California Department of Parks and Recreation, Sierra District
Cyndie Walck, CEQA Coordinator
P.O. Box 266, Tahoma, CA 96142

29 July 2018

Subject: River-Golf Course PAAEA and draft EIR/EIS/EIS for Upper Truckee River Restoration and Golf Course Reconfiguration Project

Dear Cyndie Walck,
We reviewed the subject documents, along with supporting documentation. We focused on key aspects that fall within our areas of specialization, notably fluvial geomorphology and aquatic ecology. We did not limit our review to the narrow range of issues emphasized by California Department of Parks and Recreation (CDPR), but looked at the project holistically from a river science perspective.

Our review is documented in the attached report. While the proposed project has potential, we have identified deficiencies in the information provided in the documents, leading to concerns about the project's analysis and apparent failure to account for important issues in the project planning. As Lake Tahoe water clarity continues to deteriorate, reaching the lowest recorded loss of transparency on record last year, the performance of projects designed to reduce fine sediment yield to the lake are important and must be objectively documented, to permit learning from these projects as experiments.

Our comments benefit from our decades of experience working on river issues and restoration projects in the Tahoe basin, across California, North America, and elsewhere. We appreciate this opportunity to comment on the proposed CDPR project. We hope our comments can contribute to project planning and implementation to result in reductions in both short-term and long-term fine sediment loading.

Sincerely yours,

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Review of ‘Upper Truckee River Restoration and Golf Course Reconfiguration Project’

By Michael Limm, PhD, and G Mathias Kondolf, PhD

Comments submitted to the California Department of Parks and Recreation on the proposed golf course reconfiguration and channel reconstruction project described in the ‘Preferred Alternative 2B and Additional Environmental Analysis’ and other volumes of the EIS/EIR.

29 July 2018

The Upper Truckee River, view downstream about 1.25 mi upstream Hwy 50, photo by Mike Limm July 2018

Purpose and Scope

We reviewed the Preferred Alternative 2B and Additional Environmental Analysis for the Upper Truckee River Restoration and Golf Course Reconfiguration Project, along with supporting documentation. We did not attempt a comprehensive review of the proposed project, but focused on key aspects that fall within our areas of specialization, notably fluvial geomorphology and aquatic ecology, drawing on research in the field broadly, and specifically on lessons that can be drawn from recent experience from a restoration project recently undertaken about a mile downstream on the Upper Truckee River (UTR) (referred to as 'Reach 5'). Our review is based on a site visit several years ago, another site visit in July 2018, review of environmental documents and supporting technical reports for the project, familiarity with the Upper Truckee River and other Lake Tahoe tributaries over three decades of work in the region, and experience with river restoration projects across California, North America, and elsewhere.

We note that the agency proposing the project, the California Department of Parks and Recreation (CDPR), emphasizes an invitation to provide comments only on a narrow range of issues (listed on pp 1-4 of CDPR 2018), essentially changes that were made in response to a court decision that found the 2011 EIS/EIR to be inadequate, and much of the CDPR documentation focuses on differences between the preferred alternative 2B and several prior alternatives put forward. However, in our review, we look at the project holistically, and do not limit ourselves to a narrow set of changes in project documentation made in response to an adverse legal ruling. As part of this holistic perspective, we consider important lessons that may be learned from the experience of similar projects on the river, notably the recent project on "Reach 5" 1.5 km downstream. From a river science perspective, it makes no sense to ignore information that may be gleaned from the river's response to recent channel reconstruction a short distance downstream.

Description of the Proposed Project

The California Department of Parks and Recreation proposes to reconfigure the Lake Tahoe Golf Course and increase the length of the Upper Truckee River by 1750 ft, in part by reconnecting an abandoned 3300-ft meander bend. The proposed project would reduce the length of the river directly adjacent to the golf course from 6382 ft currently to 1300 ft, and very slightly increase the area occupied by the golf course by 3 acres. The project would maintain the golf course at 18 holes, and shift 'several' existing golf holes from the stream environment zone, floodplain, or former meander belt, to higher-capability lands (under the TRPA land capability classification system). Thus, the golf course footprint would not be reduced, but some activities would be shifted farther away from the river, and the river would be flanked by more lower-elevation lands onto which it could flood more frequently. Five existing bridges would be replaced by two longer-span bridges, which would result in less lateral restriction of channel movement. The stated purpose of the project is to restore natural processes to the reach and reduce the discharge of suspended sediments to Lake Tahoe.

Summary of Findings

Overall the project has potential. The severity of incision and channelization would make it difficult for the UTR in Washoe Meadows to recover on its own given the positive feedbacks promoting further incision. We find a more compelling case of severity of incision in this reach than was the case in Reach 5, which appeared to be stabilizing and recovering (with evidence of channel narrowing through deposition) after the removal of grazing pressure, prior to the channel reconstruction project. Moreover, the Washoe Meadows reach appears to lack the excellent freshwater mussel habitat that existed in Reach 5 prior to the channel reconstruction project, and it certainly lacks the large mussel populations (ca 20,000, USDA 2016) that had to be displaced from Reach 5 for the project there. By re-establishing conditions to encourage overbank flow at frequent discharges and break the cycle of incision, by moving the golf course away from the active stream zone, by giving the UTR a zone in which it can erode, deposit, and develop its channel form, the project has potential to foster habitat suitable for a variety of aquatic organisms and improve sediment and nutrient retention.

However, there are many concerns about how the project will be implemented and potential risks during the construction period and after. The project is designed to produce more frequent and prolonged overbank flooding, yet the document presents no information to show that areas exposed in construction (access roads, staging areas, etc.) will be protected from erosion by overbank flows during the construction period, nor analysis to demonstrate that the willow wattles, sod, etc., that are planned for the floodplain surface post-project will be sufficient to resist scour during high flows, especially in the years before vegetation has fully established. Again, referring to experience in the neighboring Reach 5 project, the construction access road became a significant, unanticipated, sediment source as it eroded during overbank flows.

These lessons from erosion of Reach 5, evident from field inspection following the 2016-2017 runoff season and reflected in higher turbidity levels downstream of the project than above, seem not to have been taken into account in the planning and design of the Washoe Meadows project. Given the multi-year period over which the construction of the golf course reach project is planned, it seems unavoidable that some areas will be vulnerable to erosion during high flows. The project is premised on the reach becoming a net sink for sediment, reducing the delivery of sediment to Lake Tahoe. However, this is not assured, and the experience in Reach 5 is cautionary.

The project involves very large-scale earth moving, with the cut volume equivalent to about 4500-6300 dump truck loads and the fill volume equivalent to about 6,500-11,300 dump truck loads. Evidently smaller-scale options that would involve a smaller-footprint 9-hole golf course were rejected early in the planning process, despite the highly sensitive nature of the golf course location along the largest tributary to Lake Tahoe. Curiously, the preferred alternative 2B, which differs in many dimensions from the 2012 alternatives 2 and 2A, is reported to have exactly the same volumes of cut and fill as alternatives 2 and 2A. There is no explanation for this implausible equivalency, which raises troubling questions about the adequacy of the analysis and project planning.

We understand that mussels were historically present in the Upper Truckee River (Murphy 1942), but the current channel condition in Washoe Meadows Reach offers little refuge from high shear stresses and does not provide conditions that encourage particulate flux through the water column to the bed. However, as we discuss below, we are aware of no systematic study by mussel experts of freshwater mussel populations and mussel habitat in the Washoe Meadows reach, which seems a significant oversight.

Some obvious questions include asking whether due diligence been done on:
- preventing recapture of current channel and the sediment flux that would result from such an avulsion.

- preventing fluvial erosion of roads, staging areas, and other construction-disturbed areas as sources of sediment into UTR over the multi-year construction period and afterwards prior to establishment of a stabilizing vegetative cover.
- preventing airborne erosion of fine sediment from the roads and other disturbed sites and its deposition in the channel, directly in the lake, or to sensitive fens near the new golf holes.
- controlling overland flows from carrying fine sediment into the channel.

Have pre-project surveys been undertaken of organisms of concern currently in the channel, notably freshwater mussels, by mussel experts? What have been the success rates (to date) from the massive transplanting of mussels from Reach 5? What kind of post-project monitoring will be undertaken to document changes in habitat for and populations of mussels and other aquatic species?

The project documents assume that the UTR in Washoe Meadows will become a sediment sink overall, and that the deposition and trapping of sediments on the floodplain will outweigh increased sediment yields during construction. Monitoring of turbidity in the Upper Truckee River indicates that at least in the first storm of the 2016-2017 runoff season, Reach 5 was a source of fine sediment, not a sink. It is essential that a continuously recording turbidity meter be established upstream of the Washoe Meadows reach, which can be used with the existing station downstream to provide data upon which to assess sediment retention or generation within the reach.

Has due diligence been done regarding potential sediment impacts of the Washoe Meadows project due to timing of construction, when floods occur, severity of floods, and condition of constructed channel when floods likely to occur? Will such short-term sediment fluxes ever be compensated by future sediment trapping over the long-term?

We would have more confidence in the predictions of the benefits of the proposed Washoe Meadows reach channel reconstruction and relocation if the documents made clear that lessons from the Reach 5 experience had been thoroughly studied and taken into account. However, there is no reference to the actual performance of the Reach 5 project, despite abundant evidence of unanticipated erosion and delivery of fine sediment to the lake, and the unanticipated need to displace ca 20,000 freshwater mussels from Reach 5. The proposed Washoe Meadows reach project appears to exist in a separate universe from that of Reach 5. This may make some kind of sense in a compartmentalized world of environmental documents and their limited scopes, but we are more concerned with the health of the river and its geomorphic and ecological recovery. To ignore the opportunity to learn lessons from a recent, nearby project seems short-sighted at best. Further, we see limited concern how the initial, and hopefully short-term, degradation of water and ecological conditions in Washoe Meadows Reach due to construction and channel adjustment might impact downstream conditions and ongoing restoration efforts.

Fluvial Geomorphology

As reported by Swanson Hydrology & Geomorphology (SH&G 2004) and confirmed in our July 2018 site visit, the Upper Truckee River in the Washoe Meadows Reach shows significant incision and widening downstream from approximately 1.5 upstream of the Hwy 50 bridge (at Elks Club Rd), attributed by SH&G (2004) to past channelization and ongoing forcing, from features such as bank stabilization structures protecting the golf course. Under past and current conditions, the erosive forces generated by these concentrated flows have overcome bed and bank material strength; once incision begins, a positive feedback encourages further incision and widening, as more flow is contained within the deepened channel, resulting in deeper flows and higher shear stresses, and undermining of channel banks (Schumm 1999, Simon and Darby 1999) (Figure 1).

Figure 1. The Upper Truckee River has incised into clay in the reach around 1.2 mi upstream of the Hwy 50 bridge near Elks Club Drive, the reach with the most severe instability visible in the Washoe Meadows Reach. Note the top of the point bar on the left side of the image appears to be within about a yard of the elevation of the top of the bank on the right side of the image. Photo by Mike Limm, July 2018, looking upstream.

The restoration strategy of bypassing a severely incised reach and re-routing flow through a former channel is basically sound. The increase in channel length afforded by re-occupying the longer, former channel reduces the river's gradient and thus reduces the energy available for bed and bank erosion, and the new channel will be positioned to overflow onto its floodplain more frequently, with the benefits of energy dissipation, and hoped-for deposition of fine-grained sediment onto the inundated floodplain surface. Incised channels act as drains on the surrounding alluvial floodplain, so eliminating such drains can result in higher water tables, with benefits for riparian vegetation, and potentially improved baseflow conditions in the channel as surface water exchanges with shallow groundwater.

The primary goals of the Washoe Meadows project are stated on p.1-1 of CDPR 2018 as "to address contributions of fine sediment to the river and Lake Tahoe," and "The primary purpose of the proposed project is to restore natural geomorphic and ecological processes along this reach of river and reduce the river's discharge of suspended sediments into Lake Tahoe." Assuming the project can be put into place as planned, in the long run, the proposed configuration of relocated and reconstructed river should increase retention of fine sediment on the floodplain over the current incised channel, but it is not clear whether such a massive, ongoing project can be completed without something going wrong, and without erosion of large areas of exposed earth. One key question relevant to the primary goal of sediment retention must be what are the likely short-term increases in sediment yield as a result of disturbing and exposing lands over the 3-5 years anticipated for project construction? And what steps can be taken to minimize these short-term sediment pulses?

One of the foundational documents for this project, the report of Swanson Hydrology & Geomorphology (2004), recommends an assessment of sediment reduction from the project and distinguishing natural sources of erosion from human caused, and "whether the postulated declines in future sediment yields are sufficient to reduce the impact of excess sediment on Lake Tahoe clarity and aquatic ecosystem function." The project documents do not indicate, or at least do not highlight, whether these recommended analyses have been undertaken, and more broadly the degree to which different scenarios of project construction followed by large floods have been analyzed to provide a basis for assessing the anticipated long-term sediment reduction benefits in relation to the potential short-term increases in sediment. The recent experiences from the Reach 5 project should be considered in evaluating the risks from the Washoe Meadows project.

Project Scale

The proposed project will involve large-scale land disturbance, evidently in large measure to keep the golf course at 18 holes. Despite this sensitive location along Lake Tahoe's largest tributary, scaled-down golf course options were evidently rejected in favor of maintaining the golf course at 18 holes. Cut volumes are estimated to total 62,790 cubic yards, fill volumes from 92,000-112,700 cubic yards. To get a sense of scale, dump trucks typically have capacities of 10-14 cubic yards, so the cut volume is equivalent to 4,485-6,279 dump trucks, the fill to 6,571-11,270 dump trucks.

Curiously, the estimated cut and fill volumes for the selected alternative 2B reported in Table 2-6 'Preliminary Quantities of Cut and Fill' on page 2-42 of the PAAEA (CDPR 2018) appear to be unchanged from those reported for the previous project in Volume 1 of draft EIR, pg 2-62, despite all the changes in the project described in the document. For example, Alternative 2B is to have a golf course footprint of 19 acres less than Alternative 2, and other characteristics of Alternative 2B differ significantly from Alternatives 2 and 2A, as listed in Table 2-1 on p.2-2 of CDPR 2018. There is no explanation in the documents how the Alternatives could be so different in extent and scale, but still have precisely the same cut and fill volumes. This apparent discrepancy raises questions about how well the project has been thought out, which undermines the credibility of the proposal.

Construction Access Roads and Staging Areas as Sediment Sources

The Reach 5 project relied on a construction access road along the east side of the floodplain, east of the reconstructed channel. Unfortunately, the project had the bad luck of a very wet winter and spring immediately after construction was completed. The construction access road was a long linear area of disturbed ground, which functioned as a major flood channel during floods over the 2016-2017 winter. Monitoring data for the Reach 5 project are not yet publicly available, so at present there are no surveys to indicate (by differences in elevations pre-and post-storms) the volumes removed from the floodplain by overbank-flow erosion. However, field inspection shortly after the flood revealed extensive areas of erosion and evidence of substantial flow following the construction access road and consequent erosion of the exposed road surface.

The Washoe Meadows project is to be undertaken over a 3-5-year period, over which time construction access roads, staging areas, and other disturbed areas will be exposed, and thus vulnerable to erosion by any high, overbank flows that might occur. Under 'Project Construction' (CDPR 2018, Section 2.2.5) three 'overarching construction management measures' are listed: construction fencing to keep construction activities within delineated boundaries, dust control measures, removal of trees and wetland vegetation only as identified for removal on site-specific plans (p.2-34). The document then lists four specific measure to protect water quality. After listing washing imported gravel and cobble, and placing clean gravel on the channel bed, the document states, "A combination of native sod blanket, willow transplants or wattles, woody debris, strips of remaining golf course sod, or mulch or erosion control fabrics over seeds would be used on excavated inset floodplain surfaces." And then "Before the active river is allowed to flow through areas of new and reconnected meanders, these channel sections would be primed by pre-wetting and introducing controlled flows that would remain isolated from the active channel (protected by berms, water-filled dams, or similar measures). Any turbid water would then be pumped out onto settling basins or sprayed onto the revegetated floodplain without return flow to the channel." (p.2-41) There is no discussion of protecting disturbed and exposed areas on the floodplain from erosion during the 3-5-year construction period, nor analysis of whether the native sod blanket, willow wattles, strips of golf course sod, etc, even after they are installed, would be sufficient to protect the floodplain surfaces from erosion in the kind of high flows experienced by the Reach 5 project in the 2016-2017 water year, or how many years growth would be required before the willows and native sod could resist scour by such high flows. The project is designed to encourage frequent overbank flows, so the ability of the floodplain to resist erosion during such flows, even if they occur at an inconvenient time (such as too soon), is an important consideration. There is no discussion of the risk of a catastrophic failure in the event of a high flow that occurs during construction or before vegetation has properly established post-project.

The document states, "The final construction schedule for in-channel work would minimize the risk of high peak flows during temporary dewatering," but does not explain this statement further, nor address potential effects of high flows on exposed sites adjacent to the channel. Access, staging, and storage areas are described on pp.2-43-2-44 (CDPR 2018), and the document notes that staging areas "would be secured to prevent unauthorized access," but there is no discussion of whether and how these exposed sites would be protected from erosion by heavy rains and high flows. There is a detailed section on roads included in the EIS/EIR (pp.3-10-17-3-10-21), but its focus is entirely on potential traffic impacts on roads in the neighborhood. While it mentions construction access roads, it does not analyze the potential for these and other such exposed areas to be sediment sources during high flows, nor measures that should be taken to protect these disturbed areas from erosion, especially in light of the recent experience in Reach 5.

Channel Reconstruction Projects as Sediment Sinks or Sediment Sources?

The project documents assume that the UTR in Washoe Meadows will become a sediment sink overall, and that the deposition and trapping of sediments on the floodplain will outweigh increased sediment yields during construction. However, the project will involve extensive volumes of earth moved and a large footprint of disturbance over a 3-5-year period, so there is a risk of high flows eroding these exposed areas and generating high sediment loads before the project is completed, or after project completion but before adequate vegetation establishment to protect land surfaces.

While the amounts eroded from the construction access road and other potential sources areas in Reach 5 have not been quantified by surveys, we are fortunate to have data from continuously-recording turbidity meters upstream and downstream of the Reach 5 project. There were multiple high flows over the 2016-2017 winter-spring flow season. Data for the first major storm, 16-18 October 2016, indicate significant increases in turbidity below Reach 5 (Figure 2).

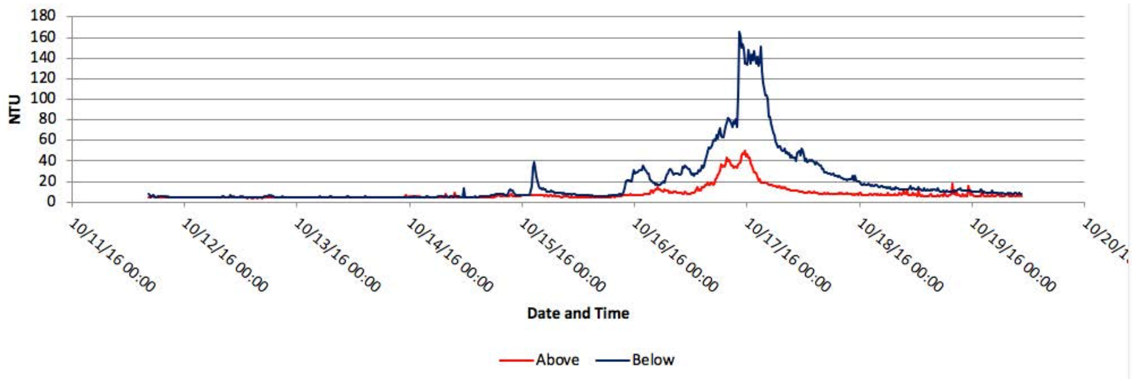

Figure 2. Turbidity values (in NTUs) recorded at a station upstream of Reach 5 (red line) and downstream (blue line), for the first significant storm of the 2016-2017 water year. Data shown from 11-19 October 2016. Source: data from US Forest Service Lake Tahoe Basin Management Unit, provided to the Lahontan Regional Water Quality Board.

These turbidity values can be converted into suspended sediment concentrations using a relation presented by Second Nature (2011, Figure 8), and then the concentrations can be multiplied by flow to yield total load, which can be summed over the course of the flood to yield total load above the reach and total load below. We have not undertaken this exercise, but the striking increase in turbidity downstream suggests large fine-sediment sources were accessed in between the two measurement stations. All the stormflows of the 2016-2017 year (and the 2017-2018 year as well), should be subject to the same analysis, to see in which storms the reach in between the turbidity gauges was a net sink, and in which it was a net source of sediment. The relative contributions to this increased load from erosion of the access road and other areas exposed due to construction disturbance, erosion of other floodplain areas, bank erosion, and upland erosion would need to be explored further to better understand the specific sediment sources in Reach 5.

The value of such turbidity data for assessing performance of the proposed Washoe Meadows project in meeting its principal objective, to "reduce the river's discharge of suspended sediments into Lake Tahoe," is obvious. The EIS/EIR and related documents for the Washoe Meadows reach do not provide details regarding the monitoring to be undertaken, but a commitment to adequate monitoring of project effectiveness should include establishment of an additional continuously-recording turbidity meter upstream of the Washoe Meadows project to allow for comparison of turbidity, and thus modeled concentrations and calculated loads up and downstream. The turbidity gauge should begin operating prior to the project construction to provide baseline data to inform interpretations of patterns observed during and after project construction.

Ecology

Conditions promoting incision reduce channel complexity, connectivity to the floodplain, and habitat available to aquatic organisms. Channel complexity influences organism abundance and diversity (e.g. Coe et al 2009, Stanford et al 1996), material flux to organisms (e.g. Cardinale and Palmer 2002), available refugia during high flow events (e.g. Sedell et al 1990), and ecosystem processes (e.g. nutrient retention, Hall et al 2002).

Some native stream organisms, especially those who are less mobile, are severely impacted by channelization. For example, freshwater mussels are sensitive to channel geomorphology (Stone et al 2004, Gangloff and Feminella 2007) and bed shear stress (Murphy 1942, Howard and Cuffey 2003). As a channel becomes more incised and channelized, the available refugia decreases and mussels are exposed to higher bed shear stress.

The Western Pearlshell Mussel, *Margaritifera falcata*, occurs in both the Upper and Lower Truckee River (Murphy 1942). With abundances of approximately 20,000 in both the Lower Truckee (Murphy 1942) and Upper Truckee (USDA 2016) near Lake Tahoe, *M. falcata* may play a key role in removing fine particulates from the water column during summer months and ultimately reduce the flux of particles entering Lake Tahoe. By filtering suspended organic and inorganic material from the water column, *M. falcata* can remove approximately 336 mg of suspended material per mussel per day (Howard and Cuffey 2006). The estimated 20,000 mussels in the Upper Truckee River (Howard 2013, USDA 2016) could potentially remove 6.7 kg of suspended material per day. According to a progress report on mussel transplants from Reach 5 (USDA 2016), the USFS transplanted 15,091 mussels (925 in 2014, 8544 in 2015, and 5622 in 2016), with "The remaining work in 2016 will be to complete relocation of the remaining mussels." We are not aware of updated information available on further transplants, nor on survival rates of transplanted mussels from Reach 5. However, given the life histories of these long-lived organisms and the unavoidable disruption to them that would occur from uprooting them and moving them to a different location, some mortality would be inevitable.

We understand that transplants from the previous project on the Airport Reach (just downstream of Reach 5) had a 70% survival rate (source asked to remain anonymous). Applying the same survival rate to mussels transplanted from Reach 5 and assuming all 20,000 were transplanted and none left to be killed by filling of the pre-existing channel (USDA 2016) still implies mortality of well over 6,000 mussels (30% of 20,000). By most standards this would be a significant ecological impact of the Reach 5 project, and it would translate into an extra 2 kg of suspended material *not* filtered by mussels, and thus passing to downstream waters every day.

Given the ecosystem functional they provide, *M. falcata* have the potential to make the Upper Truckee River more retentive for suspended sediment. Thus, their welfare should be addressed in any restoration efforts. At present, the following mitigation measures are mentioned in UTR Public DEIR-EIS-EIS_Vol II (pp. 3.5-66, 3.5-67) to address fish and less mobile organisms like *M. falcata*:

> **Mitigation Measure 3.5-1B (Alt. 2): Implement Preconstruction Surveys for Western Pearlshell Mussels.**
> Before the initiation of construction activities, State Parks will survey for western pearlshell mussels to determine whether they are present. If it is determined that western pearlshell mussels are present in the study area, then specific measures will be included to address this species in the native-fish and mussel capture and translocation plan described in Mitigation Measure 3.5-1C (Alt. 2) below.
>
> **Mitigation Measure 3.5-1C (Alt. 2): Develop and Implement Native-Fish and Mussel Capture and Translocation Plan.**
> State Parks or its representative will develop and implement a measure to prevent the loss of native fish and mussel species occupying habitat within the study area. Before any construction activities that require dewatering commences, a CDFG-approved biologist will

> conduct native-fish and mussel relocation activities within the construction dewatering area. *All captured native fish and mussel species will be immediately released to a suitable habitat near the study area.* Future restoration should not be planned for the relocation site within the next few years to allow for reestablishment of habitat and coordination with other agencies (i.e., USFS, Conservancy, City of South Lake Tahoe) should be completed so all relocation is not occurring in one reach of the river. The qualified biologist will place nets with 1/8-inch mesh at the upstream and downstream extents of the area to be dewatered to keep fish out of the area during fish removal activities. After completion of removal activities, the work area will be cleared for dewatering. Fish rescue and relocation will continue until the area is completely dewatered or until it is determined that no fishes remain in the dewatering area. These activities will take place in consultation with CDFG.

Our field observation indicates that at least some sections of the Washoe Meadows Reach are more heavily incised and channelized than Reach 5, leaving fewer areas of refugia available to organisms like freshwater mussels. Thus, we expect the Washoe Meadows project should have lower impact on mussels overall than occurred in Reach 5. However, based on our field observations and discussions with biologists involved with the Reach 5 channel reconstruction project and mussel transplants, there are serious concerns about the impact on mussels of the Reach 5 project. Thus, documents for the Washoe Meadows reach project should provide clear, specific information regarding measures to be taken to protect this sensitive species and how impacts will be monitored. Moreover, the reach immediately downstream of the Highway 50 bridge has an important concentration of mussels, which would be highly vulnerable to effects of increased sediment from construction disturbance and high-flow erosion of the Washoe Meadows reach.

Based largely on the experience in Reach 5, we make these recommendations and raise these questions for the Washoe Meadows reach:
- Clearly specify by whom and when mussel surveys will be done
- Given that the short-term degradation of channel conditions anticipated (UTR Public DEIR-EIS-EIS_Vol II, page 3.16-31) may affect not only mussels in the Washoe Meadows reach but downstream mussels as well, surveys and potential relocation of less-mobile organisms like mussels should be considered for the reach immediately downstream of Washoe Meadows (Reach 6) as well.
- Given that significant costs were incurred in the relocation efforts in Reach 5, have the likely costs of mussel identification and transplanting been realistically calculated (based on experience from Reach 5) and are funds set aside for these expenses?
- What lessons have agency biologists learned from the transplanting of 20,000 mussels for the Reach 5 project?
- Have sufficient funds been set aside for pre-restoration and post-restoration monitoring?

Post-project monitoring and accountability

Given the project objectives to "reduce the river's discharge of suspended sediments into Lake Tahoe," it is critically important that the project be adequately and properly monitored to document retention of fine sediment (e.g., through sediment traps on the floodplain surfaces) and/or erosion of sediment from channel banks and floodplain surfaces (through detailed topographic surveys). As noted above, an additional turbidity gauge should be established upstream of the Washoe Meadows reach to allow for the same upstream-downstream comparison of calculated suspended sediment loads that is possible for Reach 5.

As Lake Tahoe water clarity continue to deteriorate, the chairs of the Tahoe Science Advisory Council have expressed concern about the need to understand the factors contributing to the decline, specifically calling for additional information to understand the effect of the 2016-2017 water year on lake clarity (http://resources.ca.gov/wp-content/uploads/2018/06/CA-NV-letter-to-TSAC.pdf). In this context, having scientifically sound, objective data on sediment loads, and locating monitoring stations to pinpoint sources, is critically important.

In addition to monitoring for sediment fluxes, potential inputs of nutrients and chemicals from the golf course merit attention. Inputs from golf course management should be reduced with the proposed project, as it will create more buffer area between golf course and the river. Adding some basic water quality sampling to the turbidity measurements to track changes in water quality could be justified. As discussed above, habitat for aquatic species (including fish and mussels) and their populations should be quantified before and after the Washoe Meadows project.

Who should undertake monitoring? There are strong reasons to propose an independent entity with strong scientific credibility, such as the US Geological Survey or the Tahoe Science Center, be charged with monitoring to increase credibility of the results, and to avoid the often-encountered problems of the 'monitoring station went down' or 'lost data.'

The question of accountability is usually left unstated. As emphasized by the Tahoe Science Center chairs, the underlying causes for the recent, unprecedented decline in water quality need to be better understood, including the role of investments in erosion control projects in reducing fine sediment yield to the lake. Thus, the importance of following up on project performance to better understand the contributions on individual projects and portfolios of projects to reducing fine sediment loading to Lake Tahoe, or *increasing* sediment loading to Lake Tahoe, as available data indicate was the case for Reach 5 during the storm of 16-18 October 2016.

Ambiguous or Unclear Terminology

There is considerable ambiguity in terminology in the project documentation, which may lead to confusion on the part of reviewers. For example, the project documentation repeatedly refers to "full river ecosystem restoration" as a component of the preferred alternative 2B (CDPR 2018 pp 1-4, 2-1, and elsewhere), which hardly seems plausible given the site's context and its history of massive disturbance in the 19th and 20th century from deforestation, mining, intensive livestock grazing, road construction, direct channel alteration, and residential development. The document does not justify the use of this terminology for a river reach that will (even with the improvements to be made under the proposed alternative) still flow directly adjacent to a golf course for 1300 ft, and which is still subject to multiple modifications and constraints from the surrounding infrastructure and urban development.

The document repeatedly refers to the "reconfigured, *reduced footprint* 18-hole regulation golf course" proposed as a component of alternative 2B (CDPR 2018 pp 1-4, 2-1, and elsewhere; emphasis added). This is misleading. The footprint of the golf course proposed under 2B will actually be *larger* than the existing course by 3 acres (137 vs 134 acres). It is "reduced" only with respect to prior proposals that would have increased the golf course acreage more. While this clarification is made on p.2-1, the term "reduced footprint" is repeatedly used in the document. This is certain to mislead some readers into thinking that the golf course proposed under the preferred alternative 2B is reduced from the existing golf course, not "reduced" from a golf course that never existed and was only proposed.

The document refers to "river miles", such as "River Mile (RM) 6000" (CDPR 2018 p.2-4) for a site that appears to be about 1.1 mi upstream of Hwy 50. Examining the map of Alternative 2B presented on p.2-7 of CDPR (2018), there are triangles labeled 1000, 2000, 3000, etc., along the river, which are separated by distances of approximately 1000 ft, certainly not 1000 miles. The legend for this map identifies these triangles as 'River Stations (100 ft)'. However, these cannot be in units of 100 ft, as 100 x 1000 is 100,000 ft, and 100 x 2000 is 200,000 ft, which implies the distance between each of these triangles would be nearly 20 miles, which is also clearly not the case. In fact, these so-called 'river miles' or 'river stations (100 ft)' appear to be simply distances along the river length in ft. This appears to be a double error, the result of sloppy work in assembling the document, rather than reflecting a massive misunderstanding of the project scale, but it is surprisingly unprofessional and does not reflect well on the document.

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