

Strategies for factoring nitrate in irrigation water into nutrient management plans



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Agricultural Discharge Waiver 3.0

- **Growers were required to report applied nitrogen from fertilizer**
- **Irrigation and nutrient management plan**

Agricultural Order 4.0 (April 2021)

- **Growers are required to report N applied and N removed (A-R)**
- **A-R is estimate of N loading to the aquifer**
- **Time-table of targets and limits for N discharge**
- **Irrigation and nutrient management plan**

Table C.1-3. Compliance Dates for Nitrogen Discharge Targets and Limits

	Compliance Date		
	Target	500	12/31/2023
Target	400	12/31/2025	
Limit	300	12/31/2027	
Limit	200	12/31/2031	
Limit	150	12/31/2036	
Limit	100	12/31/2041	
Limit	50	12/31/2051	

Compliance Pathway 1

$$A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) + A_{IRR} - R =$$

Targets and limits are for physical acres per year

A_{IRR} = amount of nitrogen applied in the irrigation water estimated from the volume required for crop evapotranspiration (ET) or volume of water applied.

In complying with the Ag Order you will need to:

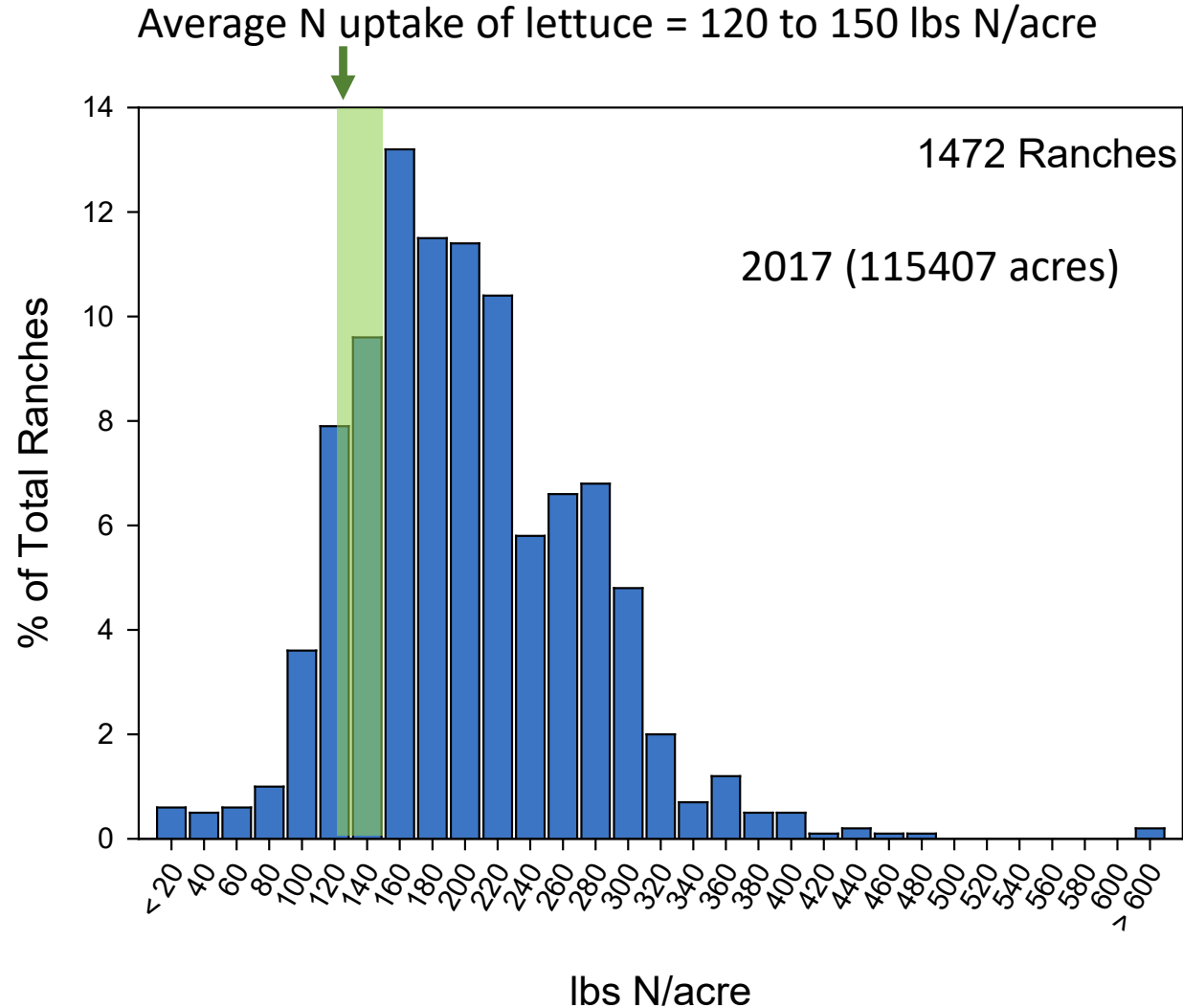
- 1. Include N in irrigation water as part of your nutrient budget**
- 2. Report on how much N was applied in irrigation water for your entire ranch**

Ag Order targets will be a challenge for vegetables:

R is often less than half of the N that the crop takes up over a season



Applied N fertilizer (N_{fer}) was more than N uptake of lettuce for more than 70% of ranches



A – R Scenarios

Romaine (Crop 1)



Broccoli (Crop 2)



Low to moderate levels of N in irrigation water

	crop 1	crop 2	Seasonal
Applied N ($A_{fert} + A_{irr}$)	romaine lettuce	broccoli	Total
Applied N (lbs N/acre)	150	200	350
Crop ET (inches)	7	10	
nitrate-N concentration (ppm)	15	15	
Applied N in water (lbs N/acre)	24	35	59
Total Applied N (lbs N/acre)	174	235	409
Removed N			
Yield (lbs/acre)	30,000	16,000	
N coefficient	0.00184	0.0046	
Total N removed (lbs N/acre)	55	74	129
A-R (lbs N/acre)			280

High level of N in irrigation water

	crop 1	crop 2	Seasonal
Applied N ($A_{fert} + A_{irr}$)	romaine lettuce	broccoli	Total
Applied N (lbs N/acre)	150	200	350
Crop ET (inches)	7	10	
nitrate-N concentration (ppm)	40	40	
Applied N in water (lbs N/acre)	64	92	156
Total Applied N (lbs N/acre)	214	292	506
Removed N			
Yield (lbs/acre)	30,000	16,000	
N coefficient	0.00184	0.0046	
Total N removed (lbs N/acre)	55	74	129
A-R (lbs N/acre)			378

Taking credit for residual N in soil and nitrate in water

	crop 1	crop 2	Seasonal
Applied N ($A_{fert} + A_{irr}$)	romaine lettuce	broccoli	Total
Applied N (lbs N/acre)	120	150	270
Crop ET (inches)	7	10	
nitrate-N concentration (ppm)	40	40	
Applied N in water (lbs N/acre)	64	92	156
Total Applied N (lbs N/acre)	184	242	426
Removed N			
Yield (lbs/acre)	30,000	16,000	
N coefficient	0.00184	0.0046	
Total N removed (lbs N/acre)	55	74	129
A-R (lbs N/acre)			298

Nitrogen in irrigation water is available for plant uptake



**Well water
(2 to 70 ppm Nitrate-N)**



**Recycled water
(15 to 30 ppm N as Ammonium + Nitrate)**

Practical challenges to take credit for N in water

- ✓ **Multiple wells often used to irrigate a crop**
- ✓ **Nitrate concentration in some wells changes during the season**
- ✓ **Need to estimate how much water will be applied between fertilizer events**
- ✓ **Need to adjust for residual nitrate in soil**
- ✓ **Many blocks to manage simultaneously in most mid to large scale vegetable and berry operations**

How do you take credit for N in soil and water?

Soil Nitrate



Current N status of Soil

N in water



Future N contribution

+

The soil nitrate quick test can be used to assess available nitrate-N in the root zone



For multiple water sources, N concentration of irrigation water in a block can be evaluated with nitrate test strips:



Determine average nitrate concentration in irrigation water



Calculating N applied from irrigation water:

$$\text{Applied water (inches)} \times \text{NO}_3\text{-N conc. (ppm)} \times 0.23$$
$$= \text{lbs N/acre}$$

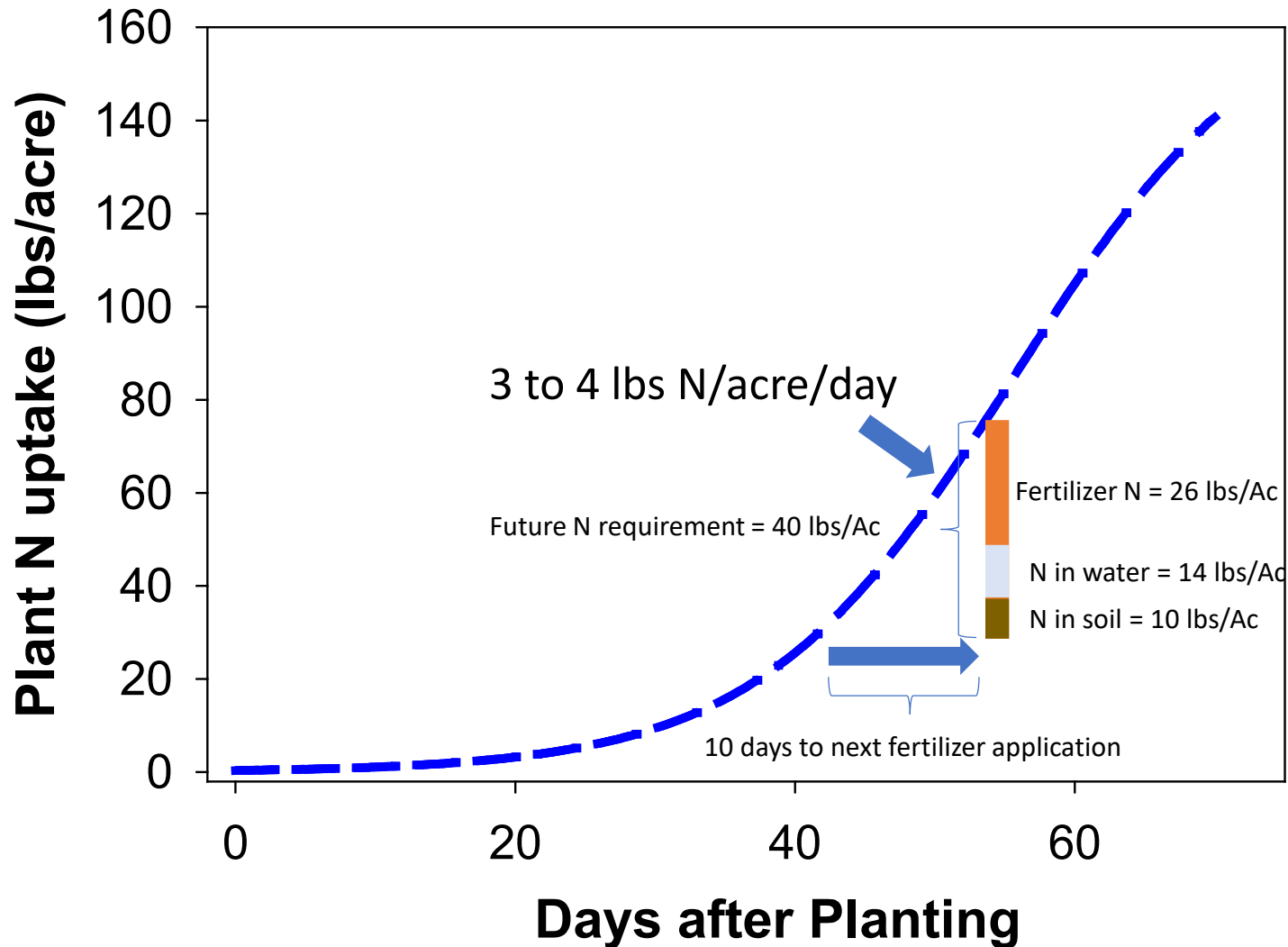
Example:

- ✓ Applied water = 2 inches
- ✓ Nitrate-N concentration = 30 ppm

$$2 \text{ inches} \times 30 \text{ ppm NO}_3\text{-N} \times 0.23$$

$$= \underline{\underline{13.8 \text{ lbs N/acre}}}$$

How much fertilizer is needed to meet crop N demand?



CropManage: Online irrigation and nitrogen management decision support

☆ broccoli example ✕

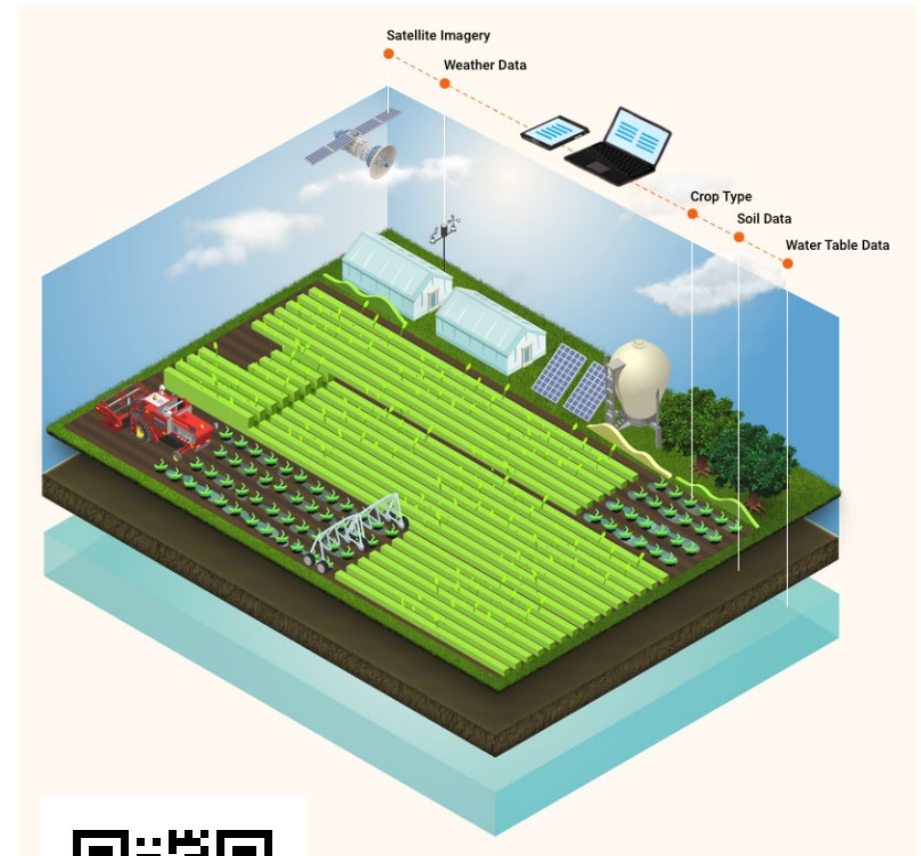
1 Oct 2022 - 31 Mar 2023 ⚙️ 📅 📄 📊

Tasks History 📅

COMPLETED

JAN 17	📄 20-0-0-5	10 gal/acre
JAN 16	🧪 Tissue Sample	4.1% Nitrogen
JAN 11	🌊 Drip	3.3 hr
JAN 6	🌊 Drip	3.2 hr
JAN 3	🌊 Drip	3.4 hr
DEC 30	🌊 Drip	3.1 hr
DEC 28	🌊 Drip	3.9 hr
DEC 23	🌊 Drip	3.2 hr

View all events by: ☰ 📅 📅



cropmanage.ucanr.edu

Using CropManage for N fertilizer recommendation

Add Fertilization Event

Event Date *
2/16/2023

Fertilizer Type *
UAN32 - Wet **Fertilizer Details**

Days To Next Fertilization *
15

Soil Sample *
2/15 - 15.00 ppm N

Choose the soil sample date used to calculate this recommendation

Recommendation lbs N/acre **Fertilizer Unit**

10.63 gal/acre

Recommendation Summary ^

Crop N Uptake ⓘ	45.57 lbs N/acre
Soil N ⓘ	60.45 lbs N/acre (15.00 ppm N)
Soil N Threshold ⓘ	55.80 lbs N/acre (13.85 ppm N)
Total Mineralized N ⓘ	3.17 lbs N/acre

Delete Cancel Save

Add Fertilization Event

Days To Next Fertilization *
15

Soil Sample *
2/15 - 15.00 ppm N

Choose the soil sample date used to calculate this recommendation

Recommendation lbs N/acre **Fertilizer Unit**

10.63 gal/acre

Recommendation Summary ^

Crop N Uptake ⓘ	45.57 lbs N/acre
Soil N ⓘ	60.45 lbs N/acre (15.00 ppm N)
Soil N Threshold ⓘ	55.80 lbs N/acre (13.85 ppm N)
Total Mineralized N ⓘ	3.17 lbs N/acre

Fertilizer N Recommendation = Crop N Uptake + (Soil N Threshold - Soil N) - Total Mineralized N

37.75 = 45.57 + (55.80 - 60.45) - 3.17

Include N Contribution From Water in Recommendation

Delete Cancel Save

Contribution from N in the irrigation water

Add Fertilization Event

Expected Irrigation Method
Drip

Use Avg. Water Source PPM Enter PPM Manually

Blending of Water from Various Water Sources

Water Source	N Concentration	% Used for Planting
Well 1	25 ppm	75 %
Well 2	5 ppm	25 %
Average N Concentration	20 ppm	100% ✓

Recommended Irrigation Amount: 1.7 Inches

Calculate Contribution for: 1.69 Inches

N Contribution from Water: 2.16 gal/acre

Cancel

Add Fertilization Event

Days To Next Fertilization *
15

Soil Sample *
2/15 - 15.00 ppm N

Choose the soil sample date used to calculate this recommendation

Recommendation
8.47 gal/acre

lbs N/acre

Recommendation Summary

Crop N Uptake	45.57 lbs N/acre
Soil N	60.45 lbs N/acre (15.00 ppm N)
Soil N Threshold	55.80 lbs N/acre (13.85 ppm N)
Total Mineralized N	3.17 lbs N/acre
Water N Contribution	7.67 lbs N/acre (2.16 gal/acre)

Fertilizer N Recommendation = Crop N Uptake + (Soil N Threshold - Soil N) - Total Mineralized N - Water N Contribution

30.08 = 45.57 + (55.80 - 60.45) - 3.17 - 7.67

Delete Cancel

CropManage can help with AgOrder compliance and reporting

N Management

- Interpretation of soil nitrate test
- Estimate N contribution from irrigation water

Water Management

- Irrigation scheduling decision support
- Crop ET calculations

AgOrder reporting

- Summarizes A_{fert} and A_{irr} by commodity
- Summarizes crop ET by commodity

Exporting applied water, Crop ET, and N in water data by ranch and crop

Export And Download Ranch Data

Are you sure you want to Export & Download Ranch Data?

This will download all the data for this Ranch in a single Zip Archive. The Data is exported to Excel and is separated per Planting.

This process will take a few minutes.

Export All Plantings

Select a Year

2022

Planting Area

All

<input type="checkbox"/>	Name	Type	Compressed size	Password...	Size	Ratio	Date modified
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<input type="checkbox"/>	Planting_11970_Lettuce_exa...	Microsoft Excel Works...	28 KB	No	35 KB	21%	2/16/2023 1:54 PM
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Satellite based tools for estimating Seasonal Crop Evapotranspiration for a Ranch

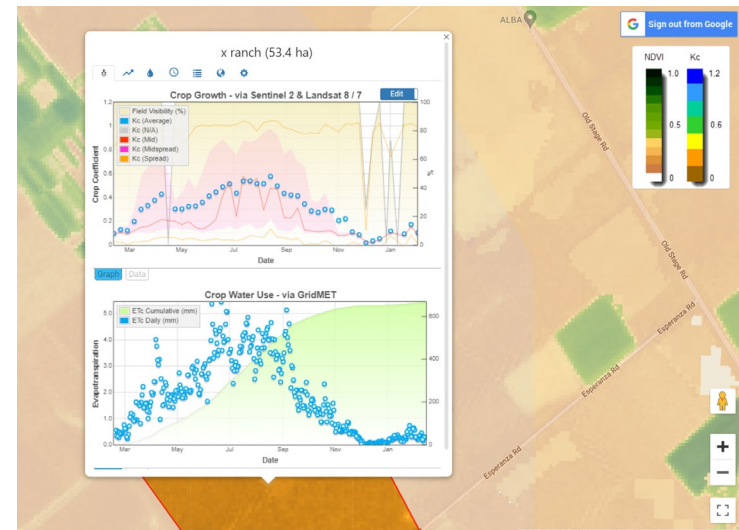
OpenET

<https://openetdata.org/>



IrriSat

<https://irrisat-cloud.appspot.com/>



OPENET

Filling the Biggest Data Gap in Water Management

Here's how it works

Generate a custom spatial summary for area up to 1000 ha.

- Zoom and drag or use the search tool to find your location of interest on the map.
- Use the polygon drawing tools to draw your area of interest.
- Once done, click "run time series" to get data specific to the area drawn on the map.

Video demo



Main Take Aways

- **If you are a grower, you will need to calculate N applied in irrigation water during the season for the Ag Order.**
- **If you have high N levels in your water source you will need to take credit for this N in your nutrient budgets to meet upcoming targets and limits.**
- **Crediting for both soil nitrate and N in the irrigation water may help you greatly reduce fertilizer N rates.**



Thank you