Assessment of Vineyard Water Use in the Navarro River Watershed

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Mendocino County Board of Supervisors

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Financial Support For This Study

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Why Conduct This Study?

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

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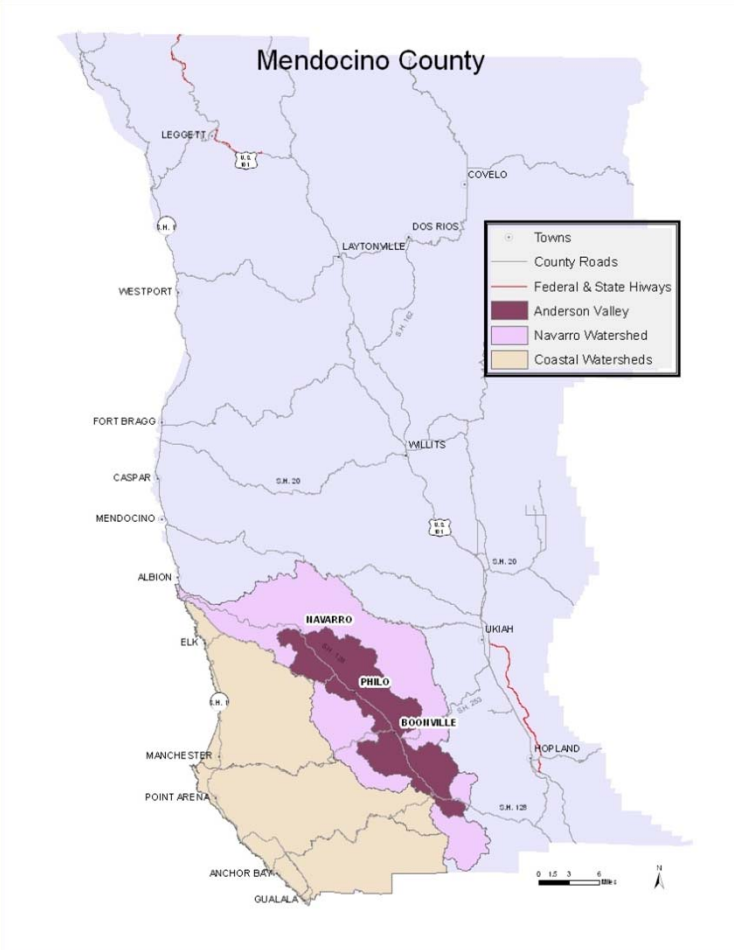
Navarro River Watershed, Mendocino County



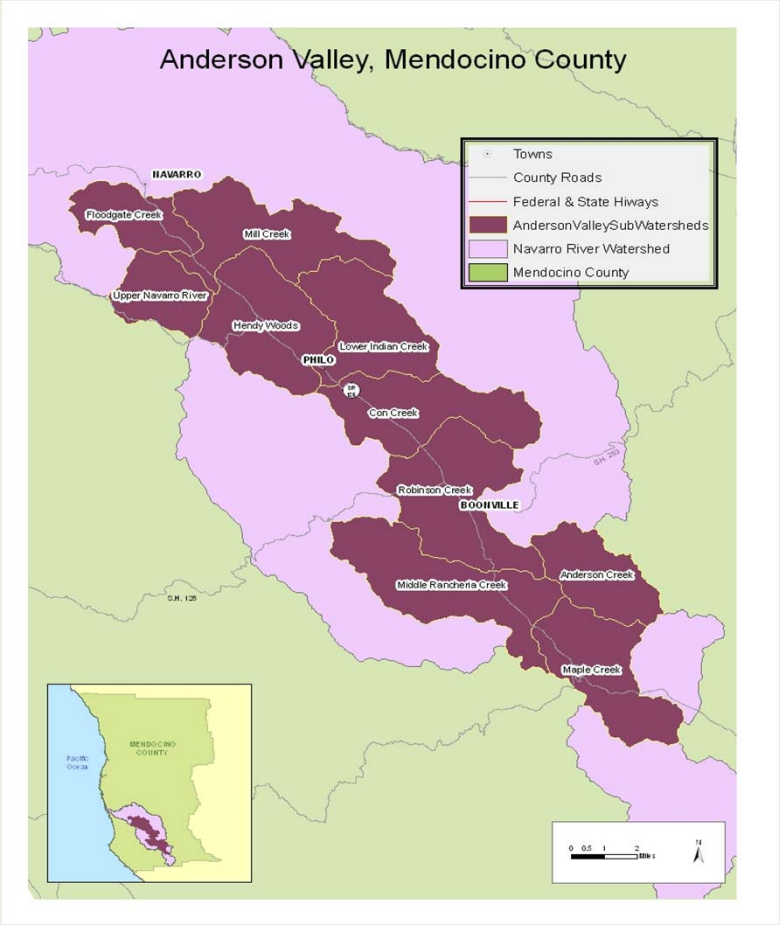
- Southern Mendocino County, California
- Drains Coast Range mountains to the Pacific Ocean
- Navarro River Watershed
  - 201,200 acres
  - Largest coastal watershed in Mendocino County

The Navarro Watershed is a Beautiful Place

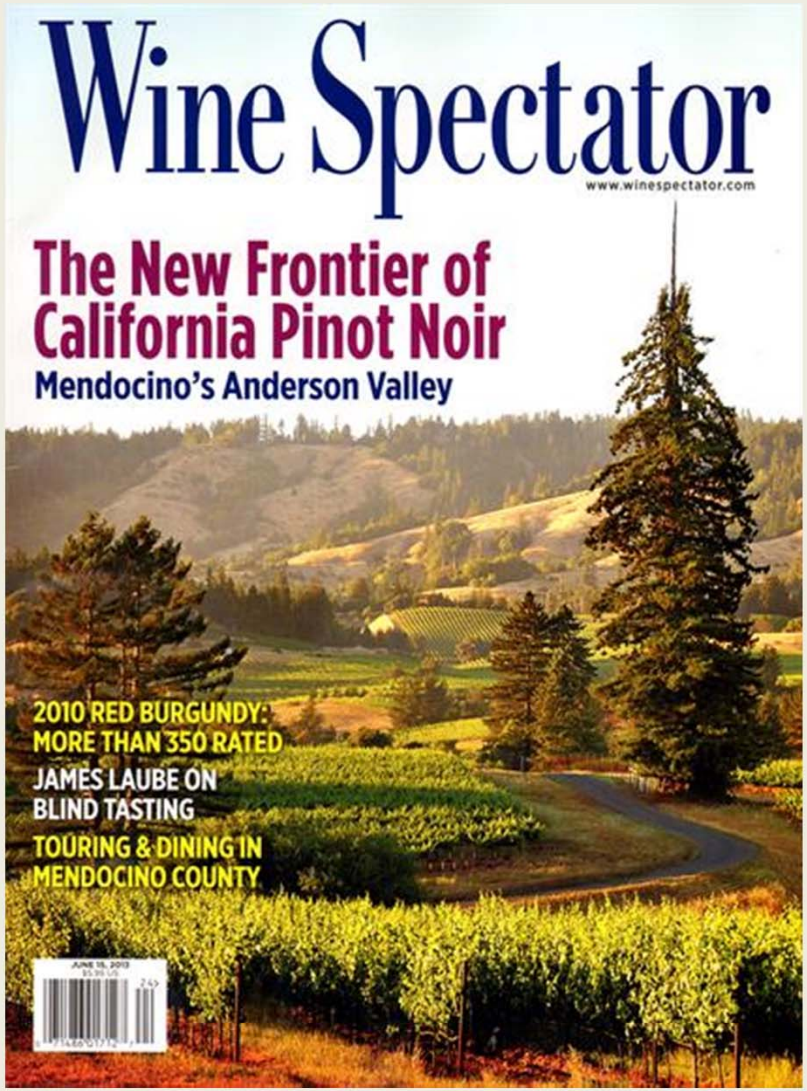





Anderson Valley, Mendocino County



- Subset of larger Navarro River watershed
  - 10 Planning Watersheds
- Agriculture
  - Historically timber & sheep, cattle grazing
  - Apples, wine grapes
- 67,840 acres (Total)
- ~3,100 acres of irrigated agriculture



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Project Goals For Study Area

- **Improve** the understanding of agricultural water needs and uses, especially volume and timing of irrigation applications
- **Understand** the basic hydrology of the watershed
- **Evaluate** the efficiency of the irrigation practices used by growers
- **Estimate** potential land area available for agricultural expansion using land form features
- **Inform** for long term resource planning

Tools Used in the Study

- GIS for determining vineyard area, pond location, soil types and water holding capacities
- Review of Historical and Proprietal Data:

  --Stream gauge flow data

  --Water rights for ponds and irrigation

  --Irrigated agriculture and crop acreage

  --ET data
- Grower Surveys, conducted 2009
- Irrigation Audits
- Canopy shade measurements to determine Kc

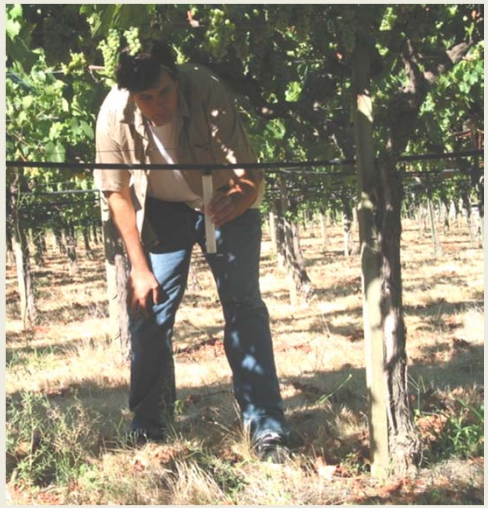
Methods | Data Compilation

- **Public Data**
  - USGS Navarro River gauge (near Hendy Woods State Park)
  - SWRCB – Anderson Valley water rights database
  - Mendocino County Agricultural Department Crop Reports
- **Private Data**
  - Roederer Adcon evapotranspiration data
  - Anderson Valley Winegrowers Association Acreage Inventory
- **Spatial Data (GIS)**
  - USDA National Agricultural Imagery Program NAIP *Aerial Imagery*
  - USGS National Elevation Dataset (NED) – *topography*
  - CalWater 2.2.1 Watershed boundaries
  - NRCS Soils Series

Methods | Grower Surveys

- Adapted surveys from prior effort focused on the Russian River
- Sent to a large segment of the Anderson Valley winegrape grower's community
- 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 Distribution Uniformity

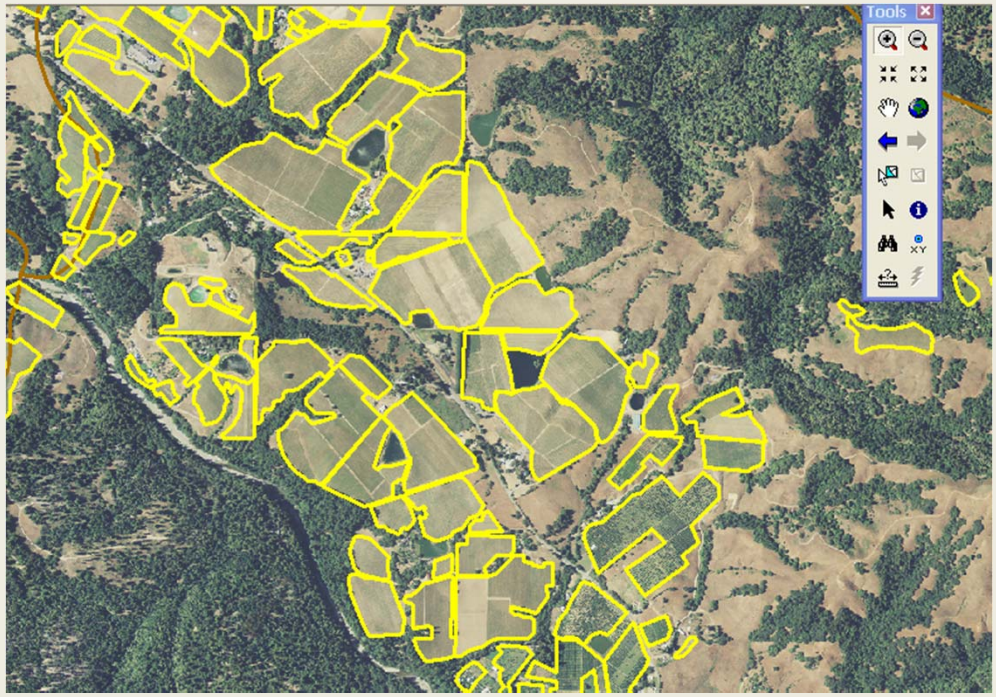


Methods | Field Measurements (Kc)

- Water use and crop co-efficients (Kc) 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
- N=6, 40 obs./site
- Kc calculated = 0.6

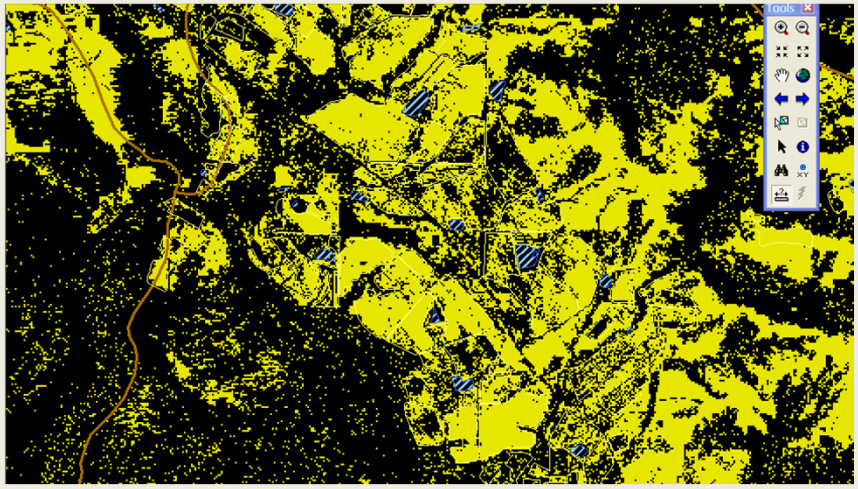
Methods | Existing vineyard acreage

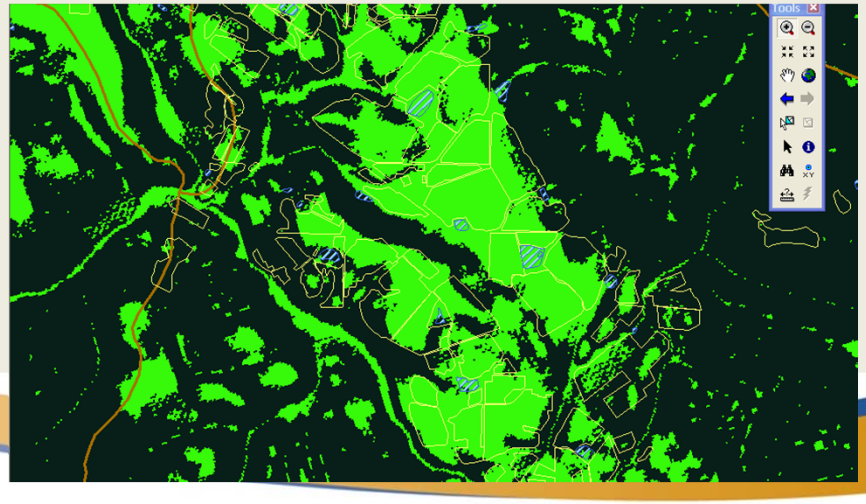
- Digitized field boundaries in a GIS using NAIP 2009 aerial imagery
- NAIP = National Agricultural Imagery Program USDA
- 0.5 acre minimum mapping unit



Methods | Potential Future Irrigated Agricultural Land

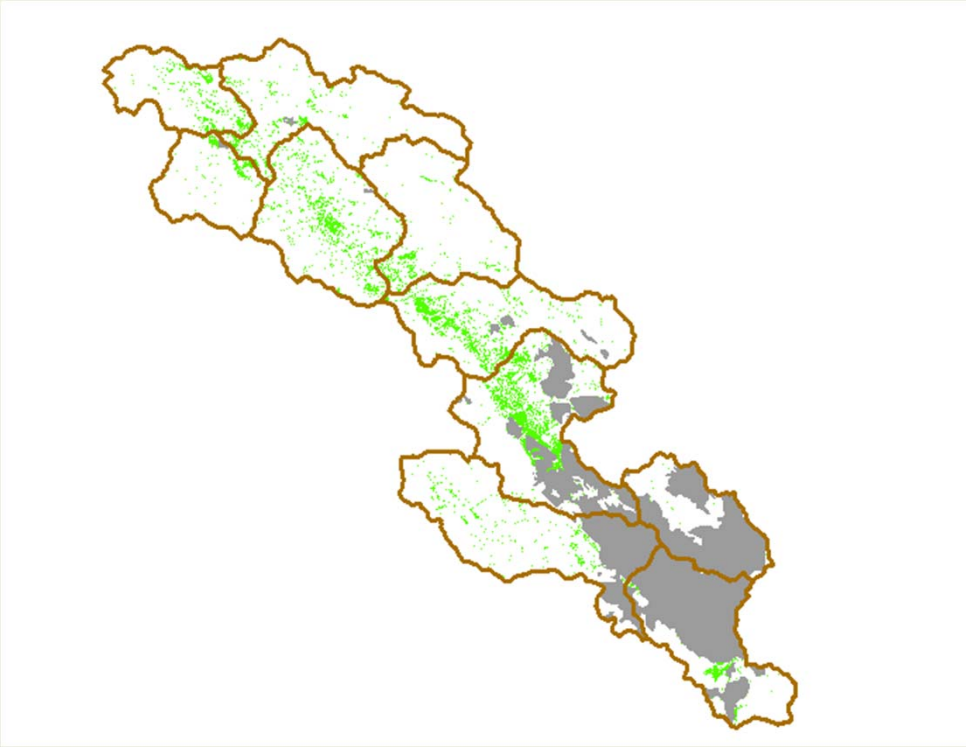
- 2009 NAIP imagery used to derive a grid-based landcover classification
  - Forest
  - Non-forest
- National Elevation Data (NED) used to derive slope surfaces
  - Reclassified into <10% & <20%





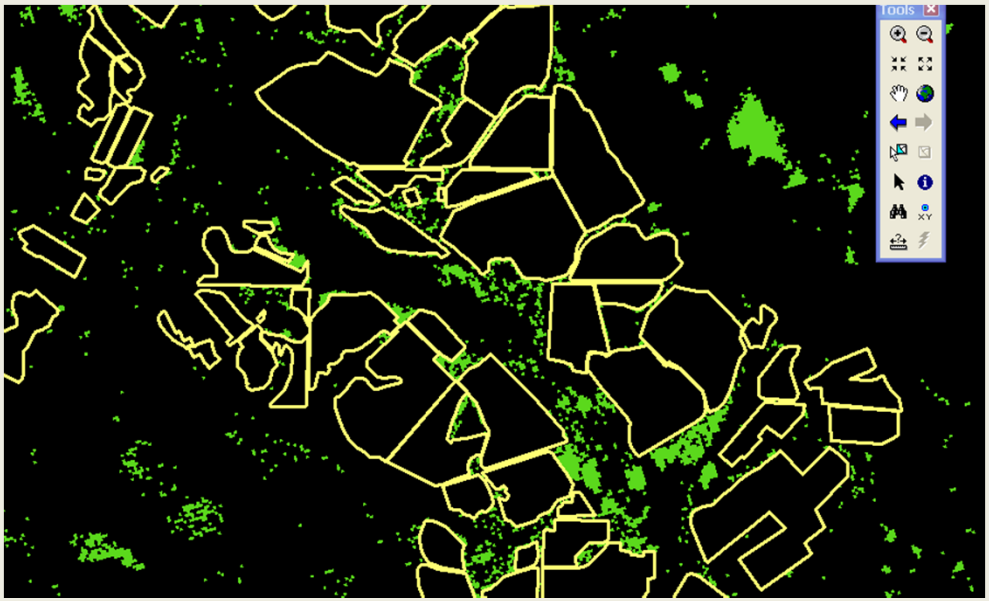
Methods | Potential Future Irrigated Agricultural Land

- Magnesium affected soils of the Yorkville-Squaw Rock-Witherall Complex were excluded from final analysis
- Primarily at eastern headwaters of Navarro River



Methods | Potential Future Intensive Agricultural Land

- Exclude existing vineyard & reservoirs from analysis
- Constrained to viticulturally active portion of Anderson Valley

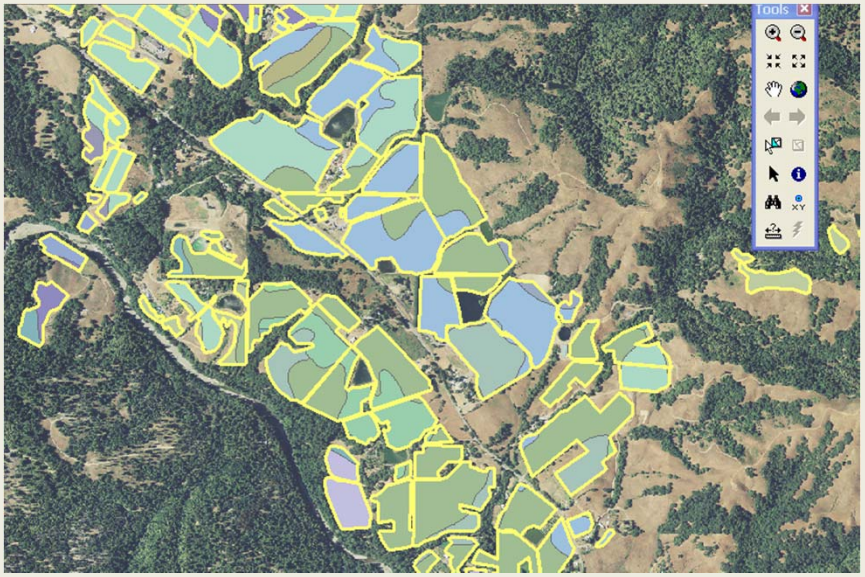


Methods | Existing Water Rights

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

Methods | Irrigation Demand

- Irrigation demand was calculated for the majority of soil series within vineyards



Where:

ID = irrigation demand

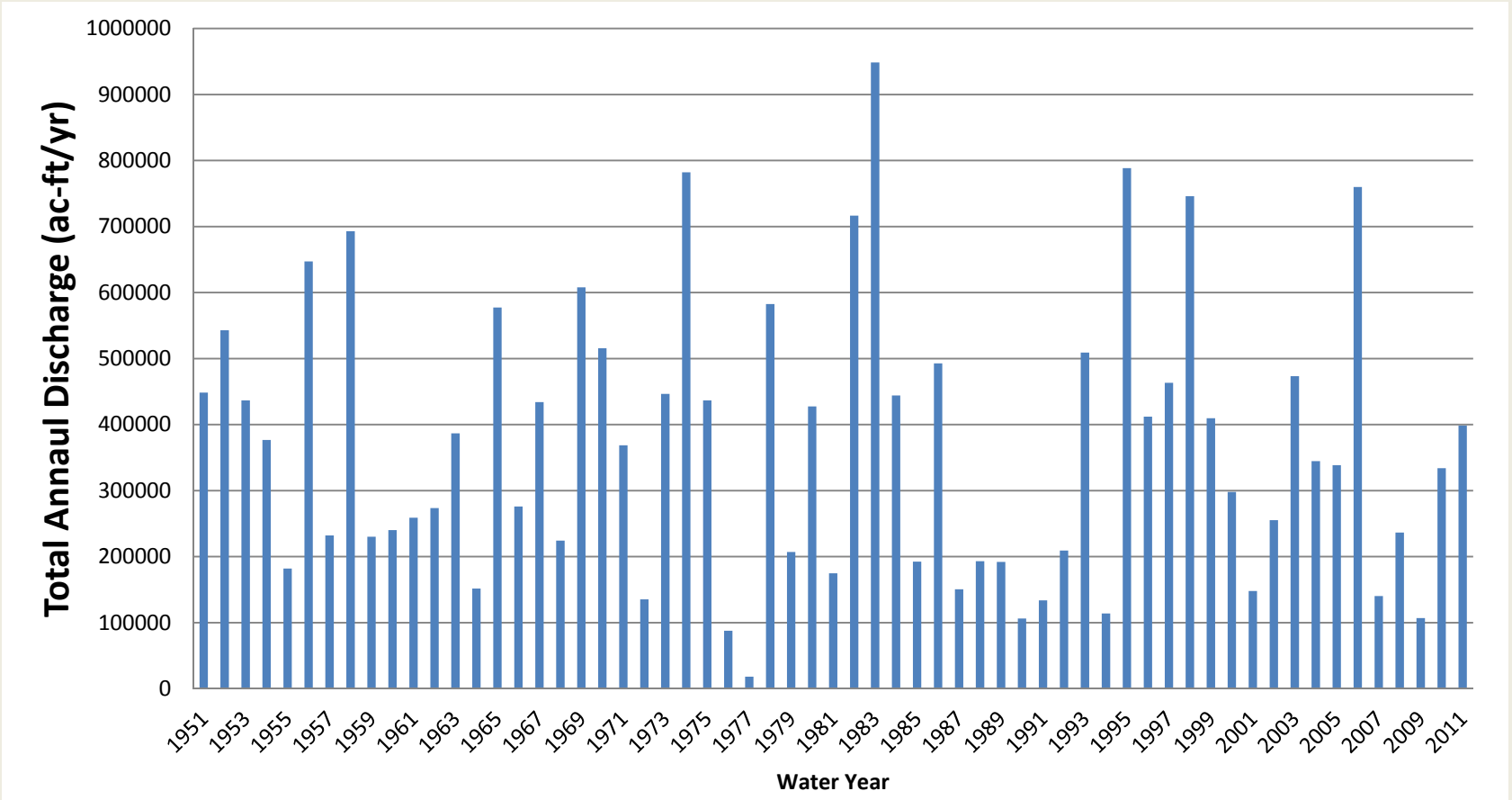
ET= evapotranspiration

Kc = crop coefficient

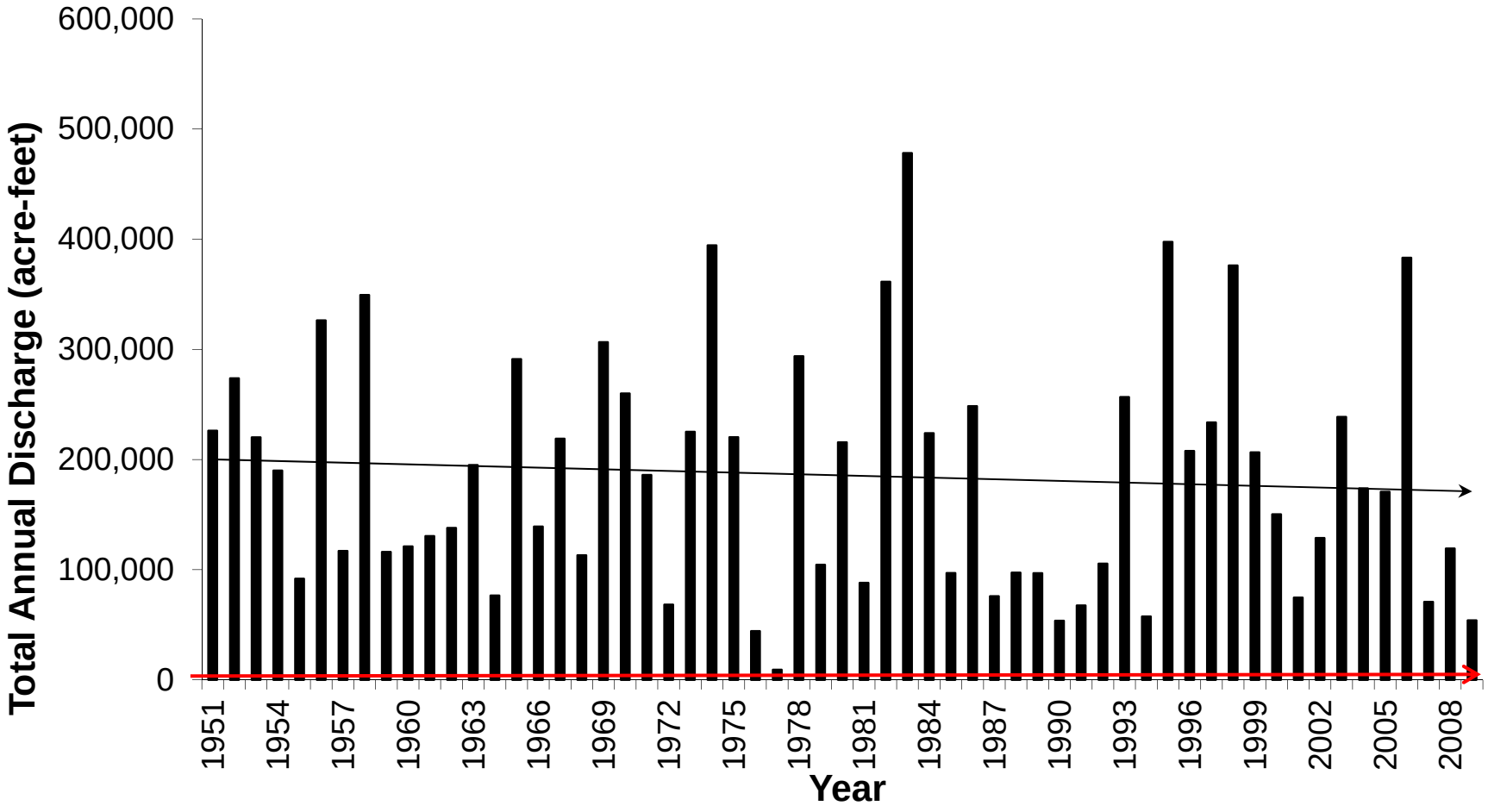
AWC= soil available water capacity

ID =ET *Kc-AWC

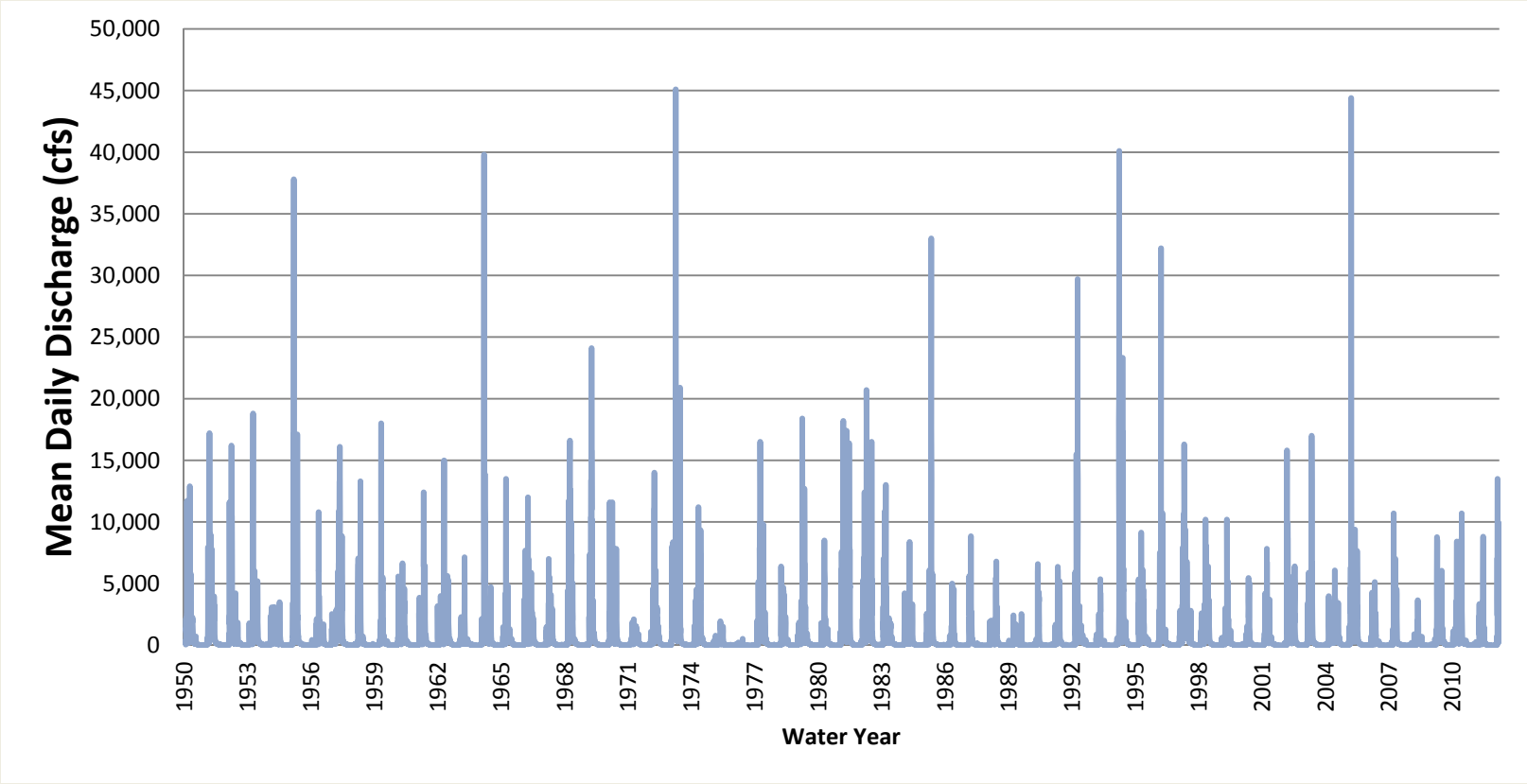
Navarro River Total Annual Discharge 1951-2012



Results | Hydrology

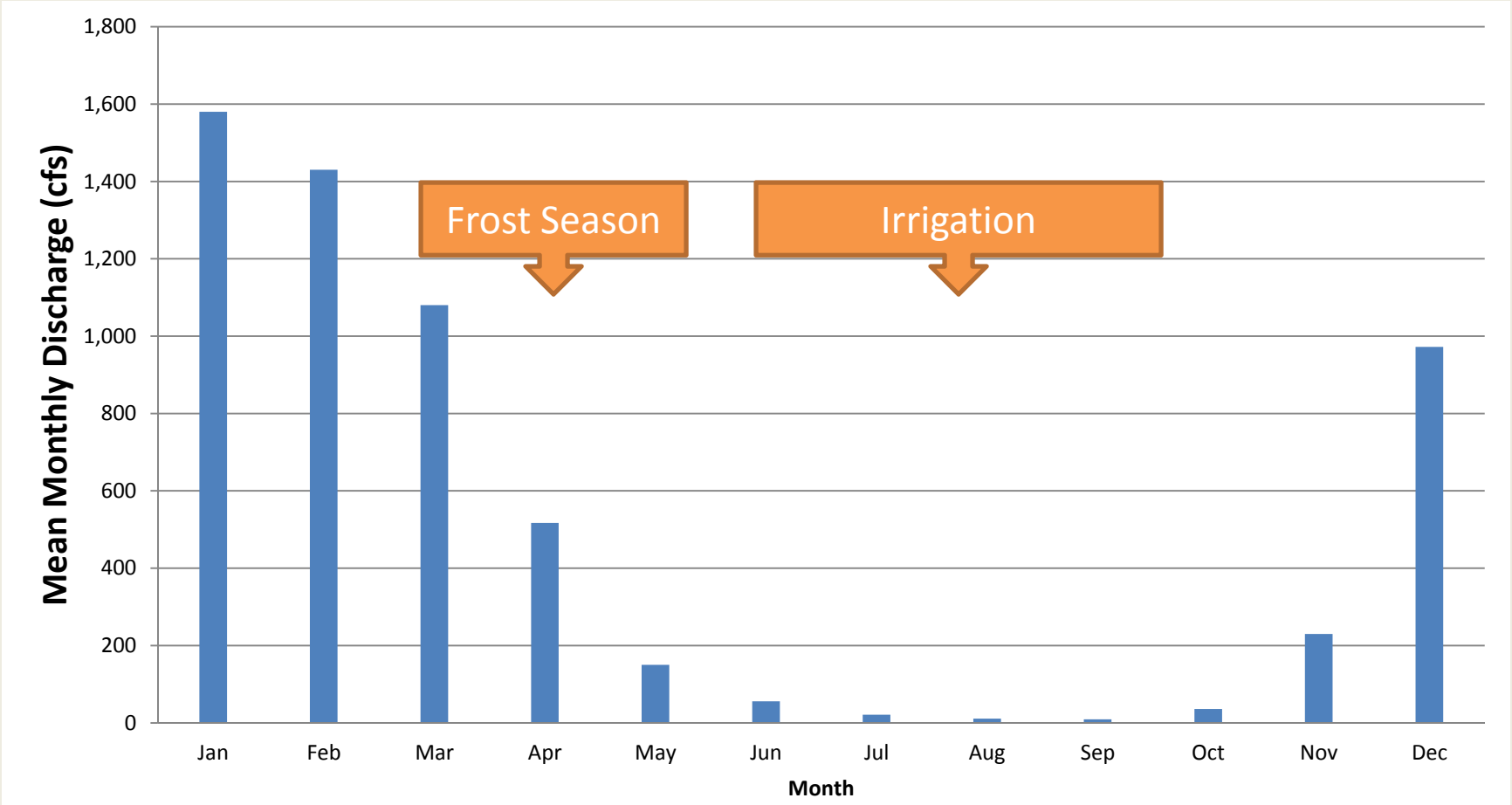


Navarro River Mean Daily Discharge, 1951-2012

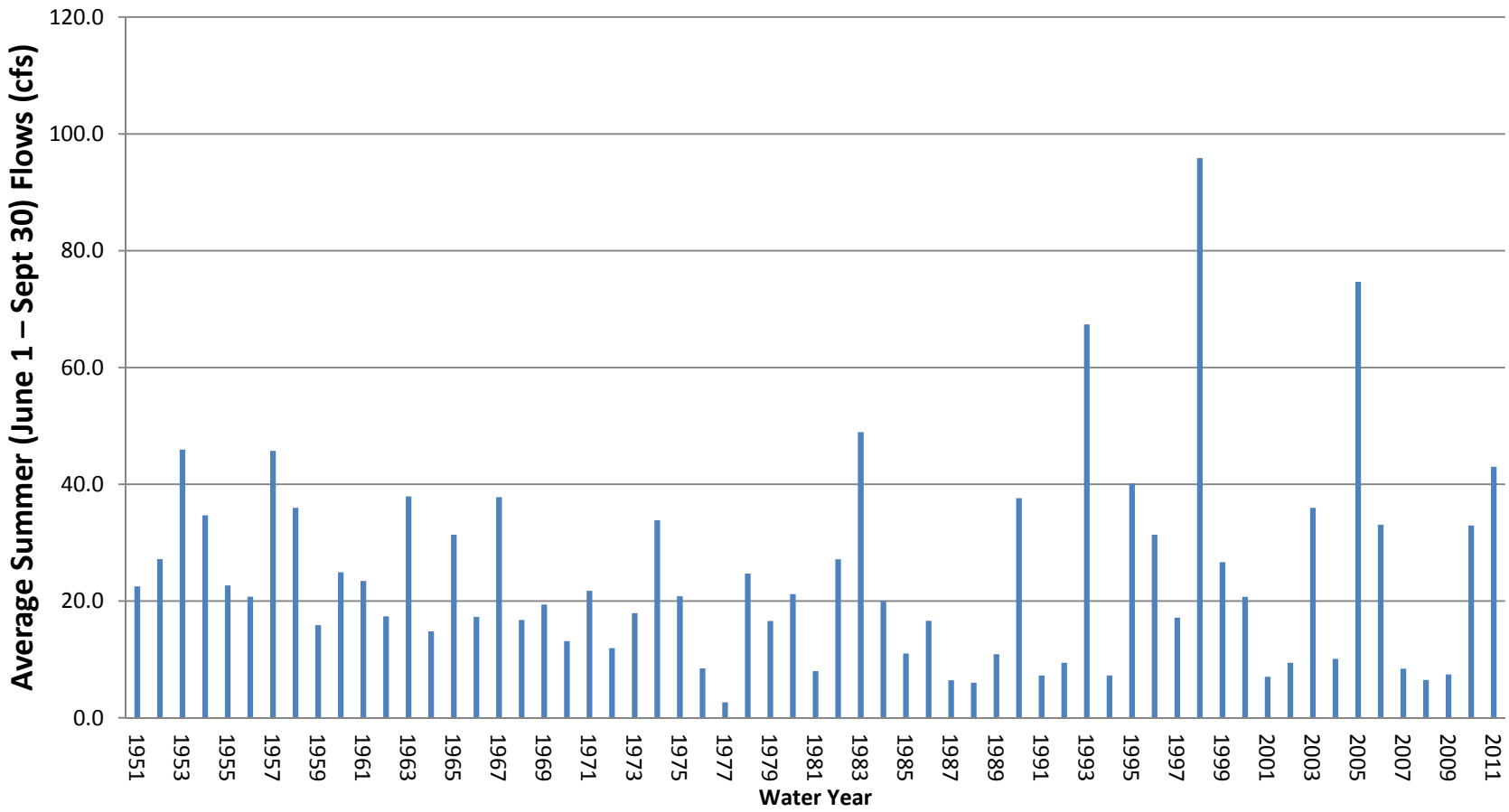


I cubic foot/sec (cfs) = 449 gallons per minute=
2 acre feet per day

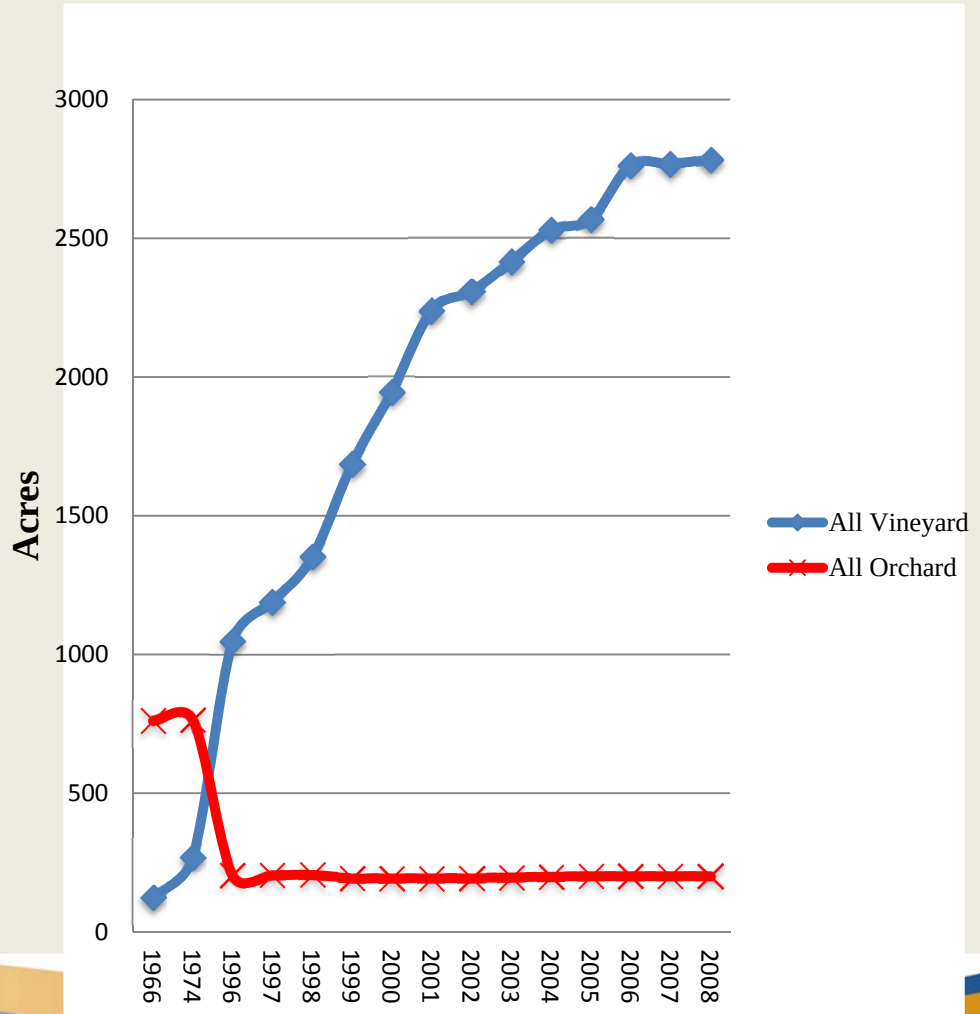
Results: Average Flows, Navarro River, 1951-2012



Navarro River Average Summer Flows, 1951-2012



Agricultural Land Use Changes



Results | Grower Surveys

Surveyed Growers' Farmed Acreage as % of Total Acreage

	Vineyard	Orchard	Pasture	Other	Totals
Acreage Farmed by Survey Respondents	1333 (48%)	218 (100%)	3 (5%)	22 (44%)	1576 (50%)
Total Irrigated Agricultural Acreage in Study Area	2790	218	66	50	3124

N= 16

Range: 2 acres to 612 acres

Average Evapo-transpiration (ET) in Philo, Anderson Valley 2009-2012.

Year	2009	2010	2011	2012
Anderson Valley (ET inches)	32.1	31.1	31.2	32.3

Source: Roederer Estate US Adcon Data

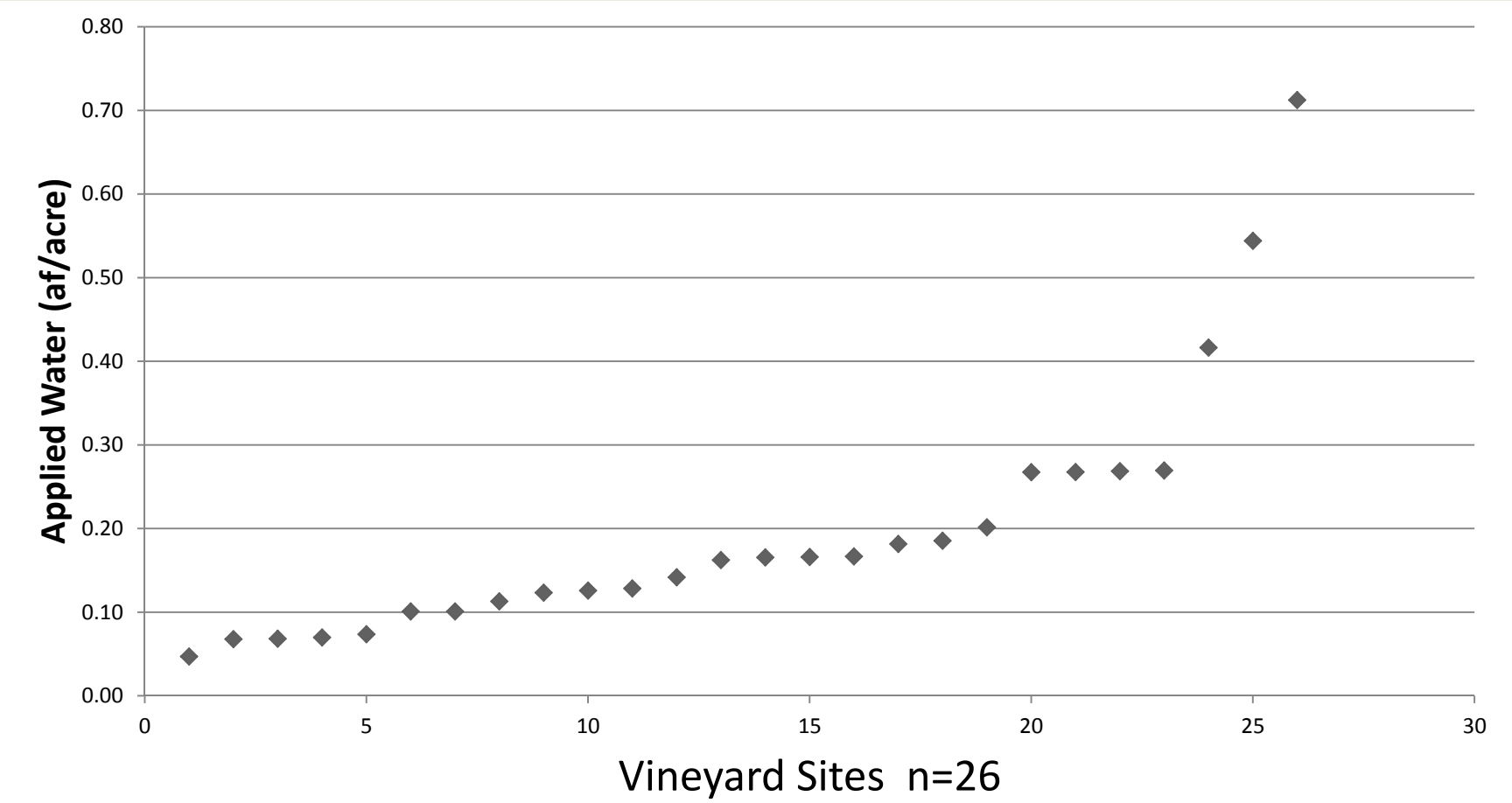
Available Water capacity for dominant soil types in irrigated agricultural lands of the Navarro River Watershed, Mendocino County, California.

Sum of MU (acres)	% of Total (n=3126)	Map Unit (MU) Name	Available Water Capacity	
			low (ac-in/in)	high (ac-in/in)
647.1	20.7%	Pinole loam, 2-9% slopes	0.14	0.19
378.5	12.1%	Boontling loam, 2-9% slopes	0.12	0.19
377.8	12.1%	Bearwallow-Wolfey complex, 5-15% slopes	0.13	0.18
190.4	6.1%	Feliz loam, 0-5% slopes	0.15	0.19
135.6	4.3%	Cole loam, 0-5% slopes	0.12	0.18
127.4	4.1%	Ornbaun-Zeni complex, 9-30% slopes	0.14	0.18
92.6	3.0%	Perrygulch loam, 0-9% slopes	0.08	0.18
90.3	2.9%	Pinole loam, 9-15% slopes	0.14	0.19
2039.6	65.2%	Averages	0.13	0.19

Results | 2009 Reported Water Use Practices - Vineyards

- Irrigation
  - Average **60 hours** total per season
  - 12 applications x 5 hours/application
- Frost protection
  - Average **40 hours** total per season
  - 5 events x 8 hours/event
- *Most irrigation happens between July 1 – Oct 1*

Results | Reported Water Use Patterns



Reported Water Use Patterns, 2009

Crop Type	Total Acreage	Water Use Type	Volume (af/acre)
Grapes	2790	Consumptive Use	558
		Frost Protection	678
		Total	1236
Orchards	206	Consumptive Use	457
		Frost Protection	0
		Total	457
Pasture	66	Total	132
		Cumulative Water Use	1825

*Results shown represent calculated values based on grower surveys for the 2009 growing season.

Results: Vineyard Water Demand in 2009

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 | Reported Water Use Patterns

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

Crop	Sample Size	Mean	Std Dev	Min	Max
Grapes	26	90%	6.60%	68.70%	96%
Orchards	3	72%	41.40%	41.40%	88%

Results | Water Rights in the Navarro River Watershed

Count of Existing Total Water Rights	264
Existing Water Rights Face Value	9,635 af/yr
Licensed, permitted or pending Irrigation Water Rights (agriculture)	88
Irrigation Water Rights Combined Face Value	3,646 af/yr

Results | Off-stream Storage

Total Pond Surface Area	140 acres (avg 0.8 acres)
Count of Ponds	165

Not all irrigation ponds – some used for aesthetics, wildlife & livestock.

Results | Irrigation Water Sources For Agricultural Ponds

Reservoir Water Source	Storage Volume (af)
Surface Water Diversion	134
Sub-surface Drainage	274
Captured rainfall & sheet flow	411
Totals	819

Results | Potential Agricultural Expansion

Total Existing Vineyard Acres	Total Potential New Acres (<10% slope threshold)	Total Potential New Acres (<20% slope threshold)
2531	2652	4649

Results | Potential Future Agricultural Water Demand

		<10% slope threshold		<20% slope threshold	
Crop	Current Water Use Rates (afa)	New Acres	Water Needed (af/yr)	New Acres	Water Needed (af/yr)
Vineyard	0.5	2,652	1,326	4,649	2,325
Orchard	2.2	2,652	5,834	4,649	10,228

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

A Quick Macroeconomic Sketch:

- One ton Pinot noir FOB vineyard: $2500
- One ton produces 160 gallons of wine, 64 cases=$180/case wholesale or $11,520 per ton; fex excise tax=$171.20 @ $1.07 per gallon
- Retail value=$23,040 per ton @$30/bottle; sales tax=$1873.15 per ton @8.13% tax rate
- 3 tons per acre average: $5,619 per acre
- **Total taxes paid:** $171.20 + $5,619= **$5,790.20/acre**

Thank You

- Liz Spence, Jason Pelletier, TNC
- Anderson Valley Winegrowers Association
- Bob Gibson and Arnaud Weyrich, Roederer Estate US
- Leif Farr, Mendocino County Planning Department
- Rhonda Smith, UCCE Sonoma County, Mark Battany, UCCE San Luis Obispo County
- Zac Robinson, Mendocino Wine, Inc.