Example:
Nitrate Rule Development

How does the Central Coast Water Board protect for nutrient pollution?

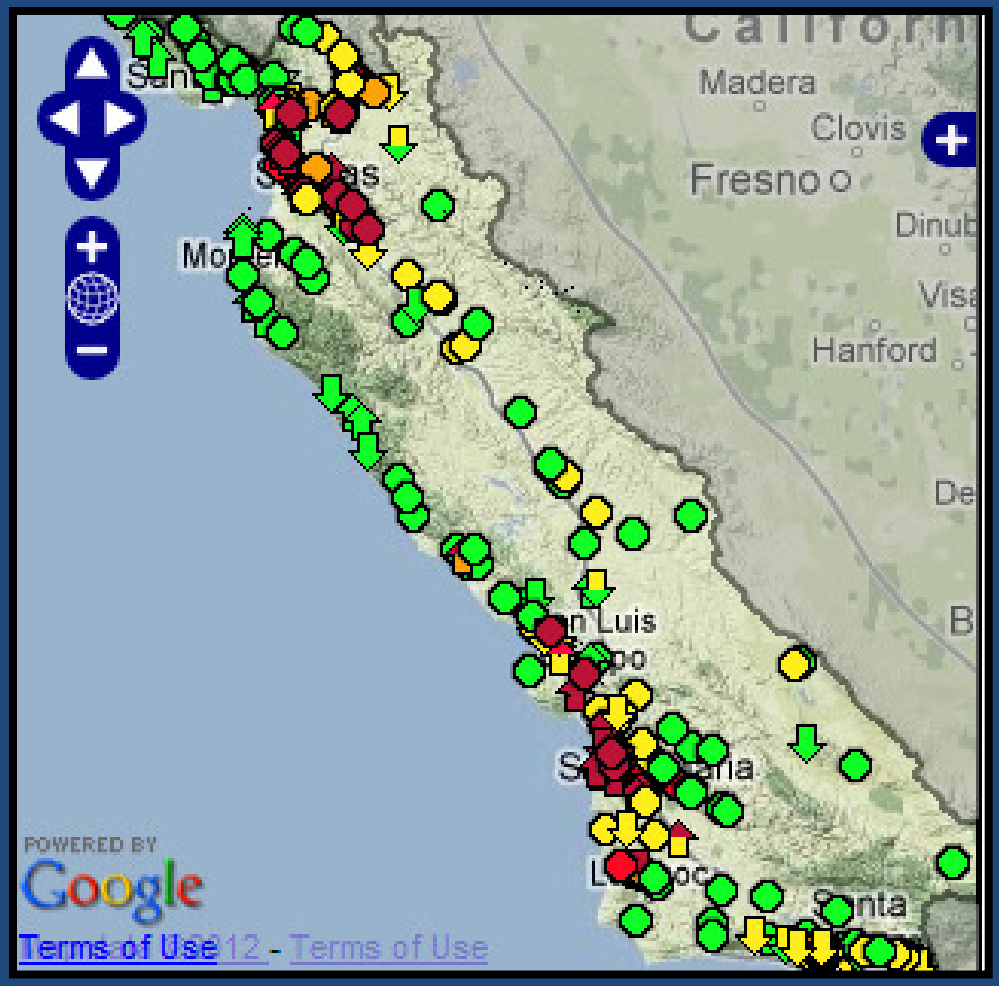
Municipal Supply Beneficial Use

- 10 mg/L Nitrate (as N)

Aquatic Life (only recently implemented)

- Exceedance of 1.0 mg/L coupled with supporting evidence
  - Predicted (or measured) benthic algal biomass and oxygen deficit (from NNE)
  - Swings in pH or dissolved oxygen
  - Floating algal mats
  - Water column chlorophyll a

Nitrate-N



www.ccamp.org

The CCAMP website currently uses a 5-color non-parametric scoring approach. Orange approximates 303(d) listing level for drinking water.

Good
Slightly Impacted
Impacted
Very Impacted
Severely Impacted

Note: CCAMP sites are repeatedly sampled over time, so scoring needs to address multiple measurements at each site

Nitrate "Rules" to drive CCAMP Website

Note: these are not protective for aquatic life

90th percentile <= 1

90th percentile > 1 and 90th percentile <= 10

75th percentile <= 10 and 90th percentile > 10

75th percentile > 10 and median <= 10

Median > 10

In English:

Almost all measurements are under 1.0 mg/L

Almost all measurements are between 1.0 and 10 mg/L

10-25% exceed 10 mg/L

25-50% exceed 10 mg/L

Over 50% of the measurements exceed 10 mg/L (!)

For this project we wanted:

- Better protections for aquatic life
- Incorporation of “blue water” threshold
- Better differentiation associated with magnitude
- Consideration of a 0 to 100 scoring scale
- Ability to incorporate into both a Human Health and an Aquatic Life index
- Possible tie into other published approaches

Two nitrate rules to address different beneficial uses?

Human Health: drinking water objective (10 mg/L)

GAMA uses the MCL and 0.5 x MCL as breakpoints applied at the measurement level (we've added 2.0 x MCL) :

ND

> 5 mg/L

> 5 and < 10 mg/L

> 10 and < 20 mg/L

> 20 mg/L

* Could be evaluated as Means, Maximums, 90th percentiles or ?

The Canadian approach could be scored using two of its three terms:

Frequency:

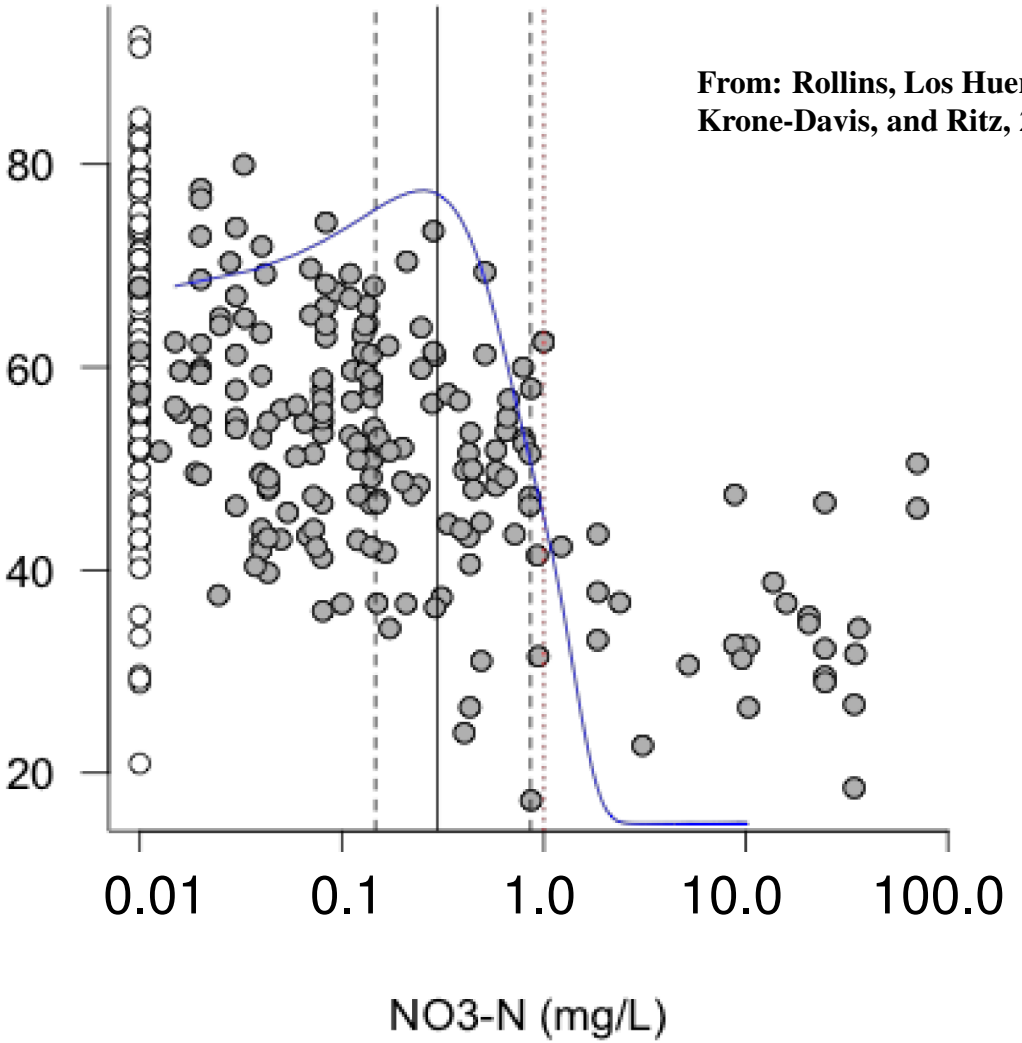
$$= \frac{\text{(number of measurements} > 10.0)}{\text{Total number of measurements}}$$

Amplitude:

$$= \frac{\sum \text{(Ind. Measurement/10.0)}}{\text{Total number of measurements}}$$

These two terms would be combined and scaled between 0 and 100.

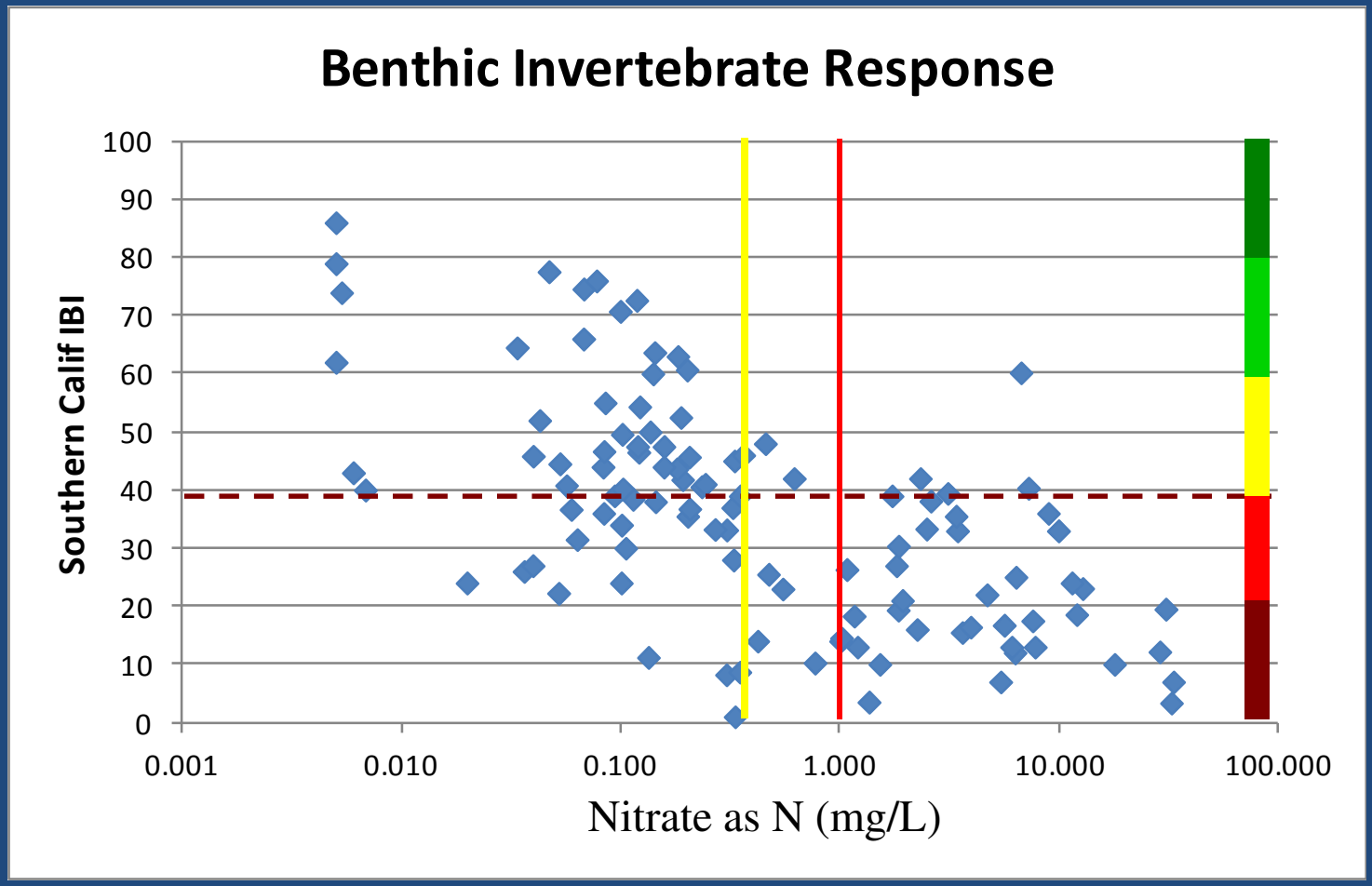
Evaluating nitrate for aquatic life support



Non-parametric change-point analysis evaluating diatom IBI/nitrate relationship

At 0.3 mg/L, 50% chance that threshold has been surpassed

At 1.0 mg/L, 86% chance that threshold has been surpassed



Invertebrate IBI and average nitrate concentration (showing listing guideline value of 1.0 mg/L and 0.3 change point threshold)

Aquatic life approach for nitrate could be similar to GAMA :

For example:

Mean < 0.15 mg/L

Mean > 0.15 and < 0.3 mg/L

Mean > .3 mg/L and < 1.0

Mean > 1.0 and < 2.0 mg/L

Mean > 2.0 and < 4.0 mg/L

Mean > 4.0 mg/L

Or instead of evaluating nitrate individually for aquatic life we could evaluate it as part of a biostimulatory risk index

For example:

- NNE benthic algal biomass
- NNE oxygen deficit
- Oxygen departure
- Floating algal mats
- Chlorophyll a (ug/L)

(the NNE terms include both TN and TP as model inputs)

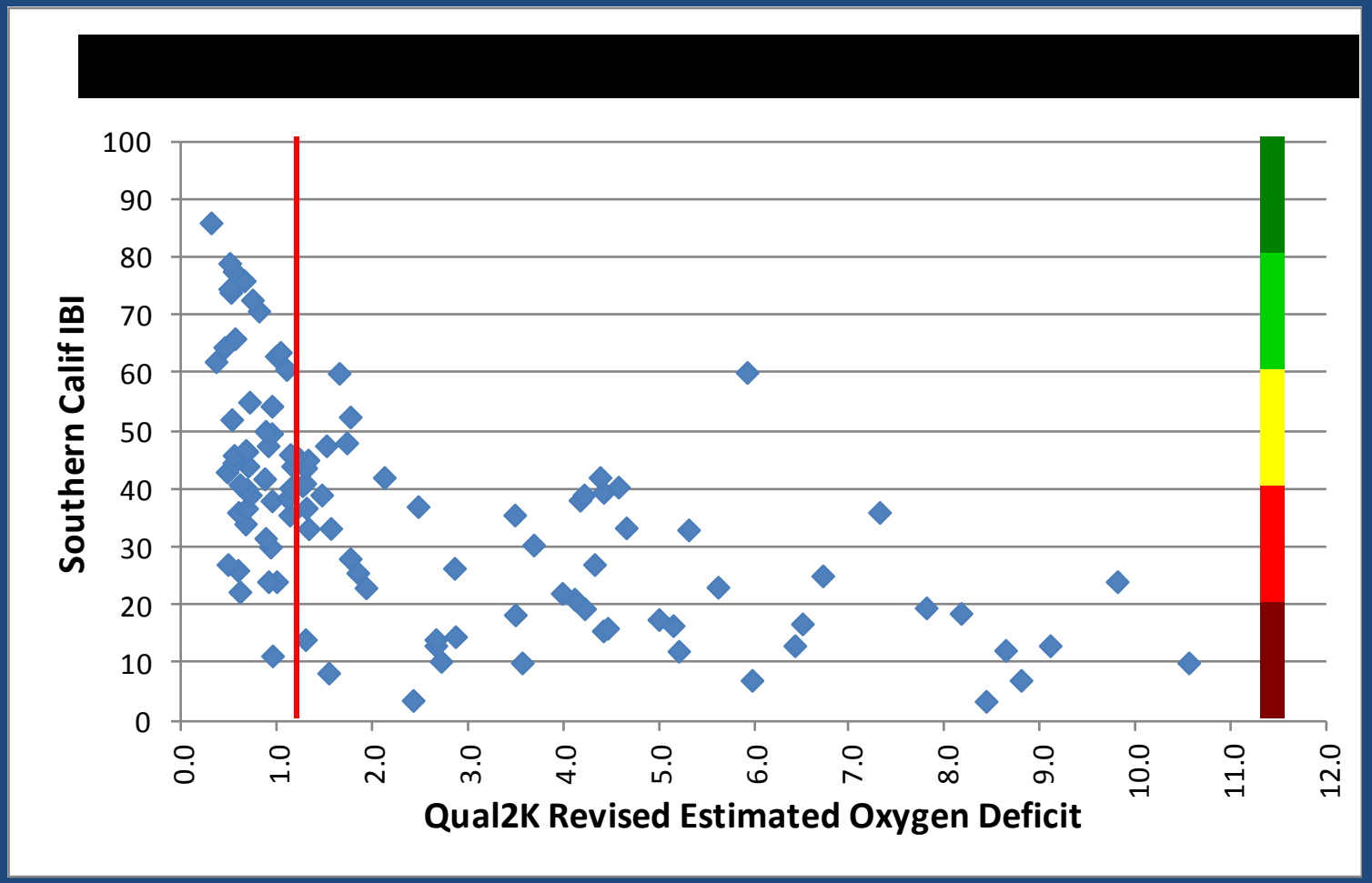
There are many potential scoring approaches, each with strengths and weaknesses.

Selection requires clear understanding of what we are trying to show.

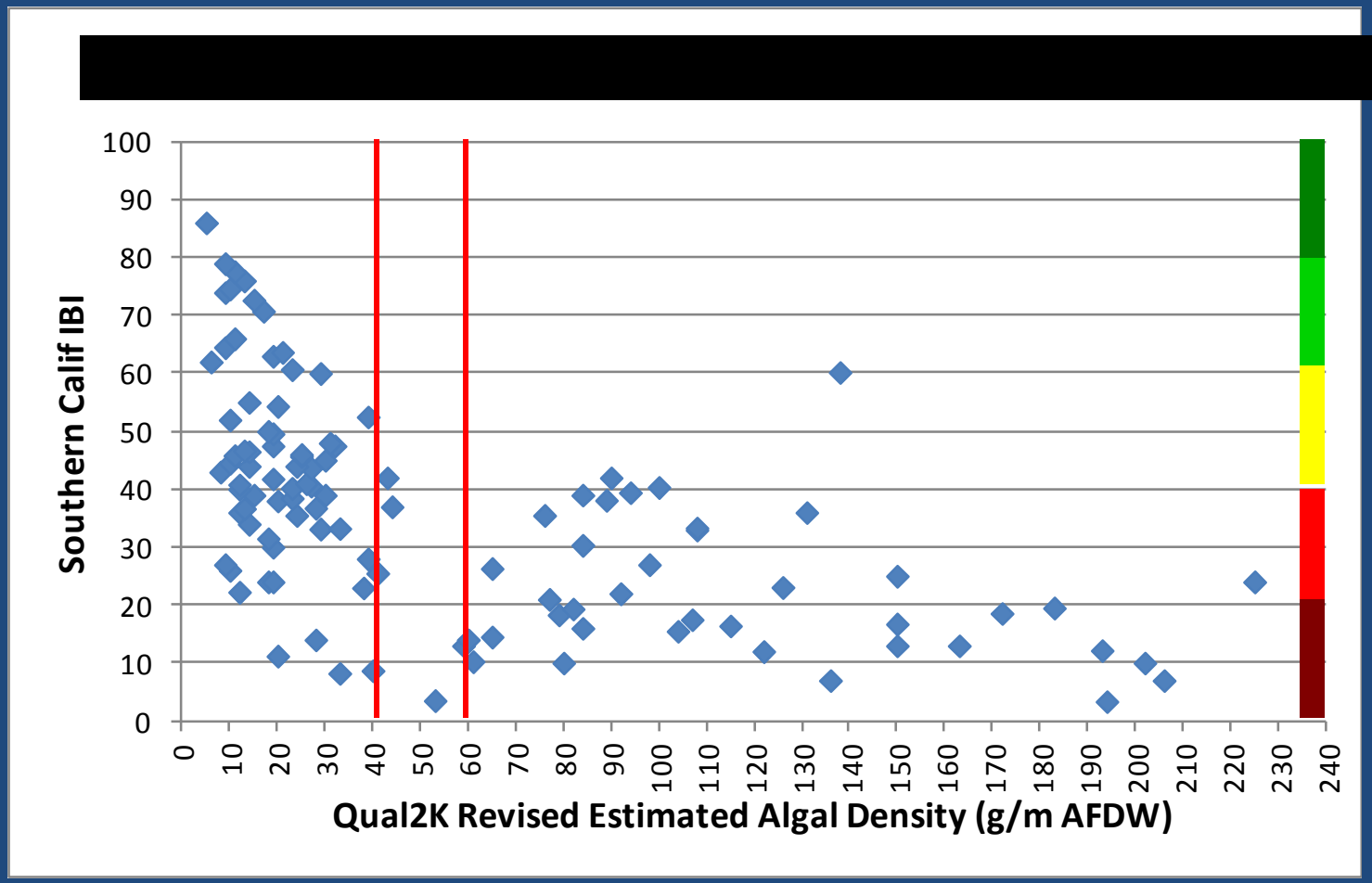
Some scoring approaches may be more applicable at a state-wide level than others

We will be testing several approaches and evaluating their relative performance over the next several months

Further discussion and questions?



Invertebrate IBI and predicted algal contribution to oxygen deficit



Invertebrate IBI and estimated algal density

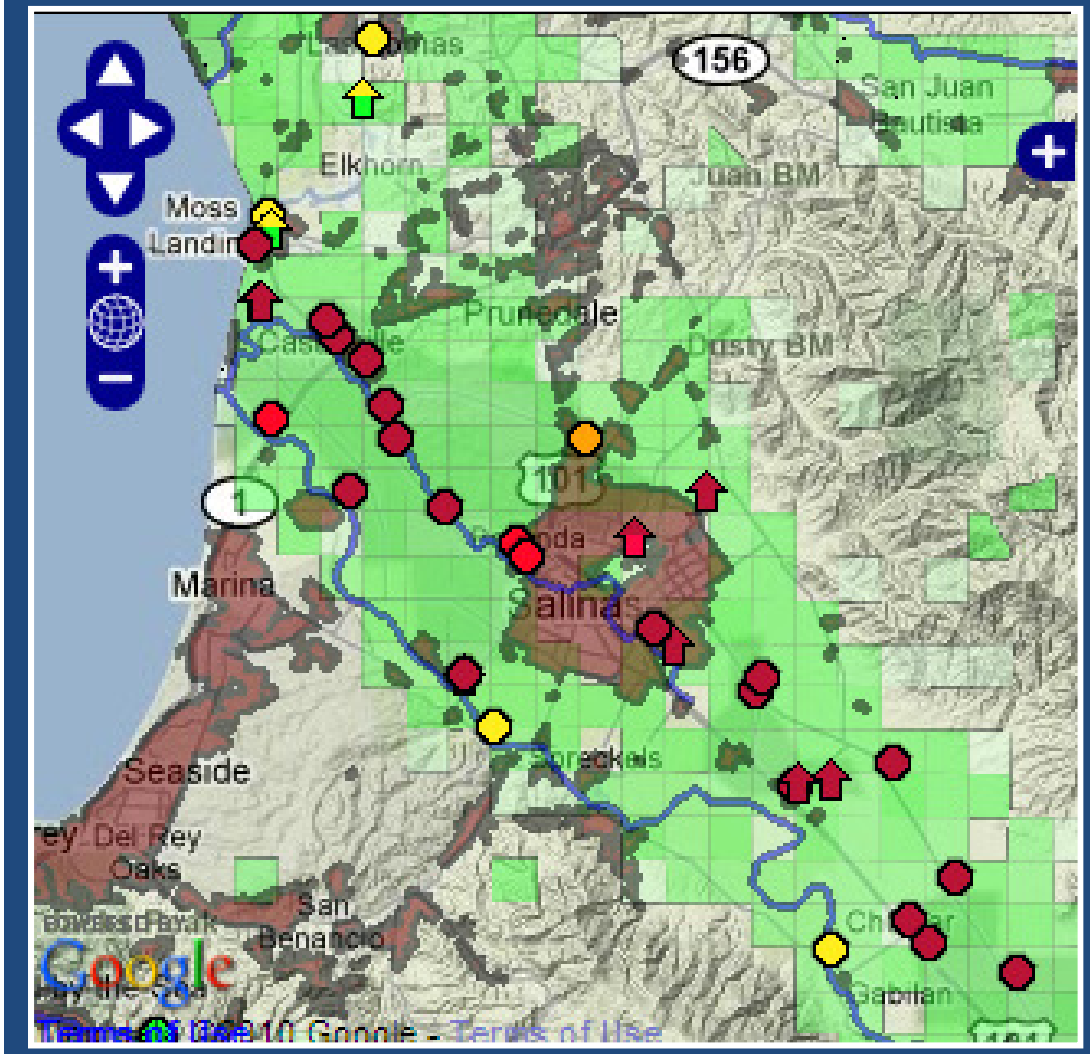
(40 and 60 g/m^2 are thresholds for "potentially" and "likely" impaired)

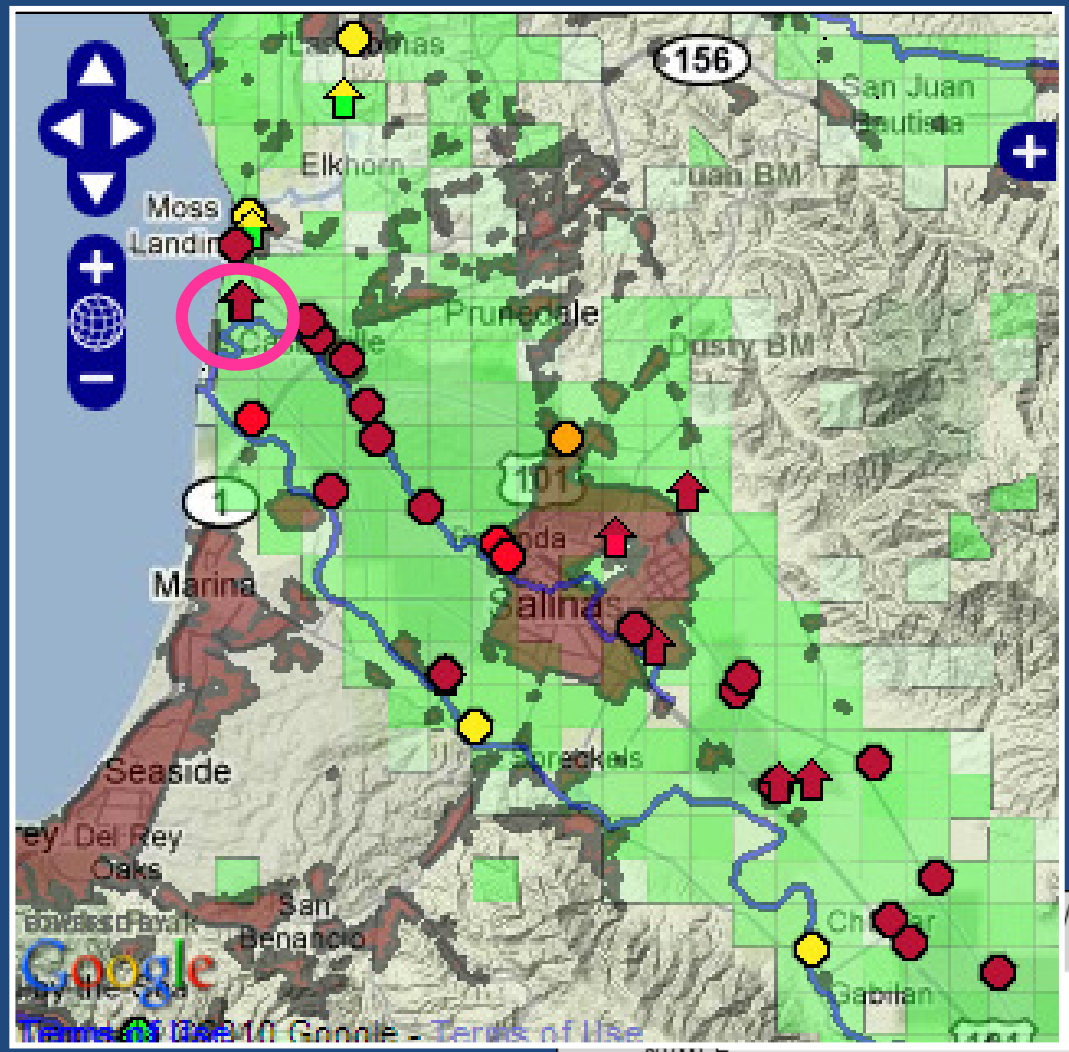
CCAMP Website assessment of change

Website currently employs a rolling t-test with a variable time window. Significant change between two groups is denoted with an arrow, that can be two-toned if the rules score differently for the two time groups.

For example: Concentration increasing from a good to fair condition

Since developing the web code we have also employed Mann-Kendall and change point analysis to evaluate change.


156
San Juan
Bautista
Elkhorn
Juan BM
Moss
Landing
Prunedale
Dusty BM
101
1
Marina
Salinas
Seaside
Del Rey
Oaks
San
Benancio
Google
Gabilan


156
San Juan
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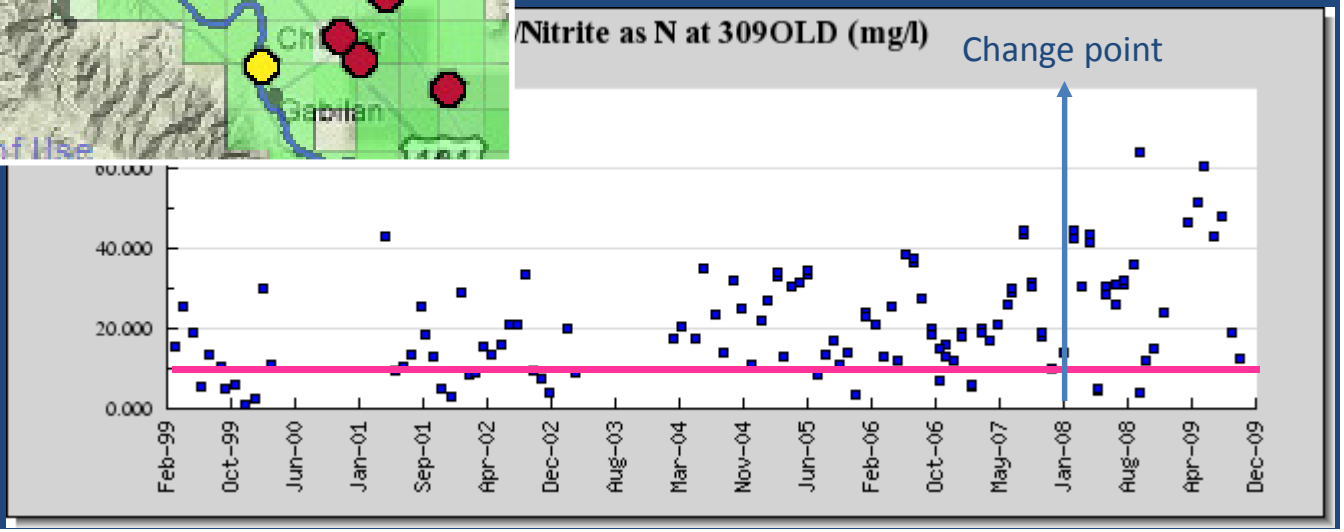
Nitrite as N at 309OLD (mg/l)
Change point
60.000
40.000
20.000
0.000
Feb-99
Oct-99
Jun-00
Jan-01
Sep-01
Apr-02
Dec-02
Aug-03
Mar-04
Nov-04
Jun-05
Feb-06
Oct-06
May-07
Jan-08
Aug-08
Apr-09
Dec-09