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To: San Francisquito Creek Joint Powers Authority, Steelhead Task Force, and Expert Advisory Panel

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Date: August 6, 2004

Subject: San Francisquito Creek Watershed Literature/Data Review and Gap Analysis for Aquatic Habitat Assessment (Work Product B)

Project #: 04262.04

Introduction

The objective of the Aquatic Habitat Assessment and Limiting Factors Analysis is to characterize channel and habitat condition with respect to factors limiting to steelhead populations in the San Francisquito Creek watershed. Data collection and analysis is necessary to evaluate these stressors for those limiting to aquatic habitat, steelhead trout (*Oncorhyncus mykiss*) populations, and specific steelhead life history stages within the watershed. However, a depth and breadth of studies have already been conducted within the watershed that can be incorporated into and provide a base for the current habitat assessment and the limiting factors analysis.

The outcome of this study will be an evaluation of the balance between stream sediment supply and transport capability and the consequent effects on aquatic habitat attributes (i.e. pool volume and filling, permeability of spawning gravels, stream bed and bank stability, streambed morphology, sediment storage, etc.), and characterization of streamflow, temperature, habitat structure, and water quality with reference to steelhead life history needs. Key questions to be answered by this study include:

- Are there other causes of aquatic habitat impairment?
- Is it valid to list San Francisquito Creek as impaired for sediment?

- What areas of Los Trancos and Lower San Francisquito Creek subwatersheds are important to steelhead and why?
- Where has steelhead habitat been impaired?
- What aspects of the aquatic habitat have changed and what caused those changes?
- What is the relative importance of these various habitat changes to steelhead?
- What is the present trend of habitat changes in the system?

The fundamental focus of this effort is based on the 303(d) listing of San Francisquito Creek as impaired for sediment. The basis for the listing is *"based primarily on a decline in native fish populations"*(RWQCB 2004). If this hypothesis is true, the steelhead habitat, which is sensitive to the impacts of excess turbidity and sedimentation, will also be impaired, thus leading to a decline in the Steelhead population in the watershed. While significant work has been done on sediment supply and transport within the watershed, a focused assessment of steelhead habitat for indications of biological consequences due to sediment has not been completed. This is the crucial link in defining the basis and extent of sediment impairment in the watershed and will facilitate the development of future management strategies and actions within the San Francisquito Creek Watershed.

Geographic Scope

Due to resource constraints, the geographic scope of this study is limited to the lower mainstem of San Francisquito Creek and the Los Trancos Creek subwatershed within Santa Clara County. The tributaries of the upper San Francisquito creek watershed and the Bear Creek watershed within San Mateo County are currently not part of the geographic scope of this study.

Within that geographic scope, the habitat assessment will specifically focus on stream segments where steelhead utilization has been recorded or in potential steelhead spawning and rearing reaches. The watershed has been extensively studied for the occurrence of steelhead and other fishes within the watershed, but is best characterized by the following studies:

- Vogel 2002. An extensive snorkel survey of juvenile *O. mykiss* in Los Trancos Creek funded. The survey covered 2.3 miles of channel downstream and 1.6 miles upstream of the Felt Lake Diversion Dam in the spring of 2002. Fry and yearling trout were identified upstream and downstream of the diversion dam.
- Launer and Holtgreive 2000. A Stanford University study, in the summers of 1998 and 1999, of all fish populations in San Francisquito Creek and Los Trancos Creek. The survey was begun at the confluence of San Francisquito and Los Trancos creeks and went upstream to Searsville Dam on San Francisquito, and up to the Felt Lake Diversion fish ladder on Los Trancos. A small portion of Bear Creek was also surveyed in 1998. The study found that non-native fishes supported by Searsville

Lake were not expanding their range into the rest of the watershed and that "moderate to high" densities of steelhead, including yearling trout.

- DFG 1995 and DFG 1976. Summer electrofishing surveys of Bear, Los Trancos, and San Francisquito Creeks in 1976 and 1992-1993. The effort was more extensive in 1992-1993, but steelhead were found in the all streams during both surveys. However, more young of year trout were found upstream of the Felt Lake Diversion (before installation of the fish ladder in 1995), suggesting a self-sustaining rainbow trout population upstream of the diversion.

The mainstem of San Francisquito Creek, below the confluence with Los Trancos Creek, has been surveyed (DFG 1976, Leidy 1984, DFG 1995) and steelhead have been observed in the upper portions of this reach, but it is likely that the majority of the mainstem below the confluence is only used as a migration corridor.

Additionally all of the streams in the watershed were classified according to the Montgomery-Buffington (1993) stream classification system (NHC and Jones & Stokes 2004). This classification breakdown will also be compared to a recent spawning and rearing habitat analysis (NHC et al. 2002) in order to define reach breaks in the watershed that will facilitate a random sampling methodology of the reaches in the watershed utilized by steelhead. These defined reaches will allow the assessment to sample habitat characteristics across a range of channel types and tributary segments critical to steelhead production in the study area.

Literature/Data Review

The initial phase of this assessment was to collect and review relevant existing sources of data and literature for the San Francisquito Creek Watershed. This process is facilitated by peer review from relevant local experts and additional oversight from the various government and non-government entities that have a stake in the future of the watershed. The review will isolate the relevant studies that can be used in the habitat assessment and limiting factors analysis. The review also identified key habitat assessment methodologies and scientific literature to support the utilization of those methodologies that specifically addressed sediment and other watershed attributes in terms of steelhead habitat and survival. Additional work may be undertaken under this assessment, as appropriate, if the need is forseen during this process or the initial stages of the field survey. If changes or additions are made to the protocol, the JPA, SCVWD, and the EAP would all be verbally consulted before implementation.

Data Gap Assessment

Data gaps are identified for the purpose of guiding inventory and research needs for this and future habitat studies in the San Francisquito Creek Watershed. Although the goal of the current study uses steelhead as an indicator of potential sediment impairment within the watershed, many of the information gaps relate to other native and non-native species and portions of the watershed outside of the geographic extent of the current study. In the

following paragraphs each potential limiting factor to be analyzed is discussed and assessed based on the amount of available data. Strategies and assessment methods that would resolve data gaps are discussed. Throughout the process, other limiting factors analyses, such as those in the Napa and Stevens Creek Watersheds, were consulted in order to maintain the consistency and repeatability of the assessment methods to be used in the San Francisquito Creek Watershed with those previous studies. This consistency facilitates consistency within the RWQCB's TMDL process and defines the watershed within the context of the greater San Francisco Bay area.

Species Presence/Absence: Obviously, a key element in using a species as an indicator for impairment is the presence of that species. Given the extent of existing data (discussed under Geographic Scope) on the occurrence and utilization of the watershed by steelhead we do not see this as a data gap. Existing studies cover key life history stages of steelhead including spawning (SCVWD 2004) and rearing (Launer and Holtgrieve 2000, Vogel 2002). The long-term, consistent finding of juveniles and evidence of spawning clearly imply a viable steelhead population. However, there is very little escapement information or data on returning adults. This includes the absence of data on the timing of outmigration and returning adults (although this information can be assumed from juvenile presence studies and spawning data). While some additional outmigrant studies would help in comparisons of outmigration and flow timing, this does not currently appear to be the best utilization of the resources available for the current project.

Physical Barriers: Physical barriers (Dams, improperly sized weirs, etc.) can isolate returning adult steelhead from spawning reaches and can prevent juvenile trout from outmigrating into San Francisco Bay. Significant rigorous studies have been completed throughout the watershed to identify potential barriers to migration (Smith and Harden 2001, NHC et al. 2002, NHC et al. 2004). Given the extent of knowledge, this is not considered to be a data gap for San Francisquito Creek. Any work conducted in the channel during the habitat assessment will look for potential barriers, but this will only be done in conjunction with other survey protocols.

Flow: Flow can affect the ability of adult steelhead to access natal streams during spawning. Flow can also hamper the ability of juvenile trout to outmigrate during low flows or flush them out of the system before they are ready to outmigrate during flood flows. High flows can also scour out redds, greatly reducing spawning success. Studies have been completed to assess flow characteristics of the watershed and a good amount of data is available (Sokol 1964, Corps of Engineers 1972, Metzger 2002, NHC et al. 2002). The majority of focused flow information exists for spring flows, low summer flows, and winter peak flood events, but USGS data exists year-round for San Francisquito Creek. This allows for a complete assessment of flow in relation to all critical life history stages within the watershed. However, the majority of this data has not been looked at rigorously in terms of juvenile outmigration or the ability of returning adults to access spawning reaches. This will be assessed in the limiting factors analysis. Additional flow information may be acquired as part of the temperature modeling effort that would be added to this dataset.

Temperature: Temperatures in excess of 77° F can cause direct physiological impacts to *O. mykiss* or can create a barrier to the movement of steelhead in and out of the watershed. Temperature data has been collected throughout the watershed and in conjunction with a variety of studies. Temperature is a simple factor to record, but can be difficult to analyze

and place within the larger context of the watershed and the various influences on temperature. We would propose the installation of Stowaway temperature loggers for the period of study. Additionally, we would propose that a Shaded Riverine Aquatic (SRA) Cover analysis and flow measurements be completed in the reaches monitored for temperature in order to develop a simple model of temperature in San Francisquito Creek. This effort would likely focus on the lower urbanized, migratory reaches of mainstem San Francisquito Creek.

Sediment: Sediment can have a variety of effects on steelhead during all life history stages. Turbid water can impact *O. mykiss* by "clogging" or damaging the gills. The accumulation of fine sediment in gravels used for spawning can reduce gravel permeability and the ability of dissolved oxygen to reach redds. The filling of pools and the interstices of stream gravels, which provide refuge for young of year and yearling trout, can reduce the availability and/or quality of rearing habitat. Bed mobility, a function of flow regime and erosion potential, can result in the scouring of redds, as discussed in the flow section.

Gravel quality, for spawning and rearing, is largely a function of gravel permeability and embeddedness, respectively. Neither of these habitat characteristics has been extensively studied within the San Francisquito Creek Watershed. We propose field studies within the selected sample reaches using a modified standpipe (Barnard and McBain 1994) to measure gravel permeability in pool tail-outs and embeddedness measurements (Burns 1984, Skille and King 1989) in sample reach riffles. The possibility of pool filling by fine sediments has also not been studied. We propose using the modified V* assessment (Hilton and Lisle 1993) to analyze the extent of pool filling in the San Francisquito Creek watershed.

Sufficient information exists to assess turbidity and bed mobility within the San Francisquito Creek watershed (NHC et al. 2003). No additional data collection is proposed.

Colorado State University is currently in the process of developing a district wide methodology for fluvial geomorphic assessment to be used by SCVWD. The proposed studies for the San Francisquito Creek Aquatic Habitat Assessment are specifically focused of the translation of geomorphic characteristics into impacts to steelhead and look at factors in different ways than they will be assessed in the CSU methodology. Assessments of embeddedness and pool filling will provide data complimentary to the proposed CSU methodology. However, gravel permeability measurements will be beyond the scope of the CSU methodology and will not likely provide useful data for the any fluvial geomorphic assessment.

Access: Santa Clara Valley Water District has existing access agreements that provide access along the mainstem of San Francisquito Creek, from Camino Real to the confluence with Los Trancos Creek. Access is available along Los Trancos Creek from the confluence up to just above the Felt Lake Diversion. The majority of access is provided through Stanford University and is coordinated through Stanford Property Management, The Stanford Golf Course, and Stanford Utilities, for the diversion area of Los Trancos Creek. However, these agreements end in December of 2004 and will likely have to be extended to facilitate any work done in early 2005. Properties accessed will be notified the week before surveys, as outlined in the access agreements.

Conclusions

Current gaps in available information may limit the ability to implement an effective management and restoration strategy. As information becomes available, it needs to be incorporated into the activities of agencies and stakeholders regulating habitat and land use. The current study seeks to resolve data gaps, particularly those related to the categorization of San Francisquito Creek as impaired due to excessive fine sediment. The conclusions of this memorandum are summarized in Table 1 (following page).

Life Cycle	Potential Limiting Factors	Data and Gaps	Potential Resolution
Adult Upstream Migration	Attraction flows	**Data Gap**	None proposed. Interruption and/or masking of attraction flows is not known to occur
	Migration barriers:(e.g. dams, dewatered reaches, inadequate flows, channel braiding, natural falls, culverts, road crossings, and water temperature)	Smith and Harden , USGS 2004	Juvenile Outmigration Barrier Analysis
	Migration corridor hazards (e.g. bypasses, poaching)	Launer and Holtgreive 1999	None proposed. Surveys will note any additional barriers.
Spawning and Incubation	Spawning gravel quantity/redd superimposition	**Data Gap**	Redd Identification, Embeddedness, and Gravel Permeability
	Spawning gravel quality (e.g. intergravel flow, sedimentation, armoring)	**Data Gap**	Gravel Permeability, Embeddedness
	Water quality and temperature	Several Sources (SCVWD 2004, City of Palo Alto, Stanford)	Temperature and Dissolved Oxygen Measurements
	Substrate mobility and scouring	NHC et al. 2003	Additional bulk sampling and visual observations
	Redd dewatering	**Data Gaps**	Flow analysis, modeling, and permeability measurements
Early Rearing	Availability of suitable stream margin habitat for fry rearing	**Data Gap**	Visual assessment of banks
	Rearing habitat/spawning area proximity	SCVWD 2004	Sample reach assessment and redd identification
	Water quality (e.g. temperature, toxics)	Several Sources (SCVWD 2004, City of Palo Alto, Stanford)	Temperature and Dissolved Oxygen Measurements
	Predation	**Data Gap**	None proposed.
	Food availability	Carter and Fend 2000	macroinvertebrate survey
	Stranding by low flows	Metzger 2002	Flow analysis and modeling
	Displacement by high flows	**Data Gap**	Flow analysis and modeling
Juvenile Rearing	Availability of summer habitat (e.g. pools, temperature refugia, SRA)	SCVWD 2004	Sample reach assessment and pool filling measurements
	Availability of winter habitat (e.g. in-channel LWD, interstitial habitat)	**Data Gap**	embeddedness measurements
	Stranding by low flows	Metzger 2002	Flow analysis and modeling
	Displacement by high flows	**Data Gap**	Flow analysis and modeling
	Predation	**Data Gap**	None proposed
	Food availability	Carter and Fend 2000	macroinvertebrate survey
	Interspecific interactions with native species	Launer and Holtgrieve 2000	None proposed
	Competition with introduced species	Launer and Holtgrieve 2000	None proposed
	Water quality/temperature	Several Sources (SCVWD 2004, City of Palo Alto, Stanford)	Temperature and Dissolved Oxygen Measurements
Smolting and Outmigration	Adequate flows for outmigration	**Data Gap**	Flow analysis and modeling
	Water quality and temperature	Several Sources (SCVWD 2004, City of Palo Alto, Stanford)	Temperature and Dissolved Oxygen Measurements
	Predation, poaching	**Data Gap**	None proposed

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