Appendix L: Environmental Assessment of Concepts

Appendix L provides the MCG-approved environmental assessment of project concepts. Concepts were assessed based on their potential feasibility, geomorphic benefit, and fisheries benefit.

MokeWISE Draft Concept Assessment Information

Version: 9 January 2015

#	Concept Name	Feasibility (scale 1-5, 1 less, 5 more) Benefit score explanation	Geomorphic benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Fisheries benefit (scale 1-5, 1 less, 5 more) Benefit score explanation	Environmental considerations	General Comments	Potential Direction for Concept Development including Additional Benefits
1a	Upper Mokelumne Anadromous Fish Restoration	4 Logistics in transporting salmonids into and out of upper watershed would carry costs. How much suitable habitat remains upstream? How much of the upper watershed has compromised habitat from hydroelectric operations? There is a high degree of interest in implementing this type of program, though none that have yet come to fruition.	5 If increased resiliency becomes a real outcome, it would be of immense benefit to stressed salmonid populations in central, interior CA. Additionally, presence of anadromous fish would result in many measures which would enhance habitat in the upper watershed. For instance, successful implementation could create positive biogeomorphic benefits through substrate rejuvenation during spawning, and in providing a reintroduction of marine nutrients into the upper watershed ecosystem when spawners die.	2 Relocating adult anadromous salmonids from the lower Mokelumne River to the upper Mokelumne River offers the opportunity to bring marine nutrients into the upper watershed and, if accomplished using steelhead, would provide advantages of increasing genetic diversity of the resident rainbow trout population in the upper watershed. Relocating adult fall-run Chinook salmon to the upper watershed, however, is not expected to produce substantial benefits in terms of increasing fall-run Chinook salmon population abundance in the absence of an effective method for trap and haul to return juvenile salmon to the lower river where they can complete their migration to coastal marine waters. Passage of juvenile Chinook salmon from the upper watershed downstream volitionally is not expected to be feasible as a result of both existing passage barriers to downstream migration as well as predation mortality occurring within the reservoirs.	Hydropower peaking flows could be disruptive to habitat requirements in the upper watershed.	Positive effects to fish populations would be anticipated to be larger than biogeomorphic effects. Studies would need to be in place to assess outcomes and to ensure that goals are met. // The concept of relocating adult salmonids to the upper parts of the watershed has merit and is a restoration activity compatible with both salmonid recovery actions, as well as establishing diversified life history strategies within the watershed. Technical issues with regard to migration feasibility, particularly for juveniles that would be migrating downstream through the watershed, would need to be addressed.	Develop implementation plan including all logistics, benefits and costs. Develop monitoring plan to track project trajectory following implementation. Identify which reaches might warrant managing for temperature, if any. // Including downstream collection facilities and transport for juvenile salmonids produced in the upper watershed (e.g., trap and haul) would substantially enhance fishery benefits but has proven to be difficult, in many cases has low trap efficiency (e.g., rotary screw traps), and has relatively high cost and ongoing annual labor needs. Variable flows and high debris loading have posed problems for downstream migrant traps. A more detailed plan of the trap and haul program for both upstream adults and downstream juvenile migrants could improve this concept.
1b	High Country Meadow Restoration Program	5 Meadow restoration projects have been successfully implemented in the Mokelumne River watershed as well as other Sierra Nevada watersheds. There appears to be a high degree of institutional interest, knowledge and support for such projects.	5 Meadow restoration would improve geomorphic functions in the upper watershed, which have been shown to result in a cascade of positive effects locally and downstream. Locally, GW retention of flows in a healthy the meadow aquifer may result in continuous flows through a dry summer. A cascade effect may occur downstream, which could include an increase in baseflows leading to better water quality and geomorphic functionality, which may improve fish habitat and riparian corridor health.	4 Protecting existing high elevation meadows, in combination with implementing the meadow restoration program, provides environmental benefit through the protection and preservation of sensitive habitat as well as promoting habitat diversity within the watershed. High elevation meadows serve a variety of environmental functions that can be easily lost if adequate protections and restoration mechanisms are not implemented.	Restoration of meadow functions would likely increase groundwater supplies and baseflows at least in the upper watershed via greater infiltration rates as waters slow from draining hillslopes to crossing meadows prior to entering streams. Peak flow and sediment transport rates should decrease during episodic flood events. Meadow morphology may be returned to approximate natural capabilities, which should allow provide increased levels of geomorphic and ecologic processes in restored meadows, including a possible shift from xeric plant species such as sage back to mesic meadow species such as grasses and sedges that have the added benefit of greater bank stability properties.	Rehabilitation actions would likely restore geomorphic functions in the meadow and downstream from it. Such projects have been shown to result in a cascade of positive effects to hydrologic elements within the greater watershed, including downstream flows and groundwater storage. Ecological elements of the meadow community such as vegetation and animal communities would also benefit from restoration. Upper watershed meadows may soon, if not quite yet, be considered a keystone environmental element much as protection and enhance of salmonids and their habitats are now, so perceived positive benefits of meadow restoration would likely be lower than those for salmonids, but may be as important geomorphically and ecologically. // The concept of restoration of diverse natural habitat, such as high elevation meadows, should be strongly supported and encouraged.	Utilize available governmental documents and grants along with existing professional expertise and literature sources to develop the proposed three-phase program. Gather baseline data pre-restoration and conduct post-restoration monitoring to quantify restoration outcomes.

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1c	Mokelumne River Day Use Area Floodplain Habitat Restoration Project	4 Floodplain connectivity was achieved when slope creation directly downstream of Camanche Dam flooded killed existing riparian trees on left bank of the river (when looking downstream). This and other floodplain restoration projects could provide a template within which to develop a program for the lower Moke.	5 Floodplain restoration would help to restore fundamental geomorphic functions, positively influencing hydrologic and ecologic functions.	4 A number of studies are currently emerging from the Yolo Bypass, Cosumnes River, and many other watersheds that have demonstrated the benefit of seasonally inundated floodplain habitat as juvenile rearing areas for Chinook salmon and steelhead. Floodplain habitat has been shown to be productive and results in increased growth rates of juvenile salmonids that has been identified as a factor increasing the probability of survival during their downstream migration through the Delta and ocean. Floodplain habitat needs to be carefully developed to provide connectivity with the mainstem river, avoid areas of stranding and dewatering as flows recede, and provide cover and substrate to promote both production of prey resources, but also to provide cover habitat to reduce the risk of predation.	The ability of flows greater than the natural "bankfull" (i.e. unimpaired, average 2-yr flow) to spread out across additional floodplain space would increase potential sediment deposition. Flood flow attenuation may decrease flood effects on downstream structures and communities. Reconnection would promote increased channel morphodynamics, as the river and the floodplain adjust to locally refreshed hydraulics.	Floodplain restoration projects are more likely to be implemented on public lands. Because the Mokelumne flows east-west, shading benefits are greater on the south bank than on the north. Different restoration techniques may be needed on the two banks to protect the existing shading values. // There is growing broad support within the scientific community for reconnecting mainstem rivers with seasonally inundated floodplain to benefit juvenile salmonid growth and survival. Floodplain restoration offers a variety of environmental benefits that can be relatively expensive to accomplish and requires a stable and sufficient funding source for implementation.	Perhaps specific individual landowners would be willing to implement additional floodplain restoration programs over and above that achieved on public lands. Any increase in connectivity between the river channel and the floodplain would be beneficial to geomorphic, hydrologic and ecologic functions. A continuous stretch of reconnected floodplain along at both sides of the river corridor would provide the most positive benefit, though any increase would be beneficial. If bankline trees are lost during a project, there could be localized temperature effects, but in the long-term replanting and natural recruitment would provide new shading.
1d	Fish Screens for Riparian Diversions in the Lower Mokelumne	4 From a technical point of view, screening diversions is a matter of installation of the necessary materials.	4 The more fish and supporting food web organisms killed because of diversions, the fewer that can contribute to river bed and bank bioturbation processes such as salmonids revitalizing the channel bed during spawning activities. Diversions alter hydraulic gradients and shear stresses, dependent on a given river discharge and the diversion rate and volume. Any reduction in kill rate would be very beneficial to the river ecosystem.	3 There are a number of riparian diversions that occur from the lower Mokelumne River, primarily for agricultural irrigation, that are currently unscreened. The largest of the diversions, such as that at the Woodbridge Irrigation District dam, have been screened to provide protection for downstream migrating juvenile salmonids. Although installation of positive barrier fish screens is identified as an environmental benefit through reducing the risk of juvenile salmonid entrainment, the incremental benefit of screening only a small percentage of the existing unscreened diversions diminishes the overall effectiveness of screening program. In addition, no information is available on the specific unscreened diversions and their operations that would contribute to the greatest level of entrainment risk and hence it is difficult, given the current state of information, to prioritize among the existing unscreened diversions, and determine which should receive the highest priority. The magnitude of biological benefit varies in response to a number of factors such as the magnitude and seasonal timing of diversion as well as the location of the diversion. Relatively large unscreened diversions located in areas where juvenile salmonid rearing occurs typically pose the greatest risk of entrainment. Funding priorities focused on providing intake screening of the largest diversions (by volume) located in sensitive habitat are expected to offer the greatest biological benefit. Installation of positive barrier fish screens on the lower Mokelumne River should be encouraged and will result in direct benefits to improving juvenile survival. The greater the volume of unscreened diversions that can be equipped with intake screens the greater the potential biological benefit.	It is unknown how many aquatic organisms are directly and negatively affected by the stresses of diversions, but diversions contribute to an overall decrease in abundance and diversity of organisms in the river ecosystem, first simply due to decreased volume of water in the river, and also due to deaths directly related to the diversion intake. A decrease in diversions would allow flows to perform more geomorphic work. An increase in diversion screens would decrease the number of organisms killed during the diversion process. Providing positive barrier intake screens on currently unscreened water diversions will contribute directly to a reduction in entrainment risk and mortality. The concept plan would be improved by providing additional detailed information on the locations, size, volume of diversion, availability of funding for intake screen installation, location relative to sensitive habitat such as juvenile rearing areas, and willingness of local landowners to participate in a screening program will be beneficial in better describing the potential biological benefits, educating local landowners regarding the benefits of screening, and for use as a technical basis for developing grant applications and securing funding.	It would be useful to determine accurate values for numbers of diversions and of those, how many are not screened. Either way, it appears to be many in number. // In general reducing sources of direct mortality, such as entrainment into unscreened diversions, provides a positive incremental benefit to increasing survival and abundance of juvenile salmonids produced in the lower Mokelumne River. The relatively large number of diversions within the lower Mokelumne River and Delta, however, make the incremental contribution of installing positive barrier fish screens on each individual diversion relatively low.	Develop a plan to quantify diversion fish fills, prioritize diversions to be screened, calculate costs associated with screening. A potential key to successful screening compliance may be in developing a compelling, consistent message that resonates with water rights owners along with making the cost of compliance via grant funding or other monies attractive/tractable, or perhaps in developing regulations or legislation that would mandate compliance. // The program would benefit from developing a plan or vision of how intake screening would be accomplished, the schedule for screening, the anticipated cost and availability of grant and other funds, identification of highest priority diversions from the river based on their size and locations, seasonal diversion patterns relative to the occurrence of sensitive fish species in the area, and proximity of the diversion to sensitive fish habitat such as juvenile salmonid rearing areas. Survival studies have been done that show relatively low survival in the Mokelumne River for juvenile Chinook salmon. Qualitative analyses of the potential contribution to juvenile survival as a result of various levels of fish screening would be helpful to provide a basis for assessing "costs and benefits" for funding proposals. Development and installation of even a small number of intake screens on a pilot scale would be beneficial to demonstrating the operational reliability and benefits to gain local landowner support for expanding the program in the future.

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1e	Riparian Restoration Program – Upstream of Pardee	5 Meadow and riparian resportation projects have been accomplished in the Mokelumne River watershed and elswhere and are demonstrated to be feasible. Challenges such as establishing and maintaining a reliable water supply for irrigation during the re-establishment phase of restoration has been a challenge for some projects. A key element to restoration success is to identify reaches where riparian restoration can be accomplished. Develop criteria in which short term goals and long term goals are equally weighted. Riparian corridor restoration that contains fully mature trees may take up to 3-4 decades. Most upstream riparian corridor lands are publically -or agency-owned, so feasibility of project implementation is likely very high. The feasiblity score is dependent on the specific locations and attributes of individual restoration sites but there is great potential benefit to the integrity of the watershed and its functions.	5 In upper watersheds, undisturbed riparian corridors provide the natural interface between the channel environment and local hillslopes, meadows and floodways. Removal of invasive plant species and an increase in native species should improve riparian/forest health and strengthen its connectivity to the river. An increase in the amount of wood available to fall into the channel (i.e. streamwood) would improve habitat diversity through structural additions to flow fields, refugia during high flows and from predation, and provide additional nutrients to aquatic organisms. Should help improve water quality, and may attenuate flood flows.	3 Protecting and improving riparian vegetation is an important watershed management activity that contributes directly towards increased habitat diversity, habitat complexity, and habitat function not only for terrestrial species, but also for those aquatic species inhabiting the Mokelumne River. Insect production from riparian areas provides a valuable foraging resource for juvenile salmonid and other fish species inhabiting the river. Much of the upper Mokelumne River watershed is under the ownership of organizations such as BLM, PG&E and the U.S. Forest Service which is expected to help facilitate planning and implementation of successful protection of existing resources and restoration of degraded resources with substantial areas of riparian vegetation that would provide significant benefit to the ecosystem. A number of small restoration projects that are fragmented within the watershed provide less environmental benefit than providing greater contiguous areas that have connectivity among riparian corridors. The benefit score for fishery habitat reflects the high potential benefits to the watershed and ecosystem. There is some uncertainty in the planning, scope and magnitude of the restoration effort, and in some projects the lack of a reliable long-term water supply for irrigation during the re-establishment process has diminished restoration success and benefits.	Riparian restoration takes time, particularly for trees to mature and become large enough to function as structural components when they enter the river network. Hydropower peaking flows could be disruptive to riparian restoration.	It is important to allow streamwood and other organic materials to remain undisturbed in the river in the patterns in which they fall or come to rest, if at all possible. Streamwood breaks down stochastically via decay and disintegration. This process is meant to contribute to carbon storage and carbon transport from upper watershed to the ocean in a range from entire trees to dissolved organic carbon. // Protecting and restoring riparian habitat within the Mokelumne River watershed is an important element in developing a more comprehensive and integrated watershed management program. The program should receive broad support from the scientific community, various agencies, and landowners as it proceeds forward.	Develop a framework and public outreach program in which streamwood is shown to be a necessary, vital component to river health. One project goal could be to educate the public that removal/cutting of streamwood when found in the river, even if it is blocking passage, is not of ecological/geomorphic benefit. Another project could be to pass through or transport streamwood around existing dams so that the structural and carbon contributions of streamwood are not lost to the downstream reaches.
1f	Riparian Restoration Program – Below Camanche	3 Identify reaches where riparian restoration can be accomplished. Develop criteria in which short term goals and long term goals are equally weighted. Riparian corridor restoration that contains fully mature trees may take up to 3-4 decades. Most downstream riparian corridor lands are privately-owned, so feasibility of project implementation is probably not as high as for concept 1e.	5 In lowland environs, riparian corridors connect river corridors and floodplains. In many cases, floodplains develop natural levees that serve to capture high flows that then spread out on the adjacent floodplain, thus providing a natural sink for particulate organics and minerals along with a percolation basin into which still waters can recharge the local aquifer while contributing to flood attenuation downstream.	3 The implementation of efforts identified in the Mokelumne River stewardship plan are valuable to provide an opportunity for coordination, communication, integrated management planning, in securing additional funding for implementation of various restoration and enhancement projects. The environmental benefits are difficult to assess at this time since the magnitude of benefit is linked to the types of projects that would be implemented, the magnitude and duration that those projects would provide benefit, and the level of funding for restoration and long-term maintenance are largely unknown.	Riparian restoration takes time, particularly for trees to mature and become large enough to function as structural components when they enter the river network.	Same comments as 1e, with an additional comment that lowland river corridors are more heavily populated than in the upper watershed. More people generally means more river interaction, and in some cases may result in more manipulation (i.e. cutting or removal) of streamwood perceived as dangerous or to be clogging the river. It's important to work to change perceptions so that residents, visitors and stakeholders understand that streamwood is "good" in rivers. // Support for the stewardship program should be broad-based within the watershed and should be used as the political and scientific foundation for identifying specific high priority projects for implementation in combination with specific estimates of the schedule for implementation and the corresponding budget. A 5 to 10 year description of the vision of the stewardship program implementation would be helpful to convey the long-term vision for the watershed.	Develop a framework and public outreach program in which streamwood is shown to be a necessary, vital component to river health. One project goal could be to educate the public that removal/cutting of streamwood when found in the river, even if it is blocking passage, is not of ecological/geomorphic benefit. Further, riparian corridors are vital components of a healthy river corridor, serving many important functions. Linking riparian corridors and adjacent floodplains provides the best possible use of near-channel space by recreating natural conditions.

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1g	Mokelumne Water Quality, Soil Erosion & Sedimentation Restoration	4 Technically feasible to inventory upper watershed roads, trails, and other areas that have been disturbed by human development and that are visibly eroded and gullied. Project may take 3-5 years to coordinate between land owners. USFS, BLM and PG&E are likely to support project goals. Similar projects have been successfully implemented in other California watersheds.	3 Water quality would improve with a decrease in artificially increased sediment supply from roads, trails, and other development. Project would likely decrease the need for mechanical removal of sediment from reservoirs (i.e. Tiger Creek Afterbay sedimentation).	3 Management of soil erosion and sediment deposition within aquatic habitats is an important element in defining the quality and suitability of aquatic habitat, particularly for salmonid spawning and juvenile rearing, but also for other aquatic resources, including macroinvertebrate and insect production within various parts of the watershed. Soil erosion as a result of road crossings, local land use, fire, and other factors has been identified as an important factor affecting habitat quality and suitability within a watershed. Development of a strategic management and restoration program to address soil erosion issues within the watershed provides a variety of environmental benefits. A key element in assessing the magnitude of potential environmental benefit of such a program, however, is dependent upon the location and the magnitude of restoration, the degree of suspended sediment and deposited sediment reduction, and the ability for long-term maintenance are key elements underscoring the magnitude of benefits such a program would have to Mokelumne River watershed aquatic resources.	A decrease in sedimentation and turbidity would increase water quality and potentially improve substrate habitat for spawning fish and invertebrates that utilize interstitial spaces in the channel bed, as well as improve spring and summer fish growth rates. Reduce fine-grained sedimentation reduces redd (fish nest) scour, with the associated loss of incubating eggs.	Large influxes of sediment from roads and trails are known to have an adverse effect on the river channel ecosystems. On the other hand, steady influxes of sediment during typical flows and runoff events should be expected. Large influxes of sediment following fire, or during episodically large runoff and flood events should also be expected. Furthermore, sedimentation build-up in reservoirs should not be unexpected given these natural processes. These examples bring home the point that it is important to identify the baseline sedimentation rates along with where increased sedimentation rates are originating from. // Sediment deposition and soil erosion has been identified as a significant factor affecting habitat conditions for salmonids and other aquatic resources throughout the Central Valley. A number of innovative programs are being developed in other watersheds, such as the Napa River watershed, that can serve, in part, as case studies and models for the development of a strategic plan for sediment erosion control, public landowner outreach and education, identification of funding mechanisms, and identification of the environmental benefits that would be derived from such a program. ~~It is encouraged that~~ Other similar programs ~~that~~ have been developed and are being implemented in other watersheds in California and can ~~elsewhere~~ be reviewed and considered when developing a similar program for the Mokelumne River system.	Use of similar watershed improvement projects and the knowledge and data developed from those studies to help in the planning and design of this project. Develop a public outreach program to achieve landowner support as needed.

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2a	Municipal Recycled Wastewater Recharge Program	3 Description focuses mainly on GW recharge, while spreadsheet focuses more on recycled water used for irrigation. Both concepts are valid and complementary.	3 The less water diverted from the river channel, the better for the geomorphic and ecological health of the ecosystem.	2 The use of treated water supplies for groundwater storage augmentation has a number of benefits associated with increasing water storage, water supply reliability, drought water contingency, and other water demand related benefits. The benefits of groundwater storage for enhancing fishery conditions, however, are considered to be relatively low given the cost of groundwater storage and the relatively small amount of water that could be used beneficially for enhancing instream flows.	Programs where reclaimed water is used to recharge aquifers exist, so frameworks and guidelines are likely readily available.	Water rights issues could "muddy" this effort. Improvements in irrigation practices, fallowing fields, or replacing water intensive crops with drought tolerate crops could create a potentially large source of water that was perhaps once needed but after changes could be used to recharge local aquifers or remain as fresh water in the channel (major benefit to the river ecosystem). California regulations for groundwater replenishment via either surface or subsurface using recycled water went into effect on June 18, 2014: http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Lawbook.shtml A potential key component of measuring successful project implementation would be that conserved water does not become supply for new demand. // There is limited experience on how groundwater storage opportunities could be used to enhance fishery habitat, however, opportunities for conjunctive benefit either directly or indirectly through groundwater storage should be explored and identified. In several systems, the use of riparian wells has been identified as a method for seasonally increasing critically low instream flows or reducing water temperatures to benefit Chinook salmon, steelhead, and other aquatic species. Benefits and these types of conjunctive operations should be further explored.	Develop framework to identify treatment plants ready and able to begin program versus those that will need upgrades. Identify GW aquifers in greatest need of recharge. Prioritize where initial implementation might be most feasible and expand program as funding and opportunities present themselves. // Additional benefits of wastewater recharge programs in reducing demands on surface water supplies may also provide instream flow benefits but they are difficult to quantify given the level of information available at this time. Reducing demand on surface water supplies offers biological benefits to Mokelumne River fishery resources. The magnitude of benefits depends, in large part, on the magnitude, seasonal timing, and water year types when surface water demands can be reduced and instream flows increased and made more reliable.
2b	Constellation Winery Wastewater Reuse	3 If private interest is high and funds are available, then project could be moved to a higher feasibility score. A simplified permit process may be helpful here, as the efforts appear to be voluntary (though not explicitly stated).	3 The less water diverted from the river channel, the better for the geomorphic and ecological health of the ecosystem.	1 There appears to be very little potential benefit to fishery habitat or resources that would be gained by the use of treated wastewater for agricultural irrigation in lieu of groundwater pumping. There may be opportunities where a reduction in groundwater demand could provide direct and/or indirect benefits to increased instream flows and enhance fishery habitat, however, those opportunities have not been identified in the concept proposal.	Monitoring requirements per CA groundwater replenishment or other pertinent regulations should be followed to provide for useful assessment of effects to GW quality and water table levels.	Individuals who voluntarily chose to participate in important changes to water use are to be highly commended. On September 30, 2014, Assembly Bill 2193 was signed into law by Governor Brown, which aims to streamline permitting processes for voluntary restoration projects. Other ways to reduce water needs may be achieved through improvements in irrigation methods and potentially development of grape strains that can tolerate less water yet produce quality grapes. A potential key component of measuring successful project implementation would be that conserved water does not become supply for new demand. // Although there is general support for the use of treated wastewater as an agricultural irrigation source that would serve beneficially to reduce demands on local groundwater storage for municipal and other water supplies, the linkage to enhancing fishery habitat through conjunctive operations has not been developed for the proposed project.	Establish a pre- and post-implementation monitoring plan that would help in the development of a region- and winery-specific framework that could be adopted by others.

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2c	Amador County Regional Reuse	4 Study proposes three alternatives and provides costs involved with implementation to use tertiary treated wastewater for city irrigation purposes initially, in Sutter Creek and Jackson, CA, Amador County. Agricultural uses may follow. Recycled water facilities would have to be funded and constructed in order to implement any of the alternatives. Technical feasibility should be high, particularly if funding is available.	3 The less water diverted from the river channel, the better for the geomorphic and ecological health of the ecosystem. The less groundwater pumped from aquifers, the better the GW water quality. Concept spreadsheet lists 400 AF/yr of recycled water use, providing conserved surface (diverted from Jackson Creek) or groundwater supplies as available for potable water uses. It is unclear whether diversions would actually decrease.	2 As described above for to be the potential benefits of water reuse programs for purposes of improving or augmenting instream flows or fishery habitat are largely unknown. Opportunities exist for conjunctive operations that would have the potential to benefit fishery habitat, however, those opportunities have not been explicitly identified or characterized.	Monitoring requirements per CA groundwater replenishment or other pertinent regulations should be followed to provide for proper assessment and follow-up that water quality standards are continually met.	It is unlikely if any water rights holders could achieve a profound reduction in volumetric water take from the system, as continuing development creates new needs even as efficiencies increase. On the other hand, a potential key component of measuring successful project implementation could be that conserved water does not become supply for new demand.	Concept development has been completed, and a refinement study presumably underway. Adoption of tertiary water for municipal and potentially even irrigation uses will likely become "second nature" in the years to come. Being near the forefront of these types of water conservation strategies reflects high degrees of civic responsibility.
3a	Solar-Powered Desalination	3 Adoption of new solar-powered desalinization technologies such as Water FX (still in pilot phases as of Fall, 2014) have a higher likelihood of failure, so while initial results are promising, feasibility is not assured at this early date. Capital costs appear to be relatively reasonable. Successful technological implementation has not yet been fully proven, so feasibility is deemed low. Nevertheless, if successful this concept could prove very valuable.	2 New technology is focused on using brackish GW supplies, so fresh water flows in the Mokelumne River might benefit incrementally, if at all.	2 Although desalinization provides the opportunity for increased water supplies for municipal and industrial application, desalinization is not a cost-effective method for increasing instream flows for fishery habitat enhancement. There are potential indirect opportunities where conjunctive operations with a desalinization facility could reduce demands on surface water supplies that could then subsequently be used for fishery habitat purposes. The magnitude and feasibility of such conjunctive use programs and their cost-effectiveness has not yet been presented.	Solar-powered desalinization plants would need to be carefully constructed and placed to prevent destruction of natural land use, and to minimize harm to wildlife.	Desalinization projects are forward looking; care must be given to planning and studies so that the benefits of additional fresh water supplies are not outweighed by unforeseen costs, such as distribution and disposal of salts or endangerment to land or wildlife. // In general, the application of desalinization appears to have positive water supply benefits, although at a potentially higher cost than many other sources. Desalinization to the extent that it is cost effective and feasible for a specific project application offers increased water supply reliability, particularly in critically low flow years, that would benefit municipal demand bur may have very little, if any, fishery benefit.	Adoption of solar-powered desalination would be very cutting-edge and if successful (both locally and if the technology itself is deemed truly successful at the demonstrated 93% recovery level), could be used to access 'new' GW sources for fresh water as well as produce derivative mineral resources for potential sale.
4a	Groundwater Banking within the Eastern San Joaquin Groundwater Basin	4 Groundwater banking projects in Southern California could be used as frameworks for similar projects in the Mokelumne River watershed. Recharge potential is generally greater in San Joaquin County than Amador or Calaveras Counties.	2 In coupled groundwater-surface water systems, improvement in the overall health of one of the systems would contribute to improved health in the other. Fewer river diversions would allow unallocated waters to stay in the river and perform geomorphic functions, though the benefit would likely be small and incremental at best.	2 As discussed above, the application of groundwater banking, although having a number of water supply benefits, does not appear to be a cost effective method for improving instream flows and fishery habitat. Opportunities may be identified where additional groundwater banking could provide direct and/or indirect benefits by reducing surface water supply demand that could have fishery benefit, however, those do not appear to have been identified to date.	New studies and results showing potential recharge areas should be used to supplement existing studies.	GW banking projects in each groundwater region could provide for equivalent benefits for each GW basin. Groundwater banking projects have the potential to reduce reliance on surface water diversions that could then be used to increase a reliable supply of instream flows that would benefit fish and other aquatic resources. The magnitude of surface water benefits has not been quantified for the proposed project and therefore potential fishery benefits, although potential, remain uncertain. Additional development of the banking concept in terms of seasonal timing of diversions, volumes diverted, changes both positive and negative in surface water flows and other details are needed to further asses the proposed project benefits.	Coupling groundwater recharge basins with floodplains adjacent to the river corridor could potentially serve multiple purposes: GW recharge, sediment deposition, increased connectivity between river and floodplain. Use of gates similar to those used at the Sutter Bypass to open and close floodplain areas to promote GW recharge could be explored for feasibility.

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4b	Amador and Calaveras Counties Hydrologic Assessment	4 A regional GW assessment is technically feasible; implementation of GW storage programs after assessment is completed should be feasible also. Recharge potential is generally greater in San Joaquin County than Amador or Calaveras Counties.	2 In coupled groundwater-surface water systems, improvement in the overall health of one of the systems would contribute to improved health in the other. Fewer river diversions would allow unallocated waters to stay in the river and perform geomorphic functions, though the benefit would likely be small and incremental at best.	2 As discussed above, the application of groundwater banking, although having a number of water supply benefits, does not appear to be a cost effective method for improving instream flows and fishery habitat. Opportunities may be identified where additional groundwater banking could provide direct and/or indirect benefits by reducing surface water supply demand that could have fishery benefit, however, those do not appear to have been identified to date.	New studies and results showing potential recharge areas should be used to supplement existing studies.	GW banking projects in each groundwater region could provide for equivalent benefits for each GW basin.	Coupling groundwater recharge basins with floodplains adjacent to the river corridor could potentially serve multiple purposes: GW recharge, sediment deposition, increased connectivity between river and floodplain. Use of gates similar to those used at the Sutter Bypass to open and close floodplain areas to promote GW recharge could be explored for feasibility.
4c	San Joaquin County Groundwater Banking and Exchange	5 Groundwater banking projects in Southern California could be used as frameworks for similar projects in the Mokelumne River watershed. Recharge potential is generally greater in San Joaquin County than Amador or Calaveras Counties.	2 In coupled groundwater-surface water systems, improvement in the overall health of one of the systems would contribute to improved health in the other. Fewer river diversions would allow unallocated waters to stay in the river and perform geomorphic functions, though the benefit would likely be small and incremental at best.	1 Increasing water diversions from the Mokelumne River for the purpose of groundwater bank augmentation provides a number of benefits for municipal and industrial water supply, but does not appear to provide any benefit to instream flows or habitat conditions occurring within the Mokelumne River for fisheries or other aquatic resources.	New studies and results showing potential recharge areas should be used to supplement existing studies.	GW banking projects in each groundwater region could provide for equivalent benefits for each GW basin. // Although surface water diversions from the Mokelumne River for increased groundwater banking provides water supply reliability and water storage benefits for municipal and industrial uses, as well as other beneficial uses, there appears to be little or no benefit to fisheries or other aquatic resources within the watershed.	Coupling groundwater recharge basins with floodplains adjacent to the river corridor could potentially serve multiple purposes: GW recharge, sediment deposition, increased connectivity between river and floodplain. Use of gates similar to those used at the Sutter Bypass to open and close floodplain areas to promote GW recharge could be explored for feasibility.
4d	NSJWCD Infrastructure Improvements	5 Concept is sound, in that existing infrastructure is upgraded. Funds for the costs of improvements would be needed.	1 Higher efficiency in pumping stations will likely not affect geomorphic conditions in the river corridor. If pipelines are constructed in place of aqueducts, then evaporation, leakage and seepage rates would diminish, thereby potentially requiring fewer AF of diversions for the same volumetric delivery.	1 Improving infrastructure to allow Increasing water diversions from the Mokelumne River for the purpose of groundwater bank augmentation provides a number of benefits for municipal and industrial water supply, but does not appear to provide any benefit to instream flows or habitat conditions occurring within the Mokelumne River for fisheries or other aquatic resources.	A decrease in GW pumping would be beneficial for GW reserves.	Investments in capital improvements will pay off in the long term, even if it appears costly in the short-term. As a society, we must consistently strive to balance environmental and human needs.	Identify the best long-term solution, regardless of short-term costs. Upgrading infrastructure prior to equipment failure or emergency repairs shows fiscal responsibility.

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5a	Regional Urban Water Conservation Program	5 Most Californians understand this goal due to current (and recurrent) drought conditions, and support the need for conservation, especially right now.	1 As flows are already thoroughly regulated throughout the watershed, any conservation gains would likely be offset by other water rights entities using non-allocated waters for other purposes, such as groundwater banking. Likely little to no geomorphic benefit.	3 The water that is available within the watershed to meet competing beneficial uses is a function of water supply and water demand. To the extent that urban water management and other conservation practices can be used to effectively reduce water demand there would be benefit to increasing available surface water supplies for other beneficial uses, including instream flow augmentation and fishery habitat enhancement. The magnitude of the incremental benefit of increased conservation on water supplies, coldwater pool management within Camanche and Pardee reservoirs, and associated instream flows in the lower Mokelumne River are difficult to quantify. Efforts within the EBMUD service area have already been implemented to enhance conservation and reduce water supply demand. The incremental additional opportunities to further enhance conservation and the magnitude of the associated water supply benefit requires further analysis and consideration.	Reduction in urban water use is a worthy and necessary goal, but does little to address needed improvements in efficiencies in agricultural irrigation, which uses ~70 to 80% of the available water supply.	The spreadsheet comment "If 20% by 2020 is already met, the additional conservation benefit is difficult to squeeze out of a new program" is not understood without additional information. It could be conjectured to refer to a current goal of a 20% reduction in municipal water use, but that is not explicitly stated. In addition to increasing efforts towards improving water conservation, further effort should also be devoted towards beneficial reuse of existing water supplies, including, but not limited to, treatment and wastewater reuse for agricultural irrigation, residential irrigation, and other water demands.	There are many avenues to pursue to reduce municipal demand. Develop a framework to guide process, potentially with incrementally bigger goals as current goals are met. Reductions should be embraced as permanent, with citizen mindsets fully embracing water conservation principles no matter what type of water year, i.e. conserve just as much during wet years as dry years.
5c	Regional Agriculture Conservation Program	5 Voluntary efficiencies would be very useful, and may lead to permanent reductions in water usage as new technologies are adopted. Challenges exist in the management and potential benefits of additional water conservation actions. For example, additional conservation has the potential to increase surface water flows that would benefit fish and other aquatic resources if left in the stream. In contrast, conservation is viewed by some as a method for increasing water supplies that would serve to meet additional agricultural, residential, commercial, and industrial demand growth and therefore would not provide additional environmental benefits . Conservation management plans would help provide guidance on the potential magnitude of additional water supplies developed through conservation programs, how those potential water supplies may vary seasonally and in response to variation in hydrology (water year type) as well as firm projections of how water supplies developed through conservation would be allocated among various beneficial uses. In the absence of better information on conservation planning and use there remains a relatively high degree of uncertainty in the magnitude and types of benefits that would be derived from such a program.	5 Since agricultural irrigation uses the vast majority of available water supply, significant increases in efficiencies have the potential to truly reduce surface water diversions and GW pumping throughout the watershed.	2 As described above for urban water conservation, agricultural water conservation and beneficial reuse offers an opportunity to reduce demand and thereby increase surface water supply availability and reliability. The magnitude of benefit to fishery habitat and instream flows that would be generated through increased irrigation conservation within the Mokelumne River watershed appears to be lower than that for urban conservation. In many of the areas within the watershed agricultural conservation measures have already been implemented in an effort to reduce water supply demand and associated cost. The incremental benefit of further agricultural irrigation conservation in benefiting instream flows, coldwater pool storage, and other aspects of fishery habitat within the watershed, however, appear to be moderately low. The incremental additional opportunities to further enhance conservation and the magnitude of the associated water supply benefit requires further analysis and consideration. New technologies are continuing to be developed to enhance agricultural water conservations such as new drip delivery systems, soil moisture monitoring, improved monitoring and modeling to predict soil moisture levels and irrigation demand, reduced over irrigation, etc. In addition, as conservation ethics increase cultural shifts are expected that will further enhance conservation. It is difficult to predict these changes with current information or to develop reliable long-term projections of the magnitude of conservation or how that additional water supply developed through conservation will be allocated among competing beneficial uses and across variously hydrologic conditions. In the absence of improved projections and detailed plans for implementation and monitoring the potential biological benefits for improved instream flows remains highly uncertain.	If diversions and GW pumping could be reduced enough to provide additional flows to the river channel, positive benefits to geomorphic and ecological processes would follow. Increased efficiencies could reduce pressures to use unallocated waters of the Mokelumne River. Benefits are also achieved by using groundwater storage as a method for reducing the demands on surface water supplies and contributing to increased instream flows that benefit fisheries and other aquatic resources. There are a number of benefits to maintaining existing instream flows in the streams for fishery benefits and meeting agricultural and other demands through alternative means including conservation.	As increased efficiencies are embraced by vanguard agricultural entities, quantification of conservation and savings may spur the embrace of such actions by other agricultural entities, resulting in further and potentially widespread adoption of the most efficient conservation methods. A potential key component of measuring successful agricultural conservation would be that conserved water does not become supply for new demand, whether agricultural or municipal.	Develop a framework that would monitor conservation projects, what worked and what did not, costs and savings (water-use and monetary), permanent changes in practices, whether conservation measures become more widespread, and other measures of how well conservation measures worked.

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6a	Mokelumne Floodplain Management Plan - Camanche to Below Woodbridge Dam	4 Successful restoration work in the EBMUD day use area directly below Camanche Dam provides a number of scientifically sound restoration techniques that have been developed, tested, and monitored, with many methods and results academically published. Other Sierra Nevada watersheds have performed similar work, so frameworks for a range of specific projects are likely readily available.	5 Restoration that involves connectivity to floodplains, side channels, and an increase in riparian corridor width and length would provide multiple biogeomorphic beneficial uses to the aquatic ecosystem. Benefits include: sediment deposition on floodplains, increased connectivity during high flows would provide for increased refugia, increased productivity on the floodplains which can yield larger juvenile fish, shading which improves water temperature, additional opportunities for streamwood to enter the active channel and provide structure, food and dissolved organic carbon to the system.	3 As discussed with regard to concept 1C, available scientific information is demonstrating biological benefits for juvenile rearing salmonids and other aquatic resources associated with levee setbacks, seasonally inundated floodplain, and improved riparian vegetation. Although the broad program outlined in concept 6a has the potential to substantially benefit large areas of aquatic habitat within the lower Mokelumne River that would be expected to improve juvenile rearing habitat, juvenile growth rates, juvenile survival, and contribute to overall increases in salmonid abundance the timing of implementation, the locations where restoration activities would occur, and the aerial extent of restoration activities have not been identified. Therefore the opportunities to enhance habitat and the magnitude of potential biological benefits remain somewhat uncertain. The opportunity certainly exists to provide major habitat benefit through such restoration activities if they were implemented over a large landscape of the lower river.	Improvements in the lower watershed are key to healthy ecosystem function within the regulated flow environment that currently exists.	Public and private support seems relatively high on the lower Mokelumne River for projects of this nature. // Types of potential restoration activities that have been identified in the concept proposal are beneficial in creating high quality habitat for juvenile salmonid rearing, increasing habitat diversity and complexity along the river for a variety of fish and other wildlife resources, and can be made compatible with the geomorphic processes, instream flows, and other factors that influence the interaction between shoreline topography and hydrologic conditions occurring within the river.	Restoration concepts are well developed and contractors have proven capable of implementing plan sets with geomorphic and engineering guidance.
7a	PG&E Storage Recovery	5 Technically feasible to remove sediment from reservoirs. Local conditions, and possibly trace-metal contamination (such as mercury), may constrain sediment removal at individual reservoirs.	4 Dams and reservoirs capture sediments that would otherwise transport downstream, resulting in sedimentation in and upstream of the reservoirs and causing erosion of the stream bed below the dam due to lack of sediments below-dam. At Tiger Creek Afterbay, sedimentation has aggraded the Mokelumne River channel at the upstream end, and only 25% of its original capacity remains (2013 survey by Sierra Nevada Conservancy). Moving appropriately-sized sediments from the reservoir to downstream locations may increase the sediment supply that could perform geomorphic work in the short-term, which could result in a significant positive geomorphic benefit.	1 Although removal of silt and accumulated sediment from upstream PG&E's reservoirs would be beneficial from the standpoint of improving water supply storage as well as hydroelectric facility operations. Sediment removal would have very little direct benefit to aquatic habitat resources within the watershed. Sediment removal from existing impoundments would reduce the risk of sediment resuspension during high flow periods, reduce suspended sediment loading and sediment deposition in habitats downstream of the reservoirs, thereby improving the quality and availability of habitat for salmonids and other aquatic resources. Increasing the reservoir storage volume by sediment removal would also create additional opportunities to further trap suspended sediments and bedload transport in the upper part of the watershed. Given the size of the PG&E facilities, and sediment trapping that would occur downstream in Pardee and Camanche reservoirs, the proposed concept proposal is expected to provide relatively little benefit for habitat enhancement within the lower Mokelumne River downstream of Camanche dam.	Sediment removal from reservoirs could be beneficial, especially if the larger size fractions of these sediments could be repurposed to provide augmentation to locations within the river corridor. Benefits may need to be assessed based on presence/absence of mercury, and the relative risks of removal/disposal or methylation if left in place. Mercury and other trace metal risks are thought to be generally lower in the Upper Moke than in other Sierran watersheds.	The project would enhance water supply by restoring reservoir capacity and retaining more cold water. This could be beneficial for aquatic species as well as humans, particularly during periods of extended drought as climate change introduces additional uncertainties to the water supply. Restoring lost water storage capacity in existing reservoirs would be more cost effective and create less impact than constructing new reservoirs // An evaluation of the feasibility of sediment removal in and of itself provides no biological benefit to the watershed. Benefit from such an action occurs only as a result of the actual implementation of sediment removal and the associated increase in water storage.	Evaluate the cost-benefit ratio of restoring existing reservoirs versus construction of new reservoirs. Evaluate feasibility and benefits of screening reservoir sediments and using those that fall within a prescribed range for gravel augmentation projects in other areas of the river corridor.

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7b	Raise Lower Bear Reservoir Feasibility Study and Update of Preliminary Engineering	5 Technically feasible to study raising dam height.	1 Raising Lower Bear Reservoir would capture waters that are currently unallocated, especially high flows during the wet season November-April, including those from atmospheric river events. High flows are needed in the upper Mokelumne to provide rejuvenating flows for aquatic species and riparian corridor ecosystem services. High flows are also needed in the lower Mokelumne to supply and move spawning gravels and to provide forces needed to re-shape and renew the enhanced and natural spawning beds in the overcoarsened sediments below Camanche Dam, which are needed to provide critical habitat for anadromous fish. Such flows are important as episodic events that may render significant changes to the river not achieved through smaller flood events. Benefits and impacts depend on operational parameters.	2 Raising the elevation of Little Bear Reservoir would provide a small increase in water storage capability and opportunities for releases downstream that could benefit the cold water pool in Camanche and Pardee reservoirs as well as enhance instream flows for salmonids within the watershed immediately downstream of Little Bear Reservoir as well as further downstream in the lower Mokelumne River. The overall benefits of increasing reservoir storage, however, on fishery habitat are considered to be moderately low. Benefits and impacts depend on operational parameters.	Capture of additional winter flood flows could reduce the ability of peak flood hydrographs from doing "natural" geomorphic work more so than under current regulated conditions. Processes that need peak flows include sediment transport, rejuvenation of channel bed and bank substrates and floodplain inundation. Benefits and impacts depend on operational parameters.	Careful consideration would need to be given to development of this concept, as the balance between supporting human needs and river ecosystem needs is fragile. Raising reservoir dam heights is likely a better solution than building new dams. Studies to understand potential effects of a raised reservoir on morphologic and aquatic resources are important to consider. Additional stored water could potentially be used to recharge GW basins in the watershed. Benefits and impacts depend on operational parameters.	Develop river hydrographs, models and criteria that could be used to evaluate and minimize adverse effects caused by loss of occasional episodic peak flows. Strive to develop hydrologic rules such that there would be small or no losses to hydrographic durations and peaks when compared to current conditions, and that potentially seek to improve upon the current hydrographic conditions. Benefits and impacts depend on operational parameters.
7c	Surface Storage Regional Assessment	5 Technically feasible to assess regional surface storage concepts.	3 Removal of additional flows from the watershed and any local river reaches may generally result in a negative geomorphic effect to the channel and the aquatic ecosystem, as lower flows become less able to perform the geomorphic work and maintenance needed in the channel. Mitigation elements that provide benefits, perhaps below Camanche Dam to enhance anadromous fish habitat, could result in a significant positive geomorphic benefit.	2 A study of the regional feasibility of increasing additional on-stream and off-stream storage within the watershed is expected to have only moderately low benefit for fishery habitat. The degree of fishery benefit would depend on specific information regarding the location of additional storage, the magnitude of additional storage, operational strategies, including instream flow releases, the effects of increased storage on geomorphic processes that affect fishery habitat, and other factors.	On-stream dam and reservoir construction would create a discontinuity in the river channel network. Such discontinuities are seldom a positive benefit for the river ecosystem, as sediment, water, aquatic and riparian processes are fundamentally disrupted. The significance of such discontinuities should be evaluated, and mitigation measures identified and weighed for their effectiveness in producing no negative effects to river ecosystem values. Off-stream storage avoids the discontinuity aspect.	Coequal goals of water supply and environmental protection were set by the legislature for the Delta. The same goals could be utilized to guide assessments in the Mokelumne River watershed. There may be a range of projects and locations in the watershed that meet a set of criteria for this concept. Care should be taken to evaluate potential environmental effects on a regional scale to provide a comprehensive evaluation of regional surface storage projects and how they might achieve the coequal goals.	Hydrographic information, geomorphic field mapping plus channel geometry analysis, and models of projects should be used to evaluate the effects of removing varying amounts of water from the river and the potential effects on the Mokelumne River channel and ecosystem.

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7d	Re-operation of Existing Storage	3 Agreement by all parties as to the scope, objectives and purposes of any re-operation could lead to gains in the ability to meet current and future human and environmental needs.	3 Depending on the objectives of re-operation, geomorphic benefits may or may not accrue with this project. There would seem to be a high potential for geomorphic benefits to be realized.	1 A feasibility study to identify the potential opportunities for increasing water supplies for consumptive use and hydroelectric generation are anticipated to have very low potential benefit for enhancing fishery habitat. A feasibility study, in and of itself, provides no benefit for fishery habitat, however, the identification of potential opportunities to implement alternative operational strategies could have a small incremental benefit on resident and migratory fish.	Reoperation of upper watershed storage could help optimize existing water supply and reduce needs for GW pumping or importing water.	This concept provides an opportunity for an element including improvement to ecosystem health, in large part through continuing to embrace new understandings of the importance of environmental stewardship, and in seeking to improve existing river conditions.	Goals and objectives should consider environmental needs to be as important as any other considerations.
7e	Optimization of Calaveras County Reservation	3 The use of full water rights would necessarily affect entities that currently use any surplus supply. Hence, this concept would probably result in less water in the river.	2 It is unlikely that additional removal of water from the river corridor will provide any geomorphic benefits.	2 The evaluation of the legal feasibility of modifying the area of origin under the State Water Resources Control Board water right permitting process appears to have relatively low potential benefit for improving fishery habitat conditions. Specific information regarding the potential changes in operations, seasonal timing, and magnitude of changes that would occur as a result of implementation of the proposed project have not been developed and therefore there is high a level of uncertainty regarding the potential magnitude of fishery benefits associated with the concept proposal.	Less water in the river corridor generally translates to increased stressors for aquatic organisms that depend on a healthy ecosystem. Problems caused by less water generally include increased water temperatures; higher concentrations of chemicals (i.e. fertilizers) in the water columns which can disrupt aquatic life cycle; fewer to no episodic high flow events, which leads to riparian encroachment, and fewer instances of channel substrate renewal associated with robust sediment transport events.	This concept faces the same challenges that so many other water use entities face, which are two-fold and in opposition. First, that of having more water rights than are used, so others may currently use water that by law belongs to a particular water rights holder. Second, the unfortunate but real problem that water rights are over-allocated, such that in no case will all rights holders receive their entire allocation, let alone those who need water but have no rights to it, and thus are subject to market rates for water supply. This dichotomy presents a problem that has not yet been solved, and which will likely continue to be in place for some years to come. In the meantime, all parties struggle to achieve a workable balance. // The concept proposal is difficult to assess from of fishery benefit perspective in the absence of additional information and detail.	Include a water use efficiency component to the evaluation, which could potentially result in a reduction in water needs that does not involve taking the full allotment of water as currently allowed under the law.
8a	Jeff Davis Water Treatment Plant Replacement	4 Replacing outdated water treatment technologies is a great idea, and could lead the way and provide a template for other entities to consider similar actions.	3 Projects that permit additional flow in the river network are beneficial to geomorphic processes, relative to increases in flow rates and hydrographic peaks, so there is some potential that this concept could result in increased flows.	1 Modifying the existing wastewater treatment plant backwashing process appears to have very little potential to benefit fishery resources. Although the proposed project would provide greater efficiency of wastewater treatment plant operations and incrementally reduce water required for filter backwashing, the magnitude of the potential change in water supply is anticipated to be minimal in terms of fishery habitat enhancement.	Would gains in efficiencies lead to increased flows in the river, or would additional flows be re-allocated to consumptive or other human needs?	Upgraded wastewater treatment plants could provide a template and lead the way for other entities to consider similar actions.	Project goals could include using reclaimed wastewaters for GW infiltration and appropriate municipal uses if possible, and to designate the accrued "water saved" to river flows.
8b	Rehab of Transmission Main	4 This project would extend the positive benefits of water conservation and treatment efficiencies by replacing or rehabilitating outdated facilities with newer equipment.	2 This project would likely not provide much in the way of geomorphic benefits to the river corridor, but could potentially be an additional factor in increased water efficiencies, which overall may provide additional waters to the river.	1 Improvements in the efficiency of water conveyance from the existing water treatment plant to local landowners, although reducing loss during transmission is expected to have very little direct or indirect fishery benefit. Presumably, increasing water conveyance efficiency would incrementally reduce the demand on surface waters. However, the incremental magnitude of such a reduction on the ability to provide instream flows or cold water pool management for fishery habitat is expected to be minimal.	Replacement/rehabilitation of existing structures would likely have minimal effects to the river corridor environment.	Good to see engagement in upgrading structural components of the water network. // There is general support for improving water conveyance and water use efficiency as a method for reducing demand. Although there is broad support for increasing conveyance efficiency the incremental benefits of individual projects are likely to be relatively low in terms of providing additional supplies that would benefit fishery resources and other aquatic species.	Explore multiple end uses for treated waters, including GW infiltration (not mentioned in the description).

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8c	Barney Way Septic System Conversion	4 Improvements to septic/sewer systems are common and would likely provide a series of health benefits to the local community.	2 The concept would provide relatively little geomorphic benefit to the river corridor, but would likely improve water quality, perhaps to the Middle Fork Mokelumne as well as to Camanche Lake.	2 Reducing the use of local septic systems through interconnection with a main wastewater treatment facility is thought to provide some moderately low incremental benefit towards improving water quality conditions within the local watersheds. Wastewater leakage from septic systems into the local water supply, including adjacent streams and rivers, reduces the potential for contaminant and bacterial growth that improve habitat quality as well as water quality. The incremental benefit of such improvement on fishery habitat associated with individual proposal, however, is expected to be moderately low.	There are environmental and human health components to this project that are compelling even though the concept has little to no geomorphic component.	Improvements in water quality, particularly those associated with sewage, are good for river ecosystem and human health environments. // Although there is general support for reducing reliance on septic systems for wastewater treatment and disposal, the incremental benefit of individual projects in improving water quality conditions that would benefit fishery habitat have not been documented.	Explore use of excess treated water for GW infiltration.
8d	Lake Camanche Village Recycled Water Project	4 Improvements in waste water treatment options are well-documented and relatively easily implemented, and would likely provide additional water supplies for non-potable use.	1 Little to no geomorphic benefit to the river corridor.	1 Converting an existing wastewater treatment plant process from one mode to another is expected to have virtually no benefit for fishery habitat. Although there is the potential for a small incremental improvement in overall wastewater treatment plant efficiency the benefit to fishery habitat through increased water supply availability, instream flows or cold water pool management is anticipated to be minimal.	An increase in waste water usage for local purposes could be beneficial by lessening the pressures on using surface and GW for non-potable needs.	Good to see engagement in upgrading structural components of the water network.	Identify beneficial uses for additional supplies of treated waste water.

Notes:

1. Three semi-quantitative scales and accompanying narratives are meant to convey a general sense of how the reviewers regarded each concept from various perspectives: overall concept feasibility, geomorphic benefit, and fisheries benefit. The scale designations do not provide a "score", nor are the scale values additive or cumulative in terms of overall concept feasibility.

2. Feasibility scale explanation: The word 'feasibility' is meant to convey the thoughts of the reviewers as to how easily a concept might be brought to fruition, generally in terms of (a) whether similar projects have been successful in the past, (b) how receptive stakeholders might be toward the project, and/or (c) technical viability.

3. Geomorphic benefit scale explanation: Geomorphic benefits are generally realized when hydrologic processes perform naturally. Such processes allow stream corridors, of any size, to evolve naturally over time, either through incremental or episodic events, which when combined, provide high quality habitat for aquatic and riparian species.

For instance, a geomorphic benefit of "5", and the accompanying narrative, would suggest that relatively substantial increases in either hydrologic or sediment transport processes would yield important benefits.
A geomorphic benefit of "3", coupled with the explanatory narrative, would suggest either (a) that some increases in hydrologic or sediment transport processes may occur or (b) that even if the project itself yielded important benefits, the geomorphic benefits would likely be moderate.
A geomorphic benefit of "1", and the accompanying narrative, would suggest that the particular concept would convey little benefit to geomorphic processes, even if the project itself would convey important benefits to the community at large.

4. Fishery benefit scores were based on qualitative professional judgment. Scores were generally ranked based on the potential certainty of implementation and the anticipated magnitude of benefit over time and in space. A proposed study, for example, would provide no immediate fishery benefit by itself (low score) but has the potential to develop into a beneficial project would have substantial benefit if implemented. For example, a project to screen diversions has great potential benefit but would rank 1 if there is no funding, plans, and the likelihood of only one diversion being screened. A project that has funding, permits, willing partners, that would screen a substantial water volume at multiple sites would rank a 5. A project that is in development but a good chance of funding and implementation that would benefit fish over a period of years but still has uncertainty regarding implementation would rank a 3. Suggestions for improving ranking scores are provided above for many of the proposed project ideas. The ranking scores are not intended to be added for a composite ranking but rather should accompany the text for discussion and context.