Sediment Quality Objectives

For California Enclosed Bays and Estuaries

Phase II Activities

Scientific Steering Committee Meeting

July 11, 2007

Phase II

Three principal tasks:

- **Provide Phase I implementation assistance**
- **Extend direct effects tools and assessment framework to estuaries to other habitats**
- **Continue development of indirect effects assessment framework and tools**

Implementation Assistance

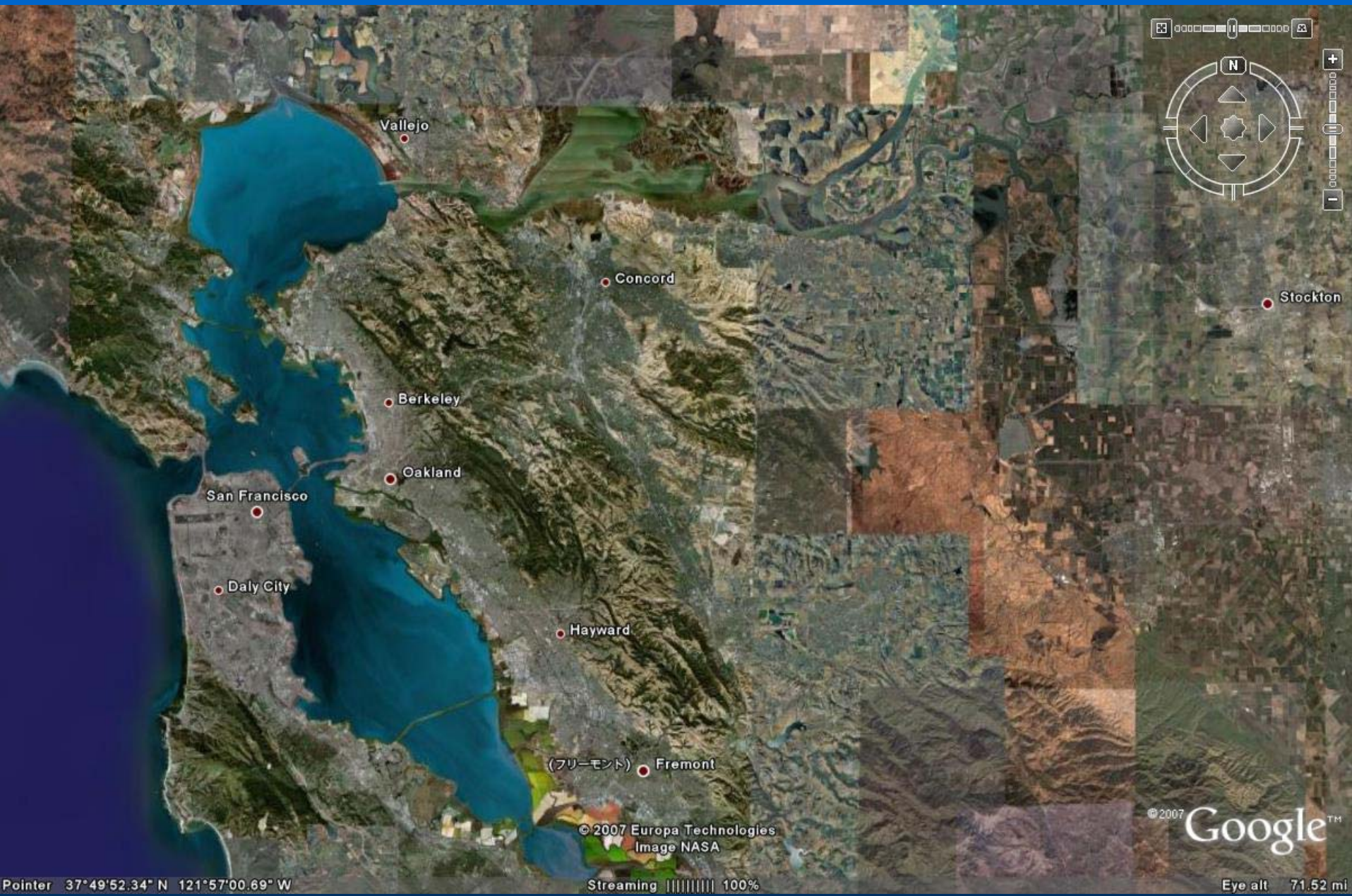
- **Develop tools for using MLOE assessment framework**
  - **Sample data sets and calculations**
  - **Guidance manuals**
  - **Calculation tools**
- **Provide training to agencies and stakeholders**
  - **MLOE assessment short course**
  - **Training activities will occur after SWRCB adoption of policy**

Direct Effects Objectives

- **Develop assessment tools for habitats not fully considered in Phase I**
- **Obtain triad data from multiple sites**
- **Develop & calibrate tools**
  - **Benthic indices**
  - **Chemistry SQGs**
  - **Toxicity tests**

Approach

- **Identify target habitats**
  - **Focus on Delta and SF Bay mesohaline**
  - **Large areas and high interest**
- **Obtain matched chemistry, toxicity, and benthic community data for multiple sites**
  - **Need at least 50 sites/habitat**
  - **Describe key gradients of effect and variations in habitat**
- **Sample in conjunction with Dept. Water Resources (DWR)**
  - **October 2007 survey (175 sites)**
  - **Multiple years of benthic community data for some sites**


Vallejo
Concord
Stockton
Berkeley
Oakland
San Francisco
Daly City
Hayward
(フリーモント) Fremont
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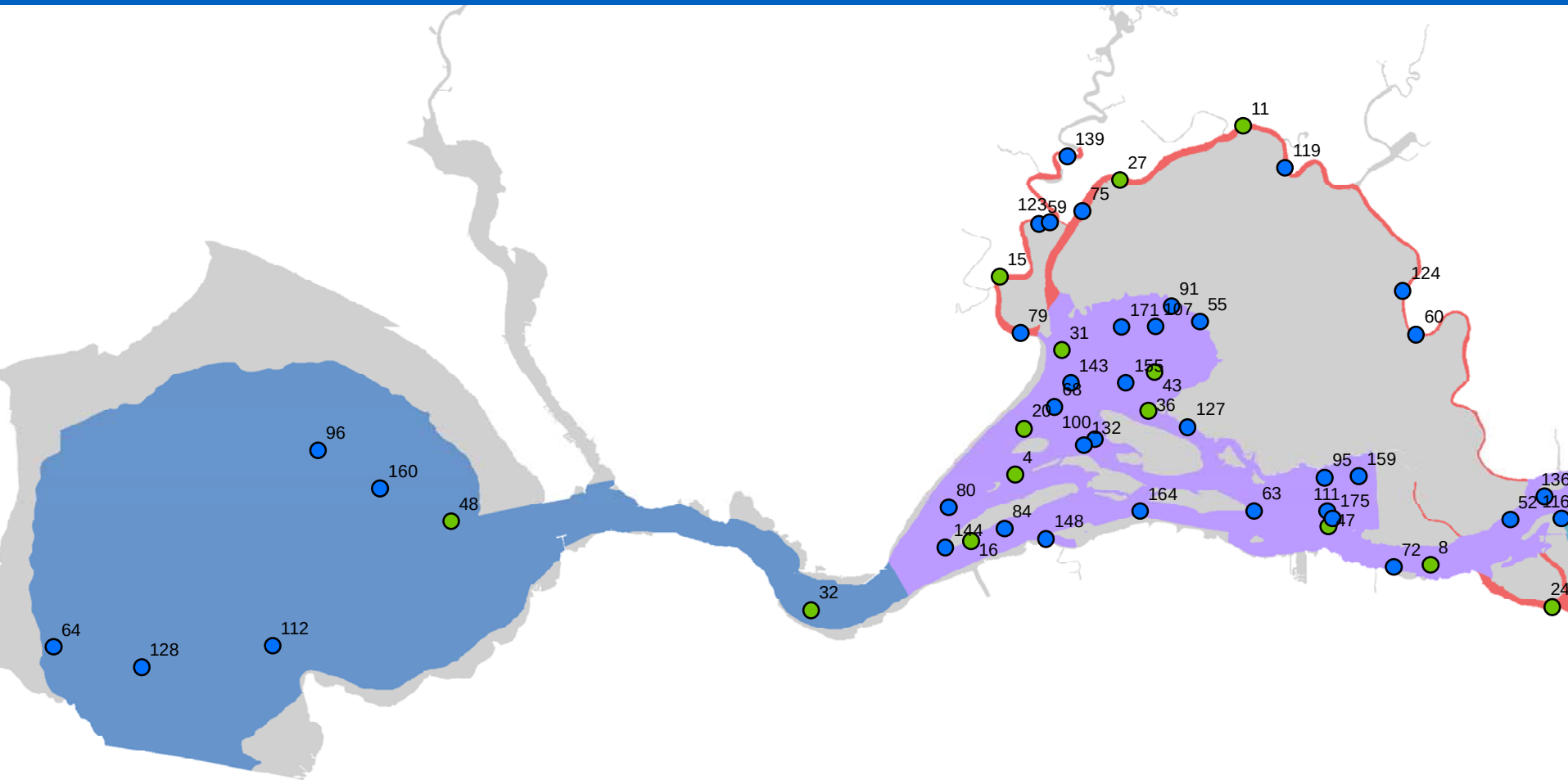
Pointer 37°49'52.34" N 121°57'00.69" W
Streaming 100%
Eye alt 71.52 mi

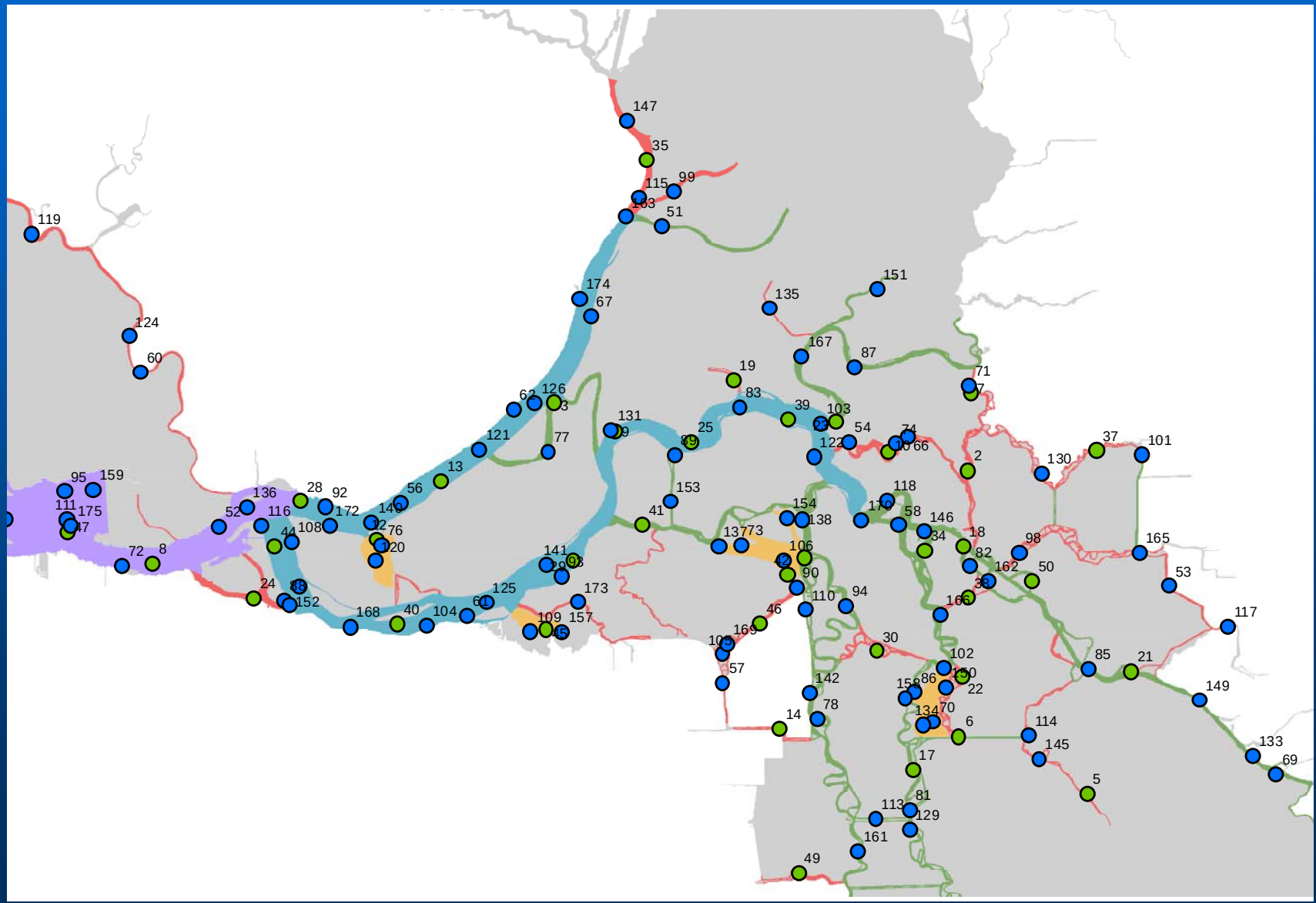
Approach

- **Identify target habitats**
  - **Focus on Delta and SF Bay mesohaline**
  - **Large areas and high interest**
- **Obtain matched chemistry, toxicity, and benthic community data for multiple sites**
  - **Need at least 50 sites/habitat**
  - **Describe key gradients of effect and variations in habitat**
- **Sample in conjunction with Dept. Water Resources (DWR)**
  - **October 2007 survey of benthic condition (175 sites)**
  - **Leverage sampling and analysis effort**
  - **Multiple years of benthic community data for some sites**

DWR Stations



DWR Stations



Approach

- **Benthic community analysis**
  - **Complete species identification and abundance**
  - **Use existing DWR expertise**
- **Toxicity**
  - **2 species at each site (lethal & sublethal)**
  - **Amphipod survival (*Eohaustorius* or *Hyalella*)**
  - **Growth/development (*Mytilus* SWI or *Chironomus*)**
- **Chemistry**
  - **Current SQO analyte list plus additional contaminants of concern**
  - **Acid Volatile Sulfides and SEM (CDA collaboration)**

Metals

Metals	
Aluminum	mg/kg (200)
Arsenic	mg/kg (0.2)
Cadmium	mg/kg (0.001)
Copper	mg/kg (2)
Iron	mg/kg (200)
Lead	mg/kg (0.5)
Manganese	mg/kg (20)
Mercury	mg/kg (0.00001)
Nickel	mg/kg (5)
Selenium	mg/kg (0.01)
Silver	mg/kg (0.001)
Zinc	mg/kg (5)

Organics

PAHs
1-Methylnaphthalene
2,3,5-Trimethylnaphthalene
2,6-Dimethylnaphthalene
2-Methylnaphthalene
Biphenyl
Naphthalene
1-Methylphenanthrene
Acenaphthene
Acenaphthylene
Anthracene
Fluorene
Phenanthrene
Benz(a)anthracene
Chrysene
Fluoranthene
Pyrene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(e)pyrene
Benzo(k)fluoranthene
Dibenz(a,h)anthracene
Perylene
Benzo(ghi)perylene
Indeno(1,2,3-cd)pyrene
Dibenzothiophene

Cyclopentadienes
Aldrin
Dieldrin
Endrin

Chlordanes
alpha-Chlordane
cis-Nonachlor
gamma-Chlordane
Heptachlor
Heptachlor Epoxide
Oxychlordane
trans-Nonachlor

DDTs
o,p'-DDD
o,p'-DDE
o,p'-DDT
p,p'-DDD
p,p'-DDE
p,p'-DDT

HCH
alpha-HCH
beta-HCH
delta-HCH
gamma-HCH

Other Synthetic Biocides
Hexachlorobenzene
Mirex
Diuron
DCPA
Metolachlor
Trifluralin

PCB congeners
8, 18, 28, 31, 33, 44, 49, 52, 56, 60, 66, 70, 74, 87, 95, 97, 99, 101, 105, 110, 118, 128, 132, 138, 141, 149, 151, 153, 156, 158, 170, 174, 177, 180, 183, 187, 194, 195, 201, 203, 206, 209

Pyrethroids and PBO
Bifenthrin
Cyfluthrin
Beta-Cyfluthrin
Cypermethrin
S-Cypermethrin (also called Zeta-)
Delta/Tralomethrin (coelutes)
Esfenvalerate
Fenpropathrin
G-Cyhalothrin
L-Cyhalothrin
Permethrin
Piperonyl butoxide (PBO)

OTHERS
Chlorpyrifos
Carbaryl
Fipronil
Fipronil degradates

Design Challenges

- **Which stations and habitats to sample?**
  - Can sample approximately 75 stations due to increased chemistry costs
  - Likely insufficient to characterize all Delta habitats

  Focus on Delta transition habitat (Suisun Bay)

- **Toxicity testing**
  - How to deal with variable salinities?
  - Which test variations to use?

  Use standard salinities to match ambient; 10 day exposures

- **Are benthic indices feasible?**
  - Previous benthic index development efforts for tidal fresh habitats have been unsuccessful
  - Habitat/seasonal variation may obscure other responses

  Assess consistency of BPJ first

Next Steps

- **Coordinate with DWR and other agency scientists regarding site selection**
  - **Define habitat type and extent**
  - **Identify stations to provide best gradients of contamination and effect**
- **Seek input on toxicity test selection**
- **Organize another Gold Standard study for Delta**
- **Form additional partnerships**
  - **Increase number of stations and habitats**
  - **Apply/evaluate alternative methods**

Indirect Effects Framework and Tools

Project Approach

- **Evaluate adequacy of conceptual model for SQO program**
- **Prioritize issues and identify Phase II products**
- **Increase interaction with SSC and Advisory Committee**
- **Focus on framework and tools rather than case studies or data collection**
- **Make a priority for next 18 months while direct effects analyses are in progress**

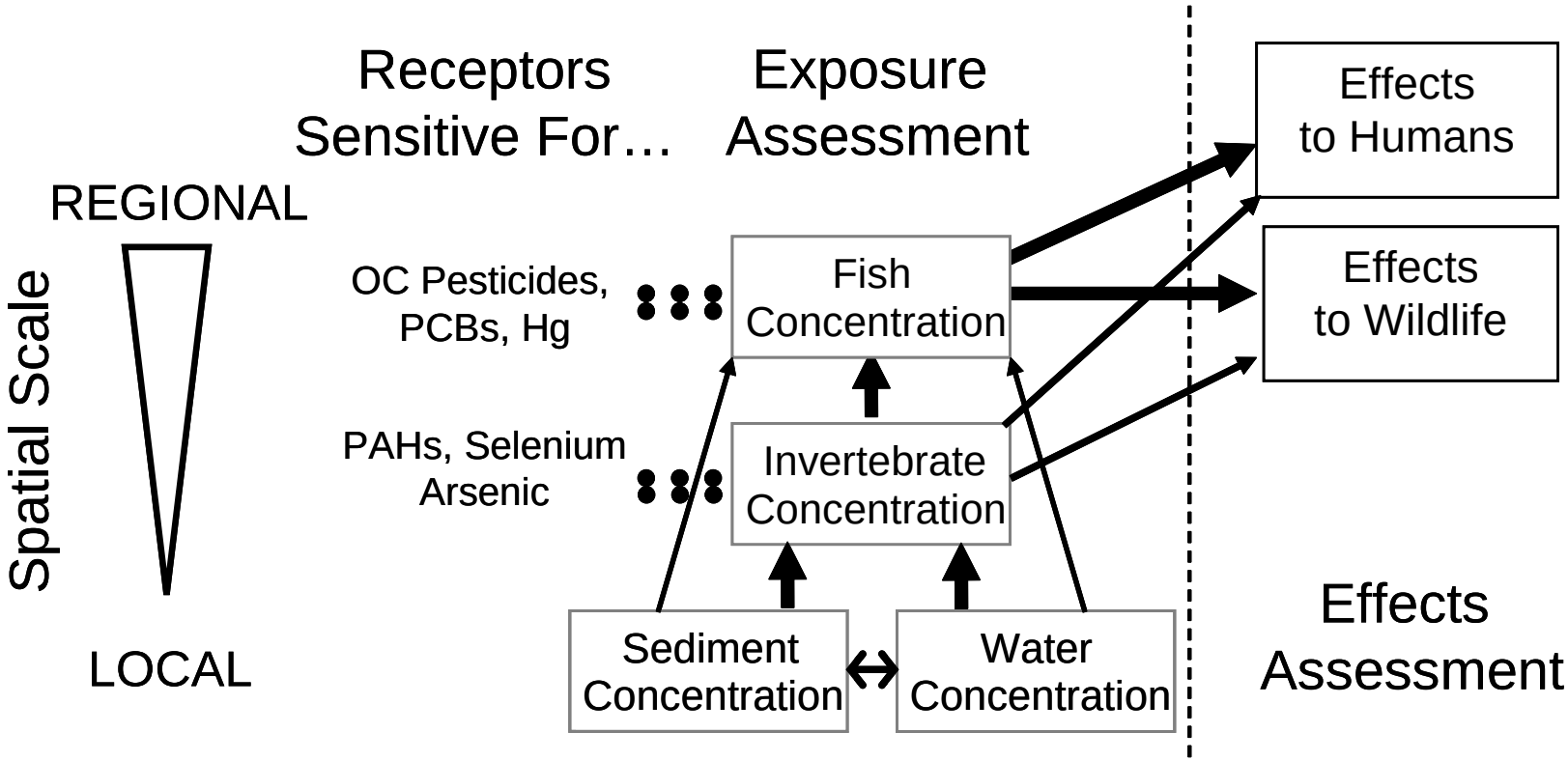
Scope of Framework

- **Establish general approach to evaluate risks of indirect effects posed by sediments**
  - **Consistent and feasible, yet allow for site-specific concerns**
- **Would be used as a screening tool to identify sediments of concern**
  - **Management actions require a more detailed study**
- **Results provide separate assessment of each sediment sample**
  - **Independent from direct effects MLOE assessment**
  - **Separate assessments for human health and wildlife**

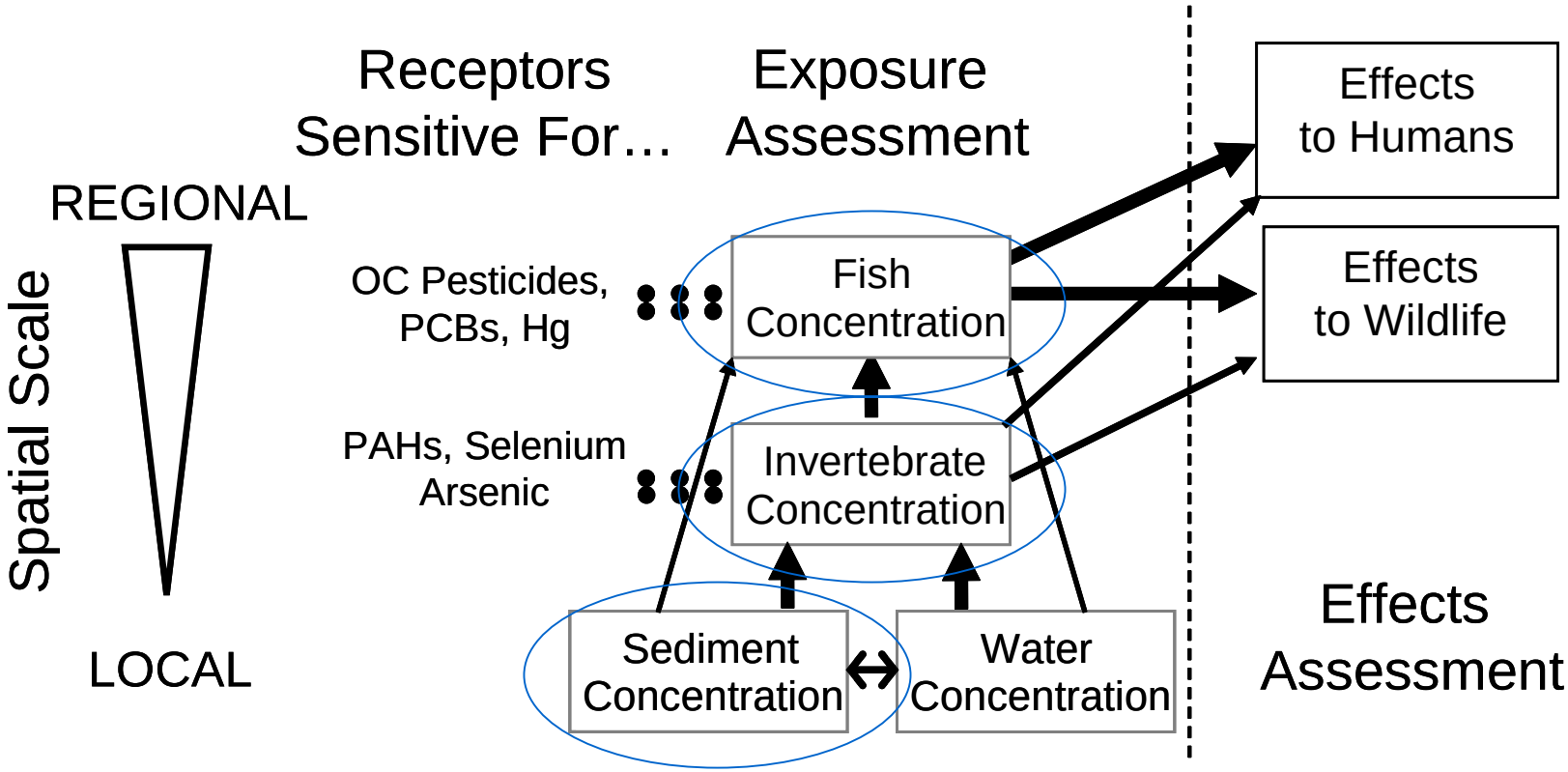
Applicable Contaminants

- **General conceptual model should address bioaccumulative contaminants of concern to humans and wildlife**
  - **Organics and metals**
- **Specific tools and methods will vary by chemical group**
  - **Initial methods will focus on “well behaved” contaminants for which key parameters are available**
  - **Legacy pesticides and PCBs**

Conceptual Model



Conceptual Model



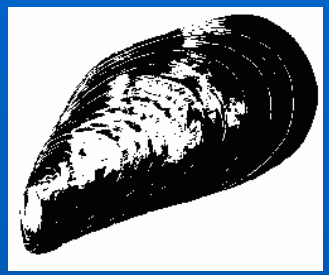
- Are fish/shellfish a risk to consumers?
- Are sediment pollutants entering the food web?
- Are pollutants in sediments high enough to account for tissue contamination observed in local fish/shellfish?

Framework Elements

- Evaluation of three matrices (LOE)
- Separately evaluate effects to humans vs. wildlife
- Sequential application
- Risk-based approach
  - Probabilistic evaluation of exposure
  - Effects thresholds are risk-based
- Sediments ranked into multiple categories

Three lines of evidence

1. Prey tissue chemistry
    - **Representative prey – could be fish or invertebrates**



2. Sediment chemistry
    - **Concentrations of pollutant in sediment**

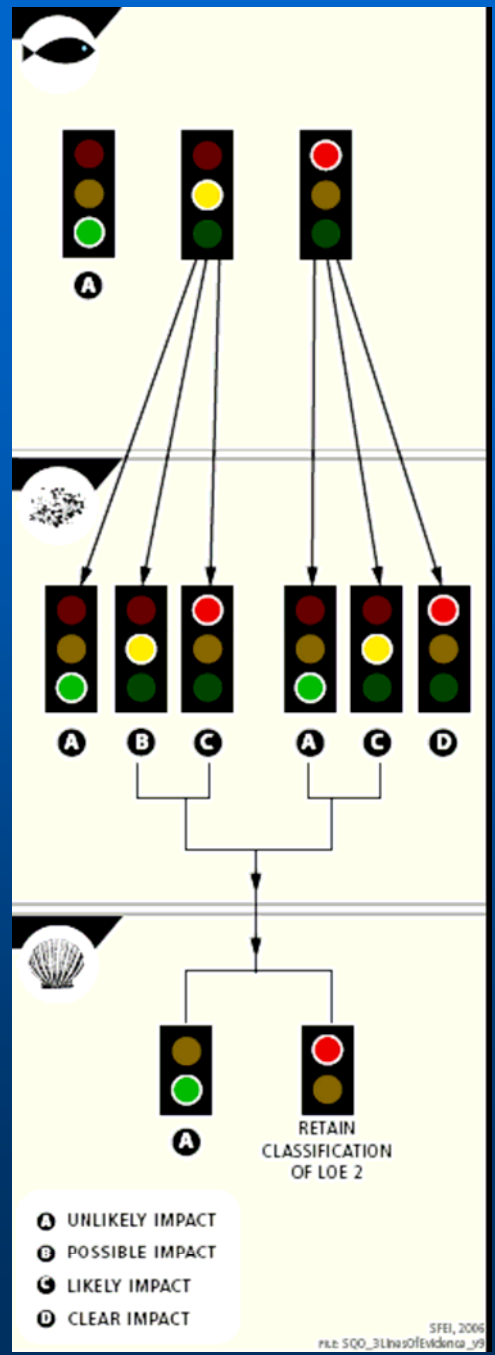
3. Bioavailability
    - **If sediment contaminants are not bioavailable, then the sediments are not the source**

Sequential Application

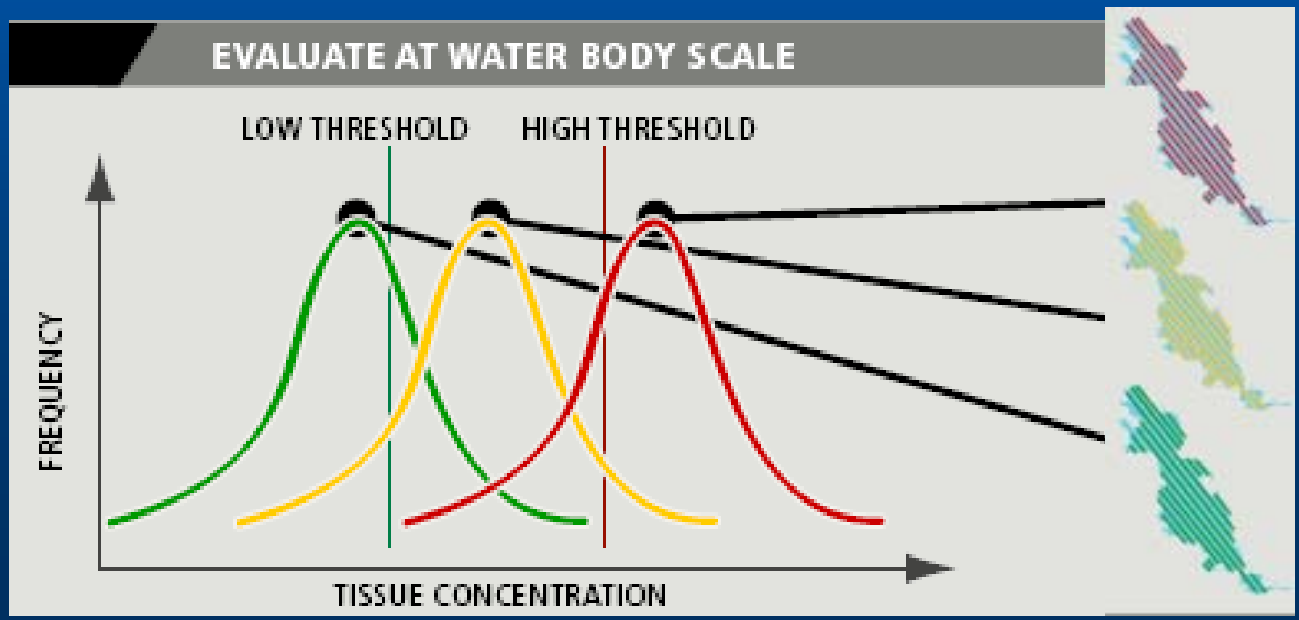
1. Prey tissue chemistry
    - **If exposure is low, no need to evaluate further.**

2. Sediment chemistry
    - **If sediment concentrations not high enough to cause significant bioaccumulation, then sediments not source.**

3. Bioaccumulation test
    - **If sediment contaminants are not bioavailable, then the sediments are not the source**

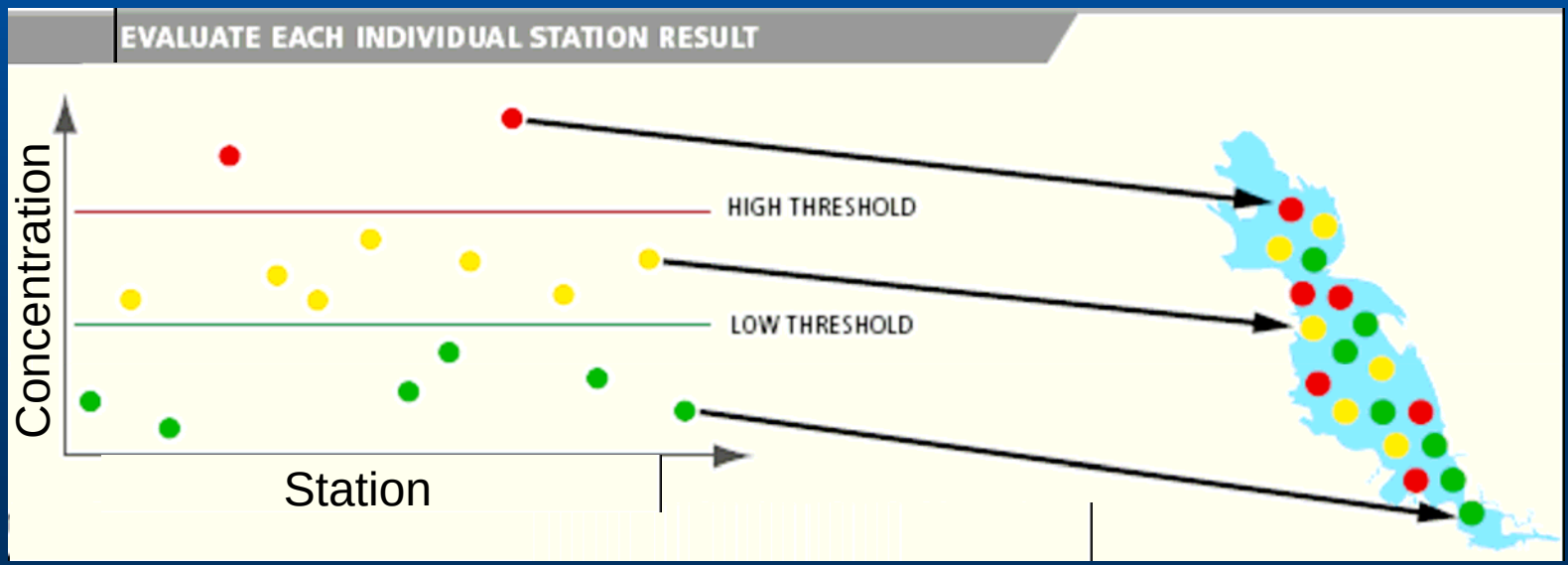


- **1. Prey tissue chemistry.**
  - Are fish/shellfish a risk to consumers?
  - Compare concentrations throughout water body to two exposure thresholds
    - Low - Below which adverse effects are unlikely
    - High – Above which adverse effects are likely
  - Below low threshold – objective would be met – no need to proceed to other LOE
  - Also look at state consumption advisories.

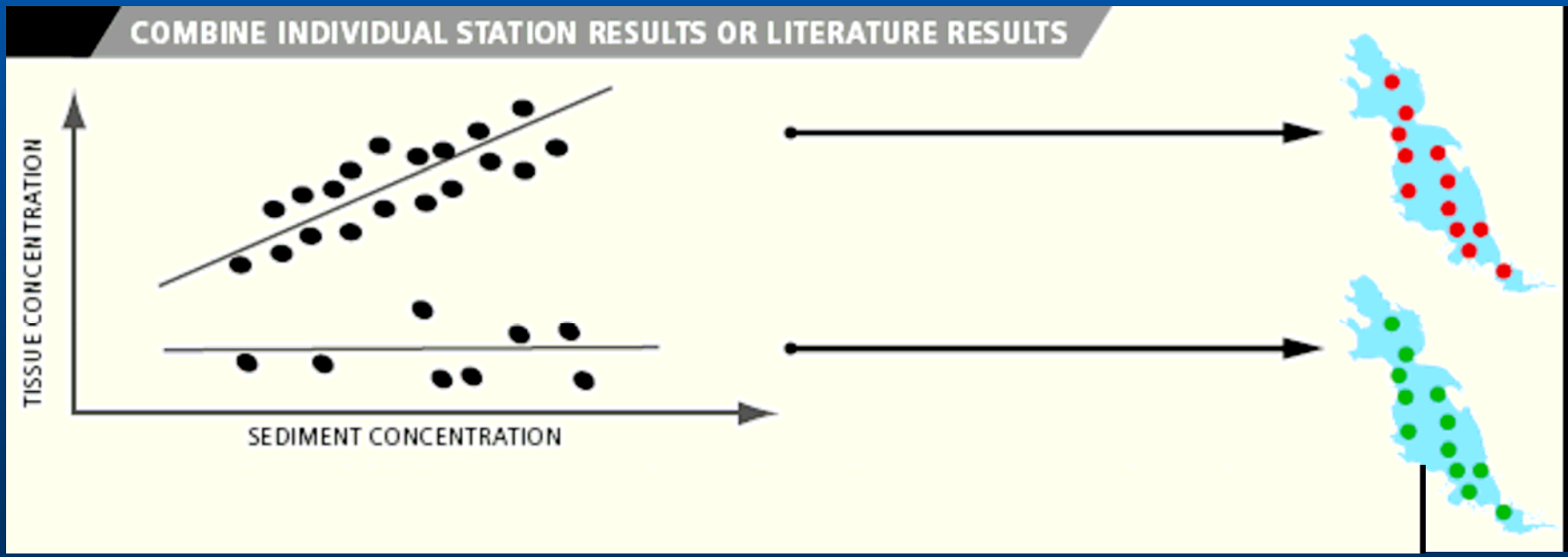


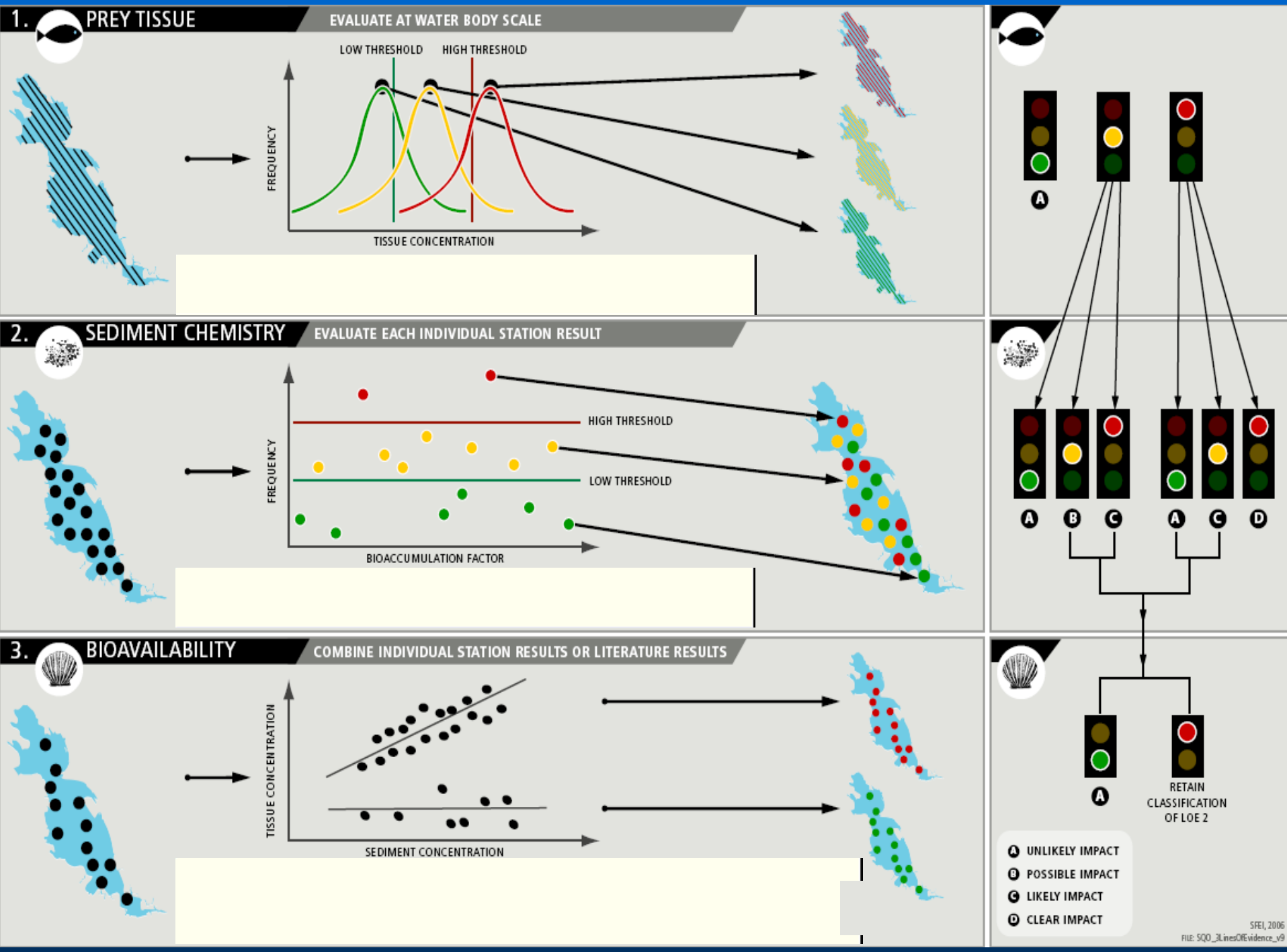
- **2. Sediment chemistry.**
- **Are pollutants in sediment high enough to cause risk to consumers of contaminated fish/shellfish?**
  - **Sediment Threshold =**

    Prey Tissue Threshold / (BAF or BSAF)
  - **Compare concentrations at individual stations to two exposure thresholds**



- **3. Bioavailability.**
  - Are pollutants in sediments entering food web?
  - Evaluate data from the water body or look at literature
  - Clear indication of no bioavailability indicates sediments are not the source




1.
PREY TISSUE
EVALUATE AT WATER BODY SCALE
LOW THRESHOLD
HIGH THRESHOLD
FREQUENCY
TISSUE CONCENTRATION
A
2.
SEDIMENT CHEMISTRY
EVALUATE EACH INDIVIDUAL STATION RESULT
HIGH THRESHOLD
LOW THRESHOLD
FREQUENCY
BIOACCUMULATION FACTOR
A
B
C
A
C
D
3.
BIOAVAILABILITY
COMBINE INDIVIDUAL STATION RESULTS OR LITERATURE RESULTS
TISSUE CONCENTRATION
SEDIMENT CONCENTRATION
A
RETAIN CLASSIFICATION OF LOE 2
A UNLIKELY IMPACT
B POSSIBLE IMPACT
C LIKELY IMPACT
D CLEAR IMPACT
SFEI, 2006
FILE: SQO_3LinesOfEvidence_v9

Station Classification

Prey Tissue	Sediment	Bioavail	Impact Category	Comments
Low	-	-	Unlikely	Tissue chemistry OK. Stop.
Moderate or High	Moderate or High	No	Unlikely	No bioavailability indicates source not sediments. Stop.
Moderate or High	Low	Yes or NA	Unlikely	Low sediment concentrations indicate other sources
Moderate	Moderate	Yes or NA	Possibly	Concentrations exceed threshold, but degree of impact uncertain.
Moderate	High	Yes or NA	Likely	Tissue is intermediate, but sediment concentrations indicate likely problem.
High	Moderate	Yes or NA	Likely	Tissue problematic, but sediment concentrations not quite high enough.
High	High	Yes or NA	Clearly	Tissue problematic, and sediments high enough to be the source.

Key Questions

- **Is the conceptual model and assessment framework appropriate for CA SQO program?**
- **If so, what are the priorities for further development?**
- **If not, how do we fix it?**