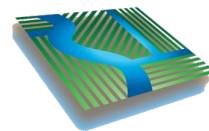




NID PFW Demand Model

Development Updates and
Sensitivity Analyses



DAVIDS
ENGINEERING, INC

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Western Water Since 1993

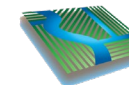
Agenda

- Overview of Demand Model and Inputs
- Development of Key Model Inputs
- Sensitivity Analyses (Current Demand Scenario)
- Next Steps (Future Demand Scenarios)

Overview of Demand Model and Inputs

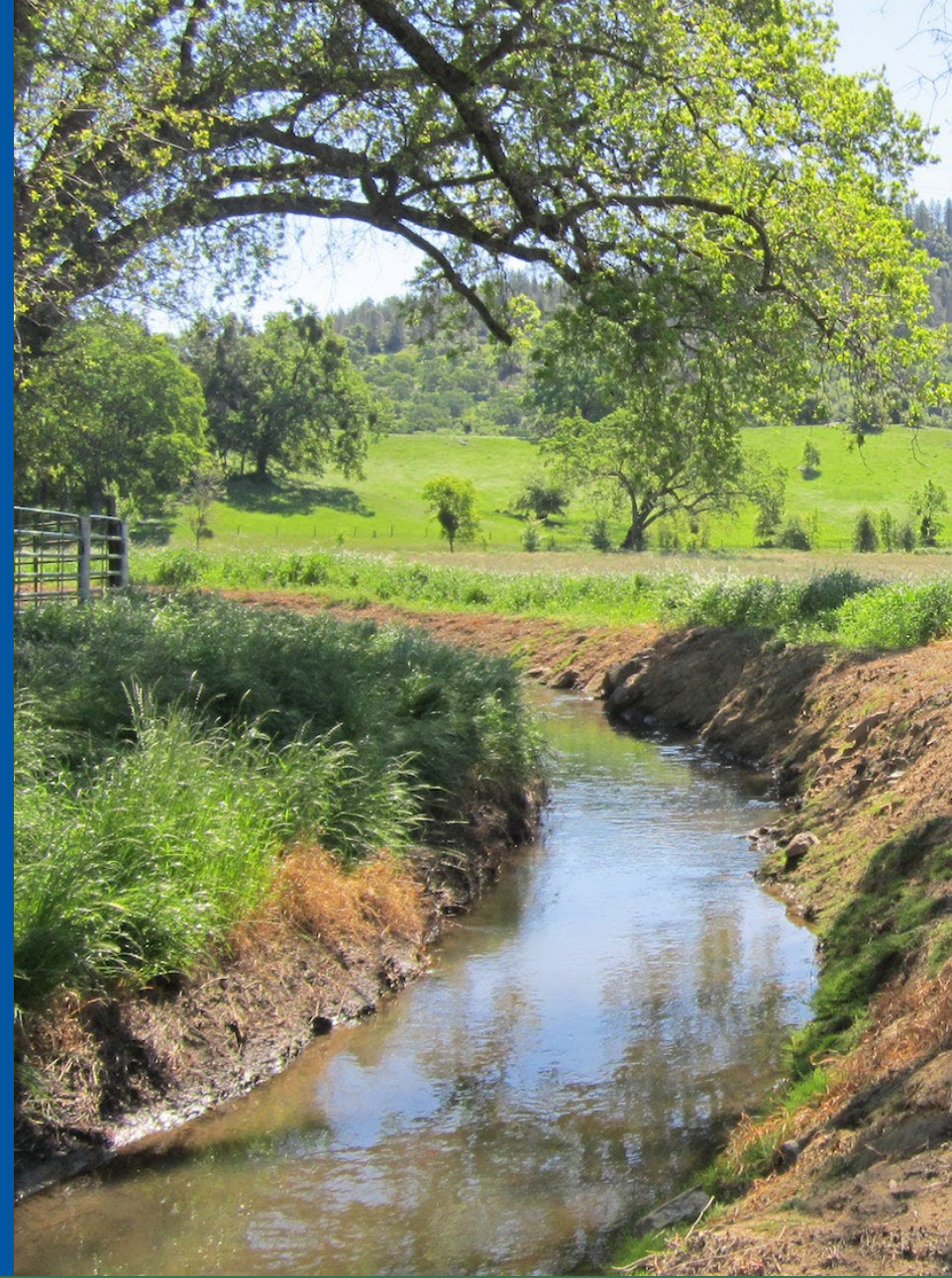
What is Demand?

- “Demand” is the volume of water needed to satisfy water users’ needs
 - Agricultural demand depends on crops, irrigation methods, climate, soils, etc.
 - Urban demand depends on population, per capita water use, climate, etc.



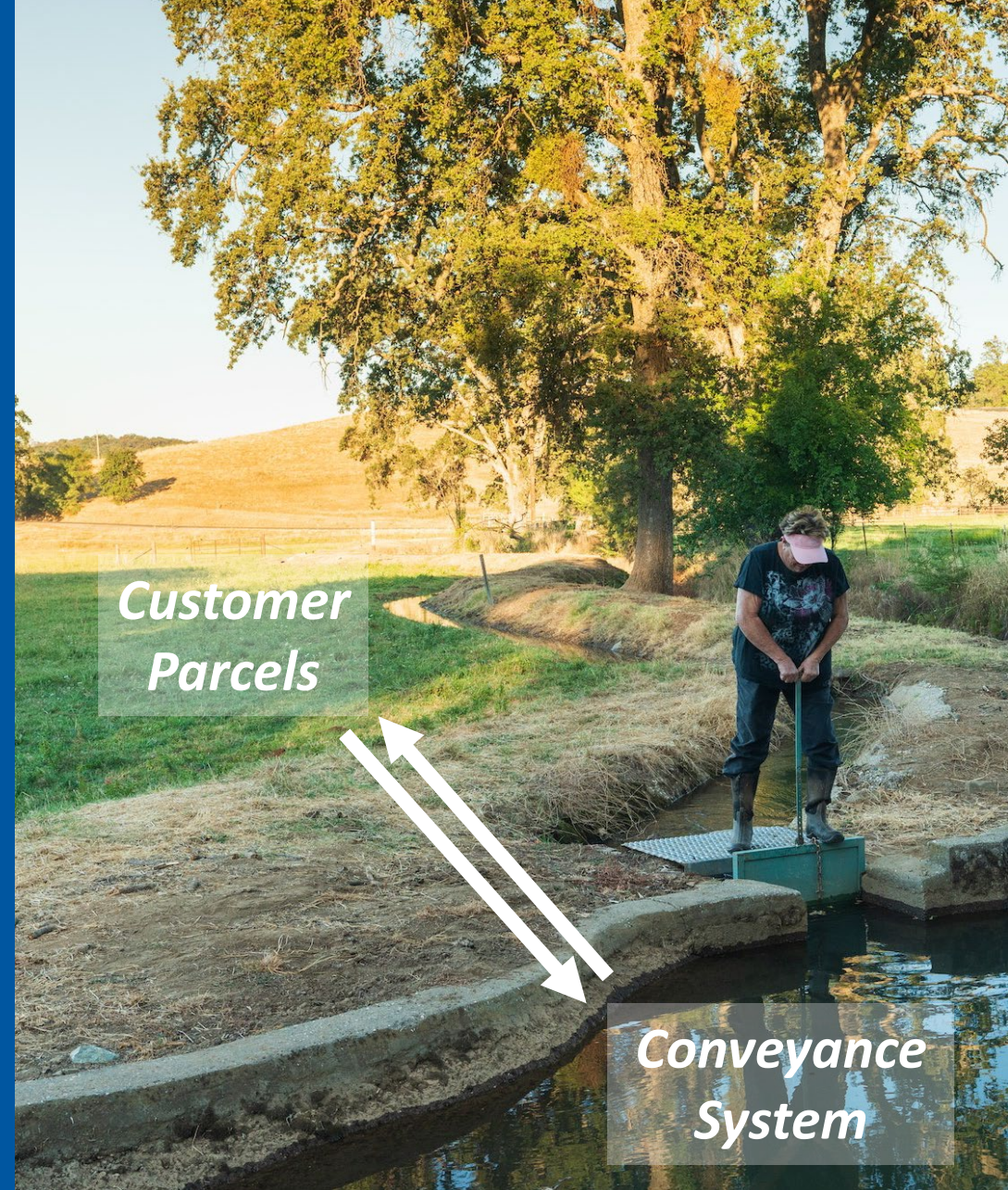
What is Demand?

- “Demand” is the volume of water needed to satisfy water users’ needs
 - Raw water
 - Treated water
 - System losses
 - Municipal
 - Environmental flows



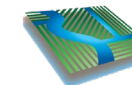
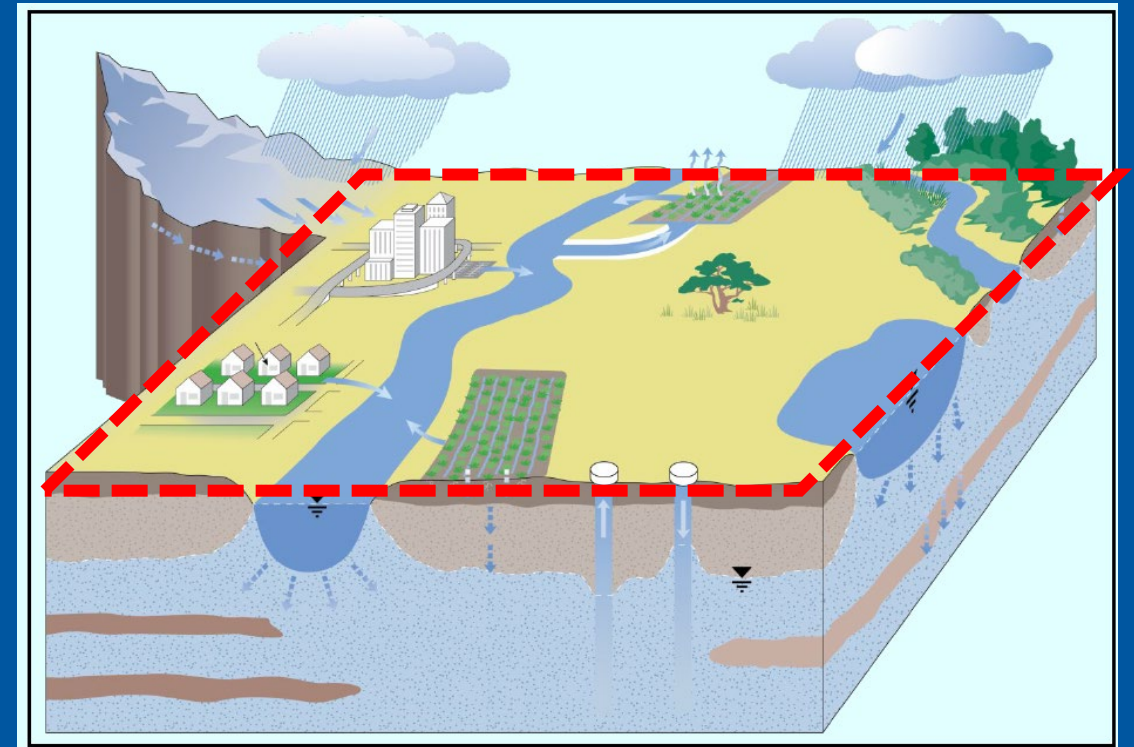
Demand Modeling Approach

- **IDC Model for Customer Parcels**
 - Simulate raw and treated water demand
 - Calibrated, physical model
- **Water Balance for Conveyance System**
 - Simulate system flows, losses
 - Link back to reservoirs
- Add in municipal, environmental flows

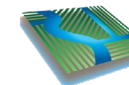
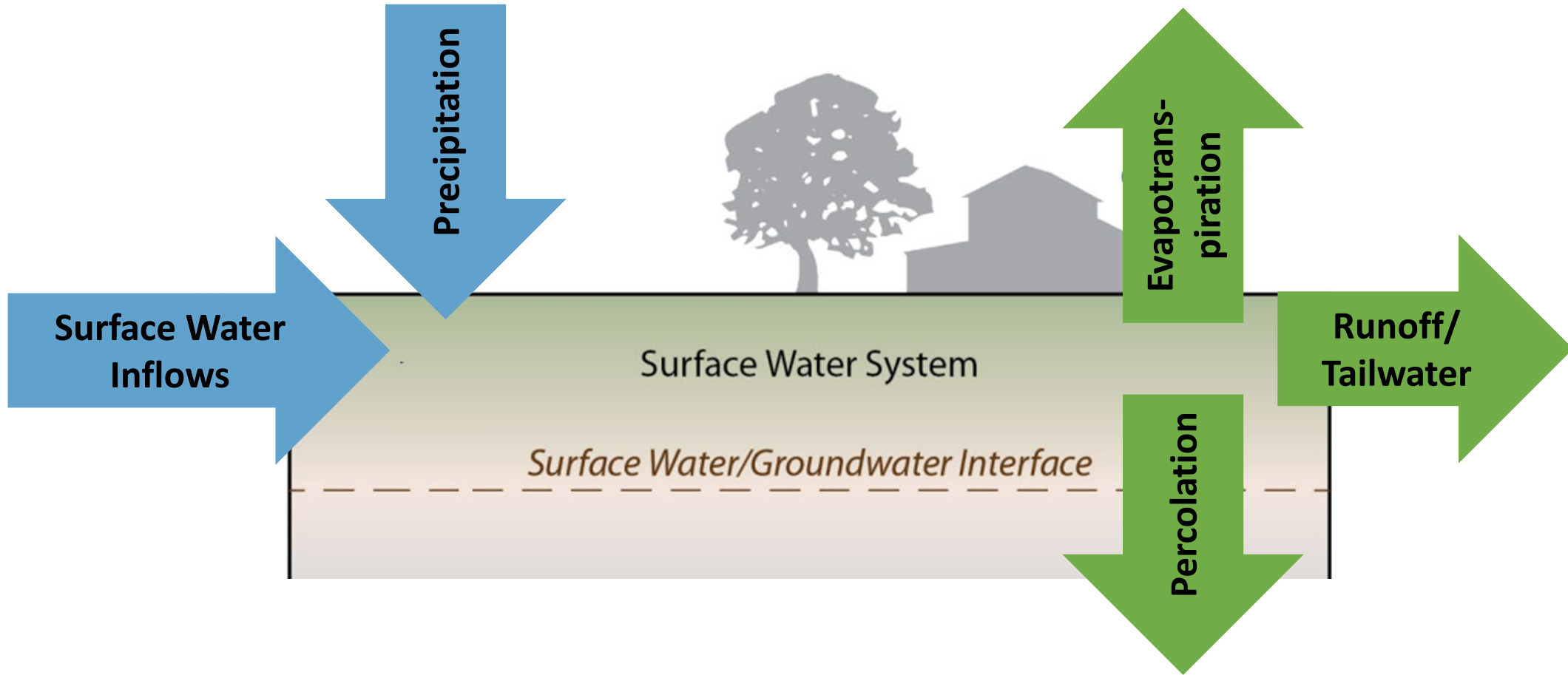


IDC: IWFM Demand Calculator

- Part of the Department of Water Resources' Integrated Water Flow Model (IWFM)
- Robust simulation of physical processes in the root zone
- Widely accepted across California
 - Agricultural water planning studies
 - Groundwater sustainability planning



IDC: IWFM Demand Calculator



Development of Key Model Inputs

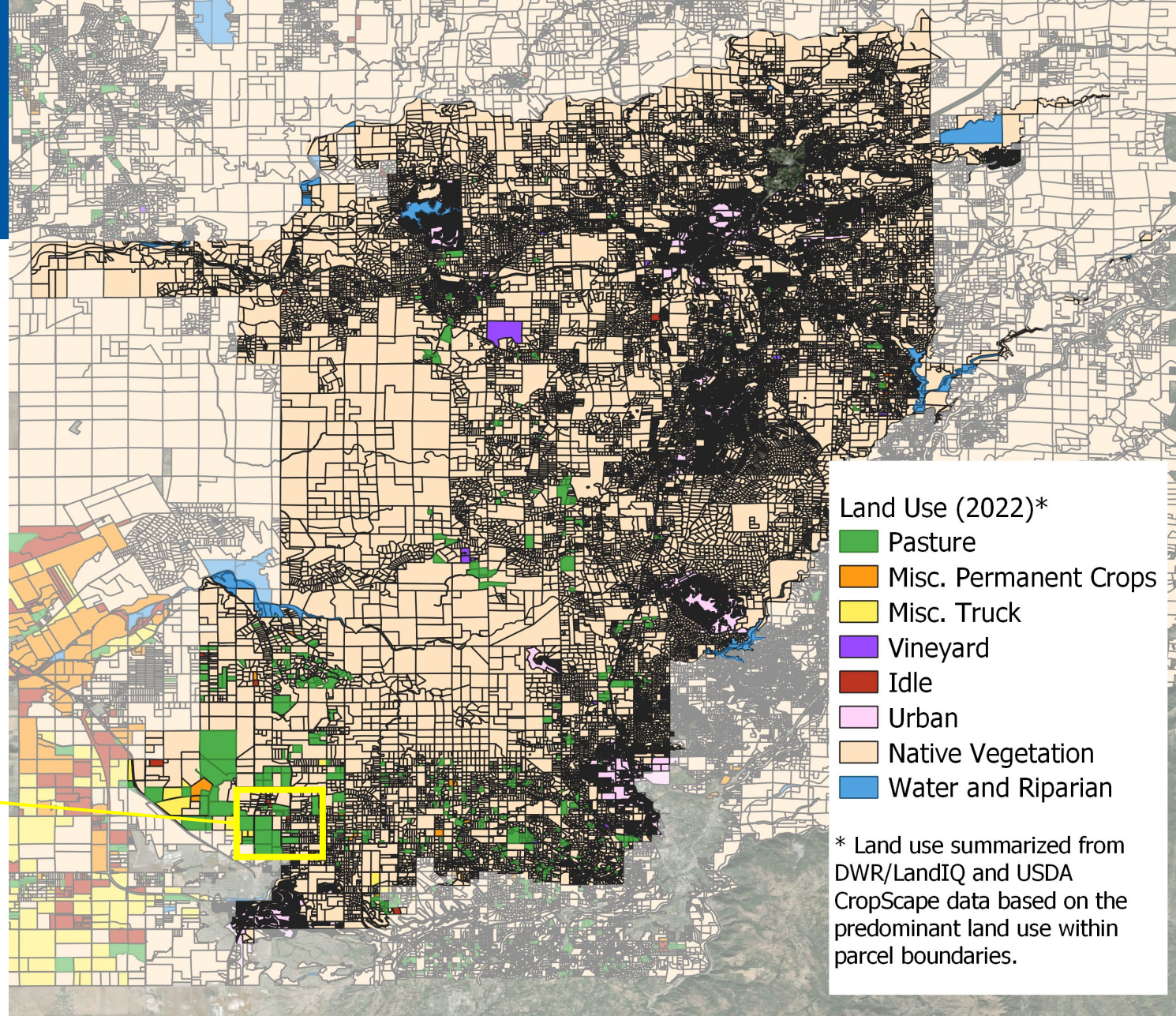
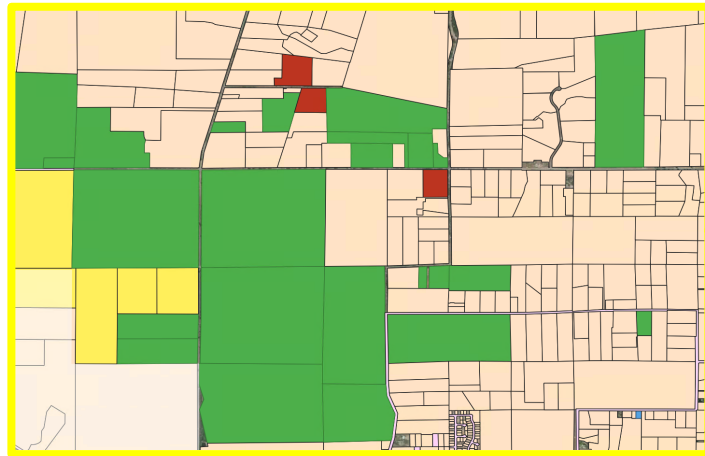
For a Current and Future Demand Scenarios

Development of Key Inputs

- Land Use
- Climate-Related Inputs
 - Precipitation
 - Evapotranspiration (ETc)

Land Use

- Data Sources:
 - DWR/Land IQ
 - USDA CropScape

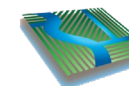
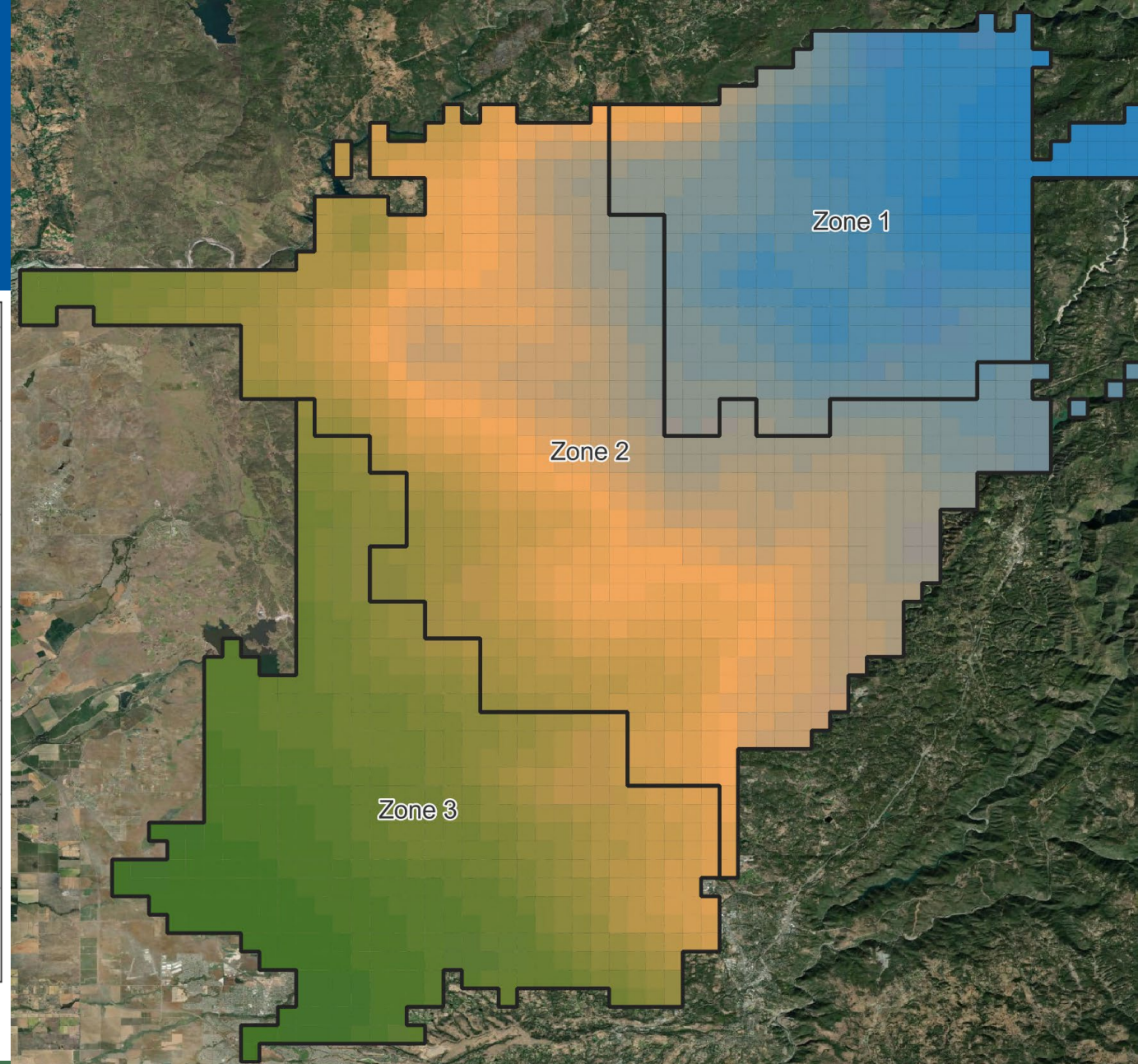
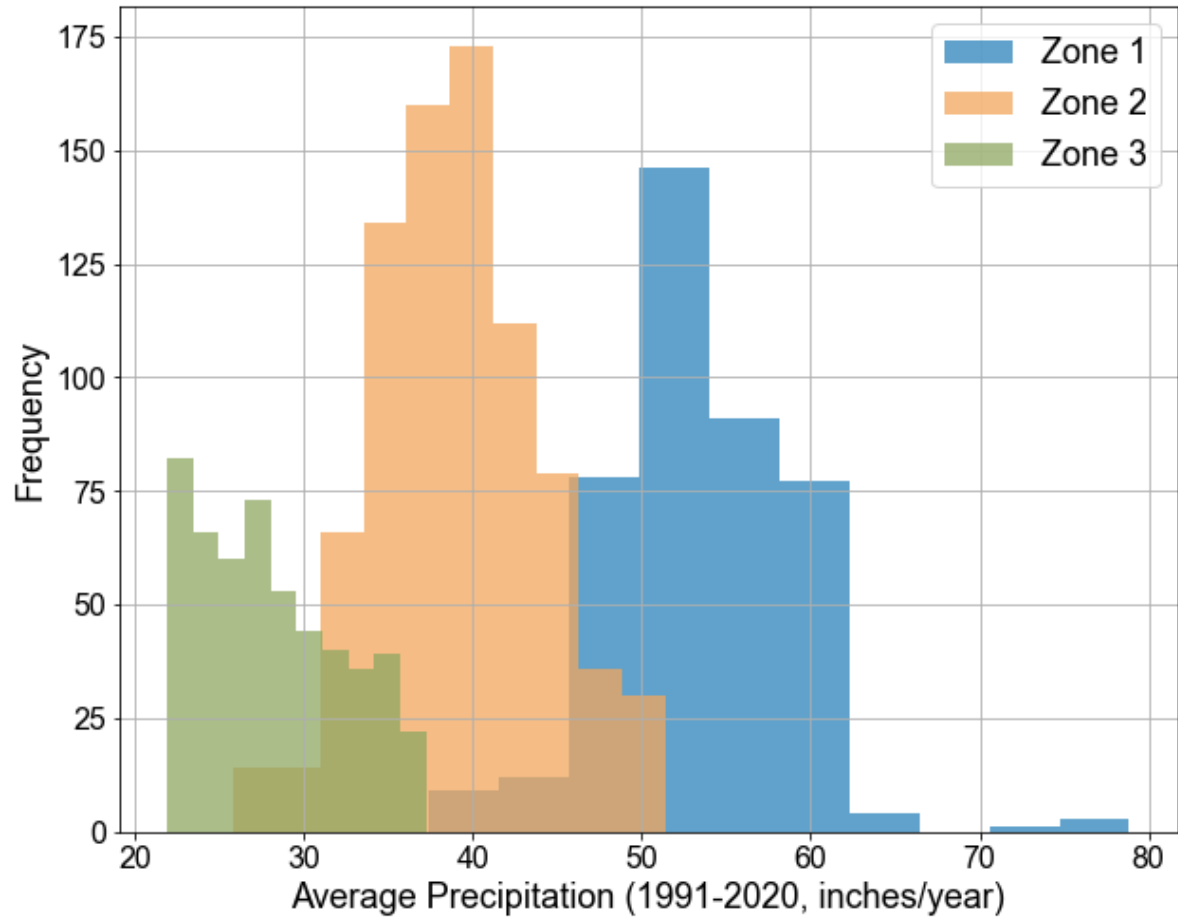


Land Use (2022)*

- Pasture
- Misc. Permanent Crops
- Misc. Truck
- Vineyard
- Idle
- Urban
- Native Vegetation
- Water and Riparian

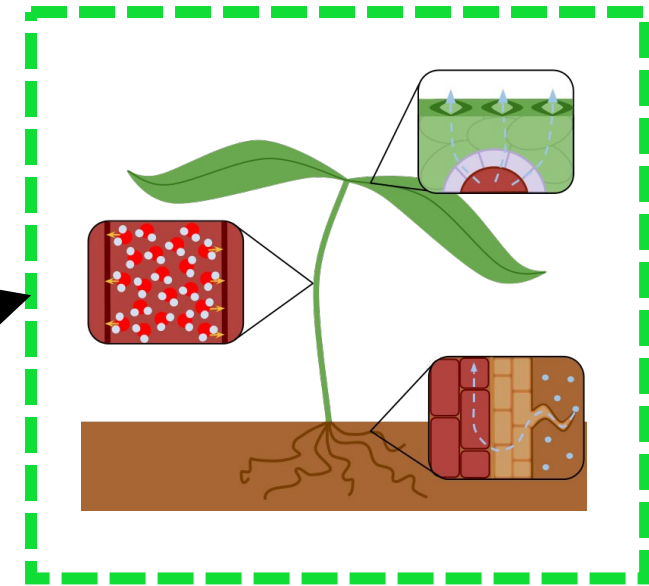
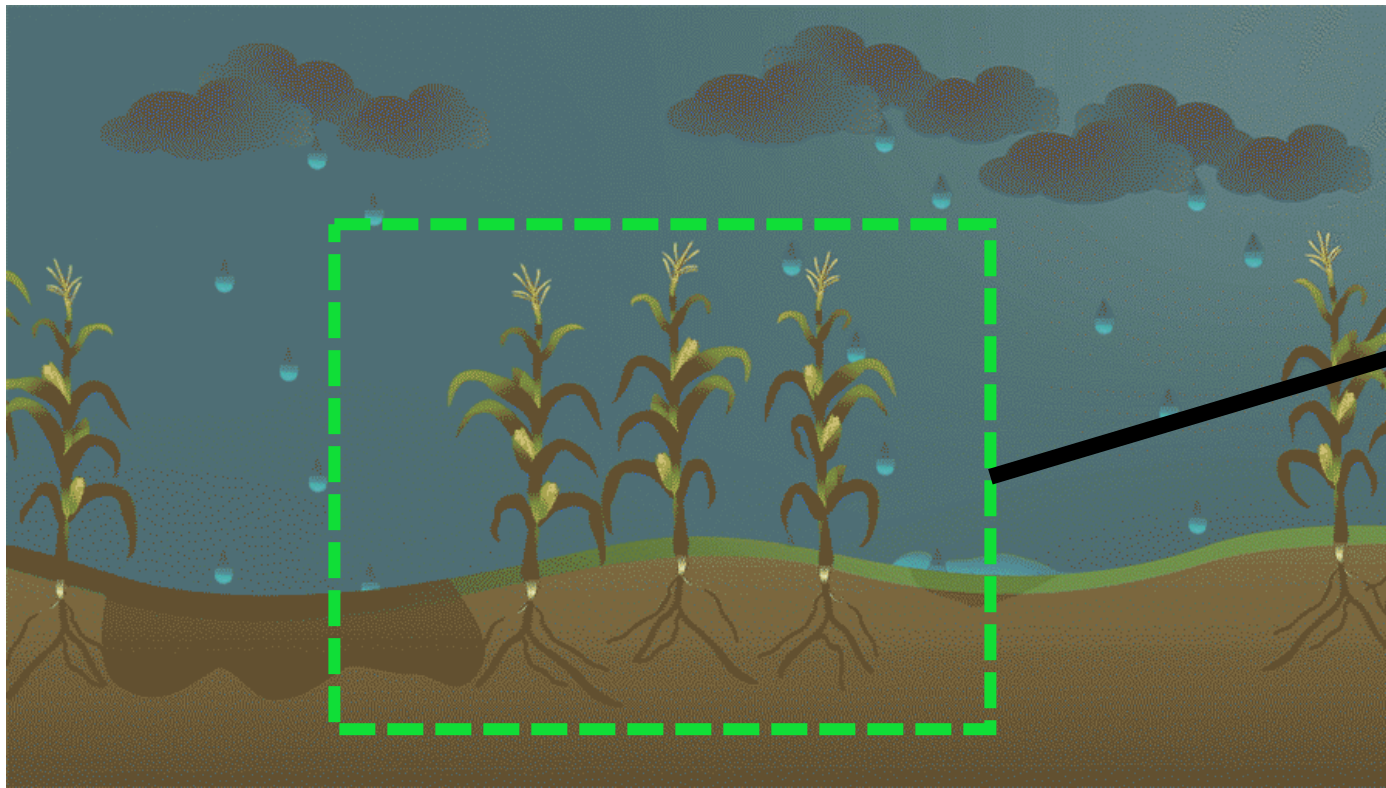
* Land use summarized from DWR/LandIQ and USDA CropScape data based on the predominant land use within parcel boundaries.

Precipitation



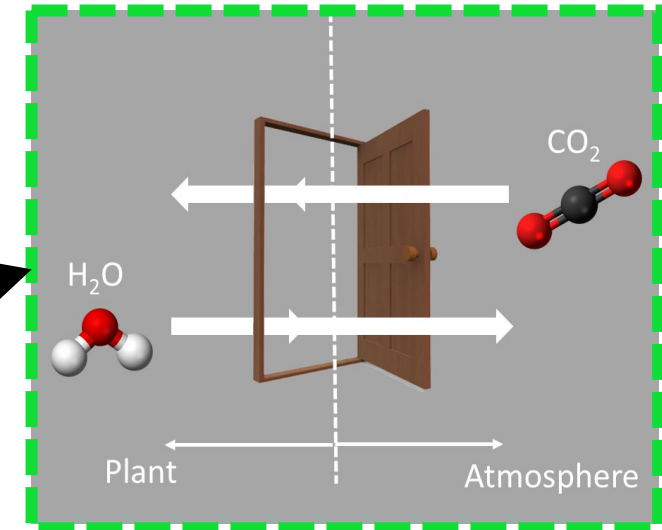
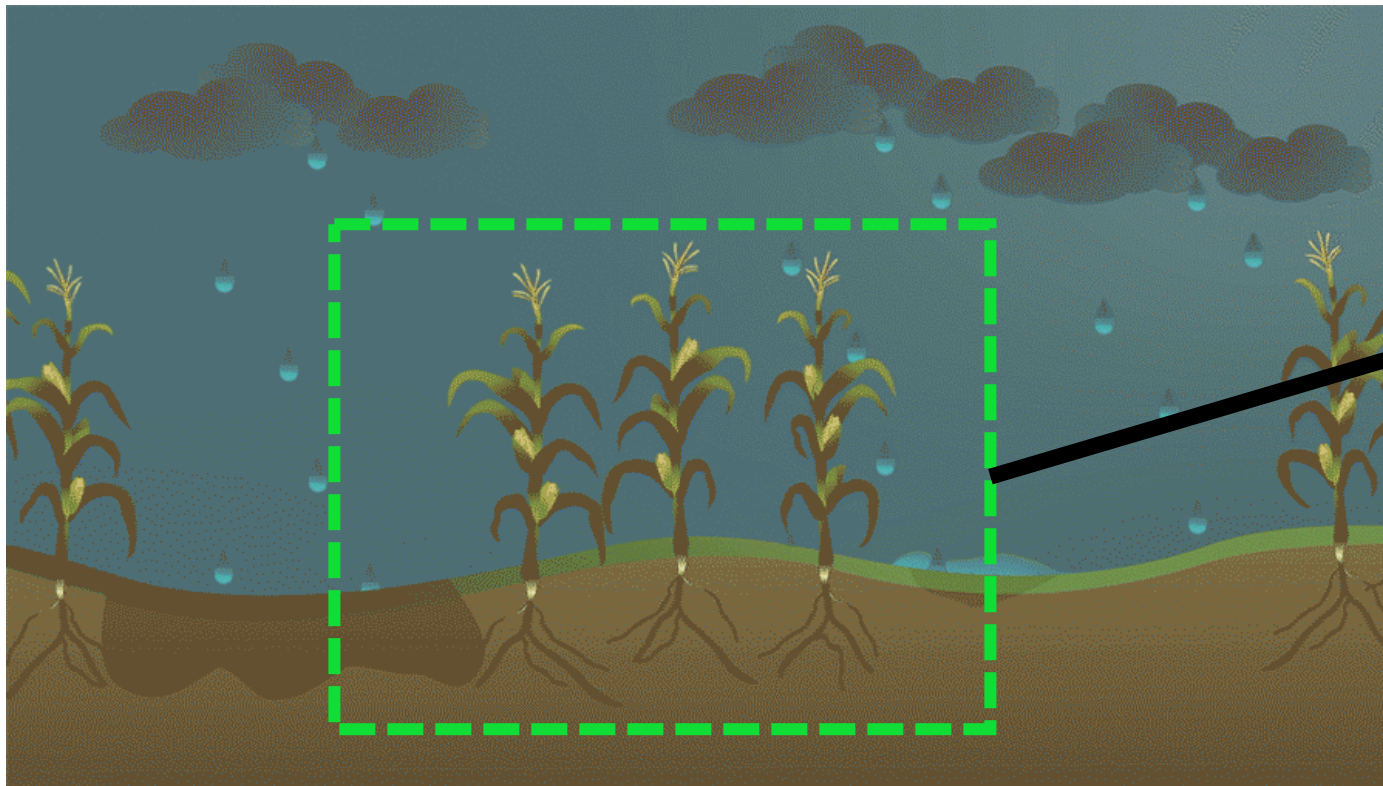
Evapotranspiration (ETc)

Process by which water is lost to the atmosphere through evaporation + transpiration.

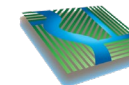


Evapotranspiration (ETc)

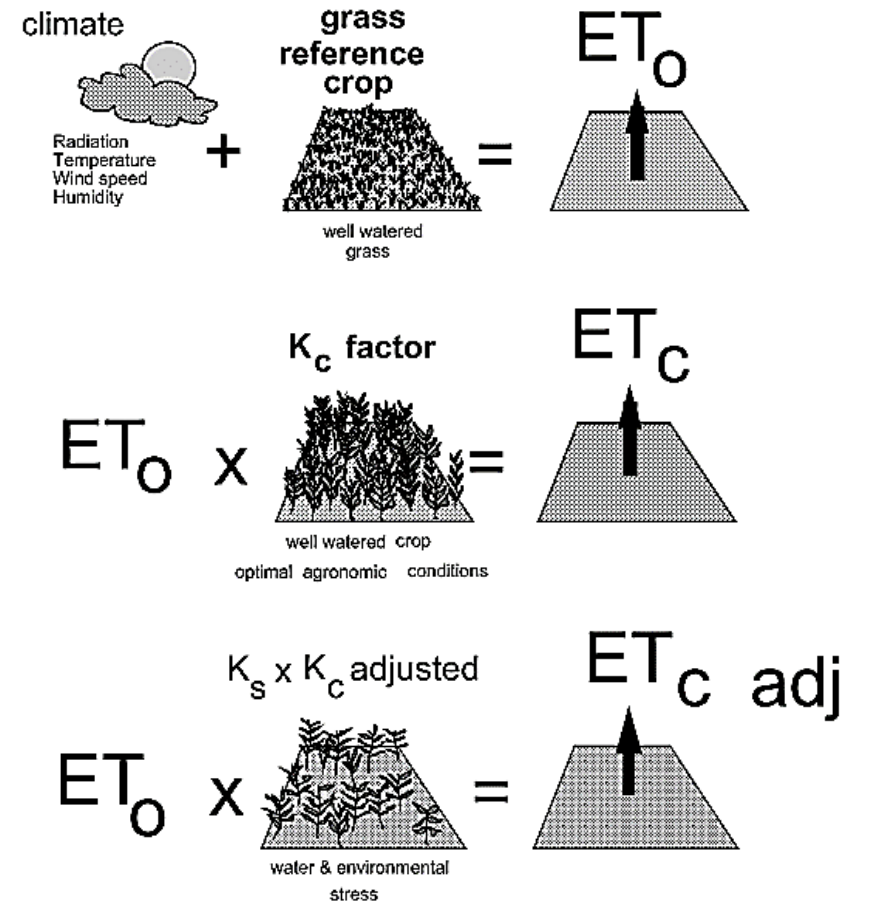
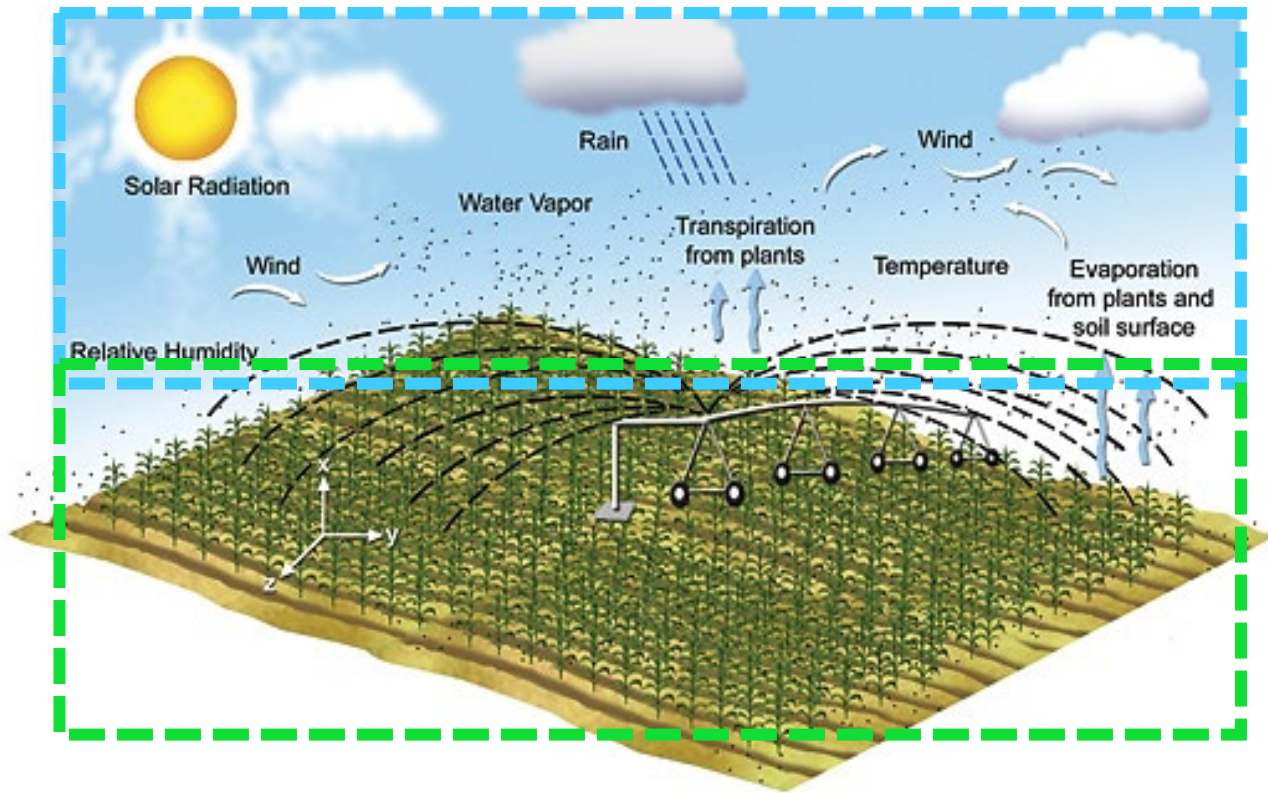
Process by which water is lost to the atmosphere through evaporation + transpiration.



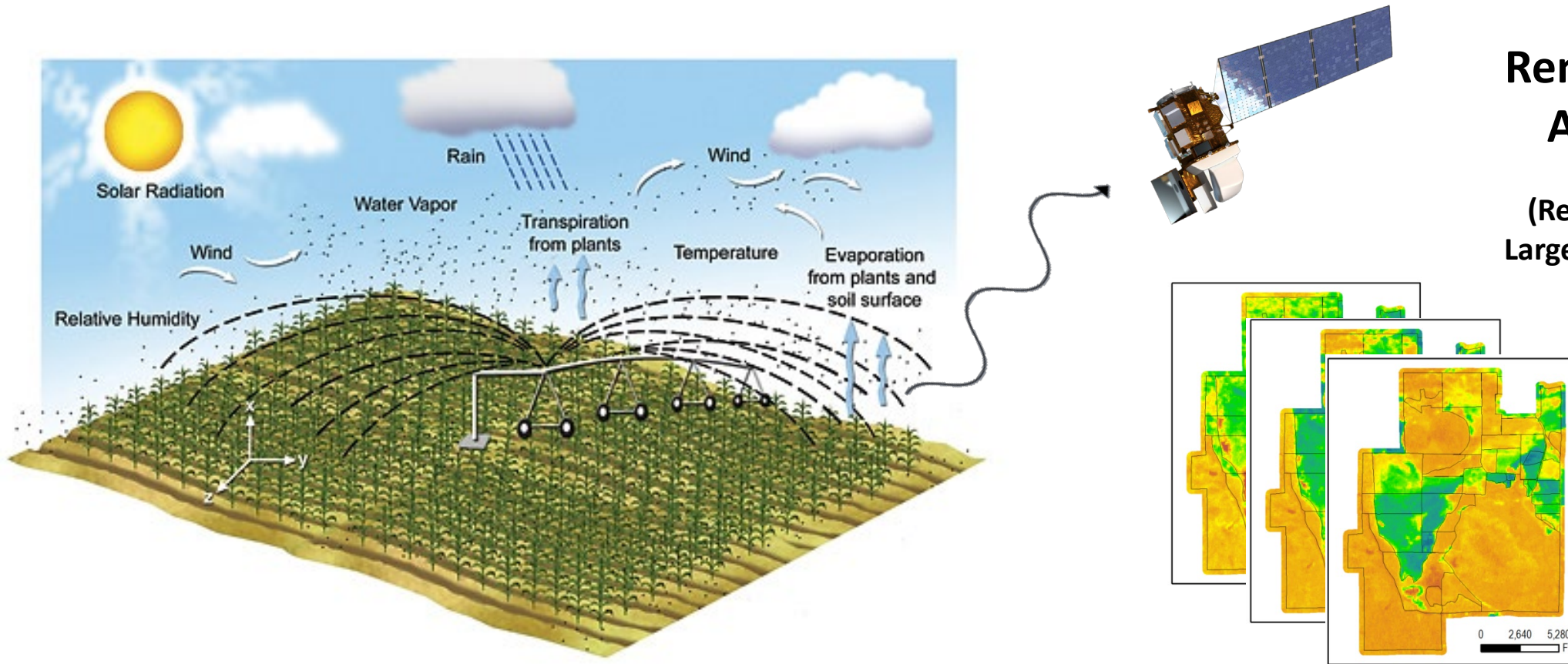
Water is released as CO₂ is taken in.



Evapotranspiration (ETc)

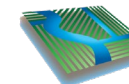


Evapotranspiration (ETc)

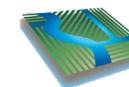
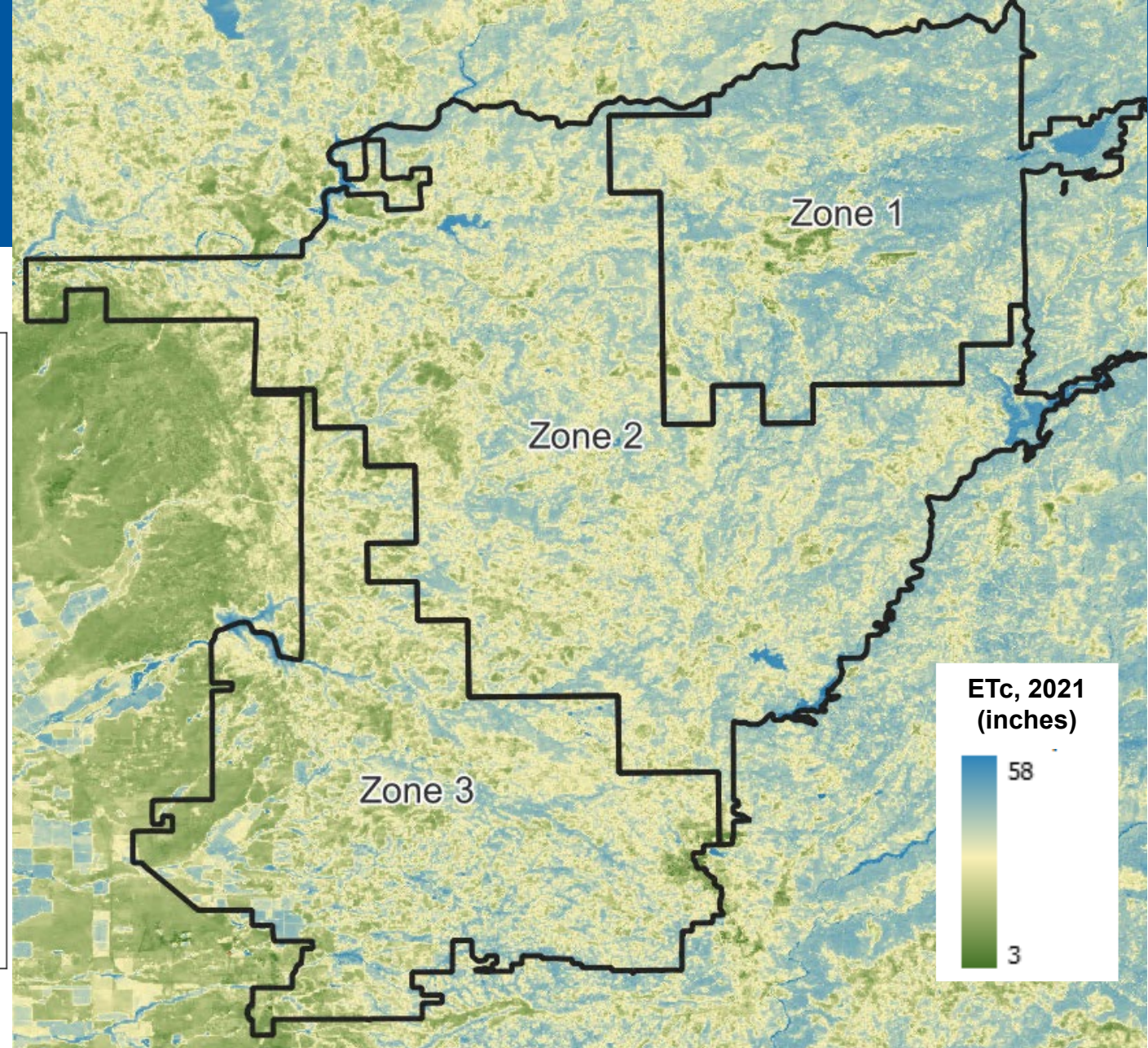
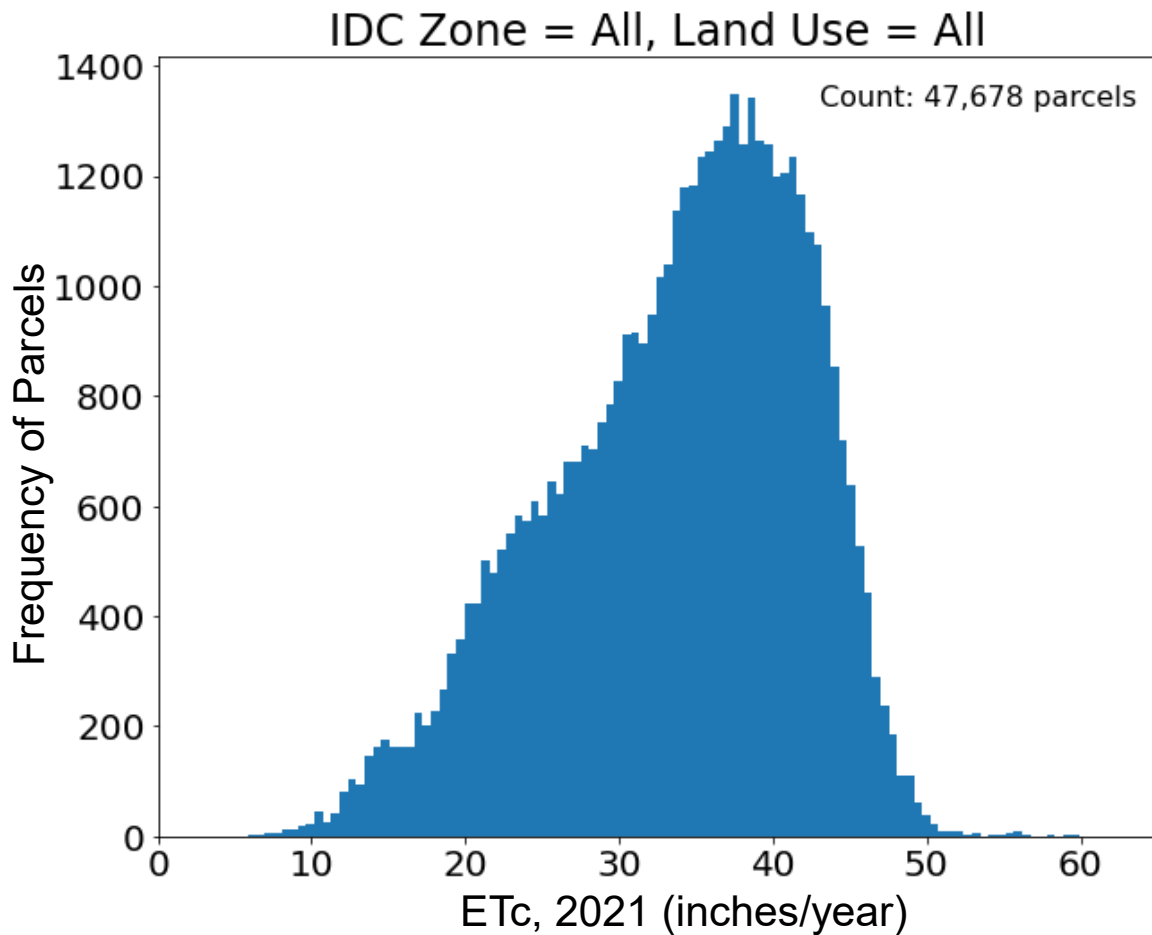


Remote Sensing Approaches

(Relatively Low Cost, Larger Spatial Coverage)



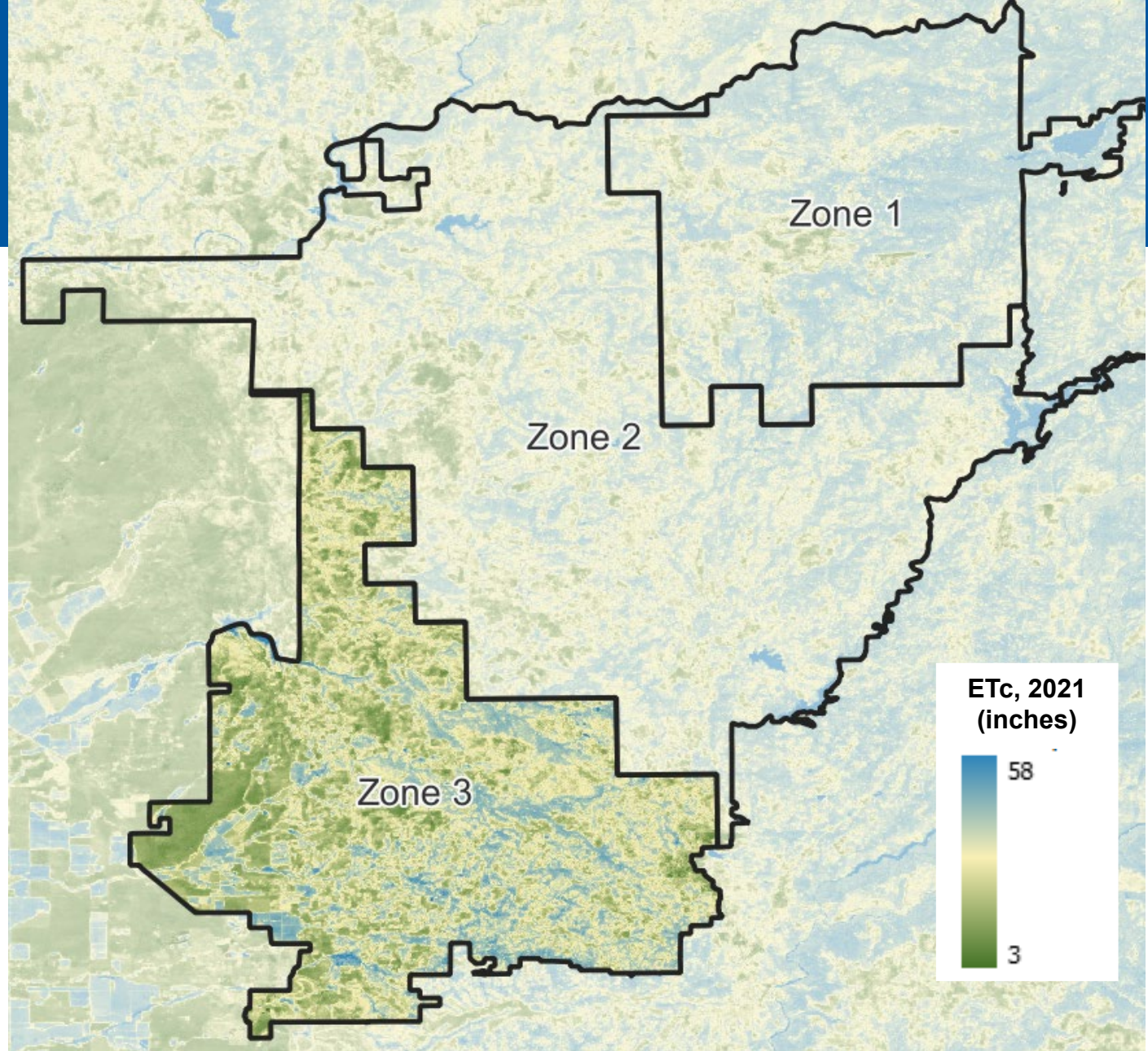
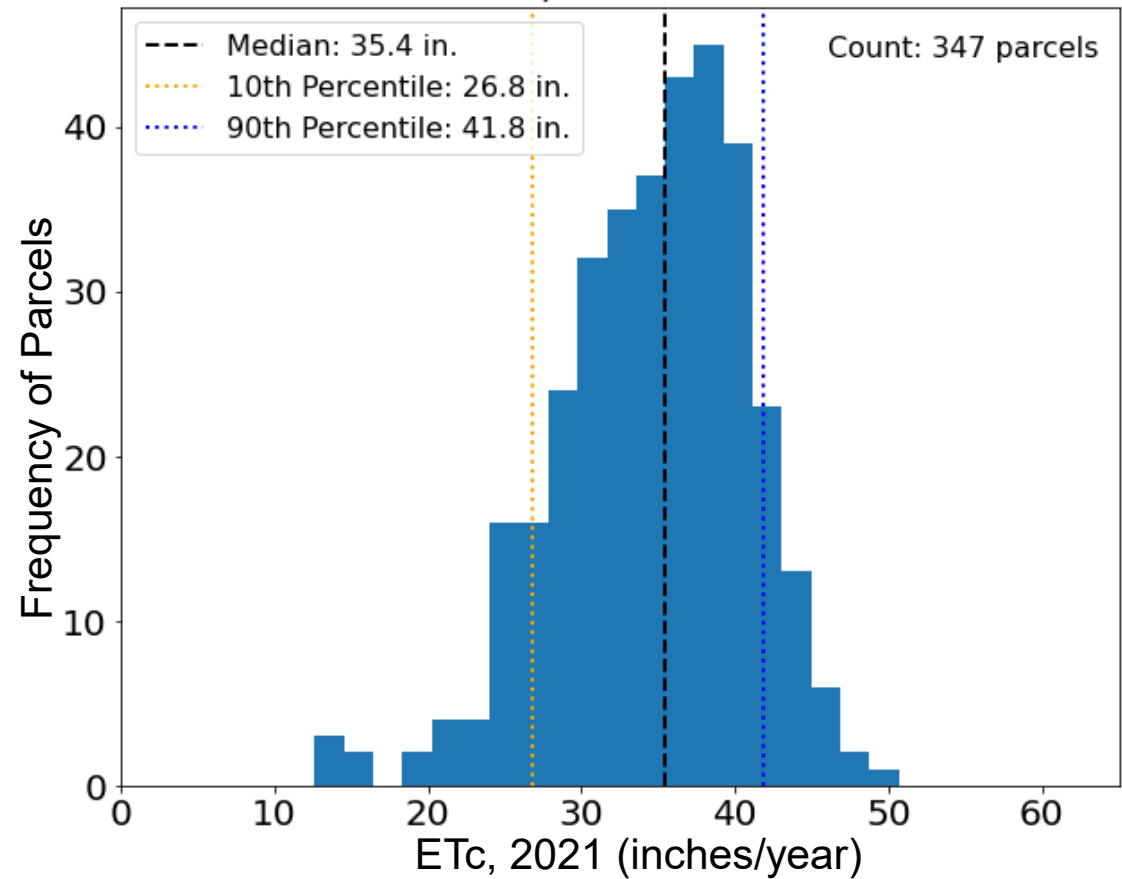
Remote Sensing Approach: OpenET



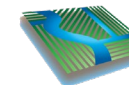
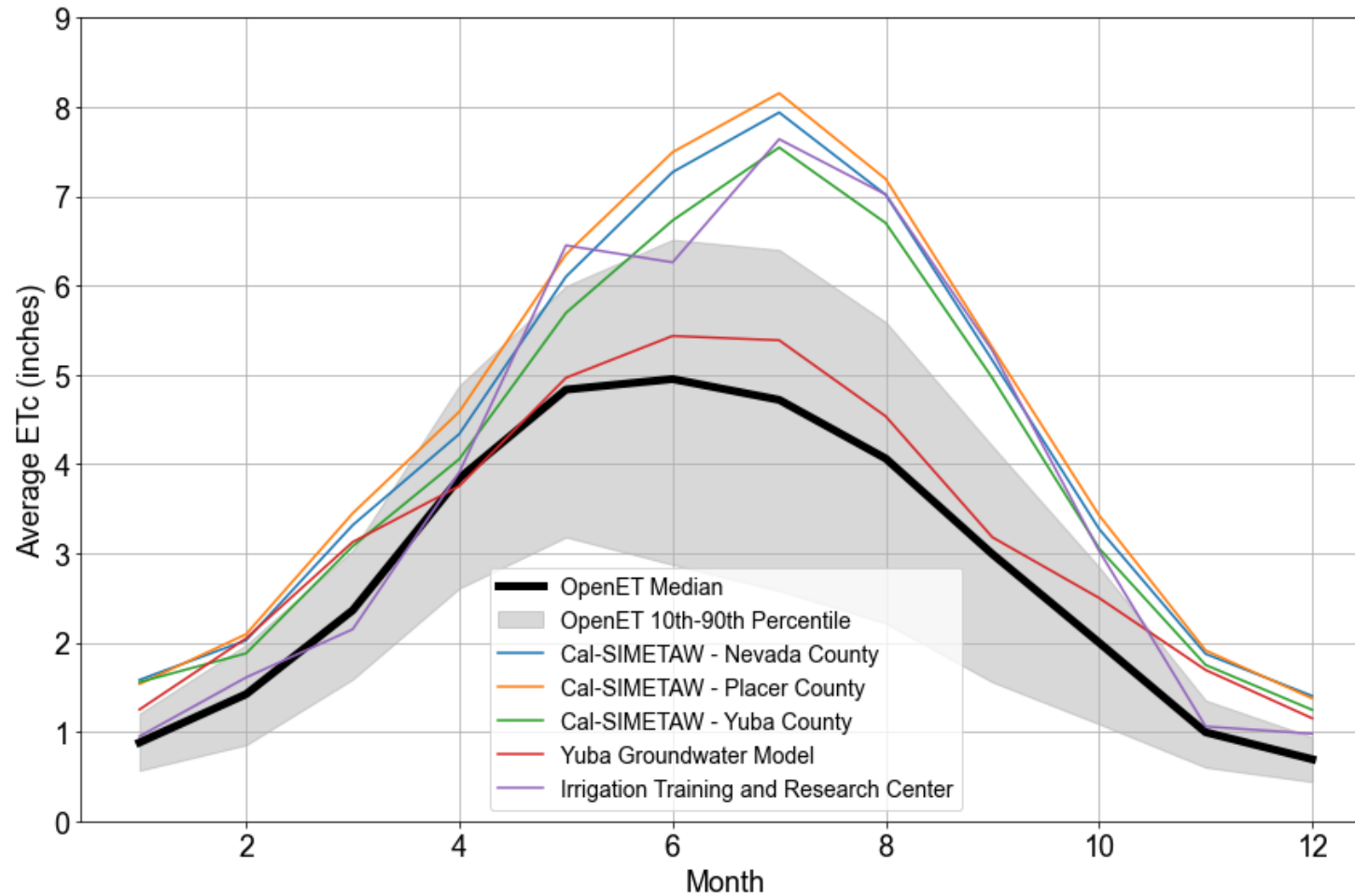
OpenET

(e.g., Pasture, Zone 3)

IDC Zone = 3, Land Use = Pasture



OpenET (Pasture, Zone 3)



Projected ETc

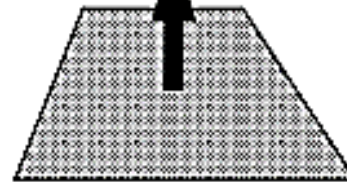
**ET_o Calculated
from Projected
Temperature**

ET_o

x



=



**Local Crop
Coefficients**

$K_s \times K_c$ adjusted

ET_c adj

**Projected
ET_c**

*Recent historical
conditions in NID,
based on OpenET data*

Sensitivity Analyses

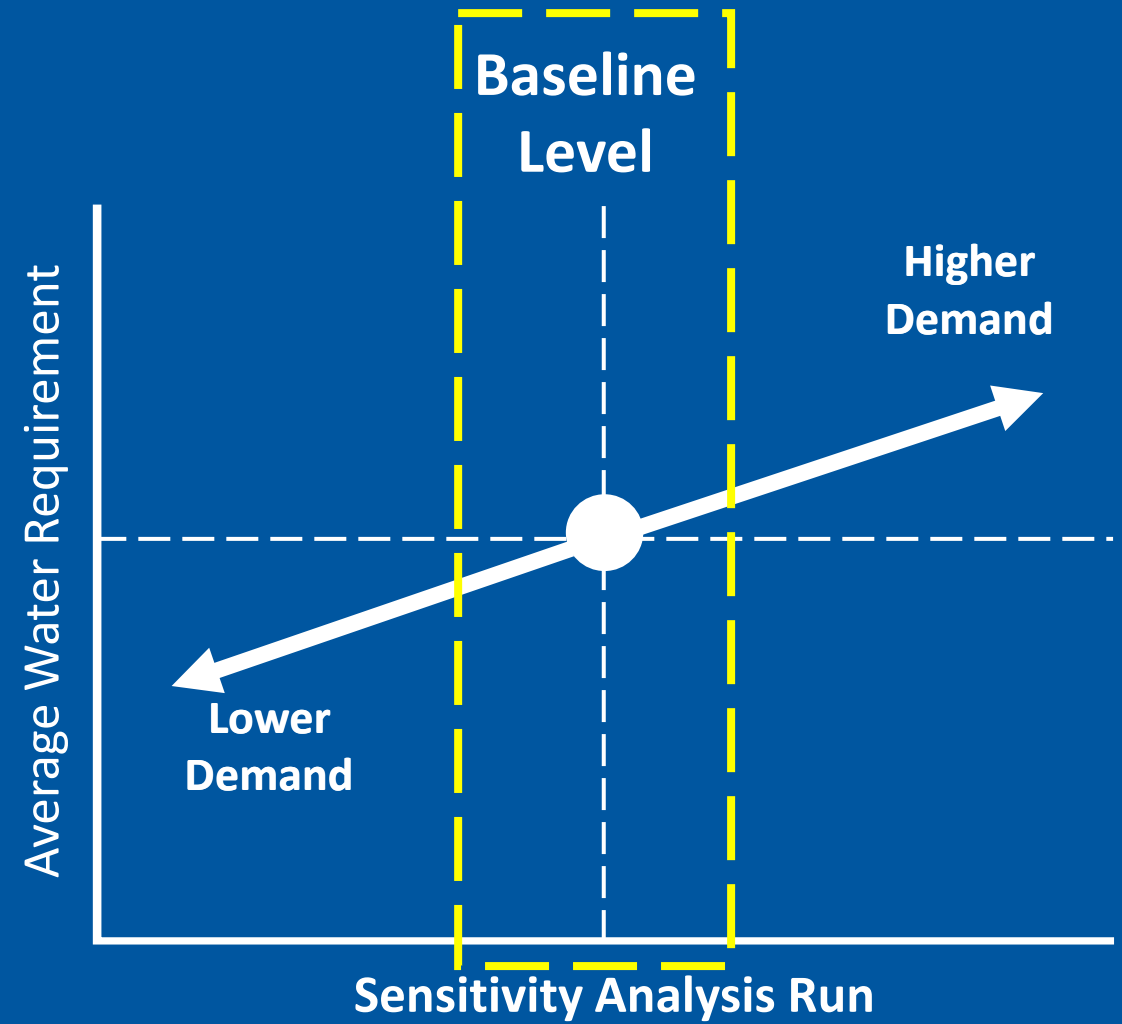
For a Current Demand Scenario

Purpose of Sensitivity Analyses

- Evaluating demand changes for “bookend” scenarios
 - Changes in NID’s customer base
 - Raw water
 - Treated water
 - Changes in crop cultivation practices and environmental stresses
 - Climate change
 - Changes in system losses

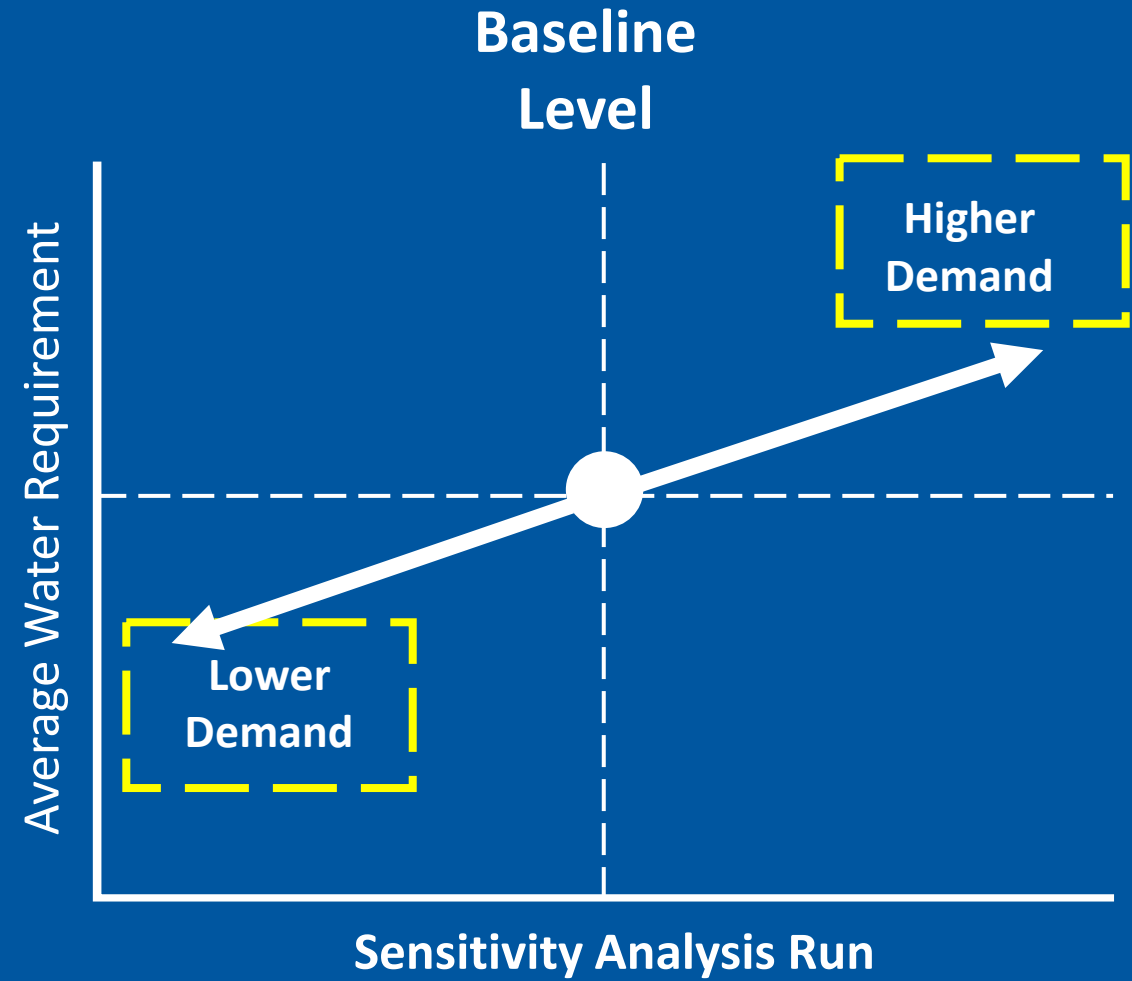
Baseline Level

- Calibrated historical model, with:
 - Precipitation: 10-year average (2013-2022)
 - ET: 7-year average (2016-2022)
 - Median (50%) ET by land use, zone
 - Land use: 2022
 - Population, urban use: 2022
 - Other inputs: calibrated historical values
 - 15% system losses
- “Average Water Requirement” includes raw water, treated water, and system loss



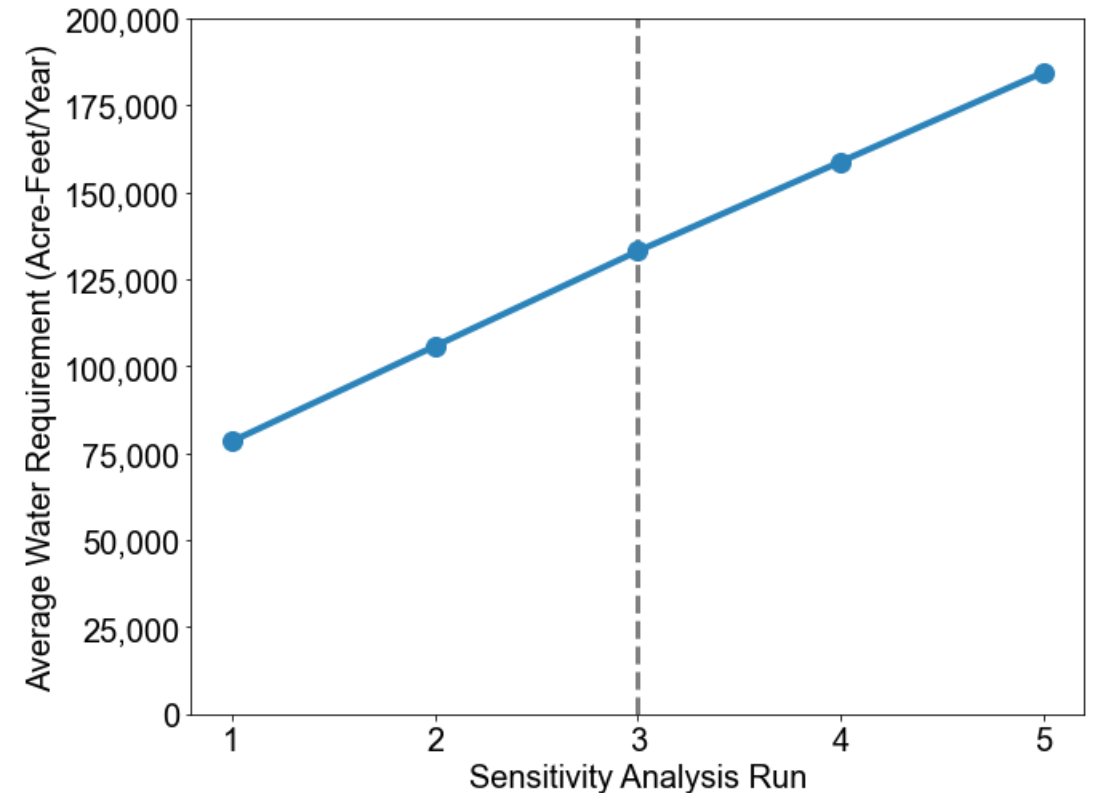
Sensitivity Analyses

- Raw Water Customers
- Treated Water Customers
- ET with Changes to Temperature (ETo)
- Total ET Changes
- System Losses



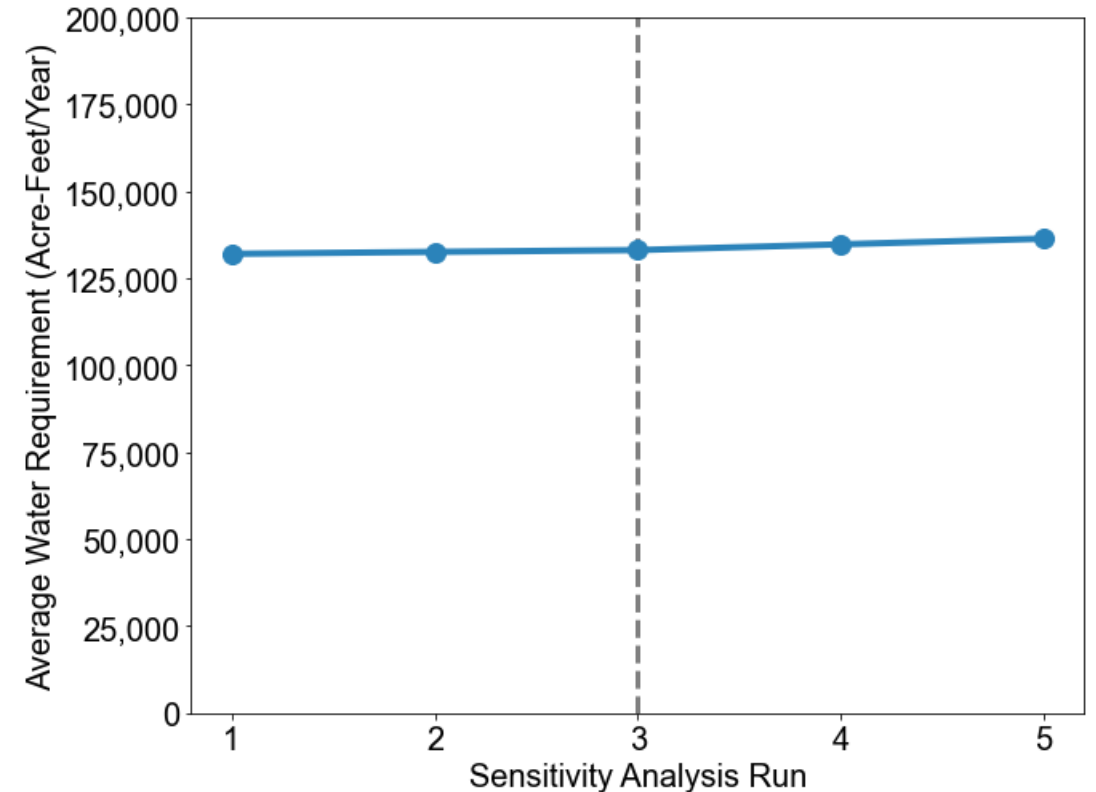
Raw Water Customers

Run	Changes
1	50% of non-permanent crops idled, no fill-in to soft service areas
2	25% of non-permanent crops idled, no fill-in to soft service areas
3 (Baseline)	No change (2022 land use)
4	Land use in 2022, plus fill-in to 50% parcels within 1000 ft of NID canals
5	Land use in 2022, plus fill-in to 100% parcels within 1000 ft of NID canals



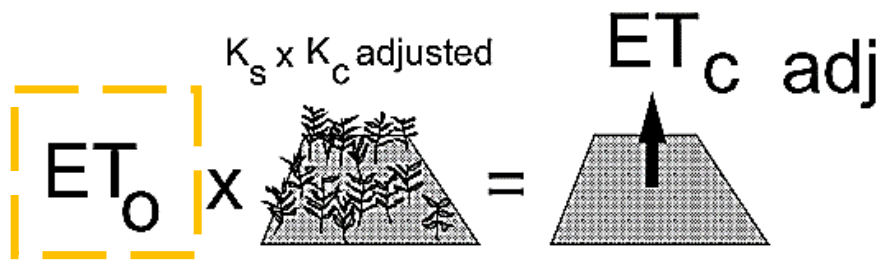
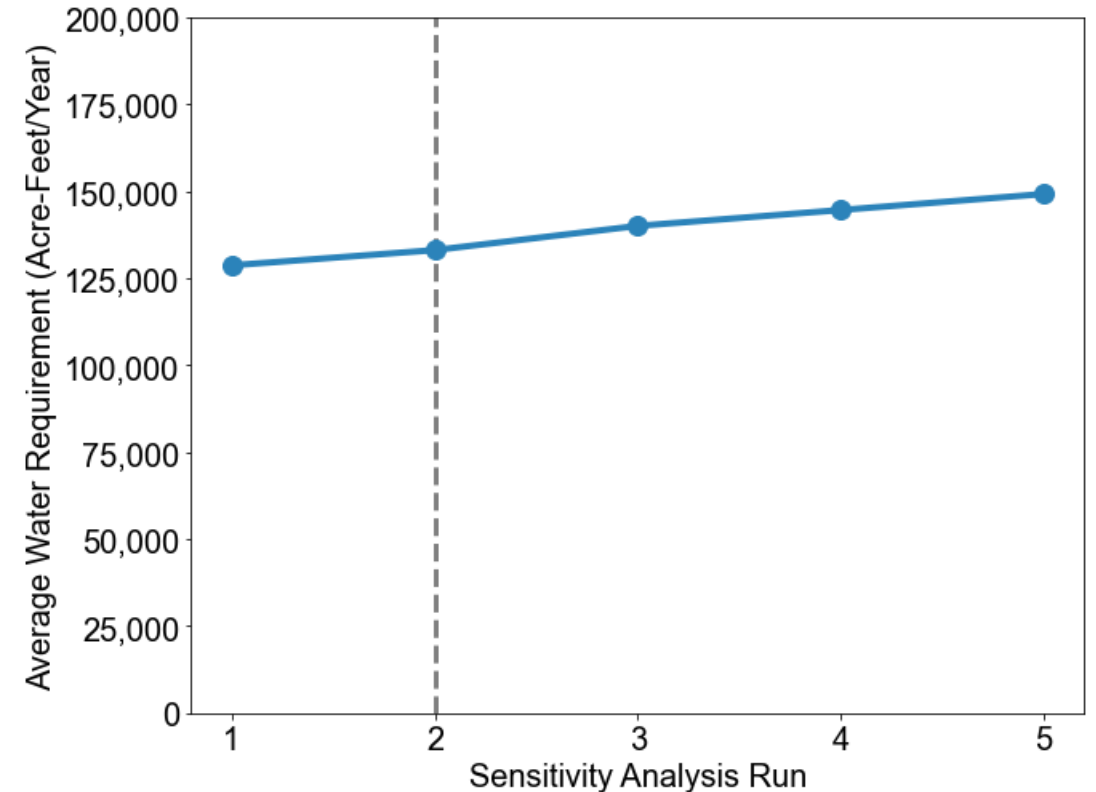
Treated Water Customers

Run	Changes
1	Population decline to minimum since 2000 (depending on location, ~80-90% of current)
2	Population decline to 2015-2019 average (pre-pandemic average, ~95% of current)
3 (Baseline)	No change (2022 population)
4	Population growth to fill 50% of soft service areas (~ +20% of current treated water customers)
5	Population growth to fill 100% of soft service areas (~ +40% of current treated water customers)



ET with Changes to Temperature (ET_o)

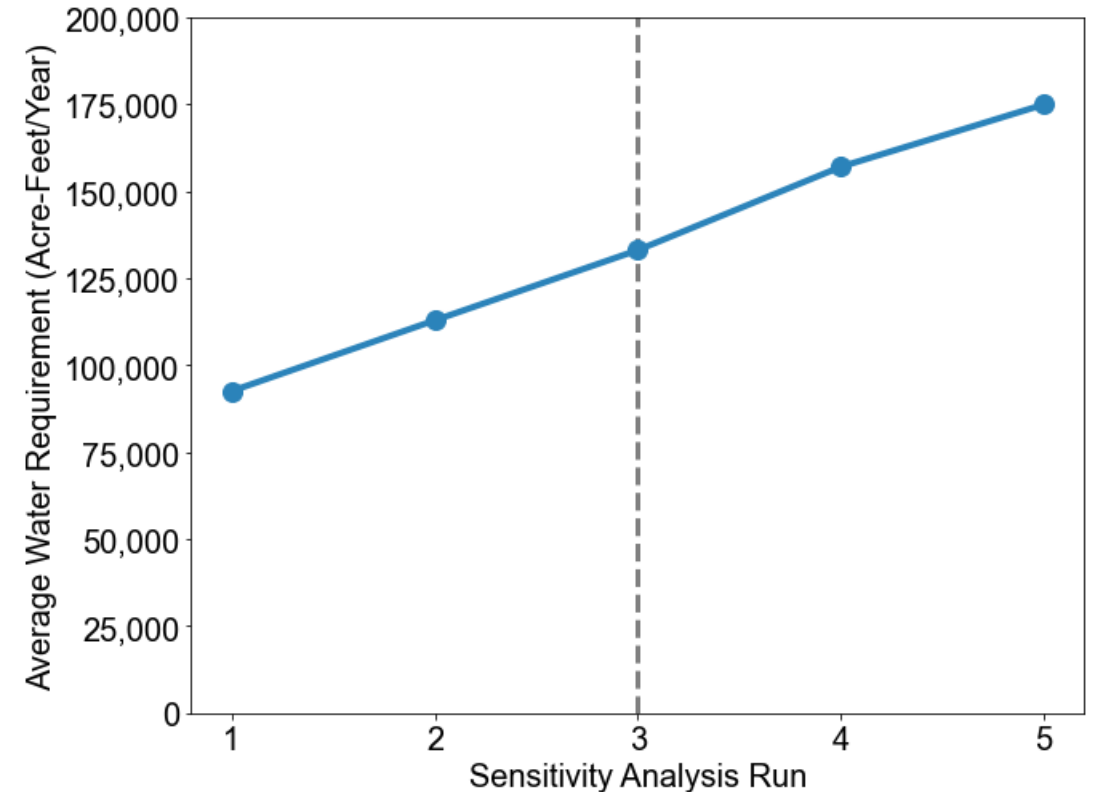
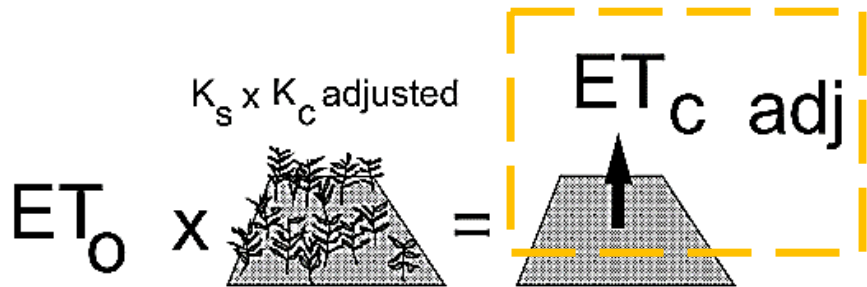
Run	Changes
1	Median historical ET _c adj. for -2.2°F (-1.2°C)
2 (Baseline)	Median historical ET _c
3	Median historical ET _c adj. for +2.2°F (+1.2°C)
4	Median historical ET _c adj. for +4.3°F (+2.4°C)
5	Median historical ET _c adj. for +6.5°F (+3.6°C)



Total ET Changes

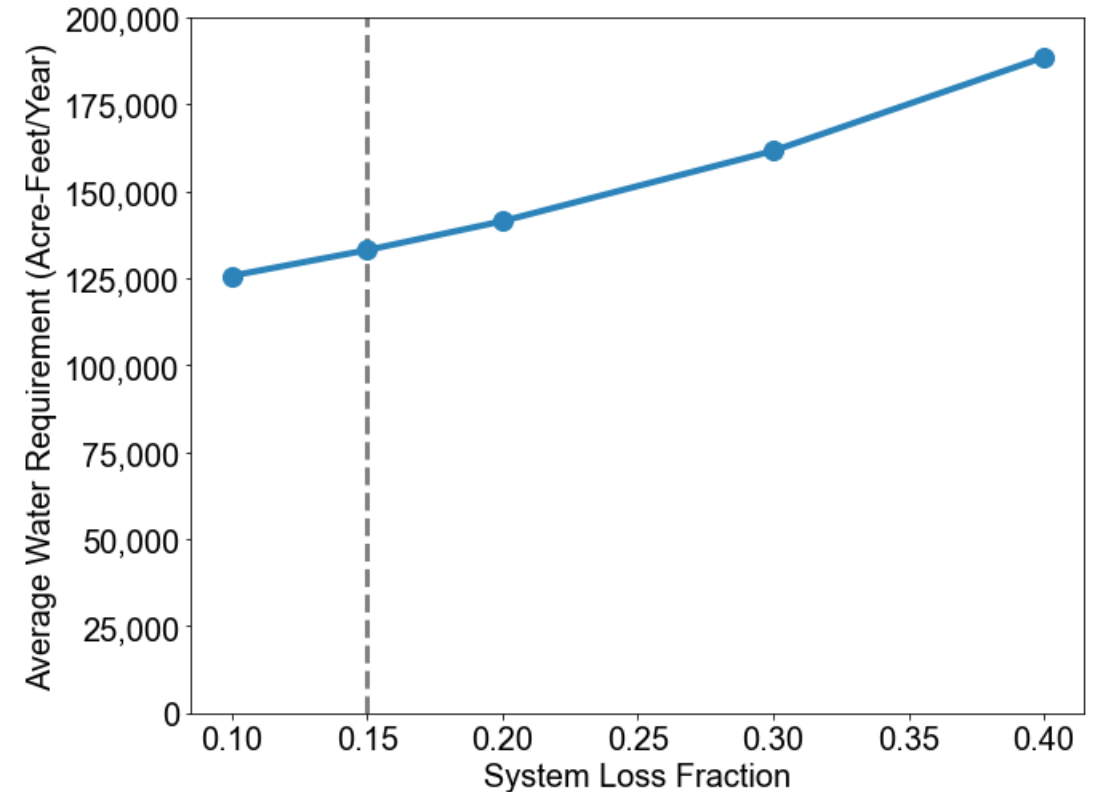
Run	Changes
1	10 th percentile ¹ ETc
2	25 th percentile ¹ ETc
3 (Baseline)	50 th percentile ¹ ETc (Median ETc)
4	75 th percentile ¹ ETc
5	90 th percentile ¹ ETc

¹ Percent of parcels, by zone and land use.

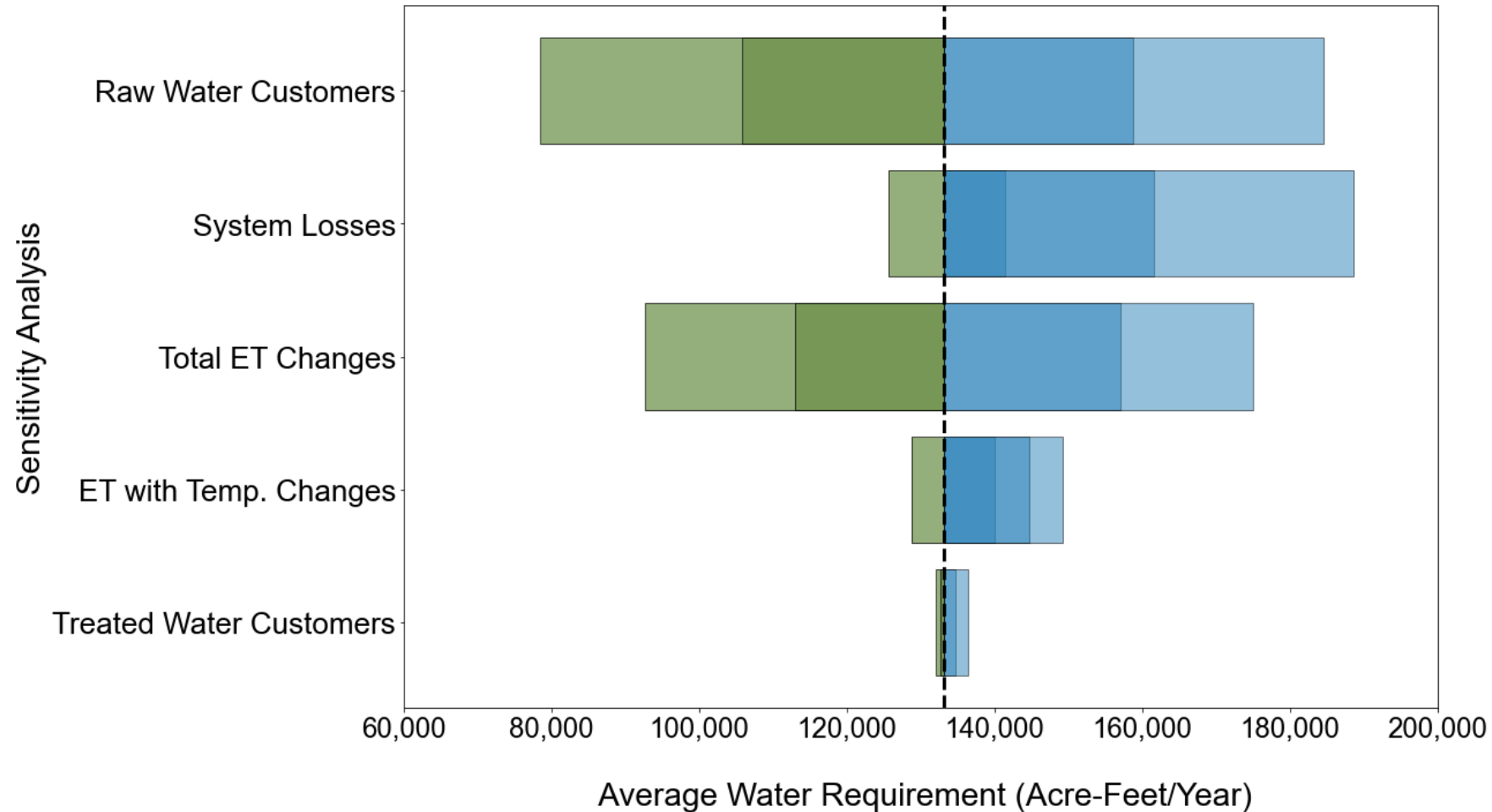


System Losses

Run	Changes
1	10% system losses
2 (Baseline)	15% system losses
3	20% system losses
4	30% system losses
5	40% system losses



Summary of Sensitivity Analyses



Next Steps

- Develop and evaluate future demand scenarios
 - Bookends to capture the range of potential future conditions
 - Link to other PFW components (ResSim, climate change analyses)
- Present future scenarios in July-August



Discussion and Questions

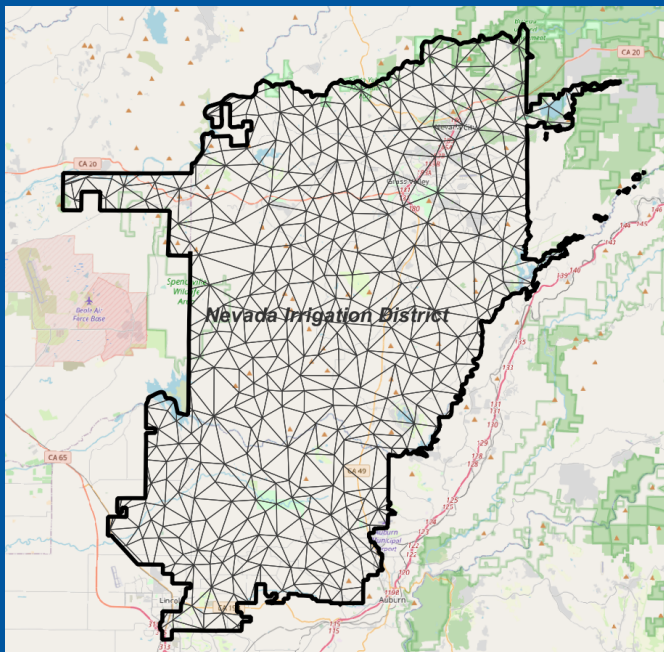
Additional Slides

Model Structure

(i.e., structure of model elements)

- IDC operates on a simple grid (simple polygons, limited number of “elements”)

Spatial Model Grid

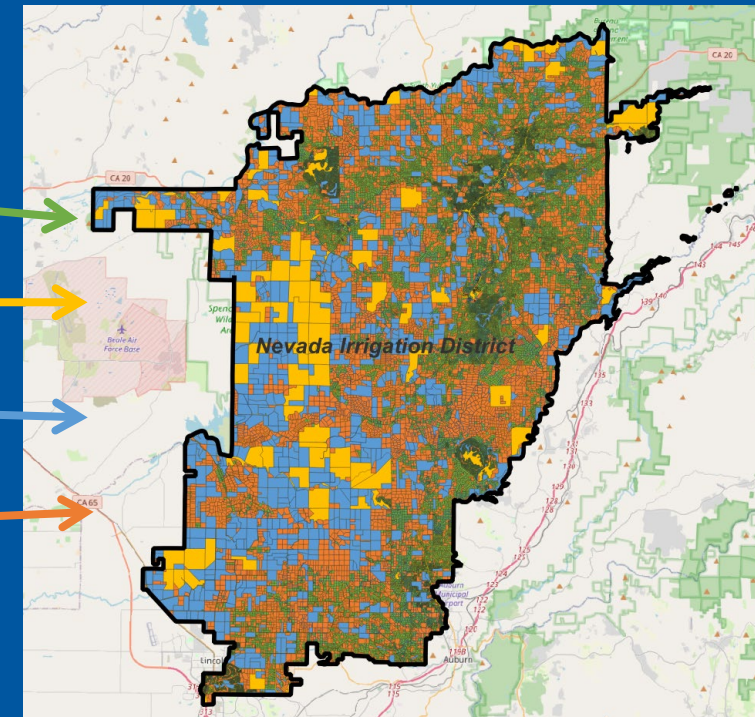


Model Elements Represent Simplified Areas in NID
(Parcel Details Are Simplified)

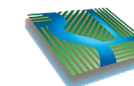
Unitized Model Grid

Land Use 1	1	2	...	m
Land Use 2	m+1
...
Land Use n	n x m
	Soil 1	Soil 2	...	Soil m

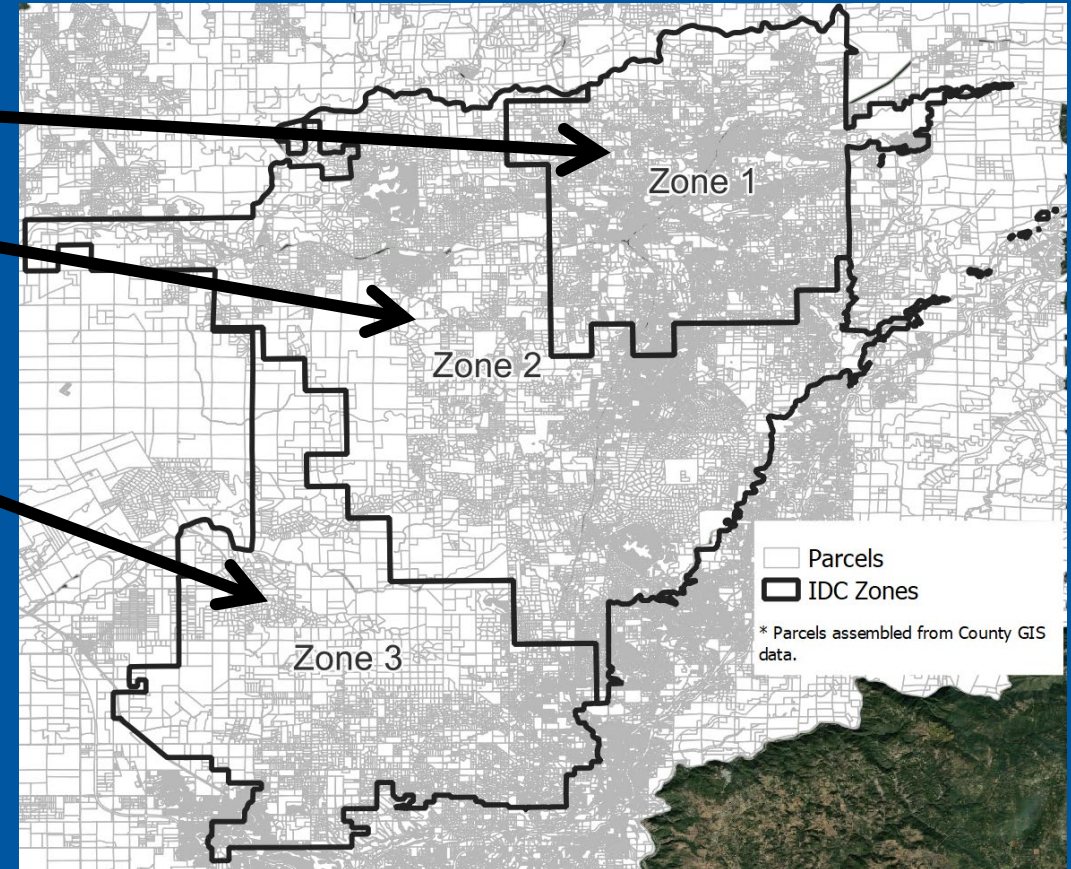
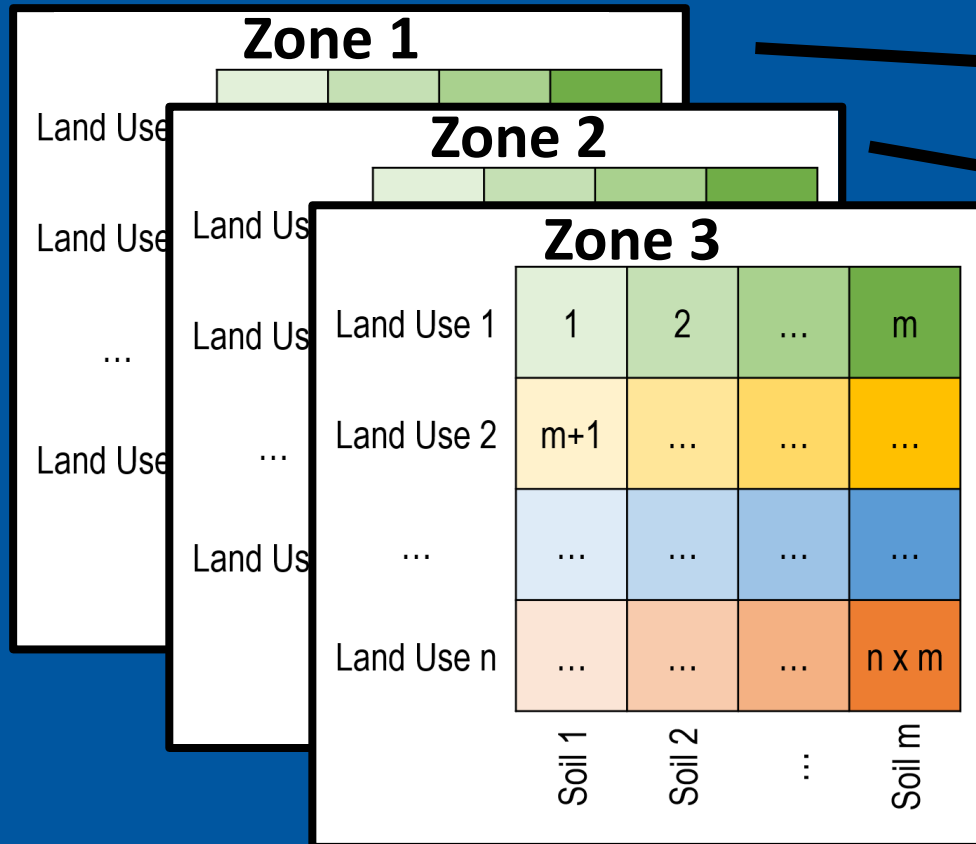
Model Elements Represent Potential Conditions/Scenarios in NID
(land use, soil, elevation zones)
(Results Are “Unit” Depths, e.g., feet/month)



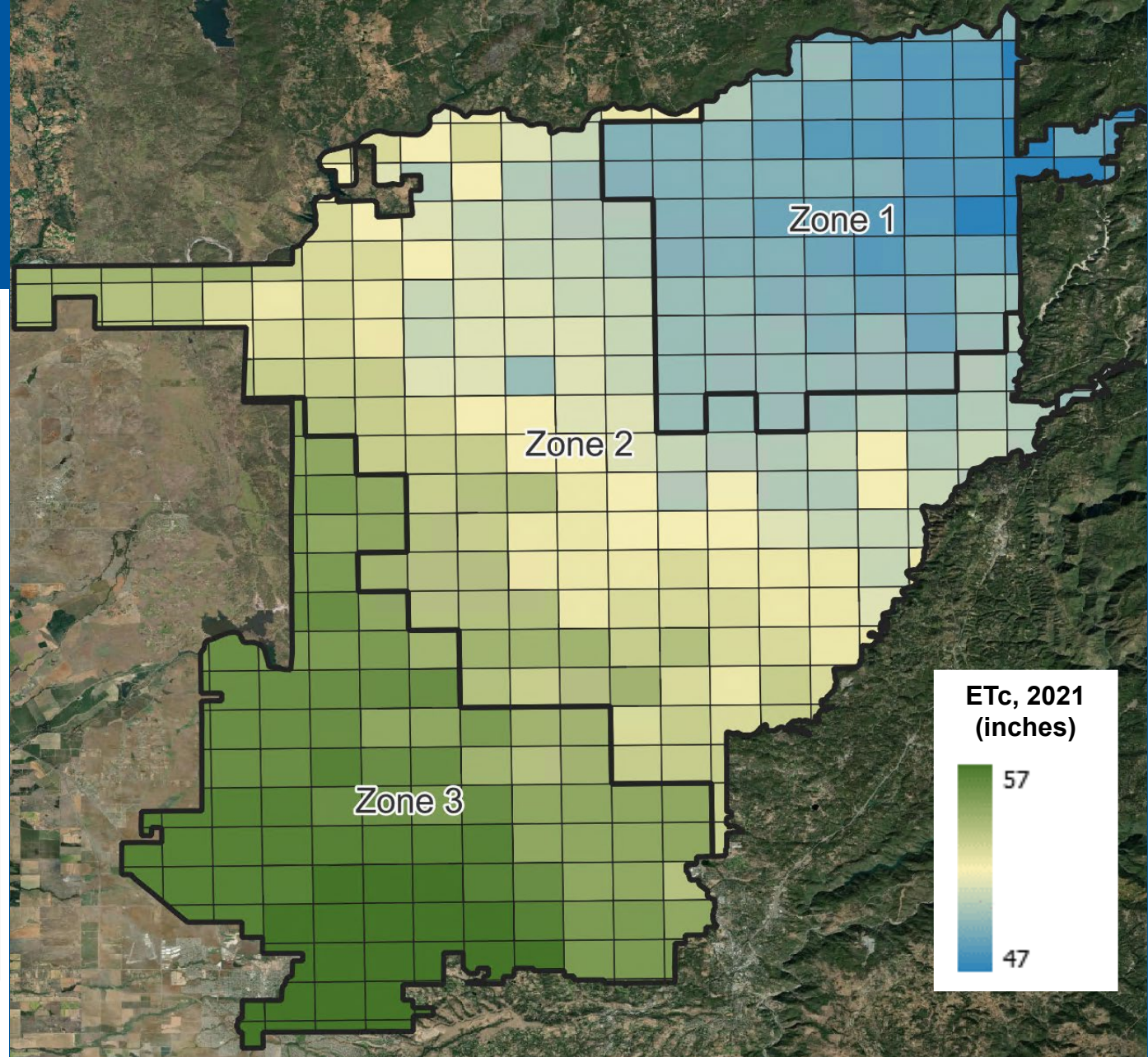
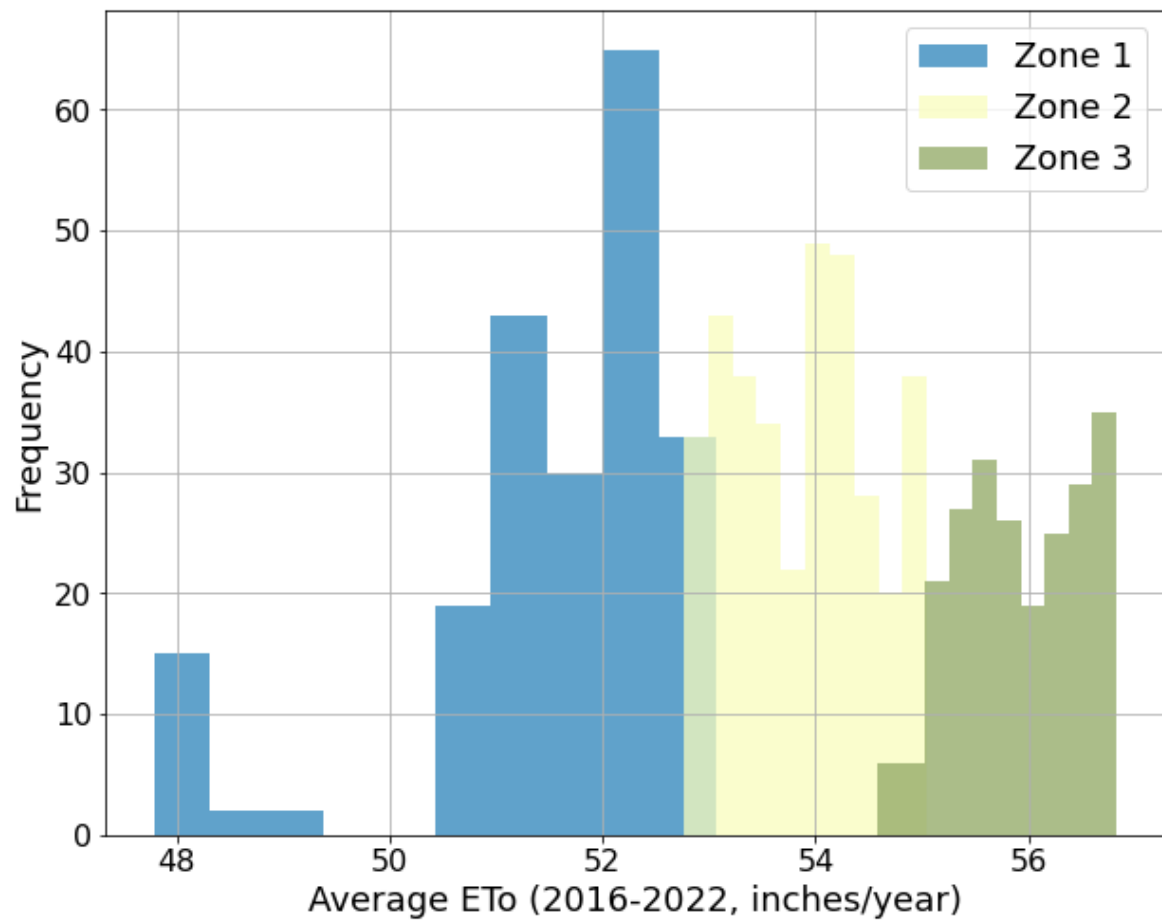
Each Parcel Linked to a Model “Unit”
(Parcels Details Preserved)



Unitized Model Structure

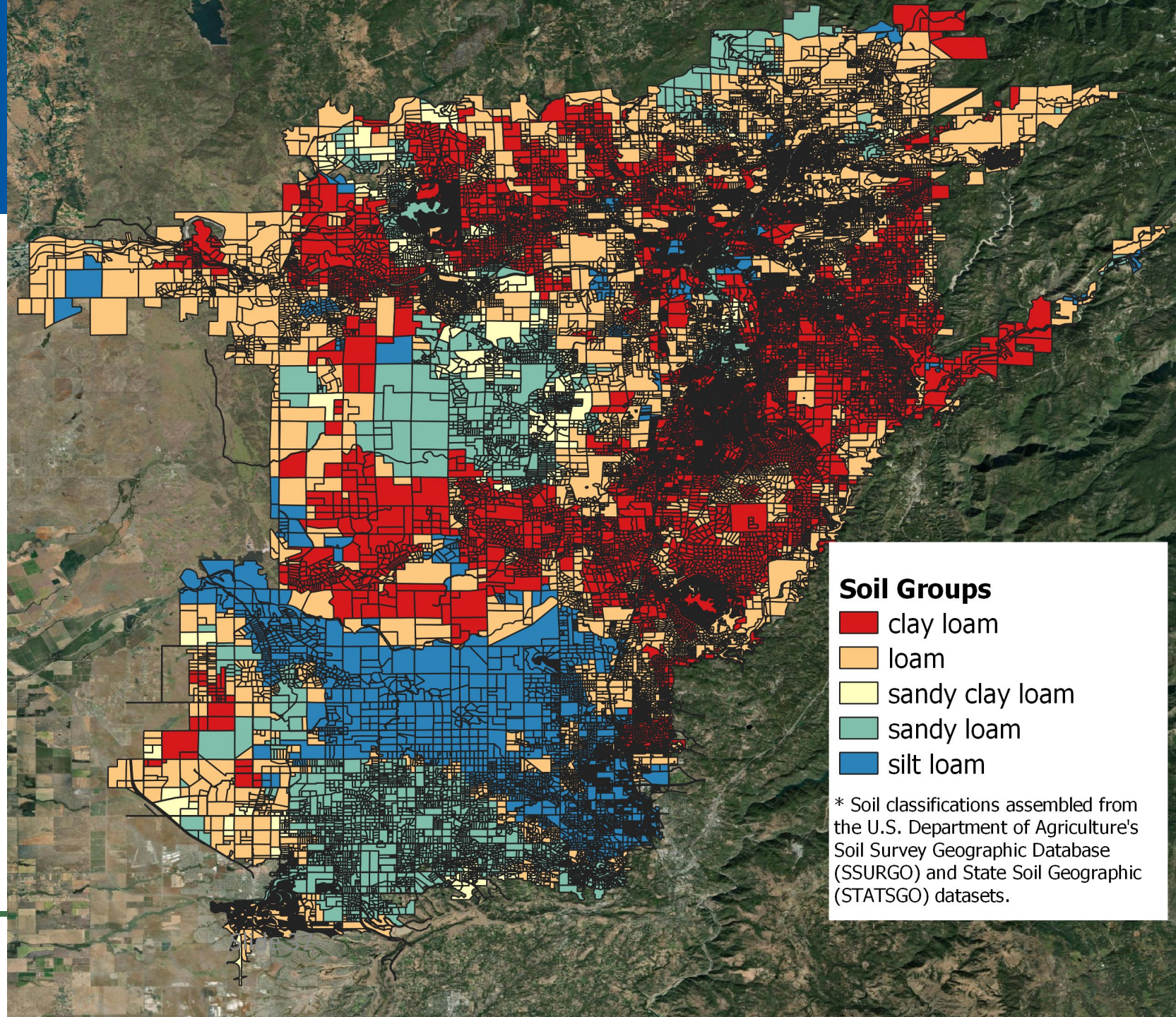


Elevation and Climate Effects on ETc (ETo)

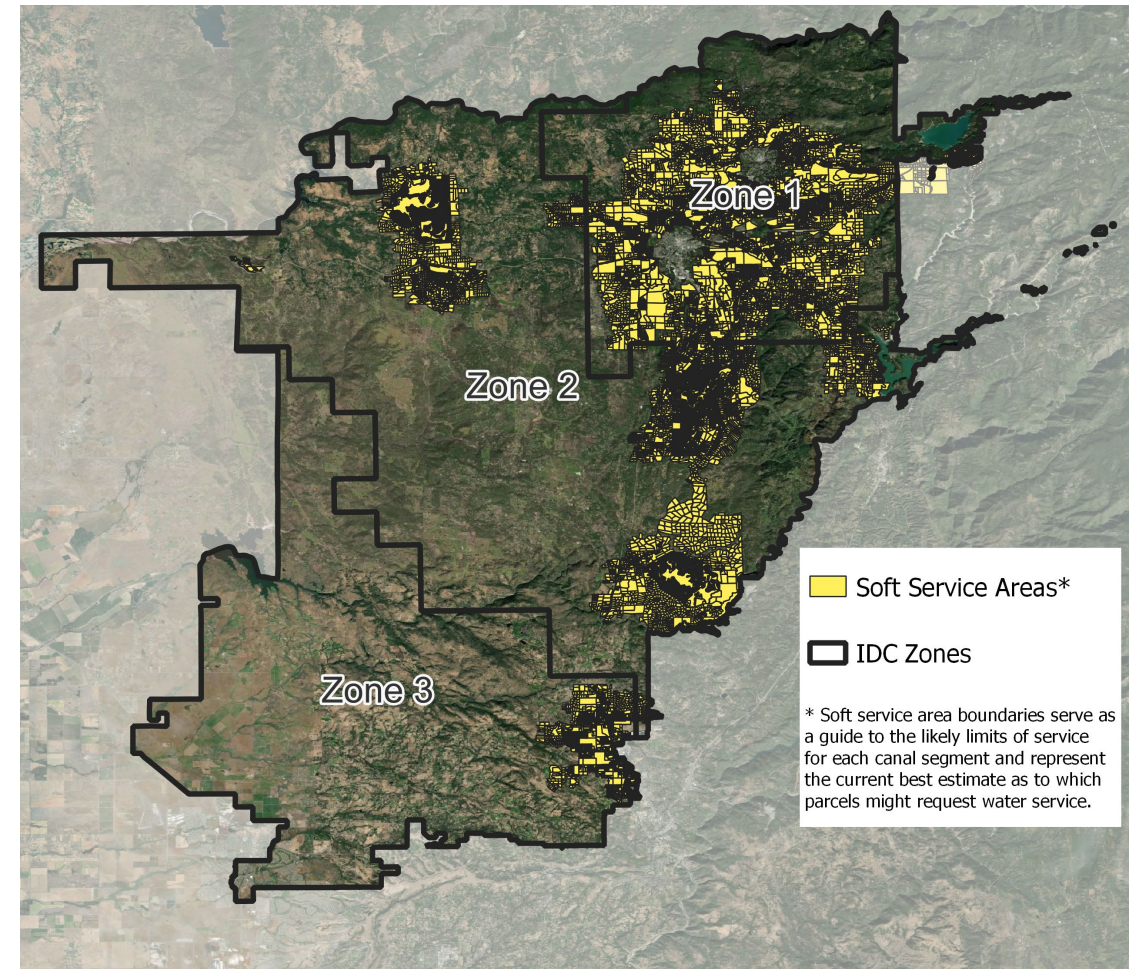
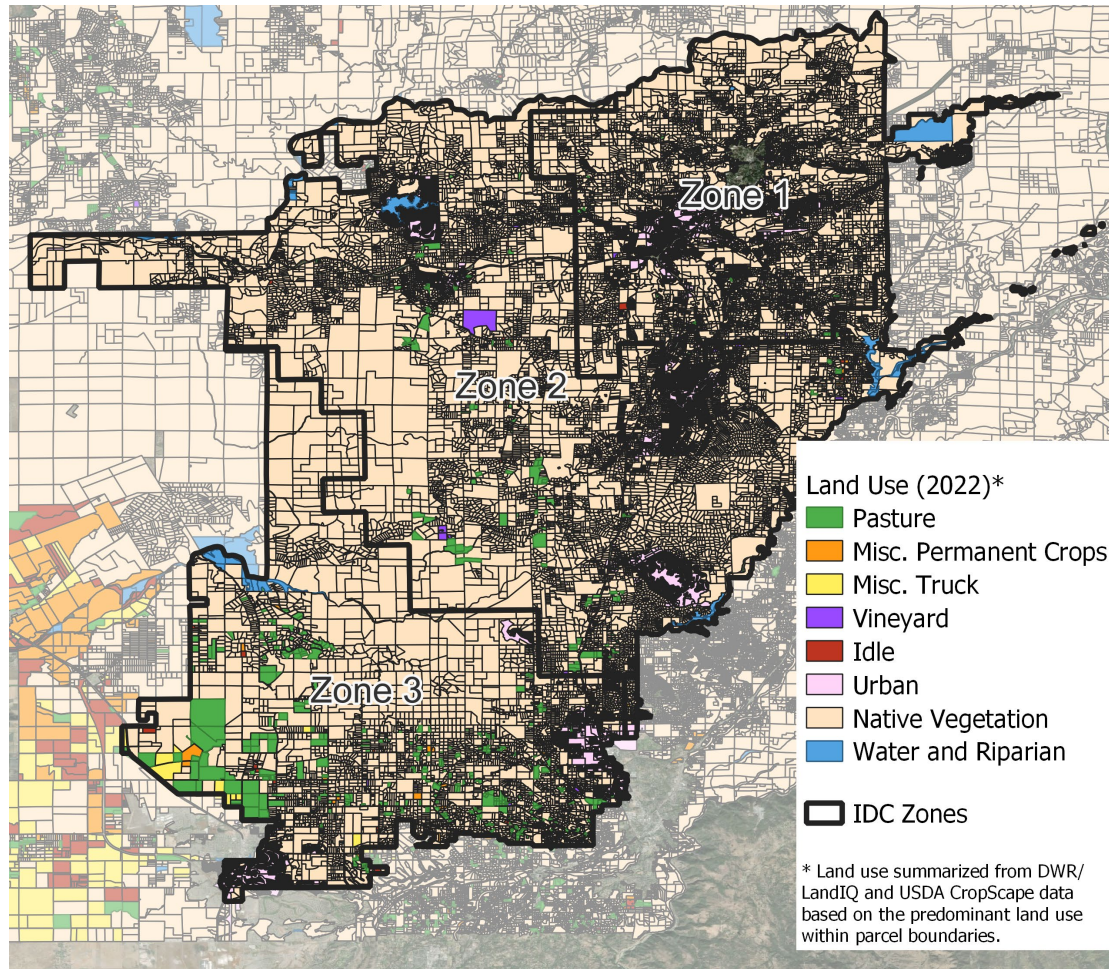


Soil

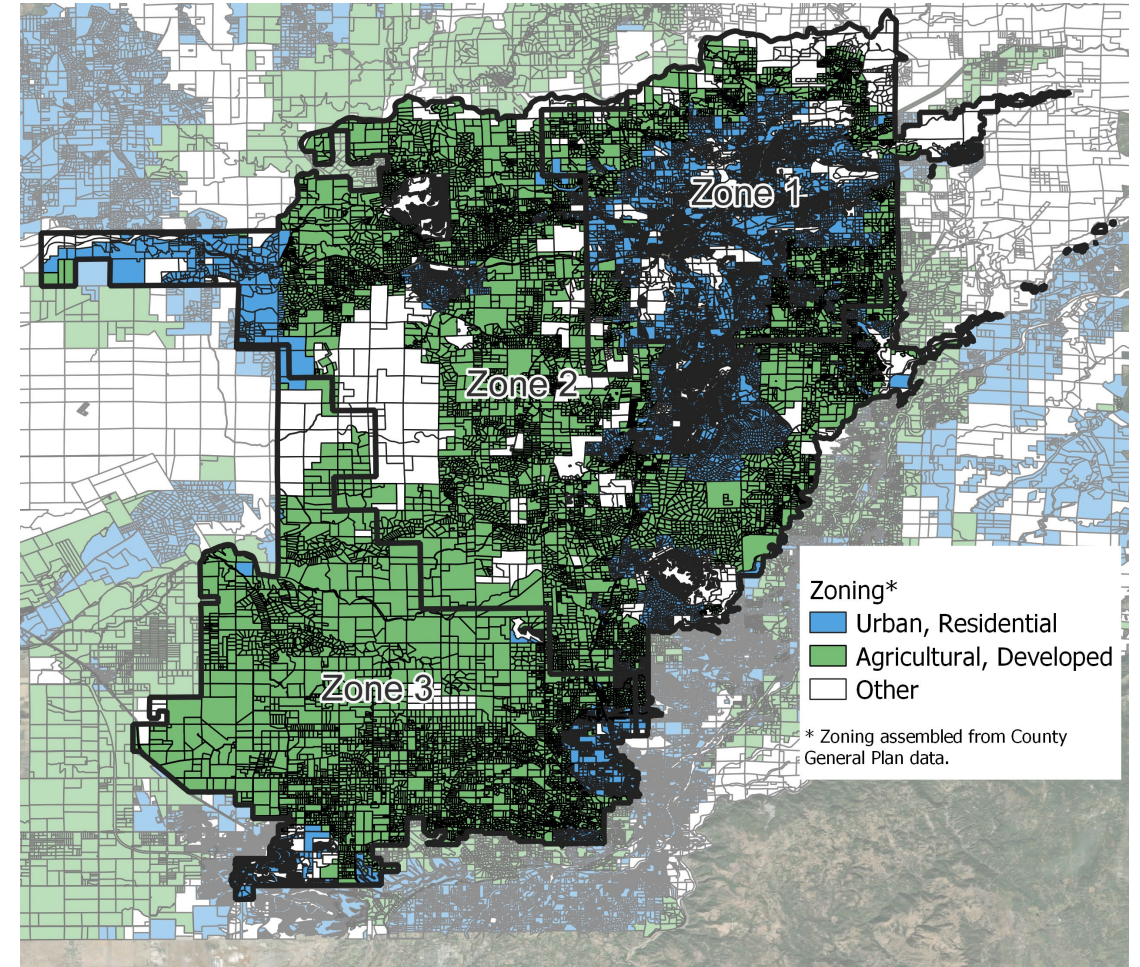
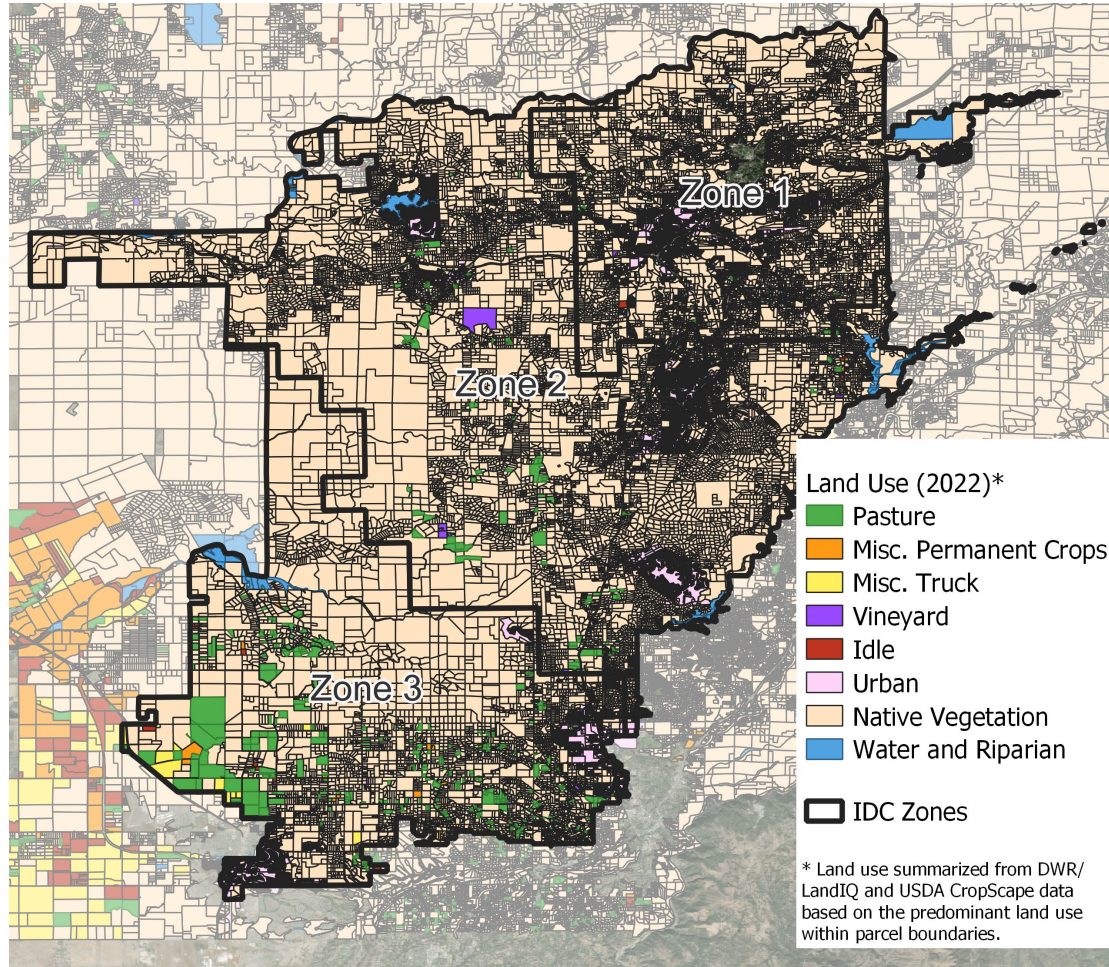
- USDA
 - Soil Survey Geographic Database (SSURGO)
 - State Soil Geographic (STATSGO) data



Land Use/Zones



Land Use/Zones

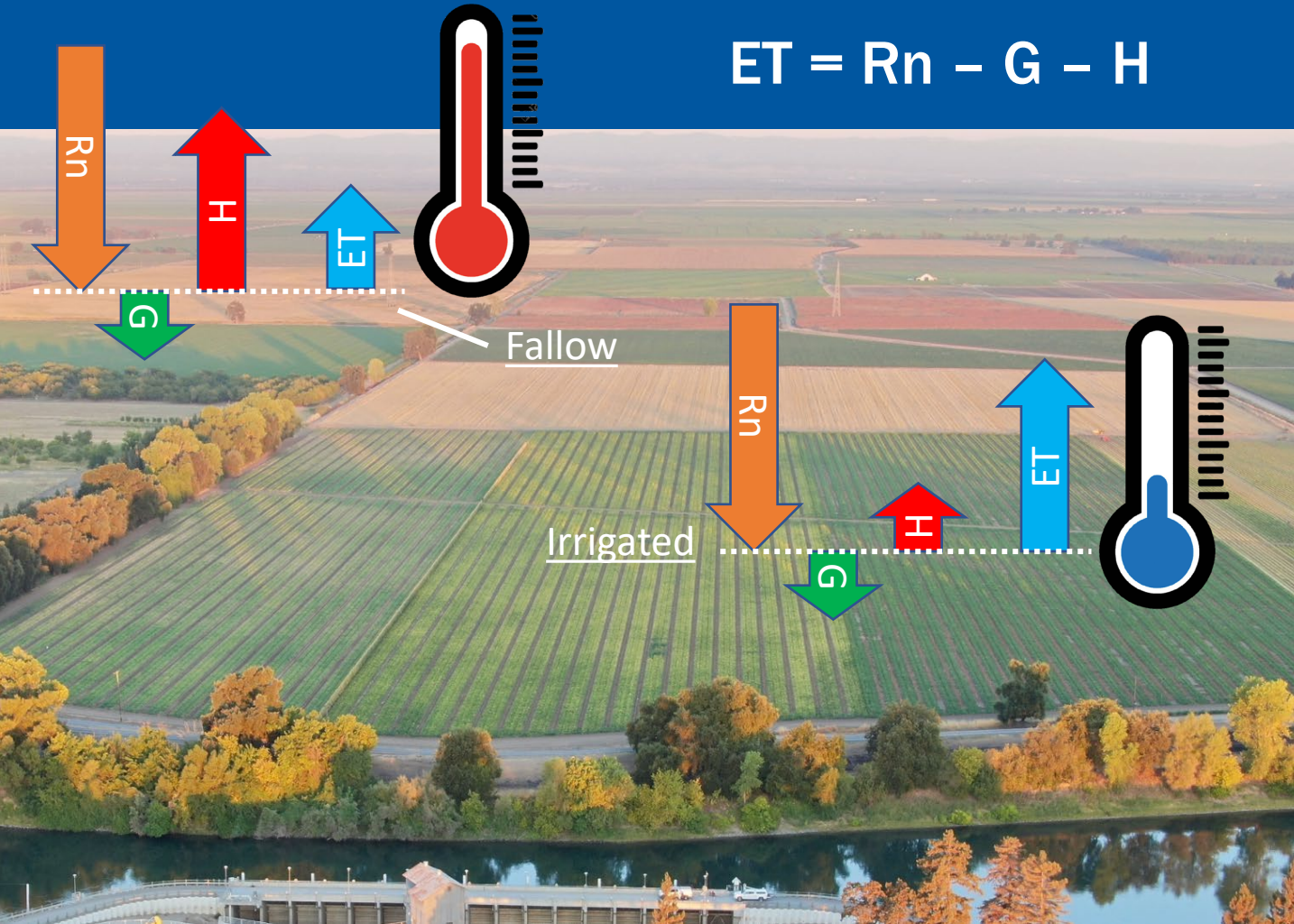


Remote Sensing – What it is

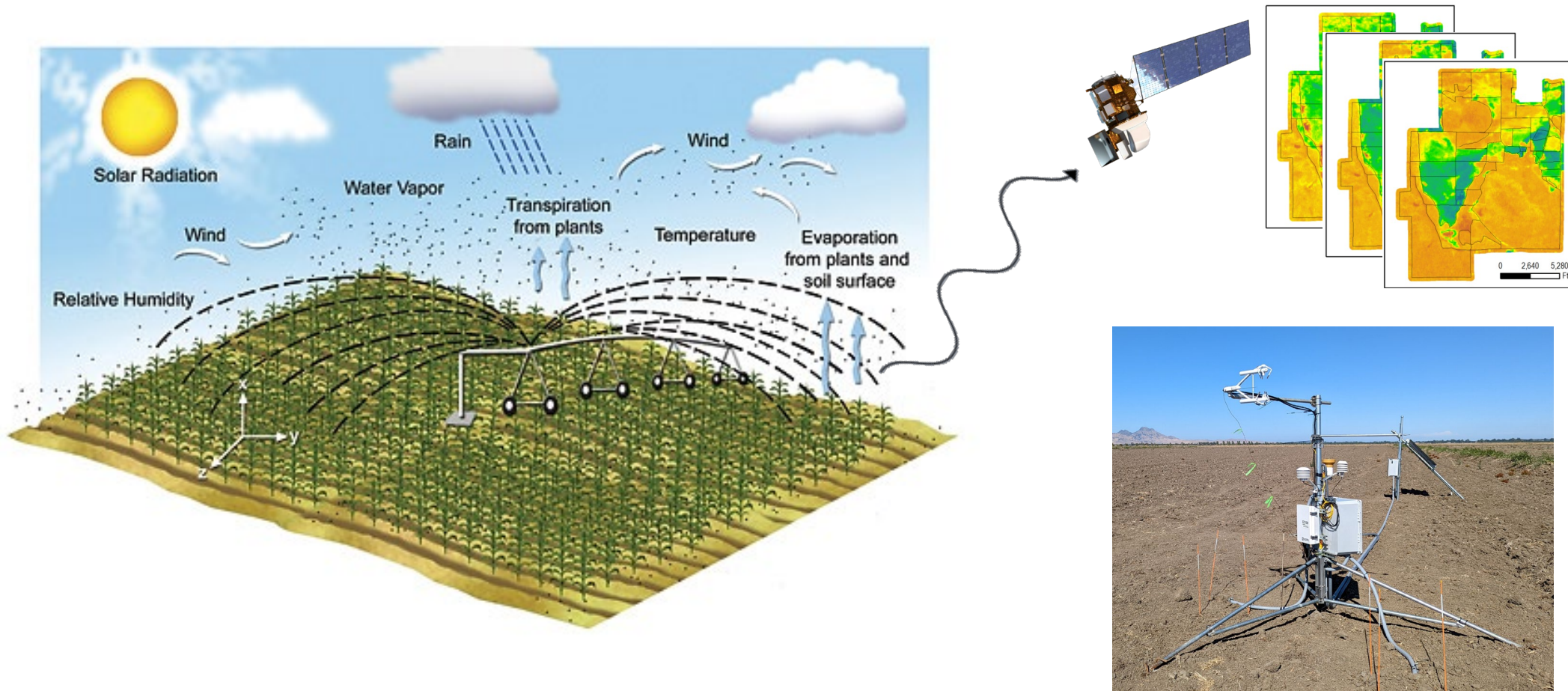
Legend

- Net Radiation
- Sensible Heat Flux
- Soil Heat Flux
- ET

$$ET = R_n - G - H$$



Evapotranspiration (ETc)



Remote Sensing Approaches

(lower cost, larger spatial coverage)

Field-Based Approaches

(higher cost, smaller spatial coverage)

Population

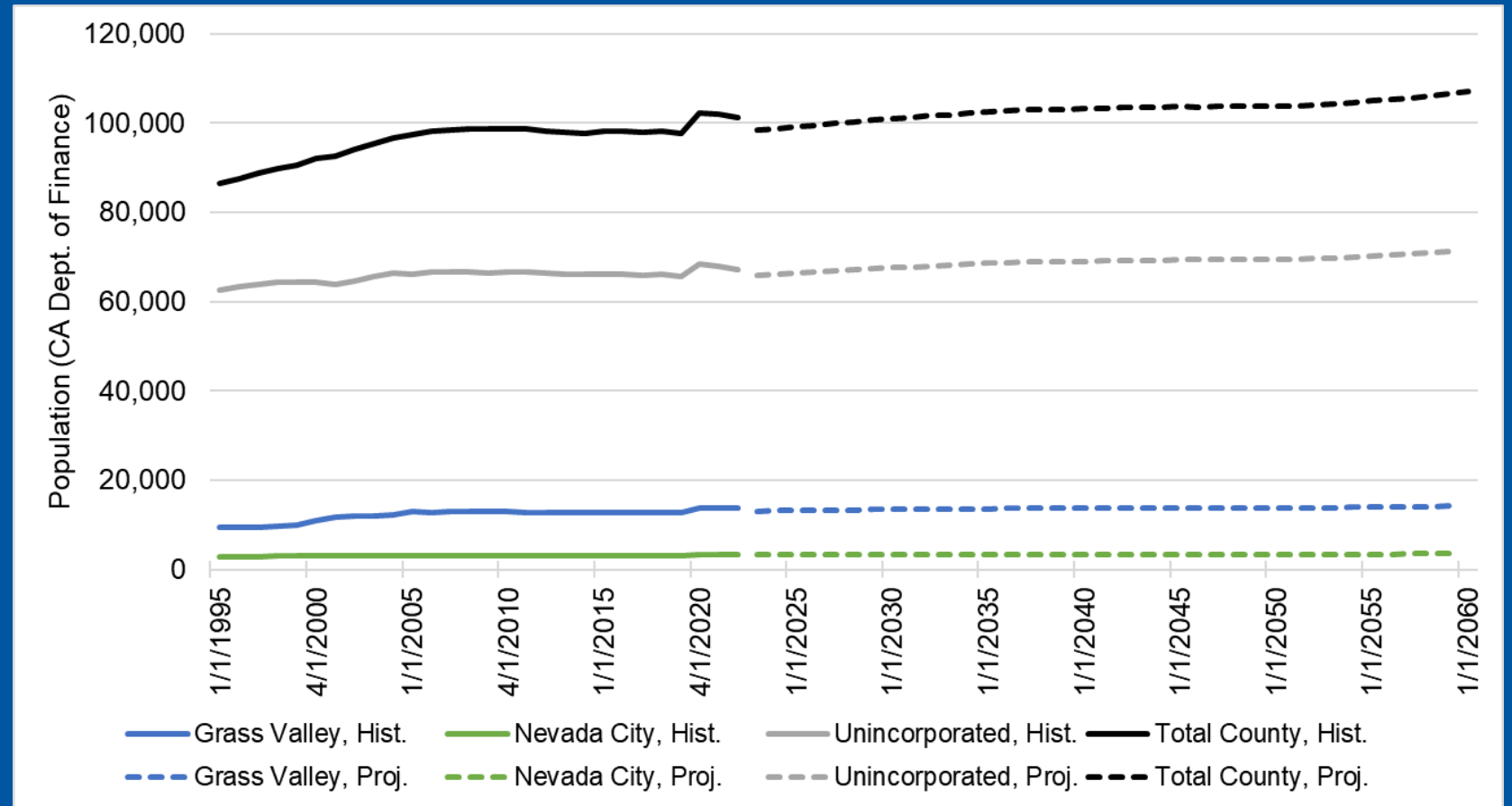
Nevada County-wide:

Historical annual population change (1995-2022):

- Average: 0.62%
- Max: 0.43% (2019→2020)
- Min: -0.66% (2021→2022)

Projected annual population change (2023-2060):

- Average: 0.22%
- Max: 0.43%
- Min: -0.02%



Population, Grass Valley and Nevada City

Historically (Since 2000)

- Grass Valley: 13% of county population
- Nevada City: 3% of county population

