

# This presentation premiered at WaterSmart Innovations

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# Water System Embedded Energy Mapping

NAVIGANT



# Presentation Agenda

1. Introduction and Background
2. The Water-Energy Nexus
3. Embedded Energy Plan
4. Next Steps

# Introduction and Background

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# District Overview



**330,000 Residential Customers**

**500,000 Daytime Population**

110,734 Service Connections

6 Cities plus unincorporated OC

181 Square Miles 20% of Orange County

27 Drinking Water Wells

1516 Miles Drinking Water Pipelines

36 Drinking Water Reservoirs

487 Miles Recycled Water Pipelines

2 Recycled Water Treatment Plants

987 Miles Sewage Collection Pipelines

13 Urban Runoff Treatment Sites

# The Water-Energy Nexus

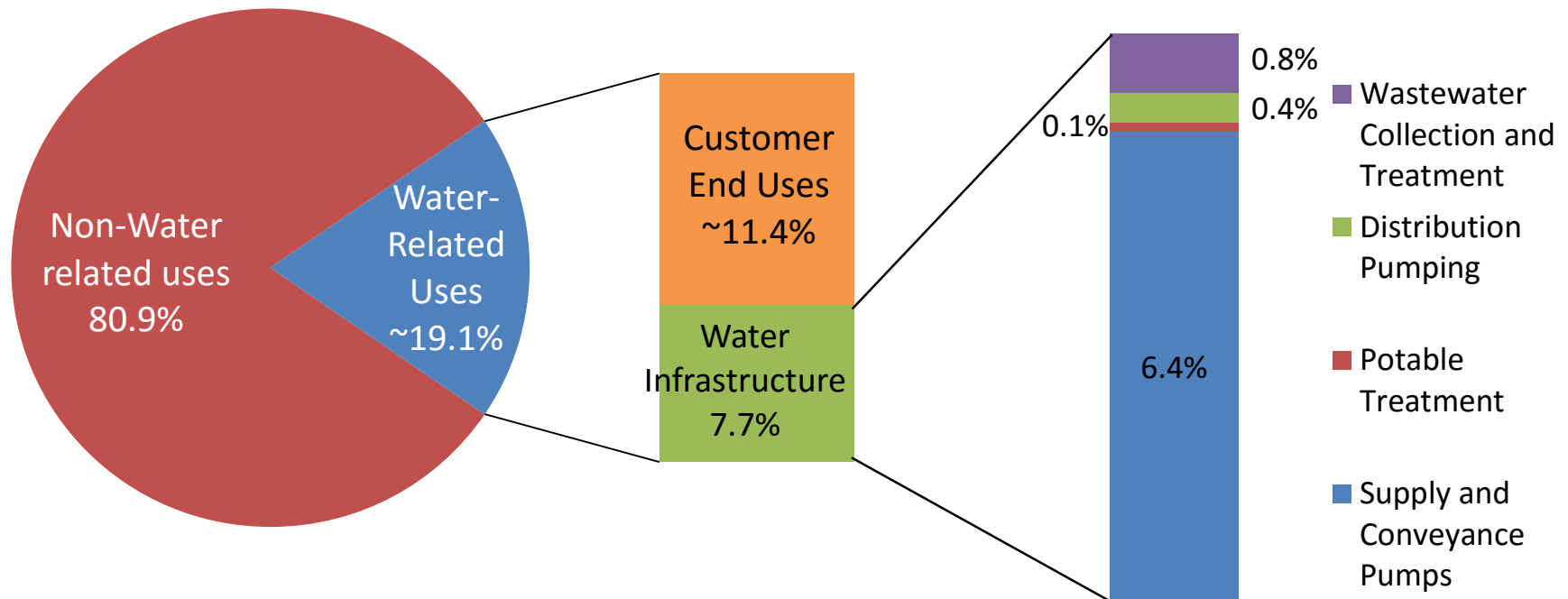
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# The Water-Energy Nexus in California

- ~8% of California's electricity use is for providing water services (US average ~4%)

California Statewide Electricity Use





# Where Does Southern California Get Its Water?

Conversion: 1 acre-foot (AF) = 325,851 gallons



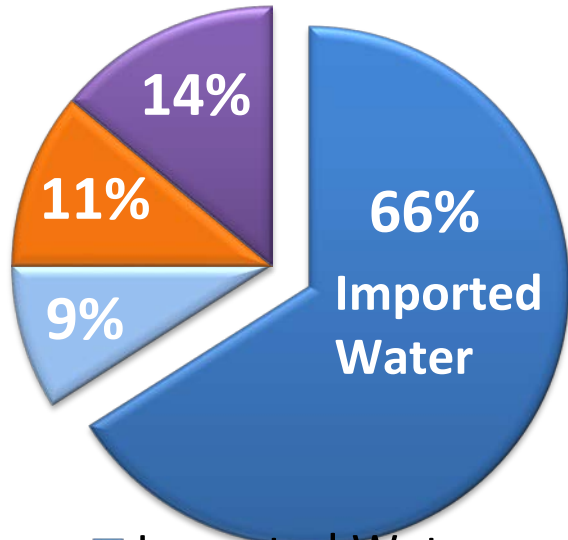


# IRWD Water Supply Portfolio

## 1990

Population Served: 114,000

Total Water Provided: 40,492 AF

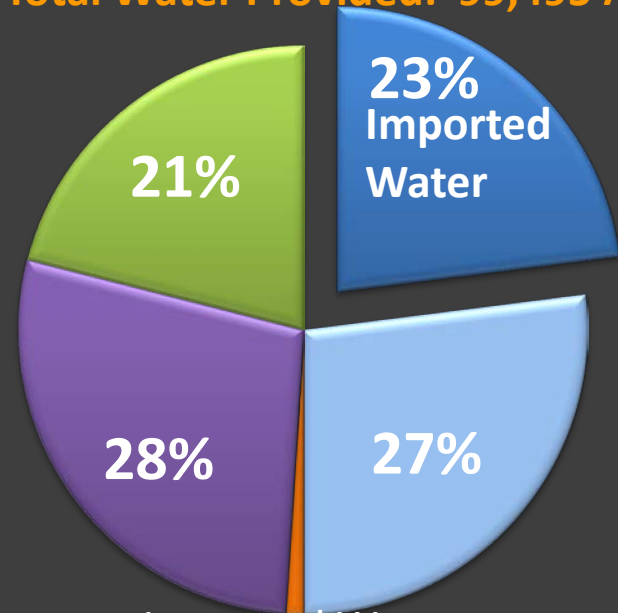


- Imported Water
- Clear Groundwater
- Local Surface Water
- Recycled Water

## 2014

Population Served: 374,000

Total Water Provided: 99,495 AF

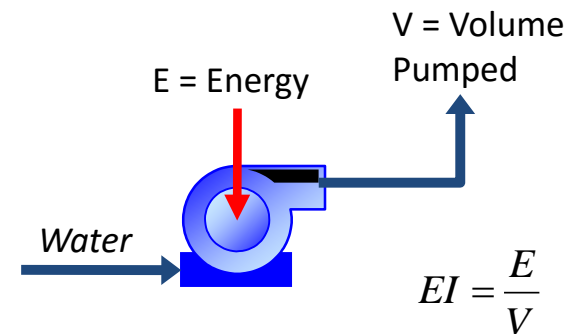


- Imported Water
- Clear Groundwater
- Local Surface Water
- Recycled Water
- Treated Groundwater

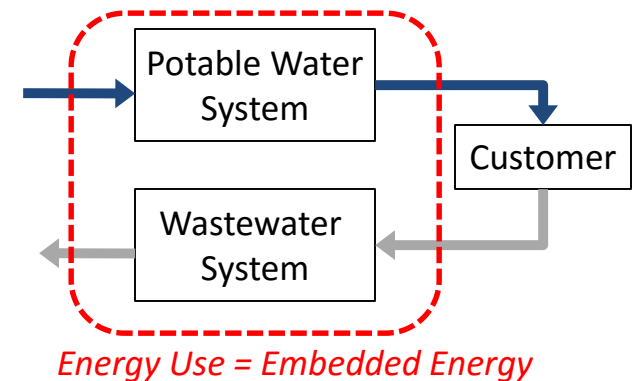
# Energy Intensity and Embedded Energy

- **Energy Intensity (EI) – kWh/AF**
  - Average amount of energy needed to transport or treat water or wastewater on a per unit basis (kWh/AF).
  - Associated with a particular facility
  - EIs of facilities can be aggregated to represent total EI of water service.
- **Energy Embedded in Water – kWh**
  - Captures the entire energy picture both upstream and downstream of an end use customer
  - Useful in quantifying energy savings as a result of water savings (water saved x EI = embedded energy saved)

## Illustrative Energy Intensity Calculation for a Pump



## Embedded Energy



# California Public Utilities Commission Activities

- Past CPUC Water Energy Nexus Studies:
  - Wholesale Supply System Energy Use
  - Retail System Energy Use
  - Water-Energy Nexus Pilots
- Current CPUC Direction
  - Consider allowing energy and water utilities to fund joint water-energy nexus programs
  - Tools and calculators to quantify embedded energy savings
  - Tools can be customized for specific water utilities

# Embedded Energy Plan

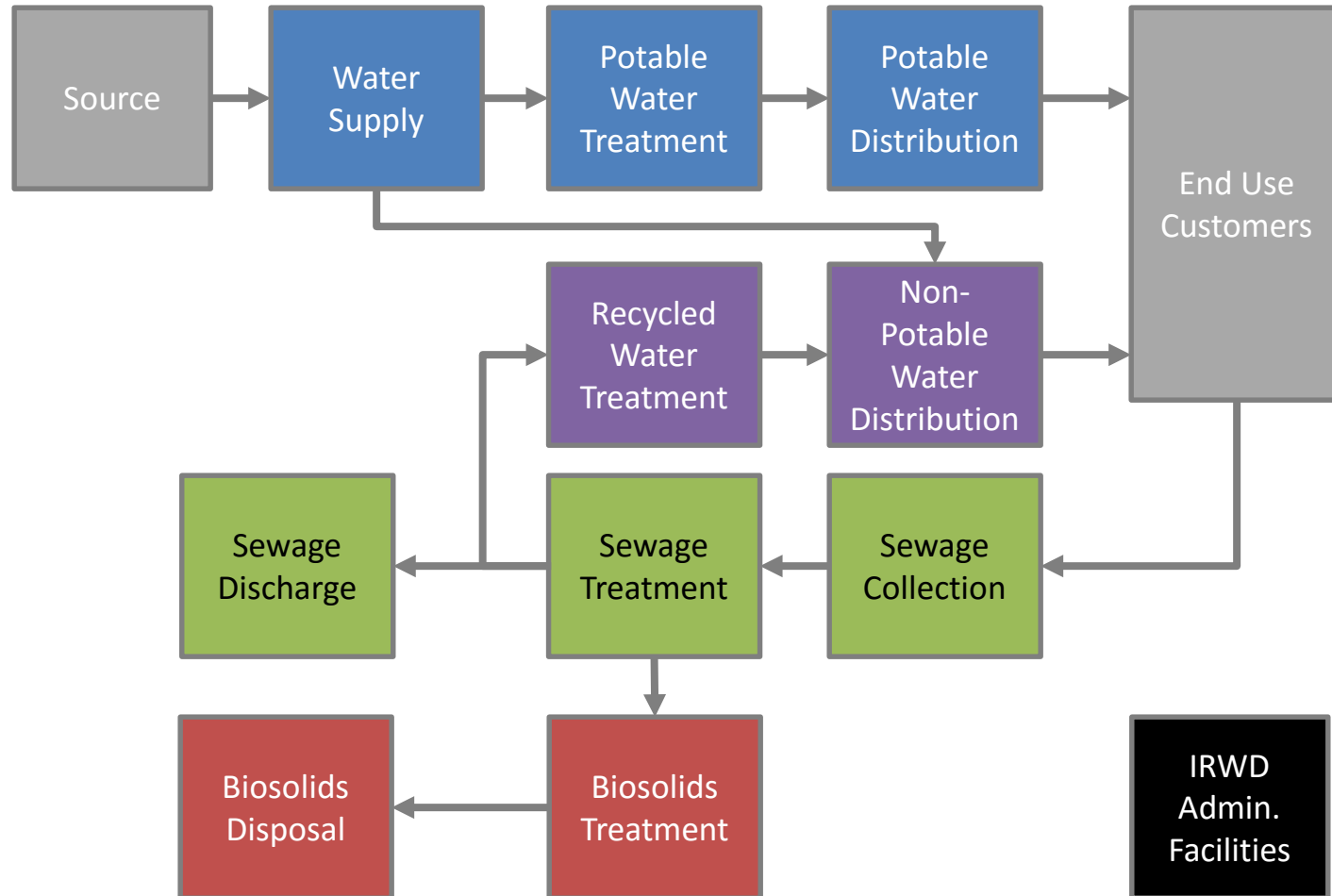
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# Goals

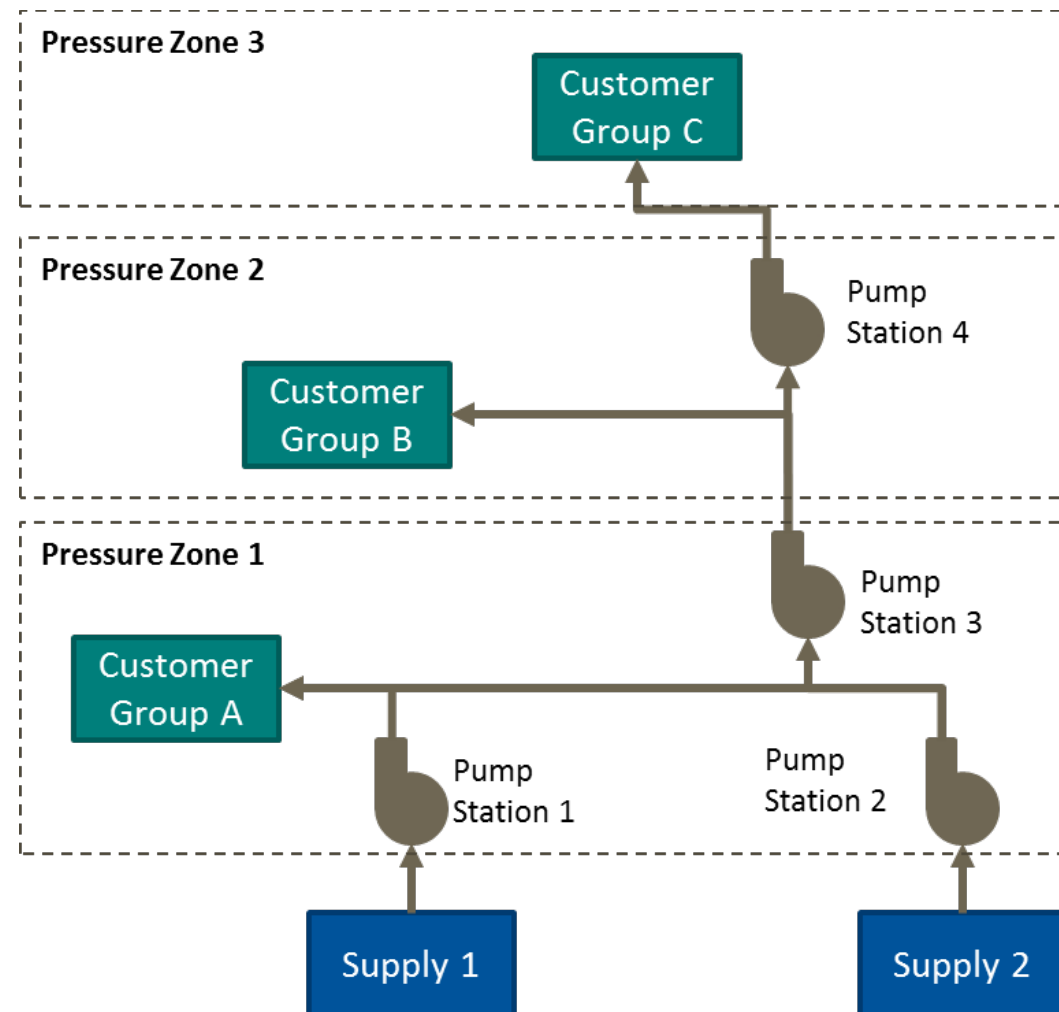
- Demonstrate embedded energy reductions over time
- Quantify the avoided cost of energy in water conservation programs
- Identify the most cost-effective geographic areas for water conservation programs
- Provide information required to develop a pumping surcharge recommendation
- Position IRWD for the possibility of obtaining energy utility funding for water conservation programs

# Methodology



# Methodology

- Generate Base Data
  - Collect, clean and analyze historic energy and water
  - Link energy data to water data
  - Map flow of water through each facility to regions
- Use Base Data for:
  - Geospatial analysis of energy use and energy intensity
  - Embedded energy savings from conservation
  - Energy cost analysis
  - Forecast future energy use

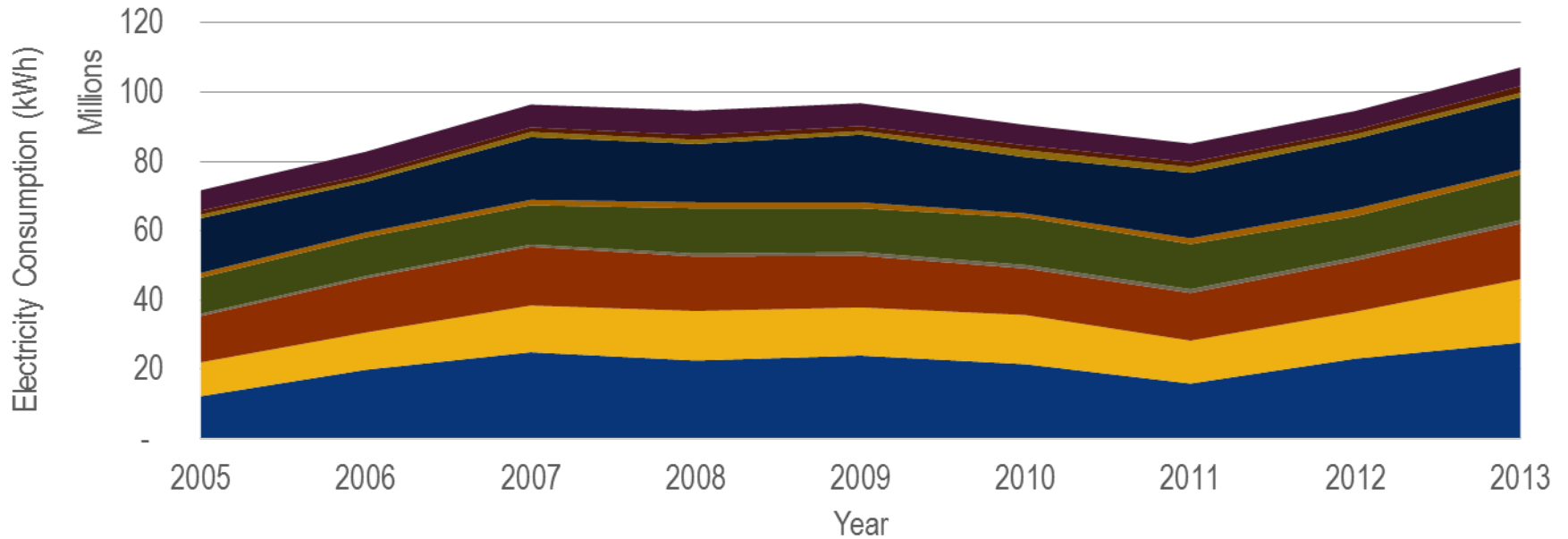




# Common Challenges

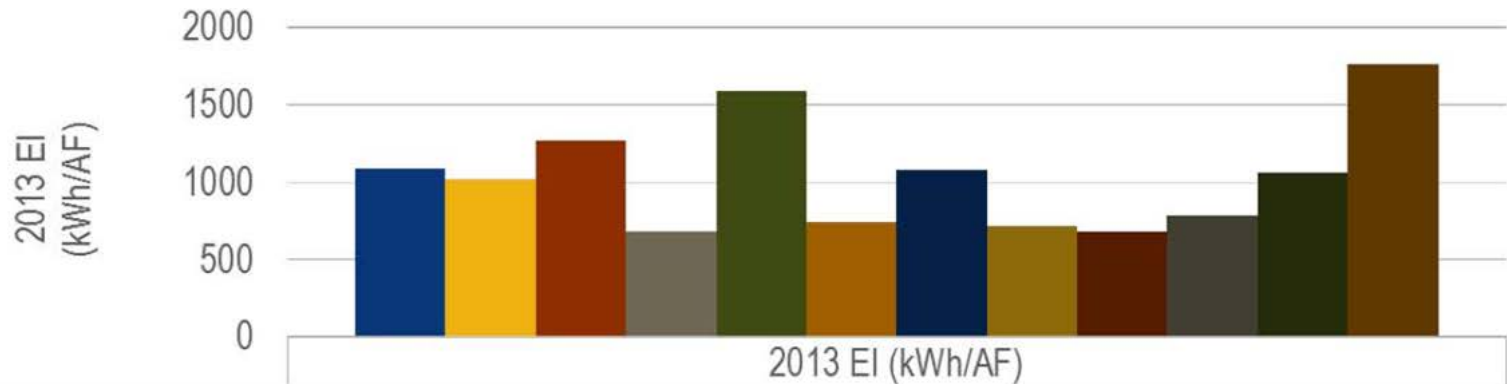
- Data availability
  - Water and energy data for the same periods of time
  - Missing/incomplete data
- Linking energy data sets to water flow data
  - Often managed/tracked separately
  - Not always a clear link based on addresses or facility names
- Reconciling flow data
  - metered at the facility vs...
  - total billed to customers vs...
  - system demand forecast models

# Results – Historic System Energy Use



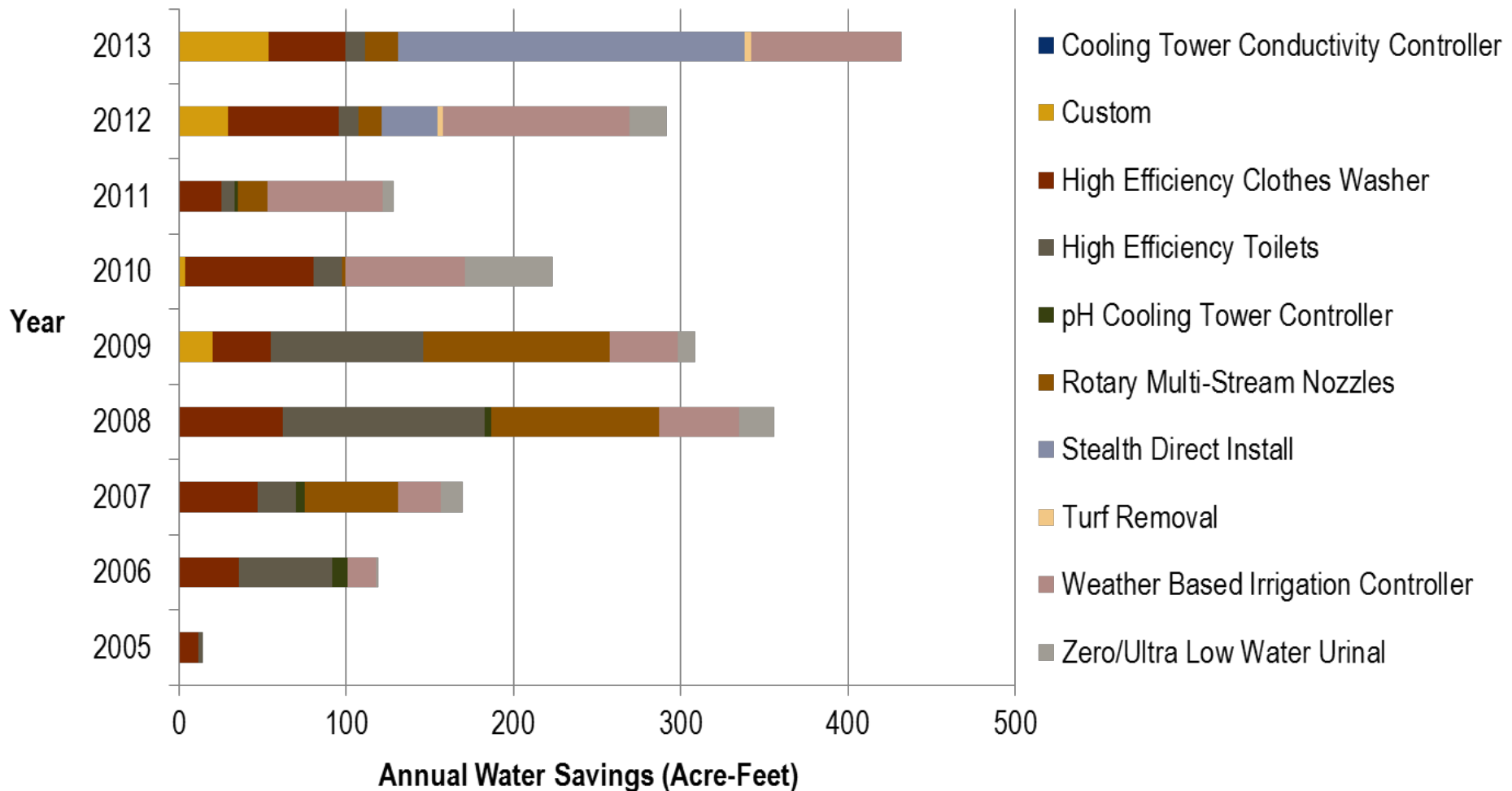
- 1. Water Supply
- 2. Potable Water Treatment
- 3. Potable Water Distribution
- 4. Wastewater Collection
- 5. Wastewater Treatment
- 6. Recycled/Non-Potable Water Treatment
- 7. Recycled/Non-Potable Water Distribution
- 8. Wastewater Discharge
- 9. Biosolids Treatment
- 10. Biosolids Product Disposal
- 11. Non-Water Operation

# Top 12 Energy Consuming Facilities (kWh/AF)

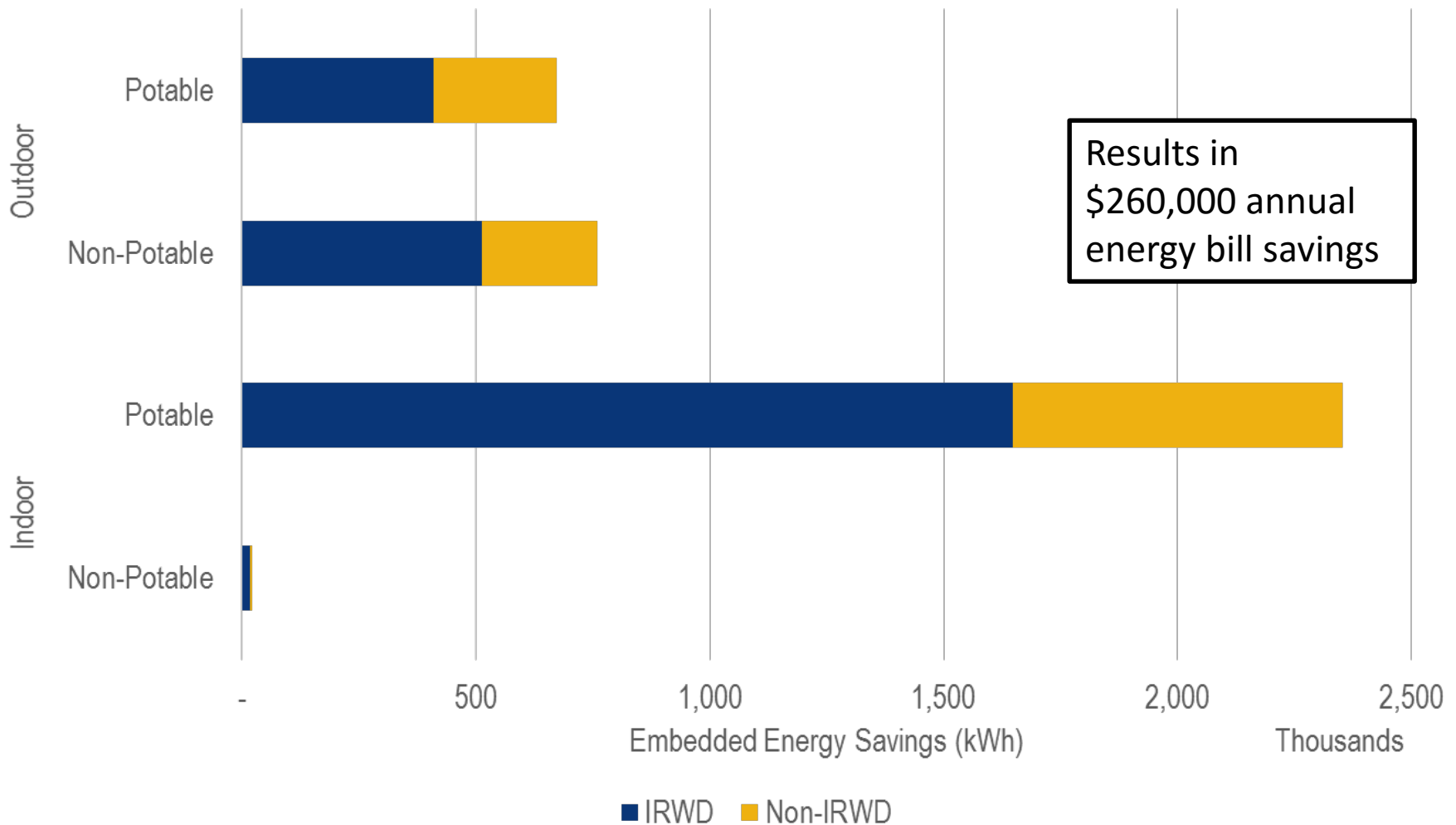


■ DATS C-8 & C-9	1087
■ Foothill Zone 6 Pump Station	1020
■ OC- 63 Coastal Zone 4 Pump Station	1274
■ Dyer Road Well 10	678
■ East Irvine Zone 3 Pump Station	1594
■ Costal Zone D Pump Station	738
■ IDP Treatment Facility	1084
■ Dyer Road Well 15	713
■ Dyer Road Well 17	682
■ Dyer Road Well 14	783
■ All MWRP	1060
■ All LAWRP	1762

# Results – Historic Water Conservation Activity

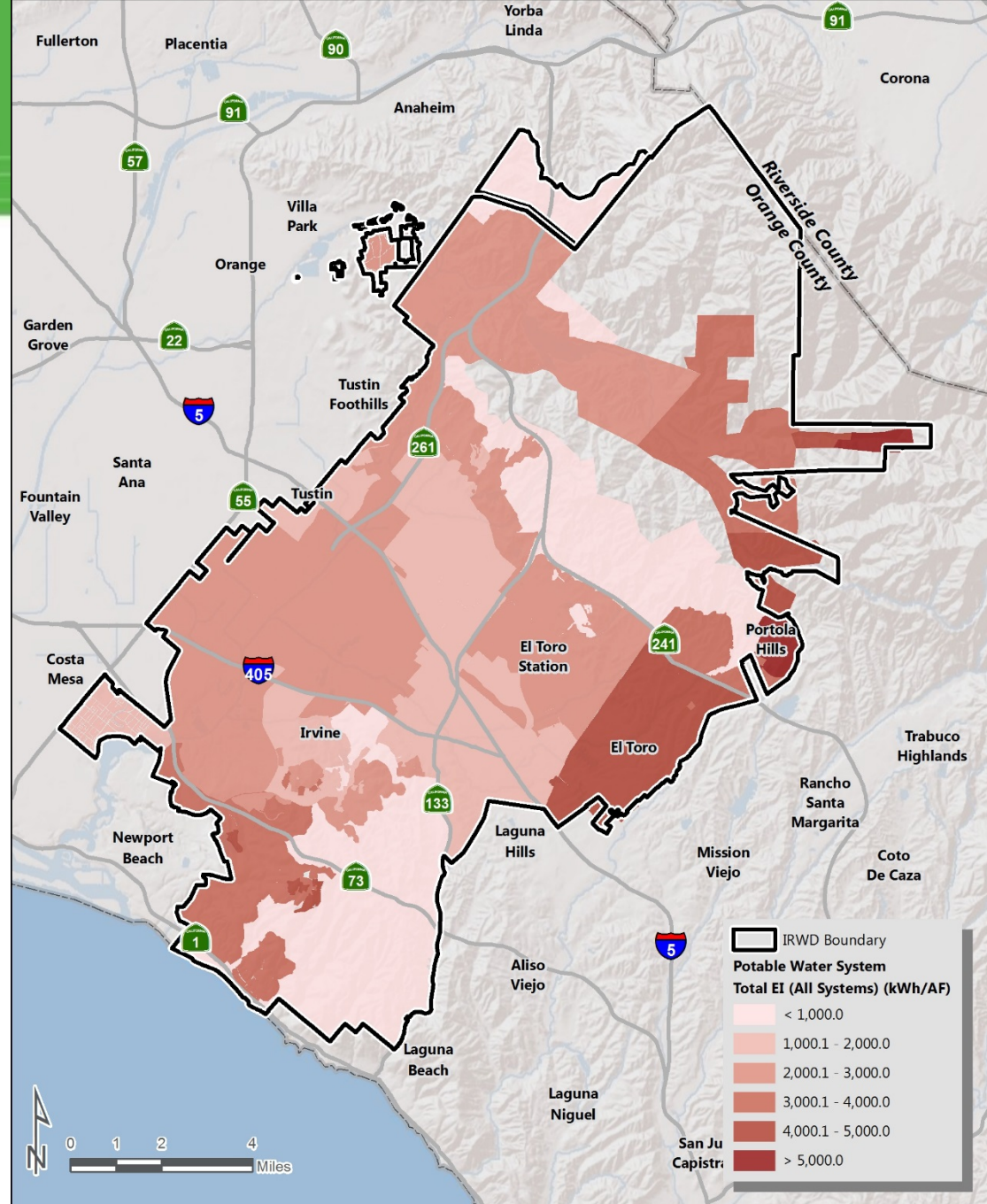


# Results – Embedded Energy Savings from Conservation



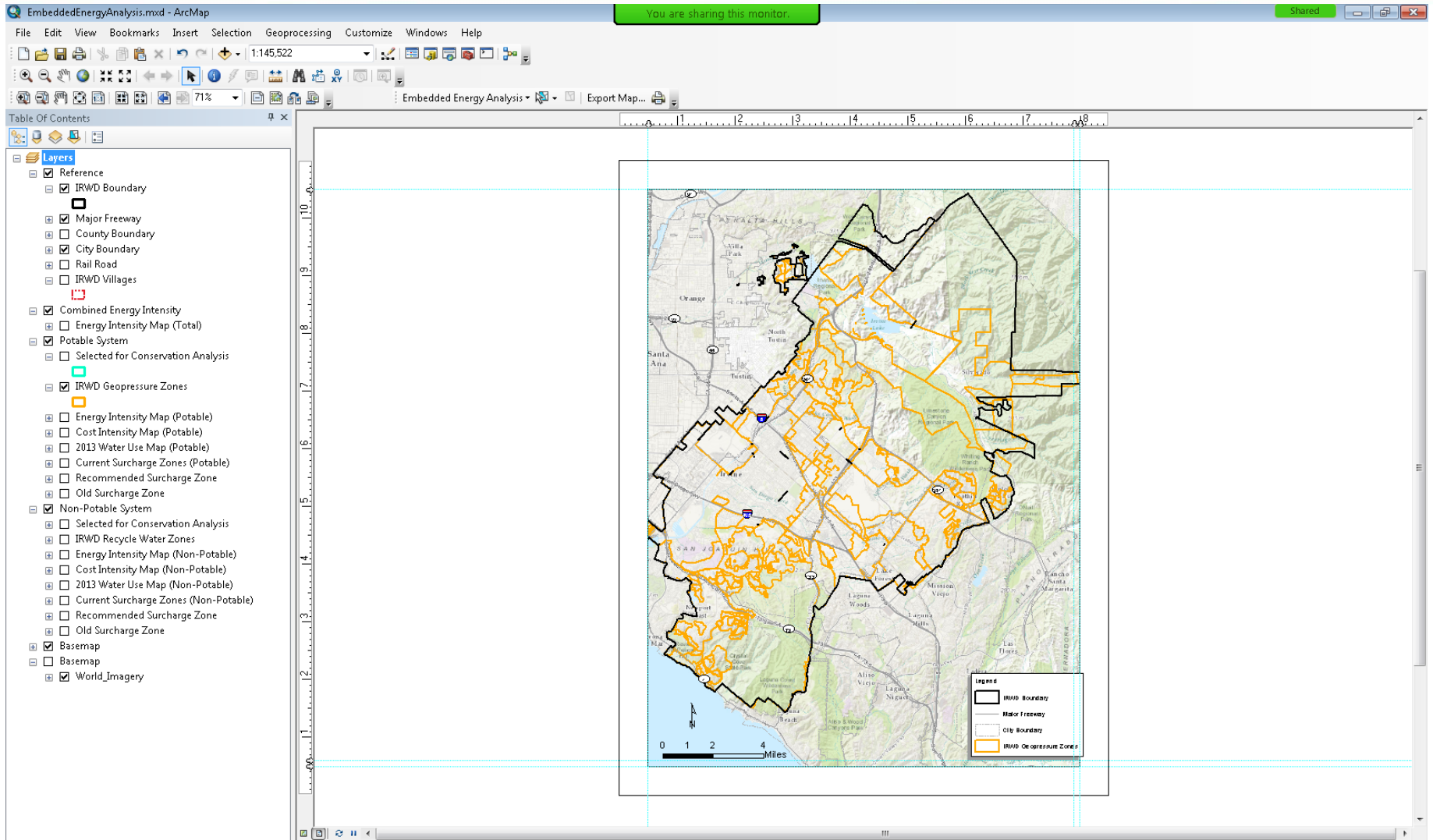
# Results – Geospatial EI

- Map energy intensity, pumping cost, water use by customer type
- Allows for geographic targeting of programs
- Dynamic, GIS-based tool





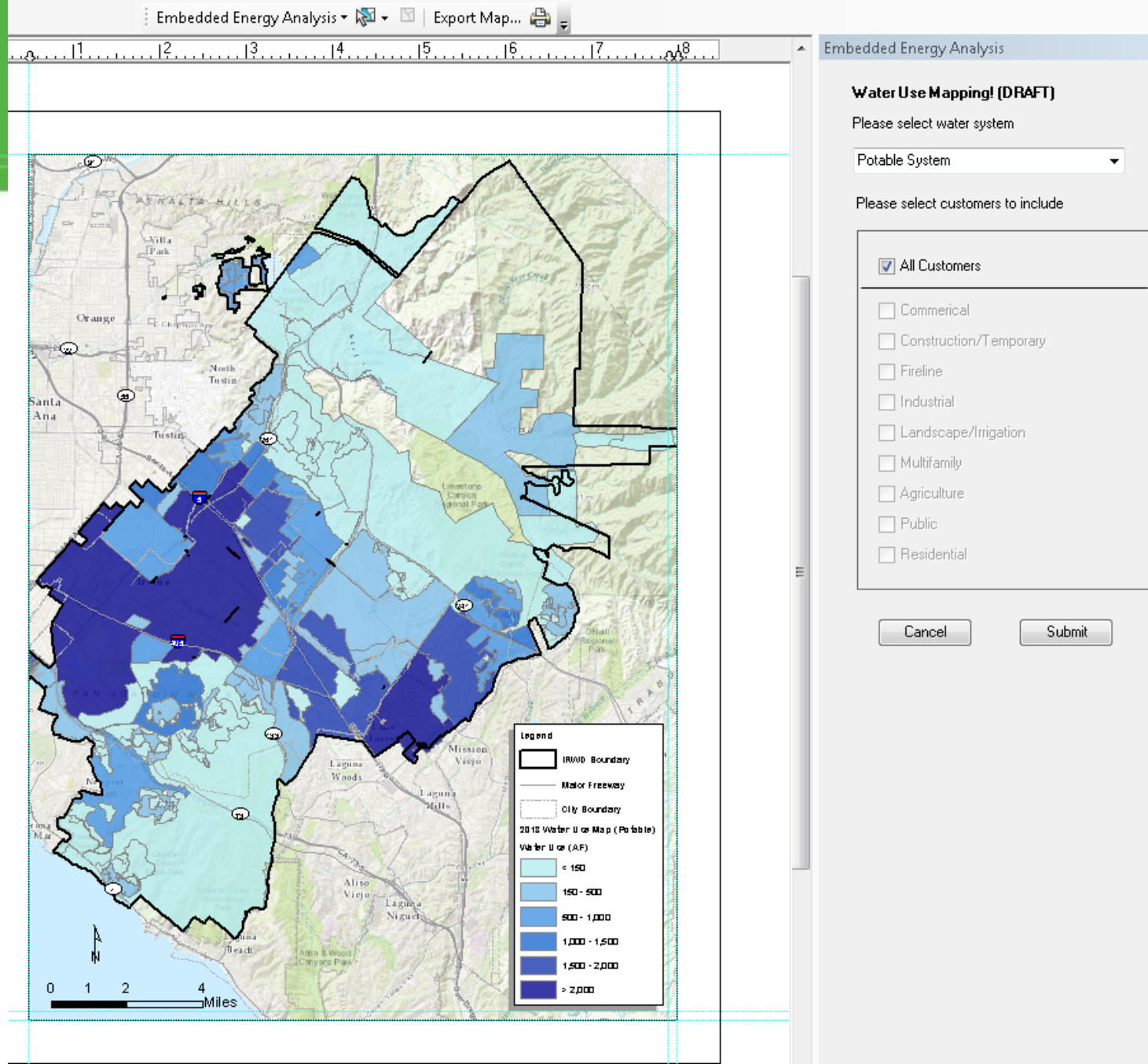
# Results – GIS Tool





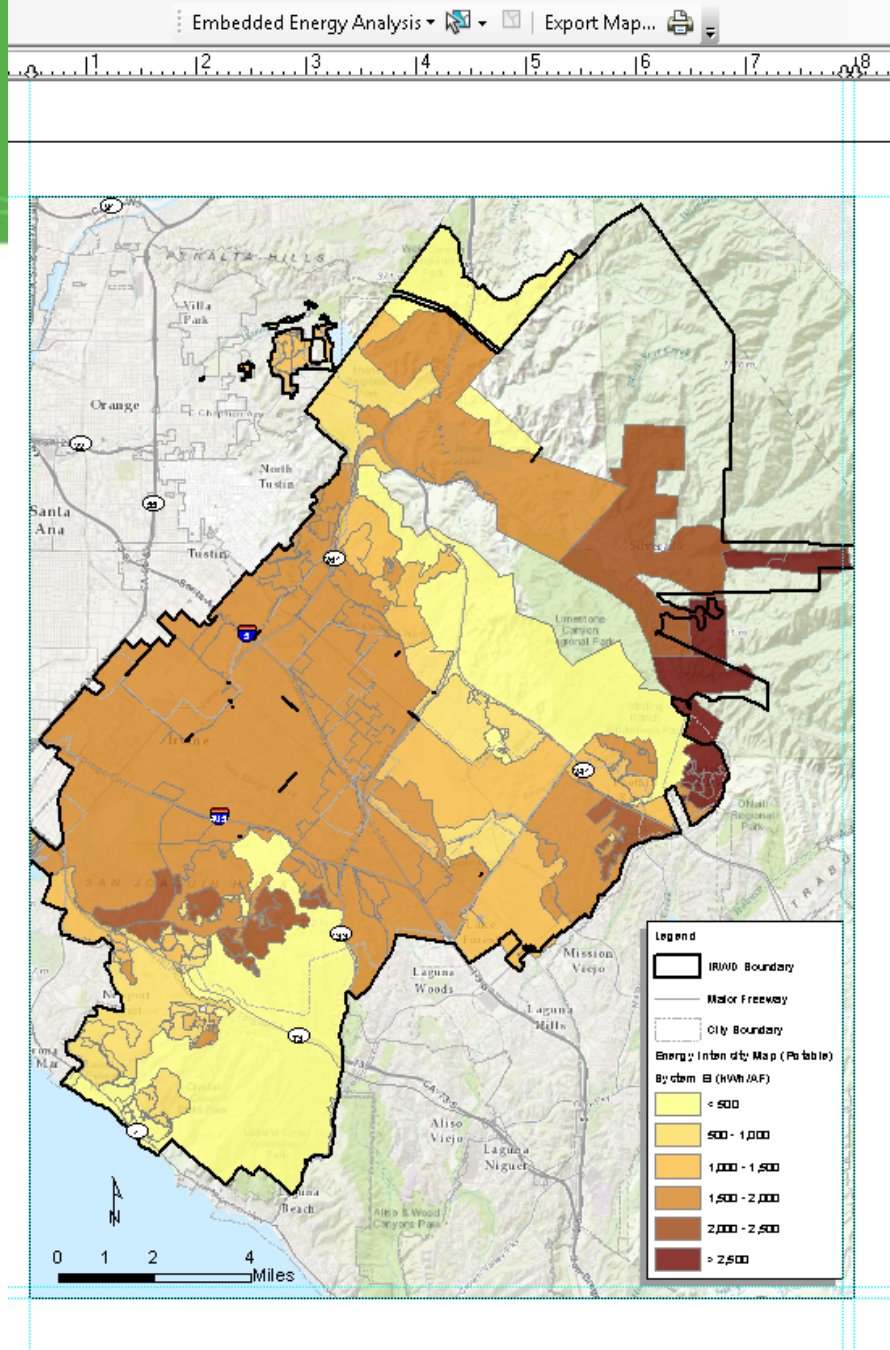
# GIS Tool

- Map Water Use
- Identify areas of high use
- Isolate by type of customer (i.e. landscape)



# GIS Tool

- Map Energy Intensity
- Identify areas of high EI
- Select systems (treatment, distribution, etc.)



Embedded Energy Analysis

### Energy Intensity (EI) Mapping

Please select water system

Potable System

Please select the system component(s) to map

- All System Component EI
- 1A-Potable Water Supply EI
- 1B-Non-Potable Water Supply EI
- 2-Potable Water Treatment EI
- 3-Potable Water Distribution EI
- 4-Wastewater Collection EI
- 5-Wastewater Treatment EI
- 6-Recycled Water Treatment EI
- 7-Non-Potable Water Distribution EI
- 8-Wastewater Discharge EI
- 9-Biosolids Treatment EI
- 10-Biosolids Product Disposal EI

Please select IRWD or Non-IRWD Energy

IRWD Energy  Non-IRWD Energy

IRWD and Non-IRWD Energy

Cancel Submit



# GIS Tool

- Conservation Analysis
- Select high use regions
- Estimate water and energy savings from targeted conservation in selected region

**Conservation Analysis**

Please select water system:  
Potable System

Please select system components to be included:

- All System Component EI
- 1A-Potable Water Supply EI
- 1B-Non-Potable Water Supply EI
- 2-Potable Water Treatment EI
- 3-Potable Water Distribution EI
- 4-Wastewater Collection EI
- 5-Wastewater Treatment EI
- 6-Recycled Water Treatment EI
- 7-Non-Potable Water Distribution EI
- 8-Wastewater Discharge EI
- 9-Biosolids Treatment EI
- 10-Biosolids Product Disposal EI

**Conservation Measurements**

**Conservation Analysis**

Do you want to apply to selected the Zones? (Use the select button in the Tool bar to select zones) **Zones you have selected: 3**

In the conservation measure table below, please fill in the following: Number Installed, Annual Water Savings (predefined or new devices)

OBJECT	Device	Indoor/Outdoor	Annual Water Savings (AF/Year) (EDITABLE)	Number Installed (EDITABLE)	Total Water Savings (AF/Year, Calculated)	Annual Energy Savings (kWh/Year, Calculated)
1	Res - High Efficiency Toilets (Melded Rate)	Indoor	0.0246	100	2.46	6000.81
2	Res- High Efficiency Clothes Washer (WF = 4)	Indoor	0.0345	10	0.345	841.58
3	Res - Weather Based Irrigation Controller < 1 acre	Outdoor	0.0414	10	0.414	975.26
4	Res - Weather Based Irrigation Controller > 1 acre (per station)	Outdoor	0.0129	0	0	0
5	Res - Rotary Multi-Stream Nozzles	Outdoor	0.0044	0	0	0
6	Res - Turf Removal (per square foot)	Outdoor	0.00013	0	0	0
7	Res - Synthetic Turf (per square foot)	Outdoor	0.00014	0	0	0
8	CII - High Efficiency Toilet (Melded Rate)	Indoor	0.0246	0	0	0
9	CII - Zero/Ultra Low Water Urinal	Indoor	0.1227	0	0	0
10	CII - Zero/Ultra Low Water Urinal (New Construction)	Indoor	0.0307	0	0	0
11	CII - Waterbroom	Outdoor	0.1534	0	0	0
12	CII - Connectionless Food Steamer (per Compartment)	Indoor	0.2501	0	0	0

Buttons: Clear, Calculate, Save Output

# Next Steps



# Where IRWD Goes From Here

- Incorporate Avoided Cost for Embedded Energy in Water Conservation Program Planning
- Identify and Track Energy Efficiency Improvements
- Potential Pilot Program with Local Energy Providers



# Contact Information

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