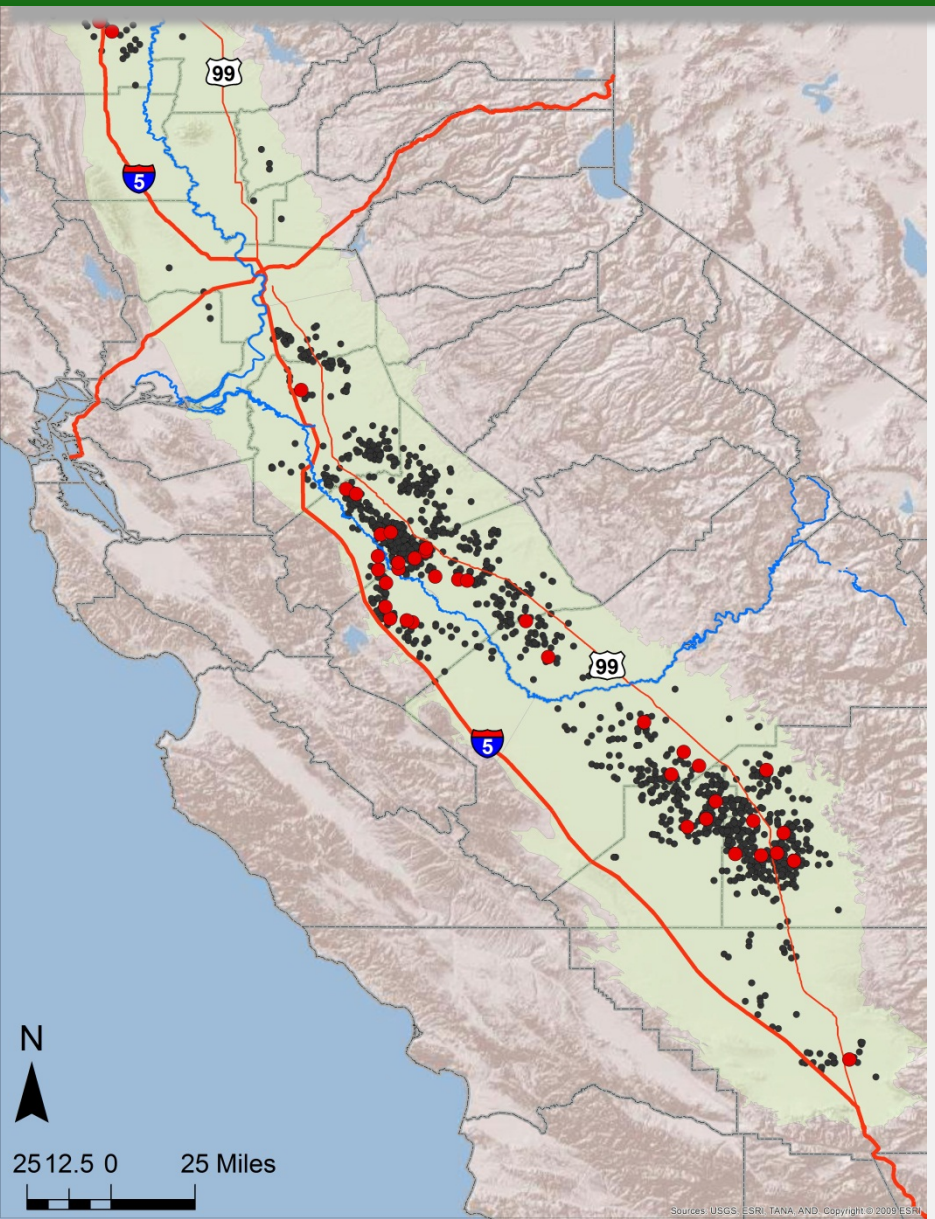
Central Valley Dairy Representative Monitoring Program – Status Update



Stakeholder Meeting

Presentation Location:

Central Valley Regional Water Quality Control Board

1685 “E” Street
Fresno, CA 93706

March 2, 2015

LUHDORFF & SCALMANINI
CONSULTING ENGINEERS

Presentation Overview

1. **RMP Overview**
2. **Issues & Activities**
   - Monitoring Well Installation
   - Lagoon Perimeter Subsurface Hydrogeologic Investigation (LPSHI) Results
   - Lagoon Seepage Testing Results
   - Pilot Lagoon Geophysical Testing Results
   - Advisory Committee Consensus on Nutrient Management Improvement
3. **2015 Outlook**
   - Lagoons
   - Nutrient Management
   - Groundwater Age Dating

1. RMP Overview

Representative Monitoring Program

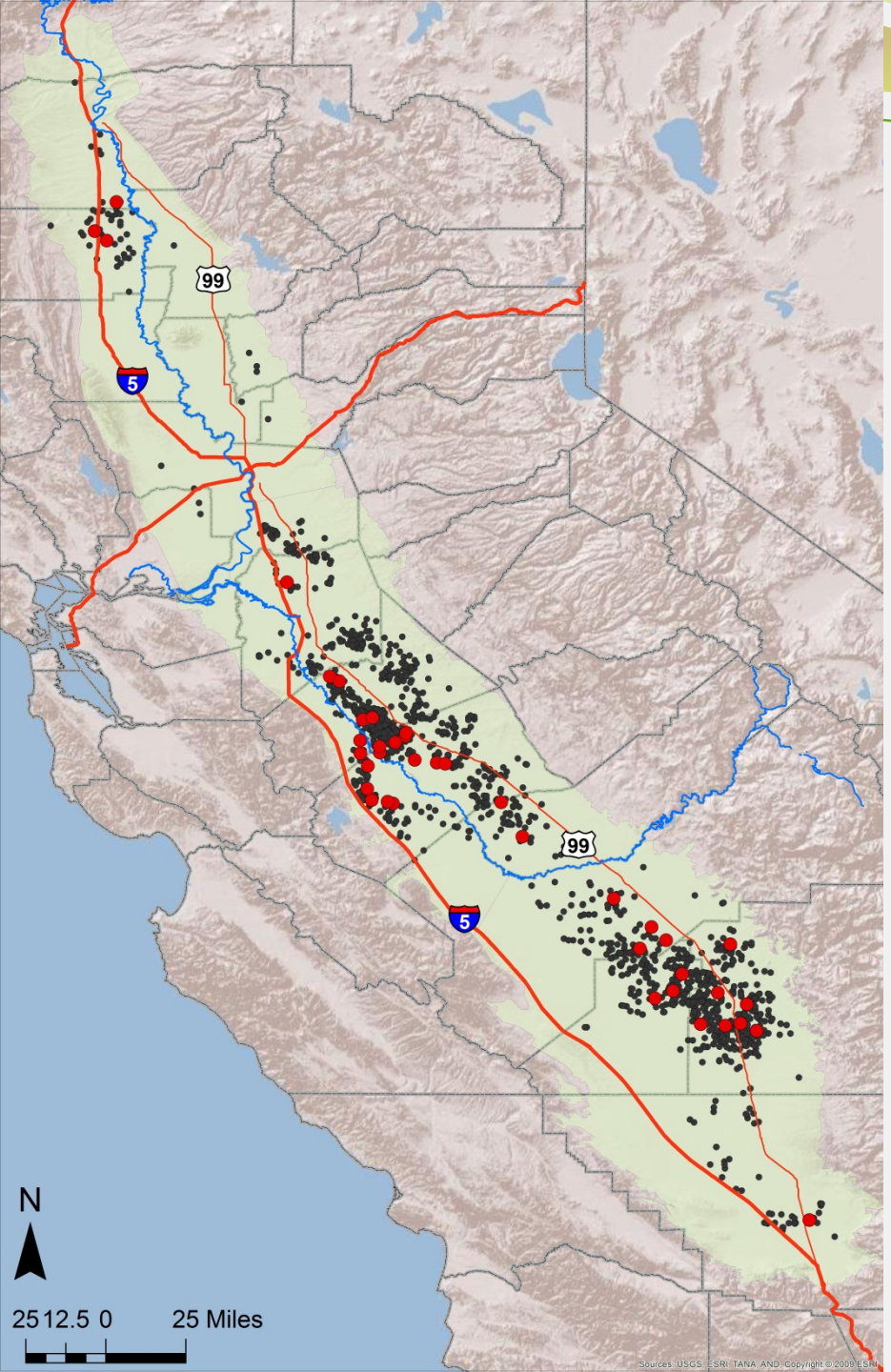
- A regulatory compliance monitoring program
- An alternative to monitoring well installation at ~1,175 dairies
- Collects data on a subset of dairies representative of the industry and pertinent site conditions
- Tasked to identify dairy management practices that are protective of groundwater quality and those that are not
- Ultimately, will recommend improved practices for implementation on monitored and non-monitored dairies

Schedule

Summary Representative Monitoring Report due **April 2019**

Pursuant to Reissued General Order

- To identify management practices that are protective of groundwater quality for the range of conditions found at dairies covered by the RMP
- To provide implementation schedules for practices that are as short as practicable, supported with appropriate technical or economic justification, not to exceed **10 years** from SRMR approval.



Basics

- 42 monitored dairies
- 443 dedicated monitoring wells at 279 well sites
- Phased approach started Jan. 2012 (18 dairies)
- Fully implemented Jan. 2013 (+24 dairies)
- Monthly GW level monitoring
- Groundwater quality monitoring
  - quarterly: 9 constituents
  - annual: 22 constituents
- >16,000 raw data points per year

2. Issues & Activities

2014 Monitoring Well Installation

- Network refinement to improve utility of data collection effort
- Seven of eight wells were installed at four dairies as planned in fall 2014.
- One well could not be installed due to facility expansion/construction plans
- Monitoring Well Installation Completion Report submitted in February 2015.

2014 Lagoon Perimeter Hydrogeologic Investigation

Motivation

At 12 “Phase 1” dairies, lagoon seepage was not evident or inconclusive based on groundwater chemical characteristics in monitoring wells.

Absence of detectable impacts to groundwater quality does not provide conclusive evidence for zero-seepage or no impact to groundwater quality.

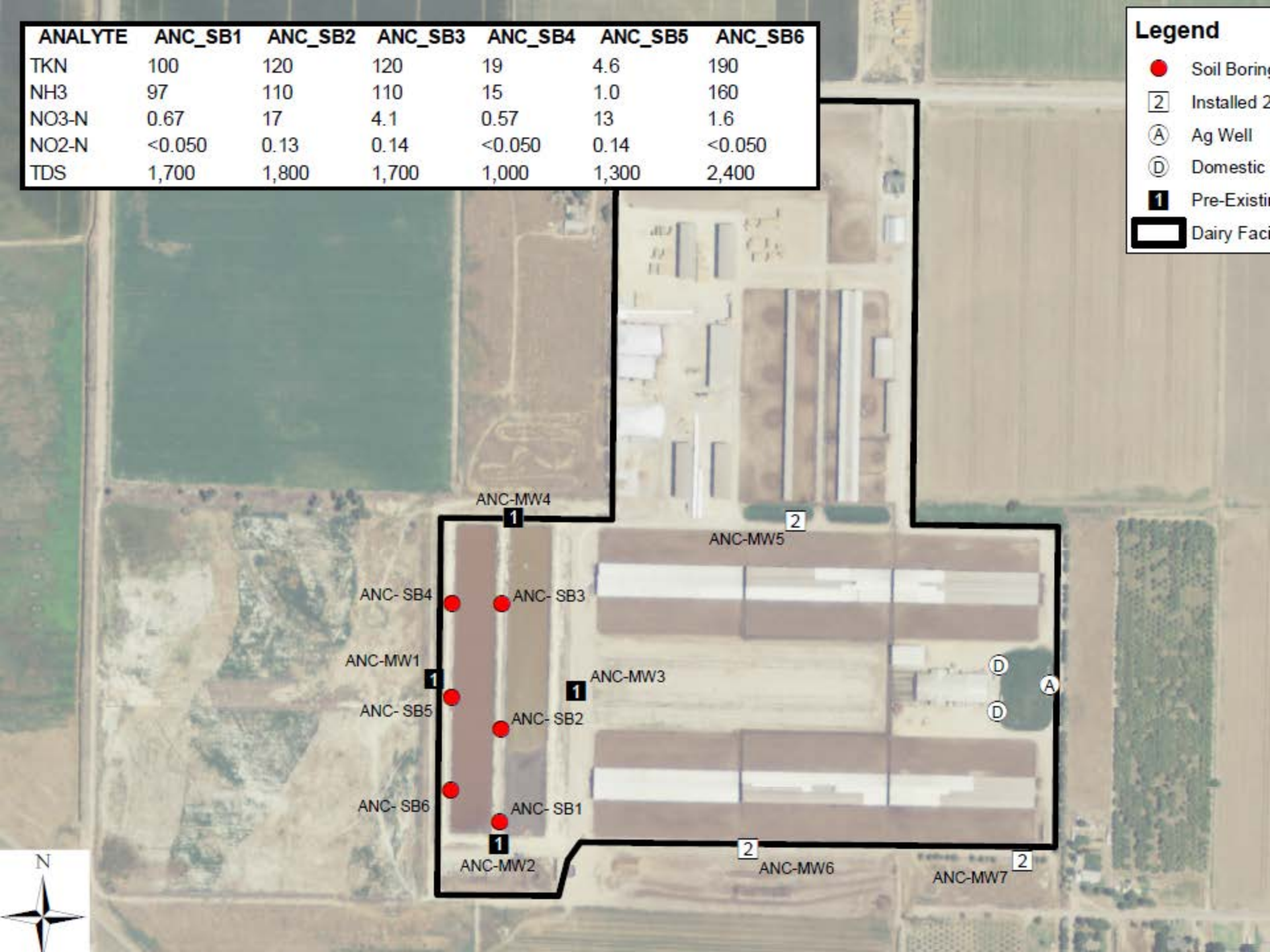
2014 Lagoon Perimeter Hydrogeologic Investigation

Scope

53 continuous soil cores to first-encountered groundwater around 12 lagoons

Groundwater sampling directly at the water table, near to the source (lagoon bottom)

ANALYTE	ANC_SB1	ANC_SB2	ANC_SB3	ANC_SB4	ANC_SB5	ANC_SB6
TKN	100	120	120	19	4.6	190
NH3	97	110	110	15	1.0	160
NO3-N	0.67	17	4.1	0.57	13	1.6
NO2-N	<0.050	0.13	0.14	<0.050	0.14	<0.050
TDS	1,700	1,800	1,700	1,000	1,300	2,400



Results

10 of 12 sites showed impacts at the water table where MWs did not

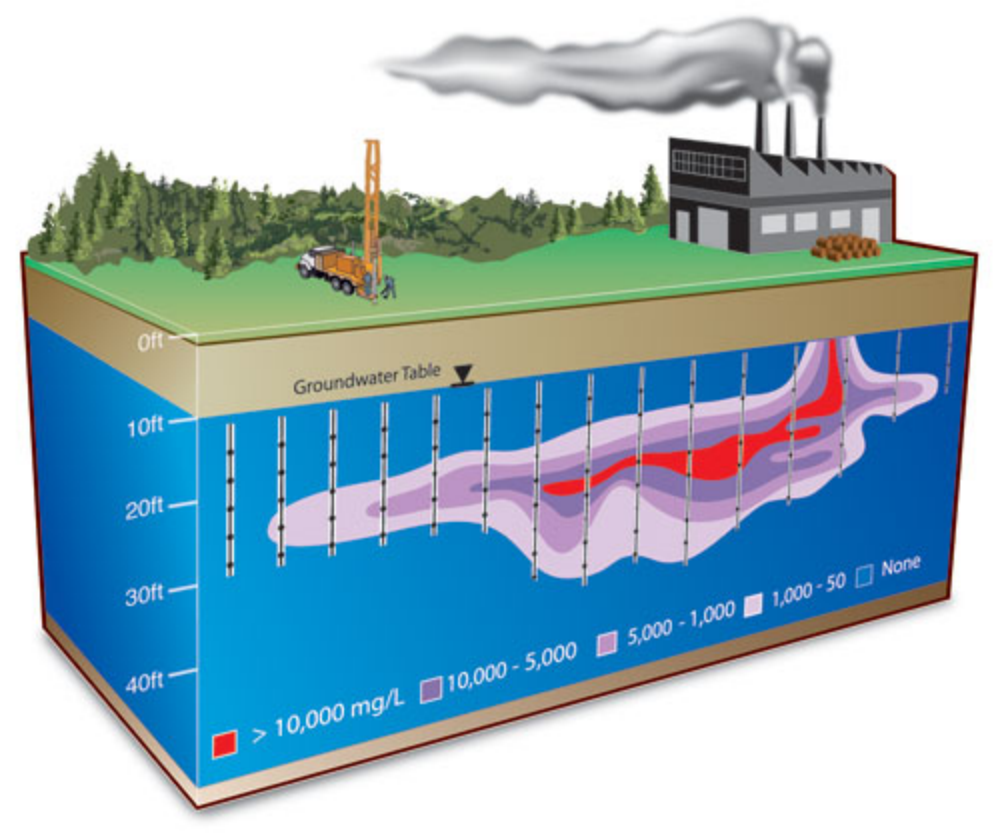
- Why? Sampling redundancy, sampling nearer to the water table and nearer to the lagoon

Effects of lagoon seepage on groundwater quality are minimal, localized in the immediate vicinity of the lagoons

- 4 lagoons: strong evidence of seepage
- 6 lagoons: slightly/moderately elevated indicator parameters in some borings
- 2 lagoons: no evidence of seepage

Groundwater concentrations

do not yield information on…



- Concentration of seepage
- Seepage rate
- Mass loading rate
- Duration of loading

Groundwater quality is not proportional to lagoon performance

Fate of Earthen Lagoons

- Guidelines, construction design standards and applicable laws intend to control seepage from earthen lagoons but not to stop it; thus: expect seepage
- Groundwater monitoring tells us “seeping” or “not seeping”

  this does not provide pertinent information

- Key to reducing subsurface mass loading of nitrate and salts on dairies is a comparative assessment between lagoon and field emissions

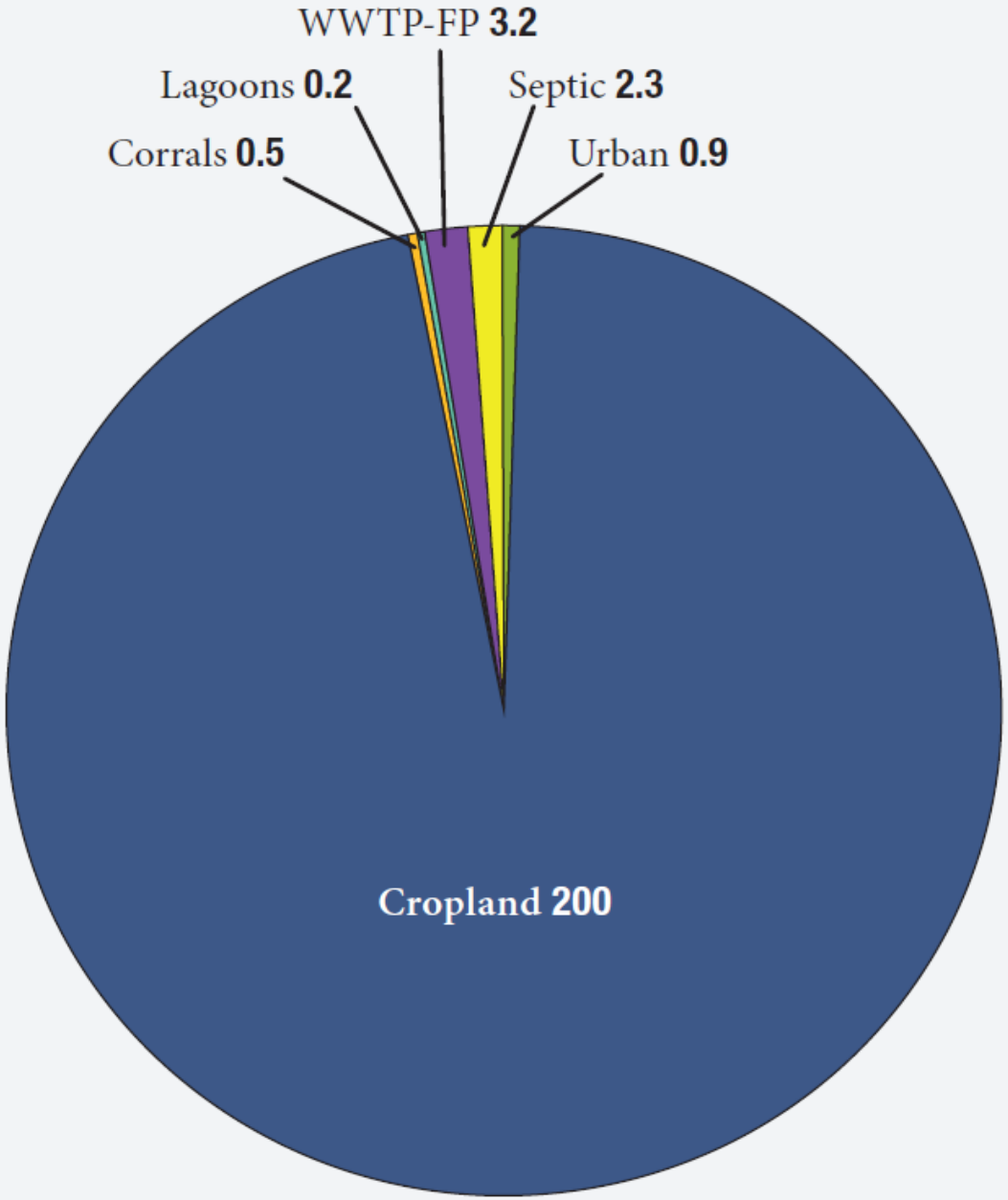
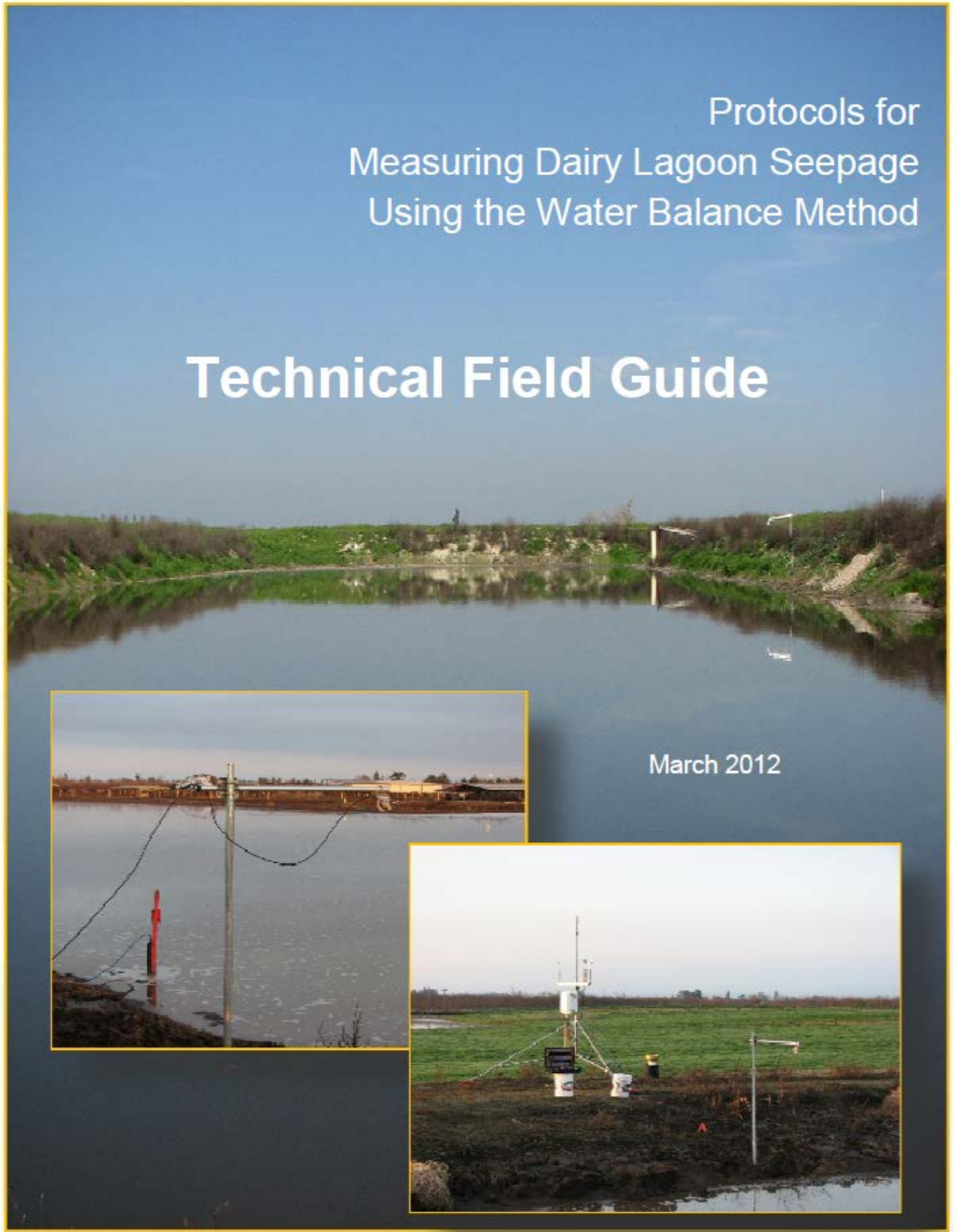


Figure ES-1. Estimated groundwater nitrate loading from major sources within the Tulare Lake Basin and Salinas Valley, in Gg nitrogen per year (1 Gg = 1,100 t).

- Cropland contributes 1000 times more nitrogen to groundwater than ponds
- Regardless, CVDRMP is aggressively moving toward identifying and evaluating potential lagoon mitigation measures

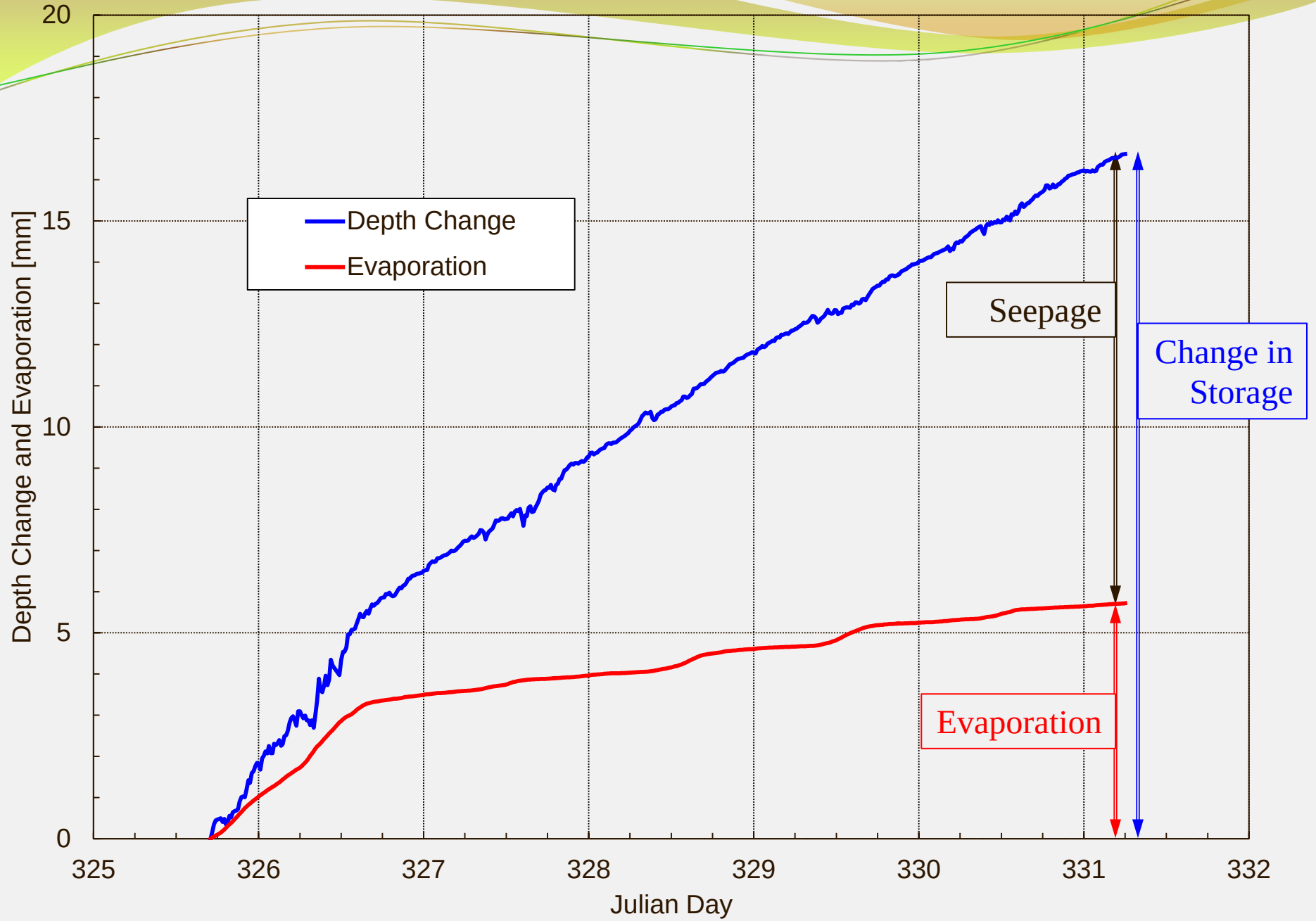
From: Harter et al. (2012), *Addressing Nitrate in California's Drinking Water*



Objective

Generate a knowledge base to aid in evidence-based decision making concerning dairy lagoons

- Field work intensive (2010-2011)
- Verified that mechanistic quantification of lagoon seepage with specified statistical confidence is possible
- Made academic method available to broader audience

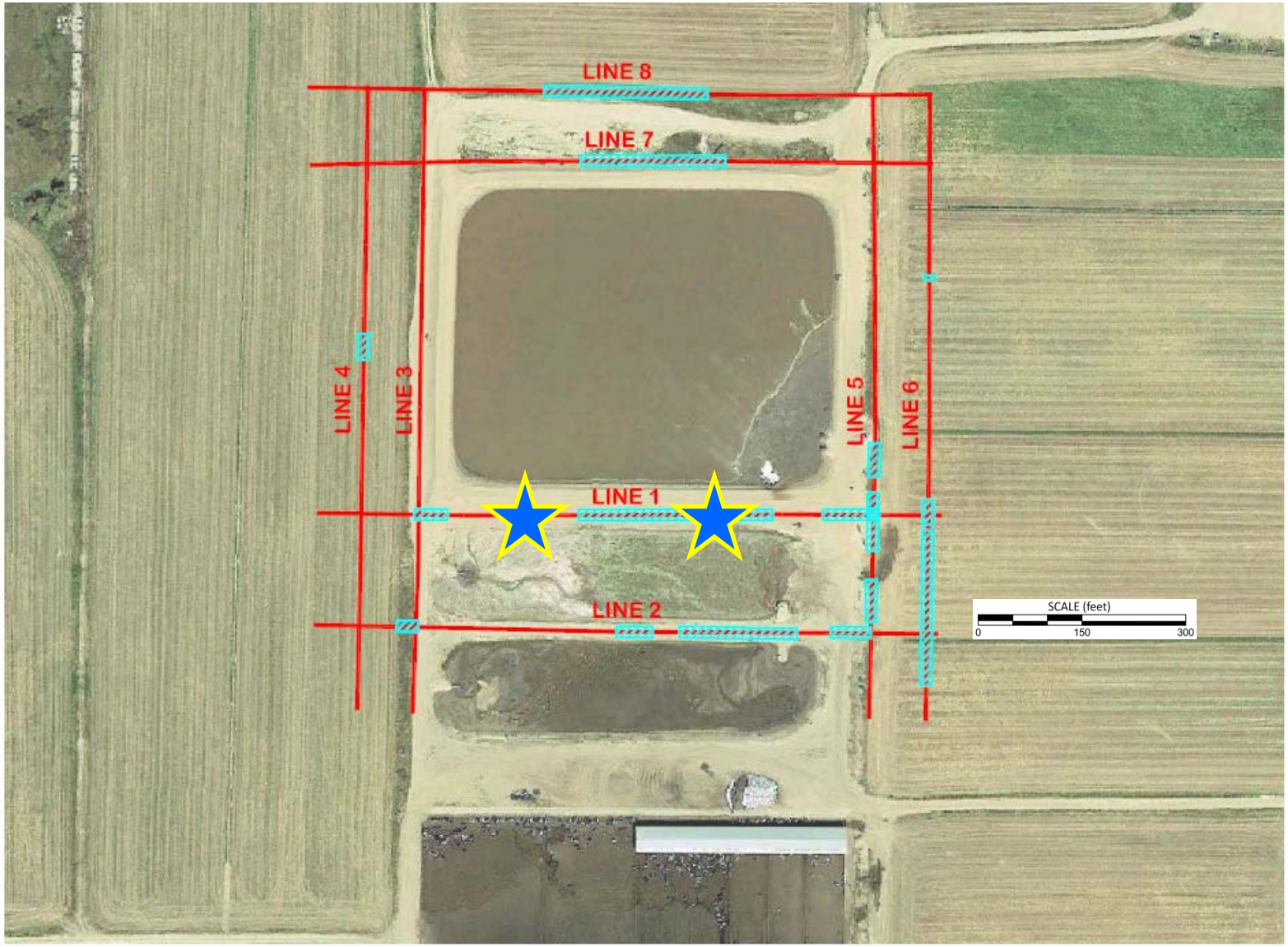

Depth Change and Evaporation [mm]
20
15
10
5
0
325
326
327
328
329
330
331
332
Julian Day
Depth Change
Evaporation
Seepage
Change in Storage
Evaporation

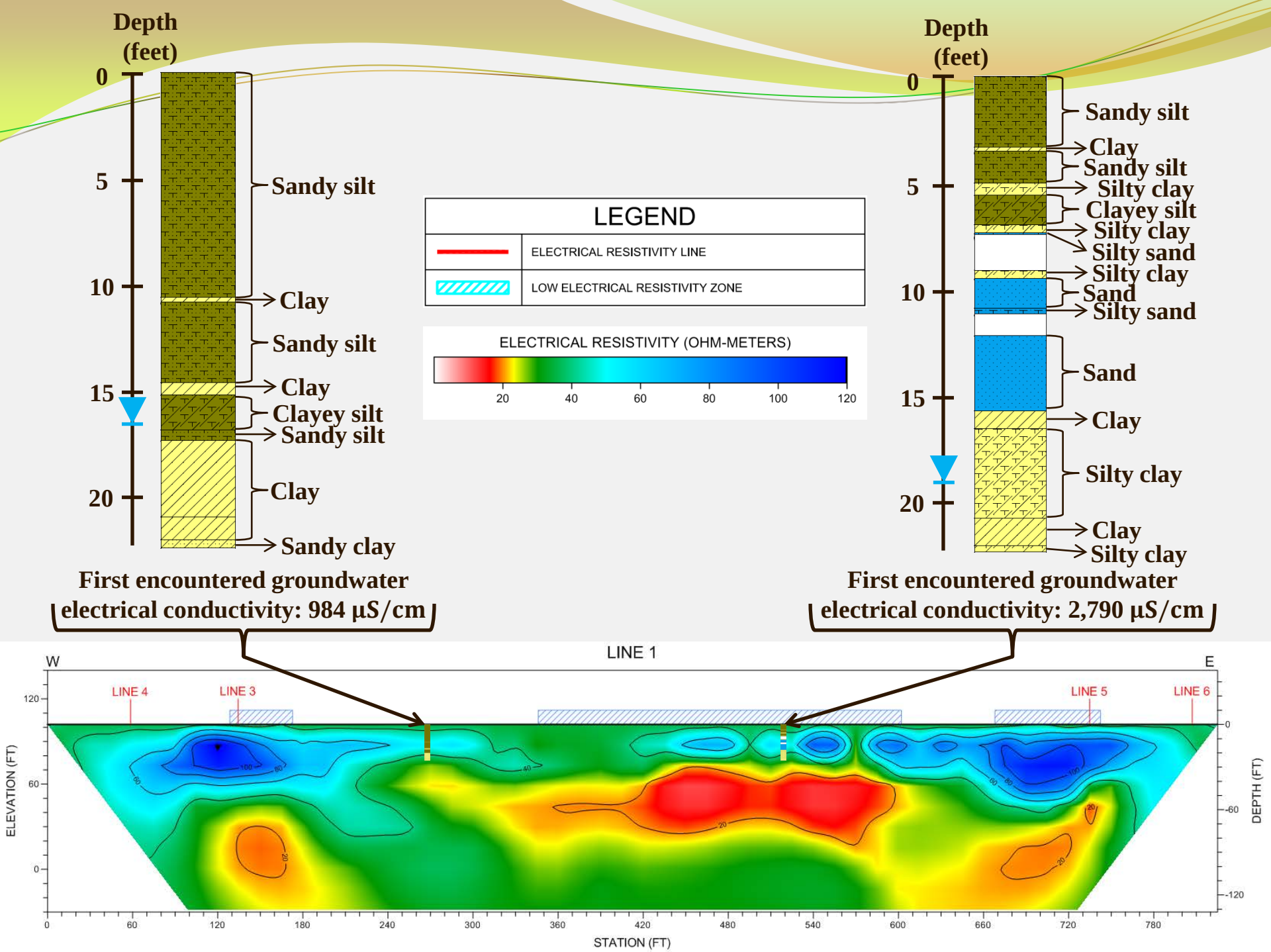
First systematic seepage tests on CA dairy lagoons agree with academic literature

2013/2014 winter season (November – February)

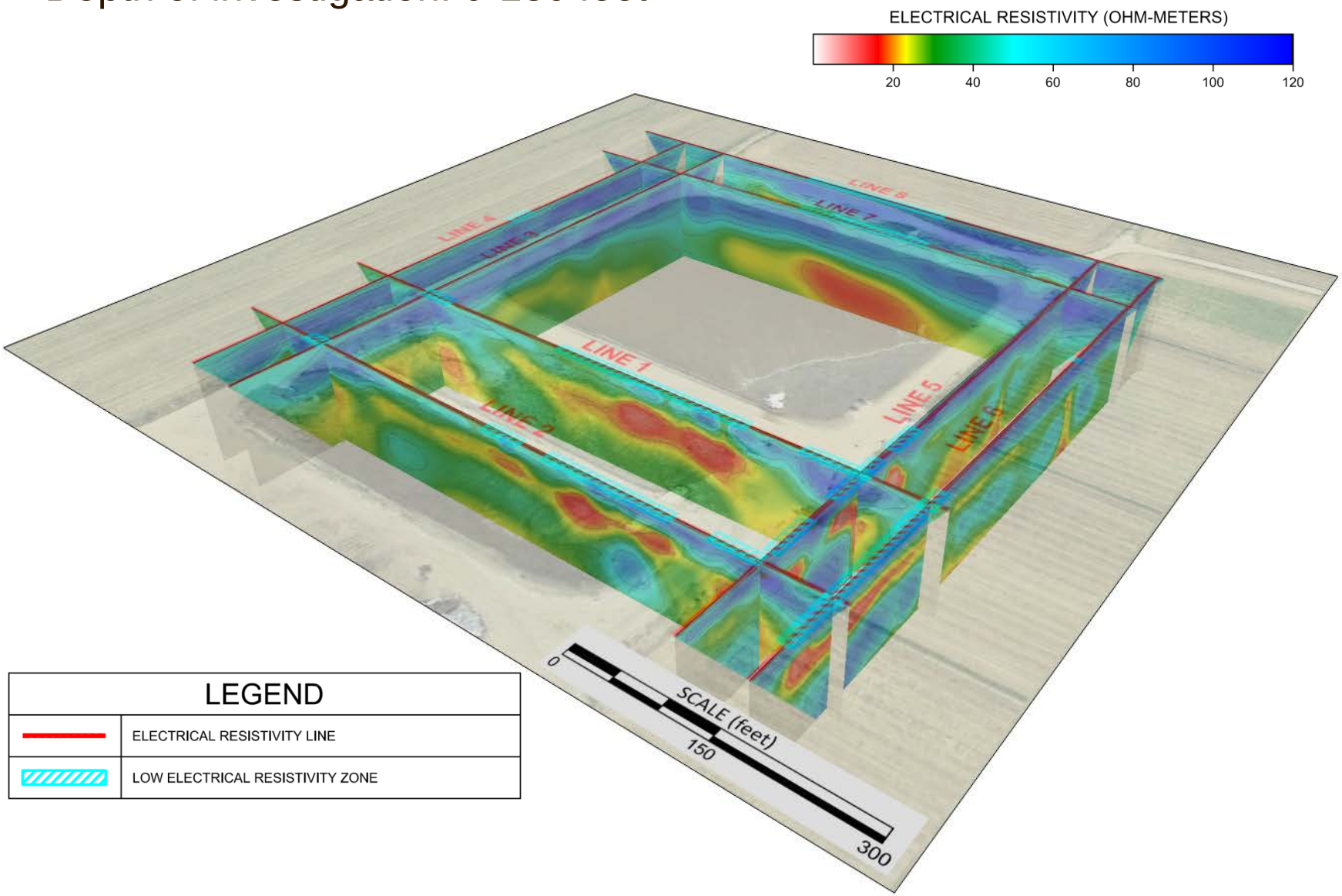
- Water balance successfully completed on 8 ponds
- Ponds constructed 1960s – 2005; no construction documentation
- Soil types: sand to silty clay
- Seepage rates: <0.2 to 2.0 mm/day (0.2 – 2.4 ft/y)
- Six of eight ponds seep less than NRCS design seepage rate (0.86 mm/day or 10^{-6} cm/s)
- No correlation to pond age or soil type
- Subsurface mass loading emanating from fields appears to dwarf mass loading from ponds

Geophysical Survey – Electrical Resistivity Tomography




Depth (feet)
0
5
10
15
20
Sandy silt
Clay
Sandy silt
Clay
Clayey silt
Sandy silt
Clay
Sandy clay
First encountered groundwater
electrical conductivity: 984 µS/cm
LEGEND
ELECTRICAL RESISTIVITY LINE
LOW ELECTRICAL RESISTIVITY ZONE
ELECTRICAL RESISTIVITY (OHM-METERS)
20
40
60
80
100
120
Depth (feet)
0
5
10
15
20
Sandy silt
Clay
Sandy silt
Silty clay
Clayey silt
Silty clay
Silty sand
Silty clay
Sand
Silty sand
Sand
Clay
Silty clay
Clay
Silty clay
First encountered groundwater
electrical conductivity: 2,790 µS/cm
LINE 1
W
E
LINE 4
LINE 3
LINE 5
LINE 6
ELEVATION (FT)
DEPTH (FT)
STATION (FT)
0
60
120
180
240
300
360
420
480
540
600
660
720
780
-60
-120

Depth of investigation: 0-130 feet



Improved Nutrient Management

1. Accurate measurements of irrigation water and nutrient inputs, and nutrient harvest removal
2. Ability to apply specific amounts of manure nutrients at the target rates and times they are needed
3. On-farm record keeping which provides timely in-season computation of application amounts
4. A means of estimating organic N release, expected leaching losses and other dynamic nitrogen processes throughout the season and integrating this information into management decisions to identify the need for adjustment of application rates from the pre-season plan

3. 2015 Outlook

Lagoons

1. LPSHI report
2. Report of seepage testing results
   - comparative assessment of lagoon and field emissions
3. Additional geophysical surveys
4. Summary report of investigative efforts
   - MW groundwater quality
   - LPSHI
   - Seepage testing
   - geophysical
5. Workplan for evaluation of lagoon management practices and begin implementation

Improved Nutrient Management

1. Farm selection, field work to start in spring 2015
2. Development of guidelines for practical sampling protocols and measurements to support nutrient management
   - Collaborative effort with Advisory Committees
3. Refine role of nutrient mass balance (i.e., Crop Nutrient Use Efficiency, Application Removal Ratio) and role of groundwater monitoring for management practice evaluation
   - Collaborative effort with Advisory Committees

Groundwater Age Dating

Objective: Support interpretation of groundwater chemical characteristics where unsaturated zone is thick, travel times are long, cause-and-effect relationships are not clear

Results are expected to critically support…

- Groundwater conditions evaluation
- Assessment of sampling schedules
- Reevaluation of deep vs. shallow groundwater conditions for purposes of achieving RMP objectives

Summary

1. **CVDRMP continues to demonstrate by action**
   - Proactive, science-based, innovative, ***successful*** approaches and methods beyond GO-required monitoring
   - Follow-through on findings in its Annual Reports
2. **Engagement of Advisory Committees will continue and intensify in 2015**
3. **General Order's schedule is ambitious**
   - CVDRMP is on track to meet 2019 deadline for Summary Report
   - Recommendations for management practices are beginning to take shape and will be incrementally refined & solidified in the coming years