Margins Ambient Sediment Data Needs

RMP April 2014

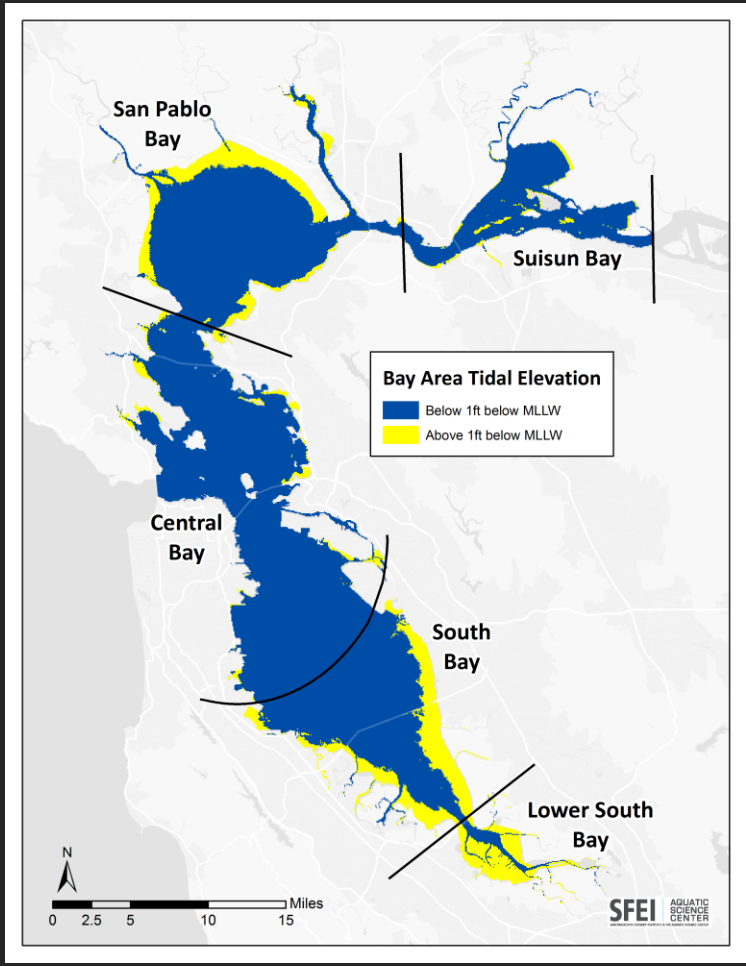
Decisions to Make

1. Do we need ambient margins monitoring?
2. Are there benefits to ambient margins data sooner/now?
3. What scope of effort should we start with?

RMP S&T Questions

1. Are chemical concentrations in the Estuary at levels of potential concern and are associated impacts likely?
2. What are the concentrations and masses of contaminants in the Estuary and its segments?
3. What are the sources, pathways, loadings, and processes leading to contaminant-related impacts in the Estuary?
4. Have the concentrations, masses, and associated impacts of contaminants in the Estuary increased or decreased?
5. What are the projected concentrations, masses, and associated impacts of contaminants in the Estuary?

Missing Margins Area?



Segment	Bay 1ft<MLLW km2	Margins 1ft<MLLW to 1ft<MHHW	% in Margins
Suisun Bay	108	8	7%
San Pablo Bay	239	50	17%
Central Bay	402	15	4%
South Bay	180	61	25%
Lower South Bay	10	29	74%

Leading Questions

- Are margins ambient data needed?
  - Are margins important habitat?
  - Do we need condition beyond managed sites?
  - Are margins data needs higher?

Ambient vs.Targeted?

- Data availability/numbers
  - Bay S&T > Margins hotspot >> Margins ambient
  - vs. is wrong framing (e.g., why Bay S&T vs. hotspots/loads/etc.)
- Why targeted before ambient?
  - Immediate before & after control needs, no $
  - Target=discharge, “near”-field ambient influenced
- Why ambient before targeted?
  - What if a “target” site is just average?

Example Needs

- General water quality management of important Bay habitat
  - Evaluating status (e.g., impairment)
  - Evaluating trends
- If margins are a habitat of concern, need ambient data for evaluation & tracking

Example Needs

- Managing bioaccumulative pollutants
  - Biota often exposure integrators
    - Ambient data needed for exposure distribution, establishing correlation
    - Spatially integrated (3-4km radius) data correlate better (small fish PCBs) than co-located/nearest samples
- Need distributed ambient data to understand/correlate exposure

Example Needs

- Managing polluted sites
  - Sites > open Bay may be just “typical” for margins
  - Ambient data may reveal unaccounted sources/factors/processes
  - Comparison to unmanaged area response
- Need ambient data (even if low power initially)

Example Needs

- Evaluating sediment re-use
  - Is sediment worse than open Bay but better than typical margins sediment?
    - E.g., simply breaching dike may supply even lower quality sediment
    - Sediment deficit in the Bay
    - Additional opportunities for sediment re-use?
- Need ambient margins data
  - Bay ambient & target margins bias data

Opportunities

- Fix exclusion of (important?) habitat
- Get unbiased evaluation of condition
- Even just a few samples start to develop power
  - Are margins much worse than Bay?
  - Can exposure explain biota patterns?
  - Are targeted sites really much different?
  - Is dredged sediment better than average?

Discussion Questions

- Are margins important part of the ecosystem?
  - If yes, margins need to be monitored
- Need status beyond hotspots & sources?
  - If yes, we need *ambient* margins monitoring
- Benefits to ambient margins sooner?
  - Less data than Bay ambient (more power improvement per sample added)
  - Needed context to interpret target sites anyway

Options

- What sediment information is needed?
  - Chem, +tox?, +benthos?
- With what approach and time frame?
  - Options based on intensity of effort, cost, locations, & timelines of targeted efforts

Costs

- Higher sampling logistics costs per station (~20%)
- Decrease of Bay S&T power if substituted for open Bay sites
  - Reduction of Bay sites to 4 per segment = <~5% power loss (except Suisun)
  - Reduction to 2 Bay sites per segment = <25% power loss (except Suisun)

Suisun Power Loss

			Suisun Bay				
			Sampling Interval (years)				
			1	2	3	4	5
Scenario: PCBs Sediment 20 Year 3.5% Annual Dedine	Samples/year	2	76%	51%	37%	26%	23%
		4	93%	71%	64%	50%	43%
		6	98%	84%	74%	63%	55%
		8	99%	88%	82%	68%	62%
		10	100%	92%	88%	72%	67%
		12	99%	92%	87%	78%	71%
Scenario: Mercury Sediment 30 Year 1% Annual Dedine	Samples/year	2	51%	29%	20%	17%	16%
		4	76%	48%	35%	34%	22%
		6	91%	60%	46%	44%	34%
		8	96%	74%	60%	55%	43%
		10	98%	83%	67%	65%	45%
		12	98%	89%	73%	68%	54%

Suisun Options

- Suisun low power due to high variance
  - Proximity to episodic sediment loads
  - Can we sample our way out of variability (spatially yes, temporally ?)
  - Are there management decisions contingent on Suisun power?
  - Could be excepted from change in N

Semi-hybrid option

- GRTS sites, alter schedule as needed
  - + Parallel targeted efforts (sites or segments)
    - Nearby sites sooner (jump sequence)
  - – Lose short term ability to compare subsets
    - GRTS designed so contiguous sequences spatially distributed and unbiased
    - Once filled in unbiased again
  - – Conflating spatial/temporal differences

Initial Effort Options

- 1st round all at once as supplement/ one time replacement of Bay S&T
  - S&T sed year or non-sed year
- 2-3 Moderate efforts
  - Cover the margins within 2-3 events
- 5 Incremental efforts
  - Eventually (5-10 yrs?) cover representatively
  - Long term stays representative
- Proportional Bay S&T swap
  - 10+ yrs to cover representatively

Option Tradeoffs

- 40 sites all at once ($420k*)
  - + Quickly catch up in representativeness
    Some statistical power quickly
  - + No/minimal confounding of spatial and temporal variations
  - - High single outlay
  - - High load on S&T labs

*(tox & benthos ~$110k of total)

Option Tradeoffs

- 2-3 Events ($200k+ x 2)

  + Catch up in representativeness < 5 yrs

  Intermediate annual outlay

  Moderate load on S&T labs

  - Some conflating spatial and temporal (e.g., wet vs dry year) variations

    Reduced if all segments in each event

    May get lucky with similar water years

Option Tradeoffs

- 5 Events ($100k- x 5)
  - + Smaller annual outlay
  - + Smaller load on S&T labs
  - - More conflating spatial and temporal (e.g., wet vs dry year) variations
    - Reduced if all segments in each event
    - Unlikely to always have similar water years
  - - Slow to catch up in representativeness
    - - Low power in early years

Option Tradeoffs

- Area proportional Bay S&T swaps
  + No change in S&T sample #s
  + Smaller load on S&T labs
  - Even more conflating spatial and temporal (e.g., wet vs dry year) variations
  - Super slow to achieve representativeness
    - No/low power in early years (1 site segments)
    - Decade(+?) to get spatial coverage

  (Similar to 5 events option in other segments)

Preferred Option?

- Offset Bay S&T Reduction
  - 40 or 20 sites every 2 years
  - 60 sites reduced to 20 every 4 years

  = up to 40 margin sites every 4 years?
- Not 4th option (area proportional)
  - Especially slow if only 20 sites every 4 yrs
  - No stats with 1 sample segments
  - More sites in early rounds helpful

Margins (Sed) S&T Needs

- Existing data not a suitable substitute
  - Bay & hotspots have different sources, processes
  - Extrapolations need validation and may be site specific
- Needed even with targeted margins data
  - Important complement to biomonitors
  - Ambient baseline & current state
    - Targeted data have biased means, variances
    - Biased (hotspot/source) data at best provides bounds
  - Fixed grids unbiased means, but biased variance

Biomonitoring Needs

- Ambient complement to biomonitors
  - Sediment comparatively immobile
  - Co-located data only sufficient for stationary species
  - Other factors in biotic variation
- If mobile (small fish) biomonitors
  - Overlapping/nearby 3-4 km radius ranges = mapping nearly all ambient anyway

Margins (Sed) S&T Limits

- Not pinpointing hotspots or sources
  - Only shows distributions & gradients
- Generally not an endpoint in itself
  - Acute & chronic tox limits usually met
  - Tissue targets for bioaccumulatives
- Initially low power (depending on ?)
  - Many samples /years for statistical power for small differences, but >0 power

Suggested Approach

- Spatially distributed
  - GRTS similar to Bay S&T
    - set exclusion zones to reduce overlap/repeat
    - can exclude cleanup sites
    - Spatial composites if small scale variation unimportant
  - Special study sites can be piggybacked
    - If spatial/ temporal needs match

Monitored Parameters

- Sediment components
  - Chemistry
  - Toxicity*?
  - Benthos (food web)*?
    - survey, not attempting effects causality

Margins Power, N=6+6=12

- 1 tailed t-test, margins PCB 3x higher

Margins (+3x)	N=4	N=6	N=8	N=10	N=12	N=14	N=16
Central Bay	77%	92%	98%	99%	100%	100%	100%
Lower South Bay	99%	100%	100%	100%	100%	100%	100%
San Pablo Bay	89%	98%	100%	100%	100%	100%	100%
South Bay	96%	100%	100%	100%	100%	100%	100%
Suisun Bay	30%	42%	53%	61%	69%	75%	80%

Margins Power, N=8+4=12

- 1 tailed t-test, margins PCB 3x higher

Margins (+3x)	N=4/2	N=6/3	N=8/4	N=10/5	N=12/6	N=14/7	N=16/8
Central Bay	57%	79%	90%	95%	98%	99%	100%
Lower South Bay	92%	99%	100%	100%	100%	100%	100%
San Pablo Bay	70%	90%	97%	99%	100%	100%	100%
South Bay	83%	97%	99%	100%	100%	100%	100%
Suisun Bay	22%	31%	39%	46%	53%	59%	64%

Margins Power, N=6+6=12

- 1 tailed t-test, margins Hg 3x higher

Margins (+3x)	N=4	N=6	N=8	N=10	N=12	N=14	N=16
Central Bay	91%	99%	100%	100%	100%	100%	100%
Lower South Bay	100%	100%	100%	100%	100%	100%	100%
San Pablo Bay	100%	100%	100%	100%	100%	100%	100%
South Bay	98%	100%	100%	100%	100%	100%	100%
Suisun Bay	64%	82%	92%	96%	98%	99%	100%

Margins Power, N=8+4=12

- 1 tailed t-test, margins Hg 3x higher

Margins (+3x)	N=4/2	N=6/3	N=8/4	N=10/5	N=12/6	N=14/7	N=16/8
Central Bay	74%	92%	98%	99%	100%	100%	100%
Lower South Bay	92%	99%	100%	100%	100%	100%	100%
San Pablo Bay	98%	100%	100%	100%	100%	100%	100%
South Bay	86%	98%	100%	100%	100%	100%	100%
Suisun Bay	45%	65%	78%	87%	92%	95%	97%

Small Power Loss (PCBs)

			San Pablo Bay				
			Sampling Interval (years)				
			1	2	3	4	5
Scenario: PCBs Sediment 20 Year 3.5% Annual Decline	Samples/year	2	96%	75%	64%	43%	36%
		4	100%	95%	88%	73%	61%
		6	100%	97%	95%	86%	78%
		8	100%	99%	97%	90%	84%
		10	100%	99%	98%	93%	89%
		12	100%	100%	99%	95%	91%
Scenario: Mercury Sediment 30 Year 1% Annual Decline	Samples/year	2	100%	100%	95%	93%	81%
		4	100%	100%	99%	98%	93%
		6	100%	100%	99%	99%	97%
		8	100%	100%	100%	99%	97%
		10	100%	100%	100%	100%	97%
		12	100%	100%	100%	100%	98%

Small Power Loss (Hg)

			Lower South Bay				
			Sampling Interval (years)				
			1	2	3	4	5
Scenario: PCBs Sediment 20 Year 3.5% Annual Dedine	Samples/year	2	100%	97%	92%	78%	67%
		4	100%	100%	98%	95%	89%
		6	100%	100%	100%	97%	95%
		8	100%	100%	100%	98%	96%
		10	100%	100%	99%	99%	97%
		12	100%	100%	100%	99%	97%
Scenario: Mercury Sediment 30 Year 1% Annual Dedine	Samples/year	2	99%	87%	74%	72%	56%
		4	100%	94%	87%	83%	76%
		6	100%	96%	91%	90%	81%
		8	100%	98%	92%	92%	84%
		10	100%	97%	94%	93%	85%
		12	100%	98%	94%	93%	88%