State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

May 23, 2018

Joseph Yun
Executive Officer
California Water Commission
P.O. Box 942836
Sacramento, CA 94236-0001

Dear Mr. Yun:

RELATIVE ENVIRONMENTAL VALUE OF WATER STORAGE INVESTMENT PROGRAM PROJECTS AND DEPARTMENT FINDINGS

Thank you for your leadership during this process. As you know, the California Department of Fish and Wildlife (Department) is tasked with the responsibility of making recommendations to the California Water Commission (Commission). I acknowledge the complexity of the process has been challenging for you, Commissioners, the reviewing agencies, and each applicant. No one has tried a competitive approach to water storage on such a scale before. The good news is that the Commission and applicants are as close as ever to adding much needed water storage capacity through a portfolio of different types of projects across a diverse geography.

This competitive approach must adhere to the controlling statute and the implementing regulations. At each step of your process, our Department has always based our recommendations on the plain instructions in the statute and the regulations. All of the current applicants, as members of a broad-based stakeholder advisory group, helped develop these regulations during a two-year dialogue. At the last Commission meeting, the Department's recommendations to the Commission on monetized ecosystem benefits to include in the public benefit ratio calculations were discussed. This package contains our next assignment under the regulations related to our calculation of relative environmental value for the ecosystem improvements of a project and preliminary findings. However, as I describe at the end of this letter, each applicant retains an important obligation to complete due diligence for their projects promptly.

Pursuant to the Water Storage Investment Program (WSIP) regulations, this letter and attachments transmit to California Water Commission (Commission) staff (1) the relative environmental value scores calculated by the California Department of Fish and Wildlife (Department) and (2) the Department's findings on the public benefits claimed by each WSIP project. The WSIP regulations require the Department to calculate a relative environmental value for ecosystem improvements, based on information supplied in each project's application. (Cal. Code Regs. tit. 23, § 6007, subd. (c).) Additionally, if the Department "finds the public benefits as described in a project's application meet all of the requirements of Water Code section 79750 *et seq.* for which the reviewing

agency is responsible, the reviewing agency shall provide to the Commission a written statement confirming the finding." (Cal. Code Regs., tit. 23, § 6012, subd. (d).) This finding is a "preliminary assessment of public benefits based on information supplied in the application that indicates that a project's public benefits meet the requirements of Water Code section 79750 *et seq.*" (Cal. Code Regs., tit. 23, § 6012, subd. (a).)

For each ecosystem benefit quantified, project applications were required to identify at least one applicable ecosystem priority listed in section 6007, subdivision (c), of the WSIP regulations. (Cal. Code Regs., tit. 23, § 6003, subd. (a)(1)(Q).) The Department applied the 10 relative environmental value criteria outlined in Table 2 of section 6007, subdivision (c)(1)(A)(1), to score each of the ecosystem priorities identified by the applicant. Based on information supplied in the application, the Department considered information supporting ecosystem benefits including the analytical methods, modeling results, and physical, chemical, or biological information. (Cal. Code Regs., tit. 23, § 6007, subd. (c)(1)(A)(1).) Section 6007, subdivision (c)(1)(A)(2), states the score shall be assigned by evaluating the degree of change between with- and without-project conditions, and the degree to which ecosystem improvements associated with each claimed priority would be provided by a project.

The relative environmental value scores reflect the Department's critical and thorough evaluations of project applications and include comments to the Commission and its staff that address the many aspects of the projects as proposed. The Department's analysis contained in this package is consistent with our analysis related to public benefits.

The Department recognizes that the projects in many cases have a long history in water management planning in California, and have additional steps in front of them that will refine the projects, reduce uncertainties, and further inform the Commission's decisionmaking. The regulations emphasize the preliminary nature of the findings submitted to you today, and the fact that changes may occur after a reviewing agency's findings. (Cal. Code Regs., tit. 23, § 6012(g).) Moreover, prior to the Commission encumbering funding, each successful applicant must enter into enforceable contracts for public benefits and non-public benefit cost shares, complete feasibility studies and environmental documentation, obtain all required federal, state, and local approvals, and provide extensive additional information to the Commission, as applicable, on items including labor compliance, urban water management plans, agricultural water management plans, and groundwater management plans or GSP(s). (Cal. Code Regs., tit. 23, § 6013(a)(1), (c).)

This letter and attachments represent the completion of the Department's technical review of WSIP projects for the purpose of contributing toward the maximum conditional eligibility determination of each project that the Commission must make. The Department looks forward to continuing to work with the Commission and project

applicants in the next phase of the WSIP.

Sincerely,

Charlton H. Bonham
Director

Encl: CDFW Findings on WSIP Public Benefits, Relative Environmental Value Scores, Technical Review Comments

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Pacheco Reservoir Expansion Project – Relative Environmental Value Score

Project Overview

The Santa Clara Valley Water District (Applicant) is proposing the Pacheco Reservoir Expansion Project (Project). The Project would remove the existing North Fork Dam on Pacheco Creek, construct a new dam and spillway, and construct new conveyance. The Pacheco Reservoir storage capacity would be increased from 6,000 acre-feet (AF) to 141,800 AF. The new reservoir would be primarily filled using natural inflows from the North and East Forks of Pacheco Creek. When needed, supplemental flows to the expanded reservoir would come from the Applicant's share of contracted Central Valley Project (CVP) water from San Luis Reservoir. The Project proposes to provide perennial stream flows in Pacheco Creek for habitat enhancement and benefits to South-Central California Coast Steelhead. Consistent with the Central Valley Project Improvement Act, the Project also proposes to provide Incremental Level 4 water, in below normal water years, to south-of-Delta wildlife refuges for habitat enhancement.

Ecosystem Priorities Identified by the Applicant

The Applicant has identified the following ecosystem priorities:

- Priority 1 – Provide cold water at times and locations to increase the survival of salmonid eggs and fry.
- Priority 2 – Provide flows to improve habitat conditions for in-river rearing and downstream migration of juvenile salmonids.
- Priority 3 – Maintain flows and appropriate ramping rates at times and locations that will minimize dewatering of salmonid redds and prevent stranding of juvenile salmonids in side channel habitat.
- Priority 4 – Improve ecosystem water quality.
- Priority 5 – Provide flows that increase dissolved oxygen and lower water temperatures to support anadromous fish passage.
- Priority 8 – Maintain or restore groundwater and surface water interconnection to support instream benefits and groundwater dependent ecosystems.
- Priority 9 – Enhance flow regimes or groundwater conditions to improve the quantity and quality of riparian floodplain habitats for aquatic and terrestrial species.
- Priority 11 – Enhance the temporal and spatial distribution and diversity of habitats to support all life stages of fish and wildlife species.
- Priority 12 – Enhance access to fish spawning, rearing, and holding habitat by eliminating barriers to migration.
- Priority 14 – Provide water to enhance seasonal wetlands, permanent wetlands, and riparian habitat for aquatic and terrestrial species on State and Federal wildlife refuges and on other public and private lands.
- Priority 16 – Enhance habitat for native species that have commercial, recreational, scientific, or educational uses.

The California Code of Regulations requires the California Department of Fish and Wildlife (Department) to apply 10 Relative Environmental Value (REV) criteria to score each of the priorities that an applicant claims would be provided by a project. (Cal. Code Regs., tit. 23, § 6007, subd. (c)(1)(A)(1).) Based on the information provided in the application, the Department scored each ecosystem priority listed above to

determine the ecosystem REV score shown below. To implement REV Criterion 1, the Department has developed a standard calculation to assign points based on the number of ecosystem priorities a project has claimed. For each priority claimed, the Department added 0.375% to a project's final ecosystem REV score. REV Criterion 2 through 10 were each scored on a scale of 0 to 6. Detailed scores are provided in Table 1. A summary of comments for each Priority-REV combination is provided in Pacheco Reservoir Expansion Project – Technical Review Comments.

REV Score Summary

Total Points Possible	594
Total Points Received	329.1
Additional % for Number of Ecosystem Priorities (REV Criterion 1)	4.1%
Total REV Score	**59.5%**

Pacheco Reservoir Expansion Project – Technical Review Comments

REV Criterion 1 (Number of different ecosystem priorities claimed)

To implement Relative Environmental Value (REV) Criterion 1, the California Department of Fish and Wildlife (Department) has developed a standard calculation to assign points based on the number of ecosystem priorities a project has claimed. For each priority claimed, the Department added 0.375% to a project's final ecosystem REV score. The Department has applied the standard calculation to each of the projects.

In its application for funding under the Water Storage Investment Program, the Santa Clara Valley Water District (applicant) identified eleven ecosystem priorities for the Pacheco Reservoir Expansion Project (Project). The calculation described above resulted in an increase of 4.1% for the Project's ecosystem REV score. The Department applied the other nine REV criteria to each priority identified by the applicant. The Department's evaluation of each priority is described below.

Priority 1: Provide cold water at times and locations to increase the survival of salmonid eggs and fry
Priority 1 – REV Criterion 2 (Magnitude of ecosystem improvements) Score = 3.3

Improvements to water temperature for fry are supported by the model data. Providing suitable temperatures from January to July improves the habitat suitability in those months, with an increase in habitat suitability score ranging from 12-157% and 12-158% under with-Project current and 2030 conditions, respectively. The supporting model data indicate lower temperatures during the summer rearing period, which would be beneficial to steelhead. The applicant assumes water temperatures under with- and without-Project conditions would be similar during the egg incubation period between January through April. However, the applicant did not point to supporting documentation to justify the assumption. The model results do not address temperature conditions for egg incubation, and it is not clear whether the applicant incorporated the incubation period into the model. Specifically, the data indicate the percentage of time within each month between February and July, at which the temperature would be at or below 19°C. This addresses temperatures necessary for the protection of fry rearing that occurs from February through July. However, the data do not indicate whether the lower temperatures (~7-11°C) necessary for the protection of egg incubation from January to late-April would be met. Additionally, the applicant does not address alevin temperature sensitivity and the potential for thermal stress.

The temperature model is based on measured stream temperature data from a single summer (2013). Because the model is based on limited empirical data, there is uncertainty about the magnitude of temperature benefits. The application provided a temperature profile for the existing reservoir from July 2013. However, this information does not demonstrate the thermal stratification profile of the proposed reservoir expansion and the availability of a cold water pool throughout the year and, therefore, it is uncertain whether colder water temperatures would last through summer and into fall as predicted. Monthly average water temperatures projected in the analysis could vary greatly at a smaller time scale. However, with-Project conditions appear to be improved over without-Project conditions based on the modeling results provided.

Priority 1 – REV Criterion 3 (Spatial and temporal scale of ecosystem improvements) Score = 4.0

Removal of the existing dam would add one mile of potential habitat for South-Central California Coast (SCCC) steelhead and the application's analysis indicates improved habitat and water temperatures under with-Project conditions across all water year types. The supporting model data indicate the Project would improve temperature conditions in an 11-mile stream reach below the new Pacheco Dam. The number of creek miles of cold water conditions was provided for fry rearing, but the applicant did not provide an analysis of the spatial extent of any improvements related to egg incubation. The increase in habitat resulting from project flows and the provision of cold temperatures through a longer period adds value to overall steelhead habitat conditions. There is sufficient documentation explaining the Pacheco Creek Steelhead Habitat Suitability Model, which was used to model miles of water temperature improvements. Because the timing of proposed water temperature improvements is appropriate for fry rearing, the Project could provide some benefits to this life stage, especially during summer.

Priority 1 – REV Criterion 4 (Inclusion of an adaptive management and monitoring program that includes measurable objectives, performance measures, thresholds, and triggers to achieve the ecosystem benefits) Score = 3.5

The application presents a developed framework that includes an agency coordination approach and a commitment to establishing a technical advisory committee with subject matter experts. The application does not identify specific funding sources for monitoring and adaptive management. There is some uncertainty regarding the proposed non-Project monitoring (physical or biological surveys) because it is dependent on research grant funding that is uncertain to occur. The application does not specifically discuss how adaptive management would be used to support this priority, although the applicant indicates flow and temperature data collection is a part of Project effectiveness monitoring. The application states, "if the public benefits as described are not provided...changes to the flow patterns are not to exceed the total water that would be released consistent with Table 2-1 [identifying average monthly release targets] each year."

Priority 1 – REV Criterion 5 (Immediacy of ecosystem improvement actions and realization of benefits) Score = 3.5

The applicant proposes the operations of the Project would be complete five years after construction begins. The Project schedule presented in the application for permit acquisition and construction is reasonable. Depending on water year type, benefits of improved flow may be partially provided during construction. The application indicates some benefits could be provided within a year or less once the temporary coffer dam is constructed, depending on the availability of water to fill the temporary reservoir. However, the application does not clearly define the scale or timing of benefits that would be provided by flows from the temporary coffer reservoir. The coffer dam may be able to provide flow, but it is unclear whether the flow would be sufficient to provide optimal temperature conditions for steelhead. The applicant acknowledges that the realization timeframe is dependent on future climate and hydrologic conditions. However, the applicant did not point to supporting documentation for the statement that benefits could be realized within six months after Project completion. It is uncertain whether the benefits would be realized in the timeframe provided by the applicant, given the intermittent presence of the target species in Pacheco Creek and the absence of a reintroduction component for steelhead in the application. Pacheco Creek's steelhead population is believed to be very small and it may take several years to document a measurable response in the population.

Priority 1 – REV Criterion 6 (Duration of ecosystem improvements) Score = 3.3

The Project expects to provide enhanced year-round flows in all water year types for a duration of 93 years. However, it is uncertain if in-reservoir cold water conditions would be present throughout that timeframe. The applicant did not point to supporting documentation for the proposed life span and continued operations of the Project after construction. Although there are concerns regarding the accuracy of temperature modeling, the model results indicate benefits to stream temperatures across all water year types under current and 2030 conditions.

Priority 1 – REV Criterion 7 (Consistency with species recovery plans and strategies, initiatives, and conservation plans) Score = 4.3

The application references several conservation plans and lists many specific recovery actions and goals with which the Project as a whole is consistent. The National Marine Fisheries Service (NMFS) SCCC Steelhead Recovery Plan actions, which call for operation of Pacheco Dam to provide required habitat functions for all steelhead life stages, are most consistent with this priority. Other actions identified from the plans are not directly applicable to the priority, such as the California State Wildlife Action Plan's target to increase riparian forests and woodland habitat and the California Water Action Plan's goal to increase regional self-reliance and integrated water management across all levels of government.

Priority 1 – REV Criterion 8 (Location of ecosystem improvements and connectivity to areas already being protected or managed for conservation values) Score = 4.0

The location of improvement is within the known SCCC steelhead range and could provide benefit to the habitat and species. The Project would enhance habitat conditions for approximately 11 river miles downstream of the new Pacheco Dam, which could benefit the species if it is present. The reservoir is adjacent to a state park, which could protect against impacts such as land development or water quality degradation. However, much of Pacheco Creek passes through lands where these risks may be present. Because the Project proposes to provide year-round flows in Pacheco Creek, there is likely connectivity with the downstream confluence of the Pajaro River and a hydrologic connection to the Pajaro River Mitigation Bank. However, it is unclear whether there would be a hydrologic connection to the ocean to allow fish to migrate/emigrate. Supporting documentation is sufficient to establish confidence in the proposed location and connectivity to the downstream confluence and Pajaro River Mitigation Bank.

Priority 1 – REV Criterion 9 (Efficient use of water to achieve multiple ecosystem benefits) Score = 4.3

The Project would likely achieve several ecosystem benefits from the same source of water. Flows would recharge groundwater basins and are likely to revive the riparian corridor from current dry conditions. The water released for year-round flows in the 11-mile section of Pacheco Creek just below the dam are estimated to maintain flows for another 8 miles downstream to San Felipe Lake in 83% of years, in addition to meeting the groundwater recharge needs of the Pacheco Pass Water District. The applicant assumes the same unit of water released from the reservoir would benefit multiple proposed ecosystem priorities. Multiple benefits were justified with supporting ecosystem priority worksheets. The applicant has committed to maintain enough storage in the reservoir and discontinue releases for water user demands in order to meet ecosystem improvements for fish in consecutive dry years. However, there is insufficient data to determine if the temperatures indicated would be adequate to support all steelhead

life stages in optimal condition, since monthly average temperatures could vary greatly at a smaller time scale.

Priority 1 – REV Criterion 10 (Resilience of ecosystem improvements to the effects of changing environmental conditions, including hydrologic variability and climate change) Score = 3.0

The Project would increase reservoir capacity and would likely provide a more reliable source of water for maintenance of flows in Pacheco Creek. The applicant provided a model analysis using 2070 climate change scenarios to address the resiliency of the proposed Project with regard to climate change and California's variable climate. The model analysis indicates resiliency of the Project's habitat improvement for steelhead with increased steelhead cohort scores from without-Project conditions. Under the 2070 climate change scenarios, the percent increase in cohort scores ranged from 178-278%. Operational adjustments can be made once the Project is built, but the resiliency of the ecosystem benefits from cold water are unclear. Flow without temperature control would likely be ineffective at attracting and maintaining a steelhead population in light of climate change. The Project relies on greater reservoir depth to increase the cold water pool, yet there was insufficient data describing with-Project reservoir stratification and cold water pool conditions for the scenarios presented. No analysis was provided regarding the resiliency of reservoir and ecosystem improvements to the other changing environmental uncertainties identified by the Department in the ecosystem worksheet.

Priority 2: Provide flows to improve habitat conditions for in-river rearing and downstream migration of juvenile salmonids

Priority 2 – REV Criterion 2 (Magnitude of ecosystem improvements) Score = 3.0

To demonstrate flow-related improvement to habitat conditions under this priority, the applicant provided data on steelhead cohort scores for all water year types. Data indicate a large increase for steelhead cohort scores from without-Project conditions under current and 2030 scenarios. Across all water year types, the percent increase in cohort scores ranged from 91-595% and 125-478% in current and 2030 conditions, respectively. However, the accuracy of the estimated magnitude of the benefit is uncertain, because the applicant did not provide data related to quantifying the benefits to juvenile rearing and downstream migration, such as abundance (number or percent change) of rearing and out-migrating juveniles or growth rates of rearing fish. Cohort score data, which provides a habitat index, were supported by documentation describing model assumptions and analysis. However, the model is based on limited empirical data on habitat typing across a wide range of flow conditions and on channel cross-sectional profiles to estimate depth/flow relationships. Because of model limitations, there is uncertainty regarding the magnitude of improvements and whether enhanced conditions would be provided for smolt outmigration. The application states, "if the public benefits as described are not provided...changes to the flow patterns are not to exceed the total water that would be released consistent with Table 2-1 [identifying average monthly release targets] each year." Additionally, the application did not discuss the availability of cold water for steelhead at low reservoir levels. Although there is uncertainty with cohort scores, the Department generally accepts the proposed habitat improvement for juvenile steelhead rearing and migration, assuming that SCCC steelhead respond to the proposed improvement and return to Pacheco Creek.

Priority 2 – REV Criterion 3 (Spatial and temporal scale of ecosystem improvements) Score = 3.2

Removal of the existing dam would add one mile of potential spawning and rearing habitat for SCCC steelhead. Modeled habitat suitability score data provide sufficient evidence that rearing conditions would improve over 11 river miles for with-Project conditions, particularly in summer. The application included supporting documentation for the Pacheco Creek Steelhead Habitat Suitability Model, however limitations in the model make it difficult to determine the accuracy of the projected magnitude of Project benefits to the steelhead population. Temporal improvements to smolt outmigration conditions were presented as steelhead cohort scores and were discussed for all water year types. The model data is also not sufficient to assess suitability of water conditions, because the analysis did not address when water temperatures would be sufficiently cool to support steelhead juvenile outmigration in optimal conditions (6.5-11°C). Although the proposed flows are year-round, flows described without temperature management do not address the other key environmental factor effecting steelhead survival.

Priority 2 – REV Criterion 4 (Inclusion of an adaptive management and monitoring program that includes measurable objectives, performance measures, thresholds, and triggers to achieve the ecosystem benefits) Score = 3.0
See comment for Priority 1 – REV 4.

Priority 2 – REV Criterion 5 (Immediacy of ecosystem improvement actions and realization of benefits) Score = 3.2
See comment for Priority 1 – REV 5.

Priority 2 – REV Criterion 6 (Duration of ecosystem improvements) Score = 2.6
See comment for Priority 1 – REV 6.

The Project expects to provide enhanced year-round flows in all water year types for a duration of 93 years. However, the applicant does not discuss maintenance of Project facilities. It is possible for sediment to accumulate in the reservoir and reduce the cold water pool size. Dredging and/or sediment sluicing is required to maintain reservoir capacity.

Priority 2 – REV Criterion 7 (Consistency with species recovery plans and strategies, initiatives, and conservation plans) Score = 4.0
See comment for Priority 1 – REV 7.

Priority 2 – REV Criterion 8 (Location of ecosystem improvements and connectivity to areas already being protected or managed for conservation values) Score = 3.4
See comment for Priority 1 – REV 8.

Priority 2 – REV Criterion 9 (Efficient use of water to achieve multiple ecosystem benefits) Score = 3.2
See comment for Priority 1 – REV 9.

Priority 2 – REV Criterion 10 (Resilience of ecosystem improvements to the effects of changing environmental conditions, including hydrologic variability and climate change) Score = 2.6
See comment for Priority 1 – REV 10.

Priority 3: Maintain flows and appropriate ramping rates at times and locations that will minimize dewatering of salmonid redds and prevent stranding of juvenile salmonids in side channel habitat
Priority 3 – REV Criterion 2 (Magnitude of ecosystem improvements) Score = 3.0

The Project would provide year-round flows in the 11-mile reach of Pacheco Creek and the supporting documentation and model data indicates the Project would eliminate stream dry-back in all water year types under current and 2030 conditions. This would likely reduce stranding events of rearing juvenile steelhead in Pacheco Creek. However, conclusions based on monthly average flows should be qualified because daily fluctuations may result in little to no flow. The Project proposes water releases as targeted averages and not as required minimum instream flows. Without required flows, confidence in the proposed benefit in terms of this priority decreases. In addition, the applicant does not adequately address Project flows related to dewatering of redds and benefits or impacts to steelhead embryos. Monthly average flow data for December through March indicate lower flow conditions resulting from the Project under current and 2030 conditions. The applicant did not point to additional information or analysis on winter flow decreases and the potential effects on redds and rearing juveniles. Ramping and reduction of releases from the dam in winter could potentially dewater redds and strand juvenile steelhead.

Priority 3 – REV Criterion 3 (Spatial and temporal scale of ecosystem improvements) Score = 3.5

The Project's flow regime would be likely to increase the amount of surface flow in the upper 11 miles of Pacheco Creek. However, the extent to which these flows would create connectivity throughout the entire reach and beyond is unclear. The application provides a rationale for targeting the upper 11 miles of the creek to improve habitat. The timing of the flow regime is appropriate to provide benefits. It appears the with-Project flows would likely reduce stranding and dewatering. The applicant provides acceptable model data to show the Project would provide continuous flows, particularly in stream reaches that currently dry up in summer. Winter flows from December to March are projected to decrease by 8-30% in the 11-mile reach, as the Project proposes to capture water that would otherwise continue downstream. Decreases in winter reservoir releases could dewater redds and strand juveniles in North Fork Pacheco Creek. However, these reductions in winter flows are outweighed by the scale of improvement during the rest of the year, particularly May through September, when supporting data indicate flow increases by 3-2521% for all reaches of Pacheco Creek.

Priority 3 – REV Criterion 4 (Inclusion of an adaptive management and monitoring program that includes measurable objectives, performance measures, thresholds, and triggers to achieve the ecosystem benefits) Score = 3.0
See comment for Priority 1 – REV 4.

Priority 3 – REV Criterion 5 (Immediacy of ecosystem improvement actions and realization of benefits) Score = 3.2
See comment for Priority 1 – REV 5.

Priority 3 – REV Criterion 6 (Duration of ecosystem improvements) Score = 2.6
See comment for Priority 2 – REV 6.

Priority 3 – REV Criterion 7 (Consistency with species recovery plans and strategies, initiatives, and conservation plans) Score = 4.0
See comment for Priority 1 – REV 7.

Priority 3 – REV Criterion 8 (Location of ecosystem improvements and connectivity to areas already being protected or managed for conservation values) Score = 3.2
See comment for Priority 1 – REV 8.

Priority 3 – REV Criterion 9 (Efficient use of water to achieve multiple ecosystem benefits) Score = 3.0
See comment for Priority 1 – REV 9.

Priority 3 – REV Criterion 10 (Resilience of ecosystem improvements to the effects of changing environmental conditions, including hydrologic variability and climate change) Score = 2.4
See comment for Priority 2 – REV 10.

Priority 4: Improve ecosystem water quality
Priority 4 – REV Criterion 2 (Magnitude of ecosystem improvements) Score = 3.5

The applicant proposes improvements to water temperature, fecal coliform concentration and dissolved oxygen (DO). However, the supporting data only demonstrate improvements to water temperature, indicating that water temperatures under with-Project current and 2030 conditions would be lower throughout May to October than under without-Project conditions. The supporting documentation and model data indicate the Project would decrease summer stream temperature and increase flow extent for SCCC steelhead habitat. However, it is uncertain whether water would be cool enough to support the steelhead life stages and other target species identified by the applicant (red-legged frog and yellow-legged frog), because monthly average temperatures could vary greatly at a smaller time scale.

It is plausible that improved flows and summer water temperatures would increase DO and decrease fecal coliform concentrations. However, the applicant did not point to supporting documentation or methodology for these proposed improvements to water quality. Since these water quality aspects were not discussed or analyzed, some reviewers provided scores reflecting only temperature improvements. The applicant did not point to supporting data for proposed ecosystem benefits to California red-legged frogs or foothill yellow-legged frogs breeding and egg incubation in the upper 10 miles of Pacheco Creek.

Priority 4 – REV Criterion 3 (Spatial and temporal scale of ecosystem improvements) Score = 3.0

Improvements to flows and temperature occur throughout the 11-mile reach and the spatial scale of the improvement is appropriate to provide water quality improvements and benefits to SCCC steelhead. The application did not provide a description nor did the applicant point to supporting documentation for the spatial scale or timing regarding fecal coliform concentration and dissolved oxygen improvements. The applicant provided sufficient data to support the timing of water temperature improvements, and the results demonstrate the benefit occurs primarily in summer. The applicant did not point to an analysis or supporting information for spatial or temporal scales for red-legged frog and yellow legged frog benefits, therefore the spatial and temporal scale of improvement for these species cannot be assessed.

Priority 4 – REV Criterion 4 (Inclusion of an adaptive management and monitoring program that includes measurable objectives, performance measures, thresholds, and triggers to achieve the ecosystem benefits) Score = 3.5
See comment for Priority 1 – REV 4.

Priority 4 – REV Criterion 5 (Immediacy of ecosystem improvement actions and realization of benefits) Score = 3.5
See comment for Priority 1 – REV 5.

Priority 4 – REV Criterion 6 (Duration of ecosystem improvements) Score = 2.8
See comment for Priority 1 – REV 6.

Priority 4 – REV Criterion 7 (Consistency with species recovery plans and strategies, initiatives, and conservation plans) Score = 4.0

The application references several conservation plans and lists many specific recovery actions and goals with which the Project as a whole is consistent. The NMFS SCCC Steelhead Recovery Plan actions, which call for operation of Pacheco Dam to provide required habitat functions for all steelhead life stages, are most consistent with this priority. The Project is also consistent with the California Wildlife Action Plan's goal to maintain and improve water quality, quantity and availability for sustaining ecosystems and their attributes. Other actions identified from the plans are not directly applicable to Priority 4 such as the California State Wildlife Action Plan's target to increase riparian forests and woodland habitat, the goal to increase vernal pool habitat, and the California Water Action Plan's goal to increase regional self-reliance and integrated water management across all levels of government. In addition, the applicant did not point to supporting documentation for the proposed benefits to amphibians under this priority, therefore the consistency with conservation plans cannot be accurately assessed.

Priority 4 – REV Criterion 8 (Location of ecosystem improvements and connectivity to areas already being protected or managed for conservation values) Score = 3.3

The Project may be able to improve water quality in the Pajaro River, which is on the State Water Resources Control Board's 303(d) list of impaired waters for fecal coliform, nutrients, sediment and turbidity. The proposed improvements in Pacheco Creek are located within the known SCCC steelhead range and could provide benefit to the habitat and species. The proposal appears to enhance habitat conditions for approximately 11 river miles downstream of the new Pacheco Dam, which could benefit the species if it is present. The reservoir is adjacent to a state park, which could protect against impacts such as land development or water quality degradation. However, much of Pacheco Creek passes through lands where these risks may be present. The applicant does not address the ranching and agricultural land use downstream of the Project, which could present a challenge to improving water quality. Because the Project proposes to provide year-round flows in Pacheco Creek, there is likely connectivity with the downstream confluence and a hydrologic connection to Pajaro River Mitigation Bank. However, it is unclear whether there would be hydrologic connection to the ocean to allow fish to migrate/emigrate. Supporting documentation is sufficient to establish confidence in the proposed location and connectivity to the downstream confluence and Pajaro River Mitigation Bank.

Priority 4 – REV Criterion 9 (Efficient use of water to achieve multiple ecosystem benefits) Score = 3.5

The Project would likely achieve several ecosystem benefits from water efficiencies, although sufficiently detailed information specific to the ecosystem Priority 4 is lacking. Flows that recharge groundwater basins are likely to revive the riparian corridor from current dry conditions. The water released for year-round flows in the 11-mile section of Pacheco Creek just below the dam are estimated to maintain flows for another 8 miles downstream to San Felipe Lake in 83% of years, in addition to

meeting the groundwater recharge needs of the Pacheco Pass Water District. The applicant assumes the same unit of water released from the reservoir would benefit multiple proposed ecosystem priorities. Multiple benefits were justified with supporting ecosystem priority worksheets. However, there is insufficient data to determine if the temperature indicated would be adequate to support all steelhead life stages in optimal condition. The enhanced flows proposed could lower temperature, fecal coliform concentrations and increase DO, particularly during summer low flow periods. However, the analysis is insufficient for fecal coliform concentration and DO improvements because the applicant did not point to supporting documentation or methodologies for these proposed improvements to water quality.

Priority 4 – REV Criterion 10 (Resilience of ecosystem improvements to the effects of changing environmental conditions, including hydrologic variability and climate change) Score = 3.0
See comment for Priority 1 – REV 10.

The resiliency regarding other proposed improvements to water quality was not directly addressed. The applicant acknowledges uncertainty related to changes in imported water supplies to supplement filling the reservoir, if local inputs are not sufficient. However, an analysis of this uncertainty was not provided in the application "due to the degree of uncertainty involved in predicting the change" in infrastructure, regulations or supply allocations.

Priority 5: Provide flows that increase dissolved oxygen and lower water temperatures to support anadromous fish passage

Priority 5 – REV Criterion 2 (Magnitude of ecosystem improvements) Score = 3.3

The higher and continuous flows provided by the Project would increase DO and improve temperatures. The model data demonstrate improvements to water temperature, indicating that water temperatures in the 11-mile reach of Pacheco Creek would be lower between May to October by 1-39% and 1-41%, under with-Project current and 2030 conditions, respectively. The supporting documentation and model data indicate the Project would decrease summer stream temperatures and increase flow extent for SCCC steelhead habitat. The projected reduction in water temperature is large enough that changes in the solubility of oxygen are likely to be beneficial, but the information describing DO levels for non-stressful passage for steelhead is insufficient. The application discusses the relationship between lower water temperatures and DO solubility, but the proposed improvements to DO levels in Pacheco Creek for steelhead is not supported with any analysis or documentation. The application provides supporting documentation for water temperature improvements between with- and without-Project conditions. However, the model results leave uncertainty about the magnitude of temperature benefits for migration and outmigration because the model is based on limited empirical data. Specifically, the temperature model was based on measured stream temperature data from a single summer (2013). The application provided a temperature profile for the existing reservoir from July 2013. However, this information does not demonstrate the thermal stratification profile of the proposed reservoir expansion and the availability of a cold water pool throughout the year and, therefore, it is uncertain whether colder water temperatures would last through summer and into fall as predicted. Monthly average water temperatures projected in the analysis could vary greatly at a smaller time scale. However, with-Project conditions appear to be improved over without-Project conditions based on the modeling results provided.

Priority 5 – REV Criterion 3 (Spatial and temporal scale of ecosystem improvements) Score = 2.8

The Project could improve water temperature and DO at the times and places where these water quality conditions are currently impaired in Pacheco Creek. Habitat surveys support the rationale for targeting the upper 11 miles of Pacheco Creek for habitat improvements. The analysis, however, for DO and temperature improvements for passage does not consider the reaches downstream of Pacheco Creek in the Pajaro River. This makes it difficult to determine if fish passage would be improved because the applicant did not point to supporting information to demonstrate that juveniles and adults can access the full extent of the migration corridor. The temporal scale response highlights improved flow, primarily in summer, which would provide temperature benefits. Model data indicate continuous flows with lower flows in winter months and higher flows for spring, summer and fall for with-Project conditions, compared to without-Project conditions. Model data support the proposed ecosystem improvement that the Project would eliminate months with dry creek conditions compared to without-Project conditions. Although the model data indicate improvements to temperature conditions, the applicant did not point to supporting information on DO and temperature improvements specific to periods of to smolt outmigration (February – May) and adult migration (January – April).

Priority 5 – REV Criterion 4 (Inclusion of an adaptive management and monitoring program that includes measurable objectives, performance measures, thresholds, and triggers to achieve the ecosystem benefits) Score = 3.5
See comment for Priority 1 – REV 4.

Priority 5 – REV Criterion 5 (Immediacy of ecosystem improvement actions and realization of benefits) Score = 3.3
See comment for Priority 1 – REV 5.

Priority 5 – REV Criterion 6 (Duration of ecosystem improvements) Score = 2.5
See comment for Priority 1 – REV 6.

Priority 5 – REV Criterion 7 (Consistency with species recovery plans and strategies, initiatives, and conservation plans) Score = 4.5
See comment for Priority 1 – REV 7.

Priority 5 – REV Criterion 8 (Location of ecosystem improvements and connectivity to areas already being protected or managed for conservation values) Score = 3.5
See comment for Priority 1 – REV 8.

Priority 5 – REV Criterion 9 (Efficient use of water to achieve multiple ecosystem benefits) Score = 3.3
See comment for Priority 1 – REV 9.

Priority 5 – REV Criterion 10 (Resilience of ecosystem improvements to the effects of changing environmental conditions, including hydrologic variability and climate change) Score = 3.0
See comment for Priority 1 – REV 10.

Priority 8: Maintain or restore groundwater and surface water interconnection to support instream benefits and groundwater dependent ecosystems

Priority 8 – REV Criterion 2 (Magnitude of ecosystem improvements) Score = 4.7

The information presented for the magnitude of additional groundwater recharge and surface water flow generally supports the claimed benefit. The groundwater model outputs indicate large increases in groundwater basin storage and flow for all four reaches in the with-Project conditions, compared to without-Project conditions. Data for the four reaches of Pacheco Creek indicate the Project would provide about 3,500 AF on average annually for all years to recharge groundwater under current and 2030 conditions. The application included supporting model outputs with a detailed description on model logic and assumptions.

Priority 8 – REV Criterion 3 (Spatial and temporal scale of ecosystem improvements) Score = 4.7

The spatial scale for in-stream and groundwater improvements appears to provide benefits to the ecosystem and multiple habitats (riparian corridor, floodplain, wetlands) in the four reaches identified in the model. The applicant proposes the Project would improve groundwater conditions in summer and fall, compared to without-Project, drier conditions during these periods. The groundwater model output data generally supported the claimed benefit. Model logic and assumptions are thoroughly documented and explained.

Priority 8 – REV Criterion 4 (Inclusion of an adaptive management and monitoring program that includes measurable objectives, performance measures, thresholds, and triggers to achieve the ecosystem benefits) Score = 4.3
See comment for Priority 1 – REV 4.

Priority 8 – REV Criterion 5 (Immediacy of ecosystem improvement actions and realization of benefits) Score = 4.3

The Project schedule presented in the application is reasonable. The use of a temporary coffer dam during construction improves immediacy and could provide interim benefits. However, because the realization of full benefits depends on future climate and hydrologic conditions, the permanent realization of benefits could be several years after construction is complete. The applicant assumes that the realization of groundwater improvements would begin immediately with Project releases. The applicant did not point to a justification or supporting documentation for the assumption that benefits can occur within six months after Project completion.

Priority 8 – REV Criterion 6 (Duration of ecosystem improvements) Score = 3.7
See comment for Priority 2 – REV 6.

Priority 8 – REV Criterion 7 (Consistency with species recovery plans and strategies, initiatives, and conservation plans) Score = 4.7

The application references several conservation plans and lists many specific recovery actions and goals with which the Project as a whole is consistent. The NMFS SCCC Steelhead Recovery Plan actions, which call for operation of Pacheco Dam to provide required habitat functions for all steelhead life stages, are most consistent with this priority. Other actions identified from the plans are not directly applicable to

Priority 8, such as the California State Wildlife Action Plan's strategy to increase desired stages of succession with a reduction in the encroachment of coyote bush/coastal scrub into grassland and the California Water Action Plan's goal to increase regional self-reliance and integrated water management across all levels of government. The conservation plans were well documented in the worksheet and in the cited references.

Priority 8 – REV Criterion 8 (Location of ecosystem improvements and connectivity to areas already being protected or managed for conservation values) Score = 4.0

The Project is located in a portion of the Pajaro River watershed that does not effectively support steelhead, but Project operations could potentially support steelhead with resulting habitat improvements in Pacheco Creek. The Project may also result in benefits to the wetland mitigation bank near San Felipe Lake. Because the Project proposes to provide year-round flows in Pacheco Creek, it is likely that there is connectivity with the downstream confluence, a hydrologic connection to the Pajaro River Mitigation Bank, and an improvement to overall groundwater/surface water connections. A map of the geographic extent and specific locations for riparian habitat improvements was not provided. However, there are direct hydrologic connections that would result in improvements to steelhead and riparian and/or wetland habitats.

Priority 8 – REV Criterion 9 (Efficient use of water to achieve multiple ecosystem benefits) Score = 4.0

In addition to meeting the groundwater recharge needs of the Pacheco Pass Water District, water released for year-round flows in the 11-mile section of Pacheco Creek can improve steelhead habitat and is estimated to maintain flows for another 8 miles downstream. The same unit of water released would likely provide multiple benefits. More stored water from the reservoir expansion would allow for better flow and temperature management for fish. Multiple benefits from the use of Project water were justified with supporting ecosystem priority worksheets.

Priority 8 – REV Criterion 10 (Resilience of ecosystem improvements to the effects of changing environmental conditions, including hydrologic variability and climate change) Score = 3.7

The Project would provide a more reliable source of water with increased storage capacity enabling ongoing operations to restore and maintain groundwater and surface water interconnection. The applicant acknowledges uncertainty related to changes in imported water supplies to supplement filling of the reservoir, if local inputs are not sufficient. However, an analysis for this uncertainty was not provided in the application "due to the degree of uncertainty involved in predicting the change" in infrastructure, regulations or supply allocations. No analysis was provided regarding the resiliency of reservoir and ecosystem improvements to the other changing environmental uncertainties identified by the Department in the ecosystem worksheet.

Priority 9: Enhance flow regimes or groundwater conditions to improve the quantity and quality of riparian and floodplain habitats for aquatic and terrestrial species

Priority 9 – REV Criterion 2 (Magnitude of ecosystem improvements) Score = 3.7

The magnitude of riparian habitat benefits in general is large. Under current and 2030 conditions the Project would eliminate dry-back of Pacheco Creek and increase the average length of flowing stream in dry months by 55%. In addition, the average extent of flow in dry months would increase by 121% and

114% under current and 2030 conditions, respectively. The improvements to flow conditions for groundwater recharge and hyporheic zone mixing appear to be well supported. In general, the model methodologies and parameters based on habitat assessments for steelhead were supported and explained in the supplemental information. However, the application and model analysis did not address target flows to support species richness of riparian vegetation during dry months. The Project has a positive benefit for creek flows, but it is unclear how this benefits biological resources other than steelhead. The worksheet and supporting documents do not discuss the extent of benefits for other riparian species. The applicant did not point to an analysis of the effects of increases to groundwater or surface flows on aquatic and terrestrial species.

Priority 9 – REV Criterion 3 (Spatial and temporal scale of ecosystem improvements) Score = 4.0

The application states that perennial water supply improvements would benefit 18 miles of existing riparian habitat by eliminating annual dry-back in most hydrologic conditions. This conclusion is supported by the model data. However, it is unclear what the specific benefits would be along the 18-mile reach for riparian habitat. The application does not provide a detailed assessment of the with- and without-Project riparian benefits, aside from an increase in flow. In general, the Project's flow increase should provide riparian habitat benefits compared to the without-Project conditions. Project operations would sustain the Pacheco Creek riparian habitat during the dry months of May to November in all hydrologic conditions. The temporal improvement is supported by an assessment of wet and dry periods in Pacheco Creek and models of flow conditions in 2017 and 2030 for with- and without-Project scenarios. The largest temporal improvement is during critically dry years, with sustained flows that would eliminate dry-back.

Priority 9 – REV Criterion 4 (Inclusion of an adaptive management and monitoring program that includes measurable objectives, performance measures, thresholds, and triggers to achieve the ecosystem benefits) Score = 3.3

The adaptive management plan described in the General Information Worksheet includes a developed framework, an agency coordination approach with appropriate experts, and provides sufficient descriptions of actions and uncertainties. The adaptive management plan identifies multiple objectives and performance measures for the Pajaro River population of steelhead. However, it is unclear if monitoring and adaptive management focused on steelhead would address benefits to riparian habitat and terrestrial species. Discussion of adaptive management for riparian vegetation diversity and terrestrial species was not provided.

Priority 9 – REV Criterion 5 (Immediacy of ecosystem improvement actions and realization of benefits) Score = 3.3

The applicant proposes the operations of the Project would be complete five years after construction begins. The Project schedule presented in the application for permit acquisition and construction is reasonable. Depending on water year type, benefits of improved flow may be partially provided during construction. The application indicates some benefits could be provided within a year or less once the temporary coffer dam is constructed, depending on the availability of water to fill the temporary reservoir. The future of precipitation inputs to the reservoir makes these estimates less certain, particularly in drought years. In addition, the application does not clearly define the scale or timing of benefits that would be provided by flows from the temporary coffer reservoir. Other sources of reservoir inputs, such as water conveyed from the San Luis Reservoir, were not discussed. The response

assumes that as soon as additional water is released, the higher flows would benefit the riparian resource. The discussion does not address any lag time between the release of water and measurable riparian ecosystem establishment or growth. There is a low chance that a diverse riparian habitat would respond immediately to increased flows. The assumptions and methodologies did not address uncertainties associated with the immediacy of releases providing measureable realization of multiple riparian habitats. The applicant acknowledges the realization timeframe is dependent on future climate and hydrologic conditions, but did not point to supporting information for the estimate that full benefits could occur within six months after Project completion.

Priority 9 – REV Criterion 6 (Duration of ecosystem improvements) Score = 2.3

The Project expects to provide enhanced year-round flows in all water year types for a duration of 93 years. If the Project operations consistently produce flows during dry months to prevent dry-back of riparian corridors, it is reasonable to assume that the riparian ecosystem benefits would be concurrent with the duration of Project operations. However, the applicant did not point to supporting documentation to further explain the maintenance of Project benefits for the life span of the Project.

Priority 9 – REV Criterion 7 (Consistency with species recovery plans and strategies, initiatives, and conservation plans) Score = 4.7

The application thoroughly identifies several plans and lists many specific recovery actions or goals with which the Project as a whole is consistent. The application adequately describes consistency with the NMFS SCCC steelhead Recovery Plan, which calls for operation of Pacheco Dam to provide required habitat functions for all steelhead life stages. The application also describes present and potential beneficial uses of surface water under the Water Quality Control Plan for the Central Coastal Basin to which the Project would contribute. For example, the Project would contribute to the RARE beneficial use that describes habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered. In some cases, the goals listed are not directly applicable to this priority such as the California Water Action Plan's goal to increase regional self-reliance and integrated water management across all levels of government.

Priority 9 – REV Criterion 8 (Location of ecosystem improvements and connectivity to areas already being protected or managed for conservation values) Score = 4.0

The Project location is clearly described in terms of enhancing the steelhead habitat in Pacheco Creek, while avoiding impacts to sensitive public land and potential landslides. Improved riparian habitat along Pacheco Creek would be beneficial. The application adequately maps and describes conservation areas and target waterways that would receive ecosystem benefits, but the applicant did not point to supporting information about how much riparian habitat would benefit.

The Project would provide continuous flows in Pacheco creek, likely providing connectivity with the downstream confluence and a hydrologic connection to the Pajaro River Mitigation Bank. However, it is unclear how the Project would affect riparian corridor habitat or habitat in the Pajaro River Mitigation Bank. Although the riparian benefit is not specifically discussed, it is implied in the map and description of stream habitat for steelhead. The application does not discuss the potential negative effects of downstream land use, such as grazing, on the proposed benefits. This creates uncertainty regarding the

effects of surrounding land use on the location of enhanced habitat and its connectivity to other conservation areas.

Priority 9 – REV Criterion 9 (Efficient use of water to achieve multiple ecosystem benefits) Score = 3.7

The referenced preliminary operations plan and adaptive management framework provided support for the assumption that operations would provide year-round flows needed to sustain steelhead habitat. The Project releases are also sufficient to meet the groundwater recharge needs of the Pacheco Pass Water District and are estimated to maintain flows for another 8 miles downstream. The applicant assumes the same unit of water released would benefit multiple proposed ecosystem priorities, which is justified by the ecosystem priority worksheets. Water efficiencies are described generally for the Project as a whole, without particular focus on riparian habitat. The focus on steelhead habitat does not address further efficiencies that may be needed to sustain riparian habitats used by terrestrial species, such as floodplains. Riparian habitat for both aquatic and terrestrial species may not receive the same benefits as steelhead from the identified water management efficiencies.

Priority 9 – REV Criterion 10 (Resilience of ecosystem improvements to the effects of changing environmental conditions, including hydrologic variability and climate change) Score = 3.3

The Project would provide a more reliable source of water with the increased storage capacity that would enable operations in support of this priority. The application provides a thorough analysis of climate change uncertainties in multiple year types, with drought, precipitation changes, reduced inflows, and water temperature changes. The application includes a commitment to discontinue releases for water user demands at low reservoir levels. This commitment would make water available for releases to provide surface water and groundwater needed for resiliency of sycamore woodland riparian corridors along Pacheco Creek. However, the extent to which the resiliency of streamside sycamore forest provides resiliency for riparian species other than steelhead is not discussed in the application. In addition, it is unclear how the cold water pool and water temperature would be managed to ensure resiliency with climate change. The applicant acknowledges uncertainty related to changes in imported water supplies to supplement filling the reservoir, if local inputs are not sufficient. However, an analysis of this uncertainty was not provided in the application "due to the degree of uncertainty involved in predicting the change" in infrastructure, regulations or supply allocations. No analysis was provided regarding the resiliency of reservoir and ecosystem improvements to the other changing environmental uncertainties identified by the Department in the ecosystem worksheet.

Priority 11: Enhance the temporal and spatial distribution and diversity of habitats to support all life stages of fish and wildlife species

Priority 11 – REV Criterion 2 (Magnitude of ecosystem improvements) Score = 2.2

Wetlands: The application states that the Incremental Level 4 (IL4) refuge water provided by the Project could benefit resident waterfowl. Data on waterfowl foods was provided, but the improvements to waterfowl food densities resulting from 2,000 AF of IL4 water were not discussed. The applicant did not provide a rationale for the assumption that 1,000 acres of wetland habitat would result from the delivery of 2,000 AF. The application identifies reptile and amphibian species associated with wetland habitat in the Central Valley. However, an analysis was not provided to demonstrate an improvement to California red-legged frog, giant garter snake, or western pond turtle and their habitat within wildlife refuges. The applicant did not point to supporting information to show that the water allocation would

enhance the diversity of species habitat. The delivery of 2,000 AF of IL4 water appears to be a very low volume, given the new reservoir capacity of 140 TAF. In addition, the application states water would be delivered only in below normal years, but the applicant did not point to supporting documentation to justify why water deliveries would only occur in one water year type.

Steelhead Habitat: The applicant provided data and documentation to support the proposed improvements to steelhead habitat. Model results indicate that enhanced flows would benefit all life stages of steelhead, with an increase in steelhead cohort scores resulting from the Project. Across all water year types, the percent increase in cohort scores ranged from 91-595% and 125-478% in current and 2030 conditions, respectively. However, the temperature model is based on measured stream temperature data from a single summer (2013). The model assumptions and analysis do not appear to incorporate habitat typing data and cross-sections of stream channel; the depth to flow relationship appears to be based on discharge only. Data for a multi-year reservoir temperature profile were not provided. Because the model is based on limited empirical data, there is uncertainty about the magnitude of temperature benefits. The application provided a temperature profile for the existing reservoir from July 2013. However, this information does not demonstrate the thermal stratification profile of the proposed reservoir expansion and the availability of a cold water pool throughout the year and, therefore, it is uncertain whether colder water temperatures would last through summer and into fall as predicted. Monthly average water temperatures projected in the analysis could vary greatly at a smaller time scale. However, with-Project conditions appear to be improved over without-Project conditions based on the modeling results provided.

Riparian Habitat: Improved perennial flows to Pacheco Creek from the Project may improve riparian habitat. However, the applicant did not point to quantitative supporting evidence for evaluating the magnitude of riparian forest spatial improvements. Flow releases from the dam do not guarantee downstream riparian habitat enhancement and species unless specific management and enhancement plans are implemented. The discussion in the application is based on the potential of increased sycamore population but not in diversity of riparian habitat; with increased flows comes a risk of dispersal of nonnative plants. In addition, effects of increased flows on geomorphological processes do not appear to be analyzed.

Priority 11 – REV Criterion 3 (Spatial and temporal scale of ecosystem improvements) Score = 2.4

Wetland habitat: The spatial scale is appropriate for the targeted habitat improvements. However, the application does not state with certainty which refuge would receive water deliveries and whether IL4 water would be diverted only to Grasslands or to additional wildlife refuges. It is possible that the Project would result in increased wetland habitat, especially for waterfowl, but the applicant did not point to sufficient information to demonstrate whether timing and amount of water delivered to the wetlands would provide benefits to giant garter snake, California red-legged frog and western pond turtle, as claimed. The applicant did not point to supporting documentation demonstrating the estimated benefit to 1,000 wetland acres. The application is also unclear as to why delivery of IL4 water would only occur in below normal water years and not during dry or critical years. The applicant did not point to supporting documentation to justify this delivery schedule.

Steelhead Habitat: Model results indicate that the Project would provide benefits to 11 miles of habitat below the dam and improved summer rearing conditions for steelhead. A monthly flow schedule indicates with-Project flows would be higher than without-Project conditions. Habitat changes likely would occur, but the benefit to smolt and adult steelhead is uncertain because it is unclear if sufficient

flows would improve habitat from the confluence with the Pajaro River and to the ocean. Uncertainties with the model analysis include the timing and magnitude of flow to allow adult migration and smolt outmigration and whether flows would provide more complex habitat during critical times of the year.

Riparian Habitat: It is unclear where and when riparian habitat improvement would occur. The applicant did not point to sufficient information regarding specific locations for riparian habitat improvement. In addition, only steelhead cohort scores for with- and without-Project under current and 2030 conditions were provided for all water year types to demonstrate the temporal scale of improvement. The document lists four reaches of Pacheco Creek that would benefit from increased flows, but does not identify specific locations for habitat and biodiversity enhancement. There is also no discussion of how the removal of North Fork dam would affect transport of sediment that is currently behind the dam.

Priority 11 – REV Criterion 4 (Inclusion of an adaptive management and monitoring program that includes measurable objectives, performance measures, thresholds, and triggers to achieve the ecosystem benefits) Score = 2.8

The application provides a sufficient description of a process to develop an adaptive management plan. The approach includes a multiagency coordination approach and establishment of a technical advisory committee with subject matter experts. The application presents a framework, but does not identify funding sources or financial commitments for monitoring and adaptive management. The application discussed uncertainty in steelhead response to year-round flows provided by the Project, but did not describe specific adaptive management approaches for this uncertainty. The application states, "if the public benefits as described are not provided...changes to the flow patterns are not to exceed the total water that would be released consistent with Table 2-1 [identifying average monthly release targets] each year."

Priority 11 – REV Criterion 5 (Immediacy of ecosystem improvement actions and realization of benefits) Score = 3.0

The applicant proposes the operations of the Project would be complete five years after construction begins. The Project schedule presented in the application for permit acquisition and construction is reasonable. The application adequately describes the immediacy timeframes. The realization timeframe is dependent on future climate and hydrologic conditions to fill the reservoir. Depending on water year type, benefits of improved flow may be partially provided during construction. The application indicates some benefits could be provided within a year or less once the temporary coffer dam is constructed, depending on the availability of water to fill the temporary reservoir. However, the application does not clearly define the scale or timing of benefits that would be provided by flows from the temporary coffer reservoir. Increased flows could provide measurable outcomes after flows are released. However, effects of sediment behind the existing dam and sediment mobilization with initial Project flows on proposed benefits were not addressed. The applicant did not point to supporting documentation to justify the estimate that benefits can occur within six months after Project completion. It is uncertain whether the benefits would be realized, in the timeframe provided by the applicant given the intermittent presence of the target species in Pacheco Creek and the absence of a reintroduction component for steelhead in the application. It may take several years in order to document a measurable response in steelhead population and improvements in riparian habitat. The immediacy and realization timeframe was not analyzed for refuge water benefits.

Priority 11 – REV Criterion 6 (Duration of ecosystem improvements) Score = 2.4

The Project expects to provide enhanced year-round flows in all water year types for a duration of 93 years. The applicant did not point to supporting documentation to justify the proposed life span of the Project after construction. The duration of the Project may provide water for many years, yet there is uncertainty in steelhead response to Project flows. Supporting documents indicate long-term benefits to steelhead habitat during the summer rearing phase. However, the duration of the benefit could be shorter than projected in the event that more flows are found necessary to generate the proposed habitat improvements but additional flows are not provided. The duration for refuge water benefits was not analyzed.

Priority 11 – REV Criterion 7 (Consistency with species recovery plans and strategies, initiatives, and conservation plans) Score = 3.6

The application references several conservation plans and list many specific recovery actions and goals with which the Project as a whole is consistent. The application adequately describes consistency with the NMFS SCCC Steelhead Recovery Plan, which calls for operation of Pacheco Dam to provide required habitat functions for all steelhead life stages. The application also describes present and potential beneficial uses of surface water under the Water Quality Control Plan for Central Costal Basin, to which the Project would contribute. For example, the Project would contribute to the RARE beneficial use that describes habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered. The California State Wildlife Action Plan contain some objectives that seem to be consistent with habitat benefits provided under this priority, such as the goal to maintain and improve ecological conditions vital for sustaining ecosystems in California. The application lists other actions that are not applicable to Priority 11, such as the California Water Action Plan's goal to increase regional self-reliance and integrated water management across all levels of government. The supporting documents reference these recovery plans, strategies and initiatives and the relevant goals, but the application did not further discuss how the Project would support the identified goals.

Priority 11 – REV Criterion 8 (Location of ecosystem improvements and connectivity to areas already being protected or managed for conservation values) Score = 2.8

Project flows would occur within the known SCCC steelhead range and could provide benefits to the habitat and species. The habitat benefits are in a location where SCCC steelhead have been observed in the past, although is uncertain if steelhead would respond to the hydrologic improvements. Project flows would likely provide connectivity with the downstream confluence and a hydrologic connection to the Pajaro River Mitigation Bank. It is unclear how often and at what time of year Pacheco Creek would connect to the ocean and allow steelhead to access the areas of improvement. Despite these uncertainties, the supporting documentation is generally sufficient to establish confidence in the proposed location and connectivity.

A map of specific locations for riparian habitat improvements was not provided. The application did not provide a detailed explanation of location selection for refuges or an analysis of connectivity for the refuge water benefit. However, water delivered to wildlife refuges would create habitat in a location that would provide benefits and establish direct hydrological connectivity between the ecosystem improvements and existing managed lands.

Priority 11 – REV Criterion 9 (Efficient use of water to achieve multiple ecosystem benefits) Score = 2.4

The Project's use of water would likely achieve multiple ecosystem benefits. In addition to meeting the groundwater recharge needs of the Pacheco Pass Water District, the enhanced flows would improve rearing conditions for juvenile steelhead, particularly in the summer. The reservoir should be able to support proposed fish flows across multiple drought years. Proposed water releases should contribute to restoring riparian and floodplain habitat downstream of the dam. However, supporting information does not adequately discuss water use efficiency related to riparian habitat benefits. The applicant did not point to an explanation or analysis for efficiency of refuge water deliveries.

Priority 11 – REV Criterion 10 (Resilience of ecosystem improvements to the effects of changing environmental conditions, including hydrologic variability and climate change) Score = 3.0
See comment for Priority 1 – REV 10.

Priority 12: Enhance access to fish spawning, rearing, and holding habitat by eliminating barriers to migration

Priority 12 – REV Criterion 2 (Magnitude of ecosystem improvements) Score = 3.0

A significant barrier to fish movement in Pacheco Creek is the current ephemeral nature and low flow conditions in the creek. The Project proposes to increase flows to address this issue and model data for with-Project conditions show large increases for steelhead cohort scores from without-Project conditions. The Project would increase steelhead cohort scores by 161% and 162% on average under current and 2030 conditions, respectively. These benefits are based on the assumption that SCCC steelhead would respond to the improvement and re-establish in Pacheco Creek. Increased summer base flow would improve connectivity and habitat access for juvenile steelhead. The application does not directly address the elimination of physical barriers to migration and relies on higher flows to address this type of barrier. There is a physical temporal barrier on Pacheco Creek and other barriers downstream on the Pajaro River that are only passable during high flows. The application proposes improved conditions during adult and smolt migration periods. However, this is not well-supported because the Project's habitat model does not incorporate specific habitat data that quantifies passage flows. Although the application generally provides sufficient supporting documentation for the model, the Department is unable to reach reliable conclusions on the magnitude of the benefit. This is because it is unclear how the cohort scores translate into habitat conditions for passage.

Priority 12 – REV Criterion 3 (Spatial and temporal scale of ecosystem improvements) Score = 3.3

The application focuses on improvements to 11 miles of habitat. Modeled habitat suitability score and steelhead cohort score data indicate improved habitat through the 11 river miles for with-Project conditions across all year types. Increased summer base flows would enhance connectivity and the ability for juvenile steelhead to move between habitats during this time period. There is a potential that decreases in winter base flow, resulting from the Project, would restrict access for adult fish to the stream under with-Project operations. In dry years, passage could potentially be impaired due to low flows and warm water. Even with sufficient flow, there is uncertainty that the water temperature would be cold enough in these years. Additionally, is it uncertain how steelhead will respond to the Project improvements.

Priority 12 – REV Criterion 4 (Inclusion of an adaptive management and monitoring program that includes measurable objectives, performance measures, thresholds, and triggers to achieve the ecosystem benefits) Score = 4.0
See comment for Priority 1 – REV 4.

Priority 12 – REV Criterion 5 (Immediacy of ecosystem improvement actions and realization of benefits) Score = 4.0

The applicant proposes the operations of the Project would be complete five years after construction begins. The Project schedule presented in the application for permit acquisition and construction is reasonable. Depending on water year type, benefits of improved flow may be partially provided during construction. However, the application does not clearly define the scale or timing of benefits that would be provided by flows from the temporary coffer reservoir. The coffer dam may be able to provide flow, but it is unclear whether the flow would be sufficient to provide optimal flows for migration. However, the applicant acknowledges that the immediacy and realization of improvements depend on future climate change and hydrologic conditions. The applicant did not point to supporting documentation to justify the estimate that benefits can occur within six months after Project completion. The realization of benefits may take longer than estimated because it is uncertain how long it would take for the reservoir to fill sufficiently to provide passage flows and it also may take several years of the enhanced flows to document a measurable response in the steelhead population.

Priority 12 – REV Criterion 6 (Duration of ecosystem improvements) Score = 3.3

The Project expects to provide enhanced year-round flows in all water year types for a duration of 93 years. However, the applicant did not point to supporting documentation to justify the proposed life span and continued operations of the Project after construction. The Project may provide water for many years, yet there is uncertainty if it would promote steelhead establishment. Supporting documents indicate long-term benefit to steelhead habitat during the summer rearing phase. However, there is uncertainty with the benefit duration due to the unpredictability of future precipitation patterns.

Priority 12 – REV Criterion 7 (Consistency with species recovery plans and strategies, initiatives, and conservation plans) Score = 4.8
See comment for Priority 1 – REV 7.

Priority 12 – REV Criterion 8 (Location of ecosystem improvements and connectivity to areas already being protected or managed for conservation values) Score = 3.5
See comment for Priority 1 – REV 8.

Priority 12 – REV Criterion 9 (Efficient use of water to achieve multiple ecosystem benefits) Score = 3.5
See comment for Priority 1 – REV 9.

Priority 12 – REV Criterion 10 (Resilience of ecosystem improvements to the effects of changing environmental conditions, including hydrologic variability and climate change) Score = 3.3

The Project would increase reservoir capacity and would likely provide a more reliable source of water for maintenance of flows in Pacheco Creek. The applicant provided a model analysis using 2070 climate

change scenarios to address the resiliency of the proposed Project with regard to climate change and California's variable climate. The model analysis indicates resiliency of the Project's habitat improvement for steelhead with increased steelhead cohort scores from without-Project conditions. Under the 2070 climate change scenarios, the percent increase in cohort scores ranged from 178-278%. Operational adjustments can be made once the Project is built, but the resiliency of the ecosystem benefits from flows and cold water are unclear. Specifically, the model does not measure passage flows and the applicant did not point to a discussion on the resiliency of Project flows for passage with climate change. Because monthly average temperature data resulting from the model could vary greatly at a smaller time scale, the data is insufficient to show that temperatures can be maintained for passage. No analysis was provided regarding the resiliency of reservoir ecosystem improvements to the other changing environmental uncertainties identified by the Department in the ecosystem worksheet.

Priority 14: Provide water to enhance seasonal wetlands, permanent wetlands, and riparian habitat for aquatic and terrestrial species on State and Federal wildlife refuges and on other public and private lands

Priority 14 – REV Criterion 2 (Magnitude of ecosystem improvements) Score = 3.0

The project's proposed 2,000 AF of IL4 water would be available only during below normal years. Delivery of refuge water from the Project would not be available in dry or critical years. The applicant did not point to supporting documents that discussed the rationale for delivery of IL4 waters in only below normal water years and not during dry or critical years. The proposed delivery of 2,000 AF appears to be a low volume considering the new reservoir capacity of 140 TAF, and is also approximately 2% of the total IL4 water needed by all identified wildlife refuges. The applicant assumed the 2,000 AF would increase wetland acreage by 1,000 acres, but did not point to documentation supporting this assumption. The application indicates that the IL4 refuge water provided by the Project could benefit resident waterfowl. The applicant provided data on waterfowl foods, but did not discuss the specific improvements to waterfowl food densities resulting from 2,000 AF of IL4 water. The application identifies reptile and amphibian species associated with wetland habitat in the Central Valley. However, an analysis was not provided to demonstrate an improvement to California red-legged frog, giant garter snake, or western pond turtle and their habitat within wildlife refuges. The applicant did not point to supporting information to show that the water allocation would enhance the diversity of species habitat. Although the proposed volume of IL4 water is low, generally the delivery of water to wildlife refuges would provide enhancement to wetland habitats.

Sufficient supporting data on steelhead cohort scores were provided for the proposed improvements to steelhead habitat. Model data demonstrates the Project would provide continuous flow in reaches that are currently ephemeral and dry-back periodically. Increased flows could enhance sycamore woodland habitat in Pacheco Creek, which should decrease temperatures to benefit steelhead. This provides a rationale for improved riparian habitat, but the applicant did not point to quantitative data to evaluate the magnitude of riparian forest improvements. The applicant also did not point to supporting evidence to demonstrate that flow alone would create an increase in sycamore alluvial woodland.

Priority 14 – REV Criterion 3 (Spatial and temporal scale of ecosystem improvements) Score = 3.2

Water deliveries to established wildlife refuges are generally an appropriate means to provide improvements to the targeted habitat, especially for waterfowl. The applicant did not point to a rationale or supporting documentation to justify the assumed increase of 1,000 wetland acres resulting

from delivery of IL4 water. Although the applicant indicates a preference for delivery of water to Grasslands, there is uncertainty associated with the exact location (refuge) for IL4 water delivery. The refuge water would not be available year-round and would be provided in only below normal years. The applicant did not point to a justification for delivery of IL4 refuge water only in below normal water years. The applicant did not include a discussion of how the timing of deliveries would benefit the listed species, other than resident waterfowl. The model analysis indicates year-round flows in Pacheco Creek could provide benefit in all water year types for enhancement of steelhead habitat and riparian habitat. The Project flows would provide improvements to an 11-mile reach of the creek, however the applicant did not point to supporting information on specific locations or acreage for riparian habitat improvement.

Priority 14 – REV Criterion 4 (Inclusion of an adaptive management and monitoring program that includes measurable objectives, performance measures, thresholds, and triggers to achieve the ecosystem benefits) Score = 2.0

The application provides a sufficient description of a process to develop an adaptive management plan for the Pacheco Creek benefits. The approach includes a multiagency coordination approach and establishment of a technical advisory committee with subject matter experts. The application presents a framework but it does not identify funding sources or financial commitments for monitoring and adaptive management. The application discussed uncertainty in steelhead response to year-round flows provided by the Project, but did not describe specific adaptive management approaches for this uncertainty. The application states, "if the public benefits as described are not provided...changes to the flow patterns are not to exceed the total water that would be released consistent with Table 2-1 [identifying average monthly release targets] each year." The priority worksheet did not include discussion of adaptive management goals for refuge water benefits. However, the General Information Worksheet included a brief discussion on participation in interagency coordination meetings for the Refuge Water Supply Program.

Priority 14 – REV Criterion 5 (Immediacy of ecosystem improvement actions and realization of benefits) Score = 4.0

The applicant proposes the operations of the Project would be complete five years after construction begins. The Project schedule presented in the application for permit acquisition and construction is reasonable. The application adequately describes the immediacy timeframes. The realization timeframe is dependent on future climate and hydrologic conditions to fill the reservoir. Depending on water year type, benefits of improved flow may be partially provided during construction. The application indicates some benefits could be provided within a year or less once the temporary coffer dam is constructed, depending on the availability of water to fill the temporary reservoir. However, the application does not clearly define the scale or timing of benefits that would be provided by flows from the temporary coffer reservoir. Increased flows could provide measurable outcomes after flows are released. However, effects of sediment behind the existing dam and sediment mobilization with initial Project flows on proposed benefits were not addressed. The applicant did not point to supporting documentation to justify the estimate that benefits can occur within six months after Project completion. It may take several years in order to document a measurable response in steelhead population and improvements in riparian habitat. Immediacy of ecosystem improvements and realization of benefits were not analyzed for refuge water benefits.

Priority 14 – REV Criterion 6 (Duration of ecosystem improvements) Score = 3.2
See comment for Priority 11 – REV 6.

Priority 14 – REV Criterion 7 (Consistency with species recovery plans and strategies, initiatives, and conservation plans) Score = 3.3
See comment for Priority 11- REV 7.

Priority 14 – REV Criterion 8 (Location of ecosystem improvements and connectivity to areas already being protected or managed for conservation values) Score = 3.7
See comment for Priority 11 – REV 8.

Priority 14 – REV Criterion 9 (Efficient use of water to achieve multiple ecosystem benefits) Score = 3.0
See comment for Priority 11 – REV 9.

Priority 14 – REV Criterion 10 (Resilience of ecosystem improvements to the effects of changing environmental conditions, including hydrologic variability and climate change) Score = 3.2
See comment for Priority 1 – REV 10.

The applicant acknowledges uncertainty related to changes in imported water supplies to supplement filling the reservoir, if local inputs are not sufficient. However, an analysis of this uncertainty was not provided in the application "due to the degree of uncertainty involved in predicting the change" in infrastructure, regulations or supply allocations. The application also did not include a discussion on the resiliency of wetland/refuge water or riparian benefits.

Priority 16: Enhance habitat for native species that have commercial, recreational, scientific, or educational uses

Priority 16 – REV Criterion 2 (Magnitude of ecosystem improvements) Score = 2.3

Data indicate a large increase for steelhead cohort scores from with-Project current and 2030 conditions, which was supported by model documentation describing the applicant's assumptions and analysis. The Project would increase steelhead cohort scores by 161% and 162% on average under current and 2030 conditions, respectively. The supporting model results indicate lower temperatures during the summer rearing period, which would be beneficial to steelhead. However, the Department is unable to make an accurate assessment of habitat improvements, since monthly average habitat conditions could vary greatly at a smaller time scale. In addition, the applicant did not point to supporting documentation to establish the commercial, recreational, scientific, or educational use of the target species.

There are uncertainties regarding the magnitude of improvements and whether enhanced habitat conditions would be provided, based on the Department's evaluation of the Pacheco Creek Steelhead Habitat Suitability Model. The model is based on measured stream temperature data from a single summer (2013). Because the model is based on limited empirical data, there is uncertainty about the magnitude of temperature benefits. The application provided a temperature profile for the existing reservoir from July 2013. However, this information does not demonstrate the thermal stratification profile of the proposed reservoir expansion and the availability of a cold water pool throughout the year and, therefore, it is uncertain whether colder water temperatures would last through summer and into fall as predicted.

Priority 16 – REV Criterion 3 (Spatial and temporal scale of ecosystem improvements) Score = 2.7

Removal of the existing dam would add one mile of potential habitat for SCCC steelhead. The supporting model data indicate the Project would improve habitat conditions in 11 miles of Pacheco Creek downstream of the Project. Sufficient documentation was provided to explain the Pacheco Creek Steelhead Habitat Suitability Model and the steelhead cohort score. The timing of proposed improvements could provide some benefits, especially during summer.

Priority 16 – REV Criterion 4 (Inclusion of an adaptive management and monitoring program that includes measurable objectives, performance measures, thresholds, and triggers to achieve the ecosystem benefits) Score = 2.7

The application provides a sufficient description of an adaptive management approach. The application discusses an agency coordination approach and commitment to establishing a technical advisory committee with subject matter experts. The application presents a framework but does not identify funding sources for monitoring and adaptive management. There is some uncertainty regarding the proposed non-Project monitoring (physical or biological surveys) because it is dependent on grant funding that is uncertain to occur. The application does not specifically discuss how adaptive management would be used to support this priority, although the applicant indicates flow and temperature data collection is a part of Project effectiveness monitoring. The application states, "if the public benefits as described are not provided...changes to the flow patterns are not to exceed the total water that would be released consistent with Table 2-1 [identifying average monthly release targets] each year."

Priority 16 – REV Criterion 5 (Immediacy of ecosystem improvement actions and realization of benefits) Score = 2.7
See comment for Priority 1- REV 5.

Priority 16 – REV Criterion 6 (Duration of ecosystem improvements) Score = 2.0
See comment for Priority 1 – REV 6.

Priority 16 – REV Criterion 7 (Consistency with species recovery plans and strategies, initiatives, and conservation plans) Score = 3.7
See comment for Priority 1 – REV 7.

Priority 16 – REV Criterion 8 (Location of ecosystem improvements and connectivity to areas already being protected or managed for conservation values) Score = 3.0
See comment for Priority 1 – REV 8.

Priority 16 – REV Criterion 9 (Efficient use of water to achieve multiple ecosystem benefits) Score = 2.3
See comment for Priority 1 – REV 9.

Priority 16 – REV Criterion 10 (Resilience of ecosystem improvements to the effects of changing environmental conditions, including hydrologic variability and climate change) Score = 2.3
See comment for Priority 1 – REV 10.

Table 1. Relative Environmental Value Scores for the Pacheco Reservoir Expansion Project												
Priority	REV2	REV3	REV4	REV5	REV6	REV7	REV8	REV9	REV10	REV1	Points Possible	Points Received
P 1	3.3	4.0	3.5	3.5	3.3	4.3	4.0	4.3	3.0	X	54	33.2
P 2	3.0	3.2	3.0	3.2	2.6	4.0	3.4	3.2	2.6	X	54	28.2
P 3	3.0	3.5	3.0	3.2	2.6	4.0	3.2	3.0	2.4	X	54	27.9
P 4	3.5	3.0	3.5	3.5	2.8	4.0	3.3	3.5	3.0	X	54	30.1
P 5	3.3	2.8	3.5	3.3	2.5	4.5	3.5	3.3	3.0	X	54	29.7
P 8	4.7	4.7	4.3	4.3	3.7	4.7	4.0	4.0	3.7	X	54	38.1
P 9	3.7	4.0	3.3	3.3	2.3	4.7	4.0	3.7	3.3	X	54	32.3
P 11	2.2	2.4	2.8	3.0	2.4	3.6	2.8	2.4	3.0	X	54	24.6
P 12	3.0	3.3	4.0	4.0	3.3	4.8	3.5	3.5	3.3	X	54	32.7
P 14	3.0	3.2	2.0	4.0	3.2	3.3	3.7	3.0	3.2	X	54	28.6
P 16	2.3	2.7	2.7	2.7	2.0	3.7	3.0	2.3	2.3	X	54	23.7
TOTAL									REV1 = [1]	4.1%	594	329.1
										TOTAL REV SCORE[2]		59.5%

[1] Additional 0.375 percent applied to total REV score for each priority claimed

[2] Total REV Score equals total points received divided by total points possible, plus REV1 percentage addition