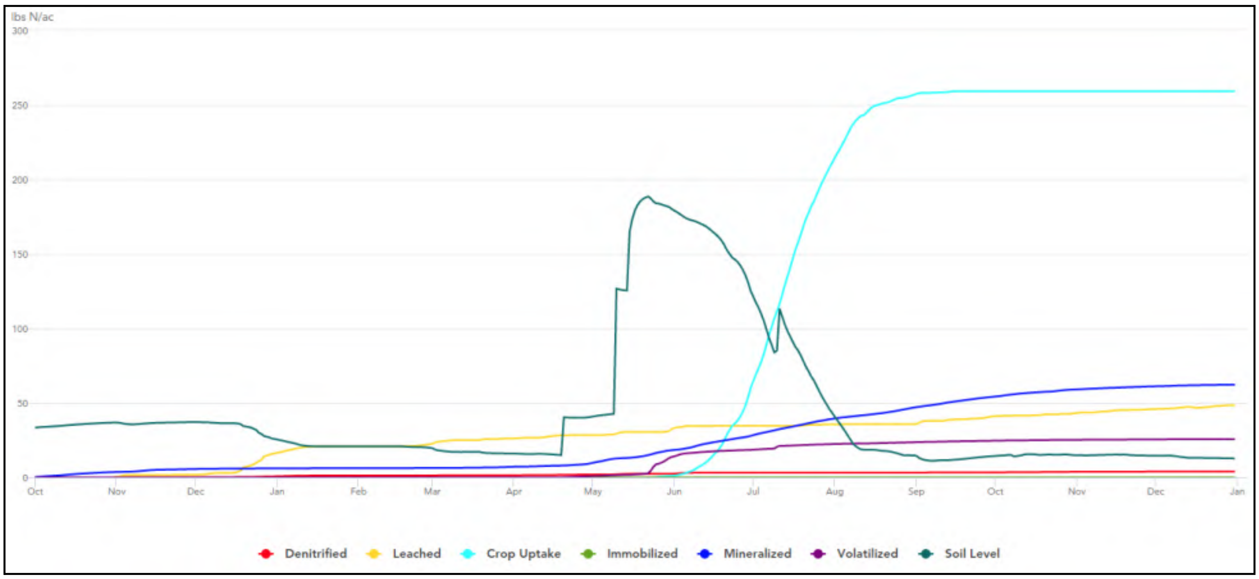
Soils Map: Cumberland County Site 1



Events & Nitrogen Availability: Cumberland County Site 1



Nitrogen Loss vs Contribution vs Uptake: Cumberland County Site 1



Note volatilization losses were higher in this site than previously presented sites. The at-planting application was injected, so calculated volatilization losses may not be from the fertilizer application.

This site had a clover, annual ryegrass, wheat and radish multi-species cover crop established in August of 2020, followed by a manure application in October. This is the "Multi-Species Grass Dominant" scenario presented in Part B of this report. A picture of the cover crop is shown below.

Notice the soil nitrate sample results in the field. It is much higher than anticipated for a cover cropped field

Mass Balance vs. the Model: Cumberland County Site 1

	Mass Balance	**Granular Nitrogen Model**
Pre Season Nitrate Soil Test	NA	40 lbs N/ac (Sampled on: 5/10/21)
Yield Goal	175 bu/ac	175 bu/ac
Manure Applications	4000 gal hog early fall	4000 gal Hog 10/1/20
Available N from manure	47 lbs N/ac	(41) lbs N/ac
Residual Manure N	20 lbs N/ac	0 lbs N/ac
Residual Legume N	60 lbs N/ac*	0 lbs N/ac
At Planting	60 lbs N/ac	60 lbs N/ac 5/10/21
Pop up/in-furrow	0 lbs N/ac	0 lbs N/ac
Pre-Emerge	0 lbs N/ac	0 lbs N/ac
Side-dress	0 lbs N/ac	50 lbs N/ac 6/10/21
Total Applied N	187 lbs N/ac	150 lbs N/ac
Pre-Harvest Field Measured Yield	140 bu/a	197 bu/a
Calculated Nitrogen Use Efficiency	1.34 lbs N/bu	0.76 lbs N/bu
Precip 10/1/2020 - 10/1/2021		46 inches
Precip Planting - 10/1/2021		19 inches

*Expected clover cover crop residual

The model recommended an additional 50 lbs of nitrogen at sidedress compared to the mass balance calculation. The result was significant yield increases. Part of the reason for this difference was the cover crop outcome. The operator had planned a clover dominant mix to provide nitrogen. Seeding ratios were mixed up and the site became dominated by annual ryegrass that probably led to immobilization issues.

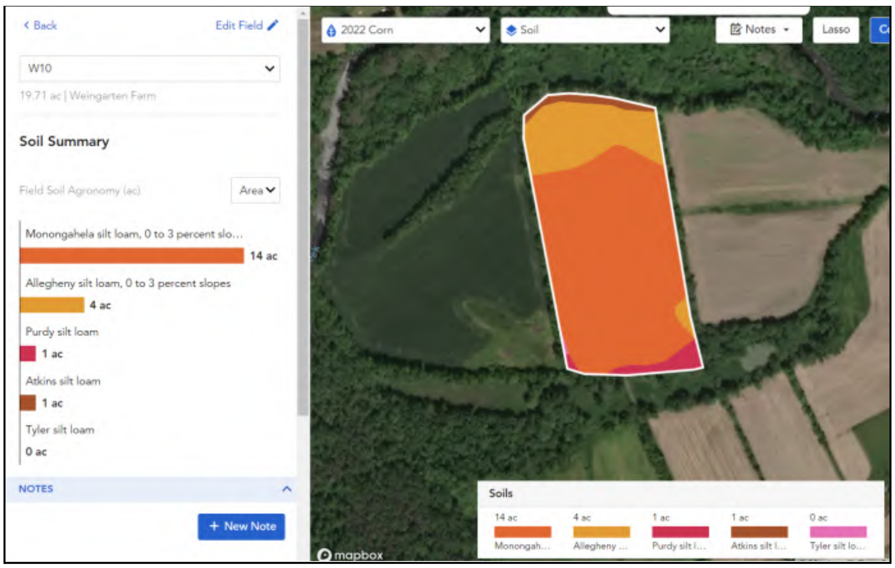
The increase of yield by 57 bushels resulted in additional phosphorus removal of 22.8 lbs/acre

Cumberland County Site 2 - 19.71 Acres

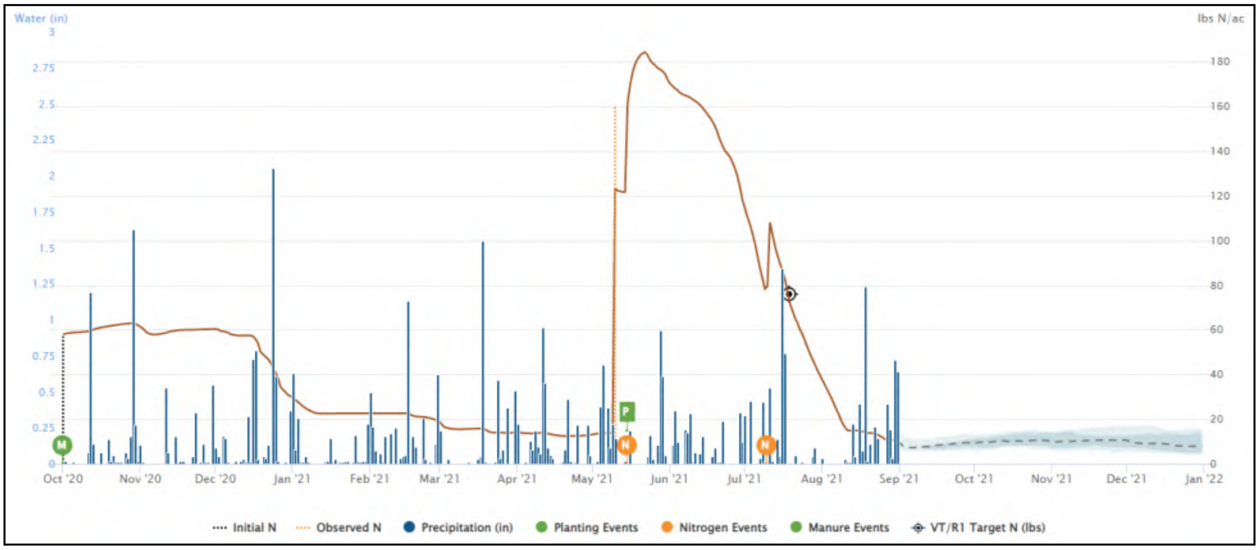
Dominant Soil Type: Monogahela silt loam, 0 to 3 percent slopes
Soil Health Practices In Place: Continuous No-Till, Multi-Species Cover Crop, Green Planting

Cumberland County Sites 1 & 2 are at the same hog farm. The farm implements a 2-year corn and wheat/multi-species cover crop rotation and applied hog manure to the cover crop in fall. Site 1 is a Tyler Silt Loam while Site 2 is a Monongahela Silt Loam.

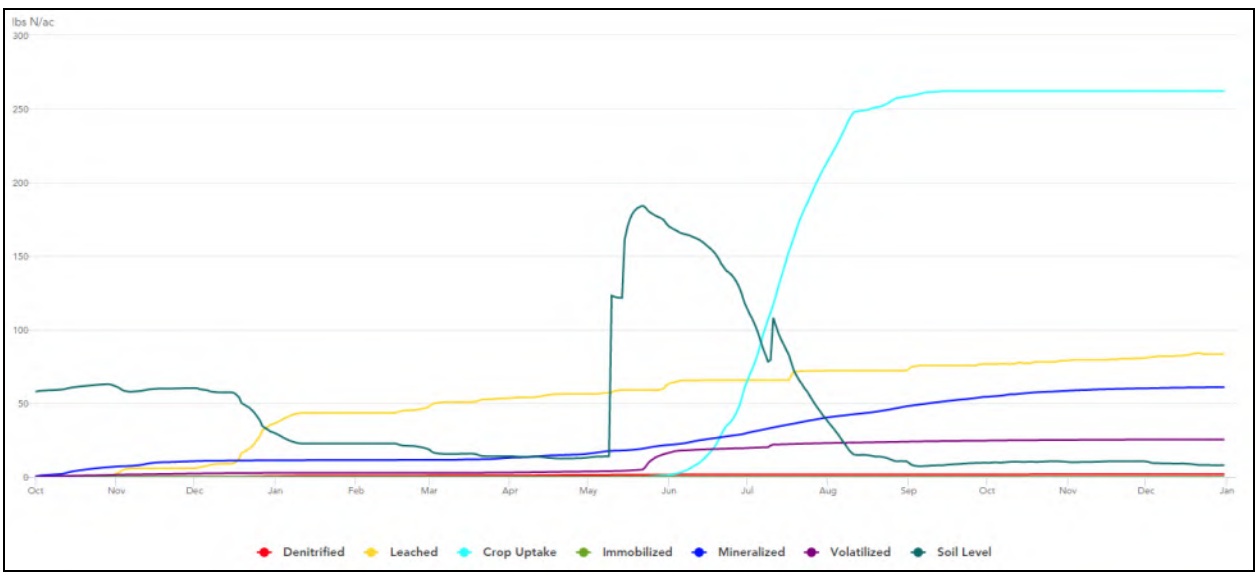
Soils Map: Cumberland County Site 2



Events & Nitrogen Availability: Cumberland County Site 2



Nitrogen Loss vs Contribution vs Uptake: Cumberland County Site 2



Note volatilization losses were higher in this site than previously presented sites. The at-planting application was injected, so calculated volatilization losses may not be from the fertilizer application.

Mass Balance vs. the Model: Cumberland County Site 2

	Mass Balance	Granular Nitrogen Model
Pre Season Nitrate Soil Test	NA	66 lbs N/ac (Sampled on: 5/10/21)
Yield Goal	175 bu/ac	175 bu/ac
Manure Applications	4000 gal hog early fall	4000 gal Hog 10/1/20
Available N from manure	47 lbs N/ac	(41) lbs N/ac
Residual Manure N	20 lbs N/ac	0 lbs N/ac
Residual Legume N	60 lbs N/ac*	0 lbs N/ac
At Planting	60 lbs N/ac	60 lbs N/ac
Pop up/in-furrow	0 lbs N/ac	0 lbs N/ac
Pre-Emerge	0 lbs N/ac	0 lbs N/ac
Side-dress	0 lbs N/ac	50 lbs N/ac
Total Applied N	187 lbs N/ac	176 lbs N/ac
Pre-Harvest Field Measured Yield	146 bu/a	187 bu/a
Calculated Nitrogen Use Efficiency	1.26 lbs N/bu	0.94 lbs N/bu
Precip 10/1/2020 - 10/1/2021		46 inches
Precip Planting - 10/1/2021		19 inches

*Expected clover cover crop residual

The model recommended an additional 50 lbs of nitrogen at sidedress compared to the mass balance calculation. The result was significant yield increases. Part of the reason for this difference was the cover crop outcome. The operator had planned a clover dominant mix to provide nitrogen. Seeding ratios were mixed up and the site became dominated by annual ryegrass that probably led to immobilization issues.

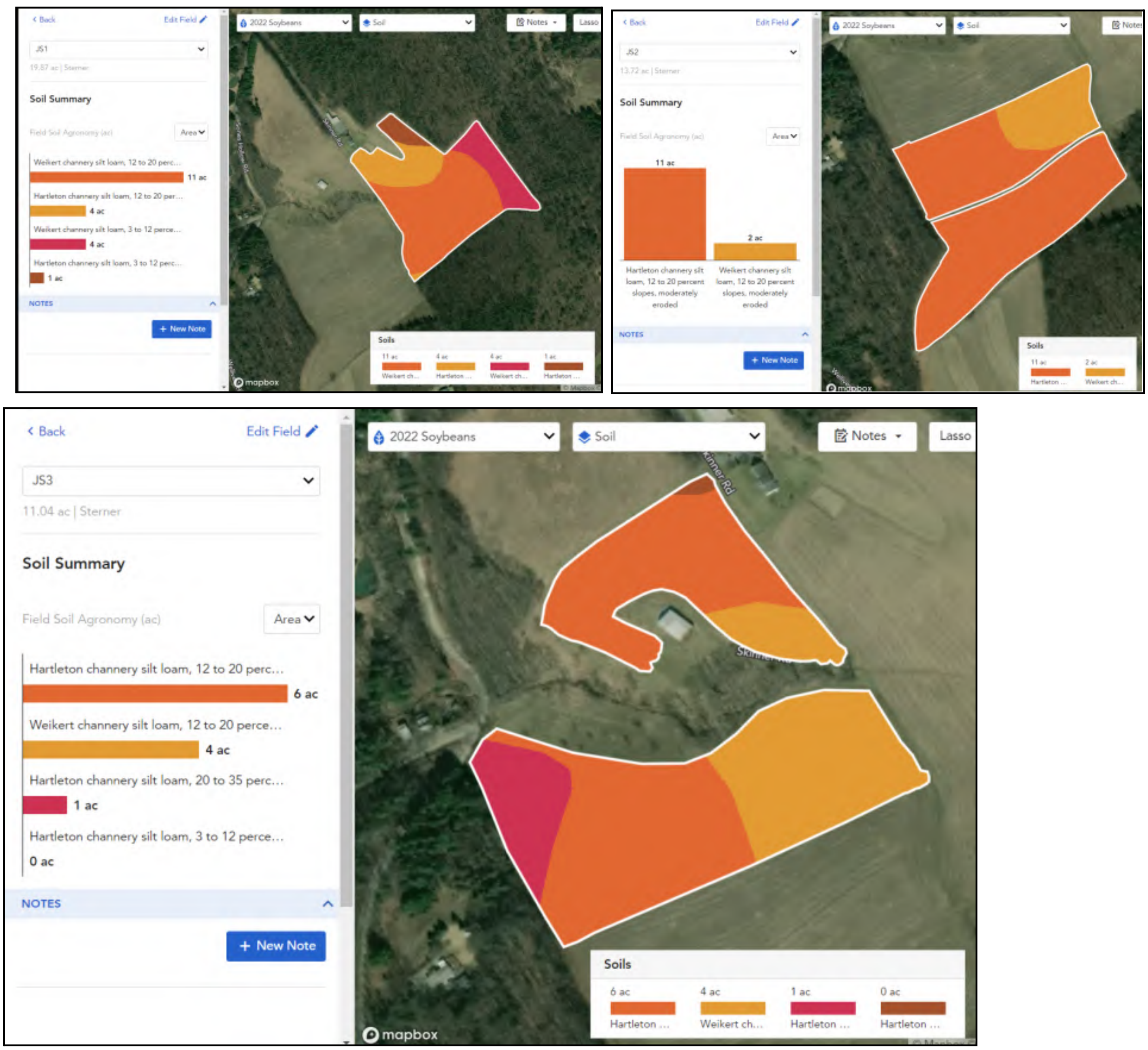
The increase of yield by 41 bushels resulted in additional phosphorus removal of 16.4 lbs/acre.

Columbia County Site 1 - 44.63 Acres

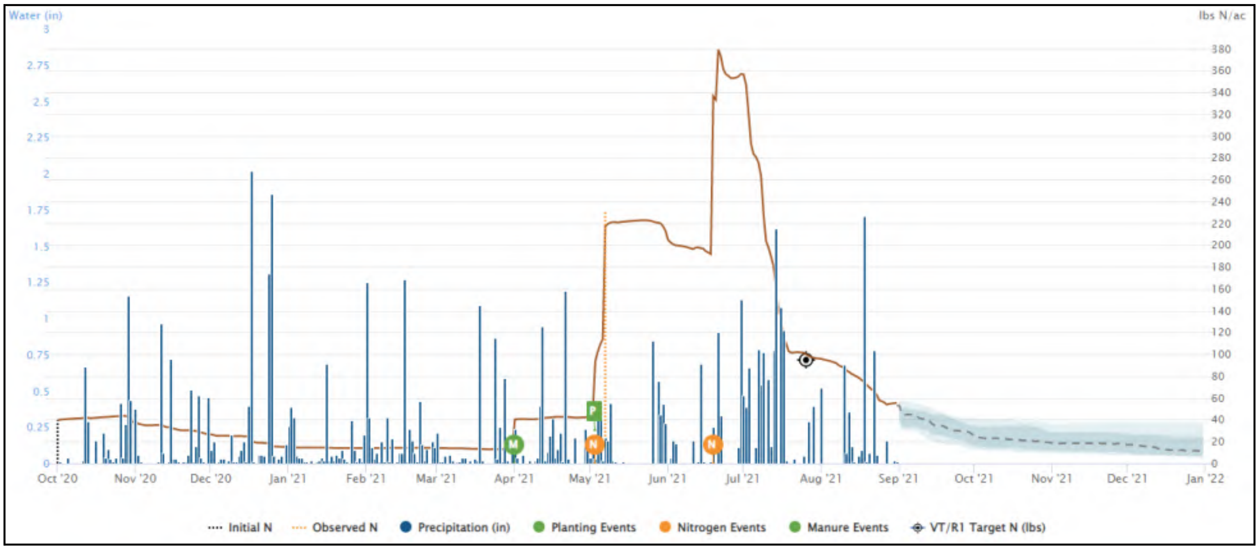
Dominant Soil Types: Weikert Channery Silt Loam, 12 to 20 percent slopes
Hartleton channery silt loam, 12 to 20 percent slopes
Soil Health Practices In Place: Continuous No-Till, Multi-Species Cover Crop, Green Planting

This is a cash grain farm that imports poultry litter to offset phosphorus and potassium needs. They have enough yield data on the farm to develop multi-year analysis yield zones and soil test those yield zones for variable rate fertilizer applications. They implement a 2-3 year rotation that includes multi-species cover crops following wheat and dominant grass covers following corn and soybeans.

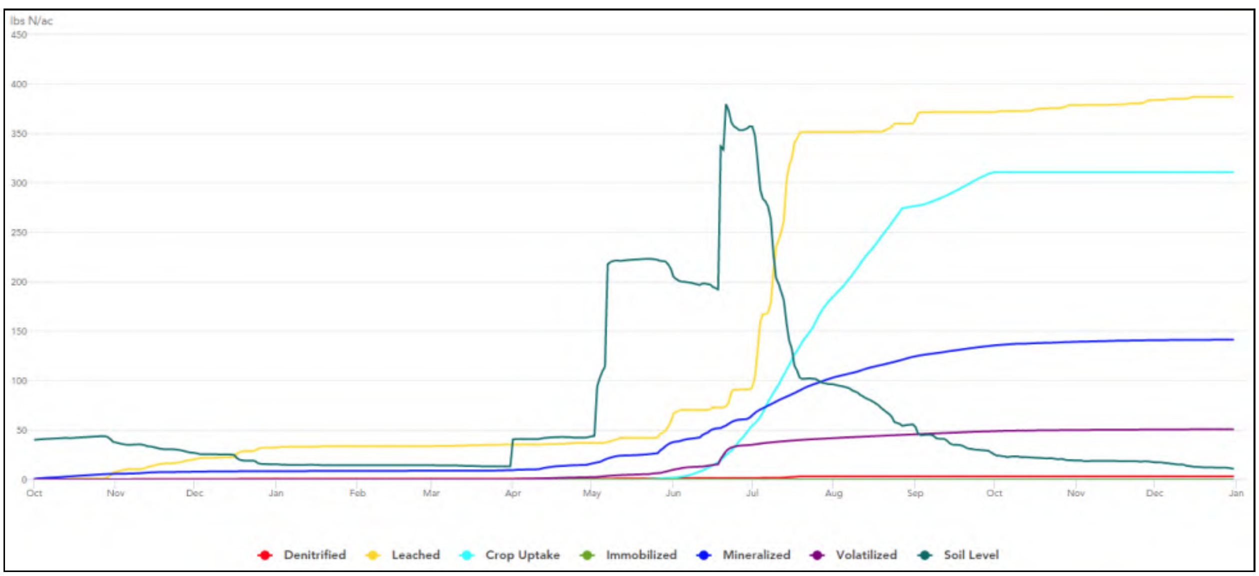
Soils Maps: Columbia County Site 1



Events & Nitrogen Availability: Columbia County Site 1



Nitrogen Loss vs Contribution vs Uptake: Columbia County Site 1



This site was unique in the project for the amount of rainfall received after the initial sidedress application. The initial modeled sidedress recommendation was for 60 lbs to be applied. This application was made on June 23rd. Notice the heavy rainfalls occurring in the field following the sidedress application (top graph), and the corresponding increase in leached nitrate (lower graph). The Granular model calculated around 200 lbs of nitrate leaching per acre! Following the multiple rain events in early July the model recalculated nitrogen needs and prescribed an additional recommendation of 140 lbs to replace the leached nitrogen. The producer did not believe the model and did not have equipment to sidedress tall corn.

Mass Balance vs. the Model: Columbia County Site 1

	Mass Balance	Granular Nitrogen Model
Pre Season Nitrate Soil Test	NA	80 lbs N/ac (Sampled on: 5/7/21)
Yield Goal	220 bu/ac	220 bu/ac
Manure Application	4.5 ton layer manure spring	4.5 ton layer manure 4-21
Available N from manure	98 lbs N/ac	(90) lbs N/ac
Residual Manure N	0 lbs N/ac	0 lbs N/ac
Residual Legume N	30 lbs N/ac*	0 lbs N/ac
At Planting	75 lbs N/ac	75 lbs N/ac 5/8/21
Pop up/in-furrow	0 lbs N/ac	0 lbs N/ac
Pre-Emerge	0 lbs N/ac	0 lbs N/ac
Side-dress	0 lbs N/ac	60 lbs N/ac** 6/23/21
Total Applied N	203 lbs N/ac	215 lbs N/ac
Pre-Harvest Field Measured Yield	185.5 bu/a	205 bu/a
Calculated Nitrogen Use Efficiency	1.09 lbs N/bu	1.05 lbs N/bu
Precip 10/1/2020 - 10/1/2021		58 inches
Precip Planting - 10/1/2021		26 inches

*soybean legume contribution

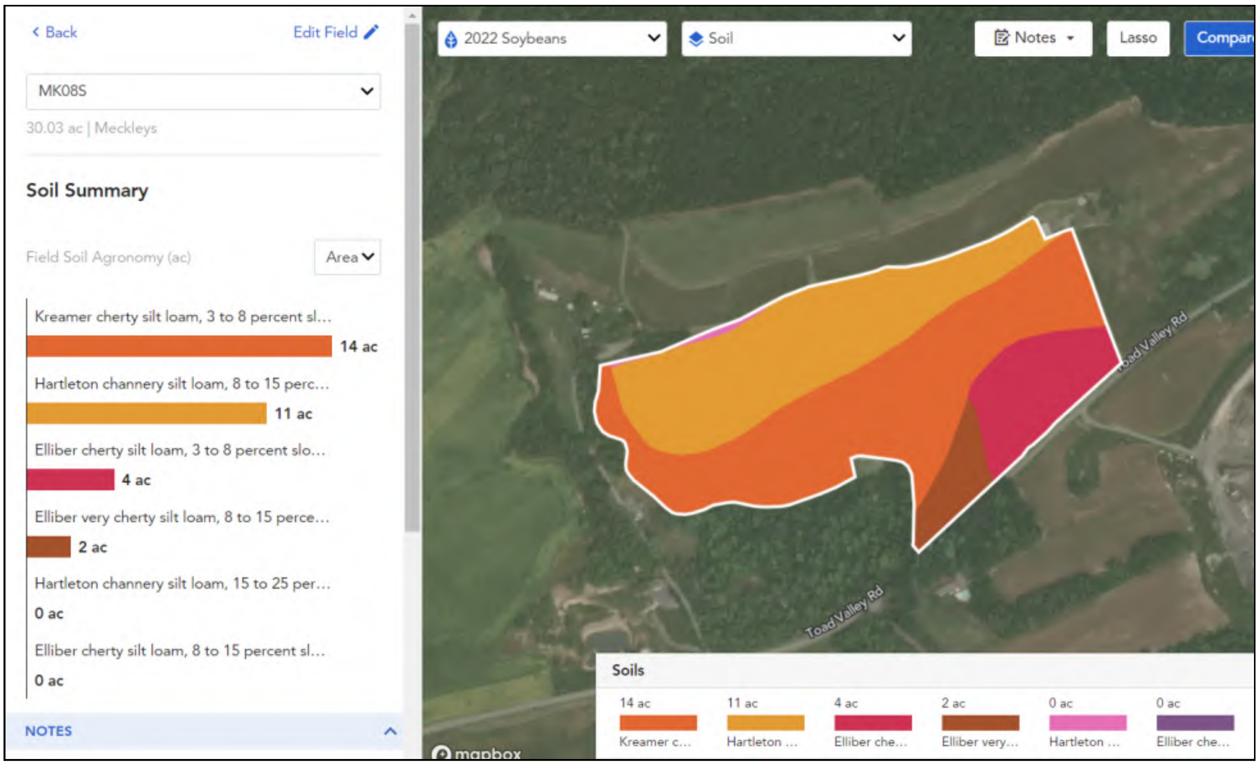
**GCM calculation was for 60+140 lbs of side-dress nitrogen. Producer did not believe the model and only side-dressed 60 lbs

Northumberland County Site 1 - 30.03 Acres

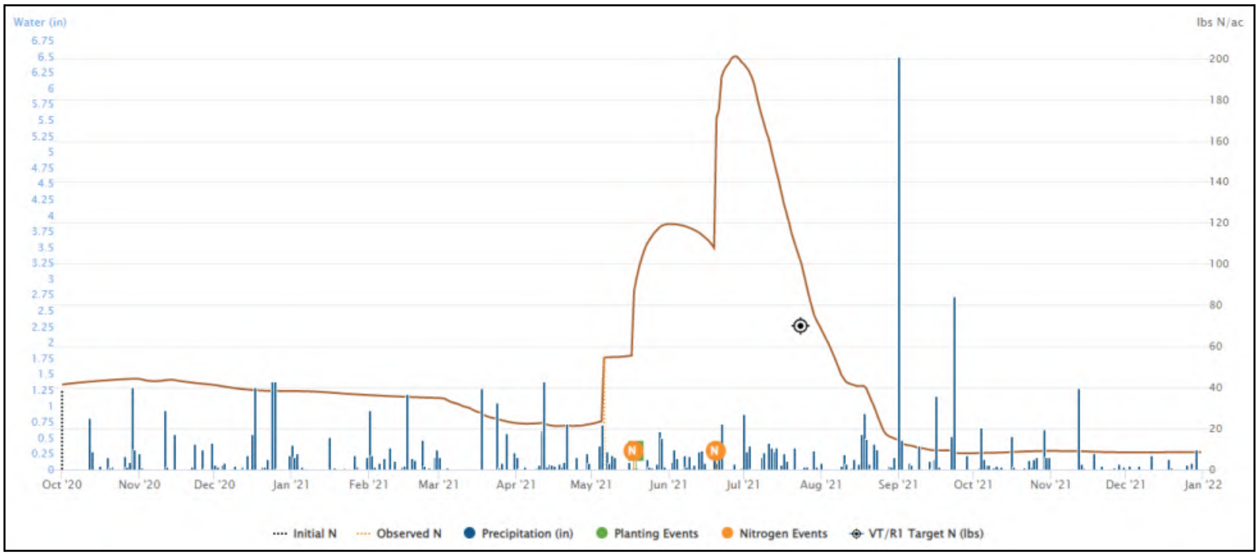
Dominant Soil Types: Kreamer cherty silt loam, 3 to 8 percent slopes
Hartleton channery silt loam, 8 to 15 percent slopes
Soil Health Practices In Place: Continuous No-Till

This farm is a hog farm with an 1,800 acre land base. Manure is applied to this tract to address phosphorus and potassium needs. No manure was applied during the 2021 crop year. The operation implements a 2-3 year rotation of corn, soybeans and wheat.

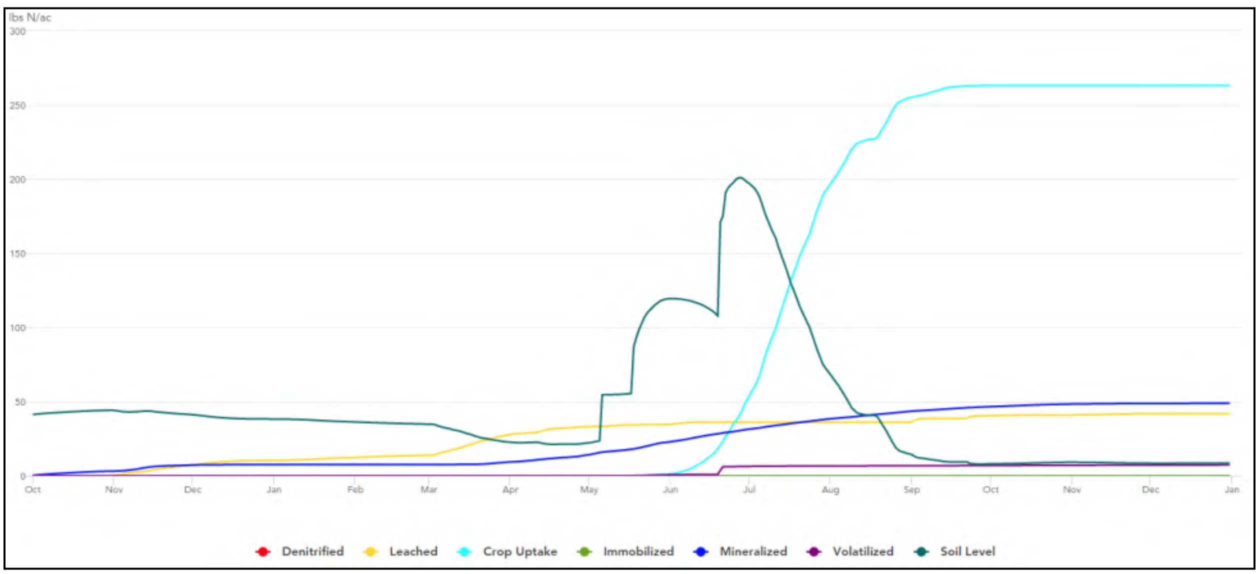
Soils Map: Northumberland County Site 1



Events & Nitrogen Availability: Northumberland County Site 1



Nitrogen Loss vs Contribution vs Uptake: Northumberland County Site 1



Mass Balance vs. the Model: Northumberland County Site 1

	Mass Balance	Granular Nitrogen Model
Pre Season Nitrate	NA	56 lbs N/ac (Sampled on: 5/6/21)
Yield Goal	220 bu/ac	220 bu/ac
Manure Applications		
Available N from manure	0 lbs N/ac	0 lbs N/ac
Residual Manure N	7 lbs N/ac	0 lbs N/ac
Residual Legume N	50 lbs N/ac*	0 lbs N/ac
At Planting	60 lbs N/ac	60 lbs N/ac 5/10/21
Pop up/in-furrow	0 lbs N/ac	0 lbs N/ac
Pre-Emerge	0 lbs N/ac	0 lbs N/ac
Side-dress	100 lbs N/ac	134 lbs N/ac 6/21/21
Total Applied N	217 lbs N/ac	250 lbs N/ac
Pre-Harvest Field Measured Yield	168 bu/a	173 bu/a
Calculated Nitrogen Use Efficiency	1.29 lbs N/bu	1.45 lbs N/bu
Precip 10/1/2020 - 10/1/2021		61 inches
Precip Planting - 10/1/2021		32 inches

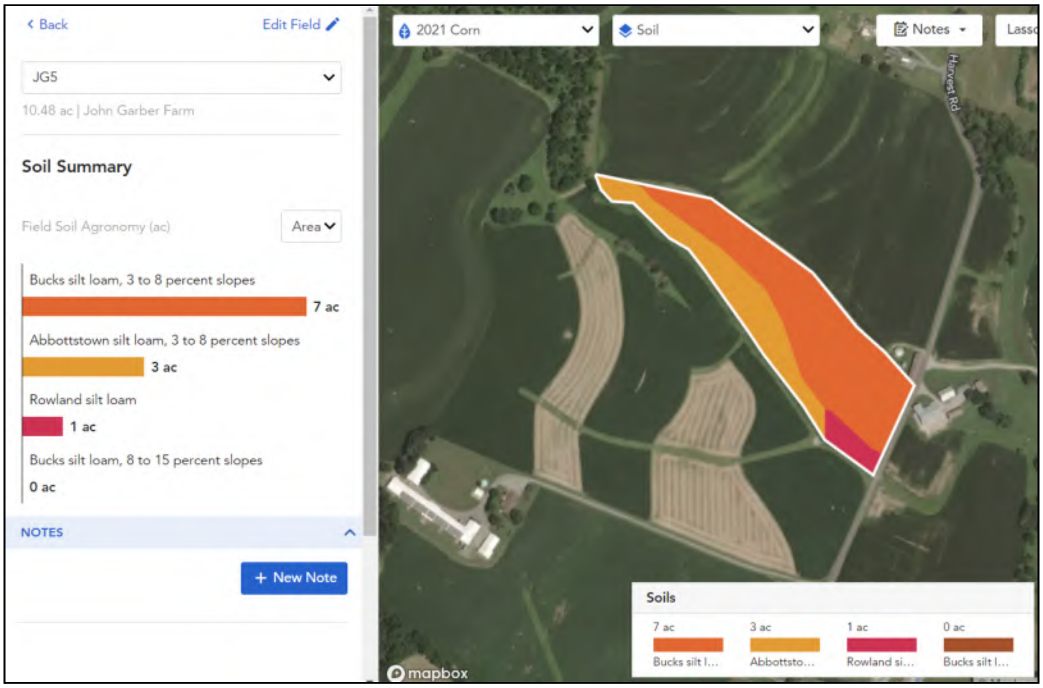
*soybean legume contribution

Lancaster County Site 1 - 10.48 Acres

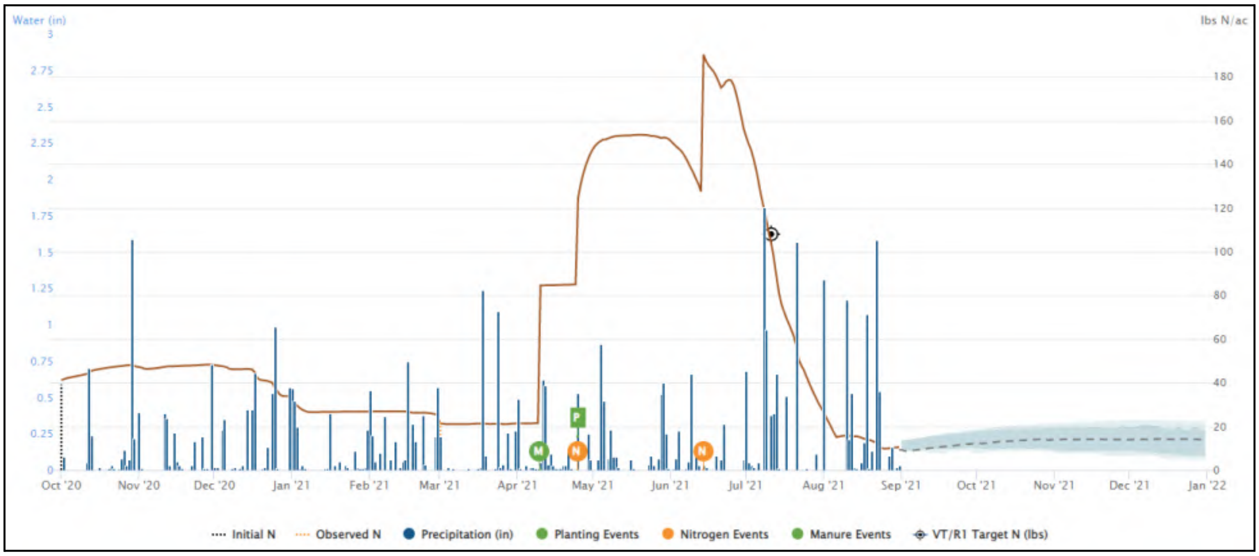
Dominant Soil Type: Bucks silt loam, 3 to 8 percent slopes
Soil Health Practices In Place: Continuous No-till, Cover Crop, Green Planting

This farm is a poultry and hog operation that utilizes the hog manure on site in its 2-3 year rotation of corn, soybean, and wheat. Cover Crops are established after corn and soybeans.

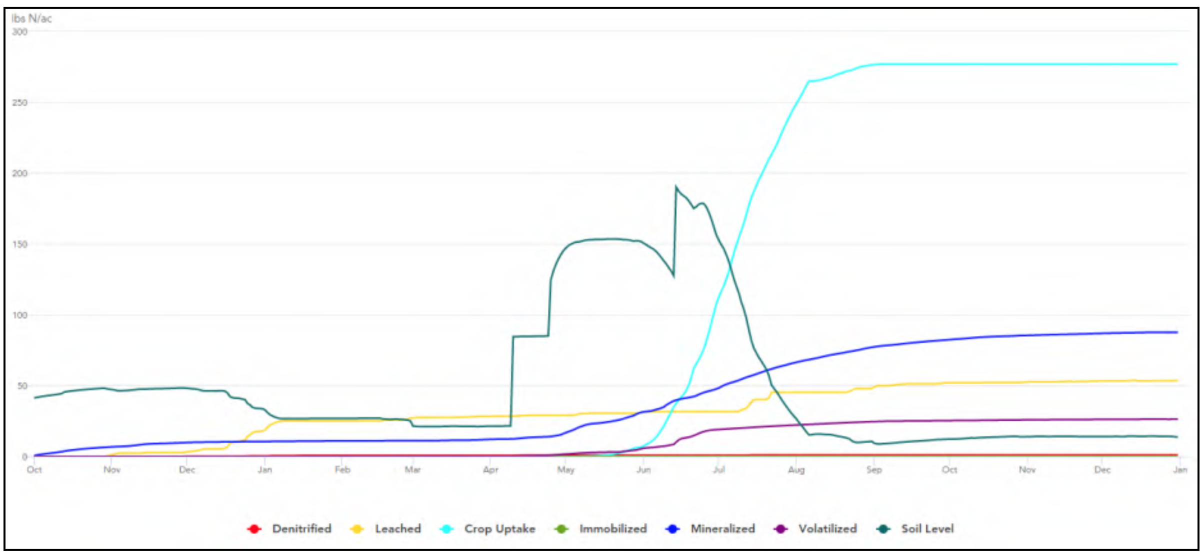
Soils Map: Lancaster County Site 1



Events & Nitrogen Availability: Lancaster County Site 1



Nitrogen Loss vs Contribution vs Uptake: Lancaster County Site 1



This site is the "Small Grain Vegetative" scenario presented in Part B of the report. See picture (at right) of the cover crop. The model is calculating leaching losses in the December timeframe that probably assume no cover crop is present. July leaching correlates to July rainfall events.

Mass Balance vs. the Model: Lancaster County Site 1

	Mass Balance	Granular Nitrogen Model
Pre Season Nitrate Soil Test	NA	32 lbs N/ac Sampled on: 4/30/21
Yield Goal	220 bu/ac	220 bu/ac
Manure Application	4000 gal hog surface applied spring	4000 gal hog surface applied 4/10/21
Available N from manure	74 lbs N/ac	(72) lbs N/ac
Residual Manure N	20 lbs N/ac	0 lbs N/ac
Residual Legume N	45 lbs N/ac*	0 lbs N/ac
At Planting	60 lbs N/ac	60 lbs N/ac 4/29/21
Pop up/in-furrow	0 lbs N/ac	0 lbs N/ac
Pre-Emerge	0 lbs N/ac	0 lbs N/ac
Side-dress	30 lbs N/ac	60 lbs N/ac 6/14/21
Total Applied N	229 lbs N/ac	152 lbs N/ac
Pre-Harvest Field Measured Yield	212 bu/a	221 bu/a
Calculated Nitrogen Use Efficiency	1.08 lbs N/bu	0.68 lbs N/bu
Precip 10/1/2020 - 10/1/2021		48 inches
Precip Planting - 10/1/2021		24 inches

*soybean legume contribution

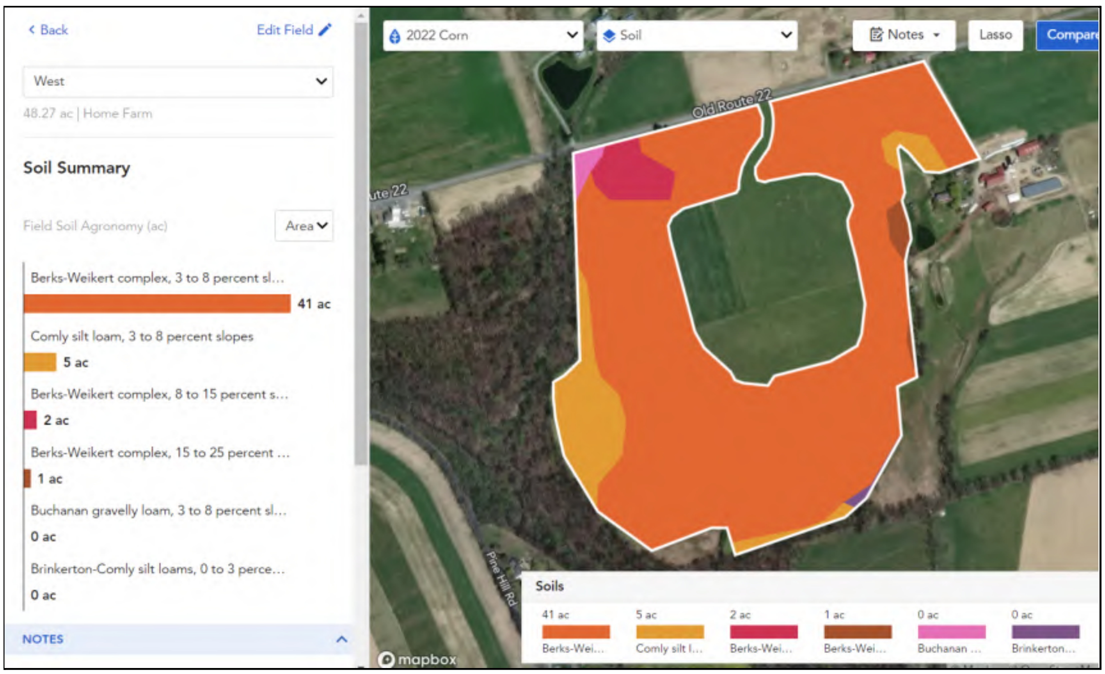
This site has done extensive cover cropping for many years. The pre-season soil nitrate sample results were lower than expected, and overall recommended nitrogen applications were lower with the model compared to the mass balance calculation. A yield response to increased sidedress rates indicates that immobilization was an issue in the cover cropped field. The lower overall nitrogen rate indicates that the model underestimated mineralized nitrogen for the site.

Berks County Site 3 - 48.27 Acres

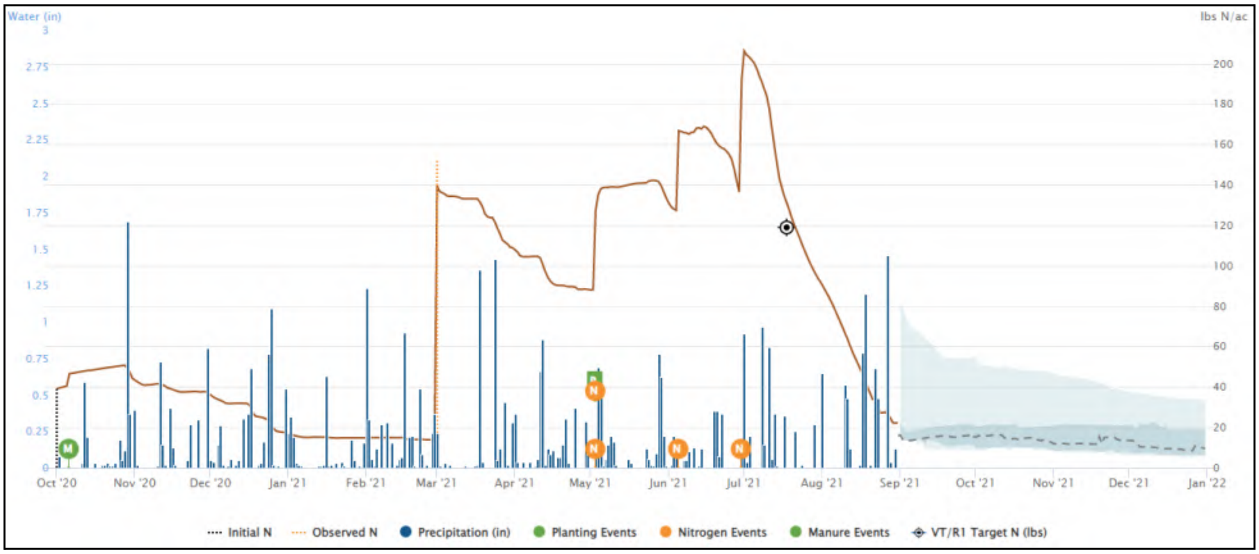
Dominant Soil Type: Berks-Weikert complex, 3 to 8 percent slopes
Soil Health Practices In Place: Continuous No-Till, Cover Crop

This is a cattle and poultry operation that utilizes a 2-year rotation of corn followed by small grain silage & soybeans. Cover crops are established after soybeans and manure is applied for most crops. The operation makes multiple passes across the field to “spoon feed” nutrients and has regularly achieved corn yields in excess of 275 bu/A over the past few years.

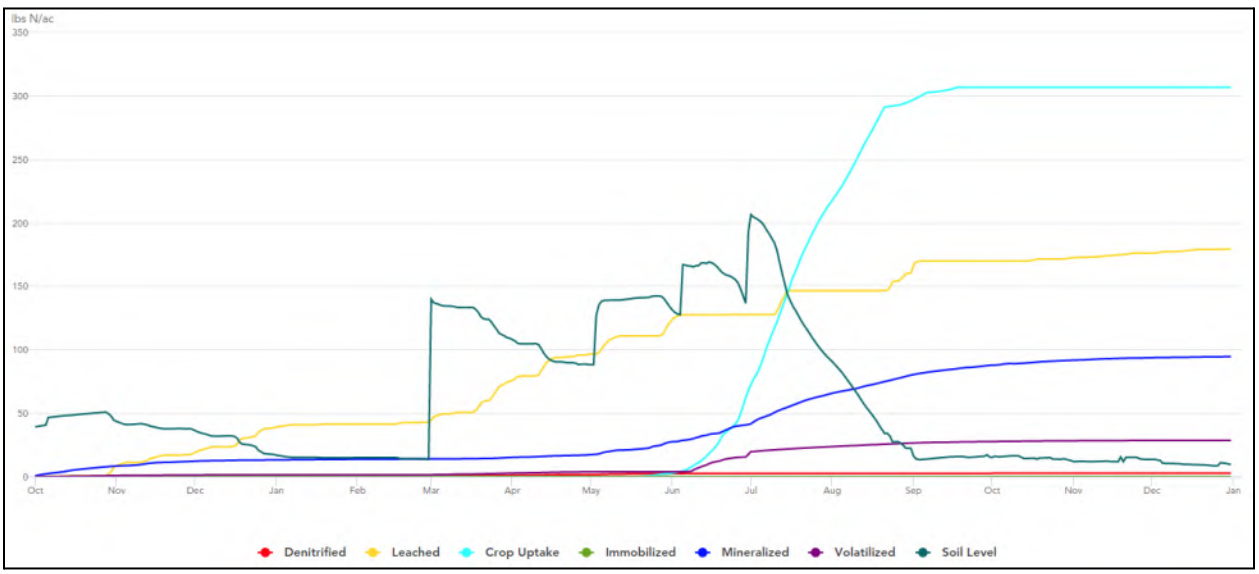
Soils Map: Berks County Site 3



Events & Nitrogen Availability: Berks County Site 3



Nitrogen Loss vs Contribution vs Uptake: Berks County Site 3



Notice the leaching losses in this field - they occur in early spring and throughout the early part of the growing season on a shaly soil with above average drainage. Multiple side-dress applications helped to overcome yield loss due to late season nitrogen deficiency.

Mass Balance vs. the Model: Berks County Site 3

	Mass Balance	**Granular Nitrogen Model**
Pre Season Nitrate Soil Test	NA	152 lbs N/ac (Sampled on: 3/1/21)
Yield Goal	275 bu/ac	275 bu/ac
Manure Applications	7000 gal heifer slurry early fall	7000 gal heifer slurry 10/1/21
Available N from manure	30 lbs N/ac	(9) lbs N/ac
Residual Manure N	24 lbs N/ac	0 lbs N/ac
Residual Legume N	55 lbs N/ac*	0 lbs N/ac
At Planting	60 lbs N/ac	60 lbs N/ac 5/1/21
Pop up/in-furrow	1 lbs N/ac	1 lbs N/ac 5/1/21
Pre-Emerge	0 lbs N/ac	0 lbs N/ac
Side-dress	110 lbs N/ac	60 + 60 lbs N/ac 6/5/21 + 6/29/21
Total Applied N	280 lbs N/ac	333 lbs N/ac
Pre-Harvest Field Measured Yield	218 bu/a	272 bu/a
Calculated Nitrogen Use Efficiency	1.28 lbs N/bu	1.22 lbs N/bu
Precip 10/1/2020 - 10/1/2021		49 inches
Precip Planting - 10/1/2021		22 inches

*soybean legume contribution

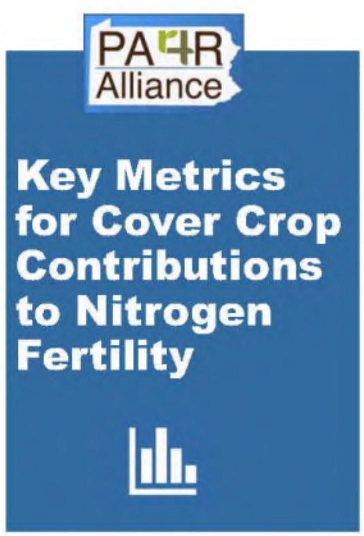
The soil nitrate sample was very high for this site, indicating a large reserve of convertible soil nitrogen present in the field. This matches with the high levels of calculated leaching for the field even though fertilizer applications were not excessive and stabilizers were used in each application. The site responded to late season nitrogen applications to provide additional nitrogen during the grain fill period.

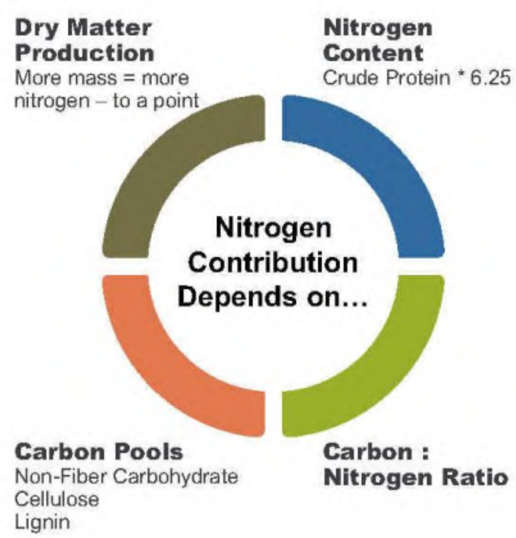
Part B: Cover Crop Quantification

The Use of Crop Models to predict Cover Crop Contributions to Nitrogen Fertility

Methodology for this CIG project included measuring both cover crop and soil parameters useful for quantifying soil health contributions to fertility. Fourteen of the participating farms implemented continuous no-till + annual unharvested cover crop, allowing direct measurements of cover crop characteristics and site specific modeling of nitrogen mineralization from the cover crop. Twenty fields were chosen from the 14 cooperators. Locations within each field were determined using remote sensing plant health imagery. Cover crop biomass was hand harvested & weighed, while nutrient concentration as well as forage characteristics were measured through lab analysis. Collected information was then entered into the Granular Crop Model and modeled using site specific soil & site specific weather data. The average nitrogen contribution of the mineralized cover crop was calculated.

Cover crop contributions to nitrogen fertility will be site specific, influenced by manure & fertilizer management, soil type, precipitation, accumulated growing degree days prior to termination, planting date, seeding rate and species selection. While higher biomass generally produces more nitrogen, availability of nitrogen is closely tied to the carbon pools present in the biomass and the overall carbon:nitrogen ratio. Covers with high non-fiber carbohydrates will cycle nitrogen quicker than covers with high lignin. Farm management of cover crops is highly influential in determining nitrogen contributions.





Most fields measured in this project fit into the following categories – small grain terminated in vegetative stage, small grain terminated after heading, multi-species dominant legume, multi-species dominant grass. There were a handful of sites planted more than one month past the optimal planting date for the chosen cover crop species and were considered a separate "later planting" category. Examples of each category are presented below.

Nutrient Uptake by Cover Crops in Selected Sites

Measured nutrient uptake from participating sites. Total uptake was calculated by in-field measurements of biomass production and lab analysis of collected biomass. All numbers are reported in lbs/acre.

Operation/Farm/Field	Nitrogen	Phosphorus (P_2O_5)	Potassium (K_2O)	Calcium	Magnesium
Small Grain Vegetative (Lancaster County)	118.2	56.8	233.4	12.9	6.5
Small Grain Heading (Adams County)	118.3	44.1	236.3	13	4.2
Small Grain Late Planting (Franklin County)	26.5	10.2	56.3	5.2	1.4
Multi-Species Dominant Grass (Cumberland County)	164.7	54.5	274.1	42.4	10.3
Multi Species Dominant Legume (Columbia County)	105.5	31.3	140.2	30.1	9
Multi Species Late Planting (Northumberland County)	53	12.7	64.1	4.5	1.7

It is important to remember that total nitrogen uptake does not equal total nitrogen availability. Availability of cover crop generated nitrogen will be based on cover crop carbon pools, soil moisture, soil temperature, soil microbial activity, and time. Also, mineralized nitrogen from cover crops are exposed to many of the same nitrogen loss pathways as fertilizer and manure - leaching, immobilization, denitrification, etc..

Simulated Mineralization from Above Ground Cover Crop Biomass

Cover Crop nitrogen mineralization simulated using the Granular Crop Model. Values were generated using site specific soils data + site specific weather data. The numbers below are the calculated average annual contribution over that period. Forage analysis details: DM=Dry Matter, N=Nitrogen, NFC=Non-Fiber Carbohydrate, CP=Crude Protein.

Operation/Farm/Field	Total Biomass (lbs/ac)	Forage Analysis Details	Nitrogen mineralized from cover crop by:		
			Tassel Emergence	Black Layer	End of Year
Small Grain Vegetative (Lancaster County)	4,959	High N High NFC	42.7	52.6	58.8
Small Grain Heading (Adams County)	5,206	High N Low NFC	33.2	45	52.4
Small Grain Late Planting (Franklin County)	1,535	Lowest CP	8.3	10.8	12.3
Multi-Species Dominant Grass (Cumberland County)	5,171	High DM Low NFC	47.8	63.9	74
Multi Species Dominant Legume (Columbia County)	4,708	High DM High N High NFC	36.8	46.3	52
Multi Species Late Planting (Northumberland County)	2,136	Low DM Low CP High NFC	18.1	22.9	25.8

This chart shows cumulative nitrogen mineralization. The Small Grain Vegetative - Lancaster County site mineralized 42.7 lbs of nitrogen from the above ground portions of the cover crop by tassel emergence. It mineralized another 9.9 lbs of nitrogen between tassel and black layer (total of 52.6 lbs), and another 6.2 lbs of nitrogen between black layer and the end of the calendar year (total of 58.8 lbs). Tassel emergence and black layer are two important growth stages in corn development. By tassel, around 75% of the total nitrogen needed by the plant has been taken into the plant. All of the cover crop nitrogen mineralized by this growth stage can contribute to corn yield. Between tassel and black layer corn plants slowly lose the ability to uptake nitrogen as the plant cannabilizes biomass (including roots) to transfer carbohydrate into grain. When the plant achieves black layer, carbohydrate transfer to grain stops and no additional nitrogen from the soil will contribute to yield. Cover crop nitrogen mineralized between tassel and black layer may partially contribute to yield. Any cover crop nitrogen mineralized after black layer has no contribution to yield. The Small Grain Vegetative - Lancaster County site averages 42.7 lbs of nitrogen per acre that can directly contribute to corn fertility and 16.1 lbs per acre that may mineralize too late for direct contribution to yield. This 16.1 lbs per acre has the same risk of leaching as over-applied fertilizer or manure if a cover crop is not established again after corn harvest.

Modeling Cover Crop Outcomes

The Granular Agronomy Nitrogen Service is constantly being updated with new features and functionality. The results from the CIG participants, as well as sites throughout the country, resulted in some changes in the Granular Nitrogen Modeling platform's ability to provide cover crop data. Here are some results from pre-release testing of a new version of the Granular Crop Model (V4.0.5) that highlight the potential benefits the new functionality can bring.

This exercise uses the "Small Grain Vegetative - Lancaster County" site as an example, using typical practices performed there, including manure and cover crops. The new model version allows for simulation of cover crop development and termination along with the regular corn crop. These features are expected to be released to the software for the 2022-23 growing season.

Example Field: Small Grain Vegetative - Lancaster County
Weather History: 2021-2022 weather through May 26, 2022, then 8 days forecast, then 2021 weather for the balance until December 31, 2022.
Soil Type: Lansdale loam, 3 to 8 percent slopes
Previous Crop: Corn, 160-200 bu/ac range, harvested on October 10, 2022
Tillage: No-Till
Seed & Fertilizer Applications:

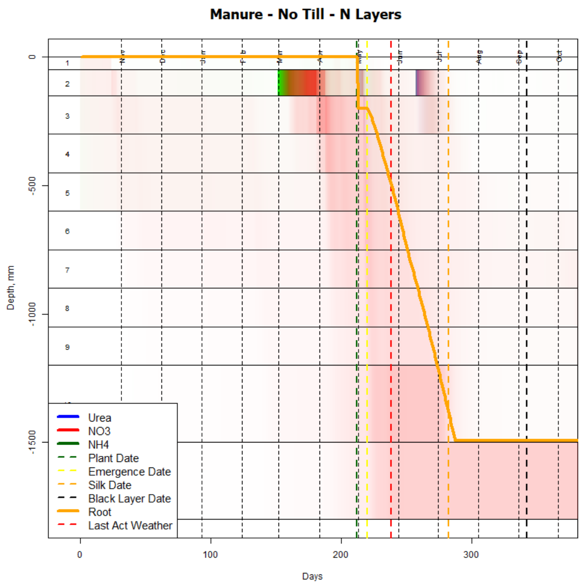
- 3000 gallons/ac of hog manure applied on March 1, 2022, injected at 4" depth, with an estimated 125 lbs N/ac of inorganic nitrogen and ~20 lbs N/ac as mineralizable organic nitrogen.
- 30 lbs N/ac as UAN injected at 4" depth on May 1, 2022 with no stabilizer. Corn is planted the same day - Pioneer P1185AM is planted at 32,000 seeds per acre.
- 90 lbs N/ac as UAN injected at 4" depth on June 15, 2022 with no stabilizer.

Variables

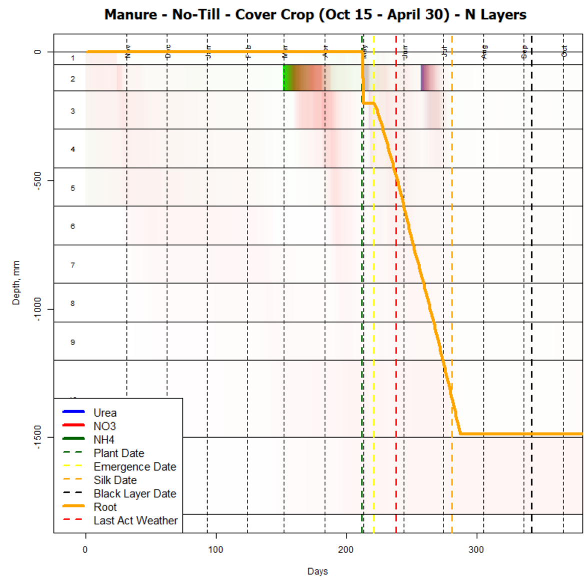
1. No Cover Crop
2. Cover Crop of cereal rye drilled on October 15, 2021, terminated on April 30, 2022
3. Cover Crop of cereal rye drilled on October 15, 2021, terminated on April 15, 2022
4. Cover Crop of cereal rye drilled on November 15, 2021, terminated on April 30, 2022

Nitrogen Forms & Concentration across Time and Soil Depth

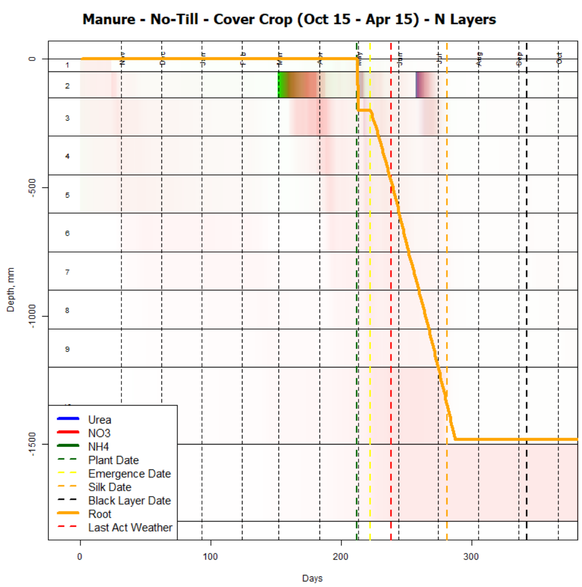
No Cover Crop



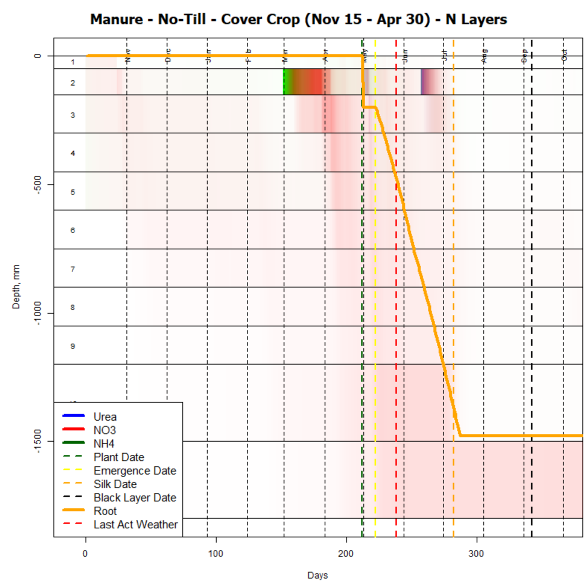
October 15 / April 30 Cover Crop



October 15 / April 15 Cover Crop



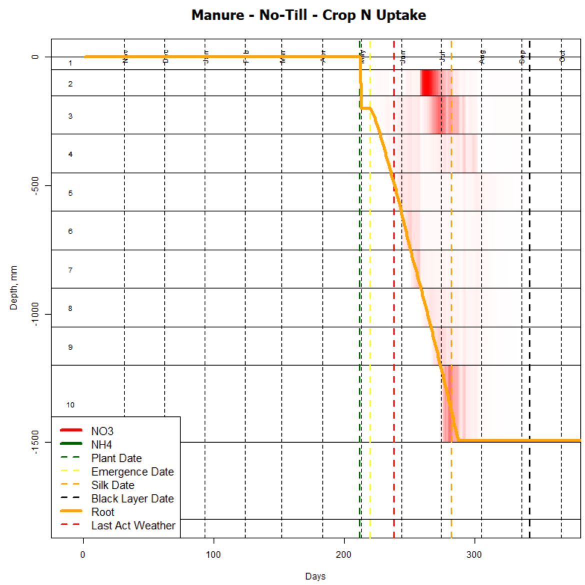
November 15 / April 30 Cover Crop



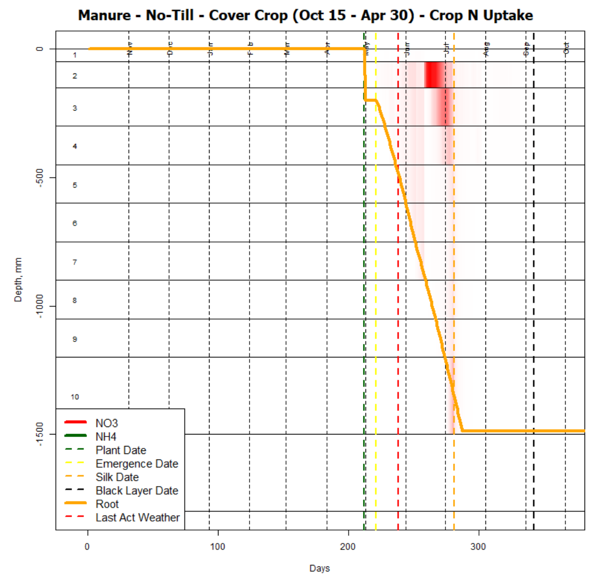
These graphs illustrate that without cover crops, nitrogen from the manure is quickly converted from ammonium to nitrate and starts to leach downward, with some of it residing just below the final rooting depth of the crop (orange line). With early seeded cover crops, nitrogen is captured before leaching, but delaying seeding of fall cover crops still allows nitrogen to leach into lower levels, similar to that of no cover crops.

Corn Crop Nitrogen Uptake across Time and Soil Depth

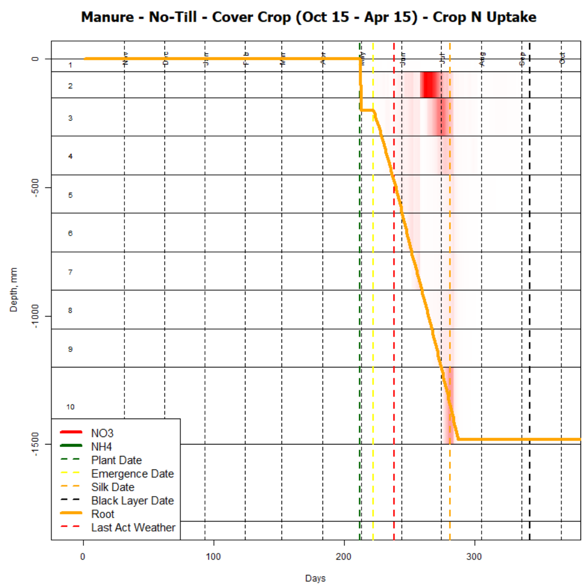
No Cover Crop



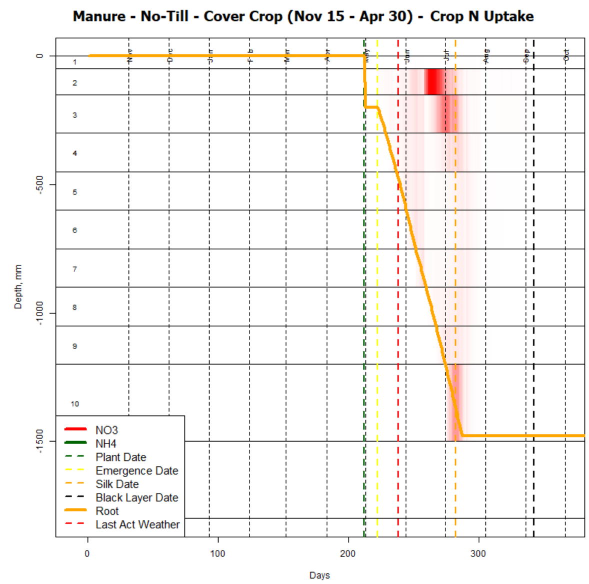
Cover Crop October 15 / April 30



Cover Crop October 15 / April 15



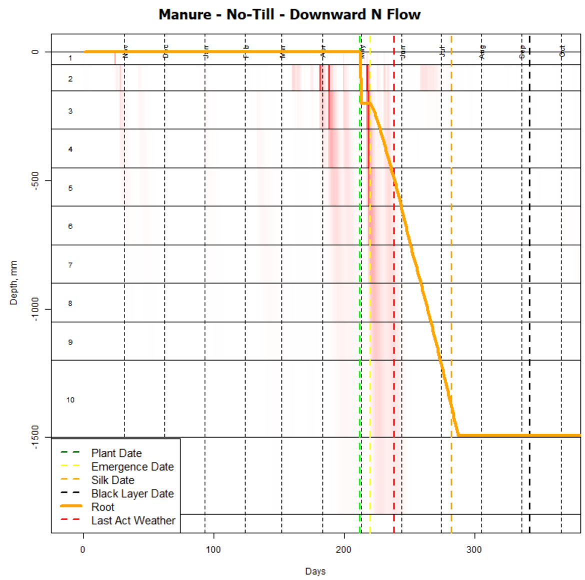
Cover Crop November 15 / April 30



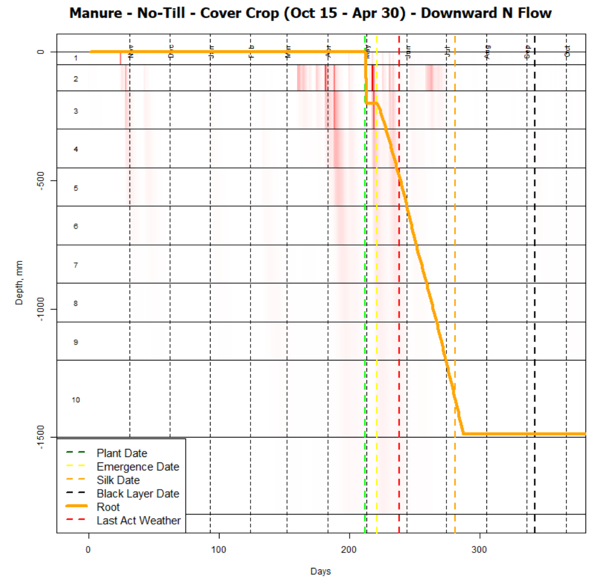
These graphs further show how the corn crop takes up nitrogen at various depths. Without cover crops (left) nitrogen is taken up across a wider range of depths, including at layer 10 (4 to 5 feet deep). With cover crops, crop N uptake is more focused on layers 2 and 3 (2 to 12 inches). Less nitrogen is exposed to loss with the rye cover crop.

Downward Nitrate Flow (Leaching) across Time and Soil Depth

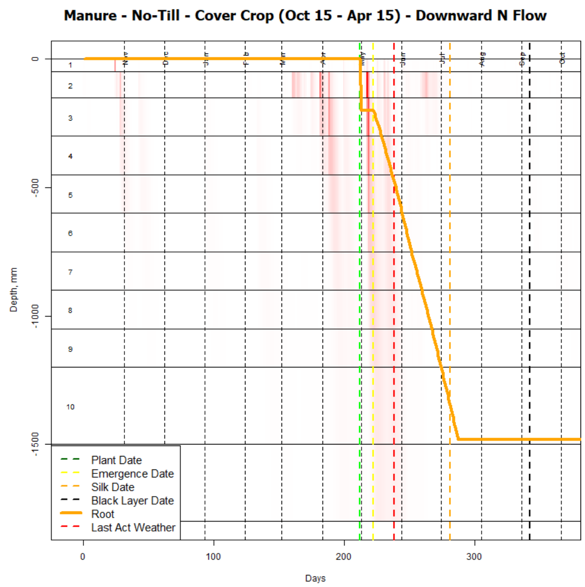
No Cover Crop



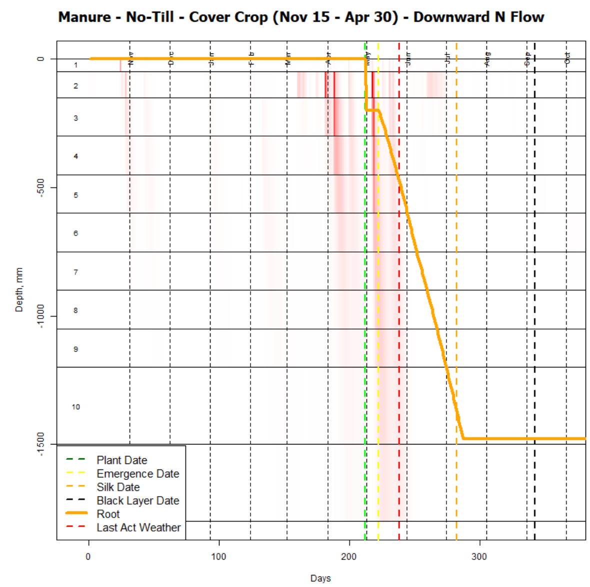
Cover Crop October 15 / April 30



Cover Crop October 15 / April 15



Cover Crop November 15 / April 30

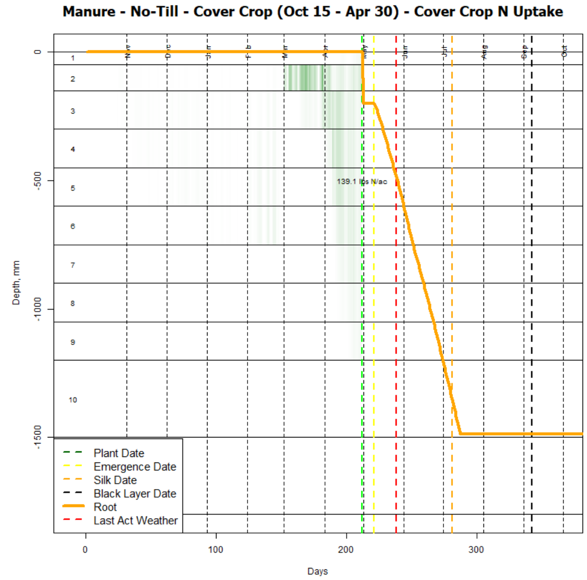


These graphs show the intensity of downward nitrogen flow based on treatment. Where no cover crop exists there is substantial downward nitrogen flow as nitrate, but with cover crops initiated in October and terminated in April there is significant reduction in downward nitrogen flow.

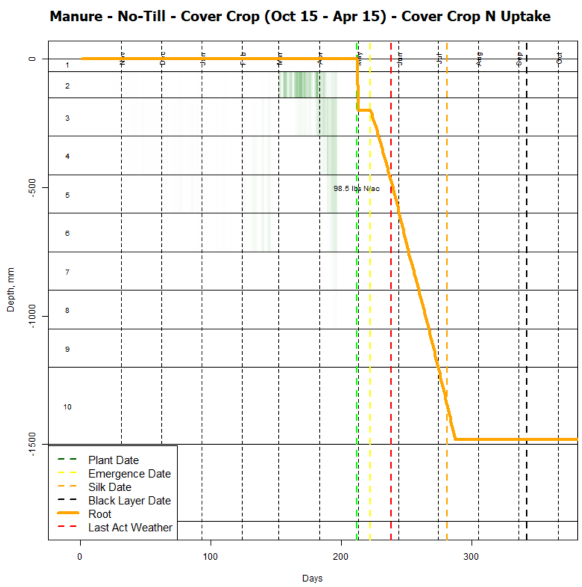
Cover Crop Dynamics - Nitrogen Uptake

No Cover Crop

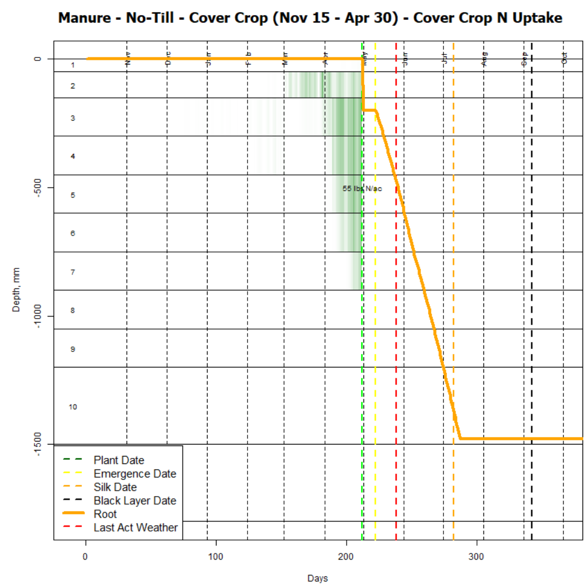
Cover Crop October 15 / April 30



Cover Crop October 15 / April 15



Cover Crop November 15 / April 30

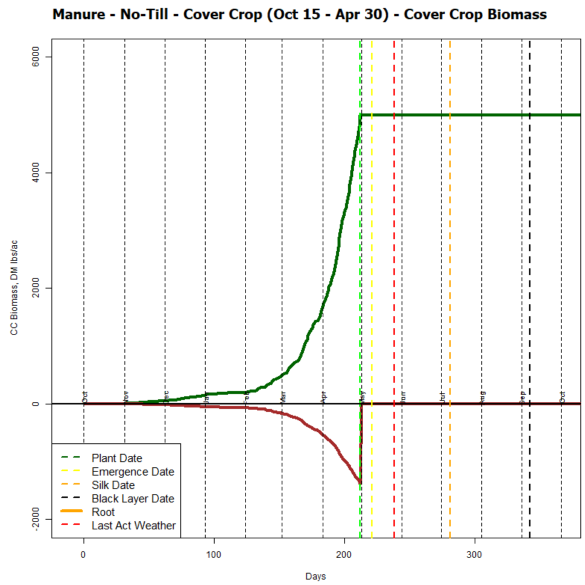


With early seeding and late termination, the model output shows that a large amount of nitrogen can be captured and taken up by the cover crops. With earlier termination, a reduction of about 40 lbs N/ac for 15 days is experienced. For later seeding and termination, however, nitrogen uptake is reduced and highly concentrated in April.

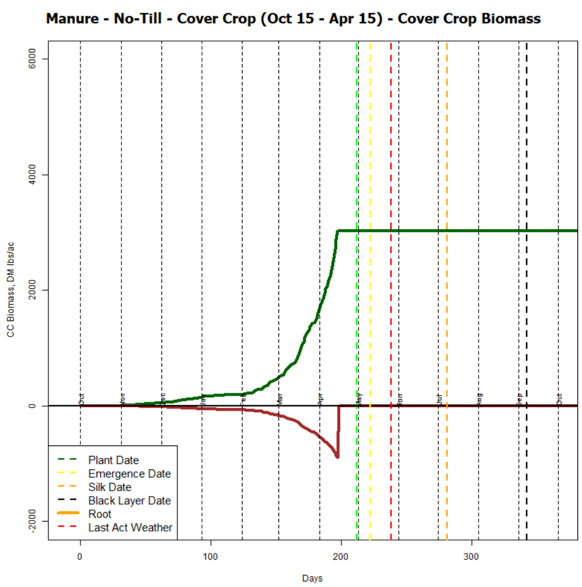
Cover Crop Dynamics - Biomass Development

No Cover Crop

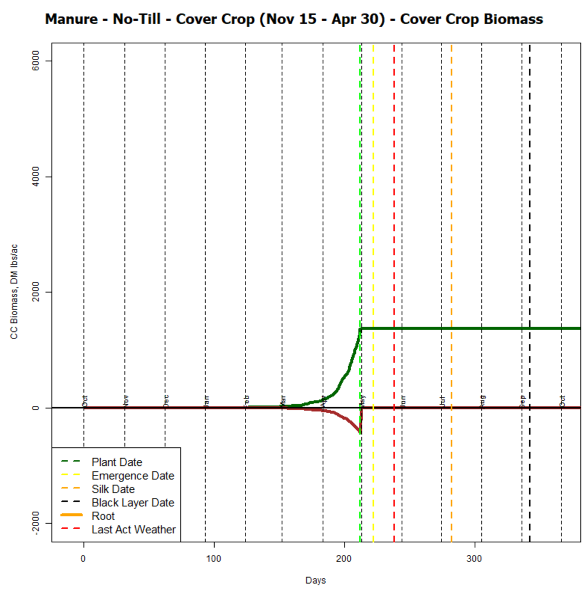
Cover Crop October 15 / April 30



Cover Crop October 15 / April 15



Cover Crop November 15 / April 30



Allowing the early seeded cover crop to grow right up until planting allowed for around 5,000 lbs/ac dry matter of above ground biomass to develop. Terminating it 15 days earlier allowed for 3,000 lbs/ac dry matter of development. Seeding and terminating later reduced the above ground biomass to less than 1,400 lbs/ac dry matter.

This illustrates how the crop model can be used to simulate different management strategies and the potential outcomes of them, including environmental ones.

Simulated Metrics	**No Cover Crop**	**October 15 / April 30 CC**	**October 15 / April 15 CC**	**November 15 / April 30 CC**
Yield, bu/ac	202.0	180.8	193.6	201.4
Plant N Uptake, lbs/ac	218.0	166.2	180.5	202.3
N leaching below 3 feet, lbs/ac	140.6	50.8	78.6	106.2
N leaching below 6 feet, lbs/ac	60.8	27.8	42.6	53.4
CC Biomass, above ground, DM lbs/ac	—	4,995	3,033	1,373
CC Biomass, below ground, DM lbs/ac		1,392	900	432
CC Nitrogen Uptake, lbs/ac		139	98.5	55

A goal of utilizing cover crops and terminating them at the proper time is to A) keep free nitrates from leaching and B) increasing the nitrogen (and potentially phosphorus) nutrient uptake upon mineralization of the cover crop. As seen here, moving the termination date of early seeded rye cover crop from April 30 back to April 15, in this simulation, increased yield by 14 bu/ac and crop N uptake by 14 lbs N/ac. Cover crop biomass was reduced by about 2,000 lbs/ac dry matter and cover crop N uptake by 41 lbs N/ac.

These simulations are examples of how a farmer, along with a trusted advisor, can utilize this modeling technology to simulate different management strategies with cover crops in order to maximize key metrics, whether they be yield, nutrient uptake, or reduction of nitrogen loss via leaching. Each field and year will be different, but by using these tools one should be able to dial in practices that work well generally across years and then dial in for particular years as they develop.

Using the same input values as before, but utilizing an Economic Optimum Nitrogen Rate (EONR) solver routine with the Granular Crop Model along with 20 years of prior weather history instead of the 2021 weather data, optimum nitrogen rates were determined for the June 15 application of UAN. Each year's weather was simulated individually, with the EONR of each determined. Then, an overall EONR rate was determined by selecting the median rate from among the 20 different outcomes.

$8.00 per bushel of corn and $1.00 per pound of N were used in the solving algorithm. This "solver" is currently being evaluated for inclusion not yet implemented into the Granular Nitrogen Management software.

Simulated Metrics	**No Cover Crop**	**October 15 / April 30 CC**	**October 15 / April 15 CC**	**November 15 / April 30 CC**
Economic Optimum Nitrogen Rate, lbs/ac	40	105	95	55
Median Crop N uptake, lbs N/ac	196.7	195.6	198.6	195.7

To achieve economic optimum yields with a full season of cover crops terminated on April 30, an additional 65 pounds of nitrogen was found to be required at late-vegetative side dressing vs no cover crop. This was reduced to 55 lbs N/ac of additional N required for early terminated cover crop, and only 15 lbs N/ac more for late seeded cover crops. This illustrates the balance that is required when using cover crops to capture free nitrogen and then release it in time for the crop to use it or apply more nitrogen than without the cover crop.

Part C: Project Review

The results of this project showed that the Granular Agronomy Nitrogen Service (GANS) product can perform at the same level as a mass balance calculation for provided farms with a recommended rate of nitrogen fertilizer to achieve the desired yield goal. This can be confirmed by a comparison of the end-of-year nitrogen use efficiency (NUE) numbers generated by each method.

The crop model also provided for new opportunities for in-field nitrogen management

1. Accounting for measured soil nitrate levels in the soil. Soil nitrate tests are not new, but the ability to incorporate a pre-season soil nitrate test into the model allowed for soil supplied nitrogen to be quantified. It was also a unique opportunity to talk to participants about soil health & historic management contributions to nitrogen fertility. Pre-season soil nitrate levels varied greatly among participants and were very site specific. It was generally higher on dairy farms with a long history of manure application.
2. Quantification of in-season nitrogen loss. Nitrogen loss occurs throughout the year and can be equally impactful on manure nitrogen, fertilizer nitrogen, and soil supplied nitrogen. Current mass balance calculations account for a certain amount of nitrogen loss from manure and soil supply sources, but fail to account for losses occurring from fertilizer sources. Furthermore, mass balance calculations are unable to identify the timing of nitrogen losses and calculate whether nitrogen losses will result in yield loss. The ability of the GANS product to quantify nitrogen loss by pathway and time was helpful for visually showing participants which loss pathways were active in their fields. It allowed for discussion on manure and fertilizer management changes that can reduce overall nitrogen loss. On occasion, the model was able to identify yield limiting N loss in time for participants to take action through a late season sidedress application.

Recommendations for using nitrogen modeling in cost share and regulatory programs.
Nitrogen modeling through a comprehensive product like Granular Agronomy is a viable option for farms to show that planned nitrogen applications meet guidelines and criteria for cost share & regulatory programs focused on improving water quality. Farms will still need to show compliance with phosphorus regulations and soil conservation plan requirements. There are a few items that should be considered when incorporating nitrogen models into water quality programs.

1. Farms should work with an individual trained in both the modeling program and state nutrient management regulations. This is important for ensuring the quality of model outcomes through program/regulation accepted background data and inputs. In PA, the models should be run by individuals that hold state nutrient management planner certifications and can provide proof that they have completed training for the modeling product that will be used.
2. Cost share & regulatory programs should stipulate that field-specific data be used. Pre-season nitrate samples, actual manure analysis, presentation of all applications and accurate application dates are all important for the quality of model outcomes.
    a. Participating farms may want to use modeling platforms for generating variable rate nitrogen prescriptions. Decision zone development processes for variable

rate nitrogen should include multi-year yield analysis. The use of decision zones should also be consistent with other regulatory criteria, including the use of Phosphorus Index tools and soil testing.

3. Reporting and verification of data. Current cost share & regulatory frameworks have successful methods of oversight through plan review and recordkeeping review processes. Farms using a nitrogen model will need to work with the product designers to ensure enough background information on fields can be provided to agencies so agency staff can verify program requirements have been met. The GANS product offers a year-end report that is customizable.

Current Limitations to the Granular Agronomy Nitrogen Service (and what is being done to address them).

The Granular Agronomy Nitrogen Service was developed for use primarily in corn/soybean rotations in the Midwest US, and therefore did not have built into it various features that are found more commonly in the Northeast US. However, these features are being addressed in future versions of the Nitrogen Service.

- **Cover Crops -** Granular has done research and trials into the development, breakdown and release of nitrogen found in cover crops. This project contributed to that knowledge base. As a result, a forthcoming version of the Granular Crop Model (GCM) contains a sub-model that simulates the development, N and water uptake, and release of N upon termination of select cover crops, including both cereals and legumes. Testing is being performed throughout 2022 to validate the simulated effects.
- **Tillage -** Incorporating residue into the soil or leaving it on the surface has different effects on mineralization and return of N to the soil. At present the Granular Agronomy Nitrogen Service assumes a tillage practice will take place on November 1 of the prior season, incorporating 50% of the previous crop's residue to a depth of 6" (150 mm). Efforts are being made to allow a user to specify if and what tillage is performed within the software. These would include dates and tillage type, with typical values of incorporation and depth associated with the tillage type.
- **Prior Manure N Credits -** Currently, the Granular Agronomy Nitrogen Service only considers the mineralized nitrogen from a manure application made in the current growing season. However, it is common in the Northeast to have manure applications from year to year, resulting in residual nitrogen from prior applications becoming mineralized and available in the current year. Additional manure settings are being developed to simulate 2nd and 3rd year manure residual nitrogen for the Granular Agronomy Nitrogen Service.
- **Prior Legume N Credits -** Corn and soybeans are the only two prior crops available in the Granular Agronomy Nitrogen Service currently. However, it is recognized that legume crops like alfalfa and clover are often terminated prior to corn, and those legume crops contribute residual nitrogen that becomes mineralized. Because of this, additional prior crops, like alfalfa, are planned to be included in the Granular Agronomy Nitrogen Service.

4R Nutrient Stewardship focuses on applying the Right Rate of nutrients, at the Right Place & Right Time, using the Right Source to ***maximize nutrient use efficiency*** and ***minimize nutrient loss***. Each "R" is a series of science-based decisions a farm makes when applying manure and/or fertilizer. The Right Place for nutrient uptake will depend on the source being applied, how the nutrient is taken into a plant, and equipment available to the producer. The Right Time for application will vary based on the loss potential of a Source and farm logistics, but is generally as close to plant uptake as possible. The Right Source depends on what the manure a farm produces, and what fertilizer sources their Ag Retailer can provide.

And the Right Rate??

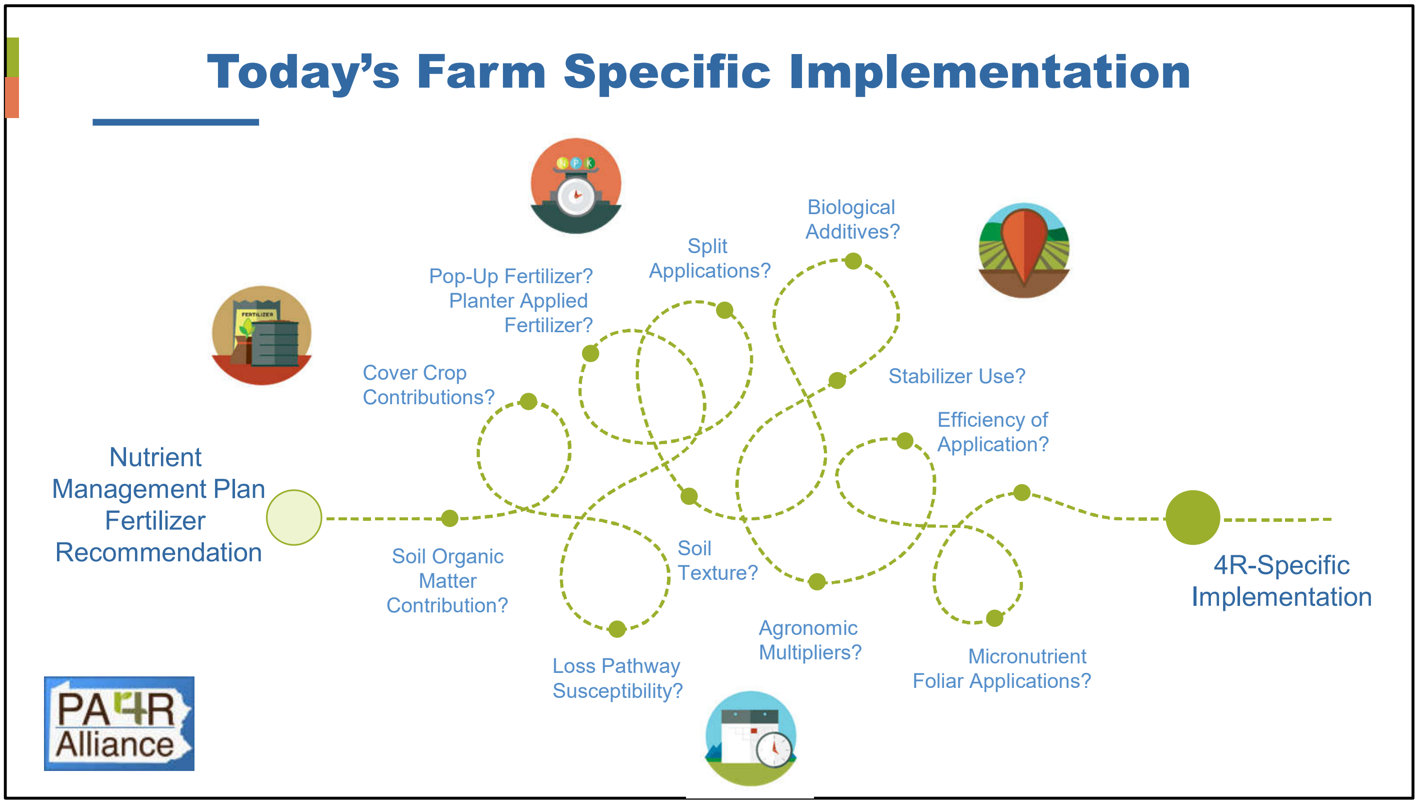
Project Overview

Cover crop contributions to fertility have traditionally followed land grant university guidelines that provided a nitrogen credit for the % legume in the cover crop and the yield potential (high, medium, low) of the soil. Like most university recommendations, they are designed to provide guidance across a wide range of soil types, weather conditions and management strategies. As soil health strategies mature, farms are looking to quantify cover crop performance through more precise tools. This project uses Granular Crop Modeling, along with site specific information, to quantify a cover crop's contribution to nitrogen fertility on 20 locations throughout PA.

The Right Rate starts with the Right manure application rate identified in their Nutrient Management Plan, followed by the Right Rate of supplemental fertilizer to achieve their yield goal. Sounds too easy – and it is! The Right Rate of nutrients certainly includes information from a Nutrient Management Plan, from estimated nutrient loads from planned manure applications + residual sources supplemented with commercial fertilizer. But, the Right Rate needed to maximize yield is dependent on many other factors -- soil texture, drainage, soil organic matter, pH, water holding capacity, nutrient cycling capacity, as well as planned Timing & Placement of the application, to name a few.

Soil health efforts over the past 20 years have increased the complexity of this Right Rate calculation by asking a simple question -- how has my investment in soil health affected my fertilizer needs? This investment in continuous no-till & cover cropping should have a measurable effect on fertility cycles and overall nutrient management. Conservation practices, like cover cropping and Continuous No-Till, are key tools in the 4R Nutrient Stewardship strategy. Their complex interconnectedness with 4R nutrient management in the soil health paradigm is outlined in the "Soil Health in Field & Forage Crop Production" (1).

(1) "Soil Health in Field & Forage Crop Production", a publication written by Joel Myers, Lisa Blazure and Sjoerd Duiker and published through USDA NRCS, Penn State Cooperative Extension, Capital RC&D, and the Clinton County Conservation District.
https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/pa/soils/health/?cid=nrcseprd940817



The journey to calculating a "Right Rate" in a soil health system continues to challenge the industry. The traditional calculation used in nutrient management planning is around 50 years old, and pre-dates no-till. Although it is a trusted calculation, it omits a number of opportunities that, if quantified, can greatly improve overall nitrogen use. These nitrogen contribution opportunities include not only cover crops and soil organic matter, but also include residue cycling, native microbial populations, added N-fixing bacteria, and much more. A lot has changed in the past 50 years…

Connecting Soil Health to Nutrient Management

In the past 25 years…

No-Till Production has taken over

Cover Cropping has Increased

Planting Green is Possible

We Measure SLAN, VAST & CO2 Burst

But the way we calculate nitrogen needs hasn't adapted to these changes.

50 years ago, farmers, and their advisers, were using mass balance calculations, like those currently used for regulatory nutrient management planning. In PA, nutrient management regulations were implemented around 25 years ago. While the PA regulatory program has made progress in refining the mass balance calculation framework, it is still limited in its ability to keep pace with soil health implementation. In the last 25 years, PA farms have made no-till planting the predominant method of crop establishment. Cover cropping has increased, and will continue to increase over the next 25 years. Planting green is possible, thanks to advances in seed genetics & equipment. New tests are available for farms to measure soil health contributions. These innovations will continue to evolve, creating a bigger need for adaptive nitrogen strategies & more opportunities for 4R nutrient management.

Connecting Soil Health to Nutrient Management

In the past 25 years average corn yields in PA have increased

40+ Bushels / Acre

- Genetic Improvements
- Improved Soil Health
- Modified Fertility Strategies
- Increased Equipment Capability
- Introduction of Data Management

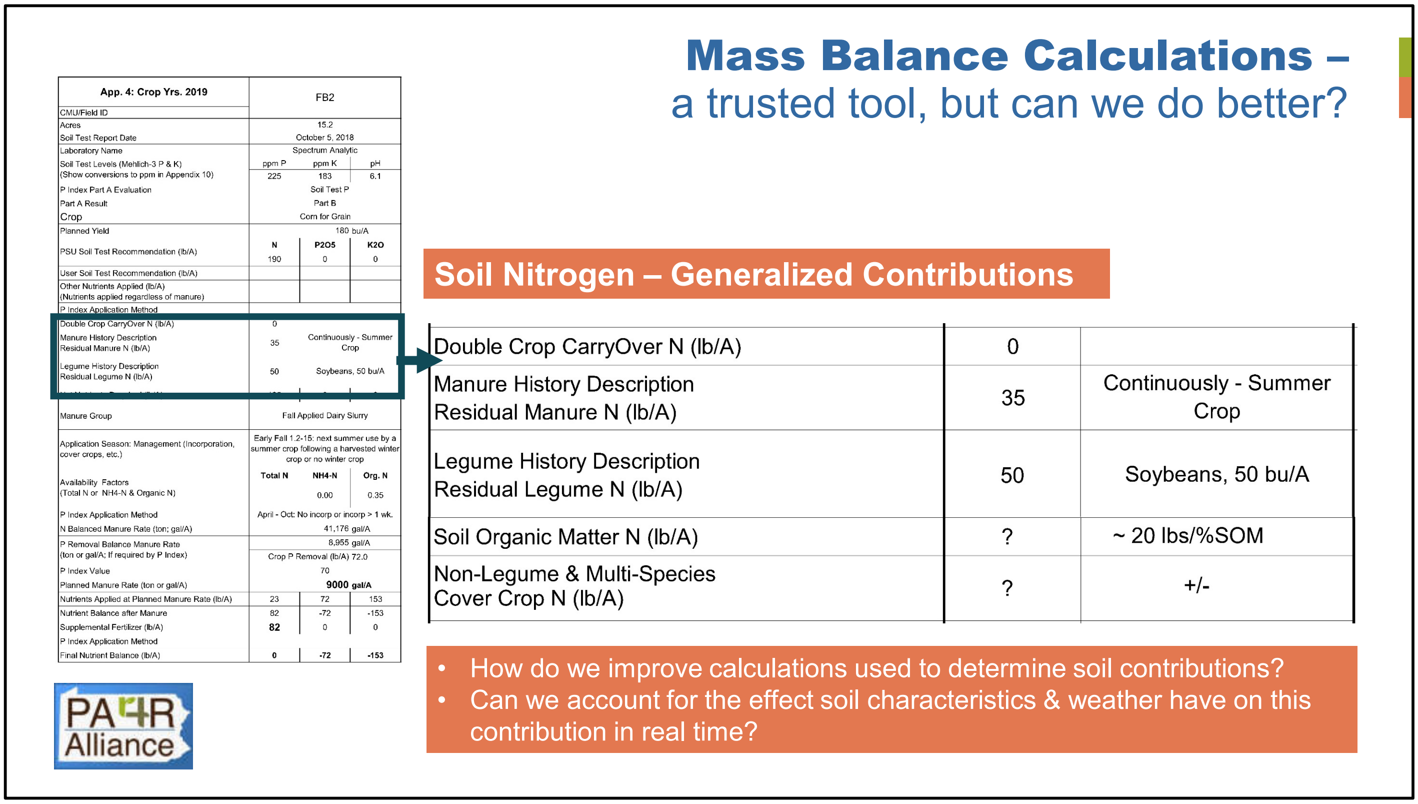
PA4R Alliance

But the way we calculate nitrogen needs remains the same.

Yield statistics reported by PA farms have shown a yield increase of over 40 bushels per acre over the past 25 years. PA farms participating in National Corn Growers Association and PA Corn Growers Association yield contests show even bigger gains. Yield is a product of 4 factors – number of ears per acre, number of rows around a ear, number of kernels per row, and kernel depth. Modern hybrids allow for higher planting populations, and create much more yield from kernel depth compared to hybrids from 25 years ago. The nitrogen uptake curve of corn has changed over this 25 year span. Today's hybrids will uptake around 20% of total nitrogen after tasseling! Nitrogen deficiency in these later growth stages can be detrimental to yield and economic performance. Farms looking to reduce the potential of nitrogen deficiency will look to 2 strategies to address this need

1. Fertilizer Management: Delaying a portion of nitrogen fertilizer needs until later growth stages and/or utilizing nitrogen stabilization products to reduce the risk of N loss
2. Soil Management: Creating a larger pool of plant available nitrogen & managing mineralization through soil health practices – continuous no till & cover crops.

Current mass balance calculations do not provide quantification of mineralization contributions from soil nitrogen Sources, nor do they provide insight on the Right Time for nitrogen fertilizer applications. These are big opportunities for site specific nitrogen management that can greatly influence yield and environmental outcomes.

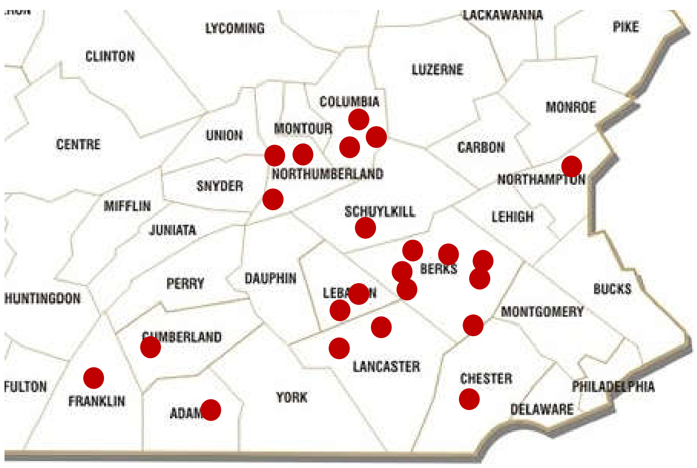


In defense of the mass balance calculations used by Certified Crop Advisers and regulatory nutrient management planners – it does a great job of simplifying the complex!

It provides a simplified, easy to follow linear path to show very complicated, ever-changing, processes. Its "ballpark" inputs with "ballpark" outputs that provides a certain level of "insurance" for most soil types. Farms implementing soil health practices need more detailed, site specific, ways to quantify soil nitrogen cycling, particularly from cover crops & crop residue, in addition to soil organic matter.

This project focused on that small piece of the nitrogen puzzle – can we quantify site specific contributions from cover crops and the soil's nitrogen cycling capacity. Does management of the cover crop affect overall cycling and when does mineralized cover crop nitrogen actually become available to the corn crop?

Project Overview



Participant Breakdown

All farms had a nutrient plan

All farms utilized manure in their rotation

All farms implemented soil health practices
- 4 continuous no till (No cover crop)
- 5 continuous no till w/ harvested cover crop
- 14 continuous no till w/ green manure cover

All sites compared nutrient management plan recommendations to model recommendations

20 locations, from the 14 no till + cover crop participants, were modeled for cover crop mineralization

The success of this project was related to many factors, including having cooperators representing the major agricultural producing soils of eastern PA. This map shows the locations of cooperators participating in the nitrogen modeling project or the cover crop project. Cooperators were broken into 3 categories – no cover crops, cover crops for forage, and cover crops for green manure. 20 fields from the 14 green manure cooperators were used for this portion of the project.

There are many reasons project cooperators establish cover crops – nitrogen contributions are only one of them. Soil erosion, biodiversity, increasing soil organic matter, weed suppression, nutrient scavenging, carbon cycling, reducing soil temperatures & conserving soil moisture are just a few. It is important, when reading this report, to remember that this project was focused solely on nitrogen contributions as a cover crop outcome.

Establishing cover crop goals is important for farms to establish a metric for cover crop success. Once the goal is established, farms identify planting windows, select suitable species for that window, and determine seeding rates. Most participants did not have nitrogen production/cycling as their main goal. It was, however, in their top 3 goals for cover cropping.

2021 Cover Crop Biomass Sampling Project

Thanks to all participating farms for allowing this project on their fields and sharing their soil health stories. We hope the information provided in the following pages is insightful and results in better 4R nutrient management strategies for your operation.

This portion of the project would not have been possible without the staff at Granular. Granular, a precision ag platform, contains crop models in addition to nitrogen models (Granular Agronomic Nitrogen Service). The model experts at Granular were able to use the collected field data in their crop model to quantify cover crop mineralization based on soil characteristics and weather. Each site was modeled through each of the past 20 years to create a average mineralization rate for the site, using known historic weather data for each location in the project. The modeled information on nitrogen contributions presented in this report is the average nitrogen contribution over that 20 year modeling period.

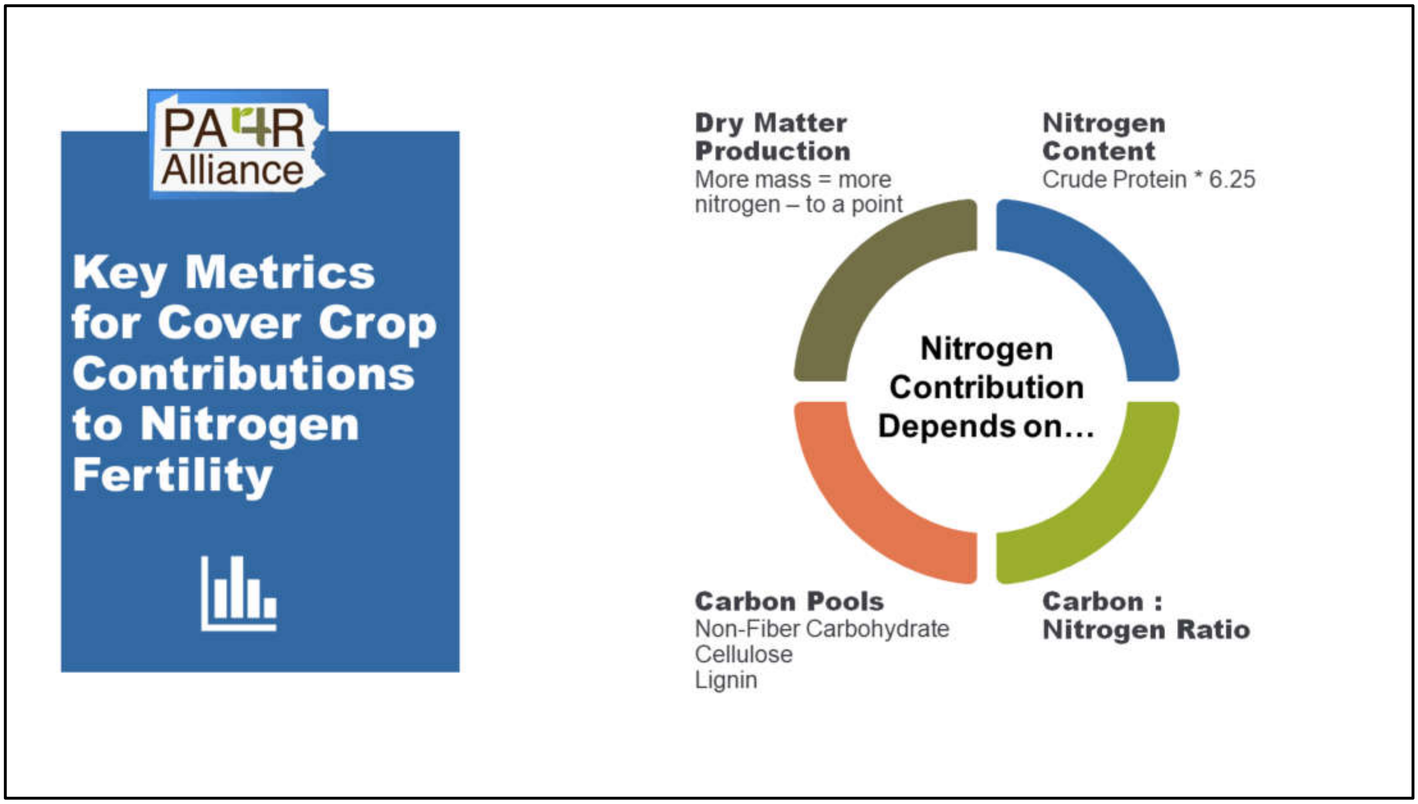
Nitrogen contributions from cover crops and soil sources will vary across a farm, and will often vary between soil types, and will certainly vary across weather patterns. Additionally, management decisions like planting date, seeding rate,& termination date greatly impact overall contributions. In order to quantify nitrogen contributions, adaptive tools that account for farm decisions, crop conditions and weather are needed. Cover crop decisions are not always made for maximum nitrogen contribution, and timing of field work does not always result in optimal nitrogen cycling.

2021 Cover Crop Biomass Sampling Project

1. Find *average area* of the field using satellite imagery
2. Measure 1 square meter and mark with flags
3. Harvest all biomass & weigh it
4. Obtain a representative sample of harvested material for forage analysis
5. Obtain soil tests for soil nitrate, total carbon, active carbon, soil texture

PA4R Alliance

For each of the 20 cooperating sites, field data was collected within a few days of cover crop termination. In-field locations were identified through NDVI plant health imagery to ensure "average" spots in the field were chosen. A 1-square meter block was delineated, and all above ground cover crop material was harvested & weighed. A sample of the cover crop was sent to a lab for analysis of nutrient content and forage quality. Soil samples for soil nitrate, total carbon, active carbon and soil texture were also obtained. All sample results were provided to the Granular modeling team for use in calculating annual mineralization rates for each site.



The cover crop forage analysis & subsequent modeling identified 4 key metrics for nitrogen contributions:

1. **Dry Matter Production:** As expected, dry matter influenced overall nitrogen contributions. The potential for nitrogen increased as dry matter increased. Available nitrogen plateaued around cover crop head emergence. Dry matter production is influenced by species selection, planting date, seeding rate, & termination date.
2. **Nitrogen Content:** Another straight forward calculation. Crude protein, measured in a forage analysis, can be converted to nitrogen using the factor 6.25, representing that protein is 6.25% nitrogen. As crude protein increases in a cover crop mix, total nitrogen also increases. Crude protein is influenced by species selection, fertility management, and planting/termination date.
3. **Carbon Pools:** The form of carbon in a cover crop was the most influential metric in determining the speed of nitrogen cycling. Non-Fiber Carbohydrates (NFC) are best represented by lush, young growth, while lignin is represented as mature growth. Higher cover crop NFC levels result in higher available nitrogen, while lower NFC levels result in lower available nitrogen. As a plant speeds towards reproductive growth stages, carbon will transform from NFC to Cellulose and finally into Lignin. Carbon pools are influenced by termination date.
4. **Carbon:Nitrogen Ratio:** Low C:N ratios indicate nitrogen availability, while high C:N ratios indicate nitrogen immobilization. There is not always a strong correlation between Carbon Pools and C:N ratios. C:N ratios are influenced by species selection and termination date.

Out of these 4 factors, Carbon Pools were found to be most influential in this project.

Small Grain Cover Crop
<12” tall

Attribute	Value
Date Sampled	4/26/2021
Species	Triticale
Dry Matter, lbs/ac	4,959
Crude Protein %	14.9
Nitrogen %	2.384
Non-Fiber Carbohydrates %	28.7
Cellulose %	69.2
Lignin %	2.2
C:N Ratio	21.3

The next several slides show site specific information from participating locations. Not all locations are presented.

Location: Lancaster County
Background: A corn, wheat and soybean rotation with annual cover cropping after corn and soybeans. Manure is applied throughout the rotation.
Summary: The sampling date of April 26^{th} was the earliest sampling date, and planting occurred a few days after sampling. Notice the surveyor flags used to mark the square meter are easily visible, indicating cover crop height around knee high. Dry matter production was very high, due to seeding rate and good growing conditions the previous fall.

Small Grain Cover Crop
Heading

Attribute	Value
Date Sampled	5/7/2021
Species	Rye
Dry Matter, lbs/ac	5,206
Crude Protein %	14.2
Nitrogen %	2.272
Non-Fiber Carbohydrates %	11.6
Cellulose %	82.6
Lignin %	5.9
C:N Ratio	22.2

Location: Adams County
Background: A corn, wheat and soybean rotation with annual cover cropping after corn and soybeans. Manure is applied throughout the rotation.
Summary: Sampled within 2 days of planting, this rye field was approximately 5’ tall. Seeding rates were less than the Lancaster 1 site, and manure was applied on the cover crop in March.

Small Grain Cover Crop
Comparing Termination Stages

Attribute	Vegetative	Heading
Date Sampled	4/26/2021	5/7/2021
Species	Triticale	Rye
Dry Matter, lbs/ac	4,959	5,206
Crude Protein %	14.9	14.2
Nitrogen %	2.384	2.272
Non-Fiber Carbohydrates %	28.7	11.6
Cellulose %	69.2	82.6
Lignin %	2.2	5.9
C:N Ratio	21.3	22.2

PA4R Alliance

Comparing Lancaster to Adams highlights how termination date is influential for nitrogen contributions from a small grain cover crop. Lancaster is identified as “vegetative”, representing a cover crop terminated in a vegetative growth stage. Adams is identified as “Heading”, representing a cover crop terminated after head emergence. Notice dry matter production between the 2 sites is not that different, and Crude Protein is very similar. Nitrogen concentrations within the sampled cover are also relatively equal. Both sites have similar amounts of total nitrogen present in the cover crop at termination, even though termination growth stages are very different.

The major differences between these sites is the Carbon Pools. % Non-Fiber Carbohydrate vs %Cellulose + % Lignin is significant. The higher % NFC in a cover crop terminated in the vegetative stage will result in higher nitrogen contributions. Also, notice the C:N ratios are almost identical. Initial reaction is that the small grain cover terminated after heading did not result in nitrogen immobilization often associated with rye covers terminated after heading. It is possible that the March manure application may have provided enough nitrogen to the rye cover to reduce overall C:N ratios, thus avoiding nitrogen immobilization

Small Grain Cover Crop
Late Planting

Attribute	Value
Date Sampled	5/5/2021
Species	Triticale
Dry Matter, lbs/ac	1,535
Crude Protein %	10.8
Nitrogen %	1.728
Non-Fiber Carbohydrates %	19.0
Cellulose %	77.0
Lignin %	4.0
C:N Ratio	29.31

This cover crop did *not* have nitrogen cycling/production as a goal. Understanding cover crop goals is important for understanding success!

Location: Franklin County
Background: This operation plants cover crops on 100% of their acres. This location was planted on the late side and planted at a lower seeding rate. No manure was applied.
Summary: Dry matter is lower, due to planting date and seeding rate. Notice the Carbon pools are dominated by Cellulose. This field was in the “boot stage” when sampling occurred. The transformation of carbon from NFC to Cellulose, then to Lignin, intensifies as the plant nears head emergence. This indicates that available nitrogen from a small grain cover will decrease rapidly over the same growth period.

Multi Species Mix
Dominant Legume

Attribute	Value
Date Sampled	5/13/2021
Species	Triticale, Clover, Winter Peas, Hairy Vetch
Dry Matter, lbs/ac	4,708
Crude Protein %	14.0
Nitrogen %	2.240
Non-Fiber Carbohydrates %	26.3
Cellulose %	68.5
Lignin %	5.2
C:N Ratio	22.9

Location: Columbia County 1

Background: This farm is a seasoned cover cropping operation. They have multiple mixes they plant based on seeding date and planned crop. This mix was planted in late summer following wheat. Poultry manure was applied in April.

Summary: Legumes were dominant in this mix, as expected given the species planted. Biomass was around 25-30" tall at the time of sampling. Crude protein levels, Nitrogen %, and C:N ratios in this multi-species mix are similar to both of the small grain covers from Lancaster & Adams, indicating total nitrogen in the cover is also similar.

Multi Species Mix
Dominant Grass

Attribute	Value
Date Sampled	5/5/2021
Species	Wheat, barley, annual ryegrass, radish, clover
Dry Matter, lbs/ac	5,171
Crude Protein %	19.9
Nitrogen %	3.184
Non-Fiber Carbohydrates %	12.9
Cellulose %	81.2
Lignin %	5.9
C:N Ratio	15.24

<u>Location:</u> Cumberland County
<u>Background:</u> Grass dominant cover crop established in late summer following wheat harvest. Manure was applied in fall. At the time of sampling, radish carcasses were present, and a small amount of clover was noticeable. Wheat and annual ryegrass were the dominant species. Planting rates at this location were high. Corn was planted the day prior to sampling, and planter rows are visible in the picture.
<u>Summary:</u> Dry matter production was high, due to the species composition and seeding rate. Notice this is the highest crude protein and nitrogen % of any location. This may be due to the % of annual ryegrass in the mix. Lignin levels & NFC levels were low, indicating that the annual ryegrass and wheat were both approaching head emergence.

Multi Species Mix
Dominant Oats

Attribute	Value
Date Sampled	5/10/2021
Species	Oats, Rye, Vetch, Wheat, Clover
Dry Matter, lbs/ac	2,896
Crude Protein %	15.8
Nitrogen %	2.528
Non-Fiber Carbohydrates %	22.3
Cellulose %	69.1
Lignin %	8.7
C:N Ratio	20.21

Location: Luzerne County
Background: A veteran cover cropping operation. This operation, and location, contained the highest percentage of oats in their cover crop mix. Planted after wheat in late summer, this location also received poultry manure. The seeding rates of all overwintering species were kept intentionally low. Nitrogen production is not the top goal of this cover crop mix.
Summary: Oats were dead at the time of sampling, and the dead plants were included in the dry matter calculation. Given the low seeding rate of overwintering species, dry matter was production was good. Lignin % was higher, probably due to the inclusion of dead oats in the sample.

Multi Species Cover Crop – Comparing Mix Structures

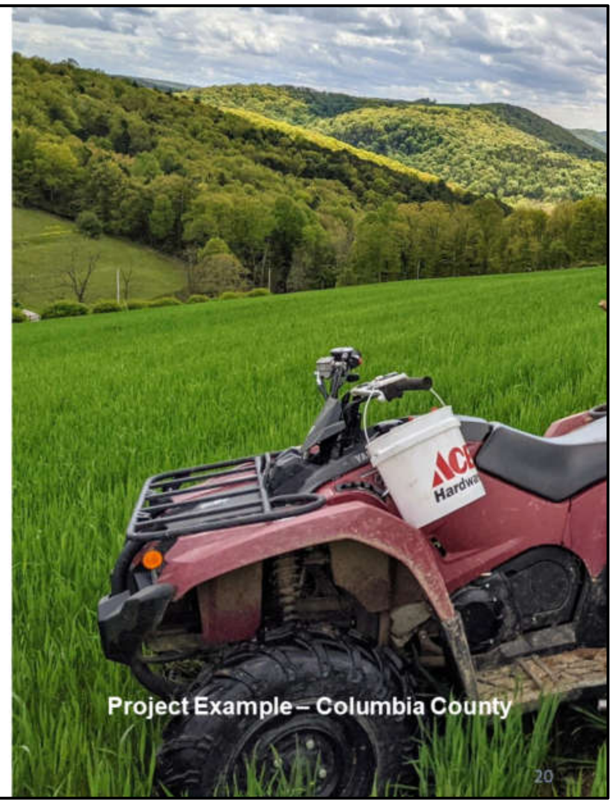
Attribute	Legume	Grass	Oats
Date Sampled	5/13/2021	5/5/2021	5/10/2021
Species	Triticale, Clover, Winter Peas, Hairy Vetch	Wheat, barley, annual ryegrass, radish, clover	Oats, Rye, Vetch, Wheat, Clover
Dry Matter, lbs/ac	4708	5171	2896
Crude Protein %	14.0	19.9	15.8
Nitrogen %	2.240	3.184	2.528
Non-Fiber Carbohydrates %	26.3	12.9	22.3
Cellulose %	68.5	81.2	69.1
Lignin %	5.2	5.9	8.7
C:N Ratio	22.9	15.24	20.21

All of the locations presented here received manure prior to termination. All mixes were terminated at roughly the same growth stage, just prior to winter grain head emergence.

All three examples provide unique data:
Legume Dominant Mix: Mixes dominated by legumes did not have higher crude protein or nitrogen % levels compared to grass dominant mixes. The higher NFC number in the legume dominant mix may indicate one of two things – either legumes are slower to convert NFC to cellulose or lignin as the plant approaches heading, or they are later maturing species.
Grass Dominant Mix: Grass dominant mixes, depending on the species composition and termination date, can result in total nitrogen levels that rival legume dominant mixes.
Oats Dominant Mix: winter killed cover crops may not have nitrogen production as a main goal, but including overwintering species at lower rates can still provide a nitrogen benefit.

Multi Species Mix
Later Planting

Attribute	Value
Date Sampled	5/10/2021
Species	“Late Fall N Mix”
Dry Matter, lbs/ac	2136
Crude Protein %	15.5
Nitrogen %	2.48
Non-Fiber Carbohydrates %	29
Cellulose %	67.6
Lignin %	3.4
C:N Ratio	20.9



What a view! Again – late plantings are tough to cash flow from a N production perspective.

<u>Location:</u> Columbia County 2
<u>Background:</u> This farm is a seasoned cover cropping operation. They have multiple mixes they plant based on seeding date and planned crop. This mix was planted in late fall and still included legume species.
<u>Summary:</u> Dry matter production was low, reducing overall potential of the cover to supply nitrogen to the system.

Nutrient Uptake by Grass Covers

Operation/Farm/Field	Nitrogen	Phosphorus (P_2O_5)	Potassium (K_2O)	Calcium	Magnesium
Small Grain 12" Lancaster County	118.2	56.8	233.4	12.9	6.5
Small Grain – Heading Adams County	118.3	44.1	236.3	13.0	4.2
Small Grain – Later Planting Franklin County	26.5	10.2	56.3	5.2	1.4

All numbers are reported in lbs/acre.

Compare Lancaster to Adams sites – It's great that there is so much nutrient uptake from timely planted cover crops! Nitrogen uptake is almost identical, even though Lancaster was terminated in the vegetative stage and Adams was terminated after heading. The higher seeding rate of the Lancaster site may have compensated for lack of cover crop height. Potassium uptake in both sites is remarkable, raising concerns about potassium cycling in addition to nitrogen cycling.

Compare the later planted Franklin site -- Notice total nitrogen uptake is much lower. The late planted site did not receive manure, nor did it have the same amount of time to develop roots for nitrogen scavenging. Later planted covers should not have nitrogen cycling be their primary goal.

While the nitrogen uptake of the early planted sites are fascinating, remember, total uptake does not equal total availability. Carbon Pools, C:N Ratio & weather still need to be accounted for!

Nutrient Uptake by Multi-Species Covers

Operation/Farm/Field	Nitrogen	Phosphorus (P_2O_5)	Potassium (K_2O)	Calcium	Magnesium
Multi species mix – Dominant Grass Cumberland County	164.7	54.5	274.1	42.4	10.3
Multi species mix – Dominant Legume Columbia County	105.5	31.3	140.2	30.1	9.0
Multi Species Mix– Late Fall Mix	53.0	12.7	64.1	4.5	1.7

N & K uptake greater for the grass dominant b/c of high annual ryegrass composition – luxury consumption of potassium & just a great scavenger of nitrogen. Notice both the legume dominant and grass dominant mixes have significantly higher calcium uptake. It is unclear why this is the case.

Again, While the nitrogen uptake of the early planted sites are fascinating, remember, total uptake does not equal total availability. Also, keep in mind we are only looking at above ground portions of the cover crop. Root systems of plants also store nutrients and have their own properties related to C:N ratio, % nitrogen and Carbon Pools.

Simulated Additional Mineralization (Lbs/Ac) from Above Ground Cover Crop Biomass – Grass Cover Crops

Operation/Farm/Field	Details	By Silking	By Black Layer	By End of Year
Small Grain – 12" Lancaster County	High N High NFC	42.7 ($26.30/ac)	52.6	58.8
Small Grain – Heading Adams County	High N Low NFC	33.2 ($20.45/ac)	45.0	52.4
Small Grain – Late Planting Franklin County	Lowest CP	8.3 ($5.11/ac)	10.8	12.3

- Simulation using Granular Crop Model
- Values were generated using site specific soil info + 20 years of weather
- Above ground contributions only – does not include any contribution from roots
- Economic data calculated using 30% UAN price of $370/ton

Let's transition the conversation to quantification of nitrogen contributions. The Granular Crop Model's (GCM) algorithm calculated mineralization rates of each location using collected data (biomass, Carbon Pools, C:N Ratio, % Nitrogen & soil texture), then overlaying precipitation & growing degree days for each of the past 20 years. The average nitrogen mineralized in each scenario is presented above.

Mineralization of organic nitrogen sources, including cover crop biomass, will occur anytime there is enough moisture and heat for microbial activity. These calculations use the following assumptions:

1. Any N mineralized by silking is assumed to be 100% available to the corn crop
2. N mineralized between silking and black layer is partially available, as root systems deteriorate through kernel fill
3. N mineralized after black layer is not available. Black layer is considered physiological maturity. No additional transfer of nutrients from the plant to grain occurs after black layer.

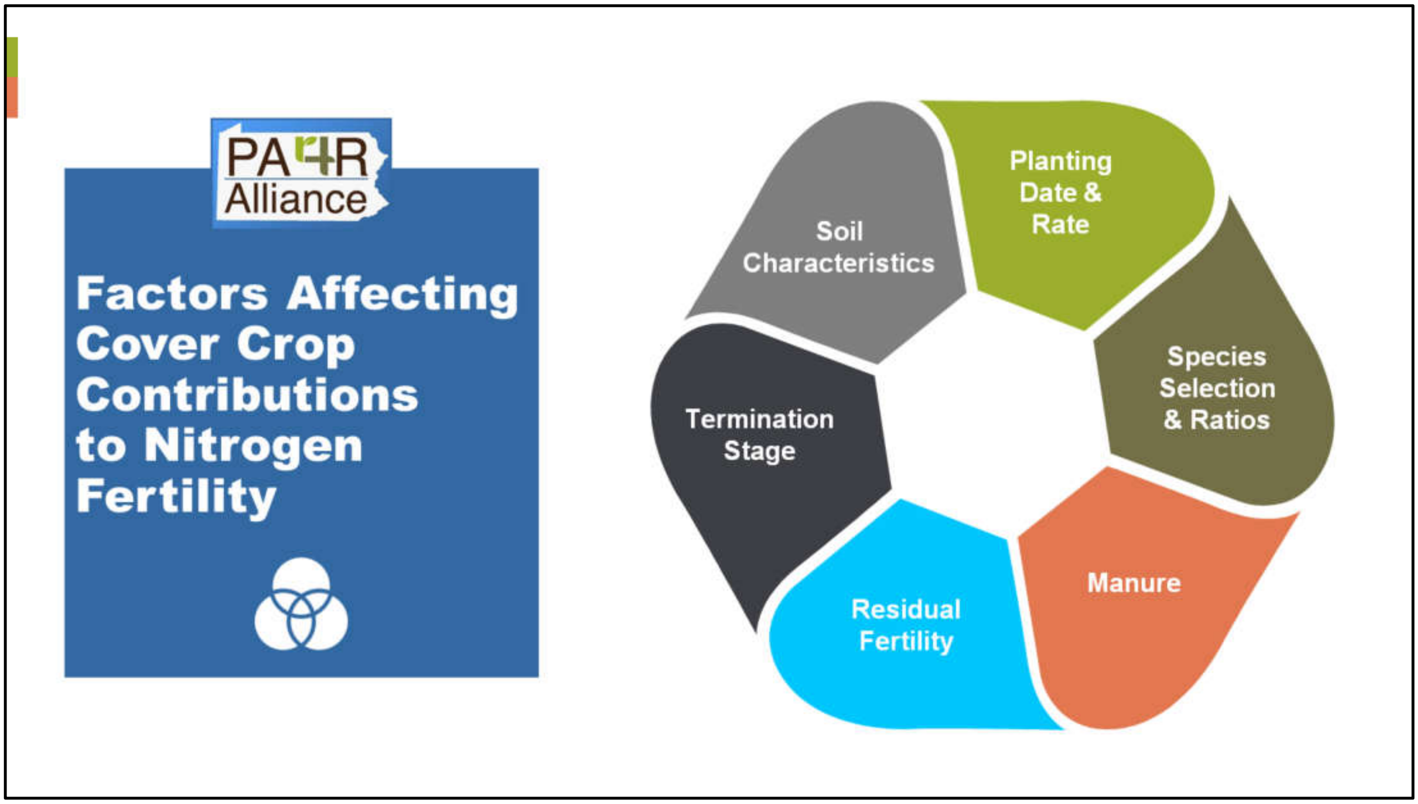
All numbers are reported in lbs/acre. The ability of a winter grain cover crop to contribute to nitrogen fertility is closely tied to the stage of growth in which it is terminated. Generally, early terminated grass covers can supply more nitrogen than later terminated grass covers. An interesting observation is that both the Lancaster and Adams County sites had total nitrogen uptake of 118 lbs/A, yet less than 60 lbs was mineralized. What happened to the remaining nitrogen?

Simulated Additional Mineralization (Lbs/Ac) from Above Ground Cover Crop Biomass – Mixed Legume/Grass Cover Crops

Operation/Farm/Field	Details	By Silking	By Black Layer	By End of Year
Multi species mix – Dominant Grass Cumberland County	High DM Low NFC	47.8 ($29.44)	63.9	74.0
Multi species mix – Dominant Legume Columbia County	High DM High N High NFC	36.8 ($22.67)	46.3	52.0
Multi species mix – Dominant Oats Luzerne/Columbia County	Mid DM	24.5 ($15.10)	31.3	35.4
Multi species mix – Later Planting Columbia County	Lower DM, CP, High NFC	18.1 ($11.14)	22.9	25.8

- Simulation using Granular Crop Model
- Values were generated using site specific soil info + 20 years of weather
- Above ground contributions only – does not include any contribution from roots
- Economic data calculated using 30% UAN price of $370/ton

It is well documented in our traditional mass balance nitrogen calculations that legume cover crops contribute nitrogen to a corn crop. It was surprising to see estimated contributions from a winter grain cover as presented on the previous page. While this is only a single comparison, it is also surprising to see a grass dominant mix can provide more nitrogen than a legume dominant mix, if terminated at the right growth stage. The legume dominant mix met the key metrics discussed earlier – high dry matter production, high nitrogen content and high Non-Fiber Carbohydrate (NFC), and it was terminated at the right time.



Our hope is that this project will increase knowledge of cover crop management for nitrogen production & cycling and provide farmers and their trusted advisers with enough confidence in cover crops as a viable nitrogen source to reduce nitrogen fertilizer rates. The 20 locations used in this project are a great snapshot of the cover cropping decisions made by farms in PA. Farms that cannot grow double crop soybeans profitably can incorporate multi-species cover crop mixes into their rotation and realize enough return on investment to offset much of the cover crop cost. Cover cropping after corn and soybeans can also have a immediate return on investment to the next crop.

Managing the key metrics – Dry Matter + % Nitrogen + Carbon Pools + C:N Ratio - are very important for farms trying to manage cover crops for nitrogen production and nitrogen cycling. The 6 factors listed here directly relate to the management of these metrics and can be prioritized as follows:

#1 – planting date & rate: plant on time to maximize dry matter production. Seeding rates can be increased in later plantings if nitrogen cycling is a main goal.
#2 – termination stage: the influence of dry matter & % nitrogen on nitrogen cycling plateaus as a plant nears heading. The importance of Carbon Pools increases significantly during this growth period! Terminate covers prior to heading for maximum nitrogen cycling.
#3 – probably field dependent, but could be any of the remaining choices:

As always, PA 4R Alliance is fortunate to work with great cooperators, partners, and stakeholders, and is thankful for the insights they provided throughout this project. Special thanks to PA NRCS for funding this project through a Conservation Innovations Grant (CIG) and the Granular team for their modeling work.

PA4R Alliance is a diverse group of Ag Retailers, Consultants, State Agencies, Federal Agencies, Land Grant Universities, and non-profit environmental organizations. Our focus is improving nutrient use efficiency through application of nutrients by using the Right Source at the Right Rate, Right Time, & Right Place. Implementation of 4R nutrient management practices leads to positive economic, social and environmental outcomes by increasing yield and reducing agriculture's impact on water quality.

LEARNING FROM HISTORY

Nitrogen Modeling Platforms Put Lessons of the Past to Work for the Future

Nitrogen modeling gives visibility to the nitrogen loss pathways we experience in the field.

Nitrogen modeling utilizes a daily time-step deterministic crop growth model that takes inputs of soil, weather, management and crop genetics and simulates both below and above ground dynamics, including nitrification, leaching, mineralization, germination, root development, crop nitrogen uptake and target grain yield. Modeling platforms utilize many years of research and development, tested and validated from hundreds of field trials, and backed up with sources through literature reviews and other scientific efforts.

More Information

To learn more about Nitrogen Modeling Platforms and the technical and financial assistance available contact your local NRCS office. To find your local NRCS office, visit **farmers.gov/service-center-locator**.

Good Information In = Good Information Out

Users can add site specific soil nitrate sample results to the model to establish their baseline nitrogen levels. These programs can also model both organic and inorganic sources of nitrogen, including common commercial fertilizers as well as organic residues from previous crops. An operation's manure analysis can be added to provide site specific nitrogen availability from the manure source(s) applied.

The accuracy of baseline information (manure analysis, pre-season soil nitrate levels rotation/cover crop history, planting date) is key for the accuracy of the model's outputs. Application dates are also critical for the success of the model. It is recommended that operations work with a trained advisor to ensure data is entered correctly and provides most accurate outputs.

Dynamic to weather

Each year's weather is different, so having the ability to make adjustments of nitrogen rates in-season is important. While modeling platforms cannot predict the weather, utilizing 20 prior years of weather history is useful to understand what could occur. Connecting this with the weather that has already occurred, a model can develop a simulation of what has occurred and what could likely happen.

Flexible with management

Because a modeling platform simulates the growth of a crop, management of the growing of that plant are necessary inputs. This includes planting date, seeding density, crop maturity rating, as well as key nitrogen information, such as rates, dates, forms of nitrogen and methods of application. A modeling platform simulates nitrogen uptake by the corn plant based on seeding parameters and adjusts potential N uptake based on maturity and seeding density. A model also simulates the conversion and movement of both commercial fertilizer and organic sources that are based on soil moisture and temperature estimations from weather.

Simulations of difficult-to-measure outputs

A modeling platform simulates many sub-processes that may be difficult to measure and quantify in most situations. These processes include the nitrogen loss pathways of nitrification, denitrification, leaching, mineralization, volatilization, and immobilization. Simulations are based on controlled lab measurements and modeling and are leveraged across individual field environments. These simulated outputs can be useful for quantifying the amount of nitrogen losses that may take place under various management programs and environments, helping farmers, planners, researchers and policy makers provide proper guidance to farmers to ensure that the environment is considered while still helping the farmer produce to the best of their abilities.

Fostering conversation, learning and changes to on-farm nitrogen management

The reports generated by a modeling platform provide growers and their trained advisors with data around the most prevalent loss pathways in a field. While the data provided may not always be able to be used to facilitate changes during the current growing season, it does provide a platform for trained advisors and farmers to have a conversation around on-farm management strategies and to modify 4R (source, rate, time and place) nitrogen decisions for the future growing season that will benefit Nitrogen Use Efficiency (NUE), yield and profitability and reduce potential negative impacts to water quality.

00/41/23 - Tim Peters (NRCS), Agricultural Engineer, was introduced and presented a report/update. (See attached Handout). He begins by saying that there was a recently hired engineer in the State Office and he started right before Christmas. His name is Paul Schaefer, and you will probably see him at future meetings. He moves on to an update on HPAI which is highly pathogenic avian influenza. They have ended poultry visit suspension on 1/3 and are back to just making normal visits. Security practices are being practiced regularly and everyone is encouraged to follow these procedures to ensure safety as nobody knows what HPAI will bring in the future. Nationally, they are requiring him to move a lot of our engineering tools to Photog, and he'll be working on this for the next month or two. On the PA NRCS engineering website, you are probably familiar with the tools such as: construction guides, design guides, engineering spreadsheets, fact sheets and standard detail drawings. These are the ones that will have to be moved to photog. When the move happens, he'll put out a notice. But, he will also l leave the link to photog tools on the website. Big news for the team is on the watershed end as they have started the first step for a watershed project in Tab Canyon. The first step for is a Piffer, which is a preliminary investigation feasibility report. That's what happens before a plan begins and provides reasonable assurances that the plan can be developed without obstacles.

State Technical Committee Meeting January 2023 ENGINEERING

Tim Peters, PE

Highly Pathogenic Avian Influenza

NRCS

- SCC resumed normal visits and NRCS followed on 1/3/23
- Continuing good biosecurity
- Prepared for changes throughout the year as needed

Standards Update

Standards ready for STC release

- 326 Clearing and Snagging
- 356 Dike and Levee
- 362 Diversion
- 368 Emergency Animal Mortality Management

Website
PA NRCS ENGINEERING

Engineering Tools and Resources

To assist in the design of engineering practices, the following standard drawings, details, guides, spreadsheets, etc. are approved for appropriate use in Pennsylvania. All technical resources are available to the general public, and while all have been examined for technical adequacy the responsibility for proper application remains with the user. Before using any of the technical resources, the designer should verify they are adaptable to the site and that the design limitations are not exceeded. All standard details and drawings must be part of a specific site design that is reviewed and approved by an individual with the appropriate approval authority.

- Construction Guides
- Design Guides
- Engineering Spreadsheets
- Fact Sheets
- Links to other Engineering sites
- NRCS Manuals and Handbooks with Pennsylvania Addendums
- Standard Pennsylvania Drawings

Tioga County PFIR

- Preliminary Investigation Feasibility Report
- Osceola – Elkland communities prone to flooding

Thank you

Tim Peters, PE

Tim.Peters@usda.gov

717-237-2212

00/46/03 - Dan Ludwig (NRCS), State Resource Conservationist, was introduced. He had few remarks and updates. There is an intro to planning training coming and in the past we had nine NRCS employees attend and 10 Conservation district staff. So, they are gearing up for the boot camps here in March and April. He is the TSP coordinator so in trying to define what the term means it has become a heavy workload. With that in mind, Dan plans on updating everyone on contracting and payment schedules in the next couple of weeks.

00/53/08 - Yuri Plowden (NRCS): Yuri will be giving a soils data update, and specifically, a land evaluation update. (See attached Handout) Lease of values can also be used in state or local farmland protection programs and in conjunction with things like farmland classification, for example, prime farmland or farmland of statewide importance. The Farmland Protection Policy Act’s purpose is to minimize the extent to which federal programs contribute to the unnecessary conversion of important farmland to nomadic uses. We don't want taxpayer money to be just willy nilly converting farmland to non ag uses. It has to be evaluated. She points out the 8106 on the slide and describes how to fill it out and its purpose. Keep in mind that soul survey data undergoes continuous updating and it's refreshed every year, so this can result in new soil map units being added or some being deleted, and so the soils data had not been examined for these changes since 2016. . If you want more information about the updates in your specific county, don’t hesitate to contact Yuri.

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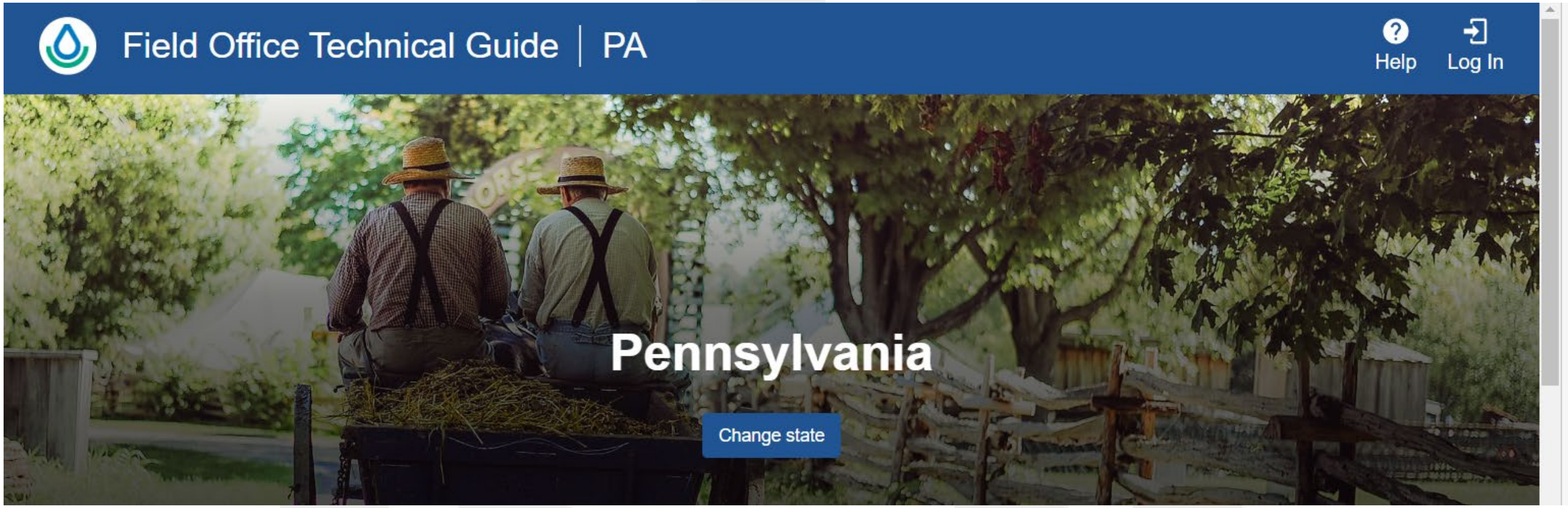

Soil Data Update

Pennsylvania State Technical Committee

January 19, 2023

United States Department of Agriculture

Pennsylvania
Natural Resources Conservation Service

Land Evaluation Site Assessment (LESA)

Update

Pennsylvania
Natural Resources Conservation Service

LESA values are used in Farmland Protection Policy Act determinations

LESA values could be used in state or local farmland protection programs along with farmland classification (example: prime farmland or farmland of statewide importance).

Farmland Protection Policy Act (FPPA)

Purpose of FPPA is to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of important farmland to nonagricultural uses.

LESA criteria are used to help federal agencies determine which agricultural land should be protected from development.

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FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request
Name of Project	Federal Agency Involved
Proposed Land Use	County and State county and state
PART II *(To be completed by NRCS)*	Date Request Received By NRCS / Person Completing Form:

Does the site contain Prime, Unique, Statewide or Local Important Farmland? *(If no, the FPPA does not apply - do not complete additional parts of this form)*	YES	NO	Acres Irrigated	Average Farm Size
Major Crop(s)	Farmable Land In Govt. Jurisdiction Acres: %		Amount of Farmland As Defined in FPPA Acres: %	
Name of Land Evaluation System Used	Name of State or Local Site Assessment System		Date Land Evaluation Returned by NRCS	

	Alternative Site Rating			
PART III *(To be completed by Federal Agency)*	Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly				
B. Total Acres To Be Converted Indirectly				
C. Total Acres In Site				
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland				
B. Total Acres Statewide Important or Local Important Farmland				
C. Percentage Of Farmland in County Or Local Govt. Unit To Be Converted				
D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value				
PART V (To be completed by NRCS) Land Evaluation Criterion Relative Value of Farmland To Be Converted (Scale of 0 to 100 Points)				

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(Criteria are explained in 7 CFR 658.5 b. For Corridor project use form NRCS-CPA-106)*	Maximum Points	Site A	Site B	Site C	Site D
1. Area In Non-urban Use	(15)				
2. Perimeter In Non-urban Use	(10)				
3. Percent Of Site Being Farmed	(20)				
4. Protection Provided By State and Local Government	(20)				

AD1006

Federal agency completes Parts I, III, VI, and VI.

NRCS responsible for Parts II, III, IV, and V

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Relative values for Soil Mapping Units in Centre County, PA

MUSYM	Map unit name	LCC	RV
Ch	Chagrin soils	1	100
HaA	Hagerstown silt loam, 0 to 3 percent slopes	1	100
HuA	Hublersburg silt loam, 0 to 3 percent slopes	1	100
MuA	Murrill channery silt loam, 0 to 3 percent slopes	1	100
No	Nolin silt loam, local alluvium, 0 to 5 percent slopes	1	100
Po	Pope soils	2w	100
HaB	Hagerstown silt loam, 3 to 8 percent slopes	2e	89
Lx	Lindside soils	2w	89
Ph	Philo loam	2w	89
AbB	Albrights silt loam, 3 to 8 percent slopes	2e	70
AlB	Allegheny silt loam, 2 to 8 percent slopes	2e	70
Ba	Basher loam	2w	70
BtB	Buchanan loam, 2 to 8 percent slopes	2e	70
BuB	Buchanan channery loam, 3 to 8 percent slopes	2e	70
CkA	Clarksburg silt loam, 0 to 3 percent slopes	2w	70
CkB	Clarksburg silt loam, 3 to 8 percent slopes	2e	70
ClB	Clymer sandy loam, 3 to 8 percent slopes	2e	70
EdB	Edom silt loam, 2 to 8 percent slopes	2e	70
GlB	Gilpin channery silt loam, 3 to 8 percent slopes	2e	70
HcB	Hagerstown silty clay loam, 3 to 8 percent slopes	2e	70
HhB	Hazleton channery sandy loam, 3 to 8 percent slopes	2e	70
HuB	Hublersburg silt loam, 3 to 8 percent slopes	2e	70
LaB	Laidig channery loam, 3 to 8 percent slopes	2e	70
LkB	Leck Kill channery silt loam, 3 to 8 percent slopes	2e	70
MeB	Meckesville silt loam, 3 to 8 percent slopes	2e	70
MnB	Millheim silt loam, 2 to 8 percent slopes	2e	70
MrB	Morrison sandy loam, 2 to 8 percent slopes	2e	70
MuB	Murrill channery silt loam, 3 to 8 percent slopes	2e	70
RaB	Rayne silt loam, 2 to 10 percent slopes	2e	70
TaA	Tilsit silt loam, 0 to 3 percent slopes	2w	70
UmB	Ungers channery loam, 3 to 8 percent slopes	2e	70
WhA	Wharton silt loam, 0 to 3 percent slopes	2w	70
WhB	Wharton silt loam, 3 to 8 percent slopes	2e	70
Bb	Barbour-Craigsville complex	2s	65
BkB	Berks channery silt loam, 3 to 8 percent slopes	2e	65
ClC	Clymer sandy loam, 8 to 15 percent slopes	3e	65
CoB	Cookport loam, 3 to 8 percent slopes	2e	65

- LESA values in PA underwent thorough update in 2016
- SSS at that time sent updated lists to each county (CDs, Farmland Preservation Boards)
- Updated tables were posted in eFOTG

Pennsylvania
Natural Resources Conservation Service

- Soil Survey data undergoes continuous update and is refreshed every year.
- Can result in new mapunits being added or some being deleted
- Soils data had not been examined for these changes since 2016 with respect to LESA tables.
- NRCS has created a tool to assist SSS in reviewing changes to soils data from year to year.
- New mapunits can be assigned a LESA value based on soils they were correlated from, farmland class, land capability class, crop yield.

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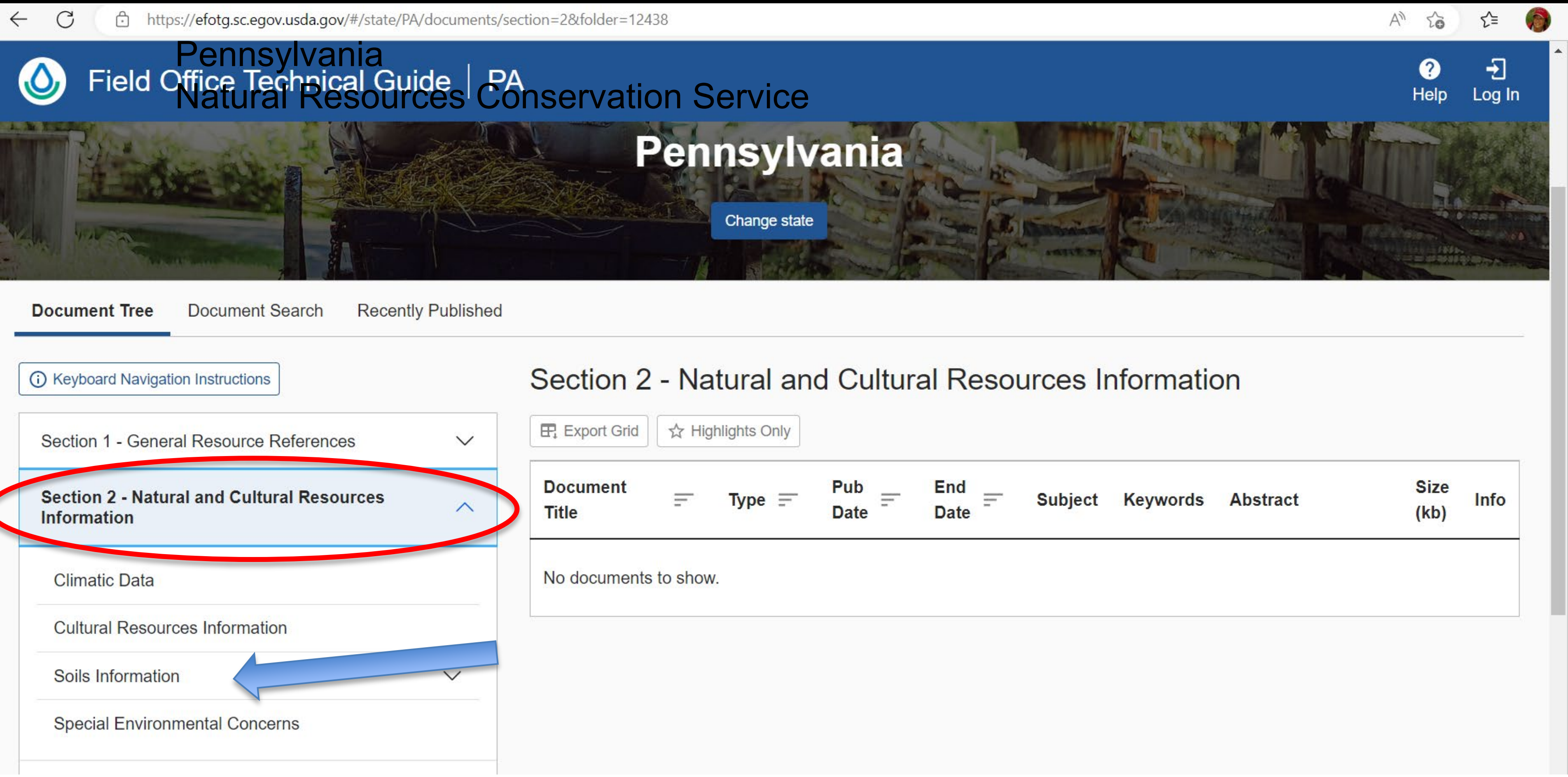
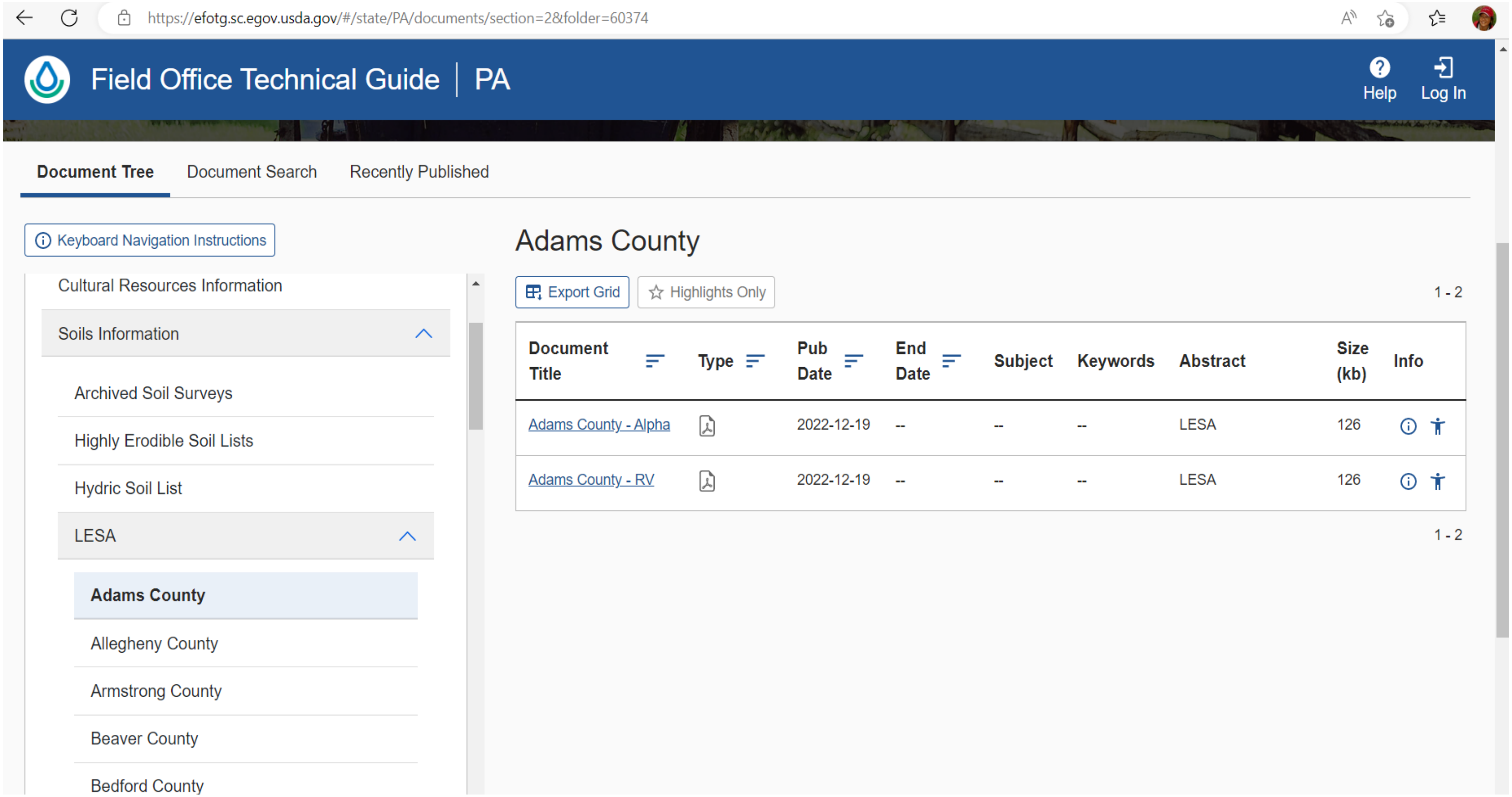


- Updated tables have now been posted to Field Office Tech Guide (FOTG). LESA values on existing mapunits have NOT been changed. [Pennsylvania | Field Office Technical Guide | NRCS - USDA]


https://efotg.sc.egov.usda.gov/#/state/PA/documents/section=2&folder=60374

Field Office Technical Guide | PA

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Hydric Soil List
LESA
Adams County
Allegheny County
Armstrong County
Beaver County
Bedford County

Adams County

Export Grid Highlights Only 1 - 2

Document Title	Type	Pub Date	End Date	Subject	Keywords	Abstract	Size (kb)	Info
Adams County - Alpha		2022-12-19	--	--	--	LESA	126	
Adams County - RV		2022-12-19	--	--	--	LESA	126	

1 - 2

Click on LESA, see drop down list of all the PA counties
Click on the county, and links to LESA lists appear on the right.
One list is alphabetized by mapunit symbol, other is sorted by LESA values

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Relative Values for Soil Mapping Units in Adams County, PA

Listed in descending order by RV

MuSym	Map Unit Name	LCC	Farm Land Classification	RV
ArB	Arendtsville gravelly loam, 3 to 8 percent slopes	2e	All areas are prime farmland	100
AtA	Athol gravelly silt loam, 0 to 3 percent slopes	1	All areas are prime farmland	100
AtB	Athol gravelly silt loam, 3 to 8 percent slopes	2e	All areas are prime farmland	100
Be	Bermudian silt loam	1	All areas are prime farmland	100
BgA	Birdsboro silt loam, 0 to 3 percent slopes	1	All areas are prime farmland	100
BgB	Birdsboro silt loam, 3 to 8 percent slopes	2e	All areas are prime farmland	100
Cm	Codorus silt loam	2w	All areas are prime farmland	100
CnA	Conestoga silt loam, 0 to 3 percent slopes	1	All areas are prime farmland	100
CnB	Conestoga silt loam, 3 to 8 percent slopes	2e	All areas are prime farmland	100
GbB	Glenelg channery loam, 3 to 8 percent slopes	2e	All areas are prime farmland	100
Lw	Lindside silt loam	2w	All areas are prime farmland	100
MyB	Myersville silt loam, 3 to 8 percent slopes	2e	All areas are prime farmland	100
NaB	Neshaminy channery silt loam, 3 to 8 percent slopes	2e	All areas are prime farmland	100
Rw	Rowland silt loam	2w	All areas are prime farmland	100

Lists also include land capability class and farmland classification

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If you want more information about LESA data updates for your specific county, contact Yuri Plowden, NRCS State Soil Scientist

yuri.plowden@usda.gov

00/59/51 – Susan Parry, NRCS Operations, and Dimka Braswell, Urban Subcommittee Chairman: (See attached Handouts.) There are new hires currently in the onboarding phase. They go on to recap the Urban Ag subcommittee meeting last month. There are a number of practices now available for small scale operations, which would include Urban AG. There is a lot of opportunity for people to utilize and get a higher payment for urban practices because we're taking into account transportation as well as you know the fact that some of these people are not going to get materials from big suppliers, they're going to go to Home Depot or something else. The next Urban subcommittee meeting is March 14th. Urban service centers have been launched in Philadelphia and 16 other locations. The ability to have 250,000 used in other urban areas of the state, not just the three, not just Pittsburgh, Philadelphia and Harrisburg are being explored. So, Susan brought up a map to display it. Melissa takes over for an easement update. ALE applications first cut off was December 31st and our next cutoff will be March 1st, but they are accepting it continually, easements are received through the local county add preservation boards and conservancies. Those higher values are driven in the more urban areas, so those rate caps would be set at 95% of the value in that area.

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NEW FARMERS

From farm loans to crop insurance, and conservation programs to disaster assistance, the U.S. Department of Agriculture (USDA) is here to support you and your operation.

GET STARTED

Contact Your Beginning Farmer and Rancher Coordinator

Each State has a coordinator that can help you with questions on working with USDA.

Find yours at **farmers.gov/manage/newfarmers/coordinators**.

Contact Your Local USDA Service Center

Service Centers are USDA offices where Farm Service Agency (FSA) and Natural Resources Conservation Service (NRCS) staff can meet with you one-on-one to discuss your vision, goals, and ways USDA can help. Steps to the process are on the next page.

USDA SERVICE CENTER AGENCIES

Farm Service Agency (FSA)

FSA provides disaster assistance, safety net, farm loan, and conservation programs and is the go-to agency for many USDA records. If you're new to working with USDA, your FSA team member will help you register your farm with a farm number. Depending on what you raise or grow, filing an acreage report each season can ensure you're eligible for many programs and allows you to vote in county FSA elections.

Natural Resources Conservation Service (NRCS)

NRCS provides financial and technical assistance and easement programs for conservation on working lands. Your NRCS team member will ask about your goals for your land and can help you develop a conservation plan and file an application for the wide range of NRCS programs.

ADDITIONAL USDA RESOURCES

Risk Management Agency (RMA)

RMA administers federal crop insurance through Approved Insurance Providers to help farmers prepare for the future. Special provisions are available to beginning farmers.

Rural Development (RD)

RD provides loans, grants, loan guarantees, and technical assistance, along with support for affordable housing, infrastructure modernization, businesses, cooperatives, and other essential community services.

Cooperative Extension

USDA and agricultural colleges around the country work together to support an extensive network of State, regional, and county Cooperative Extension offices, which can help answer questions you may have about your operation and address common issues faced by agricultural producers.

GET STARTED WITH YOUR LOCAL USDA SERVICE CENTER

Find your local USDA Service Center at **farmers.gov/service-locator**, which has staff who can meet with you one-on-one to discuss your vision for your land and how we can help. Free, real-time translation service is also available at the Service Center for non-English speakers. Learn more at **farmers.gov/interpret**.

BEFORE YOUR MEETING

1. **Make an appointment**. This will ensure quick service. Our offices can get busy, especially at times around program sign-up and reporting deadlines.
2. **Prepare**. Ask what documents are needed to help to make the most of your appointment. Examples could include lease agreements, bank account information, inventory or production records, legal paperwork, or personal identification numbers.
3. **Think about your vision**. What is your vision for your land and farm? What are your challenges?

MORE INFORMATION

Learn more at **farmers.gov/newfarmers**.

DURING YOUR MEETING

1. **Register for a farm number**. This is required to participate in USDA programs. Have available an official tax identification (Social Security number or employer ID) and a property deed. If you do not own the land, be sure to have your lease agreement. If your operation is incorporated or an entity, we may need proof of your signature authority and legal ability to sign contracts with USDA.
2. **Discuss your business and conservation goals**. Your local FSA or NRCS team members need to understand your vision to recommend programs for your operation. For example, are you looking for access to capital, to rebuild after a natural disaster, or to improve your farm's soil health, improve irrigation, or attract more wildlife?
3. **Make a plan to meet conservation compliance provisions**. You'll need to file form AD-1026 to ensure wetland areas and highly erodible lands are not farmed, unless following an NRCS conservation plan. This is required for all USDA program eligibility, including disaster assistance.
4. **Verify eligibility**. For most USDA programs, producers must file a CCC-941 to verify they do not exceed an adjusted gross income of $900,000.
5. **File your program application**. We can help you complete the forms.
6. **Sign up for email or text updates.** This will help you stay informed about program signups or deadlines.

AFTER YOUR MEETING

1. **File your acreage reports throughout the year**.
2. **Keep in touch with your local office**. Let us know if your business changes or you experience a disaster or hardship.
3. **Learn about self-service options**. Create a farmers.gov account to manage some of your USDA business online.

Program Aid 2267
June 2021

Small Scale Conservation Practices, Scenarios and Costs

	A	B	C	D	E
1	**Practice_Code**	**Practice_Name**	**Component**	**Unit_Type**	**23 Unit_Cost**
2	311	Alley Cropping	Alley Cropping Single Row - Small Acreage	No	$ 20.80
3	315	Herbaceous Weed Treatment	Herbaceous Weed Treatment for One Acre Small Farm	Ac	$ 187.19
4	317	Composting Facility	Small Farm Bins, no pad	SqFt	$ 41.00
5	317	Composting Facility	Small Farm Pad + Bins	SqFt	$ 58.00
6	317	Composting Facility	Composter, Windrow, compacted earth floor	SqFt	$ 0.25
7	317	Composting Facility	Composter, Windrow, gravel surface	SqFt	$ 0.97
8	317	Composting Facility	Composter, Windrow, concrete pads, curbs	SqFt	$ 6.83
9	317	Composting Facility	Bins, wood or concrete walls on concrete slab	SqFt	$ 15.93
10	325	High Tunnel System	Small High Tunnel, Low Snow and Wind	SqFt	$ 7.31
11	325	High Tunnel System	Small High Tunnel, Intensive Sun	SqFt	$ 7.52
12	325	High Tunnel System	Small Tunnel with Gutter	SqFt	$ 8.51
13	325	High Tunnel System	Small Gothic HT with Gutter	SqFt	$ 9.57
14	325	High Tunnel System	Small High Tunnel, Snow and Wind	SqFt	$ 10.46
15	325	High Tunnel System	High Tunnel, Low Snow and Wind Load	SqFt	$ 4.00
16	325	High Tunnel System	High Tunnel Round with Gutters	SqFt	$ 4.77
17	325	High Tunnel System	High Tunnel Gothic with Gutters	SqFt	$ 5.48
18	325	High Tunnel System	Contiguous US Snow	SqFt	$ 5.99
19	327	Conservation Cover	Orchard or Vineyard Alleyways	Ac	$ 126.46
20	327	Conservation Cover	Native Species	Ac	$ 180.90
21	327	Conservation Cover	Introduced Species	Ac	$ 184.37
22	328	Conservation Crop Rotation	Specialty Crop Rotations-Small Scale	kSqFt	$ 28.75
23	328	Conservation Crop Rotation	Basic Rotation Organic and Non-Organic	Ac	$ 11.16
24	328	Conservation Crop Rotation	Specialty Crops Organic and Non-Organic	Ac	$ 29.77
25	329	Residue and Tillage Management, No Till	Small Scale No Till	kSqFt	$ 32.59
26	329	Residue and Tillage Management, No Till	No-Till/Strip-Till	Ac	$ 18.73
27	329	Residue and Tillage Management, No Till	No Till Adaptive Management	No	$ 2,961.07

Small Scale Conservation Practices, Scenarios and Costs

	A	B	C	D	E
1	**Practice_Code**	**Practice_Name**	**Component**	**Unit_Type**	**23 Unit_Cost**
28	340	Cover Crop	Cover Crop - 1 acre or less	Ac	$ 434.17
29	340	Cover Crop	Mechanical Termination of Cover Crop per 1000 square feet	kSqFt	$ 21.66
30	340	Cover Crop	Multi-species Cover Crop per 1000 square feet	kSqFt	$ 46.21
31	340	Cover Crop	Cover Crop - Basic (Organic and Non-organic)	Ac	$ 63.97
32	340	Cover Crop	Cover Crop - Multiple Species (Organic and Non-organic)	Ac	$ 79.39
33	340	Cover Crop	Cover Crop - Basic Organic	Ac	$ 86.48
34	340	Cover Crop	Cover Crop - Adaptive Management	No	$ 2,308.77
35	342	Critical Area Planting	Permanent Cover	kSqFt	$ 16.27
36	342	Critical Area Planting	Native or Introduced Vegetation - Normal Tillage (Organic and Non-Organic)	Ac	$ 374.78
37	342	Critical Area Planting	Native or Introduced Vegetation - Moderate Grading (Organic and Non-Organic)	Ac	$ 760.26
38	342	Critical Area Planting	Native or Introduced Vegetation - Heavy Grading (Organic and Non-Organic)	Ac	$ 1,070.36
39	362	Diversion	Diversion, Rebuild	Ft	$ 2.67
40	362	Diversion	Diversion, large, greater than 300 feet	Ft	$ 3.78
41	362	Diversion	Diversion, small, less than or equal to 300 feet	Ft	$ 5.00
42	380	Windbreak/Shelterbelt Establishment and Renovation	1 row windbreak - small acreage	Ft	$ 3.06
43	380	Windbreak/Shelterbelt Establishment and Renovation	1 row windbreak, conifers, hand planted	Ft	$ 0.59
44	380	Windbreak/Shelterbelt Establishment and Renovation	2-row windbreak, conifers	Ft	$ 0.84
45	380	Windbreak/Shelterbelt Establishment and Renovation	2-row windbreak, hardwoods	Ft	$ 0.87
46	380	Windbreak/Shelterbelt Establishment and Renovation	3 or more tree rows hardwood/conifers	Ft	$ 1.01
47	380	Windbreak/Shelterbelt Establishment and Renovation	1 row windbreak, hardwood, hand planted	Ft	$ 1.24
48	380	Windbreak/Shelterbelt Establishment and Renovation	3 or more row windbreak, hardwoods	Ft	$ 1.25
49	380	Windbreak/Shelterbelt Establishment and Renovation	Single row of tree and shrub planting with tree tubelings	Ft	$ 2.05
50	380	Windbreak/Shelterbelt Establishment and Renovation	Multi-row Tree/shrub, containerized stock	Ft	$ 4.63
51	382	Fence	Fence for 1 Acre or less	Ft	$ 3.47
52	386	Field Border	Small Scale Field Border	kSqFt	$ 63.88
53	386	Field Border	Field Border, Introduced Species	Ac	$ 100.91
54	386	Field Border	Field Border, Native Species	Ac	$ 143.64
55	386	Field Border	Field Border, Pollinator	Ac	$ 380.61
56	386	Field Border	Field Border, Pollinator, Forgone Income	Ac	$ 716.33
57	386	Field Border	Field Border, Shrubs with Shelters	Ac	$ 3,657.66
58	391	Riparian Forest Buffer	Small container, hand planted	Ac	$ 4,099.51

Small Scale Conservation Practices, Scenarios and Costs

	A	B	C	D	E
1	**Practice_Code**	**Practice_Name**	**Component**	**Unit_Type**	**23 Unit_Cost**
59	412	Grassed Waterway	Waterway, small, 0.2 Acres or less	SqFt	$ 0.13
60	412	Grassed Waterway	Waterway, over 0.2 acres	Ac	$ 4,178.25
61	412	Grassed Waterway	Grass Waterway with Stone Checks	Ac	$ 5,839.94
62	420	Wildlife Habitat Planting	Very Small Acreage (<.5 ac) Planting with Seedlings	SqFt	$ 0.44
63	430	Irrigation Water Conveyance	PVC (Iron Pipe Size), less than or equal to 4 inch, Small Scale System	LnFt	$ 4.89
64	430	Irrigation Water Conveyance	HDPE (Iron Pipe Size and Tubing), less than or equal to 2 inch, Small Scale	Lb	$ 32.53
65	430	Irrigation Water Conveyance	Surface HDPE (Iron Pipe Size and Tubing), less than or equal to 2 inch, Small Scale	Lb	$ 6.77
66	430	Irrigation Water Conveyance	HDPE (Iron Pipe Size & Tubing) 3 inch or less	Ft	$ 4.93
67	430	Irrigation Water Conveyance	PVC (Iron Pipe Size), 4 inches or less	Ft	$ 5.41
68	430	Irrigation Water Conveyance	HDPE (Iron Pipe Size & Tubing) 4 Inches	LnFt	$ 7.38
69	430	Irrigation Water Conveyance	HDPE (Iron Pipe Size & Tubing) 6 inches	Ft	$ 12.96
70	430	Irrigation Water Conveyance	PVC (Iron Pipe Size) 8 Inches	LnFt	$ 18.08
71	430	Irrigation Water Conveyance	PVC (Iron Pipe Size) 6 inches to 8 inches	LnFt	$ 18.47
72	430	Irrigation Water Conveyance	HDPE (Iron Pipe Size and Tubing) 8 Inches	LnFt	$ 20.96
73	430	Irrigation Water Conveyance	PVC (Iron Pipe Size) 10 inches or greater	Ft	$ 24.92
74	430	Irrigation Water Conveyance	HDPE (Iron Pipe Size & Tubing) 10 inch	Ft	$ 32.70
75	430	Irrigation Water Conveyance	HDPE (Iron Pipe Size & Tubing) 12 Inches	LnFt	$ 43.74
76	430	Irrigation Water Conveyance	Boring, Pipeline All Sizes	LnFt	$ 108.42
77	436	Irrigation Reservoir	Small Semi-Excavated Reservoir	CuYd	$ 4.21
78	436	Irrigation Reservoir	Steel Tank	Gal	$ 0.86
79	436	Irrigation Reservoir	Fiberglass Tank	Gal	$ 1.38
80	436	Irrigation Reservoir	Plastic Tank	Gal	$ 1.61
81	436	Irrigation Reservoir	Embankment Reservoir 30 or less Acre-Feet	CuYd	$ 3.16
82	436	Irrigation Reservoir	Embankment Reservoir > 30 Acre-Feet	CuYd	$ 3.19
83	436	Irrigation Reservoir	Plastic tank, less than or equal to 1,000 gallons	Gal	$ 3.25
84	441	Irrigation System, Microirrigation	Small Surface Tape System	SqFt	$ 0.62
85	441	Irrigation System, Microirrigation	Small Microirrigation System	SqFt	$ 0.80
86	441	Irrigation System, Microirrigation	Seasonal High Tunnel Micro Irrigation System	SqFt	$ 0.09
87	441	Irrigation System, Microirrigation	Hoop House Surface Microirrigation	SqFt	$ 0.25
88	441	Irrigation System, Microirrigation	Surface Tape Annual Crops	Ac	$ 527.68
89	441	Irrigation System, Microirrigation	Surface Tape Annual Filtered, no Flow Meter	Ac	$ 1,351.73
90	441	Irrigation System, Microirrigation	Surface Tape Annual Filtered	Ac	$ 1,525.29
91	441	Irrigation System, Microirrigation	Surface PE Perennial Crops	Ac	$ 1,968.49
92	441	Irrigation System, Microirrigation	Surface PE Perennial Crops, filtered, no flow meter	Ac	$ 2,380.52
93	441	Irrigation System, Microirrigation	Microjet	Ac	$ 2,688.99
94	441	Irrigation System, Microirrigation	Surface PE Perennial Filtered	Ac	$ 2,716.70
95	441	Irrigation System, Microirrigation	Surface Tape <5 acres	Ac	$ 3,225.72
96	441	Irrigation System, Microirrigation	Microjet Filtered	Ac	$ 3,437.20

	A	B	C	D	E
1	**Practice_Code**	**Practice_Name**	**Component**	**Unit_Type**	**23 Unit_Cost**
97	442	Sprinkler System	Small Solid Set, Above Ground Laterals	Ac	$ 2,342.78
98	442	Sprinkler System	Renovation of Existing Sprinkler System	Ft	$ 8.73
99	442	Sprinkler System	Center Pivot System	Ft	$ 62.72
100	442	Sprinkler System	Linear Move System	Ft	$ 95.12
101	442	Sprinkler System	Traveling Gun System, < 2 inch Hose	No	$ 10,906.41
102	442	Sprinkler System	Traveling Gun, 2 inch or >	No	$ 19,399.43
103	449	Irrigation Water Management	Basic IWM < 1 acre	SqFt	$ 0.56
104	449	Irrigation Water Management	Intermediate IWM < 1 acre	SqFt	$ 0.74
105	449	Irrigation Water Management	Field Crops, Grains, 2nd and 3rd Year	Ac	$ 8.00
106	449	Irrigation Water Management	Basic IWM over 30 acres	Ac	$ 13.63
107	449	Irrigation Water Management	Field Crops, Grains, 1st Year	Ac	$ 15.43
108	449	Irrigation Water Management	Basic IWM 30 acres or less	Ac	$ 24.81
109	449	Irrigation Water Management	Annual Crops, Vegetables, 2nd and 3rd Year	Ac	$ 32.11
110	449	Irrigation Water Management	Perennial Crops, Orchards, 2nd and 3rd Year	Ac	$ 42.88
111	449	Irrigation Water Management	Use Computer Record Keeping System	Ac	$ 45.17
112	449	Irrigation Water Management	Annual Crops, Vegetables, 1st Year	Ac	$ 56.69
113	449	Irrigation Water Management	Perennial Crops, Orchards, 1st Year	Ac	$ 67.46
114	449	Irrigation Water Management	1st Year, Computer Record Keeping System	Ac	$ 304.56
115	468	Lined Waterway or Outlet	Turf Reinforced Matting Regional	SqFt	$ 1.10
116	468	Lined Waterway or Outlet	Grassed waterway with stone center	SqFt	$ 4.60
117	468	Lined Waterway or Outlet	Rock Lined - 12 inch	SqFt	$ 5.54
118	468	Lined Waterway or Outlet	Rock Lined - 24 inch	SqFt	$ 9.37
119	484	Mulching	Erosion Control Blanket	SqFt	$ 0.18
120	484	Mulching	Wood Chips	SqFt	$ 0.44
121	484	Mulching	Tree and Shrub	No	$ 0.99
122	484	Mulching	Natural Material - Full Coverage	Ac	$ 437.97
123	490	Tree/Shrub Site Preparation	Tree-Shrub Site Prep - small acreage	SqFt	$ 2.96
124	512	Pasture and Hay Planting	Small farm, Pasture and Hay planting for 1 ac.	Ac	$ 559.81
125	516	Livestock Pipeline	Surface HDPE (Iron Pipe Size and Tubing), Small Scale	Lb	$ 12.12
126	516	Livestock Pipeline	HDPE (Iron Pipe Size and Tubing), Small Scale	Lb	$ 32.53
127	533	Pumping Plant	Variable Frequency Drive	HP	$ 94.91
128	533	Pumping Plant	Livestock Nose Pump Regional	No	$ 479.37
129	533	Pumping Plant	<50gpm Irrg PTO pump	No	$ 821.77
130	533	Pumping Plant	1 hp pump or Siphon or Flout	No	$ 1,452.18
131	533	Pumping Plant	Water Ram Pump Regional	No	$ 1,574.05
132	533	Pumping Plant	Electric Powered Pump 3 Hp or less	No	$ 1,970.47
133	533	Pumping Plant	Electric Powered Pump 3 HP or less with Pressure Tank	No	$ 2,627.18
134	533	Pumping Plant	Internal Combustion Powered Pump 7.5HP or less	No	$ 3,005.72
135	533	Pumping Plant	50 to 500 gpm PTO Pump	No	$ 3,605.09
136	533	Pumping Plant	Electric Powered Pump 3 to 10 HP	No	$ 4,252.80
137	533	Pumping Plant	Photovoltaic Powered Pump	No	$ 5,597.93
138	533	Pumping Plant	>500 gpm PTO Pump	No	$ 6,051.59
139	533	Pumping Plant	Electric Powered Pump 3 Hp or less with pressure tank and pump housing	No	$ 6,598.12
140	533	Pumping Plant	Internal Combustion Powered Pump 7.5 to 39 HP	No	$ 8,254.81
141	533	Pumping Plant	Electric Powered Pump 10 to 40 HP	No	$ 8,300.89
142	533	Pumping Plant	Windmill Powered Pump	No	$ 9,585.77
143	533	Pumping Plant	Electric or Ram Manure Pump	No	$ 11,245.46
144	533	Pumping Plant	Electric Powered Pump 40 to 60 HP	No	$ 15,579.59

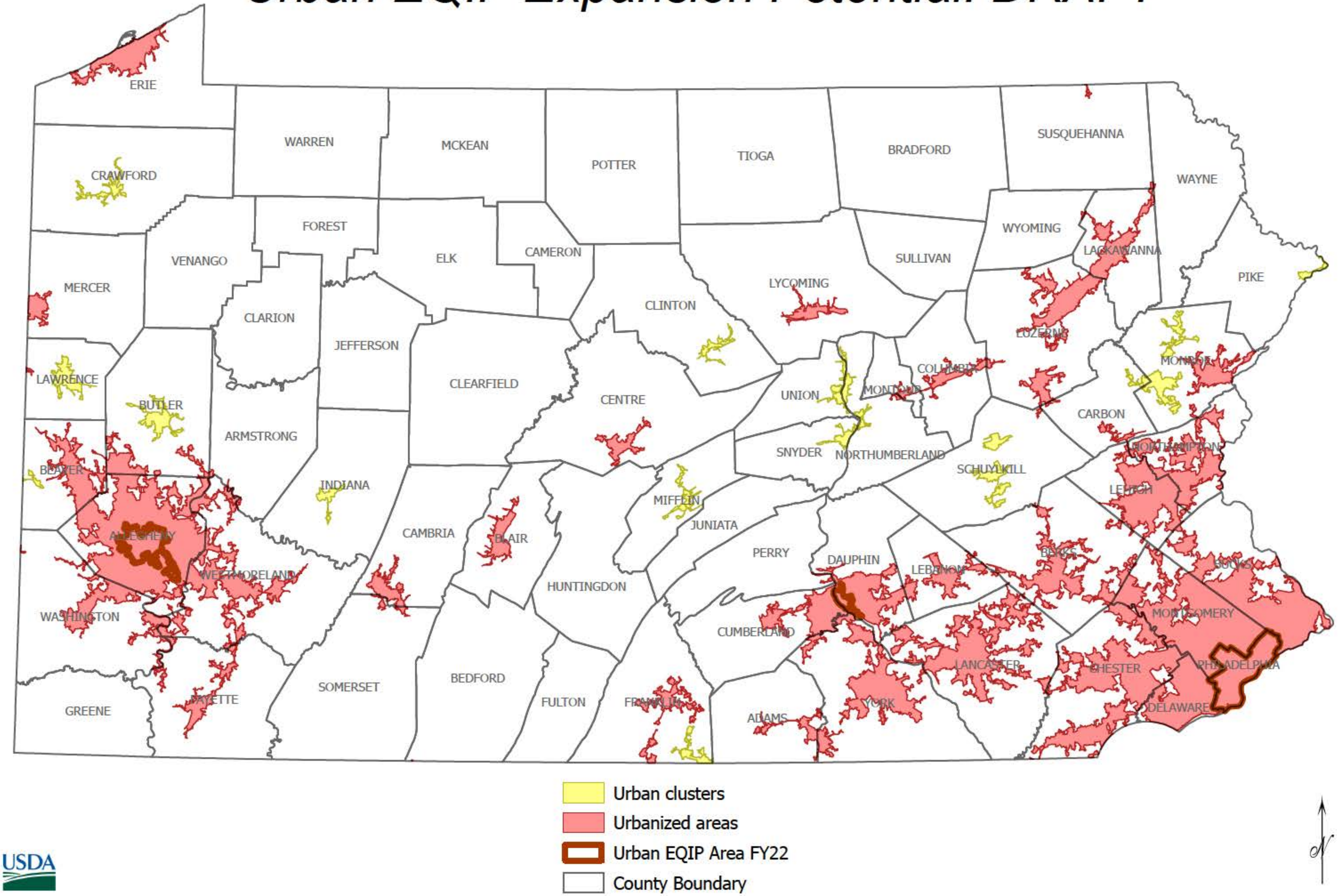
Small Scale Conservation Practices, Scenarios and Costs

	A	B	C	D	E
1	**Practice_Code**	**Practice_Name**	**Component**	**Unit_Type**	**23 Unit_Cost**
145	533	Pumping Plant	Electric Powered Pump over 60 HP	No	$ 21,458.35
146	533	Pumping Plant	Large piston Manure Pump	No	$ 37,043.84
147	533	Pumping Plant	Internal Combustion Powered Pump 40 to 75 HP	No	$ 37,711.05
148	533	Pumping Plant	Internal Combustion Powered Pump over 75 HP	No	$ 52,906.39
149	558	Roof Runoff Structure	Roof Gutter with Storage Tank	Gal	$ 1.68
150	558	Roof Runoff Structure	Roof Gutter	Ft	$ 8.31
151	558	Roof Runoff Structure	Trench Drain	Ft	$ 10.97
152	558	Roof Runoff Structure	Roof Gutter with Fascia	Ft	$ 15.28
153	558	Roof Runoff Structure	Roof Gutter, 6 inches wide with runoff Storage Tank	Ft	$ 15.57
154	558	Roof Runoff Structure	Concrete Curb	Ft	$ 17.23
155	558	Roof Runoff Structure	High Tunnel Roof Runoff Trench Drain and Storage	LnFt	$ 34.82
156	558	Roof Runoff Structure	Stone Infiltration Sump	No	$ 921.88
157	570	Stormwater Runoff Control	Rain Garden, small scale	SqFt	$ 1.36
158	575	Trails and Walkways	Wood Chips, Walkway small scale	SqFt	$ 1.55
159	587	Structure for Water Control	Culvert <30 inches HDPE	InFt	$ 2.63
160	587	Structure for Water Control	Culvert <30 inches CMP	InFt	$ 2.75
161	587	Structure for Water Control	Commercial Inline Flashboard Riser Regional	InFt	$ 4.39
162	587	Structure for Water Control	Inlet Flashboard Riser, Metal Regional	InFt	$ 4.49
163	587	Structure for Water Control	Inline Flashboard Riser, Metal Regional	InFt	$ 4.71
164	587	Structure for Water Control	Basin, earthen	LnFt	$ 23.94
165	587	Structure for Water Control	Rock Checks for Water Surface Profile Regional	Ton	$ 79.97
166	587	Structure for Water Control	Sprinkler gun	No	$ 677.90
167	587	Structure for Water Control	Water Bar	No	$ 700.06
168	587	Structure for Water Control	Grated Dropbox	No	$ 1,357.46
169	587	Structure for Water Control	Trench Drain with grate	No	$ 1,527.22
170	587	Structure for Water Control	Slide Gate Regional	Ft	$ 1,805.44
171	590	Nutrient Management	Small Scale Basic Nutrient Management	kSqFt	$ 57.91
172	590	Nutrient Management	Basic NM (Non-Organic/Organic)	Ac	$ 7.72
173	590	Nutrient Management	Basic NM with Manure and/or Compost (Non-Organic/Organic)	Ac	$ 16.29
174	590	Nutrient Management	Basic NM with Manure Injection or Incorporation	Ac	$ 33.21
175	590	Nutrient Management	Prescription Nutrient Efficiency	Ac	$ 37.47
176	590	Nutrient Management	Prescription Nutrient Efficiency and Precision Application	Ac	$ 50.24
177	590	Nutrient Management	Basic NM (Organic/NonOrganic) greater than or equal to 0.5-10 acres	No	$ 254.60
178	590	Nutrient Management	Adaptive NM	No	$ 2,267.82
179	595	Pest Management Conservation System	Plant health PAMS (Small Farm - each) labor only	No	$ 464.76
180	595	Pest Management Conservation System	Water Quality Pesticide Mitigation = 30 Point AND/OR Beneficial Insect Pesticide Mitigation - Small Farm	No	$ 993.21
181	595	Pest Management Conservation System	Plant health PAMS (Small Farm - each) labor and mitigation.	No	$ 1,514.58
182	595	Pest Management Conservation System	Water Quality Pesticide Mitigation > 30 Point AND/OR Beneficial Insect Pesticide Mitigation - Small Farm	No	$ 1,635.71
183	595	Pest Management Conservation System	Plant Health PAMS activities (Small Farm - each) labor and materials	No	$ 4,370.79

Small Scale Conservation Practices, Scenarios and Costs

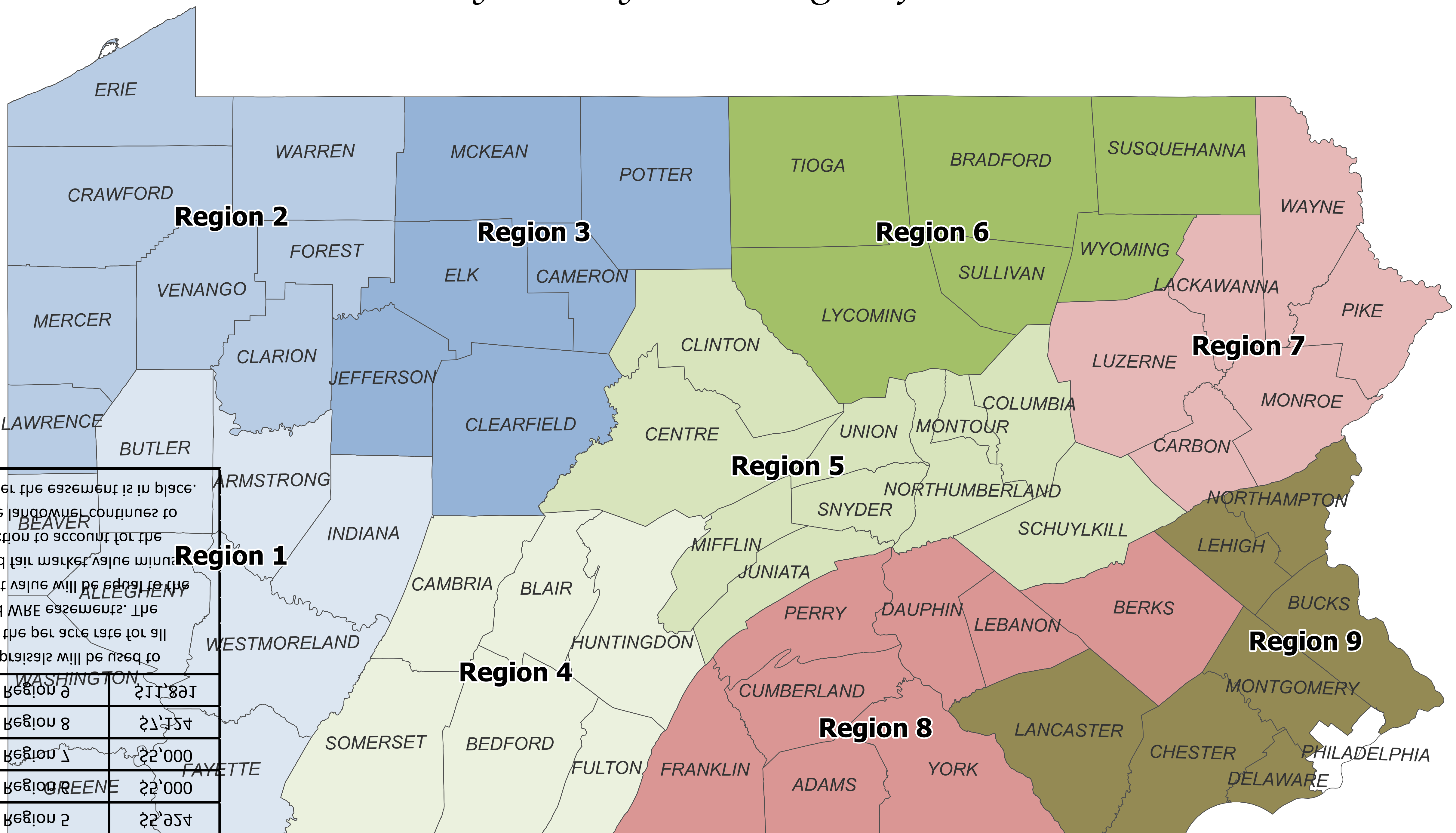
	A	B	C	D	E
1	Practice_Code	Practice_Name	Component	Unit_Type	23 Unit_Cost
184	595	Pest Management Conservation System	Plant Health PAMS activities (Small Farm - each) labor, materials and mitigation.	No	$ 6,559.72
185	595	Pest Management Conservation System	Plant Health PAMS (acs) Low labor only	Ac	$ 12.44
186	595	Pest Management Conservation System	Plant Health PAMS (acs) Low Labor and Materials	Ac	$ 18.07
187	595	Pest Management Conservation System	Water Quality Pesticide Mitigation = 30 Point AND/OR Beneficial Insect Pesticide Mitigation	Ac	$ 32.50
188	595	Pest Management Conservation System	Plant Health PAMS (acs) High labor only (intensive scouting etc.)	Ac	$ 38.75
189	595	Pest Management Conservation System	Plant Health PAMS (acs) Low Labor, materials and mitigation.	Ac	$ 49.76
190	595	Pest Management Conservation System	Pest Management Precision Ag	Ac	$ 51.77
191	595	Pest Management Conservation System	Water Quality Pesticide Mitigation > 30 Point AND/OR Beneficial Insect Pesticide Mitigation	Ac	$ 56.90
192	595	Pest Management Conservation System	Plant Health PAMS (acs) High Labor and materials	Ac	$ 349.61
193	595	Pest Management Conservation System	Plant Health PAMS (acs) High Labor, materials and mitigation.	Ac	$ 393.11
194	606	Subsurface Drain	Corrugated Plastic Pipe, Single Wall, Less than or equal to 6 inches	Ft	$ 4.09
195	606	Subsurface Drain	Enveloped Corrugated Plastic Pipe, Single Wall, Less than or equal to 6 inches	Ft	$ 5.12
196	612	Tree/Shrub Establishment	Tree-Shrub Establishment - Small Acreage	No	$ 13.51
197	620	Underground Outlet	UO 6 inch or less	Ft	$ 7.27
198	620	Underground Outlet	UO 6 inch w Riser or less	Ft	$ 7.56
199	620	Underground Outlet	UO 8 to 12 inch	Ft	$ 7.99
200	620	Underground Outlet	UO 8 to 12 inch w Riser	Ft	$ 9.43
201	620	Underground Outlet	UO 15 to 18 inch	Ft	$ 20.03
202	620	Underground Outlet	UO 21 to 24 inch	Ft	$ 31.33
203	620	Underground Outlet	UO with Boring, all sizes	Ft	$ 34.69
204	620	Underground Outlet	UO 27 to 30 inch	Ft	$ 42.01
205	620	Underground Outlet	UO over 30 inch	Ft	$ 53.51
206	649	Structures for Wildlife	Nesting Box, Small no pole	No	$ 64.42
207	649	Structures for Wildlife	Nesting Box, Small, with wood pole	No	$ 93.09
208	656	Constructed Wetland	Small <0.1 ac	SqFt	$ 0.54
209	812	Raised Beds	Unframed Raised Bedfield size < 0.5 acres Contamination or Debris Sites only	SqFt	$ 3.11
210	812	Raised Beds	Framed Raised Bed greater than or equal to 500 sq ft Contamination or Debris Sites only	SqFt	$ 3.57
211	812	Raised Beds	Unframed Raised Bed field size < 0.10 acres Contamination or Debris Sites only	SqFt	$ 4.10
212	812	Raised Beds	Framed Raised Bed < 500 sq ft Contamination or Debris Sites only	SqFt	$ 6.06
213	812	Raised Beds	Framed Raised Bed Small Lot Contamination or Debris Sites only	SqFt	$ 11.22
214	821	Low Tunnel Systems	Low tunnel management- Year 2-3	SqFt	$ 0.41
215	821	Low Tunnel Systems	Low tunnel 1000-5000 square feet, Year 1	SqFt	$ 1.24
216	821	Low Tunnel Systems	Low tunnel < 1000 square feet-Year 1	SqFt	$ 4.69

Urban EQIP Expansion Potential: DRAFT



01/12/53 – Melissa Hanner, NRCS, Easement Program Manager, was introduced and provided an update on the Agricultural Conservation Easement Program (ACEP). (See the attached Handouts.) She explained that ACEP protects the agricultural viability and related conservation values of eligible land by limiting nonagricultural uses which negatively affect agricultural uses and conservation values on eligible land. Further, that ACEP has two components, Agricultural Land Easements (ALE) and Wetland Reserve Easements (WRE). She then went into detail about the workings of these two components. She announced the sign-up deadlines for these components. Next she provided an update on GARC (Geographic Area Rate Caps) for WRE which were shown on the attached map of Pennsylvania, by region. In addition she reviewed the Subject Letter that was sent out in December 2022 by Susan Parry, PA NRCS Assistant State Conservationist for Programs that covered Proposed GARC WRE applications.

Geographic Area Rate Caps (GARC) for Wetland Reserve Easement Program (WRE) by Pennsylvania Region for FY 2023



NTE Rate per acre for Appraisals		
Legend	Region	NTE
	Region 1	$5,549
	Region 2	$5,000
	Region 3	$5,000
	Region 4	$5,000
	Region 5	$5,924
	Region 6	$5,000
	Region 7	$5,000
	Region 8	$7,124
	Region 9	$11,891

Note: Appraisals will be used to establish the per acre rate for all proposed WRE easements. The easement value will be equal to the appraised fair market value minus 5% reduction to account for the rights the landowner continues to retain after the easement is in place.

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NRCS
Natural Resources Conservation Service

Update on Agricultural Conservation Easement Program (ACEP)
January 19, 2023

ACEP protects the agricultural viability and related conservation values of eligible land by limiting nonagricultural uses which negatively affect agricultural uses and conservation values on eligible land.

ACEP has two components:

- Agricultural Land Easements (ALE) - Permanent Easements that protect croplands and grasslands on working farms by limiting non-agricultural uses of the land through conservation easements.
  ACEP-ALE requires an entity to assist with the cost of purchasing the easement and the entity also holds the easement instead of NRCS.
- Wetland Reserve Easements (WRE) – Permanent Easements that protect, restore and enhance wetlands which have been previously degraded due to agricultural uses.

Program Signup Deadlines

- Applications accepted on a continual basis.
  - ACEP ALE - Apply through local county agricultural board
  - ACEP WRE – Apply through local USDA service center
- December 31, 2022 – First cutoff
  - Pennsylvania Department of Agriculture (PDA) submitted 3 new parcel applications
- March 1, 2023 – Next cutoff

Learn more about the Easement Process - American Farmland Trust (AFT) Website
https://farmlandinfo.org/acep-ale-for-landowners/

Update on GARC (Geographic Area Rate Caps) for WRE
Request for comments were sent to State Advisory Technical Committee on December 12, 2022. In FY2023, Pennsylvania NRCS will use individual appraisals to determine the value of the land offered in WRE applications. Not to exceed rates are set based on the average cost of cropland across nine Geographic Regions across Pennsylvania. The alternative to using individual appraisals would be to contract out an annual Area Wide Market Analysis of the average land values by region across Pennsylvania. With no comments received, PA NRCS will submit the proposal to the NRCS national office to use individual appraisals.

December 12, 2022

SUBJECT: Proposed Geographic Area Rate Caps (GARC) and Not to Exceed (NTE) Rates for Fiscal Year (FY) 2023 Wetland Reserve Easement (WRE) applications

ACTION REQUESTED BY: January 19, 2023

PURPOSE: To request review and comments from the Pennsylvania State Technical Advisory Committee (STAC) on the proposed GARC and NTE Rates for FY2023 WRE Applications.

SUMMARY: Pennsylvania NRCS is accepting comments from the STAC from now until January 19, 2023, on the proposal to use individual appraisals and the NTE rates shown for FY2023 WRE applications. Comments should be identified by the subject "FY23 WRE GARC" and should be submitted by email to melissa.hanner@usda.gov, or you may mail or hand-deliver comments to:

USDA Natural Resources Conservation Service
Attention: Easements
359 East Park Drive, Suite 2
Harrisburg, PA 17111-2747

EXPLANATION: Each year, the Pennsylvania NRCS must establish GARC and NTE Rates for WRE applications received in that year. The easement value will be equal to a percentage of Fair Market Value (FMV) that is determined by Area Wide Market Analysis (AWMA) or by individual Appraisal. In prior years, Pennsylvania NRCS used a statewide AWMA. This is not currently justified given the comprehensive nature of a statewide AWMA and the limited number of easement applications. On average, Pennsylvania NRCS receives less than five eligible applications per year. **Because of the limited number of WRE applications, Pennsylvania NRCS proposes using individual appraisals for each eligible application.**

Pennsylvania NRCS proposes that easement value will be equal to 95% of the appraised FMV. The 5% reduction accounts for rights that the landowner continues to retain after the easement is in place. This is the default percentage provided in national instructions and Pennsylvania NRCS has consistently used this percentage for previous year applications.

Pennsylvania counties are grouped into 9 geographic regions for the purpose of establishing rate caps that reflect the differing land values across the state (see next page). National instructions provide for a default NTE rate cap of $5,000 per acre. States may increase the per acre rate cap for geographic regions where land values normally exceed this rate. Pennsylvania geographic groupings and proposed rate caps are based on the statewide AWMA prepared on January 4, 2022. The rate cap reflects 95% of the higher value of cropland appraised in that region over the past 3 years.

USDA

United States Department of Agriculture

Market Area or Geographic Area	Counties	Appraisal Percentage	Appraisal NTE Rate Per Acre
Region 1	Allegheny, Armstrong, Beaver, Butler, Fayette, Greene, Indiana, Washington, Westmoreland	95%	$5,549
Region 2	Clarion, Crawford, Erie, Forest, Lawrence, Mercer, Venango, Warren	95%	$5,000
Region 3	Cameron, Clearfield, Elk, Jefferson, McKean, Potter	95%	$5,000
Region 4	Bedford, Blair, Cambria, Fulton, Huntingdon, Somerset	95%	$5,000
Region 5	Centre, Clinton, Columbia, Juniata, Mifflin, Northumberland, Schuylkill, Snyder, Union,	95%	$5,924
Region 6	Bradford, Lycoming, Sullivan, Susquehanna, Tioga, Wyoming	95%	$5,000
Region 7	Carbon, Lackawanna, Luzerne, Monroe, Pike, Wayne	95%	$5,000
Region 8	Adams, Berks, Cumberland, Dauphin, Franklin, Lebanon, Perry, York	95%	$7,124
Region 9	Lancaster, Bucks, Chester, Delaware, Lehigh, Montgomery, Northampton	95%	$11,891

Contact: Questions can be directed to Melissa Hanner, Pennsylvania NRCS Easement Programs Manager, at 717-344-0553 or melissa.hanner@usda.gov.

/s/

SUSAN PARRY Digitally signed by SUSAN PARRY Date: 2022.12.13 23:28:01 -05'00'

SUSAN PARRY
Pennsylvania NRCS Assistant State Conservationist for Programs

Attachment – FY23 WRE GARC Map

01/16/30 – Ryan Cornelius, Programs (NRCS): (See attached Handout.) Ryan announced that EQIP has been allocated a little over $24 Million for FY23 with $425,200 earmarked for Golden Winged Warbler. The NWQI program has been allocated $1,000,000. AMA this year have been allocated $200,000. Currently they're ranking first round EQIP/AMA applications with the ranking deadline being January 20th. Right now, if someone were to put an application in, they would be considered a third round. He proceeded by reviewing the Application sign-up dates and the application eligibility timelines.

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PA NRCS Programs Team

Financial Assistance Programs Update
EQIP/AMA

Pennsylvania State Technical Committee Meeting
Ryan Cornelius, Conservation Program Manager

January 19, 2023

Natural Resources Conservation Service

nrcs.usda.gov/

United States Department of Agriculture

FY23 EQIP/AMA

EQIP- FY23 Allocation

- General: $24,009,000
- Golden-Winged Warbler: $425,200
- NWQI: $1,000,000

AMA-FY23 Allocation

- General: $200,000

Currently ranking 1st round EQIP/AMA applications and ranking deadline is Friday, January 20th and we will be starting to make selections next week.

FY-2023 AMA and EQIP and RCPP18

Application Sign-up Numbers: Application ranking periods for:

1 - November 1, 2022
2 - January 1, 2023
3 - March 1, 2023
4 - May 1, 2023

Application Eligibility Timelines:

1 - January 1, 2023
2 - March 1, 2023
3 - May 1, 2023
4 - July 1, 2023

Questions?

01/19/22 - Melissa Erdman, NRCS Acting CSP Manager, was introduced and provided Conservation Stewardship Program (CSP) updates. (See attached Handout.) CSP early on in the fiscal year was obligated 62 renewal contracts for 2023. Those were all obligated before the parent contract expired on December 31st. So those 62 contracts obligated $2.7 million across 19,000 acres. CSP 2023 classic round one applications were due January 1st and most activity will be done in March. She indicated that area-wide round-table meetings with the District Conservationists in February to review updates with CSP, also to discuss enhancement suites popular in areas with high participation in CSP and also to discuss future outreach to boost program enrollment.

State Technical Committee
Thursday, January 19, 2023

Conservation Stewardship Program (CSP)– Melissa Erdman, Acting CSP Manager

- CSP 2023 Renewals were all obligated by December 31. PA renewed and obligated 62 contracts for $2.7 million dollars, across 19,000 acres

- CSP 2023 Classic – Round 1 applications were due January 1. The timeline for 2023 CSP is as follows: March 1 – eligibility due; March 10 – screening of applications and field verification due; March 17 – rankings due; March 24 – applications selected for funding; May 31 – plans and contracts due for review; June 30 – obligation deadline

- We are scheduling area-wide roundtable meetings with DCs/SDCs in February to review updates with CSP, have a Q&A time, discuss enhancement suites popular in areas with high participation in CSP, discuss future outreach to boost program enrollment

01/21/41 – Johanna Davis, FSA, Huntingdon, PA Office spoke for Jim Gillis, FSA Update (NRCS). (See attached Handouts.) She discussed the Modernization of the Conserve Reserve Program (CRP) and the Conservation Reserve Program (CREP). She indicated that previous rates that we were working with, really had remained unchanged for approximately 20 years and were last updated in 2016. So the changes that have been implemented with the updates have been done in order to allow for better use of resources. Try to maximize the use of these resources within the national CRP policy. She notes that the updates to these rates do not change anything that's in the actual agreements. So, the rates that are applied for state cost share through the EP have not changed with these increases. There are fewer and smarter components which should make it simpler and more transparent to understand the process both for FSA, our technical service providers, and the producers for the most extent possible. Components are all on a per acre basis rather than something being impounded by other things in acres. She provided and discussed an example of one update that concerned CP22, Riparian Forest Buffer. CRP and CREP are currently available as ongoing offers, and there should be some announcements coming out from the National office about general sign up and grasslands sign up in the coming weeks and months as well. If there are any questions, feel free to contact a FSA representative.

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NEW Pennsylvania CRP Cost Share Program

Farm Service Agency

fsa.usda.gov

Modernizing CRP C/S in PA

The previous PA CRP C/S system was established in 2003 (PA Notice CRP-1). Rates were published in 2-CRP (Rev 5) "PA Exhibit 9" which was last updated in 2016. The system was:

- Out of date – many prices not updated since 2003
- Not producer friendly
- Hard to implement in the current FSA C/S software
- Not consistent with other USDA financial assistance

The newly approved PA CRP C/S system, effective for all new CRP/CREP contracts approved on or after 1/6/2023 and published in PA Notice CRP-34 is:

- Based on current rates and estimated prices
- More transparent and producer friendly
- Easier for FSA to administer
- More consistent with other USDA programs, using Natural Resource Conservation Service (NRCS) payment scenarios to the maximum extent possible

USDA United States Department of Agriculture

Modernizing CRP C/S in PA

To the maximum extent possible, the newly approved FSA CRP C/S rates were created by aligning CRP/CREP conservation plan activities to existing NRCS payment scenarios.

- Some NRCS payment scenarios had to be adjusted to remove ineligible items (example: forgone income, seed) or align the activity to the CRP practice standard (example: required trees per acre). FSA coordinated closely with NRCS staff (State Biologist) throughout this process.

- National CRP policy required that seed be a separate component.
    - Seed components were established based on CRP practice standards and seed cost lists from reliable vendor sources.
    - Tree planting costs were calculated using a combination on NRCS cost rates and planting costs from reliable vendor sources.

Please note that the changes to FSA CRP C/S apply to all CRP administered by FSA, including Conservation Reserve Enhancement Program (CREP). These rates do not change the PA State cost share amounts (via DEP) added through CREP.

Modernizing CRP C/S in PA

The newly approved CRP C/S program uses fewer and smarter components which will make the CRP C/S process simpler, more transparent, more producer friendly and easier to FSA to administer.

- All counties in Pennsylvania will use the same rates and components for more consistent program delivery.
- Most component costs are per acre, if possible, for ease of use.
- The new components and codes will make it easier to FSA to estimate maximum eligible cost share prior to contract approval which will help the producers.
- FSA will still be required to collect accurate receipts and bills from the producer to determine eligible costs. Ineligible costs will not be considered for cost share.

Example: CP22 Riparian Forest Buffer

Conservation plan calls for burning down the existing cover, seeding a fescue grass mix using a no till drill, followed by herbicide application and planting trees and shrubs, and fencing to exclude the livestock.

Previous CRP C/S Program
Separate components and calculations for each of these items:

- Herbicide Material (Ac)
- Herbicide Application (Ac)
- No Till Drill (Ac)
- Grass seed (lbs.)
- Herbicide Material (Ac)
- Herbicide application (Ac)
- Bareroot trees (each)
- Containerized trees (each)
- Shrubs (each)
- Trees shelters (each)
- Stakes for tree shelters (each)
- Labor for tree planting (each)
- Fence (feet)

NEW CRP C/S Program
A minimal number of components!

- Critical Area Planting (Ac)
- Critical Area Seed mix (Ac)
- Tree/Shrub site prep– Chemical (Ac)
- Establishment of Trees and Shrubs with stakes and shelters (Ac)
- Fencing (feet)

Note that the new components combine the previous components, so no payment opportunities are lost, just restructured

Questions?

Johanna Davis

Agricultural Program Specialist

Conservation Programs

Johanna.Davis@usda.gov

717-237-2132

01/27/06 - Adam Dellinger, RCPP Update (NRCS): (See attached Handout.) RCPP is on the same schedule as equip and AMA for accepting applications this year. They are in the middle of round three right now and the next cutoff date for applications will be March 1st, 2023. There are three projects right now that we are accepting applications under the Buffalo Creek Watershed Conservation Alliance project that is in Western PA Armstrong, Allegheny, and Butler counties. On the slide there's a number of counties there in the Chesapeake Bay and Central PA area. And so, these projects are ongoing, funded, and accepting applications. He goes on to show two new RCPP projects on the slides. If your organization may be interested in the RCP program, we will have another notice of funding opportunity for fiscal year 23, expect that to be published in a couple months.

END OF MEETING
No questions in chat

United States Department of Agriculture

Regional Conservation Partnership Program (RCPP) Update

Adam Dellinger

State Technical Committee Meeting

1/19/23

Natural Resources Conservation Service

nrcs.usda.gov/

United States Department of Agriculture

Fiscal Year 2023 RCPP Landowner Contracts

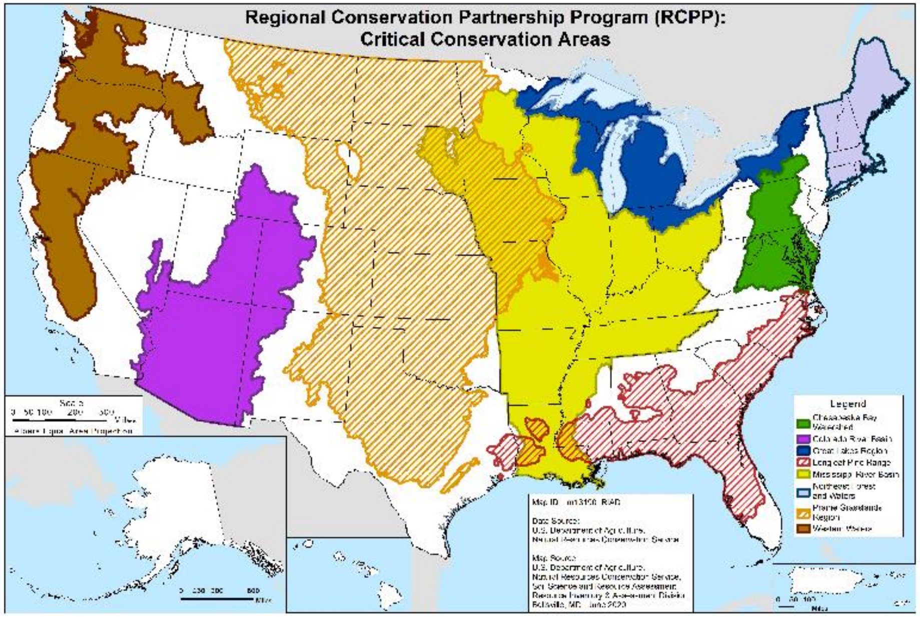
- **Accepting applications using same deadlines as EQIP/AMA**
    - Next application cutoff date March 1, 2023
- **Buffalo Creek Watershed Conservation Alliance**
    - Armstrong, Allegheny, and Butler Counties
- **Lancaster's Common Agenda for Clean Water**
    - Lancaster County
- **Turkey Hill Clean Water Partnership**
    - Lycoming, Northumberland, Union, Snyder, Blair, Bedford, Lancaster, Lebanon, Berks, Dauphin, Franklin, Cumberland, Adams, York, and Chester Counties

FY22 RCPP Projects

- **Farmland Preservation and Climate Change Mitigation**
  - Lead Partner: Pennsylvania Department of Agriculture
  - Award: $7,850,000
  - Project Area: Statewide
  - **Programmatic Partnership Agreement (PPA) currently in negotiation**
- **Strategy to rapidly restore ag-impaired streams in Central PA**
  - Lead Partner: Chesapeake Conservancy
  - Award: $9,996,006
  - Project Area: Lycoming, Union, Snyder, Clinton, Centre, and Huntingdon Counties
  - **PPA ready for review by National RCPP staff**
  - **Announcement of producer contract application signups coming very soon.**
    - **March 1, 2023 cutoff for Round 1 applications**

FY23 Notice of Funding Opportunity

- **FY23 funding announcement expected late winter 2023**
  - RCPP projects can last up to five years and projects may be funded between $250,000 and $10 million over the life of the project.
  - 50% of total funding targeted for projects in CCAs, and 50% for statewide and multi-state projects.



United States Department of Agriculture

Please reach out with any questions

Adam Dellinger, RCPP Coordinator

adam.dellinger@usda.gov

717-237-2206

Natural Resources Conservation Service

nrcs.usda.gov/

Full Name	User Action	Timestamp
+1 717-226-8445	Joined	1/19/2023, 1:07:48 PM
Anderson, Christopher	Joined	1/19/2023, 1:03:07 PM
Brenda Shambaugh	Joined	1/19/2023, 1:03:04 PM
Bresaw, Kathryn	Joined	1/19/2023, 1:00:42 PM
Challenger, Justin	Joined	1/19/2023, 12:56:00 PM
Chris Sigmund	Joined	1/19/2023, 1:05:28 PM
Coleman, Denise - NRCS, Harrisburg, PA	Joined	1/19/2023, 12:58:47 PM
Cornelius, Ryan - NRCS, Harrisburg, PA	Joined	1/19/2023, 12:59:36 PM
David Kann (Guest)	Joined	1/19/2023, 12:59:59 PM
Davis, Johanna - FSA, Huntingdon, PA	Joined	1/19/2023, 1:01:10 PM
Dellinger, Adam - FPAC-NRCS, Harrisburg, PA	Joined	1/19/2023, 12:59:35 PM
Dimka Braswell (Guest)	Joined	1/19/2023, 12:53:17 PM
Erdman, Melissa - NRCS, Mifflintown, PA	Joined	1/19/2023, 12:51:15 PM
Evans, Ted - NRCS, Harrisburg, PA	Joined	1/19/2023, 12:32:53 PM
Garcia, Beth	Joined	1/19/2023, 1:00:52 PM
Hanner, Melissa - NRCS, Harrisburg, PA	Joined	1/19/2023, 12:55:41 PM
Hebelka, Joseph	Joined	1/19/2023, 12:59:40 PM
Hoagland, Peter - NRCS, Harrisburg, PA	Joined	1/19/2023, 12:53:41 PM
Jahrsdoerfer, Sonja SJ	Joined	1/19/2023, 1:02:28 PM
Jennifer Farabaugh	Joined	1/19/2023, 12:55:27 PM
Joe Sweeney (Guest)	Joined	1/19/2023, 1:10:22 PM
Katie Ombalski	Joined	1/19/2023, 1:00:49 PM
Kinney, Timothy - NRCS, Harrisburg, PA	Joined	1/19/2023, 11:57:41 AM
Kyle (Guest)	Joined	1/19/2023, 12:45:20 PM
Lauren Bettleyon (Guest)	Joined	1/19/2023, 1:01:14 PM
Lindsay McKee | Pasa (Guest)	Joined	1/19/2023, 1:05:02 PM
Marel King	Joined	1/19/2023, 12:59:15 PM
Parry, Susan - NRCS, Harrisburg, PA	Joined	1/19/2023, 12:59:12 PM
Peters, Timothy - NRCS, Harrisburg, PA	Joined	1/19/2023, 12:58:05 PM
Plowden, Yuri - NRCS, Harrisburg, PA	Joined	1/19/2023, 12:58:33 PM
Roberts, Mark	Joined	1/19/2023, 12:57:40 PM
Schneider, Frank	Joined	1/19/2023, 1:12:47 PM
Stahl, Tom	Joined	1/19/2023, 12:58:25 PM
Tom Ulrich	Joined	1/19/2023, 1:02:02 PM
Veith, Tamie	Joined	1/19/2023, 1:06:56 PM
Wadia Gardiner	Joined	1/19/2023, 12:56:45 PM

Pennsylvania State Technical Committee Meeting

January 19, 2023

The Pennsylvania State Technical Committee Meeting was held in the USDA Conference Room at the NRCS State Office.

Denise Coleman (NRCS) (Natural Resources Conservation Service) opened the meeting at 1 PM. Denise welcomed everyone to the second quarterly STC meeting as there was one in October. She began by introducing Dan Ludwig and explaining that from there, they will go around and introduce themselves in order. They started with NRCS staff and following their introductions, the non NRCS employees introduced themselves as well. After the greetings, Eric Rosenbaum is introduced, and he begins with his presentation.

00/09/13 - Eric Rosenbaum (Conservation Innovation Grants), PA 4R Nitrogen Modeling CIG Project, Assistant Executive Director, was introduced and presented information on what he has learned from the conservation innovation grants that he has. (See attached Handouts) Eric Rosenbaum is an agronomist with Rose Tree Consulting. He is grateful to have gotten the APA Conservation Innovation Grant to do some work on cover crops and advanced nitrogen management. He thanks NRCS for their involvement, but specifically Mark Goodson, who is integral in their ability to put together programming and push it out to different stakeholders within the state, and particularly as it pertains to this project. Eric also thanks Dan for the guidance that he had given over the past year and a half to bring the project to fruition.

He moves on to begin the summary portion of this presentation. He says that what they were after in this project is to be able to look within the CSP activity E 590 DB to figure out if there were other tools that could be added to that particular enhancement to allow farmers to use nitrogen modeling and other subfield zoned developed tools to get a nitrogen rate. They also wanted to look at how to incorporate cover crop contributions into determining what the correct rate of nitrogen fertilizer was. There were two main components to this project, #1 cover crop evaluation and modeling to determine cover crop contributions and #2 system modeling to compare a nitrogen modeling platform to a NRCS 590 level of an nutrient management plan. For the cover cropping, there were 20 farms that volunteered to participate in the program and for the system modeling and there were 83 fields that eric used for comparison. The purpose was to compare a nutrient management plan using the ACT 38 template. So, there was enough confidence to provide NRCS with in modifying the E 590 modeling as a cost shareable tool for farmers to use for whole field and subfield management. His next slide lays out missed opportunities that he felt occurred with the E 590 program. They were: not integrating real time data into those nitrogen recommendations, not identifying active lost nitrogen pathways that occur within farms, and not quantifying the total loss from each pathway and being modifying the initial plan based off in season decisions. All in all, he says, the E 590 program is great, and it allows farmers to come in and manage nutrients on a field and subfield basis. However, when it comes to nitrogen, there are some missed opportunities that a nitrogen modeling program being brought in could fix. Eric would like to introduce a teaching tool. Everybody should have a copy of this teaching tool and should feel comfortable using this teaching tool for it to be able to go out to their clientele and provide information on cover crop modeling and nitrogen contributions. Eric jumps to a slide that shows the mass calculation calculator. It shows double crop carryover, manure history, and legume history, which are all well balanced in the calculator. What needs to be worked on is soil organic matter contributions and cover crop nitrogen contributions. The next couple of slides deal with granular agronomy as he wanted to spend a little bit of time talking about what they do and what their service is. They have two services that they offer to Eric and his team. One is a crop modeling service and the other is to be able to use their nitrogen modeling tool. Two things to consider when using this tool are: #1 to be certified as a TSP to write nutrient management plans and understand state level nutrient management guidelines. Following with #2, which is to be well educated on the model. On Eric's final slide, he goes over the cover crop biomass sampling project. For this project, they did 20 sites throughout the state of Pennsylvania on multiple different soil types, multiple geographies from southern Franklin County to northern Columbia County, and very different cover cropping strategies. He goes on to show three examples of the cover crops on the slides and how the tool is helpful and manageable in various situations. Eric ends the presentation by thanking everyone for their time and encourages everyone to use the tool and spread the information shared.

<u>00/41/23</u> - <u>Tim Peters (NRCS), Agricultural Engineer</u>, was introduced and presented a report/update. (See attached Handout). He begins by saying that there was a recently hired engineer in the State Office and he started right before Christmas. His name is Paul Schaefer, and you will probably see him at future meetings. He moves on to an update on HPAI which is highly pathogenic avian influenza. They have ended

poultry visit suspension on 1/3 and are back to just making normal visits. Security practices are being practiced regularly and everyone is encouraged to follow these procedures to ensure safety as nobody knows what HPAI will bring in the future. Nationally, they are requiring him to move a lot of our engineering tools to Photog, and he'll be working on this for the next month or two. On the PA NRCS engineering website, you are probably familiar with the tools such as: construction guides, design guides, engineering spreadsheets, fact sheets and standard detail drawings. These are the ones that will have to be moved to photog. When the move happens, he'll put out a notice. But, he will also l leave the link to photog tools on the website. Big news for the team is on the watershed end as they have started the first step for a watershed project in Tab Canyon. The first step for is a Piffer, which is a preliminary investigation feasibility report. That's what happens before a plan begins and provides reasonable assurances that the plan can be developed without obstacles.

00/46/03 - Dan Ludwig (NRCS), State Resource Conservationist, was introduced. He had few remarks and updates. There is an intro to planning training coming and in the past we had nine NRCS employees attend and 10 Conservation district staff. So, they are gearing up for the boot camps here in March and April. He is the TSP coordinator so in trying to define what the term means it has become a heavy workload. With that in mind, Dan plans on updating everyone on contracting and payment schedules in the next couple of weeks.

00/53/08 - Yuri Plowden (NRCS): Yuri will be giving a soils data update, and specifically, a land evaluation update. (See attached Handout)

Lease of values can also be used in state or local farmland protection programs and in conjunction with things like farmland classification, for example, prime farmland or farmland of statewide importance. The Farmland Protection Policy Act's purpose is to minimize the extent to which federal programs contribute to the unnecessary conversion of important farmland to nomadic uses. We don't want taxpayer money to be just willy nilly converting farmland to non ag uses. It has to be evaluated. She points out the 8106 on the slide and describes how to fill it out and its purpose. Keep in mind that soul survey data undergoes continuous updating and it's refreshed every year, so this can result in new soil map units being added or some being deleted, and so the soils data had not been examined for these changes since 2016. . If you want more information about the updates in your specific county, don't hesitate to contact Yuri.

00/59/51 – Susan Parry, NRCS Operations, and Dimka Braswell, Urban Subcommittee Chairman: (See attached Handouts.) There are new hires currently in the onboarding phase. They go on to recap the Urban Ag subcommittee meeting last month. There are a number of practices now available for small scale operations, which would include Urban AG. There is a lot of opportunity for people to utilize and get a higher payment for urban practices because we're taking into account transportation as well as you know the fact that some of these people are not going to get materials from big suppliers, they're going to go to Home Depot or something else. The next Urban subcommittee meeting is March 14th. Urban service centers have been launched in Philadelphia and 16 other locations. The ability to have 250,000 used in other urban areas of the state, not just the three, not just Pittsburgh, Philadelphia and Harrisburg are being explored. So, Susan brought up a map to display it. Melissa takes over for an easement update. ALE applications first cut off was December 31st and our next cutoff will be March 1st, but they are accepting it continually, easements are received through the local county add preservation boards and conservancies. Those higher values are driven in the more urban areas, so those rate caps would be set at 95% of the value in that area.

01/12/53 – Melissa Hanner, NRCS, Easement Program Manager, was introduced and provided an update on the Agricultural Conservation Easement Program (ACEP). (See the attached Handouts.) She explained that ACEP protects the agricultural viability and related conservation values of eligible land by limiting nonagricultural uses which negatively affect agricultural uses and conservation values on eligible land. Further, that ACEP has two components, Agricultural Land Easements (ALE) and Wetland Reserve Easements (WRE). She then went into detail about the workings of these two components. She announced the sign-up deadlines for these components. Next she provided an update on GARC (Geographic Area Rate Caps) for WRE which were shown on the attached map of Pennsylvania, by region. In addition she reviewed the Subject Letter that was sent out in December 2022 by Susan Parry, PA NRCS Assistant State Conservationist for Programs that covered Proposed GARC WRE applications.

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