United States Department of the Interior
FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Suite W-2605
Sacramento, California 95825-1846
SFWO_mail@fws.gov

In Reply Refer to:
2022-0014973-S7-001

October 21, 2022

Matthew J. Roberts
Senior Project Manager, California North Section, Regulatory Division
U.S. Army Corps of Engineers, Sacramento District
1325 J Street, Room 1350
Sacramento, California 95814
Matthew.J.Roberts@usace.army.mil

Subject: Reinitiation of Formal Consultation on the Creekside Development Project, Butte County, California (Corps File Number SPK-2005-00063)

Dear Matthew Roberts:

This letter is in response to the U.S. Army Corps of Engineers' (Corps) November 29, 2021, request for reinitiation of formal consultation with the U.S. Fish and Wildlife Service (Service) on the proposed Creekside Development Project (a.k.a. Bruce Road and Highway 32 Development Project, formerly known as the Old Farm Estates Project) (proposed project) in Butte County, California. Your request was received by the Service on November 30, 2021; however, the Service did not receive complete information to initiate formal consultation until February 24, 2022. The Service issued the original biological opinion (Service File Number 1-1-99-F-0143) on January 29, 2002. The Corps requested reinitiation due to a change in the environmental baseline that resulted in effects to listed species not previously considered, as well as a change in the proposed project description and conservation measures. At issue are the proposed project's effects on the federally threatened vernal pool fairy shrimp (*Branchinecta lynchi*) (fairy shrimp), the federally endangered vernal pool tadpole shrimp (*Lepidurus packardi*) (tadpole shrimp), and the federally endangered Butte County meadowfoam (*Limnanthes flocosse* ssp. *californica*) (meadowfoam). This response is provided under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.) (Act), and in accordance with the implementing regulations pertaining to interagency cooperation (50 CFR 402).

The federal action on which we are consulting is the issuance of a Clean Water Act, Section 404 permit from the Corps to George P. Eshoo (applicant) for the fill of waters of the United States associated with the proposed project. Pursuant to 50 CFR 402.12(j), you submitted a biological assessment for our review and requested concurrence with the findings presented therein. These findings conclude that the proposed project may affect, and is likely to adversely affect the fairy shrimp, tadpole shrimp, and meadowfoam.

The Corps requested reinitiation due to the discovery of a population of meadowfoam within the proposed project boundaries. The original biological opinion from January 29, 2002, concurred

with the Corps' determination that the proposed project may affect, but was not likely to adversely affect the meadowfoam because the meadowfoam had not been documented within the proposed project since 1990 despite yearly surveys. However, the meadowfoam was identified within the proposed project during a 2018 botanical survey. In addition, the proposed project boundaries have changed (the proposed project in the original biological opinion covered the entire 20.5-acre property owned by the applicant, whereas the current proposed project only encompasses 17.87 acres of the property), and the proposed conservation measures for the fairy shrimp and tadpole shrimp have been updated due to the current lack of available vernal pool creation credits within the Northeastern Sacramento Valley Vernal Pool Region where the proposed project is located.

The original biological opinion for the proposed project was appended to the February 28, 1996, *Programmatic Formal Endangered Species Act Consultation on Issuance of 404 Permits for Project with Relatively Small Effects on Listed Vernal Pool Crustaceans within the Jurisdiction of the Sacramento Field Office, California* (Service File Number 1-1-96-F-1) (programmatic consultation). The Service is no longer appending biological opinions for individual projects to this programmatic consultation as it has been over 20 years since it was updated, and the environmental baseline has changed significantly in that time. Therefore, the Service is issuing this reinitiated biological opinion and incidental take statement as a stand-alone document. The original biological opinion that was appended to the programmatic consultation provided a short summary of the proposed project description, environmental baseline, and effects to listed species. This reinitiated biological opinion will fully describe the proposed project and include a full analysis of the effects to listed species. The original biological opinion will only be referenced in the environmental baseline to highlight the consistency between the original and reinitiated biological opinion with regard to the amount of fairy shrimp and tadpole shrimp habitat within the action area.

In considering your request, we based our evaluation on the following:

1) The previously issued January 29, 2002, biological opinion for the Old Farm Estates Project;

2) The November 29, 2021, email from the Corps requesting reinitiation of formal consultation;

3) The May 12, 2020, *Biological Assessment: Bruce Road and Highway 32 Development Project* (biological assessment) prepared by ECORP Consulting, Inc. (consultant);

4) The February 2, 2022, letter from the consultant to the Corps and the Service providing additional information on the proposed project to update the biological assessment;

5) The June 22, 2022, letter from the consultant to the Corps and the Service providing additional information on the proposed project to further update the biological assessment;

6) Email, telephone, and video conference correspondence between the Service, the Corps, the consultant, and the California Department of Fish and Wildlife (CDFW); and,

7) Other information available to the Service.

Consultation History

January 29, 2002: The Service issued the original biological opinion to the Corps, which was appended to the programmatic consultation.

September 23, 2021: The Service received a request from the Corps for comments on their proposed decision to issue a Letter of Permission for the proposed project.

September 29, 2021: The Service provided email comments to the Corps alerting them to the presence of meadowfoam within the proposed project area and our recommendations for avoidance.

November 10, 2021: The Service received a telephone call from the consultant asking about the status of the consultation, and we discussed the details of the proposed project and potential options for avoidance, minimization, and compensation for loss of listed species and their habitat.

November 30, 2021: The Service received the November 29, 2021, letter from the Corps requesting reinitiation of formal consultation with the biological assessment enclosed.

December 3, 2021: The Service received clarifications from the consultant regarding information in the Corps' reinitiation request.

December 9, 2021: The Service sent a letter to the Corps requesting additional information.

December 11, 2021: The Service participated in a meeting with the consultant to discuss our request for additional information and potential compensation options.

January 7, 2022: The Service participated in email, telephone, and video conference discussions with CDFW and the consultant about the proposed project and potential compensation options.

January 25, 2022: The Service participated in a meeting with the consultant to discuss potential compensation options.

January 28, 2022: The Service received a draft response to our December 9, 2021, letter requesting additional information from the consultant that they were preparing for the Corps. The consultant asked for review of the draft response to ensure that it fully captured the discussions we had participated in since December 9, 2021.

February 1, 2022: The Service provided minor comments back to the consultant on their draft response.

February 16, 2022: The Service received the February 2, 2022, letter from the consultant to the Corps providing their final response to our December 9, 2021, letter requesting additional information.

February 24, 2022: The Service received an updated map of the conceptual land use plan that matched the acreages presented in the February 2, 2022, letter, as well as a

November 18, 2021, memo from the consultant to the Corps confirming that no elderberry shrubs are present within the proposed project.

March 1, 2022: The Service received an updated map of the proposed project area with the acreages of vegetation types within the updated project boundary.

March 17, 2022: The Service participated in a meeting with CDFW and the consultant to discuss the requirements for a consistency determination and the status of California Environmental Quality Act documents for the proposed project.

March 25, 2022: The Service attended a site visit with CDFW and the consultant to see the proposed project site and observe the consultant's protocol-level survey for Butte County meadowfoam.

April 12, 2022: The Service received a report from the consultant documenting the results of the March 25, 2022, Butte County meadowfoam survey.

April 26, 2022: The Service received a letter from the consultant updating the environmental baseline to include the March 25, 2022, meadowfoam survey results in the biological assessment.

April 29, 2022: The Service requested and received from the consultant the GIS layers for the proposed project boundary, the jurisdictional delineation of waters of the U.S., the 2022 meadowfoam survey results, and several incidental observations from site visits by the consultant in 2020.

May 23, 2022: The Service sent a letter to the Corps, the applicant, and the consultant proposing to calculate acreage of meadowfoam habitat on the proposed project site in the same way that it is calculated for the proposed Sycamore Creek Conservation Bank. This method used the results from both the 2018 and 2022 meadowfoam surveys.

May 25, 2022: The Service received a letter from the consultant, in preparation for the May 26, 2022, meeting, outlining several disagreements with our May 23, 2022, letter.

May 26, 2022: The Service participated in a meeting with the Corps, CDFW, the applicant, and the consultant to discuss our May 23, 2022, letter. We discussed the proper way to analyze the environmental baseline, the validity of the 2018 meadowfoam survey results, and the feasibility of different conservation measures to offset the loss of meadowfoam habitat.

June 22, 2022: The Service received a letter from the consultant providing an updated environmental baseline based on the Service's analysis in our May 23, 2022, letter. This was the date that all necessary information was received to begin reinitiation of formal consultation.

BIOLOGICAL OPINION

Description of the Proposed Action

The 17.87-acre proposed project is located within the 20.5-acre property owned by the applicant on the northwestern side of the intersection of Bruce Road and Highway 32 in the City of Chico, Butte County. It is bounded on the north by Dead Horse Slough. The proposed project consists of the construction of an 11.33-acre residential development, a 0.46-acre access road and bridge over Dead Horse Slough connecting the residential development to Bruce Road, 0.49 acre of neighborhood commercial space north of the access road along Bruce Road, and 4.65 acres of preserved open space and 0.91 acre of avoided area surrounding the Dead Horse Slough riparian corridor. The proposed project will incorporate appropriate design features to control stormwater runoff and protect downstream water quality. The residential development and roadway areas will be graded prior to construction.

The proposed project will result in the grading and loss of all vernal pools (0.794 acre), seasonal wetlands (0.006 acre), and seasonal wetland swale (0.030 acre) features within the residential development footprint, totaling 0.83 acre. Of this 0.83 acre, 0.18 acre of features provide suitable habitat for the fairy shrimp and the tadpole shrimp. In the southwestern portion of the proposed project, 0.51 acre of vernal pool grassland is known to be occupied by the meadowfoam and will be lost due to grading and construction. There is also 0.176 acre of seasonal wetlands and less than 0.001 acre of vernal pool features in the southeastern corner of the property that are outside of the proposed project's footprint. These features will not be graded, but also are not known to provide suitable habitat for the fairy shrimp, tadpole shrimp, or meadowfoam.

Conservation Measures

The following is a summary of the proposed conservation measures, as outlined in the biological assessment, to minimize effects on the fairy shrimp, tadpole shrimp, and meadowfoam. The conservation measures proposed below are considered part of the proposed action evaluated by the Service in this biological opinion.

1) In order to offset the loss of fairy shrimp, tadpole shrimp, and meadowfoam habitat, the applicant will either purchase credits from a Service-approved conservation/mitigation bank (described in items 1a and 1b below) or preserve an offsite property under conservation easement to protect the three species and their habitat in perpetuity (described in item 1c below).

    a. In order to offset the loss of fairy shrimp and tadpole shrimp habitat, the applicant will purchase vernal pool species preservation credits for fairy shrimp and tadpole shrimp at a 3:1 ratio for all adverse effects (3 acres of preservation credits to 1 acre of habitat affected) at a Service-approved vernal pool conservation/mitigation bank whose service area includes the proposed project. The applicant will not purchase vernal pool species creation credits for fairy shrimp and tadpole shrimp as there are currently none available within mitigation banks whose service areas include the proposed project. Therefore, the applicant has proposed to offset the total loss of 0.18 acre of suitable fairy shrimp and tadpole shrimp habitat with the purchase of 0.54 acre of preservation credits. The credits will be purchased prior to earthmoving.

b. In order to offset the loss of meadowfoam habitat, the applicant will purchase meadowfoam preservation credits at a 3:1 ratio for all adverse effects (3 acres of preservation credits to 1 acre of habitat affected) at a Service-approved vernal pool conservation/mitigation bank whose service area includes the proposed project. Therefore, the applicant has proposed to offset the total loss of 0.51 acre of occupied meadowfoam habitat with the purchase of 1.53 acres of meadowfoam preservation credits. The credits will be purchased prior to earthmoving.

    i. There are currently no approved conservation/mitigation banks with available meadowfoam preservation credits. However, the proposed Sycamore Creek Conservation Bank is currently under review by the Service and CDFW and may be approved and have meadowfoam preservation credits available by the end of 2022. This proposed bank is expected to have a service area that includes the proposed project. If this bank is approved by the Service, the applicant may elect to purchase meadowfoam preservation credits from this or any other Service-approved conservation/mitigation bank that provides credits for meadowfoam preservation whose service area includes the proposed project.

c. Instead of purchasing species preservation credits, the applicant may elect to offset the loss of fairy shrimp, tadpole shrimp, and meadowfoam habitat by preserving an offsite property under a conservation easement in perpetuity. The offsite preserve must have at least 0.54 acre of fairy shrimp and tadpole shrimp habitat and 1.53 acres of occupied meadowfoam habitat, equivalent to the acreage of conservation credits discussed above. If this alternative is chosen, the applicant will provide information to the Service regarding the environmental baseline of a potential offsite preserve, including the amount of fairy shrimp, tadpole shrimp, and meadowfoam habitat present. The Service will have the authority to determine if the proposed offsite preserve is appropriate for conservation of the three species, and Service approval of the proposed offsite preserve will be required in order to substitute this alternative for the purchase of conservation credits discussed above.

    i. Under this alternative, the applicant will protect the offsite preserve in perpetuity with a conservation easement, a preserve management plan, and by funding an endowment that will cover all necessary expenses for monitoring and management in perpetuity. The conservation easement and endowment will be held by a qualified entity, typically an accredited land trust, who is approved by the Service. The easement, management plan, endowment amount, and details regarding preserve design (size, location, buffers) will be provided to the Service for review and approval prior to any ground disturbing activities.

        1. At a minimum, the management plan will include the following:

            a. Purpose of the project and purpose of the long-term management plan.

b. A baseline description of the setting, location, history, and types of land use activities, geology, soils, climate, hydrology, and habitats and species present.

c. Overall management, maintenance, and monitoring goals, specific tasks and timing of implementation, and discussion of any constraints that may affect goals.

d. A PAR analysis for endowment funding.

e. Discussion of adaptive management actions for reasonably foreseeable events and possible thresholds for evaluating and implementing adaptive management.

f. Rights of access to the property and prohibited uses of the property as provided in the conservation easement.

g. Procedures for property transfer, land manager replacement, amendments, and notices.

2) Prior to construction, the applicant may elect to modify the proposed project description to protect some or all of the vernal pool features and meadowfoam present within the proposed project site in an onsite preserve. Under this alternative, the applicant will protect the onsite preserve in perpetuity with a conservation easement, a preserve management plan, and by funding an endowment that will cover all necessary expenses for monitoring and management in perpetuity. The conservation easement and endowment will be held by a qualified entity, typically an accredited land trust, who is approved by the Service. The easement, management plan, endowment amount, and details regarding preserve design (size, location, buffers) will be provided to the Service for review and approval prior to any ground disturbing activities.

    a. At a minimum, the management plan will include all the information discussed in item 1c.i.1 above.

    b. This alternative would constitute a significant change to the proposed project description and would necessitate reinitiation of formal consultation so that the biological opinion can be updated with the new project description and any changes to the effects to species, amount of incidental take anticipated, and amount of preservation credits proposed for purchase by the applicant.

3) If the applicant elects not to protect any of the meadowfoam habitat within the proposed project, then the applicant will work with the Service to implement a plan for collecting meadowfoam seeds from the proposed project site for either storage in a seed bank and/or transplanting to an established offsite preserve, such as the adjacent Meriam Park Preserve, or other appropriate location selected by the Service. This will help to preserve any unique genetic information present within the meadowfoam on this site. Even if the applicant does elect to protect some or all of the proposed project site as described in conservation measure 3 above, the applicant may still work with the Service to implement a plan for some seed collection and storage in a seed bank.

Action Area

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." For the proposed project, the action area encompasses the entire 20.5-acre property owned by the applicant, of which 17.87 acres is within the proposed project. Adjacent lands to the south and east are separated by roads, lands to the north are already residential development, and lands to the west are hydrologically separated by a drainage ditch.

Analytical Framework for the Jeopardy Determination

Section 7(a)(2) of the Act requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR § 402.02).

The jeopardy analysis in this biological opinion considers the effects of the proposed federal action, and any cumulative effects, on the rangewide survival and recovery of the listed species. It relies on four components: (1) the *Status of the Species*, which describes the current rangewide condition of the species, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which analyzes the current condition of the species in the action area without the consequences to the listed species caused by the proposed action, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the *Effects of the Action*, which determines all consequences to listed species that are caused by the proposed federal action; and (4) the *Cumulative Effects*, which evaluates the effects of future, non-federal activities in the action area on the species. The *Effects of the Action* and *Cumulative Effects* are added to the *Environmental Baseline* and in light of the status of the species, the Service formulates its opinion as to whether the proposed action is likely to jeopardize the continued existence of the listed species.

Status of the Species

Vernal Pool Fairy Shrimp and Tadpole Shrimp

The status of the fairy shrimp and the tadpole shrimp have been assessed in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005) (Recovery Plan) and 5-year reviews. For the most recent comprehensive assessment of the range-wide status of the fairy shrimp, please refer to the *Vernal Pool Fairy Shrimp (Branchinecta lynchi) 5-Year Review: Summary and Evaluation* (Service 2007a). For the most recent comprehensive assessment of the range-wide status of the tadpole shrimp, please refer to the *Vernal Pool Tadpole Shrimp (Lepidurus packardi) 5-Year Review: Summary and Evaluation* (Service 2007b). No change in either species' listing status was recommended in these 5-year reviews. Threats evaluated during those reviews and discussed in the final document have continued to act on the species since the 2007 5-year reviews were finalized, with loss of vernal pool habitat being the most significant effect. The Service is in the process of finalizing its most current 5-year review for the two species.

While there have been continued losses of vernal pool habitat throughout the various vernal pool regions identified in the Recovery Plan, including the Northeastern Sacramento Valley Vernal Pool Region where the proposed project is located, to date no project has proposed a level of effects for which the Service has issued a biological opinion of jeopardy for either species.

The most recent climate change models for California predict that throughout the 21st century temperatures will increase, the amount of rainfall during the wet season will become more volatile, and the timing of seasonal rainfall may shift in some areas (Bedsworth et al. 2018). Climate change is expected to alter the hydrology of vernal pool ecosystems (Pyke 2005, Montrone et al. 2019), although no studies have been conducted that assess changes to hydrology in rain-fed vernal pools using climate scenarios that reflect current expected changes to precipitation patterns in California (e.g., increasing volatility). There is a large amount of evidence that inundation timing, inundation duration, and temperature are significant drivers of invertebrate community composition and abundance, including the fairy shrimp and tadpole shrimp, in vernal pool ecosystems (Kneitel 2014, Kneitel et al. 2017, Shin and Kneitel 2019). Based on these studies, the changes to these environmental variables that are expected based on current climate change models are expected to have a negative effect on the abundance and distribution of the fairy shrimp and tadpole shrimp. However, there have not been any studies that are specific to the action area or that allow us to quantify the expected losses throughout the species ranges or in the action area with any certainty.

Butte County Meadowfoam

The status of the Butte County meadowfoam has been assessed in the Recovery Plan and a 5-year review. For a summary of the biology and the rangewide status of the meadowfoam, please refer to the *Limnanthes floccosa ssp. californica (Butte County Meadowfoam) 5-Year Review: Summary and Evaluation* (Service 2008). Butte County meadowfoam is currently known from 20 naturally occurring locations throughout Butte County plus the Tuscan Preserve (aka Wurlitzer property), where meadowfoam was introduced in 1992 and 1993 (Service 2008). However, it is unknown if the experimental population on the Tuscan Preserve is still extant. Also, several of the meadowfoam occurrences within the boundaries of the Stonegate Subdivision Project are proposed to be removed as part of that project (Service File Number 2016-F-0236-3), though the eastern part of the property is proposed to be placed under conservation easement and the applicant will attempt to transplant the meadowfoam from the western part of the property onto the preserve.

No change in the species' listing status was recommended in the 5-year review. There appears to have been little change to the species' status since the 2008 5-year review, although loss of habitat throughout the range of the species has continued. Within the Doe Mill Core Area, which is immediately adjacent to the proposed project, 76 acres of vernal pool grasslands associated with 8 projects reviewed by the Service's Sacramento Fish and Wildlife Office have been lost, and an additional 179.6 acres are proposed to be removed by the Stonegate Subdivision Project, for a total of 255.6 acres of vernal pool grassland lost within this Core Area. Nine of the 21 total extant occurrences are partially or completely protected; however, the remaining occurrences continue to be threatened by land conversion to urban development, habitat loss and fragmentation, impacts from surrounding land use, adjacent road widening, competition with nonnative plant species, potential changes to hydrology, introduction of pesticides and herbicides, off-road vehicles, stochastic extinction, and other human activities. In particular, all of the unprotected occurrences in the Doe Mill Core Area, immediately south of the action area, are threatened by proposed development projects. Secondarily, lack of management of invasive

plants, including grazing levels that are not consistent with the conservation needs of the species, is also a threat. This threat is also occurring on some lands that are otherwise protected from development. Many occurrences occupy a small area, have small numbers of plants, and lack genetic diversity (Sloop et al. 2011), indicating that extirpation is still a threat even on protected sites. As potential meadowfoam habitat is converted to other land uses throughout the four occupied core areas without conducting surveys for the species in those areas, opportunities for discovery of additional occurrences are lost.

Since the 5-year review, additional research has been conducted on the genetic structure of Butte County meadowfoam throughout its range (Sloop et al. 2011). The meadowfoam has been found to have unique genetic structure that has implications for conservation actions. As stated in the Recovery Plan (Service 2005) and the 5-year review (Service 2008), extant meadowfoam sites exist in small habitat fragments vulnerable to off- and on-site impacts. Low levels of within-population genetic diversity, resulting from the meadowfoam's predominantly self-pollinating breeding system, have been documented by various researchers (Dole and Sun 1992; Sloop et al. 2011). Sloop et al. (2011) found that levels of genetic diversity and population structure of Butte County meadowfoam are low in comparison to mainly out-crossing congeners *Limnanthes alba* and *L. vinculans*. They went on to conclude that the patterns of low genetic variation and distinct population structure found in their data are of "considerable conservation concern". They reasoned that continued absence of cross-fertilization will, over the long term, cause inbreeding depression, in turn causing small and declining populations to head toward further decline or extinction over time.

Sloop et al. (2011) suggest that recovery of pollinators to allow sexual recombination may play a decisive role in the long term persistence of Butte County meadowfoam. However, pollinators of Butte County meadowfoam have not been identified. They further note the potential importance of genetic diversity present in the seed bank to the stored adaptive potential of a Butte County meadowfoam population. This is due to the differential germination of seed, common in many vernal pool plants, where some plants may germinate after only a few years in the seed bank, while others may reside in the soil for ten or more years before germinating (Sloop et al. 2011). In other words, the within-population genetic diversity exhibited in any one year represents a snapshot of historic gene flow. However, the low genetic variation observed in many extant populations suggests that the genetic variation in the overall seed bank of Butte County meadowfoam may be "disappointingly small" (Sloop et al. 2011). These researchers suggest that long-term range-wide demographic monitoring and determination of seed bank size and variation would be beneficial, and that seed material from all extant populations should be collected over several years for long-term ex situ storage for use in future reintroductions after determining whether and what level of human-aided seed or pollen movement would be beneficial for recovery. They caution that movement of seed to inoculate newly created vernal pools should not be done without sufficient prior evaluation of the feasibility and effectiveness of human induced gene flow.

The most recent climate change models for California predict that throughout the 21st century temperatures will increase, the amount of rainfall during the wet season will become more volatile, and the timing of seasonal rainfall may shift in some areas (Bedsworth et al. 2018). Climate change is expected to alter the hydrology of vernal pool ecosystems (Pyke 2005, Montrone et al. 2019), although no studies have been conducted that assess changes to hydrology in rain-fed vernal pools using climate scenarios that reflect current expected changes to precipitation patterns in California (e.g., increasing volatility). No studies have specifically examined how changes in inundation timing, inundation duration, and temperature affect the

meadowfoam. However, species like the meadowfoam that are adapted to the unique environmental conditions found in vernal pool ecosystems are known to be sensitive to these conditions, particularly hydrology. The changes to these environmental conditions that are expected based on current climate change models are therefore expected to have a negative effect on the abundance and distribution of the meadowfoam. However, there have not been any studies that are specific to the action area or that allow us to quantify the expected losses throughout the meadowfoam's range or in the action area with any certainty.

The overall goal of the Recovery Plan is to achieve and protect in perpetuity self-sustaining populations throughout the full ecological, geographical, and genetic range of each listed species by ameliorating or eliminating the threats that caused the species to be listed (Service 2005). Recovery Plan goals do not impose any regulatory requirements on action agencies for projects undergoing section 7 consultation. They are the Service's recommendations for the best way to achieve recovery of the species. However, new information developed since a recovery plan's publication may modify these recommendations and how they may be implemented. The Recovery Plan recommends the preservation of 100% of meadowfoam occurrences that were known at the time the Recovery Plan was published in order to protect representation of the full ecological, geographical, and genetic range of the species. The Recovery Plan also recommends the preservation of 95% of all vernal pool grassland habitat within the Doe Mill, Chico, Oroville, and Vina Plains Core Areas that existed at the time the Recovery Plan was published. However, the Recovery Plan also states that alternative strategies such as development of Habitat Conservation Plans or other site-specific planning methods may present opportunities to conserve species habitat and meet the recovery criteria described in the Recovery Plan. In addition, the Recovery Plan's recommended strategies for vernal pool plant species, including the meadowfoam, include protection of small populations, seed banking, and reintroduction.

Environmental Baseline

Environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

The action area is located in the Northeastern Sacramento Valley Vernal Pool Region and is immediately north of the Doe Mill Core Area, as described in the Recovery Plan. The action area is generally surrounded by urban development to the north, east, and west, with the Meriam Park vernal pool preserve to the south across Highway 32 and grassland transitioning into the foothills to the southeast.

The action area consists of four vegetation community types. There are 12.21 acres of California annual grassland with vernal pools onsite and approximately 2.63 acres on the southeastern portion of the property outside of the proposed project boundaries. There are also 4.91 acres of willow thickets in the riparian corridor around Dead Horse Slough, 0.68 acre of needle grass grassland, and a small 0.07-acre patch of landscaped corridor in the northeast corner along Bruce Road. The soils in the action area are mostly Redsluff gravelly loam, 0-2% slopes, with some

Busacca clay loam, 0-1% slopes, and Redtough-Redswale, 0-2% slopes on the northern side of Dead Horse Slough. These soils have an underlying hardpan layer that supports the development of vernal pool hydrology.

Vernal Pools

As described in the original January 29, 2002, biological opinion, the condition of the vernal pool grassland within the action area has been substantially altered by past activities. Aerial photographs taken prior to the 1970s indicate that the action area supported vernal pools and swales that were continuous with swales located south of Highway 32 prior to its construction; today, that habitat is preserved within the Meriam Park Preserve. Between 1971 and 1973, two feet of topsoil were removed from the action area to provide fill material for nearby projects, creating shallow, flashy pools that generally dry up between rain events.

An approved jurisdictional delineation of waters of the United States was issued by the Corps on March 22, 2018, based on a wetland delineation conducted by Gallaway Enterprises. There are 0.794 acre of vernal pools, 0.006 acre of seasonal wetlands, and 0.030 acre of seasonal wetland swale features within the proposed project. In addition, there are 0.176 acre of seasonal wetlands and less than 0.001 acre of vernal pool features in the southeastern corner of the property that are outside of the proposed project's footprint, for a total of 1.006 acres of vernal pool type features within the action area. The action area generally slopes south to north from Highway 32 down to Dead Horse Slough. Therefore, almost all of the watershed for the seasonal wetlands outside of the proposed project is comprised of the area between Highway 32 and the wetlands that will not be developed.

Based on information prepared for the original January 29, 2002, biological opinion, there was 0.89 acre of aquatic features, including 0.66 acre of vernal pools, within the action area. Vernal pools can change in size from year to year based on precipitation or other climatic conditions. No activity has occurred in the action area since the original biological opinion was issued and the site topography and hydrology are unchanged. Therefore, the difference in the exact acreage of vernal pools between 2002 and today is most likely due to differences in annual precipitation or how the mapping measurements were collected and does not represent a change in the environmental baseline described in the original biological opinion.

Vernal Pool Fairy Shrimp and Tadpole Shrimp

As described in the original biological opinion, only six of the vernal pools in the action area, totaling 0.18 acre, hold water for a sufficient duration to support the lifecycle of the fairy shrimp and tadpole shrimp. Based on the information prepared for the original biological opinion and an October 12, 1999, site visit attended by the Service, the Service concurred with the assessment of habitat suitability for the fairy shrimp and tadpole shrimp. Because the environmental baseline has not changed since the original biological opinion with respect to the amount of vernal pool habitat present or its hydrology, the Service considers the amount of suitable habitat for the fairy shrimp and tadpole shrimp to be unchanged. All 0.18 acre of suitable vernal pool habitat is inside the footprint of the proposed project; the vernal pool and seasonal wetland features outside of the proposed project footprint are not suitable habitat for the fairy shrimp or tadpole shrimp.

No protocol-level fairy shrimp or tadpole shrimp surveys have been conducted within the action area. There are two known occurrences of the fairy shrimp in the California Natural Diversity Database (Database) within 5 miles of the action area; the nearest occurrence is approximately 2

miles northwest on Bidwell Ranch (Database 2022). There are eight known occurrences of the tadpole shrimp in the Database within 5 miles of the action area; the nearest occurrence is immediately southwest of the action area (Database 2022). The Meriam Park Preserve is immediately south of Highway 32 adjacent to the action area and was historically connected to the action area before the construction of Highway 32. This preserve is presumed to provide habitat for the fairy shrimp and the tadpole shrimp given the presence of suitable vernal pool habitat and survey results from around the vicinity of the preserve in 1993 and 2007 (this includes the Database occurrence southwest of the action area). Protocol-level dry-season surveys for listed branchiopods were conducted on the preserve in 2019 (California Open Lands 2019). Eggs of the genus *Branchinecta* were identified in 5 of 20 soil samples; *Branchinecta* eggs cannot be identified to the species level, but these eggs are likely to be vernal pool fairy shrimp eggs. No tadpole shrimp eggs were identified in the 2019 survey, but one dry-season survey is not sufficient to determine that the species is absent from the preserve. Because the proposed project is within the range of the fairy shrimp and the tadpole shrimp, suitable habitat for the fairy shrimp and the tadpole shrimp is present within the action area, and both species are known to occur nearby, it is reasonably likely that the fairy shrimp and the tadpole shrimp are present within the action area.

Butte County Meadowfoam

As described in the original biological opinion, a population of 150 meadowfoam plants was identified in the action area in 1990. However, no meadowfoam were detected in subsequent annual surveys from 1991 to 2001. On March 19, 2018, approximately 0.55 acre of meadowfoam was identified throughout the southwestern portion of the action area during protocol-level rare plant surveys conducted by Gallaway Enterprises. The population was described as dense, inhabiting both the wetlands and the mesic portions of the vernal pool grassland, though the exact number of plants observed was not reported. The meadowfoam was incidentally observed by ECORP biologists during a general site visit on March 27, 2020. ECORP also conducted a protocol-level rare plant survey on March 25, 2022; approximately 400 individual plants were identified within 0.047 acre of habitat throughout the southwestern portion of the action area.

The seed bank of the meadowfoam is typical of many vernal pool plants in exhibiting differential germination where some seeds may germinate after only a few years, while others may reside in the soil for ten or more years before germination. Seed dormancy can result in population fluctuations of several orders of magnitude between years, and thus the acreage of habitat that contains plants in any given year is variable and is affected by the seed bank and by environmental conditions such as the amount of rainfall. Therefore, the Service proposed in our May 23, 2022, letter to calculate meadowfoam habitat as all wetland features that are hydrologically connected to known occurrences of the meadowfoam; the consultant incorporated the Service's analysis into the environmental baseline in their June 22, 2022, letter. This methodology incorporates information from both the 2018 and 2022 survey efforts, and it is also consistent with how meadowfoam habitat is being calculated on the proposed Sycamore Creek Conservation Bank where the applicant is planning to purchase credits. Based on this analysis, the Service believes there is 0.51 acre of meadowfoam habitat within the action area (Figure 1). CDFW is planning to use a slightly different methodology for calculating the acreage of meadowfoam habitat on the proposed Sycamore Creek Conservation Bank. They will calculate meadowfoam habitat as the portions of all wetland features that are hydrologically connected to known occurrences of meadowfoam that are within 10 meters of known meadowfoam occurrences. Therefore, in our May 23, 2022, letter, the Service also calculated within the proposed project's action area using CDFW's methodology; this resulted in 0.49 acre of

meadowfoam habitat within the action area (Figure 1). For the purposes of the environmental baseline for the proposed project, the Service will use the 0.51-acre figure, which is consistent with how the Service will calculate meadowfoam habitat at the Sycamore Creek Conservation Bank.

There are eight known occurrences of the meadowfoam within 5 miles of the action area, including the occurrence which overlaps the action area (Database 2022). The Database occurrence that overlaps the action area is composed of several polygons and includes the populations in the action area, to the south within Meriam Park Preserve, and to the southeast of Highway 32 and Bruce Road between Humboldt Road and Little Chico Creek (aka Stilson Canyon or Bruce-Stilson). The Recovery Plan recommends protection of populations over the entire geographic and ecological distribution of each species to ensure representation of genetic variation, and for the meadowfoam it specifically recommends the preservation of all occurrences (defined based on Database occurrences) known at the time the Recovery Plan was published (Service 2005). Occurrences that are newly discovered or introduced after the Recovery Plan was published may not need to be protected, but protecting them may contribute to meeting the goal of preserving genetic representation. The population of meadowfoam within the action area was not known at the time the Recovery Plan was published, based on the decade of negative survey results from 1991 to 2001; this is likely why the action was not included within the Doe Mill Core Area.

Although the Database occurrence that includes the action area is referred to as 1 of 20 extant occurrences in the Service's 5-year review (Service 2008), Sloop et al. (2011) sampled from three sites within this occurrence that they referred to as three populations: Church (Meriam Park Preserve unit north of Humboldt Road), North Enloe (Meriam Park Preserve unit south of Humboldt Road), and Stilson Canyon Road (east of Bruce Road). The authors' genetic structure analysis showed that the Stilson Canyon Road population had fairly homogenous within-population genetic makeup, while the Church and North Enloe populations, which are both within the Meriam Park Preserve, had a larger proportion of individuals with mixed ancestry (Sloop et al. 2011). There may be some genetic differences between the Church and North Enloe sites even though they were only 100 meters apart, but there was not as clear of a genetic distinction as there was between some other pairs of nearby sites. The meadowfoam in the action area are approximately 350 meters away from the Church site in the Meriam Park Preserve. Sloop et al. (2011) also showed that geographically close populations were more genetically similar, and there were no major gene flow barriers between any populations in the Doe Mill Core Area. Therefore, the meadowfoam in the action area are likely to be most genetically similar to the meadowfoam within the Meriam Park Preserve, although Highway 32 likely provides somewhat of a barrier to gene flow.

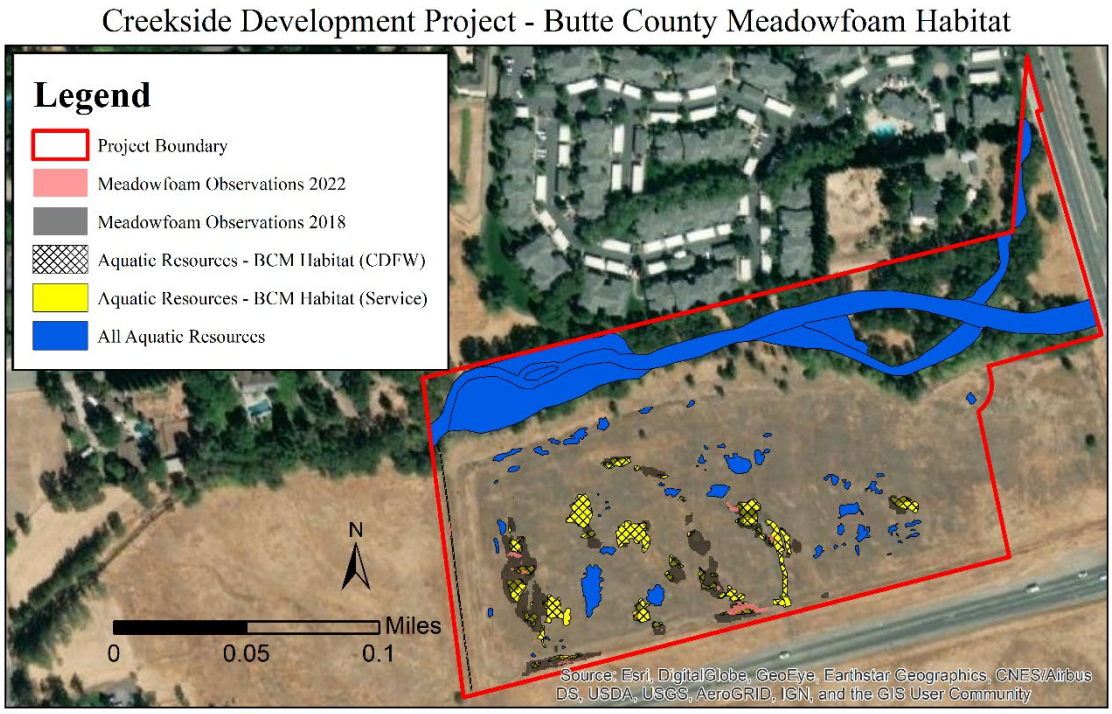

Figure 1. Map of wetland features within the proposed Creekside Development Project that provide habitat for the Butte County meadowfoam (BCM). Taken from the Service's May 23, 2022, letter regarding the environmental baseline. Methods used to calculate habitat are consistent with the proposed Sycamore Creek Conservation Bank. In addition to the Service's approved definition of meadowfoam habitat for the bank, the California Department of Fish and Wildlife (CDFW) also required that only areas within 10 meters of known meadowfoam occurrences be considered meadowfoam habitat.

Effects of the Action

Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

The proposed project will result in the grading of vernal pool grassland and the fill of vernal pools that provide 0.18 acre of suitable habitat for the fairy shrimp and tadpole shrimp and 0.51 acre of occupied meadowfoam habitat. Fairy shrimp eggs, tadpole shrimp eggs, or meadowfoam seeds in the soil may be crushed by heavy equipment and surviving eggs/seeds will not be able to hatch/germinate due to the permanent loss of all suitable habitat during development of the proposed project. The hydrology of the seasonal wetlands in the action area outside of the proposed project boundary is not expected to be altered by the proposed project since the watershed will not be developed. However, these seasonal wetland features do not have the proper hydrology to support the lifecycle of the fairy shrimp or tadpole shrimp, and the meadowfoam has never been observed in that portion of the action area. The 0.51 acre of habitat where the meadowfoam plants will be lost represent an extremely small portion of the genetic

information contained within all meadowfoam plants within the Database occurrence that includes the action area and is likely not genetically distinct from the meadowfoam within the Meriam Park Preserve.

As noted previously in the *Description of the Proposed Action* section, the project proponent has also proposed conservation measures that include the commitment to provide compensatory habitat as a condition of the action. This compensatory habitat is intended to minimize the effect on the species of the proposed project's anticipated impacts, resulting from the permanent loss of habitat described above. The compensatory habitat proposed will be in the form of either purchasing vernal pool preservation credits and meadowfoam credits at a Service-approved vernal pool conservation bank and/or placing a portion or all of the action area under conservation easement to preserve the fairy shrimp, tadpole shrimp, and meadowfoam habitat in perpetuity.

This component of the action will have the effect of protecting and managing habitat for the species' conservation in perpetuity. The compensatory lands will provide suitable habitat for breeding, feeding, or sheltering commensurate with or better than habitat lost as a result of the proposed project. Providing compensatory habitat (through the purchase of credits at a conservation/mitigation bank) as part of a relatively large, contiguous block of conserved land may contribute to other recovery efforts for the species.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. During this consultation, the Service did not identify any future non-federal actions that are reasonably certain to occur in the action area of the proposed project.

Conclusion

Vernal Pool Fairy Shrimp and Tadpole Shrimp

After reviewing the current status of the fairy shrimp and tadpole shrimp, the environmental baseline for the action area, the effects of the proposed project, and the cumulative effects, it is the Service's biological opinion that the Creekside Development Project, as proposed, is not likely to jeopardize the continued existence of the fairy shrimp or tadpole shrimp. The Service reached this conclusion because the project-related effects to the species, when added to the environmental baseline and analyzed in consideration of all potential cumulative effects, will not rise to the level of precluding recovery or reducing the likelihood of survival of the species based on the following:

1) The 0.18 acre of habitat that will be adversely affected by the proposed project represents a very small portion of habitat available in the Northeastern Sacramento Valley Vernal Pool Region; and,

2) The proposed conservation measures will ensure that habitat for the fairy shrimp and the tadpole shrimp will be protected and managed in perpetuity.

Butte County Meadowfoam

After reviewing the current status of the meadowfoam, the environmental baseline for the action area, the effects of the proposed project, and the cumulative effects, it is the Service's biological opinion that the Creekside Development Project, as proposed, is not likely to jeopardize the continued existence of the meadowfoam. The Service reached this conclusion because the project-related effects to the species, when added to the environmental baseline and analyzed in consideration of all potential cumulative effects, will not rise to the level of precluding recovery or reducing the likelihood of survival of the species based on the following:

1) The 0.51 acre of occupied habitat that will be adversely affected by the proposed project represents a very small portion of habitat available in the Northeastern Sacramento Valley Vernal Pool Region;

2) The proposed project is not within any of the core areas identified in the Recovery Plan;

3) A significant portion of the Database occurrence that includes the action area has already been protected within the Meriam Park Preserve;

4) The meadowfoam plants within the 0.51 acre of occupied habitat that will be adversely affected by the proposed project represent a small portion of the genetic variation present across the entire species and within the Database occurrence that includes the action area, and therefore the proposed project is not expected to result in loss of the occurrence or inhibit the preservation of genetic variation representative of the entire geographic and ecological distribution of the species; and,

5) The proposed conservation measures will ensure that habitat for the meadowfoam will be protected and managed in perpetuity.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by Service regulations at 50 CFR 17.3 as an intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the same regulations as an act that actually kills or injures wildlife. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to

regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of federally listed endangered plants or the malicious damage of such plants on areas under federal jurisdiction, or the destruction of endangered plants on non-federal areas in violation of State law or regulation or in the course of any violation of a state criminal trespass law.

Amount or Extent of Take

The Service anticipates that incidental take of the fairy shrimp and the tadpole shrimp will be difficult to detect due to the fact that it is not possible to know how many eggs are in the soil of any wetland feature. Incidental take of the fairy shrimp and the tadpole shrimp in the form of mortality will result from the fill of 0.18 acre of vernal pools that provide suitable habitat within the proposed project. The life stage affected by this action will be the fairy shrimp's and the tadpole shrimp's eggs, which are embedded in the soil and are difficult to detect without a detailed microscopic analysis. Therefore, due to the fact that it is not possible to know how many eggs are in the soil of any wetland feature, or how many eggs will occupy any wetland feature later in time, the Service cannot quantify the total number of fairy shrimp and tadpole shrimp eggs that we anticipate will be taken as a result of the proposed project. In instances in which the total number of eggs anticipated to be taken cannot be determined, the Service may use the acreage of habitat impacted as a surrogate for the take of eggs. Therefore, the Service anticipates take incidental to the proposed project as the killing of all fairy shrimp and tadpole shrimp eggs within the 0.18 acre of suitable vernal pool habitat that will be filled, which stands as a surrogate for the species.

Upon implementation of the following reasonable and prudent measures, incidental take of the fairy shrimp and the tadpole shrimp associated with the Creekside Development Project will become exempt from the prohibitions described in section 9 of the Act. No other forms of take are exempted under this opinion.

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the fairy shrimp or tadpole shrimp.

Reasonable and Prudent Measures

All necessary and appropriate measures to avoid or minimize effects on the fairy shrimp and the tadpole shrimp resulting from implementation of this project have been incorporated into the project's proposed conservation measures. Therefore, the following reasonable and prudent measure is necessary and appropriate to minimize incidental take of the fairy shrimp and the tadpole shrimp:

1) All conservation measures, as described in the *Description of the Proposed Action* section of this biological opinion, will be fully implemented and adhered to. Further, this reasonable and prudent measure will be supplemented by the terms and conditions below.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must ensure compliance with the following terms and conditions, which implement the reasonable and prudent measure described above. These terms and conditions are nondiscretionary.

1) The Corps shall include full implementation and adherence to the conservation measures as a condition of any permit or contract issued for the project.

2) The Corps will provide the Service's Sacramento Fish and Wildlife Office, Sacramento Valley Division Supervisor with a copy of the completed bill of sale and payment receipt upon the purchase of all credits at a Service-approved conservation/mitigation bank.

3) In order to monitor whether the amount or extent of incidental take anticipated from implementation of the proposed project is approached or exceeded, the Corps will adhere to the following reporting requirement. Should the anticipated amount or extent of take be exceeded, the Corps must immediately reinitiate formal consultation, as per 50 CFR §402.16.

    a. For those components of the action that will result in habitat loss, degradation, or modification whereby incidental take is anticipated, the Corps will provide a precise accounting of the total acreage of habitat impacted to the Service's Sacramento Valley Division Supervisor, (916) 414-6600, after completion of construction.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends the following actions:

1) The Corps should work with the Service to assist in meeting the goals of the Recovery Plan for the fairy shrimp, tadpole shrimp, and meadowfoam as outlined in the December 2005 Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (Service 2005).

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION—CLOSING STATEMENT

This concludes formal consultation on the Creekside Development Project. As provided in 50 CFR §402.16(a), reinitiation of consultation is required and will be requested by the federal

agency or by the Service where discretionary federal involvement or control over the action has been retained or is authorized by law, and:

1) If the amount or extent of taking specified in the incidental take statement is exceeded;

2) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;

3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or

4) If a new species is listed or critical habitat designated that may be affected by the identified action.

If you have any questions regarding this biological opinion, please contact Ian Perkins-Taylor, Senior Fish and Wildlife Biologist by phone at (916) 414-6585 or by email (ian_perkins-taylor@fws.gov), or Megan Cook , Sacramento Valley Division Supervisor, by email (megan_cook@fws.gov), at the letterhead address, or by phone at (916) 414-6492.

Sincerely,

MICHAEL FRIS Digitally signed by MICHAEL FRIS
Date: 2022.10.21 13:37:26 -07'00'

Michael Fris
Field Supervisor

ec:
U.S. Army Corps of Engineers, Regulatory Division, Sacramento, California
Hillary Kraft, U.S. Army Corps of Engineers, Sacramento, California
George Eshoo, Law Office of George P. Eshoo, Redwood City, California
Molly Enloe, ECORP Consulting, Rocklin, California
Melissa Stanfield, California Department of Fish and Wildlife, Chico, California

LITERATURE CITED

Bedsworth, L., D. Cayan, G. Franco, L. Fisher, and S. Ziaja. 2018. Statewide Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-013.

California Natural Diversity Database (Database). 2022. Biogeographic Data Branch, California Department of Fish and Wildlife, Sacramento, California. Government version dated January 4, 2022. Retrieved January 27, 2022.

California Open Lands. 2019. Annual Report for Meriam Park Preserve (USACE #200501036; USFWS file no. 1-1-06-F-0273). Prepared by California Open Lands, Chico, California. Submitted to the U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Sacramento, California. December 23, 2019.

Dole, J.A. and M. Sun. 1992. Field and genetic survey of the endangered Butte County meadowfoam—*Limnanthes floccosa* subsp. *californica* (Limnanthacea). Conservation Biology 6: 549-558.

Kneitel, J.M. 2014. Inundation timing, more than duration, affects the community structure of California vernal pool mesocosms. Hydrobiologia 732: 71-83.

Kneitel, J.M., N. Samiylenko, L. Rosas-Saenz, and A. Nerida 2017. California vernal pool endemic responses to hydroperiod, plant thatch, and nutrients. Hydrobiologia 801: 129-140.

Montrone, A., L. Saito, P.J. Weisberg, M. Gosejohan, K. Merriam, and J.F. Mejia. 2019. Climate change impacts on vernal pool hydrology and vegetation in northern California. Journal of Hydrology 574: 1003-1013.

Pyke, C.R. 2005. Assessing climate change impacts on vernal pool ecosystems and endemic branchiopods. Ecosystems 8: 95-105.

Shin, H.R. and J.M. Kneitel. 2019. Warming interacts with inundation timing to influence the species composition of California vernal pool communities. Hydrobiologia 843: 93-105.

Sloop, C.M., C. Pickens, and S.P. Gordon. 2011. Conservation genetics of Butte County meadowfoam (*Limnanthes floccosa* ssp. *californica* Arroyo), an endangered vernal pool endemic. Conservation Genetics 12: 311-323.

U.S. Fish and Wildlife Service (Service). 2005. Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon. U.S. Fish and Wildlife Service, Region 1. Portland, Oregon. Xxii + 574 pp.

U.S. Fish and Wildlife Service (Service). 2007a. Vernal Pool Fairy Shrimp (*Branchinecta lynchi*) 5-year Review: Summary and Evaluation. Sacramento Fish and Wildlife Office, Sacramento, California. September 2007.

U.S. Fish and Wildlife Service (Service). 2007b. Vernal Pool Tadpole Shrimp (*Lepidurus packardi*) 5-year Review: Summary and Evaluation. Sacramento Fish and Wildlife Office, Sacramento, California. September 2007.

U.S. Fish and Wildlife Service (Service). 2008. *Limnanthes floccosa* ssp. *Californica* (Butte County Meadowfoam) 5-year Review: Summary and Evaluation. Sacramento Fish and Wildlife Office, Sacramento, California. June 2008.