

Meeting irrigated agriculture water needs in the Navarro River Watershed

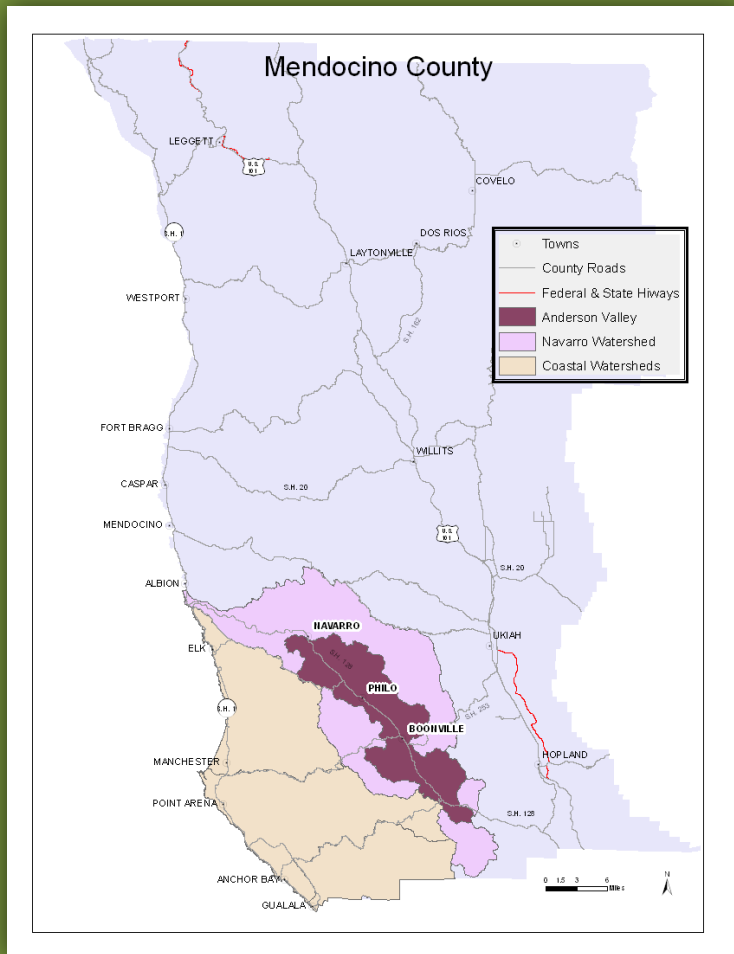
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Overview

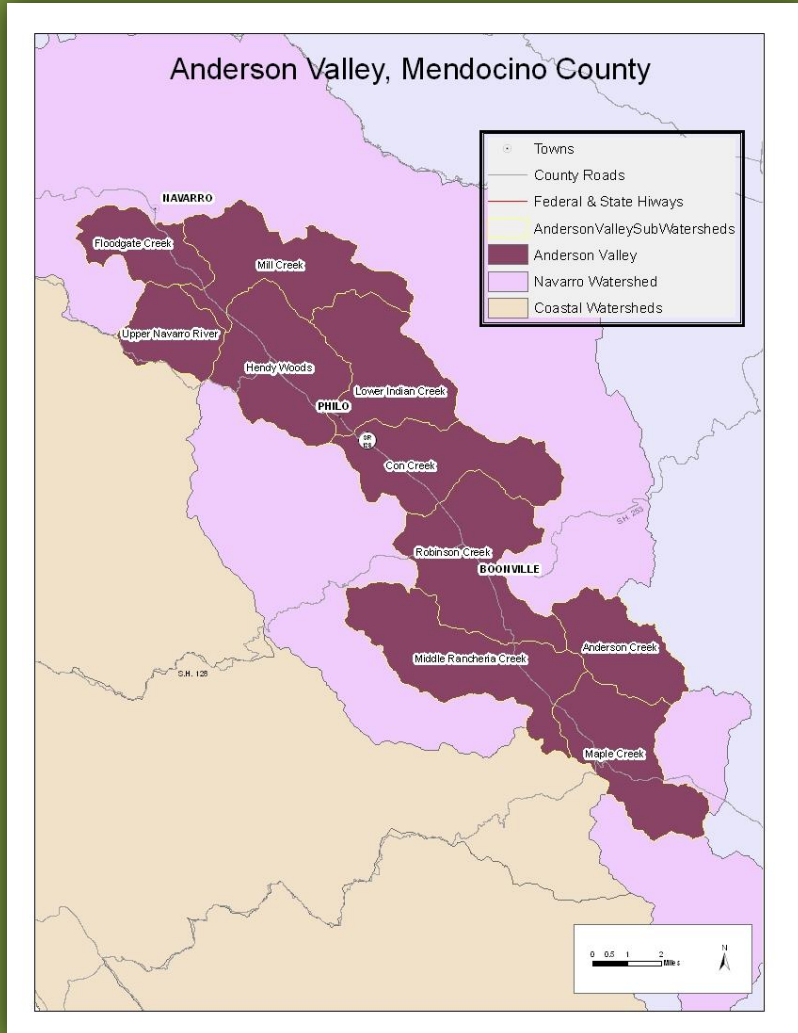
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Navarro River Watershed, Mendocino County



- Southern Mendocino County, California
- Drains Coast Range mountains to the Pacific Ocean
- Navarro River
 - 201,200 acres
 - Largest coastal watershed in Mendocino County
- Anderson Valley
 - 67,840 acres (Total)
 - ~3100 acres of irrigated agriculture (*vineyard, orchard, pasture, other*)

Anderson Valley, Mendocino County



- Subset of larger Navarro River watershed
- Agricultural
 - Historically timber & grazing
- 67,840 acres (Total)
- ~3100 acres of irrigated agriculture
- 10 Planning Watersheds
 - Mill Creek
 - Floodgate Creek
 - Hendy Woods
 - Upper Navarro River
 - Lower Indian Creek
 - Con Creek
 - Robinson Creek
 - Middle Rancheria Creek
 - Anderson Creek
 - Maple Creek
- RAIN = Robinson, Anderson, Indian, Navarro

Drivers



- Local interest in continued quality land stewardship & sustainability
- State & Federal water quality regulations
 - Assembly Bill 2121
 - Water Code section 1259.4
 - NMFS – Chinook salmon Critical Habitat Designation (70 FR 52488)

Financial Support

UC
CE



The Nature
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Project Goals

- **Improve** the understanding of agricultural water needs and uses within the Navarro River Watershed
- **Evaluate** the efficiency of the irrigation practices used by growers in the Navarro River Watershed
- **Estimate** the amount of potential land area available for agricultural expansion in the Navarro watershed using land form features
 - Existing cleared land
 - Slopes <10% & <20%
- **Inform** long term resource planning

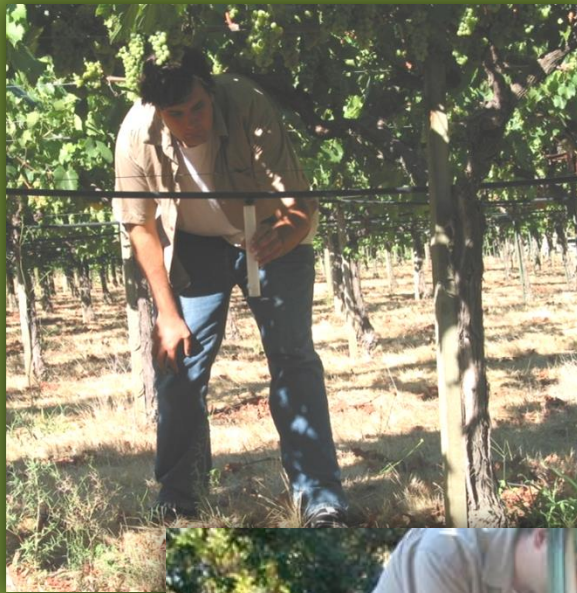
Methods | Data Compilation

- Public Data
 - USGS Navarro River gauge 11468000, located near Navarro, 1951-2011
 - SWRCB – Anderson Valley water rights database
 - Mendocino County Agricultural Department Crop Reports
- Private Data
 - Roederer *reference evapotranspiration* (ET_o)
 - Anderson Valley Winegrowers Association Acreage Data
- Spatial Data
 - USDA National Agricultural Imagery Program NAIP *Aerial Imagery*
 - USGS National Elevation Dataset (NED) – *topography*
 - CalWater 2.2.1 Watershed boundaries
 - Center for Environmental Management & Restoration (CEMAR) - *Vineyards & Ponds* (private)

Methods | Grower Surveys

- Adapted surveys from prior effort focused on the Russian River watershed (Lewis et al. 2008)
- Sent to a large segment of the Anderson Valley winegrape grower's community with support from the AVWA.
- Designed to document past and present on-farm water use patterns
- Inquired about grower awareness of and participation in existing conservation efforts and their motivations for participation

Methods | Field Measurements (System Uniformity)



Methods | Field Measurements (K_c)

- Water use and crop coefficients (K_c) are highly correlated
- Used Paso Panel technique (*Battany 2012*) to directly measure canopy shaded area on representative sites and trellis designs in the Anderson Valley



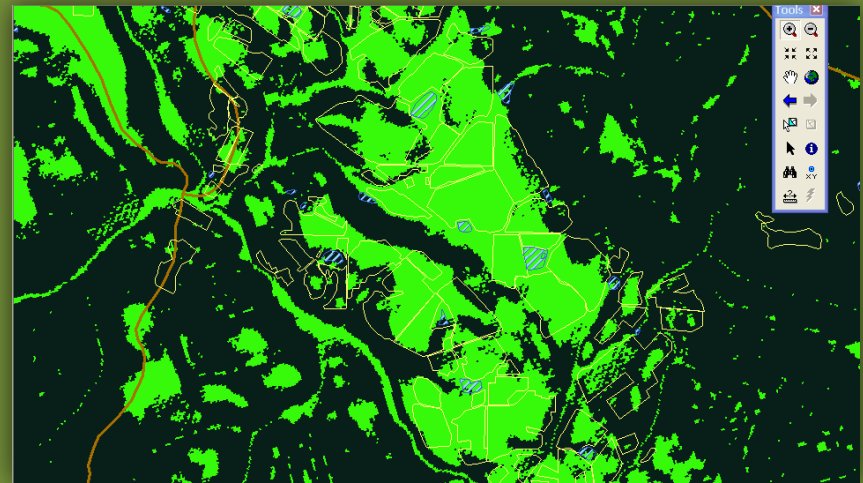
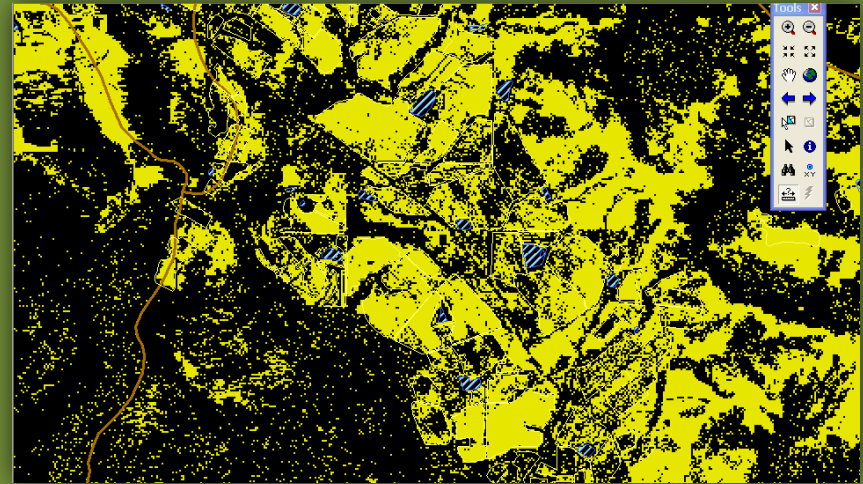
Methods | Existing vineyard acreage

- Digitized field boundaries in a GIS using NAIP 2009 aerial imagery
- NAIP = National Agricultural Imagery Program USDA
- 2 similar efforts:
 - UCCE (2009)
 - CEMAR (2012)



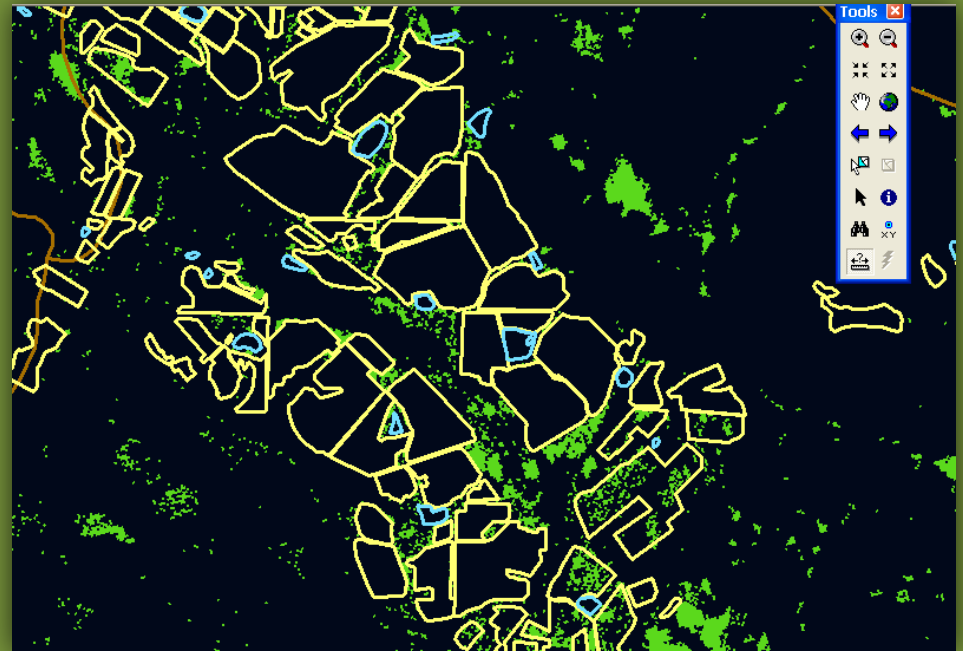
Methods | Potential Future Intensive Agricultural Land

- 2009 NAIP imagery used to derive a grid-based landcover classification
 - Forest
 - Open grassland
- National Elevation Data (NED) used to derive slope grids
 - Reclassified into $<10\%$ & $<20\%$ binary grids



Methods | Potential Future Intensive Agricultural Land

- CEMAR data used to exclude existing vineyard & reservoirs from analysis
- Constrained to viticulturally active portion of Anderson Valley



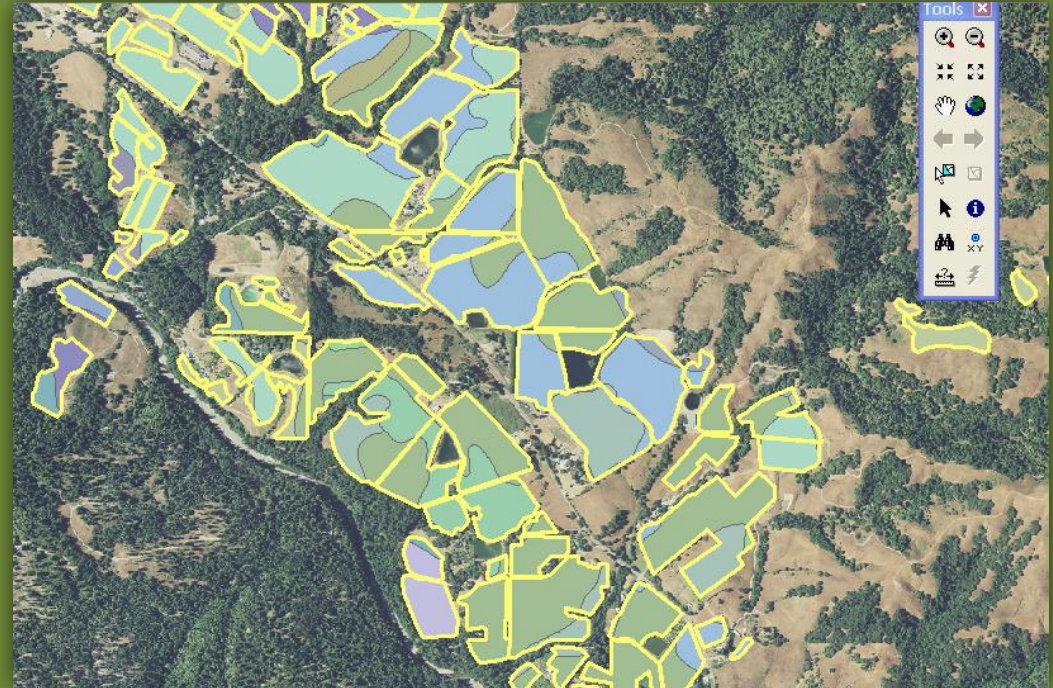
Methods | Existing Water Rights

- Focus on Surface Diversions & Ponds
- Summarized existing water rights for the Anderson Valley (SWRCB Data)



Methods | Irrigation Demand 1

Irrigation demand was calculated for the majority of soil series within vineyard boundaries

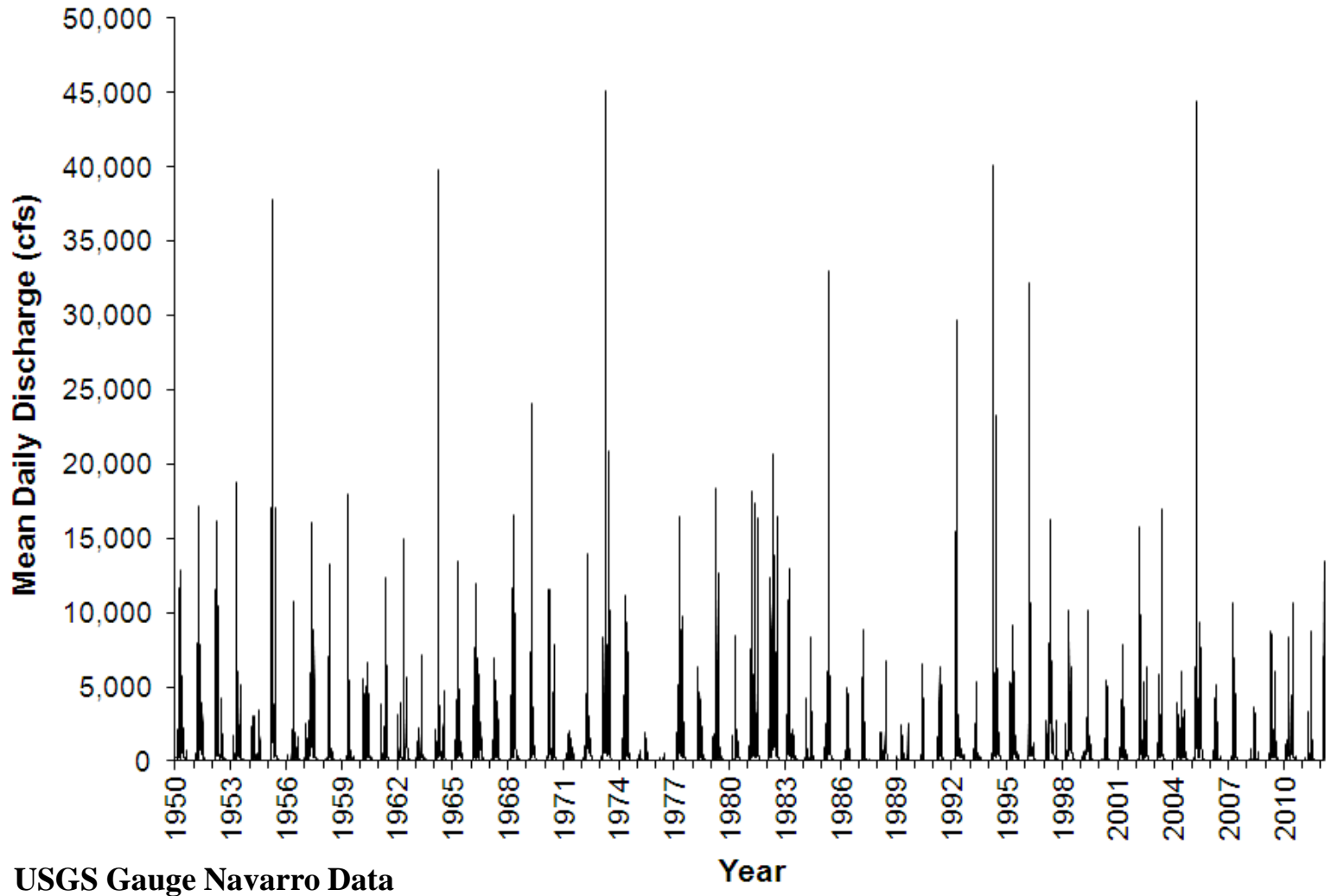


Methods | Irrigation Demand 2

- Calculating irrigation demand (ID) relies on the known relationships between evapo-transpiration (ETo), crop coefficients (Kc), and soil available water capacity (AWC)

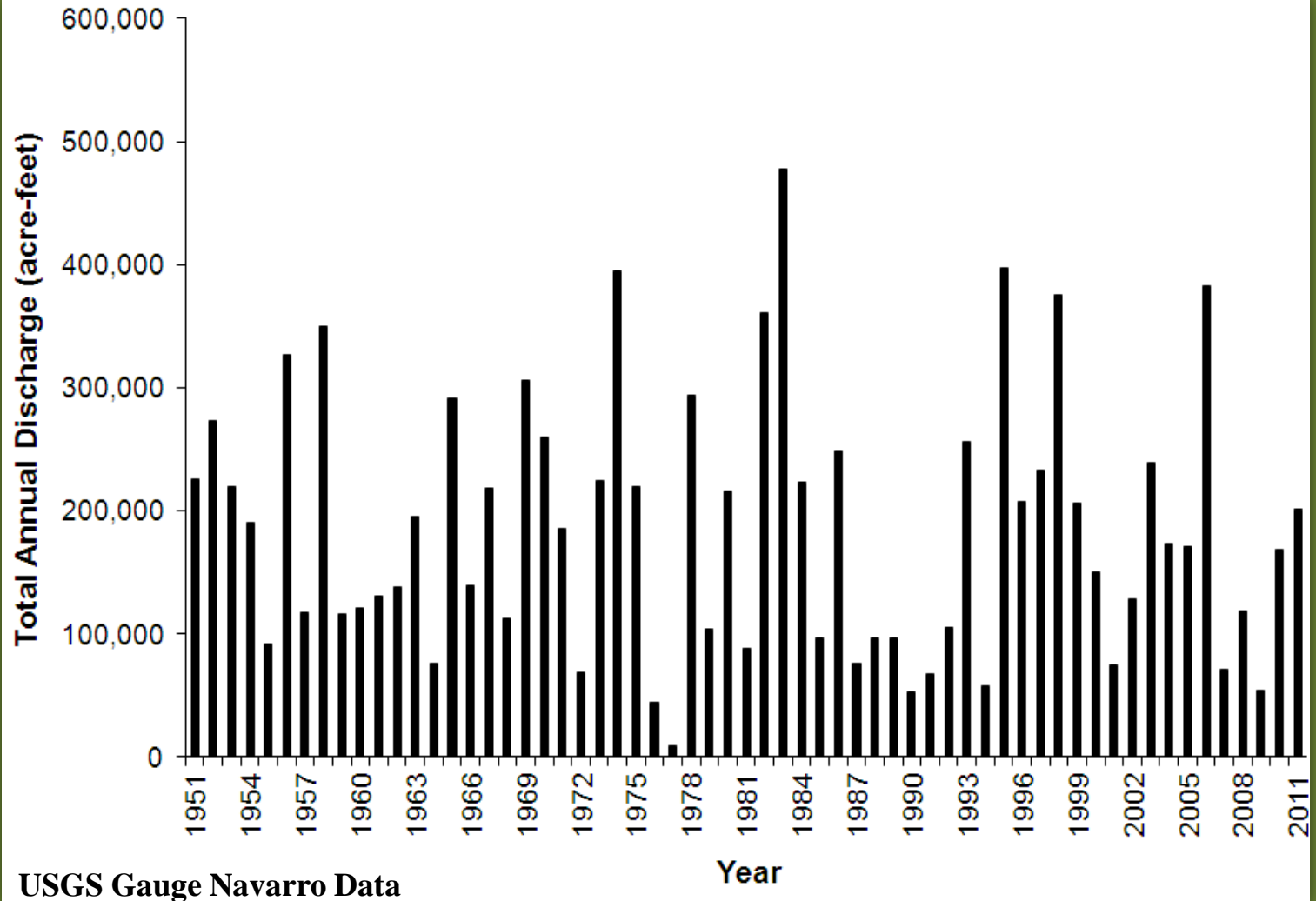
$$ETo * Kc - AWC = ID$$

Results | Hydrology

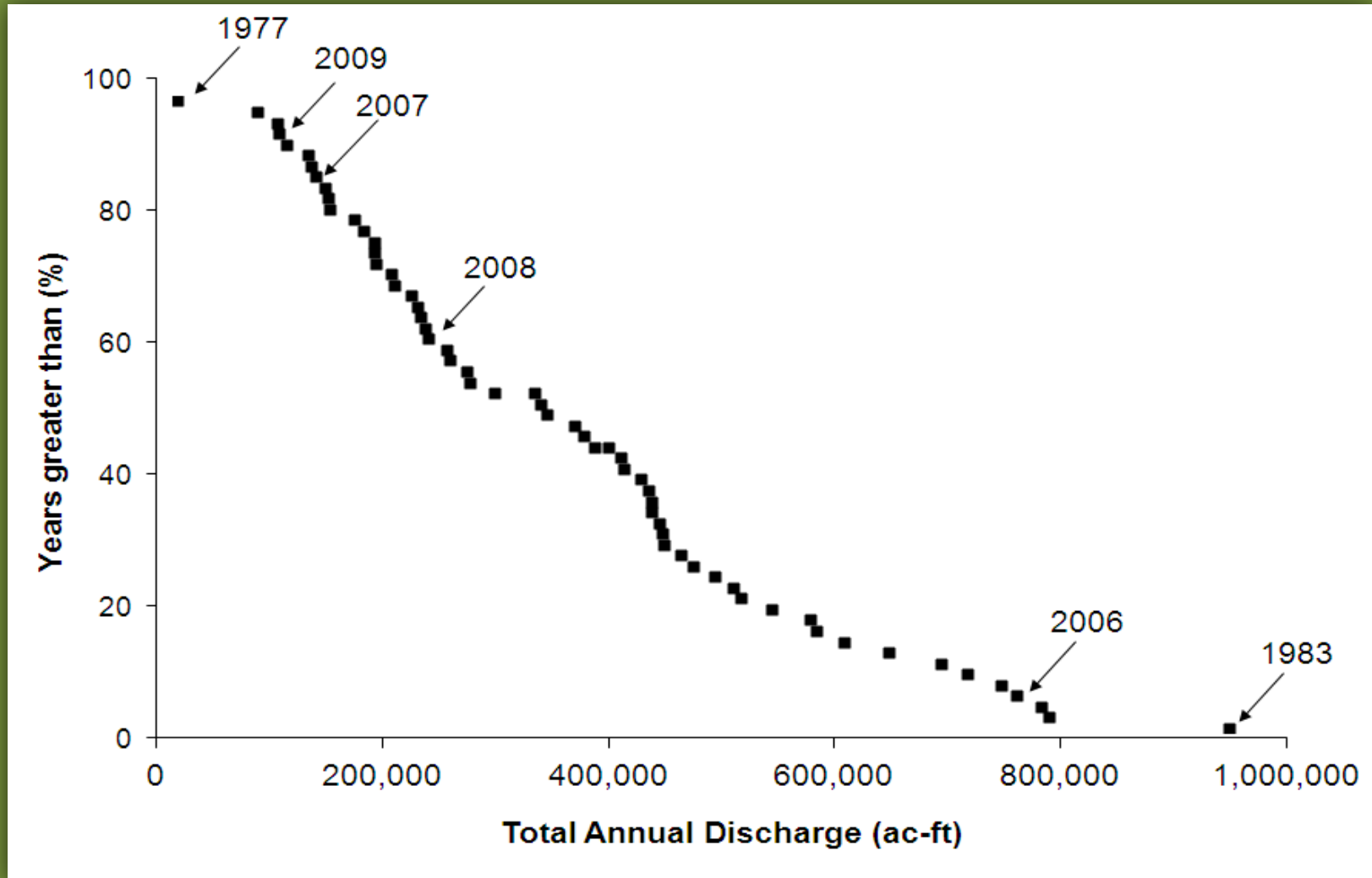


USGS Gauge Navarro Data

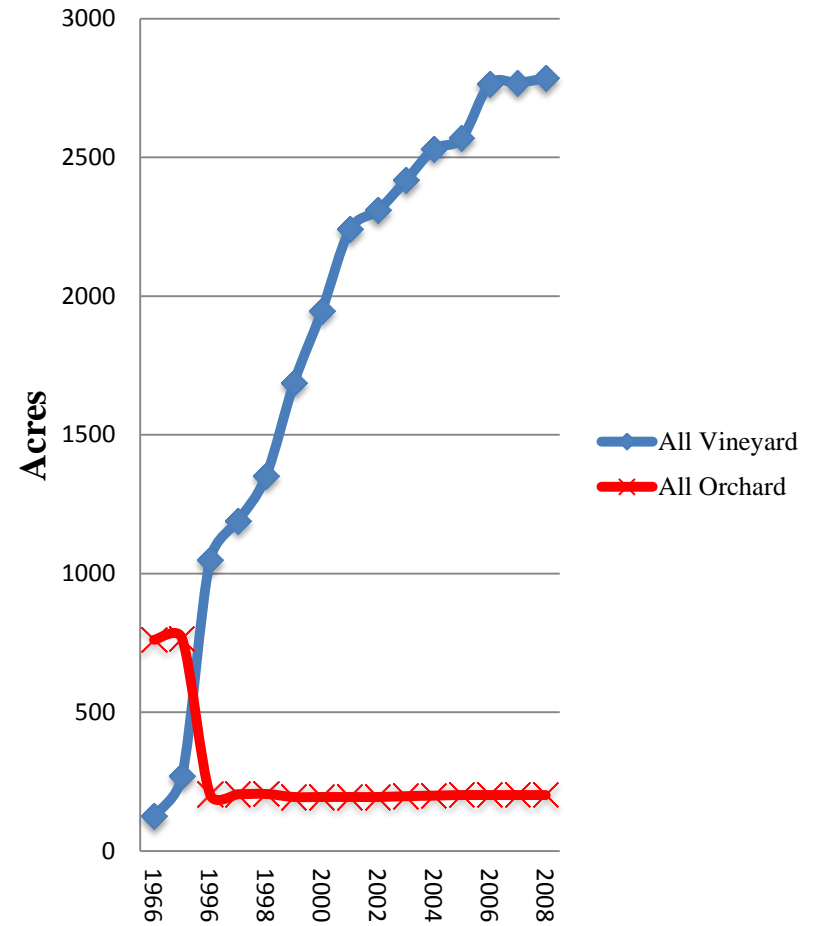
Results | Hydrology



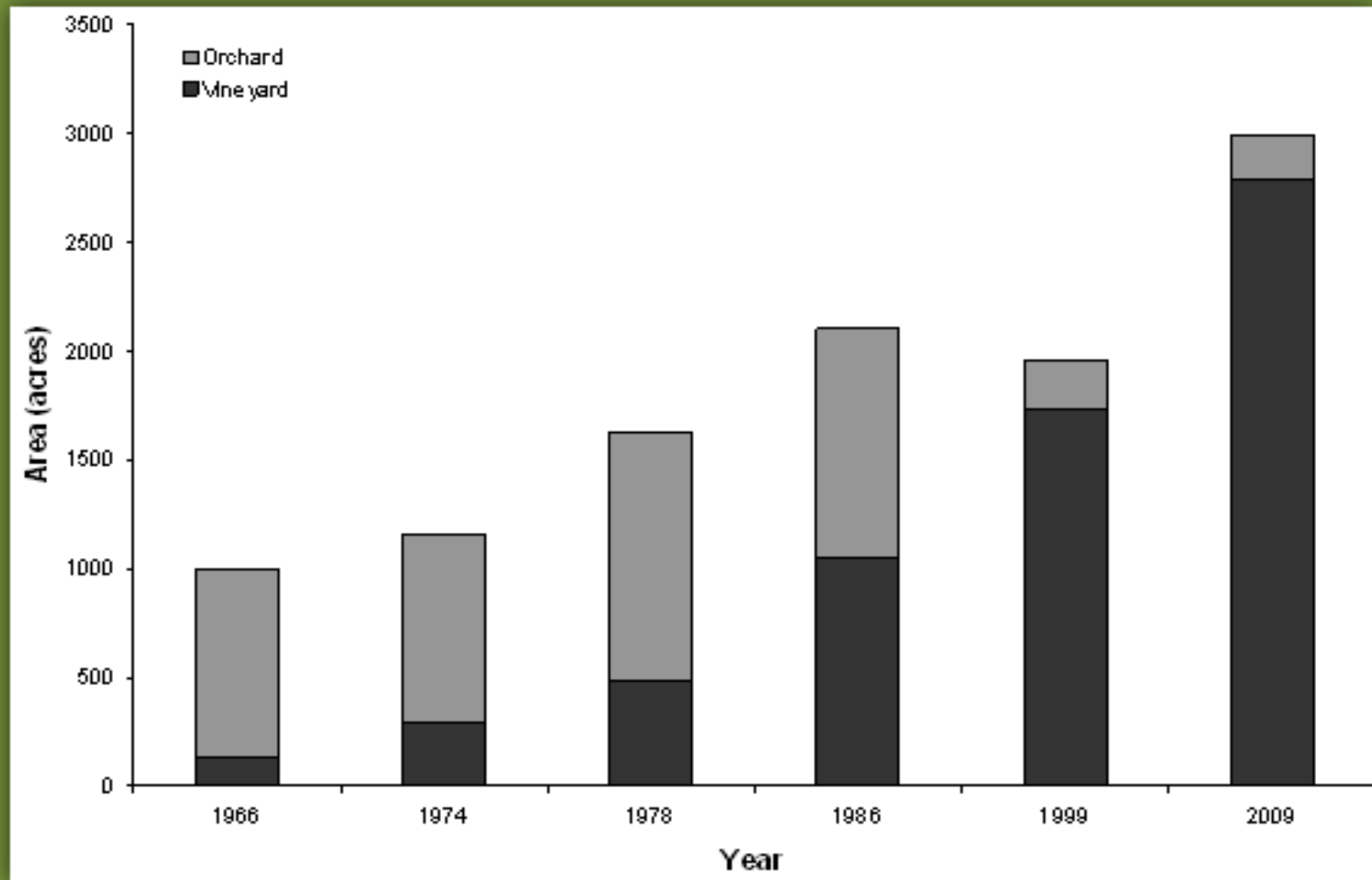
Results | Hydrology



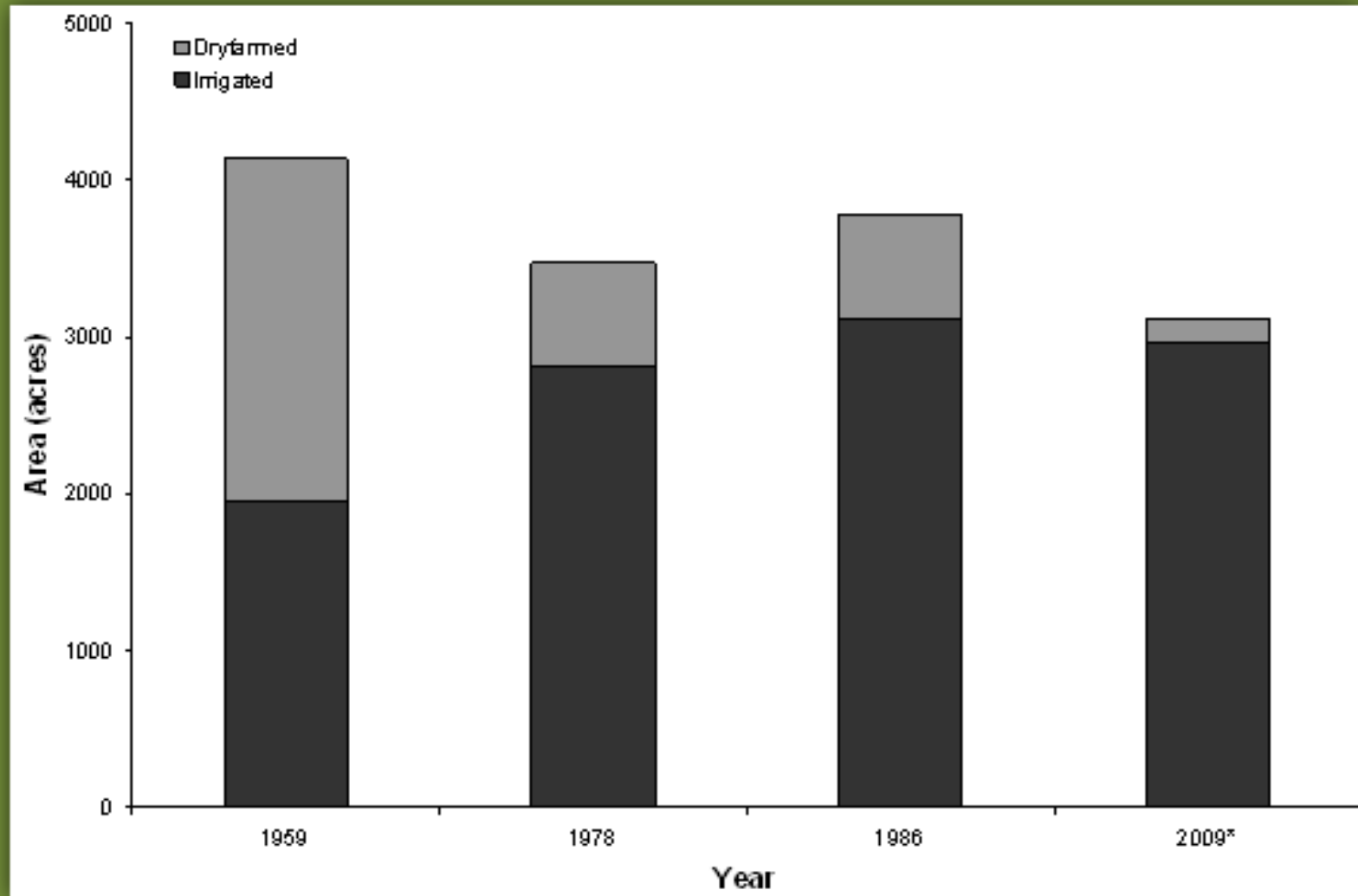
Results | Agricultural Change



Results | Farmed Acreage



Results | Irrigated Acreage

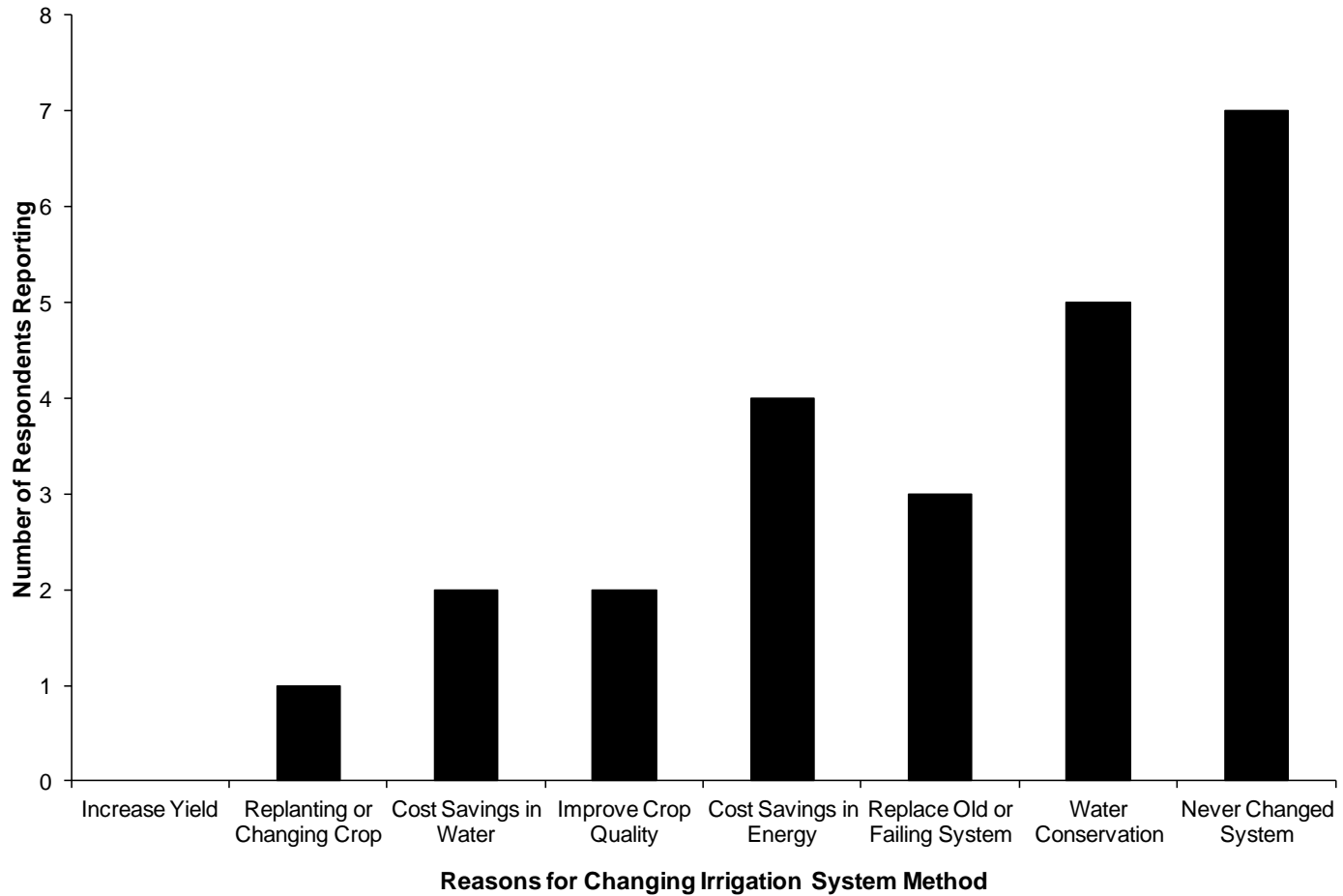


Results | Grower Surveys

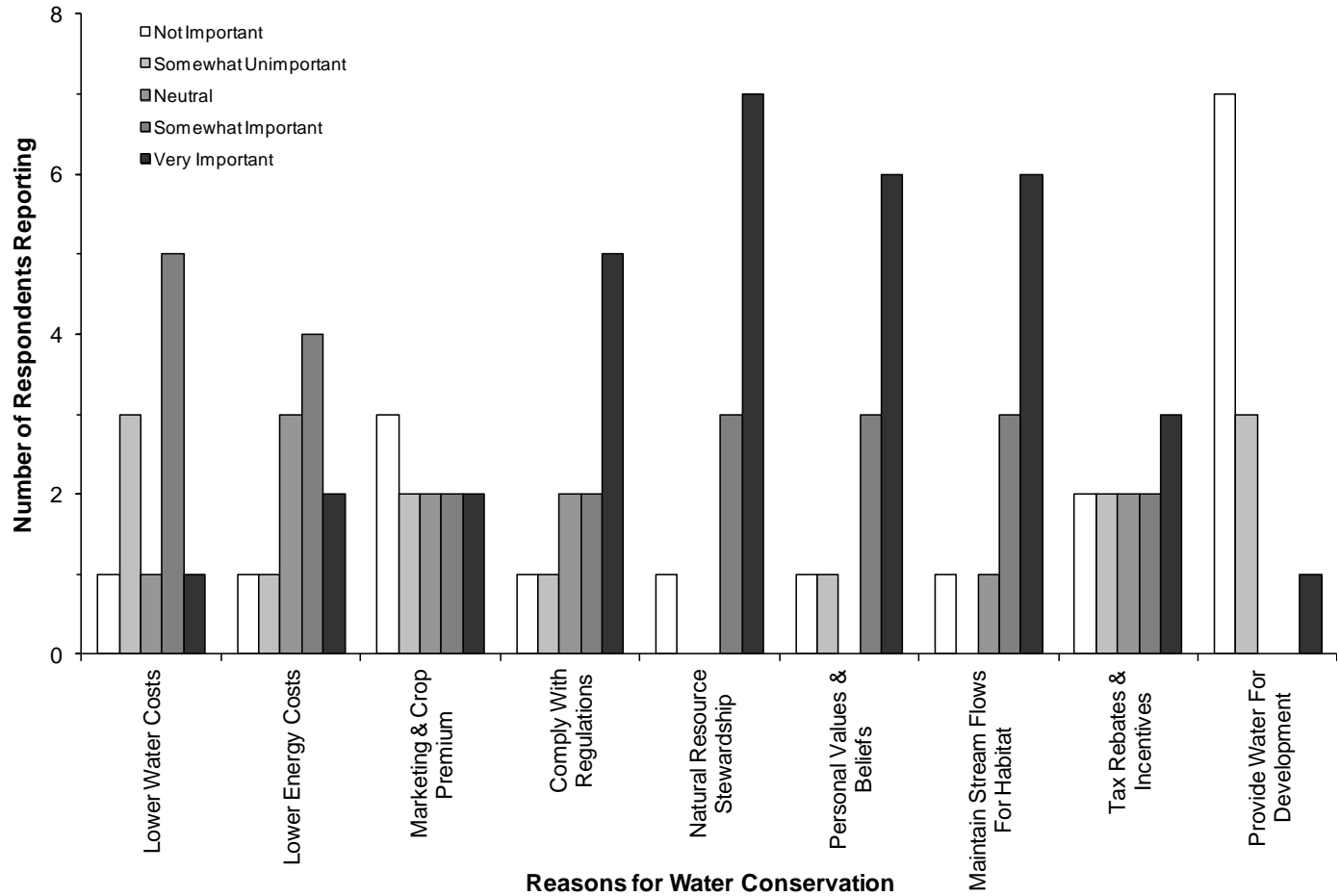
Surveyed Growers' Farmed Acreage as % of Total Acreage

	Vineyard	Orchard	Pasture	Other	Totals
Acreage Covered by Survey Respondents	1125 (40%)	191 (93%)	3 (5%)	22 (43%)	1341 (43%)
Total Acreage in Study Area	2790	206	66	50	3111

Results | Grower Surveys



Results | Grower Surveys



Results | Water Use Patterns

Irrigation system uniformity in grape vineyards and apple orchards during 2009 field surveys

Crop	Sample Size	Mean	Standard Deviation	Min	Max
Grapes	26	90%	6.6%	68.7%	96%
Orchards	3	72%	41.4%	41.4%	88%

Results | Water Use Patterns

Irrigated Acres by Water Source Among Surveyed Growers

Source	Vineyard	Orchard	Other	Pasture	Totals
Groundwater	22.5	0	20.5	0	43
Direct Diversion	102	96	1	3	202
Off-stream storage	1204	50	0	0	1254
Total Surveyed Acreage	1328.5	146	21.5	3	1499

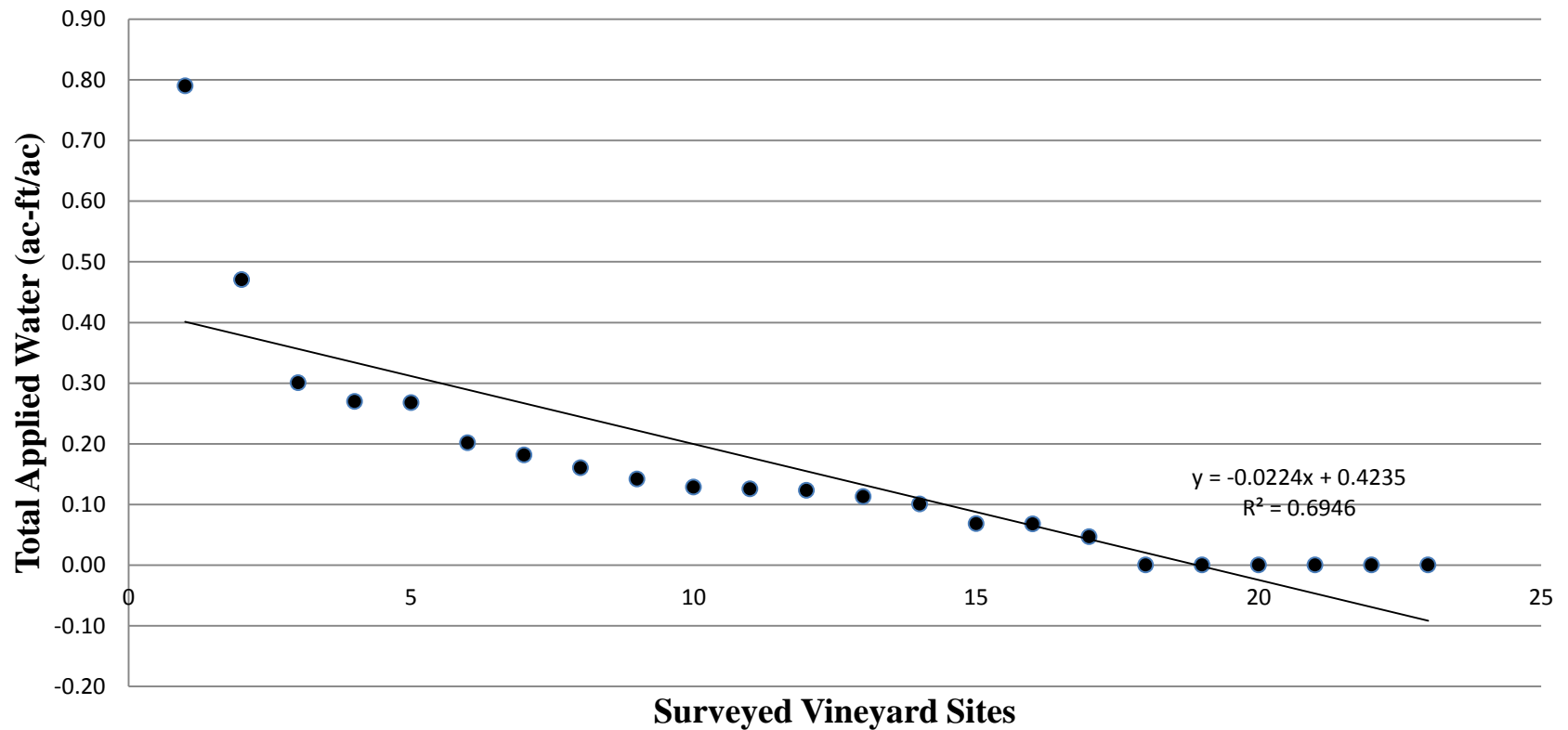
Results | Water Use Patterns

Frost Protection Methods and Practices Among Surveyed Growers

Methods	Vineyard	Orchard	Other	All Ag
No Protection	255	111	19.5	385.5
Overhead	947	80	2	1029
Fan	70	0	0	70
Microsprinkler	67	0	0	67
Total Surveyed Acreage	1339	191	21.5	1551.5

Results | Water Use Patterns

Applied Water during the 2009 growing season at 25 vineyards in the Anderson Valley, CA



Results | Water Rights

Count of Existing Water Rights in Anderson Valley	264
Existing Water Rights (<i>Face Value</i>)	9635 ac-ft/yr
Total Pond Surface Area	140 acres (<i>Avg pond size = 0.8 acres</i>)
Count of Ponds	165

Existing water rights in Anderson Valley are generous.
Not all agricultural ponds – some used for wildlife.

Results | Water Use Practices - Vineyards



- Irrigation
 - Average 11 events
 - Average 56 hours total per season
- Frost protection
 - Average 7 events
 - Average 38 hours total per season
- *Most irrigation happens between July 1*
 - *Oct 1*

Results | Water Use Practices - Orchards



- Irrigation
 - Average 8 events
 - Average 19 hours total per season

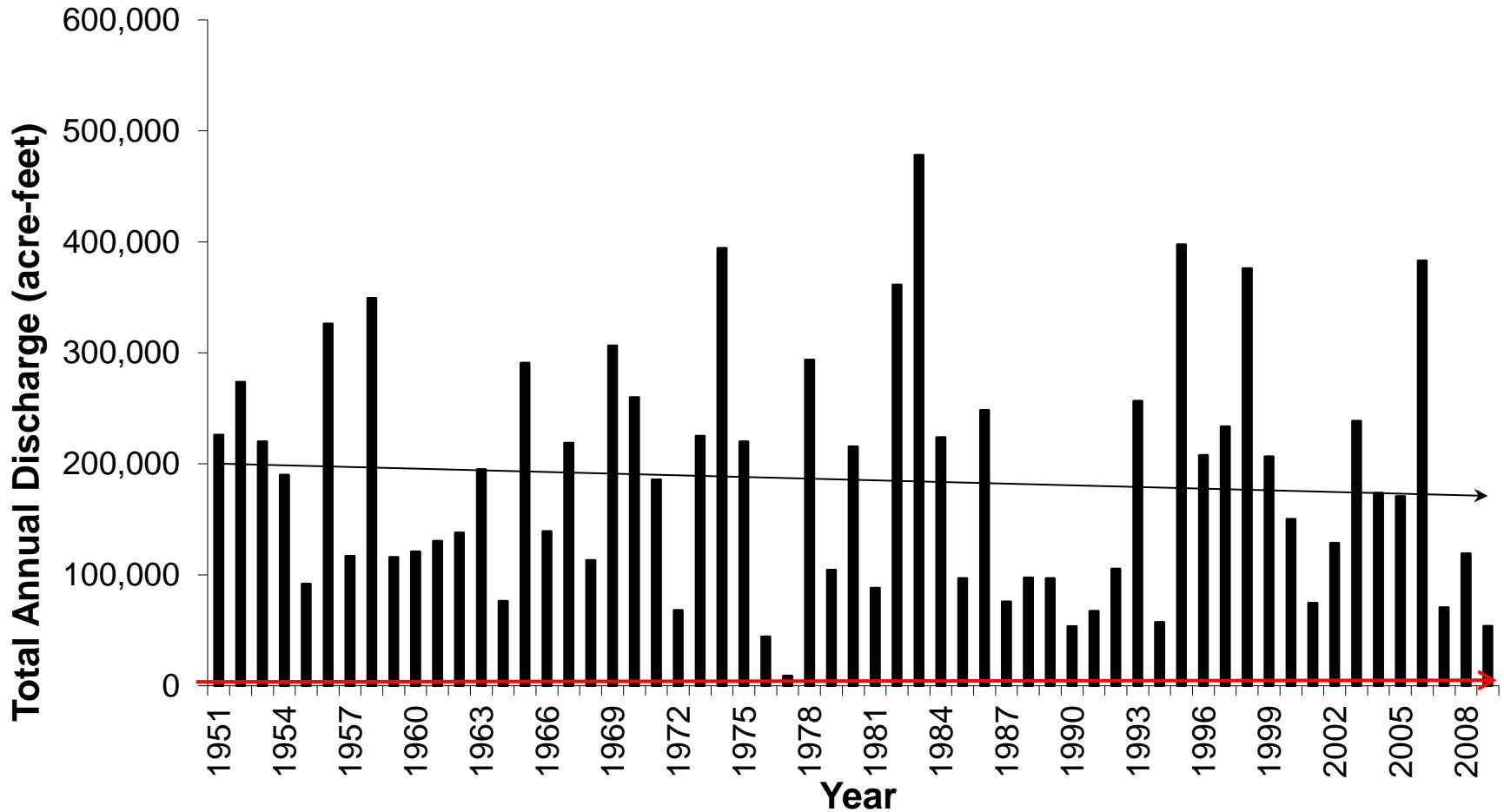


Results | Water Demand

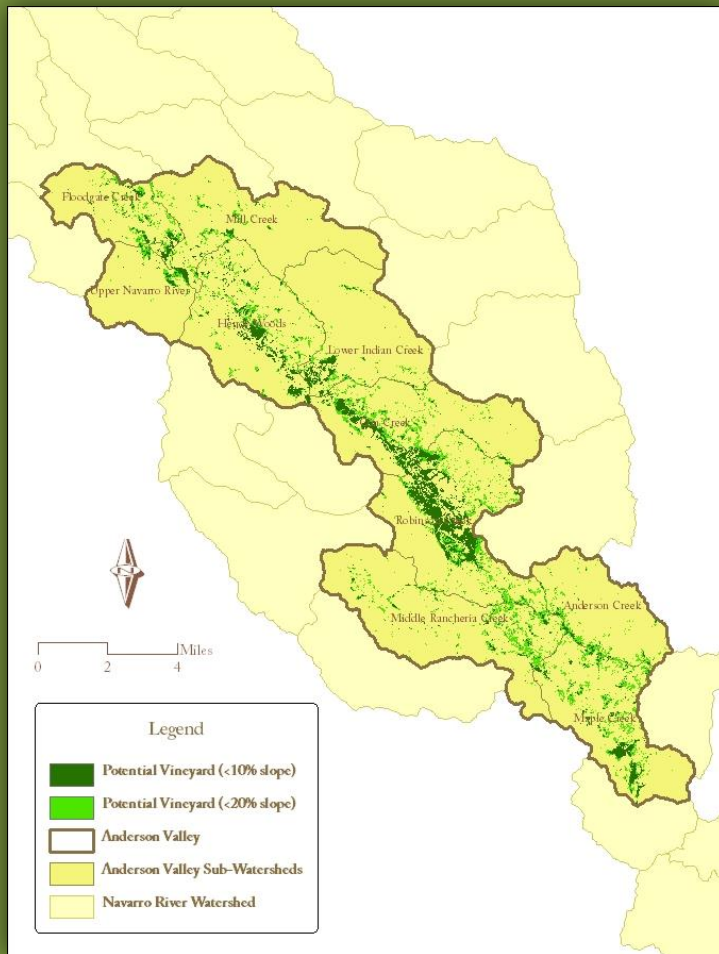
Source	Total Water Use
Estimated Method (Full-ET)	2272 -2905 (ac-ft/yr)
Vineyard Irrigation (Grower Survey*)	537 ac-ft/yr (average)
Vineyard Frost Protection (Grower Survey)	222 ac-ft/yr
Orchard (Grower Survey)	457 ac-ft/yr

*Most vineyards in the Anderson Valley are growing for quality using Regulated Deficit Irrigation (RDI) practices.

Results | Hydrology



Methods | Potential Future Intensive Agricultural Land



	Acres
AV Total Area	67000
Existing Vineyard	2900
Potential new at 10% slope threshold	3200
Potential new at 20% slope threshold	6700

Recommendations

1. Establish a program to provide growers with irrigation system evaluation service
2. Form productive partnerships among diverse stakeholders to provide input into State water policy
3. Investigate alternative water sources and solutions to relieve the pressure from summer surface water diversions
4. Assess domestic and commercial water use in the watershed

Thank You

