Minimum Thresholds, MODFLOW, and Sustainable Yield—

Example of Model Application in a Coastal Groundwater Basin

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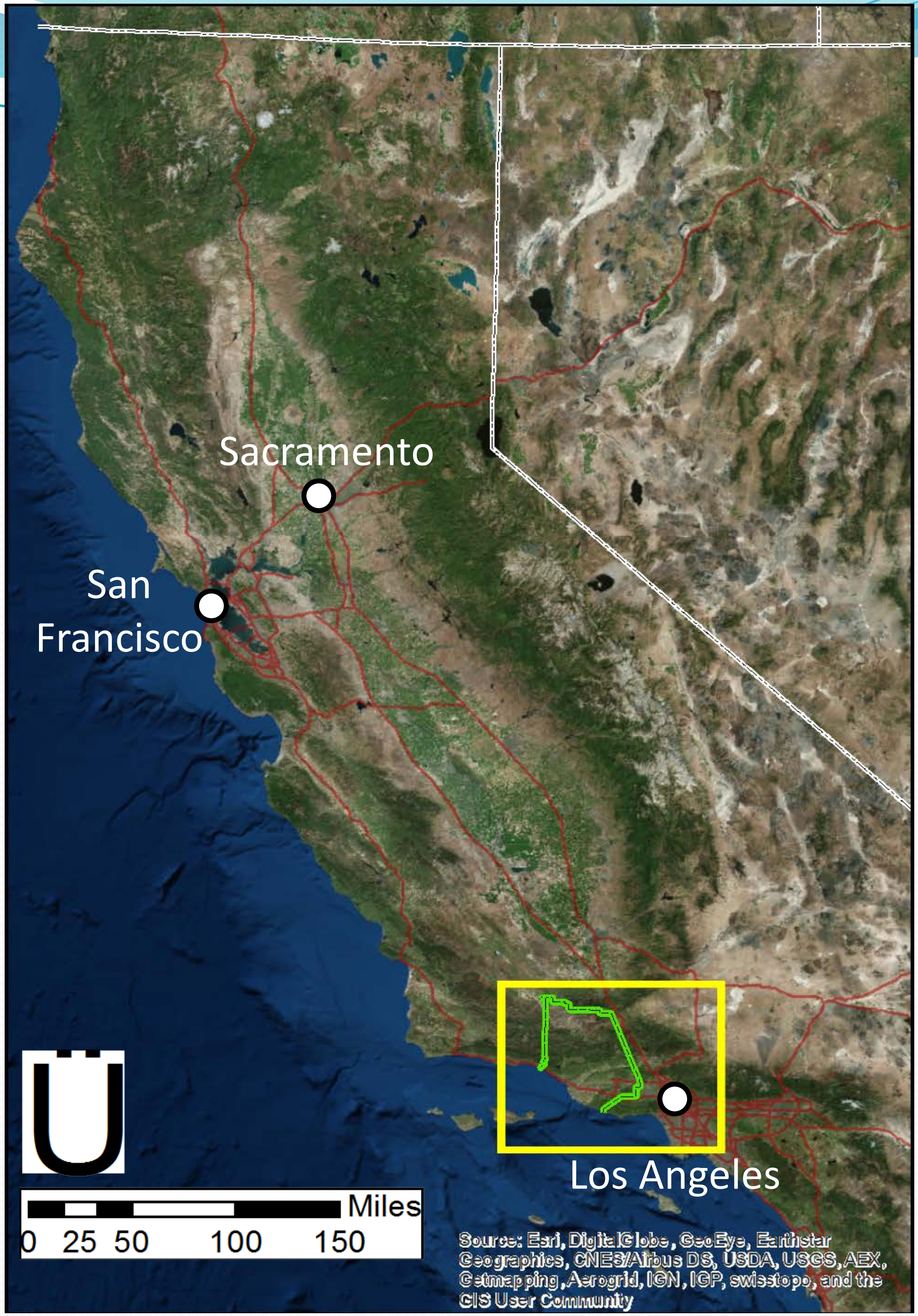
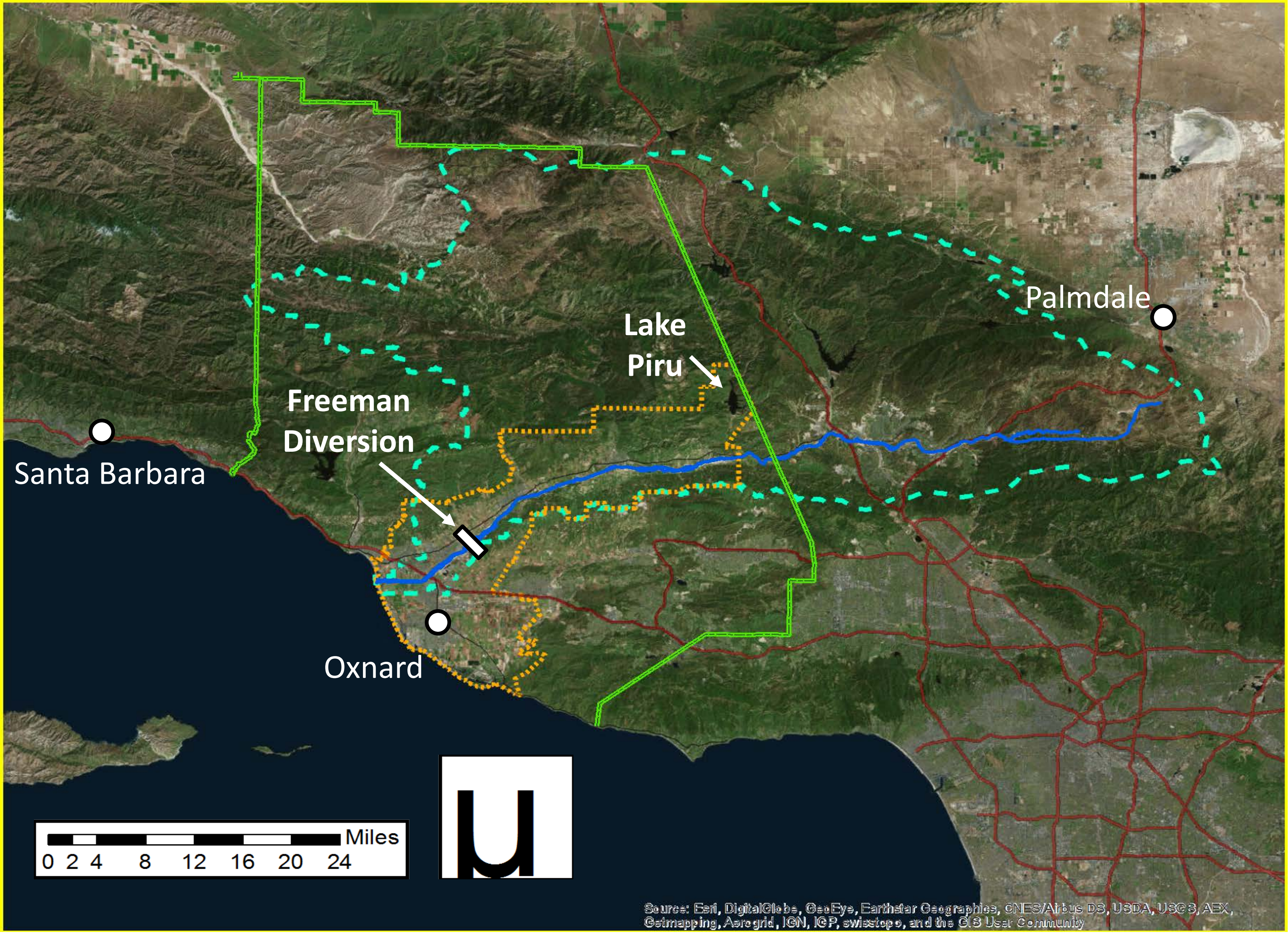
Objectives

- United was asked to make a preliminary estimate of sustainable yield of groundwater basins in the Oxnard coastal plain
  - Needed to help water users develop a workable allocation approach, for the Groundwater Sustainability Plans (GSPs)
- Effort also provided a starting point for thinking about minimum thresholds (MTs) and measurable objectives (MOs)

Study Area

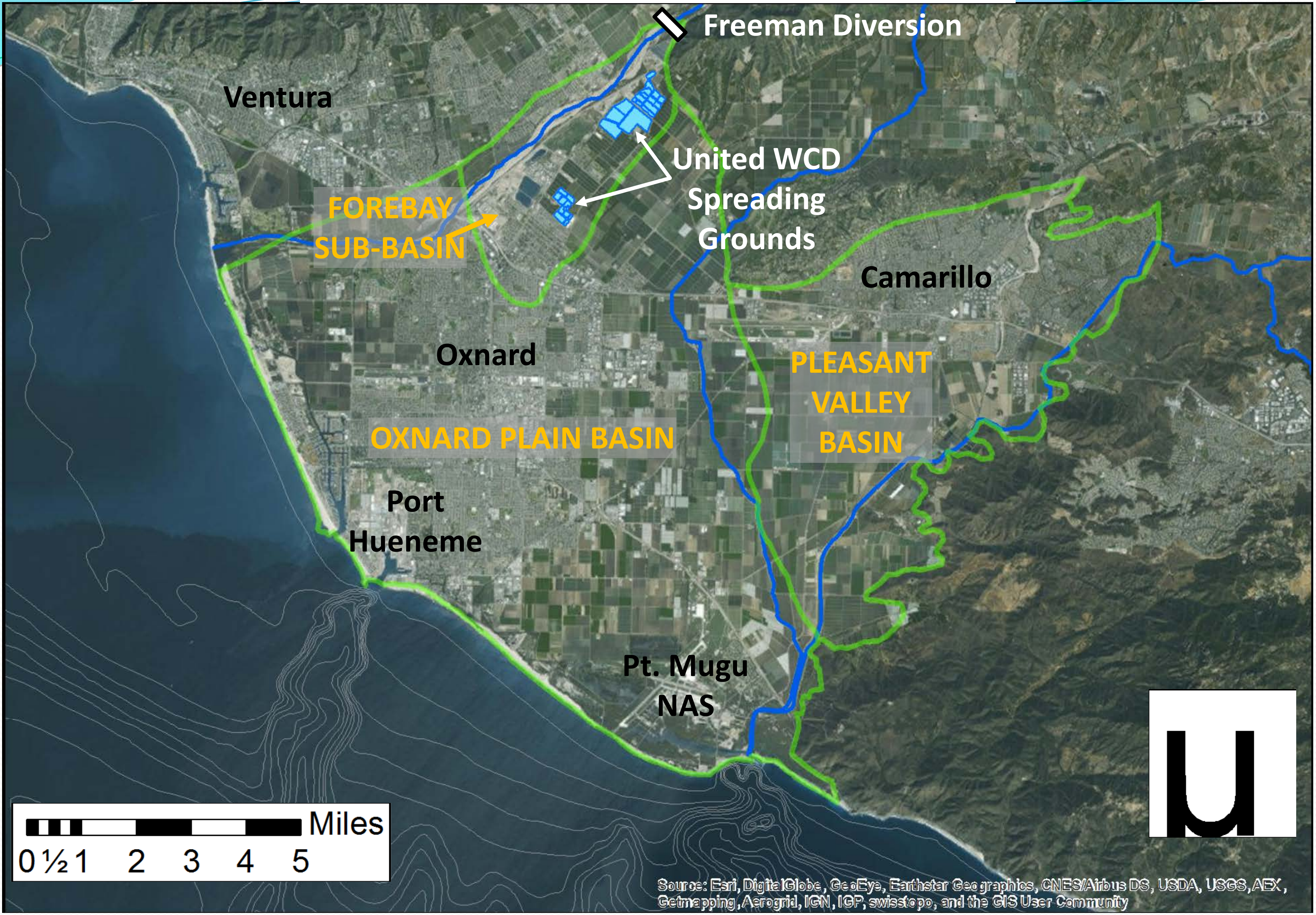

Sacramento
San Francisco
Los Angeles
Miles
0 25 50 100 150
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Santa Clara River Watershed

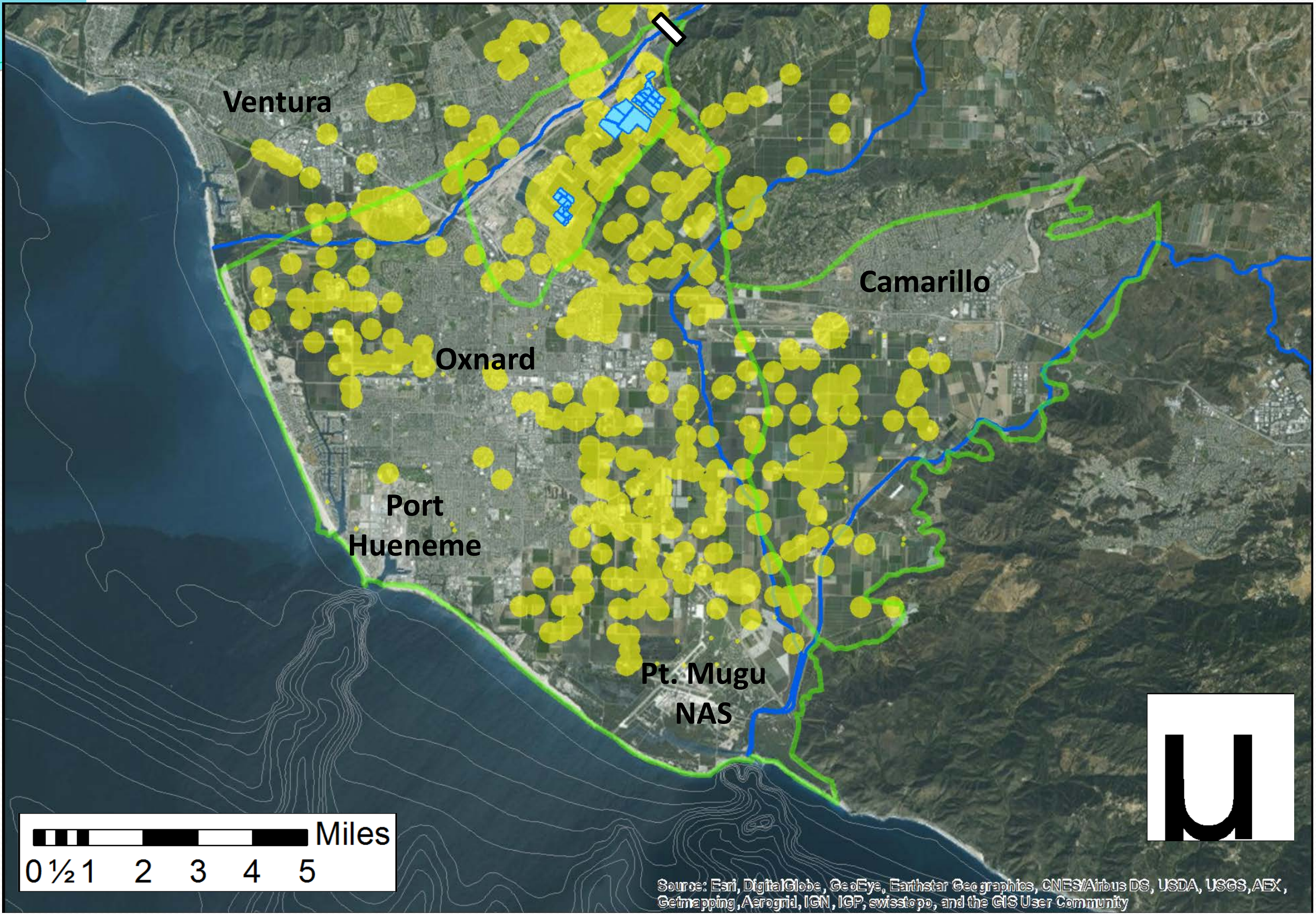


Santa Clara River

Oxnard Coastal Plain



Pumping on Oxnard Coastal Plain

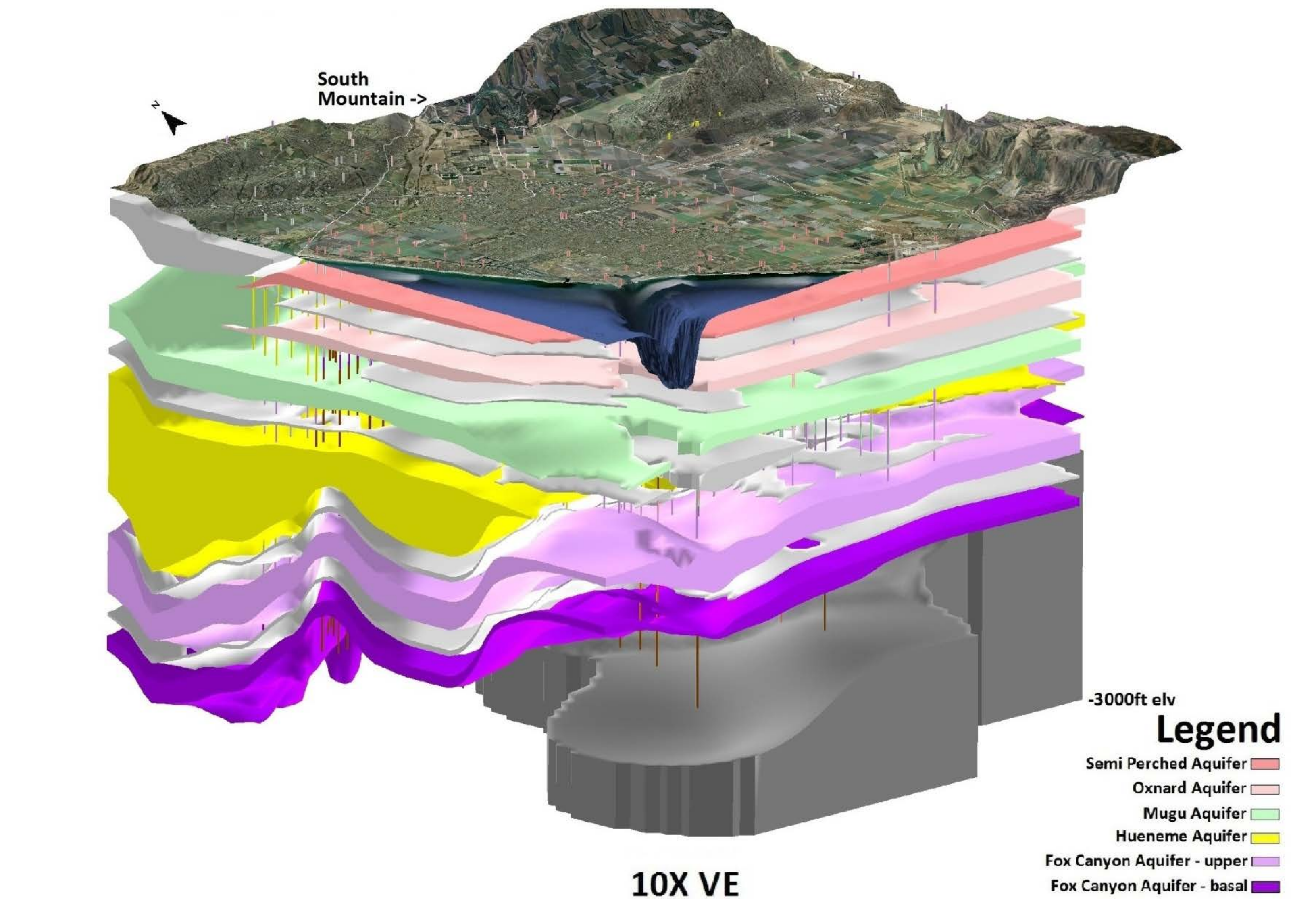


Saticoy Spreading Complex

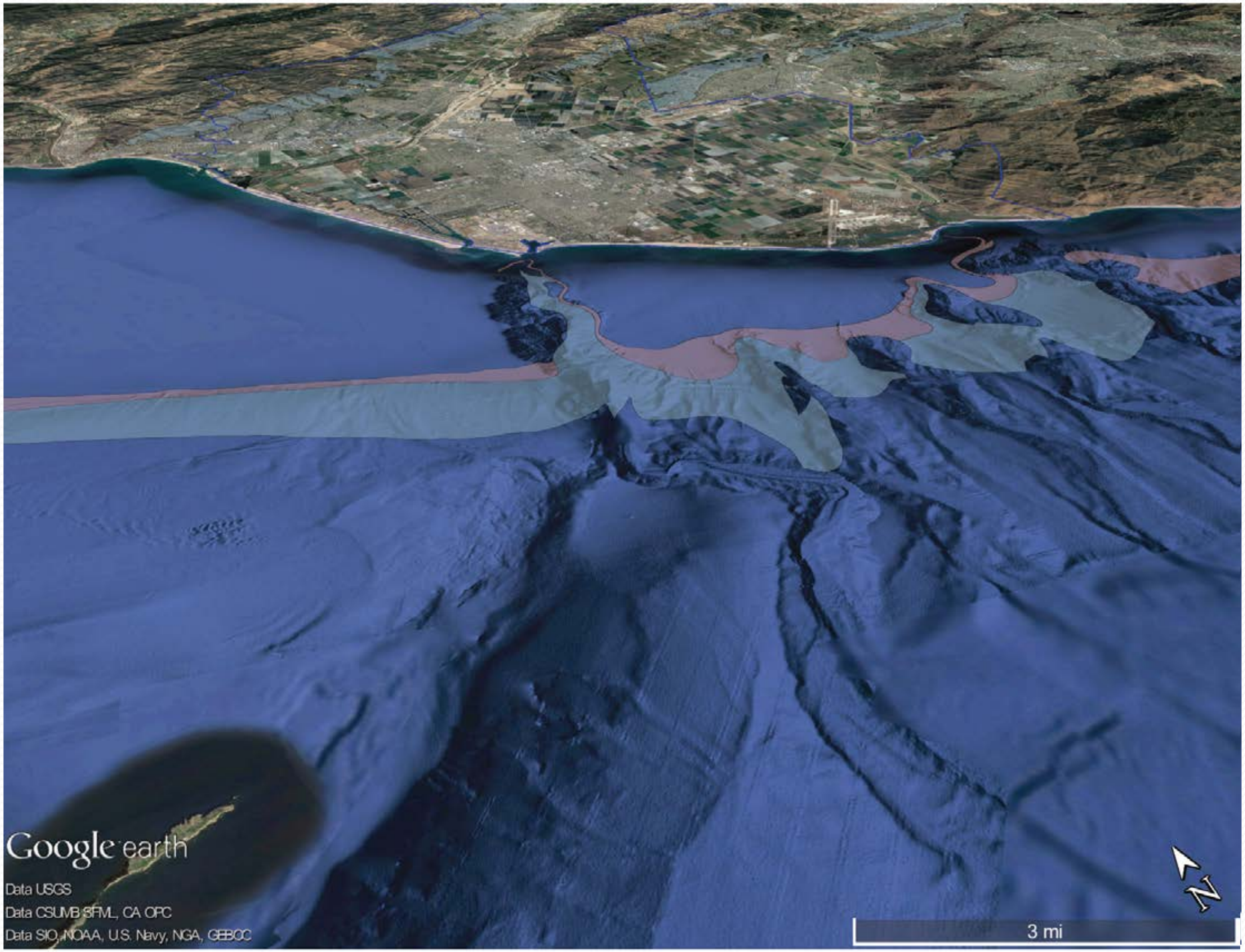
Regional Aquifers

System	**Hydrostratigraphic Unit**
Shallow	Semi-Perched Aquifer
Upper Aquifer System (**UAS**)	
	Oxnard Aquifer
	Mugu Aquifer
Lower Aquifer System (**LAS**)	
	Hueneme Aquifer
	Fox Canyon Aquifer - upper
	Fox Canyon Aquifer - basal
	Grimes Canyon Aquifer
	Older sedimentary rocks and Conejo Volcanics

Hydrostratigraphic Model

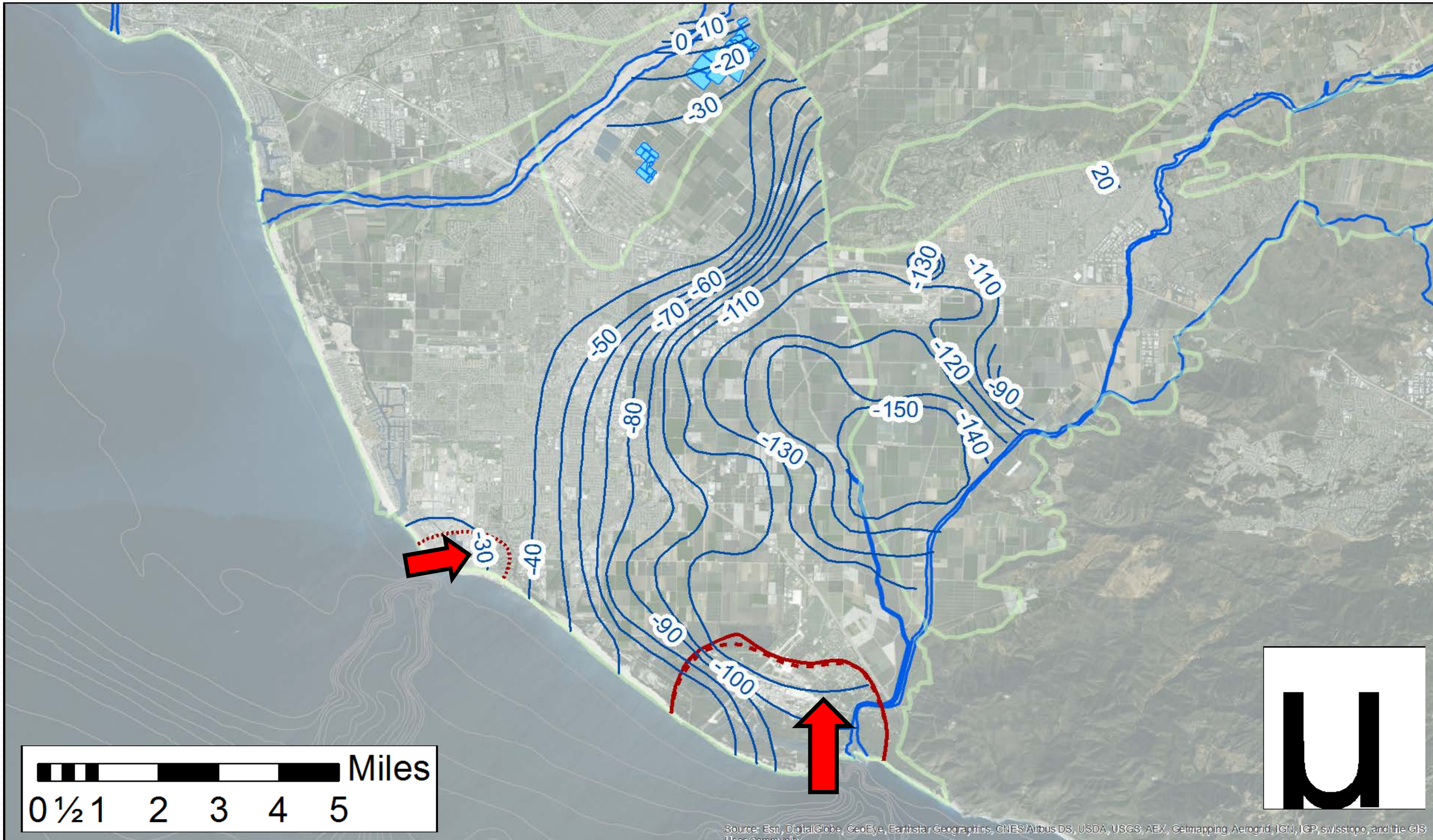


Offshore Extent of Aquifers

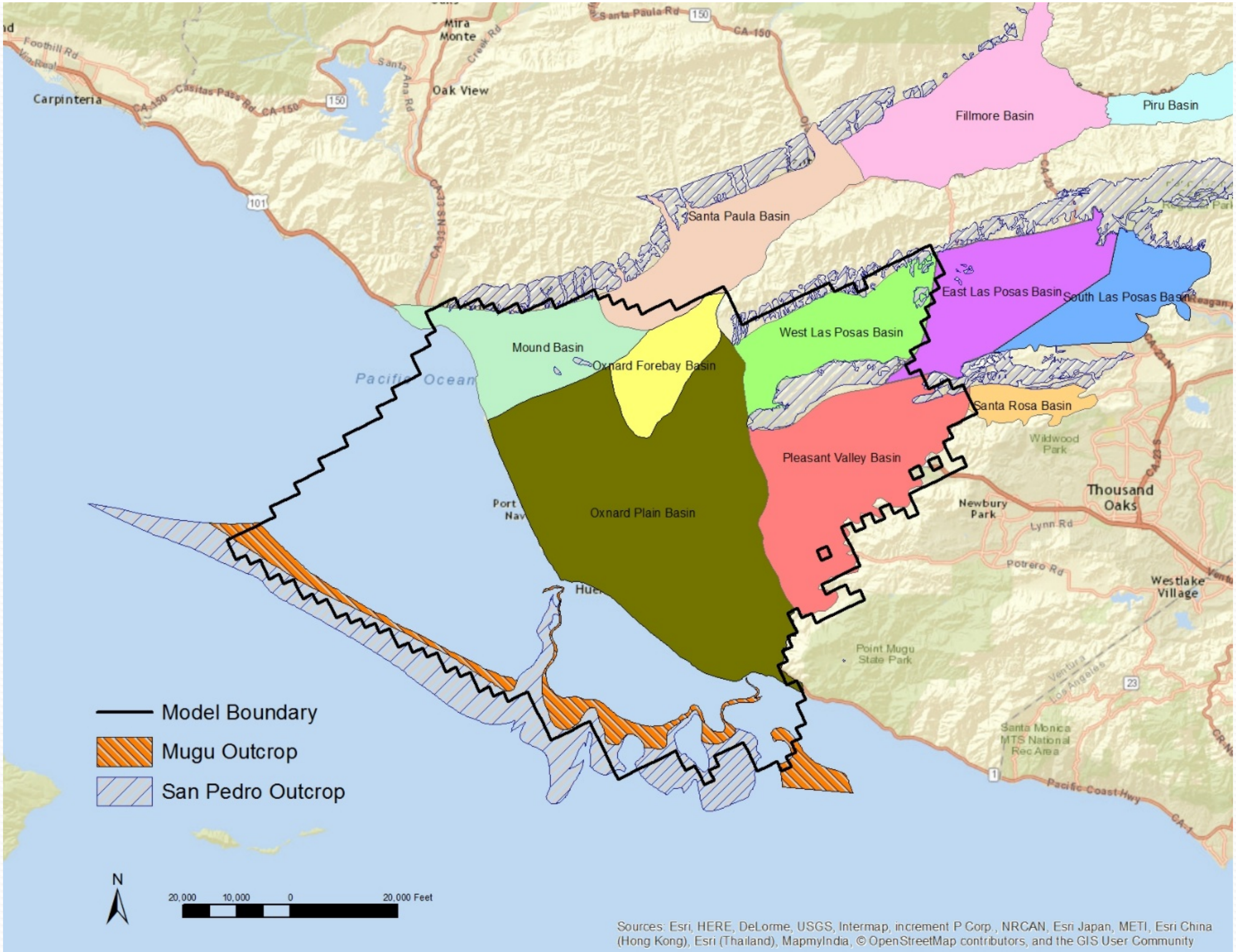


Fall 2015 Groundwater Conditions—UAS

Fall 2015 Groundwater Conditions—LAS

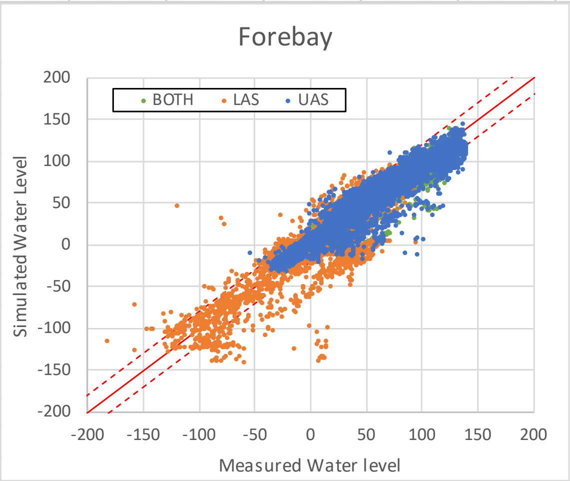


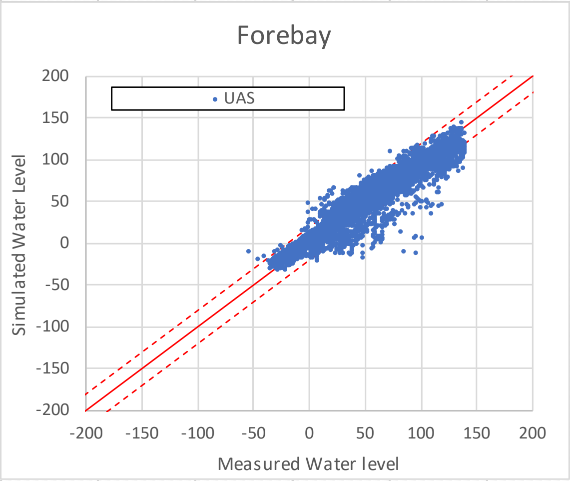
United Model (MODFLOW-NWT)

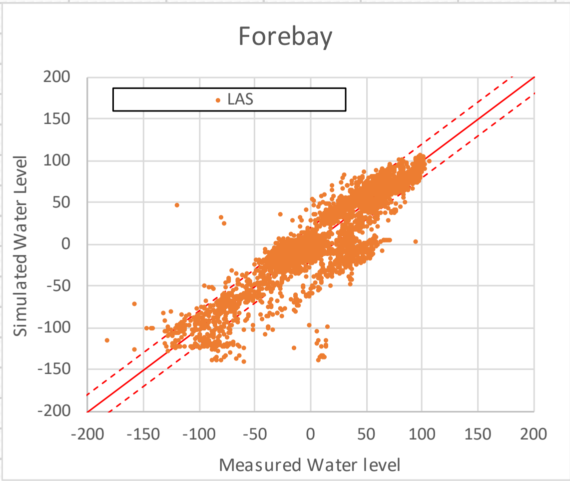


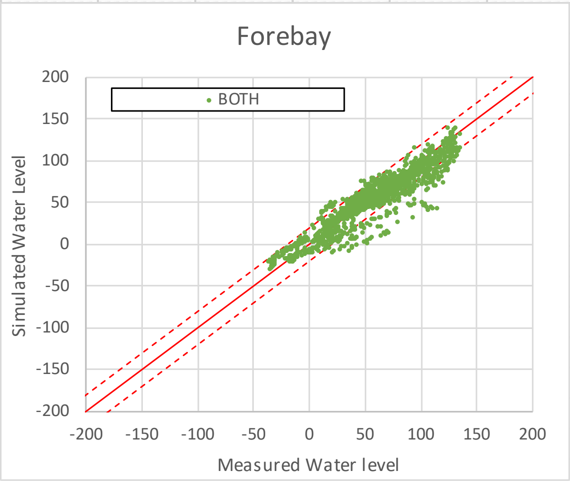
Calibration Example—Forebay Area

Current United Model

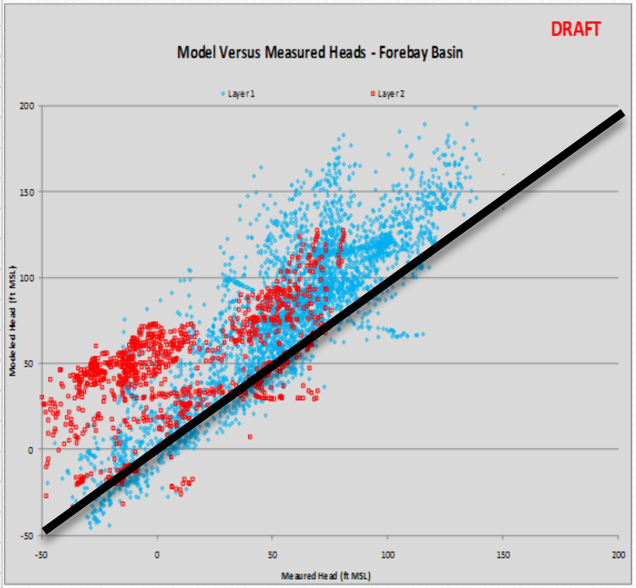




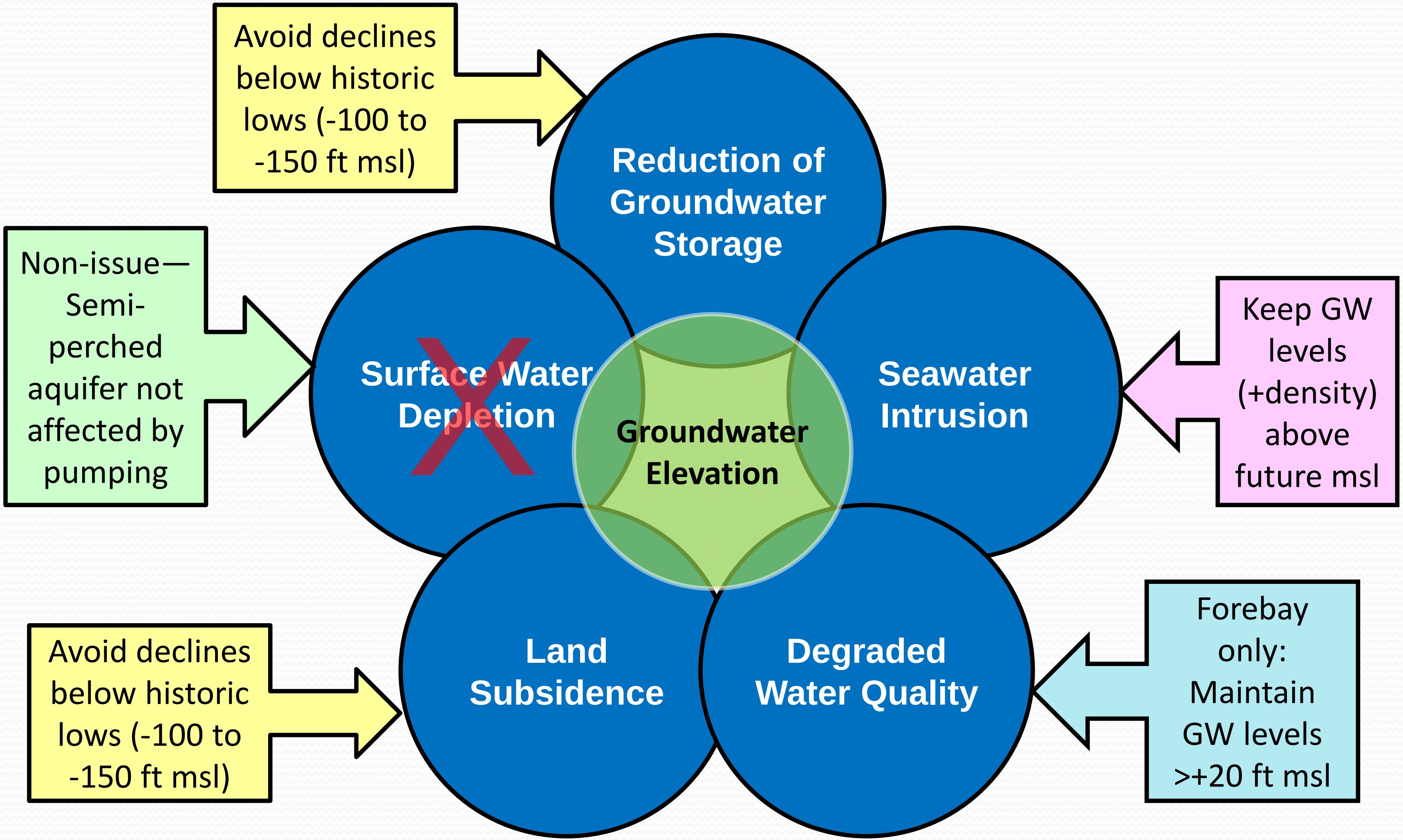




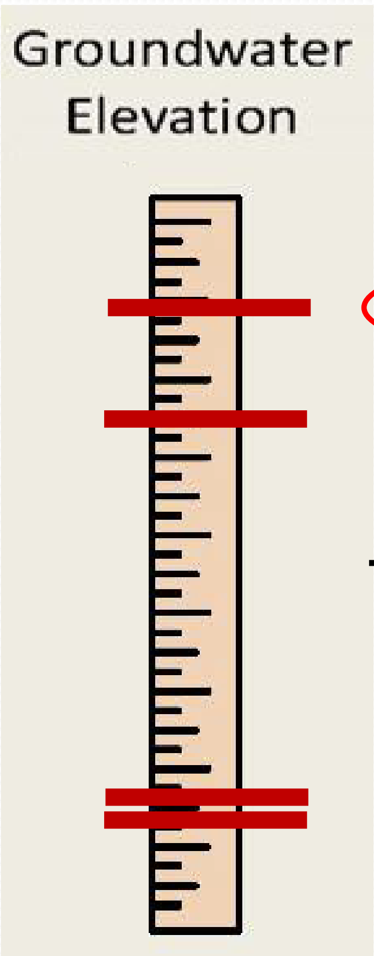
2003 USGS Model



Sustainability Indicators and Minimum Thresholds



Establish “Target Groundwater Levels”



Sea Water Intrusion

Degraded Quality

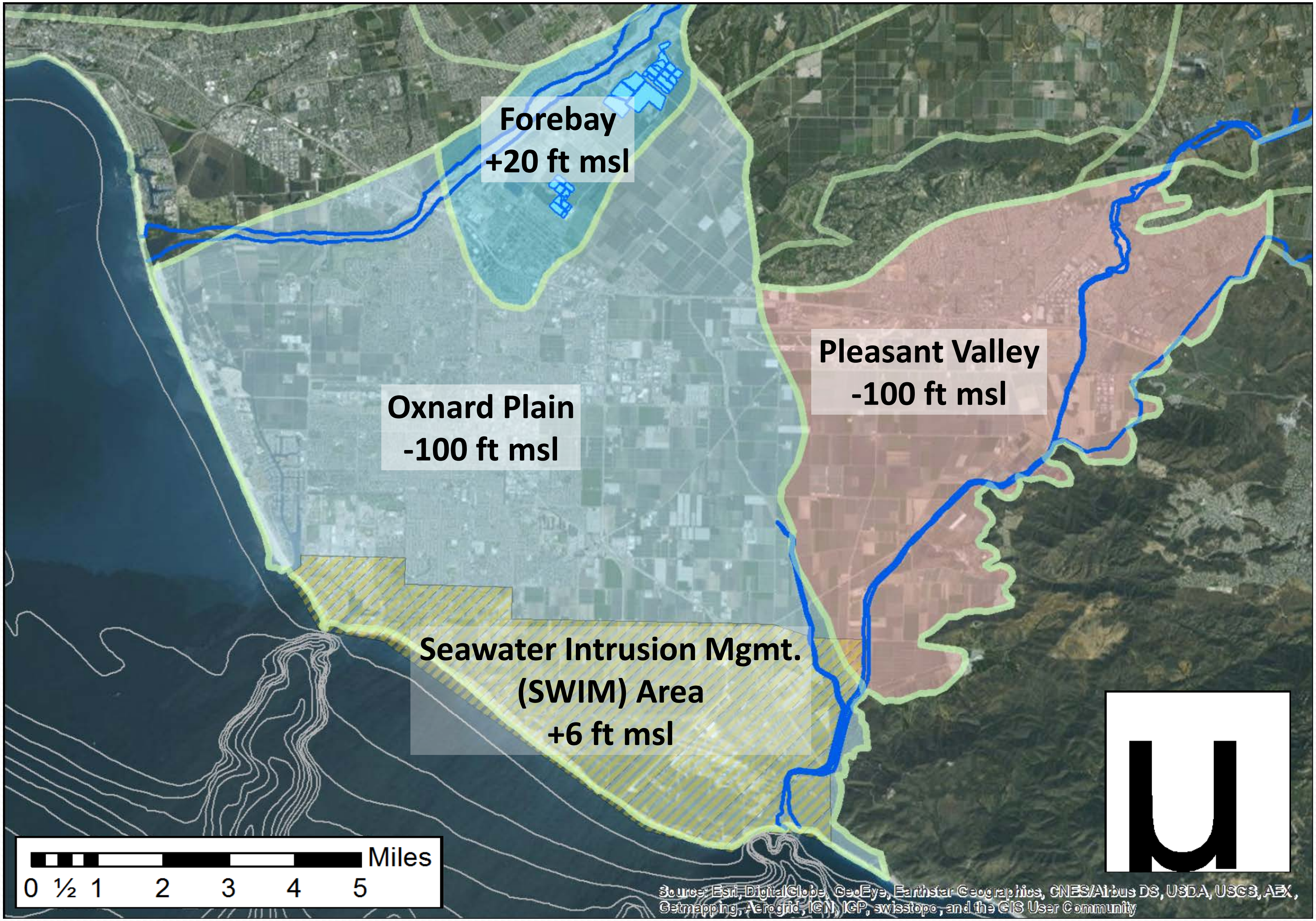
~~**Surf. Water Depletion**~~

Subsidence &
Reduction in Storage

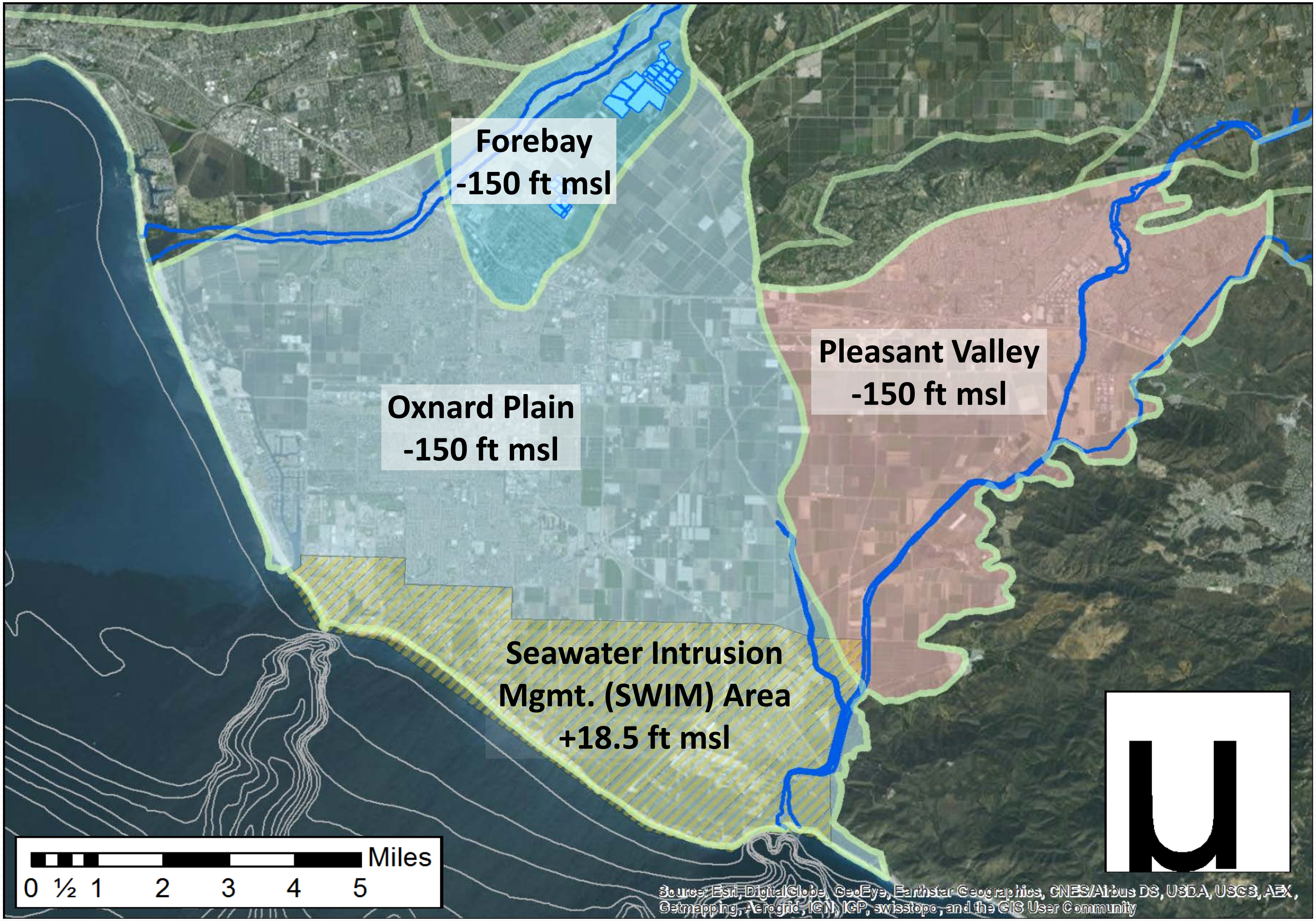
Target Groundwater Level = Highest minimum threshold

Can be different for each groundwater basin OR management area within a basin

Target Groundwater Elevations—UAS



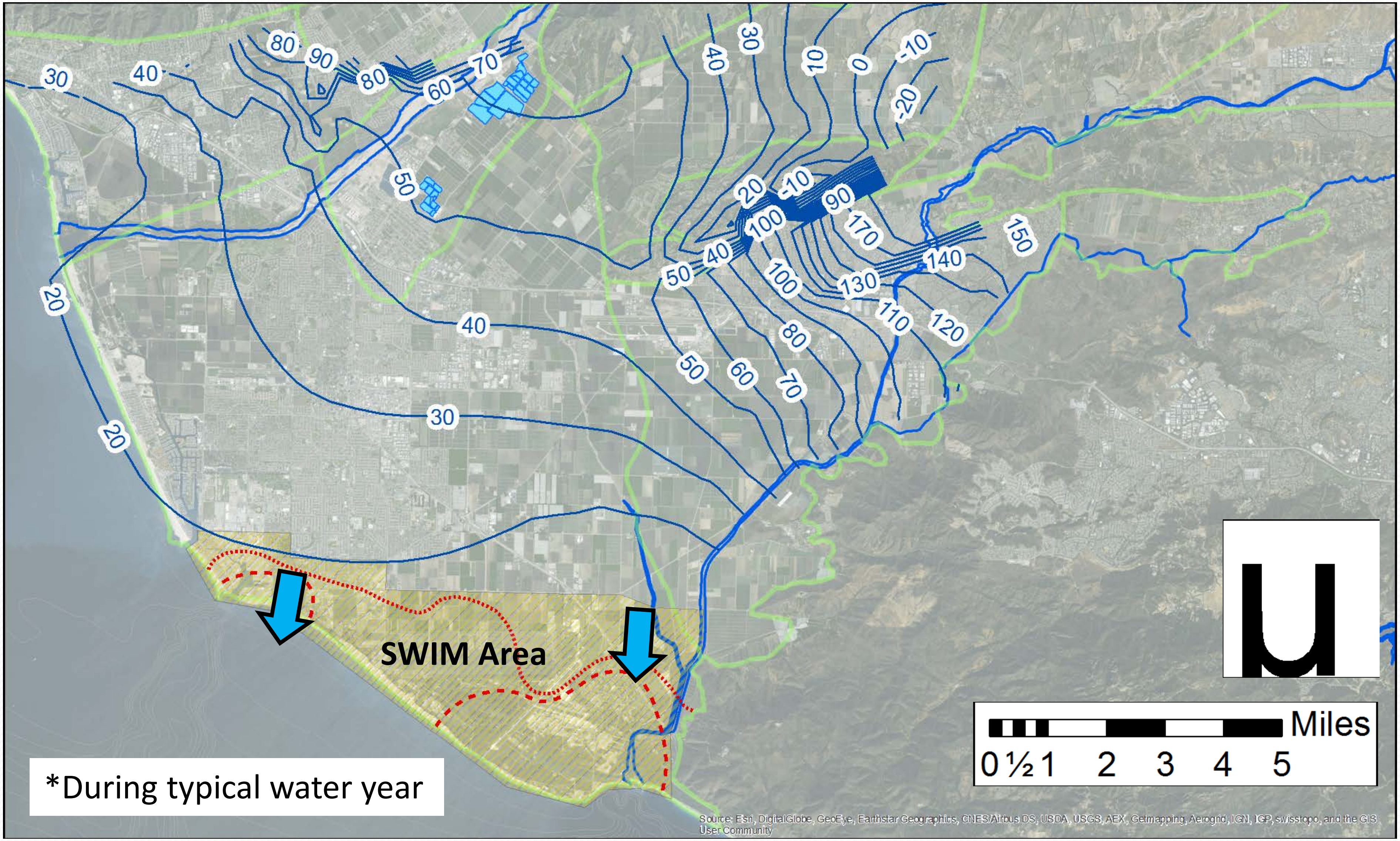
Target Groundwater Elevations—LAS



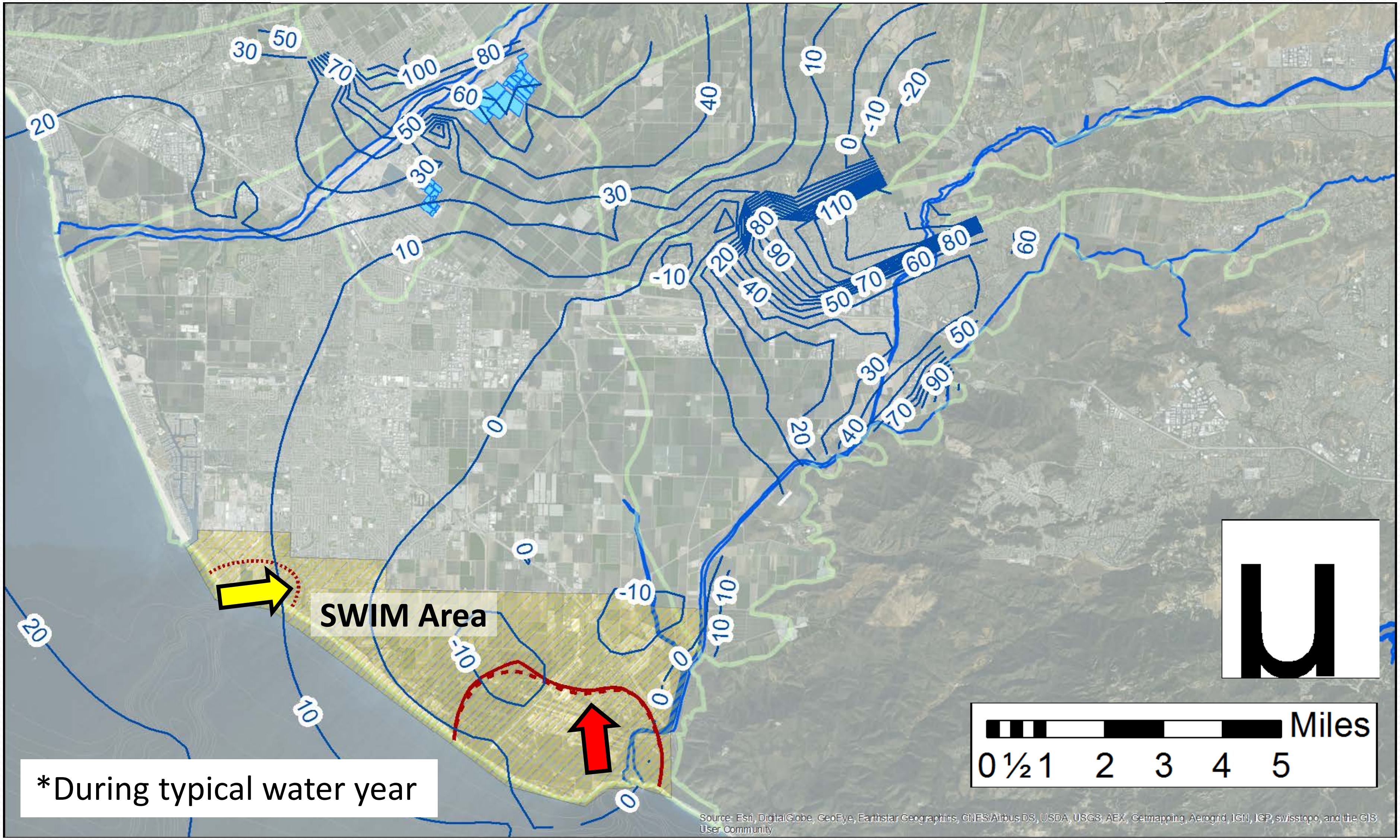
Pumping Scenarios Considered (No New Water-Supply Projects)

Scenario	Description	Avg. GW Extractions (AF/yr)	Reduction in Pumping (%)
Base Case	No changes in 1985-2015 pumping rates	99,000	0
A	50% “haircut” in OP & PV (except Forebay)	61,700	38
B	75% reduction in LAS pumping in OP & PV (except Forebay)	60,600	39
C	100% reduction in SWIM area only (nowhere else)	89,300	10
D	No pumping in SWIM area, 70% reduction in LAS pumping in OP & PV	59,900	39
E	No pumping in SWIM area, 75% reduction in LAS pumping, 50% increase in UAS pumping	69,300	30

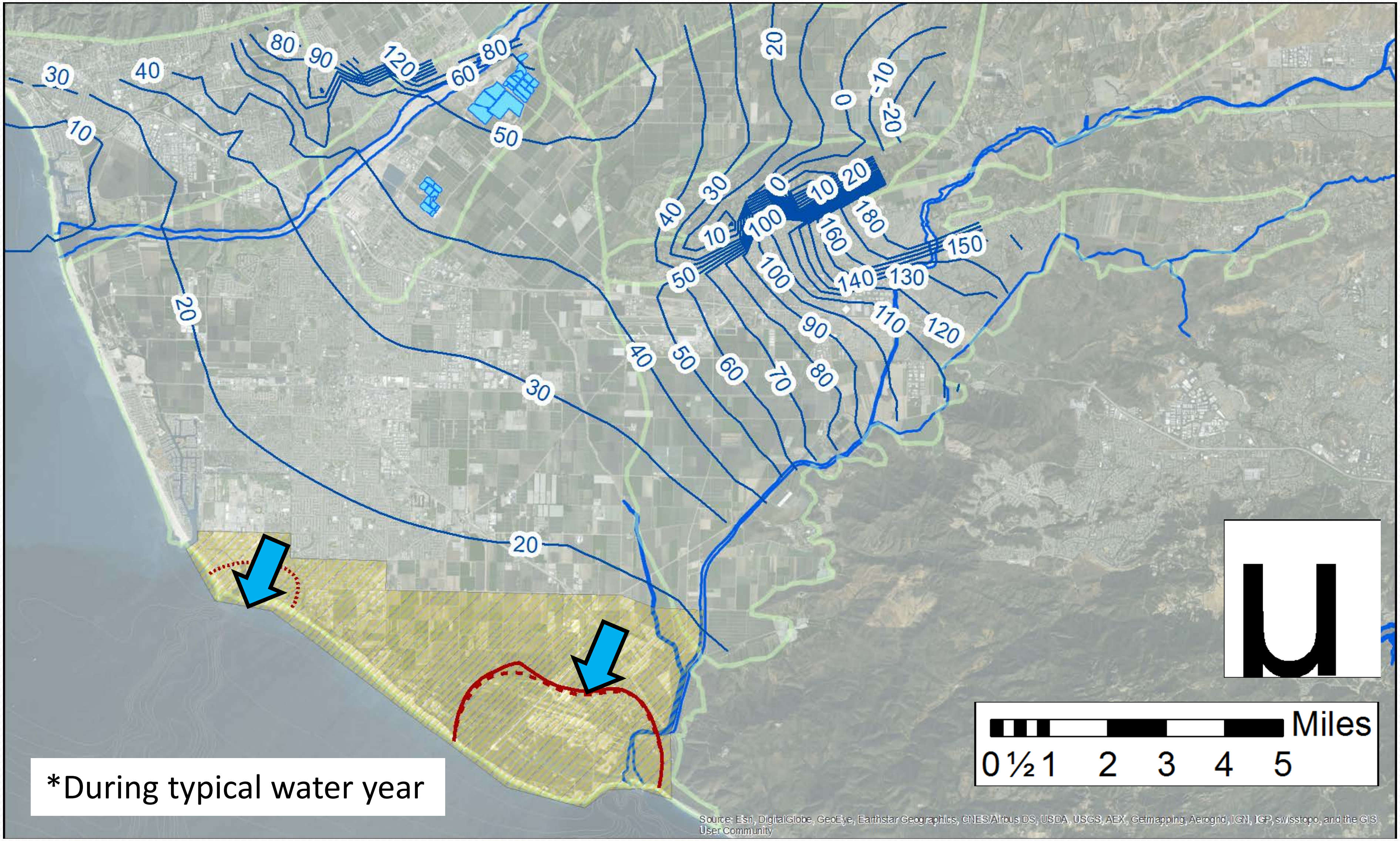
Scenario A Results—UAS



Scenario A Results—LAS

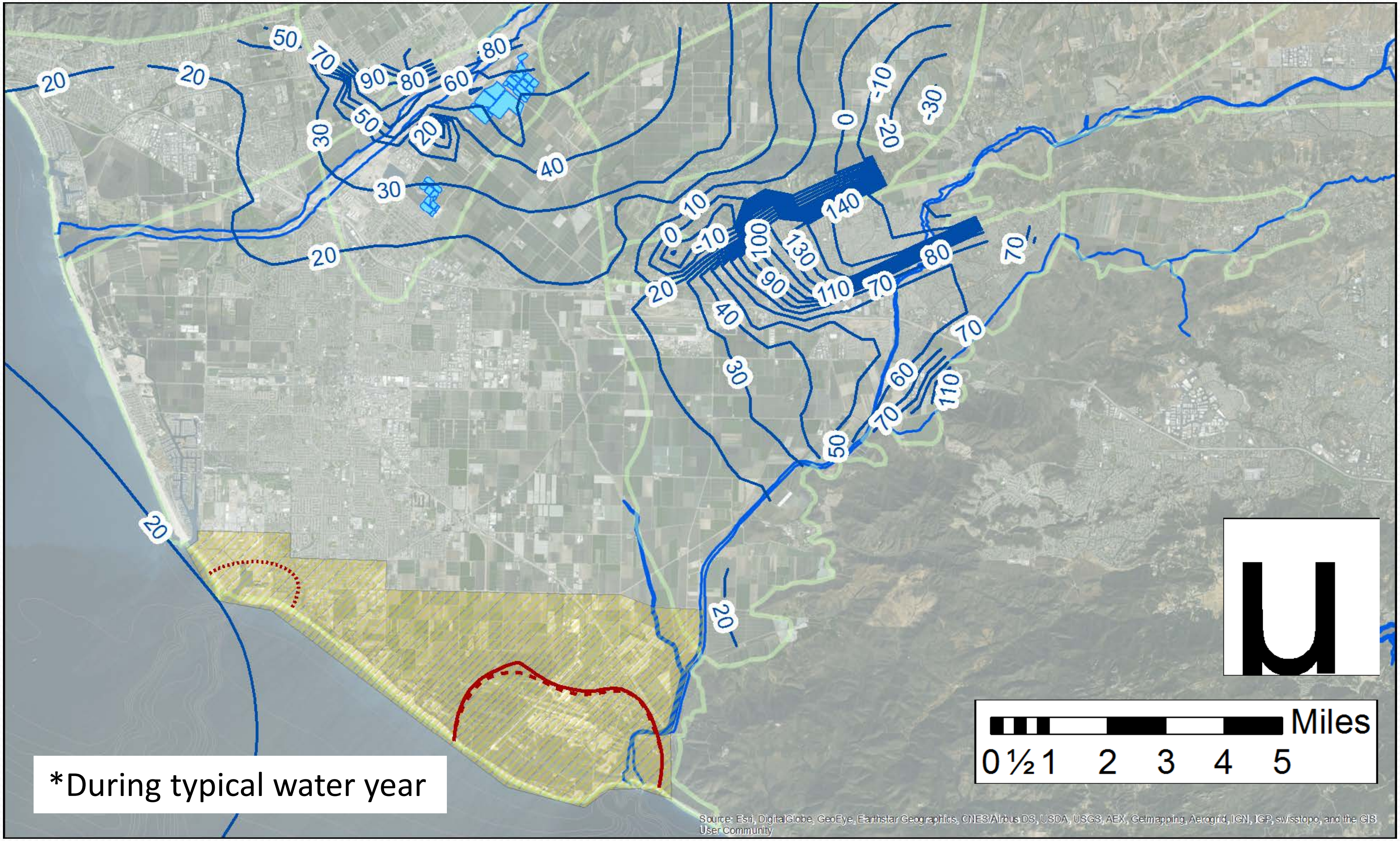


Scenario E Results—UAS



*During typical water year

Scenario E Results—LAS



Effectiveness of Scenarios at Achieving Sustainable Yield

Scenario	Pumping Rate (AF/yr)	Reduction of Storage	Seawater Intrusion		Degraded Water Quality	Land Subsidence
			Port Hueneme	Mugu Lagoon		
Base Case	99,000	Partial	No	No	No	Partial
A	61,700	Yes	Partial	Partial	Yes	Yes
B	60,600	Yes	Yes	Partial	Yes	Yes
C	89,300	Partial	Partial	No	Partial	Partial
D	59,900	Yes	Yes	Yes	Yes	Yes
E	69,300	Yes	Yes	Yes	Yes	Yes

Key Findings

- In this case, GW elevation was a suitable "proxy" sustainability indicator
- Sustainable yield ***ranges*** from <60,000 to 70,000 AF/yr (similar to previous estimates)
- Location and depth of pumping has a big influence on yield:
  - "Haircut" approach => lower yields & fails to achieve sustainability goals
  - "Zoned" approach => higher yields & achieves sustainability goals

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