ALAMEDA CREEK INSTREAM FLOW AND HABITAT ASSESSMENT
WY2009 SAMPLING AND ANALYSIS PLAN

Prepared for:

Alameda Creek Fisheries Restoration Workgroup

Flows Subcommittee

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INTRODUCTION

The Alameda Creek Sampling and Analytical Plan will be a fundamental step toward implementation of a Memorandum of Understanding (MOU) developed and executed in 2007 to support restoration of steelhead trout to the Alameda Creek watershed.[1] The goal of the MOU is to design and conduct studies for estimating the magnitude, timing, duration, frequency, and location of streamflows necessary to restore steelhead fisheries while minimizing the impacts to water supply operations. The Alameda Creek Fisheries Restoration Workgroup Flows Subcommittee finalized the *Alameda Creek Population Recovery Strategies and Instream Flow Assessment for Steelhead Trout* in January 2008. The Alameda Creek Sampling and Analytical Plan for WY2009 is the first step toward implementing a basin-wide recovery strategy. Upper Alameda Creek was selected as the WY2009 pilot study site, with other locations in the Alameda Creek watershed to be evaluated in future water years (e.g., steelhead habitat quantification in the pivotal Niles Canyon mainstem). Implementation of this WY2009 plan (October 1, 2008 to September 30, 2009) will provide key information regarding habitat quality and quantity under variable streamflows for the Upper Alameda Creek watershed (upstream of the Arroyo de la Laguna confluence) so that MOU signatories can better understand how instream flows will influence anadromous salmonid and amphibian habitat.

The Alameda Creek Sampling and Analytical Plan for WY2009 is a distillation of numerous meetings and workshops held by the Alameda Creek Fisheries Restoration Workgroup Flows Subcommittee. The subcommittee’s objective was to take what is known about recommending instream flows, evaluate what has been attempted elsewhere, and then construct an instream flow strategy, methodology, and analytical framework that will best meet the unique needs of Upper Alameda Creek. Two technical workshops were held in summer 2008 to discuss, refine, and finalize components of the field sampling and assessment plan (Task 2). The first workshop was held July 23, 2008 to develop physical criteria for the field habitat mapping, discuss habitat mapping field methods, and do a mock analysis of Number of Good Days (refer to *Alameda Creek Population Recovery Strategies and Instream Flow Assessment Study Plan* (2008) for a description of this analytical tool).

The second technical workshop was held on August 8, 2008 with local hydrologists, biologists, and temperature modelers to plan construction of annual hydrographs and thermographs for regulated and unregulated conditions. This workshop reviewed available streamflow and water temperature monitoring data, reviewed available meteorological data, discussed methods to generate regulated and unregulated daily average annual hydrographs and thermographs, and discussed a temperature modeling approach to produce daily average and daily maximum temperatures for the study reaches.

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[1] Signatories to the MOU are Alameda County Flood Control and Water Conservation District, Alameda County Resource Conservation District, Alameda Creek Alliance, Alameda County Water District, California State Coastal Conservancy, East Bay Regional Park District, Natural Resources Defense Council, Pacific Gas and Electric Company, San Francisco Public Utilities Commission, and the Zone 7 Water Agency.

SAMPLING AND ANALYTICAL APPROACH

There are many steps, methodological and analytical, that must be addressed before applying the Number of Good Days (NGD) approach to prescribing instream flows that will benefit steelhead populations in the Alameda Creek watershed. Steelhead reintroduction and population recovery will succeed if future management actions target multiple steelhead life history tactics, while balancing the habitat needs of other species. NGD can be a direct output of management activities and can be effectively monitored, recognizing that the actual purpose of management activities is for those good days to result in an abundant and healthy population.

One promising steelhead life history tactic is for adult steelhead to migrate through Niles Canyon and the Sunol Valley bottomland and spawn in the Upper Alameda Creek mainstem, with their progeny migrating to the ocean as smolts one or two years later. Adult steelhead spawning as far upstream as the base of Little Yosemite Canyon, and possibly farther upstream in wetter water years, will require adequate instream flows for successful adult spawning and juvenile rearing. This steelhead life history tactic was selected for the Flows Subcommittee's WY2009 pilot field study. Based on what is learned and accomplished in WY2009, other mainstem segments downstream of the San Antonio Creek confluence that are important to this life history tactic (and other tactics) also must be investigated (e.g., pre-smolt growth and migration through the Niles Canyon mainstem reach). Other promising life history tactics elsewhere in Alameda Creek watershed will likely be considered for assessment in WY2010.

The ultimate management goal for this Upper Alameda Creek steelhead life history tactic will be to produce a size class distribution of smolts and pre-smolts leaving Upper Alameda Creek that is capable of self-sustaining annual adult steelhead runs. An important component of the WY2009 study will be to characterize the streamflows necessary for steelhead spawning and rearing in the Upper Alameda Creek mainstem. Chinook spawning and fry rearing habitat (in the habitat mapping criteria, 'fry' habitat will apply to early Chinook fry and steelhead fry) will be incorporated into the steelhead habitat mapping planned without requiring additional resources. Habitat – streamflow quantification for benthic macroinvertebrates and selected amphibians will require additional fieldwork in WY2009, but will be necessary for considering instream flows from a stream ecosystem perspective.

This WY2009 Sampling and Analytical Plan will estimate Number of Good Days (NGD) and Number of Good Years (NGY) from WY1995 through WY2008 for regulated and unregulated annual flow regimes for multiple life stages of steelhead and amphibians, as well as for productive macroinvertebrate riffle habitat. Additional years may be analyzed if data are available or can be reasonably estimated. These annual NGD and NGY estimates will provide the basis for comparing different proposals for instream flow releases. This WY2009 Sampling and Analytical Plan is organized into four tasks:

TASK 1: Basemap Construction of Mainstem Study Sites

TASK 2: Habitat Mapping and Riffle Depth Surveying

TASK 3: Analysis of Number of Good Days and Progress Report

TASK 4: Project Management and Meetings.

Once adopted and funded by the Fisheries Workgroup, this WY2009 sampling and analysis plan will be implemented. Fieldwork should be completed by June 2009 and a draft technical memorandum on the fieldwork and findings completed by early-September. Following a comment period on the draft, a final would be due in late-October.

Task 1. Basemap Construction of Mainstem Study Reaches

Three mainstem channel reaches in Upper Alameda Creek were recommended by the Flows Subcommittee for the WY2009 instream flow study (Figure 1). To do habitat mapping, each study reach will require a high quality basemap created from low altitude aerial photography.

Diversion Dam Study Reach

This 2,000 ft mainstem reach (STN 1465+00 ft downstream to STN 1445+00 ft) comprises one complete alluvial flat along the longitudinal channel profile from the Diversion Dam (STN 1505+00 ft) downstream to the top of Little Yosemite Canyon (STN 1372+00 ft). An alluvial flat is formed where constricting valley walls function as a hydraulic control that promotes extensive coarse sediment deposition immediately upstream. Several similar flats can be observed from the road paralleling this mainstem reach.

These alluvial flats have distinctly lower gradients than the overall longitudinal channel profile. Each alluvial flat is sufficiently long to include several meander bends with multiple riffle/pool sequences. Low summer streamflows in dry years go subsurface in this reach. However, at the valley wall constriction downstream, this shallow subsurface flow returns to the channelbed surface to sustain at least one pool and wet one riffle. These isolated habitat units provide the opportunity for 0+ and 1+ juvenile steelhead to survive and grow through the low summer baseflow period until autumn rains arrive. A threshold streamflow that will maintain connectivity between habitat units may be important for identifying those water years capable of keeping 0+ and 1+ juvenile steelhead habitat capacity high. Juvenile rearing habitat in the Diversion Dam Reach may always have been restricted to isolated pools by mid-summer following all but the wettest springs and/or early summers.

Alameda Grove Study Reach

This 1,550 ft mainstem reach (STN 1301+00 ft downstream to STN 1285+50 ft) begins 600 ft downstream of the Camp Ohlone Road Bridge in Alameda Grove of Sunol Regional Park. The study site is comprised of four meander bends that include deep pools, broad runs, and coarse riffles. Over-summer juvenile steelhead rearing in this segment of the mainstem channel will be critical to sustaining an Upper Alameda Creek life history tactic.

Sunol Mainstem Study Reach

This 1,600 ft mainstem reach (STN 1131+50 ft to STN 1115+50 ft) begins 250 ft downstream of the Sunol Water Treatment Plant Bridge and ends where the mainstem splits at the head of the sycamore floodplain. This mainstem channel is wide and shallow, with long runs, low gradient cobble riffles, and an occasional pool. This reach likely provided relatively limited juvenile rearing habitat that lasted through the summer (compared to juvenile habitat in mainstem reaches farther upstream), but likely provided good rearing habitat during smolt and pre-smolt downstream migration from late-winter into early-summer. Chinook salmon are more likely to spawn in this reach than steelhead (they tend to migrate higher into watersheds), but upstream/downstream adult access will be necessary for both anadromous species.

Basemaps for the habitat mapping will be constructed by geo-referencing aerial photographs of the three mainstem study reaches using a digital camera mounted to a ground-controlled helium balloon. Control points on the ground will be installed and surveyed with a total station prior to the balloon photography to establish horizontal coordinates necessary to correct distortion (rubbersheet) in the balloon photographs. Habitat mapping basemaps will have a scale of 1 inch = 10 ft, and laminated versions (11x17 inch format) will be created for use in the field. Balloon photographs will be taken following the autumn leaf drop of alders and willows in December 2008.

M&T Level of Effort:

- 46 hrs G. Hales/F. Meyer/B. Powell for total station surveying of control points
- 42 hrs B. Powell; 34 hrs G. Hales/F. Meyer; balloon photography of the 3 mainstem study sites
- 80 hrs geo-referencing the photographs and production of laminated basemaps ready for habitat mapping 6 streamflows in 3 study sites

Agency Level of Effort:

- SFPUC staff assisting on site access and field assistance

M&T Cost Estimate: $33,936

Task 2: Habitat Mapping and Anadromous Fish Passage Fieldwork

Habitat availability as a function of streamflow in the mainstem of Upper Alameda Creek will be estimated using habitat mapping (refer to *Alameda Creek Population Recovery Strategies and Instream Flow Assessment for Steelhead Trout* (2008) for more detailed description). The following species and life stages will be habitat mapped: (1) salmonid fry, (2) juvenile steelhead 1+ and 2+, (3) Foothill yellow-legged frog and California red legged frog breeding and tadpole, (4) adult Chinook and steelhead spawning, and (5) benthic macroinvertebrates in riffles. Streamflows will be mapped based on availability from mid-December 2008 through June 2009. Six streamflows will be targeted for habitat mapping: 5, 10, 20, 30, 50, and 80 cfs.

Task 2.1. Assemble and Calibrate Habitat Mapping Teams

A core habitat mapping team must be available to rapidly deploy when streamflows targeted for habitat mapping and thalweg measuring occur. Pete Alexander (EBRPD), Scott Chenue (SFPUC), Darren Mierau (M&T), and Bill Trush (M&T) will comprise this core team. At least two of these mappers, though preferably three, would be present at all mapping events. The entire core crew must meet with amphibian and steelhead experts in the field to finalize physical habitat preferences, participate in preliminary polygon mapping for calibration, and map the first few streamflows together. The core team concept requires that Scott Chenue and Pete Alexander receive approval from their respective agencies to make their participation a professional priority.

An auxiliary team comprised of agency biologists and local experts will be assembled to assist core team members. Auxiliary members will be encouraged to attend the field calibration session. The ideal crew size is three core team members actively engaged in the mapping and 1 to 3 auxiliary team members observing and assisting. Auxiliary team efforts will be funded by the sponsoring agency (i.e., not included in this cost estimate).

M&T Level of Effort:

- 40 hrs M. Mierau/B. Trush for planning/leading calibration workshop

Agency Level of Effort:

- Scott Chenue and Pete Alexander as core team members will attend the 2-day calibration workshop
- Agency biologists participating as auxiliary team members will attend 2-day field calibration workshop

M&T Cost Estimate: $9,755

Task 2.2. Survey Cross Sections for Spawning Habitat Assessment

Five good Chinook/steelhead spawning locations in Upper Alameda Creek up to the base of Little Yosemite Canyon will be surveyed to assess spawning risk (as discussed in *Alameda Creek Population Recovery Strategies and Instream Flow Assessment for Steelhead Trout* (2008)). Each cross section will monitored during the WY2009 habitat mapping to develop a streamflow rating curve and a corresponding habitat rating curve, as well as monitoring channelbed mobility.

M&T Level of Effort:

- 20 hrs fieldwork B. Powell/M. Mierau/B. Trush

Agency Level of Effort:

- Agency onsite approval of cross section locations

M&T Cost Estimate: $6,510

Task 2.3. Field Habitat Mapping of the Three Mainstem Study Reaches

Responding to winter and spring streamflow events in Upper Alameda Creek, the core habitat mapping team and auxiliary team members will map habitat on the three mainstem study sites and five cross-section locations at six streamflows ranging from 5 cfs to 80 cfs. Monumented photopoints will be installed for repeat photos (at each mapped streamflow) and panoramic photographs will be taken at these selected locations to show other interested parties unable to participate in the fieldwork. Streamflow will be measured during each mapping event. Each study reach will require up to one field day of habitat mapping for each streamflow. Details of the habitat mapping procedure are provided in *Alameda Creek Population Recovery Strategies and Instream Flow Assessment for Steelhead Trout* (2008).

M&T Level of Effort:

- 270 hrs fieldwork B. Powell/M. Mierau/B. Trush

Agency Level of Effort:

- Core team members P. Alexander and S. Chenue participation to greatest extent feasible for the 6 targeted streamflows and calibration field meeting
- Unspecified participation of auxiliary team members

M&T Cost Estimate: $54,949

Task 2.4. Riffle Crest Thalweg Surveys in Sycamore Floodplain and Sunol Gravel Pit Mainstem Reaches and Field Assessment at Little Yosemite Canyon

The Flows Subcommittee agreed that a field assessment of upstream and downstream fish passage, as a function of surface streamflows, should compliment the mainstem habitat mapping. Trihey & Associates, Inc. (2003) document a sharp decline in baseflows beginning downstream of the USGS Gaging Sta. No.1173575 (at the Sunol Water Treatment Plant Bridge, STN 1134+00 ft). A steady 30 cfs streamflow in October 2001 at this USGS gage dropped to 22 cfs at the San Antonio Pumping Plant Road (STN 1056+00 ft), essentially the bottom of the Sycamore Floodplain mainstem reach, then down to a 12.5 cfs baseflow near the bottom of the Sunol Gravel Pit mainstem reach. No habitat mapping has been planned for the split mainstem channel in the Sycamore Floodplain reach during WY2009. Pending field observations in WY2009, this mainstem segment may warrant habitat quantification in the future.

Recent streamflow measurements by SFPUC staff at a variety of locations in the Sunol Valley during the spring 2008 5-day bench releases will provide better sub-reach estimates of existing conditions flow losses under steady-state conditions. Future flow losses in the reach may decrease once the gravel operators install cut-off walls between Alameda Creek and the gravel pits (as required by their new lease agreements with the SFPUC).

All riffle crest thalweg depths will be surveyed for 4 to 6 baseflows (ranging from 35 cfs down to 5 cfs) from the top of the Sycamore Floodplain mainstem reach (STN 1115+00 ft) downstream to the bottom of the Sunol Gravel Pit mainstem reach (STN 973+00 ft) to assess available passage for adult upstream/downstream migration, as well as for juvenile/smolt downstream migration. Each of the 6 field surveys will require two crew members for 1 field day. Streamflow will be recorded/measured at 4 locations: (1) the existing USGS gage at the Sunol Water Treatment Plant Bridge, (2) at the top of the Sycamore Floodplain mainstem reach, (3) at the bottom of the Sycamore Floodplain mainstem reach, and (4) at the bottom of the Sunol Gravel Pit mainstem reach.

A field visit, available to all concerned parties, prior to the thalweg surveys will identify thalweg riffle crest locations and other potential barriers (though not including the PG&E crossing, where a more detailed fish passage analysis is/will be required). This site visit will be coordinated with other field trips. Recommended locations will be mapped onto the existing aerial photographs and assigned river mile locations. Panoramic photographs, taken at each streamflow surveyed, will be repeated at 5 of these mainstem locations to document fish passage conditions for Flows Subcommittee members unable to participate in the fieldwork. The SFPUC has been assessing fish passage requirements in the reach. Thalweg profile and cross section surveys are proposed for the reach between Sunol Water Treatment Plant and the Arroyo de la Laguna confluence (T. Ramirez, pers comm). These studies and data will soon be released, and upon review, some field effort in this subtask may be adjusted to fill gaps (if any) with the SFPUC surveys and fish passage analysis.

The role of the mainstem channel downstream of the Diversion Dam but above Little Yosemite Canyon might play in sustaining a headwater life history tactic will depend on how frequently Little Yosemite Canyon can pass adult steelhead. While some investigators consider the canyon a complete barrier, others argue that high streamflows from mid-December through March might offer passage in wetter years. Without adult steelhead to observe, this uncertainty will prevail. The Flows Subcommittee has proposed to include this mainstem reach in the sampling plan, although no specific fish passage evaluation is being conducted in WY2009. A field trip during high sustained streamflows in Little Yosemite Canyon this winter would enable first-hand observation of potential passage conditions and better guide future actions.

M&T Level of Effort:

- 30 hrs fieldwork M. Mierau/B. Trush

Agency Level of Effort:

- Core team members P. Alexander and S. Chenue participation to greatest extent feasible for the 6 targeted streamflows and thalweg site selection during calibration field meeting
- Auxiliary team members participate as available, though will require one representative from NMFS and CDFG in thalweg site selection and a short-notice field trip to Little Yosemite Canyon during high streamflows

M&T Cost Estimate: $6,540

Task 3: Analysis of Number of Good Days

Two analytical strategies for evaluating instream flows are: (1) the number of good days (NGD) in a given year for a particular species and life stage and (2) the number of good years (NGY) for a particular species and life stage(s). Both acquire ecological significance through comparison to a reference condition, typically the ecological condition predicted under unregulated streamflows. Suppose juvenile 1+ steelhead would have experienced 80 good days of river rearing conditions (ample physical habitat, very favorable water temperatures, and abundant food) had streamflows been unregulated during the winter-spring hydrograph in WY2000, but actually experienced 10 good days in WY2000 under the actual present regulated streamflows. Only by contrasting 80 good days with 10 good days do we begin to recognize potential effects of regulated streamflows on juvenile steelhead rearing. This analysis becomes more powerful when we determine the Number of Good Years (NGY) over 30 or more water years rather than one. Then we can game alternative instream flow regimes to predict NGD and NGY. Without the reference condition for comparison, an ecological perspective toward allocating streamflows is hampered. The NGD analysis will require the following steps:

Step No.1: Select species, life stage, and relevant time period for analysis.

Step No.2: Construct annual hydrographs and annual thermographs for as extensive a hydrological record as possible.

Step No.3: Establish threshold for 'good habitat' on habitat rating curves and define temperature preference ranges ("good" water temperatures). The selection of thresholds greatly simplifies the model, but requires application of professional judgment. Threshold selection therefore deserves a dedicated effort that eventually must be accepted by all Subcommittee members. More sophisticated modeling may be warranted to aid threshold selection. For example, an energetic growth model might be used to select a minimum 'good' specific growth rate that would result (within the time period selected) in a juvenile attaining some minimally desired size necessary for reasonable survival. This growth rate would be useful in selecting water temperature thresholds. Potential effects of stream turbidity will be considered in this analysis.

Step No.4: Replace streamflow (Q) on the Y-axis of annual hydrographs with the biological variables from the habitat rating curves.

Step No.5: Replace water temperature (T) on the Y-axis of the annual thermograph with specific growth rate.

Step No.6: Identify the dates in a specific water year that the Y-axis value exceeds the threshold for each biological variable. Record the dates when all biological thresholds are exceeded. The total number of these dates is the Number of Good Days (NGD). Subcommittee members have noted that depending on how/why the biological thresholds are selected, the Number of Fair Days (NFD) and better can be computed (or number of bad days as well). If benthic macroinvertebrate habitat in riffles is abundant on a given date but water temperatures are too warm to be considered 'good' on these same dates, the date might still be 'good' if the negative effect of warmer temperatures would be reduced by increasing food availability. Additional considerations of this type will be incorporated into the analysis as more is learned during the fieldwork.

Step No.7: Compare NGD estimates for individual water years computed under different streamflow management scenarios, including the unregulated annual hydrograph and thermograph (that can be considered a reference condition), by plotting each water year's results. NGY will be computed for the entire annual hydrograph period, though a threshold number of good days per year will be required.

Step No.8: Perform a sensitivity analysis targeting suspected errors in measurement and range in threshold establishment.

Step No.9: Consider habitat continuity. The NGD analytical framework simply tallies the number of good days, and does not assess habitat continuity. For example if all the 'good days' occurred near the end of a life stage's time period in the creek, a different biological outcome would be expected if, in another WY or under a different management scenario in the same WY, the 'good days' all occurred near the start of a species life stage's time period. This 'problem' will be contained by subdividing the time period and computing NGD separately for each subdivision.

The following tasks will be required to complete these steps:

Task 3.1: Construct Annual Hydrographs and Annual Thermographs

The NGD analysis requires estimates of unimpaired and impaired hydrographs and thermographs. USGS streamflow and temperature data, as well as agency temperature data, contribute towards this data need (Figure 2). Discussions at the August 8, 2008 workshop on flow and water temperature needs found that:

- A temperature model will need to be developed and applied to predict unimpaired and future daily average, maximum, and minimum thermographs needed fulfill the water temperature data requirements to conduct the NGD analysis.
- Additional computations will be needed to estimate unimpaired daily average streamflows. Existing gaging station data should be adequate to make these computations.
- Adequate meteorological data is available at several locations within the watershed.

Additional details are provided in the following sections.

Hydrographs

Flow releases that approximate natural hydrologic events are evaluated not simply because "natural is good", but because each hydrologic event accomplishes specific biological and physical tasks necessary to sustain river ecosystems and salmonid populations. Scientists identify certain properties of natural flow events that can be altered, including their magnitude, duration, frequency, and timing, without significant interference with ecological processes that impair populations. Annual regulated and unregulated hydrographs from WY1995 through WY2008 (and possibly additional years if data allow) will be constructed for the NGD analysis using existing gaged streamflow data. The following locations will be nodes for estimating regulated and/or unregulated annual hydrographs from WY1995 to WY2008 in Upper Alameda Creek:

(1) above and below the Alameda Creek Diversion Dam (STN 1520+00 ft)

(2) below Calaveras Dam (STN 1490+00 ft),

(3) at the confluence of Alameda Creek and Calaveras Creek (STN 1350+00 ft, USGS gage 11-173510),

(4) at the Sunol Water Treatment Plant below Welch Creek confluence (STN gage 1120+00 ft),

(5) at the PG&E pipeline crossing (STN 1012+00 ft),

(6) below the San Antonio Creek confluence (STN 987+50 ft).

Impaired hydrographs will be estimated from existing USGS gaging stations at most nodes, and adding accretion estimates for nodes without a gaging station on-site. Unimpaired hydrographs will be estimated by adding accretion flows to gaging stations upstream of the diversions/reservoirs. These unimpaired flow estimates will be compared to measured pre-dam flow estimates to ensure that the estimates are reasonable during baseflow periods. The following stations will be used to estimate unimpaired and impaired flow data:

(1) Alameda Creek above the Diversion Dam (Alameda Creek STN 1520+00 ft, USGS gage 11-172945)

(2) Arroyo Hondo above Calaveras Reservoir (USGS gage 11-173200)

(3) Calaveras Creek immediately below Calaveras Dam (Calaveras Creek STN 1360+00, USGS gage 11-173500)

(4) Alameda Creek above Calaveras Creek confluence (Alameda Creek STN 1405+00, USGS gage 11-173000)

(5) Alameda Creek immediately below Calaveras Creek confluence (Alameda Creek STN 1340+00, USGS gage 11-173510)

(6) Alameda Creek below Welch Creek confluence (Alameda Creek STN 1140+00, USGS gage 11-173575)

(7) San Antonio Creek immediately below San Antonio Dam (San Antonio Creek STN 1030+00, USGS gage 11-174000)

Accretions will be additive, and given the short travel distance and analysis focus on baseflows, no storage induced flood hydrograph attenuation or flood wave routing computations is proposed.

Thermographs

Unimpaired and impaired thermographs will be estimated at the same locations described above for the same time periods. Contemporary impaired thermographs will be estimated from thermistors operated by the USGS and SFPUC. However, estimating unimpaired thermographs for the 1995 to 2008 period, as well as future thermographs under different flow release scenarios, requires a temperature model. The cost and level of effort vary substantially depending on the complexity of the temperature model, data availability, model time-step, and whether reservoir boundary conditions are assumed or a linked reservoir model is included. Therefore, temperature model development should be phased, starting with a simple model for the reach from the Alameda Creek Diversion Dam to the Arroyo de la Laguna confluence (STN 1520+00 ft to 900+00 ft). The temperature model should be based on an existing water temperature platform (i.e., modify an existing temperature model that can be fine-tuned for application to Alameda Creek). A reservoir temperature model for the new Calaveras Reservoir will need to be developed to predict upstream boundary conditions for gaming future scenarios, but measured seasonal water temperatures measured immediately downstream of the existing Calaveras Dam can be used for upstream boundary conditions until the reservoir temperature model is completed. The SFPUC may be developing a reservoir temperature model in the near future. Its development should be coordinated with the needs of the instream temperature model. Both models need to output daily average water temperatures, as well as daily maximum and minimum temperatures. Based on discussion at the August 8, 2008 workshop, the instream temperature model should use a 4-hour time-step to provide accurate daily average and daily maximum temperature data while minimizing data needs and effort to run the model.

Temperature model calibration and validation should be based on results of available temperature measurements in the creek, CIMIS or other available meteorological data, and existing measurements of channel geometry (supplemented with data collected as part of the flow studies this year), and streamflow hydrology. Cross sections collected as part of this study, along with those being collected by the SFPUC, can be used to estimate average water depth, average velocity, and wetted width as a function of streamflow for input into the temperature model. Results of the initial model should be used to test model temperature predictions, perform sensitivity analyses (e.g., temperature response at various locations to flow changes), and identify areas of future refinement.

M&T Level of Effort:

- Several hours for S. McBain to coordinate with temperature modeler

Agency or Contractor Level of Effort:

- Approximately 60 hours for a senior level modeler and 80 hours for a technician to provide modeling support

M&T Cost Estimate: $5,700

Outside Contractor Cost Estimate: $20,000

Total Cost Estimate: $25,700

Task 3.2: Recommend Temperature/Growth Thresholds

Step 3 of the NGD analysis requires several physical thresholds related to biological processes. Water temperature effects on growth rates and life history periodicities will be important biological considerations in estimating NGD. A panel of three Flows Subcommittee members will develop these thresholds from literature review and experience then report its findings to the Flows Subcommittee. Chuck Hanson, a representative from NMFS (Josh Fuller), and a representative from CDFG (Kristine Atkinson) have agreed to serve on the panel. Bill Trush of M&T will coordinate the panel's meetings (primarily conference calls) and help draft a technical memorandum on the panel's findings.

M&T Level of Effort:

- 40 hrs B. Trush coordinating calls, technical memo, and attending one meeting; D. Mierau technical memo assistance; B. Powell graphics

Agency Level of Effort:

- 20 hrs participation of C. Hanson, J. Fuller, and K. Atkinson as panel members making thresholds and reviewing the draft technical memo

M&T Cost Estimate: $7,229

Task 3.3: Digitize Polygons from the Basemaps and Construct Habitat Rating Curves

Once the WY2009 fieldwork is complete, the mapped polygons must be digitized from the aerial photographic basemaps and compiled. Habitat rating curves will be constructed for each species and life stage for the three mainstem study reaches, with the Y-axis = habitat (ft^2) and X-axis = streamflow (cfs) at each study site.

M&T Level of Effort:

- 120 hrs B. Powell digitizing polygons from basemaps and preparing basic graphical representation of habitat rating curves

Agency Level of Effort:

- None anticipated

M&T Cost Estimate: $10,472

Task 3.4: Compute and Assess Number of Good Days

Each desired ecological outcome (once these are finalized by the Flows Subcommittee) will be stated as precisely as possible to make it quantitatively tractable. By utilizing the thresholds and habitat rating curves established in the former tasks, NGD will be computed for each regulated and unregulated annual hydrograph using a simple spreadsheet. Increments in streamflow on the X-axis will be plotted against NGD on the Y-axis for each water year over the range of regulated and unregulated baseflows. This analysis will identify the range in streamflows (for a particular mainstem reach and species life stage) providing the most habitat benefit. The data on fish passage will be computed similarly, using the number of days that a threshold depth at the riffle crest is exceeded.

As noted in the July 2008 Workshop, NGD must be considered among all life stages collectively (and sequentially) rather than individually. A spring outmigration period for 1+ headwater juveniles with a high NGD will benefit recovery only if 0+ juvenile rearing in the headwaters the previous summer had a favorable NGD. A steelhead population tactic of 1+ juveniles leaving the headwater as pre-smolts – to then enter San Francisco Bay as 1+ smolts – will require a 2-yr sequence to complete all necessary life history stages. Note that a 2-yr sequence would not be the same as a ‘cohort’ because each 2-yr sequence needs a good adult run and spawning conditions to produce enough eggs. Annual adult runs will be multi-generational, including repeat spawners. Our management goal would be to produce 2-yr headwater sequences with each life history stage experiencing a high NGD, i.e., good habitat capacity and productivity.

This goal will be portrayed as a matrix, where each line comprises one 2-yr sequence. Life stages for this Upper Alameda Creek headwater 1+ steelhead tactic are: (1) fry emergence, (2) 0+ spring/summer/early-fall rearing, (3) 0+ mid-fall/winter rearing, (4) 1+ spring rearing, (5) 1+ downstream migration, and (6) smoltification and entry into San Francisco Bay. Each life stage will be subdivided in the matrix to improve resolution as a management tool. For example, the fry emergence life stage, which relies on successful spawning, is comprised of successive events: adult migration, redd construction, redd survival during incubation, and fry emergence. In the matrix, the spawning life stage can be sub-divided into spawning habitat access and incubation success. Similarly, the 0+ spring/summer/early-fall rearing can be subdivided into productive spring/early-summer 0+ rearing habitat and survival mid-summer/early-fall 0+ rearing habitat. The 1+ downstream migration life stage will be subdivided by location: headwaters of Upper Alameda Creek (above the mainstem branching at STN 1115+00 ft that is 1,900 ft below the Sunol Water Treatment Plant bridge), valley bottom of Upper Alameda Creek (where the mainstem branches and downstream to the Arroyo de la Laguna confluence), and Lower Alameda Creek (downstream of the Arroyo de la Laguna confluence.

In addition to estimating the change in NGD under different streamflows, the analysis will include an assessment of anadromous salmonid spawning risk and amphibian breeding/tadpole rearing risk. Annual risk assessment for anadromous salmonid spawning and amphibian rearing will require several steps.

The first risk assessment step will be to establish the spawning/breeding window from life history studies. For example, Foothill Yellow-legged Frog (FYLF) breeding and egg laying typically extends from March 1 to May 15, with the exact timing and duration likely highly influenced by rising spring water temperatures. The second step would be to estimate the ultimate size and survival probability of tadpoles originating as eggs deposited on successive days through the breeding window. For example, will eggs laid on March 1 have a good chance of producing successfully metamorphosed tadpoles by mid-summer? How about for eggs laid on March 2? March 3? Each water year would therefore have an estimate of the number of days laid eggs would have a good chance of becoming adult frogs. The third step will be to perform this annual risk assessment over many years, e.g., from WY1995 to WY2008. The inter-annual variability in number of successful days (X-axis = water year and Y-axis = successful days) is the natural variation valued in an ecosystem approach.

Specific sites will be selected for analysis of amphibian breeding success, including side-channels. But all sites are not created equal. Some sites may have a lower success rate (of eggs becoming tadpoles) but produce exceptionally large tadpoles that might better survive the rigors of their first winter. Side-channels might be the ‘hot-spot’ for these tadpoles. Side-channels will have an incipient flow threshold for receiving mainstem streamflows and another broader threshold for higher mainstem streamflows that create good side-channel habitat. In snowmelt dominated river ecosystems, the slow recession limb might be the key feature of the annual hydrograph. How many successful years are necessary to sustain a robust population of frogs? Note that this threshold is not a minimum. Amphibian biologists will be called upon to recommend a threshold inter-annual rate of breeding success.

M&T Level of Effort:

- 120 hrs M. Mierau and 56 hrs B. Trush

Agency Level of Effort:

- Unspecified effort commenting on preliminary analyses, including field time

M&T Cost Estimate: $17,840

Task 3.5: Prepare Technical Memorandum

A draft technical memorandum will be prepared on the habitat mapping fieldwork and analytical findings by early-September 2009. Following the fieldwork completed in June, but prior to this draft, M&T will summarize the findings at one of the Flows Subcommittee meetings. The draft technical memorandum will be distributed to the Subcommittee for comments, with a final technical memorandum that addresses Subcommittee comments due late-October 2009. This technical memorandum will identify any necessary remaining tasks for quantifying instream flows for the Upper Alameda Creek watershed. Panoramic photographs of specific locations at each mapped streamflow and monitored thalweg (for fish passage assessment), annual regulated and unregulated annual hydrographs at each location, and all habitat rating curves will be provided as a .pdf file and/or excel files.

M&T Level of Effort:

- 95 hrs D. Mierau; 60 hrs writing B. Trush; 15 hrs S. McBain
- 20 hrs B. Powell figure/table/photograph preparation and 10 hrs S. Loya desktop publishing

Agency Level of Effort:

- Unspecified hours reviewing the draft

M&T Cost Estimate: $21,290

Task 4. Meetings and Project Management

Habitat mapping in WY2008 will require considerable coordination among/within agencies and M&T, particularly in assembling and calibrating the core mapping team and in mapping habitat during fluctuating winter streamflows. Annual meetings and individual technical sessions will be needed discuss preliminary results and to plan fieldwork for WY2010.

M&T Level of Effort:

- 30 hr B. Trush; 20 hr S. McBain; 8 hr R. McBain for contract/project mgmt
- Attend 4 1-day meetings for D. Mierau/S. McBain and B. Trush

M&T Cost Estimate: $31,693

PRELIMINARY SCHEDULE FOR WY2009 FIELDWORK AND ANALYSES

1. Basemap construction (Task 1) by late-December 2008.
2. Habitat mapping and riffle crest monitoring in Upper Alameda Creek beginning mid-January and ending by early-June 2009 (Task 2).
3. Preliminary analysis by mid-July 2009 (Task 3), draft technical memorandum by early-September 2009 final technical memorandum by end of October 2009.
4. General meetings and project management on an as-needed basis.

WY2009 SUMMARY BUDGET ESTIMATES FOR TASKS 1 THROUGH 4

Task #	Task description	M&T Cost Estimate	External Cost Estimate*
1	**Basemap Construction of Mainstem Study Sites**	**$33,936**	**$0,000**
2	**Prepare Sampling and Analytical Plan**	**$77,754**	**$0,000**
2.1	Assemble and Calibrate Habitat Mapping Teams	$9,755	$0,000
2.2	Survey Cross Sections for Spawning Habitat Assessment	$6,510	$0,000
2.3	Field Habitat Mapping at Three Mainstem Study Sites	$54,949	$0,000
2.4	Riffle Crest Surveys in Sycamore Floodplain Reach	$6,540	$0,000
3.	**Analysis of Number of Good Days**	**$62,531**	**$0,000**
3.1	Construct Annual Hydrographs and Thermographs	$5,700	$20,000
3.2	Recommend Temperature/Growth Thresholds	$7,229	$0,000
3.3	Digitize Habitat Mapping Polygons and Construct Rating Curves	$10,472	$0,000
3.4	Compute and Assess Number of Good Days	$17,840	$0,000
3.5	Prepare Technical Memorandum	$21,290	$0,000
4	**Meetings and Project Management**	**$31,693**	**$0,000**
	TOTALS:	**$205,914**	**$20,000**

*Assumes staff salaries for Agency participation covered by respective agency

REFERENCES

Trihey & Associates, Inc. 2003. Sunol Valley Surface Flow Study. Final Report. Prepared for: Office of the City Attorney, City and County of San Francisco. Project No. 307127, October 2003.

McBain & Trush, Inc. 2008. Alameda Creek Population Recover Strategies and Instream Flow Assessment for Steelhead Trout, Final Study Plan, Prepared for: Alameda Creek Fisheries Restoration Workgroup, 56 pp. http://www.cemar.org/alamedacreek/alamedacreekindex.html

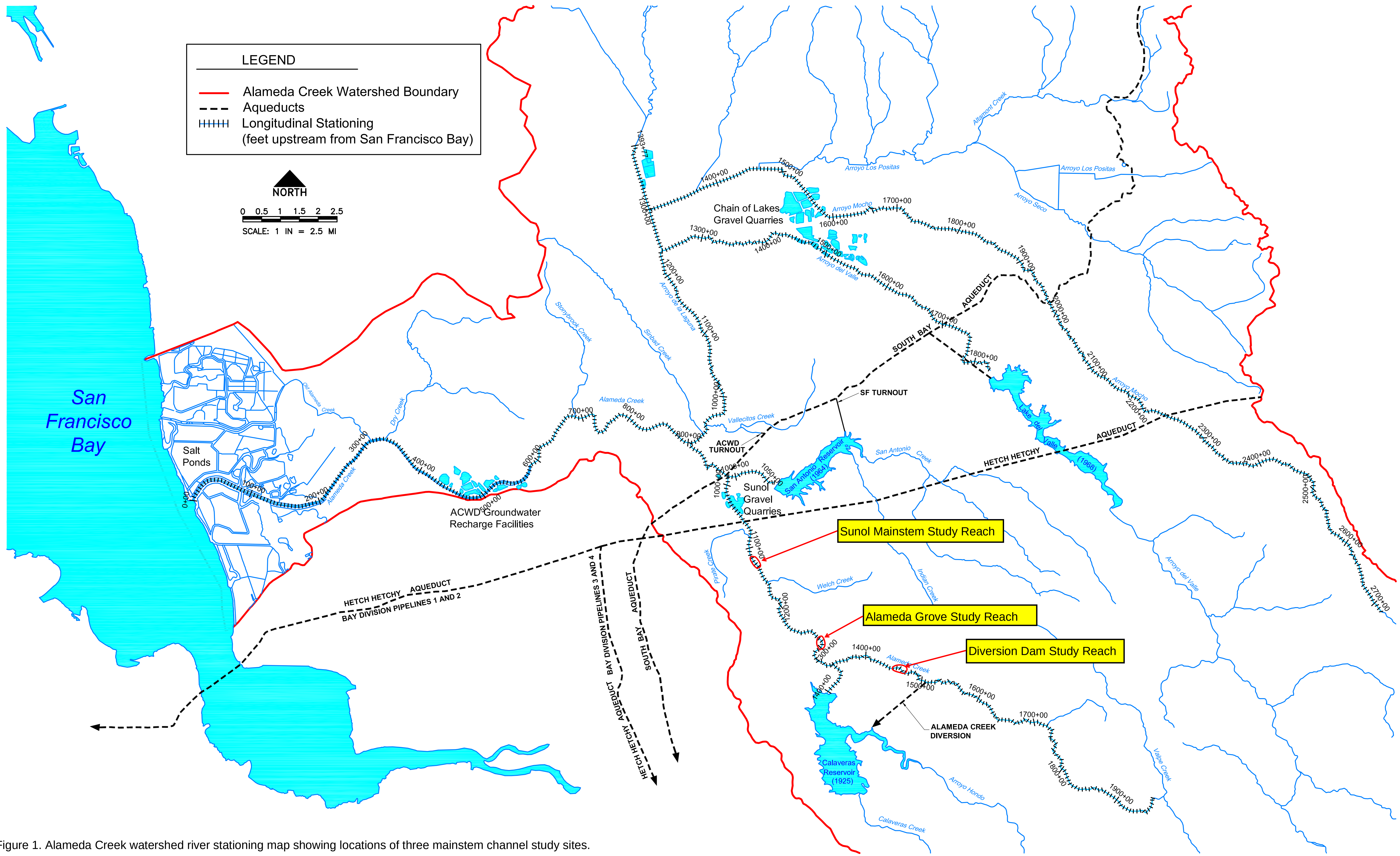

Figure 1. Alameda Creek watershed river stationing map showing locations of three mainstem channel study sites.

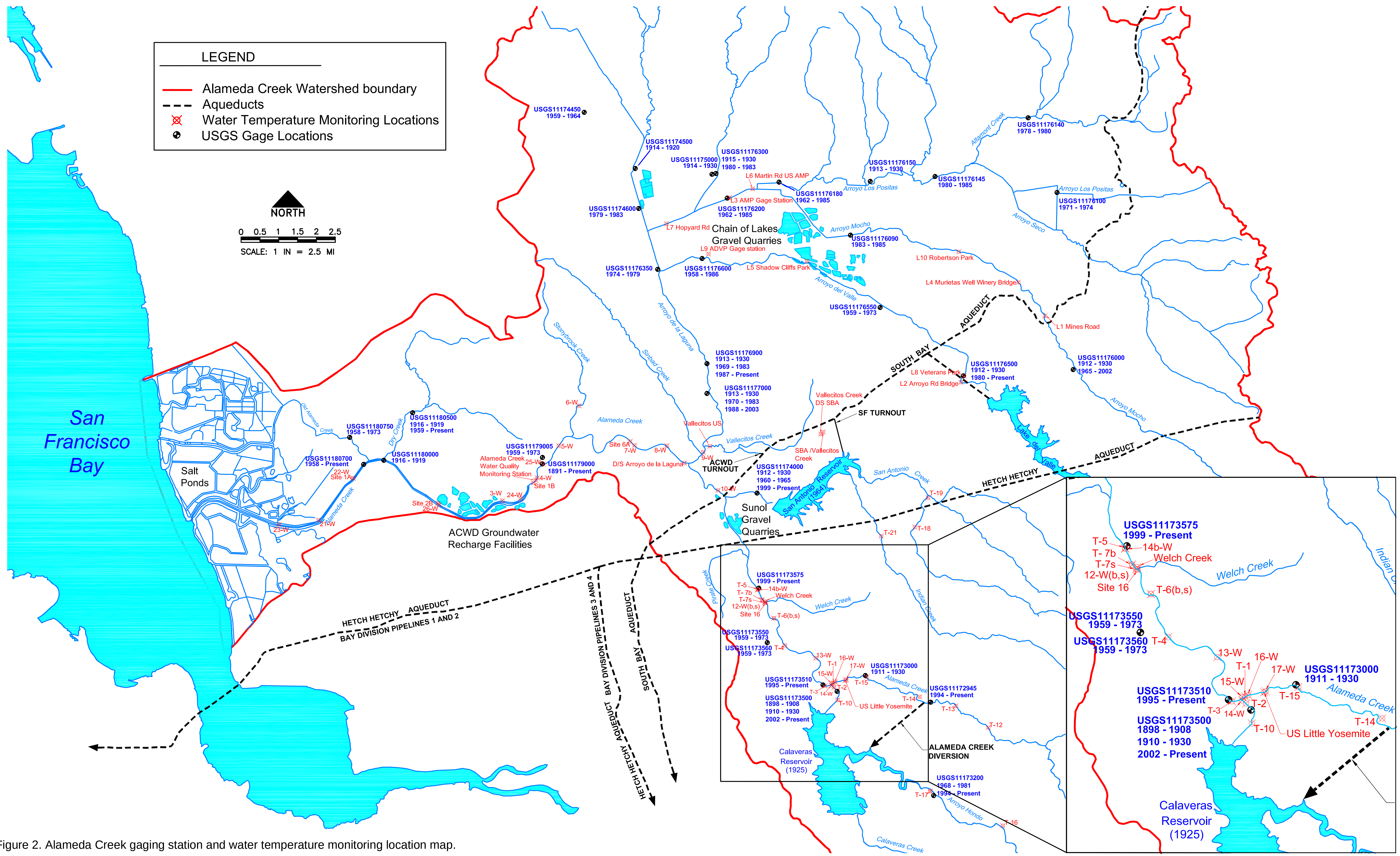

Figure 2. Alameda Creek gaging station and water temperature monitoring location map.