Coastal Watershed Assessment:

Template for Assessing Water Quality Conditions at the Watershed Level

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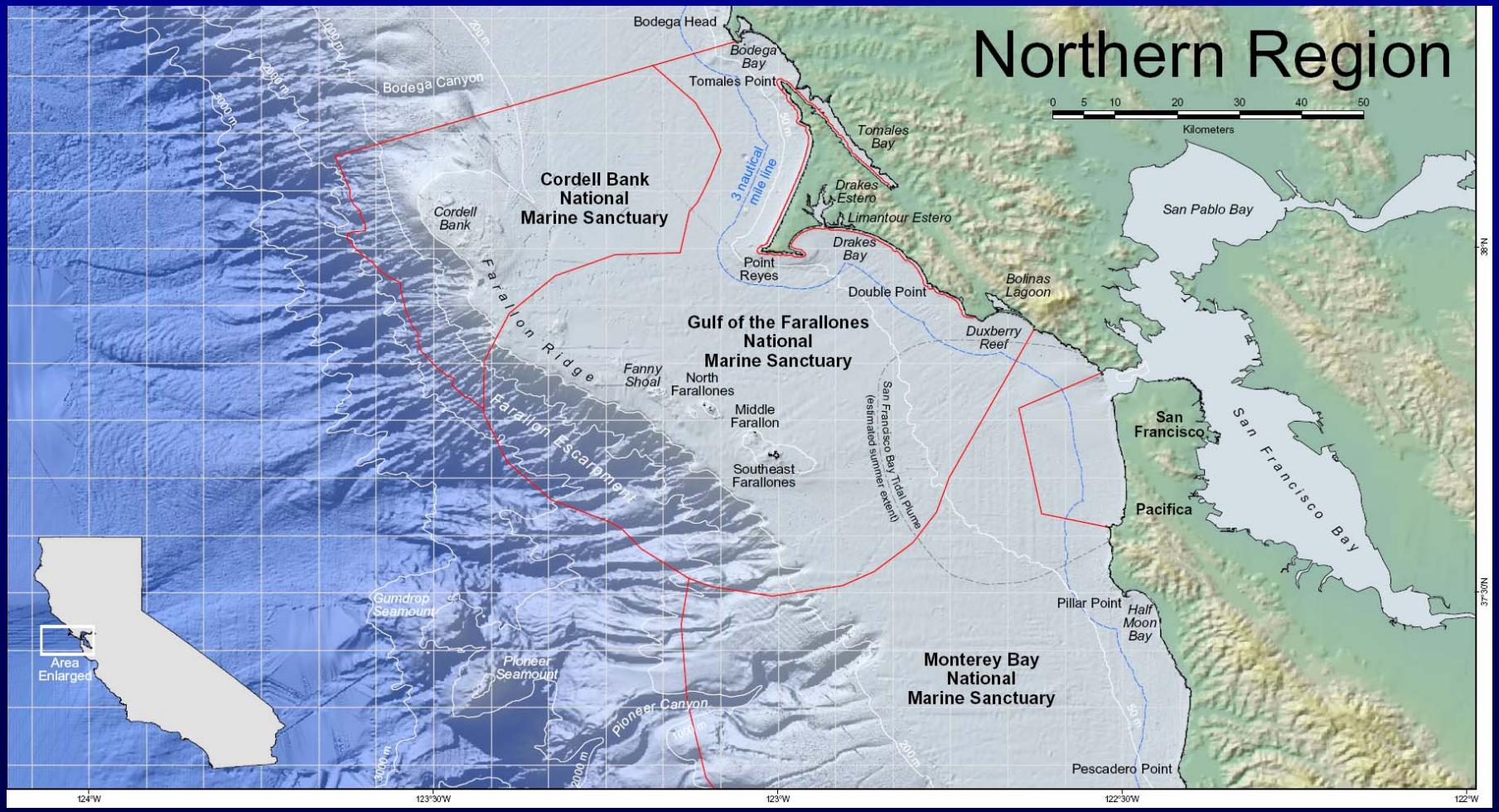
NPS Coastal Watershed Condition Assessment Reports

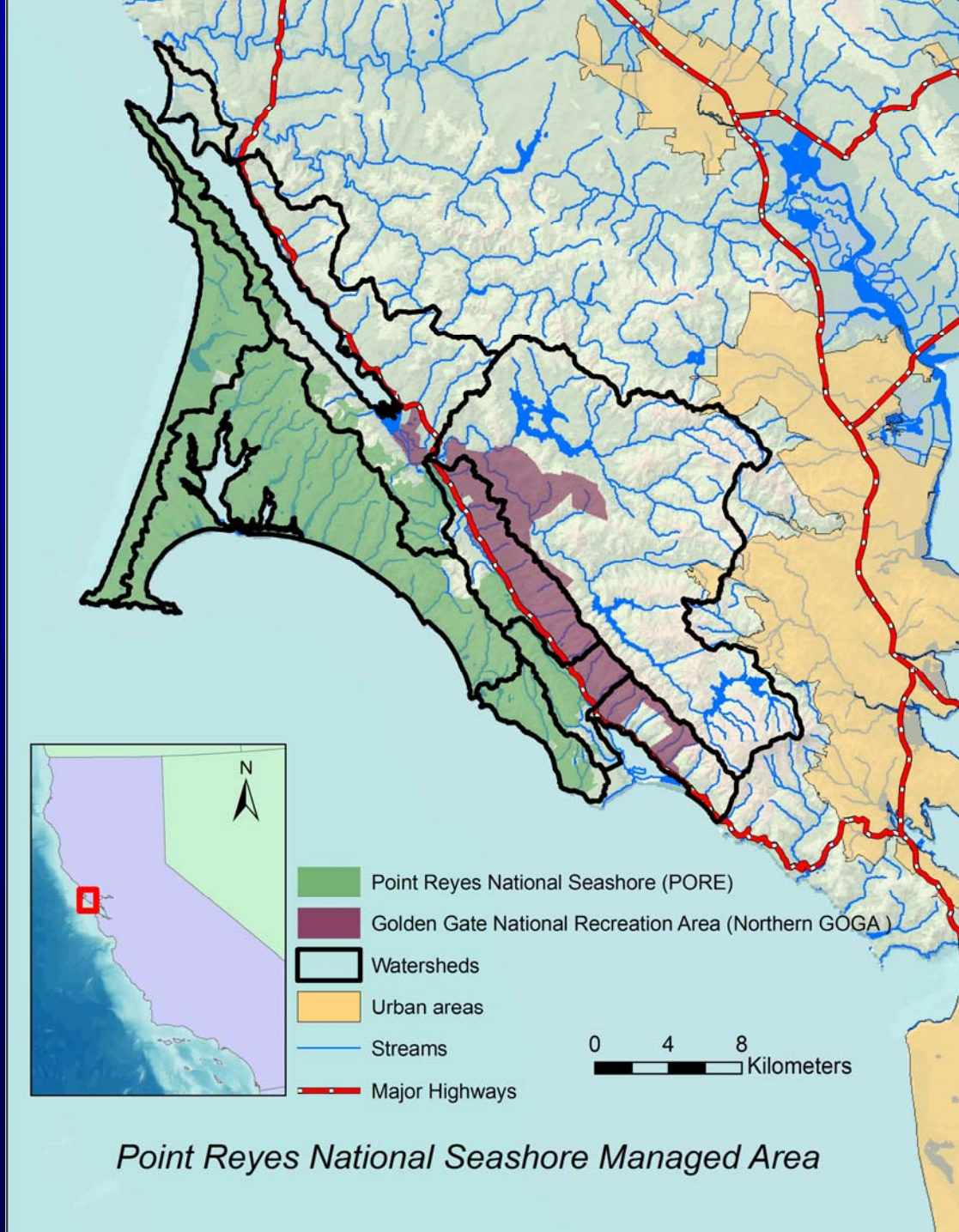
-- review and synthesize information to determine the status of coastal Park resources including water quality, habitat condition, invasive species, extractive uses, coastal development, and other issues affecting their condition.

-- characterize the relative health or status of water resources, identify actual or potential “stressors” upon these systems, and make recommendations for further studies or assessments where needed to fill information gaps to more fully evaluate condition.

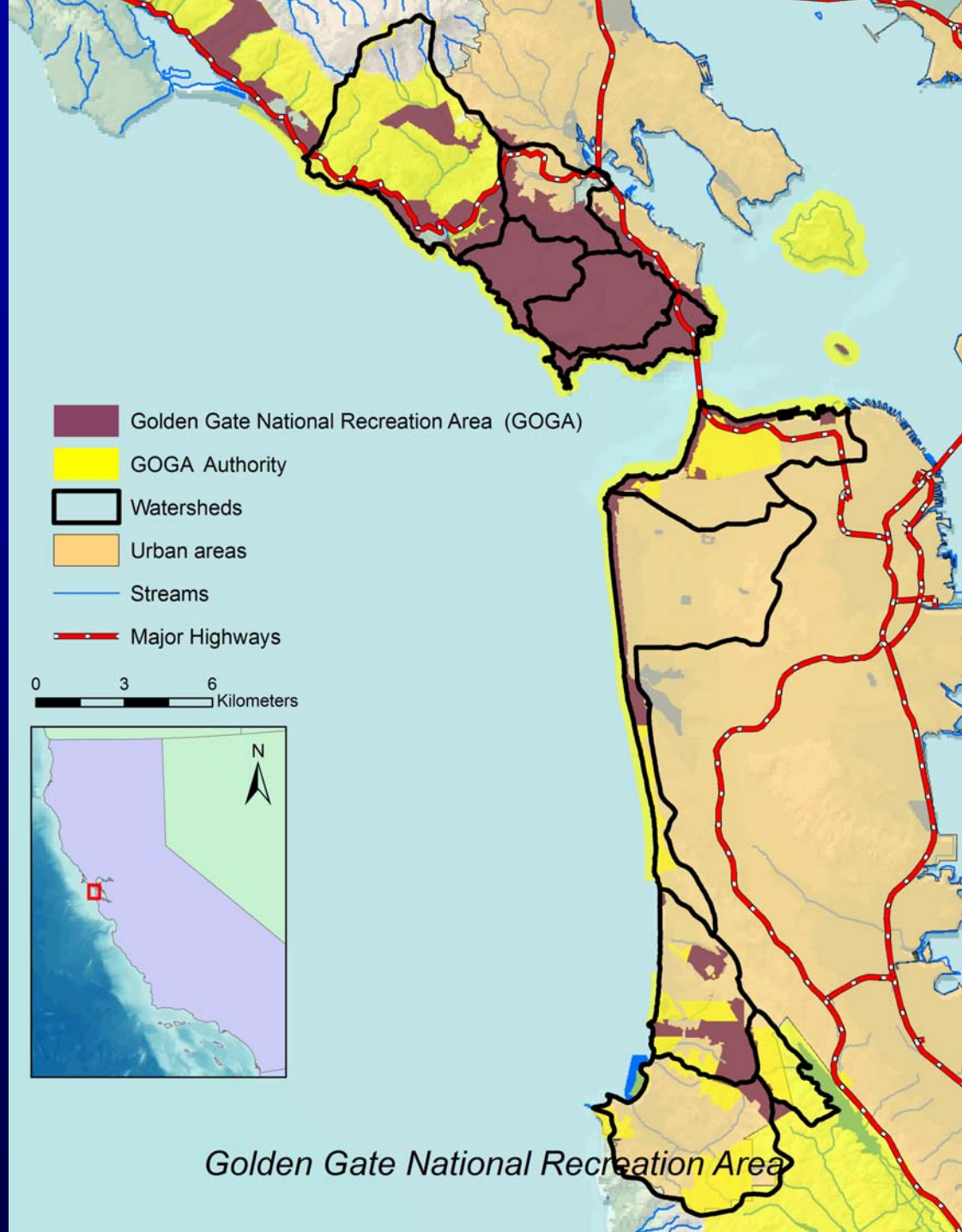
Two National Parks
>125 miles of coastline



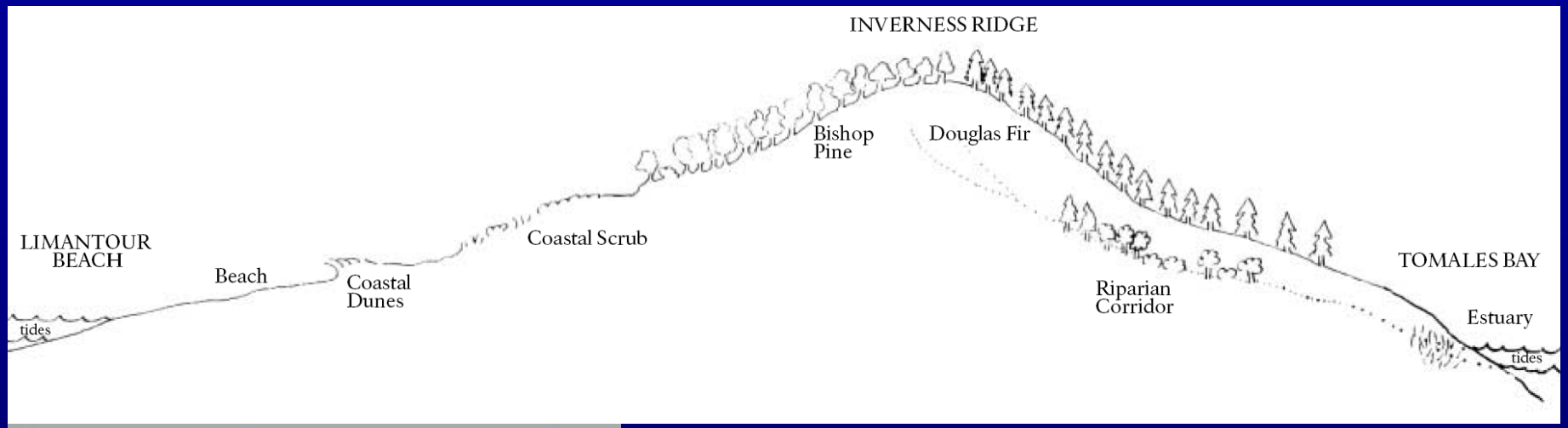
Point Reyes National Seashore



Golden Gate National Recreation Area



From open ocean to upland habitats….



Point Reyes National Seashore

"Coastal watersheds"

Similar to CALWATER superplanning watersheds (7 for PRNS)

Aggregate "planning watersheds"

Point Reyes National Seashore

Examples from 3 watersheds and most from Drakes Bay/Estero

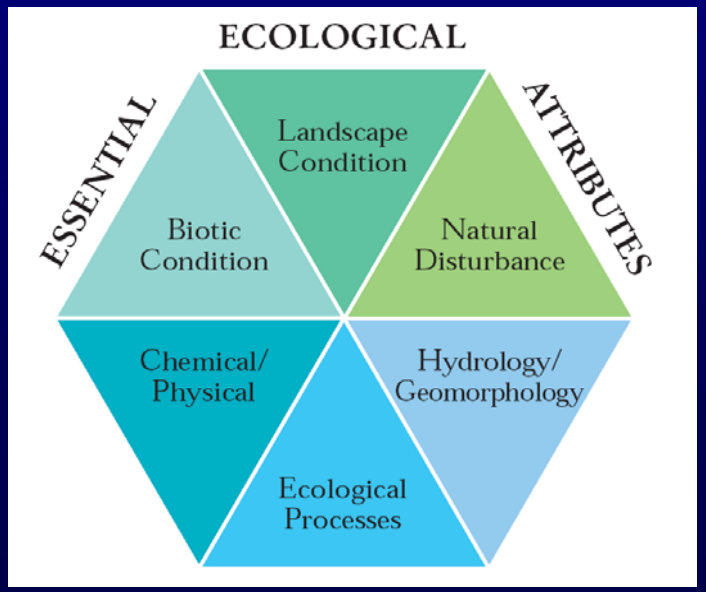
Objectives

Assess & compare condition of watersheds

- Introduce a standardized Framework / Reporting structure to organize findings
- Methods – literature review, GIS, data, and interviews
- Illustrate GIS products for one of 14+ watersheds (Point Reyes NS – Drakes Bay/Estero)
- Illustrate Water Quality Assessment methods using examples from 3 watersheds - coastal streams to esteros/bays (Point Reyes example)
- Summarize issues and future directions

Watershed Assessment

- Evaluate condition using existing information
- Broad overview to target conservation/restoration resources
- Evaluating condition using a basic model which combines the OECD's PSR and EPA SAB frameworks
  - Stressors (P)
  - Conditions (S)
    - Landscape (habitat)
    - Hydrology/geomorphology
    - Biotic condition
    - Chemical/Physical condition
    - Ecological processes
    - Natural disturbance
  - Management Response (R)
    - Management Actions, Restoration



EPA SAB 2004

Stressor Categories and ratings

- Outside influences
  - Climate change, development, air quality, natural disturbance
- Agricultural operations (farming, dairies)
- Resource Extraction (mostly offsite except fishing)
- Recreation
- Water pollution (PS, NPS)
- Water diversion (hydromodification)
- Geomorphic alteration
- Invasive Species
- Disturbed lands (legacy problems)

Ratings – Low, Medium, High and Potential Problem. Level of Information to support rating.

Stressors

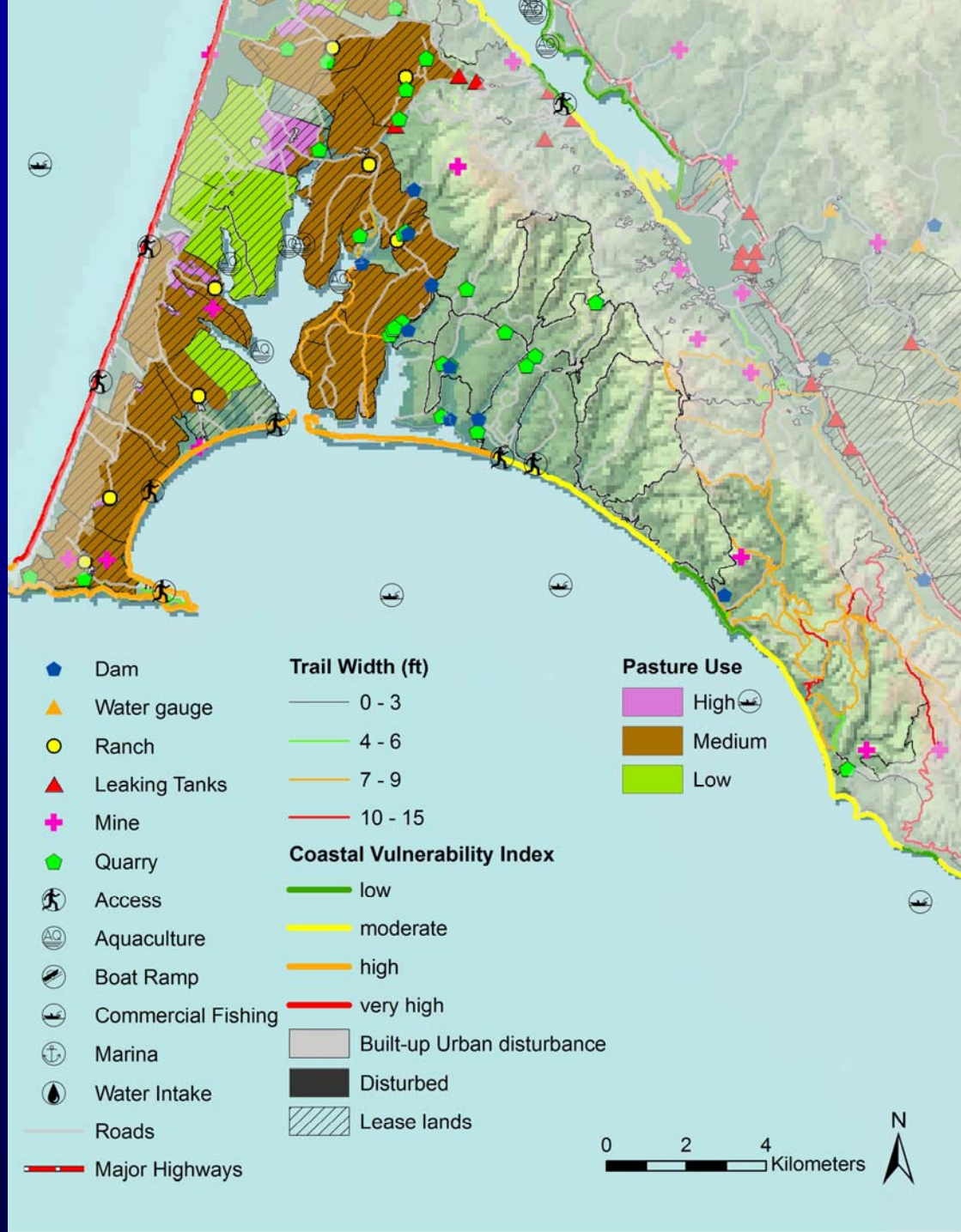
Drakes Bay/Estero

Investigation of GIS sources provides

- A straightforward assessment of data availability
- Quick summary of major problems (caveat)
- Ability to compare across watersheds

For this example, medium pasture use, quarries, trails and roads, high vulnerability to SLR

Plus invasives…



Additional Issues/Stressors from literature and interviews:

- Historic loss of tidal habitat from diking or filling
- Impaired tidal circulation, and possibly accelerated sedimentation in Drake’s Estero from oyster farming
- Erosion of cliffs
- Water quality issues - septic systems, dairies, ranching
- Introduced invertebrates
- Disturbance to shorebirds, wildlife by recreation

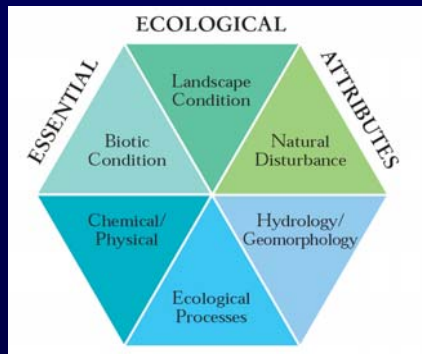
Maps, interviews, and workshop allowed us to rate stressors:

	Kehoe - Abbots	Drakes Bay - Limantour	Olema
Agricultural operations			
Dairies	**HP**	**HP (changes made)**	**NA**
Grazing	**MP**	**MP**	**MP**
Cultivation (silage, row crops)	**MP**	**LP**	**PP**
Aquaculture (e.g. Oyster culture)	**NA**	**MP**	**NA**

Drakes Estero /Limantour

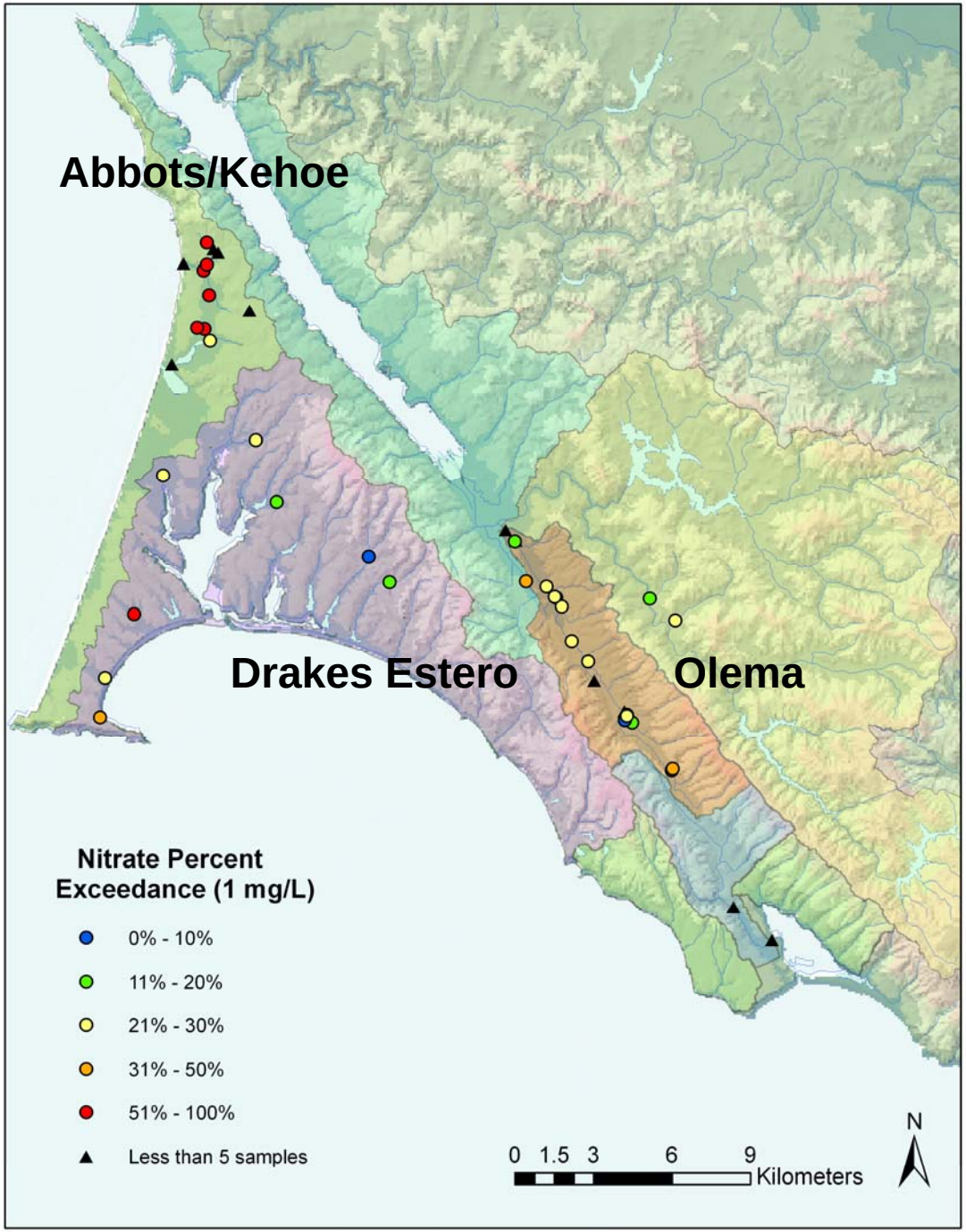
Condition (State)

- Landscape (habitat) – extent of major habitat types
- Hydrology/geomorphology – sedimentation rate
- Biotic condition – status and trends of shorebirds, harbor seals, elephant seals
- Chemical/Physical condition – Water Quality Index high nutrients, fecal coliform
- Ecological processes – PPR/chlorophyll
- Natural disturbance – El Niño, PDO



Decision-makers and the Public need summaries…

- Watershed Assessment quickly becomes unwieldy
- Frameworks help to categorize information
- But for broad comparisons, we still need methods that summarize status and trends
- Still for many resources, data not uniform – impediment for summarization
- Water Quality tends to most uniformly sampled
- Let's test methods for assessment & summariza-tion -- Water Quality Example



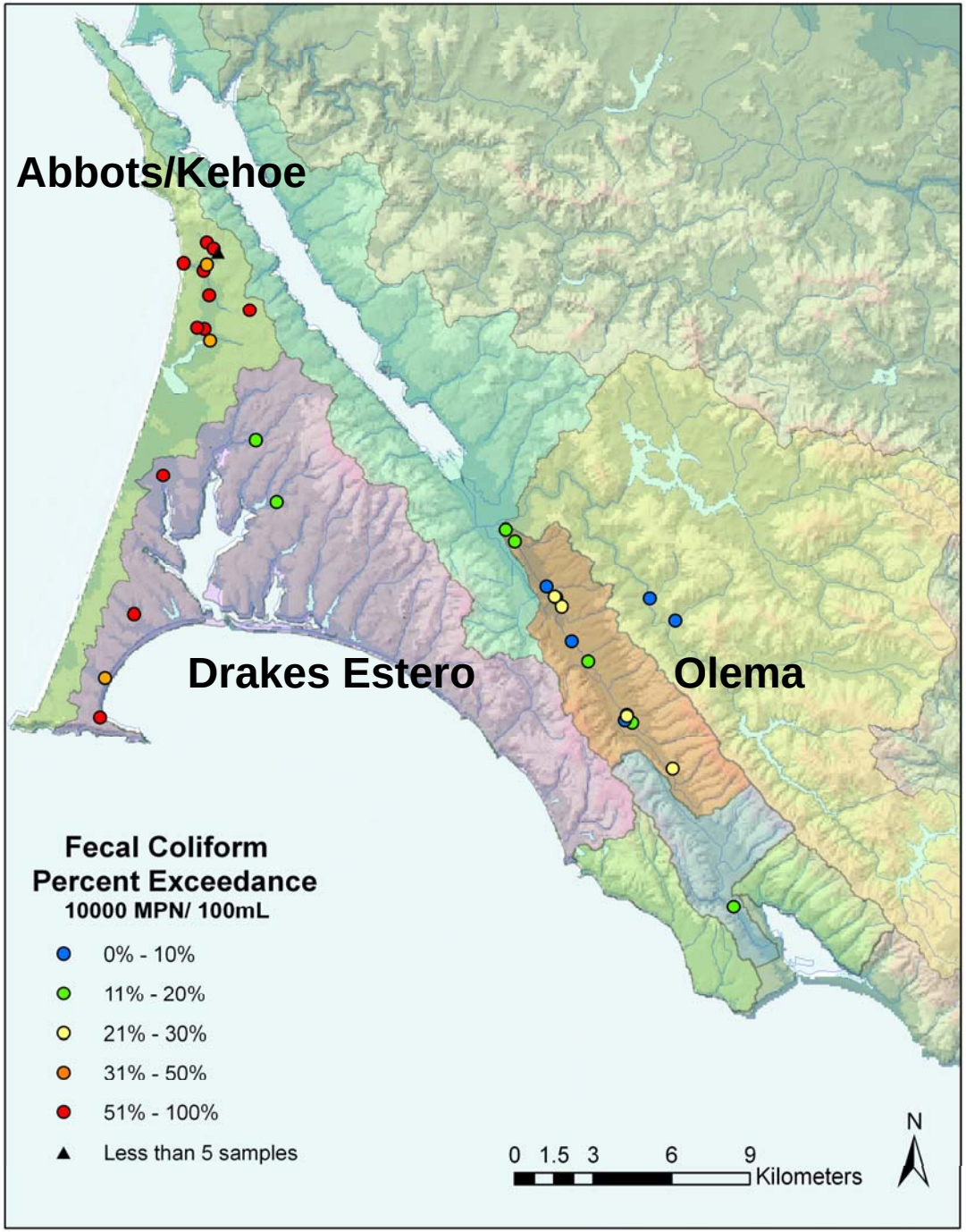
Water Quality

NPS data 1999 - 2005 (NPS Water Quality Monitoring)

Measurements offer a means to perform quantitative assessment

Example - Nitrate

- Comparisons of exceedances at specific locations
- Investigating best nutrient criteria for analyses



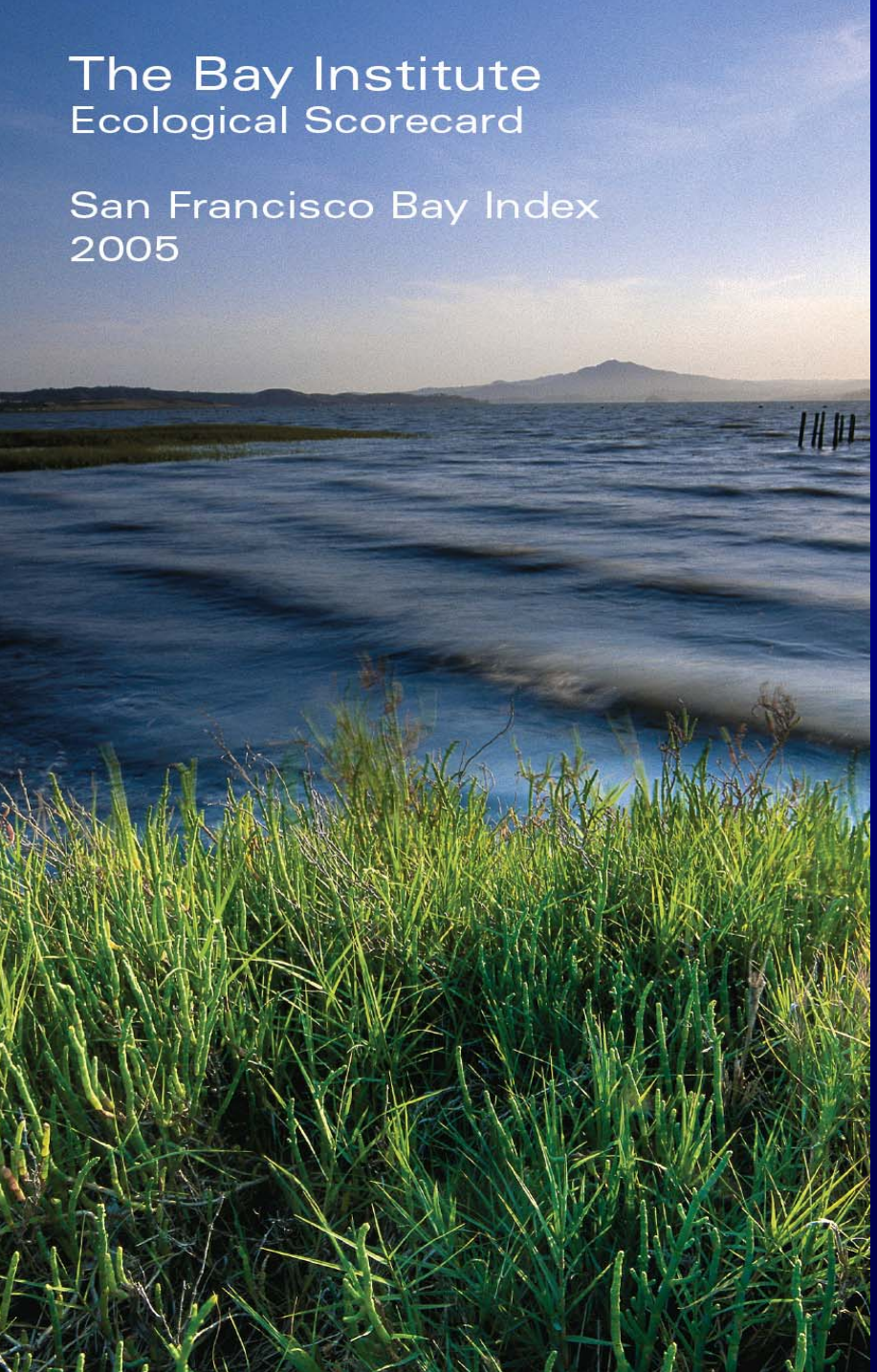
Water Quality

– Fecal Coliform

- Comparisons of single parameters possible with GIS, but multiple comparisons are difficult
- Percent exceedances shown here
- Need more sophisticated approach to compare watersheds

Water Quality Assessment Needs

- Summarize the results for multiple parameters
- Summarize the scope, magnitude, and frequency of the water quality problem
- Compare water quality using existing standards
- Compare water quality among watersheds
- Develop a rating system to assess condition



www.bay.org/Scorecard

AREA	GRADE	SUMMARY	SHORT TERM	LONG TERM
	D+ Score = 31	**Habitat** Bay habitat loss is slowly being reversed, but pace of restoration unchanged since 2003 – at current rate, more than 150 years to reach tidal marsh restoration goal.	▲	▼
	C+ Score = 58	**Freshwater Inflow** Reduced inflows still degrade the Bay ecosystem – inflow improved in 2004, but overall conditions since 2000 are worse than two previous decades.	◀▶	▼
	B- Score = 65	**Water Quality** Open waters are cleaner than in 2003, but not all standards are met in parts of the Bay. Toxic sediments, stormwater runoff are major problems. South and San Pablo Bays are most polluted.	▲	▲
	F Score = 10	**Food Web** Plankton levels in Suisun Bay are still critically low, reducing food resources for fish and birds. Phytoplankton levels in all other parts of the Bay are improving.	◀▶	▼
	B Score = 73	**Shellfish** Crab and shrimp numbers rise in Central and South Bays, but not in the upper Bay. Estuarine species lose ground to marine shellfish.	▲	▼
	C- Score = 45	**Fish** Recent upward trend reverses, fish populations return to critically low levels. Estuarine species of the upper Bay are hardest hit.	◀▶	▼
	C- Score = 38	**Fishable-Swimmable-Drinkable** More fish were caught but most are still unsafe to eat. Beach closures continue to rise, drinking water violations hold steady.	◀▶	▼
	C- Score = 46	**Stewardship** Little progress towards conserving more water, reducing pesticide use, and restoring freshwater inflows, but some efforts to issue pollution limits move forward.	◀▶	▼

CCME Water Quality Index 2.0 Method

CCME

Canadian Council of Ministers of the Environment | Le Conseil canadien des ministres de l'environnement

Method developed by the British Columbia Ministry of the Environment, Lands and Parks and adopted by the Canadian Council of Ministers of the Environment.

- Calculation incorporates three metrics:

  1. number of variables whose objectives are not met "failed variables" (**Scope**)

  2. frequency with which the objectives are not met "failed tests" (**Frequency**)

  3. amount by which the objectives are not met (**Amplitude**)

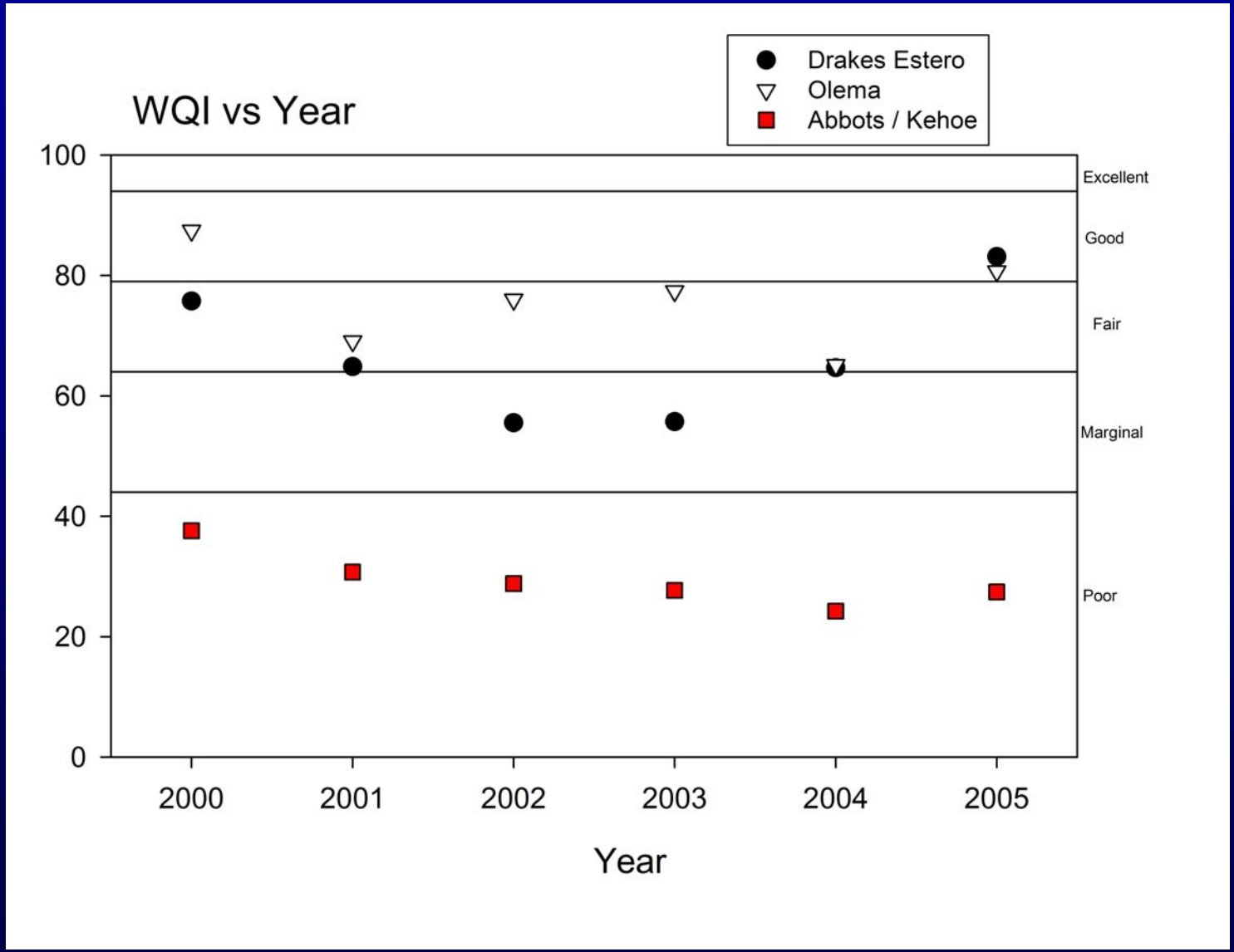
- Index calculator available – 100 point scale where 100 is excellent

- Possible limitations – depends on data quality and consistency

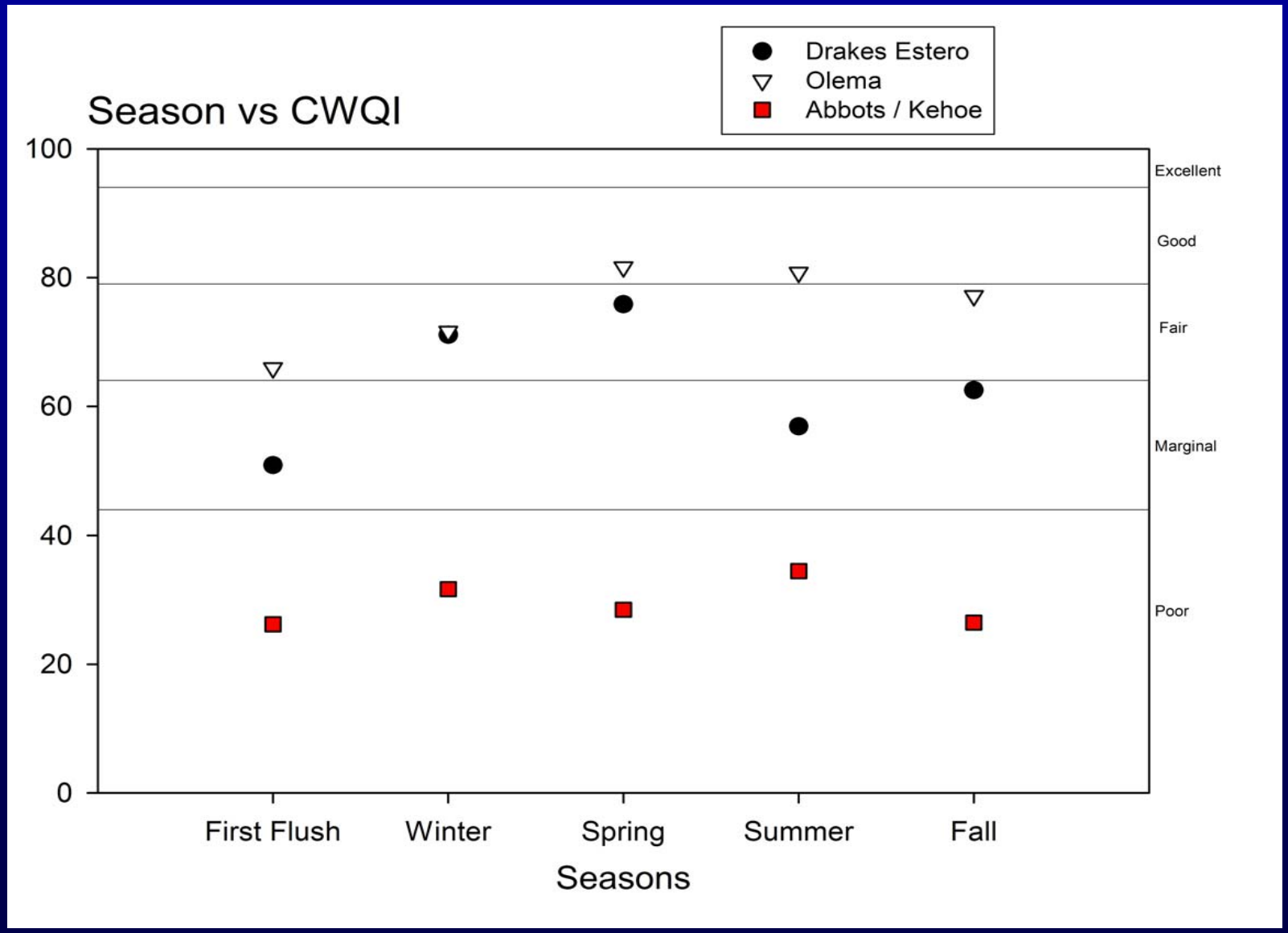
Parameters & standards being tested

Water Quality Parameter	Non-compliance if:	Limit 1 (lower range)	Limit 2 (upper range)	Unit
Dissolved Oxygen	<	7		mg/L
Total Coliform	>	10000		MPN/100 mL
Fecal Coliform	>	400		MPN/100 mL
pH	<>	6.5	8.5	
Nitrate	>	1.0		mg/L
Un-dissociated Ammonia (NH3)	>	0.025		mg/L

WQI - Year


WQI vs Year
Drakes Estero
Olema
Abbots / Kehoe
100
80
60
40
20
0
Excellent
Good
Fair
Marginal
Poor
2000
2001
2002
2003
2004
2005
Year

WQI - Season


Drakes Estero
Olema
Abbots / Kehoe
Season vs CWQI
100
80
60
40
20
0
Excellent
Good
Fair
Marginal
Poor
First Flush
Winter
Spring
Summer
Fall
Seasons

Conclusions

- PSR/SAB framework useful for organizing information and can be linked directly to indicators

- Useful for illustrating data gaps

  -- Data to assess condition for many aspects of framework <u>not</u> comprehensive

  -- Water quality, Habitat extent – wetlands, riparian corridors and Key species e.g. Harbor seals, Salmon hold the most promise

- GIS useful for investigating status of datasets (extent of coverage) and a powerful visual tool

- CCME Water Quality Index –
  - Useful summarization and exploration tool
  - The tool is only as good as the data – selection of sites affects the analysis (random versus directed sampling)
  - Allows comparisons of unique combinations - can be used to compare temporal, seasonal, regional effects
  - Used with GIS – provides an even more robust analysis

Future Directions

- Finish applying PSR/SAB template to compare watershed condition for all watersheds
- Water Quality Index-
  - Extend analysis to other watersheds
  - Perform Sensitivity Analysis
    - Effect of Data rich versus data poor
    - Effect of parameters
    - Effect of changing criteria
    - Compare results with more traditional statistical measures