RMP REGIONAL MONITORING PROGRAM FOR WATER QUALITY IN SAN FRANCISCO BAY
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RMP PCB Workgroup Meeting Summary
May 31st, 2017, 9:00am - 5:00pm

Attendee	**Affiliation**
Craig Jones	Integral Consulting
Dick Luthy	Stanford University
Frank Gobas (Science Advisor)	Simon Fraser University
Fred Hertzel	
Yeo-Myoung Cho	Stanford PhD Student
Arleen Feng	ACCWP
Jan O'Hara	SFB Regional Water Quality Control Board
Luisa Valiela	EPA Region 9
Paul Salop (remote access)	Applied Marine Sciences

SFEI/RMP Staff:

Alicia Gilbreath, Don Yee, Jay Davis, Diana Lin, Lester McKee (remote access)

1. Introduction
2. **Information: RMP Planning Overview**
    - Arlene: Largest source is uncontrolled source is reservoir in the Bay. Lot of work being done in hot spots
    - Luisa: under pressure to demonstrate efficacy of regulations. Need to explain success story - hope that PCB can be success story.
    - Jay: looking at PCB in stormwater, looking at concentrations of particles coming out of different watersheds.
        - Tracking trends in concentrations in loads from watersheds being investigated by STL
        - Focusing on areas with high concentrations where management action most likely to be the most effective
    - Jan: Will TMDL be revised? Any confirmation
        - Jay: reviewed regularly in annually, and there has not been changed
        - Luisa, Not on FTE schedule and assigned to someone
        - May depend on what we learn,
    - Jay: Can we expect declines, info how to manage loads (what storm types deliver the most loads -> find out small storms more important than expected), where to focus reduction efforts, and how should we monitor reductions to detect changes.
    - PCB multi-year plans, our job today is to update plan. 2016, received SEP funding funded extensive field study - conceptual model $60K
        - Luthy: where does extra SEP funding come from
        - Jay, permit violation penalties - get additional funding through SEP
        - Arlene: RMP asked to priority projects that would get funding, if right perpetrator of violation gets fined.
        - Fred: State board environmental supplemental fund, RMP is one of recipients
3. **Information: San Leandro Bay - Progress on the Field Study (Jay)**
    - Inform workgroup on findings
    - SEP funding
    - Written Emeryville Crescent report, concepts helped inform monitoring that can be done in San Leandro Bay, had to conduct monitoring right away, before conceptual model could be developed
    - Goal: Improve food web model for TMDL 2.0,
    - key to include prey fish in model, and info from passive samplers,
    - Sediment and water data, passive sampler data analyzed; don't have food web data yet
        - Additional fish analysis
        - Gobas any stable isotope analysis? (No) - cheap, another way of figuring out who is eating who, sample analysis is cheap ($10/sample), get additional info from gut content analysis. Correlation between stable isotope analysis and gut content
    - Multiple watersheds feeding into Bay
    - Arlene: Oakland channel is an estuary, tidal action, makes Alameda an island
    - Channel rife with PCB hot spots

- 1998 thorough sediment survey conducted - good dataset for comparison
  - Gobas asked if there is way to look at new data compared with old data (Yes, will show later)
- Hypothesis: Epibenthic invertebrates may be more responsive to watershed changes because of food habits.
  - Collected two layers at 9 locations to test hypothesis from surface and subsurface sediment samples, and water samples
  - Silversides and top smelt (indicator species) - got samples only caught at subset of locations,

4. **Decision: San Leandro Bay -**
   - Importance of remaining data analysis
     - Benthos ($1900/sample) - > $52K
     - Fish gut contents ($50/sample), 80 shiner and 160 prey fish -> $12K. Identify critters in gut, not PCB analysis
     - Isotope analysis
   - If we got another penalty funding, could be used here or elsewhere.
   - Gobas: may be similarities between PMUs
     - Andy John: Have had surprises in the past. Top smelt - thought as water column species, but found at this size range, mostly bottom feeders which has changed thinking.
     - Gobas: Key piece of model is to have new data
     - Silversides, need to have data to include in model, and long term-fate model. This information is key.
     - Assumption is that everything is bottom feeder.
     - G: Stable isotopes will help, there is too much variability , so difficult to interpret. Key to pull 2 datasets together (gut content and stable isotope). Worthwhile to get extra information. N most important for food web, C gives you source of C being accessed. Data is qualitative.
     - J: fish gut content not that expensive. How important is benthos
     - G: yes
     - Benthos: benthic community - all invertebrates. May make sense for benthic community to same level as gut contents. If guts only has polychaetes, then dont' need to analyze polychaetes.
     - Jan: more important to finish this data than to collect more data.
     - Arlene: this is as complete of dataset, as likely to have
     - May make more sense to find out PCB content in benthic community - different analysis and sampling
     - J: no decision needed
     - Don: how quantitative do we need this data to be
     - G: do fish content analysis first, then guide what to do in benthos data, and what kind of analysis would be useful. For example, could be selective feeders.
     - J: could include gut content as part of RMP budget, and fit in later.
     - Luthy: if shiner is what is driving TMDL, important to know what the shiner are eating.

        - Craig Jones: allow adaptive management
        - J: added to menu for recommendations

5. **Decision: San Leandro Bay - Draft Conceptual Model Report (Part 1)**
    - J: due to analysis situation, where data not all there, doing report in phases. Partly due to agreements, should not have included deliverable in agreement. Because need report, will report what is available. Tributary loading, initial retention and long-term fate section, comparison of sediment data
        - Arlene: can you call them phases instead of part I and II. because report may change, from later data. **
        - J: phases may be confusing with phases of the funding.
    - Open Bay dataset: average concentration is 10 ppb, exclude Marin 27? ppb
    - J: sum of PCB data, draft still out.
    - 1998 data: shows, highest concentration in east channel and Elmhurst channel 200-500 ppb, Damon channel lower, except for one at far end.
        - Concentrations comparable, some are higher than was observed. Interesting congener profiles. QA data.
        - PCB 209 used in steel manufacturing, some spots with high concentration of PCB 209.
        - What assume from no concentration changes from 1998? (L)
        - Maybe high residence time, high deposit, or continuing input.
        - Luthy: are there major storm drains
        - A: East creek, large watershed. Watersheds go into Oakland, bathtub ring of industrial sites.
        - Sediment comes from hills, PG&E substation
    - Jan data from cleanup site, bend in Arroyo Viejo
    - J: goal to quantify impact of hot-spots like this and cleanup.
    - Union Pacific Railyard, junkyard, auto, site has been used for
    - 1260 higher industrial use, heavy duty transformers, there is trend from 1260 to 1254 which represent different PCB
    - Cleanup water board and DTSC. Will be required to remove some of stuff in channel, dredging, and removing, and backfilling to put channel back to original capacity
    - A: hope more have to be taken out now, GE will be paved over, and wait for later developer, need durable cover to prevent
    - Cleanup action will be slow -
    - Union Pacific Railroad slow in response.
    - Tributary Loading: **Alicia** and Lester
        - J: are GE and Arroyo sites - are these the only known hot spots?
        - Arlene: only ones with regulatory activity. There are more with past cleanups, and Water Board. Old days got pass if PCB were low ppm range, and now want to cleanup or sequester, there is residual, smearing buffer effect, things have migrated off site and distributed along corridor - diffuse sources. Relative contribution and scales at which they become dominant, is one of challenges of going from high to watershed view. Some of these sites, durable cover, but don't know how effective they are.

        - J: should we pull more info on other potential spots
        - A: still stumbling around at this stage, have not found systematic markers
        - Jan: have dots that they have,
        - J: concentration at Elmhurst channel high suggesting potential sources
        - Phase 2: will incorporate how to integrate hi
        - 0.5 load from old Comm + Trans and other half old industrial + dirty SA (less than 3% of land area)
        - 94% of load is coming during storm (as opposed to dry season flow)
        - Ideas on how to incorporate this information into conceptual model of stormwater drainage and load
        - J: examples of Superfund sites? where detailed flux studies at channel, and loadings through site to estimate long-term recovery. Jones: mostly E coast.
        - Jones; current modeling good for level of study without looking at close level.
        - J: worth looking at those studies
        - Luthy: are PCBs sloshing around or inputs? There could be inputs, but don't know. Need some sampling from this channel during storm event to find out. PPB in bay, PPM in channel.
        - Local context, big input, when whole watershed, may not be
        - Signals from tributaries, what influence at San Leandro Bay ppt -> ppm ->ppb. Normal range.
        - Jan: important to include this in outlook.
        - Craig, what would monitoring look like if want to get more sophisticated and accurate with loads.
        - We sampled single storm in 6 locations in this drainage area. Composite sample. Relatively close to Bay, also usually tidally influenced. Waiting for big storm with low tide -> sampled this year. Waiting for data this summer. Single storm can underestimate loads, transport can be episodic between storm events.
        - Water sampling during storm event, composite sample over course of storm event. Multiple grabs
        - G: what mass of PCB in watersheds getting into Bay?
        - A: real cleanup going to be from redevelopment, need real interest for cleanup. Emeryville has gone through massive cleanup (only a few sites left), aggressive in getting brownfield funding took advantage. San Leandro more rust belt situation, more leftover factories, some tentative plan, but not active redevelopment area, people still leaving. Older urban had other PCB uses. Extensive electric street car in East Bay that went along transportation corridor, transformers from streetcar turnaround sites. Keyrut system. Tracks went down shattuck, and major streets Adeline.
    - Don: What happens to PCB loads
        - Short term and long term.
        - Shallow, half volume gone every tidal cycle on average (similar to Hunters Point)

- Estimate proportion of sediment loads going into SLB stay.
- Discharge guesses
- 1.7 m/s from Emeryville, soft banked channels tend to self enlarge fro velocity.
- Max ebb tide velocities (m/s) map.
- Solids settling (0.1 - 1 hr)
- Most discharges <1 yr ARI 24 hr event mostly stay inside PMU
- Jones: expect high trapping efficiency in SLB, expect >80% than what is estimated.
- Luthy: channel dredged (A: no, some 303(d) sites up there)
- G: small area that responds fairly quickly. Temporal changes likely slow because watershed constant load. Inform monitoring activity. Hasn't changed much in 20 years, may not change that quickly. Unless significant changes. Calculations likely close enough. -> can respond quickly.
- Don: watershed holds reservoir. Conceptually, based on tidal excursion volume, stuff in water column go into SLB.
- J: how will system respond to changes?
- Long term
- Not strong evidence of newer cleaner sediment
- A: benthic taxa would be interesting for bioturbation, don't need to do all down to species
- YM: can check bioturbation depth, want to know dynamic depth of sediment (Don, may not be able to get that from samples)
- Jones - push coring and pictures and ORD depth can easily get bioturbation depth
- Comparison 1998 to 2016, 2016 concentrations mostly higher now, than previously. May be lab method artifact. Example of improved extraction method. Account for extraction difference (probably 2xs difference), still doesn't fully account for differences.
- One-Box model (like model from SF Bay)
- 15 cm mixed layer from bioturbation. PCB 118.
- Steady-state 35 ng/g estimate for open bay.
- Watershed loads very influential
- Water factors dominate impact mass balance and recovery.
- Luthy: these inputs are controlling (long-term input) 25-50 ppb estimate, not necessarily PCB sloshing around
- Lester: how improve flocculation factor
- Jones: have follow-up conversation, Hudson R. sorption time absorbed to particulates. Schulheimers work on flocculation in the Bay, particles flocculate when hit low shear environment.
- Jay: did we overestimate flux out of Emeryville.
- JOnes: In estuary can have enriched organic layer in intertidal, subtidal layer (fluff layer), can rapidly absorb PCB, and be long-term source of

PCB. What are burial rates. What are rates of sediment accumulation, if you cut off sources, will you see concentrations decrease?

- Don: Watershed yield map, most of sediment coming from upper, and picking up of PCB from lower watershed.
- Arlene: also have sea level rise, will increase accumulation rate
- Luthy: sediment traps that can measure new sediment coming in.
- Fred: has anyone characterized organic layer. SLB has been hit by episodic events.
- YM: sediment traps needs to be there 2-3 months, will be averaged out for time period.
- Lester: what would it take to meet goals in fish. What would parameters need to be in model. Is this achievable in the next 100 years? 0 PCB load, but still sediment.
- Luthy: how long to get to CA toxic load: 23 ppb
- Jay: 5-fold decrease, and same change in fish would get below no consumption limit.
- Arlene: will need to see inter-annual variation
- Don: pushing for sediment traps
- Fred: fish model data, because can answer something from that. Other modeling seems like conjectures.
- Jones: exposure pathway will be key to identify low hanging fruit, if it's in the water column, then need to know water column loadings.
- Shiner eating invertebrates of structures and sediment

6. **Discussion San Leandro Bay - Passive Sampler Data from the Field (Luthy)**
    - Jones: organic layer is on the mm layer at the sediment surface
    - Concentrations in porewater similar to overlying water in the 0.5 - 2.5 ng/L
    - Reflects continuing input of PCB based on previous discussed PMU study
    - Jay: have you done similar work in Richmond Harbor
    - Lester: is it logical sampling in area with intertidal exposure - expect porewater pumping, and expect things to be in equilibrium? (Luthy: integrated measurement over sampling period) Don: we were in low water (but not MLLW) YM: some question about overlying water, so don't know if it was exposed, but should be OK because can't lose PRC. Exchange rate should only underestimate water concentration. YM: interesting to see same concentration in overlying water same as porewater
    - CA Toxic rule for water base concentration: 0.17 ng/L - passive samplers allows you to do that. Can measure at level of water quality criteria.
    - Fred: would be interesting to see treatment in mesocosm with AC, porewater would go down, and flux would be going into the sediment.
    - Gobas: data confirms assumption that overlying water same as concentration in porewater
    - Don: fluff layer, would that sorb to PE, and would there be exchange. Luthy: acts more like kinetic layer.
    - Jones: fluff only there temporarily, and since PE integrate over time.

- Luthy; PE best you can get in terms of dissolved concentration. Work in Lauritzen channel (dredged in late 1990s), not all contaminants removed. Looking at residual management.
- G: loadings have likely remained constant. Or mixing is very good. How does data look on congener specific basis. (YM: similar from individual congeners as well.
- Jay: spatial distribution implications. Hypothesis: constant loading and good mixing in area.
- Jones: passive samplers can be valuable monitoring tool , measure every year or two. Hypothesis: dry season measurements, doesn't show necessarily show loading. YM: just shows sediment is not source.
- Gobas: play with model on different loading factors
- Luthy: deploy PE at DOM site
- Jay: GE site is being done, is now the time to start PE monitoring. Should do during wet season.
- Luthy: what is key question trying to answer
- Fred: not good relationship with GE.
- YM: how can connect this data with food web modeling.
- Jay: link watershed loads with fish concentration. Shiner surfperch ideally. Smaller fish good surrogate. Tool to monitor at local site at GE site, can couple PE with fish and track changes in both, to see local change response.
- Luisa: need to have success story to explain why we are spending millions of $. If not success story, inform what to do next (Jan).
- Jones: need baseline to see when it is dirty, and then having right monitoring data.
- Luisa: monito
- Fred: silversides, choose short-lived fish biosetinel species. Or maybe passive samplers are method to measure.
- Jay: how much are fish moving around, if fish in SLB good integrator.
- YM: co deploy worm and passive samplers, and found results the same
- Jay: Don's write up will include recommended next step, and invite everyone to consider.

7. **Discussion Steinberger Slough - Progress Report on Conceptual Model Development (Alicia)**
   - Highest conc 20 mg/kg
   - Lower estimated yields
   - Don: expect strong export of sediment. Plug flow model. Sample along channel. Even more complex to model, not much bathymetry data. Need tidal volume and flow direction can get order of magnitude estimate. More redevelopment may have more money to cleanup. Will work . Sims metal does have dredging near the 20.8 ppb measurement.
   - Jay: high yield watersheds
   - Delta star status? Jan - doing phase of cleanup, found a storm drain that was not known, and cleaned up in the last 2 years. Some work being done in adjoining site. Many sites there being cleanup by DTSC and water board. Area also have groundwater issue

- G: this system responds much faster. Annual loading (inventory)... Inventory 3 kg - 7 kg /year loading. Inventory in SLB 5-10 kg/yr. Could be deeper buried inventory.
- Lester: vegetated marsh is a sediment sink. How should it be included in conceptual model.
- Don: slough to wetland flux, things get stuck, different from tidal flushing estimate
- Jones: good to look at dredging history in that channel
- Don: don't have estimate of mass/inventory in slough, complex in terms of flow.
- Bear island recently restored, then good place to do monitoring.
- Jan: see impact of management. How do fish in channel related to rest of Bay. More dynamic system, need to move with water.
- Arlene: 4 PMUs representative Steinberger representative of this part of Bay. how do fish partition different in slough, versus channel or marsh
- Fred: recommend whether this is a site to be further studied.
- Luisa to find out if there is monitoring as part of permit. Check to see what monitoring is required of dredging work.
- Jan: a lot of work has been done in the area.
- Jay:

8. **Information: Dioxin Synthesis (Don)**
   - Data highly composited
   - Build dioxin loads and inventories
   - Timeline draft end of summer, and final end of year.
   - Fred will be co-author
   - Are there any hot-spots: not in ambient water. See pretty similar patterns
   - Lester: not aware of hotspots.
9. **Information: PCB Workgroup Proposals for 2018**
   - Analysis of DMMO PCB Data
     - Fred said it would be interesting to look at the PCB congener data, to see if there are any interesting PCB fingerprints. There was discussion that it would be interesting to look at PCB congener distribution and whether it would look like general weathered PCB distribution or show any local sources.
     - Gobas said it would be helpful to develop guidelines for thresholds that take into account biomagnification of PCB in the food web. And that many sediment threshold guidelines consider benthic species, even though biomagnification in the food web can lead to higher order organisms having much higher PCB concentrations, which would guide the need for stricter threshold guidelines that those developed based only on bioaccumulation in benthic species.
     - The proposal can also figure out what parts of the data in the database are useful, and develop recommendations for future data collection
     - Yeo-Myoung lead a discussion of how representative the sample would be of either surface sediment or sediment dredged since the sediment sample may not be representative of either depth. There was also discussion

about the value of a highly composited sample that is used for dredging evaluations.

- Discussion on proposal priorities.
  - Craig Jones mentioned that it could be cheaper and more useful to do sediment profile imaging in San Leandro Bay and get qualitative benthic community data and bioturbation mixing depth.
  - Yeo-Myoung said there are many benthic community databases, and there may be some useful benthic data available that can be applied for San Leandro Bay.

10. Information: PCB Workgroup Proposals for 2018