

Meeting Remediation and Restoration Objectives: How Do We Measure Success?

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What is success or failure?

- We need a definition, up front.
- Who decides success?
- Views are varied, but all are important
 - regulator(s)
 - PRPs
 - trustees
 - communities
 - enviros

What can be/should be measured?

- RAOs – “To select the most appropriate remedy for a site, it is important to develop clearly defined remedial action objectives (RAOs) and contaminant-specific risk-based remediation goals (RGs). RAOs are used in developing and comparing risk reduction approaches for the site and in providing the basis for developing more specific RGs, which in turn are used by site managers to select final sediment clean-up levels based on the other NCP criteria.”
 - can vary for different parts of the site
 - should address all human health and eco risks
 - often includes – “reduce risks to... from...”
- Cleanup levels or action level
 - usually contaminant specific sediment concentration, but
 - can be based on multi-contaminant sediment quality indices
 - can be based on toxicity, bioassessment, removal depth

Remedy Effectiveness vs. Risk Reduction vs. Restoration

- Remedy performance - easy to measure
 - were dredging residuals low?
 - was resuspension and transport low?
 - did the cap stay where it was placed?
 - is the cap isolating buried contaminants?
 - is sedimentation and chemical degradation continuing at the same rate?

Measuring Risk Reduction

- Need measures to evaluate trends, are we seeing improvements?
- Need RAOs that can be measured
- RAOs can include numerical or narrative goals, e.g., reach 200 ppb in 12 years, or increase the number of fish meals that may be eaten to two per month

Achieving Restoration

- Habitat improvement or creation is often part of global site management
- Often involves mitigation of wetlands or acres impacted by the remedy
- Habitat improvement should be part of cap or other remedial designs, e.g., selecting materials when using thin layer placement after dredging, fish mix.
- Good background or reference information is necessary to measure level of improvement

Design Monitoring Plan to Address All Needs

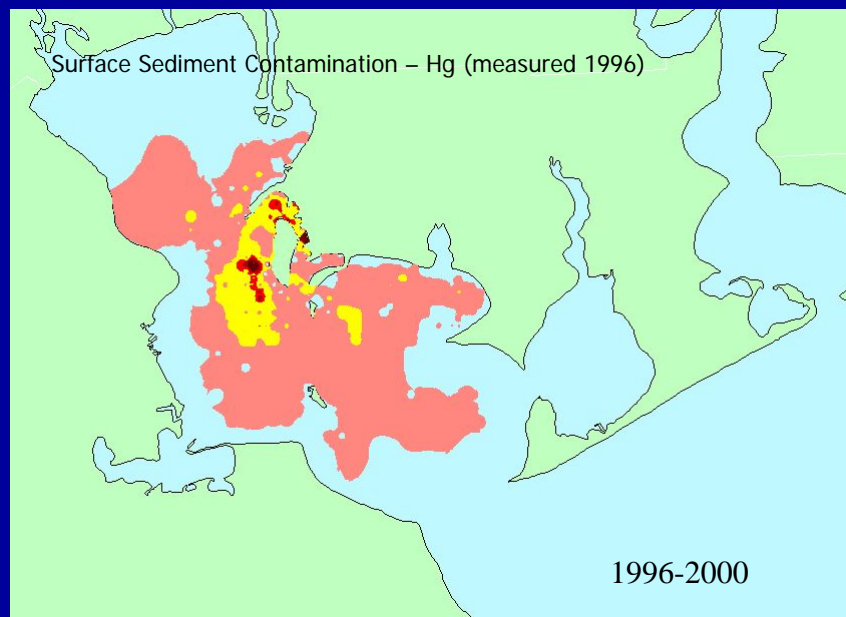
- Threshold question – is remedy working as expected or is another response warranted?
 - Need measures of short and long-term remedy performance
- Are risks being reduced?
 - design monitoring to measure reduction in risk drivers over time short and long-term risk reduction
 - short and long-term habitat improvements

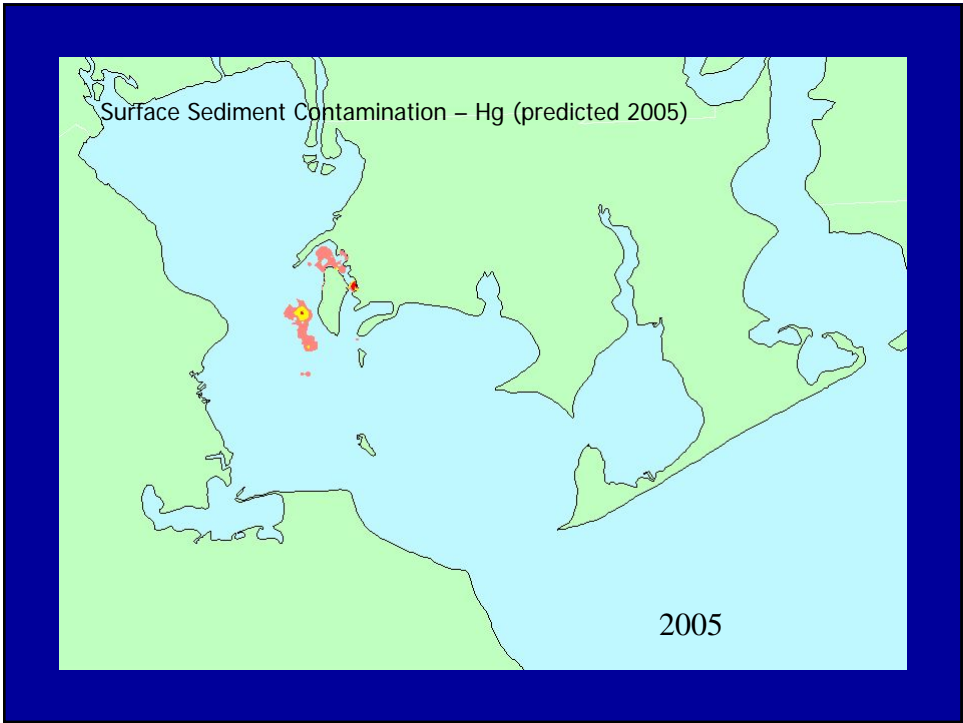
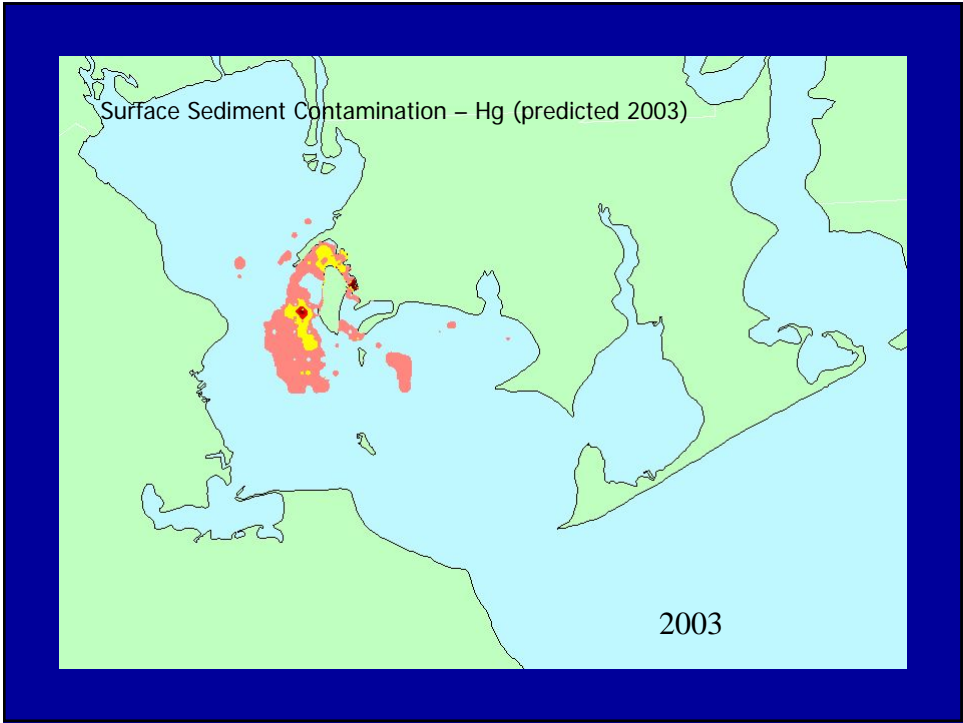
Example RAOs and Cleanup Levels

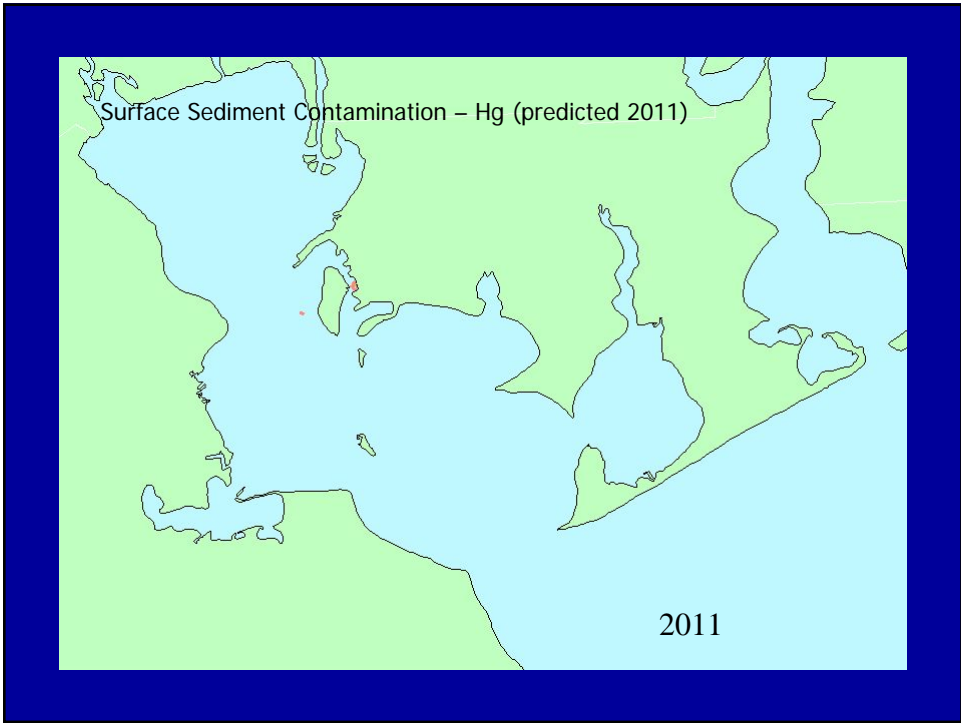
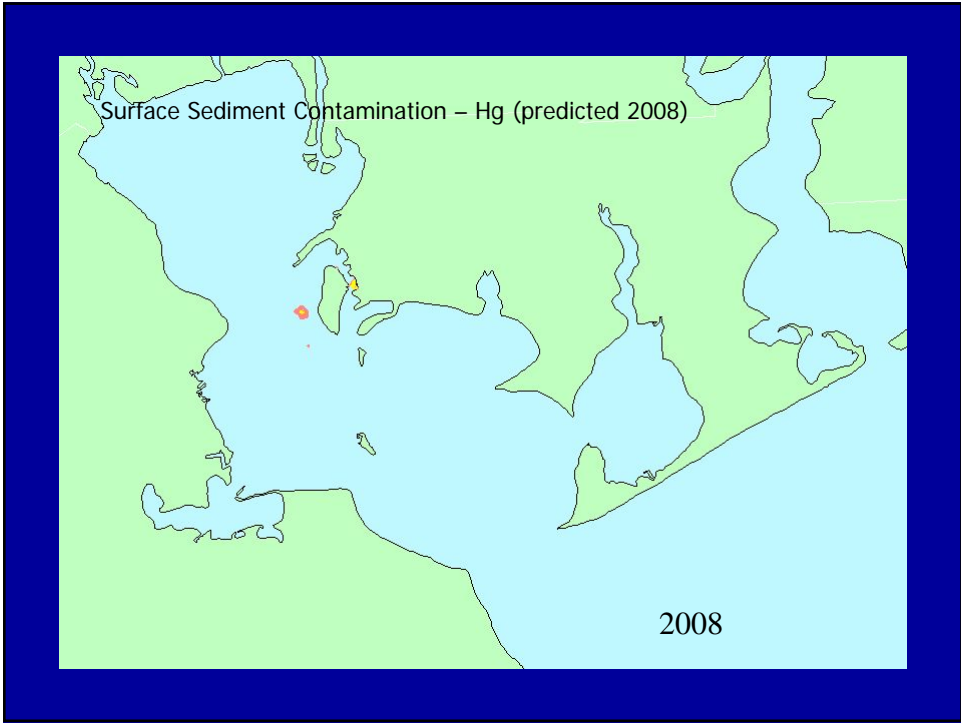
- RAOs for Iron Mountain Mine - Protect the Sacramento River ecosystem from releases of heavy metals originating from the Spring Creek Arm, by preventing the mobilization and redeposition of contaminated sediment into important fishery spawning habitats located in the Sacramento River downstream of Keswick Dam.
- Prevent adverse impacts on water quality and the beneficial uses of the Sacramento River below Keswick Dam, by reducing the metal loads and suspended solids associated with contaminated sediment discharged from the Spring Creek Arm to the Sacramento River.

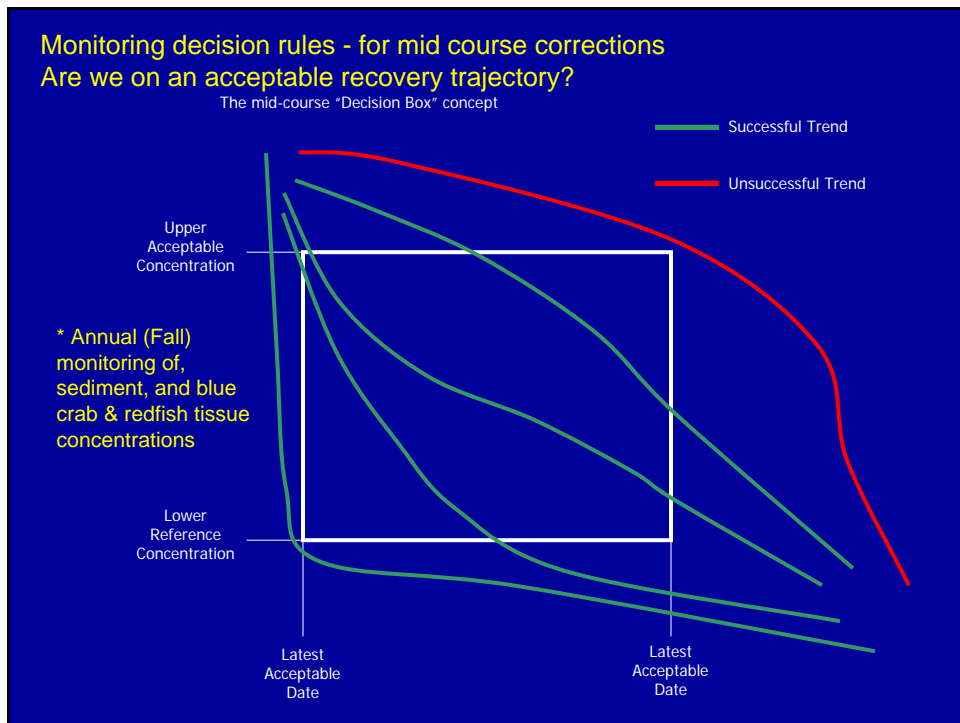
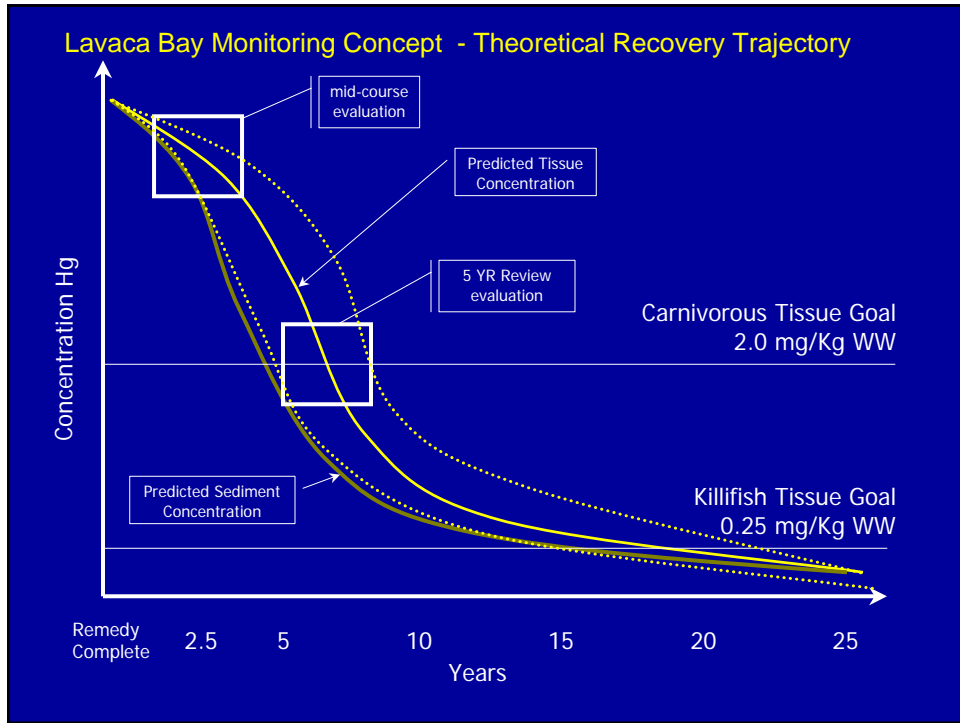
Example RAOs and Cleanup Levels

- RAOs for the Lavaca Bay Site - Protect the ecosystem from releases of mercury originating from the Alcoa Point Comfort Facility,
- For mercury in sediment
 - For sediments in fringe marsh, 0.25 ppm mercury to reduce tissue levels of the smaller resident species (killifish within marshes) below the 0.5 ppm mercury tissue level noted for potential behavioral effects.
 - For sediments in open-water, 0.5 ppm mercury this combined with the above will reduce large predatory carnivorous fish tissue below the 2 ppm mercury concentration noted for adverse effects on survival and reproduction.



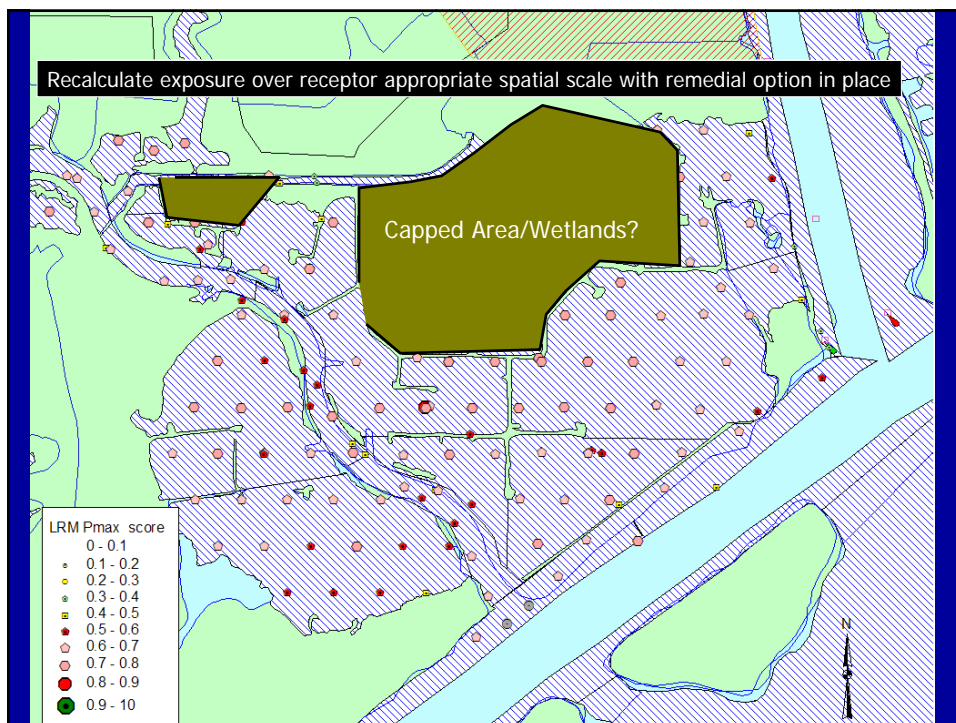






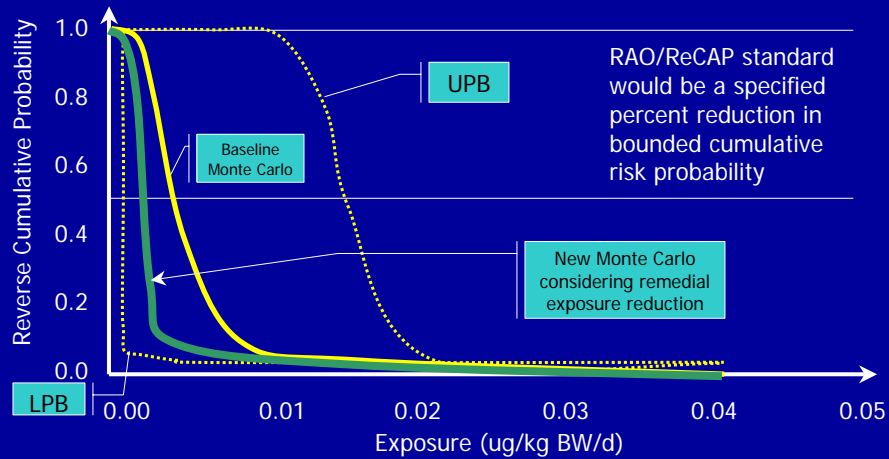
Example

- RAOs for the Bayou d'Inde/Calcasieu Estuary Site – conceptual / in development now for a complex mixture of directly toxic and bioaccumulative contaminants
- The RAOs for in sediment
 - Step 1, develop RAOs (LA ReCAP standards) for protection of benthic organisms;
 - Step 2, evaluate reduction in exposure of upper trophic levels to collocated, bioaccumulating hazardous substances; and
 - Step 3, if exposure is not sufficiently reduced, revise the extent of remediation & exposure reduction & re-evaluate residual risk



Conceptual RAOs and Cleanup Levels

Example Reverse Probability Distribution for Average-Sized Piscivorous Mammals exposed to Dioxin & co-planar PCB TEQs



Conceptual Monitoring Program –

- Develop a monitoring plan for selected organisms & sediment locations
- Develop and apply a “decision box” type evaluation to assure recovery is on an acceptable trajectory
- Take additional exposure reduction actions, if remedy doesn't perform as expected

Questions

