



Integrating surface water, groundwater and landscape
stressor data into a regional assessment to support
management decision-making

Karen R. Worcester
Senior Environmental Scientist, Central Coast Region

Dave Paradies
Bay Foundation of Morro Bay

Healthy Watersheds

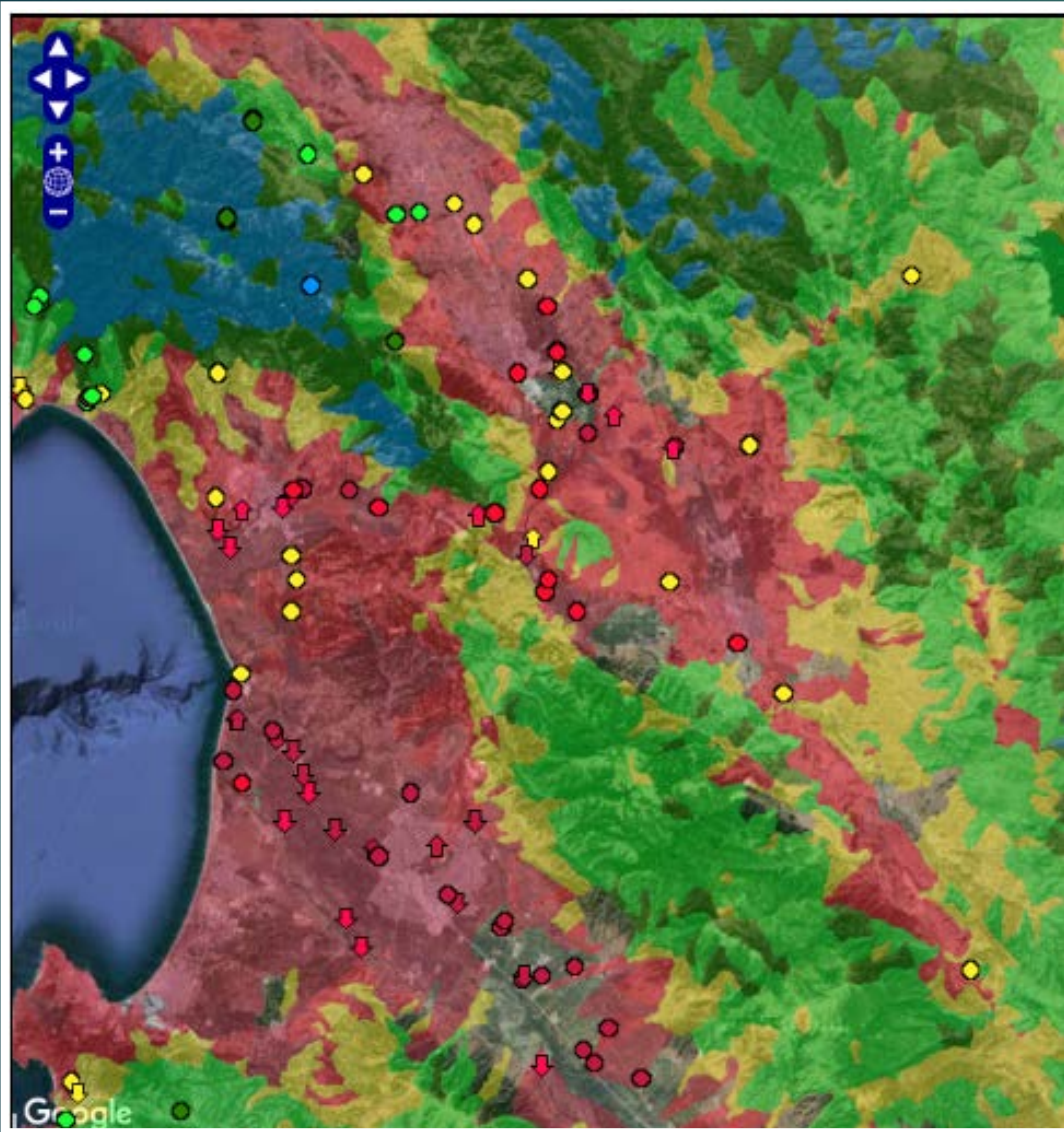


By 2025:

Healthy Aquatic Habitat - 80% of aquatic habitat is healthy; remaining 20% exhibit positive trends in key parameters

Proper Land Management - 80% of land is managed to maintain proper watershed functions; remaining 20% exhibit positive trends in key parameters

Clean Groundwater- 80 percent of ground water is clean, and the remaining 20 percent will exhibit positive trends in key parameters

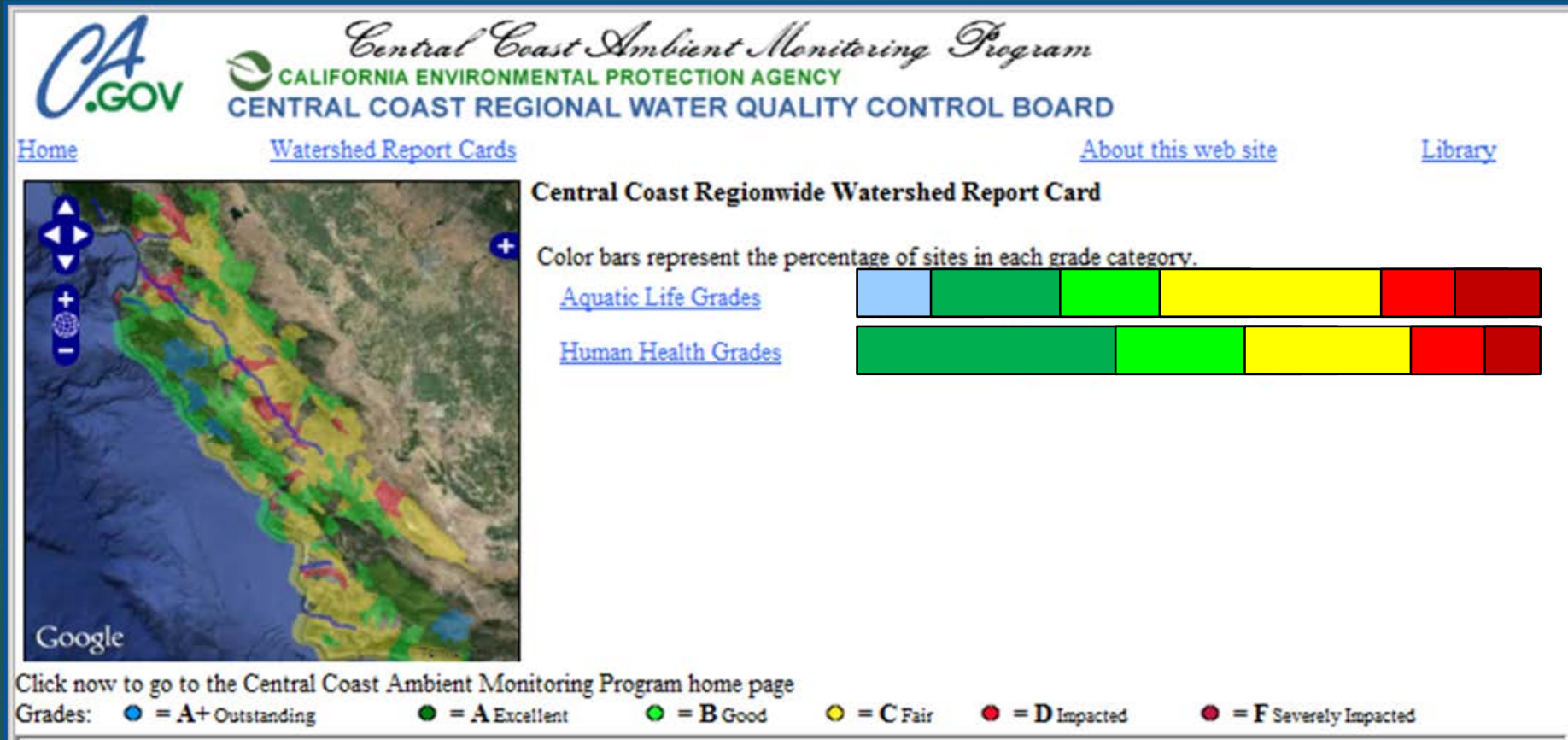


For 2016 Science Symposium we reported on the Central Coast Aquatic Health Assessment

- ▶ Both measured and modeled data
- ▶ Site scores are attributed to reaches and travel upstream to next site
- ▶ Land Use boundaries define spatial extent of site scoring
- ▶ Web geomapping environment
- ▶ Drill down for details


Aquatic Life Web Report Card

4



Aquatic Life Web Report Card


5


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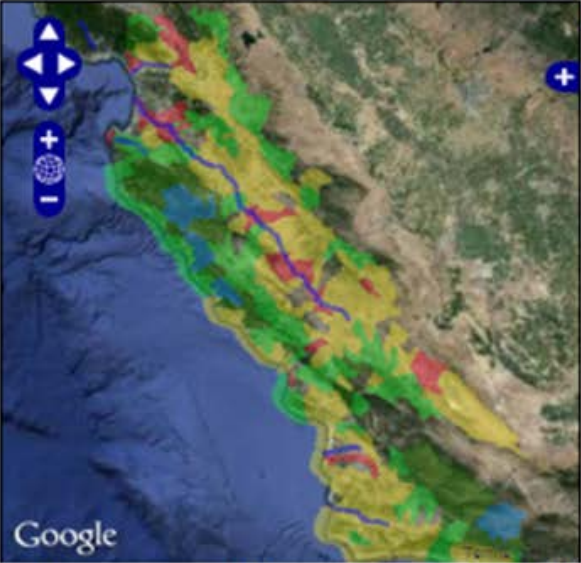
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Central Coast Regionwide Watershed Report Card

Color bars represent the percentage of sites in each grade category.

[Aquatic Life Grades](#) 

[Human Health Grades](#) 

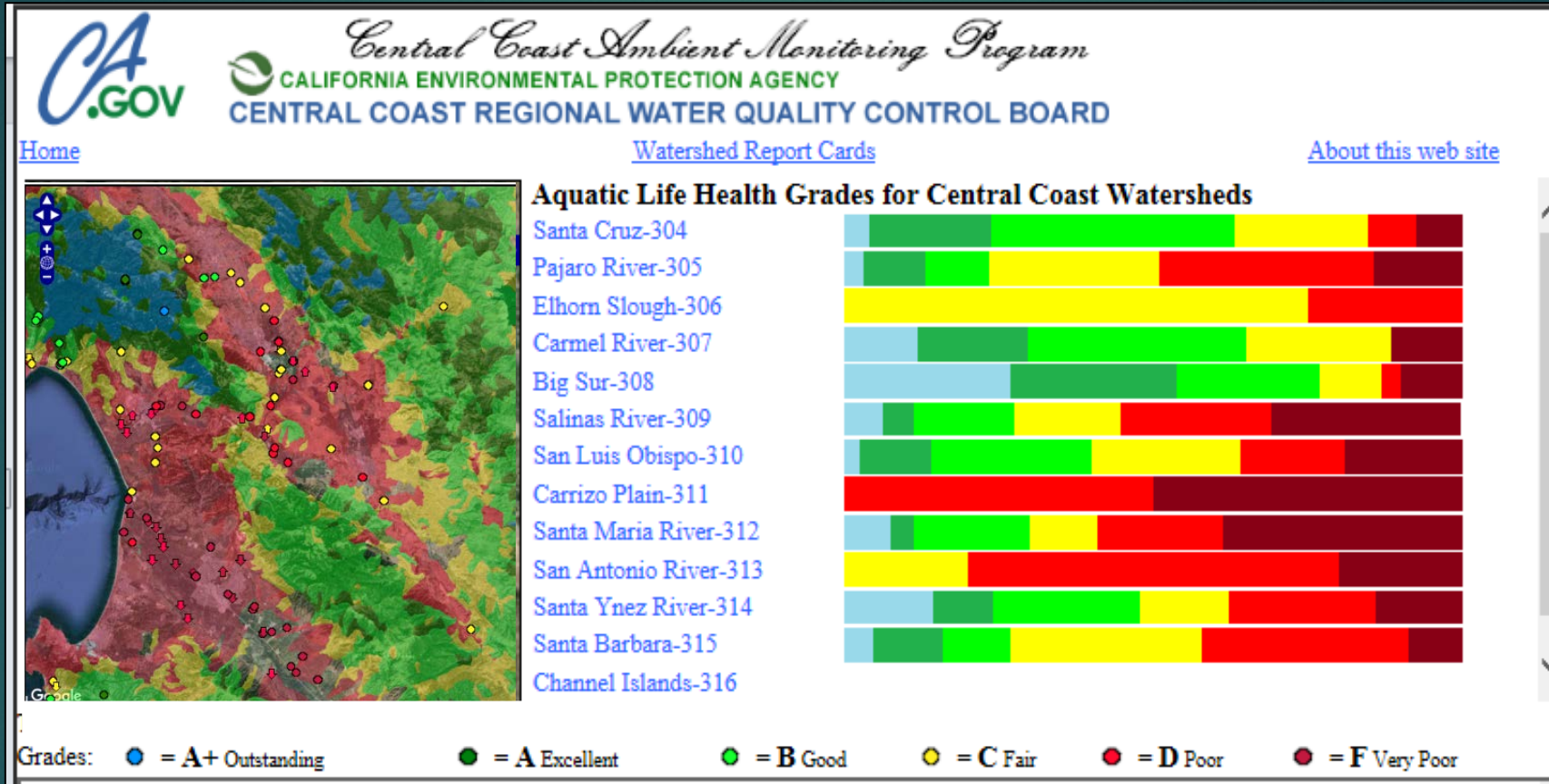


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Grades: ● = A+ Outstanding ● = A Excellent ● = B Good ● = C Fair ● = D Impacted ● = F Severely Impacted

Select a hydrologic unit (or large watershed area)

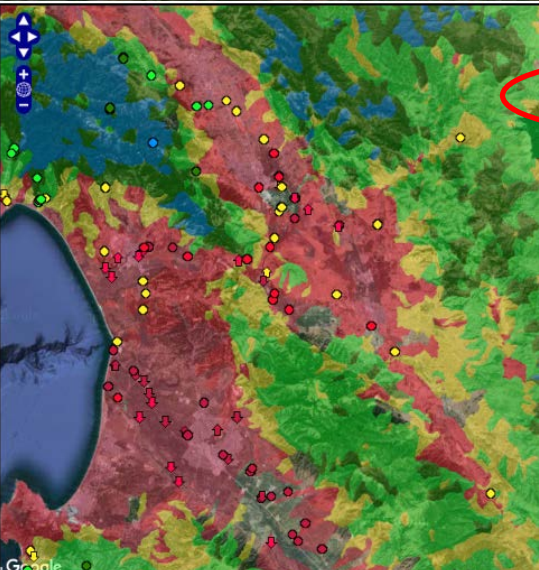


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Aquatic Life Health Grades for Central Coast Watersheds



Watershed	Health Grade
Santa Cruz-304	B Good
Pajaro River-305	C Fair
Elkhorn Slough-306	C Fair
Carmel River-307	B Good
Big Sur-308	C Fair
Salinas River-309	D Poor
San Luis Obispo-310	C Fair
Carrizo Plain-311	F Very Poor
Santa Maria River-312	D Poor
San Antonio River-313	D Poor
Santa Ynez River-314	C Fair
Santa Barbara-315	C Fair
Channel Islands-316	C Fair

Grades: ● = **A+** Outstanding ● = **A** Excellent ● = **B** Good ● = **C** Fair ● = **D** Poor ● = **F** Very Poor

Select a water body

California Environmental Protection Agency
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Aquatic Life Grades for Waterbodies in the Pajaro River Watershed

Waterbody	Aquatic Life Grade	Aquatic Life Score
Bodfish Creek	A	95
Carnadero Creek	C	66
Clear Creek	A	95
Clear Creek (San Benito County)	C	72
Corralitos Creek	D	49
Furlong Creek	C	67
Harkins Slough	C	72
Laguna Creek	C	77
Little Arthur Creek	A	95
Llagas Creek	C	65
Millers Canal	D	55
Pacheco Creek	C	74
Pajaro River	D	57
Pescadero Creek	C	77
Salsipuedes Creek (Santa Barbara County)	D	48
Salsipuedes Creek (Santa Cruz County)	D	54

Grades: = A+ Outstanding = A Excellent = B Good = C Fair = D Poor = F Very Poor

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Select a site

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Aquatic Life Health Grades for Sites - Llagas Creek

Site	Site Name	Aquatic Life Grade	Aquatic Life Score
305CE0062	Llagas Creek ~1.3mi below Sycamore Ave	B	84
305CE0484	Llagas Creek Below Sycamore Avenue	F	42
305CHE	Llagas Creek at Chesbro Reservoir	B	85
305HOL	Llagas Creek at Holsclaw below Leavesley Rd.	D	58
305LCS	Llagas Creek at Southside	C	66
305LEA	Llagas Creek at Leavesley Rd	D	64
305LGCABR	Llagas Creek @ Bloomfield Rd. above bridge	F	35
305LGCBCRC	Llagas Creek above Baldy Ryan Cyn. Cr.	A	90
305LHB	Llagas Creek at Highway 152	D	60
305LLA	Llagas Creek at Bloomfield Avenue	C	70
305LLAOSP	Llagas Creek-305LLAOSP	A	94
305LUC	Llagas Creek at Luchessa Avenue-Southside Drive	D	61
305MAS	Llagas Creek at Masten Avenue	F	6
305MON	Llagas Creek at Monterey Rd	C	70
305OAK	Llagas Creek at Oak Glen Avenue	B	85
305PS0061	Llagas Creek below E San Martin Ave.	C	73

Grades:
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Select a site

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Site: 305LLA - Llagas Creek at Bloomfield Avenue

Aquatic Life	Conventional Analytes	Biostimulation	Biology	Toxicity	Metals	Organic Chemicals
C (70)	74	61		78	91	16

Human Use	Nitrogen Species	Salts	Pathogens	Metals	Organic Chemicals
D (61)	24	56	28	99	100

Data Summary for Llagas Creek at Bloomfield Ave. (305LLA):

AQUATIC LIFE HEALTH GRADE

The overall Aquatic Life Health Grade for this site is D.

The aquatic life health grade for 'Conventional Water Quality' at this site is D.

8 conventional analytes were sampled at this site. 2935 individual measurements are included in the index score. pH departure and total Ammonia as N scored in 'Very Good' condition.

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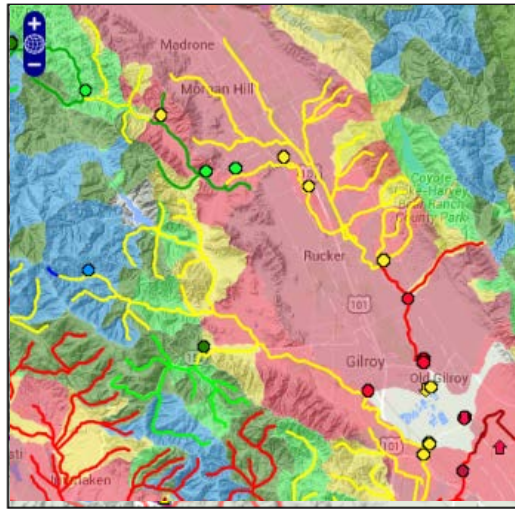
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* Analyte	Units	Matrix	Min	Mean	Max	Samples	Grade	Score	Threshold
Water Temperature	degrees c	water	9.4	16.4	20.1	162	C	79	18
Ammonia as N, Total	mg/l	water	0.01	0.07	0.34	59	A	97	1.9
Nitrate, Nitrite as N	mg/l	water	1.42	12.1	22	59	F	4	1
OrthoPhosphate as P	mg/l	water	0.003	0.04	0.23	59	B	81	0.13
Suspended Solids, Total	mg/l	water	3.2	16	64	52	C	78	30
Turbidity	ntu	water	0	37.3	224	61	D	64	25

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Llagas Creek at Bloomfield Avenue (305LLA)

	Watersheds		Waterbodies		Sites	
Aquatic Life	Conventional Analytes	Biostimulation	Biology	Toxicity	Metals	Organic Chemicals
D (58)	67	53			90	16
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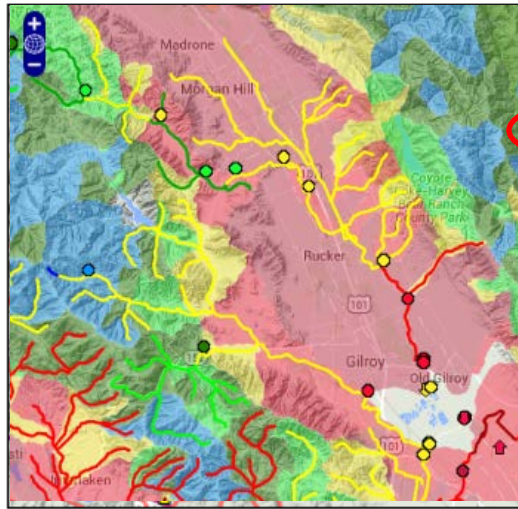
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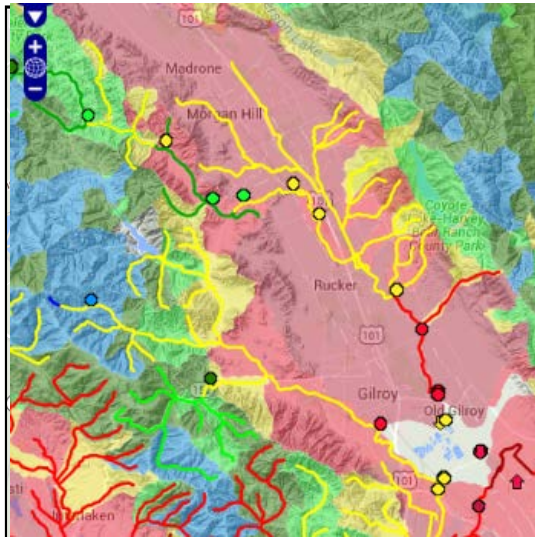
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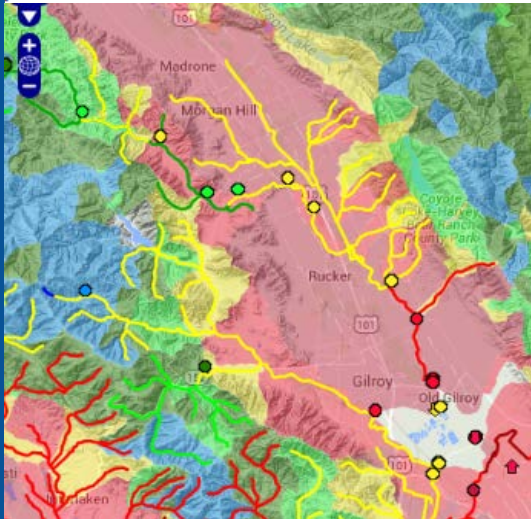


Parameter	Unit	Medium	Q1	Q2	Q3	Count	Grade	Score	Max
Total Phenolics	ug/l	water	4.9	5.35	6.6	13	A	99	100
Phosphamidon	ug/l	water	0.03	0.03	0.03	2	A	100	0.8
Phorate	ug/l	water	0.05	0.05	0.05	2	A	100	0.21
Phosmet	ug/l	water	0.05	0.05	0.05	2	A	100	0.8
Prothiophos	ug/l	water	0.03	0.03	0.03	2	A	100	1.4
Stirophos(Tetrachlorvinphos)	ug/l	water	0.03	0.03	0.03	2	A	100	51
Sulfotep	ug/l	water	0.03	0.03	0.03	2	A	100	0.2
Sulprofos	ug/l	water	0.03	0.03	0.03	2	A	100	0.083
Terbufos	ug/l	water	0.03	0.03	0.03	2	A	100	0.03
Thionazin	ug/l	water	0.04	0.04	0.04	2	A	100	9
Trichlorfon	ug/l	water	0.03	0.03	0.03	2	A	100	0.009
Trichloronate	ug/l	water	0.03	0.03	0.03	2	A	100	0.01
Bifenthrin	ug/kg dw	sediment	2.4	2.4	2.4	1	F	16	1.29
Cyfluthrin	ug/kg dw	sediment	0.48	0.48	0.48	1	A	100	1.37
Cypermethrin	ug/kg dw	sediment	0.72	0.72	0.72	1	A	100	1.49
Deltamethrin/Tralomethrin	ug/kg dw	sediment	0.48	0.48	0.48	1	A	100	0.99
Esfenvalerate/Fenvalerate	ug/kg dw	sediment	0.48	0.48	0.48	1	A	100	4.18
Permethrin,Total	ug/kg dw	sediment	2.89	2.89	2.89	1	A	100	20.1

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Site: 305LLA - Llagas Creek at Bloomfield Avenue

Category	Conventional Analytes	Biostimulation	Biology	Toxicity	Metals	Organic Chemicals
Aquatic Life	C (70) 74	61		78	91	16
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Llagas Creek at Bloomfield Avenue (305LLA)

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Aquatic Life	Conventional Analytes	Biostimulation	Biology	Toxicity	Metals	Organic Chemicals
D (58)	67	53			90	16

Human Health	Nitrogen Species	Salts	Pathogens	Metals	Organic Chemicals
D (61)	25	53	30	100	100

Data Summary for Salinas River at Davis Rd. (309DAV):

AQUATIC LIFE HEALTH GRADE

The overall Aquatic Life Health Grade for this site is D.

The aquatic life health grade for 'Conventional Water Quality' at this site is D.

8 conventional analytes were sampled at this site. 2935 individual measurements are included in the index score. pH departure and Total Ammonia as N scored in 'Very Good' condition. Oxygen, Dissolved Water Temperature, Turbidity, OrthoPhosphate as P, and total Suspended Solids scored in 'Poor' condition. Nitrate-Nitrite as N scored in 'Very Poor' condition.

WIKI →

► Data Summary for Salinas River at Davis Rd. (309DAV):

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The aquatic life health grade for 'Conventional Water Quality' at this site is D.

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The aquatic life health grade for 'Biostimulatory Risk' at this site is F.

Two biostimulatory risk analytes are modeled from nutrient data and other inputs using the Numeric Nutrient Endpoint Benthic Biomass Tool (Tetratech, 2007). These include benthic algal biomass and oxygen deficit. 5 biostimulatory risk analytes were sampled or modeled for this site. individual measurements are included in the index score. Algae, floating mats scored in 'Fair' condition. Dissolved oxygen and chlorophyll a scored in 'Poor' condition. Benthic chlorophyll a (NNE) and Oxygen Deficit scored in 'Very Poor' condition.

The aquatic life health grade for 'Metals in Water' at this site is A.

8 metal analytes were sampled in water at this site. individual measurements are included in the index score. Selenium, Zinc, Lead, Cadmium, Arsenic, and Silver scored in 'Very Good' condition. Copper scored in 'Fair' condition. Aluminum scored in 'Very Poor' condition.

The aquatic life health grade for 'Metals in Sediment' at this site is D.

7 metal analytes were sampled in sediment at this site. individual measurements are included in the index score. Silver scored in 'Good' condition. Arsenic, Lead, and Mercury scored in 'Fair' condition. Zinc scored in 'Poor' condition. Cadmium and Copper scored in 'Very Poor' condition.

The aquatic life health grade for 'Water Toxicity' at this site is D.

5 toxicity analytes were sampled in water at this site. 30 individual measurements are included in the index score. Fish Growth, Fish Survival, Invertebrate Reproduction in water, and Invertebrate Survival in water scored in 'Very Good' condition. Algae cell growth scored in 'Poor' condition.

The aquatic life health grade for 'Sediment Toxicity' at this site is D.

One toxicity analyte was sampled in sediment at this site. 10 individual measurements are included in the index score. Invertebrate Survival in sediment scored in 'Poor' condition.



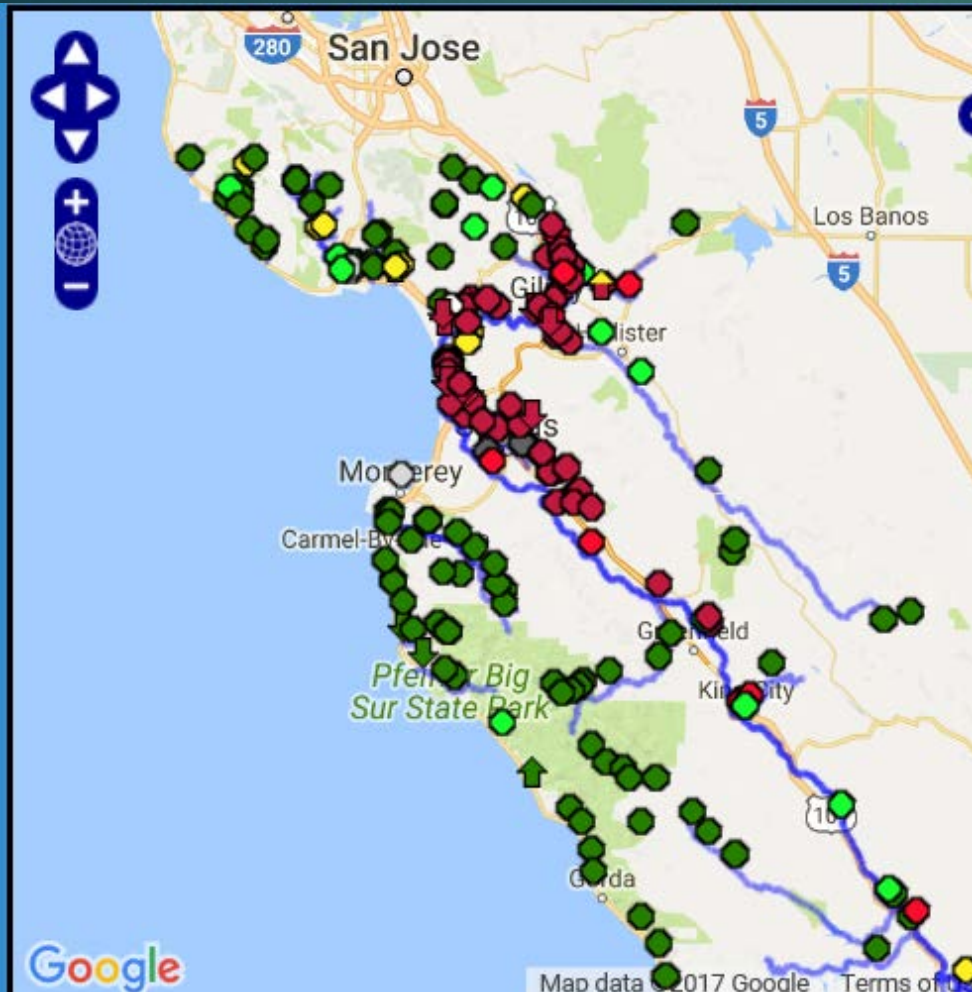
We are adding groundwater and
land management assessments to
our Healthy Watersheds Report
Card



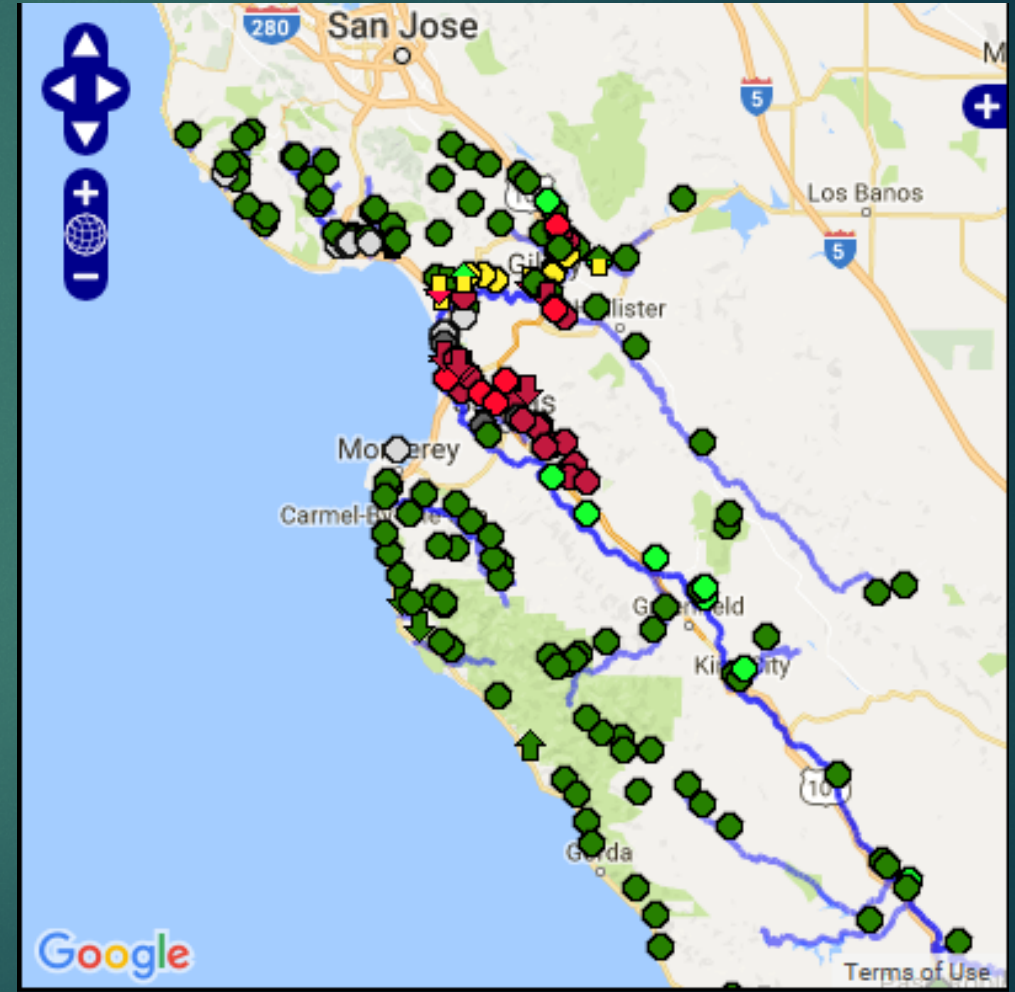
Nitrate is a serious problem in ground and
surface water in the Central Coast
Region

Nitrate scores in surface water in the northern Region

Aquatic Life threshold = 1 mg/L



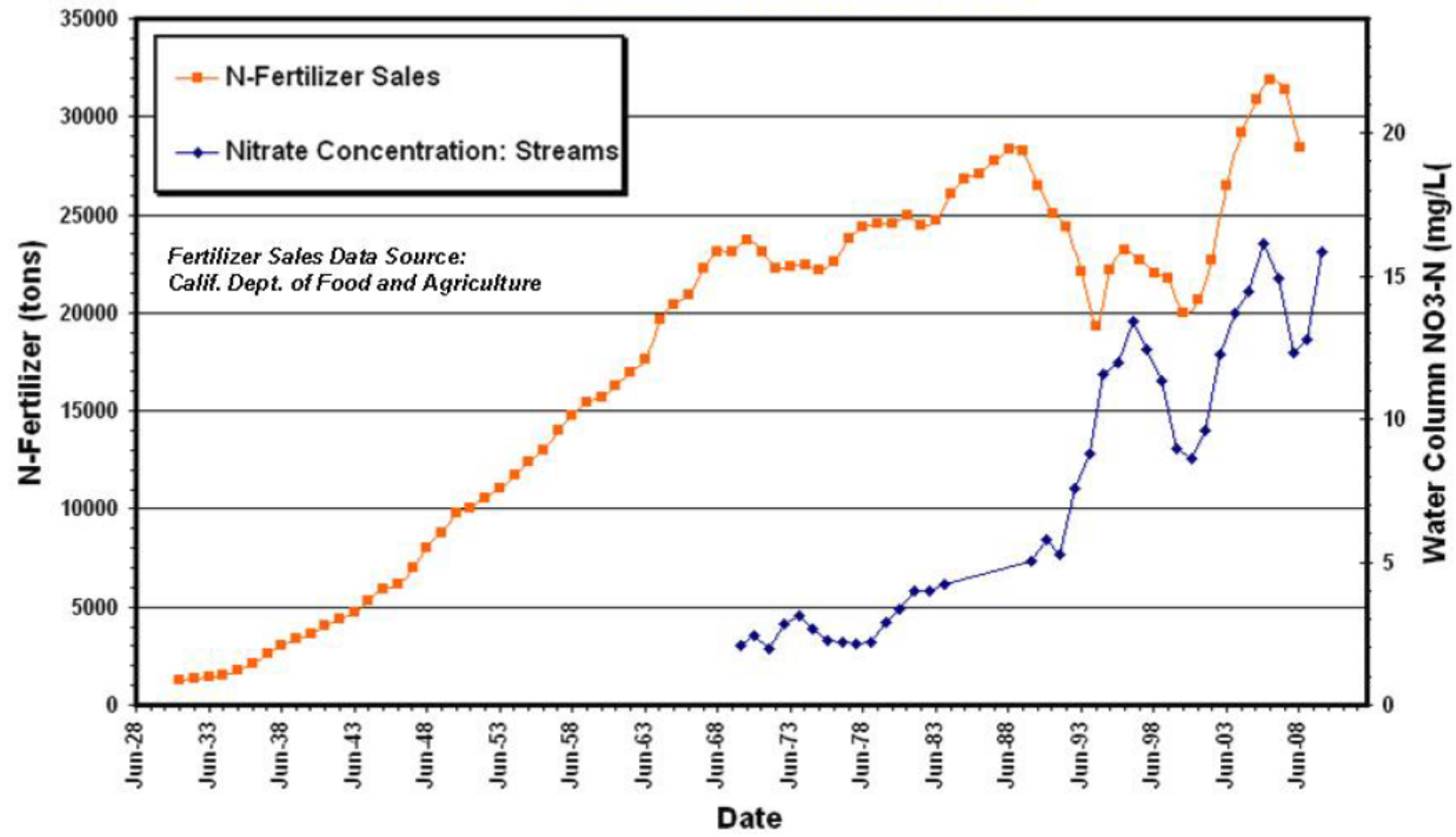
Human Health threshold = 10 mg/L



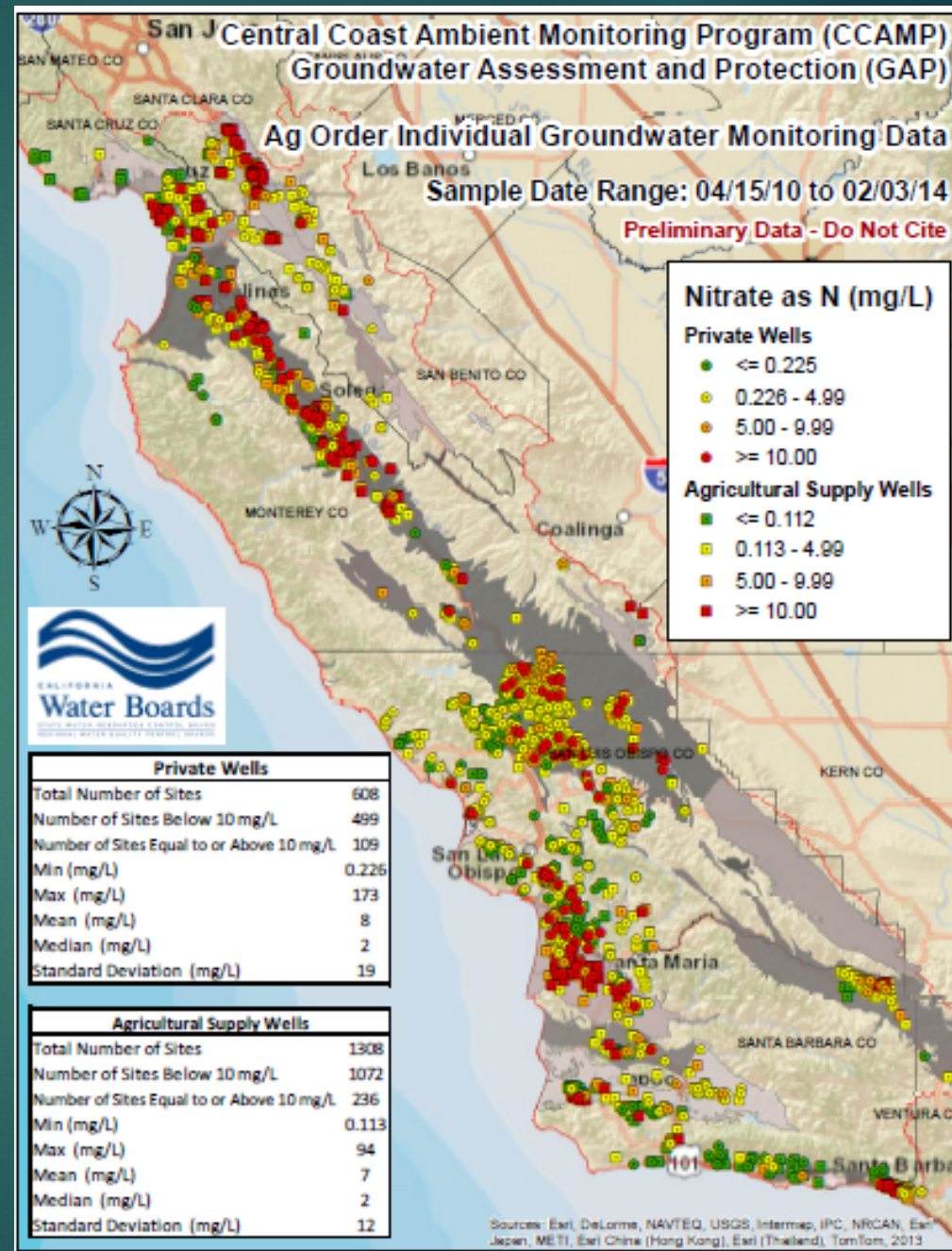
5-Year Moving Averages: N-Fertilizer Sales in Monterey County

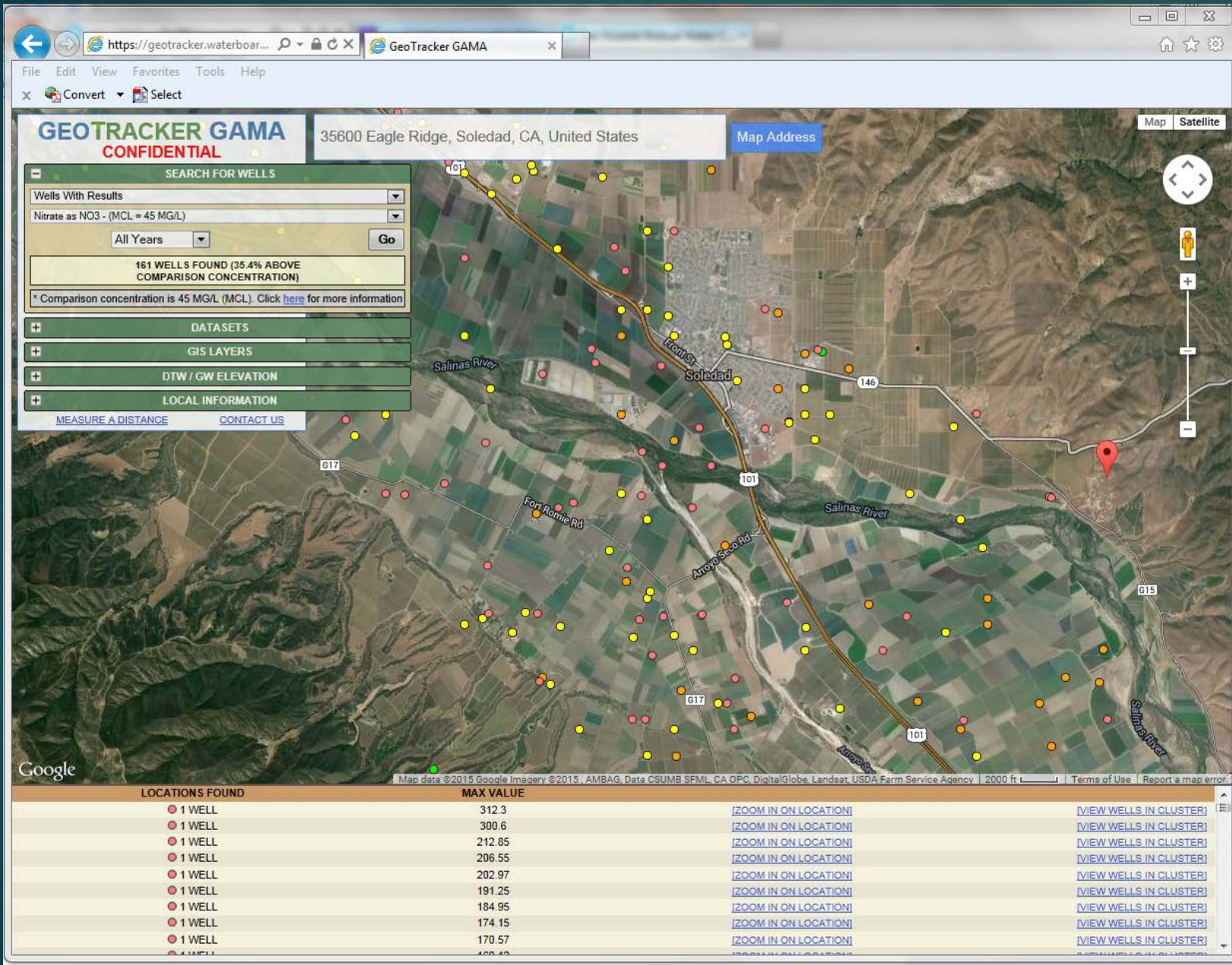
with overlay of

5-Year Moving Averages: all NO3 Concentration Data in Streams in Salinas River Basin



Nitrate groundwater contamination is also widespread, particularly in agricultural areas.





This creates an environmental justice issue for many small agricultural communities in the Salinas and Santa Maria valleys

Initial groundwater data evaluation

- ▶ Groundwater wells in Geotracker/GAMA are assigned to groundwater basin and sub-basin where available
- ▶ Many wells fall outside Bulletin 118 groundwater basins
- ▶ Geospatial joining of well locations to surface water areas, including HUC12s and NHDPlus catchments
- ▶ Mean average for well data assigned to sub-basins, HUCs and catchments
- ▶ Initial scoring approach:


Example for nitrate-N, drinking water threshold = 10 mg/L:

>0 < 1.0 mg/L
>1 <2.5 mg/L
>2.5 <5 mg/L
>5 <10 mg/L
>10 mg/L

Groundwater data challenges

From Initial evaluation of GAMA/Geotracker data

- ▶ Data Quality
 - ▶ Minimal QA documentation
 - ▶ Quality control concerns
 - ▶ Zeroes and missing MDLs/RLs
- ▶ Well IDs
 - ▶ Multiple well names at same location
 - ▶ Absence of well naming conventions
 - ▶ Data collection sources not explicit

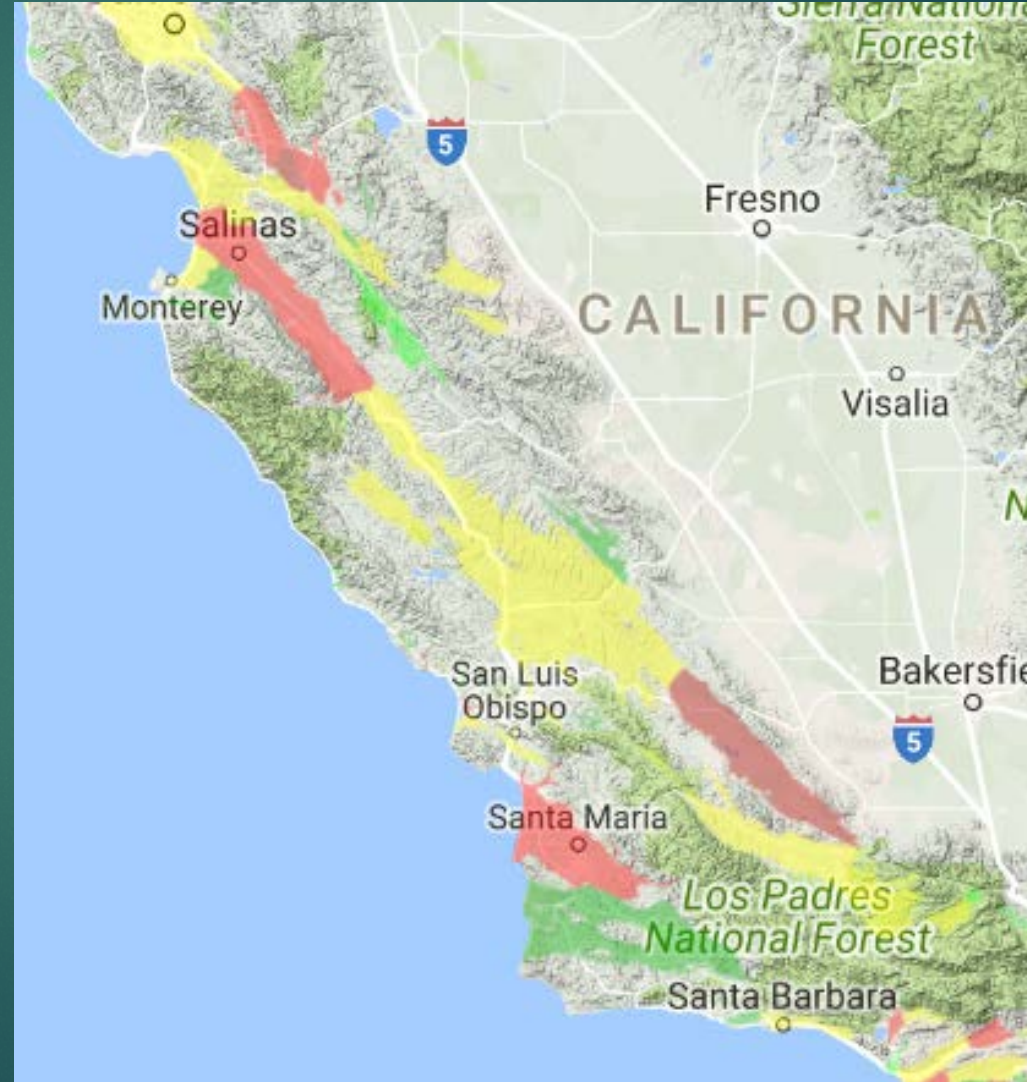


Deciding on spatial scale for a Central Coast groundwater assessment



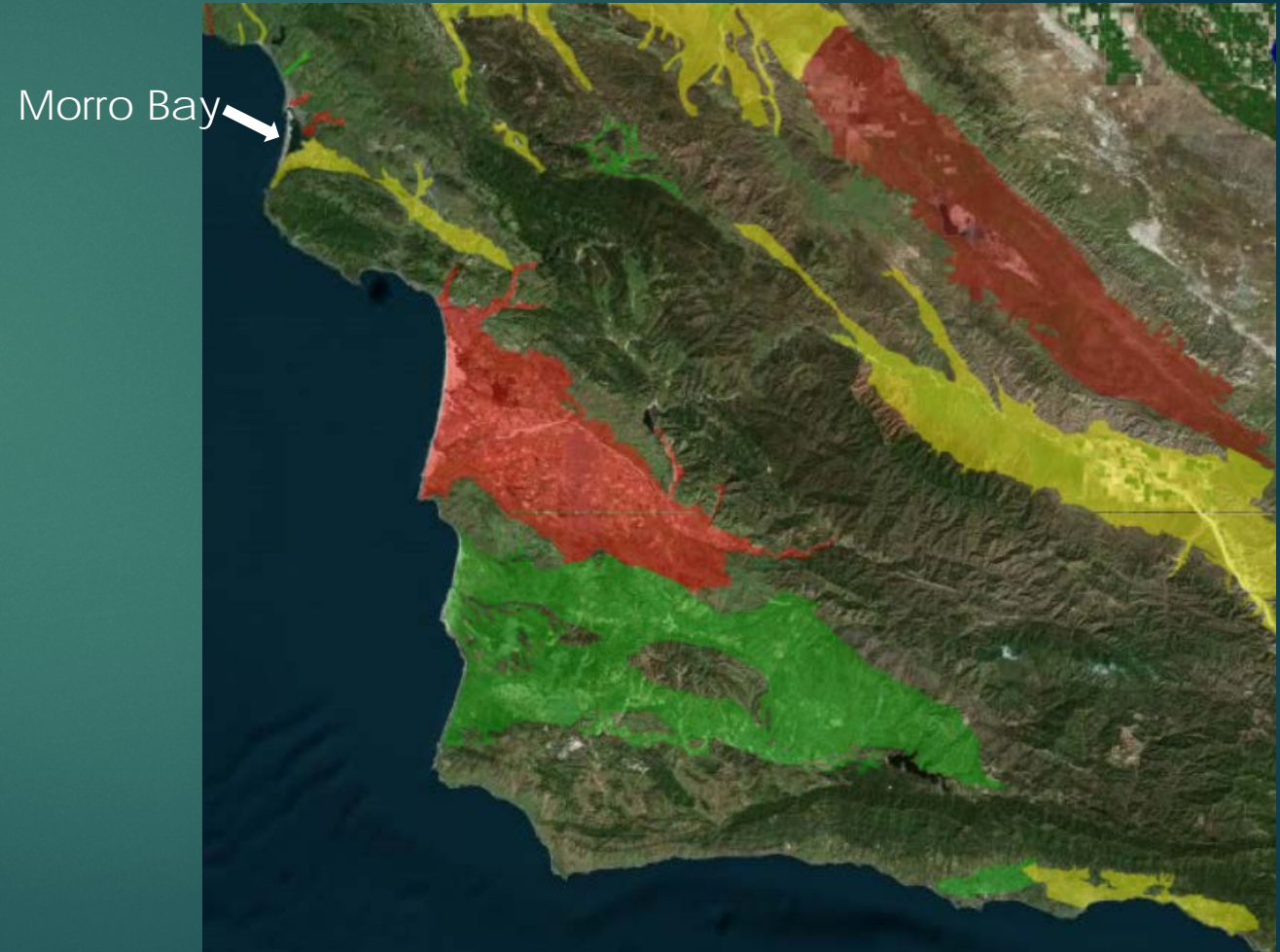
California's
Groundwater
Basin definitions
come from DWR
Bulletin 118

Groundwater sub-basins, scored for nitrate-N as an average



>0 < 1.0 mg/L
>1 < 2.5 mg/L
>2.5 < 5 mg/L
>5 < 10 mg/L
>10 mg/L

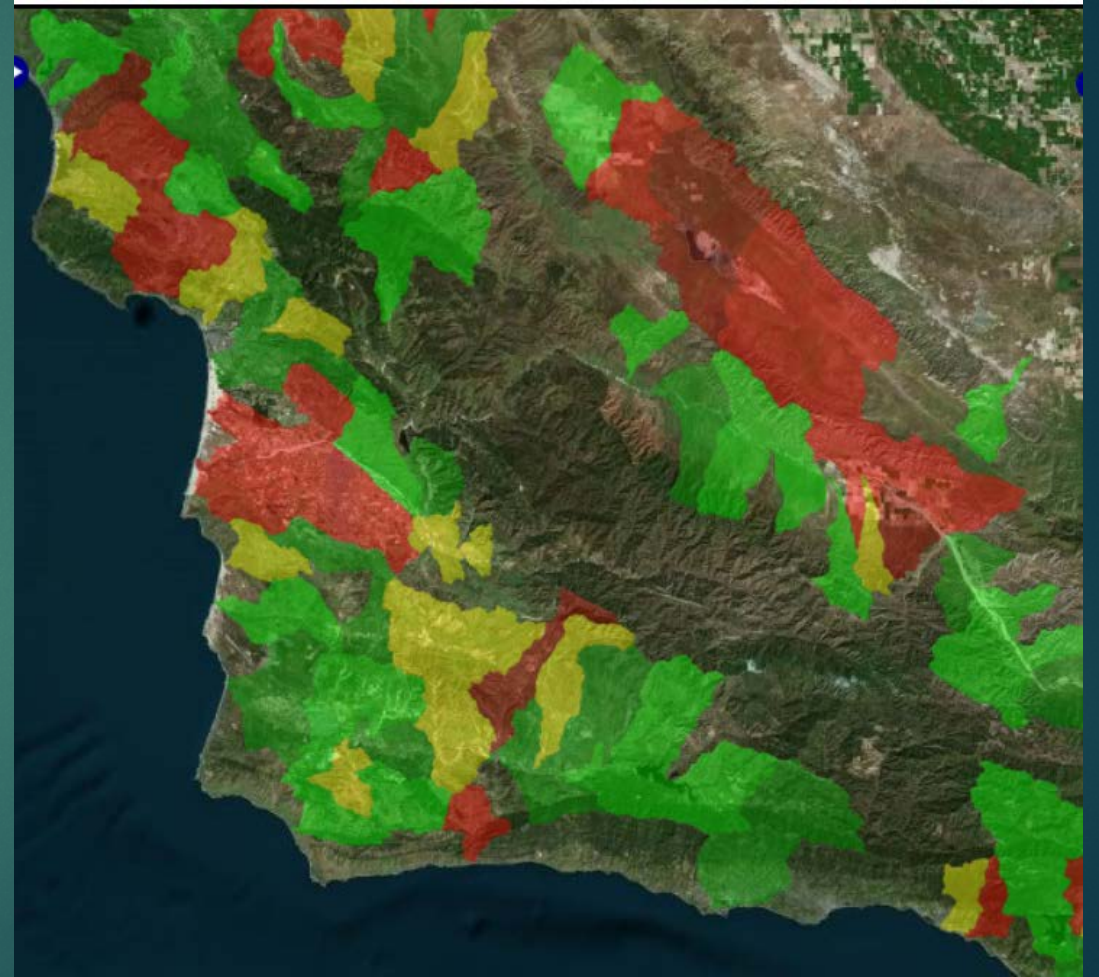
Groundwater Basin size is highly variable



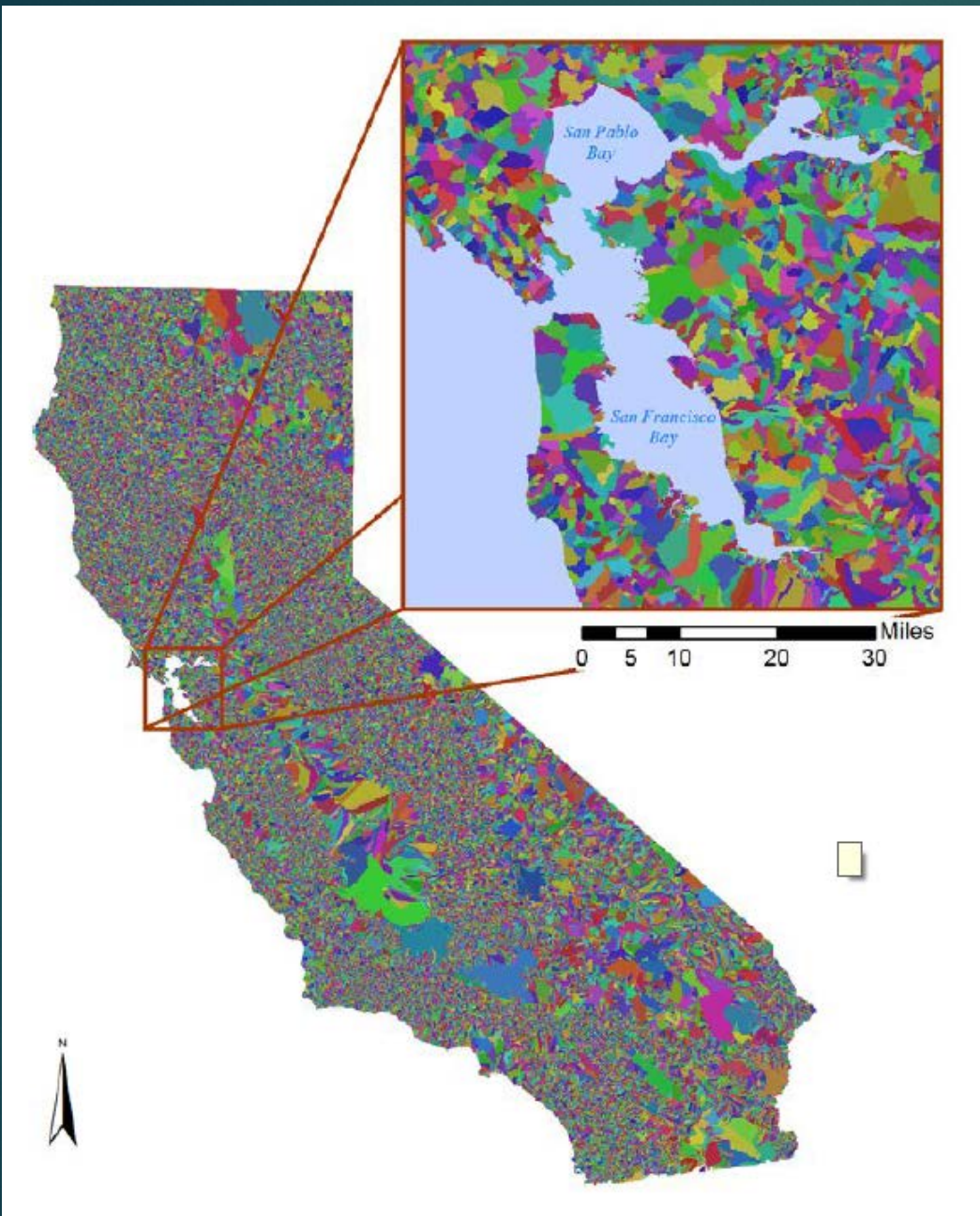
Surface water HUC 12s cover the entire landscape and are often smaller than groundwater basins.



Groundwater basins



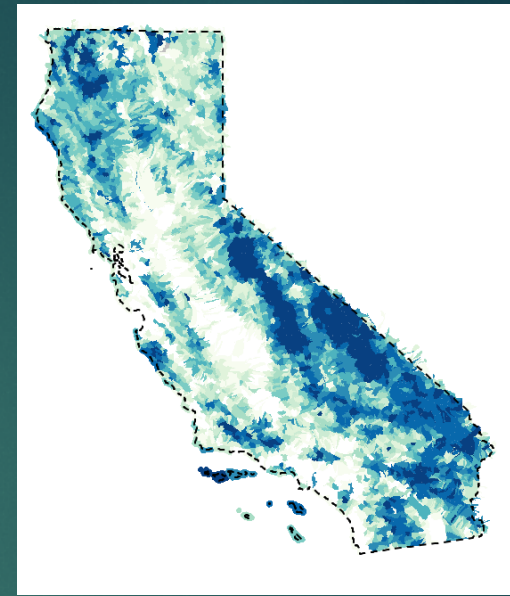
HUC 12s



NHDPlus Catchments are typically even smaller

(pretty graphic from California Integrated Assessment of Watershed Health (2013))

Landscape stressors



Baseline “Stressor” information is collected from multiple sources at multiple scales

- ▶ California Healthy Watersheds Assessment
- ▶ US E.P.A Recovery Potential
- ▶ Pesticide Use
- ▶ Irrigation and nitrogen application practices

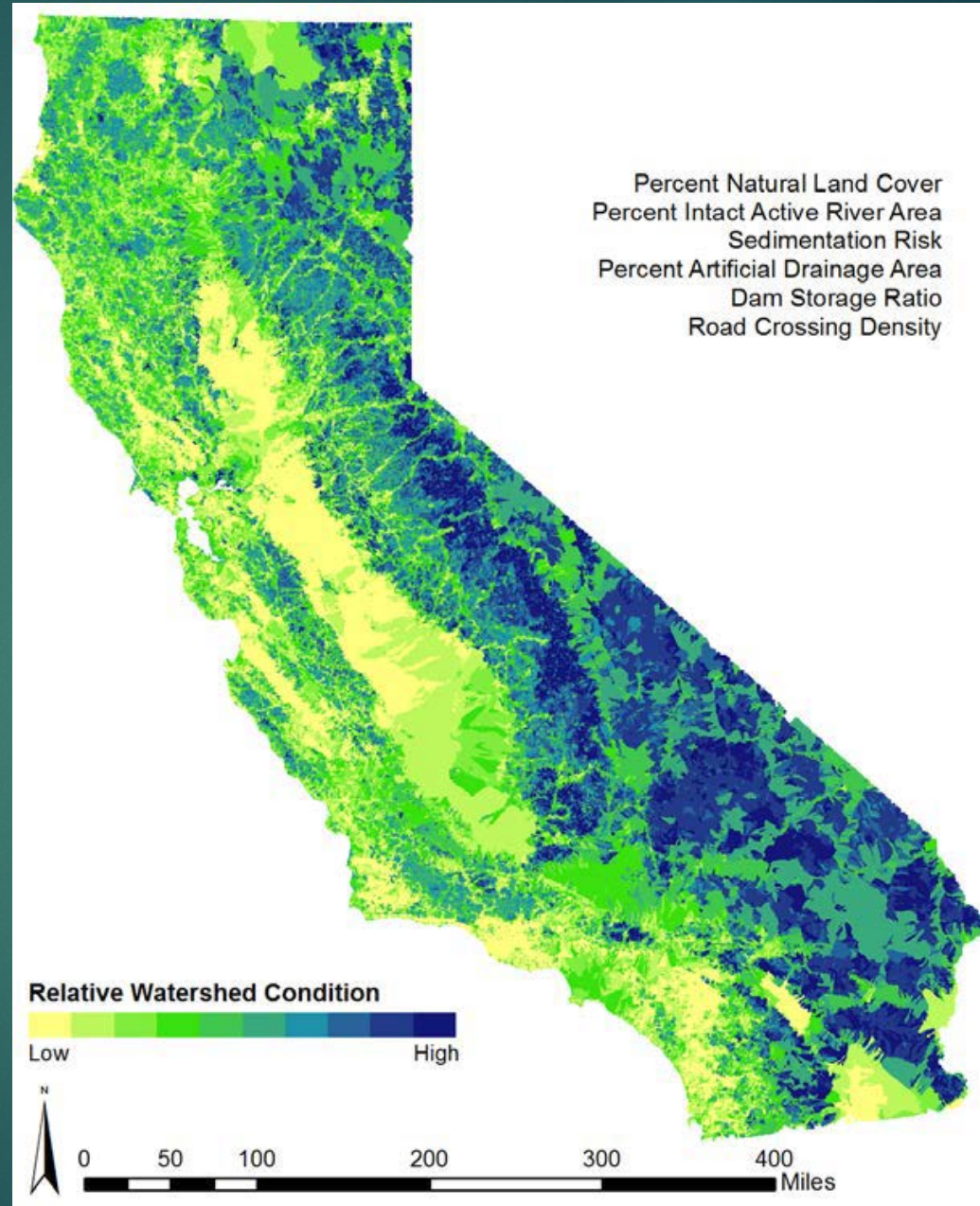
NHDPlus Catchment

HUC 12

T-S-R

Ranch

California Healthy Watersheds Assessment provides a number of data layers at a relatively high resolution



Ag Index

Statewide measures

▶ % Cultivated Crops in HCZ	RPS	HUC12
▶ % Cropland on >10% Slope	RPS	HUC12
▶ Synthetic N Fertilizer Application in WS	RPS	HUC12
▶ Agricultural Land Cover	CHWA	Catchment
▶ Percent Irrigated area (WS)	CHWA	Catchment
▶ Percent Irrigated Area (Catchment)	CHWA	Catchment

Regional measures of land management (to be added)

▶ Pesticide Use	DPR PUR	T-S-R
▶ Total Nitrogen Applied	Ag Order	Ranch
▶ Total Nitrogen Residual	Ag Order	Ranch
▶ Acres of Drip Irrigation	Ag Order	Ranch
▶ Wetland treatment systems (linear feet)	BMP Tracker	
▶ Etc.		

Urban Index

Statewide measures

▶ % Urban in Hydrologically Connected Zone	RPS	HUC 12
▶ % Developed, High Intensity in Watershed	RPS	HUC 12
▶ % HUC12 with > 5% Impervious Cover	RPS	HUC 12
▶ Population Density (Watershed)	CHWA	HUC 12
▶ Population Density (Catchment)	CHWA	HUC 12

Potential regional measures of land management (to be added)

- ▶ LID acreage treated
- ▶ Volume of stormwater retention basins
- ▶ Etc.

General Human Stress Index

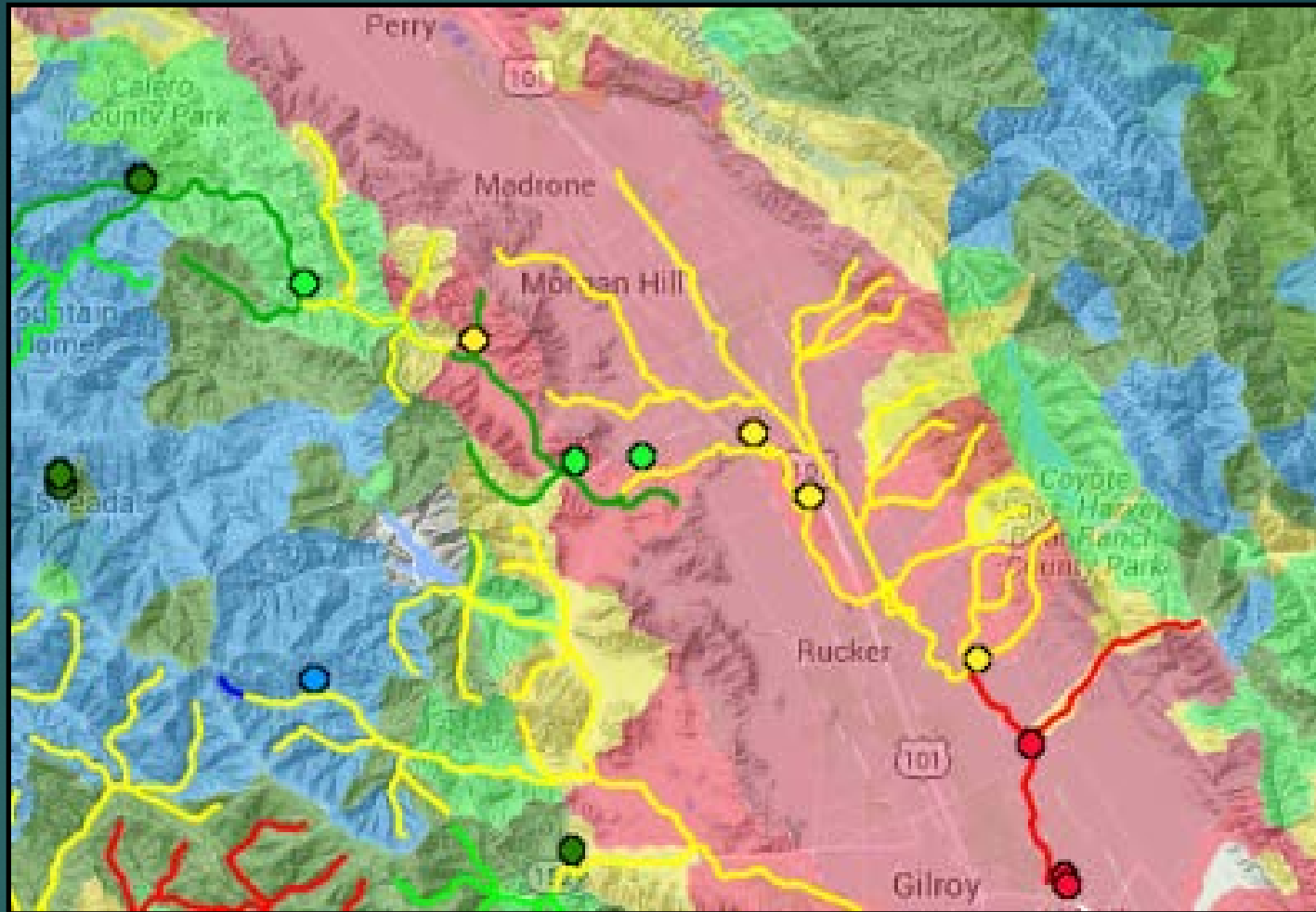
- ▶ % Human Uses, including bare ground (watershed)
- ▶ % High Intensity Land Cover in Riparian Zone
- ▶ Soil Erodibility, Mean in Hydrologically Connected Zone
- ▶ Dam Storage Ratio
- ▶ Natural Land Cover (Catchment)
- ▶ Natural Land Cover (Riparian area)
- ▶ Road Crossing Density (Watershed)
- ▶ Road Density (Catchment)

Potential Regional Measures of Land Management (to be added):

- ▶ Water diversions
- ▶ Fish barriers
- ▶ Miles of Road Treatment
- ▶ Wetland acreage protected/restored
- ▶ % of cleanup sites closed
- ▶ Etc.

This is a work in progress

- ▶ Add additional groundwater data from Geotracker
- ▶ Assess groundwater sites for change analysis
- ▶ Apply surface water scoring approach to groundwater wells
- ▶ Assess % of groundwater basins that are healthy
- ▶ Update Healthy Watersheds website to incorporate groundwater and land stressor and management data



The Central Coast Healthy Watersheds Report Card puts SWAMP data, Geotracker/GAMA data and other data sources together in a user friendly environment to support decision-making



?

Spare parts

