Appendix I: Supporting Information for Implementation Plan

This appendix provides supporting information for the implementation plan (Chapter 9). This appendix includes the following sections:

I.1 Mine Sites Upstream of Mercury-Impaired Reservoirs

This section provides supporting information for cleanup of mine sites that discharge mercury from historical mines located upstream of mercury-impaired reservoirs.

I.1.a. Goals for Mine Sites

Section 9.2.1 explains the goal for cleanup of mine sites is to reduce transport of mercury-contaminated mining waste to mercury-impaired reservoirs by restoring the landscape to nearly natural (pre-anthropogenic) erosion and runoff rates by reasonable and feasible means. Achieving the mine site cleanup goal is expected to provide greater than 90% mercury load reduction for reasons explained in section I.1.b.

Previous State Water Board Findings and Directives

In 2005, the State Water Board considered mercury discharges from California's Gold Rush legacy and the number of unremediated and abandoned mines and mining areas in its

Resolutions No. 2005-0026 and No. 2005-0060. The State Water Board found "that a significant portion of the abandoned mines and mining areas contaminated by mercury in the State of California are situated on federal lands, and therefore the federal government is responsible for cleaning up these areas to attain water quality standards. The USEPA should actively use its Superfund and other authorities to promptly initiate such investigation and cleanup, and cause the other relevant federal agencies to assume their responsibilities for cleaning up their lands."

Accordingly, the State Water Board planned to "consider the extent to which USEPA has taken the initiative under its superfund or other authority, to commence a comprehensive effort to remediate abandoned mines in both watersheds." Further, the State Water Board directed the San Francisco Bay and Central Valley Regional Water Boards to "create a watershed legacy mercury inventory and establish a priority list for addressing these sources. The Water Boards shall also propose potential methods or strategies to remediate priority sources."

Sections 9.2 on mine sites and 9.3 on mining waste downstream of mine sites address the directives to create a watershed legacy mercury inventory and encourage USEPA involvement. The inventory for mine sites on private lands could be developed by the Regional Water Boards. The inventory for mine sites on public lands should be developed by public agencies, including the USEPA, via a coordinated, inter-agency effort such as the existing California Abandoned Mine Lands Agency Group[1] (CAMLAG).

Tracking of Mine Sites

The State Water Board could work with the California Abandoned Mine Lands Agency Group to ensure that a list and map of mines upstream of reservoirs that have the potential to discharge mercury-contaminated mining wastes is compiled and maintained. The list could be updated after the mine site prioritization tiers have been assigned in Phase 1, and periodically thereafter. The list also could include the dates that plans, reports, and cleanup are due for each mine site. This list could be used to track and report on progress of mine cleanup to the State Water Board and the public.

I.1.b. Implementation Actions and Effectiveness

Most simple erosion control methods and techniques are reasonable and feasible to implement at many mine sites. The California Department of Conservation, Office of Mine Reclamation describes these methods and techniques in *Rehabilitation of Disturbed Lands in California – A Manual for Decision-Making*[2]. These methods and techniques may include actions such as the following:

[1] The Department of Conservation convenes the California Abandoned Mine Lands Agency Group (CAMLAG) to provide governmental inter-agency venue for coordination and collaboration on resolving problems stemming from abandoned mines in California. More information is available at: http://www.conservation.ca.gov/omr/abandoned_mine_lands/Pages/amlu_forum.aspx

[2] Available at: http://www.conservation.ca.gov/omr/publications/Pages/Index.aspx

- Conduct a site investigation to evaluate the erosion potential of mercury-contaminated mining waste, and the potential for seeps and drainages to exacerbate discharges of waste to surface waters;
- Re-contour and terrace steep or exposed waste slopes (cut-and-fill, install benches at regular intervals, and compact fill), without offsite disposal, imported soils, or an impervious cap;
- Install earthen or concrete drainage ditches to collect rain that falls directly onto the re-contoured and stabilized waste slope or other wastes, and route stormwater runoff away from the stabilized waste slope;
- Construct surface water diversion channels and sub-drains to route stormwater runoff away from the stabilized waste slope or other wastes; and
- Plant exposed stabilized waste slope and other wastes with grass and native vegetation to minimize sheet-flow erosion; soil amendments may be needed such as compost described in the next paragraph, or even a layer of top soil may be needed if the waste largely consists of rock.

The Gambonini Mercury Mine in western Marin County in the Coast Ranges is an example of a mercury mine without acid mine drainage where these simpler erosion control techniques were used. Erosion control reduced sediment loads by 55–60%, and reduced mercury loads by 92–93%, based on before-and-after data and accounting for differences in rainfall (Kirchner 2011). This site is featured on the cover of *Rehabilitation of Disturbed Lands in California – A Manual for Decision-Making* (CGS 2003). The only imported material was compost, which was incorporated into the outboard edge of the stabilized waste pile. An extensive native-plant re-vegetation program has resulted in dense grass and bush coverage on the stabilized waste pile.

At the other end of the spectrum, construction of an engineered on-site waste management unit or landfill may be necessary for some mine sites. If the mining wastes are classified as hazardous waste, off-site disposal at hazardous waste landfills is unlikely to be reasonable or feasible due to monetary and environmental costs of long haul distances.

Construction of an engineered, on-site landfill may include actions such as the following:

- Conduct a site investigation to delineate areas of mercury-contaminated mining waste;
- Characterize waste for acid generation potential and leachable concentrations of mercury;
- Locate liner and cap soil material, either from an on-site borrow area or from off-site;
- Excavate, stockpile, haul, and consolidate waste in an engineered, lined, and capped waste management unit;
- Construct surface water diversion channels and sub-drains to route stormwater runoff away from the stabilized waste slope or other wastes; and
- Plant landfill cap with grass and short-rooted native vegetation to minimize sheet-flow erosion.

Turkey Run mercury mine, located in Lake County in the Coast Ranges, is an example of a mercury mine where waste was not found to contain leachable concentrations of mercury (above the soluble threshold limit concentration). Consequently, effective cleanup of major mine features consisted of consolidating mining wastes, regrading and benching to prevent ponding of stormwater, capping the consolidated wastes, and implementing controls to prevent stormwater from running on to the consolidated wastes. Mercury loads discharged from the consolidated and capped wastes will be nearly eliminated. A mine cleanup feasibility study suggested that a 95% reduction in mercury load from Turkey Run and several other nearby mines is technically attainable (Tetra Tech EM Inc. 2003).

Environmental Impacts and Costs

Even in the absence of the Reservoir Mercury Control Program, current mine site property owners are responsible for discharges from their property. Many California and federal agencies undertake themselves or require others to undertake cleanup of mine sites (e.g., USEPA superfund; USBLM; California Natural Resources Agency's Department of Conservation; Cal/EPA Department of Toxic Substances Control; and State and Regional Water Boards.) In this context, the Reservoir Mercury Control Program will not pose new economic costs or environmental impacts to address discharges from mercury and gold mines. Therefore, existing requirements for mine site cleanup will be used as baseline conditions in the environmental and cost analysis for the Reservoir Mercury Control Program.

I.2 Mining Waste Downstream of Mine Sites but Upstream of Mercury-Impaired Reservoirs

This section contains a plan for remediation of "downstream sites" for consideration by the State Water Board during program review at the end of Phase 1 of implementation (see section 9.13.2). This plan is for remediation of mercury-contaminated mining waste and/or mercury-laden sediment accumulated in creeks, floodplains, and reservoirs that discharge mercury from historical mines to mercury-impaired reservoirs. In other words, this section addresses mercury previously discharged from mercury-contaminated mine sites that has accumulated in areas upstream of, adjacent to, or in mercury-impaired reservoirs ("downstream sites").

I.2.a. Overview of Goals and Phasing for Downstream Sites

The goal for remediation of mercury-contaminated downstream sites is restoration to a stable configuration that minimizes excessive erosion or deposition of mercury-contaminated mining waste and/or mercury-laden sediment by reasonable and feasible means. This goal only considers the benefits to mercury-impaired reservoirs. However, cleanup of downstream sites is expected to also have immediate local benefits in creeks and rivers. Accordingly, the Regional Water Boards may prioritize other downstream sites as high priority for cleanup to improve water quality for parameters other than mercury and in receiving waters (e.g., creeks and rivers) upstream of mercury-impaired reservoirs.

However, downstream sites are affected by upstream sites. Consequently, upstream mine sites should be remediated prior to remediating downstream sites. This phasing of remediation avoids re-contaminating downstream sites from upstream mercury sources. Therefore, the State Water Board should evaluate the timing for remediation of downstream sites in program review at the end of Phase 1 of implementation (see section 9.13.2). Concepts the State Water Board may consider for remediation of downstream sites are provided herein.

I.2.b. Overview of Mercury at Downstream Sites

Mercury contamination downstream of mine sites is widespread across California. Large amounts of mercury-contaminated mining waste from thousands of mines in California have contaminated and altered the configuration of many creeks.

Despite the court decision that banned hydraulic mining in 1884, it was common practice prior to enactment of the Clean Water Act in the early 1970s for mines to dispose of wastes by dumping them in or near creeks. The purpose was to minimize mine expenses; wastes would be transported offsite and downstream by winter flows at no cost to the mines.

This common practice worked well at dump sites with steep slopes and occasional large winter storms, such as at New Almaden, where calcines (processed mercury ore) from the Hacienda Furnace Yard were disposed in Alamitos Creek. As a result, many miles of Alamitos Creek are highly contaminated by mercury (SFBRWQCB 2008b). Like Alamitos, many other creeks in California are contaminated by mercury from mining. Often, mercury concentrations decrease with distance downstream, due to natural creek sediment transport processes and consequent mixing with uncontaminated sediment. In other words, downstream sites typically contain a mix of native soil and mining wastes.

Similarity to dredging

As described in section 9.10, there are many types of projects unrelated to mercury that happen to occur in mercury-contaminated floodplains and creeks; for example, dredging of sediments to deepen rivers or reservoirs; excavating sediments for bridge pier construction or repair; and placement of sediments for watercourse crossings. The Water Boards will pursue a similar approach for downstream sites as they pursue for dredging. They will use the same regulatory authorities and impose similar requirements. Both dredging and downstream projects need to be designed for channel stability; to implement measures during construction to minimize erosion; and to monitor and report on the performance—over time—of the design in attaining a stable channel form; i.e., the same measures required for any project subject to Clean Water Act section 401 certifications.

In addition, existing reservoirs may act as settling basins. Dredging projects to improve the water storage capacity of some of these reservoirs—particularly small-water-volume reservoirs in catchments with high sediment yields (see section 7.6.2 in Chapter 7)—might also improve their sediment trapping capacity and prevent some contaminated sediment from being transported to downstream rivers and reservoirs. (See section 9.10 for the implementation plan for use, dredging, and disposal of mercury-contaminated sediments from reservoirs and other dredging projects.)

However, some creek and river channels with highly contaminated sediments may not be feasible to remediate. Removing mercury from river channels with contaminated sediment by constructing settling basins or dredging is expected to be highly expensive and to have substantial potential for negative environmental impacts. It may be necessary in some channels to rely on natural erosion to eventually remove the mercury. Such sites should be identified in prioritization reports.

I.2.c. Recommended Goals and Phasing for Downstream Sites

The recommended goal for remediation of mercury-contaminated downstream sites is restoration to a stable configuration that minimizes excessive erosion or deposition of mercury-contaminated mining waste and/or mercury-laden sediment by reasonable and feasible means. Achieving this goal is expected to significantly reduce loads of mercury-laden sediment from unstable, contaminated creeks and thereby reduce mercury inputs to reservoirs. The load allocations in Table 8.1 for downstream sites will be implemented as management practices and are not cleanup standards; site-specific mercury concentration or other cleanup standards will be established as necessary and appropriate, typically on a site-specific basis. Similarly, removal or cleanup of non-soil wastes such as mercury-contaminated machinery and visible elemental mercury will be addressed as necessary in permits and cleanup orders.

Recommended phasing of remediation should account for the fact that downstream sites are affected by upstream sites. Consequently, upstream mine sites should be remediated prior to remediating downstream sites. This phasing avoids re-contaminating downstream sites from upstream mercury sources. Therefore, the State Water Board should evaluate the phasing for remediation of downstream sites during program review at the end of Phase 1 of implementation (see section 9.13.2). The State Water Board should begin the evaluation with an assessment of progress made in remediating mine sites described in section 9.2.

Additionally, remediation of downstream sites will be phased (i.e., prioritized) by distance from the reservoir and degree of contamination, as described by the four tiers in Table I.1 (next page). The phasing focuses first on areas with “significant discharges of mercury” (see definition in Table I.1). Highly contaminated sites closest to reservoirs will be assigned highest priority (Tier 1) for remediation, because they have a greater effect on reservoir sediment mercury concentrations. Priority decreases with lesser degree of contamination and greater distance from reservoirs. Priority decreases because these sites generally have less effect on reservoir sediment mercury concentrations because the greater distance corresponds to a larger watershed area with a greater proportion of sediment from native soils uncontaminated by mines. Consequently, these less contaminated and more distant sites are assigned lower priority (Tiers 2–4) for remediation.

Tiers for Downstream Site Prioritization

Tier 1 sites are those sites that may possibly result in timely and measurable reductions in reservoir bottom sediment mercury concentrations. Water Board staff hypothesize that Tier 1 sites are located within a relatively short distance of the reservoir (1 km upstream of reservoir high water) and discharge either elemental mercury or high concentrations of mercury (i.e., concentrations greater than ten times the allocation for geology surrounding mine sites, see Table I.1.)

Importantly, conditions farther than 1 km upstream should also be evaluated. If areas farther upstream also have significant discharges of mercury, and mercury from these discharges is accumulating in a potential Tier 1 site, then this potential site should not be remediated until after the upstream areas are remediated.

Table I.1 – Downstream Site Prioritization

Tier	Creeks Tributary to Mercury-Impaired Reservoir
1	Sites with significant discharges of mercury within 1 km upstream of the reservoir
2	Sites with significant discharges of mercury between 1 to 10 km upstream of the reservoir
3	Less significant discharges of mercury and/or less significant erosion of mercury-contaminated mining waste into creeks tributary to the reservoir
4	Average mercury concentration less than twice the allocation in erodible soil or sediment

Notes:

"Significant discharges of mercury" is defined as where average mercury concentration in discharge of mining wastes is greater than 3 mg/kg from mercury mine sites or 1 mg/kg from non-mercury mine sites (i.e., greater than ten times the allocation for geology surrounding mine sites), or elemental mercury is present and being discharged or is likely to discharge.

"Less significant discharges of mercury" is defined as average mercury concentration in discharge of mining wastes is between 0.6 to 3 mg/kg from mercury mine sites or between 0.2 to 1 mg/kg from non-mercury mine sites (i.e., two to ten times the allocation for geology surrounding mine sites).

Distance from reservoir is measured from reservoir high water mark.

Tier 2 sites are those sites that may possibly result in measurable reductions in reservoir bottom sediment mercury concentrations. Water Board staff hypothesizes that Tier 2 sites are located farther upstream of the reservoir (1 to 10 km upstream of reservoir high water) and have significant discharges of mercury. Staff also hypothesizes that it will take a longer duration of time for Tier 2 than for Tier 1 sites for measurable reductions in reservoir bottom sediment mercury concentrations to occur.

Water Board staff hypothesize that remediation of sites farther upstream or with lower concentrations of mercury in their discharges, i.e., Tier 3 and 4 sites, may not result in measurable reductions in reservoir bottom sediment mercury concentrations. No action should be required at Tier 3 sites to conserve resources to remediate countless higher-priority mine and downstream sites for mercury and other metals in California. No action should be required at Tier 4 sites because remediation would have little if any effect on reservoir sediment mercury concentrations.

I.2.d. Regulatory Authority and Approach for Downstream Sites

The Water Boards plan to use its California Water Code authority, and as applicable its federal Clean Water Act section 401 authority, for remediation of downstream sites. The Water Boards have authority to compel cleanup of waste discharges (Wat. Code, § 13304) and to issue general or individual waste discharge permits (Wat. Code, § 13260 et seq.) and Clean Water Act section 401 certifications.

I.2.e. Responsible Parties for Downstream Sites

Responsible parties under the Reservoir Mercury Control Program are defined as follows (in accordance with Wat. Code, § 13304, subd. (a)):

> Any person…who has caused or permitted, causes or permits, or threatens to cause or permit any waste to be discharged or deposited where it is, or probably will be, discharged into the waters of the state and creates, or threatens to create, a condition of pollution or nuisance, will upon order of the regional board, clean up the waste or abate the effects of the waste, or, in the case of threatened pollution or nuisance, take other necessary remedial action, including, but not limited to, overseeing cleanup and abatement efforts.

Responsible parties include, but are not limited to, current creek and creekside property owners, public agencies with easements in floodplains and creeks, current mine site property owners, and prior mine owners and/or operators. The State or Regional Water Boards may elect to compel current property owners and public agencies that have easements to undertake site remediation. In turn, these landowners and agencies may pursue cost recovery or other arrangements with other responsible parties.

Creekside property owners not undertaking implementation actions themselves have the following responsibilities: provide reasonable access to the floodplain or creek for site studies before construction; access for construction; access for post-construction monitoring, which may occur periodically for several years; and to not take actions on their property that worsen the discharge of mercury-laden sediment or mercury-contaminated mining waste into the creek.

Voluntary, cooperative, grant-funded remediation and habitat restoration

On occasion, downstream site remediation occurs on a voluntary basis, may be partly supported by grant funding, and includes extensive habitat restoration. For this, the State Water Board encourages a cooperative effort among state and federal land managers and creekside property owners to undertake comprehensive creek and floodplain remediation and habitat restoration projects. Such comprehensive partnership projects include the following: (1) remove, stabilize, or other method to reduce erosion of mercury-contaminated sediments; and (2) restore habitat in floodplains and creeks. Typically, cooperation would be undertaken on properties under partner jurisdiction or on property partners own or for which they have easements.

Role of watershed groups

Watershed groups who are not responsible parties nonetheless can help the State Water Board or public agencies identify, prioritize, and implement creek remediation, restoration, and stabilization projects. In addition, watershed groups and public and private landowners can work together to implement management practices for erosion control, and thereby reduce discharges of inorganic mercury.

I.2.f. Requirements and Implementation Actions for Downstream Sites

Existing Requirements

The Porter–Cologne Water Quality Control Act gives the Water Boards the authority to require responsible parties to clean up and abate wastes that cause or threaten to cause pollution. Even in the absence of the Reservoir Mercury Control Program, responsible parties are answerable for pollutant discharges from downstream sites. The Water Boards issue about a thousand Clean Water Act section 401 certifications annually in California. As described previously in section I.2 (see section I.2.b, Similarity to dredging), the Reservoir Mercury Control Program relies on the same measures required for any project subject to Clean Water Act section 401 certifications. These measures are considered baseline requirements for the purposes of the Reservoir Mercury Control Program. In this context, the Reservoir Mercury Control Program will not pose greater economic costs or environmental impacts to address mercury discharges from downstream sites, but these costs and impacts may occur sooner than without the Reservoir Mercury Control Program.

Downstream Site Prioritization

As with mine sites (see section 9.2.4), staff considered and recommends different prioritization approaches for downstream sites on private lands from those on public lands or where public agencies hold easements, and may combine remediation tasks for mines (see section 9.2.4) with remediation tasks for mining waste downstream. For downstream sites on private property, the Regional Water Boards plan to identify and prioritize sites and encourage responsible parties to obtain grant funding and voluntarily conduct remediation. For downstream sites on public lands or where public agencies hold easements, public agencies including the USEPA are encouraged to undertake site prioritization and remediation voluntarily and via a coordinated, inter-agency effort. For both private and public sites, where necessary, the State Water Board plans to compel responsible parties to undertake site remediation.

Public Lands and Easements: Downstream Site Prioritization

Many public agencies own lands or have easements on privately-owned parcels that contain creeks and floodplains that discharge mercury-contaminated mining waste and sediment. Such public agencies include but are not limited to the federal Bureau of Land Management and Forest Service; California Departments of Parks and Recreation, Fish and Wildlife, and Forestry and Fire Protection; and county and municipal water and flood control agencies. Further, the USEPA could use its Superfund and other authorities to initiate such investigation and remediation, and cause the other relevant federal agencies to assume their responsibilities for remediating their lands.

State and federal land management agencies and other agencies with easements or ownership of floodplains and/or creeks ("public agencies") will be encouraged in the future to undertake the following tasks voluntarily, either individually or in a coordinated, inter-agency effort. However, if necessary, at some future date the State Water Board may compel public agencies to undertake these tasks. The State Water Board may use Water Code section 13267's investigation and reporting requirement or other authority to compel non-compliant public agencies to cooperate in this effort.

Sequence of Tasks

The following are a sequence of tasks to identify, prioritize, and cleanup downstream sites, to be conducted on a schedule determined by the State Water Board in the future during program review.

Task 1: Develop a plan and schedule to identify and prioritize downstream sites in accordance with the downstream site prioritization tiers in Table I.1.

Task 2: Submit downstream site prioritization report(s) for review and approval by the applicable Regional Water Board. The prioritization reports should include schedules for submitting site investigation plans and subsequent remediation plans.

Task 3: For Tier 1 sites, complete site investigation plans and submit them for review and approval by the applicable Regional Water Board.

Task 4: For Tier 1 sites, develop site remediation and long term operations, maintenance, and monitoring plans and submit them for review and approval by the applicable Regional Water Board.

Task 5: For Tier 1 sites, implement site remediation plans and submit a completion report to the applicable Regional Water Board.

Task 6: For Tier 1 sites, implement long term operations, maintenance, and monitoring plans and report periodically to the applicable Regional Water Board.

Task 7: Water Boards to direct when to undertake tasks 3–6 for lower tier sites.

Site Investigations

Downstream site investigations should evaluate the potential for mercury to be discharged into surface waters. Discharge of both sediment-bound mercury and mercury not attached to sediment (typically elemental mercury) should be evaluated. Discharge of sediment-bound mercury typically results from high flows resulting from storms or snow melt that erode creek banks, bottoms, and floodplains. The median mercury concentration in downstream site sediments should be determined by comparing characterized median total mercury in fines, i.e., sediments passing 62.5 micron sieve to the applicable load allocation. Sieving may not be needed if mining waste and soil are shown to consist primarily of fines.

Remediation Plans

Remediation plans should specify erosion and sediment controls designed to minimize or prevent the discharge of mercury-contaminated sediments. Best conventional pollutant control technology for erosion and sediment controls are discussed in "Implementation Actions" in the next section. The plans should also describe best management practices to minimize and prevent the discharge of mercury not attached to sediment.

Implementation Actions

The actions required to achieve the goal for downstream sites will vary from simpler creekbank stabilization actions to complex remediation and habitat restoration projects depending on site-specific conditions. (The goal is restoration to a stable configuration that minimizes excessive erosion or deposition of mercury-contaminated mining waste and/or mercury-laden sediment by reasonable and feasible means.) Site remediation may also need to address other goals not related to mercury in reservoirs, such as providing flood protection or meeting a site-specific cleanup goal (i.e., mercury concentration in surface soil).

Some creekbank stabilization projects are relatively simple to implement, making them a reasonable and feasible means to remediate many downstream sites. These types of projects may include actions such as the following to stabilize previously straightened channels with undercut banks:

- Investigate the extent of mercury-contaminated sediments;
- Re-contour the creek channel to increase sinuosity, make the banks less steep, and connect channel to floodplain (earth-moving equipment to cut-and-fill, and compact fill, without offsite disposal or imported soils);
- Use bioengineering techniques to reduce erosion of graded areas;
    - Plant creekbanks, floodplains, and riparian areas with native vegetation; and
    - Install boulders and root wads as needed to stabilize bank toe and provide fish habitat.

At the other end of the spectrum, implementation of more complex remediation and habitat restoration projects may be necessary to remediate some downstream sites. These projects are reasonable and feasible to implement, and may include actions such as the following to stabilize previously straightened channels with undercut banks:

- Investigate the extent of mercury-contaminated sediments;
- Excavate mercury-contaminated sediments, transport, and dispose at an appropriate disposal facility (earth-moving equipment to excavate and transport);
- Re-contour the creek channel and floodplain to reduce flow velocity and scour (earth-moving equipment to cut-and-fill, and compact fill, with imported soils);
    - Construct detention basins; restore appropriate sinuosity; make the banks less steep; connect channel to floodplain;
- Use bioengineering techniques to reduce erosion of graded areas;

- Install geotextile materials;
- Plant creekbanks, floodplains, and riparian areas with native vegetation; and
- Install boulders and root wads as needed to stabilize bank toe and provide fish habitat.

I.2.g. Tracking, Reporting, and Monitoring for Downstream Sites

A public agency work group (e.g., CAMLAG, see section I.1.a) or the State Water Board could compile, maintain, and publish a list and map of public and private downstream sites. The tracking could include the dates that plans, reports, and remediation projects are due to be completed for each downstream site, and be made available on a public agency website to track progress of remediation for downstream sites.

Cleanup orders (or voluntary, written commitments) for sites downstream from mine sites that discharge mercury-contaminated mining waste or mercury-laden sediment will require responsible parties to develop plans and conduct post-construction maintenance, monitoring, and reporting, and to submit monitoring reports annually for at least five years. The purpose of this maintenance and monitoring is to ensure that downstream site actions continue to perform effectively, and if not, to determine why not, and to fix the problem.

In most cases, monitoring is expected to consist of visual assessment of the downstream site for evidence of erosion and plant growth and survival, and field measurements of the channel (cross-sections and profiles of the channel, floodplain, and terraces). Consequently, most reporting will likely consist of a short narrative, photo documentation, and graphic of channel dimensions to show design channel compared to then-current channel based on field measurements.

Downstream Creek Erosion Control Monitoring

Monitoring plans will be required to address the following questions regarding the effectiveness of restoration to a stable configuration that minimizes excessive erosion or deposition of mercury-contaminated mining waste and/or mercury-laden sediment:

1a. What is the design level of performance?
1b. Are the erosion control measures performing at least as well as designed?

2a. If not, why not?
2b. What is necessary to improve performance to the design level?

Suggested components for monitoring plans to address downstream creek questions are provided in section 9.9 of the Guadalupe River Watershed Mercury TMDL Staff Report (SFBRWQCB 2008b), and provided in section 10.1.

Monitoring Reports for Downstream from Mine Sites

Responsible parties may be required to submit erosion control effectiveness monitoring reports to the Executive Officer of the applicable Regional Water Board annually for at least five years.

Frequency of reporting may be reduced upon receipt of written approval of the Executive Officer of the applicable Regional Water Board. These reports will describe observations related to stormwater and erosion, and any additional measures are needed for creek projects to increase floodplain, creek bank, or creek bed stability or improve vegetation survival. If additional measures are needed, the responsible parties will propose additional measures in their annual reports. Construction of additional measures in floodplain, creek bank, or creek bed is subject to review and written approval of the Executive Officer of the applicable Regional Water Board.

I.3 Atmospheric Deposition

This section provides supporting information for the implementation plan for atmospheric deposition to California.

I.3.a. Goals and Phasing for Atmospheric Deposition

As described in section 9.4, the primary goal for Phase 1 is to determine whether there is a trend of increasing or decreasing atmospheric deposition during Phase 1. Not knowing the trend could confound interpretation of reservoir pilot test results. Secondary goals for Phase 1 are to monitor and model atmospheric deposition of mercury in California and assess whether load allocations for California and global anthropogenic sources are likely to be attained by the end of Phase 2. The goal for Phase 2 is to attain the allocations for anthropogenic sources. These goals reflect the fact that atmospheric deposition of mercury from natural sources is not controllable.

This appendix addresses the secondary goals for Phase 1. To satisfy these goals, California Air Resources Board (CARB) and USEPA or other organizations may coordinate to monitor and model atmospheric deposition. The model results could then be assessed as to whether allocations for atmospheric deposition attributed to anthropogenic sources are or are not likely to be attained.

I.3.b. Atmospheric Deposition Questions

Monitoring and modelling of atmospheric deposition of mercury is needed to answer several questions, as follows.

Question 1a. Have some local emissions already decreased?
Question 1b. Have fish methylmercury levels decreased as a consequence of lower local emissions?

Additional monitoring and modelling of atmospheric deposition is needed to confirm or refute the prediction of decreased atmospheric deposition at several reservoirs due to reductions in California anthropogenic emissions. The source assessment (Chapter 6) indicates there are three 303(d)-listed reservoirs where (a) atmospheric deposition from local industrial mercury emissions is the primary anthropogenic source, and (b) local industrial mercury emissions greatly decreased between 2001 and 2008.

USEPA's Regional Modeling System for Aerosols and Deposition (REMSAD model, see Chapter 6) attributes more than half of 2001 atmospheric deposition to California anthropogenic emissions to El Dorado Park Lakes (83%), Indian Valley Reservoir (57%), and Puddingstone Reservoir (53%) (section 6.4.4). Mercury emissions from the City of Long Beach Southeast Resource Recovery Facility (SERRF) decreased between 2001 and 2008 by 87% (section 6.4.4 and Table D.1); the REMSAD model estimates that this facility contributed 50% of atmospheric deposition to the Los Angeles Area in 2001, which includes both El Dorado Park Lakes and Puddingstone Reservoir (Table 6.8). Reported mercury emissions from Units 13 and 16 of The Geysers geothermal power plant decreased by more than 99% between 2001 and 2008 (Table H.3); REMSAD estimates that these units contributed 70% of atmospheric deposition to nearby areas in 2001, including Indian Valley Reservoir (Table 6.8).

If these reductions in mercury emissions have been sustained since 2008, then atmospheric deposition modelling comparable to the REMSAD modelling for 2001 conditions, field measurements of atmospheric deposition, and fish methylmercury sampling, should be conducted at these reservoirs to resolve question 1. For other reasons, the Water Boards already have conducted recent fish methylmercury sampling at Puddingstone Reservoir, the data are available in California Environmental Data Exchange Network (CEDEN, www.ceden.org), and it appears that in 2013 the sport fish target was met. Field measurements of atmospheric deposition in the Los Angeles area and near The Geysers would be useful to verify the results of updated modelling (also see question 2). Fish methylmercury data subsequent to 2013 would be useful to evaluate whether the sport fish target is maintained in Puddingstone Reservoir, and if not, to help determine if other actions are necessary for these reservoirs to achieve and maintain the sport fish target.

Also if these reductions in mercury emissions have been sustained since 2008, for modelling and monitoring of atmospheric deposition in the vicinity of these reservoirs, the Water Boards recommend that USEPA, CARB, and other researchers (e.g., USGS) work together. Both USEPA Region 9 Laboratory and USGS Mercury Research Laboratory have mobile atmospheric mercury sampling and analysis equipment. For monitoring of fish methylmercury levels, the Water Boards proposes that its SWAMP BOG program work together with California Department of Fish and Wildlife (DFW), USEPA, and the reservoir owners and operators. Ideally, the atmospheric deposition and fish methylmercury monitoring should be completed by year 8 of Phase 1 of implementation, and the modelling and assessment by year 10, to allow for results to be evaluated during the adaptive management review planned at the end of Phase 1. See question 2 for additional proposals regarding modelling of atmospheric deposition in California.

Question 2. What is progress towards meeting the statewide load allocations?

Water Board staff recommends that progress towards and ultimate compliance with the statewide load allocations for atmospheric deposition be determined using the USEPA's REMSAD model, updated to reflect any changes in California and global emissions, or other comparable atmospheric deposition model. Modelling of atmospheric mercury deposition is needed to assess whether allocations to anthropogenic sources are already attained, or will soon be attained, or if a new plan is needed to further reduce mercury emissions. The modelling and assessment should be completed by year 8 of Phase 1 of implementation to allow for results to be evaluated during the adaptive management review planned at the end of Phase 1. The Water Boards recommend that CARB and USEPA conduct this modelling.

Question 3. Are there other atmospheric deposition data available?

Additional field measurements of atmospheric deposition in all regions of California would be useful to assess deposition trends and verify the results of updated modelling conducted to address question 2. As shown in Figure 6.16, no monitoring data are available for large portions of California (i.e., northern inland California, northern and central Sierra Nevada, and southeastern California). In addition, as reviewed in Chapter 7 and Appendix H, substantial decreases in California anthropogenic emissions are expected as current and planned rules and control programs are implemented. However, mercury emissions from Asia and Africa are expected to increase substantially if recent emission trends continue. Finally, as described in section 7.7.5, present and past atmospheric conditions may no longer be a reliable guide to the future due to global climate change. Consequently, atmospheric deposition patterns in the future are not expected to reflect past deposition patterns. This highlights the need for additional monitoring at previously monitored locations and at new locations.

For acquisition of additional data, Water Board staff recommends coordination between local agencies and mercury researchers such as the local air districts, CARB, USGS Mercury Research Laboratory, and USEPA Region 9 Laboratory. Afterward, Water Board staff proposes performing a review of the scientific literature to glean data generated since the development of this report. (Any data generated from answering atmospheric deposition question 1 also would be included.) The collection and compilation of new monitoring data should be completed by year 6 of Phase 1 of implementation, to allow for results to be evaluated during the modelling assessment effort that should be completed by year 8 to address question 2, and the adaptive management review planned at the end of Phase 1.

I.3.c. Approaches for Monitoring, Modelling, and Assessing

One approach is for the Water Boards to encourage a coordinated program between CARB and USEPA to monitor, model, and assess atmospheric deposition of mercury to California. (Other approaches could also be developed and taken, if necessary.) The Water Boards could encourage CARB and USEPA to negotiate a Memorandum of Agreement (MOA) to address mercury from atmospheric deposition. In any case, the first step would be to develop a plan that identifies methods and parties responsible to evaluate changes in deposition patterns in California associated with local and global anthropogenic emissions.

The evaluation may include a review of published literature, assessment of California and global emission inventories, review of monitoring data from existing Mercury Deposition Network stations, collection of additional monitoring data from previous and new locations, and deposition modelling. Presently, there are three long-term monitoring sites in California for the national Mercury Deposition Network. Although these are very few sites for such a large and greatly varied land area, California has a lesser need than other states for monitoring sites because it receives relatively low mercury deposition. Additionally, the REMSAD model, or equivalent model that “tags” emission sources, should be updated to reflect emission changes since 2001. (USEPA's REMSAD model output for 2001 was used in the source assessment in Chapter 6.)

In addition, the MOA should specify methods and parties responsible to track progress towards achieving the goals for atmospheric deposition. The MOA also should outline the potential steps to identify and implement additional mercury controls for California emissions and/or additional national and international actions (a) if the assessment indicates the load allocations likely will not be achieved by the end of Phase 2, or (b) if new deposition hotspots affecting reservoirs are observed in California.

Monitoring, Tracking, and Reporting for Atmospheric Deposition

Monitoring and modelling of atmospheric deposition of mercury could be used to assess whether allocations for anthropogenic sources are already attained, or will soon be attained, or if a new plan is needed to further reduce emissions of mercury. The assessment should be completed by year 10 so that results can be evaluated during program review at the conclusion of Phase 1 of implementation (see section 9.13.2). CARB could take the lead in making monitoring results, reports, and plans available to the public.

Recent CARB and USEPA programs designed to reduce greenhouse gas emissions may also reduce mercury emissions. These recent programs should be fully implemented by 2020. USEPA and CARB should evaluate whether these greenhouse gas emissions programs caused changes in statewide mercury emissions, as part of assessing progress towards meeting the load allocation. In addition, USEPA should update the REMSAD model to incorporate updated emission inventories, including nonpoint sources, which are likely important in some areas of California.

USEPA and CARB could evaluate changes in regional emissions that contribute to California emissions hotspots. The USEPA REMSAD 2001 model run identified 18 hotspots in California where California anthropogenic emissions may account for 20% or more of all 2001 deposition (section 6.4.4). Emissions in all but three of the hotspots substantially decreased since 2001. CARB and USEPA could use future emission inventories and the REMSAD model (or a higher resolution model) to assess regional emissions and associated deposition in these three and other hotspot areas. If emissions that contribute to making the hotspots do not decrease, then the Water Boards and CARB should consider the development of regional load allocations for atmospheric deposition in program review.