Over the past 12 years, the LTMS agencies have commissioned technical studies to improve the understanding of potential impacts of dredging, dredged sediment disposal, and beneficial reuse. The studies can be categorized as follows: studies carried out by the LTMS Environmental Work Windows Science Work Group (Science Work Group); studies pertaining to methylmercury; and studies pertaining to sediment transport modeling. The Science Work Group undertook studies designed to help refine science underpinning the work windows set for through the LTMS programmatic biological opinions from the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) with concurrence from the California Department of Fish and Wildlife. The methylmercury studies focused on the potential for mercury to methylate at wetland restoration sites that use dredged sediment, and included conducting field work prior to placing sediment on the site to understand existing conditions. The sediment transport modeling studies, which are currently underway, consider the pathways and initial deposition of sediment placed at aquatic disposal and potential shallow water placement sites. The studies included literature reviews, as well as scientific experiments carried out in the laboratory and field. Syntheses of these studies and related topics were presented at several LTMS Science Symposia.

The following sections provide more detail on the various types of science studies undertaken by the LTMS agencies. Completed studies are posted on the LTMS webpage (http://www.spn.usace.army.mil/Missions/DredgingWorkPermits/LTMS/StudiesSymposia.aspx). The table beginning on page F-4 provides a summary of all LTMS-accomplished science studies and symposia.

LTMS ENVIRONMENTAL WORK WINDOWS SCIENCE WORK GROUP STUDIES

The Science Work Group was conceived in 2001 to address technical underpinnings related to environmental work windows primarily pertaining to fish. The work group's first major product, the *Framework for Assessment of Potential Effects of Dredging on Sensitive Fish Species in San Francisco Bay* (Framework Document), was issued in 2004 and outlines management concerns, scientific knowledge, known data gaps, chief scientific unknowns, potential study topics to resolve unknowns, and priorities for technical studies. Accordingly, it served as a basis for the studies commissioned by the LTMS program through the Science Work Group. The Framework Document was updated in 2013 to account for listed species that were not fish, newly listed species, and other species of concern.

The premise underlying the studies was to determine each of the components listed below for various species. While each component has value in itself, the intent was that, if all components are completed, there would be sufficient basis for re-examining regulatory restrictions.

- Distribution of the organism in time and space
- Effect footprint (e.g., dredge plume, entrainment field) in time and space
- Effect of various components of dredging operations (e.g., water quality, entrainment)
- Effect of dredging operation on distribution (i.e., avoidance or attraction)
- Integration of distribution, effect, effect footprint, and behavior on individuals and populations in a risk analysis or risk analysis-like consideration

METHYLMERCURY STUDIES

Methylmercury is of concern because mercury is present Bay-wide and has the potential to generate methylmercury, which becomes biologically available, bioaccumulates up the food chain, and can result in reproductive and developmental impacts, and as such can have adverse effects on fish, wildlife, and humans. It is present in existing and restored wetlands. The Hamilton Army Air Field (HAAF) Wetlands Restoration Project site was of particular interest to the LTMS agencies because it was slated to, and has received dredged sediment from the Bay. It was thought that monitoring this site would provide insight into whether the use of dredged sediments in wetland restoration was similar to or different from methylation (transforming relatively less toxic forms of mercury into more toxic forms) at restoration sites where dredged sediment was not reused or at existing marshes of a similar nature. The intent of the initial studies was to determine the potential for methylation on the site prior to dredged sediment placement, to examine a few environmental parameters that might be used as the basis for best management practices, and to examine the feasibility of less expensive/difficult monitoring technology.

SEDIMENT TRANSPORT MODELING STUDIES

The decline in sediment transport into the Bay and the potential concomitant adverse effects on marshes and mudflats has been documented in several recent technical publications. These resources are further at risk because of climate change-induced sea level rise. Based on the challenges of dealing with dredged material as cost-effectively as possible, the opportunity to utilize dredged material to supply needed sediment is under investigation.

The LTMS has funded efforts in this direction. Although interim results are currently under review, more sediment dynamics modeling and other studies are required to determine the practicability of this approach. Further, the potential impacts to sensitive species associated with the activities modeled in these studies have yet to be evaluated or considered.

STUDY OUTCOMES

Favorable outcomes of LTMS Science Work Group and methylmercury studies include the following[1]:

- The fish tracking studies for the specific hatchery-raised salmonids (which served as surrogates for the sensitive species) showed a short duration of migration period through the Bay and thus a short period of potential exposure to adverse effects of dredging operations. It is expected that the studies will provide the scientific underpinnings needed for NMFS to ease some dredging restrictions pertaining to salmonids. The collaborative nature of the fish tracking studies (involving USFWS, NMFS, U.S. Bureau of Reclamation, and various ports and marinas) garnered respect for the LTMS program and increased partnerships.
- The results of the studies on herring demonstrated adverse effects (developmental changes) due to the presence of increased suspended sediment adhered to fertilized eggs within two hours of spawning and also larval herring, thereby corroborating aspects of the restrictions on dredging pertaining to herring.
- The results of two aspects of the methylmercury studies conceived and funded by LTMS have been followed up on at an international level and are now being used in monitoring and best management practices elsewhere. However, the studies at the HAAF Wetlands Restoration Site were terminated due to concerns over funding such expensive studies at the regional level.
- The LTMS-sponsored symposia were widely attended by local and regional resource and regulatory agency staff, dredgers, and port and marina operators, among others. The symposia increased the general understanding and provided a forum for discussion of the known science for this user group.

[1] Sediment transport modeling study outcomes are not final as of the time of preparing this document.

Title and Author(s)	Management Question	Study Objective	Results
Environmental Work Windows – Framework			
Framework for Assessment of Potential Effects of Dredging on Sensitive Fish Species in San Francisco Bay Final Report. (2004; Levine+Fricke) Updated in 2013 by SFEI.	What management questions do the regulatory and resource agencies have regarding dredging and dredged sediment disposal activities on commercially important or state/federally-listed species? Can scientific studies be developed and implemented that will answer these questions? What would the study topics be?	Identify the potential effects of dredging on commercially important state/federally-listed species and identify studies that may provide additional information to support refining the environmental work windows.	The original document only included aquatic species. The 2013 update provides information on commercially important or state/federally-listed invertebrates, fish, avian, and mammalian species. This document served as the basis for the studies listed below.
Environmental Work Windows - Fish Studies			
Juvenile Salmonid Outmigration and Distribution in the San Francisco Estuary: 2006-2008 Interim Draft Report. (2010; ECORP, UCD, USACE)	Are the salmonid work windows appropriate given the amount of time salmonids are traveling from the tributaries, through the estuary, and to the ocean?	Estimate travel times and pathways or out-migrating salmonid smolts from 2006 to 2008.	In this pilot study, 49 Chinook and 49 steelhead salmon were released during January and February 2007, as well as 50 of each species in March 2008. Fish released by two other studies were also used in parts of the data analysis. The mean travel time between the Rio Vista and Golden Gate bridges was 10.2 days for Chinook salmon and 8.5 days for steelhead trout. The median exposure time at SF-10 was 6.5 minutes for the species. Both species tended to use mid-channel waters around the Richmond-San Rafael Bridge rather than the shallow flats on either side of the channel. Both species also tended to pass by at least one dredged material placement site. *Note that this was not produced as a final document, as the results served as the basis for subsequent studies and are included therein.*
Juvenile Salmonid Outmigration And Green Sturgeon Distribution In The San Francisco Estuary: 2009 Annual Report. (2011; UCD and USACE)	See above for salmonid question. What parts of San Francisco Bay (Bay) do green sturgeon use, and what period of time do they spend in various locations/habitats?	Estimate travel times and pathways of out-migrating salmonid smolts from 2006 to 2008. Identify general distribution and movements of adult green sturgeon within the Bay.	500 Chinook salmon and 500 steelhead were released in February 2009. One third of Chinook salmon and steelhead trout successfully migrated to the Golden Gate Bridge. The median travel time was 2.2 days for salmon and 1.9 days for steelhead, and was potentially influenced by tides. Exposure time at marinas and dredged sites near shoals was only a few minutes for up to five fish, whereas the exposure time at SF-10 was up to 200 minutes. Disposal operations were not occurring on-site at the time of fish monitoring. Both species tended to use deeper channels and/or passed by at least one dredged material placement site. Limited tagged green sturgeon were available for this study.
Juvenile Salmonid Outmigration and Green Sturgeon Distribution in the San Francisco Estuary: 2010 Annual Report. (2012; UCD and USACE)	See above.	Estimate travel times and pathways or out-migrating salmonid smolts from 2006 to 2008. Identify general distribution and movements of adult green sturgeon within the Bay.	In this study, two thirds of Chinook salmon and steelhead trout successfully migrated to the Golden Gate Bridge. The median travel time was 2.7 days, with transit rates increasing further downstream and potentially influenced by tides. Exposure time at marinas and dredged sites near shoals was variable (mostly less than 30 minutes but up to 20 hours). Median exposure time at SF-10 was 5.3 minutes for salmon and 6.5 minutes for steelhead. Disposal operations were not occurring on-site at the time of fish monitoring. Adult green sturgeon were mostly detected around the Golden Gate and Carquinez Bridges in summer and fall, but more evenly dispersed in winter.
Literature Review: Fish Behavior in Response to Dredging and Dredged Material Placement Activities. (2009; ECORP)	Does the behavior of listed fish species change as a result of dredging or dredged sediment disposal activities? Would that change in behavior have adverse effects on the fish (i.e., more energy expenditure for foraging)?	Identify behavioral responses of fish to dredging-related activities in the Bay.	Juvenile salmonid migration behavior is disrupted when exposed to dredging activity or sediment plumes, but returns to normal shortly thereafter. Fish tend to exhibit avoidance behavior for about two to three hours after dredged sediment disposal, and densities of fish communities generally return to baseline levels after three hours. Typical maximum suspended sediment levels resulting from mechanical dredging operations in the Bay are in the range of preferred turbidity levels for Pacific herring feeding behavior. Initial adverse effects to benthic macroinvertebrates from dredging activities are almost universally observed. Demersal fish species are more vulnerable to entrainment during dredging activities than pelagic species. Noise generated from pile-driving can elicit avoidance by juvenile salmonids.

Title and Author(s)	Management Question	Study Objective	Results
Tools for Assessing and Monitoring Fish Behavior Caused by Dredging Activities Final Report. (2011; Rich)	What management or technological tools can be used to monitor changes in fish behavior due to dredging and dredged sediment disposal in the Bay?	Review current knowledge and methods/tools used to assess the behavioral responses of fishes to dredging activities in the Bay. Propose studies that would provide further information for the LTMS.	Methods/tools would provide a useful approach for Bay studies; however, any future studies should include an initial pilot study. Modeling the results of swimming performance for a given fish could be used as a preliminary assessment of entrainment risk to different types of dredgers.
LTMS Longfin Smelt Literature Review and Study Plan. (2011; SFEI)	What is known about the ecology, life stages, and risks associated with dredging and dredged sediment disposal activities on longfin smelt? This issue was raised in response to the new listing of this species as threatened.	Review the life history, ecology, risks from dredging, and other threats to longfin smelt. Propose studies that would provide further information for the LTMS.	Potential impacts of dredging include direct mortality due to entrainment or burial of eggs, removal of spawning habitat, changes in water quality due to increased suspended sediment, and indirect effects resulting from habitat alteration. It is unlikely that turbidity associated with dredging would cause adverse impacts on adult or juvenile longfin smelt. Potential indirect impacts of dredging pertain to the creation and maintenance of shipping channels, which may facilitate the introduction of invasive species, as well as harm by commercial vessel wave action and propeller damage.
Potential Impacts of Re-suspended Sediments Associated with Dredging and Dredged Material Placement on Fishes in San Francisco Bay, California, Literature Review and Identification of Data Gaps. (2010; Rich)	What are the impacts of increased suspended sediment levels on fish that live in or migrate through the Bay?	Assess current knowledge on the effects of re-suspended sediment on priority fishes, as well as the impacts of suspended sediment, suspended solids, and turbidity from non-dredging activities on fishes. Propose studies that would provide further information for the LTMS.	The studies identified were primarily conducted in the laboratory mostly using suspended sediment concentrations that were far above both the ambient and dredging-related concentrations. Experimental durations in the laboratory studies also exceeded likely exposures found in the Bay. Consequently, to determine the effects of dredging-related re-suspended sediment on fishes, a number of field and laboratory studies are needed.
A Bibliography of Scientific Literature on Pacific Herring (Clupea pallasi), with Additional Selected References for Baltic Herring (Clupea harengus) Draft. (2004; PE)	Is there existing scientific literature on the effects of dredging on Pacific herring?	Compile available scientific publications that address the effects of dredging-related sediment suspension and sediment-associated contaminants on the spawning and early life stages of Pacific herring.	Several hundred publications regarding the Pacific herring were identified. Publications were also identified for the Baltic and Atlantic herring.
A Review of Scientific Information on the Effects of Suspended Sediments on Pacific Herring (Clupea pallasi) Reproductive Success Final Report. (2005; PE)	What is currently known about the potential effects of increased suspended sediment loads on Pacific herring and their spawning success in the Bay?	Assess the effects of suspended sediments on the spawning and early life stages of Pacific herring.	The peak TSS concentration of dredging-related suspended sediments is below the threshold concentrations reported for effects on embryo development and hatching and larval herring survival, with a possible exception. The observation of enhanced feeding by larval Pacific herring at 500 mg/L suspended sediments suggests that dredging-related activities may actually be beneficial to the Pacific herring population(s).
Potential Impacts of Dredging on Pacific Herring in San Francisco Bay Final Draft White Paper. (2006; SFEI)	Evaluate the current state of knowledge and uncertainties regarding the effects of dredging on Pacific herring in the Bay, and evaluate the efficacy and need for the fish work window.	Identify information gaps and potential research that could better assess potential impacts of dredging on Pacific herring in the Bay.	Priorities for continued research should focus on suspended solids and contaminants. Many recommended studies could take years, and potential effects may never be fully understood. The LTMS should develop short-term, practical solutions to minimize the conflict between dredging and resource management.
Impacts of Suspended Sediments on Fertilization, Embryonic Development, and Early Larval Life Stages of the Pacific Herring, Clupea pallasi. (2008; BML and UCD)	How do increased suspended sediment concentrations affect the spawning success of Pacific herring, and what levels of suspended sediment are of concern?	Identify and evaluate the effects of suspended sediment on the early life stages of Pacific herring.	During the first two hours after herring eggs contacted water, the embryos were adhesive and susceptible to permanent attachment of sediment particles. Exposure to dredged sediment during this time increased the eggs' self-aggregation and led to sublethal and lethal effects, including increases in larval precocious hatch, abnormalities, and mortality. After the first two hours, contact with the dredged sediment did not have an observable impact.

Title and Author(s)	Management Question	Study Objective	Results
Impacts of Suspended Sediments on Fertilization, Embryonic Development, and Early Larval Life Stages of the Pacific Herring, Clupea pallasi. (2009; BML and UCD)	See above.	Identify and evaluate the effects of suspended sediment on the early life stages of Pacific herring.	During the first two hours after herring eggs contacted water, the embryos were adhesive and susceptible to permanent attachment of sediment particles. Exposure to dredged sediment during this time increased the eggs' self-aggregation and led to sublethal and lethal effects, including increases in larval precocious hatch, abnormalities, and mortality. After the first two hours, contact with the dredged sediment did not have an observable impact.
Impacts of Suspended Sediments in San Francisco Bay on Pacific Herring Larval Survival and Condition. (2010; BML and UCD)	Given the identified developmental impacts from increased suspended sediment concentrations, are there developmental impacts on the surviving Pacific herring larvae from dredging projects in the spawning area?	Describe the effects of suspended sediment particles on Pacific herring larval survivability and condition.	Exposure to 400 mg/L or less of suspended sediment for 16 hours did not impair Pacific herring larvae.
Environmental Work Windows - Least Tern Studies			
Least Tern Literature Review and Study Plan Development Final Report. (2012; Harvey)	Is there existing scientific literature on the effects of dredging and dredged sediment disposal on least tern?	Evaluate available scientific information supporting California least tern dredging restrictions.	Direct effects of dredging on nesting birds may be caused by equipment noise and human activity. Turbidity may also play a role, as fish tend to move closer to the surface in turbid water and deeper in clearer water. Potential indirect impacts include reduced water quality and contamination of fish and the least tern. Dredging work windows may not accurately reflect current least tern breeding/foraging distributions. Dredging-induced turbidity and suspended sediment concentrations may not exceed tolerance limits of fish. Fish contaminant concentrations may exceed tolerance levels of predatory birds. Contaminant levels at a dredge site rapidly revert to ambient levels away from the dredge site.
Water Quality Related - Knockdown/Plume Studies			
Spatial Characterization of Suspended Sediment Plumes During Dredging Operations through Acoustic Monitoring Final Report. (2004; MEC and USACE)	What is the increased concentration of suspended sediments in the water column from a dredging project, and what is the spatial and temporal extent of the impact?	Track suspended sediment plumes during bucket dredging operations in the Port of Oakland's Outer Harbor.	Few indications of surface components were detected, as the major loss of sediment via re-suspension appeared limited to the lower water column. Plumes were very heterogeneous, consisting of pulses of elevated TSS concentration generated by the bucket's impact with the substrate. The net flux of plume-borne sediments was lateral toward the center of the channel rather than toward open Bay waters, even during ebbing tides. However, the weak current flows did not extend to the innermost portion of the harbor navigation channel. TSS concentrations were consistently lowest in the "dead end" area, where flows allowed fine sediments to settle.
Characterization of Suspended Sediment Plumes Associated with Knockdown Operations at Redwood City, California. (2005; Weston and USACE)	How does the suspended sediment concentration increase with large knockdowns, and how does it compare to background levels and dredging projects?	To understand the suspended sediment concentration levels, as well as temporal and spatial extent, of knockdown dredging plumes.	Lateral spread of plumes was slow, but over time they expanded up to 25 meters wide. Concentration gradients within the plumes varied greatly, but generally decayed to less than 200 mg/L within 5 to 6 minutes. Residual plumes with concentrations in the 50 to 100 mg/L range persisted for 13 minutes or longer.
Effects of Short-term Water Quality Impacts Due to Dredging and Disposal on Sensitive Fish Species in San Francisco Bay. (2008; SFEI)	What are the potential short term water quality impacts from dredging and disposal of dredged sediments at in-Bay disposal sites?	Describe the short-term water quality impacts of dredging operations on sensitive fish species in the Bay.	Water quality impacts of concern include dissolved oxygen reduction, pH decrease, and releases of toxic components such as heavy metals, hydrogen sulfide, ammonia, and organic contaminants. The latter include polycyclic aromatic hydrocarbons, polychlorinated biphenyl, and pesticides. Potential short-term effects include acute toxicity, subacute toxicity, and biological and other indirect effects such as avoidance.

Title and Author(s)	Management Question	Study Objective	Results
Wetland Restoration – MeHg Studies			
Mercury Concentrations Bordering the Hamilton Airfield Remediation Site: September 2001. (2002; USACE)	What are the current levels of MeHg production at the HAAF Wetlands Restoration Site?	Assess the pre-construction soil-sediment levels of total Hg, MeHg, and methylation and bioaccumulation potential of Hg at the HAAF Wetlands Restoration Site.	In this preliminary/pilot study, the highest median total Hg concentrations were found along the HAAF Bay Edge and in the Bel Marin Seasonal Wetland. There were both high and low total Hg outliers, and MeHg concentrations were highly variable and contained numerous high (but not low) outliers. While Bel Marin Creek/Pond had the lowest total Hg concentrations, it had the highest methylation potential.
Mercury Concentrations Bordering the Hamilton Army Air Field Remediation Site: February 2003, Wet Season – Dry Season Contrast. (2003; USACE)	What are the current levels of MeHg production at the HAAF Wetlands Restoration Site?	Conduct soil and sediment sampling and analysis for total Hg and Me Hg at selected stations bordering the former HAAF Wetlands Restoration Site.	In this preliminary/pilot study, total Hg concentrations in soils and sediments at seven locations bordering the HAAF Wetlands Restoration Site and nearby China Camp were mostly similar during the dry season of 2001 and wet season of 2003. MeHg in the same samples increased an average of three-fold during the wet season. Highest total Hg was consistently found in samples at the intertidal zone, but MeHg increased less than two-fold in the same samples during the wet season. Highest methylation occurred in samples taken closer to the levee and was less influenced by tidal fluctuation. High MeHg concentrations suggested that meteorological or surface water influence Hg methylation of the higher marsh areas.
Mercury Cycle Studies Associated With the Hamilton Wetland Restoration Project. (2006; USACE)	What are the links between Hg biochemistry and restoration at the HAAF Wetlands Restoration Site?	Evaluate the potential impact of MeHg at the HAAF Wetlands Restoration Site.	Pre-construction data were collected to determine on-site methylation and demethylation rates; measure Hg species in water and sediment pore-water using a new DGT device; understand the fate and effects of Hg species into salt marsh food webs; and quantify the biomagnification of Hg species and postulate the existence of two food webs.
Preconstruction Biogeochemical Analysis of Mercury in Wetlands Bordering the HAAF Wetlands Restoration Site Parts 1, 2, and 3. (2006, 2007, 2009; ARA, AS, Trent University, University of Florida, USACE, and USEPA)	What site-specific knowledge is available of the geochemical, geophysical, microbial, and predominant plant- and animal-related interactions that affect the stabilization and mobilization of MeHg in the sediments and soils of existing wetlands bordering the HAAF Wetlands Restoration Site?	Describe studies that focus on mitigating MeHg bioaccumulation in the Bay's aquatic food webs.	The studies identified focused on site-specific rates of methylation and demethylation; food web sources and pathways; accumulation of water- versus sediment-associated Hg in clams, fish, and DGT; and recalibration of a screening-level model that integrates the physical, chemical, and biological processes that drive Hg cycling in San Pablo Bay salt marshes.
Comparison of DGT Sentinels and Bioassays for Long-term Mercury TMDL Monitoring under San Francisco Bay Field Conditions. (2009; SFEI, Trent University, and USACE)	See above, and can DGTs be used as a supplement or replacement for biosentinels in monitoring bioaccumulation of MeHg?	Evaluate the performance of DGTs for long-term MeHg total mean daily load monitoring in the field.	DGT-labile MeHg concentrations of the water-DGTs were usually less than unfiltered water concentrations. The MeHg-time relationships of the water-DGTs differed from those of the +1.5-cm-sediment-DGTs. The MeHg concentrations of the water-DGTs appeared to respond to the same processes as other organisms like the *T. japonica* test clams, site-inhabiting clam *Mya arenaria*, and site-inhabiting fish *M. audens*.
LTMS Science Symposia – These Symposia were conducted to provide a forum for the latest LTMS Science Studies related to dredging for the public			
2003 Symposium on Herring			Symposium primarily focused on reviewing the white paper entitled: *Potential Impacts of Dredging on Pacific Herring in San Francisco Bay* (2005; SFEI). Specifically, the symposium addressed the factors that impact herring populations, possible impacts of dredging operations, and information gaps in the white paper. Areas of uncertainty and proposed future research areas were also prioritized.
2007 LTMS Science Symposium			Presentation topics included using science to improve management of dredging, transport and fate of sediment and contaminants, framework for assessment of effects of dredging, sediment plumes, impacts of suspended sediments on herring, salmon tracking study update, least tern foraging requirements, entrainment of fish, update on the LTMS BO and salmonid and green sturgeon work windows, basics of an aquatic transfer facility for HAAF Wetlands Restoration Site, MeHg study update.

Title and Author(s)	Management Question	Study Objective	Results
2008 LTMS Science Symposium			Presentation topics included the role of science in the LTMS program, salmonid tracking update, fish entrainment, dredging impacts on the native oyster, MeHg and dredging, sediment plumes during dredging, decreased sediment concentrations in SF Bay, Sediment pathways in SF Bay and impacts of sand and gravel mining.
2009 LTMS Science Symposium			Presentation topics included risk to green sturgeon from dredging activities; Bay dredging operations; life history model of green sturgeon stressor and risks; past, present, and future green sturgeon studies; indirect impacts on sturgeon through bioinvasions; response of white sturgeon to dredging operations; exposure of sturgeon to vessel propellers; and contaminated sediments and fish health.
2010 Science Symposium			Presentation topics included the use of science in defining windows; fish tracking project update; least tern study update; mandated dredge monitoring of the Delta's federal shipping channels; suspended sediment impact on Bay Pacific herring; environmental visualization tools; guidance for potential removal of creosote-treated pilings; utilization of dredged materials for habitat restoration; and MeHg in dredging operations and dredged sediment reuse.
2010 Methylmercury and Dredged Operations Symposium			Presentation topics included MeHg management context and needs; context for evaluating dredging and dredged material disposal and reuse, as well as dredging operations and disposal quantities; MeHg mass budget for Bay context and extrapolation of dredged material/wetland contribution; effects of sediment mobilization on inorganic Hg speciation and methylation potential; HAAF Wetlands Restoration Site studies; MeHg transport to and from Suisun Bay wetlands; Hg methylation in dredged material sediment ponds; measuring MeHg exposure; and monitoring options.
Studies Not Yet Complete			
3-D Sediment Transport Modeling: North San Francisco Bay Study	Can sediment placed at shallow in-bay sites be attributed to marsh accretion?	Establish a three-dimensional hydrodynamic, wind wave, and sediment transport model that can be used to estimate sediment transport in the North Bay and Delta.	In progress.
3-D Sediment Transport Modeling for Regional DMMP: South San Francisco Bay Study	Can sediment placed at shallow in-bay sites be attributed to marsh accretion?	Understand sediment dynamics in the South Bay to work towards identifying beneficial reuse opportunities.	In progress.
Tributaries Contribution (USGS) to Regional Sediment Management Science Studies	What is the sediment flux in and out of the tributaries to the Bay?		In progress.
Provenance Study, Fine Grain (USGS) for the Regional Sediment Management Science Studies	What is the origin of fine grain sediment supplied to different embayments?		In progress.

Notes:
BML = Bodega Marina Laboratory
BO = biological opinion
cm = centimeters
DGT = diffusive gradients in thin films
DMMP = dredged material management plan
ECORP = ECORP Consulting, Inc.
HAAF = Hamilton Army Air Field
Harvey = HT Harvey & Associates
Hg = mercury
MEC = MEC Analytical Systems, Inc.
MeHg = methylmercury
mg/L = milligrams per liter
PE = Pacific EcoRisk
Rich = A. A. Rich and Associates
SFEI = San Francisco Estuary Institute
TMDL = total maximum daily load
TSS = total suspended solids
UCD = University of California Davis
USACE = U.S. Army Corps of Engineers
USGS = U.S. Geological Survey
Weston = Weston Solutions, Inc.