Appendix B: Methods and Resources Subcommittee Meeting Materials

Attachment 1

Members List

METHODS AND RESOURCES
Joe Anderjaska
Brittany Bartak
Don Batie
Jesse Bradley
Russ Callan
Brian Kissinger
Scott Knobbe
Tim Mundorf
Annette Sudbeck

Attachment 2

Meeting Schedule

DATE	*LOCATION*
July 16, 2025	Kearney
August 21, 2025	Kearney
September 24, 2025	Kearney
October 22, 2025	Virtual
November 13, 2025	Kearney
December 16, 2025	Norfolk

Attachment 3

Presentation Materials

Presented by Hillside Solutions & Soil Dynamics

On Farm Organics Management in Nebraska

B-4

Who are we and why are we here today?

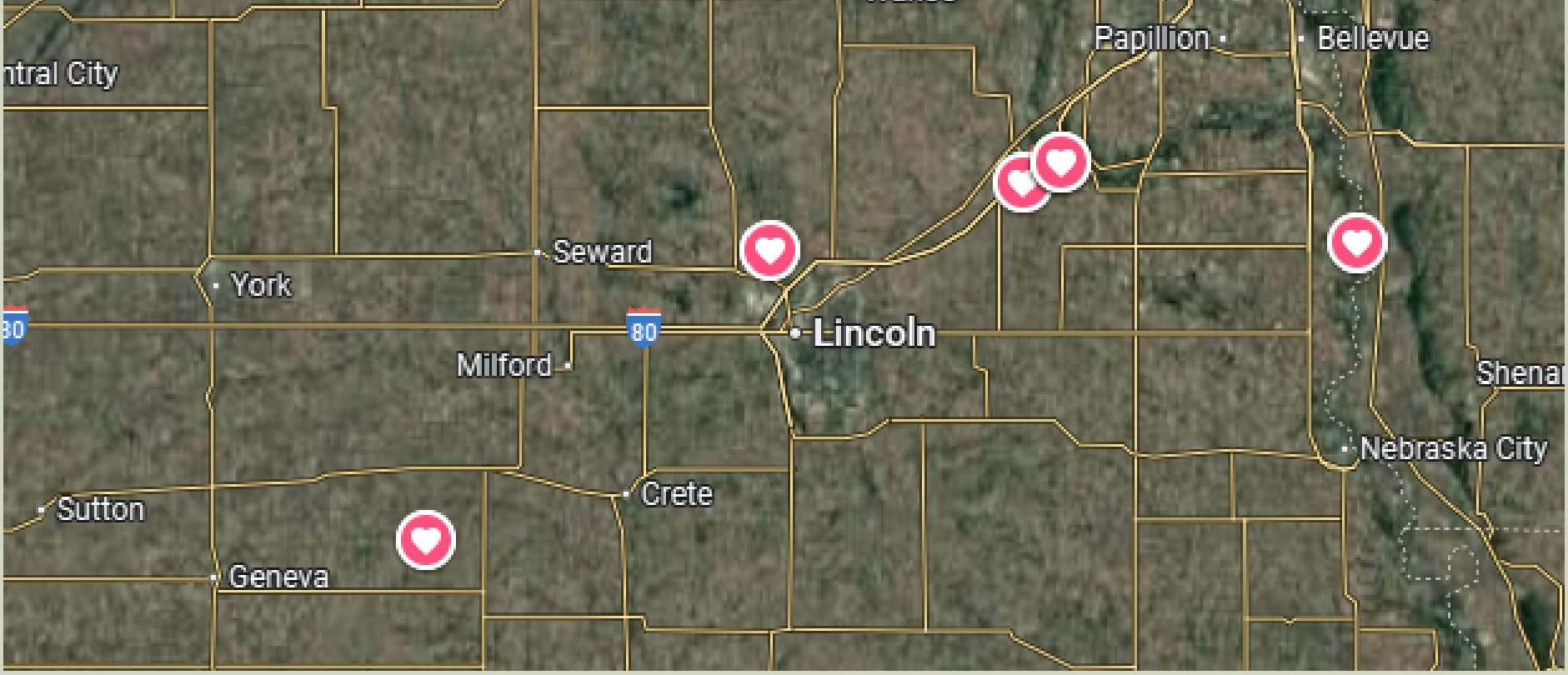
Hillside Solutions-Gretna Sanitation-Soil

Overview of the Waste Business

Where does all the trash go?

So what did we do?

Got back into farming!



Farm Locations

We're doing this!

REPORT NUMBER
20-316-1158
COMPLETED DATE
Nov 16, 2020
RECEIVED DATE
Nov 10, 2020
ACCOUNT
27403

Midwest Laboratories®
13611 B Street · Omaha, Nebraska 68144-3693 · (402) 334-7770
www.midwestlabs.com

PAGE 1/2
TODAY'S DATE
Nov 16, 2020

SOIL DYNAMICS

PO BOX 810
GRETNA NE 68028

IDENTIFICATION
FRIEND NE FARM

SOIL ANALYSIS REPORT

LAB NUMBER *370*	SAMPLE IDENTIFICATION	ORGANIC MATTER	PHOSPHORUS			POTASSIUM	MAGNESIUM	CALCIUM	SODIUM	pH		CATION EXCHANGE CAPACITY C.E.C.	PERCENT BASE SATURATION (COMPUTED)				
						K	Mg	Ca	Na	SOIL pH	BUFFER INDEX		% K	% Mg	% Ca	% H	% Na
75765	1	1.9 L	6 VL	15 L		211 H	382 VH	1871 L	13	5.2	6.2	20.0	2.7	15.9	46.8	34.3	0.3

LAB NUMBER *370*	NITRATE-N (FIA) SURFACE			SUBSOIL 1			SUBSOIL 2			Total lbs/A	SULFUR S	ZINC Zn	MANGANESE Mn	IRON Fe	COPPER Cu	BORON B		SOLUBLE SALTS
75765	7	13	0-6							13	4 VL	0.4 VL	14 H	43 VH	0.8 L	0.1 VL	L	0.1 L

The above analytical results apply only to the sample(s) submitted. Samples are retained a maximum of 30 days.

WARD Laboratories, Inc.

Ag Testing - Consulting

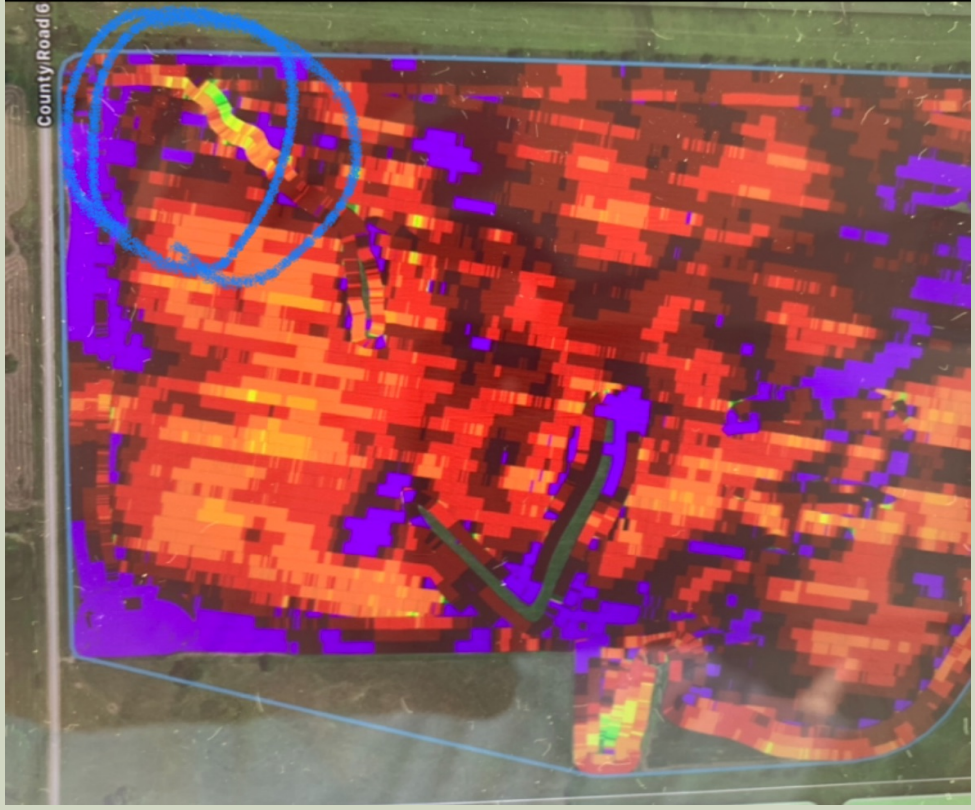
Account No. : 96647

HARPENAU, ANDY
19580 W H 31
SPRINGFIELD NE 68059

Results For : ANDY HARPENAU
Location : FRIEND FARM

Lab No. : 292752	Depth : 0 - 8
ID : FRIEND-SOUTH	
Organic Matter LOI, %	3.7
Organic Carbon, % C	1.827
Ace Protein, g/Kg	3.29
POX-C, ppm C	322
Aggregate Stability 1-2mm, %	56

OMG look at that OM! 2024 on the right.



2021 Yield Map

WHY??

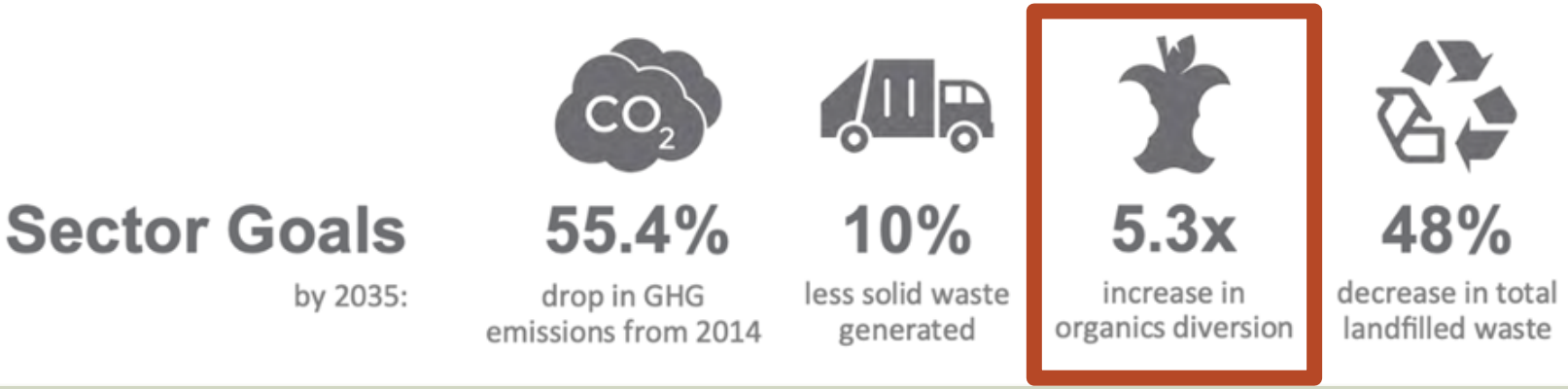
No soil moving

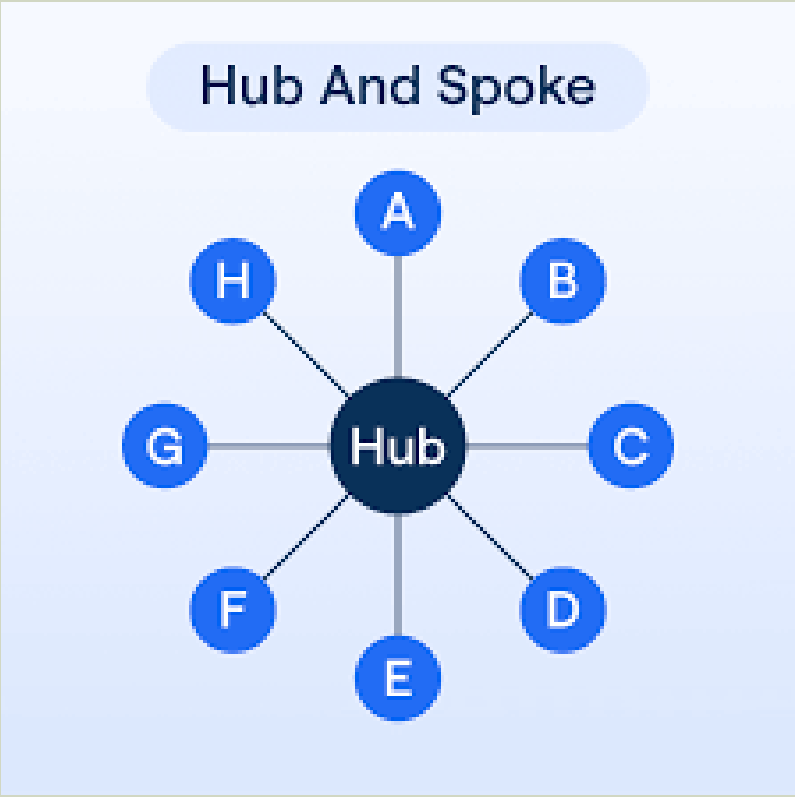
Mr Rooster better be quick!

Bringing it all together, together.

Feedback from the **Omaha Climate Action Plan**.

Goals of the Omaha Action Climate Plan by 2035





Hub and Spoke-How does this work?

Win-Win for everyone!

- Reduces reliance on synthetic fertilizers → less groundwater pollution.
- Diverts organics from landfills → lowers methane emissions.
- Supports regenerative/organic agriculture.
- Improves soil health-water retention
  - → less need for irrigation
  - → reduces flooding risks.
- Increases farm profitability → Farmers start managing input costs
- Aligns with Governor Pillen's water quality/quantity agenda
- Creates no taxpayer cost, extends landfill life.

Economic Benefits to Farmer (3,000 yds Incoming Organics)

Revenue & Value

- $5/yd incoming material → **$15,000**
- Replaces $125/ac anhydrous (200 bu corn @ 220 lbs) → **$20,000**
  - No credit for beans/cover crops; excludes other nutrients
- **Gross: $35,000 (160 ac = $218.75/ac)**
  - Based on $0 off-farm nutrient cost

Labor & Trucking (20 mi haul, 3,000 yds/yr)

- Compost: 2% N = 20 lbs/yd (½ available Yr 1; 1,600 yds remain)
- Delivery & row building: 43 loads @ $4/mi + loader $100/hr → **$4,440**
  - Includes double-ground mulch for odor control
- Screening: $450/hr (includes haul-away) → **$6,750**
- Spreading: 10 yds/ac → $8/yd (if done during screening) → **$12,800**
- **Total cost: $23,990**

Net Income: $11,010 total or **$68.81/ac**

Pad prep-1 time cost $10-15k

The Challenges

- Odors
- Regulatory-NDWEE
- Contamination
- BMPs and NMPs
- Rented ground

- No silver bullet
- Not for everyone

Andy Harpenau
President
andy@hillside.solutions

Two little weeds that keep growing.

Questions?

Examining the effect of fertilizer application practices on soil nitrate and water quality

Presented by:

Chris Hobza, Lead Hydrologist, P.G. and

Jason Moudry, LLNRD Water Programs Specialist

With contributions from:

Derek Vogt, Harold Benton, Mikaela Cherry, Ben Dietsch, Brent Hall, Tylr Naprstek, and Russ Callan

August 21, 2025

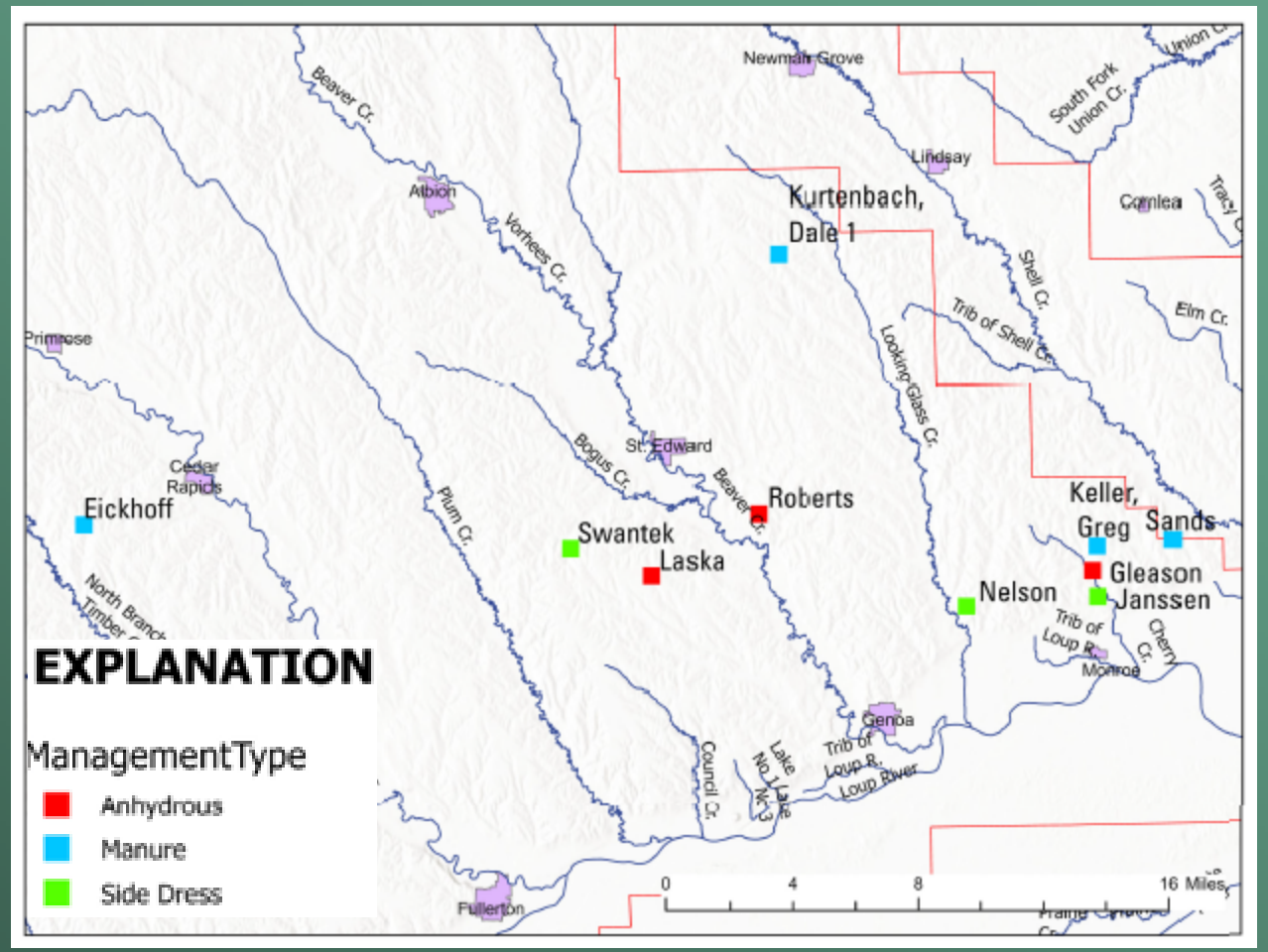
U.S. Department of the Interior
U.S. Geological Survey

Project timeline

- Starting in fall of 2022 the LLNRD began discussions on banning fall application of commercial fertilizer across the District
- Proposed rule changes received a lot of push back during public meetings in January 2023
- February Board adopted all proposed rule changes EXCEPT the fall fertilizer ban with the idea it would be revisited in one year
- Shortly thereafter LLNRD staff began conversation with USGS on how to assess the influence of fertilizer application practices on nitrate movement
- In spring 2023, the LLNRD and the USGS began developing a study plan to sample soil N (ammonia and nitrate) through the 2024 growing season

Site selection and initial work plan

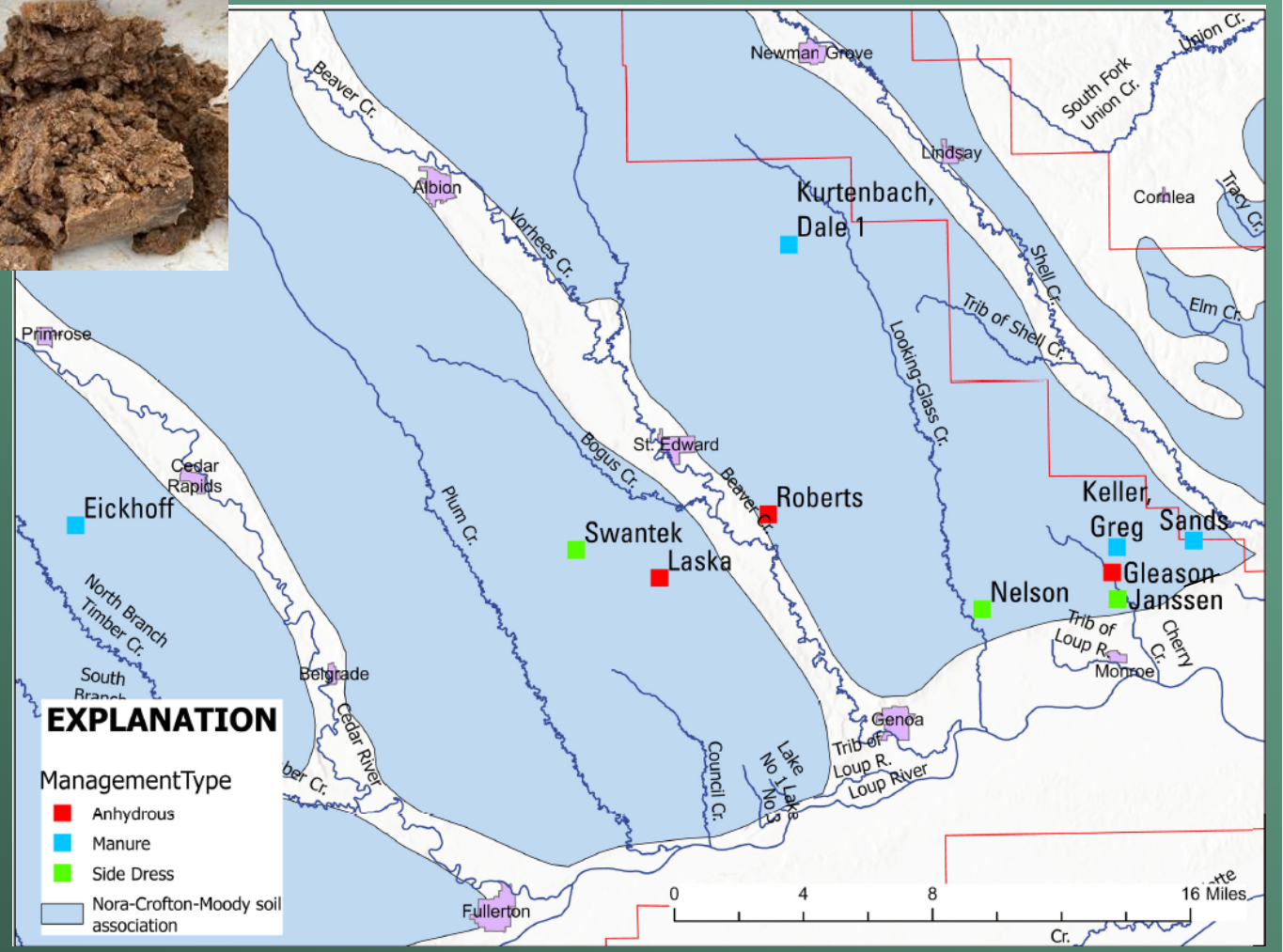
- Board encouraged affected producers to participate in study with NRD
- 10 groundwater irrigated fields were selected that used different fertilizer application practices: fall anhydrous, manure, and side dress
- Thank you to all study participants!



USGS

Area soils and site characteristics

- All sites are in areas mapped as Nora-Crofton-Moody soil association
- These soils are deep, well-drained, and located in upland areas
- Texture is generally silt loam or silty clay loam
- Moderately high to high infiltration rate (0.2 to 2.0 in/hr)
- Typically, irrigated corn and soybeans (where there is sufficient groundwater available)



Soil parent material and hydrologic characteristics

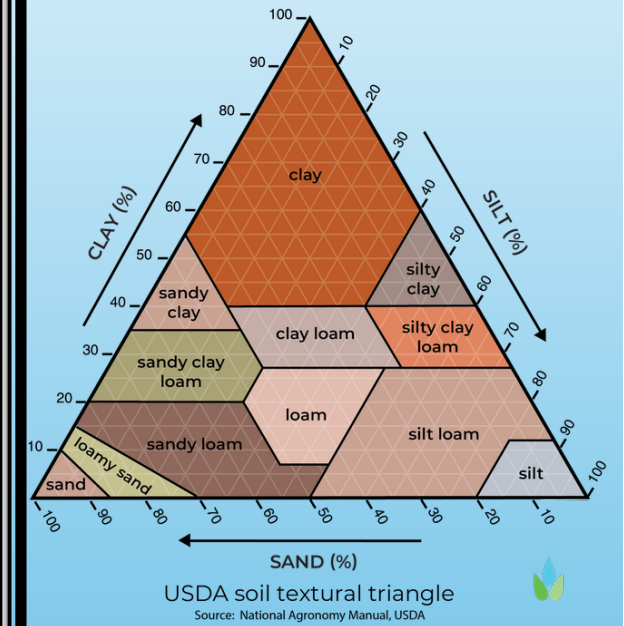
- Nora Crofton soils are derived from Peoria Loess parent material
- Loess is wind blown silt deposited during last glacial period
- Soil structure and development of macropores (voids, cracks, etc) can lead to higher infiltration rates

USGS

Field Textures

Depth	Laska 1	Roberts 2	Gleason 1	Eickhoff 2	Sands 2	Keller 2	Kurtenbach 2	Janssen 3	Nelson 1	Swantek 2	Choat #3
0-1	Silty Clay	Silty Clay	Silty Clay Loam	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Clay Loam
1-2	Silty Clay	Silty Clay Loam	Silty Clay Loam	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Clay Loam
2-3	Silty Clay	Silty Clay	Silty Clay Loam	Silty Clay Loam	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Clay Loam
3-4	Silty Clay	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Silty Clay Loam	Silty Clay Loam	Silt Loam
4-5	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay	Silty Clay	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silt Loam
5-6	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silt Loam
6-7	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silt Loam
7-8	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silt Loam
8-10	Silty Clay Loam	Silty Clay Loam	Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silt Loam
10-12	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silt Loam
12-14	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silt Loam
14-16	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silt Loam
16-18	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silt Loam
18-20	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silt Loam
20-22	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay	Silty Clay Loam	Silty Clay Loam	Silt Loam
22-24	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam		Silty Clay Loam	Silty Clay	Silty Clay Loam	Clay Loam	Silt Loam
24-26	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam		Silty Clay	Silty Clay	Silty Clay Loam		Silt Loam
26-28	Silty Clay	Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam		Silty Clay Loam	Silty Clay Loam	Silty Clay Loam		Clay Loam
28-30	Silty Clay	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam		Silty Clay Loam	Silty Clay Loam	Silty Clay Loam		Clay Loam

Silty Clay Loam	Silty Clay	Silt Loam	Clay Loam



USDA soil textural triangle

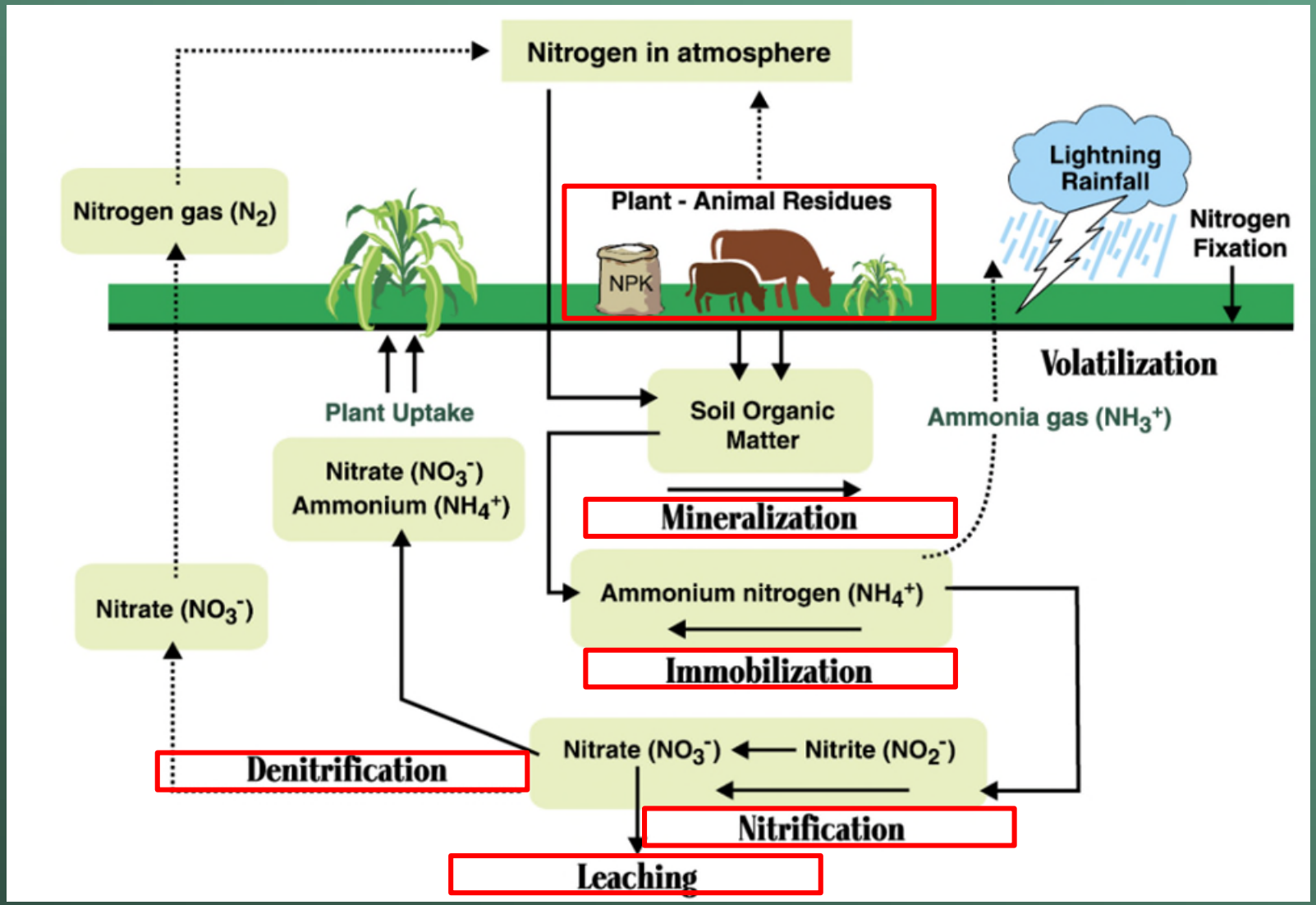
Source: National Agronomy Manual, USDA

Study approach – soil-N sampling

- Soil cores collected at 10 fields through growing season at specific crop stages
  - 30-ft samples when fields were accessible
  - 8-ft samples collected during growing season
- For each field, cores were collected at three locations
- Each core was subdivided into 1-ft increments to 8-ft, then 2-ft increments to 30-ft and sent to Ward Labs for analyses

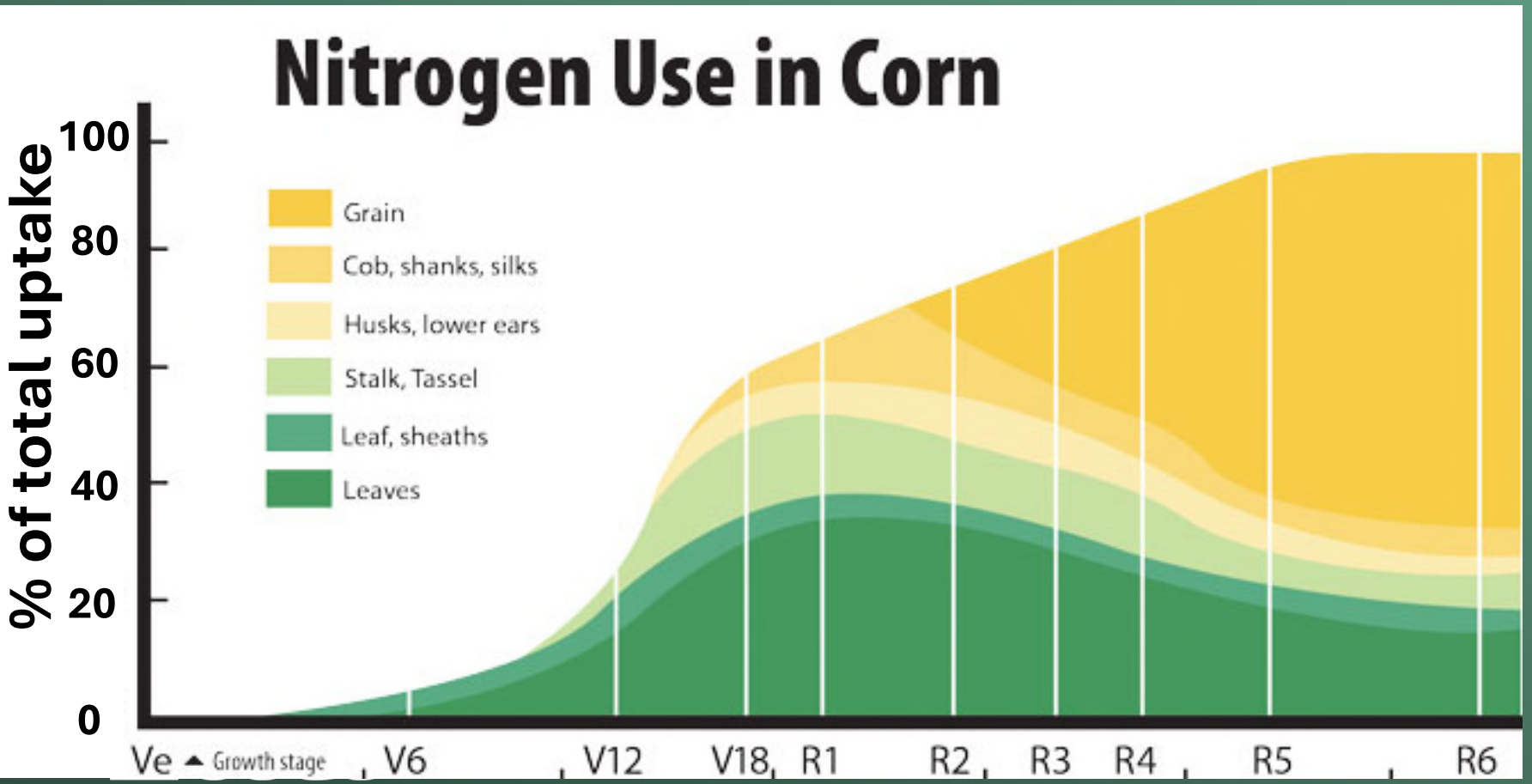
USGS

The nitrogen cycle in agricultural landscapes



From Keena and others, 2022

When is nitrogen needed?



- Much of N use is between V6 to V18 (typically mid-June to mid-July
- For context commercial fertilizer application mid-November to early December

Study approach – Bromide tracer test

- Bromide was applied at land surface to estimate the infiltration rates of solutes through the soil
- Bromide (negatively charged ion) is an ideal conservative tracer (will not bind to soil particles or lost by plant uptake)
- Repeated soil coring can track solute movement and can be used to determine the maximum rate of percolation

USGS

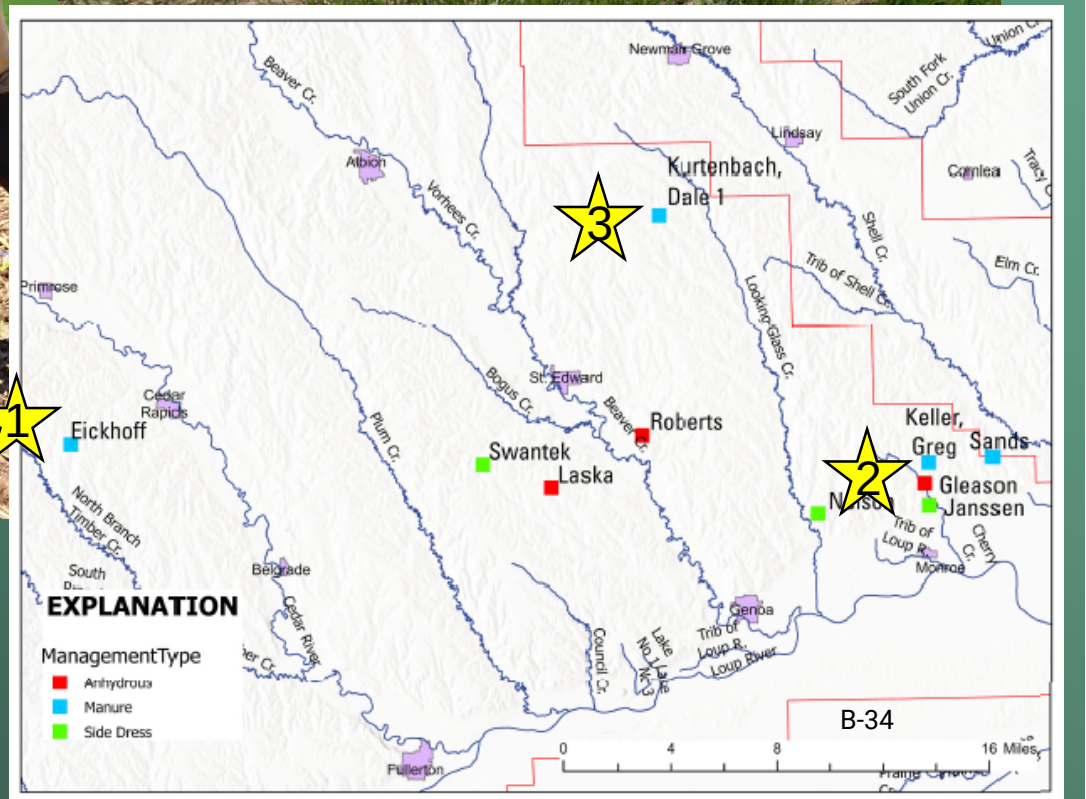
Study approach – Bromide tracer test

- Potassium bromide, was applied to all 10 fields in June in a 10 ft by 10 ft area
- Soil cores were collected ~9 weeks later to determine how much bromide moved
- The time elapsed from application to sampling, total precipitation, and irrigation water applied affect the depth that bromide had reached

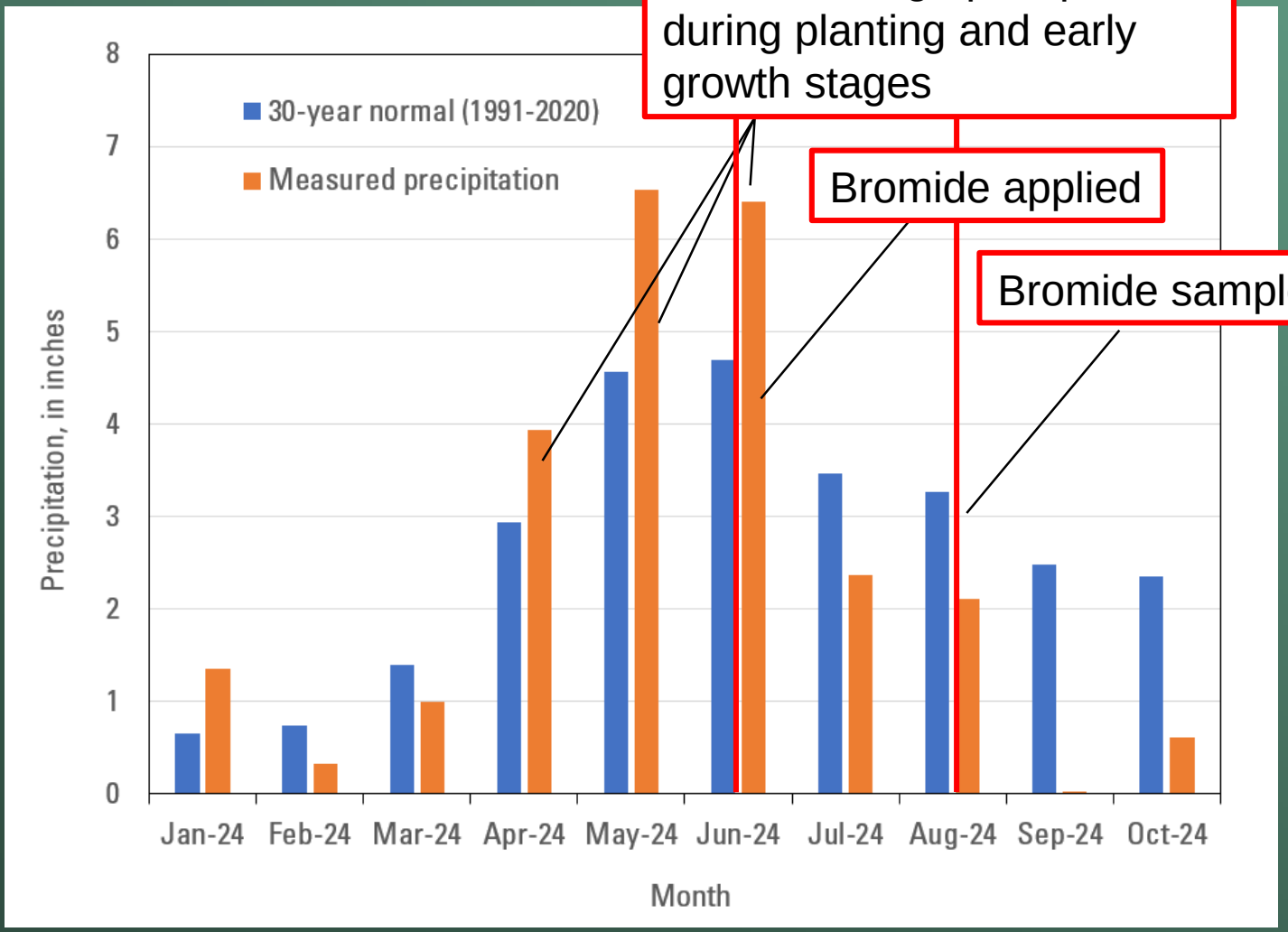
USGS

Soil moisture monitoring

- Soil moisture was collected continuously at 3 sites
  - Capture extreme precipitation events
  - Identify irrigation events
  - Track the development and extent of the root zone through the growing season
- Continuous water content data at 9 depths down to 3.3 ft



Measured precipitation vs. 30-year normal

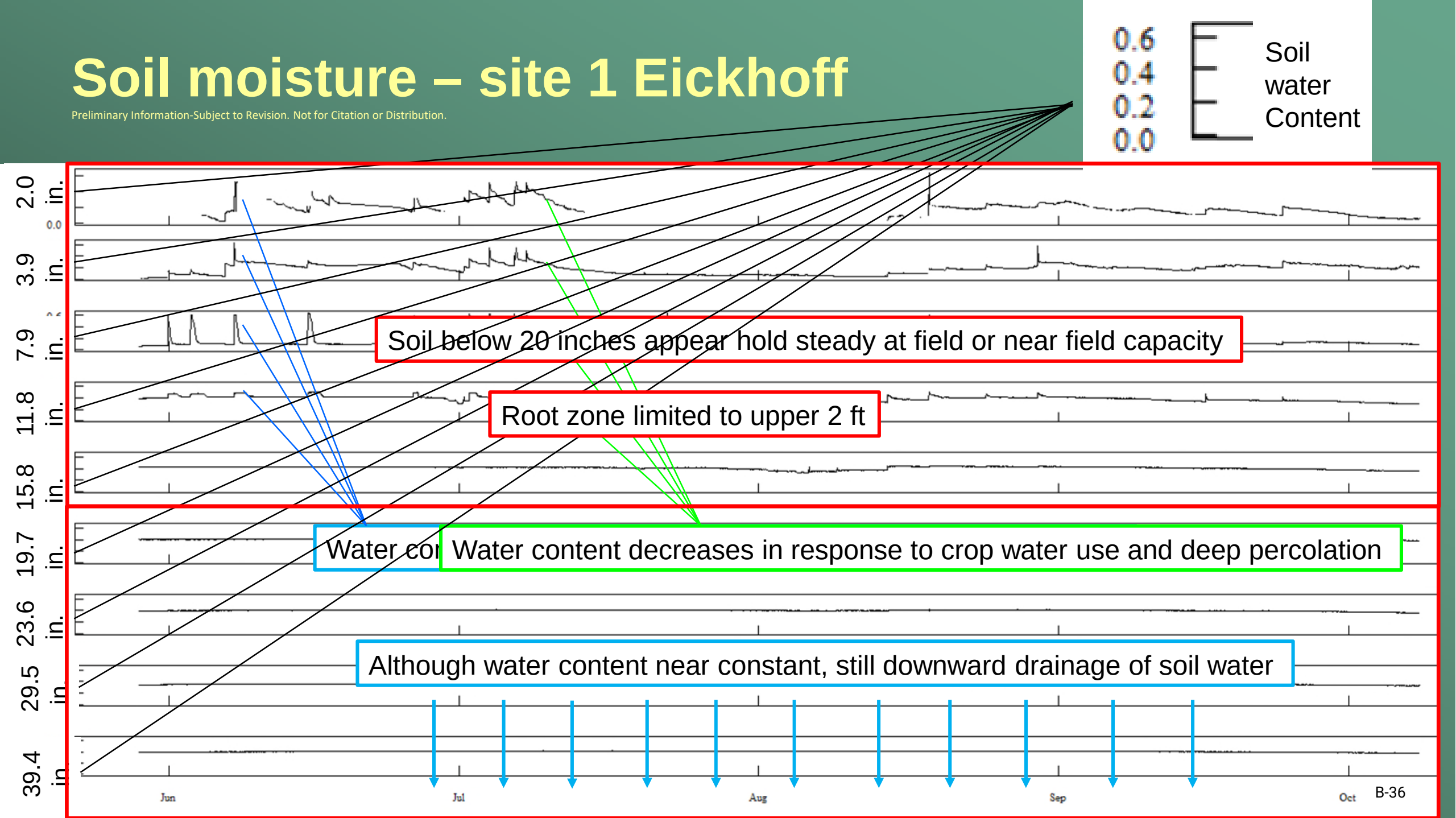


- Above normal precipitation totals April through June
- Increased precipitation affected planting and soil sampling schedules
- Later summer to early fall extremely dry
- Bromide movement expected following precipitation and/or irrigation

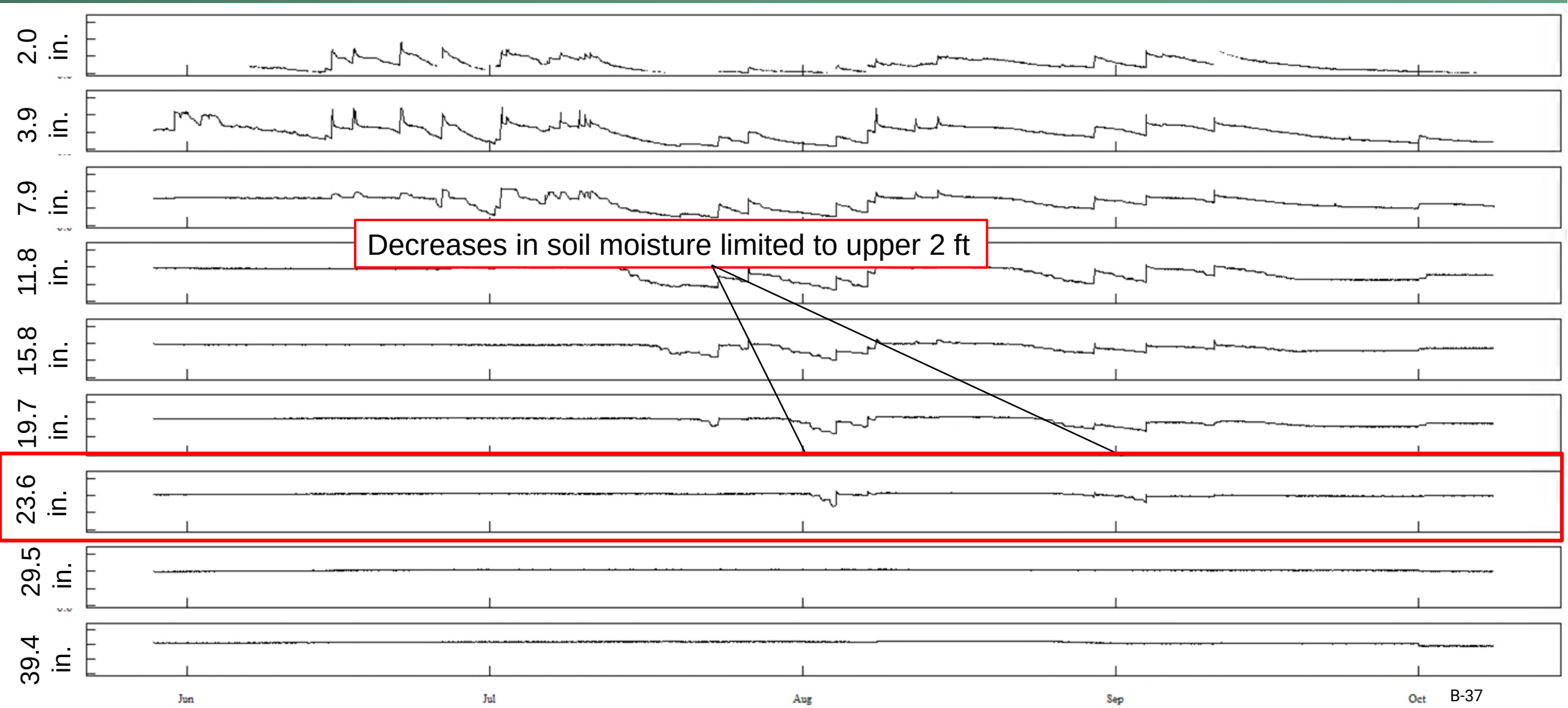
Data from National Center for Environmental Information, 2024

Soil moisture – site 1 Eickhoff

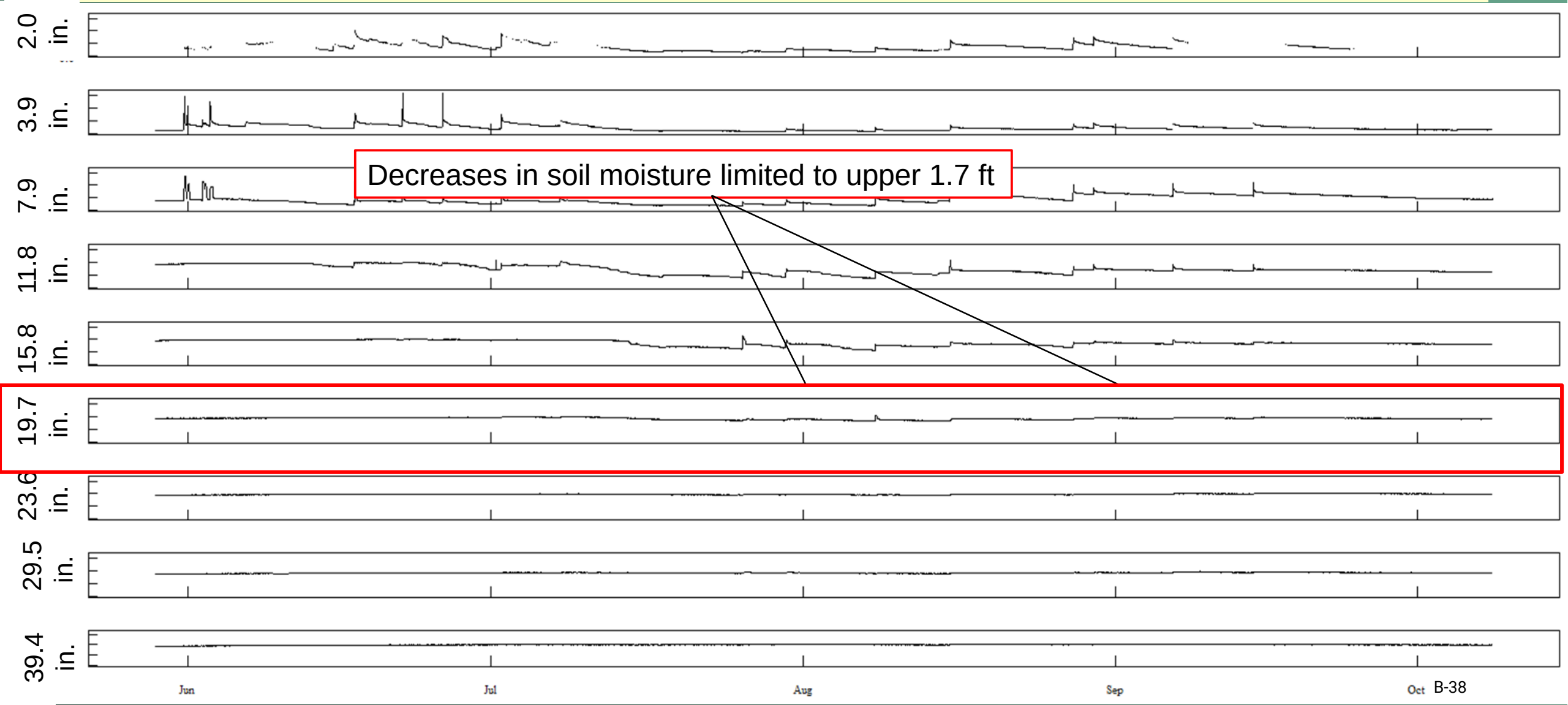
Preliminary Information-Subject to Revision. Not for Citation or Distribution.



Soil moisture – site 2 Keller



Soil moisture – site 3 Kurtenbach

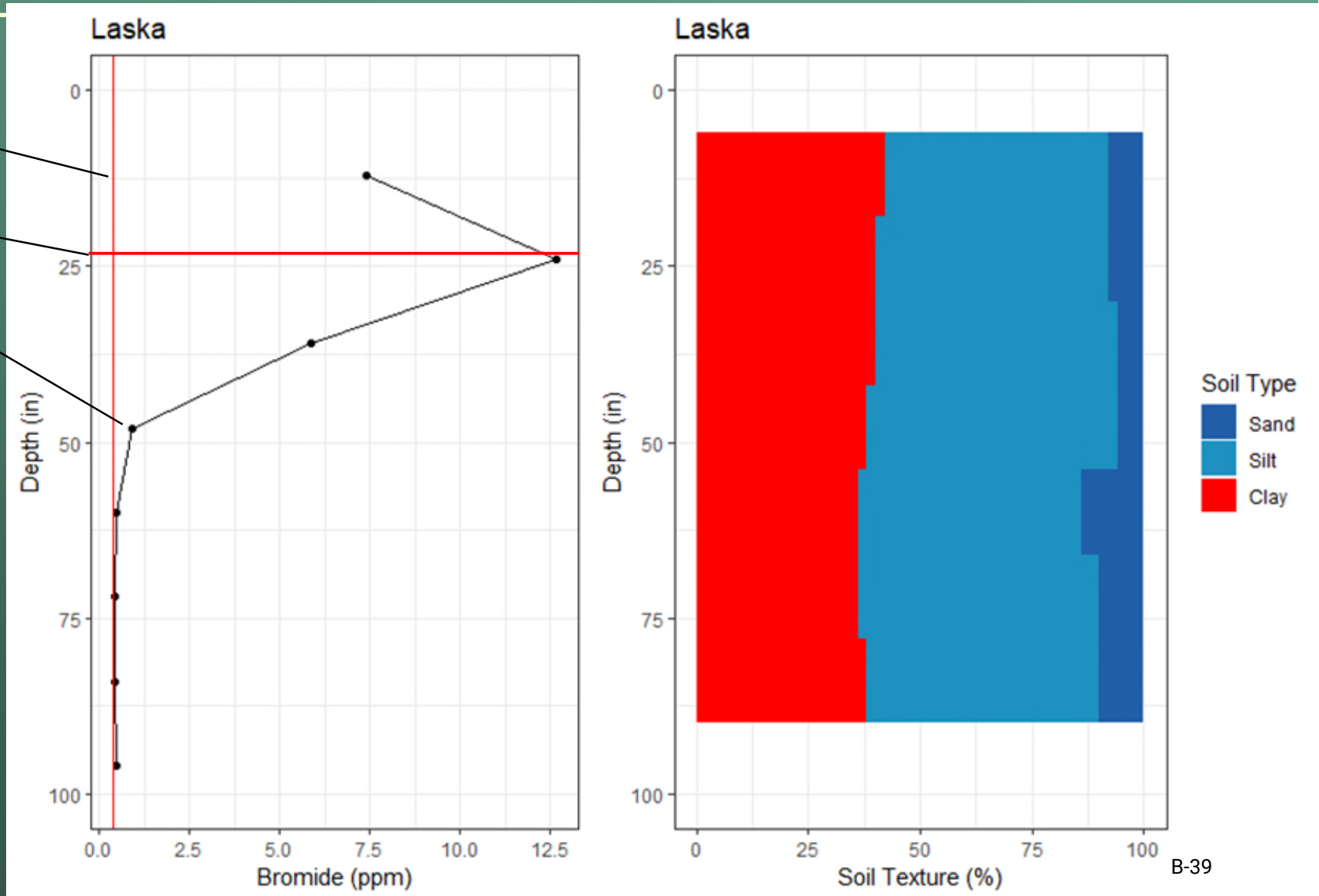


Example bromide tracer and soil texture data

Natural background concentration of bromide (0.5 ppm)

Maximum depth of root zone

Leading edge, or maximum depth

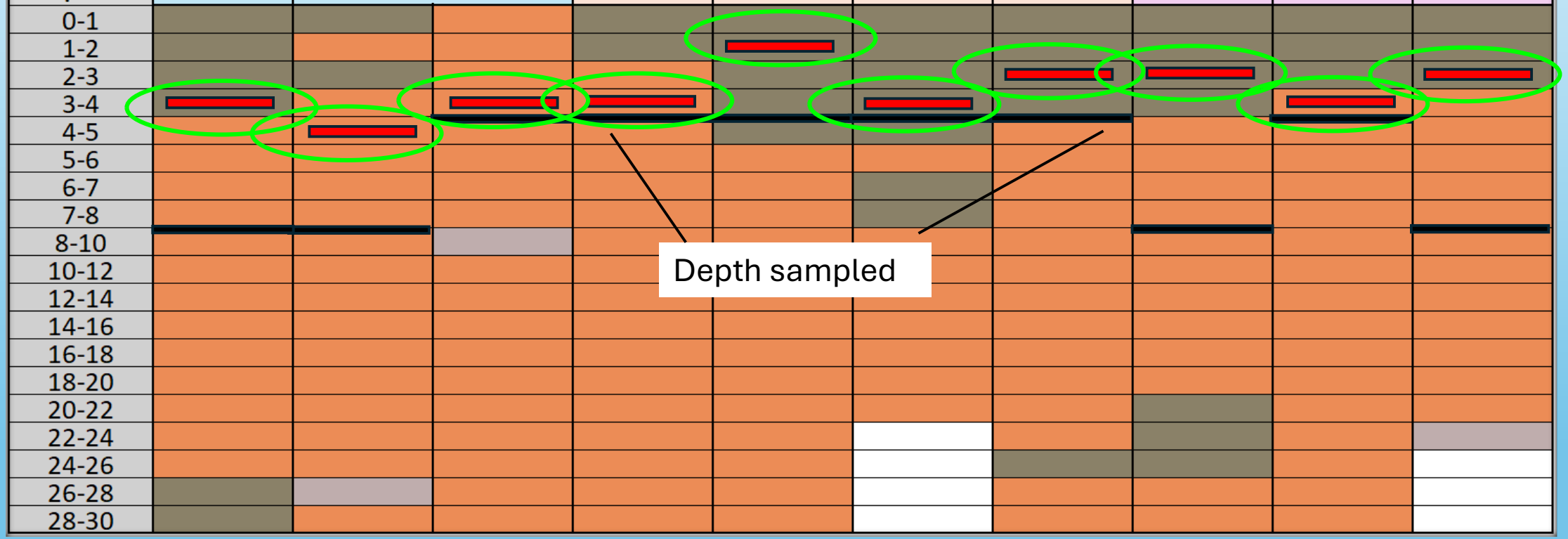


Bromide Tracer Movement

Fe

Da Measured rainfall between Br-
ap application and sampling

Practice	Anhydrous			Manure				Sidedressed		
Days Applied	79	73	48	56	48	52	56	52	55	58
Rainfall - In.	11.6	11.5	6.8	7.5	8.6	8.3	7.5	8.3	9.8	9.8

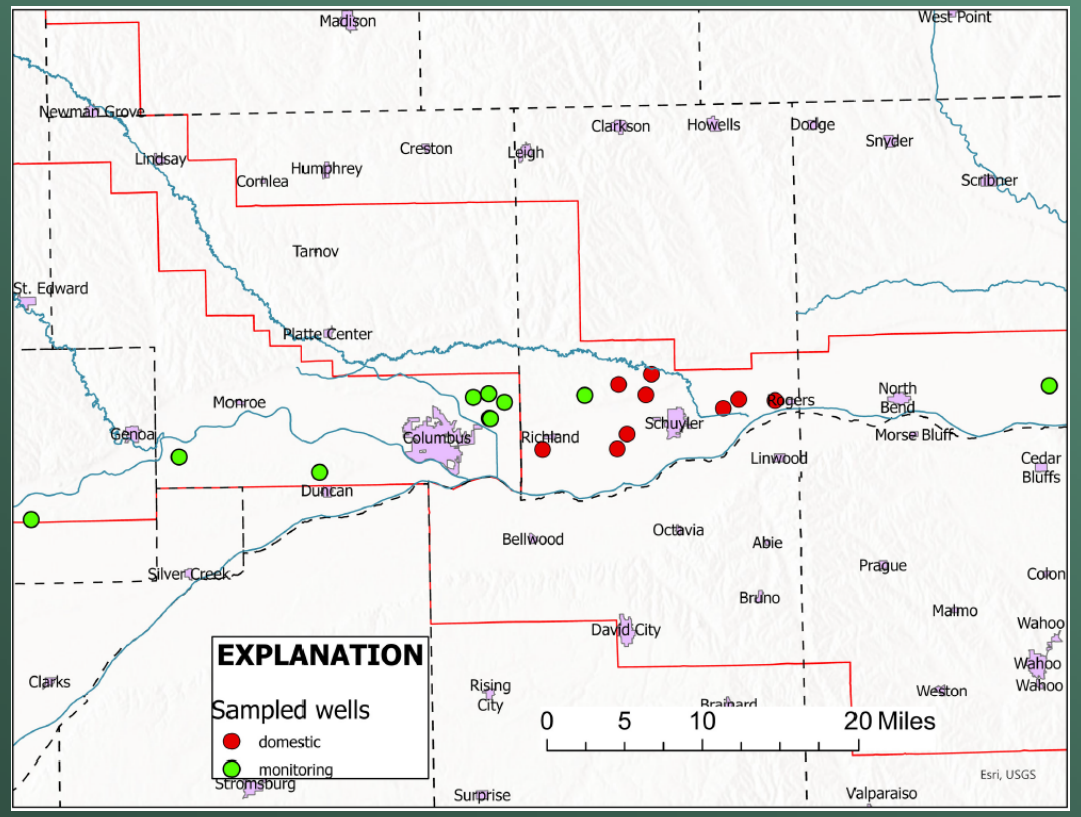


Silty Clay Loam | Silty Clay | Silt Loam | Clay Loam

Bromide Leading Edge

Depth sampled

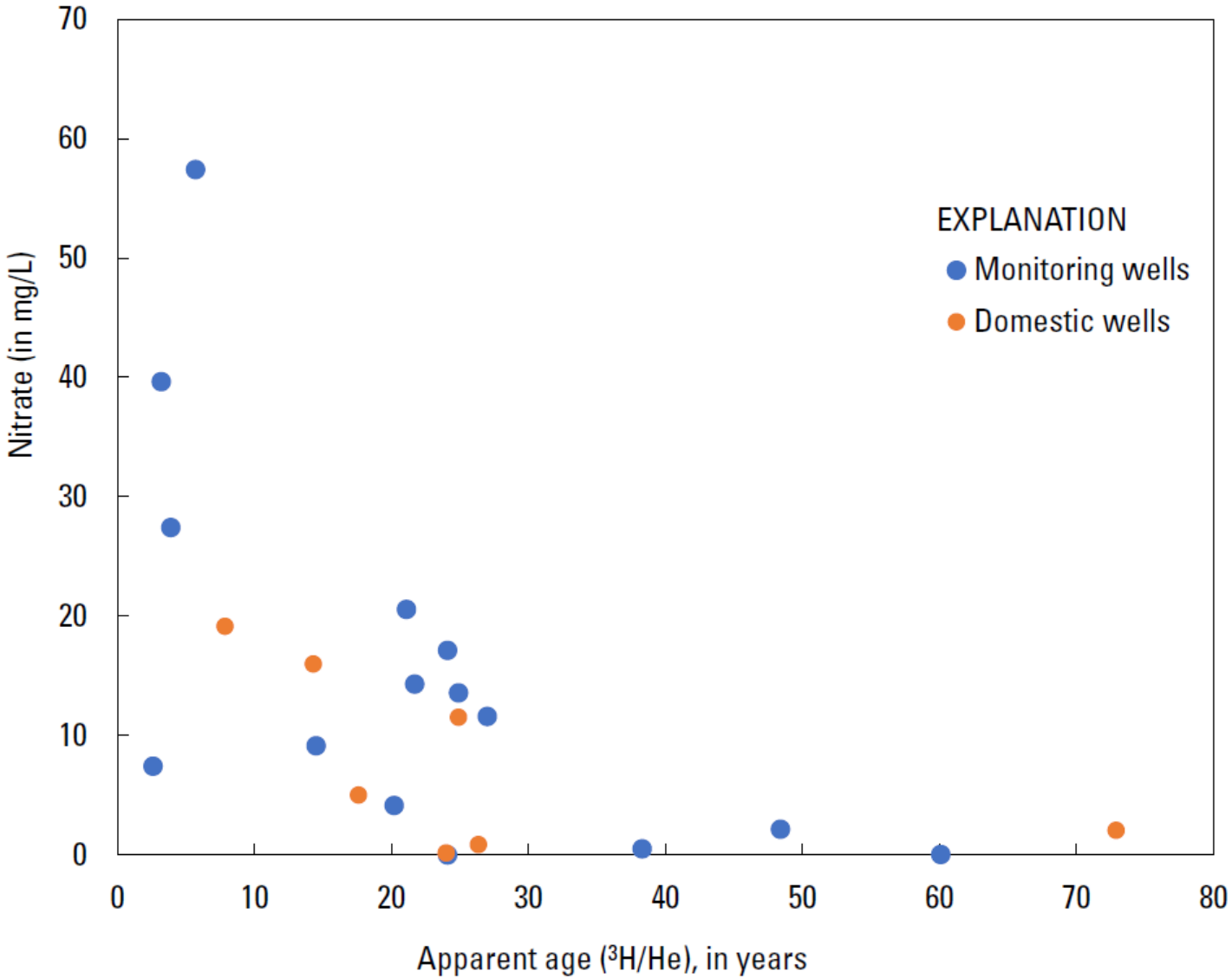
Legacy nitrate groundwater sampling project



- Complimentary study with Lower Platte North NRD assess role of legacy nitrate in current groundwater conditions
- Assess effectiveness of current water management strategies to reduce nitrate concentrations
- Sampled 24 wells to determine the age and nitrate concentration in groundwater

USGS

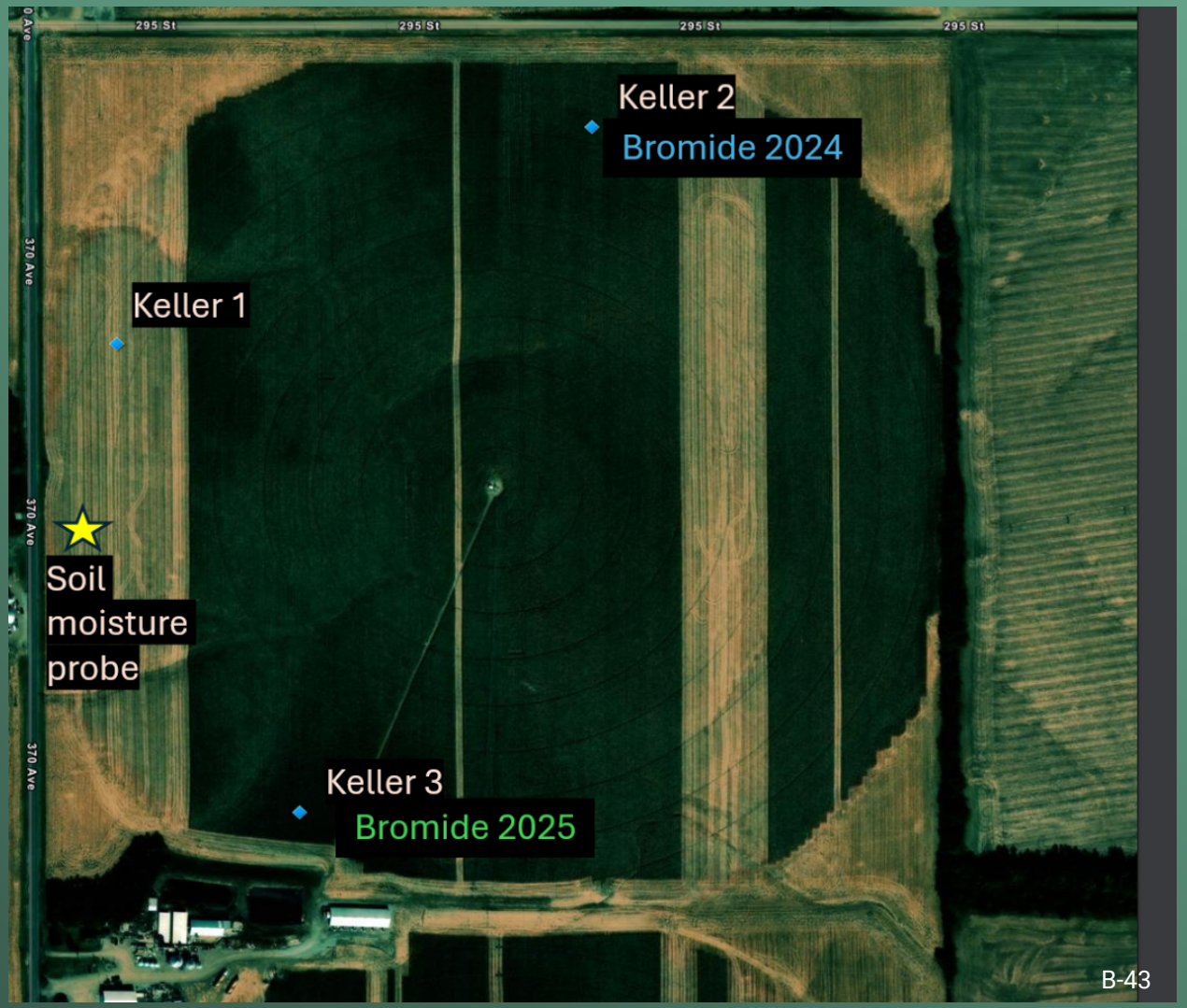
Groundwater age and nitrate concentration



- Apparent age and nitrate inversely related
- All samples that exceed EPA MCL of 10 mg/L are less than 27 years old
- Samples with the 3 highest concentrations of nitrate are less than 5 years old

Bromide tracer tests for 2025 growing season

- Bromide tracer tests repeated in new part of same fields
- Primary purpose was to determine how reproducible the results were
- Examine influence of different climatic conditions on results



USGS

Bromide Tracer Movement

Summer 2025

Practice	Anhydrous			Manure				Sidedressed		
Days Applied	25	35	28	37	43	35	35	44	36	25
Rainfall - In.	10.4	12.9	13.8	11.7	10.9	9.1	11.7	10.9	12.9	10.4
Depth-Ft	Laska 3	Roberts 1	Connelly 3	Eickhoff 1	Sands 1	Keller 3	Kurtenbach 1	Janssen 2	Nelson 2	Swantek 1
0-1										
1-2										
2-3										
3-4										
4-5										
5-6										
6-7										
7-8										
8-10										
10-12										
12-14										
14-16										
16-18										
18-20										
20-22										
22-24										
24-26										
26-28										
28-30										

Did not detect

Silty Clay Loam | Silty Clay | Silt Loam | Clay Loam

Bromide Leading Edge

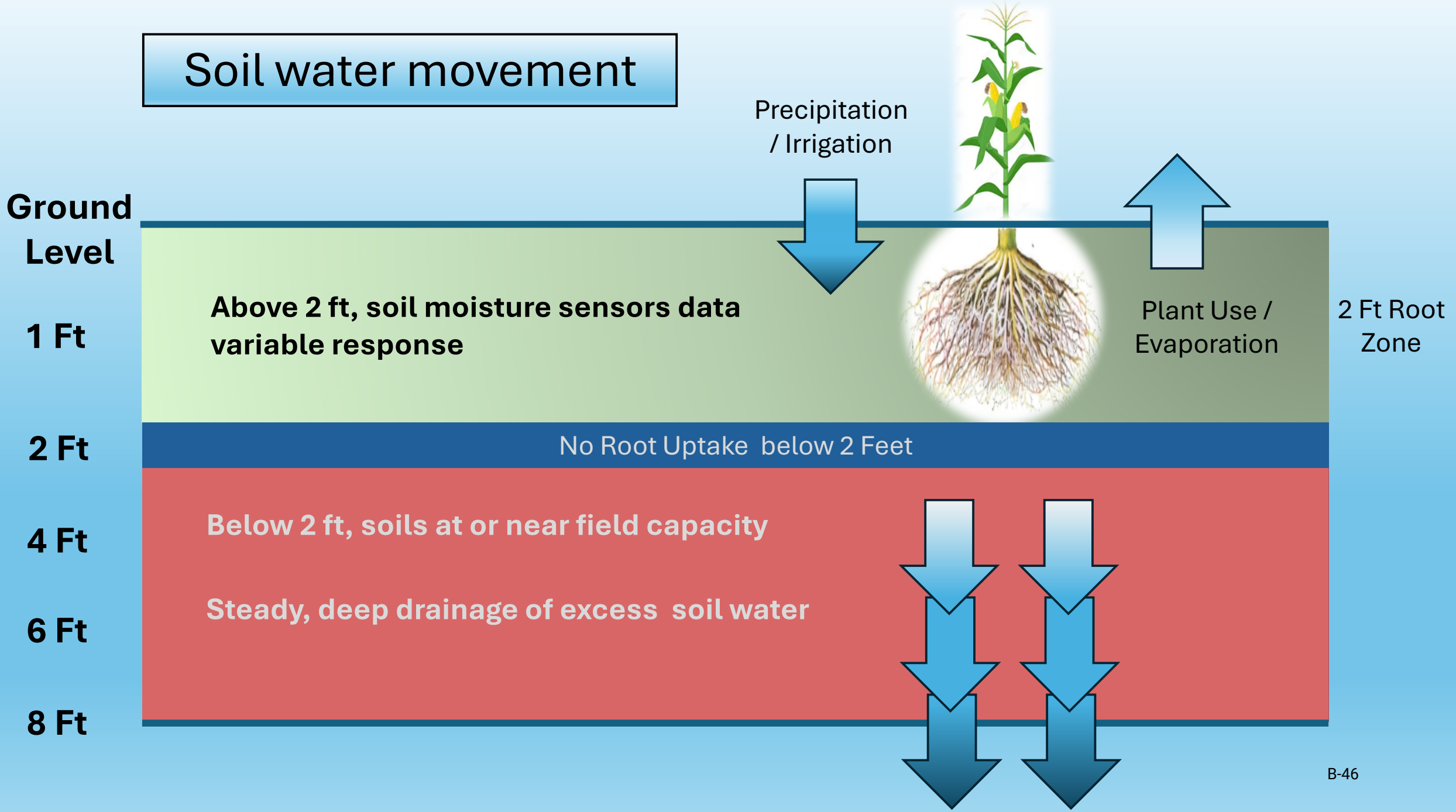
Testing Depth

Leaching rates: Bromide vs nitrate

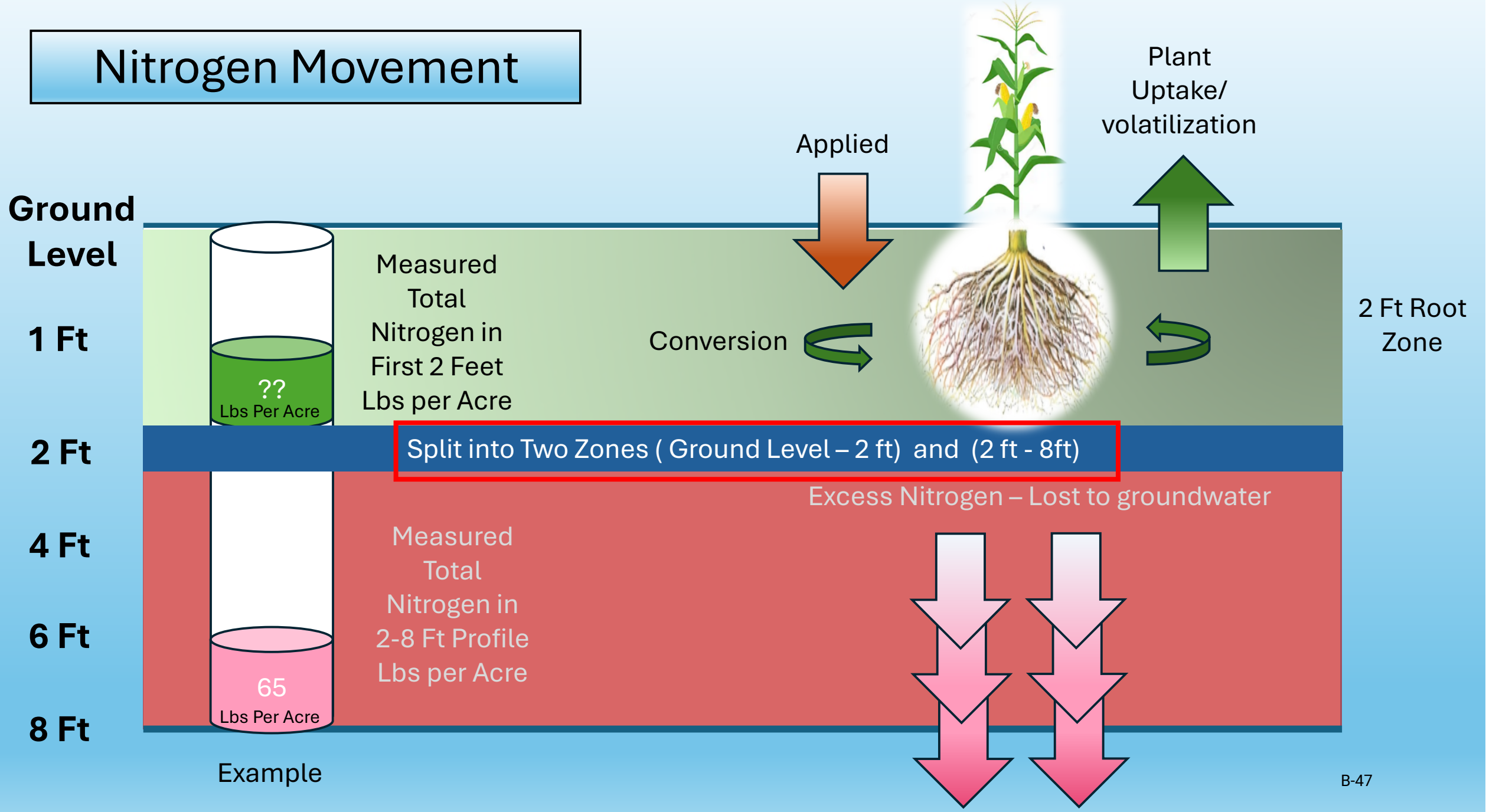
- Bromide tracer tests are a standard approach to estimating nitrate movement in the unsaturated zone
- Bromide and nitrate are both anions and are expected to move through soils at similar rates
- Published literature suggests that if bromide is used to estimate loss of nitrate to leaching, it could lead to a 25% overestimate (Clay and others, 2004)
- Actual transport rates (i.e. maximum rate of movement) for nitrate and bromide were nearly identical (Jiang and others, 1997)

USGS

Soil water movement

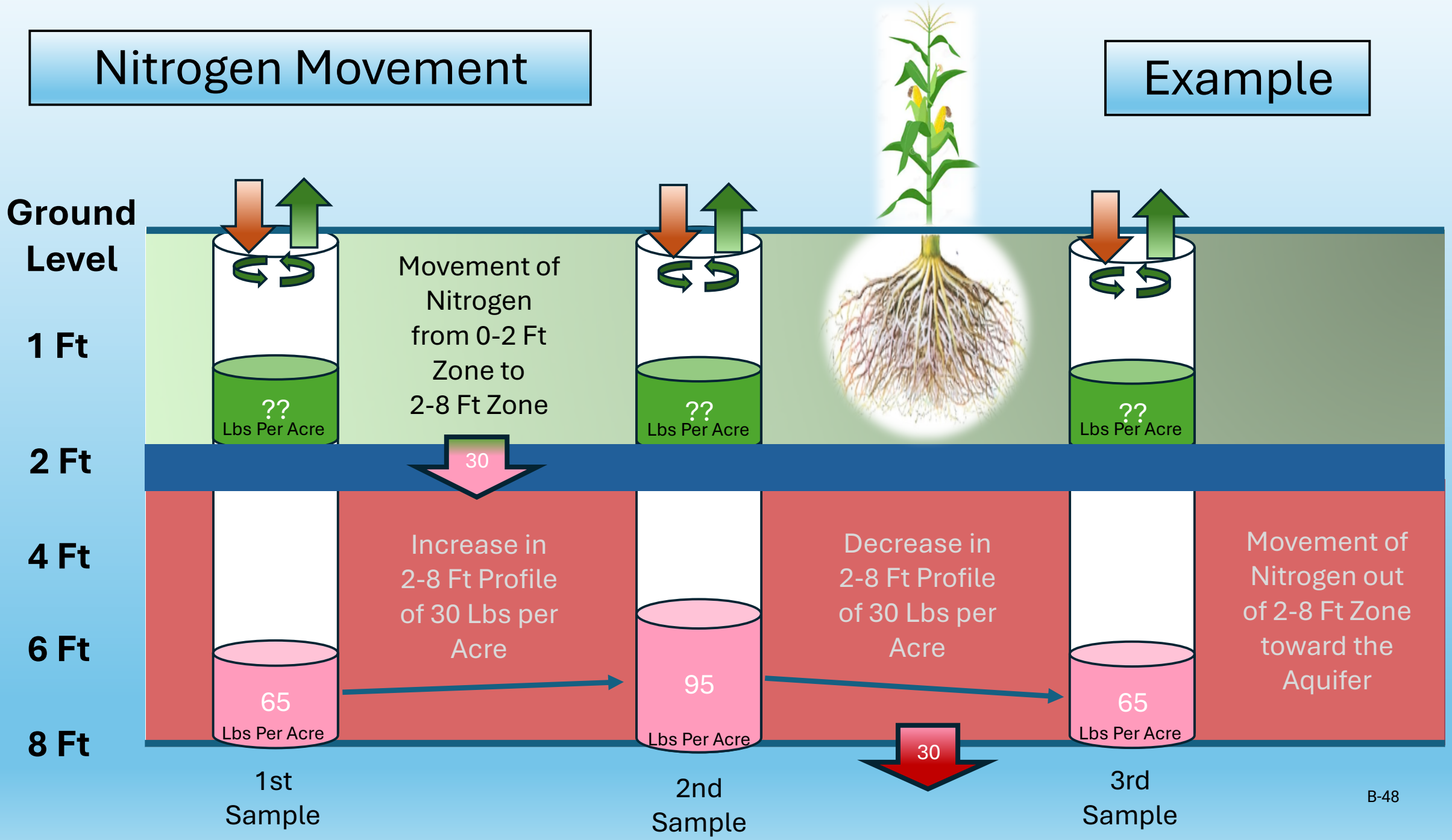


Nitrogen Movement



Nitrogen Movement

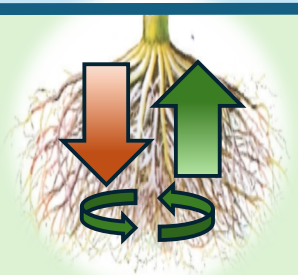
Example



NO_3^- Movement Through 8 Foot Profile

Anhydrous
Laska #1
3 Miles SE of St Edward

Ground Level



	Oct 23	Dec 23	Mar 24	Apr 24	Jun 24	Aug 24	Nov 24	Dec 24
2 Ft NO_3^- Lbs per Acre	33	52	86	173	203	22	18	21
		55		82	12		22	
8 Ft NO_3^- Lbs per Acre	29	23	78	47	129	141	55	77
	6		31			86		

Cumulative NO_3^- Passing Below 8 Ft: 123

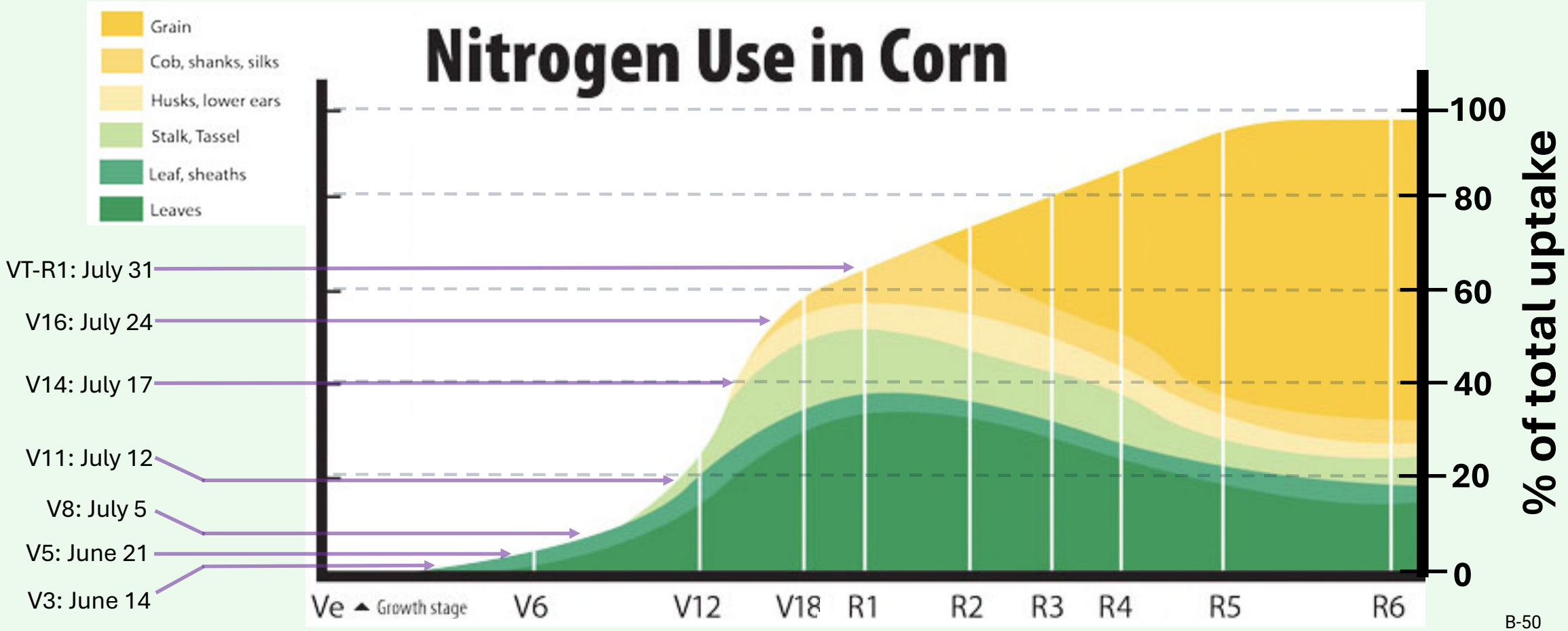
Corn Growth Stages 2024

Field Two

- Planted: May 17
- Emerged: May 27

Anhydrous Application: 12/07/2023

Our wet spring caused delayed planting for this field. A corn plant has only taken up 10% of it's total required N for the season at growth stage V6, which for this field was around 06/25/2024



NO_3^- Movement Through 8 Foot Profile

Manure

Producer: Mike Sands #1
3 Miles W of Platte Center

Ground Level

	Oct 23	Dec 23	Mar 24	Apr 24	Jun 24	Aug 24	Nov 24	Dec 24
2 Ft NO_3^- Lbs per Acre	14	188	103	111	34	10	42	36
	11	22			69		13	
8 Ft NO_3^- Lbs per Acre	30	41	63	29	98	62	41	54
			34		36	21		

Cumulative NO_3^- Passing Below 8 Ft

91

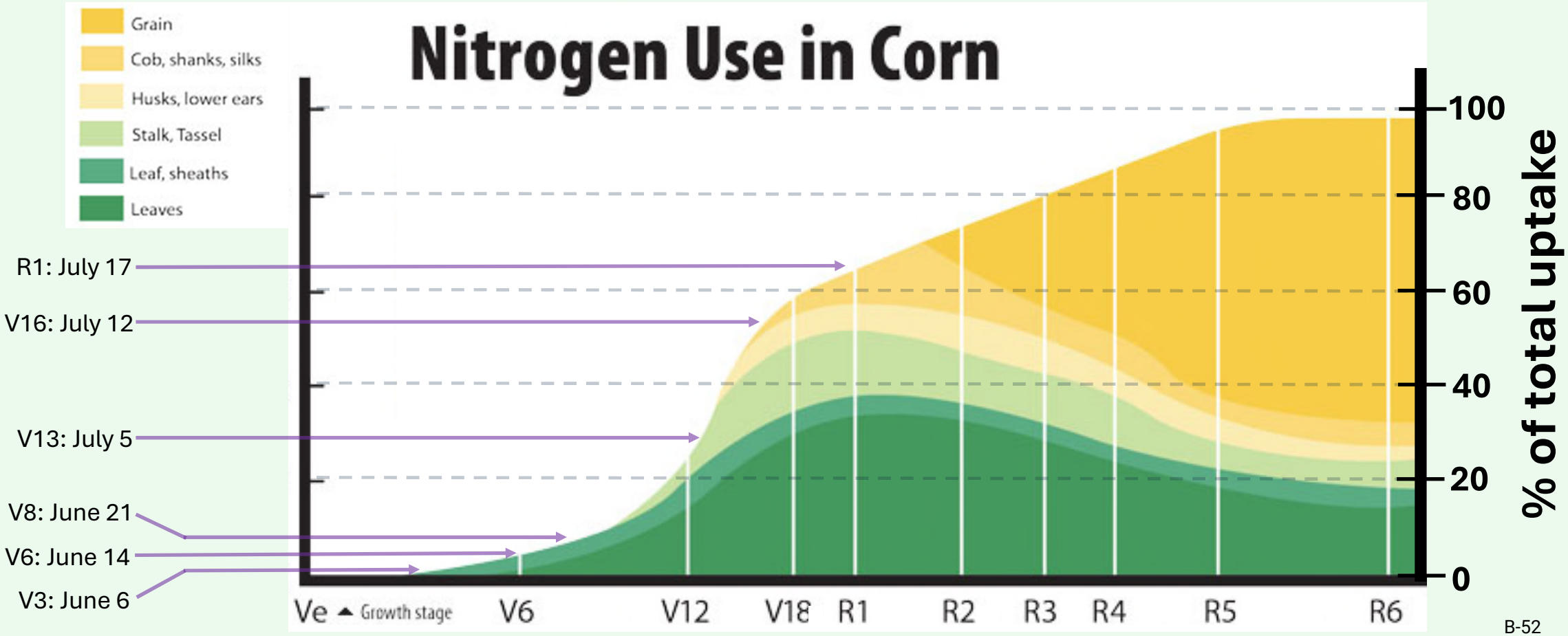
Corn Growth Stages 2024

Field One

- Planted: April 24
- Emerged: May 10

Fall Applied Hog Slurry

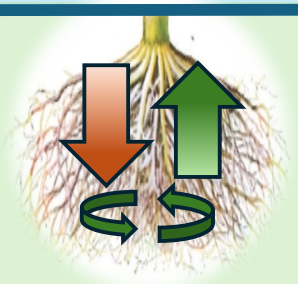
A corn plant has only taken up 10% of it's total required N for the season at growth stage V6, which for this field was around 06/14/2024



NO_3^- Movement Through 8 Foot Profile

Sidedressed
Swantek #2
2 Miles N of Monroe

Ground Level

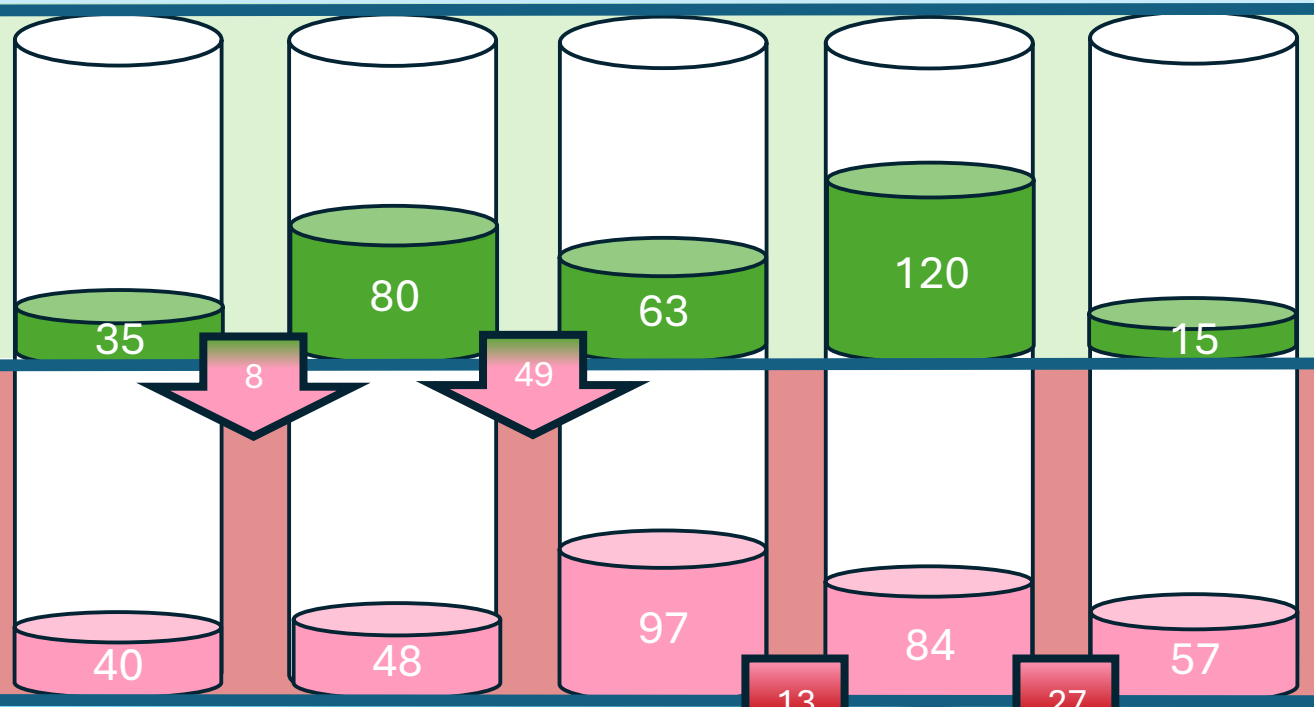


2 Ft

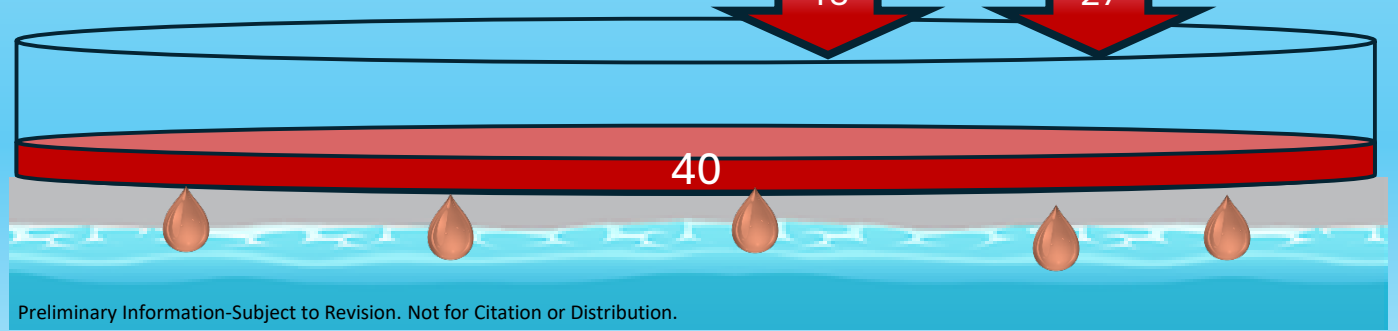
NO_3^- Lbs per Acre

8 Ft

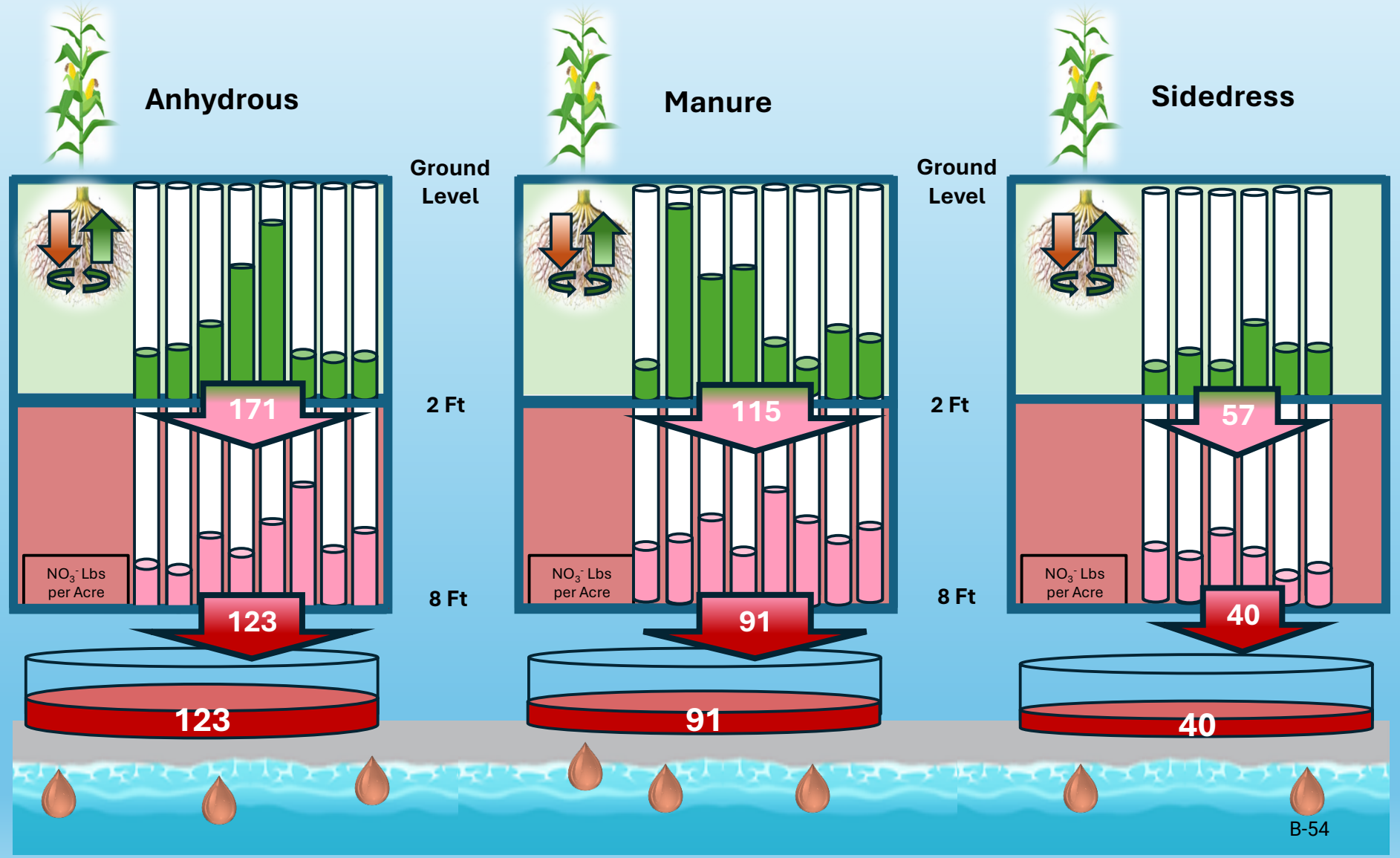
NO_3^- Lbs per Acre



Cumulative NO_3^- Passing Below 8 Ft

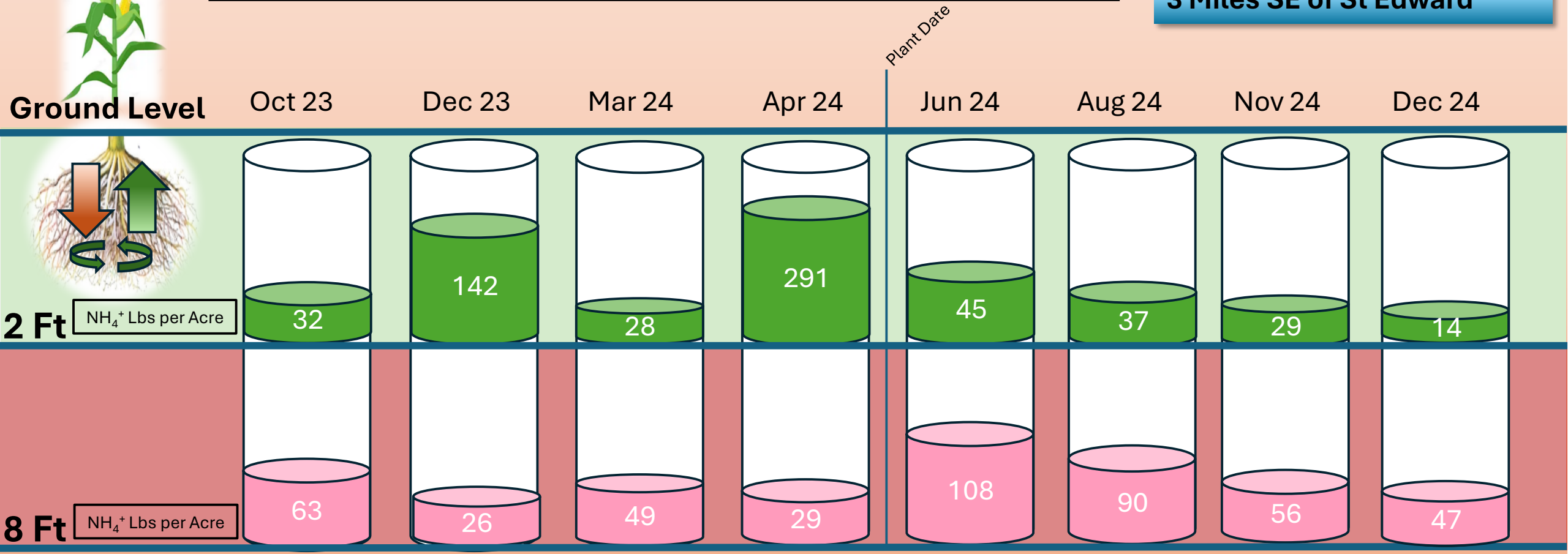


October 2023 to December 2024 NO_3^- Losses



NH_4^+ concentrations in 8-foot profile

Anhydrous
Laska #1
3 Miles SE of St Edward



Questions remain:

Is NH_4^+ moving through the profile?
Why is NH_4^+ so variable?
Why are NH_4^+ +concentrations so high at depth?

Preliminary observations and lessons

- Deep, loess-derived soils lack restrictive layer that would limit N movement
- Early spring/summer precipitation may have limited root zone development to 2 ft
- Maximum movement of bromide was near 1 inch per day; comparable to maximum rate of nitrate
- Rapid water movement and shallow root zone increases the likelihood some N is not being used by the crop and lost to groundwater

USGS

Preliminary observations

- N movement influenced by application of groundwater - water application and nitrogen management go hand in hand
- Questions remain about ammonium concentrations and movement

USGS

Next steps

- Continued soil coring and analysis
  - 2025 growing season soil core collection and analysis is ongoing
  - Continue to track migration of bromide
- Examine and interpret soil moisture data from 2025 growing season
  - Temperature Sensors added to sites
  - Estimate root zone depth and capture potential extreme rain events
  - Different precipitation patterns could produce different results
- Water Sustainability Fund grant: expanding pilot project into new areas of the LLNRD and include focus areas within Central Platte and Upper Big Blue NRDs

USGS

Questions

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Water Programs Specialist
(308) 728-3221
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USGS

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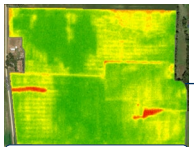
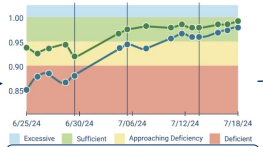
End the guesswork – Sentinel uses your crop to guide your nutrient and water management in-season.

SENTINEL

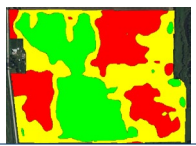
- + $22/ac profit (243 bu/ac average)
- + 23% NUE (0.59 average)



Data



Insights



Recommendations

Key Advantages: No yield goals, soil samples, N credits, or labor; hybrid/variety specific; pre-visible demand detection.

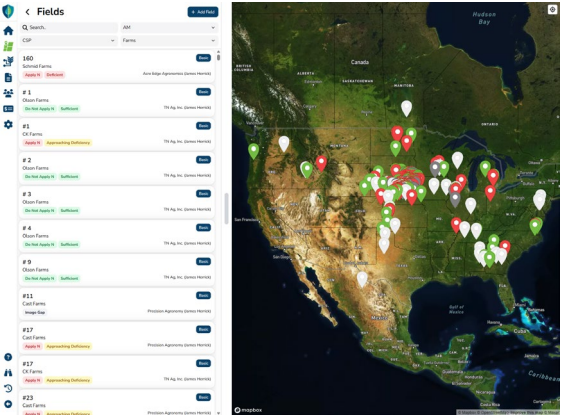
Crops Served: Corn, Sorghum, Cereals, Potatoes, Beets, Cotton, and more.

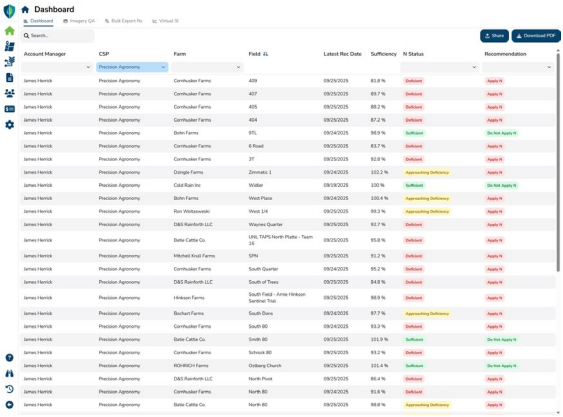
Tiers: Irrigation, Standard, Advanced, Complete

How it Works

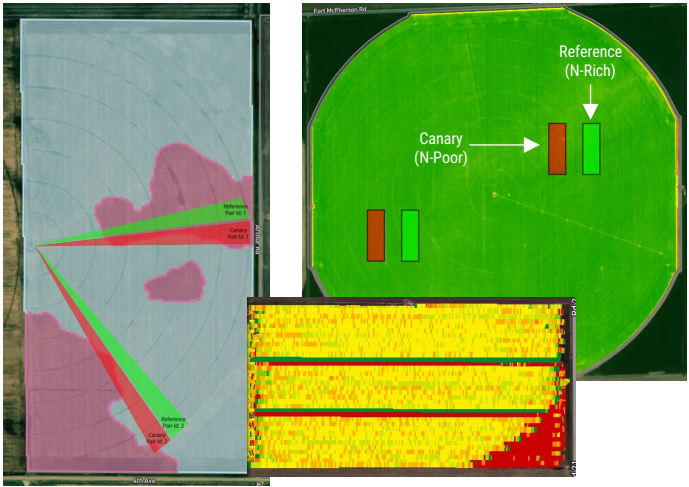
Implementing the Sentinel platform to make better in-season decisions.

Sentinel's Field List and Home Dashboard help users quickly digest the nitrogen status of their fields.





We isolate the impact of Nitrogen on crop yield potential and calibrate every image using paired N-rich (reference) and N-poor (canary) plots in the field.



Sentinel plots help you see:

1. The crop's potential with extra N
2. N demand before it occurs

Sentinel plots can be established in any operation using:

- Plots
- Slices
- Field-length Strips

Sentinel plots should be established prior to mid-vegetative growth:

- Lighter soils – at or after planting
- Heavier soils – any application

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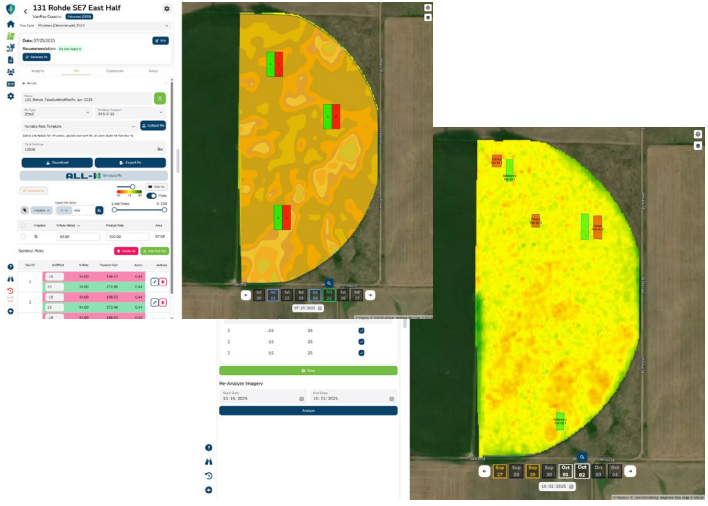
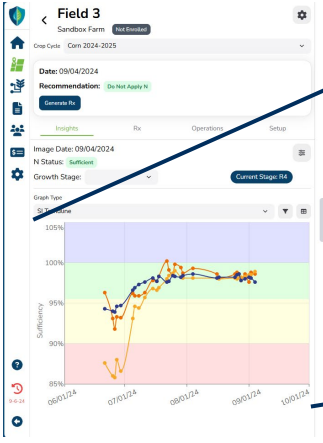
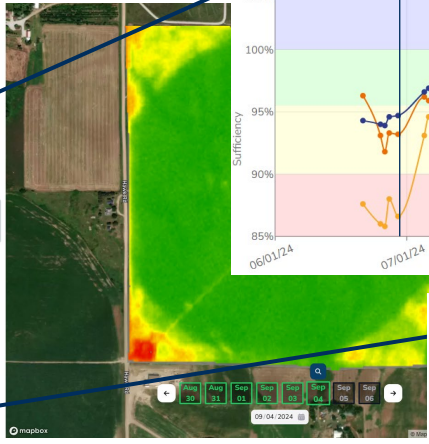
Sentinel creates prescriptions for ground or fertigation applied plots. It can also use plots created with an application executed without a Sentinel-originated Rx.

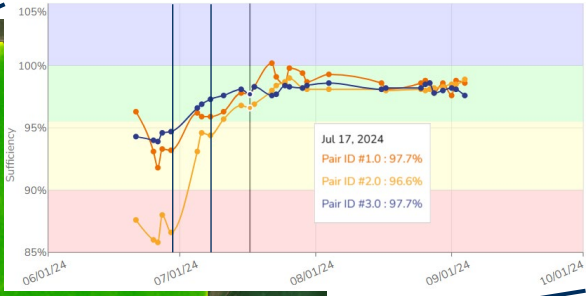


- Placed using best available zones.
  - Autoplace feature
  - Image-based zones
- Sentinel plots can be activated for insights with confirmation or upload.
- Sentinel offers multiple ways to validate plot locations if desired.
  - User editing of plots
  - Automated as-applied processing
  - Validation against virtual SI

Sentinel uses crop data and imagery to continuously monitor crop nitrogen status and detect when there is demand for additional nitrogen using the Sufficiency Index (SI).







Recommendation	Application
6/21/24	6/29/24
7/5/24	7/5/24
7/11/24	7/14/24

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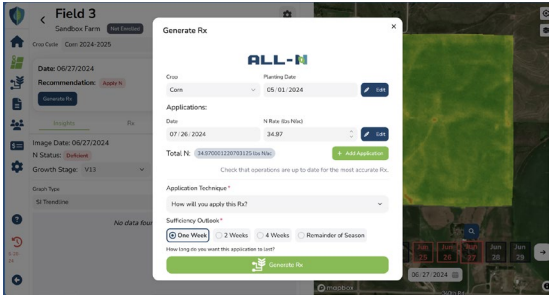
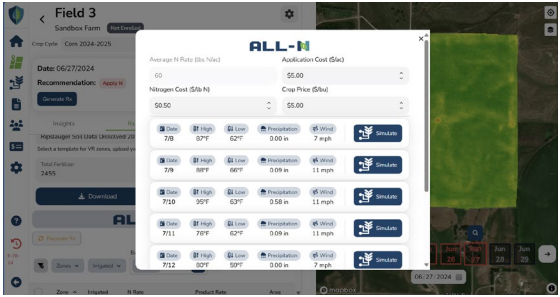


Generate prescriptions to satisfy crop demand.

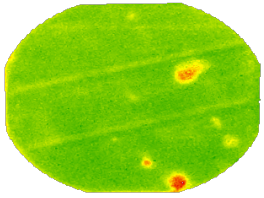
- Image-based dynamic zones
- Rates based on imagery and modeling

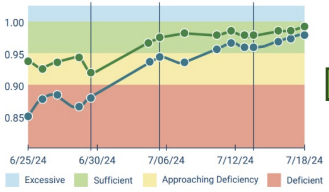


Compare the impact of timing on uptake and ROI.

- See how precipitation impacts uptake.
- Assess potential ROI from the application.

Detailed product, timing, and rate comparisons coming soon.





Capture

Calibrate

Detect

Algorithm

Measured N Demand

SI Values

Weather

Crop & Soil

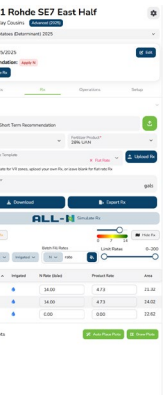
Applications

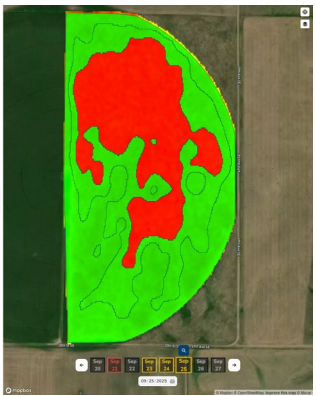
Preferences

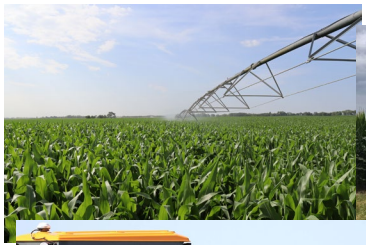
Model

Forecasted N Demand

N Recommendation







Source: *Farm Equipment*

Source: University of Nebraska - Lincoln

Source: *Successful Farming*

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Uses and Benefits

How Sentinel empowers agile nitrogen stewardship.

	2022	2023	2024
Yield (bu/ac)	241	246	242
NUE (lb-N/bu)	0.81	0.70	0.75
N Savings	+ $40/ac	+ $34/ac	+ $27/ac
NUE Change	+ 23%	+ 26%	+ 20%
N Change	- 42 lb/ac	- 50 lb/ac	- 45 lb/ac
Sample Size	42	56	108

NATIONAL CORN GROWERS ASSOCIATION

THE 60TH ANNUAL YIELD CONTEST

- Yield Contest Low N Champion in 2023 with 313 bu/ac on 178 lb-N/ac
- Five Top-6 finishes in two years

We benchmark! Check out our on-farm trial results.

Category	% of Fields
20+ lb-N/ac Reduction	82%
30+ lb-N/ac Reduction	73%
40+ lb-N/ac Reduction	59%
Increase N	4%

Largest Reduction: 124 lb-N/ac
Largest Increase: 81 lb-N/ac

Change Range: 205 lb-N/ac

Benchmarking Results – 2021 to 2024 (36 sites)

Treatment	Yield (bu/ac)	N Applied (lb-N/ac)	NUE (lb-N/bu)	Profit* ($/ac)
Sentinel	243	139	0.59	$1,271.68
Grower	245	189	0.78	$1,249.73
Difference	-2	-50	-0.19	$21.95
Change	-1%	-24%	+23%	+2%

Academic literature and our private dataset is developing around optimal nitrogen management benefits for crop and soil health, both of which may lead to better attribute marketability for ag products.

Crop Health

Numerous crop health benefits are being associated with optimal nitrogen management.

- Reduced disease pressure
- Reduced insect pressure
- Improved standability*
- Enhanced root development
- Plant growth control

Soil Health

Soil health benefits of optimizing nitrogen applications are also being identified through groups like the Soil Health Institute and NE Soil Health Coalition.

- Microbe activity
- Soil pH consistency
- Leveraging mineralization

Attribute Marketability

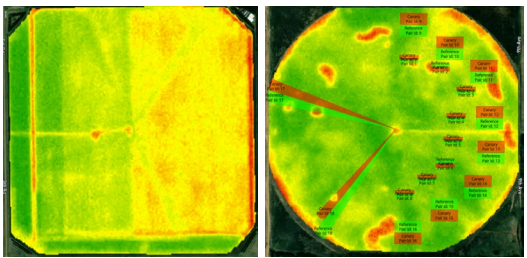
As international agriculture continues to evolve, American products will increasingly need to gain value through better attributes.

- Crop quality
- Processability
- Digestability
- Carbon Intensity
- Water Intensity

Sentinel is working with partners to gather data on disease incidence, stalk quality, soil health attributes, and grain quality under changes in N management.

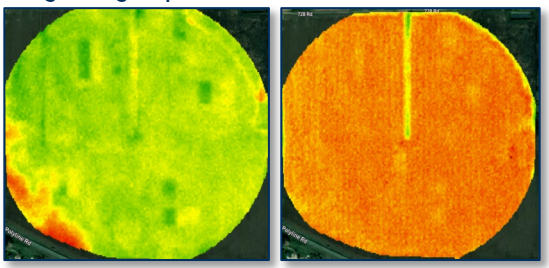
Biologicals, Stimulants, Alternatives

- Measure product impact on N uptake and N sufficiency
- Control risk with the information you need to intervene in-season



Regenerative Practices & Practice Changes

- Determine previous/cover crop residue N tie up and ensuing breakdown
- Tillage changes, interseeding, overwinter grazing impacts can be detected



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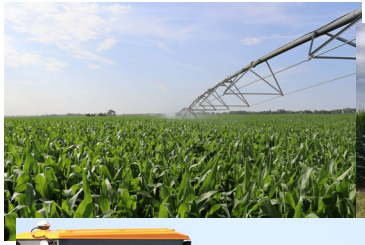
- Detect and track N availability from base manure application
- Quantify impact of in-season manure applications
- Identify when synthetic/commercial N needs to be used
- Determine field(s) with most capacity when lagoon water must be pumped
- Opportunity for implementation with only manure N

- **Opportunities with Sentinel**
  - Detect overapplication with up-front N
  - Guide transition to in-season N
  - Detect need for in-season N (rescue)
  - Lowest tier built in-part to serve these situations
- **In-season application ancillary value**
  - Reduce hail and wind risk exposure
  - Adjust for pest and disease pressure
  - Justify applications with SI value
- **Challenges with in-season N**
  - Labor/timing
  - Fertilizer procurement

Amplifying our Impact

Adding capabilities that are critical to our customers maximizing their N benefit.

- Application strategies used
  - Sidedress
  - Fertigation
  - Aerial/Drone
  - Rescue
- Product types
  - Commercial fertilizer
  - Alternative fertilizers
  - Manure
- Systems served
  - Fertigated
  - Irrigated
  - Rainfed

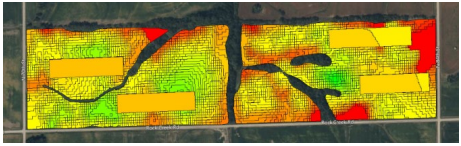


Source: *Farm Equipment*

Source: University of Nebraska - Lincoln

Source: *Successful Farming*

- N optimization leading to whole farm commitments
  - 3 first-year farms (so far) transitioning to 100% acres in year 2
  - Two new farms already going 100% in based on other results
- Trial results in non-fertigated management very encouraging
  - +5 bu/ac on 30 lb-N/ac reduction
  - +5 bu/ac on 10 lb-N/ac increase
  - "Before the application, I thought Sentinel's rates would be too high. Making the application, I'm confident Sentinel's are more accurate. We over accounted for our credits."
  - "Zones are spot on."
  - More data will be processed and put into Codex
- 100% of previous on-farm trial users used Sentinel commercially in 2025

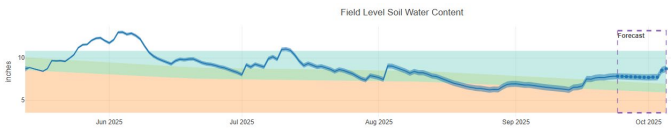


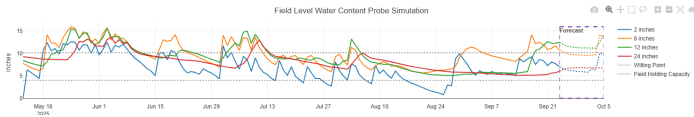
Coming in 2026 – Sentinel Irrigation and Sentinel Complete will provide soil moisture and crop water use insights.

- Completely remote soil moisture and crop water use insights
- Captures spatial variability in crop and soil water metrics
- Guaranteed daily insights
- 93% alignment with soil moisture probes

SENTINEL IRRIGATION

SENTINEL COMPLETE





powered by NAVE

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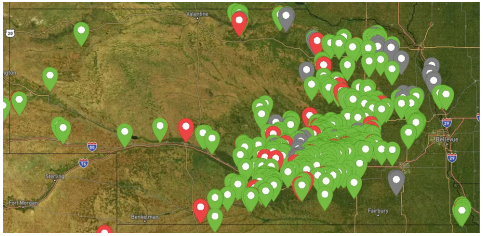
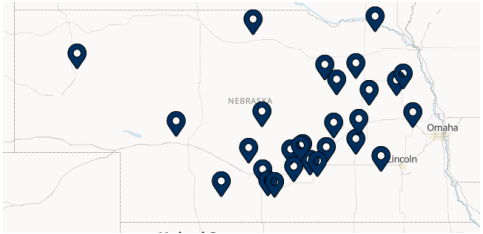
Customers throughout Nebraska are benefitting from Sentinel and being served by our Sentry Network.





- Sentry Network of Certified Service Providers (CSPs)
  - 28/39 (72%) are in Nebraska
  - CSPs are trained in our platform
  - CSPs backed up by Sentinel RAM

- CSPs meet the following criteria:
  - Serve agronomy needs in-season
  - Leverage data for agronomic decisions
  - Focus on farm profitability
  - Align with natural resource stewardship


SENTINELAG
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Ithaca, NE 68033
Sign up for our Newsletter
Find us on Social Media
Keep us on your Calendar
Coming Soon
SENTRY NETWORK SUMMIT
January 22nd & 23rd 2026
Scott Conference Center
6450 Pine St, Omaha, NE 68106