Appendix D

Responses to Comments

Responses to Comments

Part I: Staff responses to written comments submitted in response to March 2014 draft Staff Report and proposed Basin Plan amendment

Part II: Staff-initiated changes

Part III: Peer review

References

INTRODUCTION

The Water Board received three comment letters in response to the March 10, 2014, Basin Plan amendment, draft Staff Report, and Environmental Checklist: 1) County of Marin, 2) Marin Municipal Water District, and 3) Dennis Poggio. Our responses to these comments follow immediately below.

PART I: STAFF RESPONSES TO WRITTEN COMMENTS SUBMITTED IN RESPONSE TO MARCH 10, 2014 DRAFT STAFF REPORT AND PROPOSED BASIN PLAN AMENDMENT

Comment Letter No. 1: County Of Marin, Department Of Public Works

Comment 1.1: Thank you for the opportunity to submit comments. The County greatly appreciates the time, energy, and technical expertise that went into developing and interpreting the technical studies that support the TMDL.

Thank you.

Comment 1.2: We would like to acknowledge and thank the Regional Water Board staff for engaging in the peer review process for the initial draft of the staff report, and acknowledging many of the resulting constructive comments and discussions in the current draft staff report and BPA. While the revisions have resulted in an improved plan to address many of the sediment and habitat challenges in the Lagunitas Creek watershed, the County would like to encourage the Regional Water Board to revisit the prescribed timeline for compliance actions on paved public roads in the TMDL project area. The County believes that the current activities through existing programs are directly supporting the TMDL. Specifically, requirements in the existing NPDES Phase II permit, and leadership in the Fish Passage and San Geronimo Salmon Enhancement Programs, which are summarized below, align well with the required implementation measures in the BPA. So, as we did in our July 31, 2013 response to the CEQA scoping process, the County is requesting an incremental, iterative process that meshes with our available resources.

We appreciate the County's leadership and involvement in the programs and actions you cite above. Nevertheless, we conclude that additional actions are needed to ensure that County paved roads are not a significant source of sediment delivery to channels and do not impact stream-riparian habitats. The timeline in the BPA calls for the County to complete an inventory of paved roads within 5 years of TMDL adoption. Any actions that stem from the inventory would be scheduled for completion within 20 years from TMDL adoption. We assert that this timeline provides sufficient time for the County to assess what actions need to be taken and budget for those actions.

Comment 1.3: The County of Marin's Stormwater Program is working towards meeting TMDL performance standards on our County paved road system through compliance with the 2013 NPDES Phase II permit in Woodacre, the largest populated area in the TMDL project area. The NPDES permit process requires the County to asses and prioritize storm drain maintenance by June 30, 2015, and develop and implement a program to assess Operations and Maintenance (O & M) activities for roads, bridges, and Right-of-way (ROW) maintenance by June 30, 2016. These efforts will support the goals of the TMDL and will result in progress towards the County requirements under the BPA.

We agree that these efforts support the TMDL. Specifically, the requirements to assess and identify priority sites and begin maintenance at identified priority storm drainage facilities by June 2016 clearly support the TMDL.

Comment 1.4: The BPA requires all public agencies to adopt and implement road maintenance guidelines to protect aquatic habitat, water quality, and protect salmonid habitat and conduct an annual training program for road maintenance staff. The County of Marin has met these requirements by developing a roads maintenance manual and conducting annual trainings for road workers and their managers: *County Road Maintenance Guidelines for Protecting Aquatic Habitat and salmonid Fisheries* (2004). This existing program supports the NPDES permit requirement for O&M assessment, and the implementation requirement in the BPA.

We agree that the County is in a very good position with respect to this requirement, having previously developed such guidance. Therefore, the only remaining tasks for the County related to the guidelines for road maintenance would appear to be: a) continued implementation; b) regular reporting on the development and implementation of best management practices and staff training; and (c) adaptive updates as needed.

Comment 1.5: The County requests that the Water Board remove the 5 year deadline to complete assessments and develop a schedule for repairs for County paved roads because funding for paved road assessments is difficult to secure, the County is working through existing programs including the Local Stormwater Program, DPW Roads Division, the County Watershed Program and other efforts to support many of the recommendations in the BPA, and the timeline imposed for paved roads does not align with the characterization in the Staff Report that paved roads are a much lower priority sediment source than unpaved roads.

We do not agree that the 5 year deadline should be removed. The purpose of the inventory required by the BPA is to establish whether paved County roads are meeting the sediment discharge performance standard that is specified as part of the BPA: 350 yd^3 per mile per 20-year period (Table 4.2). In some cases, sediment delivery from blocked and/or diverted road crossings, road-related landslides, and/or inboard ditch erosion can result in very high rates of sediment discharge from paved roads. For example, future sediment delivery to channels

resulting from road-related concentration or diversion of runoff on paved public roads in the Dry Creek watershed, a tributary to the Napa River, that are under the jurisdiction of the County of Napa, is estimated at approximately 1100 yd^3 per mile per 20-year period, or more than 300% of the proposed road sediment discharge standard for the Lagunitas Creek watershed, of 350 yd^3 per mile per 20-year period (see Pacific Water Associates, 2003).

We also note that road erosion inventories have been completed on all other publically-owned roads in the watershed, almost all of which are unpaved, except for those under the jurisdiction of Marin County Public Works. Considering that almost 40% of the total road length in the project area is paved roads, we have concluded that it is important to also develop a more accurate estimate of sediment discharge from the paved roads, exercising caution with regard to water quality protection. Should the inventory confirm that sediment discharge rates from the paved roads are at or below the performance standard (350 yd^3 per mile per 20-year period), then no repairs or retrofits would be required beyond routine operation and maintenance. In the event that the inventory confirms that sediment discharge rates exceed the performance standard, the County will have at least fifteen years to achieve the performance standard, an amount of time that allows the County plenty of time to budget for and conduct the necessary activities.

Comment 1.6: Marin County has a long history of working in the Lagunitas watershed to improve water quality and salmonid habitat through a variety of programs including the NPDES permit compliance program, FishNet 4C, Public Works Fish Passage Program, Roads and Wood Debris MOUs with MMWD, the Salmonid Enhancement Plan for the San Geronimo Valley, and the San Geronimo Valley Landowners Assistance Program. Many of the elements in these existing programs functionally meet the goals and objectives of the BPA and the County anticipates continued implementation of these existing programs during the implementation phase of the TMDL. Marin County looks forward to working with the Water Board collaboratively in the future on these important issues.

We agree that many of the existing programs are helping to meet the goals and objectives of the TMDL and staff also look forward to continued collaboration with the County. The programs you list contribute to a foundation for conservation that we must build upon to substantially increase the watershed populations of coho salmon, steelhead, and California freshwater shrimp. That is why we call for additional actions to enhance habitat complexity and connectivity in Lagunitas Creek and its tributaries.

Comment 1.7: The TMDL calculates sediment contribution from channel incision and bank erosion and states sedimentation can be reduced by engineered log jams, riparian management and restoration to substantially increase the size and number of large fallen trees in channels. Water Board staff recommends projects to reconnect the channel to its floodplain. The County of Marin is meeting these goals in the following ways:

MMWD MOU on Woody Debris: **The County is a signatory to a multi-agency MOU on Woody Debris Management developed by MMWD. The MOU spells out how wood will be managed with the objective of retaining and recruiting wood in the creek for salmonid habitat. County Public Works (DPW) adheres to this MOU and only removes fallen wood from Lagunitas Creek and its tributaries in cases where the wood is threatening a County structure, such as a bridge, road or property. Best Management Practices are employed by DPW where wood needs to be removed or modified No fallen trees are removed from private property by County crews. When wood is removed it is taken to the Nicasio Corps Yard where it is saved to be used in restoration projects.**

We concur that the Woody Debris Management MOU will contribute over time to increases in the amount of large woody debris in channels and related habitat functions, and we commend the County on the actions it has taken to date. However, there remains a significant deficit of wood in channels, and that is why we also call for construction of engineered log jams.

Comment 1.8: Landowner Assistance Program projects will install engineered wood structures: In 2010, the County developed a Salmon Enhancement Plan (SEP) which led to the formation of a Landowner Assistance Program in the San Geronimo Valley (SGV LAP). The SGV LAP performed evaluations on 40 privately owned properties to identify actions that would improve salmonid habitat. At several of the sites, the program has received DFW FRGP funding for the development of designs to install large wood structures in the mainstem of the San Geronimo Valley Creek. The structures will be engineered and securely anchored in place, in order to protect downstream properties from the impacts of mobile logs. The design, engineering, permitting, and construction cost is expensive and participants do not have sufficient funds to obtain permits and implement the projects themselves. The Board should support installation of wood structures in the San Geronimo Valley by providing funds for landowners seeking to enhance salmonid habitat.

We understand these types of projects can be expensive. In the Staff Report (Chapter 6 Implementation, section on Channel Incision), we emphasize that we support such projects, and we provide further specific criteria for when such projects would be considered as having priority for grant funding from the Water Board. We will work with landowners and, in particular, support formation of voluntary stewardships to accomplish this type of work.

Comment 1.9: Need for hydraulic analysis: The Board could facilitate the installation of woody debris in San Geronimo Creek by providing hydraulic analysis in key reaches. No modeling exists to analyze impacts of placing wood in the creek, so that burden would fall to homeowners proposing these projects.

We agree that hydraulic analysis is important as part of the planning and design of these projects. All projects meeting the habitat enhancement criteria described in the draft Staff Report (Chapter 6, Implementation, Channel Incision), or otherwise demonstrating significant

potential for aquatic habitat enhancement, should compete well for potential funding under State and federal grant programs.

Comment 1.10: Impacts of regulations on collapsing stream bank repair projects:
County DPW maintains numerous roads, culverts, and bridges throughout the Lagunitas Creek watershed and needs to have the ability to make repairs to protect those structures when the bank of the creek collapses or the structure is threatened (e.g., slip-outs downslope). Often a threat to a County structure poses a dangerous situation to the traveling public and the repair needs to be implemented in an emergency, or within a short timeframe. Additionally, the County's Landowner Assistance Program provides assistance to landowners in San Geronimo Creek watershed whose properties are threatened by bank erosion. Restoration projects are planned where the project objectives include habitat restoration in conjunction with stabilizing collapsing banks and preventing further loss of property through bank erosion.

Regulatory actions taken by the Board under the TMDL to curtail or delay permits for bank stabilization could highly impact the County's ability to protect the traveling public. These types of regulatory actions could also highly impact a landowner's ability to prevent loss of property due to bank erosion. The Board should describe what type of additional analysis would be required when applying for permits to implement bank stabilization projects, and what it would cost The Board should also clarify if they will withhold permits for more traditional bank stabilization (rock rip rap) in areas where the installation of engineered wood structures would threaten adjacent properties.

It is unclear what regulatory actions to curtail or delay permits for bank stabilization the County is referencing. We have not proposed any changes to our permitting process and will continue to implement the Water Board's standing policy that water quality impacts should be avoided, minimized, and then mitigated as part of the permit process.

Comment 1.11: Roads including Road Surfaces, Cut Banks, and Inboard Ditches

Request to eliminate timeline in BPA for County paved roads assessments and scheduling of repairs: The County requests the timeline for compliance for County paved roads be revised or removed for the following reasons:

Sediment Delivery Rate Methodology:
The Staff report acknowledges that sediment coming off of public roads is a high priority for implementation of the TMDL, however the report admits that the contribution of sediment from paved County roads is most likely not as critical an issue as sediment coming from unpaved public roads on State Parks or NPS lands. Never-the-less, the BPA directs the County, within five years of TMDL adoption, to conduct an inventory of its paved roads within the project area to identify sediment delivery sites, and produce a schedule for treatment to achieve the road sediment delivery performance standard.

We do not agree that the timeline for compliance for County paved roads should be revised or removed. Please see our response to comment 1.5, where we make the points that: a) at present it is not possible to accurately predict future sediment discharge from County paved roads, and whether or not they are meeting the road performance standard, absent conducting a field inventory of these roads; and b) paved public roads, in some cases, can have very high rates of sediment delivery; note the Dry Creek/Napa River example (Pacific Watershed Associates, 2003).

County staff reviewed the findings in the Staff Report and have the following issues with the methodology used to calculate Road Sediment Delivery Rates from County *paved* roads. Sediment delivery rates for all roads in the watershed were generated by Stillwater Sciences for the purposes of the TMDL. Sediment delivery rates for all roads in the watershed were then doubled by Water Board staff based on prior assessments conducted on steep, unpaved fire roads and trails in the upper watershed. The 200% increase also took into account the potential risk of failure at culverts and storm drains on these types of road systems. The increased rate of sediment delivery generated from unpaved roads and crossings was then applied to all roads in the watershed including County paved roads. According to the Staff Report and BPA:

To ensure that effective sediment source controls are implemented on all public roads – unpaved and paved – consistent with the State Nonpoint Source Program, WDRs, or a conditional waiver of WDRs is required to meet the road sediment delivery performance standard (Table 4.2). Whether through adoption of a conditional waiver or adoption of WDRs, the required actions are as follows:

The County of Marin Department of Public Works, within five years of TMDL adoption, must conduct an inventory of its paved roads within the project area to identify sediment delivery sites and produce a schedule for treatment, as needed to achieve road sediment delivery performance standard listed in Table 4.2 of the BPA.

The analysis performed by Stillwater Sciences of sediment delivery from roads utilized a modeling approach, which only calculates sediment delivery from surface erosion processes (acting on unpaved road surfaces, and cut banks and inboard ditches along both paved and unpaved roads). The model does not estimate sediment delivery from road-related gullies and landslides that result from concentration and/or diversion of road drainage and watershed runoff. The model also is sensitive to the proximity of the road to a channel, and it calculates a uniform surface erosion rate along the inboard ditch, cut bank, and unpaved road surface, that is a function of traffic levels, road dimensions, and other parameters.

Typically, we note that County paved roads are wider than most of the unpaved roads in the project area and therefore will have larger inboard ditches (and/or convey greater runoff). Cut bank heights should be similar to conditions on unpaved roads, as unpaved roads were

inventoried throughout the project area, on ranches and parklands, many of which are ridge roads (narrow and no cutbank) or roads that parallel stream channels in their valleys.

Pacific Watershed Associates (PWA, 2007a, 2007b, and 2010) conducted field inventories of unpaved roads throughout the project area, which included estimation of sediment delivery for surface erosion processes and also sediment delivery from road-related concentration and/or diversion of runoff. PWA's estimate of sediment delivery from surface erosion processes acting on bare earth surfaces (unpaved road tread, inboard ditch, and cut bank) was two-times as large as the modelled rates calculated by Stillwater. PWA also estimated road-related sediment delivery from road crossing erosion and/or diversion and also landslides (that is sediment delivery caused by road-related concentration or diversion of runoff), and estimated that this was approximately as large as the amount contributed by surface erosion processes.

In order to ensure that all road-related sediment deliver was accounted for, we doubled Stillwater's overall estimate of road-related sediment delivery (for all roads throughout the project area), resulting in a 100% increase in our estimate of total sediment delivery from all roads in the project area.

We note that the TMDL and Habitat Enhancement Plan were peer reviewed and the reviewers agreed that road-related sediment was a problem and did not question our analysis. The best way to estimate road-related sediment will be when Marin County Public Works conducts a field inventory of County paved roads in the project area and develops a sufficiently accurate estimate of future sediment delivery. This can then be used to guide decision-making with regard to operation and maintenance and/or prioritization of repairs and retrofits.

Comment 1.12: Inequitable Regulation Amongst Agencies
The County maintains 25 miles of paved roads in the Lagunitas Creek watershed, where the estimated sediment delivery rates were increased by 200% using approximations from unpaved roads. Board staff, when questioned about this, responded saying they do not know if there is a sediment delivery problem associated with County paved roads, but never-the-less the BPA is requiring the County to conduct inventories and produce a schedule for treatment within five years of BPA adoption. The staff report also states that the California State Parks, and the US National Park Service, must control sediment delivery sites on unpaved roads to achieve the performance standard, however no timeline was stipulated. Several places in the staff report point to higher sediment delivery rates from unpaved roads vs. paved roads, yet Marin County Public Works was given a strict timeline for assessment and scheduling and public agencies with unpaved roads were given no immediate timeline for compliance with assessments. Aside from being inequitable, it does not treat sediment sources off of unpaved roads with the same urgency as paved roads, which contrary to the goals and objectives of the TMDL.

Please see our responses above where we describe the concerns regarding potential sediment delivery from County paved roads and rationale for requiring an inventory. As for the timeline

for completing a field inventory to assess road sediment delivery from County paved roads, we note that such inventories have already been completed on all unpaved public roads within the project area. That is why the other public agencies were not required to complete an inventory within five years. MMWD and the Marin County Open Space District have also already achieved the road sediment delivery performance standards for unpaved roads under their jurisdiction and therefore do not need to take additional actions. All other public agencies who operate roads – the California Department of Parks and Recreation, the U.S. National Park Service, and the County of Marin, Department of Public Works, are being required by the Basin Plan amendment to submit a schedule for actions (over the 20-year TMDL implementation period) to achieve the road sediment delivery performance standard. All proposed requirements for public agencies with regard to inventory and control of road-related sediment delivery to channels are equitable and consistent.

Comment 1.13: Cost of implementation to Marin County Public Works: The County maintains 25 miles of paved roads and four miles of roadside ditches in the Lagunitas Creek watershed. The staff report estimates the cost of sediment reduction from publically owned paved roads at $1.3 million, and the pro-rated cost to the County is then estimated to be slightly greater than $800,000.

Please note that we chose conservative cost estimates ($150 per cubic yard of sediment savings); actual costs should be lower. If the County-prepared road inventory shows that the road-related performance standards are already being met, these predicted costs would be dramatically reduced. All parties have until 2034 to achieve the performance standards and load allocations for roads, sufficient time to prioritize and budget for actions.

Comment 1.14: Need for grants for implementation: The County has an active fisheries restoration program that has committed resources to eight high priority projects including fish passage barrier removal and installation of woody debris structures within the Landowner Assistance Program. These projects are always grant funded with a modest match from the County. Receiving a costly unfunded mandate from the Board to conduct road inventories on paved road systems, has the potential to detract from already established restoration priorities and funds. Furthermore, the County *does not have* the funds to conduct these types of inventories and repairs without substantial grant funding and grants to work on paved roads are difficult to obtain, given the more urgent need to address sedimentation from unpaved roads. Therefore, in order for this action item to be implemented on schedule with the TMDL, the Board should provide the funding necessary to complete the road related inventories and repairs for paved roads as needed and in accordance with the cost estimate generated in the staff report.

We disagree that this is an unfunded mandate. The Board has authority based on Water Code section 13267 to require the County, as a discharger of sediment to an impaired waterbody, to conduct the inventory. We assert that the burden of compliance bears a reasonable relationship to the need for the work and the potential benefits. We estimate that a road erosion inventory

for the County's paved roads within the project area to be $60-to-120,000 (Napolitano, 2014). Where County paved roads are found to be discharging high rates of sediment to channels, the drainage infrastructure, by definition, would also be quite vulnerable to damage or failure during large storms. Planned, pro-active retrofits or replacements of poorly functioning drainage structures along the roads are generally much less expensive than emergency repairs. Also, as noted above, there is a 20-year period for implementation/achievement of the TMDL, so it is possible to schedule and prioritize any necessary repairs, retrofits, or replacements accordingly, so that the cost in any given year is not too large. Finally, if the cost does turn out to be $800,000 for the County to achieve the road sediment delivery performance standard, then the annual cost throughout the 20-year implementation period would be $40,000 per year.

Comment 1.15: Road maintenance standards, NPDES, and partnership with Marin County Stormwater Program

The staff report and BPA requires all public agencies to adopt and implement road maintenance guidelines to protect aquatic habitat, water quality; conduct an annual training program for maintenance staff, and once every three years submit a report that documents implementation, and/or recommends adaptive updates to the maintenance practices. As part of the FishNet 4C program, the County has already met these requirements The County requests that these previous efforts be recognized as complying with the BPA.

We concur that the FishNet 4C Guidelines (FishNet 4C, 2004) satisfy the road maintenance guidelines requirement. We recognize the County for its leadership and effort in this area. Please also see our response to MMWD below (Comment 2.10) where we have revised the frequency of training and reporting so that it would be on a biennial (once every two year) basis. Because the County has already implemented the FishNet 4C Guidelines, the required ongoing training and reporting should be fairly straightforward to implement.

Comment 1.16: As well, the County is currently implementing the Phase II Small MS4 General NPDES ("Stormwater") Permit (WQO 2013-0001-DWQ). The permit boundary overlaps with the Lagunitas Creek sediment TMDL project area only within the Woodacre CDP (Census Designated Place). However, the stormwater permit requirements do support some of the Basin Plan amendment requirements for County roads. Specifically, section E.11.f and E.11.g require the County to assess and prioritize maintenance of the storm drain system within the permit area which would be undertaken within the Woodacre CDP within the schedule established in the permit. In addition, section E.11.h requires the County to develop and implement a program to assess Operations & Maintenance activities and subsequently develop and implement applicable Best management Practices for road and parking lot maintenance, bridge maintenance, and Right-Of-Way maintenance. We request permission to focus on Woodacre CDP before transferring any knowledge acquired through the NPDES permit compliance program to other roadway segments within the Lagunitas Creek watershed.

We support the County starting in Woodacre, but we fully expect the County to comply with the overall schedule and requirements as proposed in the BPA. In short, we need to have properly functioning roads throughout the project area, roads that will not discharge high rates of sediment in future years, so that we can restore properly functioning substrate conditions in the Lagunitas Creek watershed. Investments in road erosion inventory and control throughout the project area will provide a strong basis for prioritization, will yield environmental and fiscal benefits, and will also enhance road conditions and public safety.

Comment Letter No. 2: Marin Municipal Water District

(General Comments)

Comment 2.1: To begin, we'd like to acknowledge the involvement of Regional Board staff in Lagunitas Creek and the Technical Advisory Committee. Your involvement has been enormously helpful to MMWD's fisheries work, particularly for expanding our understanding of geomorphic processes and their impacts on salmonid populations. We also appreciate your efforts to meet with and seek input from MMWD and the Lagunitas TAC regarding the TMDL. We expect and rely on the involvement of Regional Board staff in the stewardship of Lagunitas Creek. Your expertise and presence is crucial to successful implementation of the Lagunitas Sediment TMDL. We look forward to an ongoing collaboration with the Regional Board for many years to come.

Thank you for the acknowledgements. We also look forward to ongoing collaboration.

Comment 2.2: The approach to achieve sediment reduction and habitat enhancement is very much in line with the approach and goals MMWD identified in our 2011 *Lagunitas Creek Stewardship Plan*; this plan addresses actions to be taken by MMWD to manage the habitat of Lagunitas Creek for the benefit of populations of coho salmon, steelhead, and California freshwater shrimp. We would appreciate seeing this plan referenced in the Sediment TMDL.

In response, we have added the language shown in underlined text to the Staff Report:

"**6.1 Introduction/Overview**

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Channel incision is the result of multiple direct and indirect historical and ongoing disturbances occurring throughout the watershed. Working together watershed stakeholders can implement projects to address channel incision by restoring a balance between channel sediment transport capacity and supply, and partially restoring channel habitat complexity and connection to the floodplain. Actions would include installation of engineered log jams and riparian management and restoration efforts to substantially increase the number and size of large fallen trees in channels, and projects to reconnect the channel to its floodplain in reaches where these actions would not threaten public safety or damage property. <u>These actions are consistent with and build upon *the Lagunitas Creek Stewardship Plan* (MMWD, 2011b)."</u>

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Comment 2.3: We applaud the RWQCB's approach to achieve sediment management and habitat improvement through floodplain restoration and woody debris enhancement. These are innovative and non-regulatory approaches that have clearly grown out of the studies, assessments, and monitoring results specific to the conditions in Lagunitas Creek.

Thank you for the comments and support.

Comment 2.4: The Lagunitas Sediment TMDL advocates for a number of habitat enhancement projects to improve streambed conditions in the creek. The Regional Board could assist by streamlining the permit process, which is often arduous and causes unnecessary delays.

The Basin Plan amendment emphasizes channel habitat enhancement and floodplain reconnection. We think these actions are essential to help recover federally-listed populations of coho salmon, steelhead, and California freshwater shrimp. We will continue to work to improve the permit approval process for restoration projects regionwide.

<u>Comments specific to the Basin Plan Amendment</u>

Comment 2.5: The BPA references the TMDL as a percentage of the natural background sediment delivery rate but never mentions what that natural background rate is; this should be mentioned or discussed in the BPA. Based upon the text and Tables 2a, 2b, 3a, and 3b, it appears that natural background sediment loading was about 6,200 metric tons/year upstream of Devils Gulch and about 10,800 metric tons/year upstream of Olema Creek.

We concur and have revised the Basin Plan amendment to list the calculated natural background supply as footnotes to Tables 3a through 3c as indicated below:

Table 3a: Load Allocations for Sediment Discharges Upstream of Devils Gulch

Source category	Load during 1983-2008		Estimated reductions needed (percentage)	Load allocations	
	Metric tons/year	Percentage of Natural Background		Metric tons/year	Percentage of Natural Background
Landslides, Gullies, and Soil Creep	2,600	42	50	1,300	21
⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮
Total	14,100	227	48	7,400	119
Note: Natural background for Lagunitas upstream of Devils Gulch = 6200 metric tons/year					

Table 3b: Load Allocations for Sediment Discharges Upstream of Olema Creek

Source category	Load during 1983-2008		Estimated reductions needed (percentage)	Load allocations	
	Metric tons/year	Percentage of Natural Background		Metric tons/year	Percentage of Natural Background
Landslides, Gullies, and Soil Creep	5,600	53	50	2,800	26
⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮
Total	22,100	209	47	11,800	110

Note: natural background for Lagunitas upstream of Olema Creek = 10,700 metric tons/year

Table 3c: Wasteload Allocations for Stormwater upstream of Olema Creek

Source Category	Current Load		Reductions needed (percentage)	Wasteload Allocations	
	Metric tons/year	Percentage of Natural Background		Metric tons/year	Percent of Natural Background
Construction Stormwater NPDES Permit No. CAS000002	30	0.3	0	80	0.3
Municipal Stormwater NPDES Permit No. CAS000004	70	0.7	0	20	0.7
TOTAL	**100**	**1.0**	**0**	**100**	**1.0**

Note: Above estimates for loads, percent reductions, and allocations are rounded to two significant figures. Natural background for Lagunitas Creek upstream of Olema Creek = 10,700 metric tons/year.

Comment 2.6: The BPA correctly states that coho salmon, steelhead trout, and California freshwater shrimp are all listed under the federal Endangered Species Act. It should note that coho and freshwater shrimp are also listed under the California Endangered Species Act.

We agree and have revised the Basin Plan amendment as follows:

"Lagunitas Creek provides essential habitat for coho salmon, steelhead trout, and California freshwater shrimp, all of which are listed under the federal Endangered Species Act (coho salmon and California freshwater shrimp also are listed under the California Endangered Species Act)."

Comment 2.7: We agree that streambed scour can be a source of mortality to incubating salmonid eggs (see comments on the Staff Report below) and so we appreciate that Table 1 of the BPA includes a redd scour target. However, the BPA should give a bit more context to the issue of redd scour and explain why it is one of the targets for sediment reduction and habitat enhancement. It may also be informative to explain that the approach to reduce redd scour is to reduce fine sediments, coarsen the streambed, and reduce the probability or frequency for scour. The scour studies conducted by Balance Hydrologics (2010) and Stillwater Sciences (2008) basically concluded that bed scour did not appear to be as big of a problem as we thought it might be, at least in mainstem Lagunitas Creek. The BPA should explain why and where in the watershed redd scour is a concern that warrants a target for improvement. Perhaps pulling more information from the Staff Report into the BPA would sufficiently do this.

In response, we have added the following introductory language to the Basin Plan amendment:

"**Numeric Targets**

Increased rate and fining of the bed material supply, channel incision, and a reduction in the number and size of large fallen trees in channels, have all contributed to high to very high rates of streambed mobility and scour in tributaries to Lagunitas Creek that provide important spawning habitat for coho salmon and steelhead, including Arroyo, Cheda, and San Geronimo creeks, and Devils Gulch. To restore properly functioning conditions, we call for actions to substantially reduce sand supply to Lagunitas Creek and its tributaries, to substantially increase the amount of large woody debris in channels, and, where safe and feasible, to reconnect the channel to its floodplain. As such we proposed the following targets for streambed mobility and redd scour."

Meeting the numeric targets listed in Table 1 will allow water quality in Lagunitas Creek and its tributaries to achieve the narrative water quality objectives for sediment, settleable material, and population and community ecology.

Comment 2.8: Measuring and monitoring Tau-Star will need to be developed and refined through implementation of the Sediment TMDL and this should happen in collaboration with MMWD. Tau-Star is a difficult concept to understand and it is not easily measured. Interpretation of the data can vary depending upon the assumptions of sheer stress that are used. This could limit the effectiveness of using Tau-Star as a sediment target. MMWD's sediment monitoring plan does includes periodic measurements at selected sampling sites to analyze Tau-Star and the metric q^*, a theoretical fluvial geomorphologic index of the state of sediment supply in relation to sediment transport capacity. Our monitoring efforts will be informative to the RWQCB for evaluating streambed mobility. For example, our 2012 monitoring data found Tau-Star in some locations to be within the 0.003 – 0.006 range of the Sediment TMDL but overall the mean Tau-Star from all sites was 0.2. We recommend the BPA identify an ongoing collaboration with MMWD to work adaptively towards the bed mobility target of the Sediment TMDL.

We look forward to the opportunity to work in collaboration and have added the following underlined text to the Evaluation and Monitoring section of the Basin Plan amendment:

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"In-channel effectiveness monitoring should be conducted by local government agencies … to evaluate attainment of water quality objectives for settleable material. Water Board staff will work collaboratively with local partners to develop and refine the in-channel effectiveness monitoring program."

We also note that it is our intention to adaptively implement as described in the Basin Plan amendment.

Comment 2.9: The BPA (on page 9) calls for all public agencies to develop and implement road maintenance guidelines. It also requires annual training of road maintenance staff and reports every three years. We recommend the trainings be conducted no more frequently than every other year and a brief report could coincide with the training efforts. This frequency should be more than sufficient for agency staff to stay current on road maintenance practices and to review maintenance activities. We would also encourage agency inspectors and contractors to participate in the trainings.

We agree that having the timing of the training and reporting coordinated, so that they both are on the same two-year cycle, is a reasonable request. As such, the Implementation Plan section of the Basin Plan amendment has been modified as follows:

"3. All public agencies with jurisdiction over roads within the project area must adopt and implement road maintenance guidelines to protect aquatic habitat, water quality, and salmonid fisheries; conduct ~~an annual~~ a biennial training program for road maintenance staff, and ~~once every three years~~ biennially submit a report that documents implementation and/or recommends adaptive updates to the maintenance practices."

Comment 2.10: The actions for sediment discharges described in Table 4.1 and 4.2 should include using and updating the GIS database of roads in the Lagunitas Creek watershed that was developed by MMWD. This GIS database provides an inventory of the road network and can also serve to track sedimentation problems, repairs, and monitoring and maintenance activities. The GIS database was developed with the intention of all stakeholders being able to utilize and contribute to it.

We agree that it would be useful for all stakeholders to use and update the GIS database, but it is not necessary to add this as a required implementation action.

Comment 2.11: The BPA acknowledges the roads MOU and it should also acknowledge the 2007 woody debris management MOU.

We agree and, in response, the Basin Plan amendment has been modified to add the underlined text shown:

"**Actions to Enhance Stream-Riparian Habitat Complexity and Connectivity**
Although future sediment delivery from channel incision … Goals for these actions are presented in Table 4.4. Continued implementation of the *Memorandum of Understanding for Woody Debris Management in Lagunitas Creek Watershed* by the Marin Municipal Water District and other public agencies will also contribute to increased large woody debris loading."

Comment 2.12: MMWD's Lagunitas Creek Stewardship Plan describes MMWD as participating in the implementation of winter habitat and floodplain enhancement projects. Rather than be singled out to lead projects to efforts to enhance habitat complexity and connectivity we would prefer to see Table 4.3 of the BPA identify MMWD as pursuing partnerships in these efforts.

We have confidence in the District's intention to help facilitate these actions. As such, we have revised Table 4.3 of the Basin Plan amendment to add the underlined text shown:

Table 4.3: Actions to Enhance Habitat Complexity and Connectivity in Lagunitas Creek and its Tributaries

Stressor	Management Objective(s)	Actions	Implementing Parties	Completion Dates and Notes
Habitat degradation as a result of incision of Lagunitas Creek and its tributaries.	Enhance channel habitat complexity and connectivity as needed to support self-sustaining populations of coho salmon and steelhead and to enhance the overall health of the native fish community. Reduce rates of sediment delivery (associated with incision and accelerated bank erosion) to channels by 67 percent in Lagunitas and San Geronimo creeks and by 33 percent in tributaries to both streams.	1. Develop and implement plans to enhance large woody debris loading and restore natural rates of recruitment to channels, as needed to achieve numeric targets for large woody debris loading (Table 1) and to achieve load allocations for sediment (Tables 3a and 3b). The above plan will include a survey to quantify baseline values for large woody debris loading. 2. Develop detailed technical studies to characterize reach-specific opportunities and priorities for floodplain restoration.	Along San Geronimo Creek and its tributaries, local government agencies or non-profits in partnership with reach-based landowner stewardships will develop and implement projects to enhance habitat complexity and connectivity. Elsewhere in the Lagunitas Creek watershed, the Marin Municipal Water District will ~~lead efforts~~ pursue partnerships to develop and implement projects to enhance habitat complexity and connectivity.	Targets for large woody debris loading will be achieved within 10 years of Basin Plan amendment adoption. Technical studies to characterize reach specific opportunities and priorities for floodplain restoration will be completed within 5 years of Basin Plan amendment adoption. Comply with conditions of Clean Water Act section 401 certifications in the implementation of projects to enhance large woody debris loading and recruitment.

Comment 2.13: The basis for many of the goals for floodplain restoration and woody debris enhancement, in Table 4.4, are not well established in the BPA but they are discussed in the Staff Report. We recommend additional review from the Staff Report be incorporated into the BPA, so that future readers of the BPA will better understand these goals.

The section in the Basin Plan amendment titled "Actions to Enhance Stream-Riparian Habitat Complexity and Connectivity" has been revised to add the underlined text shown:

"Although future sediment delivery from channel incision is … of coho salmon and steelhead is a key factor in their decline. Floodplains and large woody debris jams provide essential high quality rearing habitats and enhance food production for coho salmon, steelhead, and California freshwater shrimp. These features also reduce streambed scour and sort, meter, and store fine sediment, thereby substantially enhancing the diversity of streambed substrate patches. … ."

Comment 2.14: The floodplain restoration goal of storing fine sediment in the floodplain (Table 4.4, goal #4) could be perceived to conflict with the simultaneous goal of increasing fish habitat in the floodplain but staff has described that the dynamic complexity of the floodplain should allow for both goals to be met. The BPA should make mention of this dynamic complexity.

The Staff Report provides context and discussion of this and other issues that involve presentation of considerable background information. The Basin Plan, by design, is brief and focuses upon objectives and standards and the policies and actions to achieve these. The Staff Report is perhaps the most important document contained in the administrative record for the project. It will remain available as a public document throughout the TMDL implementation period and the life of the project.

Comment 2.15: The Lagunitas Sediment TMDL describes that current sediment delivery needs to be reduced by 50 percent, overall, and also a need to reverse channel incision, leading to aggrading the channel to re-engage the floodplain. The BPA should discuss how sediment reduction and aggrading the channel can be simultaneously achieved.

The Basin Plan amendment provides the following context (note: below we *italicize* the text that provides this context):

"Sediment Sources

Field inventories conducted throughout the Lagunitas Creek watershed provide credible estimates of the rates and sizes of sediment delivered to channels in the watershed during water years 1983 through 2008. Based on this work, the Water Board concludes:

1. Sediment supply to Lagunitas Creek was greater than or equal to two times natural background. Hillslope erosion processes considered together with road-related erosion,

accounted for about 40 percent of sediment delivery to Lagunitas Creek. *Human-caused channel incision and associated bank erosion, primarily the result of historical land-use disturbances, accounted for about 60 percent of the supply.*

⋮

In summary, the net result is an elevated amount of fine sediment in the streambed, and substantial simplification of channel habitat structure."

In response to comment 2.15, we also refer you to the following passage in the Basin Plan amendment:

"Actions to Enhance Stream-Riparian Habitat Complexity and Connectivity
Although future sediment delivery from channel incision is predicted to decline substantially as a result of natural process adjustments, absent implementation of a habitat enhancement program, stream-riparian habitat condition will remain substantially degraded."

Comment 2.16: The Adaptive Implementation section of the BPA should mention that Lagunitas Creek has been identified as a life-cycle monitoring station in the California Department of Fish and Wildlife's (CDFWs) Coastal Monitoring Plan (CMP) and that Lagunitas Sediment TMDL will seek to dovetail with the CMPs evaluations of salmonid population status and trends in the watershed.

In response, the Basin Plan amendment has been revised to add the underlined text shown:

"**Adaptive Implementation**

In concert with the monitoring programs, described above, … in response to changes in the quantity and quality of freshwater habitat. We note that Lagunitas Creek has been identified as a life-cycle monitoring station in the California Department of Fish and Wildlife's Coastal Monitoring Plan (CMP). The Lagunitas Creek Sediment TMDL will seek to dovetail with the CMP's evaluations of salmonid population status and trends in the watershed."

(Comments specific to the Staff Report)

Comment 2.17: The Staff Report should incorporate and reference the *Lagunitas Creek Fine Sediment Investigation* completed for MMWD by O'Connor Environmental Inc. (O'Connor and Rosser 2006). This study focused on fine sediment conditions in Lagunitas Creek and provides a significant body or work that is informative to sediment management and the TMDL.

There is a large body of research regarding habitat and sediment conditions in Lagunitas Creek. Erring on the side of brevity, we chose only to reference and discuss in detail the four reports that were primary sources for the science that informed our policy: Balance Hydrologics (2010), Cover (2102), Stillwater Sciences (2010), and Stillwater Sciences (2008).

Based on review of O'Connor and Rosser (2006) and Bratovich and Kelley (1988), we concur with both researchers' findings that the percentage of fine sediment in the streambed, which was documented in the State Park Reach of Lagunitas Creek during both sampling periods, did not appear to cause significant adverse impacts on hyporheic flow and dissolved oxygen content for incubating eggs and alevins. The proposed actions will greatly reduce sand supply and, therefore, result in enhanced incubation environment for incubating eggs and alevins.

Comment 2.18: Scouring of salmonid redds can be a significant source of early life-stage mortality in the Lagunitas Creek watershed and so we agree with the goal of reducing redd scour. Any redd scour target should apply to floods that are frequent enough to impact salmonid populations with some regularity, so applying the target to floods with a recurrence interval of approximately five years seems reasonable. Monitoring would need to take place over many years and in many locations to document scour at these intermediate flows. What frequency and duration of redd monitoring is likely to be necessary to determine compliance with the redd scour numeric target? How should the burden of this monitoring effort be shared among agencies? As mentioned above, we recommend further collaboration to monitor redd scour.

The redd scour target applies to the median depth of scour in all spawning sites in winter runoff events less than or equal to the 5-year flood. Water Board staff will work with the Lagunitas TAC to develop a detailed monitoring plan including site selection, number of sites, monitoring protocols, frequency of monitoring, etc. Monitoring including plan development would qualify for potential funding under the Clean Water Act 319h grant program administered by the State Water Board. Because there is only a 20 percent probability of getting a 5-year flood in any given wet season, one way attainment of the target could be evaluated (absent monitoring a 5-year event) would be to develop a curve where we compare median depth of scour to flow magnitude recurrence interval and/or estimated shear stress (for such a flow). We then could extrapolate or infer response to a 5-year event. We look forward to working with the District and other agencies and stakeholders to develop methods of evaluating the success of efforts in the area.

Comment 2.19: The reach of Lagunitas Creek below the confluence with Nicasio Creek ("Lower Lagunitas Creek") is identified as potentially the most promising reach for floodplain restoration (page 84), despite its severe incision and lack of coarse sediment input. The TMDL recommends a feasibility study to investigate floodplain restoration in this reach. We have some questions we would like addressed before moving forward with this feasibility study or any restoration projects.

- **MMWD recently completed the *Lagunitas Creek Salmonid Winter Habitat Assessment Report* (Kamman et al 2013), funded by the CDFW Fisheries Restoration Grant Program. The assessment evaluated the potential for floodplain restoration along the entire mainstem of Lagunitas Creek and determined that restoration in the Lower Lagunitas Creek reach was impractical largely because of the extreme incision of the**

channel. Does Regional Board staff disagree with this determination?

- **The loss of coarse sediments, which are trapped by Nicasio Reservoir, make it difficult to reverse channel degradation in Lower Lagunitas Creek. There may only be a few locations where the floodplain could be effectively reconnected with the channel. Are there process-based restoration actions that could aggrade the stream channel and re-engage the floodplain?**
- **If dredging of Nicasio Reservoir and piping the dredged material to Lagunitas Creek is a consideration, are there likely to be deposits of coarse substrates close enough to the dam to make this a feasible option?**
- **If trucking of dredged material is a consideration, has Regional Board staff considered the carbon emissions resulting from such a project?**

Kamman et al. (2013) did not conclude that floodplain restoration was impracticable in Lower Lagunitas Creek. They proposed two sites in the Lower Lagunitas Reach: sites no. 1 and 2 (Kamman et al., 2013, pp. 26-30 and Figure 16). Nevertheless, we agree that reconnecting a significant portion of Lower Lagunitas Creek to its floodplain would be much larger than anything Kamman et al. considered and likely much more challenging and expensive. That said, potential ecological benefits could be much greater.

As for the impacts of Nicasio Reservoir on gravel supply, and how this might limit feasibility, we note that streambed elevation along Lower Lagunitas Creek appears to be stable because the streambed slope has declined with incision and perhaps the streambed also has coarsened. Adding engineered log jams, and/or increasing width-to-depth ratio and/or channel sinuousity might be sufficient to facilitate aggradation, although the timeframe for reconnecting the channel to the valley flat, absent full restoration of gravel supply, would appear to be many decades to a few centuries.

Dredging Nicasio Reservoir and then transporting gravel into lower Nicasio Creek to restore natural supply should be carefully evaluated because coarse sediment deposition in the reservoir reduces its storage capacity and also substantially impairs habitat complexity and connectivity in Lower Lagunitas Creek. If a gravel augmentation program can be developed, it may be possible to reconnect Lower Lagunitas Creek to its historical floodplain *within a few decades or less*. Gravel augmentation combined with actions to reduce sediment transport capacity in the incised reach – engineered log jams and/or working to establish beaver dams – may be effective in rapidly aggrading the stream to re-engage its floodplain.

It would be speculative at this time to comment on potential impacts with regard to carbon emissions. The first step is to determine if there are feasible restoration approaches that could result in significant ecological benefits. If so, we will evaluate costs and perform a complete analysis of potential environmental effects, as required under the California Environmental Quality Act.

Comment 2.20: As mentioned above, the *Lagunitas Creek Salmonid Winter Habitat Assessment* evaluated the potential for floodplain restoration along the entire mainstem of Lagunitas Creek. That study concluded by identifying floodplain restoration sites within the Tocaloma and Devils Gulch reaches of Lagunitas Creek. These reaches offer some of the best opportunities to re-engage the floodplain and provide the most productive juvenile salmonid rearing habitat. The Lagunitas Sediment TMDL should identify and describe these reaches as priority reaches for floodplain restoration.

Although we are very excited about the projects that will be constructed as a result of the *Lagunitas Creek Salmonid Winter Habitat Assessment* and think this report provides a solid foundation, it is premature to identify priority reaches for floodplain restoration. We believe additional analysis is called for to evaluate and consider the potential for larger scale projects that will substantially increase the amount of high quality floodplain and channel habitat, in particular in Lower Lagunitas and the State Park reaches, where there appears to be very poor winter habitat at present.

Comment 2.21: Road related sediment delivery is still a problem despite many years of work to reduce it. As stated in the Lagunitas Sediment TMDL, "road erosion control projects likely will continue to receive strong support from public agencies providing grants" (page 76). These road improvement projects can achieve sediment reductions but are much less likely than floodplain restoration or woody debris projects to significantly improve habitat, coho salmon survival, or increase the population carrying capacity. In addition, roads account for about 20 percent of the mean annual sediment delivery to Lagunitas Creek and so have a smaller role than in-channel sediment supplies that can be managed through woody debris and floodplain connectivity. We request that the Lagunitas Sediment TMDL include language stating that floodplain restoration and woody debris projects will also receive strong support when awarding grants.

We have revised the Staff Report by adding the underlined as follows to make it clear that these types of projects will receive strong support when awarding grants:

"In summary, increasing large woody debris loading … carrying capacity for juvenile coho salmon and steelhead trout. Upon adoption of the TMDL, the Water Board will identify large woody debris enhancement projects within the Lagunitas Creek watershed as having a priority for funding under the Clean water Act Section 319(h) grant program. "

"In addition to substantial enhancement of habitat complexity … for floodplain restoration with regard to potentially significant carbon sequestration benefits. Upon adoption of the TMDL, the Water Board will identify floodplain restoration projects within the Lagunitas Creek watershed as having a priority for funding under the Clean Water Act Section 319(h) grant program."

Comment 2.22: Devil's Gulch is described as a "redwood channel reach" (page 53), although there's little evidence that this sub-watershed supported abundant redwoods historically. A single old-growth redwood grows along the creek, and redwood stumps are nearly non-existent. Unless stumps were removed during logging operations (which was not the case elsewhere in Samuel P. Taylor State Park), this creek should be considered a "hardwood channel reach."

The Staff Report has been revised as follows:

4.4 Large Woody Debris Loading
Habitat Targets for Redwood Channel Reaches
Within 10 years of adoption of the Basin Plan amendment, … include the Shafter and State Park Reaches of Lagunitas Creek, and most of the length of ~~Devils Gulch and~~ Arroyo Creek.

Comment 2.23: A source of early life stage mortality for coho salmon that was not addressed is predation by age-1+ steelhead (pages 19 and 52). Our monitoring data suggest that early life stage mortality is higher in years following large age-0+ steelhead populations, suggesting that high numbers of age-1+ steelhead decrease coho survival. We have also observed that age-1+ steelhead can appear to have gorged themselves on salmonid fry when both are present in a confined area. Steelhead predation on coho could be reduced by increasing wood loading, as has been proposed to reduce involuntary entrainment.

Thanks for sharing these observations. If predation by 1+ steelhead is a significant source of early life stage mortality for coho, we agree that increases in large woody debris loading would also be beneficial for reducing predation (as a result of enhanced refuge habitat).

Comment 2.24: We strongly support the inclusion of beaver reintroduction as a potential remedy to channel incision. Recent research provide compelling evidence that beavers inhabited coastal drainages near Lagunitas Creek and there's little reason to believe beavers were not native to the creek. Beaver ponds provide excellent winter habitat for coho salmon and could assist in the re-aggradation of the streambed and reconnection of the creek to its floodplain.

We agree and think this approach should be carefully evaluated as part of the proposed study to identify additional opportunities and priorities for floodplain restoration.

Comment Letter No. 3: Dennis Poggio

Comment 3.1: The April 7, 2014 staff presentation was outstanding in consolidating the key points of the TMDL impact upon the Lagunitas Creek watershed. It was refreshing to listen to scientists speak regarding what conditions are negatively affecting our creeks and aquatic life.

Thank you very much for the positive feedback. We appreciated the opportunity to describe the sedimentation and habitat problems and the policies we propose to address these.

Comment 3.2: It is my contention that when the Water Board schedules any and all future public meetings relative to the Lagunitas Creek Watershed, in a public meeting room in the San Geronimo Valley, not only the local residents should be in the audience but also the following public agencies and private property owners must be in mandatory attendance. Those public agencies include but are not limited to:

- **Marin Municipal Water District**
- **Marin Resource Conservation District**
- **County of Marin - Fire Department**
- **County of Marin - Open Space District**
- **County of Marin - County Public Works**
- **County of Marin - Marin County Stormwater Pollution Prevention Program**
- **California State Parks Department**
- **California Department of Fish and Wildlife**
- **Golden Gate National Recreation Area**
- **Private Agricultural businesses that include but not limited to commercial Animal Husbandry to Farming**

I am proposing this list of public/private land owners to attend future Water Board meetings because it is essential to have all affected stakeholders present, and to [be] exposed to what is being proposed by the Water Board and its impact upon each stakeholder's property and how to manage their property to reduce TMDLs.

We cannot compel anyone to attend an informational meeting, and, even if we could, we are not convinced this would be the most productive way to engage parties. We also note that representatives from all of the public agencies listed, except the Marin County Fire Department, attended a related public meeting to discuss the Lagunitas Creek sediment TMDL that took place on April 10, 2013, at the Marin Municipal Water District in Corte Madera, so the public agencies are addressing these issues together.

Overall, the point is valid that there is a real need for ongoing communication among all effected and interested parties and for government agencies to work together and coordinate their actions and programs. We will continue to do our part to communicate with all interested and/or responsible parties and to collaborate and coordinate our actions with our agency counterparts.

Comment 3.3: It would be most helpful to visually and verbally distinguish the specific land boundaries of where: the San Geronimo Creek Watershed begins and end; and Lagunitas Creek Watershed begins and end. This geographic information will greatly assist all West Marin property owners in understanding where these watersheds begin/end.

The *San Geronimo Valley Enhancement Plan* (Stillwater Sciences, 2009) includes several figures/maps that show the land area boundaries for the San Geronimo Creek watershed. Included below is Figure 2.2 from that report that overlays major roads, trails, and large channels on top of a shaded relief map.

In words, we provide the following description of the boundaries of the San Geronimo Creek watershed: "San Geronimo Creek begins in the headwaters of Woodacre Creek and the North Fork of San Geronimo Creek. Its major tributaries include Woodacre Creek, Larsen Creek, and Arroyo Creek. It continues downstream to the confluence of San Geronimo Creek with Lagunitas Creek, approximately at the Shafter Bridge." Adjacent watersheds include San Anselmo Creek, upper Nicasio Creek, and the upper Lagunitas Creek/Kent Lake watershed.

Figure 2.1 in the Staff Report (Water Board, 2014) shows the Lagunitas Creek sediment TMDL project area, outlined in yellow. We also include it here.

Section 2.2 states that the TMDL project area includes "the entire land area and all channels draining into and including Lagunitas Creek, below Kent Lake and Nicasio Reservoir, downstream to the confluence of Lagunitas Creek with Olema Creek." The San Geronimo Creek watershed is included within the TMDL project area.

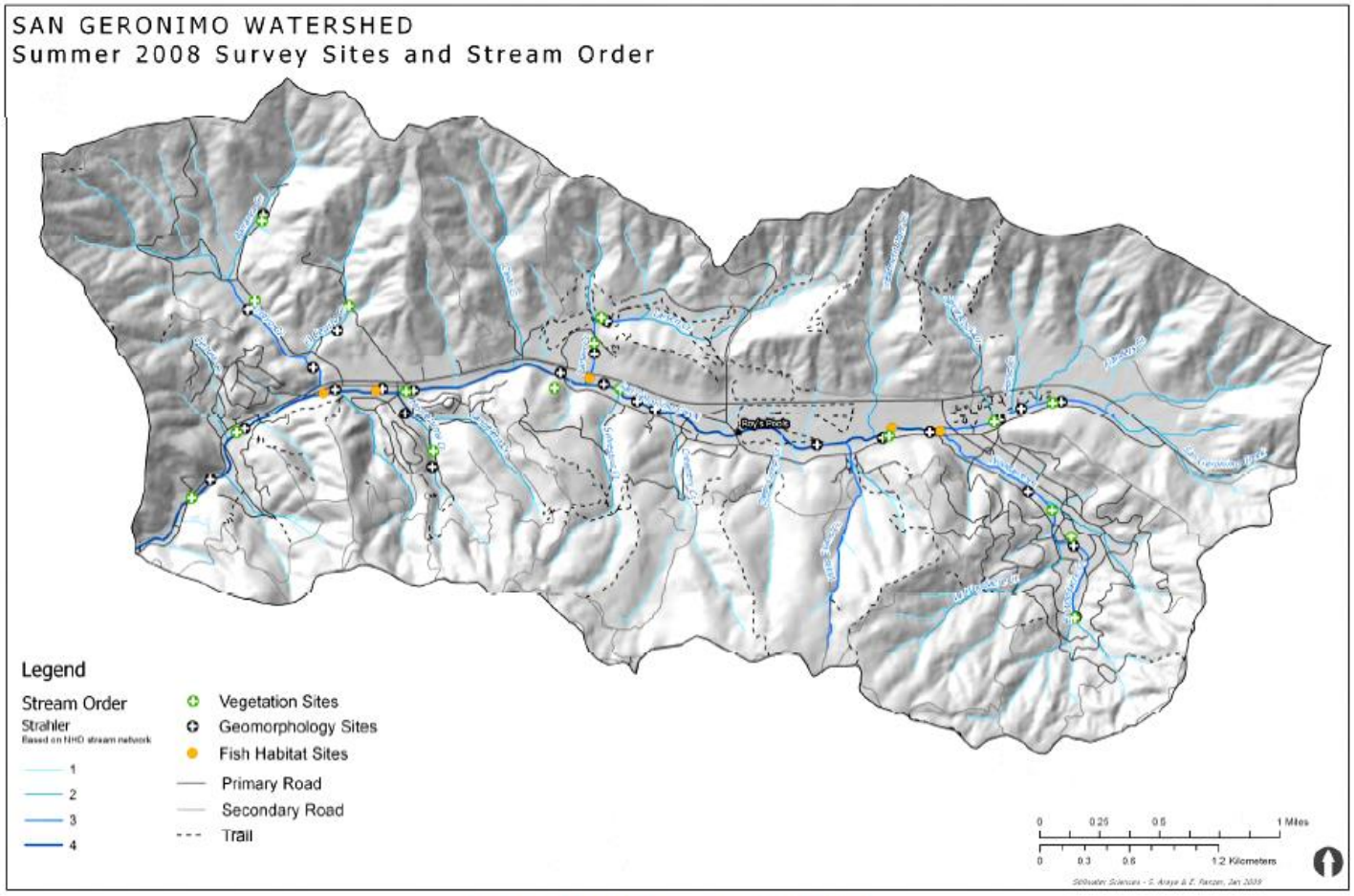

Figure 2-2. Summer 2008 Survey Sites and Stream Order.

Figure 2.1: Lagunitas Creek watershed in western Marin County, California. The TMDL project area (outlined in yellow) includes the entire land area and all channels draining into and including Lagunitas Creek, below Kent Lake and Nicasio Reservoir, downstream to the confluence of Lagunitas Creek with Olema Creek.

Comment 3.4: The scientific terminology in the Lagunitas Creek Watershed Fine Sediment Reduction and Habitat Enhancement Plan is challenging to fully understand. I am proposing that a "Glossary of Concepts/Terms" be included before the "References Cited" section in all future staff reports. This explanation of information will greatly aid the readers to understand what the Water Board is proposing relative to scientific evidence and desired scientific outcomes.

Thank you for this suggestion. We will take the comment into consideration for future staff reports.

Comment 3.5: The proposed Basin Plan mentions "establishing a regulatory program to reduce sediment delivery to channels resulting from road-related erosion". I believe a Water Board Regulatory Program is essential in order to realize a decreased TMDL but the Regulatory Program should describe to affected public or private property owners of the legal/financial consequences for failing to reduce their TMDLs.

When we establish the permit program for sediment discharge from roads, which only will apply to public agencies, it will include specific conditions and describe required submittals (in detail), and it also will describe the process by which the Water Board may consider enforcement. The *Water Quality Enforcement Policy* (State Board, 2009) describes the enforcement process in general.

Comment 3.6: What is the Water Board's Plan to reduce sediment as stated in Table 3a - Load Allocations for Sediment Discharges Upstream of Devils Gulch - 14,100 Metric tons/year compared to Table 3b - Load Allocations for Sediment Discharges Upstream of Olema Creek - 21,000 Metric tons/year? The sediment discharge from Olema Creek is 50% greater than Devils Gulch. It appears Olema Creek is greater need to reduce TMDLs.

Load allocations listed in Tables 3a and 3b in the Basin Plan amendment are for the two locations along Lagunitas creek, where TMDL attainment will be evaluated: Lagunitas Creek upstream of Devils Gulch and Lagunitas Creek upstream of Olema Creek. Primarily because the land area upstream of the confluence of Lagunitas Creek with Devil's Gulch is smaller, the corresponding TMDL is smaller.

In response, we also have revised the headings to Tables 3a and 3b as follows:

Table 3a: Load Allocations for Sediment Discharges to Lagunitas Creek Upstream of Devils Gulch

Source category	Load during 1983-2008		Estimated reductions needed (percentage)	Load allocations	
	Metric tons/year	Percentage of Natural Background		Metric tons/year	Percentage of Natural Background
Landslides, Gullies, and Soil Creep	2,600	42	50	1,300	21
⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮
Total	14,100	227	48	7,400	119

Table 3b: Load Allocations for Sediment Discharges to Lagunitas Creek Upstream of Olema Creek

Source category	Load during 1983-2008		Estimated reductions needed (percentage)	Load allocations	
	Metric tons/year	Percentage of Natural Background		Metric tons/year	Percentage of Natural Background
Landslides, Gullies, and Soil Creep	5,600	53	50	2,800	26
⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮
Total	22,100	209	47	11,800	110

Comment 3.7: The Basin Plan requires the County of Marin - Department of Public Works to conduct within five years of TMDL adoption, an inventory of its paved roads within the project area to identify sediment delivery sites and produce a schedule for treatment to achieve reduced sediment. I recommend that after the TMDL Adoption, the County of Marin - Department of Public Works annually perform an assessment of all their paved roads in West Marin for reducing TMDLs along with plans to reduce those TMDLs to acceptable Water Board levels, not every five years. I would take this road assessment inventory approach further by requiring all public agencies within the Basin Plan perform annual assessment of all non-paved roads and develop a five year plan to reduce TMDLs beginning with those roads/landslides that have contributed the largest amount of sediment into the San Geronimo and Lagunitas Watersheds.

The inventory as currently proposed involves assessment of road drainage and how this may effect erosion and sediment delivery to channels. The road drainage infrastructure already is in place, and it is unlikely it will change substantially on an annual time-step. Although erosion sites related to the roads can change substantially following large storm and/or flood events, one of the primary purposes of the inventory is to identify causes for erosion at specific sites (which do not change). The other purpose is to identify specific treatments (e.g., retrofits to roads, like installation of trash racks on culvert inlets, replacement of culverts, and installation of critical dips to prevent new gullies and landslides from forming). For these reasons, we did not revise the Basin Plan amendment to require an annual inventory.

In contrast, we do expect, through the implementation of road maintenance guidelines (see Basin Plan amendment, Table 4.2), that County staff will perform annual or more frequent inspections of the road drainage infrastructure to guide timely maintenance actions and avoid problems during storms. Note: all of the public agencies identified in Table 4.3 will implement the road maintenance guidelines.

Comment 3.8: Funding to reduce sediment from non-paved road should be provided via federal and Water Board grants.

These projects do qualify for Water Board funding through, for example, the Clean Water Act Section 319(h) grant program. The California Department of Fish and Wildlife, through its Fisheries Restoration Grant Program, also has provided funding for such projects.

Comment 3.9: Which public agency will ensure and provide funds to stakeholders along San Geronimo Creek and its tributaries to develop reach-based stewardships groups to implement channel habitat enhancement projects?

Lagunitas Creek watershed is identified as a priority watershed for funding under the Clean Water Act Section 319(h) grant program. Channel habitat enhancement projects and other restoration actions called for under the Basin Plan amendment are expected to be eligible for funding. Such projects also may qualify for funding from other public agencies including the Fisheries Restoration Grant Program of the California Department of Fish and Wildlife. A few years ago, the State Coastal Conservancy funded a landowner assistance program in the San Geronimo Valley to aid implementation of projects to protect water quality, and habitat and similar projects could be funded in the future.

Comment 3.10: Will the Water Board provide guidance in determining the prioritization of all channel habitat enhancement project? If no, what agency will assume that role?

We have provided a general set of criteria for determining whether such projects might be considered for funding. This is included in the Staff Report, as follows:

"… Examples of the types of channel reaches that may have a high potential for enhancement include those that are:

a) Along the North Fork of San Geronimo Creek, upstream of the Dickson Weir, where it may be safe and feasible to aggrade the channel and reconnect it to a broad historical floodplain;

b) Adjacent to reaches where coho salmon spawning density already is high;

c) At/near tributary confluences, where backwater conditions may be created or enhanced to increase winter rearing habitat capacity for coho salmon and steelhead;

d) In reaches where an inset floodplain can form or be constructed, and/or where an inset floodplain already has formed, and an alcove or side channel could be constructed; and/or

e) Where bank habitat suitable to provide winter high flow refuge habitat for salmonids and other native aquatic species can be created and maintained.[55]

[55] In some locations where bank erosion presents a significant threat to a home or other building, installation of a flow-deflection jam (see below, Figure 6.3) or bank input jam may be effective in providing protection and in creating habitat."

We will provide additional guidance through the request for proposals process for the Clean Water Act 319(h) grant program, and other communication and outreach efforts.

Comment 3.11: What role will the Water Board assume to ensure the channel habitat enhancement projects are streamlined for an individual property owner to obtain public funding/grants for stream permits and having qualified licensed civil/general engineering contractors, besides the Salmon Protection and Watershed Network, bid on these selected habitat enhancement projects in the San Geronimo Creek area?

For projects that are awarded grants from the Water Board, our staff manage the grants and work closely with permit staff at the Water Board and at other responsible agencies to coordinate and streamline the permit review and approval process for restoration actions. All construction activities, as part of a channel habitat enhancement project, would be based on plans and specifications developed by a licensed professional. Non-profit organizations, public agencies, and public colleges are eligible to apply for funding.

Comment 3.12: I suggest the Water Board consider the Marin Resources Conservation District in Point Reyes Station to be the lead agency instead of the California Department of Fish and Wildlife to accomplish these habitat enhancement projects in the San Geronimo Creek Watershed and in the Lagunitas Creek Watershed.

It is possible that the Marin County RCD may be interested in providing assistance to landowners in the development and implementation of channel habitat enhancement projects in

the San Geronimo Valley. Our agency, and the California Department of Fish and Wildlife (CDFW), have worked closely with the RCD on many of these types of projects over the past several decades. Please note that it is unlikely that either the Water Board or CDFW would be a lead agency for development and/or implementation of such a habitat enhancement program. Instead, we would be in the role of providing grant funding and administration, communication and outreach about the projects, permitting, and technical input and review.

Comment 3.13: The Water Board's Proposed Basin Plan Amendment has been long overdue in scientifically determining those impaired West Marin watersheds with excessive TMDL's that are negatively affecting the aquatic habitat in those watersheds.

Comment noted.

Comment 3.14: The Basin Plan is a non-bias scientific document that provides recommended scientific solutions, hopefully funding sources and staffing resources to ensure that the endangered aquatic and vegetation habitat will once again thrive in the West Marin watersheds in the immediate future.

Comment noted.

PART II: STAFF-INITIATED CHANGES TO THE MARCH 10, 2014 DRAFT STAFF REPORT AND PROPOSED BASIN PLAN AMENDMENT

Staff made non-substantive changes to the Basin Plan amendment and Staff Report to correct grammatical and formatting errors. An example of this type of change is shown immediately below:

Change 1: Basin Plan Amendment - Problem Statement

> "Channel incision causes habitat simplification, which herein is defined as the progressive lowering over time of the streambed elevation as a result of net erosion. San Geronimo and Lagunitas creeks and alluvial reaches of their tributaries have incised substantially during the historical period. Channel incision obliterates the basic physical habitat structure of the channel, expressed by a substantial reduction in the frequency and area of ~~gravels~~ gravel bars, riffles, and side channels. If a channel incises …"

Change 2: Basin Plan Amendment – Total Maximum Daily Load and Allocations

Table 3c was revised to be consistent with the analysis presented in the Staff Report to present the correct values for the proposed wasteload allocations.

"Table 3c: Wasteload Allocations for Stormwater upstream of Olema Creek

Source Category	Current Load		Reductions needed (percentage)	Wasteload Allocations	
	Metric tons/year	Percentage of Natural Background		Metric tons/year	Percent of Natural Background
Construction Stormwater NPDES Permit No. CAS000002	30	0.3	0	~~80~~ 30	0.3
Municipal Stormwater NPDES Permit No. CAS000004	70	0.7	0	~~20~~ 70	0.7
TOTAL	**100**	**1.0**	**0**	**100**	**1.0**
Note: Above estimates for loads, percent reductions, and allocations are rounded to two significant figures.					

Change 3 – Staff Report – Waste Load Allocations

Table 5.2 in the Staff Report was revised to be consistent with the analysis presented in Section 3.9 of the Staff Report:

"Table 5.2: Wasteload Allocations for Urban Runoff and Wastewater upstream of Olema Creek

Point Source Category	Current Load		Reductions needed (percentage)	Wasteload Allocations	
	Metric tons/year	Percentage of Natural Background		Metric tons/year	Percent of Natural Background
Construction Stormwater NPDES Permit No. CAS000002	~~80~~ 30	**~~0.8~~ 0.3**	**0**	~~50~~ 30	**~~0.8~~ 0.3**
Municipal Stormwater NPDES Permit No. CAS000004	**~~20~~ 70**	**~~0.2~~ 0.7**	**0**	**~~20~~ 70**	**~~0.2~~ 0.7**
TOTAL	**100**	**1**	**0**	**100**	**1**

Note: Above estimates for loads, percent reductions, and allocations are rounded to two significant figures."

PART III: STAFF RESPONSES TO PEER REVIEW OF THE MARCH 7, 2013 DRAFT STAFF REPORT AND BASIN PLAN AMENDMENT

Response to Comments Submitted by Dr. John G. Williams

Comment W-1 (Study area description): The staff report did not include a detailed description of the study area, which is needed to distinguish where and how the channel attributes change (e.g., alluvial reaches, bedrock reaches, streambed slope, depth of incision, riparian vegetation, etc.).

Response to Comment W-1:
To address this comment, we added Appendix I, a detailed description of the study area, and detailed shaded relief maps to illustrate landform attributes.

Comment W-2 (Stream connectivity, role of large woody debris, and influence of debris flows):
With regard to channel connectivity and the role of large woody debris, the report cites studies of stream systems that are not similar to Lagunitas Creek. Sonoma Creek and the Napa River are not appropriate analogs to Lagunitas because both are more unconfined and have lower slopes. Similarly, with regard to extrapolating the role of large woody debris in shaping channels, the report seems to rely too heavily on studies of the Queets River, which is fully alluvial and unconfined. It appears that Lagunitas Creek only becomes fully alluvial near Point Reyes Station, and it probably is much more subject to the influence of debris flows.
Regarding connectivity, the report seems not to distinguish two different phenomena. In one case, tributaries are disconnected from the channel because normally water sinks into permeable canyon fills or fans, and reaches the larger stream by subsurface flow. … In the other case, tributaries may not join, or be delayed in joining, the stream because they are blocked by natural levees, or streams may flow into one side of a wetland and out the other, as reported for Sonoma Creek by Dawson et al. (2008). My hunch is that the Redwood Creek sort of disconnection may well have applied in the San Geronimo Valley, based on the topography, but that Lagunitas Creek is too steep and too confined for the Sonoma Creek sort. These situations should be distinguished in the report.

Response to Comment W-2:
Stream connectivity: In referencing the Napa River and Sonoma Creek, we intended to call attention to the alluvial fan type of disconnection. To avoid confusion, and demonstrate that natural tributary disconnection – resulting from alluvial fan deposition – likely also occurred along San Geronimo Creek, Nicasio Creek, and Lagunitas Creek (in its Tocaloma and Lower reaches) - we now rely instead on references to Miller Creek (added) and Redwood Creek in Marin County (as previously cited in the peer review draft), which are similar to Lagunitas and its tributaries, with regard to streambed slope and valley confinement.

Role of large woody debris: The Queets River research (Abbe and Montgomery, 2003) documents process-form relationships for debris jams throughout the channel network including

steep confined tributary channels with modest drainage area, and continuing downstream to the lower Queets River, a very broad unconfined alluvial channel. For example:

> "Interpretation of 1:12,000 color infrared aerial photos taken during low-flow conditions in August 1993, together with field surveys during the summers of 1993–1995, were used to map and measure WD jams in ≈75 km of the mainstem Queets river and 16 km of tributary channels whose widths range in size from 2 to over 150 m." (Abbe and Montgomery, 2003, p.83)

> "Bench jams observed in channels with gradients up to 20% substantially extend the upstream limits of floodplain landforms in the tributaries we examined." (Abbe and Montgomery, 2003, p. 92)

Although we do feature the Queets River watershed research prominently (because it characterizes the role and significance of large woody debris throughout the channel network including large alluvial channels), we also call attention to studies of smaller channels, both confined and unconfined, draining old-growth coast redwood forests (Keller et al., 1995), and other locations (Sear et al., 2010) to support the primary elements of our channel reference model: a) incised channel reaches were uncommon; b) large woody debris was the primary agent shaping complex channel habitat and for the formation of multiple-thread channels in some reaches; and c) channels typically were much wider, shallower, and more complex prior to disturbance.

Montgomery et al. (2003) which we cited in the peer review draft, and more recently also a review article by Wohl (2013), provide strong support for the importance of large woody debris in shaping channels and floodplains in streams draining forested areas.

Influence of debris flows in shaping valley floor deposits: We revised the public review draft of the Staff Report to include the following information about channel attributes that bears upon the influence of debris flows in shaping habitat (in Appendix I):

> "In the State Park Reach, although the lower reaches of many tributaries are steep enough to transport debris flows (they have slopes ≥ 3 percent), such debris flows are deposited in the tributaries and/or at or near their confluences with Lagunitas Creek, because Lagunitas Creek (slope = 0.25-to-1 percent) is not steep enough for the debris flows to remain entrained along its channel[1]. Therefore, debris flows are not significant in shaping Lagunitas Creek and/or its valley except at/near its confluences with steep tributaries.
>
> [1] Debris flows are deposited commonly at slopes of 3-to-10 percent in channels with watershed areas between 1 and 10 km^2 (Stock and Dietrich, 2006). Lagunitas Creek in the State Park Reach has a much more gentle slope (less than 1 percent) and a much larger drainage area ≥ 80 km^2, and hence, any debris flows that continue in transport through the tributaries and into Lagunitas Creek would be deposited immediately at/near the tributary confluence (e.g., see description of debris flow deposition and channel changes described in Balance Hydrologics, 2010, Appendix C). In the State Park reach, at/near the confluences of Lagunitas Creek with its steep tributaries, debris flows likely are important sources of coarse sediment and large woody debris delivery, and agents for shaping complex habitat."

"Based on interpretation of exposures at sites of active bank erosion, the valley floor deposits are comprised predominantly of floodplain deposits (Stillwater Sciences, 2010, p.40)."

Comment W-3 (Debris flow observations): Based on my own observations in central and northern California streams, debris flows can create terraces of poorly sorted, angular to sub-angular sediments in an aggradation-incision sequence in a single high flow event. Debris flow typically occur during intense rainfall on already wet ground, so the elevation of the terrace reflects both the usually high flow at the time and the temporary aggradation immediately after the flow reaches the stream, and so can be relatively high above the channel, although silt may still be deposited on the terraces during infrequent floods, especially if they are vegetated.

Response to Comment W-3:
In addition to response W-2, immediately above, we also wish to draw your attention to the documented responses to debris flow generation during the January 4-5, 1982 storm, both in the Lagunitas Creek watershed, and throughout the Central California Coast Range.

The response of Lagunitas Creek in the State Park Reach to the January 4-5, 1982 storm is described in HEA (1983) and net changes in streambed elevation are reported in Balance Hydrologics (1988). 48-hour rainfall totals at precipitation stations located within the watershed (at Alpine Lake, Kent Lake, and Lake Lagunitas) are estimated to have had recurrence intervals of 40-to-100 years (Brown, 1988, Table 1.4, p. 14). Although, there were a very large number of debris flows mapped in the Lagunitas Creek watershed (Ellen and Wieczorek, 1988, Plate 5), some of which entered directly into Lagunitas creek in the State Park Reach, the net average change in bed elevation in Lagunitas Creek (measured in the summer of 1982) was only 0.2 feet of fill, and this fill was not sustained. There are no descriptions of substantial overbank deposition or rapid and persistent channel aggradation in the State Park Reach. Also, more recently, we note that the debris flows described in Balance Hydrologics (2010) that entered the channel near the Big Bend, did not result in significant overbank deposition or massive channel aggradation. Instead, the net effect was modest aggradation and expansion of local gravel bars. Fluvial processes reworked this input and transported much of it through the reach.

Elsewhere in streams in the Santa Cruz Mountains, that share similar-or-higher uplift rates and natural sediment supply as compared to Lagunitas Creek, Nolan and Marron (1988) documented a modest response of moderately confined gravel-bedded pool-riffle channels (e.g., the same type of channels as Lagunitas Creek) in the Santa Cruz Mountains in response to the January 4-5, 1982 storm. They also contrast this response to the dramatic channel changes and aggradation that occurred in these types of channels in northwestern California following the December 1964 storm. They suggest the contrast is best explained by much lower sediment delivery to, and storage in channel, in the Santa Cruz Mountains as compared to northwestern California, and also that much of the sediment delivered to channel in the Santa Cruz Mountains is sand in size. As a result, channels in the Santa Cruz Mountains are much more effective in transporting sediment during large storms, and resultant changes typically are much less significant and persistent.

Comment W-4 (The report depends heavily on idea that, in a properly functioning unconfined stream, water will spill out of the channel onto the floodplain about every two years on average. This recurrence interval is well established for some streams, such as snowmelt dominated streams draining the east slope of the Rocky Mountains, but I am unaware of studies making a convincing case that the idea also holds for streams in coastal California. They may exist, and if so, should be cited. On the other hand, Nolan et al. (1987) reported that the recurrence interval for bankfull flows in in five streams in northwestern California is 10 years or more "because floodplain formation appears to be due more to overbank deposition during large sediment-laden discharges than to lateral channel migration and point bar formation."

Response to Comment W-4: Please see our response immediately above and note the following:

Lagunitas Creek in the Tocaloma Reach spills onto its floodplain during 1-to-2 year event: At present in the Tocaloma Reach, the elevation of the channel bed in many locations is not much (< 1 meter) below the height of the valley flat/floodplain. This occurs in reaches where channel-spanning debris jams effectively trap bedload and cause aggradation. It is common in this reach for side channels and/or most of the floodplain to be inundated during runoff events with peaks flows with recurrence intervals of 1-to-2 years (see Figure 12 in Kamman et al., 2013).

The valley flat adjacent to Lagunitas Creek in the Lower Lagunitas Reach appears to have been an active floodplain during the historical period. Prior to incision, this reach likely functioned similarly to the Tocaloma Reach, with most of the valley flat being inundated during the annual flood or more frequently. Although this reach is deeply incised at present (10-to-20 feet in most locations), we hypothesize that all-or-most of the incision occurred during the historical period as evidenced by: a) riparian trees that are less than 50 years old growing adjacent to the channel with exposed roots perched uniformly about 6 feet above the streambed; and b) the channel bed in this reach is only a few feet above sea level. Prior to construction of Nicasio Reservoir in 1961, gravel supply to the Lower Lagunitas Reach was very high (total sediment supply to Nicasio Creek upstream of the dam has averaged 350 tons/km^2/year since dam closure; also, there used to be a large gravel mining operation on Lagunitas Creek immediately downstream of its confluence with Nicasio Creek). Dam construction, gravel mining, and/or possible historical ditching and draining of the valley flat for agriculture, all may have contributed to historical incision.

In the State Park Reach, prior to disturbance, large fallen old-growth redwood trees would act as key pieces, and cause a patchwork floodplains to form. As described in Abbe and Montgomery (2003) and Montgomery and Abbe (2006), valley jams and/or bench jams which can be deposited in confined and/or moderately confined and fairly steep stream channels, can form patchwork floodplains with surfaces of variable elevation (including surfaces that are several meters above the bankfull channel) that are formed by logjam forced channel aggradation. Montgomery and Abbe (2006) note the following:

> "Our surveys show that local bed aggradation associated with logjams not only influences channel patterns and profiles but leads to development of a patchwork of elevated

landforms that can coalesce to form portions of the valley bottom with substantial (i.e., 1 to >4 m) relief above the bankfull elevation." (p. 147)

"The ability of logjams to form alluvial surfaces up to several meters higher than the bankfull elevation has been recognized for many years in steep confined channels (e.g., Keller and Swanson, 1979; Montgomery et al., 1996). In our surveys of the Queets River basin, the effects of logjams on channel aggradation were most dramatic in steep tributaries (those with slopes of 0.04–0.20) where valley-spanning jams elevated channels up to 5–11 m … " (p. 152)

"Consequently, we propose that formation of individual floodplains may be considered to reflect the competing influences of point bar migration, overbank deposition, and logjam-forced aggradation. In short, our observations from extensive field surveys in old-growth forest along the Queets River indicate that logjam mediated processes provide a distinct mechanism of floodplain development." (pp. 154-155)

Comment W-5 (Time period of sediment budget): I am concerned that the sediment budget presented in Stillwater Sciences (2010) may cover too short a period (1983-2008) to represent a longer-term average, because channel change and the delivery of sediment to streams in coastal California is highly episodic, occurring largely by debris flows after intense rainfall on already wet terrain, or after fires. … [I]t seems that the budget period began just after major inputs of sediment from the hillslopes. As noted by Stillwater Sciences (2010:80), the proportion of channel-derived sediments in their budget is unusually high, and the period covered may well explain this. Clarification is needed.

Response to Comment W-5: We agree that channel incision inferred in headwater reaches, in some cases might instead be an evacuation of debris flows deposited during the January 4-5, 1982 storm. Given additional resources we would have expanded the timeframe for the sediment budget.

As a practical matter however, this would not influence our policy recommendations because we are not calling for actions to control incision in headwater channels, primarily because potential interventions therein could, under certain circumstances, cause more harm than good, the cost per ton of sediment prevented from future delivery to channels would be very high, and because these actions are not needed to achieve the TMDL.

Comment W-6 (Temporal and spatial scales of incision and size distribution of sediment): The report properly emphasizes incision, which can be expected given the dams and urbanization of Geronimo Valley, but it should pay more attention to temporal and spatial scales and variation. Incision cannot continue forever (Stillwater Sciences 2010:74), especially given that bedrock is already exposed in places in the State Park Reach (Balance Hydrologics 2010), and, according to Stillwater Sciences (2010, Table 4-7),[1] the reach from Nicasio [sic] Creek to Devil's Gulch is aggrading. Finally, the report should pay more attention to the size distribution of sediments, and not just to the total amounts.

[1] Table 3.2 in the report gives a slightly different number for aggradation in the mainstem "in Tocaloma."

Response to Comment W-6:

Temporal and spatial scale of incision: The public review draft of the Staff Report was amended to contain Appendix I, a detailed description of study area. Therein, we describe how incision varies with location along the channel network (Public review draft - Staff Report, p. 161, and 164-165). We concur with your comment that incision cannot continue forever, and the Basin Plan amendment and Staff Report have been revised as follows to make sure that this point is clear to the reader:

> "Considering the significant exposure of hard bedrock in the streambed along San Geronimo Creek, and in the mainstem of Lagunitas Creek in the Shafter and State Park reaches, it is unlikely that streambed elevation will become much lower in these reaches. Absent intervention complex habitat that now includes riffles and bars will likely decrease and bedrock exposure will increase, which would further impair habitat."
>
> (Proposed Basin Plan amendment, p.4)
>
> "In future years, further significant lowering of the elevation of the streambed in these channel reaches is unlikely because hard bedrock is exposed in the channel bed in many locations along San Geronimo Creek and in the Shafter and State Park reaches of Lagunitas Creek, such that the rates of sediment delivery from incision are expected to decrease. Future primary concerns relating to incision are further stripping and/or removal of gravel from the streambed (increasing the frequency/extent of bedrock channel sub-reaches), and persistent simplification of channel habitat complexity and disconnection from the floodplain."
>
> (Public review draft - Staff Report, p.80)

Size distribution of sediment: The accuracy of the estimates of rates for significant active process of sediment delivery to channels is only within a factor of two (Public review draft - Staff Report, footnote 13, p.37). Obtaining a representative sample to characterize the particle size distribution of sources of sediment is a very challenging problem that has not been well addressed by geomorphology as a science, and the Lagunitas Creek watershed sediment budget reflects this limitation. Therefore, we chose to describe sediment sources qualitatively with regard to particle size distributions making the point that roads, construction sites, and sheetwash erosion from grazing areas are all largely comprised of fine sediment that contributes to degraded streambed substrate conditions (p. 76-77) which we define (Public review draft - Staff Report, p.11) as mostly sand and some fine gravel. We also expressed caution in considering actions to control sources rich in gravel and coarser sediment:

> "c) As a result of the construction of Peters Dam, coarse sediment supply in the State Park Reach of Lagunitas Creek is now much lower than it was during the 1850-to-1960 period. As a result, San Geronimo Creek now provides most of the coarse and fine sediment supplied to Lagunitas Creek in the State Park Reach. Therefore, actions to control fine and/or coarse sediment supply from San Geronimo Creek, not only have the potential to affect San Geronimo Creek, but also Lagunitas Creek in the State Park Reach.

d) The above described conditions create challenges which have to be carefully considered in trying to develop an implementation plan to control adverse changes to the sediment budget for the Lagunitas Creek watershed. Looking at the problem another way though, some real opportunities become apparent like the value of floodplain restoration and large woody debris engineering as center pieces in a program to re-establish more favorable substrate conditions, and also to create a suite of more complex and interconnected habitats."

(Public review draft - Staff Report, p.42)

Comment W-7 (Hyporheic habitat quality and shortage of coarse sediment): The report should give more emphasis to the quality of hyporheic habitat, especially on incubating eggs and alevins. Most salmon and steelhead die before they get out of the gravel, and more may perish if they emerge in poor condition. In this regard, the problem seems to be an overabundance of fine sediment and a shortage of coarse sediment; i.e., the report should pay more attention to the size distribution of sediments, as noted above. It does give some attention the effect of the quality of hyporheic habitat to invertebrates, but more would be better.

Response to Comment W-7:

Hyporheic flow: Whether caused by impaired hyporheic flow **(**low dissolved oxygen levels) and/or a fine cap that results in entombment as you suggest, or high rates of redd scour and/or a reduction in the biomass of benthic macro-invertebrate prey as we suggest, increases in the amount of fine sediment appear to be a problem in channel reaches that provide significant spawning and rearing habitat for coho salmon and steelhead including Woodacre creek, San Geronimo Creek, Arroyo Creek, San Geronimo Creek, and Cheda Creek (and perhaps Devils Gulch).

Shortage of coarse sediment: Gravel augmentation, if warranted, would really only be appropriate along the mainstem of Lagunitas Creek (with the logic being that the dams have diminished the gravel supply and/or quality as compared to the natural condition). In the State Park Reach, fine sediment deposition appears to be more limited (O-Connor and Rosser, 2006, pp. 44-45, Figures 14-16), and the result of our analysis as presented in the public review draft of the Staff Report suggests, even taking into account the effects of Peters Dam on gravel supply, the present-day rate does not appear to be below natural background in the State Park Reach; nevertheless we have not ruled out gravel augmentation as a restoration action in the State Park Reach (please also see our response to comment W-17 below).

The reach where we think that gravel augmentation could be most beneficial, is the Lower Lagunitas Reach, where construction of Nicasio Reservoir, and/or historical gravel mining plausibly have caused, or contributed to, very deep incision. Gravel augmentation will be considered a potential tool for restoration of channel habitat complexity and floodplain connection in that reach, as part of the floodplain restoration opportunities and priorities study that we call for in the public review drafts of the Basin Plan amendment (p. 13) and also the Staff Report (pp. 143-144).

Comment W-8 (Flexibility of coho juvenile life patterns): The report assumes that coho juvenile life patterns are rather rigid, with smolting in the spring after one year in the stream. Recent work has shown that coho juvenile life history patterns are more flexible; for example, at the 2013 Salmonid Restoration Foundation meeting, Darren Ward of Humboldt State reported that about half the juveniles in Freshwater Creek migrated into estuarine tidal habitat and wintered there (Ward et al. 2013). The extent to which juvenile coho winter in the lower tidal reaches of Lagunitas Creek or in Tomales Bay, is an important uncertainty that the report should acknowledge.

Response to Comment W-8: To clarify, we note that the research presented by Ward et al. (2013) documented that less than 10% to about one-quarter of juvenile coho monitored in Freshwater Creek migrated early (in the fall or winter) into the estuary (Hauer, 2013, p. 46). This research also highlighted that little is known about the relative rates of survival of this life history variant. The carrying capacity of overwinter habitat for juvenile coho salmon in Lagunitas Creek within the Tocaloma reach, where the channel is complex and connected to an active floodplain, has been documented to be very high (Stillwater Sciences, 2008, p.17). Also, we note that recently there a large tidal wetland restoration project was completed near the mouth of Lagunitas Creek (National Park Service, 2008). If the estuary does provide important overwintering habitat, we would expect this would only help, with regard to conservation of the coho salmon population in the Lagunitas Creek watershed. In the public review draft of the Staff Report, we emphasized the importance of the high quality channel/floodplain habitat in the Tocaloma reach because this fact has been demonstrated. We then rely on this information to assert that additional restoration of complex channel habitat and floodplain reconnection could substantially increase watershed smolt production.

Considering the small number of adult coho salmon that have been returning to Lagunitas Creek watershed in recent years (about 50-to-400), channel and floodplain restoration would appear to be essential actions to help facilitate population recovery.

Comment W-9 (Uncertainty in sediment yield estimates): Generally, the staff report and the reports upon which it is based present estimates without confidence intervals, and with much more specificity than is justified. This tends to mislead the reader into thinking that the estimates are more accurate[2] than they are. For example, Stillwater Sciences (2010) gives sediment yield estimates down to ones of tons per year. For example, Table 4.1 gives the sediment yields from hillslope slides and gullies and from tributary bank erosion as 5,327 and 5,349 tons per year. Given the uncertainty in the estimates, these estimates are identical, and probably are better reported as about 5,000 tons per year.

Response to Comment W-9: We concur. The estimates in the public review draft of the Staff Report and Basin Plan amendment are enumerated only to two significant figures. We also have

[2] By accurate I mean both reasonably precise and unbiased.

tried to be transparent in emphasizing that our process rates estimates are thought to be accurate only to within a factor of two (Public review draft Staff Report, footnote 13, p.24).

Comment W-10 (Probability sampling vs. "representative" site extrapolation): Geomorphic estimates are commonly based on estimates from "representative" sites, extrapolated to the whole study area. Stillwater Sciences (2010) used such a process to estimate bed and bank erosion in tributaries (p. 40). Statisticians have known since the 1930s that estimates derived from probability sampling are more accurate than estimates derived from "representative" sites (Neyman 1934), but for various reasons probability sampling is still not common in stream studies. … Again, probably all the report can do is to disclose the problem.

Response to Comment W-10: Although we appreciate this comment, we did not find that it warranted revision/explanation in the public review draft of the Staff Report, because the Staff report is not the primary source for the sediment budget, it only provides a summary of that work. The approach and limitations of the watershed sediment budget are described in detail in Stillwater Sciences (2010).

Comment W-11 (Adaptive management in light of uncertainties regarding geomorphology and climate change): Although a great deal is known about geomorphology and ecology, much remains uncertain, and some of the things we know will turn out to need revision (e.g., Walter and Merritts 2008). Ecological and geomorphic systems are open, complex, non-linear, and perhaps even chaotic, and estimates of states and rates may be accurate only to an order of magnitude (e.g., the sediment budget). To make matters worse, even mid-term environmental planning and regulation must take notice of climate change, but the best evidence is that regional climate change can be much less predictable than global climate change (Deser et al. 2012).

For these reasons, all management and regulation is experimental, whether it is intended to be or not, but management can be more effective if this is recognized, and learning becomes one of the objectives. This is the essence of adaptive management. According to the 3 January 2013 letter from Jim Ponton, the Basin Plan Amendment will include "An adaptive management plan to guide regular updates of the TMDL and implementation plan." This is not part of the material that we were asked to review, but will be critical for whether the Basin Plan is "based on sound scientific knowledge, methods, and practices."

Response to Comment W-11: We agree. Please note that validation and effectiveness monitoring of restoration actions will be an integral part of the program of implementation. The proposed Basin Plan amendment emphasizes these points:

"***Adaptive Implementation***
In concert with the monitoring programs, described above, the Lagunitas Creek Sediment Reduction and Habitat Enhancement Plan and TMDL will be updated as necessary. At a

minimum, in adaptively updating the Basin Plan amendment, we also will consider the results of validation monitoring conducted to confirm or reject hypotheses regarding effects of actions to enhance large woody debris loading and floodplain area on population dynamics of coho salmon, steelhead, and California freshwater shrimp. The Water Board also will consider the results of salmonid population monitoring programs including juvenile population estimates, adult spawner surveys, and smolt outmigration surveys performed to evaluate the status and trends of these populations, and also related analyses of smolt population dynamics in response to changes in the quantity and quality of freshwater habitat.

(Proposed Basin Plan amendment, p.17)

The Marin Municipal Water District (MMWD) has conducted long-term monitoring to estimate juvenile coho salmon and steelhead populations and the population of adult coho salmon since water year 1995, and also the population of adult steelhead since water year 2002 (see http://marinwater.org/controller?action=menuclick&id=442). Beginning in water year 2006 and continuing through present, MMWD also has operated a trap to estimate the number and fitness of coho salmon and steelhead smolts (juvenile fish migrating from freshwater into the ocean). MMWD's efforts are supplemented by additional surveys by the Salmon Protection and Monitoring Network (SPAWN) in the San Geronimo Creek sub-watershed, and by the US National Park Service in the Olema Creek sub-watershed.

(Public review draft - Staff Report, p.91)

The above described population censes provide a basis for evaluating the population status and trends for coho salmon and steelhead in the Lagunitas Creek watershed. In addition, recommendations provided within the "California Coastal Salmonid Monitoring Program" (CMP) (Adams et al., 2011) and future updates to this document, should be considered in refinement of the protocols used to conduct redd counts and adult spawner surveys, and for juvenile population censes in the Lagunitas Creek watershed. The CMP has been formally incorporated into recovery planning efforts for coho salmon in coastal California to provide a basis for evaluation of the status and trends of individual populations and also at the ESU-level (Adams et al., 2011; pp. 13-14). Redd counts can be converted to accurate estimates of the number of spawners based on the methods described in Gallagher and Gallagher (2005), and Gallagher et al. (2007). These methods are recommended to reduce bias, and improve accuracy and precision of estimates of adult abundance, which are fundamental to recovery planning. The CMP also indicates that Juvenile censes will provide the primary basis for evaluation of the spatial structure of populations, and recommends protocols for snorkel surveys to estimate juvenile population abundance and spatial structure."

Comment W-12 (Speculation regarding thermal adaptation): Lagunitas Creek is coastal, and so may be cool relative to more inland streams such as the South Fork Eel that support significant coho populations. Generally, along the Pacific Coast, the coastal-inland temperature gradient is much steeper than the north-south gradient. It would be helpful if the speculation about thermal adaptation at p. 17 were supported by temperature data.

Response to Comment W-12: Your point is well taken and we have revised the draft Staff Report to no longer assert that the Lagunitas Creek watershed population may be better adapted to high

temperatures. To respond to this comment, we reviewed Sawyer et al (2000, Table 3.1, p. 45) and Spence et al. (2011, p. 22-24), which both confirm your point: that there probably is broader east-west gradient to temperature than there is in the north-south direction.

Comment W-13 (Attributes influencing measurement of Tau-star): [T]he intent of the numeric target for τ^*_{50} is that sediment transport remains in the partial mobility mode during "normal" winters. However … I think things are a bit more complicated than presented by the report. For example, τ^* depends on depth, and I suspect that the range of τ^*_{50} values given for partial mobility assume a channel that is not incised. There is also the complication that the relevant shear stress is the stress acting on the bed, the "grain stress," which is a variable fraction of the calculated reach-average stress, so that, for example, putting large wood in the reach would tend to lower the reach-average grain stress, although it could increase the local stress.

Setting the criterion in terms of reach-averaged Shield's stress at bankfull discharge leaves open the questions of defining the reach, and of defining bankfull discharge. Defining the reach is obviously subjective, and so is determining bankfull depth … And, accurately estimating the Shields stress is not easy, as noted by Cover (2012:30) …

In sum, the sensitivity analysis of Q* calculations indicates that the four input parameters must be determined with high accuracy in order to avoid substantial errors in Q* values. Although not presented here, *errors in input parameters for τ*and D'50 – D50 also produced extremely large errors.* In order to insure that Q* values err by <0.3 (an error that would result in misclassification of sites in this study into low, medium, and high categories), errors in surface and subsurface D50 must be <5-7mm, errors in slope must be <0.002, and *errors in bankfull depth must be <0.1 m*. If errors are compounded, errors in individual input parameters must be even smaller [emphasis added].

For me, these issues raise the question whether the reach-averaged bankfull Shields stress is really measurable, in the sense intended by the statute. I recommend that the authors of the report carefully read Wilcock et al. (2009), which gives an exceptionally clear and accessible discussion of sediment transport, and re-think the matter. It seems to me that setting the criterion in terms of sediment transport rate at some specific discharge calculated with a specified formula might be better."

Response to Comment W-13:
Attributes that influence Tau-star: In response to your comment we added the following descriptive footnote (footnote 24) at the bottom of p. 45 of the public review draft of the Staff Report:

"[24]Tau-star (τ^*) represents the balance between the force of the flowing water (that provides the impetus for particles in streambed to be mobilized) and the resistance to motion provided by the gravitational force (or the weight of the particles in the streambed). This balance of forces is represented by the following equation for Tau-Star:

$\tau^* = (\rho gRS)/(g(\rho s-\rho)*D50)$, where ρ is density of water, ρs is the density of the grains in the streambed, g is the gravitational force, R is the hydraulic radius (which is approximately equal to the average depth of flow in the channel), S is the water surface slope, and D50 is the median grain size of particles on the surface of the streambed.

It is important to note that only a fraction of the total boundary shear stress (ρgRs, the flow energy) is available to mobilize grains that comprise the streambed. This is because bends, bars, bedrock, boulders, and large fallen trees, vegetation, and variations in channel width, and entrainment and transport of sediment, all create perturbations that extract energy from the flowing water. Therefore, the more complex and variable a channel (i.e., more bars, bends, obstructions, changes in width, and vegetation), the smaller the proportion of the total boundary shear stress that is available to mobilize the grains that comprise the streambed.
As can be inferred from examining the formula for τ^*, as the streambed becomes finer (i.e., D50 becomes smaller), which can occur as the rate of supply of sand and/or gravel to the channel increases, τ^* also will increase. Also, as the depth of flow in the channel increases, as a consequence of incision, τ^* also will increase. All of the channel reaches examined by Cover (2012) are deeply incised and the amount of large woody debris in the channels is very low. Therefore, in addition to elevated total and fine bed material supply, channel incision and lack of wood in channels, also elevate streambed mobility in most tributaries to Lagunitas Creek. The streambed mobility target reflects a healthy balance between channel sediment transport capacity and supply. Therefore, actions to control fine bed material supply, reduce incision, and/or increase complexity and roughness (i.e., increases in the amount of large woody debris in channels) all will contribute to attainment of the streambed mobility target."

Tau-star measurement accuracy: We disagree with your comment about the ability to accurately measure Tau-star. Cover (2012) was able to define a strong statistical correlation between estimates of Tau-star and estimates of sediment supply suggesting that although there may be errors in estimating Tau-star, they are not so large as to obscure the response to changes in sediment supply, provided care is exercised in field observations and measurements, and channel conditions are sampled across a range that is two-fold or greater (between the high and low rate of supply).

Comment W-14 (Justification of survival to emergence estimate): The 50% estimate for survival to emergence in Table 4.3 and > 30% in related text is much larger than the 25% average estimate given by Quinn (2005), as noted in the text at p. 51, and seem high given the condition of the substrate. Survival to emergence can be much higher when conditions in the redd are good, and, although they do not mention it, I suspect that the authors of the report have been influenced by Bratovich and Kelley (1988), who reported suspiciously high levels of dissolved oxygen in redds in Lagunitas Creek. Given the descriptions of the sediment, I suspect that methodological issues biased their measurements high, as noted above. In any event, the 50% estimate needs justification, if it is not revised. If data on the percentage of fine sediment < 1 mm are available, a defensible estimate could be obtained from Figure 2 in Kemp et al. (2011), but the variance implied by the figure should also be noted.

Response to Comment W-14: To clarify, in the public review draft of the Staff Report, we have added the following additional explanatory note to Table 4.3, page 54:

"[6]Given a 50% reduction in sediment supply per TMDL, absent redd scour effects we input a 50% value for egg survival during incubation into the model. In early 1980s, even under high sediment supply, Bratovich and Kelley (1988) estimated that absent redd scour mortality the average egg survival during incubation was > 50% (not considering the effects of scour). Note: This parameter accounts only for mortality related to the incubation environment. When the other causes for mortality from spawning-to-emergence that are considered in our simple model, also are factored in, the resultant average value for egg-to-fry survival is approximately 33 percent: 95% (of eggs buried) x 67% (eggs not entrained) x 50% (egg survival during incubation) ≈ 33 percent. For comparison, Quinn (2005) estimates that the average value for egg-to-fry survival for coho salmon, for wild or naturally rearing populations is approximately 25 percent; slightly lower than we predict will be the case following a 50% reduction in sediment supply and a > 100 percent increase in wood loading."

Comment W-15 (Underestimation of hyporheic conditions): In general, the report underestimates the importance of hyporheic conditions. Low levels of dissolved oxygen probably are the main cause of mortality (Williams 2006, Ch. 7, and citations therein). As noted by Chapman (1988:9):

The key inference from the body of work described above is that deprivation of dissolved oxygen leads to subtle problems often not detectable in tests of survival in various oxygen concentrations. It appears incorrect to set critical oxygen levels at any arbitrary point, or to assume that survival to time of emergence is sufficient evidence of ecological success. *Any* detrimental reduction in dissolved oxygen from saturation probably reduces survival to emergence or post-emergent survival.

That is, later stage embryos and alevins are normally under more or less oxygen stress except when the water is very cold and development slow. At the relatively mild winter water temperatures typical of California coastal streams, the saturation concentration of oxygen will be lower, and the metabolic rate and oxygen demand of the organism will be higher, than in colder parts of the geographic range of *Oncorhynchus*. Dissolved oxygen levels are also related to the risk of entombment or entrainment, since stressed alevins are weaker and so less able to butt their way through a layer of sand or cope with high flows. I think a more useful numerical criterion could be developed in terms of the difference between the dissolved oxygen level in the surface stream and in spawning gravels at the usual depth of egg pockets.

Response to Comment W-15: Please see our response to comment W-7 above. We also wish to emphasize that actions to reduce fine bed material supply by 50 percent-or-more, coupled with a two-fold or greater increase in large woody debris loading (which will enhance fine sediment sorting, and metering), and substantial increases in active floodplain area, all will contribute to less sand in the streambed at potential spawning sites and improved hyporheic conditions. We also conclude that upon achievement of the proposed redd scour and streambed mobility targets, hyporheic conditions will be properly functioning.

Comment W-16 (Applicability of large-wood hypothesis): The discussion of the "large wood hypothesis" at p. 55 raises the channel reference model issue again. Lagunitas Creek may be in

the North Pacific coastal ecoregion, but Collins et al. (2012:467) do not claim that their discussion applies to all streams in the region:

> "The phenomena described above can be observed in many rivers in the North Pacific coastal ecoregion having intact valley-bottom forests and intermediate slopes and discharges and having channel patterns variously classified as 'Type 5 anastomosing' rivers (Nanson and Knighton, 1996), 'wandering' rivers (Church, 2002), or 'island-braided' (Beechie et al., 2006). Further investigation *might* demonstrate a wider geographic applicability to the large wood cycle model." (emphasis added.)

Large wood is clearly important in Lagunitas Creek, but whether the large wood hypothesis applies is questionable.

Response to Comment W-16: Prior to incision, it appears that Lagunitas Creek in the State Park reach is a "wandering" gravel channel. It has a slope that varies between 0.25 and 0.5 percent, valley confinement varies - with moderate confinement being most common - and bankfull discharge (recurrence interval = 1.5 years, annual maximum series) is approximately 1600 cfs (for additional details, see Public review draft - Staff Report, Appendix I). Based on streambed slope and bankfull discharge, Lagunitas Creek in the State Park Reach plots within the region that Church (2002) defines as "Wandering gravel channels and braided sand bed channels" (See Figure 4, p. 549).

Prior to incision, Lagunitas Creek in the Tocaloma Reach also appears to have been a "wandering" gravel channel based on streambed slope (typically 0.002) and bankfull discharge of approximately 2300 cfs, which plots within the "Wandering gravel channel and braided sand bed channels" domain as defined by Church (2002).

Therefore, we would conclude that floodplain-large wood cycle hypothesis applies as indicated above to Lagunitas Creek

Comment W-17 (Gravel augmentation): Why does the report not consider whether coarse gravel should be added to the channel below Peters Dam? Adding gravel below dams is a common practice, and superficially seems appropriate in this case.

Response to Comment W-17: We infer that present-day bed material supply to the State Park Reach is greater than or equal to natural background. Based on our analysis of the total natural sediment supply to Lagunitas Creek, although Peters Dam traps all of the sediment delivered from the upper Lagunitas Creek watershed, there has been a several-fold increase in total sediment supply from San Geronimo Creek, and as a result, the estimated present-day total sediment supply to the State Park Reach, 160 tons/km^2/year is much greater than natural background rate, which is estimated at 70 tons/km^2/year (Public review draft - Staff Report, see Table 3.3 on page 37 versus Box 5.1, page 70). Furthermore, considering occurrence of naturally disconnected tributaries to San Geronimo Creek (which ended in alluvial fans, where gravel was deposited), and more greater prominence of large woody debris jams (that also stored and metered bed material supply), we infer that for the bed material supply, the ratio of present-day to

natural background also is a factor-of-two or greater. It's also important to point out however, that gravel supply to the State Park reach is greatly reduced as compared to the historical period prior to construction of Peters Dam in 1957.

Nevertheless, we have not ruled out the prospect of gravel augmentation as part of a program to enhance channel habitat complexity in the lower Lagunitas and/or State Park reaches, and to reconnect the channel to its floodplain. This is something that would be considered as part of the evaluation of opportunities and constraints on floodplain restoration. Please also see our response to comment W-7 above.

Comment W-18 (Actions to limit incision): To the extent that incision results from increases in peak flows from increases impermeable surface area or from interruption of subsurface flow at road cuts, as seems likely for San Geronimo Creek, then requiring detention basins, permeable pavements, etc., may be effective in limiting incision.

Response to Comment W-18: Actions to reduce sediment delivery from dirt roads also will be effective in substantially attenuating land-use related increases in peak runoff. Also, incision has almost entirely run its course along San Geronimo Creek and its tributaries in alluvial reaches that provide actual/potential habitat for fishes. Outsloping and/or installation of rolling dips on unpaved roads together with installation of engineered log jams will be effective in preventing additional incision.

Approximately one-half of the total impervious surface area within the watershed is associated with roads. And, roads have a disproportionately greater influence on peak runoff increases than other impervious surfaces because in addition to the impervious surface that is created as a result of construction of the road tread - and the resultant Horton overland flow -, roads also intercept subsurface storm flow at cut banks along hillslopes. The dominant runoff process in the Pacific Coastal Ecoregion, in watersheds where precipitation falls as rainfall, is subsurface storm flow. Road cuts intercept subsurface storm flow, and more than 90 percent of the increase in runoff that is caused by roads relates to interception of subsurface storm flow (Wemple and Jones, 2003).

Half of the total length of roads within the San Geronimo Creek watershed are unpaved. To achieve the road sediment discharge performance standard, unpaved roads will be out-sloped and/or rolling dips will be installed to achieve sediment delivery performance standards. These actions also will greatly attenuate the storm runoff increase caused by the unpaved roads because most the intercepted subsurface storm flow will be dispersed and effectively infiltrated back into hillslopes. We conclude that these retrofits to road drainage will greatly attenuate storm runoff increases.

Note also, that there are no high density residential developments and/or large business districts in the watershed, where installation of a detention basin might be needed to further attenuate increases in peak runoff. Voluntary actions by landowners to create rain gardens and/or capture runoff from rooftops also would be useful locally in attenuating concentrated sources of runoff

that are discharged at/near stream channels. Such a program (10,000 Rain Gardens) is off to a good start in Marin County including the San Geronimo Valley.

Comment W-19 (Relative roll of loss of wood in channels): I think the report puts more emphasis on loss of wood in the channel as a cause of incision than is justified, given that incision would be expected given the dams and urbanization in the San Geronimo Valley. The problem with overemphasizing the role of large wood as a cause is that it may lead to a similar overemphasis on large wood as a cure, and the report puts more faith in the efficacy of constructed large wood structures as a mitigation measure than is justified by the literature. Lagunitas Creek is not the Queets or Nisqually River writ small, and the biological benefits from constructed large wood structures have been questioned. In a meta-analysis, Whiteway et al. (2010) did find support for the idea that large wood structures in stream do effect change in stream habitats and do tend to increase fish abundance at the site or reach scale, but the evidence for abundance effects is stronger for resident than for anadromous fish, and the effects are not all that large. Whiteway et al. (2010) did not consider costs, and so do not provide evidence on the relative cost-effectiveness of constructed wood structures and, say, adding coarse gravel below Peters Dam.

Response to Comment W-19: Responses to comments W-2, W-4, and W-16, address concerns about the role of large woody debris in shaping habitat along Lagunitas Creek and its tributaries.

The review article by Whiteway et al. (2010) focuses on the efficacy of instream structures including those comprised of large woody debris. While such structures may yield fish population increases, we agree their effectiveness sometimes can be quite limited. As a result, we advocate for a design with nature approach – examining the natural architecture of large woody debris jams (which is a function of debris input processes, the caliber and resistance to decay of debris supplied, channel size, and valley type)- and then call for construction of engineered/constructed log jams.

Roni et al., 2010 (see Table 1) - another review article which focuses on steelhead and salmon responses to restoration actions – documents that constructed logjams and restored floodplain habitats are quite effective in increasing the number of juvenile coho salmon. The relative effectiveness of constructed logjams as compared to instream structures is a factor of four or greater with regard to increases in the number of juvenile coho salmon during the dry season, and of similar effectivess in increasing the number of juvenile coho salmon in the wet season. Restored floodplain habitats are about twice as effective in increasing the number of coho salmon in the wet season, as compared to instream structures, and/or constructed log jams. With regard to increasing the number of juvenile steelhead during the dry season and/or the wet season, constructed log jams appear be much more effective than all other types of restoration actions.

Considering all of the above, we have emphasized engineered/constructed log jams and restored floodplains in our implementation plan, which is intended to help facilitate recovery of coho salmon and steelhead populations. Although gravel augmentation may be worthwhile as part of a

tool kit to accelerate reconnection of the channel to its floodplain, spawning habitat, and/or the quality of the incubation environment does not appear to be limiting steelhead and/or coho salmon smolt production. The limiting freshwater life stage for both species, under current conditions, appears to be the wet season. Constructed log jams and restored floodplains appear to be the most effective actions for increasing wet season carrying capacity for both species.

Responses to Comments Submitted by Dr. Benjamin R. Hayes

Comment H-1 (Scope and Approach): In summary, your *Sediment Reduction and Habitat Plan for the Lagunitas Creek Watershed* is based on sound scientific knowledge, methods, and practices. The rest of this letter provides comments specific to the regulatory elements proposed in that plan.

Response to Comment H-1: We appreciate your support.

Comment H-2 (High rates of streambed mobility and simplification of channel habitat): Lagunitas Creek remains in a protracted phase of adjustment and will require space and time to adjust its morphology and bed sediments to the proposed (1) reduction in the sediment delivery to ≤ 125% of natural levels and (2) reintroduction of large wood debris to the channel network, and (3) reconnection to abandoned side channels and restoration of the riparian forests. These proposed measures are necessary to help the fluvial system maintain sufficient aquatic habitat to support a viable salmonid population.

Response to Comment H-2: We appreciate your review and support for the proposed actions to restore properly functioning substrate conditions, channel habitat complexity, and connectivity to the floodplain.

Comment H-3 (Sediment mobility targets): It's hard to say how much the differences in streambed conditions in Lagunitas Creek are associated with differences in sediment supply, but you have documented sufficient evidence for proposing bed mobility (τ^*) as a TMDL parameter. Part of the monitoring effort in the future should include additional surveys of bed mobility parameters, as well as repeat surveys of patch-based pebble counts in the mainstem of Lagunitas Creek, where most of the channel and floodplain restoration efforts will likely take place.

Response to Comment H-3: We appreciate your support for using Tau-star (bed mobility) as a numeric target. We plan to require regular monitoring to evaluate attainment of this parameter, and will be working in collaboration with other agencies' scientists to evaluate the effect of restoration projects on bed mobility.

Comment H-4 (Habitat complexity and connectivity): Your proposed targets of large woody debris loading of ≥ 300 m^3/ha in Redwood channels and ≥ 100 m^3/ha in hardwood channels seem reasonable and supported by Florsheim' s (1985) study of northwest California Coast Range streams and Keller et. al. (1995) findings that for wood frequencies on the range of 10 to 100 trees pieces per km of channel, there is typically one pool every 2 to 6 bankfull channel widths (see Buffington et. al, pg. 69). Re-introducing wood to the channel will provide the obstructions necessary to increase the number of pools per kilometer of channel and provide more spawning habitat. The salmonid habitat and floodplain re-connectivity projects that I have been part of in New England and mid-Atlantic region, experienced the greatest success using this approach.

I agree with your list four approaches that can be employed to reestablish connection to floodplains (Chapter 6, page 83).

Response to Comment H-4: We appreciate your review and support of our proposed targets for large woody debris loading.

Comment H-5 (Sediment TMDL and allocations): [T]he sediment budget … is sufficiently accurate to guide management decisions. Your estimates of TMDL assimilative capacity for sediment established at ≤ 125 percent of natural background for two locations along Lagunitas Creek are consistent with previously adopted sediment TMDLs for stream channels elsewhere in northwestern California. Based on my limited review, I agree with your proposed reduction of sediment delivery by approximately 50 percent from the current proportion of the total load to achieve the TMDL. I was especially pleased to see you mention that the TMDL and sediment load allocations will be adaptively updated in response to results of sediment and fisheries monitoring programs that are recommended under the implementation plan.

Response to Comment H-5: Thank you for your support of the proposed sediment TMDL, its allocations, and adaptive approach towards its implementation and monitoring. .

Comment H-6 (Hydrologic Considerations): a) Have adaptive management strategies for reservoir operations been considered? b) During low flow years such as 1988, 1990, 1994, and 2001, will current reservoir operational strategies provide sufficient water to Lagunitas Creek to maintain water levels in the channel and the newly-created side channel habitats? C) How do reservoir discharge's influence water depths, temperatures, and water quality (e.g., dissolved oxygen levels) in the … stream? d) How does the hydrology of Lagunitas Creek compare to the other two reference watersheds that the sediment TMDL is based upon?

Response to Comment H-6: Water Rights Order 95-17 (Water Board, 1995) includes several terms and conditions including required releases for spawning attraction flows, and winter, spring, and summer baseflow, as well as the requirement to reduce sedimentation and achieve an appreciable improvement in fisheries habitat conditions. Some existing side channels in the Tocaloma Reach (see, Kamman et al., 2013, Figures 12 and 15; monitoring for this study occurred during a dry year), and/or side channels, created as part of the program of wood and floodplain restoration, would be wetted during typical winter baseflow (50-to-100 cfs), others would only be wetted during storm runoff events. Although the reservoirs likely reduce the duration of inundation of the side channels, we still think that it will be possible to accomplish a significant increase in the amount of this key habitat type that remains inundated throughout most of the wet season (even in dry years).

The water rights order has previously assessed the effects of the reservoirs on streamflow attributes, water temperature, and water quality, and reservoir releases are conditioned to address these issues.

The natural hydrology of the Lagunitas Creek watershed is quite similar to the Noyo River, where average annual precipitation is approximately equal to Lagunitas. Redwood Creek watershed is much wetter. The large reservoirs in the Lagunitas creek watershed have substantially reduced wet season peak flows, and increased dry season baseflow.

Comment H-7 (Consideration of effects of future population growth): Considered population growth and development patterns in this region, what are the projected human demands for water in this basin over the next 40 to 50 years (the time span mentioned for riparian forest rehabilitation)? Doubling the area of floodplain habitat and its associated improvements in groundwater storage will become only become more important. Have these factors been considered? If so, even conceptually, these factors could be articulated in your plan, which would likely strengthen the case for your proposed management strategies.

Response to Comment H-8: The additional groundwater storage in reconnected floodplains could enhance spring and summer baseflow persistence in lower Lagunitas creek, but this would not contribute substantially to available water supply.

Comment H-8 (Additional maps, photos, and figures would be helpful): Finally, the clarity and readability of the basin plan could be greatly improved by incorporating more maps, figures, and photographs. Additional maps would be especially useful, starting with a large, color-shaded relief map of the entire watershed, showing drainages, tributaries, management areas, and place names that are referred to in the text clearly labeled.

Response to Comment H-8: Please see Appendix I – a detailed description of the study area- and also Maps 1 and 2, which address in part your suggestion. Furthermore, following adoption and final approval of the Lagunitas Creek sediment TMDL Basin Plan amendment, it will be incorporated into the San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan) which contains maps and figures of Region 2 watershed boundaries and hydrologic features. The Lagunitas Creek watershed and key hydrologic features are identified on Figure 2-3, Marin Coastal Basin.

Comment H-9 (Summary): In summary, after carefully reviewing your *Sediment Reduction and Habitat Plan for the Lagunitas Creek Watershed*, I found it to be based on sound scientific knowledge, methods, and practices. It identifies regulatory programs that will greatly reduce human-caused sediment impacts to Lagunitas Creek and voluntary programs which will enhance the channel habitat complexity and connection to the floodplain. I am confident that given sufficient time, your proposed measures will help provide the aquatic habitat improvements necessary to sustain viable coho salmon, steelhead, and California shrimp populations.

Response to Comment H-9: Thank you very much for your review and for your support.

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