Update on the Central Coast Ambient Monitoring Program and Healthy Watersheds Assessment

Karen Worcester

September 23, 2016

CALIFORNIA Water Boards

What I'll cover today

- Quick overview of CCAMP
- Highlights of data findings for the Region
- Introduction to Healthy Watersheds Report Card

What we do

Watershed Rotation Area Monitoring

- 1998 / 2005 / 2011 / 2017
- 1999 / 2006 / 2012
- 2000 / 2007 / 2013
- 2001 / 2008 / 2014
- 2002 / 2009 / 2015

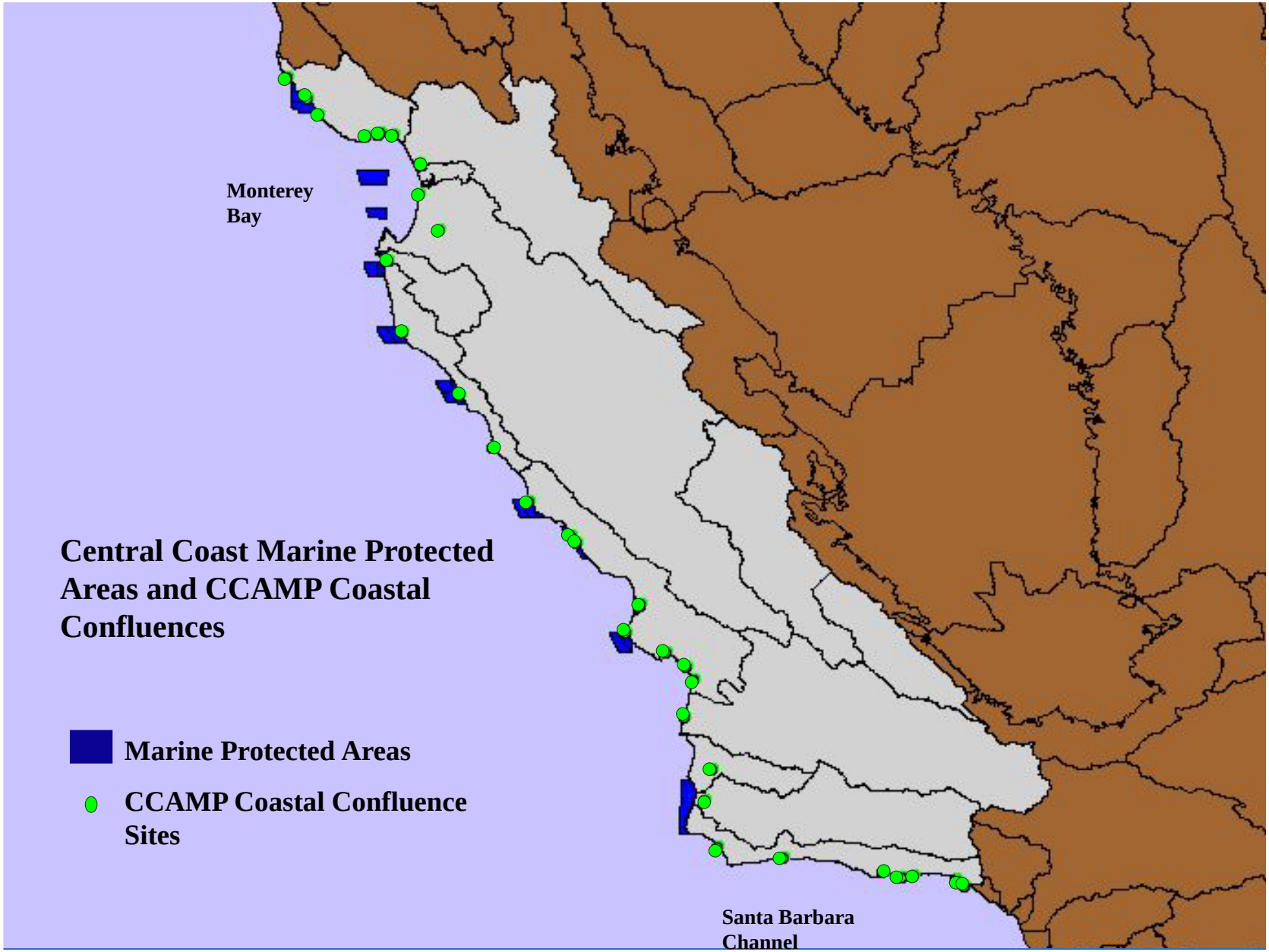
Monthly monitoring at thirty sites in each rotation area since 1998

3

What we do

Long-term trend monitoring at Coastal Confluences sites

Monthly monitoring at thirty-three sites since 2001


Monterey Bay
Central Coast Marine Protected Areas and CCAMP Coastal Confluences
Marine Protected Areas
CCAMP Coastal Confluence Sites
Santa Barbara Channel

What we do

Conventional Water Quality

Monthly Monitoring at All Sites

- Nutrients
- Salts
- Copper and Zinc
- Pathogen indicators
- Probe measurements
- Flow

What we do

Less frequently at a subset of CCAMP sites

- Benthic Invertebrate and algal assemblages
- Instream habitat assessment
- Water and sediment toxicity
- Microcystin screening
- Pesticide and metals chemistry (recent)
- Riparian assessment (in development)

Our data supports:

- Enforcement actions
- TMDL development and tracking
- Agricultural, storm water, and permit program decisions
- Trend and change detection associated with regulatory actions
- Hundreds of decisions for 303(d) Listing
- … and more

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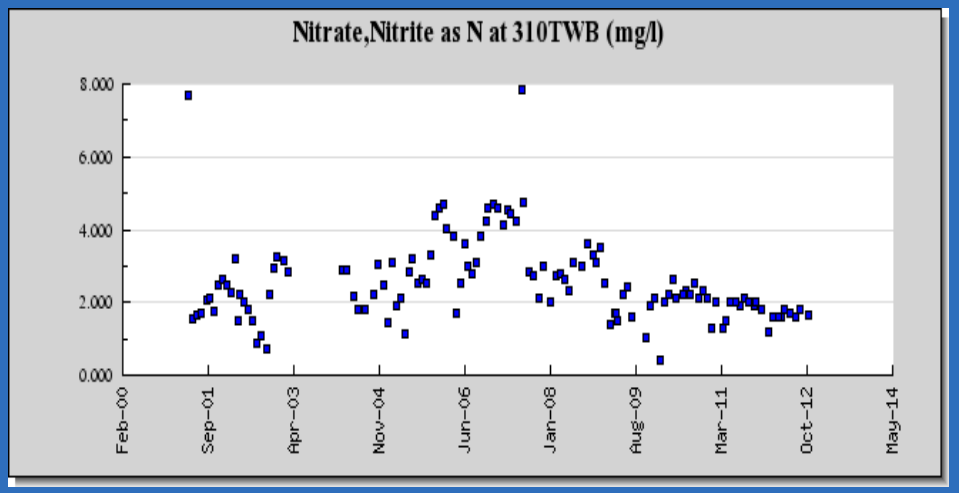
In this case, a treatment plant upgrade went online in May, 2007



Making our data accessible at www.ccamp.org

- CCAMP has had data online since 2000
- CCAMP Data Navigator is our primary data display tool.
- This tool updates from multiple databases, including the California Environmental Data Exchange Network (CEDEN)

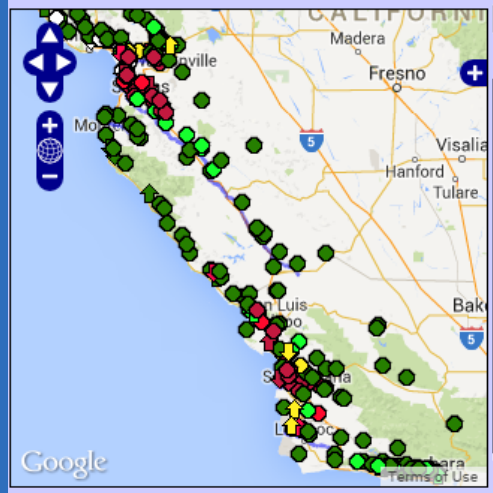
Examples from the CCAMP Data Navigator

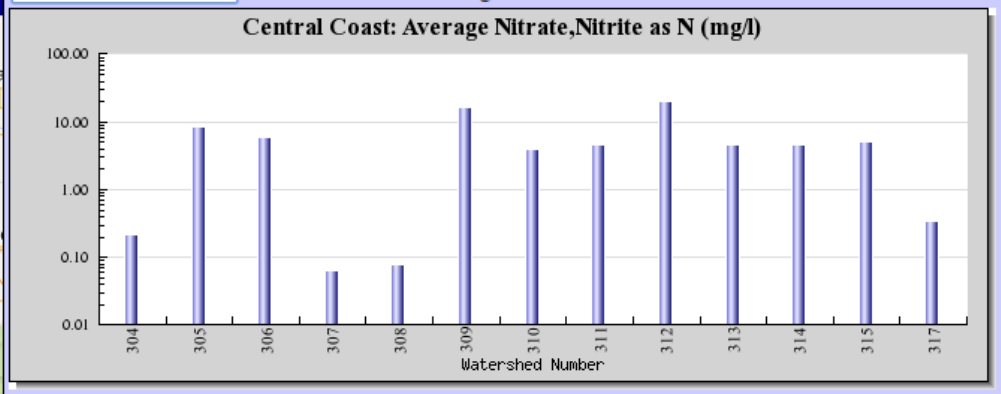
Nitrate-nitrite in Region 3

Home | Watersheds | Waterbodies | Monitoring Sites

Basic Water Quality | Analytes

Human Health | Watershed: Regionwide





Map Overlays | Chart Options | More Information | Get Data

● = Excellent ● = Good ● = Fair ● = Impacted ● = Severely Impacted ⇧ = Getting Better ⇩ = Getting Worse ○ = No change

Lowest ○ = 0-25% ○ = 25-50% ○ = 50-75% ○ = 75-100% Highest

Hydrologic Unit	Units	Min	Mean	Geomean	Median	Max	Samples
Santa Cruz (304)	mg/l	0.02	0.22	0.19	0.19	1.81	1,085
Pajaro River (305)	mg/l	0.01	8.52	6.89	8.15	89.12	1,578
Elkhorn Slough (306)	mg/l	0.00	6.04	4.90	5.95	36.27	207
Carmel River (307)	mg/l	0.02	0.06	0.05	0.04	0.58	181
Big Sur (308)	mg/l	0.02	0.08	0.07	0.06	0.37	607
Salinas (309)	mg/l	0.00	16.80	11.80	15.11	153.00	2,180
San Luis Opispo (310)	mg/l	0.00	4.03	3.05	3.58	79.80	1,472

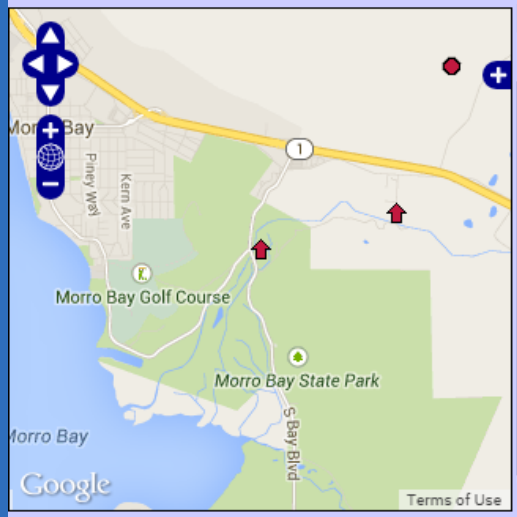
Chorro Creek is improving after a treatment plant upgrade. Nitrate-nitrite is shown below.

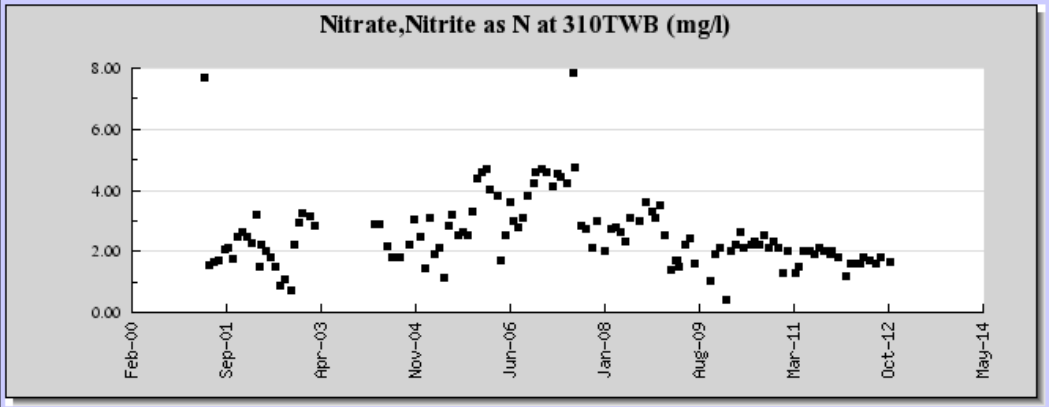
Home | Watersheds | Waterbodies | Monitoring Sites

Basic Water Quality | Analytes

Human Health

310TWB - Chorro Creek at South Bay Boulevard





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**	Analyte Name	Units	Min	Mean	Geomean	Median	Max	Samples	Dates	Aquatic life Goal	Human health Goal
○	Algae-floating mats	%	0	5	0	0	100	114	2001-2012	20	
⇧	Ammonia as N,Total	mg/l	0.010	0.046	0.034	0.029	0.360	124	2001-2012	1.900	30.000
⇧	Ammonia as N,Unionized	mg/l	0.0001	0.0019	0.0009	0.0008	0.0368	107	2001-2011	0.0250	
⇧	Boron,dissolved	mg/l	0.01	0.13	0.12	0.11	0.26	115	2001-2012	1.50	1.00
⇧	Calcium	mg/l	16.0	42.6	42.2	42.5	57.0	122	2001-2012		
⇧	Chloride	mg/l	29.0	82.1	78.2	81.5	130.0	116	2001-2012		
⇩	Chlorophyll a	ug/l	0.010	2.764	1.075	1.600	35.920	117	2001-2012	15.000	

Scoring Approach

- Adapted from Canadian Water Quality Index
- Magnitude and exceedance components
- Report card scoring and coloring paradigm

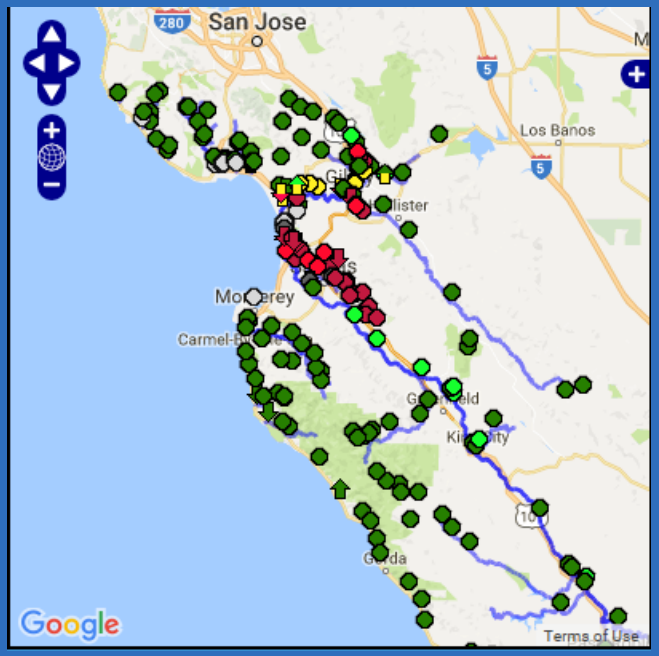
A+	Combined score over 95		
A	90	to	100
B	80	to	90
C	65	to	80
D	45	to	65
F	1	to	45

Technical details are peer reviewed and documented in the "California Central Coast Healthy Watersheds Project" manual on the SWAMP website
http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/workplans/rb3_methods_paper.pdf

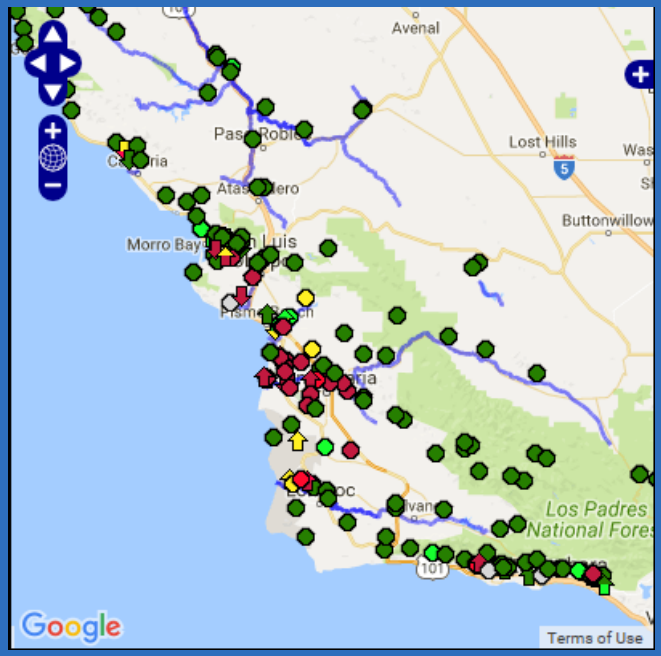
Change Icons show direction of change (up is improving)

This site is improving from "poor" to "fair" condition

Patterns remain consistent across many analytes for the Region



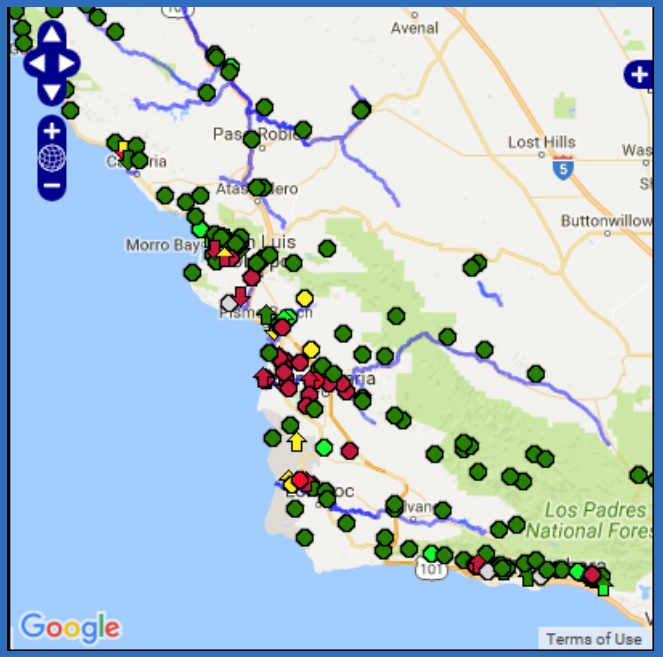
Northern half of region



Southern half of region

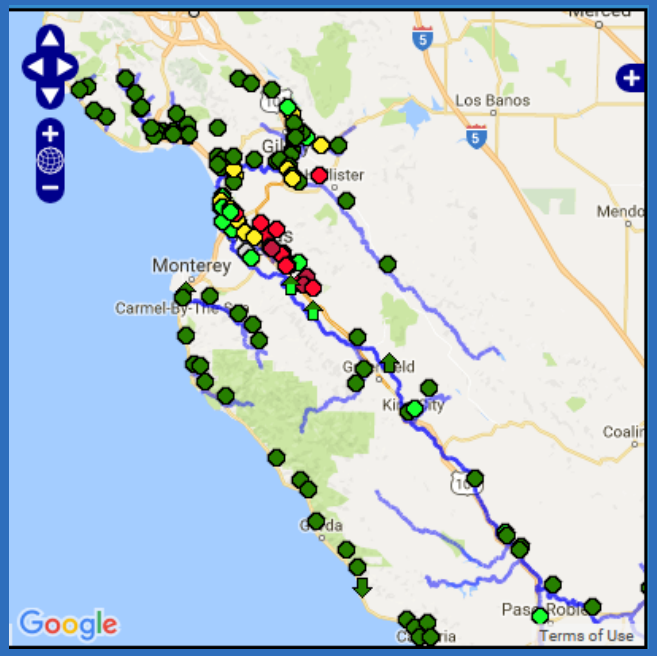
Nitrate-Nitrite (scored using drinking water threshold of 10 mg/L-N)

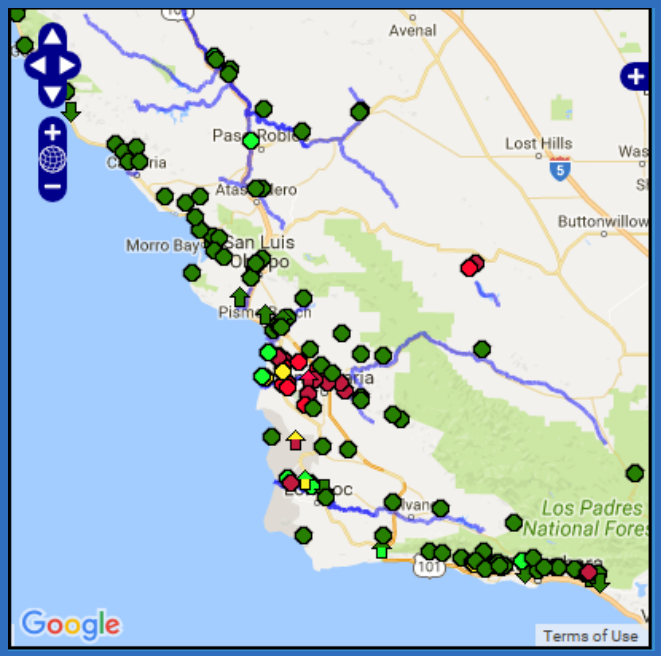
Choice of thresholds can change the message



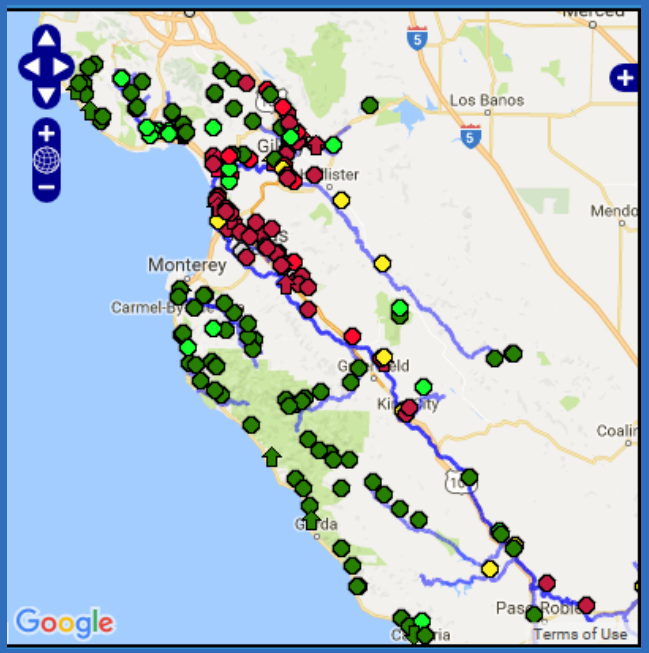
Nitrate-Nitrite scored using drinking water threshold of 10 mg/L (as N)

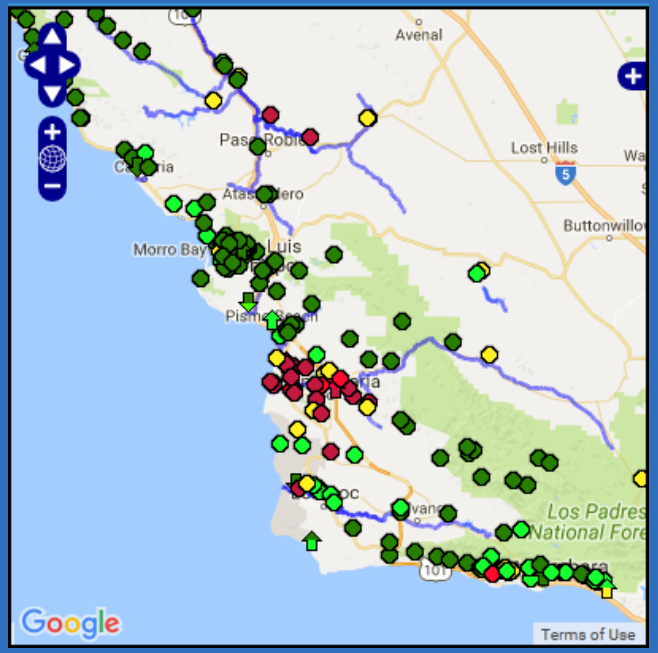
Nitrate-Nitrite scored using aquatic life guideline of 1 mg/L (as N)



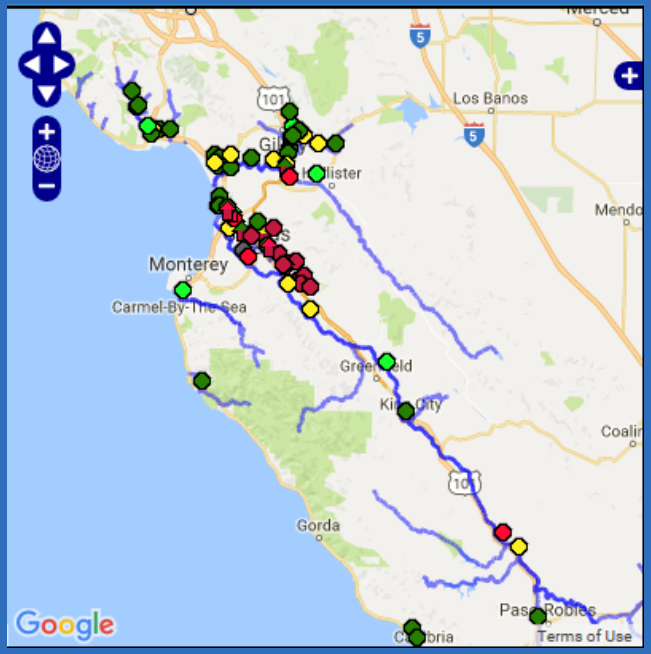


Unionized Ammonia (scored on Basin Plan general objective of 0.025 mg/L)

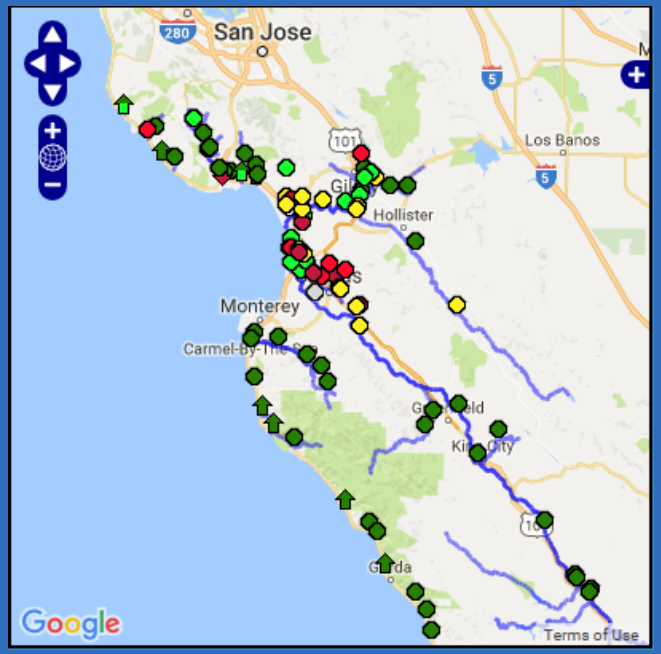


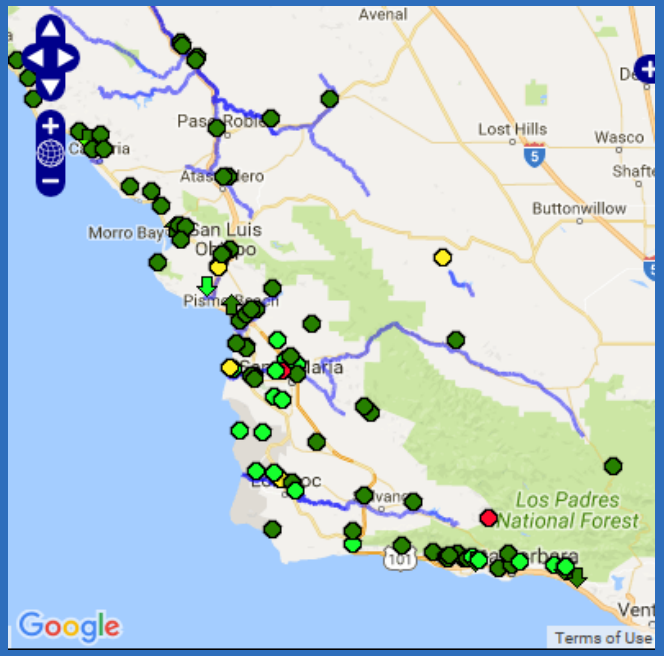


Turbidity (scored on 25 NTU, a level associated with harm to steelhead trout

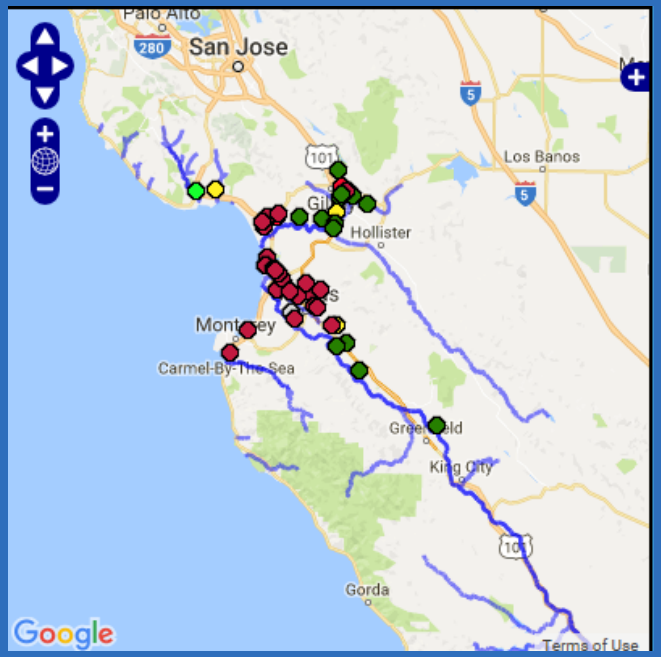


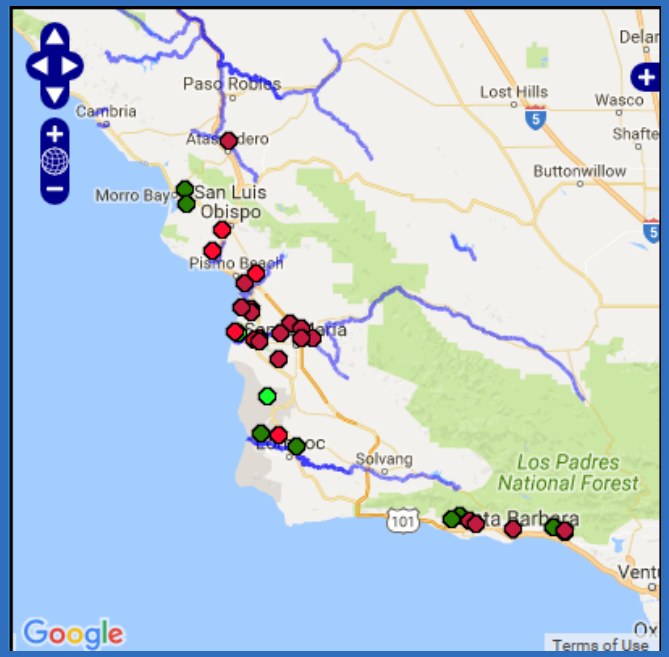
Invertebrate survival in water





Copper in water (scored on California Toxics Rule Criteria Continuous Concentration)





Bifenthrin in sediment, scored on 1/10th the Acute Lethal Concentration (LC50)

Pesticides in Sediment

Analyte	# sites	% poor or very poor	Type of pesticide
Bifenthrin	81	67%	Pyrethroid
DDT	97	65%	Legacy Organochlorine
Chlordane	97	37%	Legacy Organochlorine
Toxaphene	88	37%	Legacy Organochlorine
Cypermethrin	81	31%	Pyrethroid
Cyfluthrin	81	30%	Pyrethroid
Dieldrin	97	27%	Legacy Organochlorine
Permethrin	81	26%	Pyrethroid
Chlorpyrifos	93	3%	Organophosphate

Sediment thresholds are based on threshold effects levels and EPA Aquatic Life Benchmarks

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Pesticides in Water

Analyte	# sites	% poor or very poor	Type of pesticide
Diazinon	135	21%	Organophosphate
Chlorpyrifos	135	21%	Organophosphate
Dioxathion	26	15%	Organophosphate
Diuron	42	12%	Herbicide
Malathion	90	9%	Organophosphate
Disulfoton	90	8%	Organophosphate

Thresholds are Criteria Continuous Concentrations and lowest acute benchmark adjusted to approximate chronic effects

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Change in Conventional Analytes

Analyte	Number of sites with enough samples to detect change	Percent Improving	Percent Getting Worse	Number of sites in poor condition* *aquatic health thresholds except TDS	Percent of poor sites improving / getting worse
Ammonia, Total	175	8%	11%	12	33% / 17%
Nitrate (N)	167	15%	14%	93	23% / 19%
Turbidity	175	17%	2.3%	48	27% / 0%
Dissolved Oxygen	197	4%	10%	101	7% / 20%
Chlorophyll a	154	11%	27%	27	15% / 41%
Orthophosphate	171	5%	30%	101	6% / 39%
Total Dissolved Solids	154	6%	15%	106	9% / 18%

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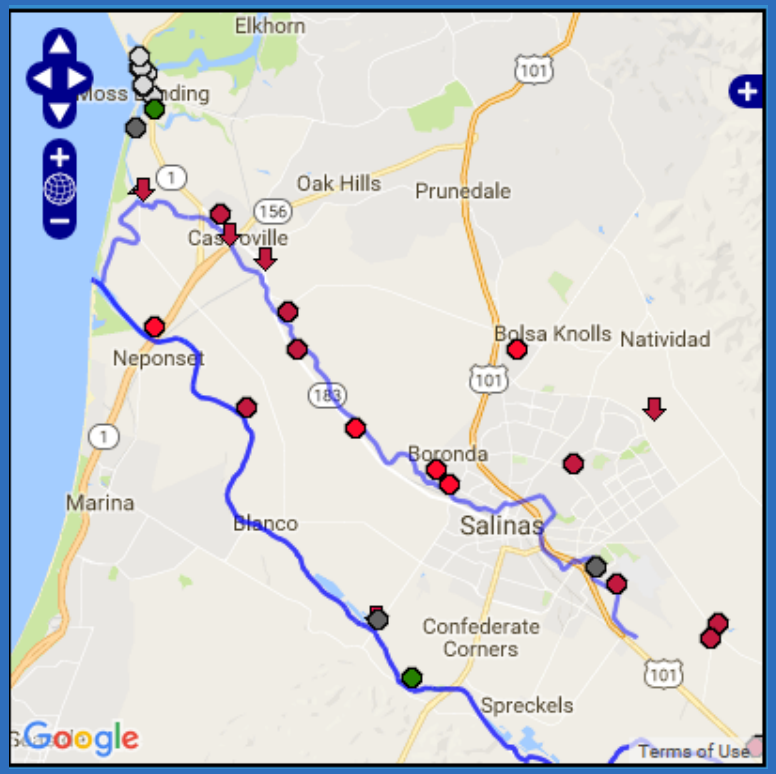
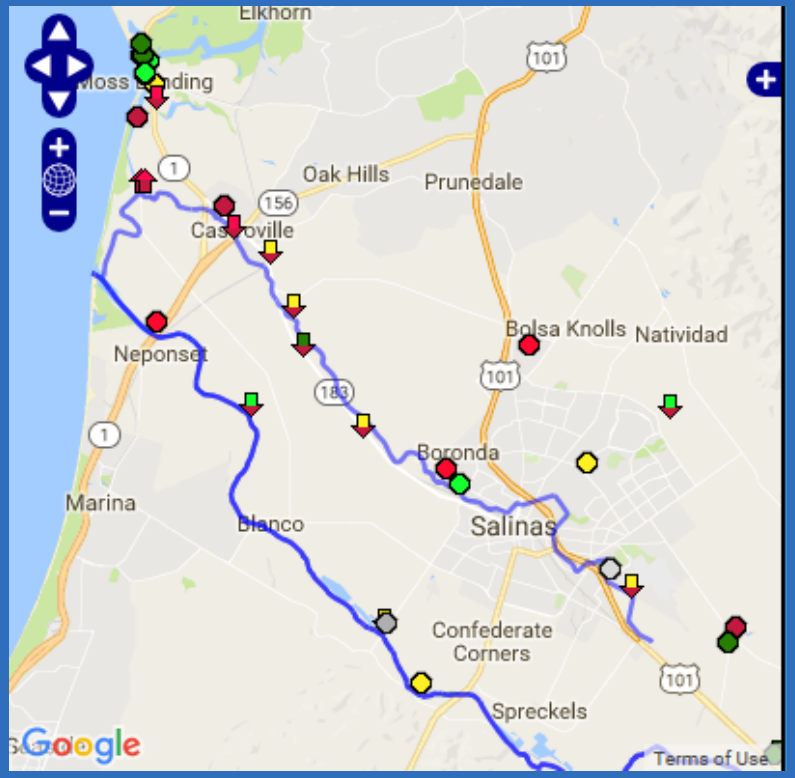
Nitrate and Chlorophyll in Salinas Reclamation Canal



Nitrate-N



Chlorophyll *a*

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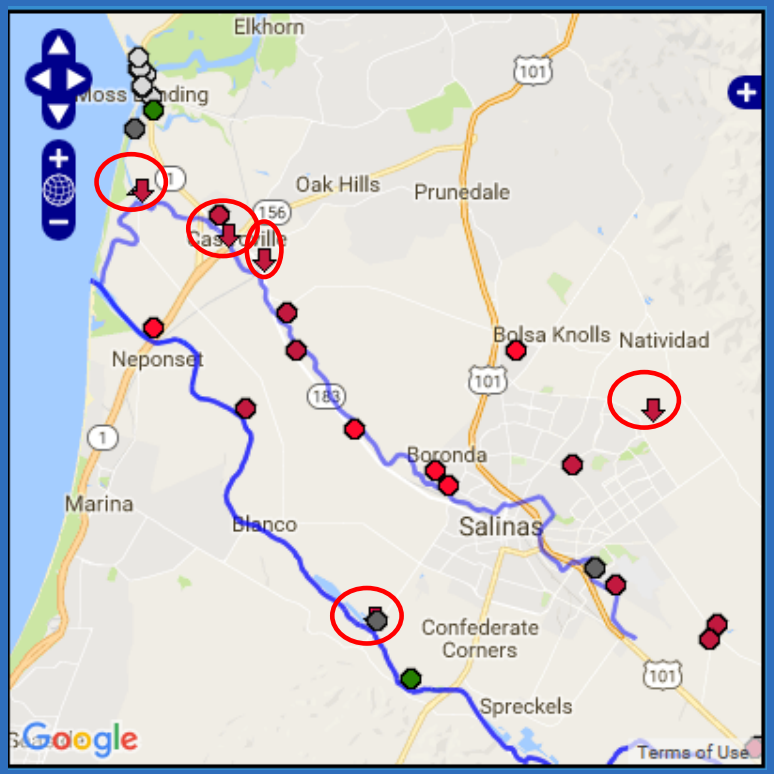
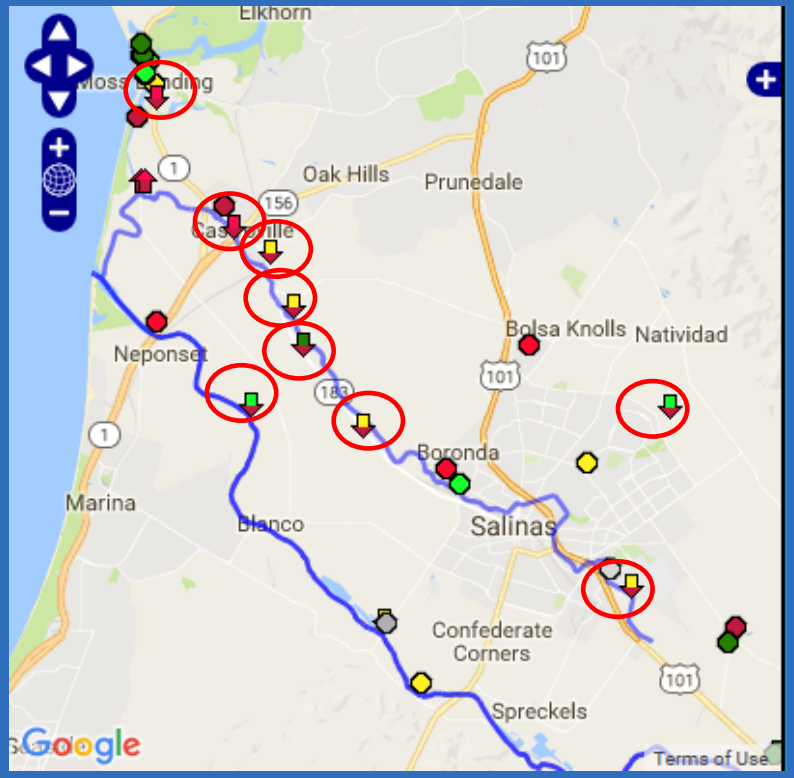
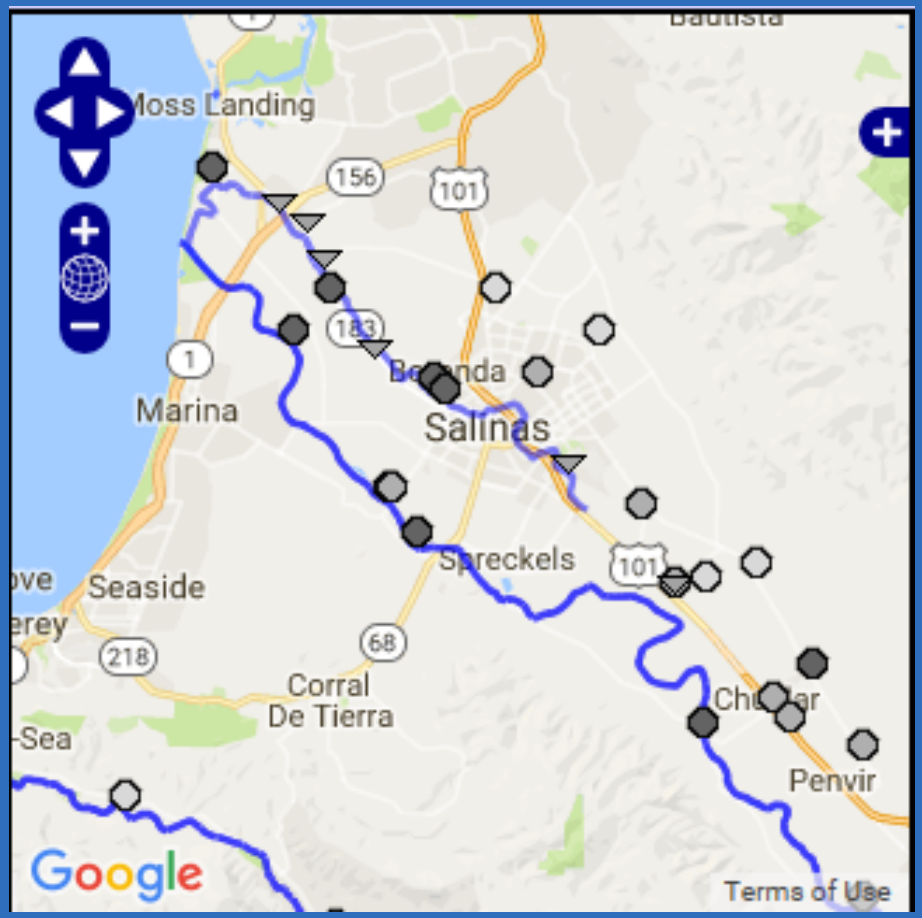


Nitrate-N



Chlorophyll *a*

Nitrate Loading



Toxicity

Sediment (invertebrate)

- 171 sites; 55 (32%) in poor or very poor condition
- No significant change

Fish

- 150 sites; 2 (1.3%) in poor or very poor condition
- No significant change

Algae

- 133 sites; 46 (27%) in poor or very poor condition
- One site shows significant change, getting worse

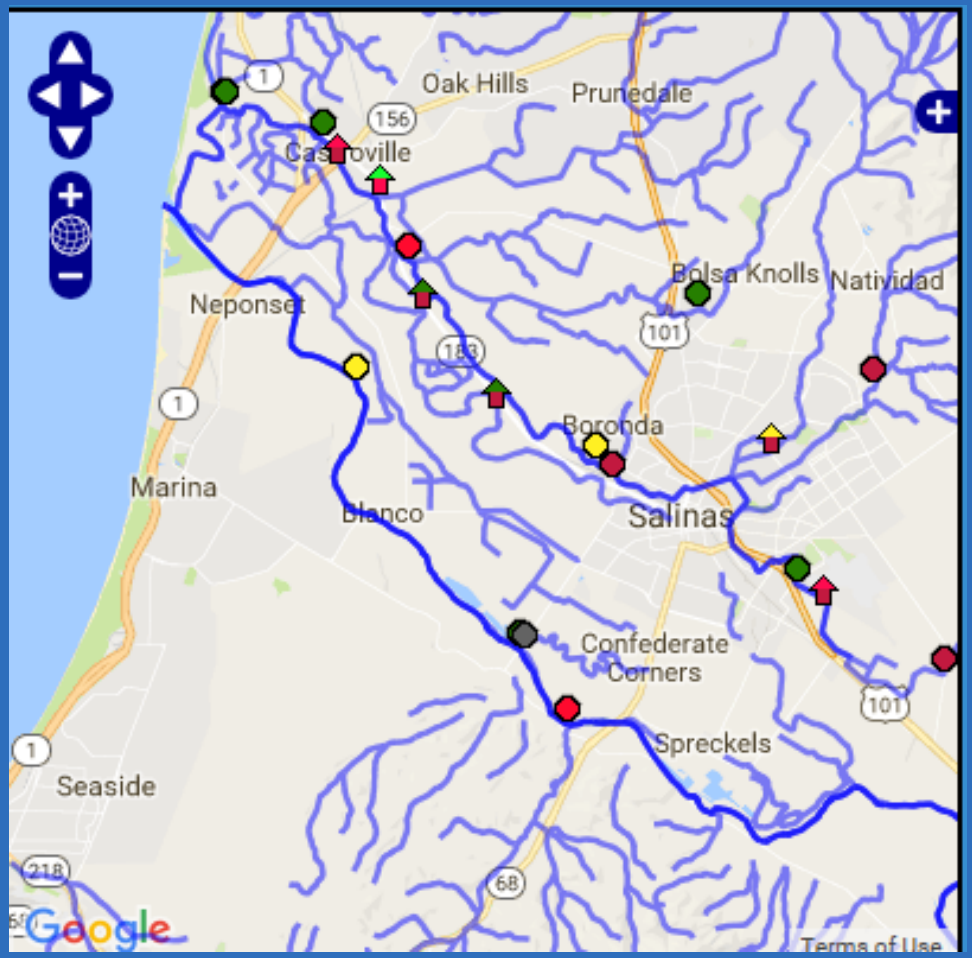
Changes in Water Column Toxicity for *Ceriodaphnia*

Watershed	# sites sampled	# sites with enough data to show change	% improving*
Salinas	39	17	41% (7)
Santa Maria	28	9	56% (5)
Pajaro	25	10	10% (1)

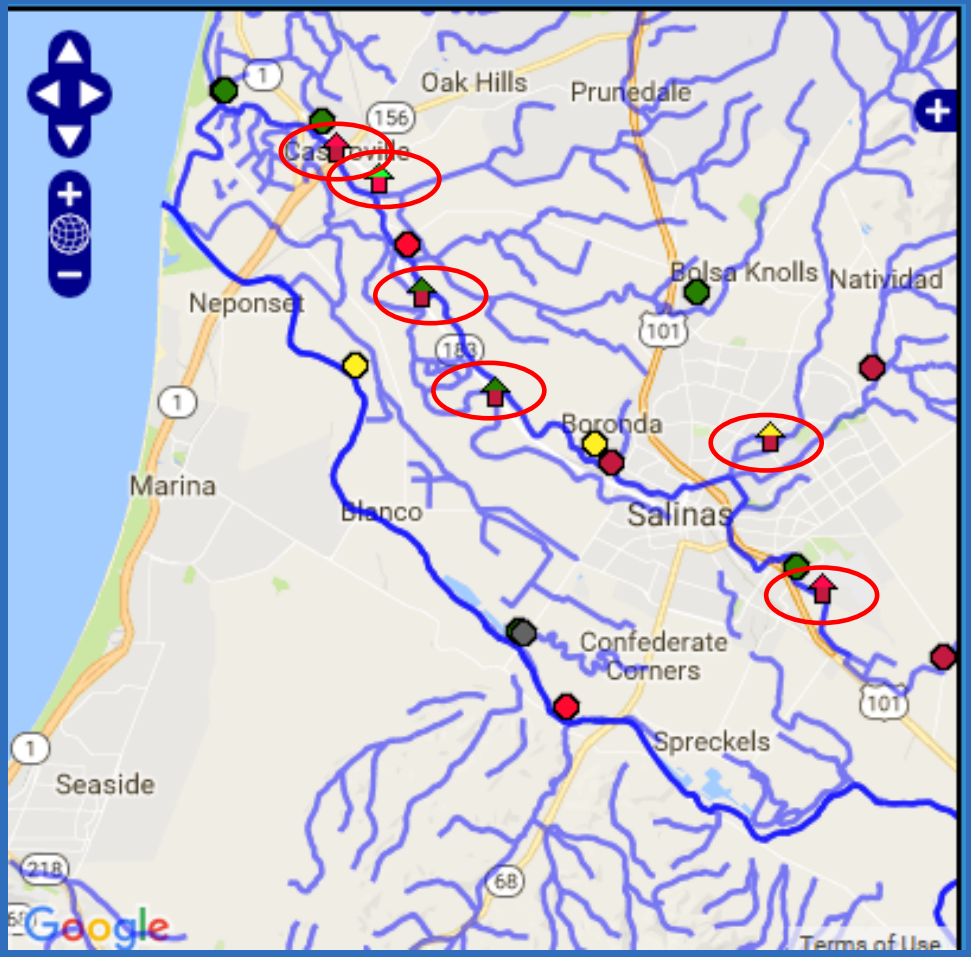
* Only one site, in Santa Maria area, showed signs of getter worse

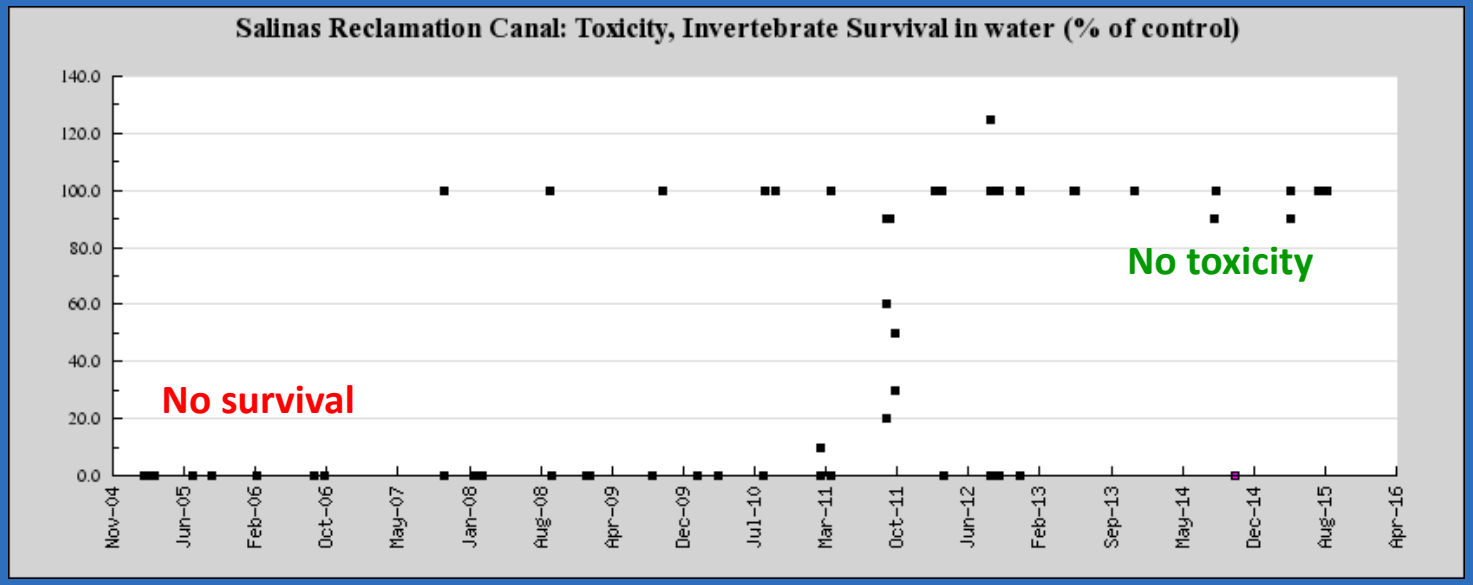
Waterbody	"Before" Mean survival	"After" Mean survival	Sample Size
Salinas	45.7	78.8	412
Santa Maria	40.2	83.0	237
Pajaro	87.5	91.2	236

Improvements in water column toxicity to *Ceriodaphnia* in the Salinas Reclamation Canal



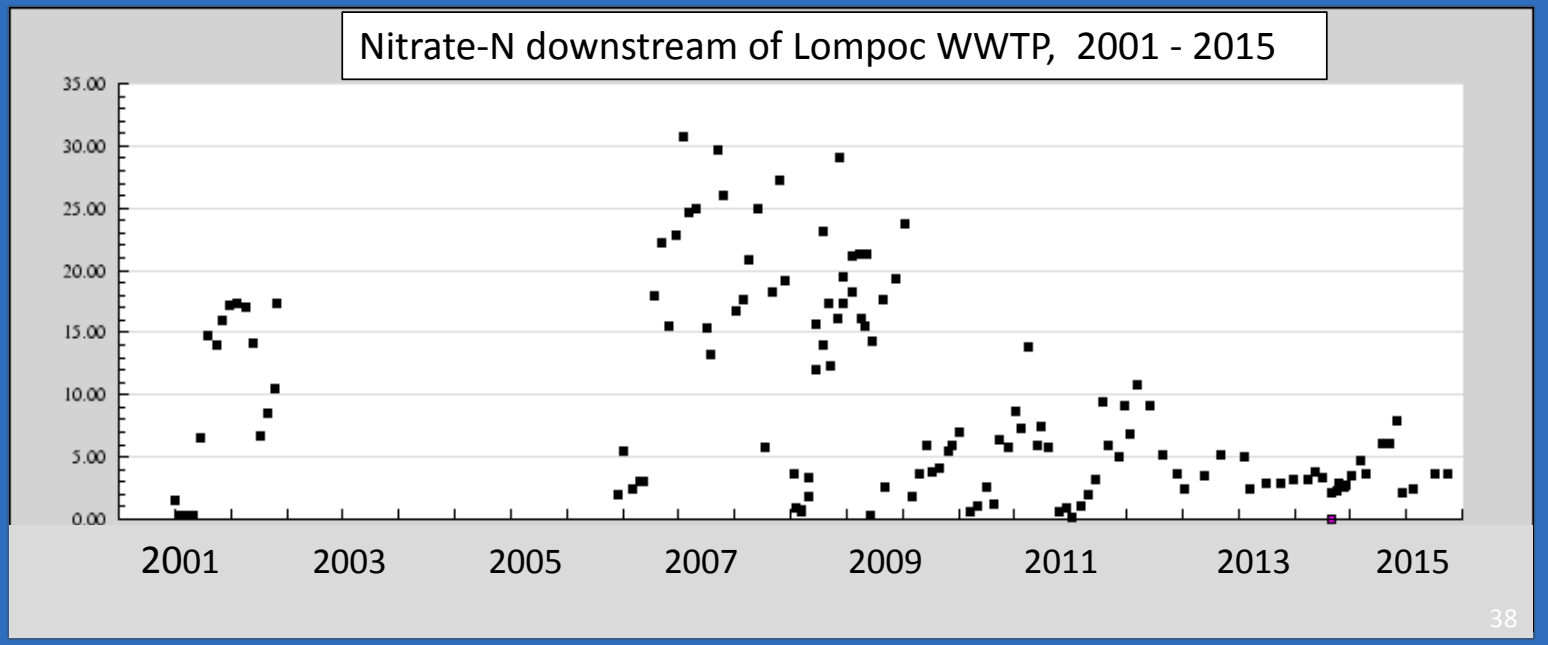
Improvements in water column toxicity to Ceriodaphnia in the Salinas Reclamation Canal




Salinas Reclamation Canal: Toxicity, Invertebrate Survival in water (% of control)
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Nov-04
Jun-05
Feb-06
Oct-06
May-07
Jan-08
Aug-08
Apr-09
Dec-09
Jul-10
Mar-11
Oct-11
Jun-12
Feb-13
Sep-13
May-14
Dec-14
Aug-15
Apr-16
No survival
No toxicity

Improving trends downstream of WWTP upgrades

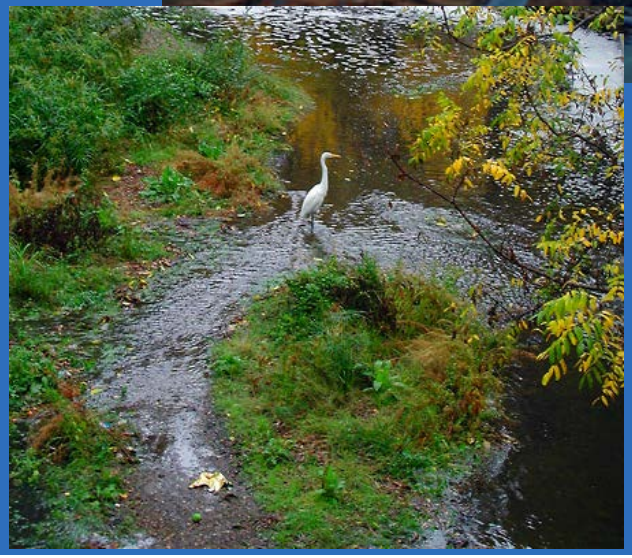
- Chorro Creek (CMC) - Nitrate, ammonia, orthophosphate
- San Simeon (Cambria) - Nitrate (see EO report)
- Santa Ynez (Lompoc) - Nitrate, ammonia, pH, oxygen



How can we use this wealth of data to understand the overall health of our watersheds?

Our Vision for the Central Coast…

Healthy Watersheds



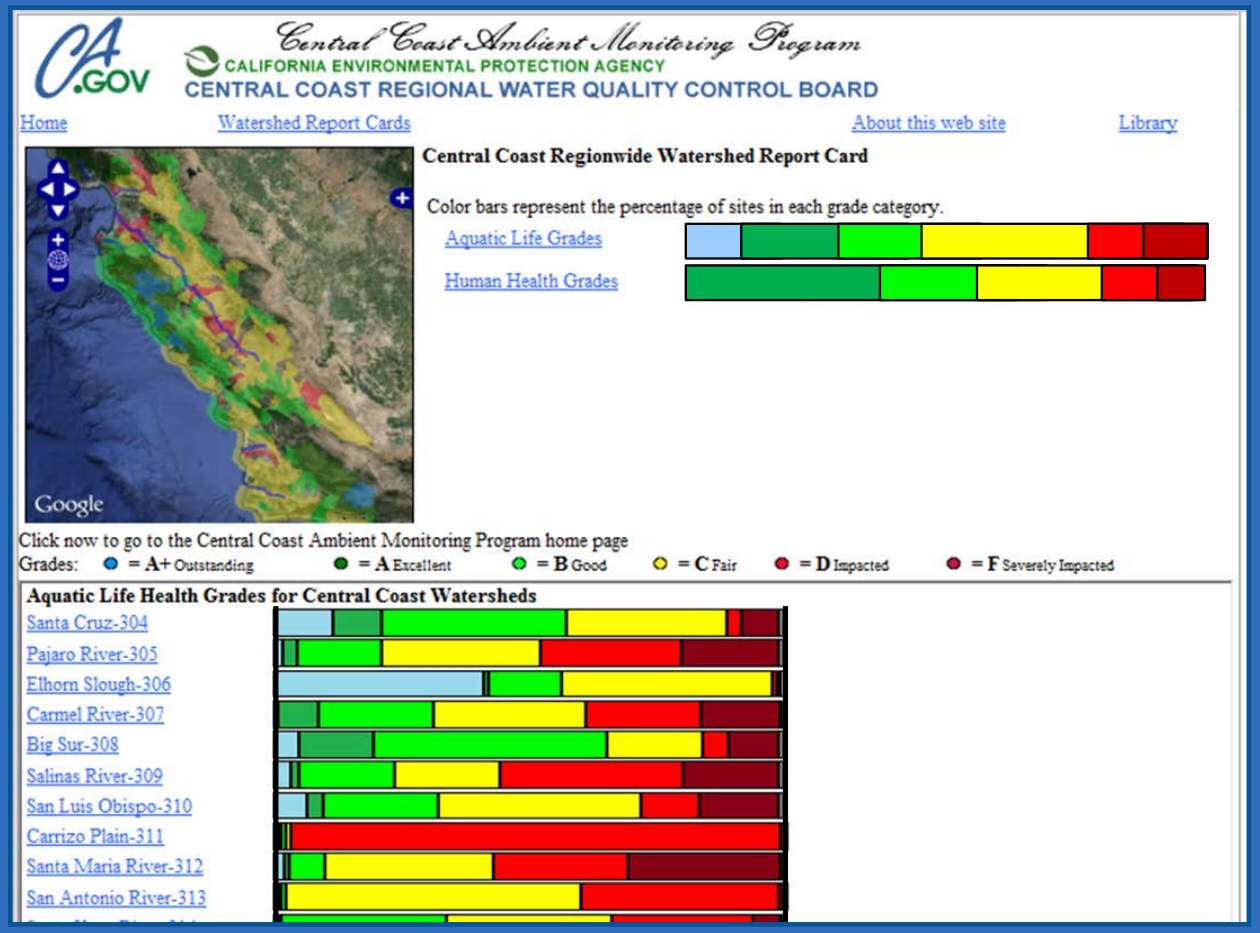
By 2025:

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

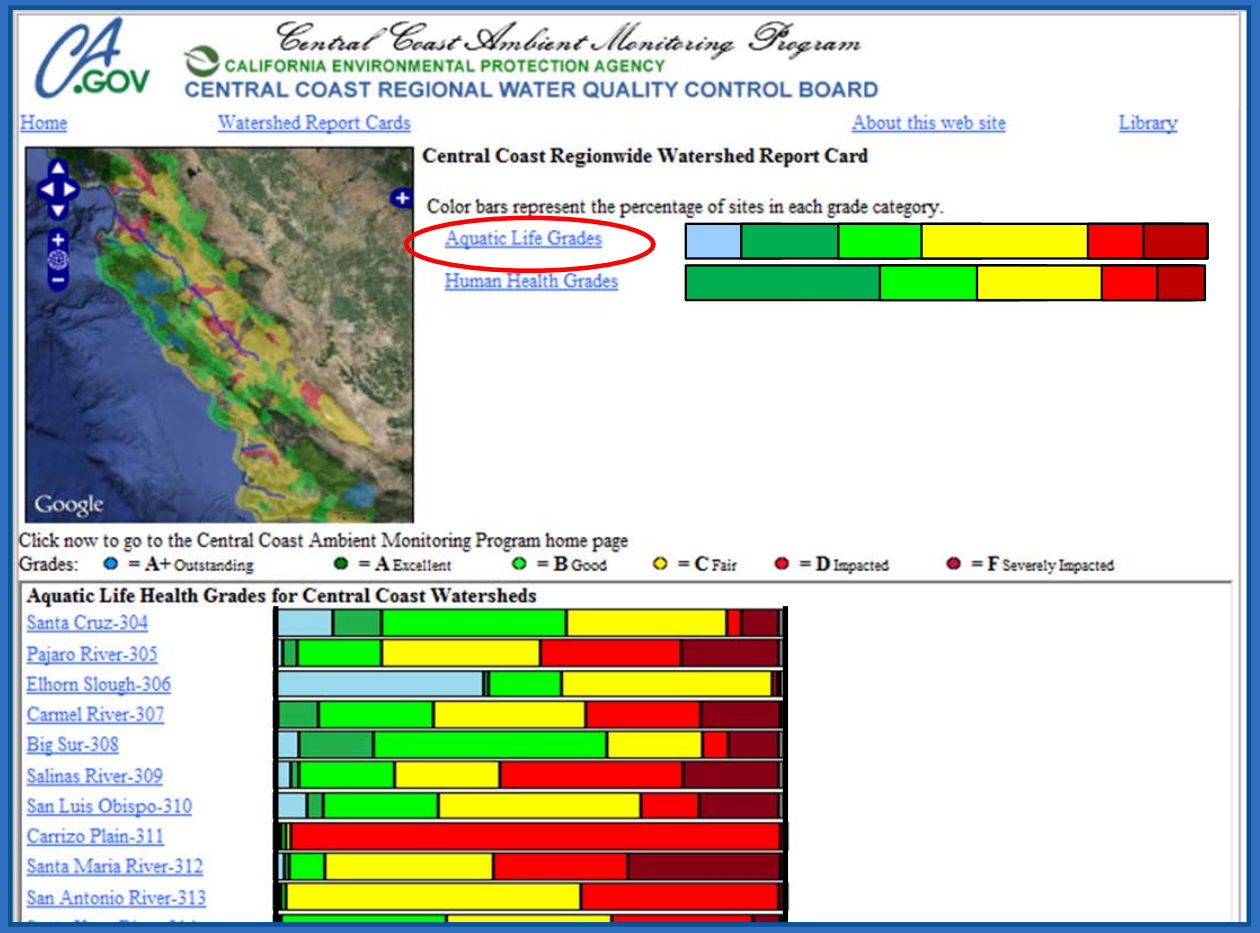
Clean Groundwater- 80 percent of ground water is clean, and the remaining 20 percent will exhibit positive trends in key parameters

Healthy Watersheds Web Report Card



(not yet publically available)

Healthy Watersheds Web Report Card



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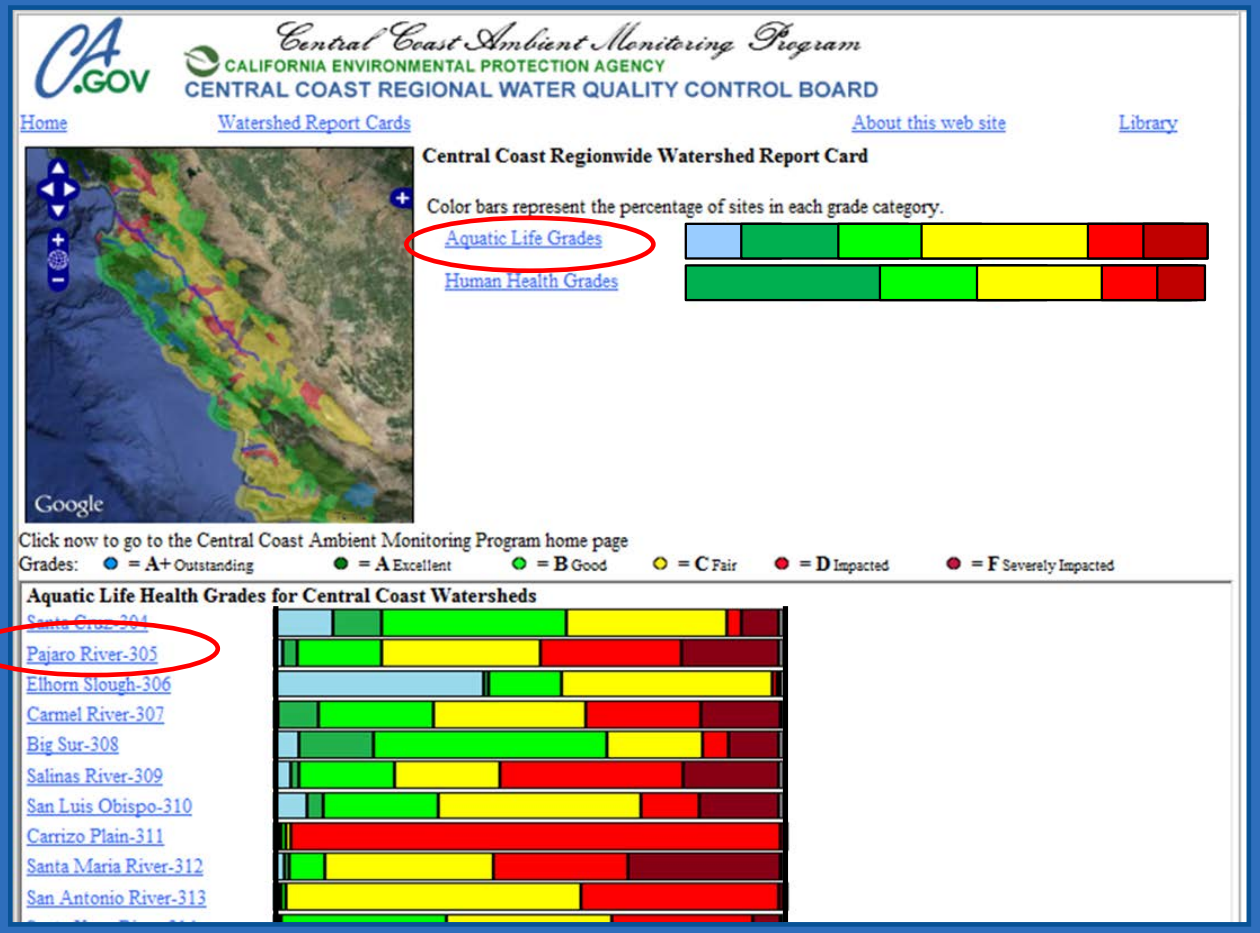

(not yet publically available)

Central Coast Ambient Monitoring Program

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

CENTRAL COAST REGIONAL WATER QUALITY CONTROL BOARD

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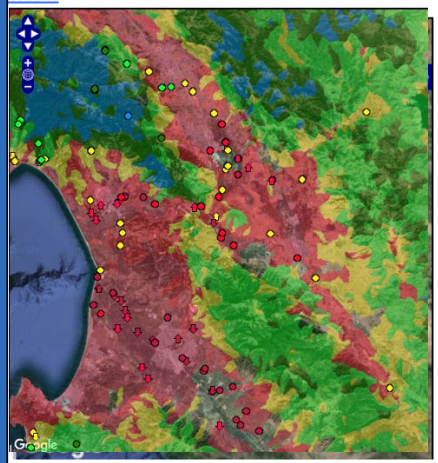
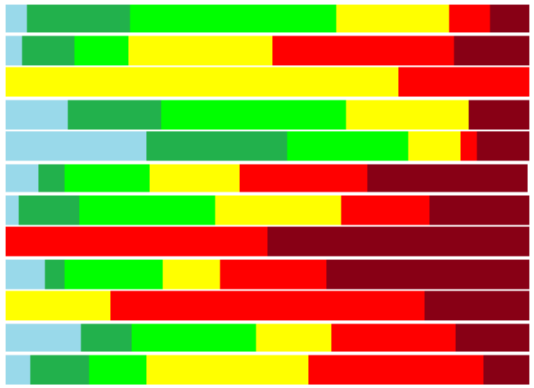


Aquatic Life Health Grades for Central Coast Watersheds



This map changes as you navigate this site (IT IS NOT YET FULLY CONNECTED TO THE DATA).

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

Aquatic Life Grades in the Pajaro River Watershed Watersheds

Waterbody	Aquatic Life Grade	Aquatic Life Score
Bodfish Creek	A	94
Carnadero Creek	C	67
Clear Creek (San Benito County)	C	73
Corralitos Creek	C	72
Furlong Creek	C	72
Harkins Slough	C	79
Laguna Creek	B	85
Little Arthur Creek	A	97
Llagas Creek	B	82
Llagas Creek (above Chesbro Reservoir)	B	88
Llagas Creek (below Chesbro Reservoir)	D	58
Millers Canal	D	54

Central Coast Ambient Monitoring Program

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

CENTRAL COAST REGIONAL WATER QUALITY CONTROL BOARD

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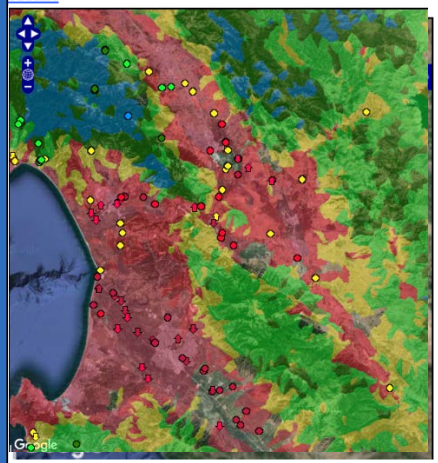

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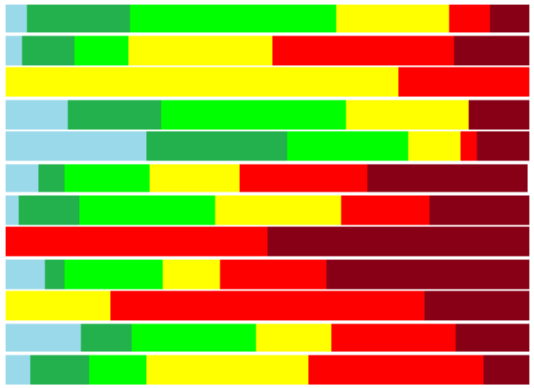

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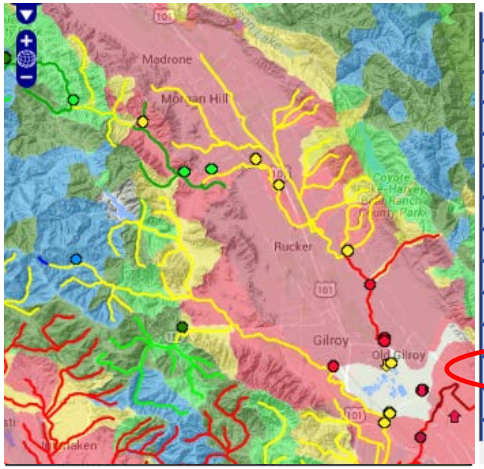


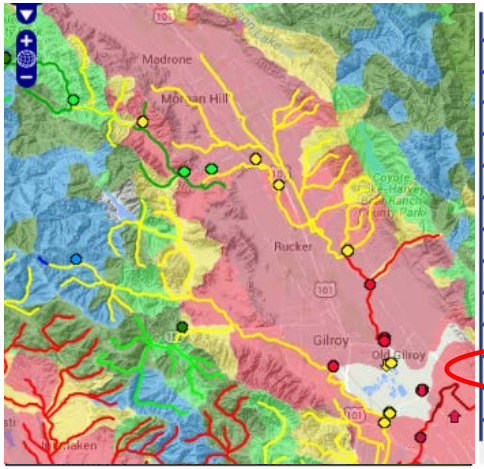
Beach Road Ditch	D	56
Bodfish Creek	A	94
Carnadero Creek	C	70
Clear Creek (San Benito County)	C	72
Corralitos Creek	B	88
Furlong Creek	D	63
Harkins Slough	C	74
Laguna Creek	B	84
Little Arthur Creek	A	97
Llagas Creek	B	85
Llagas Creek (above Chesbro Reservoir)	B	88
Llagas Creek (below Chesbro Reservoir)	D	57
Millers Canal	D	54
Pacheco Creek	C	72

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

Aquatic Life Health Grades for Sites - Llagas Creek (below Chesbro Reservoir)

Watersheds Waterbodies

Site	Site Name	Aquatic Life Grade	Aquatic Life Score
305CE0484	Llagas Creek Below Sycamore Avenue	B	85
305HOL	Llagas Creek at Holsclaw below Leavesley Rd.	D	52
305LEA	Llagas Creek at Leavesley Rd	D	55
305LGCABR	Llagas Creek @ Bloomfield Rd. above bridge	F	35
305LHB	Llagas Creek at Highway 152	D	45
305LLA	Llagas Creek at Bloomfield Avenue	D	58
305LUC	Llagas Creek at Luchessa Avenue-Southside Drive	C	66
305MON	Llagas Creek at Monterey Rd	C	66
305OAK	Llagas Creek at Oak Glen Avenue	B	80
305PS0061	Llagas Creek below E San Martin Ave	C	71



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305LLA	Llagas Creek at Bloomfield Avenue	D	58
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Central Coast Ambient Monitoring Program

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

CENTRAL COAST REGIONAL WATER QUALITY CONTROL BOARD

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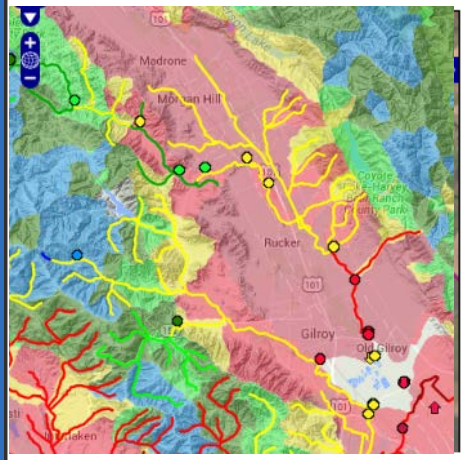

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Grades: = A+ Outstanding = A Excellent = B Good = C Fair = D Poor = F Very Poor

Llagas Creek at Bloomfield Avenue (305LLA) Watersheds Waterbodies Sites

Aquatic Life	Conventional Analytes	Biostimulation	Biology	Toxicity	Metals	Organic Chemicals
D (61)	72	53			90	16

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

Healthy Watersheds Home

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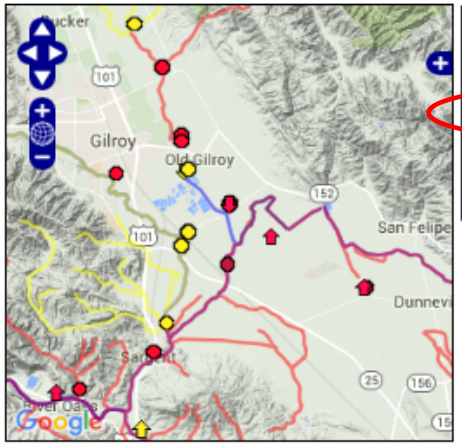


*	Analyte	Units	Matrix	Min	Mean	Max	Samples	Grade	Score	Threshold
	Water Temperature	degrees c	water	9.4	16.4	20.1	162	C	79	18
	Ammonia as N,Total	mg/l	water	0.01	0.07	0.34	59	A	97	1.9
	Nitrate,Nitrite as N	mg/l	water	1.42	12.1	22	59	F	4	1
	OrthoPhosphate as P	mg/l	water	0.003	0.04	0.23	59	B	81	0.13
	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

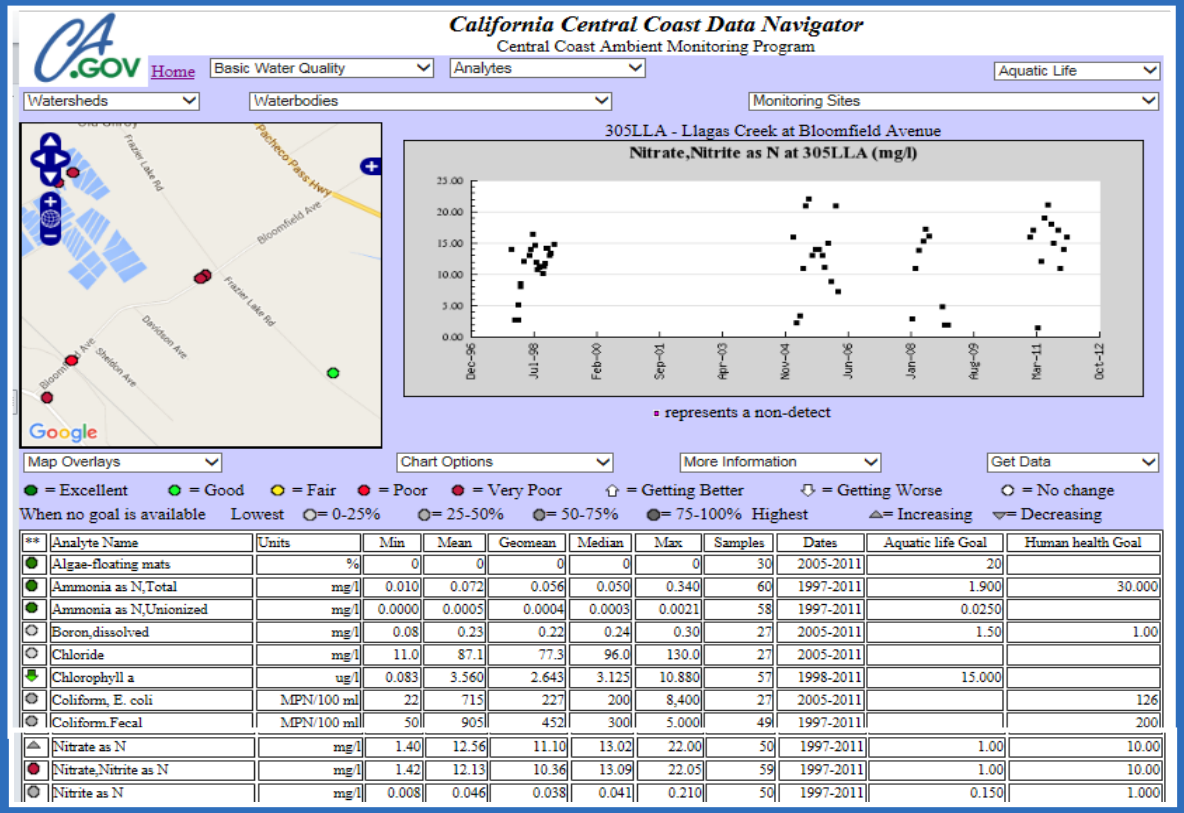
Grades: = **A+** Outstanding = **A** Excellent = **B** Good = **C** Fair = **D** Poor = **F** Very Poor

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

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

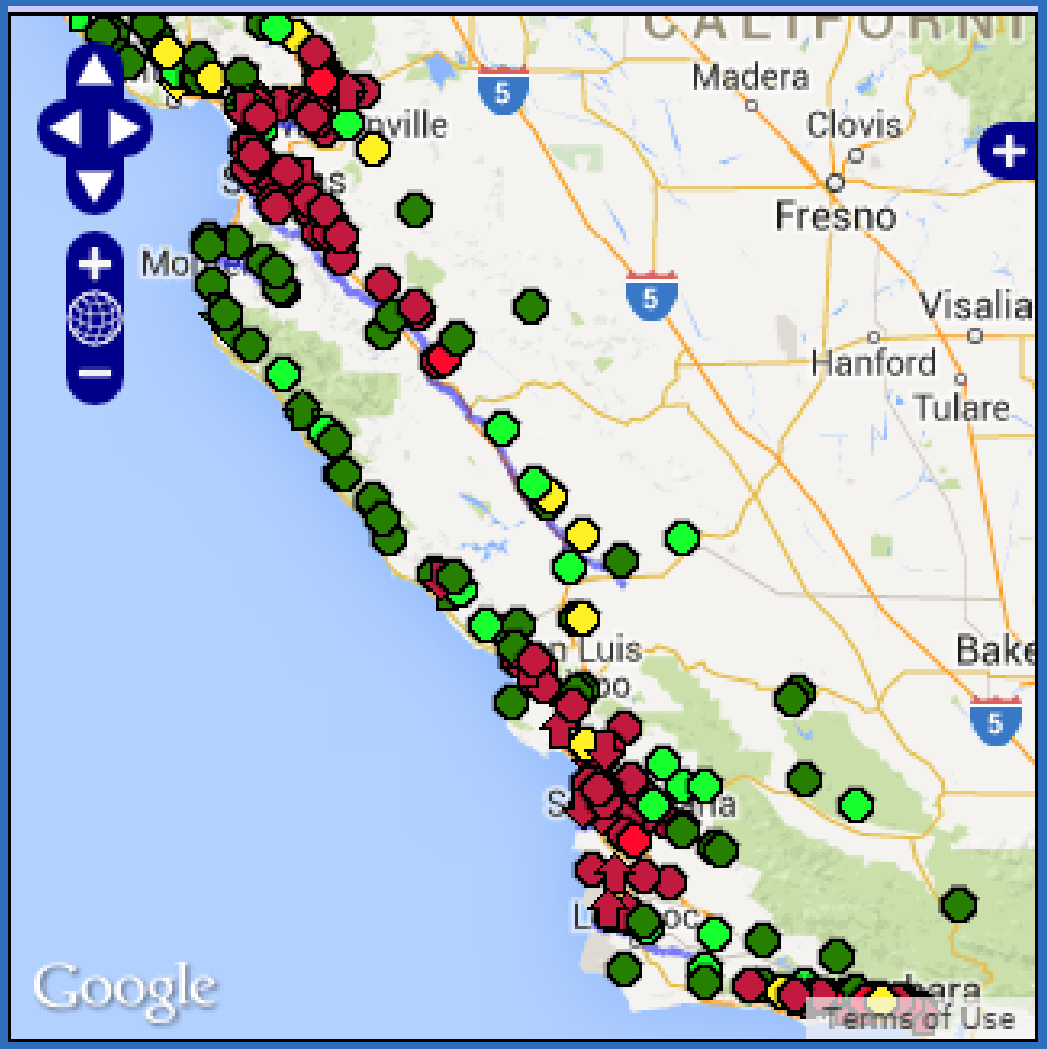
"Report Card" provides index scores for different data types and access to individual analyte scores. It also provides wiki space for written assessments by staff.



**	Analyte Name	Units	Min	Mean	Geomean	Median	Max	Samples	Dates	Aquatic life Goal	Human health Goal
	Algae-floating mats	%	0	0	0	0	0	30	2005-2011	20	
	Ammonia as N,Total	mg/l	0.010	0.072	0.056	0.050	0.340	60	1997-2011	1.900	30.000
	Ammonia as N,Unionized	mg/l	0.0000	0.0005	0.0004	0.0003	0.0021	58	1997-2011	0.0250	
	Boron,dissolved	mg/l	0.08	0.23	0.22	0.24	0.30	27	2005-2011	1.50	1.00
	Chloride	mg/l	11.0	87.1	77.3	96.0	130.0	27	2005-2011		
	Chlorophyll a	ug/l	0.083	3.560	2.643	3.125	10.880	57	1998-2011	15.000	
	Coliform, E. coli	MPN/100 ml	22	715	227	200	8,400	27	2005-2011		126
	Coliform,Fecal	MPN/100 ml	50	905	452	300	5,000	49	1997-2011		200
	Nitrate as N	mg/l	1.40	12.56	11.10	13.02	22.00	50	1997-2011	1.00	10.00
	Nitrate,Nitrite as N	mg/l	1.42	12.13	10.36	13.09	22.05	59	1997-2011	1.00	10.00
	Nitrite as N	mg/l	0.008	0.046	0.038	0.041	0.210	50	1997-2011	0.150	1.000

Report Card connects to CCAMP Data Navigator to access data, maps, graphs, summary stats, trend analysis and other statistical tools

Scoring at site/analyte level….



Combining Measures into a Aquatic Life Index score for the site

Sub-Indices

- Conventional Analytes
- Toxicity
- Biostimulatory Risk
- Metals
- Organic Chemicals
- Biology (bugs, algae)
- Habitat

Integrating Site level data into a spatial assessment of whole watersheds

- Measured data overlaid on modeled data to adjust scoring
- Site scores (including change scores) are attributed to upstream reaches
- Land Use boundaries define spatial extent of scoring

Modeled data from California's Healthy Watersheds (CADMUS) Assessment

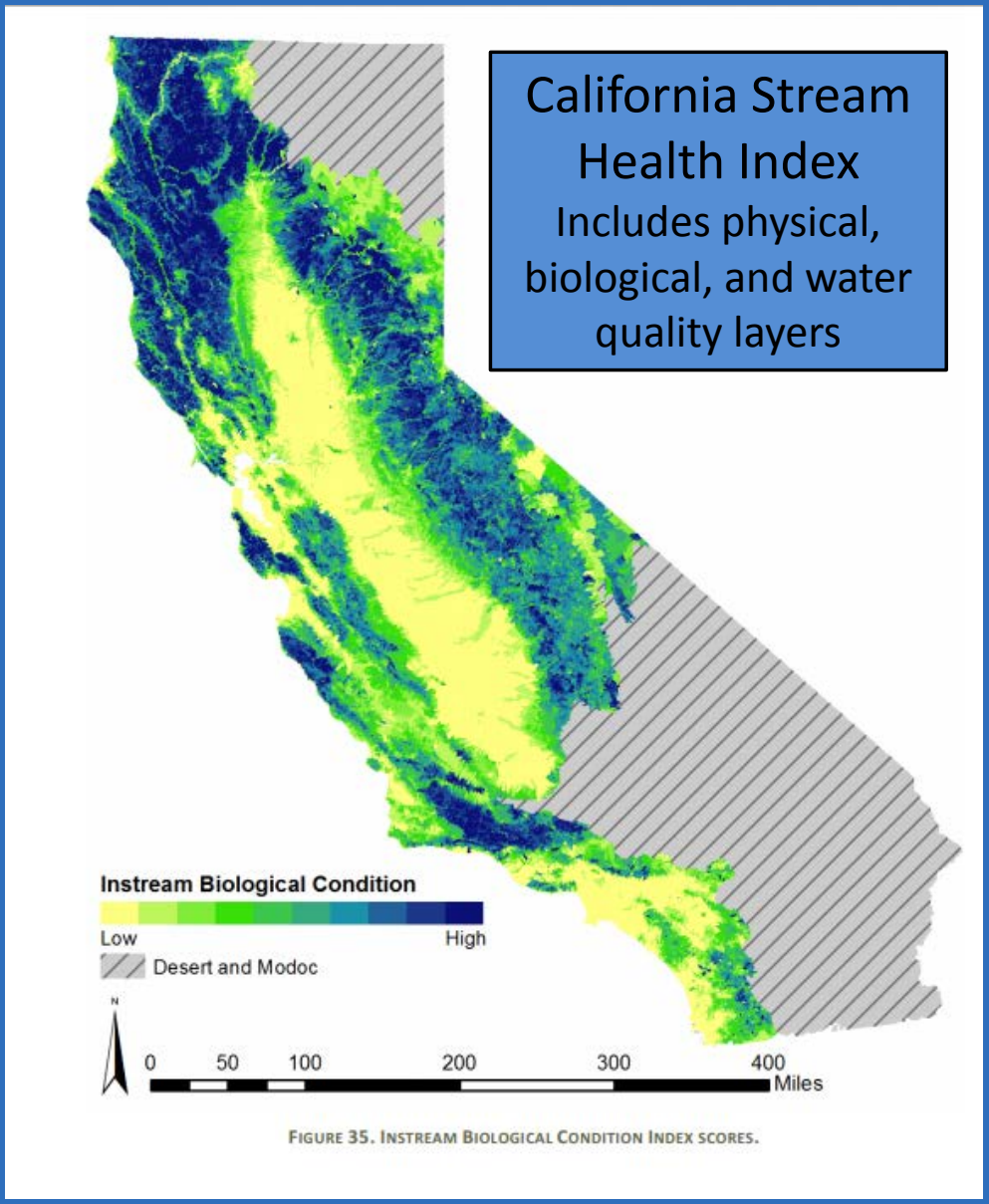
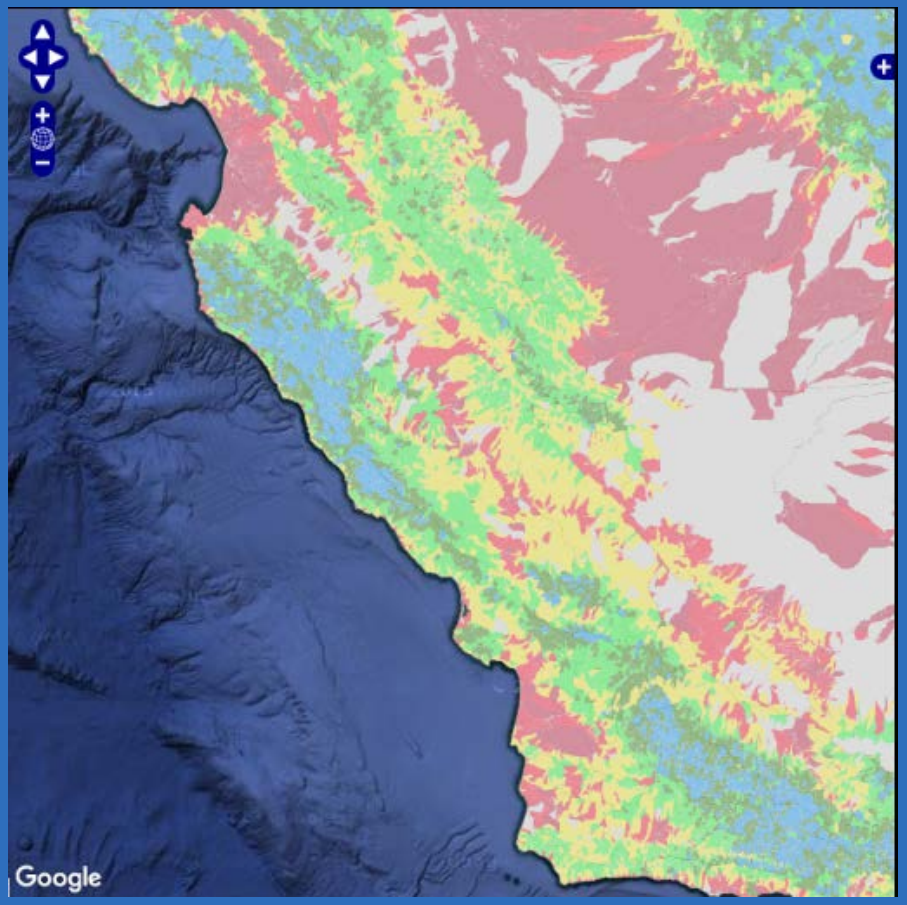
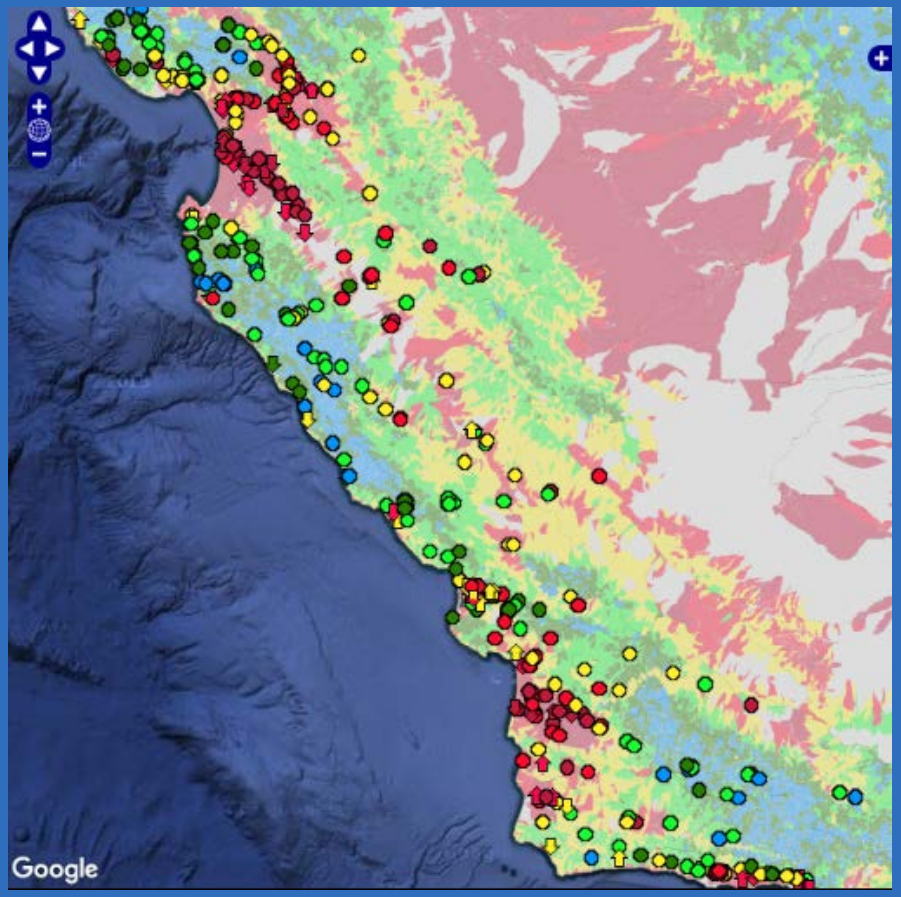


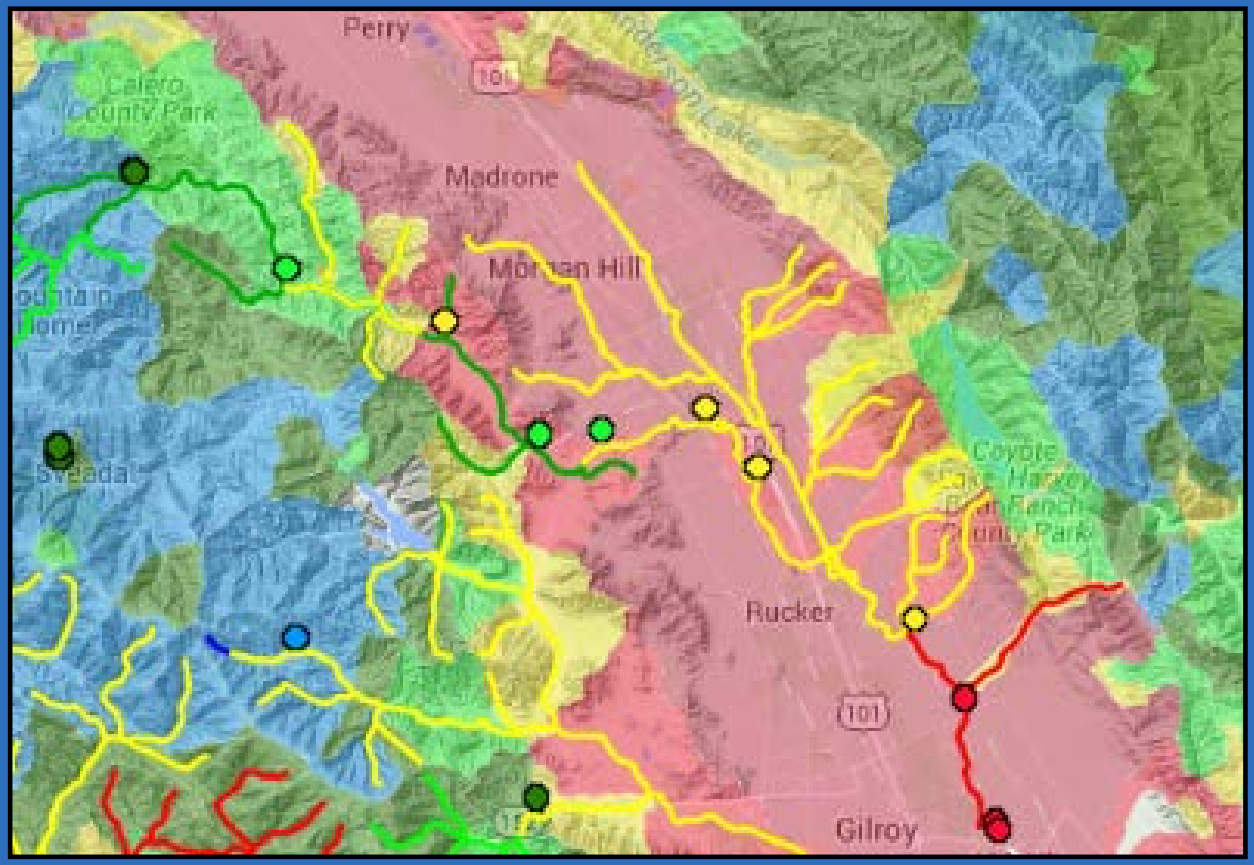
FIGURE 35. INSTREAM BIOLOGICAL CONDITION INDEX SCORES.

CADMUS Stream Health Index in the Central Coast Region, using report card coloring paradigm



Central Coast Aquatic Life Index scores and CADMUS Stream Health



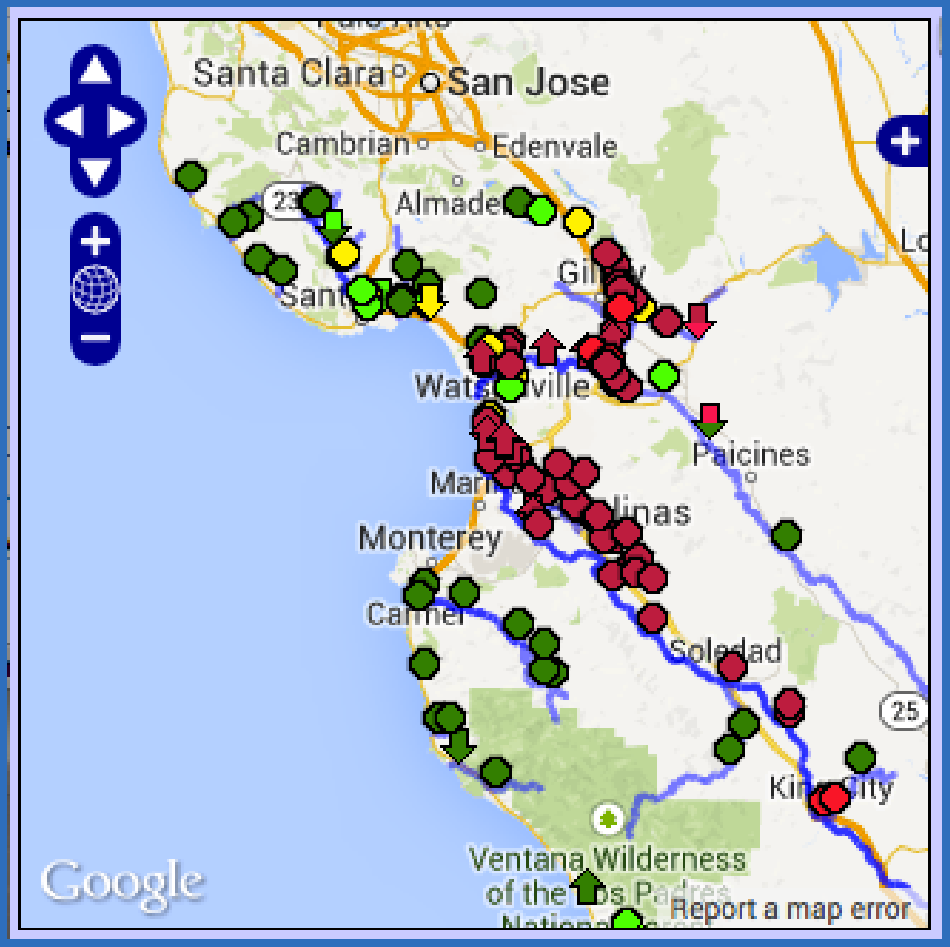


Site scores are modifying upstream reaches, overlaid on California HSP “Stream Health” data layer

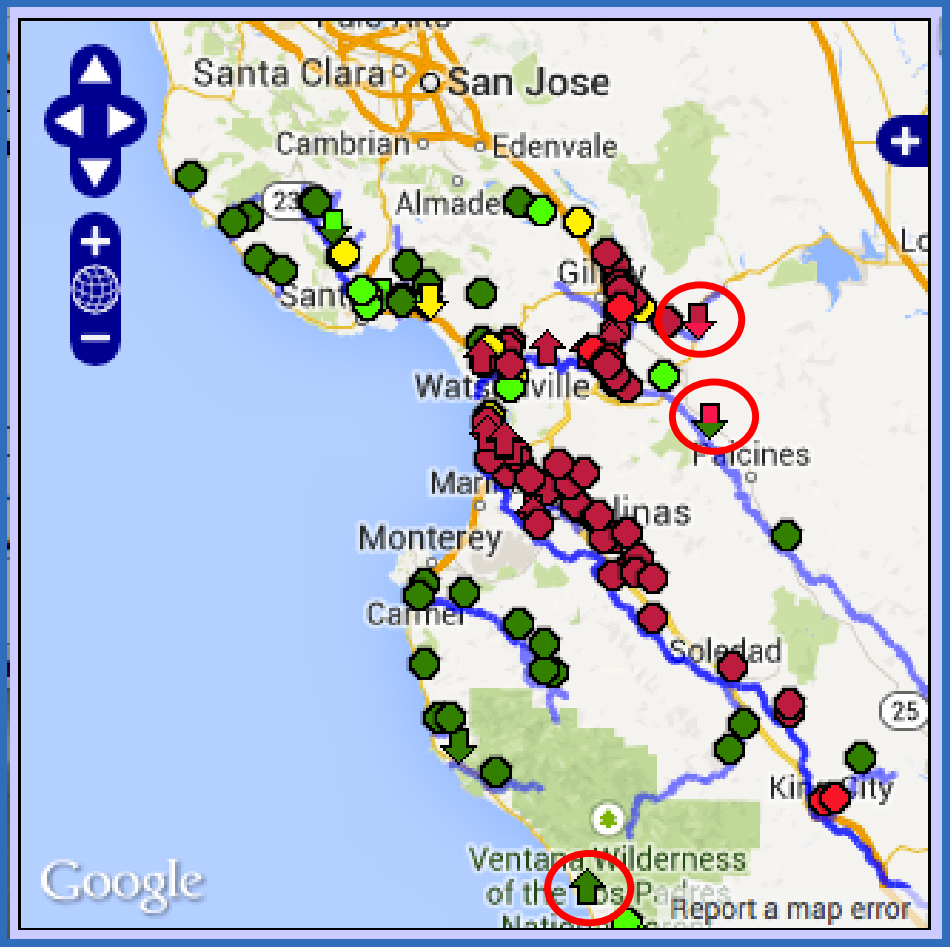
Next Steps

- Finalize our aquatic life evaluation
- Work with other programs to develop and/or compile existing spatial measures of land management
- Develop and implement a spatial display approach for Geotracker/GAMA groundwater data

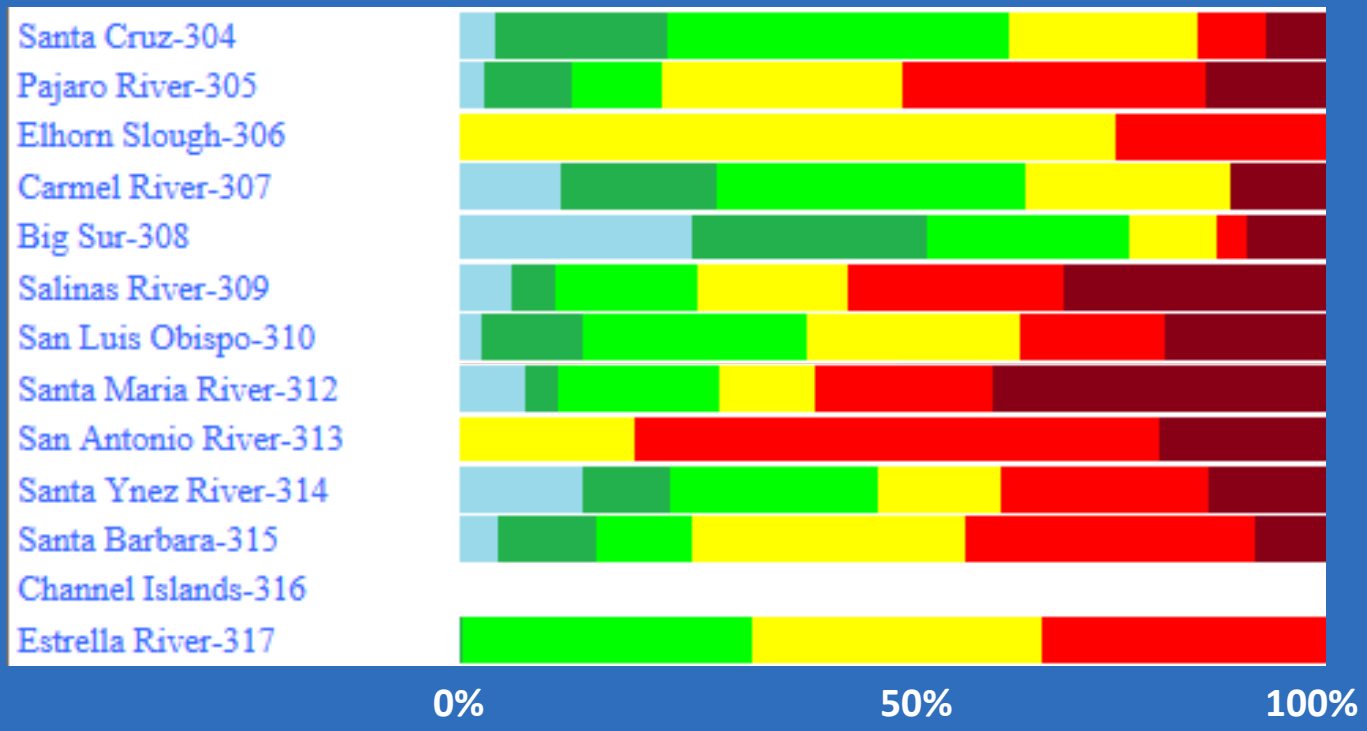
This versatile tool supports smart decision-making and can measure tangible program outcomes in support of our Vision



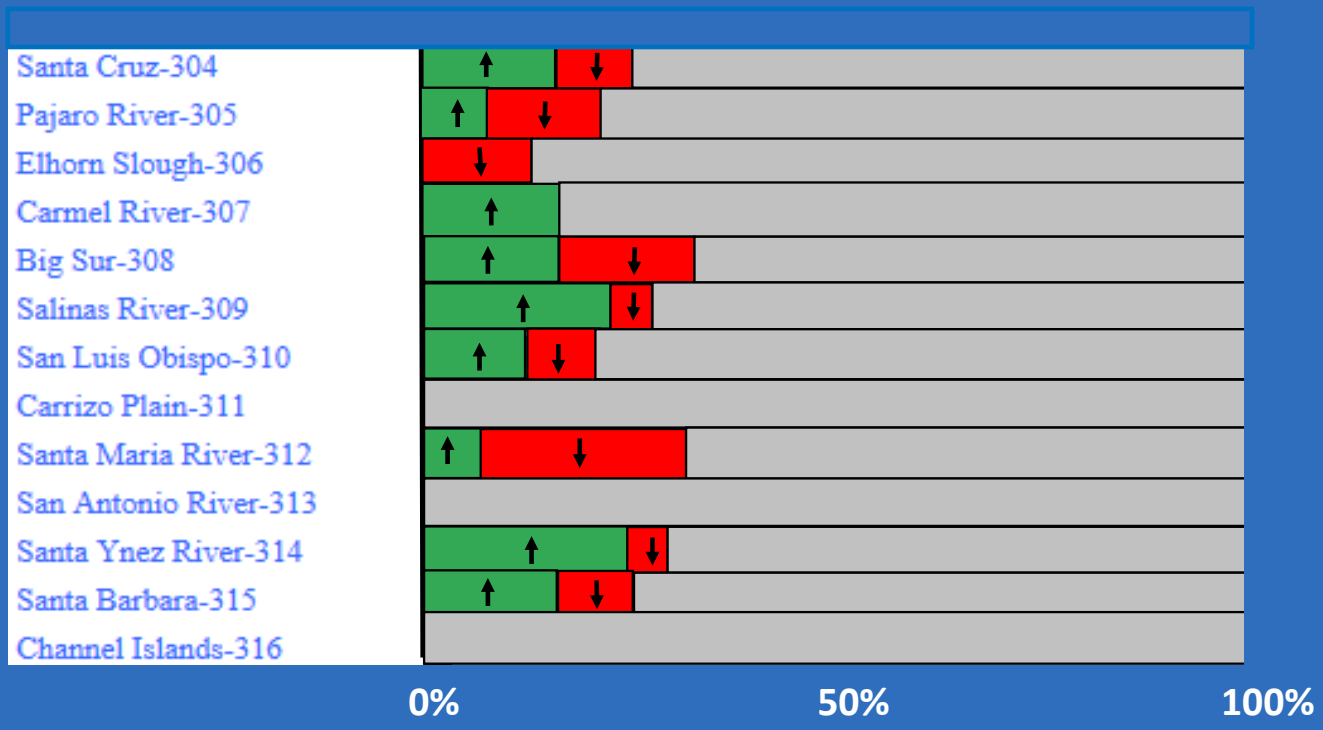
From our website: Nitrate in the Monterey Area



From our website: Nitrate in the Monterey Area (note arrow icons denoting change).



Report Card Scores for Hydrologic Unit areas



Percent of Hydrologic Unit areas showing improvement (green) or degradation (red) in health scores.

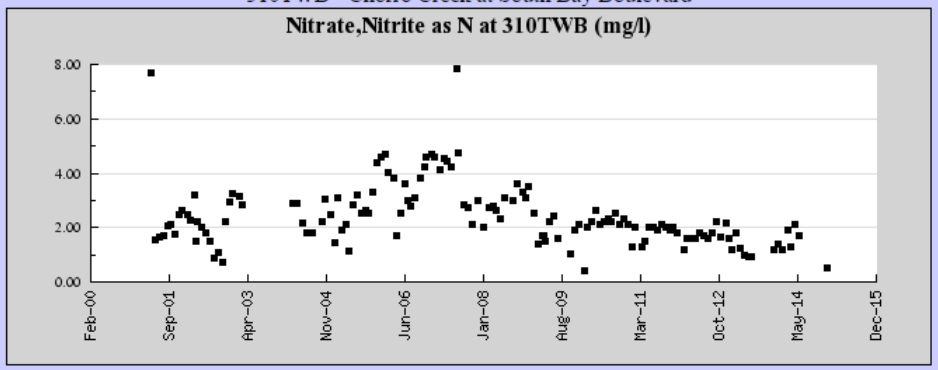
California Central Coast Data Navigator

Central Coast Ambient Monitoring Program

Home | Basic Water Quality | Analytes | Aquatic Life

Watersheds | Waterbodies | Monitoring Sites

310TWB - Chorro Creek at South Bay Boulevard



▪ represents a non-detect

Map Overlays | Chart Options | More Information | Get Data

● = Excellent ● = Good ● = Fair ● = Poor ● = Very Poor ⇧ = Getting Better ⇩ = Getting Worse ○ = No change

When no goal is available Lowest ○= 0-25% ○= 25-50% ○= 50-75% ○= 75-100% Highest △= Increasing ▽= Decreasing

**	Analyte Name	Units	Min	Mean	Geomean	Median	Max	Samples	Dates	Aquatic life Goal	Human health Goal
●	Algae-filamentous	%	0	22	15	5	100	25	2001-2004	50	
●	Algae-floating mats	%	0	0	3	0	10	107	2005-2015	20	
●	Ammonia as N,Total	mg/l	0.010	0.046	0.035	0.030	0.360	144	2001-2014	1.900	30.000
⇧	Ammonia as N,Unionized	mg/l	0.0001	0.0015	0.0008	0.0007	0.0368	140	2001-2014	0.0250	
▽	Boron,dissolved	mg/l	0.01	0.13	0.12	0.11	0.26	133	2001-2014	1.50	1.00
▽	Chloride	mg/l	29.0	83.1	79.5	83.0	130.0	134	2001-2014		
⇩	Chlorophyll a	ug/l	0.000	2.634	1.422	1.600	35.920	136	2001-2015	15.000	
○	Coliform, E. coli	MPN/100 ml	4	402	87	86	19,000	109	2005-2014		126
●	Coliform,Fecal	MPN/100 ml	8	664	142	155	50,000	140	2001-2014		200
●	Coliform,Total	mpn/100 ml	46	4,810	1,171	920	160,000	139	2001-2014		1,000
▽	Dissolved Solids,Total	mg/l	270.0	611.6	604.8	610.0	890.0	141	2001-2014		500.0

AQUATIC LIFE GOAL: 80% of aquatic habitat is healthy; remaining 20% exhibit positive trends in key parameters

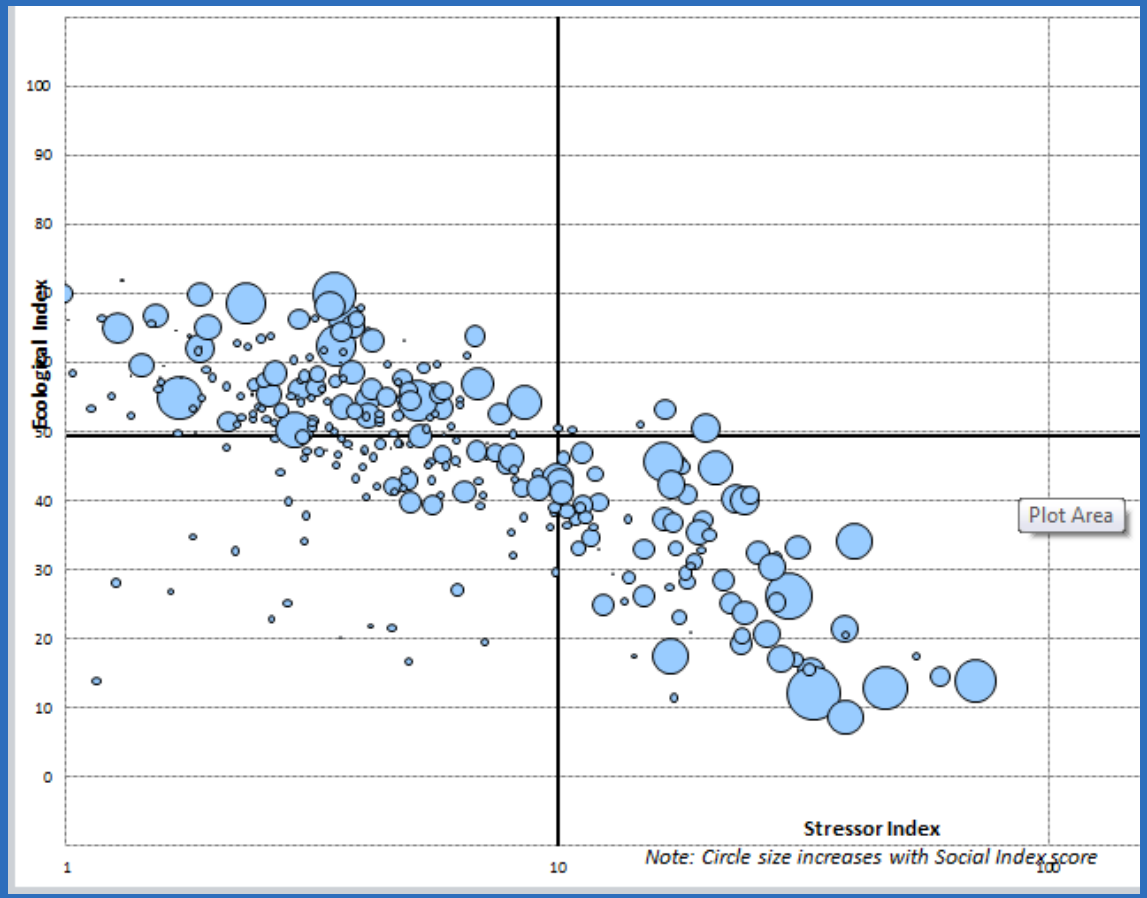
INTEGRATION OF:

I. Multiple data types into a report card assessment of "healthy aquatic habitat"

III. Trends in analytes, indices and spatial areas

II. Site level data and modeled data into a spatial assessment of whole watersheds

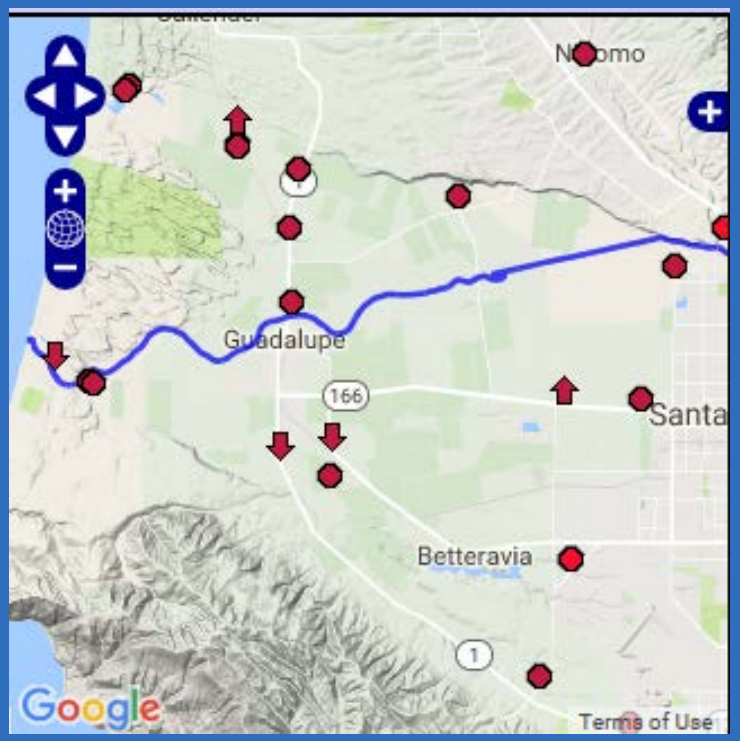
Recovery Potential provides a way to assess ability to implement protection and/or recovery for streams and watersheds

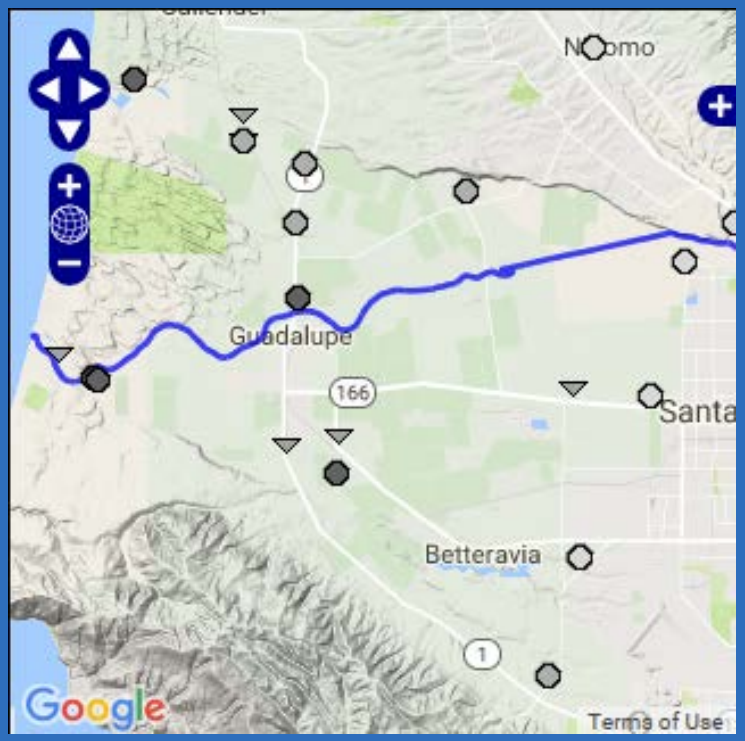


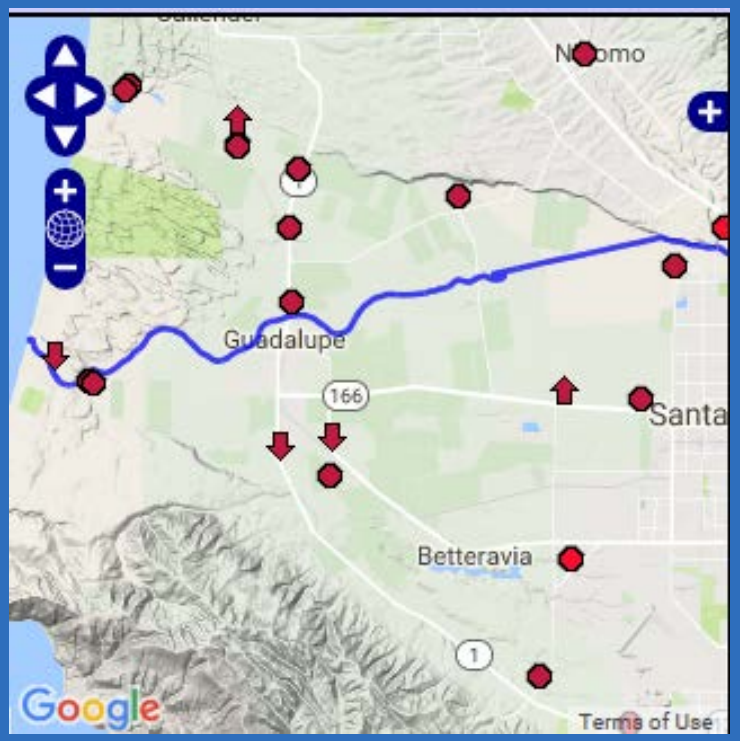
Ecological Index

Stressor Index

Nitrate Loading






Guadalupe
166
Santa
Betteravia
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Google
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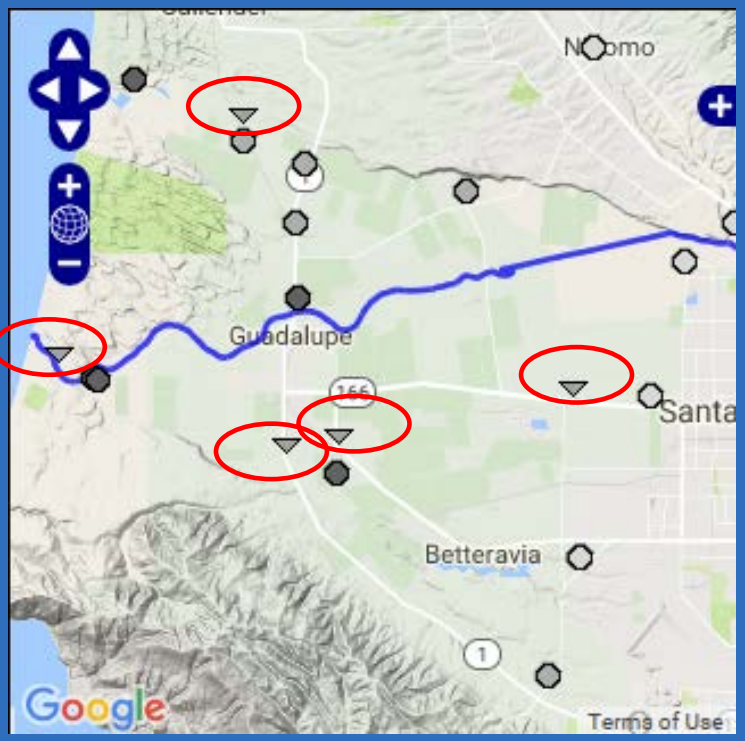
Guadalupe
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Santa
Betteravia
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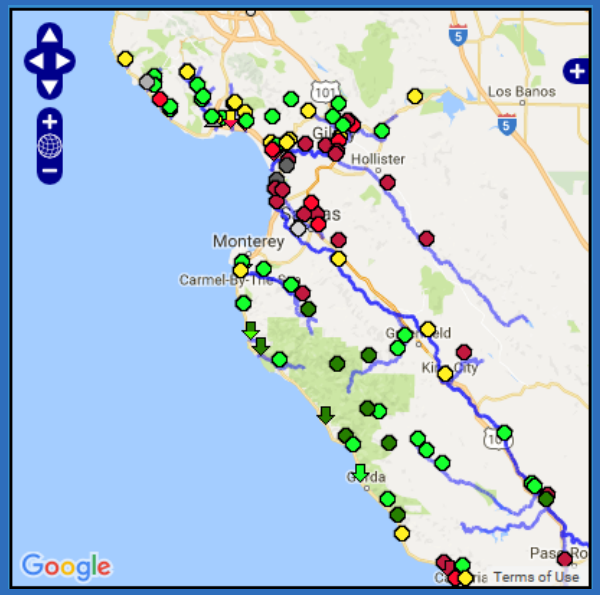
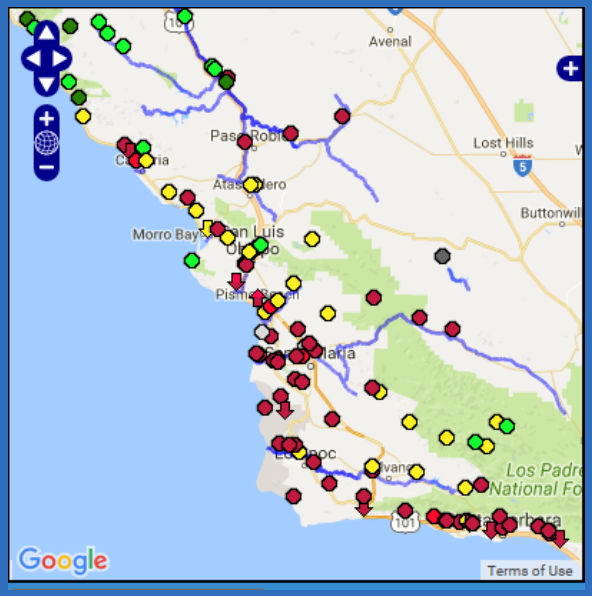
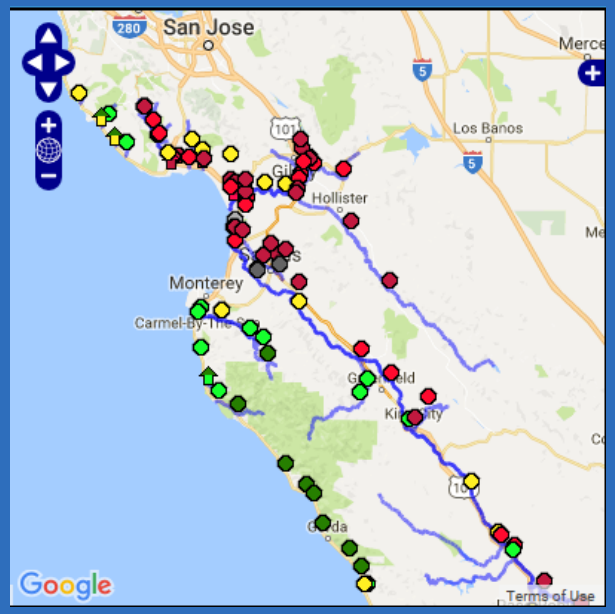
Some analytes show regional differences that may relate to land use as well as geology.

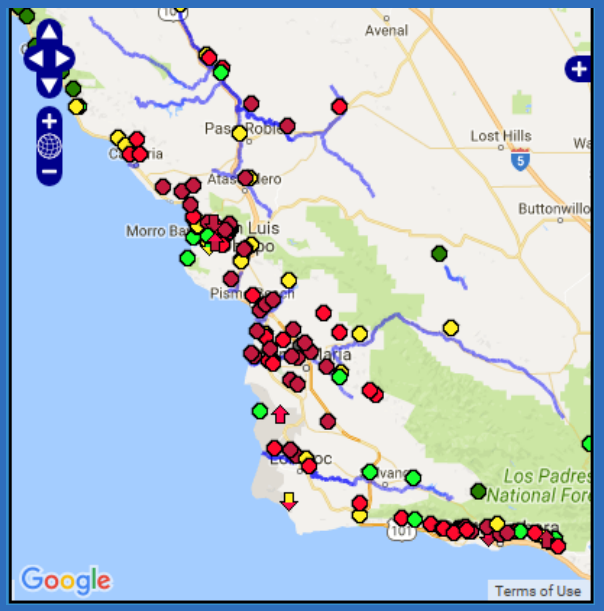




Sodium (Scored on 60 mg/L, a US EPA Advisory Threshold for Taste)

Some problems are more widespread. Pathogen indicators are elevated virtually wherever human activities are present.





E. coli (scored on 126 MPN/ml as a geomean)