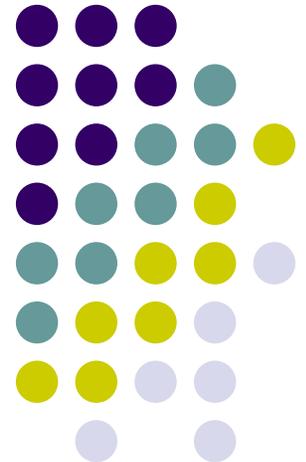


# Monitoring and Assessment

## Water Quality Standards Academy

---

Terry Fleming  
Monitoring and Assessment Office  
Water Division, US EPA Region 9



# What Does This Session Cover?



- Clean Water Act structure for monitoring
- Monitoring objectives & information needs
- What should be monitored
- Tools for monitoring & assessment
- Reporting on water quality

# Clean Water Act

## Drivers for Monitoring



- Section 305(b)
  - States must report on condition of all waters
  - Specifically the extent that support healthy aquatic life and recreation in and on the water
- Section 303(d)
  - States must submit prioritized list of waters that do not meet WQS and need a TMDL
  - Develop and implement TMDL
- Other CWA programs
  - Setting & refining Water Quality Standards
  - Issuing and ensuring compliance with NPDES permits
  - Managing NPS to meet WQS

# Critiques of Water Monitoring\*



- EPA and States need better data to support management decisions
  - Develop and refine water quality standards
  - Implement measures to protect and restore waters
  - Evaluate the effectiveness of management actions
- And to make scientifically defensible of the condition of all waters
  - Small portion of water resources are assessed by States
  - Indicators, parameters, and sampling procedures vary
  - Methods to define amount of water assessed vary

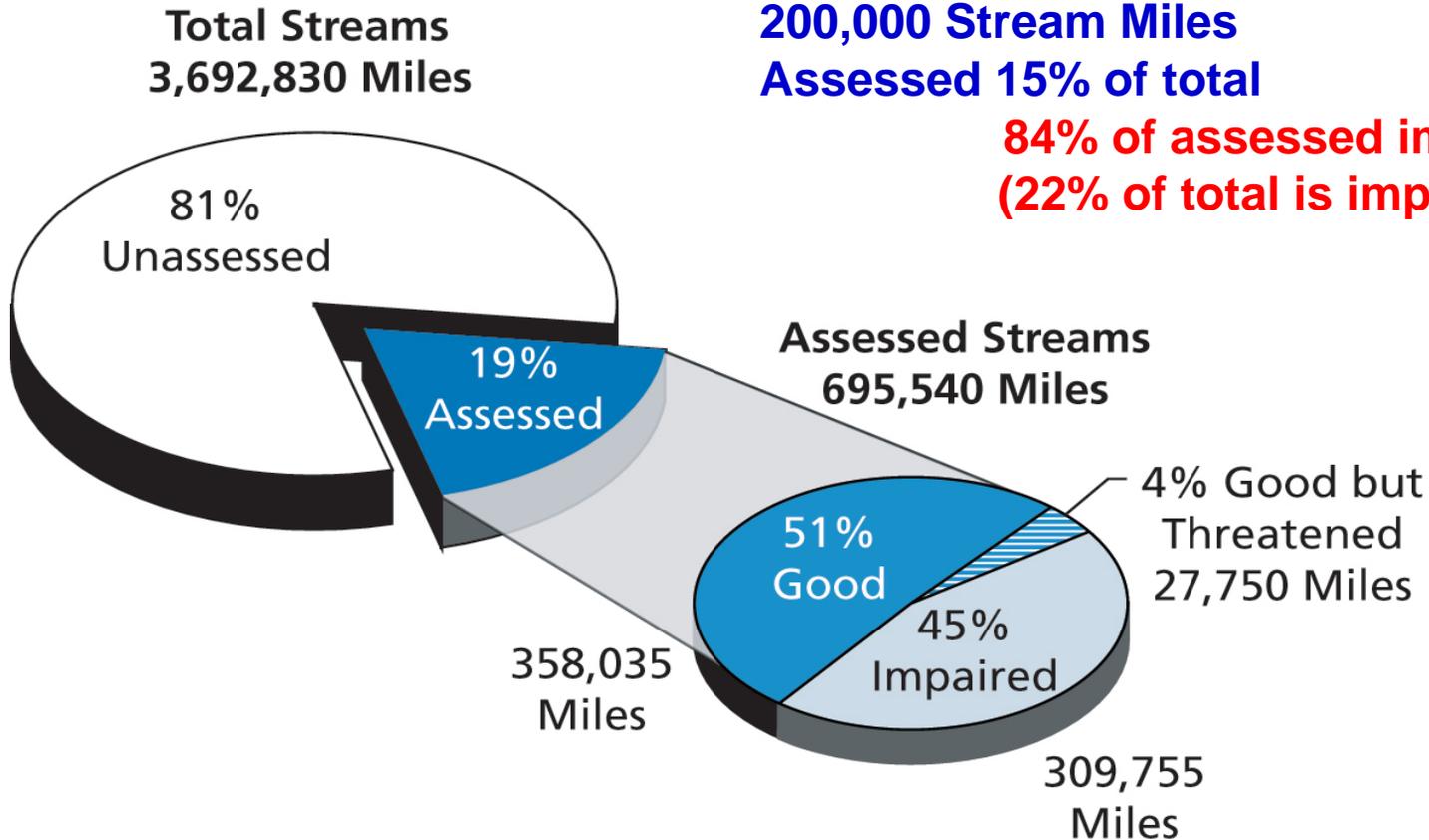
*Government Accounting Office (2000), National Research Council (2001), National Academy of Public Administration (2002), Heinz Center (2002) USEPA (2003), Environmental Integrity Project (2004), Resources for the Future (2004)*



# Streams Assessed in 2002

California 2004 305(b) Report  
200,000 Stream Miles  
Assessed 15% of total

**84% of assessed impaired  
(22% of total is impaired)**

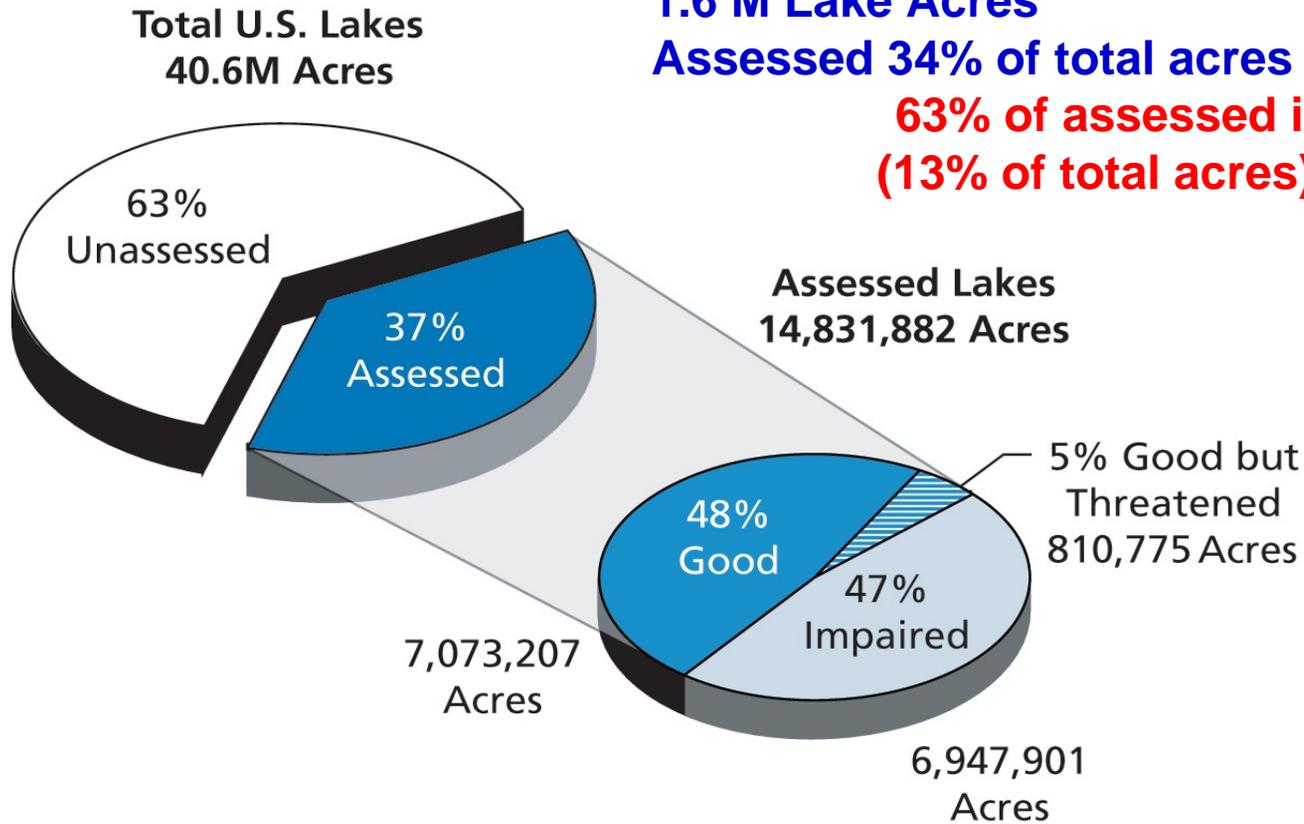




# Lakes Assessed in 2002

California 2004 305(b) Report  
> 10,000 Lakes  
1.6 M Lake Acres  
Assessed 34% of total acres

**63% of assessed is impaired  
(13% of total acres)**

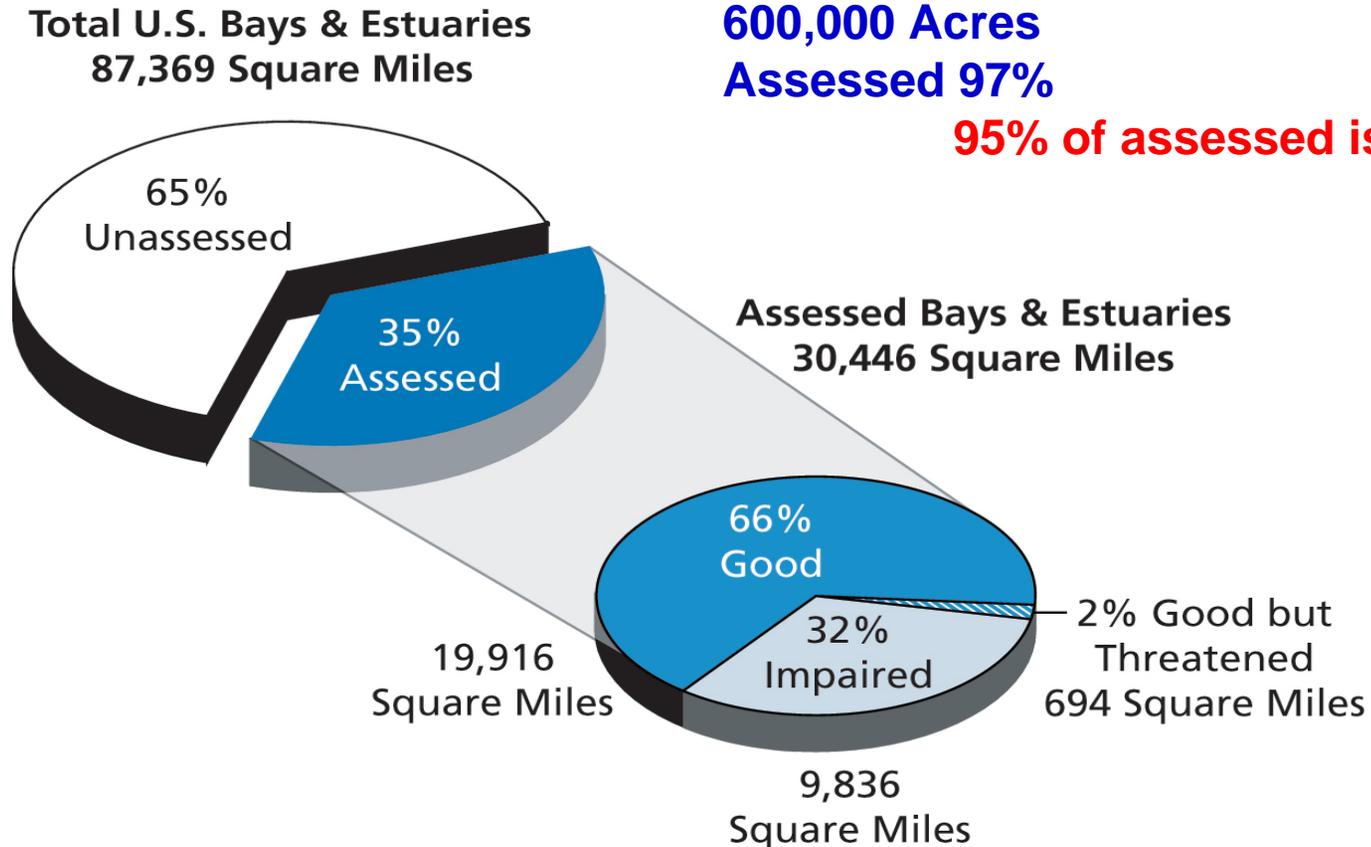


# Bays and Estuaries Assessed in 2002

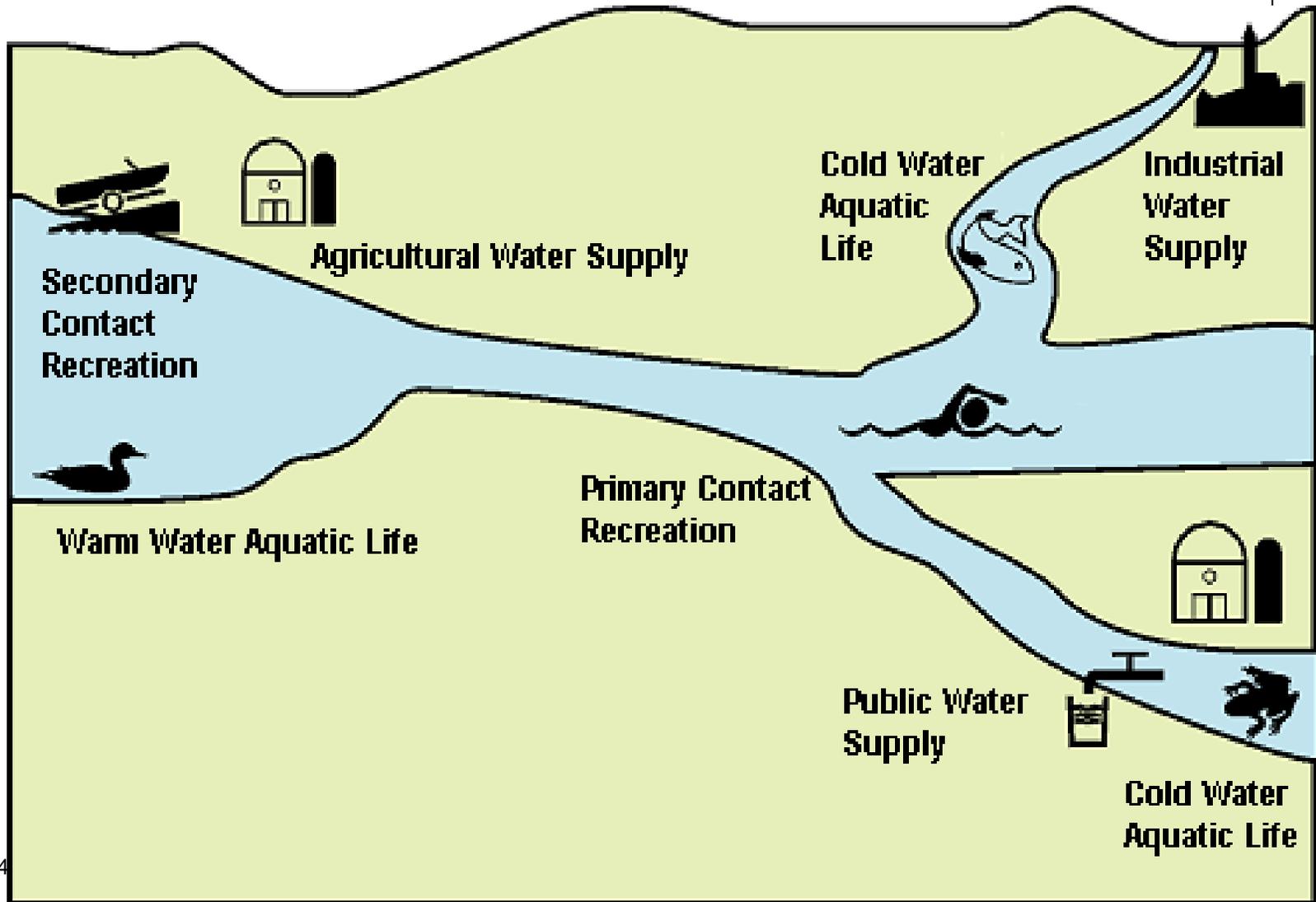
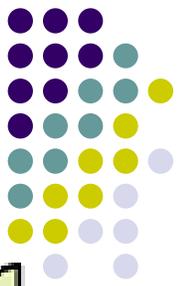


California 2004 305(b) Report  
600,000 Acres  
Assessed 97%

**95% of assessed is impaired**



# Designated Uses



# The SWAMP Challenge:

## Assess all waterbodies for all beneficial uses



- **Waterbody types**

- Lakes
  - >10,000 lakes
  - 1.6 million acres
- Rivers
  - >200,000 miles
  - ~ 30% perennial
- Bays, Harbors, Estuaries
  - >600,000 acres
- Beaches
  - >3,000 miles of coastline
  - ~ 1000 beaches
- Nearshore coastal zone
- Wetlands?

- **Core Beneficial uses**

- Safe to Drink?
- Safe to Swim?
- Safe to Fish?
- Aquatic life protected?

## 2. Monitoring Objectives



- Monitoring objectives are broad
  - Are uses supported?
  - Are waters getting better over time?
  - What are the stressors affecting the uses?
  - Are protection and restoration efforts working?

SWAMP Monitoring Strategy

<http://www.waterboards.ca.gov/swamp/docs/cw102swampcmas.pdf>

# 3. Design Monitoring Project



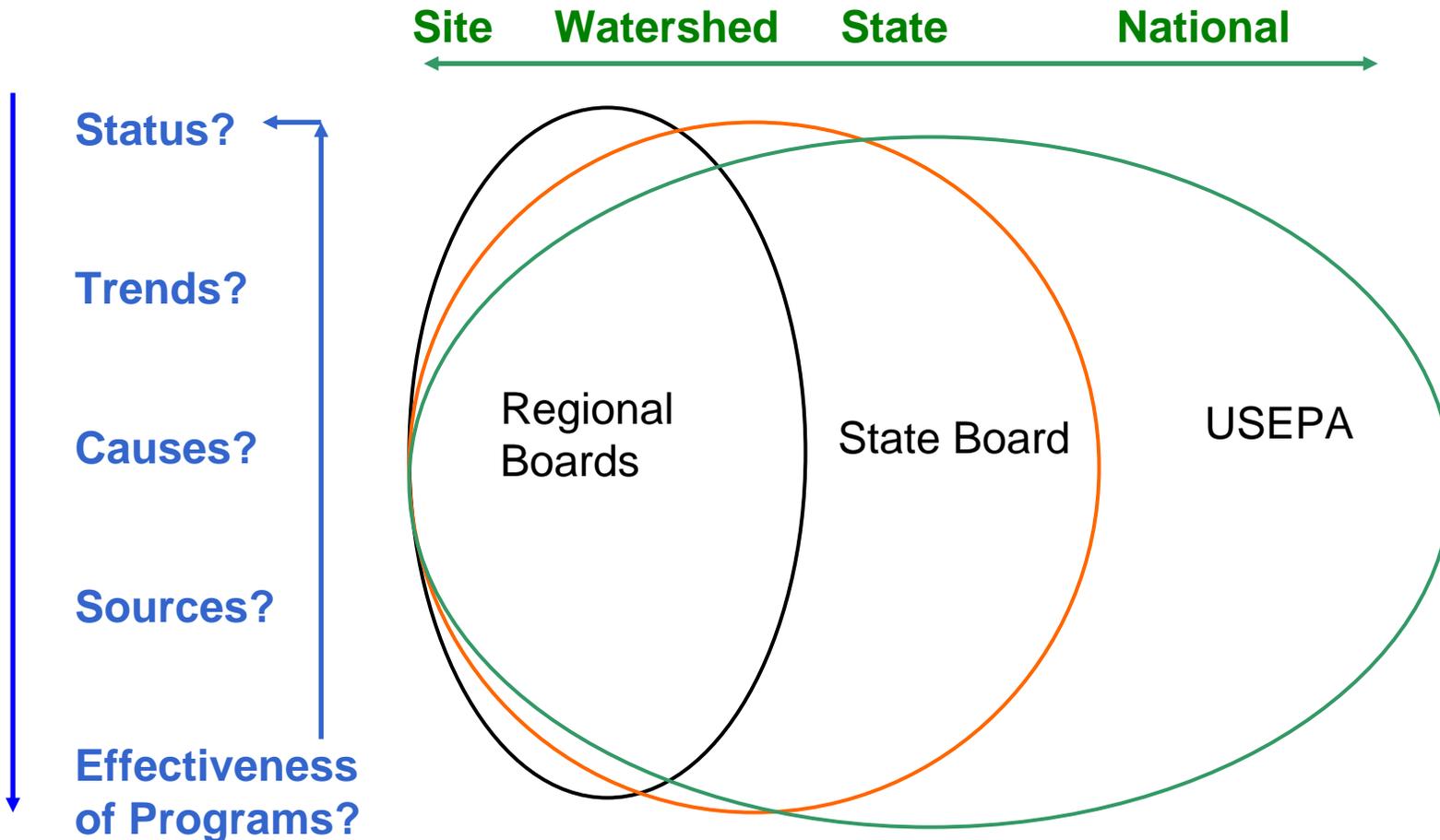
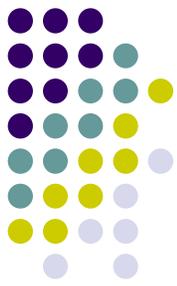
- Translate objectives into specific monitoring goals
  - Broad objective: *“Is it safe to swim in the stream?”*
  - Specific monitoring goal: *Assess x streams relative to e. coli standard during summer bathing season*
- Look at existing data
  - Do we need to go out and collect the information ourselves?
- This is a critical step
  - The **who, what, how, and where** of monitoring
- Costs are a major consideration



# Who Monitors Water Quality?

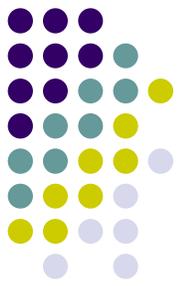
- States and Tribes implement monitoring programs under CWA 106
- Federal agencies monitor to support their management and research needs
- Volunteer and citizen groups monitor to understand local conditions
- Other organizations include local government, academic organizations

# 3. Design: Common questions (but questions of scale)



Programs needing answers:

Standards, Permits, Nonpoint Source, TMDLs, Drinking water, Groundwater



# 3. Design: Matching design to scale of question

	Statewide	Regional	Local
Status	Statewide by waterbody type	Watersheds and individual waterbodies	Individual waterbodies
Trends	Are things getting better overall?	Are conditions in the watershed doing better?	Are conditions in Reach 2 getting better?
Sources	What are the relative sources?	↔	Who's discharging and how much?
Effectiveness	How well are programs working overall?	Are we writing good permits?	Did the BMP work?

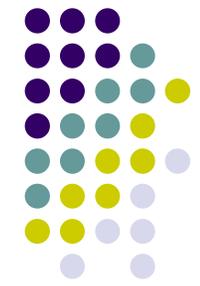


# 3. Design: Matching design to scale of question

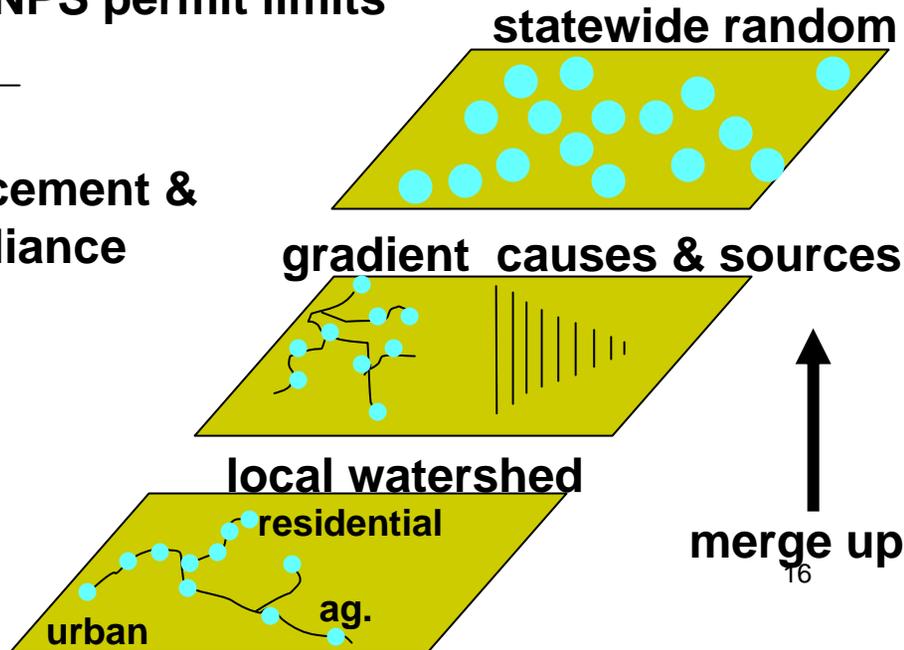
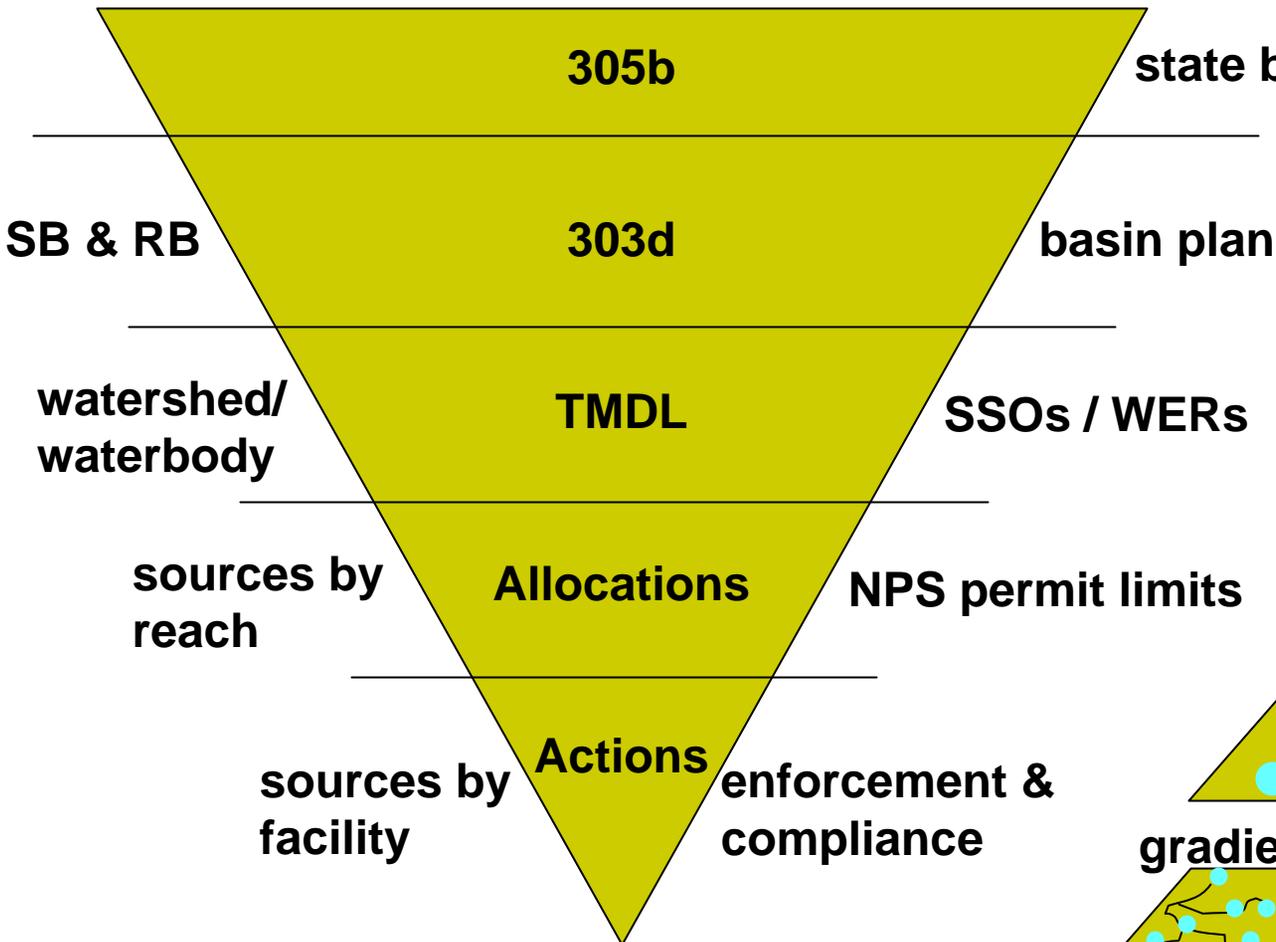


Probability surveys	<ul style="list-style-type: none"><li>● Assessment of background condition (context)</li><li>● Predict proportion of waters in good or poor condition</li><li>● Measure broad-scale water quality trends</li><li>● Prioritize targeted monitoring</li></ul>
Modeling and landscape analysis	<ul style="list-style-type: none"><li>● Determine where water quality is likely impaired</li><li>● Predict water quality trends</li><li>● Prioritize targeted monitoring</li></ul>
Targeted monitoring	<ul style="list-style-type: none"><li>● Assess WQS attainment for specific segments</li><li>● Measure localized water quality trends</li><li>● Identify sources of pollutants to specific waters</li><li>● Support development of local management measures</li><li>● Assess performance of management measures</li></ul>

# Integrating across scale



statewide  
↑  
local

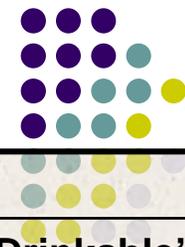


# USEPA Actions to Support States and Improve Monitoring



- Strengthen State, Tribal and Interstate programs (~\$170,000/yr)
- Collaborate to produce statistically-valid assessments of the nation's waters (~\$160,000/yr)
  - Lakes (2007),
  - Rivers (2008/09),
  - Coastal (2010)
  - Wetlands (2011)
- Expand accessibility to and use of data
- Development of assessment tools

# Statewide Surveys in California



Water Body Type	Beneficial Use			
	Aquatic Life	“Fishable”	“Swimmable”	“Drinkable”
Wadeable Streams	<i>SWAMP Bioassessment (2005 – ongoing)</i>		<i>SWAMP Scoping Study (2007-08)</i>	
Large Rivers	<i>EPA Flowing Waters Study (2008-2009)</i>		<i>SWAMP Scoping Study (2007-08)</i>	
Lakes	<i>EPA Lakes Survey (2007)</i>	<i>SWAMP Bioaccumulation Study (2007-09)</i>	<i>SWAMP Scoping Study (2007-08)</i>	
Coastal Waters	<i>EPA Coastal Survey (planned for 2010)</i>	<i>SWAMP Bioaccumulation Study (2009-10)</i>	<i>SWRCB Beach Program (2000 – ongoing)</i>	NA
Bays/ Estuaries				NA
Wetlands	<i>EPA Wetland Survey (planned for 2011)</i>	NA	NA	NA

# 4. Indicators

## What Should be Monitored?



	<b>Aquatic Life</b>	<b>Recreation</b>	<b>Drinking Water</b>	<b>Fish / Shellfish</b>
<b>C O R E</b>	Biological communities Basic chemistry (e.g. DO, pH) Nutrients Flow Habitat assessment Landscape condition	Pathogen indicators ( <i>E. coli</i> , enterococci) Nuisance plant growth Nutrients Chlorophyll Flow Landscape condition	Trace metals Pathogens Nitrates Salinity Sediments/TDS Flow Landscape condition	Pathogens Mercury Chlordane DDT PCBs Landscape condition
<b>O T H E R</b>	Ambient toxicity Sediment toxicity Toxics in water or sediment Health of organisms	Toxics in water or sediment Hazardous chemicals Aesthetics	Chemicals of concern in water or sediment VOCs (in reservoirs) Hydrophyllic pesticides Algae	Bioaccumulative chemicals in water or sediment

# 4. Indicators.

## How to interpret the results.



- Narrative or numeric expressions of parameters designed to protect designated uses
  - Temp, pH, nutrients (Basin Plans)
  - No toxics in toxic amounts (Basin Plans)
  - Numeric toxic criteria (CTR)
- Biological criteria: numeric or narrative expressions that describe the "desired" aquatic communities inhabiting a waterbody.
- Habitat, Flow and Landscape?



# 5. QA/QC - Protocols, Field & Laboratory methods



## Chemistry

Usually well documented field and lab methods

- SWAMP SOPs for field measurements and collection of water and bed sediments
- SWAMP Chemistry performance based approach

## Biology and Physical Habitat

Usually well documented field and lab methods

Sometimes multiple methods (standardization an issue)

Methods vary by waterbody type

- SWAMP SOP for collection of benthic macroinvertebrate samples and associated physical and chemical data for ambient bioassessments in California

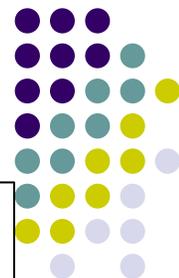
# 5. QA/QC



Before  
you go out in  
the field....

You need to  
develop a Quality  
Assurance Project  
Plan (QAPP)

4-15-08



22

# 5. QA/QC at the Waterboards



- State Water Board Quality Management Plan
  - Generic covers all Water Board Programs
- SWAMP QA Program Plan
  - Specific to ambient water quality
  - A standard reference for other programs
- Project Specific QA Project Plans
  - Where projects need more detailed QA/QC

# 6. Managing Data (EPA)



- EPA's STORET/Water Quality Exchange for easier data sharing
- Redesigned STORET to facilitate easier upload and download of water quality data
- Data warehouse provides quick access to data of documented quality ([www.epa.gov/storet](http://www.epa.gov/storet))
- GIS supports data analysis and interpretation
- Record sampling locations (Lat./long., stream name)
- National Hydrography Dataset
- Hint – make sure that your contract Lab sends data in a STORET ready format

# 6. California's SWAMP IM Plan



## 1. SWAMP Data Management procedures

<http://mpsl.mlml.calstate.edu/swcompare.htm>

- Tables and naming conventions for:

  - Chemistry (water, sediment, tissue)

  - Toxicity

  - Biological communities (fish, invertebrates)

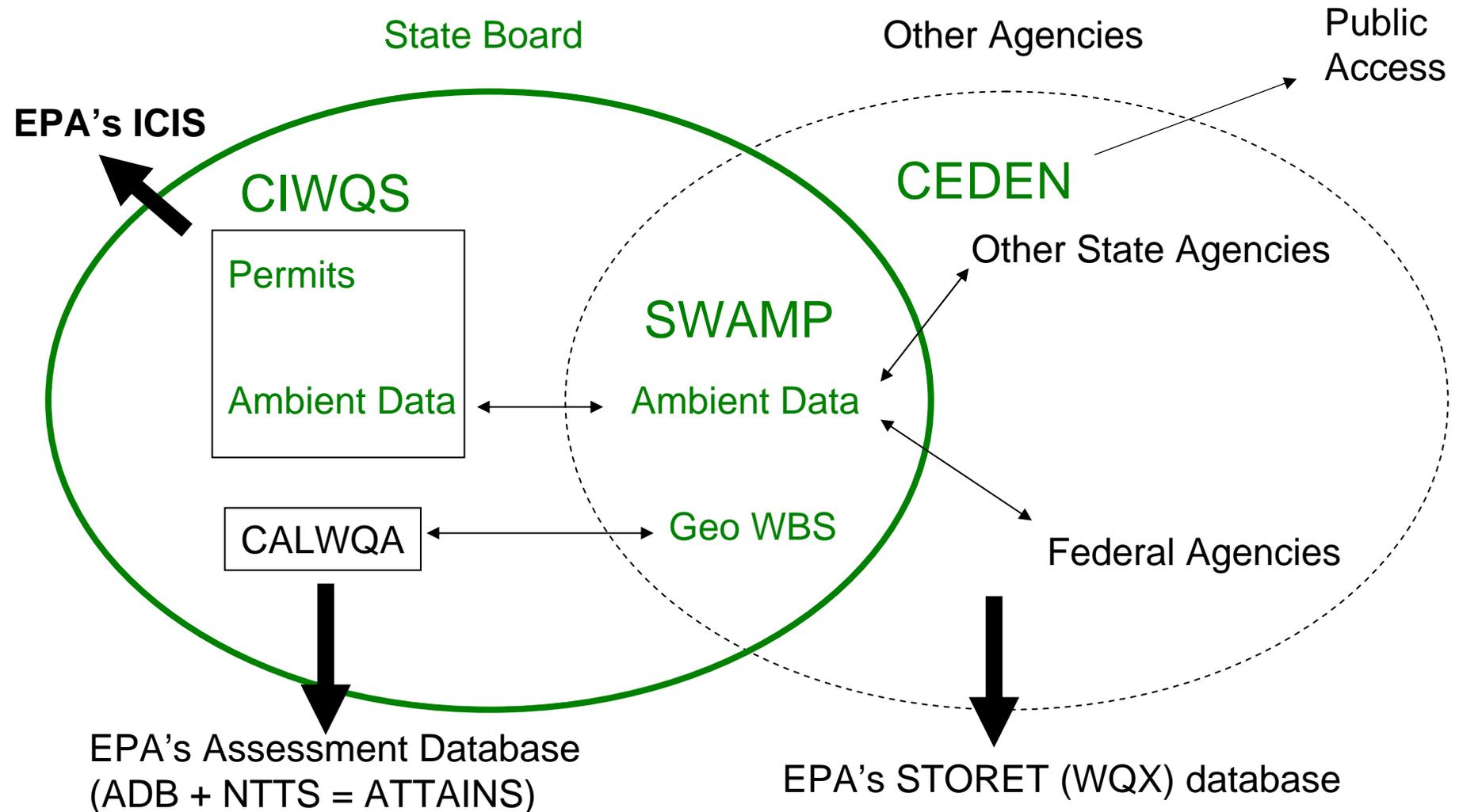
  - Physical habitat

- Minimum metadata expectations for comparability

## 2. How to get SWAMP data?

<http://mpsl.mlml.calstate.edu/swdata.htm>

# A State Board Perspective of the Data World



# 7. Assessment Methodology

## Turning data into assessment



Aquatic Life	Recreation
Dissolved Oxygen	<i>E. coli</i>
pH	
Temperature	
Macroinvertebrates	



# 7. Assessment Methodology



Describes the hierarchy of indicators and tools used to assess water quality and documents procedures

For collecting and reviewing all readily available and existing data and information

For making WQS attainment decisions for all applicable criteria

- Address numeric criteria, narrative criteria, and designated uses
- Define data quality and documentation needs
- Describe analytical approaches for interpreting data and information

EPA Consolidated Assessment and Listing Methodology

<http://www.epa.gov/owow/monitoring/calm.html>

# 7. California Listing Policy



- Data Quality (approved QAPP)
- Number of exceedances of magnitude, duration and frequency
- Age of data
- Temporal and spatial representativeness
- Aggregation of data by reach/area
- How to interpret numeric objectives (binomial)
- How to interpret narrative objectives (evaluation guidelines)

California Listing Policy

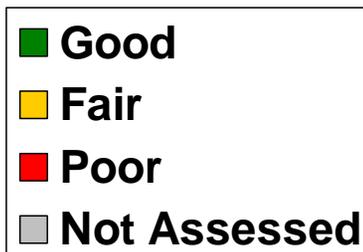
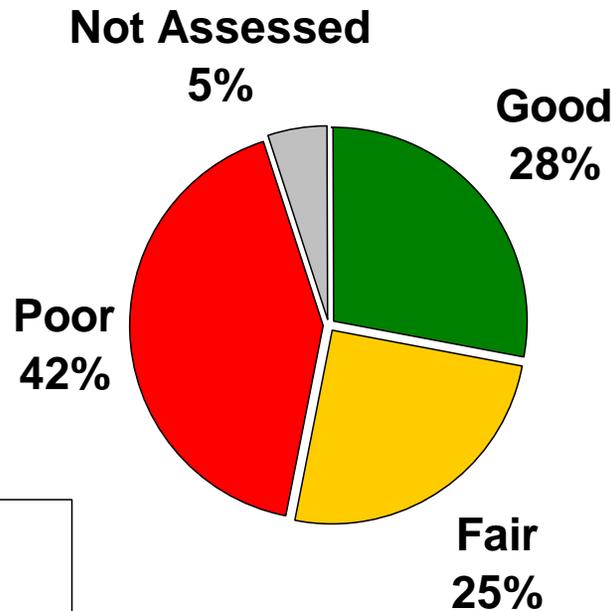
[http://www.swrcb.ca.gov/tmdl/303d\\_listing.html](http://www.swrcb.ca.gov/tmdl/303d_listing.html)

# 8. Reporting Communicating Results



- Summarize the information
  - Few people will understand the raw data
  - Provide an interpretation of the data
- Provide to States, Tribes, other interested/affected parties, to newspapers, etc.
  - Presentations and written documents are both needed

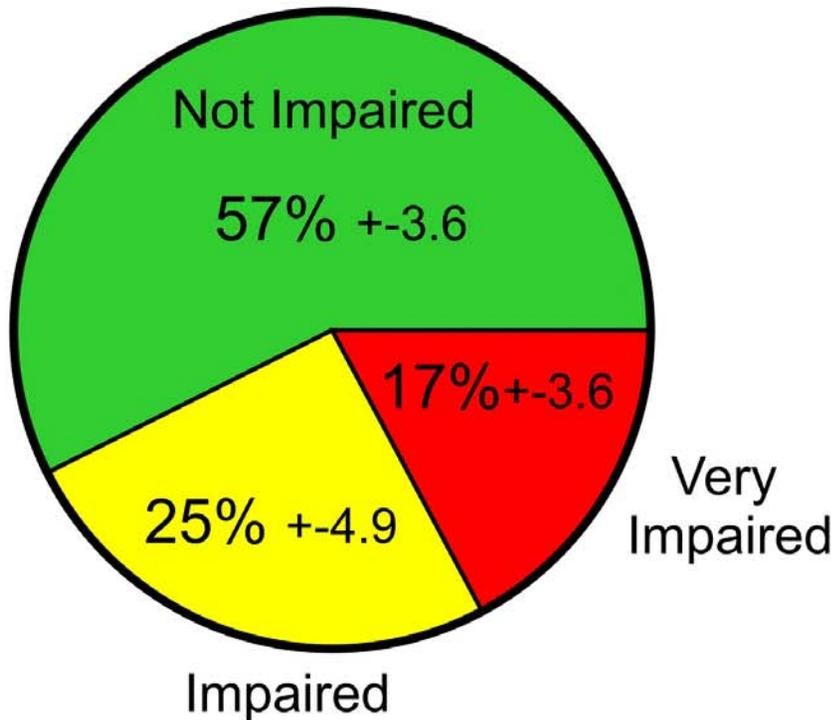
# 8. Reporting (National) Wadeable Streams Assessment



- The WSA found 28% of streams in good condition, compared to least-disturbed reference condition.
- Across the US 25-30% of streams have high levels of nutrients or excess sedimentation. **These streams are twice as likely to have poor biology.**

**Biological Condition of Streams  
(Index of Biotic Condition)**

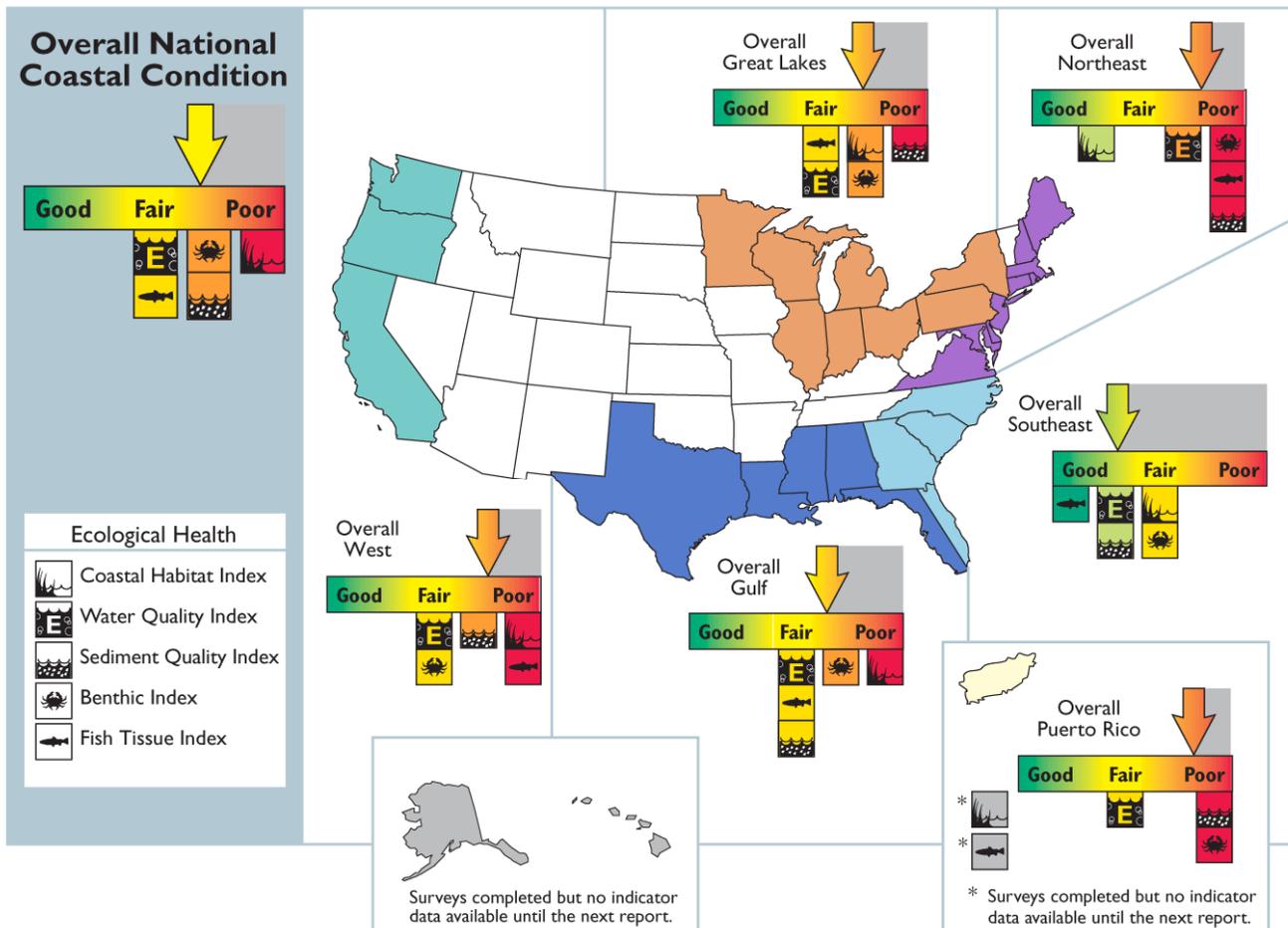
# 8. Reporting California Wadeable Streams (2006)



**Biological Condition of Streams  
(RIVPACS O/E)**

- SWAMP found 30% of streams in good condition, compared to least-disturbed reference condition.
- Across the California 35% of streams have high levels of nitrogen. **These streams are 3X as likely to have poor biology.** No such pattern was observed with high nitrogen

# 8. Reporting National Coastal Condition Report



All coastal states and Puerto Rico participated in monitoring

Data support assessments at national, regional, state and local scales

2005 report found:  
21% in good condition  
44% in fair condition  
35% in poor condition

# 8. Reporting in California



- 2006 305(b) Report Coastal Waters and Wadeable Streams
- 2007 Sediment Quality Report for Bays and Estuaries
- 2008 305(b) Report on Coastal Wetlands
- 2009 305(b) Report on Fish Tissue in Lakes

Clean Water Act Section 305b Report 2006

Water Quality Assessment  
of the Condition of California  
Coastal Waters and  
Wadeable Streams

October 2006



# 8. Reporting

## 305b/303d Integrated Reports



- Integrate CWA water quality assessments & reports
- Describe assessment methodology for WQS attainment decisions
- Categorize state waters based on WQS attainment status
- Present results of probability-based design at state or watershed scale
- Establish monitoring priorities for next 2 years
- Establish TMDL development priorities for all Category 5 waters

# Integrated Report Categories



## 305 (b) Report

1. Attaining all designated uses
2. Attaining some designated uses, and insufficient information to determine if remaining uses are attained
3. Insufficient or no data and information to determine if the standard is attained
4. **Impaired** or threatened for one or more designated uses but not needing a TMDL because --
  - a. **TMDL has been completed**
  - b. **Expected to meet standards**
  - c. **Not impaired by a pollutant**
5. **Impaired or threatened by pollutant(s) for one or more designated uses and requiring a TMDL** } **303(d) List**

# Monitoring and Assessment Websites



- General Monitoring Information <http://www.epa.gov/owow/monitoring/>
- Information on Biological Assessments  
<http://www.epa.gov/owow/monitoring/bioassess.html>
- Consolidated Assessment and Listing Methodology guidance  
<http://www.epa.gov/owow/monitoring/calm.html>
- 2006 Integrated Report Guidance  
<http://www.epa.gov/owow/tmdl/2006IRG/#documents>
- Section 303d Lists of Impaired Waters  
[http://oaspub.epa.gov/waters/national\\_rept.control](http://oaspub.epa.gov/waters/national_rept.control)
- National Water Quality Reports (under Section 305b)  
<http://www.epa.gov/owow/monitoring/reporting.html>
- National Coastal Condition Reports  
<http://www.epa.gov/owow/oceans/nccr/>
- Wadeable Streams Assessment  
<http://www.epa.gov/owow/monitoring/wsa/index.html>
- National Lakes Fish Tissue Study  
<http://epa.gov/waterscience/fishstudy/>

# State Board Websites



- SWAMP Homepage <http://www.swrcb.ca.gov/swamp/index.html>
- Monitoring Strategy <http://www.waterboards.ca.gov/swamp/docs/cw102swampcmas.pdf>
- SWAMP Field Manual <http://www.swrcb.ca.gov/swamp/docs/reports/>
- SWAMP Bioassessment Procedures <http://www.swrcb.ca.gov/swamp/docs/reports/>
- SWAMP QA/QC Program <http://mpsl.mlml.calstate.edu/swcompare.htm>
- SWAMP Data Management procedures <http://mpsl.mlml.calstate.edu/swcompare.htm>
- How to get SWAMP data <http://mpsl.mlml.calstate.edu/swdata.htm>
- California Listing Policy [http://www.swrcb.ca.gov/tmdl/303d\\_listing.html](http://www.swrcb.ca.gov/tmdl/303d_listing.html)
- CA 2006 303d Lists of Impaired Waters [http://www.swrcb.ca.gov/tmdl/303d\\_lists2006approved.html](http://www.swrcb.ca.gov/tmdl/303d_lists2006approved.html)
- Narrative 305b Report <http://www.waterboards.ca.gov/swamp/docs/factsheets/305breport2006.pdf>