

Status, Trend and Change Evaluation and Web Displays of Data for Healthy Watershed Assessments



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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

To address our goals we needed to characterize both status (health) and change

- Multi-metric approach
- Use of measured regional data and modeled State Watershed Health Assessment
- Use of site specific data to score reaches
- A consistent, threshold-based scoring approach across all analytes
- Change at different scales
 - Analyte scale
 - Multi-metric scale

Scoring Analytes

- Adapted from Canadian Water Quality Index (CCME)
- Combines magnitude and exceedance quotients (MEQ)
- “Report card” paradigm for scoring

A - Excellent

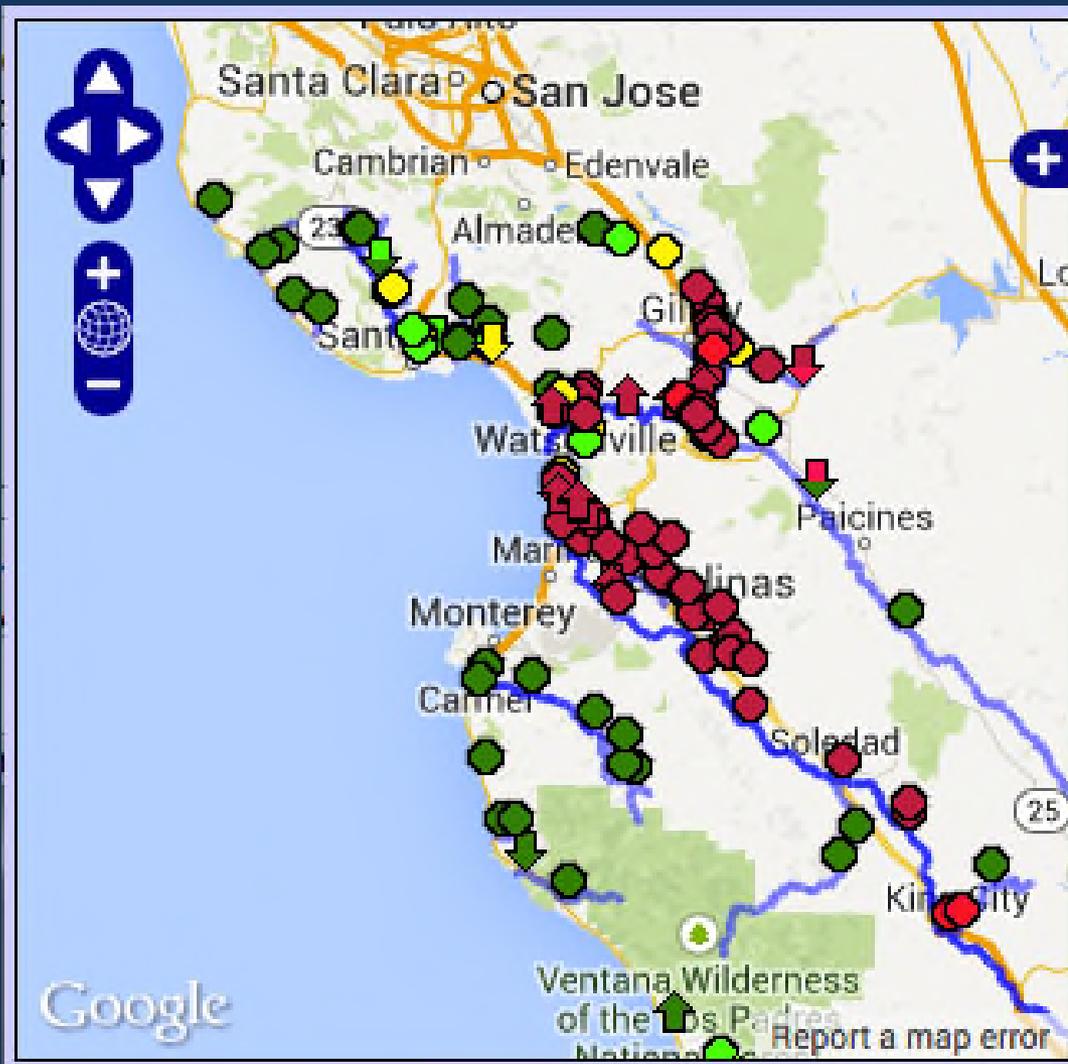
B - Good

C - Fair

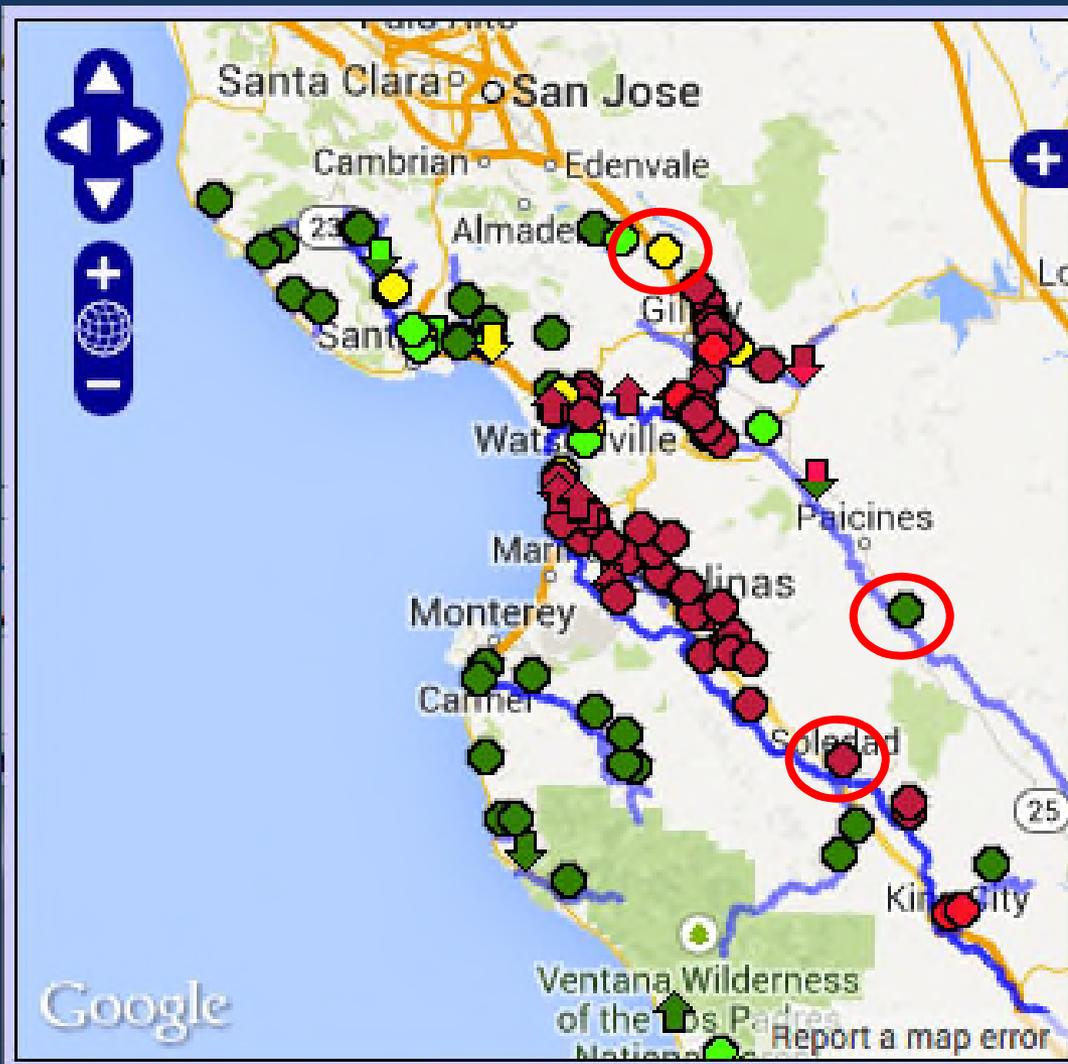
D - Poor

F - Very Poor

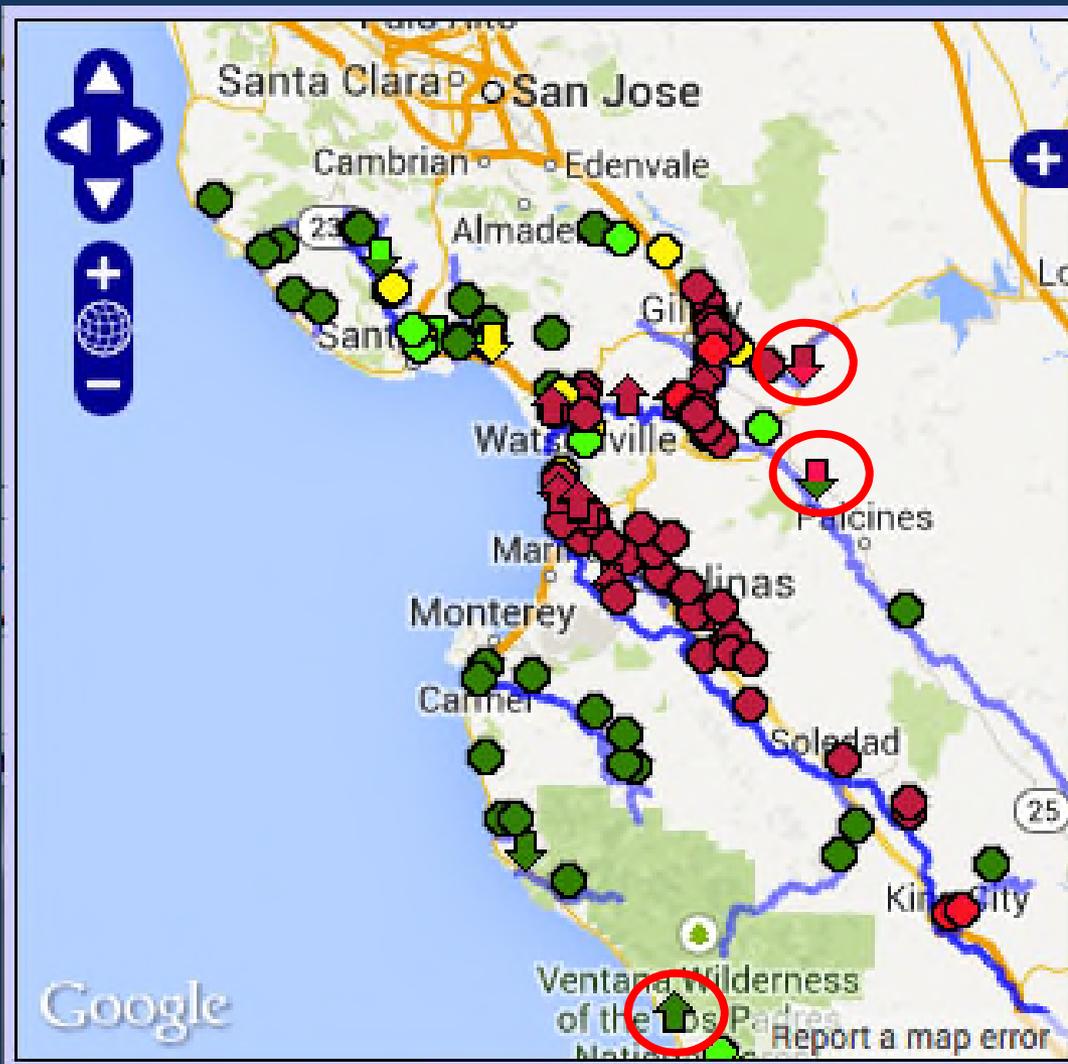
We are also designating **Outstanding (A+)** for streams that score Excellent across all metrics. These are our “Blue Water Streams”



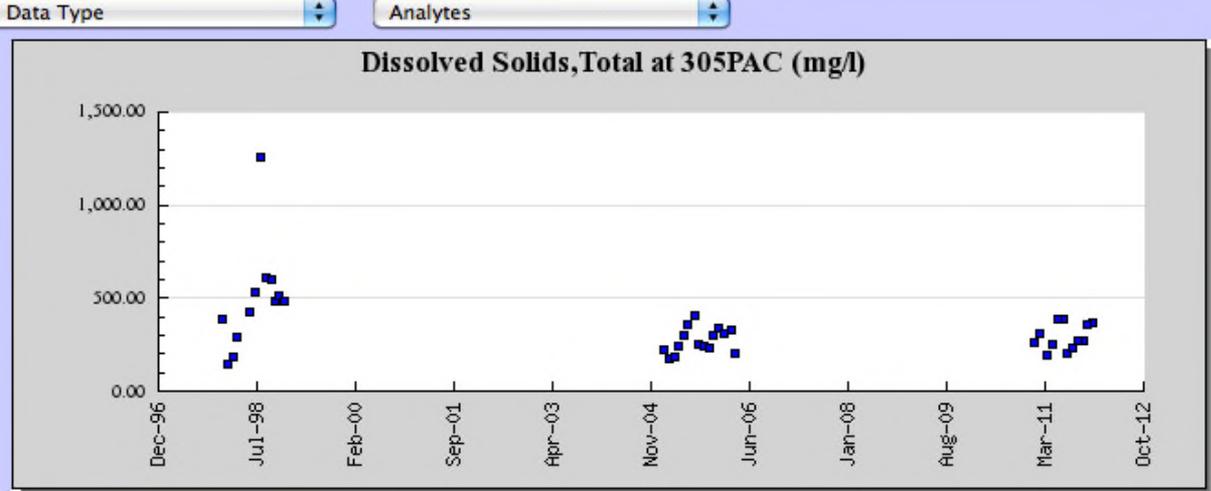
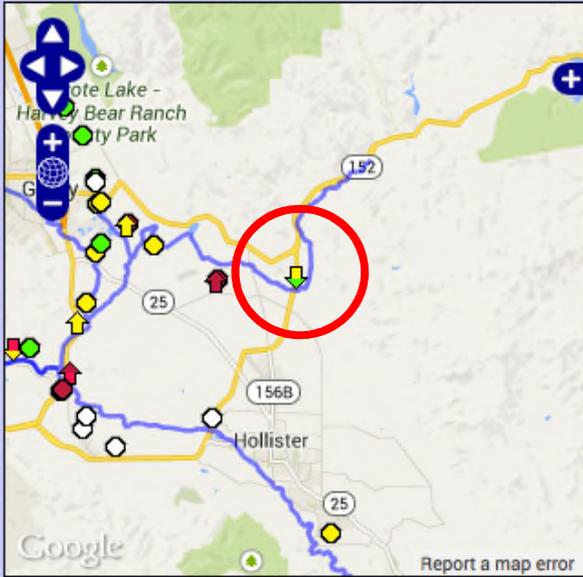
From our website: Nitrate in the Monterey Area



From our website: Nitrate in the Monterey Area



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

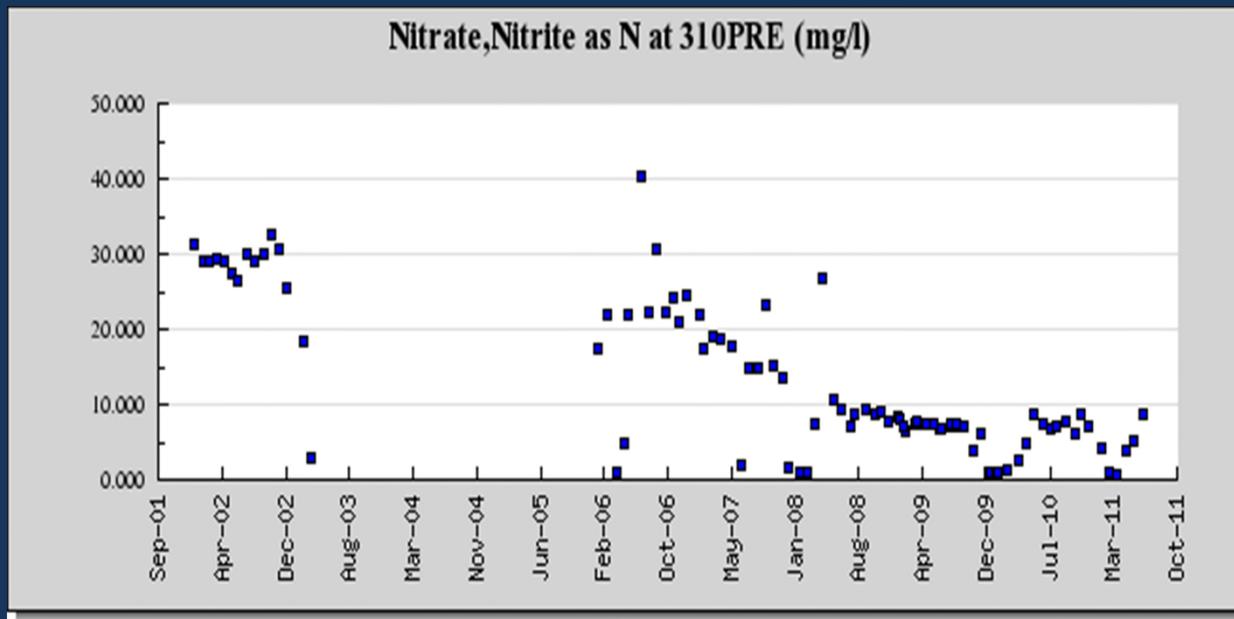


This site is crossing a Grade (color) boundary from “Fair” to “Good” (threshold is 1000 mg/L)

How did we go from overall scoring to change scoring??

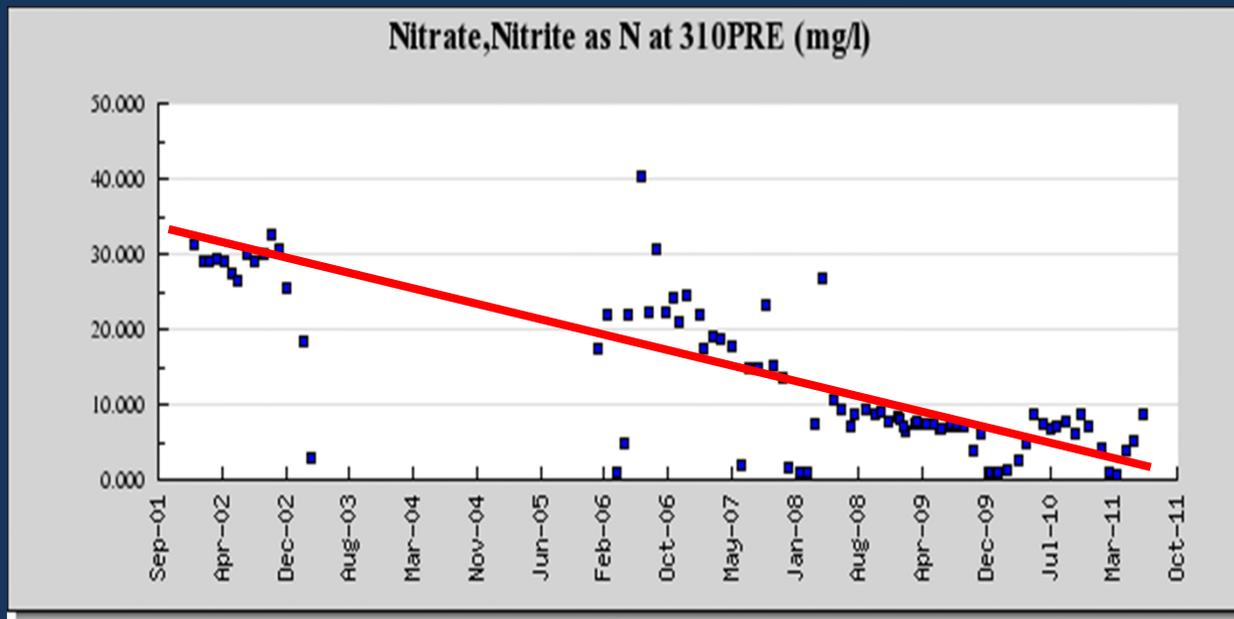
We look at change at the site level in two ways:

Kendall Trend Analysis

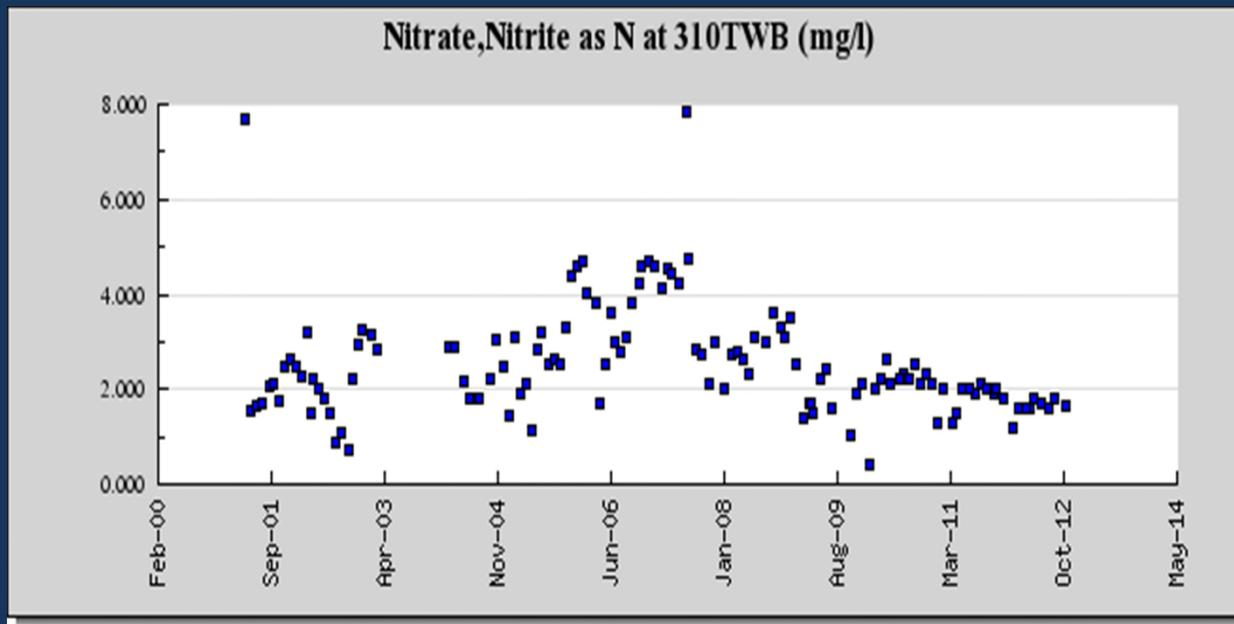


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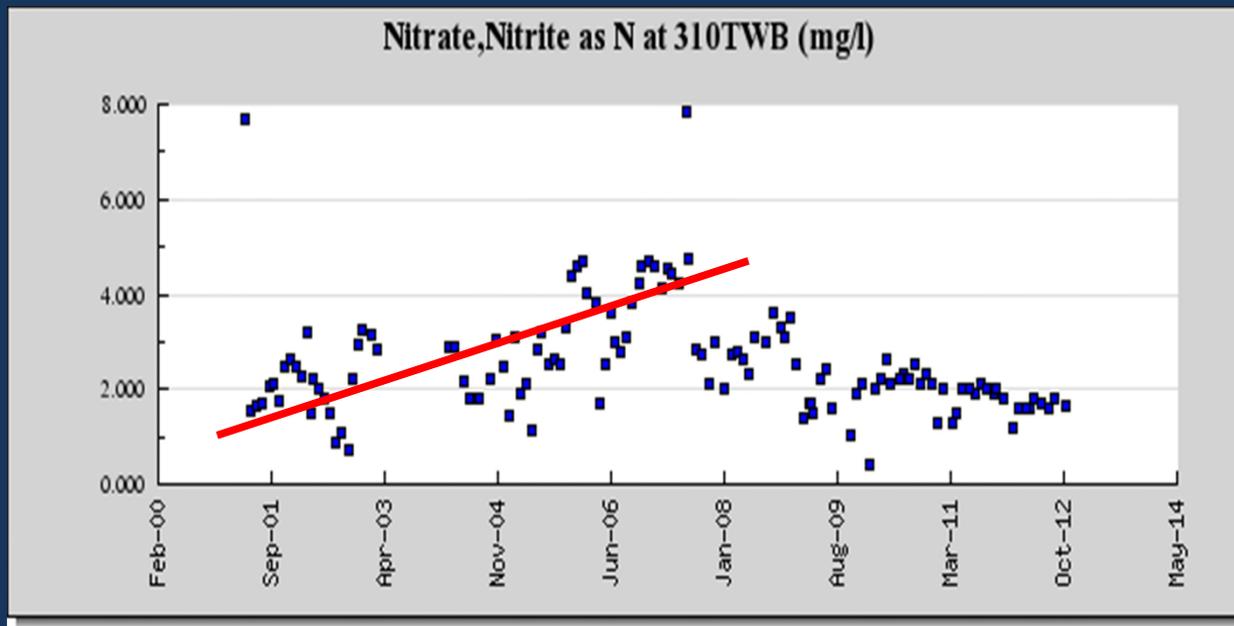
Kendall Trend Analysis



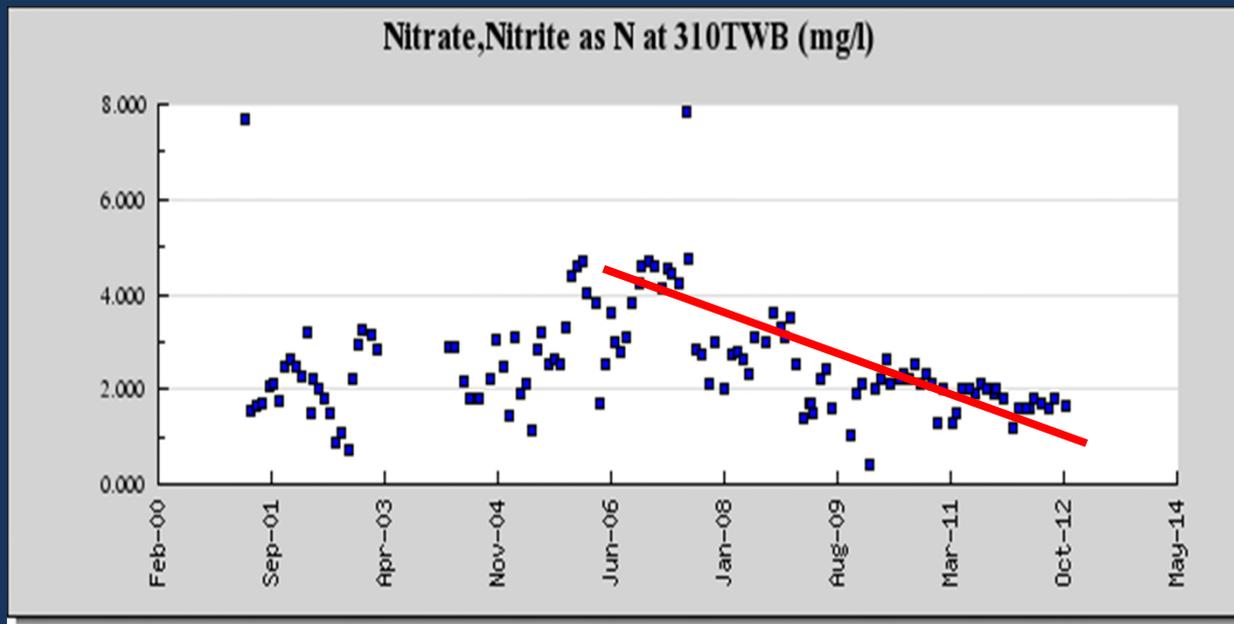
Some change doesn't fit a straight line:



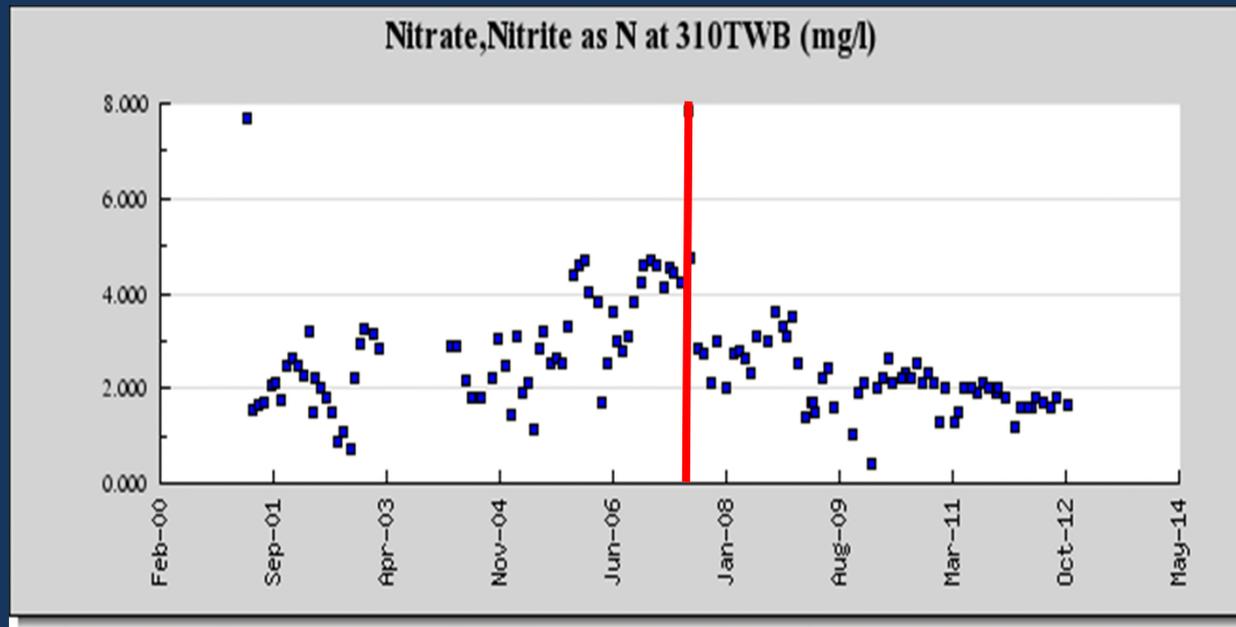
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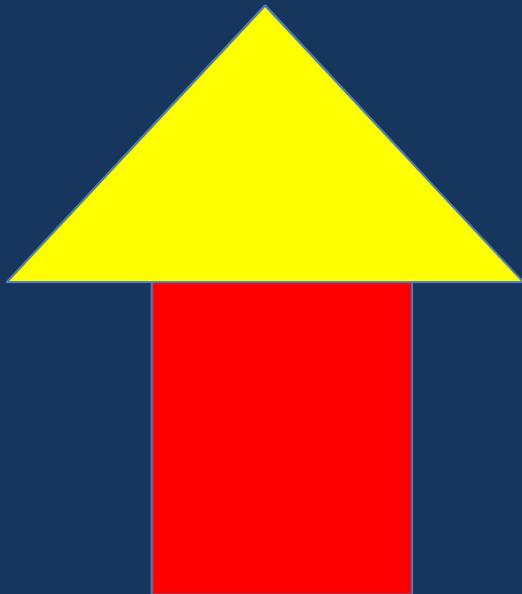


Change Point Analysis defines probable change points in a time series of data

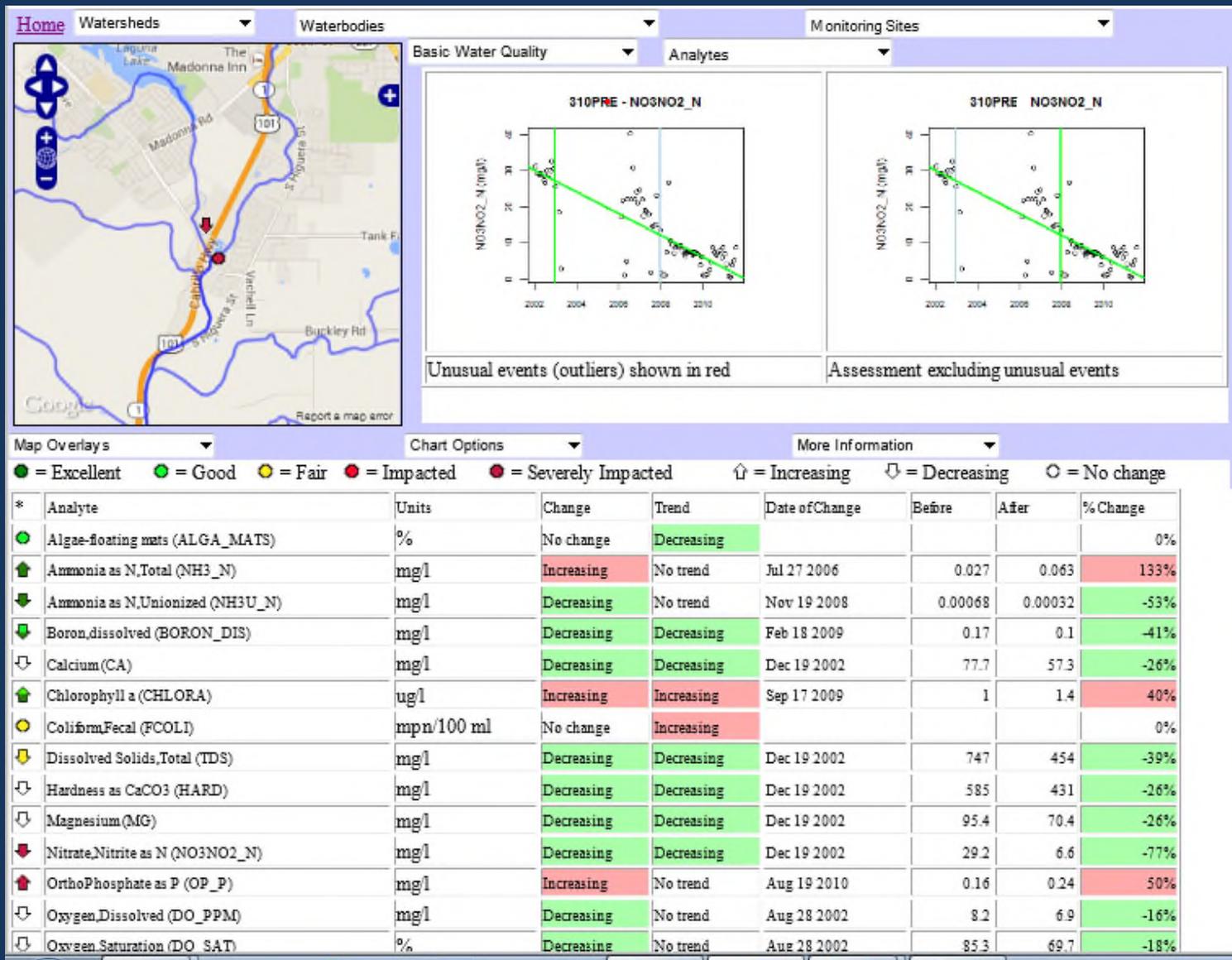


In this case, a treatment plant upgrade went online in May, 2007

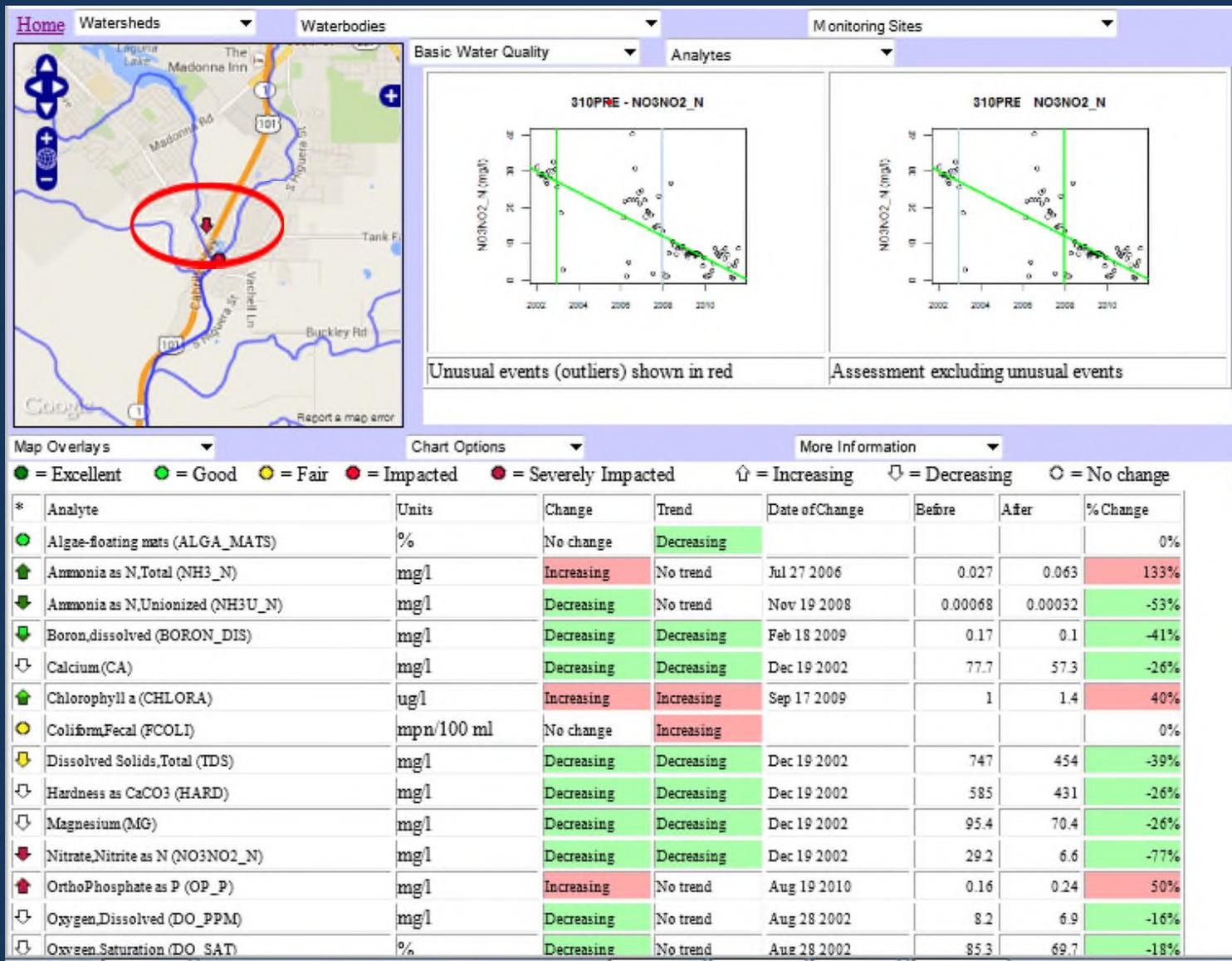
Apply MEQ scoring to data on each side of Change Point to grade (color) two sections of arrow icon



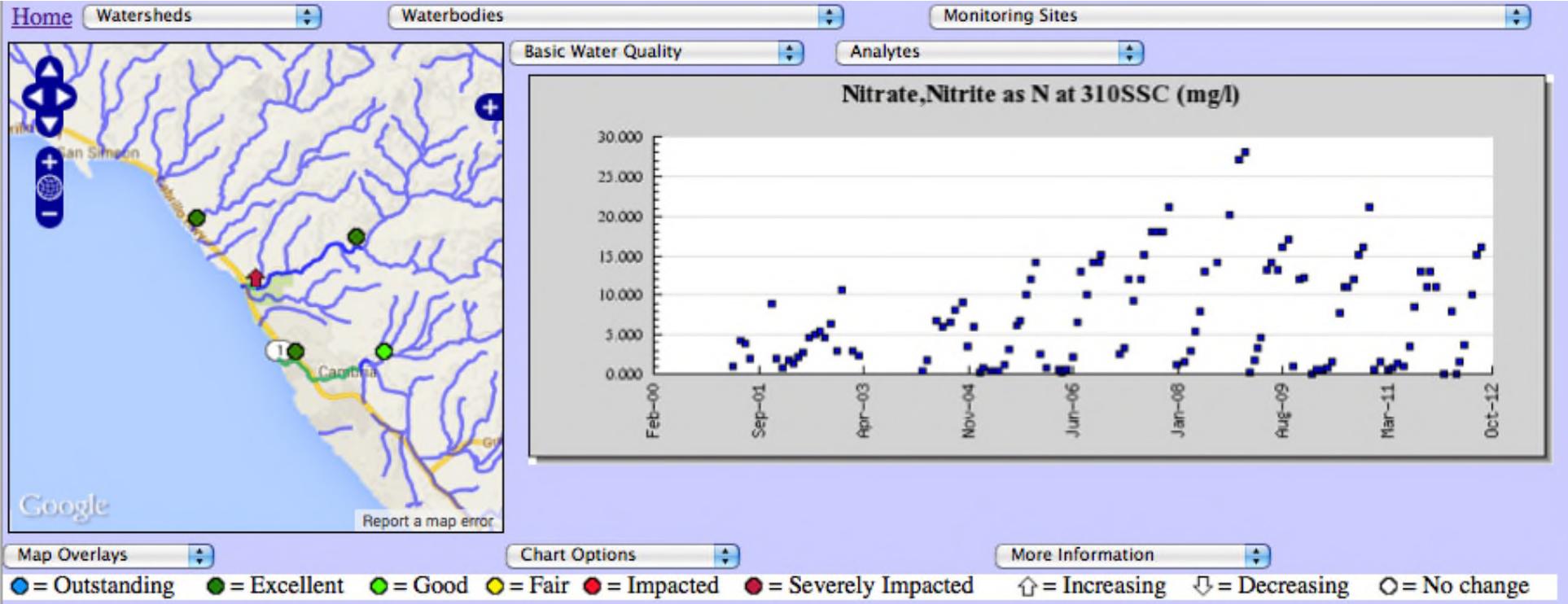
We have found Change Point Analysis to be more useful than traditional trend analysis and are relying on it as our primary change scoring approach.



This site is associated with a large plot of agricultural land that was retired from cultivation in 2006.

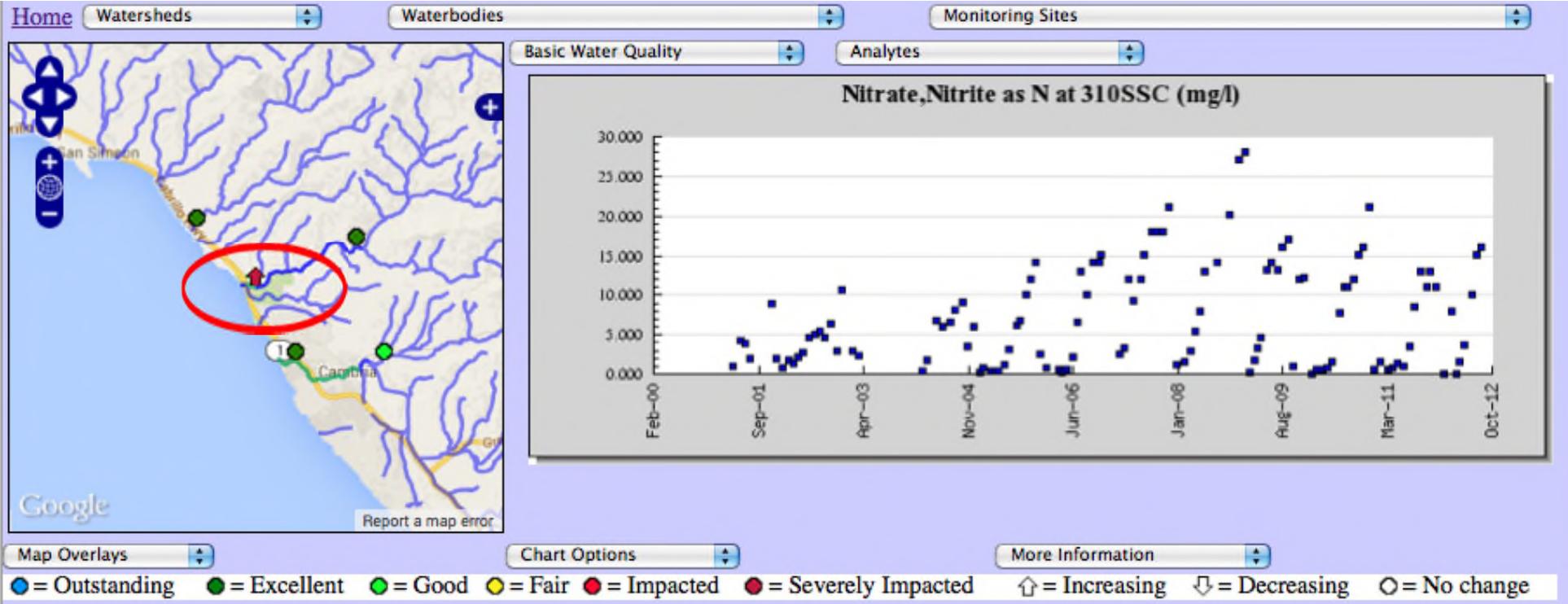


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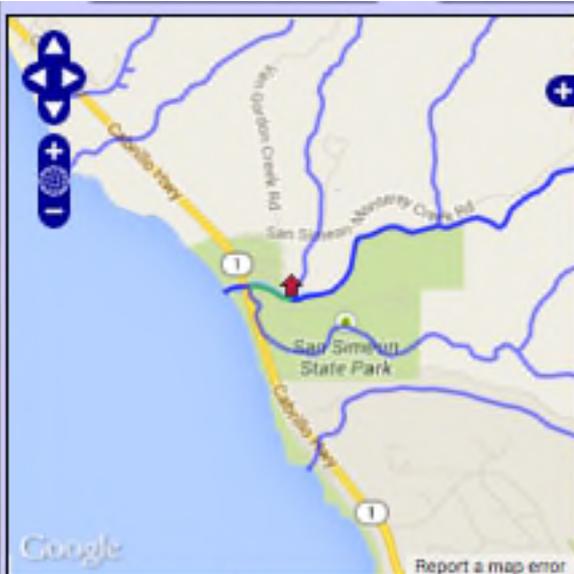
This nitrate data is from one of our important coastal streams, in an otherwise relatively pristine area.

Nitrate increases are associated with wastewater spray fields adjacent to the creek just upstream.



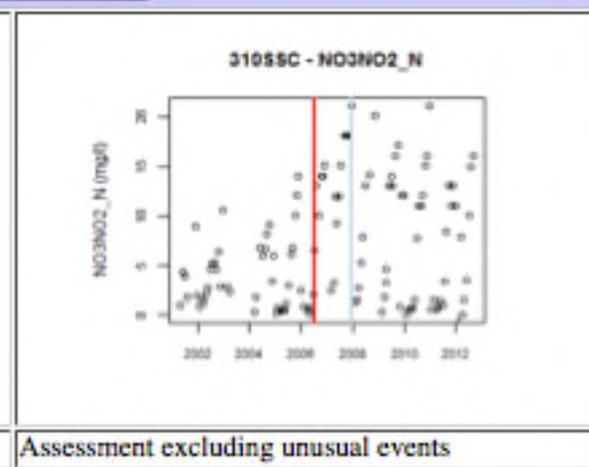
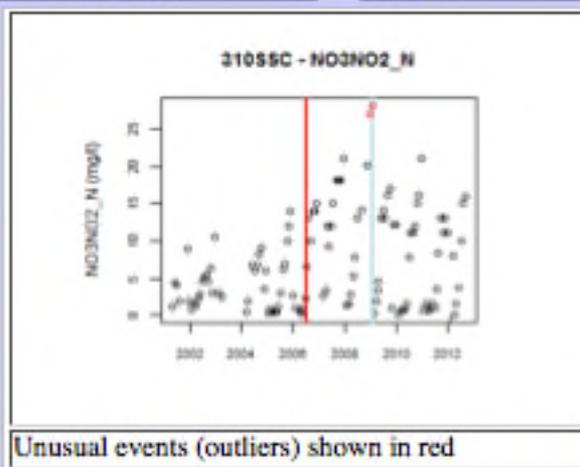
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Basic Water Quality

Analytes



Map Overlays

Chart Options

More Information

● = Excellent
 ● = Good
 ● = Fair
 ● = Impacted
 ● = Severely Impacted
 ↑ = Increasing
 ↓ = Decreasing
 ○ = No change

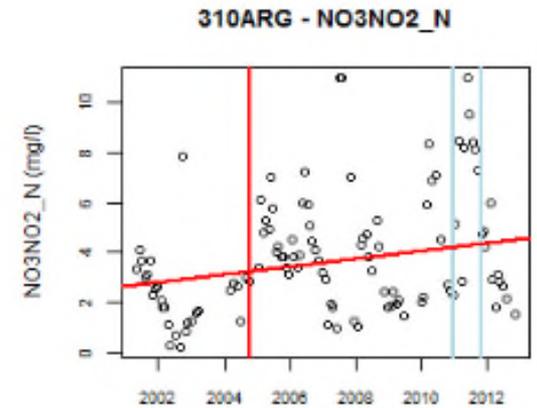
* Analyte	Units	Change	Trend	Date of Change	Before	After	% Change
↓ Algae-floating mats (ALGA_MATS)	%	Decreasing	Decreasing	Oct 10 2002	39.6	5.7	-86%
↑ Ammonia as N,Total (NH3_N)	mg/l	Increasing	No trend	Aug 04 2004	0.024	0.031	29%
↓ Ammonia as N,Total-load (NH3_N_LOAD)	mg/l	Decreasing	Decreasing	Apr 10 2006	79.5	11.7	-85%
↓ Ammonia as N,Unionized (NH3U_N)	mg/l	Decreasing	Decreasing	Jun 23 2005	0.00103	0.00022	-79%
↑ Chlorophyll a (CHLORA)	ug/l	Increasing	Increasing	Apr 09 2009	2	3.3	65%
↑ Chlorophyll a-load (CHLORA_LOAD)	ug/l	Increasing	Increasing	Jul 16 2009	1286	3815	197%
↑ Copper (CU)	ug/l	Increasing	Increasing	Oct 18 2011	0	3.3	0%
↑ Flow (FLOW)	cfs	Increasing	No trend	Jan 14 2009	5.5	16.8	205%
↑ Nitrate,Nitrite as N (NO3NO2_N)	mg/l	Increasing	No trend	Jul 05 2006	4	7.4	85%
○ Nitrate,Nitrite as N-load (NO3NO2_N_LOAD)	mg/l	No change	Increasing				0%
↑ Nitrogen,Total (N_N)	mg/l	Increasing	No trend	Jul 05 2006	4.6	7.6	65%
↓ Nitrogen,Total Kjeldahl (TKN_N)	mg/l	Decreasing	Decreasing	Jan 20 2010	0.4	0.18	-55%
↑ OrthoPhosphate as P (OP_P)	mg/l	Increasing	Increasing	Jul 05 2006	0.37	0.72	95%
○ OrthoPhosphate as P-load (OP_P_LOAD)	mg/l	No change	Increasing				0%
○ Turbidity-load (TURB_N_LOAD)	ntu	No change	Increasing				0%
○ Urea-load (UREA_LOAD)	mg/l	No change	Increasing				0%
↓ Water Temperature (H2O_TEMP)	degrees c	Decreasing	Decreasing	Sep 28 2006	16.6	15.2	-8%

Trends in Load

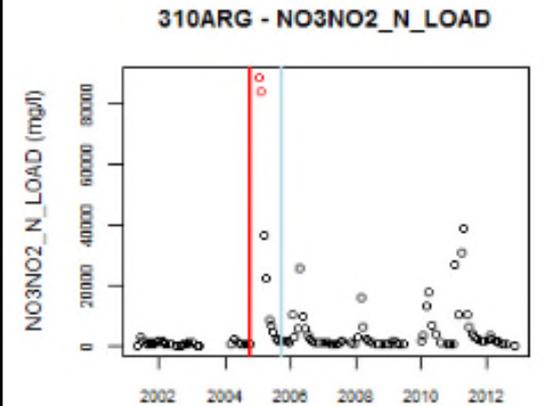
Agricultural efforts to reduce nutrient pollution has resulted in major reductions in irrigation discharge.

Trends in loading are as important as trends in concentration

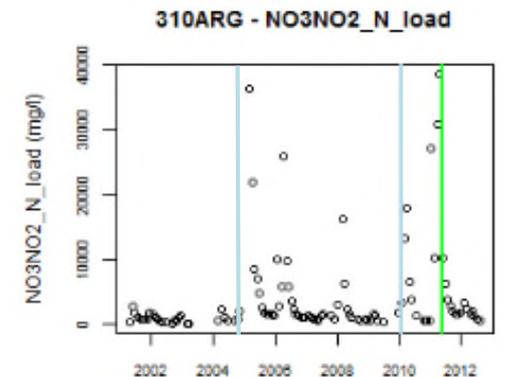
Concentration



Load - Outliers included



Load - Outliers excluded



Indices of Health

Human Health Index*

- Nitrogen species
- Salts
- Metals
- Organic Chemicals

- Pathogens

Aquatic Life Index

- Conventional Analytes
- Toxicity
- Bioassessment
- Biostimulatory Risk
- Metals
- Organic Chemicals

* Note two beneficial uses are involved

Aquatic Life Index

Conventional water quality

- pH departure
- Water temperature
- Nitrate - N
- Total and unionized ammonia
- Orthophosphate - P
- Total suspended solids
- Turbidity

Pesticides and other Organics

- sediment and water

Metals

- sediment and water

Bioassessment (Scores follow IBI or CSCI approach)

Biostimulation

- Oxygen departure
- Chlorophyll a (ug/L)
- % floating mats
- NNE oxygen deficit
- NNE predicted benthic chlorophyll biomass

Toxicity

- Algal cell growth
- Fish survival
- Fish growth
- Invert survival in water
- Invert reproduction in water
- Invert survival in sediment

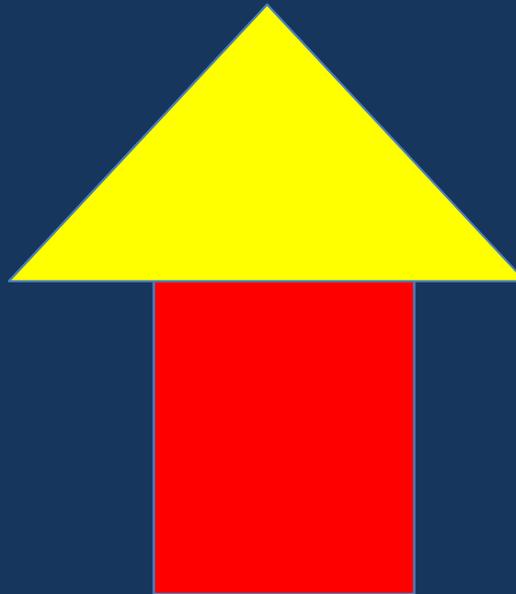
Aggregating scores into an index

Different combining approaches are used for different types of parameters:

- Mean average
- Harmonic Mean
- Worst score

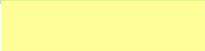
To address our goals requiring “change in key parameters” ...

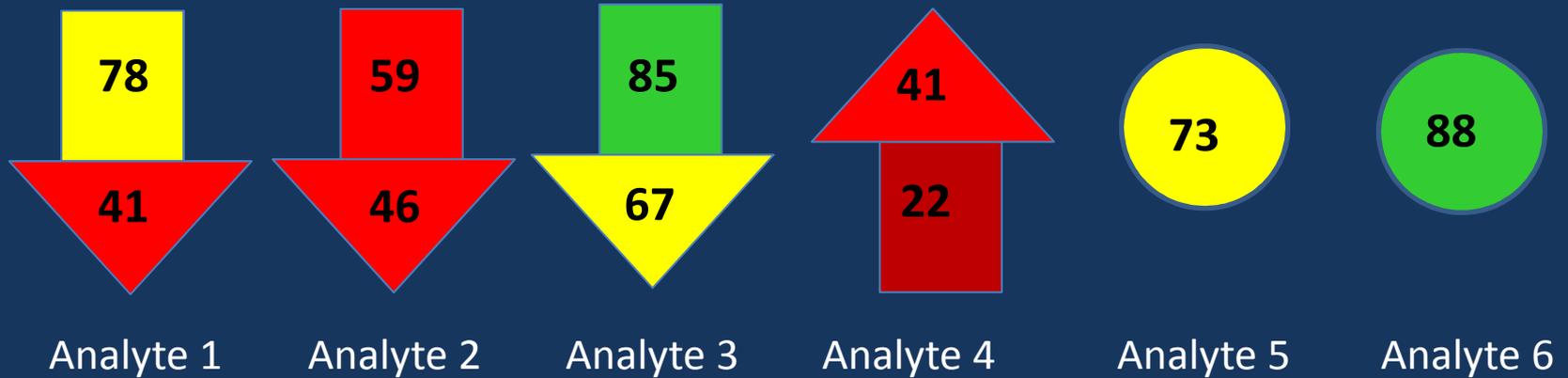
**How to score change at the level of a
Health index??**



EXAMPLE:

Down arrow = Getting Worse
Up Arrow = Getting Better

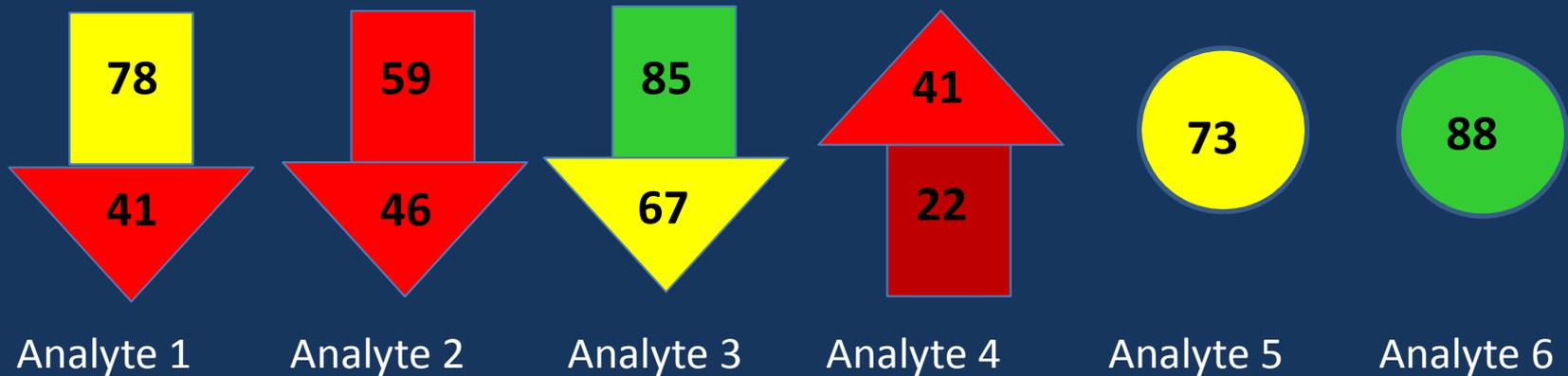
A	100	to	90	
B	90	to	80	
C	80	to	65	
D	65	to	40	
F	45	to	1	



Of six analytes that make up an index, 3 are getting worse, 1 is getting better and two show no change

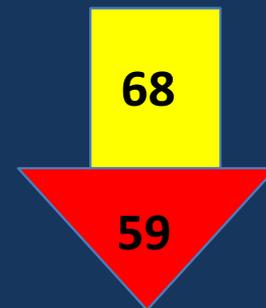
Down arrow = Getting Worse
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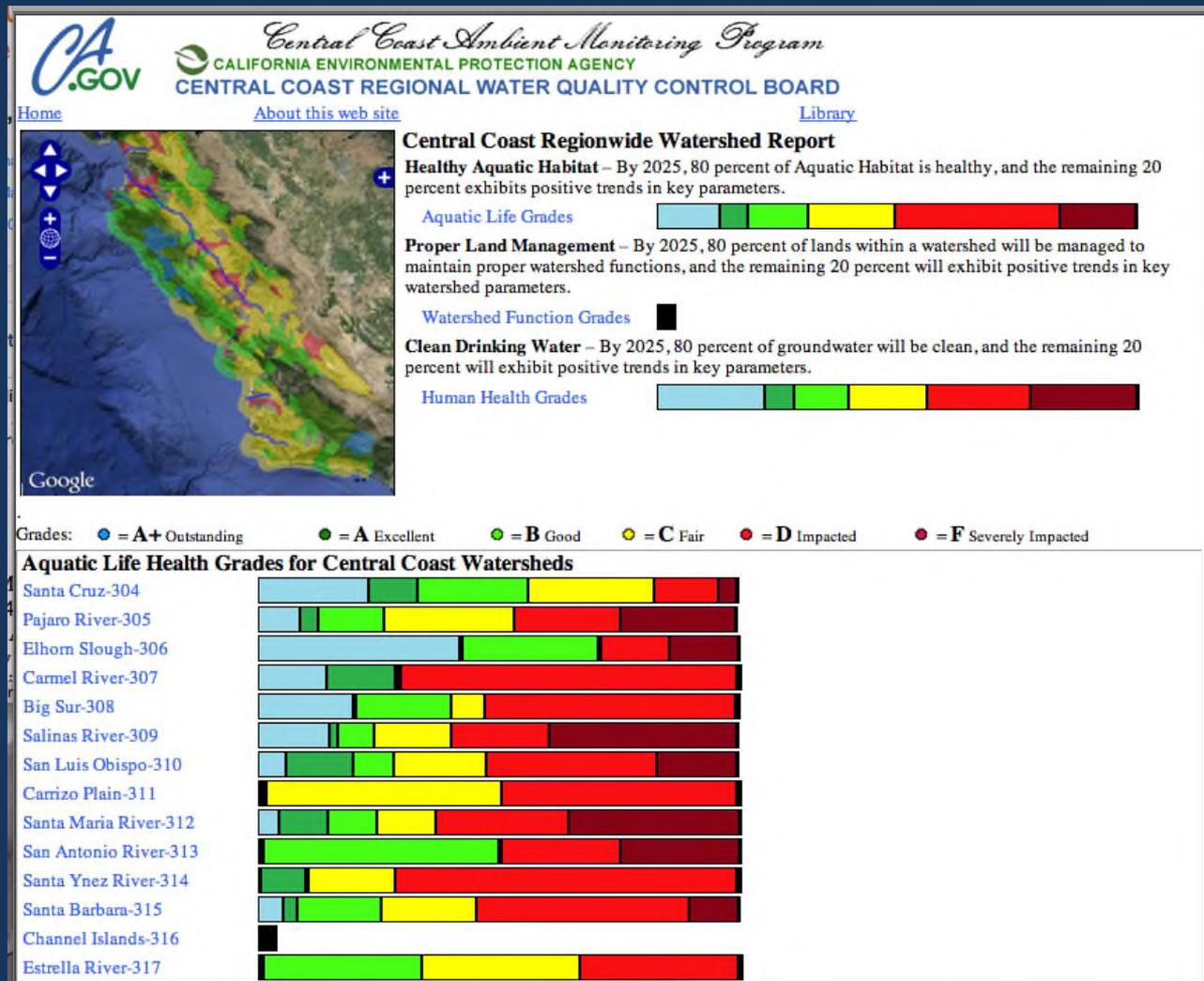
Using the most recent significant change point for each analyte and the appropriate aggregation approach:

Before period: Mean (78 + 59 + 85 + 22 + 73 + 88) = 68
 After period: Mean (41 + 46 + 67 + 41 + 73 + 88) = 59

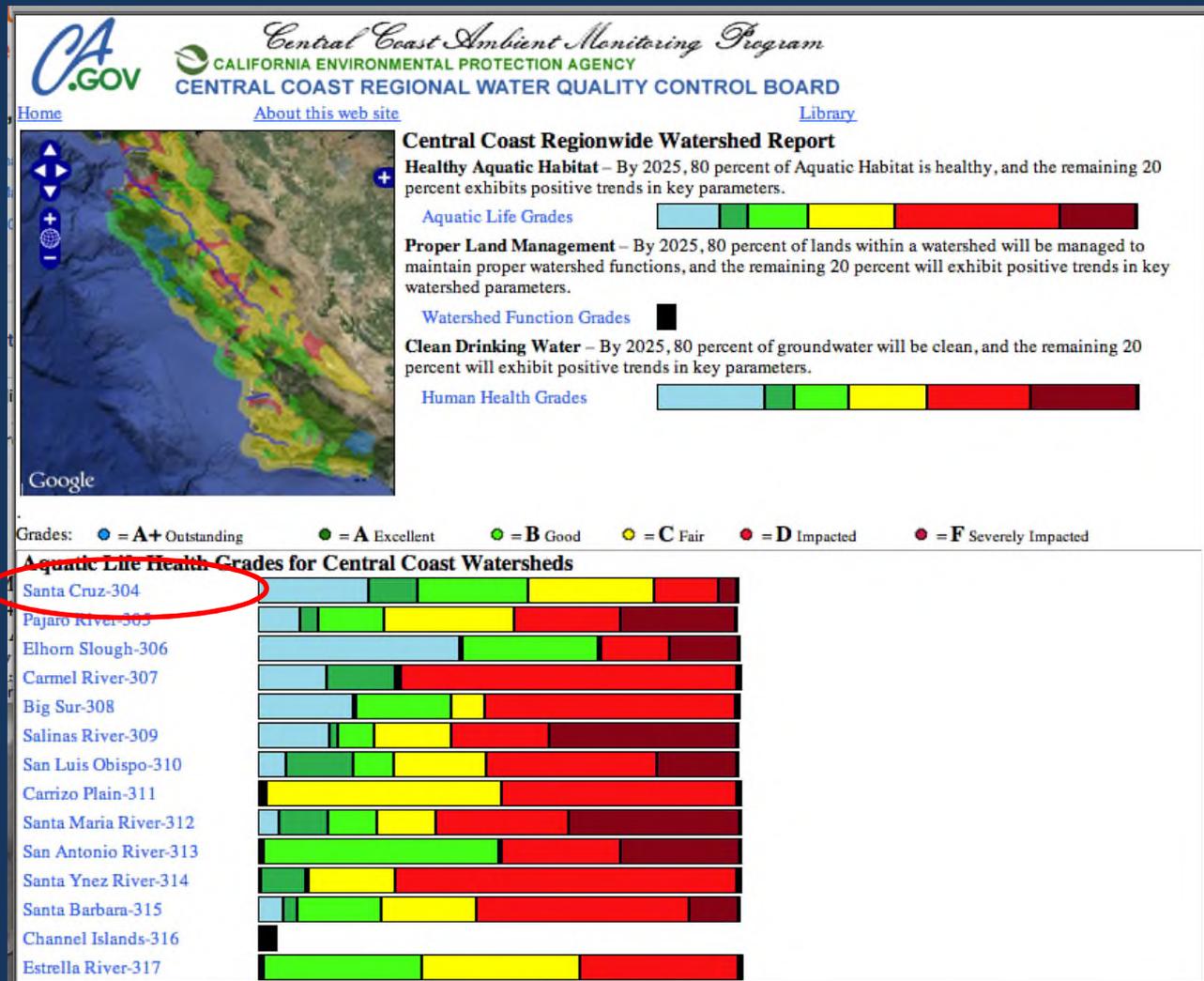


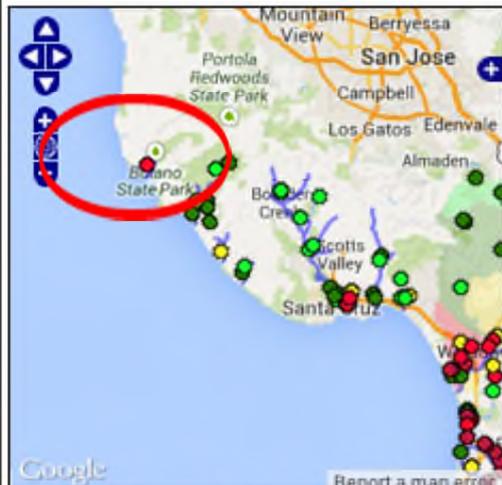
At the level of the index, the site is getting worse

We have created a report card approach to displaying our data, which will be available at CCAMP.org this summer

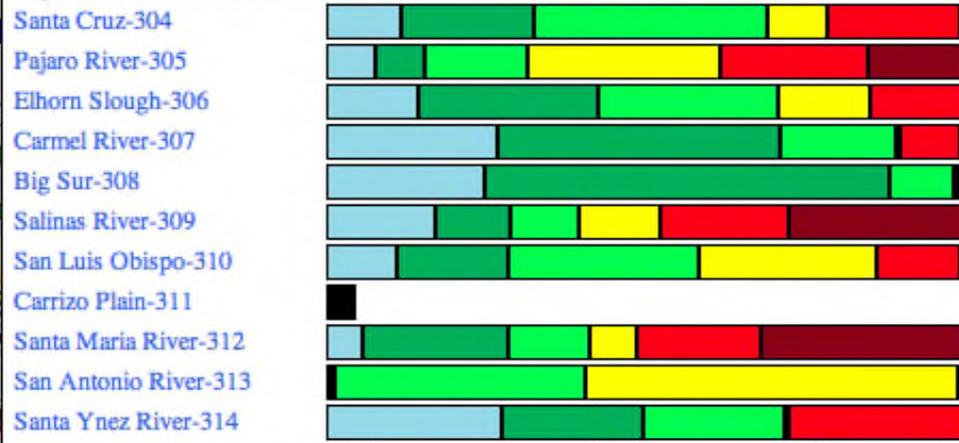


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Aquatic Life Health Grades for Central Coast Watersheds



Sturgeon Generals Warning: this web app is a very rough work in progress version.

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

Aquatic Life Grades for Waterbodies in the Santa Cruz Watershed

[Watersheds](#)

Waterbody	Aquatic Life Grade	Aquatic Life Score
Aptos Creek	B	89
Arana Gulch Creek	B	85
Bear Creek(Santa Cruz County)	B	83
Boulder Creek	B	85
Branciforte Creek	A	92
Gazos Creek	D	61
Kings Creek	not yet	
Lompico Creek	B	86
Majors Creek (Santa Cruz County)	not yet	
San Lorenzo Estuary	B	84
San Lorenzo River	A	91



CENTRAL COAST AMBIENT MONITORING PROGRAM
 CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
 CENTRAL COAST REGIONAL WATER QUALITY CONTROL BOARD

[Wiki Work](#)

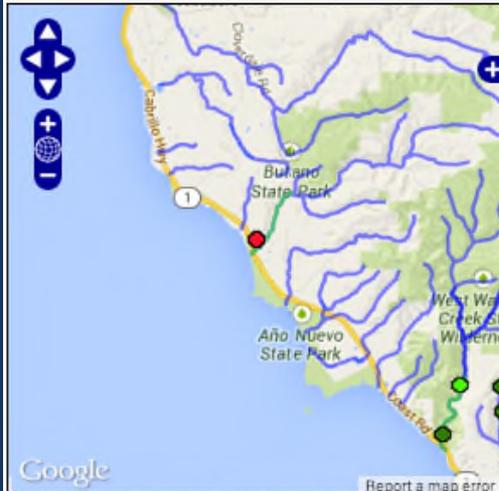
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San Vicente Creek	A	92
Santa Cruz Harbor	D	60

[Watersheds](#)



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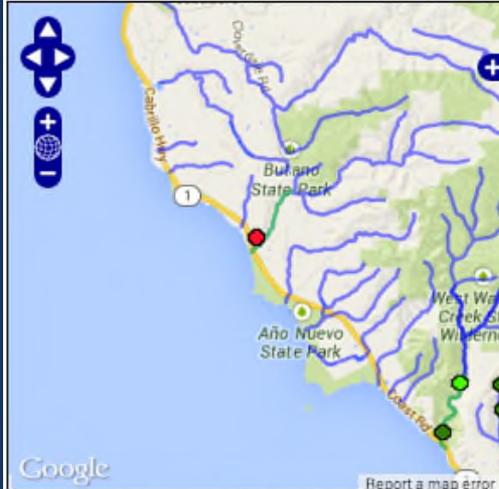
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Aquatic Life Health Grades for Sites in the wb_id_280

[Watersheds](#)

[Waterbodies](#)

Site	Site Name	Aquatic Life Grade	Aquatic Life Score
304GAZ	Gazos Creek Lagoon at Hwy 1	not yet	61



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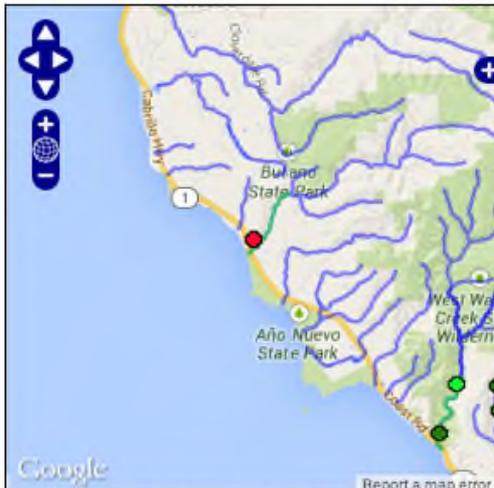
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In the near future this map will change as you navigate this site.

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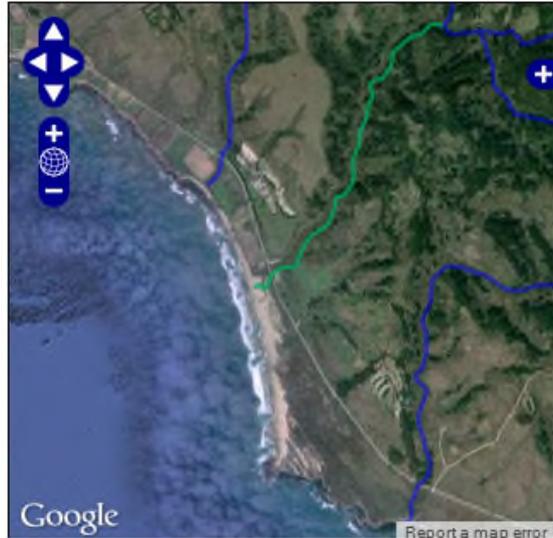
Gazos Creek Lagoon at Hwy 1 (304GAZ)

Aquatic Life	Conventional Analytes	Biostimulation	Benthics	Toxicity	Metals	Organic Chemicals	Hydrocarbons
D (61)	95	88			79	23	96
Human Health	Nitrogen Species	Salts	Pathogens	Metals	Organic Chemicals	Hydrocarbons	Groundwater
A (96)	98		85	100	100	100	

Auto text is incomplete. Lets explore drill down table work first. Also, syntax handlers (e.g. plural-singular, good site bad site) are not yet implemented.

The Aquatic Health Grade of **D (61)** was based on scoring of ***n_analytes_aquatic_life analytes and ***n_samples individual tests. 0 conventional analytes were in poor or very poor condition. Other conventional analytes scored fair or better, with 9 in excellent or good condition. Of ***25 organic chemicals tested in water or sediment, ***5 were detected and ***2 scored poor or very poor; these were diazinon in water (2 samples) and chlorpyrifos in sediment (3 samples). No samples were collected for hydrocarbons. Of ***6 metals tested in water or sediment, ***6 were detected and ***2 scored poor or very poor; these were copper (5 total samples) and arsenic (3 samples). Benthic invertebrates scored ***D, and toxicity scored C overall, with ***invertebrates in sediment scoring lowest.

The Human Health Grade of **A (96)** was based on scoring of nitrogen and pathogen indicators in surface water only. Groundwater is not assessed at the level of the site. Nitrate scored ***C and exceeded the drinking water standard in ***4 of ***63 samples. Pathogen indicators scored ***B when evaluated relative to water body contact thresholds. ***3 analytes showed increasing concentrations over time; these include ***nitrate, ***turbidity, and ***diazinon. ***2 analytes showed decreasing concentrations over time; these include ***chlorophyll a and ***pH. No trends in loads were detected.



Gazos Creek Lagoon at Hwy 1 (304GAZ)

* Analyte	Units	Matrix	Min	Mean	Max	# Samples	Grade	Score	Threshold
● Chlorfenvinphos	ug/l	water	0	0	0	1	A	100	0.028
● Coumaphos	ug/l	water	0	0	0	1	A	100	0.0074
● DDT, total	ug/kg dw	sediment	13.1	13.1	13.1	1	F	38	5.28
● Dieldrin	ug/kg dw	sediment	0	0	0	1	A	100	2.85
● Methyl Parathion	ug/kg dw	sediment	0	0	0	1	A	100	15.8

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

Gazos Creek Lagoon at Hwy 1 (304GAZ)

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Human Health	Nitrogen Species		Salts	Pathogens	Metals	Organic Chemicals		Hydrocarbons
B (89)	99		72	83	100	100		

www.ccamp.org

