UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

December 2, 2019 **Refer to NMFS No:** WCRO-2013-00009

James Mazza
Acting Chief, Regulatory Division
U.S. Army Corps of Engineers, San Francisco District
450 Golden Gate Avenue, 4th Floor, Suite 0134
San Francisco, California 94102-3406

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Carmel Lagoon Scenic Road Protection Structure and Interim Sandbar Management Plan Project (Corps File No. 1996-19089S)

Dear Mr. Mazza:

Thank you for your letter of August 13, 2013, requesting initiation of formal consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq.*), for the Carmel Lagoon Scenic Road Protection Structure and Interim Sandbar Management Plan Project (herein referred to as "Project"). This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016). The Corps of Engineers (Corps) proposes to provide authorization to the Monterey County Resource Management Agency (MCRMA) pursuant to Section 404 of the Clean Water Act of 1972, as amended (33 U.S.C. § 1344 *et seq.*), and Section 10 of the Rivers and Harbors Act of 1899, as amended (33 U.S.C. § 403 *et seq.*) to implement the Project, located in Monterey County, California.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1855(b)) for this action.

The enclosed biological opinion is based on our review of the proposed Project and describes NMFS' analysis of the effects of the implementation of the Project on threatened South-Central California Coast (S-CCC) steelhead (*Oncorhynchus mykiss*) and their designated critical habitat in accordance with section 7 of the ESA.

In the enclosed biological opinion, NMFS concludes the Project is not likely to jeopardize the continued existence of the S-CCC steelhead Distinct Population Segment (DPS), nor is the Project likely to result in the destruction or adverse modification of designated critical habitat for S-CCC steelhead. However, NMFS anticipates take of S-CCC steelhead is likely to occur as a result of the Project. An incidental take statement with non-discretionary terms and conditions is included with the enclosed biological opinion.

Regarding EFH, NMFS has reviewed the proposed project for potential effects and determined that the Project will occur within an area identified as EFH for Pacific Groundfish and Coastal Pelagic species, managed under the Pacific Groundfish and Coastal Pelagic Species Fishery Management Plans. NMFS has determined the Project will result in adverse effects to EFH due to disturbance of the lagoon's water surface elevation, volume, and water quality during implementation. However, the project has proposed several minimization measures, including some recommended by NMFS, to avoid or minimize potential adverse effects to EFH. Thus, no additional EFH conservation recommendations are provided.

Please contact Mr. Joel Casagrande at 707-575-6016, or joel.casagrande@noaa.gov if you have any questions concerning this section 7 consultation, or if you require additional information.

Sincerely,

Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Enclosure

cc: Greg Brown, Corps, San Francisco (Gregory.G.Brown@usace.army.mil)
Carl Holm, MCRMA, Salinas (holmcp@co.monterey.ca.us)
E-File: ARN File # 151422SWR01SR277

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

Carmel Lagoon Scenic Road Protection Structure and Interim Sandbar Management Plan Project (Corps File No. 1996-19089S)

NMFS Consultation Number: WCR-2013-00009
Action Agency: U.S. Department of the Army, Corps of Engineers, San Francisco District

Table 1. Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
South-Central California Coast steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	Yes	No

Table 2. Essential Fish Habitat and NMFS' Determinations:

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Groundfish	Yes	No
Coastal Pelagic Species	No	No

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By:

Alecia Van Atta
Assistant Regional Administrator

Date: December 2, 2019

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LIST OF ACRONYMS AND ABBREVIATIONS

ARN	Administrative Record Number
BA	Biological Assessment
BMP	Best Management Practice
C	Celsius
Caltrans	California Department of Transportation
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
cm	centimeters
Corps	U.S. Army Corps of Engineers
CRLEP	Carmel River Lagoon Enhancement Project
CRSA	Carmel River Steelhead Association
DPS	Distinct Population Segment
DQA	Data Quality Act
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EPB	Ecosystem Protective Barrier
ESA	Endangered Species Act
FMP	Fishery Management Plan
FR	Federal Register
HAPC	Habitat Area of Particular Concern
ISMP	Interim Sandbar Management Plan
ITS	Incidental Take Statement
MCDPW	Monterey County Department of Public Works
MCRMA	Monterey County Resource Management Agency
MCWRA	Monterey County Water Resources Agency
MPWMD	Monterey Peninsula Water Management District
mm	millimeters
MOU	Memorandum of Understanding
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NAVD	North American Vertical Datum
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
NOAA	National Oceanic Atmospheric Administration
PBF	Physical or Biological Features
PCE	Primary Constituent Elements
RPA	Reasonable and Prudent Alternative
RPM	Reasonable and Prudent Measures
s	second
S-CCC	South-Central California Coast
SRPS	Scenic Road Protection Structure
TAC	Technical Advisory Committee
TRT	Technical Review Team
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WSE	Water Surface Elevation
WY	Water Year

1 INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3 below.

1.1 Background

NOAA's National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.), and implementing regulations at 50 CFR 402, as amended.

Updates to the regulations governing interagency consultation (50 CFR part 402) were effective on October 28, 2019 [84 FR 44976]. This consultation was pending at that time, and we are applying the updated regulations to the consultation. As the preamble to the final rule adopting the regulations noted, "[t]his final rule does not lower or raise the bar on section 7 consultations, and it does not alter what is required or analyzed during a consultation. Instead, it improves clarity and consistency, streamlines consultations, and codifies existing practice." We have reviewed the information and analyses relied upon to complete this biological opinion in light of the updated regulations and conclude the opinion is fully consistent with the updated regulations.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at NMFS' North-Central Coast Office located in Santa Rosa, California (ARN # 151422SWR01SR277).

The Monterey County Resource Management Agency (MCRMA) proposes to implement the Scenic Road Protection Structure (SRPS) and Interim Sandbar Management Plan (ISMP) to protect public infrastructure from river and wave scour, reduce flood risk of private properties adjacent to the Carmel River Lagoon (lagoon), and to enhance habitat conditions in the lagoon for South-Central California Coast (S-CCC) steelhead (*Oncorhynchus mykiss*).

1.2 Consultation History

The artificial (mechanical) breaching of the Carmel Lagoon has been carried out by the County of Monterey (County) since at least 1973.

By letter dated December 7, 2000, the Corps requested formal consultation under the ESA for their proposed authorization of a long-term sandbar breaching program at the Carmel Lagoon proposed by the Monterey County Water Resources Agency (MCWRA). By letter dated March 16, 2001, NMFS requested the Corps provide a clearer project description as well as any relevant environmental documents. During an interagency meeting held with MCWRA on May 23, 2001, NMFS requested a review of alternative breaching methods and the preparation of a biological assessment (BA) that would analyze impacts of proposed and alternative breaching methods. A draft BA was submitted to NMFS from the Corps on October 19, 2001. In letters dated November 28, 2001, and January 9, 2002, NMFS informed the Corps the analysis and data contained in the draft BA were inadequate and NMFS identified the additional data and analysis needed to initiate formal consultation. Through 2002 and early 2003, NMFS, MCWRA and the Corps continued to discuss different sandbar breaching alternatives.

On February 4, 2003, NMFS received a letter from the Corps stating MCWRA had provided all the information they could obtain, and requested initiation of consultation based on the information provided to date. In a letter dated February 16, 2003, NMFS informed the Corps the consultation was initiated on February 4, 2003. At a meeting on June 2, 2003, NMFS informed MCWRA that the breaching project, as proposed, was likely to jeopardize the continued existence of the S-CCC steelhead DPS. A draft reasonable and prudent alternative (RPA) with suggested changes to the proposed project was presented to MCWRA. On June 29, 2003, NMFS requested an extension of the consultation period to work with the Corps and MCWRA to develop changes to the project that would avoid a jeopardy determination.

In 2005, the Carmel Lagoon Technical Advisory Committee (TAC) was formed in order to develop solutions for near and long-term lagoon management strategies. In April 2007, the Carmel Lagoon TAC finalized a study plan with a detailed scope of work that identified both short and long-term objectives for integrated management of the Carmel Lagoon.

By letter dated April 25, 2008, NMFS again reminded MCWRA to obtain authorization for the incidental take of steelhead caused by ongoing sandbar management activities, or discontinue their unauthorized actions.

By letter dated October 15, 2010, the Carmel River Steelhead Association (CRSA) filed a 60-day notice of intent to sue MCWRA for violating the ESA, and advised MCWRA to take whatever legal steps necessary to prevent the County from engaging in unauthorized take of steelhead from continued lagoon breaching. By letter dated November 5, 2010, NMFS agreed to work with the County and MCWRA to establish milestones in the development of alternatives to mechanical breaching, and encouraged the County to obtain the necessary permits for breaching.

On November 4, 2010, NMFS requested breaching data from the MCWRA and Monterey County Department of Public Works (MCDPW) for the years of 2002-2010, as well as additional information necessary for the completion of a biological opinion. MCWRA and MCDPW provided some of the requested information to NMFS via e-mail on January 18, 2010. Several additional requests were made by NMFS to obtain the remaining information from MCWRA and MCDPW, but no response was received. The remaining information was received by NMFS on April 19, 2011, and May 12, 2011. The final project description included mechanical breaching. In early 2011, NMFS prepared an internal draft jeopardy opinion with a draft RPA for the proposed long-term sandbar breaching for flood control, which proposed permanent solutions to reduce or avoid mechanical breaching. In September 2011, the MCRMA assumed the lead role for Carmel Lagoon management. Soon after, MCWRA withdrew its application for long-term sandbar breaching and the MCRMA replaced the long-term, breach-only program proposed by

MCWRA with the actions presented in NMFS' 2011 internal draft RPA as the new project and submitted a new application to the Corps. This application was deemed incomplete by the Corps pending technical studies and a new BA.

In an effort to demonstrate its commitment towards implementation of permanent solutions to reduce or avoid mechanical breaching, the MCRMA worked with the Corps to develop a Memorandum of Understanding (MOU) that would include the Corps, Monterey County, and NMFS as signatory agencies. This document was reviewed by the U.S. Fish and Wildlife Service (USFWS) as a consulting agency to the Corps under the ESA. The MOU promulgated several items: (1) a long-term plan to balance protection of private property with protection of federally listed species; (2) the negative impacts to fish and wildlife resources from long-term mechanical sandbar breaching of the Carmel Lagoon; (3) two long-term solutions as alternatives to performing sandbar management: the Ecosystem Protective Barrier (EPB) and the SRPS; and (4) the agreement among the MOU parties to allow the ISMP while the County develops and implements the EPB and SRPS projects.

The MOU was approved by the Monterey County Board of Supervisors on June 11, 2013 (Corps et al. 2013) and expires in September 30, 2020. Based on the objectives outlined in the MOU, a group of consulting firms, led by Whitson Engineers, were contracted by the MCRMA to complete a planning and feasibility study focused on the EPB and SRPS projects. The *Carmel River Lagoon Ecosystem Protective Barrier and Scenic Road Protection Structure Projects Feasibility Report* (Feasibility Report) was completed in May 2013 (Whitson Engineers 2013), and the *Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River Lagoon Biological Assessment* was completed in January 2014 (Ballman and Senter 2014).

On August 13, 2013, NMFS received the Corps' written request for formal consultation along with the *Carmel Lagoon Ecosystem Protective Barrier (EPB), Scenic Road Protection Structure (SRPS), and Interim Sandbar Management Plan (ISMP) Project Draft Conceptual Proposed Action/Project Description for Biological Assessment* (Denise Duffy and Associates 2013). However, the information provided with the request was deemed incomplete by NMFS.

In December 2016, the MCRMA issued its draft Environmental Impact Report (EIR) for the EPB, SRPS, and the continued implementation of the ISMP (Denise Duffy and Associates 2016a). The EIR included much of the information lacking from the Corps 2013 request for consultation, but also identified future studies necessary to fully evaluate the environmental effects of the project. The public comment period for the draft EIR closed on January 31, 2017. The vast majority of the public comments[1] received were in opposition to the EPB for various reasons including potential flood risks, damage to property values and aesthetics, cost, use of public lands for flood protection of private property, and a concern the EPB would not be able to fully provide the flood protection services as proposed. Under the preferred alternatives for the EPB and SRPS that were described in the draft EIR and biological assessment, both structures would require construction within lands owned by State Parks. State Parks submitted comments

[1] Technical studies, EIR and public comments are available at: https://www.co.monterey.ca.us/government/departments-i-z/resource-management-agency-rma-/planning/current-major-projects/carmel-lagoon-ecosystem-protective-barrier-and-scenic-road-

during the public review period for the draft EIR as well as directly to the regulatory agencies that outlined their opposition to constructing infrastructure within state-owned lands (including a designated State Natural Preserve) for the protection of private properties from flooding.

On March 23, 2017, the Corps transmitted an updated biological assessment (Denise Duffy and Associates 2016b) to NMFS for the Project which incorporated much of the information included in the 2016 EIR. However, considering the extensive public comment received during the draft EIR in opposition of the EPB and SRPS components, and considering the continued dispute between the MCRMA and State Parks for the proposed alignment of the EPB and SRPS, a definitive project description remained unresolved. The MCRMA held a meeting/conference call with the regulatory agencies on June 20, 2017, which included representatives from NMFS and State Parks, to discuss the project, its potential alternatives, and the need for further technical studies related to the SRPS. On August 8, 2017, the MCRMA held an additional meeting with the regulatory agencies to further discuss the issues covered during the June 20, 2017, conference call. During this meeting, the concept of exchanging land parcels with State Parks to allow for the installation of these structures was discussed, although no specific properties were identified. On June 8, 2018, the MCRMA requested a meeting with regulatory agencies and interested stakeholders to provide an update on the current status of the project components, funding, and to review and discuss the various stakeholder comments received for each project component during the public comment period for the draft EIR.

On June 21, 2019, the MCRMA provided NMFS and the Corps (via email) potential options of a final project scope for consultation. The options included: (1) SRPS and ISMP (no EPB); (2) SRPS, ISMP, and delayed EPB; and (3) SRPS, ISMP, and EPB (as originally proposed). Development of the first two options were borne from the continued lack of public support and access to lands owned by State Parks for construction of the EPB component. One alternative for the SRPS (mid-slope toe wall) would also occur on State Parks' property. As such, the MCRMA has begun discussions with State Parks for an easement to build this alternative of the SRPS. The other alternative for the SRPS (full height seawall) would be built on existing County road easements.

Throughout July and early August 2019, NMFS, the Corps and the MCRMA continued discussions of the three proposed project components via conference calls and email. Due to the overwhelming lack of support for the EPB from the public, State Parks, and the Carmel Area Wastewater District, it was clear the EPB was unlikely to be constructed within the short timeframe evaluated in the biological opinion (10 years[2]). On August 30, 2019, the MCRMA informed the Corps and NMFS to proceed with SRPS, ISMP, and no EPB as the Project. NMFS, the Corps and the MCRMA agreed the EPB may be considered through a separate consultation in the future, if and when the access and funding for constructing the project became available. Although technical studies are still needed for the SRPS, the MCRMA expects the outcomes of those studies will primarily inform which of the two alternatives will be more appropriate for the location. This is not, however, expected to change the potential effects to species or habitats, as described below in the biological opinion. NMFS initiated consultation on August 30, 2019.

[2] The Corps intends to issue a 5-year permit for the Project that may be extended in the future as necessary.

1.3 Proposed Federal Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02).

The Corps proposes to authorize the MCRMA under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, to construct and implement the Carmel Lagoon SRPS and ISMP, in Monterey County, California. The ISMP is necessary to avoid flooding of private properties. The SRPS is necessary as Scenic Road is vulnerable to wave and river scour that could result in road failure, disrupt property access, and lead to the failure of buried utilities, including water and sewage that are buried beneath the roadway. Installation of the SRPS will increase options for sandbar management, which is expected to further minimize potential impacts to steelhead and their habitat in the lagoon.

1.3.1 Interim Sandbar Management Plan

The objectives of the ISMP are to help protect private property from flooding in a manner that would minimize impacts to steelhead and designated critical habitat, and to maintain or enhance estuarine habitat for fish and wildlife by: (1) maximizing the volume of freshwater in the lagoon during the dry season; (2) allowing the lagoon's water surface elevation (WSE) to increase to the greatest extent prior to sandbar management (i.e., sandbar grading – described below); and (3) minimizing how the lagoon responds (i.e., rate of lagoon draw down) by working with NMFS on the selection of the most optimal alignment for the sandbar grading given the existing setting. While these recent changes to sandbar management have improved lagoon management relative to historic management (i.e., prior to the MOU), manipulation of the sandbar for flood control still has the potential to suppress lagoon ecosystem function and, in some instances, introduces the potential for impacts to steelhead. The impacts to lagoon function from continued sandbar management actions are largely attributed to the restriction of management only in the southern and central portions of the sandbar. Implementation of the SRPS component will increase options for sandbar management by allowing management to occur on the northern end of the beach which is expected to improve lagoon response during a sandbar breach and draining.

The ISMP includes the following elements[3]

- Sand Bags: Before the rainy season (October 15 – April 15), and before management of the sandbar is necessary, the MCRMA would stockpile sand and place sand bags around homes along the north end of Carmel Lagoon (Camino Real, River Park Place, Monte Verde Street, 16th Avenue). This action is subject to receiving permission from property owners.
- Public Outreach: The MCRMA will initiate public outreach to warn homeowners to take appropriate precautions to protect their property during the rainy season (October 15 – April 15). Public outreach will include education on the potentially adverse effects to habitat and species within the lagoon from artificially opening the sandbar by members of the community.
- Immediate-need (winter) Sandbar Management: When necessary, the MCRMA would implement the immediate-need, or winter season (typically October to April), sandbar

[3] The general elements of the ISMP are described in more detail in a section of the 2013 MOU (Corps et al. 2013).

management action when necessary to prevent flooding of homes (described below). This would be implemented in a manner that, to the greatest extent, would minimize or avoid impacts to steelhead and their habitat. Prior to management of the sandbar, the MCRMA will implement all flood protection and awareness measures described above (i.e., sand bags, public outreach, etc.) to reduce the flood risk to the surrounding homes and infrastructure to the greatest extent feasible, and conduct the necessary survey and monitoring as outlined below.

- Re-establishment/Summer Management: Should the MCRMA implement winter sandbar management for flood protection, they would also be required to consider implementation of a summer management action to close the lagoon the following spring or early summer (typically April to July). Implementation of the summer management action (summer closure) would be determined through coordination and approval of NMFS and other resource agencies and would be contingent on the current and projected environmental conditions, including river inflow to the lagoon, oceanic conditions, and the availability of sand on the beach. The intent of the summer sandbar closure is to promote habitat for listed species in the lagoon throughout the summer months by trapping the declining levels of freshwater inflow to the lagoon. When, or if, the level of water subsides in the Carmel Lagoon so the area around State Parks' parking lot is dewatered, and there is adequate quantities of sand located on the beach, the MCRMA will harvest sand from the beach to restore beach access from Carmel River Beach State Park parking lot and close the lagoon outlet channel. If the ISMP outlet channel is located on the northern end of the beach, then implementation of the summer closure management action may be compromised by a lack of access from the existing State Parks parking lot to harvest and place sand in the outlet channel by heavy equipment.

1.3.1.1 Immediate-need (winter) Sandbar Management (connecting the lagoon to the ocean)

The decision to mobilize and conduct immediate-need (winter) sandbar management would be based upon one or more of the following conditions:

- Lagoon Water Surface Elevation: Implementation would occur when the lagoon water elevation reaches a surface elevation of 12.77 feet North American Vertical Datum of 1988 (NAVD 88)[4]; or
- River Flows: When the rate of increase in water elevation in the lagoon indicates less than 12 hours until the lagoon reaches a surface elevation of 12.77 feet NAVD 88, or when Carmel River flows reach or exceed approximately 200 cubic feet per second (cfs); or
- Ocean Influence (High Tides and/or Storm Surge): Data indicates the likelihood of wave overwash events would begin to rapidly increase the water surface elevation of the lagoon or increase the sandbar elevation.

Immediate-need (winter) sandbar management would include the following actions. As necessary, a bulldozer or excavator would be used to grade a section, or pilot channel, within the

[4] At the project location, 12.77 feet NAVD 88 is equivalent to 10 feet National Geodetic Vertical Datum (NGVD) of 1929 (NGVD29). The County would mobilize based on the staff gauge located in the north arm of the lagoon (i.e., as measured at the staff gauge, the County would begin channel excavation at 10 feet NGVD29.

sandbar to an elevation that would allow water in the lagoon to begin spilling over the sandbar and induce a breach prior to flooding nearby property. The specific location and orientation of the sandbar grading will be determined through close coordination with the resource permitting agencies and the results of the pre-implementation sandbar topographic surveys. The pilot channel grading will be on the southern end of the beach until the SRPS is constructed at which time the options will expand to include grading at the northern end of the beach.

The specified area of the sandbar would be graded to a maximum elevation of 12.77 feet NAVD 88. Graded sand would be stockpiled adjacent to the low point. Depending on the location of the ISMP outlet channel, water year type, and observations of both lagoon WSE and river inflow, sand may be dumped in the opening of the sandbar to ensure the lagoon water surface level does not drop below 8.77 feet NAVD 88. The ability to implement this action may be compromised if the outlet channel and lagoon waters are located on the northern end of the beach and against the parking lot, where access to the channel and stockpiled sand may be limited. Implementation of this action would also require close coordination and agreement from NMFS and other permitting agencies. The intent of this action is to avoid prolonged periods of low lagoon elevation and volume when river inflow is low and habitat suitability in the lagoon may be limited. The primary area of site disturbance (including the channel, side-cast area, and sand stockpile area) is estimated at approximately 0.60 acres and 300 linear feet. If sand grading is required in any given year, the MCRMA will provide more specific calculations based on actual beach sand conditions and the work area.

1.3.1.2 Summer Management Action (disconnecting the lagoon from the ocean)

The objective of the summer management action is to maintain and enhance habitat for fish and wildlife, including threatened steelhead, by maximizing the volume of freshwater in the lagoon at the beginning of the dry season. The goal is to maximize the lagoon WSE by closing the outlet channel in the sandbar before freshwater river flows diminish to low summer levels. Implementation of the summer closure will include placement of sand with heavy equipment to close the channel. Each year, the MCRMA will work with NMFS regarding the timing of sandbar closure to maximize the benefits to steelhead. The goal is to raise the lagoon water level to a maximum elevation of 12.77 feet NAVD 88. The timing of sandbar closure will depend on river inflow to the lagoon and beach conditions. When river inflow declines to approximately 20 cfs or less (though project activities may occur at higher or lower flows), the MCRMA will implement the closure shortly after sandbar dimensions are determined. Sandbar dimensions (elevation and width) to be constructed will likely be determined between April and June, in consultation with NMFS. The ability to implement the summer closure may be compromised if the outlet channel and lagoon waters are located on the northern end of the beach and against the parking lot, where access to the channel and stockpiled sand may be limited. However, under these rarer circumstances, the need for implementation of the summer closure action would be reduced because the lagoon is expected to facilitate a perched configuration when the outlet channel is at the north end of the beach (described in the Effects Section).

The MCRMA proposes to implement the following minimization measures:

- Subsequent to any sandbar management and after high inflows from the river have receded, the sandbar will either be allowed to naturally close or remain with an open outlet channel flowing over the sandbar in a meandering channel that would be designed to mute tidal influence and rapid draining of the lagoon. The MCRMA will consult with NMFS on whether actions should be taken to maintain water surface elevation in the lagoon at a minimum of 8.77 ft NAVD 88. This may include placement of sand into the outlet channel to reduce outlet flows, or close the lagoon entirely.

- MCRMA staff will monitor the sandbar and lagoon water elevations during and after the sandbar opens, and as often as necessary as conditions warrant. A qualified biological monitor (i.e., minimum three years of experience with anadromous salmonids) will be present during the initial opening (or soon after opening) and closing of the sandbar. The day of (or morning after if the lagoon drains at night), the biologist will monitor the channel twice daily (a.m. and p.m.) to document if any steelhead become stranded, or other occurrences that pose a risk to steelhead. During closure, the biologist will monitor the channel and surrounding areas. Any stranded steelhead encountered alive during the draining of the lagoon or following a sandbar closure will be collected, and safely released into waters of the lagoon. The fish will be collected by hand or by dip-net and placed immediately into a bucket (or similar container) filled with ambient lagoon water and then released immediately. A report produced by the biological monitor documenting construction activities will be submitted to the Corps and NMFS within two weeks post-construction. The report will also outline all implemented measures of flood protection to protect surrounding homes and infrastructure, and estimated volume of sand moved.
- MCRMA staff require approximately 24 to 48 hours, depending on weather conditions and the size of the sandbar, to mobilize and implement sandbar management activities with one to two bulldozers or excavators. Equipment will be driven on the beach for sand management only. Loading and fueling will take place on paved areas to ensure containment of hazardous materials.
- MCRMA staff will usually work during daylight hours when large waves can be seen. In addition, work would occur outside of active rain storms to the greatest extent feasible while maintaining the primary goals of preventing flooding impacts and/or maintaining minimum water levels in the lagoon. Heavy equipment will not be operated in open waters of the lagoon.

The MCRMA will perform topographic surveys of the sandbar to guide sandbar management. Prior to implementation, a topographic survey (or surveys) of the beach will be conducted to determine the geometry of the beach, identify the ranges of sandbar elevations including the location and height of the sandbar low point, and to estimate the amount of sand that would need to be graded. The survey will be done at least once per management season, and may be repeated (partial update or full survey) closer to the date of implementation. A topographic map of the beach will be generated from the surveys and any proposed pilot channel locations will be added to the map and shared with the NMFS.

The ISMP project component would continue for up to the next 10 years. During this 10-year period, continued monitoring and reporting of ISMP implementation will inform NMFS on any potential impacts associated with the ISMP actions. Depending on the status of the EPB project, continued implementation of the ISMP beyond these 10 years may be necessary but will be evaluated under a future consultation using the information gathered from monitoring past ISMP performance. If the EPB project is constructed in the future, the need for continued sandbar management is expected to be reduced to only rare and unforeseen, emergency situations.

1.3.2 Scenic Road Protection Structure

The project feasibility report (Whitson Engineers 2013) evaluated four different alignments and designs for protecting Scenic Road. As of September 2019, the two alternatives for the protection of Scenic Road most likely to be implemented include the full height seawall and the mid-slope toe wall.

1.3.2.1 Alternative 1. Full Height Seawall

The SRPS Full Height Wall alternative would consist of construction within the footprint of the existing Scenic Road roadway (Figure 1). Due to its location at the top of the bluff, the full-height wall has a potential exposed height of approximately 25 feet. A cantilever wall of this height is infeasible, and, therefore, tieback anchors would have to be incorporated into the retaining wall design concept. The type of retaining wall would be a secant pile wall embedded into the marine terrace layer and tied back with earth anchors at the top of the wall extending under Scenic Road. After construction is completed, the roadway would be reconstructed and repaved. The completed pile wall would be completely below grade. The wall would be completely buried until large riverine flow events or large wave events scour away the bluff toe. As the bluff toe scours, more of the pile wall becomes visible; eventually the entire retained height could be exposed. After the storm event has passed, normal wave action or mechanical sand movement would only partially recover the pile wall with sand, leaving the top portion visible.

The tiebacks would likely extend beyond the right-of-way (ROW) and an easement would be needed for the tiebacks to extend onto private property. This wall alternative does include a rock toe to protect from scour, but that may be optional depending on the characteristics of the existing hard pan (marine terrace). An additional section of revetment would extend around and protect the beach parking lot.

Construction of the secant pile wall would require the full roadway width of Scenic Road. Large equipment (e.g., cranes, loaders, excavators, concrete trucks, dump trucks) would be required. Temporary access and detours would be provided during construction. Public access, including vehicles and pedestrians, would be prohibited along Scenic Road during construction.

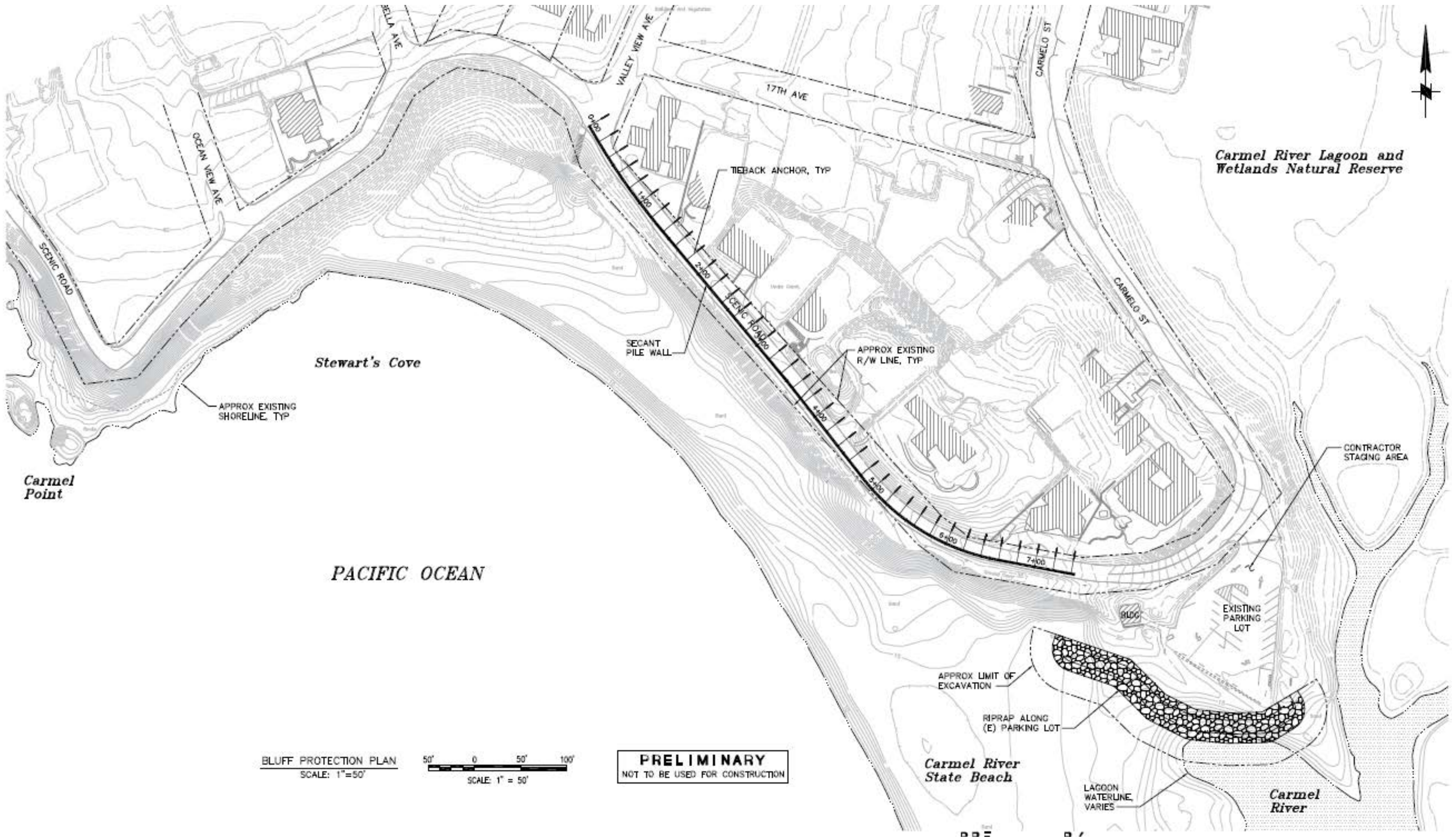

Figure 1. The proposed alignment of the full height wall alternative for Scenic Road protection. The rock slope protection element shown surrounding the existing parking lot is optional and dependent on approval from State Parks. The maps depicts the Carmel River against the parking lot and proposed RSP – this is not the current configuration of the river/lagoon which during the dry season is much farther south – see current Google Earth imagery.

1.3.2.2 Alternative 2. Mid-Slope Toe Wall

The SRPS mid-slope toe wall alternative would be constructed near the existing toe of slope (Figure 2). This location would be mid-slope once the beach sand is transported offshore by wave and river flow. A cantilever wall of this height is feasible and, therefore, tieback anchors would not be required as part of the design concept. The type of retaining wall recommended is a soldier pile wall consisting of drilled soldier piles and lagging panels. The soldier piles are steel structural shapes and the lagging panels are precast concrete planks or panels.

The design of this alternative does not include an aesthetic treatment of the exposed face, if it ever does get exposed. This wall alternative includes a rock toe to protect from scour, but that may be optional as well depending on the characteristics of the existing hard pan (marine terrace).

Construction of the soldier pile wall would be done from the beach. Large equipment (e.g., cranes, loaders, excavators) would be required to access the beach. Public access, including vehicles and pedestrians, would be prohibited along the portion of the beach north of the river mouth. This alternative may require excavation of up to 10 feet in beach sand that may expose waters. These isolated waters would be pumped out of the area and allowed to filter through dry beach sands.

For both Alternative 1 (Full Height Wall) and Alternative 2 (Mid-Slope Toe Wall), there is an optional element to also protect the existing parking lot – if there is approval from State Parks or a land transfer can be arranged. Protection of the parking lot would include a 300-foot long section of rock revetment. The rock revetment would require excavation, rock placement, and backfill, or covering with sand. Construction of the rock revetment would be landward of the mean high water line and, thus, would be out of jurisdictional limits. The parking lot would also be used as a staging area for equipment and materials.

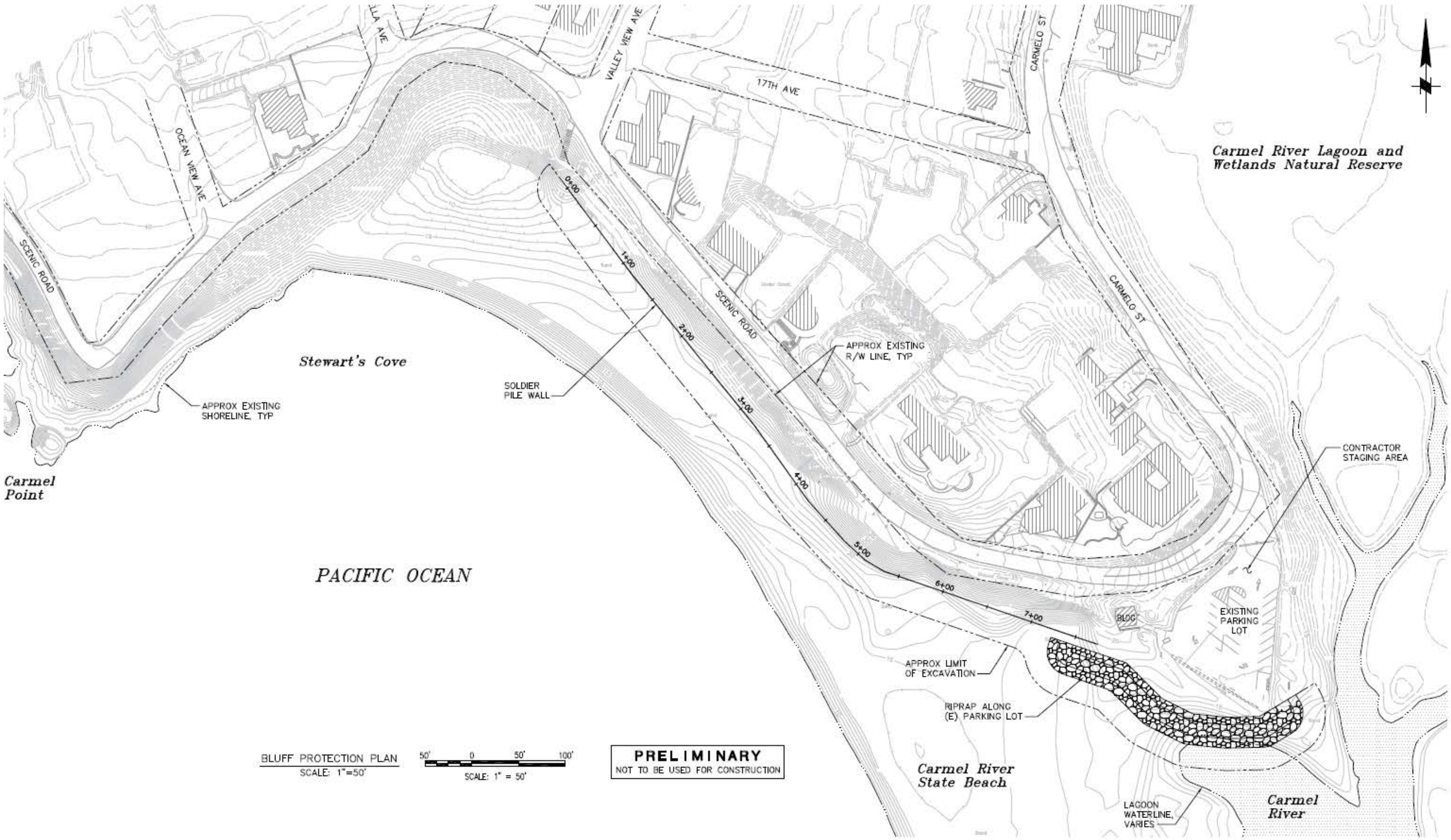

Figure 2. The proposed alignment of the mid-slope toe wall alternative for Scenic Road protection. The rock slope protection element shown surrounding the existing parking lot is optional and dependent on approval from State Parks. The maps depicts the Carmel River against the parking lot and proposed RSP – this is not the current configuration of the river/lagoon which during the dry season is much farther south – see current Google Earth imagery.

1.3.3 SRPS Construction Timing and Equipment

Construction of the SRPS project component may be dependent on access easement or acquisition between the County and State Parks. Construction of the SRPS would last approximately 60 days, likely during the months of July – September period.

Standard construction equipment will be used for the SRPS project components, such as excavators, vibratory/impact hammers, backhoes, graders, pavers, rollers, bulldozers, concrete trucks, flatbed trucks, boom trucks and/or cranes, forklifts, welding equipment, dump trucks, air compressors, and generators.

1.3.4 Avoidance and Minimization Measures

The Project includes several avoidance and minimization measures which include:

- use of species-specific construction windows (e.g., June 15 – October 31) – extensions outside this range may be permissible with approval from NMFS;
- use of NMFS-approved biologists for monitoring construction sites for the presence of or threats to steelhead; and
- use of construction best management practices (BMPs), which include: (1) restricting the use of heavy equipment in waters that support steelhead; (2) use of only heavy machinery that is deemed in good condition; (3) use of appropriate and timely placed erosion control measures; (4) possession and use of hazardous spill response plans and materials, as needed; (5) designation and use of specific staging areas for refueling or parking heavy machinery that avoids impacts to steelhead or their critical habitat; and (6) restoration of disturbed slopes after construction is completed.

See Appendix D of Denise Duffy and Associates (2016b) for a complete list and further details on all proposed avoidance and minimization measures.

We considered whether or not the proposed action would cause any other activities and determined that it would not.

2 ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1 Analytical Approach

This biological opinion includes both a jeopardy analysis and/or an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of" a listed species, which is "to engage in an action that 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). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species (50 CFR 402.02).

The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ''destruction or adverse modification'' analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44977), that definition does not change the scope of our analysis and in this opinion we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly 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, or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.1.1 Use of Best Available Scientific and Commercial Information

To conduct the assessment presented in this opinion, NMFS examined an extensive amount of information from a variety of sources. Detailed background information on the biology and status of the listed species and critical habitat has been published in a number of documents including peer reviewed scientific journals, primary reference materials, and governmental and non-governmental reports. Additional information regarding the potential effects of the proposed Project-related activities on the listed species in question, their anticipated response to these actions, and the environmental consequences of the actions as a whole was formulated from the aforementioned resources, and the biological assessments provided for the projects.

For information that has been taken directly from published, citable documents, those citations have been reference in the text and listed at the end of this document. A complete record of this consultation is on file at NMFS North-Central Coast Office in Santa Rosa, California (ARN # 151422SWR01SR277).

2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that conservation value.

2.2.1 Status of the S-CCC Steelhead DPS

Populations of S-CCC steelhead throughout the DPS have exhibited a long-term, negative trend since at least the mid-1960s when spawning populations were estimated at 17,750 individuals (Good et al. 2005). Available information shows S-CCC steelhead population abundance continued to decline from the 1970s to the 1990s (Busby et al. 1996), and more recent data indicate this trend continues (Good et al. 2005). Current S-CCC steelhead run-size estimates in the five largest systems of the DPS (Pajaro River, Salinas River, Carmel River, Little Sur River, and Big Sur River) are likely greatly reduced from 4,750 adults in 1965 (CDFG 1965). More recent estimates for total run-size do not exist for the S-CCC steelhead DPS (Good et al. 2005; Williams et al. 2016) as few comprehensive or population monitoring programs are in place.

Recent analyses conducted by the S-CCC steelhead Technical Review Team (TRT) indicate the S-CCC steelhead DPS consists of 12 discrete sub-populations representing localized groups of interbreeding individuals, and none of these sub-populations currently meet the definition of viable (Boughton et al. 2006; Boughton et al. 2007). Most of these sub-populations are characterized by low population abundance, variable or negative population growth rates, and reduced spatial structure and diversity. The Pajaro River and Salinas River populations are in particularly poor condition (relative to watershed size) and exhibit a greater lack of viability than many of the coastal subpopulations. In the Carmel River there has been a variable but consistent decline in abundance of anadromous adults (Williams et al. 2016; Boughton 2017). The decline is somewhat unexpected because it coincides with a concentrated effort to restore the habitat in the Carmel River and to improve numbers through a rescue/captive rearing operation (Williams et al. 2016). This decline could indicate an increase in S-CCC steelhead DPS extinction risk (Williams et al. 2016).

Although steelhead are present in most streams in the S-CCC DPS (Good et al. 2005), their populations are small, fragmented, and unstable (more subject to stochastic events) (Boughton et al. 2006). In addition, severe habitat degradation and the compromised genetic integrity of some populations pose a serious risk to the survival and recovery of the S-CCC steelhead DPS (Good et al. 2005). NMFS' 2005 status review concluded S-CCC steelhead remain "likely to become endangered in the foreseeable future" (Good et al. 2005). NMFS confirmed the listing of the S-CCC steelhead DPS as threatened under the ESA on January 5, 2006 (January 5, 2006; 71 FR 834).

In the most recent status update (Williams et al. 2016), NMFS concluded there was no evidence to suggest the status of the S-CCC steelhead DPS has changed appreciably since the publication of the previous status review (Williams et al. 2011), therefore, the S-CCC steelhead DPS remains listed as threatened (Williams et al. 2016; 81 FR 33468).

2.2.2 Status of Critical Habitat for the S-CCC steelhead DPS

In designating critical habitat, NMFS considers, among other things, the following requirements of the species: 1) space for individual and population growth, and for normal behavior; 2) food, water, air, light, minerals, or other nutritional or physiological requirements; 3) cover or shelter; 4) sites for spawning, reproduction, and rearing offspring; and, generally 5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of this species (50 CFR 424.12(b)). In addition to these factors, NMFS also focuses on PBFs and/or essential habitat types within the designated area that are essential to the conservation of the species and that may require special management considerations or protection (81 FR 7214).

PBFs for S-CCC steelhead critical habitat and their associated essential features within freshwater include:

1. freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
2. freshwater rearing sites with:
    a. water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;
    b. water quality and forage supporting juvenile development; and
    c. natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;
3. freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and

overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

PBFs for S-CCC steelhead critical habitat and their associated essential features within estuarine areas include areas free of obstruction and excessive predation with the following essential features: (1) water quality, water quantity and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and (3) juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation (70 FR 52488).

The condition of S-CCC steelhead critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations. NMFS has determined the present depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat: agriculture, grazing, and mining activities, urbanization, stream channelization, construction of dams and other migration impediments, wetland loss, water resource development including aquifer overdraft, and past recreational harvest. Impacts of concern include alteration of stream bank and channel morphology, alteration of water temperatures, fragmentation of habitat, loss of downstream recruitment of spawning gravels and large woody debris, degradation of water quality and quantity, alteration or loss of riparian vegetation communities, and fish passage constraints (Busby et al. 1996; 70 FR 52488).

Depletion and storage of streamflow have drastically altered the natural hydrologic cycles in many of the streams in the S-CCC steelhead DPS (Good et al. 2005; NMFS 2013). Alteration of streamflows results in migration delays, loss of suitable habitat due to dewatering and blockage, stranding of fish from rapid flow fluctuations, increased water temperatures, and have degraded estuary/lagoon access and function. Overall, the current condition of S-CCC steelhead critical habitat is degraded, and likely cannot provide the conservation value necessary for the recovery of the species absent habitat restoration efforts.

NMFS' recovery plan for the S-CCC steelhead DPS (NMFS 2013) describes the key threats and the actions needed to achieve recovery for populations within each biogeographical population group (BPG). For the Carmel River population and BPG, critical recovery actions included: (1) development and implementation of criteria for the management and protection of ground and surface water extractions; (2) remove or modification of passage impediments, including Los Padres, San Clemente, and Old Carmel River dams[5] to provide natural rates of migration for steelhead life stages both upstream and downstream as well as the natural transport of spawning gravel and large wood through the basin; and (3) identify, protect, and where necessary, restore estuarine habitats by providing supplemental water to the estuary and by management of artificial breaching of the river's mouth.

[5] Old Carmel River and San Clemente dams were removed in 2015 and 2016, respectively.

2.2.3 Global Climate Change

Another factor affecting the rangewide status of CCC steelhead and aquatic habitat at large is climate change. Impacts from global climate change are already occurring in California. For example, average annual air temperatures, heat extremes, and sea level have all increased in California over the last century (Kadir et al. 2013). While snow melt from the Sierra Nevada has declined, total annual precipitation amounts have shown no discernable change (Kadir et al. 2013). S-CCC steelhead may have already experienced some detrimental impacts from climate change. NMFS believes the impacts on listed salmonids to date are likely fairly minor because natural, and local, climate factors likely still drive most of the climatic conditions steelhead experience, and many of these factors have much less influence on steelhead abundance and distribution than human disturbance across the landscape. In addition, S-CCC steelhead, the Santa Lucia Mountains, are not dependent on snowmelt driven streams and thus not affected by declining snow packs.

The threat to CCC steelhead from global climate change will increase in the future. Modeling of climate change impacts in California suggests that average summer air temperatures are expected to continue to increase (Lindley et al. 2007; Moser et al. 2012). Heat waves are expected to occur more often, and heat wave temperatures are likely to be higher (Hayhoe et al. 2004; Moser et al. 2012; Kadir et al. 2013). Total precipitation in California may decline; critically dry years may increase (Lindley et al. 2007; Schneider 2007; Moser et al. 2012). Wildfires are expected to increase in frequency and magnitude (Westerling et al. 2011; Moser et al. 2012).

In the San Francisco Bay region[6], warm temperatures generally occur in July and August, but as climate change takes hold, the occurrences of these events will likely begin in June and could continue to occur in September (Cayan et al. 2012). Climate simulation models project that the San Francisco region will maintain its Mediterranean climate regime, but experience a higher degree of variability of annual precipitation during the next 50 years and years that are drier than the historical annual average during the middle and end of the twenty-first century. The greatest reduction in precipitation is projected to occur in March and April, with the core winter months remaining relatively unchanged (Cayan et al. 2012).

Estuaries, including seasonally closed lagoons, may also experience changes detrimental to salmonids. Estuarine productivity is likely to change based on changes in freshwater flows, nutrient cycling, and sediment amounts (Scavia et al. 2002; Ruggiero et al. 2010). Continued sea level rise (0.42 to 1.67 meters by 2100) is expected to cause sandbars to form farther inland which can affect the amount of time the lagoon is connected to the ocean (Dalrymlpe et al. 2012; Rich and Keller 2013). For example, using the above projections for sea level rise and local hydrologic data, Rich and Keller (2013) predicted 14 and 44 percent decreases in the amount of time the Carmel Lagoon will be open to the ocean under a 0.42 and 1.67 meter sea level rise scenarios, respectively. In marine environments, ecosystems and habitats important to juvenile and adult salmonids are likely to experience changes in temperatures, circulation, water chemistry, and food supplies (Brewer and Barry 2008; Feely 2004; Osgood 2008; Turley 2008; Abdul-Aziz et al. 2011; Doney et al. 2012). The projections described above are for the mid to late 21st Century. In shorter time frames, climate conditions not caused by the human addition of

[6] Both the San Francisco Bay and Monterey Bay regions exhibit similar Mediterranean climate patterns. The action area is located within the Monterey Bay region.

carbon dioxide to the atmosphere are more likely to predominate (Cox and Stephenson 2007; Smith et al. 2007; Santer et al. 2011).

2.2.4 Life History of S-CCC Steelhead

Steelhead are anadromous forms of *O. mykiss*, spending some time in both fresh- and saltwater. The older juvenile and adult life stages reside in the ocean, until the adults ascend freshwater streams to spawn. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby et al. 1996; Moyle 2002). Although one-time spawners are the great majority, Shapovalov and Taft (1954) reported that repeat spawners are relatively numerous (17.2 percent) in California streams. Eggs (laid in gravel nests called redds), alevins (gravel dwelling hatchlings), fry (juveniles newly emerged from stream gravels), and other juvenile life stages all rear in freshwater until they migrate to the ocean where they reach maturity.

O. mykiss exhibit a variable life history. Coastal *O. mykiss* populations in central and southern California are classified into three principle life history strategies: fluvial-anadromous, lagoon anadromous, and freshwater resident or non-anadromous (Boughton et al. 2007). The anadromous forms of S-CCC steelhead are classified as "winter-run" steelhead because they emigrate from the ocean to their natal streams to spawn annually during the winter; although run times can extend into spring months (April and May) (Moyle 2002). Within the S-CCC steelhead DPS, adults typically enter freshwater between December and May, with peaks occurring in January through March (Wagner 1983; Fukushima and Lesh 1998). It is during this time that streamflow quantities (depths and velocities) are suitable for adults to successfully migrate to and from spawning grounds. The minimum stream depth necessary for successful upstream migration is about 13 centimeters (cm), although short sections with depths less than 13 cm are passable (Thompson 1972). More optimal water velocities for upstream migration are in the range of 40-90 cm/s, with a maximum velocity beyond which upstream migration is not likely to occur of 240 cm/s (Thompson 1972).

Redds are generally located in areas where the hydraulic conditions limit fine sediment accumulations. Reiser and Bjornn (1979) found that gravels of 1.3-11.7 cm in diameter were preferred by steelhead. Survival of embryos is reduced when fines smaller than 6.4 millimeters (mm) comprise 20 to 25 percent of the substrate. This is because, during the incubation period, the intragravel environment must permit a constant flow of water in order to deliver dissolved oxygen to and remove metabolic wastes. Studies have shown embryo survival is higher when intragravel velocities exceed 20 cm/hr (Coble 1961; Phillips and Campbell 1961). The number of days required for steelhead eggs to hatch is inversely proportional to water temperature and varies from about 19 days at 15.6˚ degrees (°) Celsius (C) to about 80 days at 5.6˚ C. Fry typically emerge from the gravel two to three weeks after hatching (Barnhart 1986). Other intragravel parameters such as the organic material in the substrate effect the survival of eggs to fry emergence (Chapman 1988; Everest et al. 1987; Shapovalov and Taft 1954).

Once emerged from the gravel, steelhead fry rear in edgewater habitats along the stream and gradually move into pools and riffles as they grow larger. Cover, sediment, and water quality are important habitat components for juvenile steelhead. Cover in the form of woody debris, rocks, overhanging banks, and other in-water structures provide velocity refuge and a means of avoiding predation (Bjornn *et al.* 1991; Shirvell 1990). Steelhead, however, tend to use riffles and other habitats not strongly associated with cover during summer rearing more than other salmonids. In winter, juvenile steelhead become less active and hide in available cover, including gravel or woody debris. Young steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. Water temperature can influence the metabolic rate, distribution, abundance, and swimming ability of rearing juvenile steelhead (Barnhart 1986; Bjornn and Reiser 1991; Myrick and Cech 2005). Optimal temperatures for steelhead growth range between 10 and 20° C (Hokanson et al. 1977; Myrick and Cech 2005; Wurtsbaugh and Davis 1977). Fluctuating diurnal water temperatures are also important for the survival and growth of salmonids (Busby et al. 1996).

Although variation occurs, S-CCC juvenile steelhead that exhibit an anadromous life history strategy usually rear in freshwater for 1-2 years (NMFS 2013). S-CCC steelhead smolts emigrate episodically from freshwater in late winter and spring, with peak migrations occurring in April and May (Shapovalov and Taft 1954; Fukushima and Lesh 1998; Ohms et al. 2019). Steelhead smolts in California range in size from 120 to 280 mm (fork length) (Shapovalov and Taft 1954; Barnhart 1986). Smolts migrating from the freshwater environment may temporarily utilize the estuarine habitats for saltwater acclimation and feeding prior to entering the ocean.

Juvenile steelhead of the lagoon-anadromous life history rear in lagoons for extended periods (Smith 1990; Boughton et al. 2006; Hayes et al. 2008). Lagoons are a specific type of estuarine habitat where a seasonal impoundment of water develops after a sandbar forms at the mouth of the watershed, temporarily separating the fresh and marine environments (Smith 1990). Like other estuary types, bar-built lagoons can serve as important rearing areas for many fish and invertebrate species—including juvenile steelhead (Simenstad et al. 1982; Smith 1990; Robinson 1993; Martin 1995). Due to the combination of high prey abundance and seasonally warmer temperatures, juvenile steelhead that rear in lagoons have been found to achieve superior growth rates relative to upstream fish of the same cohort, and can therefore disproportionally represent future adult steelhead returns (Bond et al. 2008; Hayes et al. 2008). This is especially important considering that lagoon habitats often represent a fraction of the watershed area. For the S-CCC steelhead DPS, it is hypothesized that the most limiting habitat in terms of availability is over-summer rearing habitat, including functional lagoon habitats (Boughton et al. 2006).

2.3 Action Area

“Action area” means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The Action Area includes the Carmel Lagoon and areas immediately adjacent to the lagoon, in Monterey County, California (Figure 3). The Carmel Lagoon is owned and managed by State Parks and consists of a mixture of wetland habitat types including perennial open water areas surrounded by willow (*Salix sp.*) and black cottonwood (*Poplus trichocarpa*) riparian forests/scrub shrub and emergent wetland and shore habitats across approximately 300 acres (Casagrande 2006). Specifically, the action area includes the entire Carmel Lagoon, its surrounding wetlands, as well as some upland areas adjacent to the wetlands including roads, a parking lot, and the Carmel Area Wastewater District’s Treatment Plant (Figure 3). A portion of the greater lagoon area was designated by State Parks as a Natural Preserve, which includes the North Arm marshes. On the southern side of the lagoon, is the South Arm, which extends south and east into the former Odello property, now also owned and managed by State Parks. The South Arm provides the deepest and most extensive quantities of deeper water habitat in the lagoon. The Carmel Lagoon is designated critical habitat for S-CCC steelhead, of which the boundaries extend up to the extreme high water line. The maximum water surface elevation recorded for the Carmel Lagoon is at 15.4 feet NAVD 88, which occurred on January 8, 2008 (Corps et al. 2013).

The SRPS is proposed to be constructed within the sand dunes in the northwest corner of Carmel State Beach. The bluff bordering Scenic Road has a relatively steep, sandy slope. The dominant plant species occurring on the slope is the non-native hottentot fig (*Carpobrotus edulis*), a type of iceplant often used for erosion control. At the north end of the bluff, the native species California sagebrush (*Artemisia californica*) co-occurs with iceplant. Otherwise, native coastal dune plant species are lacking. Large areas of the bluff are devoid of vegetation, especially near the toe of the slope and where there has been slope failure. A small parking lot for Carmel River State Beach exists in the northwest portion of the action area. The sandy slope bordering the parking lot's east side is stable enough to support coastal dune scrub vegetation and is dominated by California sagebrush and coyote brush, with seaside woolly sunflower (*Eriophyllum staechadifolium*), buckwheat (*Eriogonum parvifolium*), and mugwort (*Artemisia douglasiana*). On the west side of the North Arm marshes, the Carmelo Street roadway embankment is vegetated by grasses, including wild oat (*Avena fatua*), with California blackberry (*Rubus ursinus*) and shrubs including the native coyote brush (*Baccharis pilularis* subsp. *consanguinea*) and non-native Sydney Golden Wattle (*Acacia longifolia*). On this side, the width of ruderal vegetation between the road edge and the tule marsh is approximately 20 to 25 feet.

To the east of the North Arm marshes and on the north side of the river is a field, part of which is owned by the Carmel Unified School District and part by Mission Ranch. Habitat within the North Arm of the lagoon consists primarily of dense California bulrush, or tule (*Schoenoplectus californicus*) marsh that are seasonally inundated. The North Arm marsh vegetation is drained by a network of small, natural channels that increase in width and depth closer to the main embayment of the lagoon (Figure 3). By mid-to late summer, the marsh areas within the majority of the North Arm marsh are usually dry, or with limited standing water beneath the tules.

Downstream of State Route 1, the Carmel River transitions into the tidally influenced lagoon area. Both banks of the Carmel River channel through this reach are bordered by dense stands of mixed aged riparian forest consisting of willow, cottonwood and alders, with occasional blue gum (*Eucalyptus globulus*) trees (Figure 3). The dense trees on banks overhang the river and form complex habitat in the form of scour pools at the margins of the river.

Figure 3. The Project action area. From Denise Duffy and Associates (2016b). See also Figure 10 for detail of Scenic Road.

2.4 Environmental Baseline

The "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 consultations, and the impact of State or private actions which 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 (50 CFR 402.02).

The Carmel River drains approximately 255 square miles of the northern Santa Lucia Range and enters the Pacific Ocean approximately 7 miles south of the City of Monterey. Past and present land uses within the Carmel River watershed include open space, rangeland grazing, agriculture, golf courses, as well as residential and commercial developments (Carmel River Watershed Conservancy 2005). Combined with land use change, significant and widespread anthropogenic impacts have occurred throughout the watershed which have resulted in the degradation of habitat utilized by steelhead (Smith et al. 2004). Specifically, these impacts include overutilization of surface and ground waters, urbanization, roads and highways, construction and operation of dams and reservoirs, construction of wells and other surface water diversions, and management of the lagoon and river for flood control (e.g., sandbar management, levee construction). Recently, two longstanding dams were removed from the watershed (Old Carmel River Dam in 2015, and San Clemente Dam 2016) which has improved sediment transport and hydrologic conditions in the river.

2.4.1 Status of S-CCC Steelhead Critical Habitat in the Action Area

2.4.1.1 Description of the Carmel Lagoon

The Carmel Lagoon is typical of many coastal lagoons along the central California coast where its size (area and volume) and water quality are strongly influenced by seasonal changes in freshwater and saltwater inputs, timing of sandbar formation, and the configuration and elevation of the outlet channel through the sandbar. The sandbar, or barrier beach, is situated between bedrock outcrops at the north and south ends of Carmel River State Beach (Figure 3). The thickness of the sandbar is considerably wider on the north end of the sandbar (approximately 230 feet) than the southern end (approximately 98 feet); although these distances vary depending on the season and WSE (Carmel River Technical Advisory Committee 2007). The northern end of the beach has smaller grain-sizes and a lower slope than the southern portion of the beach (Moffat and Nichol 2013), while longshore currents tend to carry sand to the north due to diffraction of waves around the bedrock outcrops. In general, the beach is steep with slopes at the southern end (28 percent) being more than twice as those at the northern end (12 percent) (Thornton 2005). The concave shape of Carmel River State Beach is due its alignment with the breaking wave crests, and according to Thornton (2005), this shape suggests the longshore currents and littoral transport are weak at this beach. The characteristics of the beach (i.e., range in slopes, grain sizes and beach thickness) and waves patterns provide an indication as to why the lagoon outlet tends to migrate towards the north (Ballman and Senter 2014).

The Carmel Lagoon provides important PBFs for steelhead rearing and migration. Steelhead adults and smolts migrate through the lagoon once the sandbar is open, which typically occurs during the wet season (December-June). As juveniles, steelhead can rear in the lagoon for extended periods and are therefore able to take advantage of the high prey abundance (e.g., macroinvertebrates) as long as water quality conditions remain suitable. Because of this elevated productivity, juvenile steelhead that rear in the Carmel Lagoon can exhibit rapid growth relative to riverine reared juveniles of the same cohort (Smith 1990; Hayes et al. 2008). Studies in nearby Scott Creek have shown that lagoon-reared steelhead contribute disproportionally to adult returns (Bond et al. 2008). Therefore, a properly functioning lagoon environment is likely to provide similar contributions to the steelhead population in the Carmel River watershed.

Habitat quality in the Carmel Lagoon changes seasonally and is directly related to changes in water quality and depth (Casagrande et al. 2002; Casagrande and Watson 2003). In seasonally closed lagoons, such as Carmel, each of these parameters is driven primarily by the timing of sandbar formation and both the volume and duration of freshwater inflow to the lagoon (Smith 1990). Surface flow from the Carmel River provides the primary source of freshwater to the lagoon, with smaller contributions from groundwater (Watson and Casagrande 2004). Greater depths in the lagoon are important because they provide necessary escape cover from avian predators and because they can facilitate more optimal water quality conditions, particularly when the water column is more fully converted to freshwater. The South Arm supports the deepest habitat in the lagoon with depths often greater than 10 feet (Casagrande et al. 2002).

Habitat quality in the lagoon for rearing steelhead is most limited during the summer and early fall. This is during a period when there is little to no freshwater inflow to the lagoon, the lagoon WSE (i.e., depth) is at a minimum, and when water quality is typically sub-optimal. Water temperatures are often near or above 20°C during summer and early fall, and persistent density-driven water column stratification causes reduced dissolved oxygen concentrations at depth (Casagrande et al. 2002; Casagrande and Watson 2003; Hagar Environmental Science 2003; Watson and Casagrande 2004). This is especially problematic in deeper, off-channel areas of the lagoon (e.g., the South Arm) where the volume of trapped saltwater at depth is greater and submerged aquatic vegetation is more dense (Alley 1997; Casagrande and Watson 2003; Hagar Environmental Science 2003). The thickness of the freshwater layer is important because it allows for better vertical mixing of the water column and thus more suitable water quality conditions for juvenile steelhead. The elevation, or height, of the sandbar is typically greatest in summer when ocean wave energy is generally low and sand accumulates on the beach.

In fall (September – December), ocean wave heights increase and wave overwash into the lagoon can provide a substantial volume of saltwater and marine debris (e.g., kelp) (Casagrande and Watson 2003; Hagar Environmental Science 2003; Watson and Casagrande 2004; James 2005). Wave overwash can temporarily improve water quality through mechanical mixing, and the addition of cooler water temperatures, however the potential lack of freshwater inflow during this time can subsequently result in a strengthening of the water column stratification and a reduction (or depletion) of dissolved oxygen concentrations at depth. Increased wave energy and overtopping can erode the sandbar, sometimes causing a partial or full breach of the lagoon.

Kraus et al. (2008) describes two processes in which sandbars breach naturally. Running water flowing across the sandbar can scour an outlet channel thereby connecting the lagoon to the ocean. This process can occur in either direction – from the lagoon side to the ocean or from the ocean to the lagoon. The second process for a natural breach is when water seepage through the sandbar results in the sandbar becoming super-saturated and the sandbar begins to slump or fail thus inducing a breach. In this case, the duration of high water levels is an important factor as longer saturation time increases the likelihood of liquefaction and a breach. A breach is more likely to occur when sandbars have lower elevations, narrower widths, and when there is sufficient head differential between the lagoon and ocean.

When the Carmel Lagoon breaches, the majority of the impounded water in the main embayment is eventually drained, which restricts available habitat for juvenile steelhead to areas with sufficient residual depth such as the South Arm (Hagar Environmental Science 2003; Ballman and Senter 2014). Depth in the lagoon is important for predator avoidance as well as for providing areas where juvenile steelhead can continue foraging and acclimating to brackish water prior to entering the marine environment. During exceptionally dry years, breaching of the sandbar may be delayed, or not occur at all (e.g., winters of 1988-89, 1989-90, and 2013-14). Lagoon breaching, especially when done out of season (e.g., in summer), can result in adverse effects to habitat quantity and quality within the lagoon. This is especially true for the Carmel Lagoon which does not have a source of freshwater input during the summer months to reconvert the water column to freshwater. As noted above, closed lagoons serve as critical nursery environments for juvenile steelhead (Smith 1990; Hayes et al. 2008). Once the outlet channel is connected and draining begins, the volume and rate of water exiting the lagoon continues to increase and eventually a substantial proportion of the rearing habitat within the lagoon is drained within several hours.

The location, angle and length of the outlet channel across the sandbar can affect the rate and extent of lagoon draining. Outlet channels that are long and more perpendicular to the shoreline often facilitate a slower draining and a perched lagoon configuration. A perched lagoon occurs when the WSE in the lagoon remains relatively fresh with a WSE higher than sea level even during low tide. The Carmel Lagoon tends to maintain a perched configuration when there is a longer outlet channel at the northern end of the beach (e.g., in 2005, Denise Duffy and Associates 2016b). Conversely, when the outlet channel is at the center of the beach, the channel is able to scour deeper through the sandbar, which results in a more complete draining of lagoon and a more direct window for seawater transport into the lagoon. The elongated northern outflow channel develops in approximately 50 percent of the years based on available data (James 2005). In wet years, the lagoon may stay open or in a perched condition well into June or July, whereas in drier years the lagoon may open for a few weeks, or not at all. In most years, however, the lagoon (like many other coastal lagoons) will experience a natural cycle of repeated closures and openings, particularly in spring as reduced streamflow to the lagoon often remains enough to cause the lagoon to fill and crest the reformed sandbar (Figure 6).

The sandbar will close for the year when streamflow in the lower river is less than 20 cfs. This usually occurs in spring or early summer, and closure is often associated with a higher than usual high tide and/or ocean swell (James 2005). After the sandbar forms and streamflow declines, the WSE in the lagoon gradually declines through the summer and fall seasons via percolation through the sandbar into the ocean (Casagrande et al. 2003; Watson and Casagrande 2004; James 2005).

Other fish species known to occur in the Carmel Lagoon include threespine stickleback (*Gasterosteus aculeatus*), starry flounder (*Platichthys stellatus*), and Pacific staghorn sculpin (*Leptocottus armatus*). Striped bass (*Morone saxatilis*), an introduced species and known predator of juvenile salmonids, are also present in the lagoon. In 2008, CDFW began a striped bass removal project in the lagoon which has continued annually with varying degrees of effort. The project is intended to not only remove striped bass, but also to determine the impact striped bass predation may have on the population of steelhead in the lagoon through diet analysis. To date only a few individual striped bass out of more than 400 captured fish have contained detectable evidence of juvenile steelhead predation in the lagoon. However, full stomach digestion under average water quality conditions is less than six hours, and therefore detection of juvenile steelhead in the stomachs of striped bass would be difficult unless the predation was very recent (Urquhart, K., MPWMD, personal communication, August 2017).

2.4.1.2 Land Use and Past Restoration Actions in the Carmel Lagoon

The Carmel Lagoon has been altered by development and hydrologic manipulations. Early in the 20th century, wetlands on the north side of the lagoon were partially filled, first for use as pasture, then for residential development. The fill was in place by 1939; however, few houses were built until the 1950s. The floodplain north and east of the lagoon was also leveed for commercial and residential development, and the floodplain south and east of the lagoon (the former Odello property) was leveed and graded for agricultural use. Other hydrologic alterations to the lagoon include upstream development, and diversion of water from the Carmel River.

Since at least the early 20th century, the sandbar at the lagoon has been managed (breached) to prevent flooding of private property. This was first conducted by horse and plow or with hand tools, and later by use of heavy machinery (Denise Duffy and Associates 2016b). Between 1973 and 2011, sandbar management was conducted almost annually by MCWRA or State Parks. On average, at least one mechanical breach occurred each year, with as many as thirteen management actions in one year. Prior to 2012, the sandbar was usually managed to evacuate the lagoon in the quickest and most efficient manner, and such actions were often conducted in anticipation of large storm events.

During the winter of 2010-11, the County attempted an outlet channel on the northern end of the sandbar to try for a perched configuration. However, the combination of high river flow and wave conditions caused the outlet channel to move farther north where it caused extensive scour of the beach and bluffs beneath Scenic Road. The County made several efforts to redirect the channel, however this ultimately resulted in significant sand loss from the beach and widening of the outlet channel. The scour threatened the road's stability, washed away a portion of the Carmel River State Beach parking lot, and undermined a portion of the park's restroom building. The State Beach parking lot is the primary access to the beach for the public and for emergency response teams. In addition to providing beach access, Scenic Road is currently the only access to six private homes, and the road has active water and sewer pipelines buried beneath it.

Over the past 30 years several land use changes and habitat restoration actions have been implemented within the lagoon. Farming on approximately 43-acres of the former Odello West property (purchased by State Parks in 1974) was discontinued following flooding and damage to the fields in 1995. State Parks entered into a Cooperative Agreement with Caltrans to restore and enhance the area as a mitigation bank for unavoidable impacts to wetland and riparian habitats associated with future transportation projects in the Monterey Area (State Parks 2002). In 1997, the South Arm (along the granite bluffs) was excavated to create more deep water habitat in the lagoon. Farming of the remaining portion of the former Odello West property was discontinued following flooding in 1998. In 2004, State Parks implemented the Carmel River Lagoon Enhancement Project (CRLEP) to restore the natural landforms and plant communities within this area (Larson et al. 2005). Restoration efforts within the Carmel River Mitigation Bank and CRLEP included levee removal, an extension of the South Arm into the former Odello property, grading to modify drainage on the former Odello property, and native riparian and wetland restoration (James 2005; Larson et al. 2005). The 1997 and 2004 excavations resulted in a 24 percent increase in lagoon storage at typical breaching levels (James 2005; Hope 2007). In 2009 and 2017, the Carmel River Steelhead Association installed large wood and boulder structures into locations within the lagoon to increase escape cover for steelhead.

2.4.1.3 Past Implementation of the ISMP

As described above in section 1.2 Consultation History, the MCRMA assumed the lead role for sandbar management activities for Monterey County in 2011. That year the MCRMA began working with resource agencies to revise sandbar management procedures in order to minimize or avoid impacts to steelhead. The revised sandbar management procedure, or ISMP, has been implemented in 5 of the last 8 years, and the general results of these actions, as well as their potential implications for steelhead, are described below.

2011-12 – In late November and late December 2011, the MCRMA attempted to reduce the WSE in the lagoon by grading pilot channels through the sandbar angled to the southwest. River inflow to the lagoon during this period was between 10 and 20 cfs. Each attempt resulted in temporary, minor decreases in the WSE but the sandbar quickly reformed due to low river flows and low wave energy (Figure 4). By early January 2012, river inflow to the lagoon remained low (<15 cfs), however the WSE gradually increased and reached approximately 12.7 feet NAVD 88 on January 17, at which time the County regraded the pilot channel along the southern end of the sandbar. The lagoon WSE declined from 12.7 feet to 9.7 feet NAVD 88 before the sandbar reformed and quickly rose again to 12.0 feet NAVD 88. On January 22, the County regraded another pilot channel to the southwest, which subsequently closed on January 23, and then reopened through the same channel on January 24. Throughout February river inflow to the lagoon remained low (10-20 cfs) which caused the WSE in the lagoon to gradually increase. The sandbar breached on its own at a WSE of approximately 13.1 feet NAVD 88 on February 20, 2012 (Figure 4). The sandbar quickly reformed and again breached naturally on March 4, at approximately 12.7 feet NAVD 88. The lagoon was closed by the MCRMA on May 25, 2012.

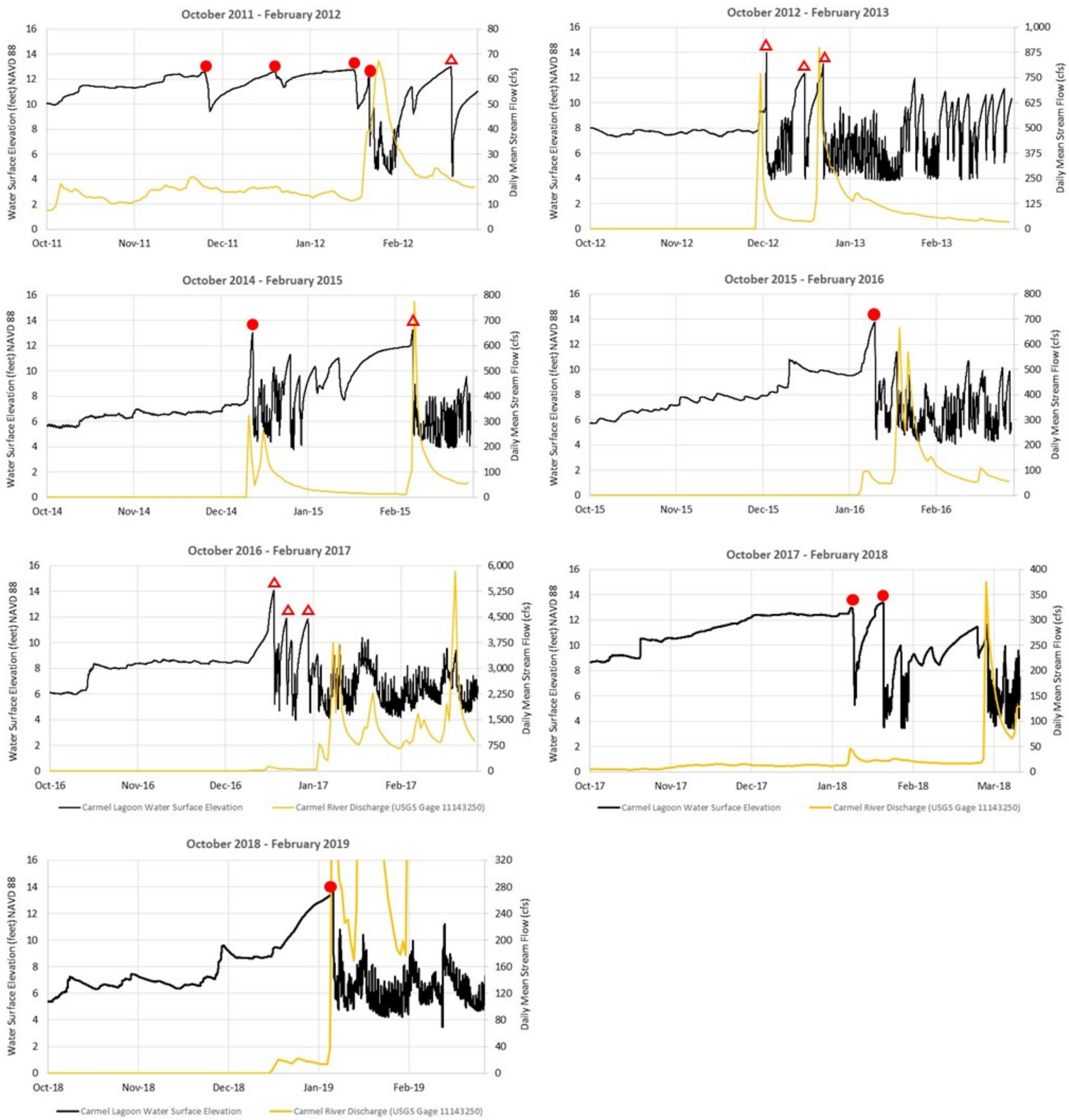

Figure 4. Water surface elevation in the Carmel Lagoon and daily mean streamflow in the lower Carmel River (USGS gage 11143250) for the winters 2011-12 through 2018-19 (except 2013-14 – sandbar remained closed). Solid red circles indicate ISMP assisted breach; hollow red triangles indicate a natural breach.

2012-13 – On December 3, 2012, the lagoon WSE quickly reached 14 feet NAVD 88, due primarily to high river inflow, which resulted in a natural opening of the sandbar (Figure 4). The sandbar was open most of January, closed on January 23, reopened naturally January 25, closed again on January 27, and naturally reopened on January 28. The ISMP was not implemented during this winter season. On April 9, 2013, the sandbar closed naturally for the remainder of the dry season.

2013-14 – The sandbar did not open to the ocean during the winter of 2013-14 due to the exceptionally dry conditions. The lagoon WSE reached a maximum of approximately 8.2 feet NAVD 88 in February and remained at that level through early April before beginning a gradual decline over the spring-fall period.

2014-15 – On December 12, 2014, streamflow in the lower river increased from 0 to >300 cfs, which caused the WSE in the lagoon to increase by 5 feet (Figure 4). The MCRMA graded a pilot channel per the ISMP on December 12, and the lagoon crested through the channel after the WSE reached approximately 13 feet NAVD 88 early on December 13, when inflow to the lagoon approached 1,000 cfs. No steelhead were observed prior to, during, or after implementation of ISMP and lagoon draw down. The lagoon went through a cycle of brief closures and openings, but essentially stayed open for most of December and into January. Larger storms in early February increased the WSE again to more than 13 feet NAVD 88, which resulted in a natural breach. The sandbar reformed by mid-March and the WSE steadily increased to approximately 11.9 feet NAVD 88 until it breached naturally on March 29. The sandbar naturally reformed on April 1, and remained closed for the rest of the season.

2015-16 – The lagoon remained closed until storms in early January 2016 raised the lagoon WSE from 9.5 to 13.8 feet NAVD 88 in less than 5 days with moderate and steady river inflow (Figure 4). The MCRMA implemented the ISMP on January 11, 2016. No steelhead were observed prior to, during, or after implementation of ISMP and lagoon draw down. The sandbar reformed a week later and reached a WSE of 11.4 feet NAVD 88 before opening naturally during a large storm/runoff event. In early May, the lagoon closed naturally and the WSE reached approximately 11.3 feet NAVD 88 before opening on its own on May 10. The lagoon maintained a perched condition with a WSE above 7 feet NAVD 88 through the remainder of the month and into early June. On June 13, 2016, river inflow to the lagoon was approximately 9 cfs and the MCRMA closed the lagoon.

2016-17 – A series of storms steadily increased river inflow to the lagoon throughout December 2016 from less than 10 cfs at the beginning of the month to a peak of nearly 150 cfs on December 17 (Figure 4). This resulted in a gradual filling of the lagoon, which opened naturally at an elevation of approximately 14.2 feet NAVD 88 on December 19, 2016 (Figure 4). The sandbar reformed and opened naturally multiple times through the end of the month. However, beginning in early January 2017, a period of consistently high river inflow to the lagoon began, which lasted through early March 2017. The very wet winter and spring maintained an open sandbar into early July before closing naturally on July 14.

2017-18 – Between December 1, 2017 and January 9, 2018, daily mean inflow to the lagoon ranged from 12 to 46 cfs (Figure 4). The relatively low inflow maintained a high lagoon WSE between 12 and 13 feet NAVD 88 during this period (Figure 4). On January 9, the MCRMA initiated the ISMP. No steelhead were observed prior to, during, or after implementation of ISMP and lagoon draw down. The sandbar quickly reformed due to declining river inflows (<30 cfs). Between January 10 and 20, river inflow to the lagoon ranged from 20 and 42 cfs, which increased the lagoon WSE from approximately 5.5 to 13.5 feet NAVD 88. As a result, the ISMP was implemented again on January 20. Biological monitors on site did not observe any steelhead prior to, during, or after implementation of ISMP and subsequent lagoon draw down. The sandbar reformed on February 11 and the lagoon WSE gradually increased to approximately 11.8 feet NAVD 88 before opening naturally on March 2 in response to high inflow to the lagoon (> 300 cfs). Through April and May, the sandbar went through a period of repeated closure and natural openings. The duration of each closure increased as river inflow declined and the lagoon closed naturally for the summer on May 28.

2018-19 – The Carmel River connected to the lagoon on approximately December 17, 2018. Between the December 17, 2018 and January 5, 2019, streamflow remained below 30 cfs. This moderate inflow to the lagoon increased the WSE from approximately 9 feet NAVD 88 on December 17, 2018, to approximately 13.3 feet NAVD 88 on January 6, 2019. A significant storm in early January resulted in substantial runoff in the watershed. In response to the high lagoon WSE and anticipated high inflow to the lagoon, the MCRMA proceeded with sandbar management activities on January 4. Prior to management, the sandbar had built to a height of 15.1 NAVD 88 at its highest point, although most of the sandbar remained at a lower elevation. A pilot channel at the southern end of the sandbar was graded to an elevation of approximately 12.8 feet NAVD 88 with a sand plug left at a height of approximately 13.7 feet NAVD 88. At 11:00am on January 6, 2019, staff from the MCRMA observed that the lagoon had begun draining through the pilot channel, however the WSE continued to rise to a maximum height of 13.7 feet NAVD 88 by 6:45pm and maintained that elevation until 8:45pm. On January 7, 2019, mean daily inflow to the lagoon reached 741 cfs and the channel through the sandbar widened and resulted in a more rapid draining of the lagoon (Figure 4). Following the initial breach and draining on January 7, the sandbar remained open through winter and spring with WSEs fluctuating with the tides and periods of high river inflow. The lagoon was closed mechanically on July 10, 2019 at a streamflow of approximately 23 cfs.

Summary and Implications for Steelhead – Since the 2011-12 winter season, the sandbar has opened naturally or with assistance from the MCRMA via the ISMP. The sandbar opened under a range of hydrological conditions, including the severe multi-year drought (2012-2016) and two very wet years (2017, 2019). As shown in Figure 4, the lagoon WSE declined to approximately 4 feet NAVD 88 relatively quickly during both natural and assisted sandbar openings, and in most years the sandbar reformed and breached several times during the winter and spring period before the final summer closure. Natural breaches occurred in response to both rapid and large increases in streamflow (December 2012) as well as more moderate increases in streamflow to the lagoon (December 2016). Similarly, ISMP events were initiated in response to both gradual but sustained filling of the lagoon as well as large storm events that produced high river flows. For all ISMP events, biological monitors surveyed the lagoon area during and after each ISMP event and no stranded or moribund steelhead were observed.

Management of the sandbar causes the lagoon to open to the ocean earlier than what would naturally occur – the time differential between when an assisted breach occurs and when a natural breach would have occurred if left unmanaged can vary from hours to several days. The time differential depends on the height and thickness of the sandbar, as well as the pattern and rate of river and oceanic inputs to the lagoon. The difference between a managed and natural breach event correlates to human-induced impacts on rearing habitat for juvenile steelhead in the lagoon. This is because the longer the sandbar is kept intact, the longer and higher lagoon WSEs are maintained. Prolonged high WSEs in the lagoon result in more of the adjacent marsh and riparian areas becoming inundated which can enhance foraging and escape cover for young fish. Thus, the maximum duration and extent of WSEs observed under natural conditions are truncated by a managed breach event.

The highest recorded WSE at the Carmel Lagoon is 15.4 feet NAVD 88, which occurred on January 8, 2008 (Corps et al. 2013). For the recent ISMP events, we estimate the WSE in the lagoon would have exceeded 15.4 feet and breached naturally within approximately 3 to 18 days from the date of the ISMP action (Table 3). These are, however, conservative estimates as they assume the low point in the sandbar was at an elevation of 15.4 feet, which is almost never the case. For example, just prior to implementation in January 2019, a survey of the sandbar found the lowest elevation just above 14 feet NAVD 88. The estimates provided in Table 3 are based on the rate of expected filling using observed daily mean streamflow values in the lower Carmel River (USGS gage 11143250) and a conservative through-sandbar percolation rate of 15 cfs. The estimates, however, do not consider possible wave overwash into the lagoon, which if present would further expedite lagoon fill rates and decrease the time differential between assisted and natural openings.

Table 3. The date of past ISMP implementation (first of the season), WSE on date of implementation, estimated lagoon volume on date of implementation, and the projected number of days until a natural breach would have occurred based on the maximum recorded WSE (15.4 feet NAVD, January 8, 2008).

ISMP Implementation Date	Lagoon WSE (feet, NAVD 88)	Estimated Volume from Milam 2013 (acre-feet)	Mean Daily Flow at USGS Gage 11143250 (cfs)	Projected # of days between date of ISMP and date of Natural Opening
January 22, 2012	12.7	450	39.1	4
December 12, 2014	13.0	472	48.6	3
January 11, 2016	13.8	585	60.6	4
January 9, 2018	13.0	472	46.4	18
January 4, 2019	13.3	525	13.5	3

For the January 22, 2012, December 12, 2014, January 11, 2016, and January 4, 2019 ISMP events, the lagoon would have exceeded 15.4 feet WSE within approximately 4, 3, 4, and 3 days, respectively (Table 3)[7]. Similarly, between 1993 and 2012, projections for the average number of days between when sandbar management occurred and when a natural breach would have been expected to occur was 4 days, with a median of 0 days, and a maximum of 25 days (Table 4, from Ballman and Senter 2014). Therefore, in four out of five years in which sandbar management occurred in accordance with the ISMP MOU between 2012 and 2019, sandbar management had only minimal impact on rearing habitat quantity in the lagoon.

[7] The winter of 2017-18 was considered dry with few large storms that occurred later in the winter (March). Thus, in comparison with the 1993-2019 data, the projected 18 days until a natural breach is therefore considered as an outlier.

Table 4. Carmel Lagoon first seasonal breach for years 1993 to 2012. From: Ballman and Senter 2014.

Water Year (WY)[1]	Water Year Type[2]	Date of first breach[3]	# of Days into WY	Mechanical or Natural	Daily mean flow on day of breach (cfs)	Date of assumed natural breach[4]	Days into water year	# of days between mechanical breach and assumed natural opening of the lagoon outlet channel[5]	# of days from first breach until lagoon summer closure[6]
2012	Dry	11/25/2011	56	Mechanical	18	12/16/2011	77	21	174
2011	Above Normal	11/24/2010	55	Mechanical	19	12/19/2010	80	25	238
2010	Above Normal	10/14/2009	14	Mechanical	759	10/14/2009	14	0	271
2009	Normal	2/16/2009	139	Mechanical	749	2/16/2009	139	0	91
2008	Normal	1/5/2008	97	Natural	509	1/5/2008	97	0	114
2007	Critically Dry	2/11/2007	134	Mechanical	29	2/16/2007	139	5	37
2006	Wet	12/28/2005	89	Mechanical	81	12/31/2006	92	3	170
2005	Wet	12/30/2004	91	Mechanical	532	12/30/2004	91	0	194
2004	Below Normal	12/30/2003	91	Mechanical	416	12/30/2003	91	0	120
2003	Normal	12/16/2002	77	Mechanical	1,250	12/16/2002	77	0	197
2002	Below Normal	12/3/2001	64	Mechanical	402	12/3/2001	64	0	178
2001	Normal	1/11/2001	103	Mechanical	148	1/11/2001	103	0	141
2000	Above Normal	1/24/2000	116	Mechanical	1,000	1/24/2000	116	0	100
1999	Normal	11/3/1998	34	Mechanical	21	11/23/1998	54	20	233
1998	Extremely Wet	12/6/1997	67	Mechanical	112	12/6/1997	67	0	270
1997	Above Normal	12/9/1996	70	Mechanical	27	12/10/1996	71	1	154
1996	Above Normal	12/13/1995	74	Mechanical	36	12/21/1995	82	8	184
1995	Extremely Wet	1/9/1995	101	Mechanical	445	1/9/1995	101	0	201
1994	Critically Dry	2/17/1994	140	Mechanical	106	2/18/1994	141	1	404
1993	Wet	1/3/1993	95	Mechanical	85	1/7/1993	99	4	173
Summary Statistics									
Average			85		337		90	4	182
Median			90		130		91	0	176
Maximum			140		1,250		141	25	404
Minimum			14		18		14	0	37
Standard Deviation			33		367		30	8	79

Notes:

1. Water year (WY) is defined as October 1 of one year to September 30 of each subsequent year, for instance WY 2012 encompasses October 1, 2011 through September 30, 2012.
2. WY type as designated by MPWMD
3. Date of first breach is defined as that in which the lagoon area >feet in depth declines by >20 percent.
4. Date of assumed natural breach used an assumed seepage rate and known inflows that traced predicted changes in lagoon WSE and volume (Milam 2013), and then calculating date of assumed breach, using WSE of 15 feet as the arbitrary elevation at which breaching would occur.
5. Number of days where artificial breaching opened lagoon earlier than natural processes. Calculations were not performed in increments of less than a day.
6. First breach was mechanically initiated in each year of this analysis (with one exception in 2008 due to safety issues), even when days between mechanical and assumed natural opening of the outlet channel were zero.

Between 1993 and 2019[8], sandbar management occurred 10 days or more (maximum of 25 days) earlier than when a natural breach is estimated to have occurred in 4 years (Table 3 and Table 4) – again the calculated projections conservatively assume the low-point in the sandbar each year was 15 feet NAVD 88. For the remaining years, the lagoon either opened naturally, didn't open at all, or the sandbar was managed within 8 days or less of when a natural breach was expected, of which 11 were expected to occur on the same day.

Left unmanaged, the lagoon extent (area) and volume would continue to increase until the WSE crested the low point in the sandbar and formed an outlet channel. The initial rate of WSE drawdown is low and gradually increases as the outlet channel widens and deepens. The rate of lagoon WSE drawdown depends on the location, angle and length of the outlet channel, and the difference in WSE between the lagoon and the ocean at the time of breach (i.e., head differential), and the river inflow to the lagoon.

For past ISMP actions, the average rate of drawdown has ranged from -0.3 to -1.6 feet/hour, with an average of -0.9 feet/hour, whereas for natural events the average rate of WSE drawdown has ranged from -1.2 to -1.3 feet/hour (Table 5). The maximum, or peak, rate of WSE drawdown (feet/15 minutes) ranged between -0.25 to -1.5 feet/15 minutes with an average maximum rate of -0.8 feet/15 minutes for ISMP events. For the two natural breaches, the observed maximum rates of WSE drawdown were -0.8 and -1.6 feet/15 minutes. The change in lagoon WSE during past events ranged from -5.5 to -9.9 feet, with an average of -7.9 feet (Table 5). For the two natural breaches the total decline in WSE following breaches was -8.7 and -8.9 feet, with an average of -8.8 feet. Although the values were similar across management types, the two natural breaches experienced higher maximum rates of WSE drawdown and total overall change in WSE.

[8] The 1993-2019 observations represent the historic baseline. As noted above, the 1993 to 2012 data are from Ballman and Senter (2014) and we assume earlier observations were not recorded or were unavailable.

Table 5. Date and time of maximum pre-breach WSE, post-draining WSE, extent and rate of drawdown, and mean daily streamflow to the lagoon during ISMP and natural breach events 2012-2019.

Date/Event	Natural Breach or ISMP	Time between max WSE to low WSE post breach (hours)	Lagoon WSE (feet)	Rate of WSE drawdown (feet/hour)	Maximum rate of drawdown (feet/15 min)	Daily mean streamflow (cfs)
January 22, 2012	ISMP	22 Jan 12 16:45	12.2			39.1
		23 Jan 12 01:30	6.7			
Δ		8.75	-5.5	-0.6	-0.5	
December 3, 2012	Natural	03 Dec 12 02:15	14.0			770.0
		03 Dec 12 09:00	5.3			
Δ		6.75	-8.7	-1.3	-1.6	
December 13, 2014	ISMP	13 Dec 14 07:30	13.0			138.0
		13 Dec 14 13:15	5.8			
Δ		5.75	-7.3	-1.3	-0.9	
January 11, 2016	ISMP	11 Jan 16 02:15	13.8			60.6
		11 Jan 16 07:45	5.3			
Δ		5.5	-8.5	-1.6	-1.3	
December 19, 2016	Natural	19 Dec 16 01:15	14.1			96.2
		19 Dec 16 09:00	5.2			
Δ		7.75	-8.9	-1.2	-0.8	
January 9, 2018	ISMP	09 Jan 18 16:00	13			46
		10 Jan 18 15:30	5.3			
Δ		23.3	-7.7	-0.3	-0.25	
January 21, 2018	ISMP	21 Jan 18 11:00	13.4			21.8
		21 Jan 18 21:00	3.5			
Δ		9.75	-9.9	-1.0	-1.5	
January 6, 2019	ISMP	06 Jan 19 20:45	13.7			39.0
		07 Jan 19 05:15	7.2			
Δ		8.5	-6.5	-0.8	-0.6	
Average Δ - Natural		7.3	-8.8	-1.2	-1.2	
Average Δ - ISMP		10.3	-7.6	-0.9	-0.8	

As described above, the general response of the lagoon WSE following a breach (rate and magnitude of draining) has been similar in both ISMP and natural breaches (Figure 4 and Table 5). The responses following an ISMP event have also been comparable to the general responses of other lagoons on the central California coast such as Scott Creek (Santa Cruz County, Figure 5) and Pescadero Creek (San Mateo County, Figure 6), which typically breach naturally during winter.

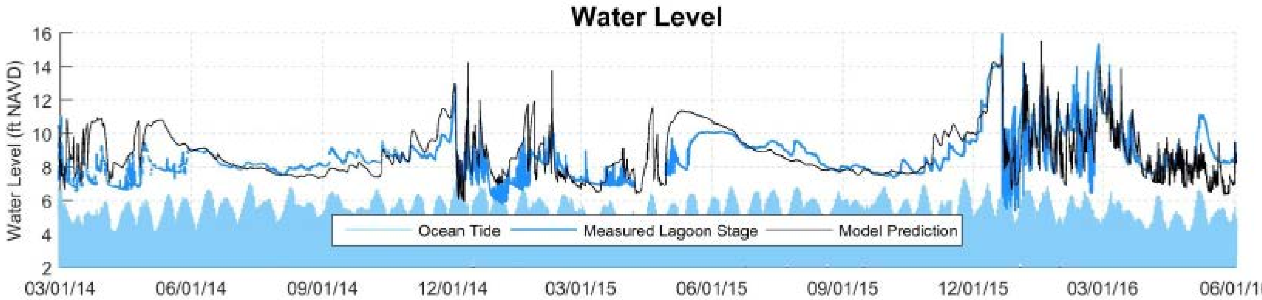

Figure 5. Observed (and predicted) WSE in Scott Creek lagoon, 2014-2016. From: Behrens et al. 2017.

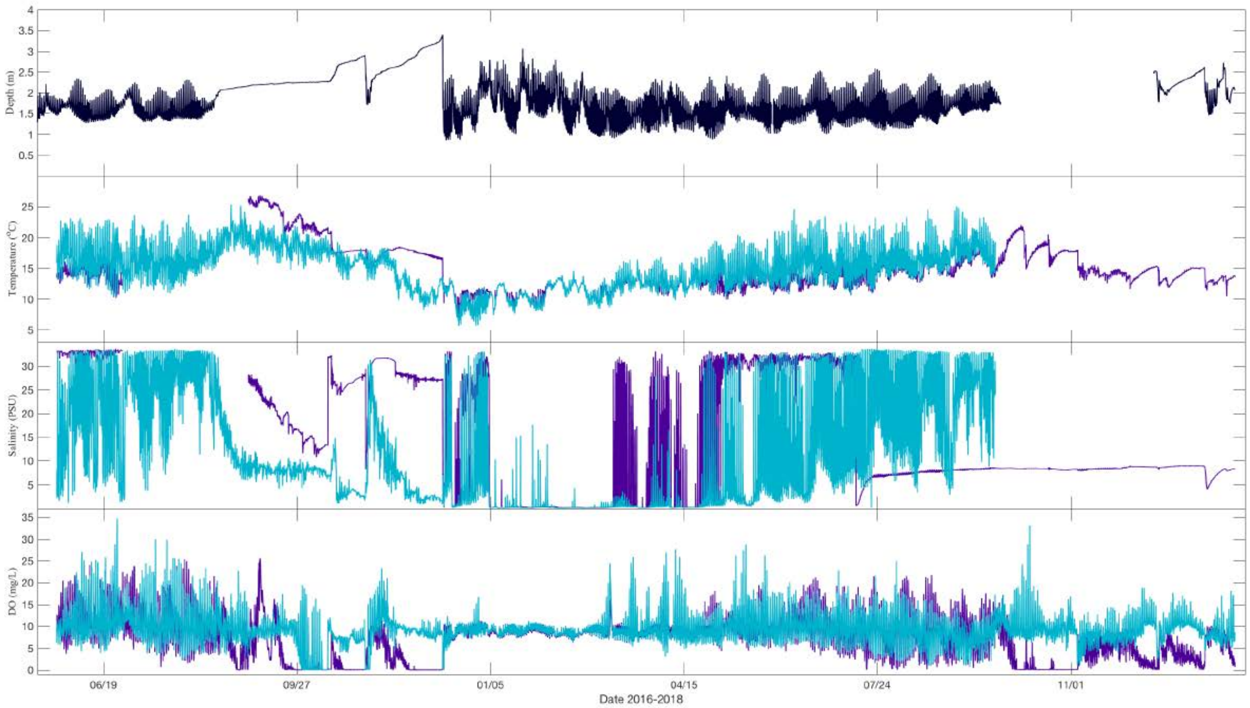

Figure 6. Observed WSE in Pescadero Lagoon, 2016-2018 (top plot). From: Largier et al. 2018.

The seaward pulse of flow following a sandbar breach (natural or assisted) can cause adult steelhead to enter the lagoon from the ocean when streamflow in the lower river is insufficient for successful migration to spawning habitat in the upper watershed. Adult steelhead passage through the lower Carmel River is successful when streamflow in the lower river is approximately 30 cfs or greater (Urquhart, K. MPWMD, personal communication, 2018), and the primary period for adult escapement into the Carmel River is January through March (Wagner 1983). Between 1993 and 2019, sandbar management has been implemented in 6 years when streamflow in the lower river was less than or equal to 30 cfs at the time of implementation (Table 6). Two of these events (November 2011 and January 2018) were followed by prolonged periods of low or declining streamflow. On November 25, 2011, sandbar management was conducted an estimated 25 days prior to a natural breach (Table 4). Adding 25 days would be December 20, 2011, which would be the beginning of the when adult steelhead typically migrate into the Carmel River. However, even if a natural breach had occurred on December 20, streamflow in the Carmel River did not exceed 30 cfs until January 22, 2012, and therefore adult steelhead would have had to wait an additional month for migration conditions to improve.

Despite the potential delay, adult escapement that year, based on counts at the former San Clemente Dam fish ladder and Los Padres Dam trap, were above recent averages and represented some of the highest returns in nearly a decade (Figure 7).

The January 9, 2018 ISMP event was conducted when streamflow in the lower river was approximately 46 cfs, which was sufficient for successful adult steelhead passage through the lower Carmel River. This ISMP event was initiated approximately 18 days prior to a natural breach, or January 27. However, the ISMP was again implemented on January 21, when streamflow in the river was approximately 22 cfs. This was followed by a prolonged period (40 days) with little to no precipitation and declining streamflow in the lower Carmel River throughout January and most of February until storms produced substantial runoff in the watershed in late February and into March. These conditions comport with the observed adult steelhead at the Los Padres Dam fish trap where 0 adult steelhead were trapped in January and February (the lagoon was closed the majority of these months), 6 adults trapped in March, 20 adults in April, and 2 adults in May (Urquart, K., MPWMD, personal communication, May 2018).

For all other years, streamflow in the lower river was sufficient for adult passage. Potential delays of adult steelhead migration as a result of unsuitable passage conditions following sandbar management has been limited to only a few years and has largely been restricted to periods outside the primary adult steelhead migration window of January-March in the Carmel River (Wagner 1983). The number of adults that may have been impacted by these instances of early sandbar opening is unknown but were likely few if any because of timing of these events relative to the primary migration window for adult steelhead (see section 2.5.1 Effects on S-CCC steelhead). Adult steelhead that may have entered the watershed would have had sufficient habitat in South Arm of the lagoon and along the lower river where depths, even at low flows, are sufficient in the scour pools beneath dense overhanging riparian vegetation of the lower river.

Table 6. Date of initial sandbar breach (per water year), daily mean discharge at USGS gage station 11143250, and the number of days after the breach until the daily mean discharge was greater than or equal to 30 cfs.

Water Year (WY)	Date of Breach	Natural Breach	Mean Daily Streamflow Date of Breach	Number of Days After Breach Until Streamflow was ≥ 30 cfs	Date of Mechanical Breach within Adult Migration Window (January - March)
1993	January 3, 1993		85	0	Yes
1994	February 17, 1994		106	0	Yes
1995	January 9, 1995		445	0	Yes
1996	December 13, 1995		36	0	No
1997	December 9, 1996		27	1	No
1998	December 6, 1997		112	0	No
1999	November 3, 1998		21	9	No
2000	January 24, 2000		1,000	0	Yes
2001	January 11, 2001		148	0	Yes
2002	December 3, 2001		402	0	No
2003	December 16, 2002		1,250	0	No
2004	December 30, 2003		416	0	No
2005	December 30, 2004		532	0	No
2006	December 28, 2005		81	0	No
2007	February 11, 2007		29	1	Yes
2008	January 5, 2008	Natural	509	0	*N/A*
2009	February 16, 2009		749	0	Yes
2010	October 14, 2009		759	0	No
2011	November 24, 2010		19	25	No
2012	November 25, 2011		18	58	No
2013	December 3, 2012	Natural	770	0	*N/A*
2015	December 12, 2014		49	0	No
2016	January 11, 2016		61	0	Yes
2017	December 19, 2016	Natural	96	0	*N/A*
2018	January 9, 2018		46	0	Yes
2019	January 4, 2019		14	2	Yes
Average				4	
Median				0	

Notes: WY 2014 the sandbar did not open.

Another component of the ISMP is the summer sandbar closure action. Although intended to enhance habitat quantity and quality in the lagoon for juvenile steelhead during the dry season, the summer closure action can have unintended consequences of blocking smolt and adult passage to the ocean.

Since the beginning of the ISMP, the sandbar has been mechanically closed on three occasions (Table 7). In general, sandbar closure, natural or mechanical, blocks fish from moving between the lagoon and ocean, and would force steelhead adults and smolts to remain in the lagoon through the dry season. However, as shown in Table 7, the dates and environmental conditions during the three mechanical closures were similar to those observed during natural closures—and based on the timing, these closure actions took place after the vast majority of the smolts emigrated. For example, the water years 2017 (natural closure) and 2019 (mechanical closure) were both wet years with similar streamflow conditions in the lower river (> 20 cfs) and similar lagoon closure dates. On May 28, 2018, despite daily mean streamflow of 27 cfs in the lower river, the lagoon closed naturally at a time and flow volume when smolts were able to migrate downstream and pass into the ocean. In 2016, a mechanical closure of the sandbar was delayed until June when streamflow in the lower river was less than 10 cfs, which resulted in a lower maximum WSE (8.7 feet NAVD 88) at the beginning of summer. Although the delay may have provided smolts and adults time to enter the ocean, the late closure with declining streamflow also limited the volume of water stored in the lagoon at the beginning of summer.

Table 7. Date of final, dry-season closure, closure type, daily mean streamflow (lower Carmel River at USGS gage 11143250), and maximum WSE post-closure for water years since implementation of the ISMP began in 2012.

Water Year	Date of Closure	Closure Type	Daily Mean Streamflow (cfs)	Maximum WSE After Closure (feet NAVD 88)	Date of Maximum WSE After Closure
2012	May 25, 2012	Mechanical	16.4	10.8	June 7, 2012
2013	April 9, 2013	Natural	18.5	10.0	April 22, 2013
2014		Did not open			
2015	April 1, 2015	Natural	13.0	11.3	April 30, 2015
2016	June 13, 2016	Mechanical	9.0	8.7	June 14, 2016
2017	July 14, 2017	Natural	20.5	9.4	July 29, 2017
2018	May 28, 2018	Natural	27.0	11.2	June 15, 2018
2019	July 10, 2019	Mechanical	25.1	10.5	August 7, 2019

2.4.1.4 Climate Change and the Carmel River

The long-term effects of climate change have been presented in Section 2.2.3 Global Climate Change. These include air temperature and precipitation changes that may affect steelhead and critical habitat by changing water quality, streamflow, lagoon WSE, and steelhead migration opportunities.

The threat to S-CCC steelhead in the action area from climate change is likely going to mirror what is expected for the rest of Central California. NMFS expects that average summer air temperatures would increase, heat waves would become more extreme, and droughts and wildfire would occur more often (Hayhoe et al. 2004; Lindley et al. 2007; Schneider 2007; Westerling et al. 2011; Moser et al. 2012; Kadir et al. 2013). Many of these changes are likely to further degrade S-CCC habitat in the action area by reducing streamflow in the lower river, the volume of freshwater in the lagoon during the summer which can impact water quality (water temperatures and dissolved oxygen concentration) in the lagoon. If the timing and the amount of freshwater inflow to the lagoon decline, we can expect longer periods with a shallower and more stratified water column in the lagoon that would reduce habitat suitability for S-CCC steelhead. However, the above will be buffered by required reductions in the overutilization of groundwater from the Carmel River basin and commensurate increases in surface flow duration in the lower river (see section 2.6 Cumulative Effects).

Continued sea-level rise is expected to affect the elevation of the sandbar and therefore the duration and frequency of sandbar openings. By 2100, Rich and Keller (2013) estimate the amount of time the mouth of the Carmel Lagoon will be open to the ocean will be reduced by 14 and 44 percent under 0.42 and 1.67 meter sea-level rise scenarios, respectively.

2.4.2 Status of S-CCC steelhead in the Carmel River and Action Area

In 1965 the Carmel River steelhead run was estimated to be 1,650, based on observations from local field biologists (Titus et al. 2010). Since 1949, adult steelhead have been counted inconsistently at a fish trap at the base of Los Padres Dam trap that is used to capture adults and relocate them above the dam for release. Adult counts were also made within the fish ladder that ascends San Clemente Dam until the dam was removed in 2015. Consistent annual counts were made at both locations from 1988 to 2015, and continued at Los Padres Dam to present. Between 1988 and 2015, mean annual adult steelhead returns at San Clemente Dam were 312, and between 1988 and 2019, mean annual returns at the Los Padres Dam trap were 87. These periods covered multiple severe droughts that resulted in no river flow reaching the ocean (1976-1977, 1988-1990, and 2014). Although the river opened to the ocean in 2015 and 2016, no adult steelhead were counted at the Los Padres Dam fish trap and only 7 were counted at San Clemente Dam in 2015, the year it was removed. Since the 2012-2016 drought, the number of adult steelhead returning to the Los Padres Dam fish trap has begun to show signs of improvement, with 7, 29, and 126 adults in 2017, 2018, and 2019 respectively (Figure 7). Due to their location in the upper third of the watershed basin, the counts at both facilities are partial and do not represent the entire adult escapement to the Carmel River watershed. Spawning also occurs in several tributaries and in the mainstem downstream of both dams.

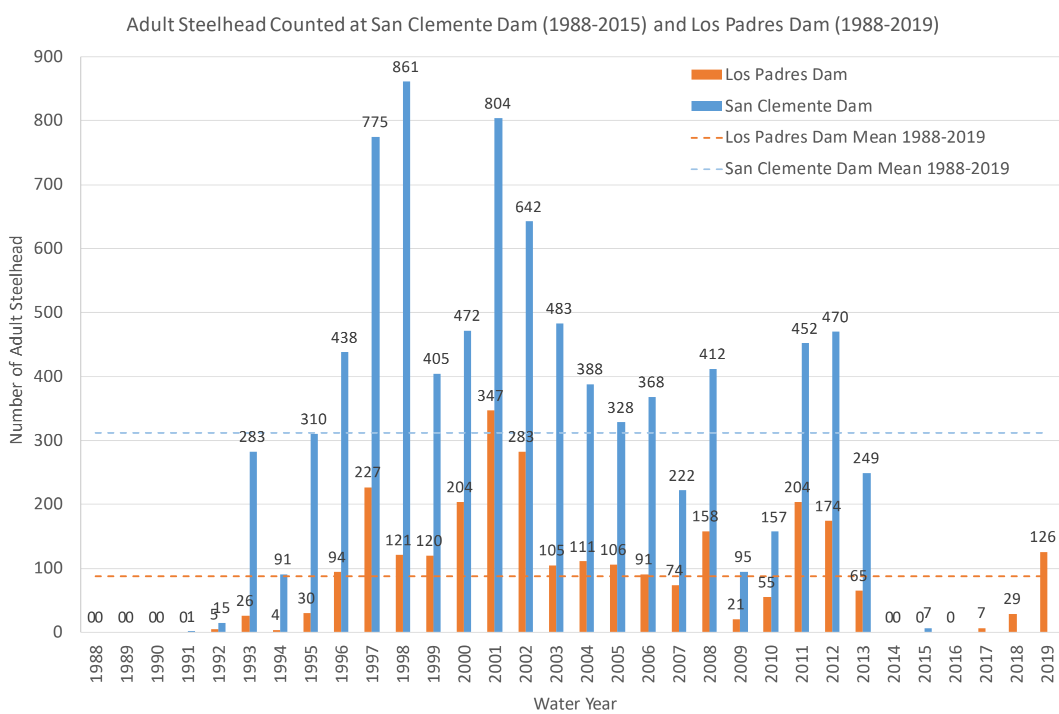

Figure 7. Number of adult steelhead counted at the Los Padres Dam (river mile 24.8, 1988-2019) fish trap and the former San Clemente Dam fish ladder counter (river mile 18.6, 1988-2015). Data Source: California-American Water.

Since the early 1980’s, monitoring of juvenile steelhead abundance in the lagoon has been conducted sporadically with varying levels of effort. These monitoring efforts have produced a few lagoon population estimates but mostly the data provide periodic snapshots of steelhead presence, relative abundance, and size ranges.

Surveys conducted between April and October 1982 (a wet year), resulted in approximately 2,000 steelhead captured in the lagoon, with age-classes ranging from YOY to out-migrating smolts (Dettman 1984). A mark-recapture study in the summer and fall of 1996 (moderately wet year), estimated the juvenile steelhead population in the lagoon at approximately 5,000 and 6,000 fish (Alley 1997), with sizes ranging from 90 to 189 mm standard length. Alley (1997) estimated this number of fish could equate to approximately 7 or 8 percent of the summer rearing population for the entire Carmel River watershed based on observed juvenile densities at multiple sites in the river upstream of the lagoon and the abundance of rescued fish throughout the basin. As others have found (Smith 1990; Bond et al. 2008; Atkinson 2010; Jankovitz 2018), properly functioning lagoon habitat can be highly productive and juvenile steelhead can grow rapidly resulting in a substantial increase in the number and size of smolts produced in the watershed. For example, in August 1999 (a wet year) the California Department of Fish and Game captured several hundred to a thousand rearing steelhead in a single seine haul at the entrance to the South Arm of the lagoon with mean lengths between 200 to 300 mm (Urquhart, K., personal communication, 2017). This large smolt size is important because studies have shown the vast majority of the returning adults (80 to 90 percent) can be disproportionally represented by juveniles that reared in the lagoon and reached a larger size (>150 mm fork length) prior to ocean entry (Bond et al. 2008).

On November 20 and 26, 2001, seining in the lagoon was conducted at several sites including the main embayment, South Arm, North Arm and the river arm upstream of the main embayment to determine relative abundance and distribution of juvenile steelhead within the lagoon (Hagar Environmental Sciences 2002). Capture effectiveness was limited in some areas including the deep portions of the South Arm (due to depth and vegetation) and areas of the river arm upstream of the main embayment (extensive emergent vegetation), although surface feeding by juvenile steelhead was observed in these areas. Juvenile steelhead were captured or observed throughout the lagoon with the greatest abundance of captured fish located in the main embayment. A total of 154 juvenile steelhead were captured during these two days with catch per seine haul ranging between 3 and 23 fish (Hagar Environmental Sciences 2002). Steelhead sizes ranged from 111 mm to 219 mm fork length, with an average of 157 mm. Repeated sampling conducted in December after the sandbar had been opened resulted in 22 fish captured with catch efficiencies between 4 and 18 fish per seine haul. Although the total number of fish captured was less than the November sampling, capture per haul remained similar. The reduction in total capture was again due to limited areas where fish could be effectively captured by seine as most of the main embayment was drained and the South Arm remained deep and complex. However, 5 fish that were marked in November were recaptured in the South Arm in December after the lagoon had been opened. The fish lengths observed in November (mean = 157 mm) were typical of smolt sized fish.

In late October 2002, sampling by seine was conducted to document relative abundance and distribution of juvenile steelhead throughout the lagoon (Hagar Environmental Sciences 2003). A total of 436 steelhead were captured and steelhead were found in all areas that could be effectively sampled (main embayment and back portion of the South Arm). Sizes of captured juvenile steelhead ranged from 85 mm to 191 mm FL, with an average being 125 mm. The increase in abundance of juvenile steelhead in the lagoon between 2001 and 2002 and the smaller sizes were partially attributed to the release of approximately 3,000 juvenile steelhead that had been rescued from the upper watershed and relocated to the lagoon during summer by CRSA. An early November storm resulted in substantial wave overwash to the lagoon. The storm only produced brief (<48 hours) and minimal amounts (<25 cfs) of freshwater inflow from the river (Hagar Environmental Sciences 2003; Casagrande et al. 2003). The surge of saltwater and rotting marine debris (e.g., kelp) to the lagoon with a limited supply of freshwater resulted in a heavily stratified water column that depleted dissolved oxygen concentrations (Hagar Environmental Sciences 2003; Casagrande et al. 2003). The sandbar did not open and there was no connectivity to upstream habitats in the river. Repeated sampling for steelhead abundance in early December resulted in zero captured steelhead, which suggested the steelhead that were previously present in the lagoon died as a result of predation (observed) or subsequent lack of dissolved oxygen (Hagar Environmental Sciences 2003).

In July 2006, staff from the Watershed Institute at CSUMB, State Parks, and the MPWMD conducted nine seine hauls throughout the lagoon which produced approximately 1,100 juvenile steelhead. Precise counts were not made due to the large number of fish captured and the potentially stressful water quality conditions at the time of sampling. Sizes ranged from 75 to 185 mm fork length (Casagrande, J., NMFS, unpublished data). Later in December 2006, staff from CSUMB, NMFS, CRSA, and MPWMD conducted multiple seine hauls at various sites throughout the lagoon over three days. Several hundred juvenile steelhead were captured, which confirmed that juvenile steelhead not only survived through the summer-fall dry period while rearing in the lagoon, but that these fish grew exceptionally well based on comparisons of length frequencies captured between the two periods (Casagrande, J., NMFS, unpublished data).

Between May 26 and June 3, 2012, MPWMD attempted to estimate the population of steelhead in the lagoon by mark-recapture techniques. However, only 17 juvenile fish were captured and marked, followed by 14 additional captures of which none were marked so a population estimate could not be generated. Overall, capture efficiency was low due to high water levels and inability to sample deep water—the lagoon was mechanically closed on May 25, 2012 and the WSE from May 26 – June 3 ranged from 9.8 and 10.7 feet NAVD 88.

2.4.3 Previous Section 7 Consultations in the Action Area

NMFS has completed six formal section 7 consultations on actions within the action area (the lagoon). Most anticipated small amounts of incidental take that were unlikely to affect future steelhead returns and all were found to not jeopardize the continued existence of S-CCC steelhead nor destroy or adversely modify its designated critical habitat. NMFS has also completed six informal consultations for sandbar management and restoration projects within the Carmel Lagoon.

Several research and enhancement projects resulting from NMFS' Section 10(a)(1)(A) research and enhancement permits and section 4(d) limits or exceptions could occur in the action area. Currently, fisheries research and monitoring is conducted in the Carmel River watershed by

NOAA's Southwest Fisheries Science Center, the California Department of Fish and Wildlife, and the MPWMD. These activities are closely monitored by NMFS and require measures to minimize take of steelhead. In addition, in 2019, NMFS issued a section 10(a)(1)(A) enhancement permit to the MPWMD for their continued operation of the Carmel Rescue and Rearing Enhancement Program. This program includes the rescue of natural origin steelhead from the Carmel River mainstem and the lower reaches of select tributaries which are either relocated to other areas of the watershed and released (including the lagoon), or they are brought to an existing rearing facility where they are reared to the advanced parr or smolt life stage, then released into the river the following winter. NMFS has analyzed these activities under section 7 and determined that they would not jeopardize the S-CCC steelhead DPS nor adversely modify its designated critical habitat.

2.5 Effects of the Action

Under the ESA, "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 (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

NMFS anticipates the implementation of the ISMP is reasonably certain to result in the following effects on steelhead and their critical habitat:

- Juvenile stranding: A small number of juvenile steelhead may become stranded following an ISMP-induced breach and would likely die as a result of predation or desiccation.
- Premature reduction of winter rearing habitat: In some years, the ISMP may be necessary when the sandbar would otherwise not breach for an extended period of time. The premature disruption of the expanding lagoon habitat can limit steelhead rearing (growth) in the lagoon.
- Migration delays: The early opening of the sandbar and seaward flow of water can induce steelhead adults to enter the lagoon and lower river channel when there may be insufficient flow for upstream passage to spawning areas.
- Trapped in the lagoon: Implementation of the summer closure action may block a small number of late, emigrating steelhead adults from returning to the ocean, as well as a small percentage of the annual steelhead smolt cohort from entering the ocean. These fish will therefore remain in the lagoon for the dry season where they may experience stress or mortality from predators or poor water quality conditions in some years.
- Enhanced summer lagoon habitat: Closure of the lagoon will impound declining freshwater inflow in early summer, prolonging the likelihood of adequate water quality and depths in the lagoon for steelhead to avoid predators. This will improve the rearing habitat and growth opportunities for a larger cohort of younger juvenile steelhead.

2.5.1 Effects on S-CCC steelhead

2.5.1.1 ISMP

Juvenile steelhead – Implementation of the ISMP avoids direct take of steelhead because grading of the pilot channel on the sandbar will be done outside of waters, and contact with steelhead by heavy equipment will not occur. Indirectly, juvenile steelhead will die as a result of stranding and subsequent predation or desiccation as the lagoon drains. In some years, juvenile steelhead may experience reduced growth opportunity from the premature, partial draining of the lagoon habitat, which has been estimated to occur between 0 to 25 days earlier than a natural breach.

Stranding – Due to the change in WSE during a lagoon draining, a small number of juvenile steelhead that are located at the extreme edges of the flooded marshes are likely to become stranded. As the WSE drops in the Carmel Lagoon, fish that become isolated in the marshes are exposed to increased risk of desiccation, predation, or may succumb to poor water quality conditions (i.e., lack of dissolved oxygen). Fish stranding occurs naturally on floodplain and marsh habitats and is considered a risk for species that seek to utilize these productive habitats for foraging and as refuge during high flow events (Bradford 1997; Sommer et al. 2005; Nagrodski et al. 2012). The physical response of the lagoon (i.e., the change in WSE and habitat volume) following a natural breach of the sandbar is very similar to that observed during implementation of the ISMP (see Section 2.4.1.3 Past Implementation of the ISMP), and therefore it is difficult, if not impossible, to attribute the quantity of fish stranding caused by an ISMP-induced breach from that of a naturally-induced breach.

Observations of fish stranding during and following a breach of the Carmel Lagoon are extremely limited. In other lagoons, observations of juvenile steelhead stranding following a breach are also limited, and where they exist they are usually associated with unseasonal breaches (i.e., summer breaches) with limited to no upstream refuge habitat[9], or due to mortality associated with poor water quality conditions during the breach (Jankovitz 2018). During the recent ISMP events (2012-present), biological monitors have not observed stranded juvenile steelhead within the Carmel Lagoon or along the shoreline of the beach. Prior to the implementation of the ISMP protocols, two juvenile steelhead were found dead in the North Arm of the Carmel Lagoon during a mechanical breach in fall 2001 (Hagar Environmental Sciences 2002). However, the water column in the North Arm was nearly anoxic prior to the breach and the draining of anoxic water may have caused their mortality (Hagar Environmental Sciences 2002).

The lack of recent stranding observations is likely due to several factors. It is possible that some observations go undetected by biological monitors due to the size and complexity of the vast marsh areas. Also we must consider the evolution and behavior of the species. In order to complete their anadromous life history, steelhead rely on sandbar breaches to move between the freshwater and marine environments. Therefore they have inherently evolved within these highly variable and dynamic bar-built lagoon systems where breaches and rapid draining are part of the natural processes. The ISMP protocols were developed to mimic, as close as possible, a natural breaching by allowing the lagoon WSE elevation to rise and crest pre-graded channel positioned at approximately 12.77 feet NAVD 88. Recent observations of the lagoon draining following

[9] https://www.venturariver.org/2010/09/estuary-breach-kills-fish.html

implementation of an ISMP confirm the initial rate of lagoon WSE drawdown is low and gradually increases towards a more rapid drain. This gradual increase in the rate of WSE decline would provide juvenile steelhead time to leave habitat areas that are shrinking. As the WSE declines, we presume most, if not all, juvenile steelhead will remain near the bottom of the lagoon (where food availability is most abundant) and continue seeking deeper waters as the lagoon drains. During winter months in Pescadero Creek Lagoon, juvenile steelhead fed almost exclusively on gammarid amphipods, *Corophium* and *Eogammarus*, which are found on or very near the bottom substrate (Martin 1995).

Based on the above and considering the natural behavior and evolution of the species in these environments, NMFS expects few juvenile steelhead would be killed by stranding from the ISMP, and rates of mortality are likely to be comparable to those observed under a natural sandbar breach. Based on NMFS' professional judgement in consideration of the above, NMFS assumes no more than 30 juvenile steelhead (smolt and pre-smolt juvenile life stages) would be killed by stranding (or subsequent desiccation or predation) during each ISMP season (i.e., October to March).

As described in the project description, any steelhead encountered during the monitoring of a lagoon draining (or closing) action that are still alive will be collected and immediately relocated to the nearest suitable habitat in the lagoon. Fish collecting gear, whether passive (Hubert 1996) or active (Hayes et al. 1996), has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of unintentional injury and mortality attributable to fish capture varies widely depending on the method used, the ambient conditions, and the expertise and experience of the field crew. Here, fish collection activities will be conducted by qualified fisheries biologists by hand or by dip-net and quickly released. NMFS does not expect any mortality or injury from this minor handling.

<u>Lagoon Draining and Entrainment into the Ocean</u> – The rapid draining of a lagoon following a sandbar breach has the potential to induce involuntary entrainment of juvenile steelhead to the ocean. Juvenile steelhead that may become entrained in the seaward flow can experience osmotic shock (i.e., caused by salt water intolerance), thermal shock (i.e., caused by sudden water temperature change), and mortality due to predation and/or acute stress and disorientation.

NMFS is unaware of literature or research specifically on the occurrence and rate of involuntary emigration, or entrainment, of juvenile salmonids from a lagoon during a sandbar breach. Instead, there are a few observations made from monitoring of relative lagoon fish abundances before and, in some cases, after a sandbar breach. As noted above in 2.4.1.3 Past Implementation of the ISMP, following a County breach of the Carmel Lagoon in fall 2001, Hagar Environmental Sciences (2002) reported similar catch per effort before and after a breach including recapture of multiple juvenile steelhead in the South Arm of the lagoon that were marked in the main embayment prior to the breach. While this monitoring was not designed to fully evaluate entrainment rates, it does indicate at least some of the juvenile steelhead present in the lagoon prior to the breach were able to seek refuge in areas of the lagoon. Monitoring in other nearby lagoons has found that juvenile steelhead abundance remained high following a sandbar breach. Smith (1990) found juvenile steelhead remained abundant in San Gregorio Creek lagoon following a breach, and similar observations were recently made following a breach of the San Lorenzo River lagoon (Hagar, J., Hagar Environmental Science, personal communication, 2019). All three of these lagoons have areas with accessible residual depth that serve as refuge for juvenile steelhead during a sandbar breach and subsequent draining.

While the lagoon is draining, the area within the lagoon that experiences the greatest change in water velocity is within the outlet channel itself. As indicated above, the rate of WSE decline is initially low but gradually increases due to increases in river flow and or due to increases in the head differential between the lagoon and the ocean. Figure 8 shows the outlet channel on the mornings of January 9 and January 10, 2018, following the grading of an ISMP pilot channel on the afternoon of January 8, 2018. Despite a high WSE in the lagoon on January 8 (> 12 feet NAVD 88), the low river inflow to the lagoon (< 50 cfs) and a long and slightly angled outlet channel towards the south allowed the lagoon to drain slowly over the first 24 hours until the pilot channel grew and the rate of drawdown increased. As shown in Table 5, the rates of lagoon draining (including the maximum rate of WSE decline) during past ISMP events were similar to, if not slower, than the rates observed during two recent natural breaches of the sandbar and therefore implementation of the ISMP would not introduce additional entrainment risk to steelhead beyond what would otherwise happen naturally.

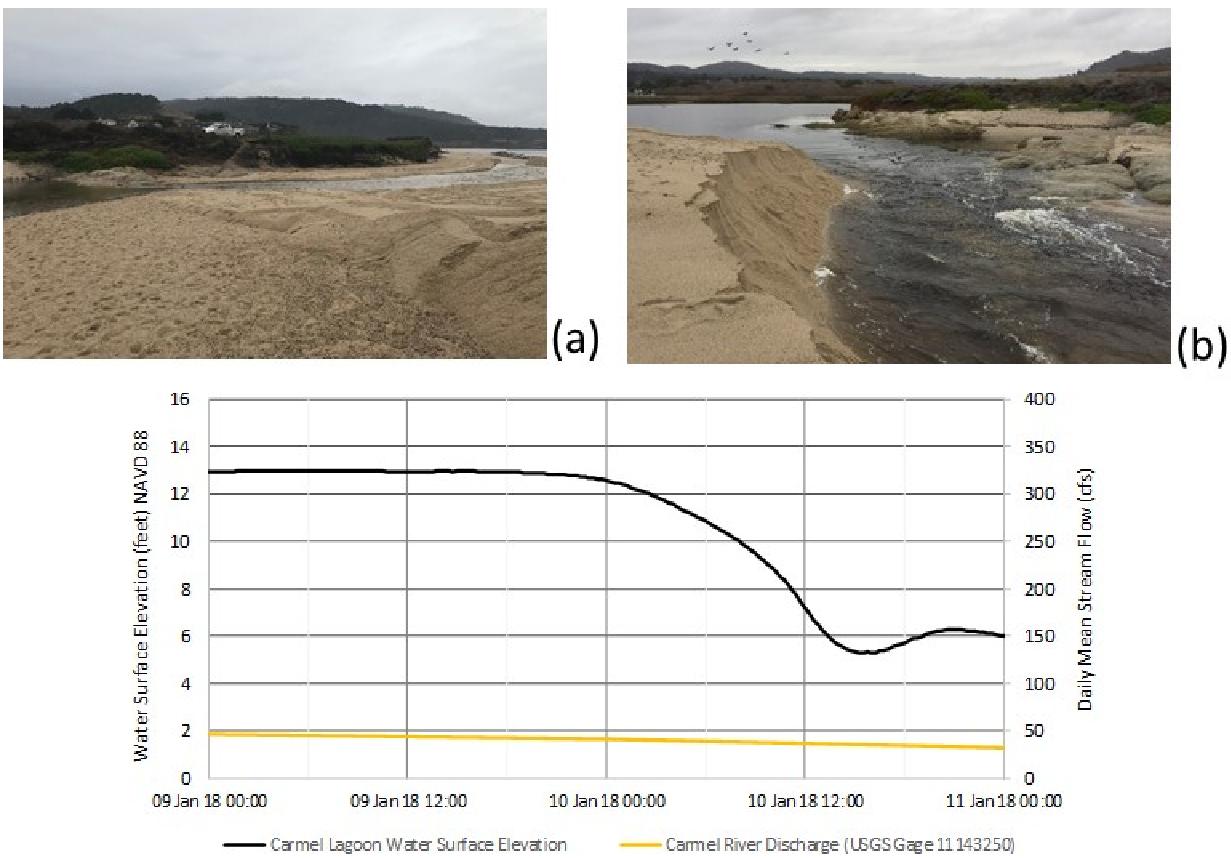

Figure 8. Water exiting the outlet channel on January 9, 2018 at 8:22 am (a), January 10, 2018 at 8:13 am (b), and the water surface elevation and daily mean streamflow in the lower river during an ISMP event. Between 0:00 and 12:00 January 10, the lagoon WSE dropped approximately 2 feet, and approximately 7.7 feet overall during this ISMP event. Note the calm water conditions in the background of (b).

NMFS assumes juvenile steelhead in the vicinity of the outlet channel at the time of initial draining will either relocate to other areas of the lagoon or the lower river, or volitionally exit the lagoon and enter the marine environment. As such, NMFS assumes the likelihood that juvenile steelhead experience entrainment into the ocean to be extremely low, and indiscernible from levels that would occur during a natural breach of the sandbar. Therefore, the potential for added risk of entrainment is considered improbable.

Changes in Water Quality – Juvenile steelhead in the lagoon may be exposed to rapid changes in water quality, including the delivery of large amounts of cold, saltwater to the lagoon as waves enter through the open sandbar. As noted above, changes in salinity and temperature can induce shock in younger life stages of steelhead. Juvenile steelhead that experience shock can become disoriented and are therefore more susceptible to predation (Donaldson et al. 2008). The potential for osmotic shock depends on the salinity levels in the lagoon in the months leading up to a breach, or their acclimation time. Gradual acclimation to waters of increasing salinity results in greater smolt survival compared to direct entry into full strength seawater (Dey 1993). As noted in Section 2.4 Environmental Baseline, during fall and early winter, waves typically deliver substantial quantities of saltwater to the Carmel Lagoon (Hagar Environmental Sciences 2002; Casagrande et al. 2003; Watson and Casagrande 2004). This more gradual addition of saltwater provides an opportunity for juvenile steelhead in the lagoon to acclimate in brackish water and avoid rapid conversion from fresh to full strength seawater. In Pescadero Creek Lagoon, juvenile steelhead ranging in size from 50 to 280 mm were captured in heavily brackish waters that were exposed to tidal fluctuations (Casagrande, J. NMFS, personal observation, July-September 2019). Because implementation of the ISMP is intended to mimic a natural breach and will be carried out during the times of year that sandbars typically open to the ocean, and wave overwash typically occurs, we expect the exposure of juvenile steelhead to saltwater from the ISMP to mimic natural conditions. Therefore, the ISMP's effects to steelhead from changes to water quality in lagoon are considered indiscernible from natural water quality conditions and changes.

The potential for juvenile steelhead to experience cold (thermal) shock depends on the differences in water temperature in the lagoon and the ocean. Ocean water temperatures between December and March range between 10.5 and 14.5 ºC near Carmel State Beach (Figure 9). Observed temperatures in the Carmel Lagoon during these same winter months have been very consistent, or between 10 and 15 ºC (Casagrande et al. 2002; Casagrande et al. 2003; Watson and Casagrande 2004; Larson et al. 2006). Thermal shock is more likely to occur during a late spring or summer breach when the difference in water temperatures between the lagoon (warmer) and the ocean (colder) are much more substantial. Based on the above, NMFS expects the potential risk of exposure to ocean water temperatures that are significantly colder than lagoon water temperatures during a winter breach to be miniscule.

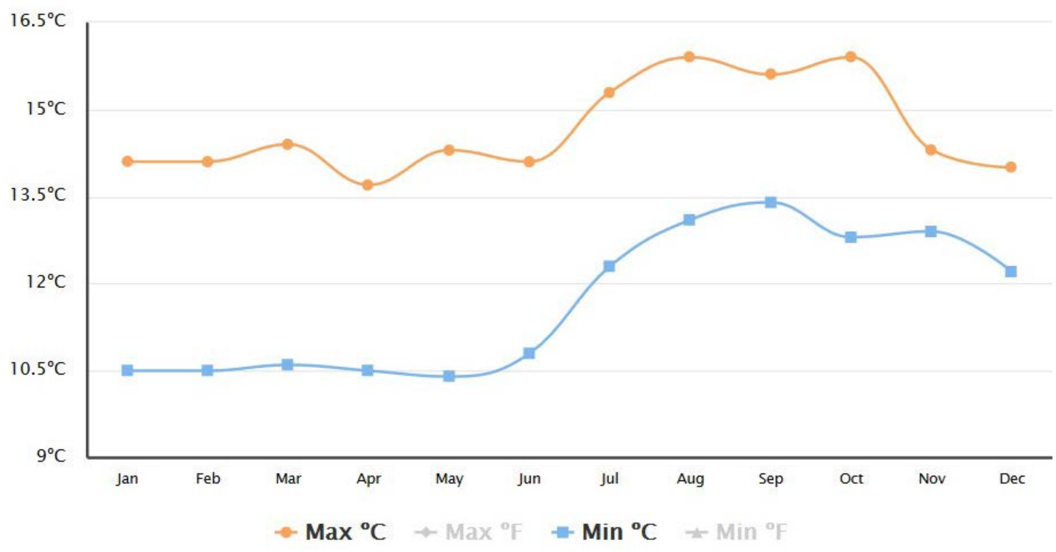

Figure 9. Monthly average maximum and minimum sea surface water temperature in the Pacific Ocean near Carmel-by-the-Sea. Source: https://www.seatemperature.org/north-america/united-states/carmel-by-the-sea.htm.

Summer Closure and Smolt Emigration – For years where the MCRMA implements the ISMP for flood protection they will be required to close the sandbar the following spring or summer in order to impound as much of the declining freshwater inflow to the lagoon as possible. Unlike many other central California coast lagoons, streamflow into the Carmel Lagoon ceases by early to mid-summer in most years. Closing the sandbar is necessary to impound as much of the declining freshwater inflow as possible in order to maximize water quality and depths in the lagoon at the beginning of the dry season. A fuller and deeper lagoon with reduced water column stratification will offer better rearing habitat for juvenile steelhead (see Section 2.4.1.1 Description of the Carmel Lagoon).

Implementation of the summer closure action is done only after an evaluation of current environmental conditions (i.e., streamflow levels into the lagoon and sand supply on the beach) and discussion with the regulatory agencies. Closures will be implemented when streamflow in the lower river is approximately 20 cfs or less. This threshold is important because it is a sufficient amount of freshwater inflow to raise the lagoon WSE, but an amount that is unlikely to induce a breach, and because adult migration through the lower river becomes highly restricted or blocked at these low flows (discussed below).

Closure of the lagoon presents a conflict between enhancing habitat in the lagoon for a larger number of juvenile fish that will rear there prior to entering the ocean the following winter/spring, versus potentially blocking a much smaller number of post-spawned adults and smolts from entering the ocean. Table 7 shows the dates and streamflow conditions for recent summer closures—natural and ISMP closures. Natural closures occurred during periods when stream flow was sufficient for smolt passage into the lagoon (13-27 cfs) and at times of year when smolts are migrating downstream (April through June). These flow values and periodicity are similar to those during the three ISMP closure events since 2012. NMFS estimates the dates and inflow conditions during ISMP closure events are consistent with natural closures and are likely to result in natural rates of smolt capture in the lagoon. In most years, NMFS assumes that the majority of smolts would have passed through and only the tail end of the outmigration would be captured. Unlike adults, pre-smolt and smolt juvenile fish are more tolerable of warmer water temperatures in the lagoon as long as food availability remains high (Smith 1990; Hayes et al. 2008).

Adult steelhead – As with juvenile steelhead, implementation of the ISMP (winter and summer actions) will not result in the direct take of adult steelhead, but is likely to result in indirect effects including potential initiation and delay of immigration (winter action), and blocking post-spawned adults (kelts) from returning to the ocean (summer action).

Initiation of Immigration and Delay – Depending on the time of year, the large pulse of seaward flow from the draining lagoon may entice adult steelhead to enter the lagoon when streamflow in the river is insufficient for migration upstream to spawning areas. Adult steelhead migrate into the Carmel River between December and May, with 95 percent of adults counted at the former San Clemente Dam during the months of January through March (Wagner 1983). Successful passage to upstream spawning and rearing habitat requires streamflow to be approximately 30 cfs or greater (Urquhart, K., MPWMD, personal communication, 2018). If the ISMP is conducted during low streamflow conditions and at a time when adult steelhead are likely to begin upstream migration, adults may experience delays in reaching spawning habitat in the upper watershed and would be forced to return to the ocean or seek refuge in the lagoon or the lower river channel.

The lagoon and the lower river channel contain suitable holding habitat for adult steelhead. Even during low tide with an open sandbar, the South Arm of the lagoon offers extensive areas of deep water habitat, and the margins of the lower river channel are comprised of a network of scoured pools beneath the dense overhanging riparian trees, debris, and logs installed by CRSA. Water temperatures at this time of year would be expected to remain similar to ocean temperatures (see above) and typical of winter conditions, and are therefore not likely to pose a threat to adults.

NMFS assumes delays in adult upstream migration will occur as a result of the ISMP in some years. Over the next 10 years, NMFS assumes the frequency and duration of conditions capable of causing migration delays will be similar to those observed over the past 27 years of sandbar management, which has been low (see Section 2.4.1.3 Past Implementation of the ISMP). Table 6 shows the number of days adult steelhead may have waited post sandbar breach for streamflow in the lower river to exceed 30 cfs. Between 1993 and 2019, the delay has exceeded 10 days only twice (2011, 25 days and 2012, 58 days). However, both events were during periods (November) outside of the normal migration timing for adult steelhead. Also, it is common for adult steelhead to enter estuaries before streamflow is sufficient for upstream migration (e.g., Pescadero Creek Lagoon, Jankovitz, J., CDFW, personal communication, October 2019). NMFS expects the existing deep water habitats within the lagoon (South Arm), the existing complex habitats along the lower river margins, and suitable water temperatures throughout lower river-lagoon region, will offer adult steelhead suitable shelter and habitat conditions until passage conditions improve. NMFS is unaware of any data or observations of adults becoming stranded in the river during winter following a sandbar breach—natural or assisted. Since the ISMP attempts to mimic natural breach events, and suitable habitat exists in the lagoon for delayed adults to wait until passage upstream improves, the exposures to and responses of adult steelhead are assumed to be similar to natural conditions. Therefore, NMFS does not expect any meaningful increase in the risk of adult migration failure from implementation of the ISMP.

Capture in the Lagoon – Depending on the time of year and water year type, mechanical closure of the sandbar may trap emigrating steelhead adults (kelts) in the lagoon that would otherwise return to the ocean. Adult steelhead are known to become trapped in the Carmel Lagoon following natural sandbar closures (see Larson et al. 2005), as well as other central California lagoons (Casagrande, J. NMFS, personal observations). While the Carmel Lagoon provides sufficient habitat space (depth and volume) during summer, water quality (particularly temperature) usually becomes stressful, if not lethal, for adult steelhead later in summer (Watson and Casagrande 2004; Larson et al. 2005).

NMFS expects the annual occurrence and number of adult steelhead that will become trapped in the lagoon as a result of the ISMP summer closure will be extremely low, or none and indiscernible from the frequency and magnitude of adult fish trapped under natural closure conditions. This expectation is based on recent monitoring of adult emigration, and streamflow criteria (<20 cfs) used to guide closure timing.

Recent monitoring of tagged adult steelhead has shown that once they leave soon after spawning and once they begin their emigration, they move quickly through the Carmel River towards the ocean (Ohms et al. 2019). During the winter of 2018-19, a total of 84 adult steelhead captured in the Los Padres Dam fish trap were PIT-tagged and released upstream into Los Padres Reservoir to continue their upstream migration. There are several stationary tag antennas located throughout mainstem Carmel River. Of the 84 tagged adults from the upper watershed, the last tag detection at the Scarlett Well PIT-tag antenna located in the lower river was on June 1 (i.e., during their emigration from the watershed), despite streamflow in the lower river exceeding 75 cfs (a streamflow rate suitable for adult passage in the river) (Ohms, H., NMFS, personal communication, October 2019). This highlights that streamflow conditions may have less influence on the duration of post-spawn adult residency or emigration timing and that most adults leave soon after spawning is over. Mechanical closure would not happen until streamflow in the lower river is at or less than 20 cfs, which is less than what is known to be conducive for adult migration and emigration. By this point, NMFS expects nearly all post-spawn adults would have already emigrated. Any emigrating adults still present in the river upstream of the lagoon are expected to be few and blocked by low streamflow conditions farther upstream, thereby restricting adult steelhead from reaching the lagoon (or the ocean). As shown in Table 7, the three summer closure actions occurred at similar times and under similar environmental conditions as natural closures—or later. Based on the information above, NMFS does not expect adverse effects to adult steelhead from the summer closure action. Future data from monitoring of tagged adult steelhead and down-migrant trapping in the lower Carmel River will further our understanding on emigration timing and streamflow conditions as well as potential impacts caused by summer closure actions.

2.5.1.2 SRPS

Construction of the SRPS is will have no effects on S-CCC steelhead because of the proposed location/alignment of the structure, the construction window, and the lack of working in waters capable of supporting steelhead. The SRSP will be constructed within sand dunes and coastal bluffs adjacent to Scenic Road, which are expected to be dry during the proposed construction season. Construction will occur on the beach and coastal bluff where the primary sediment consists of sand. Once construction is completed, the dune and bluff will be re-contoured. Due to the porosity of the sand dunes, any rainfall onto the disturbed area of the beach and bluffs will be absorbed in the sand and therefore not expected to create plumes of turbid runoff to the nearshore environment or the lagoon. No impacts to fish in the lagoon or nearshore environment are expected as a result of increased erosion or turbidity.

2.5.2 Effects on Critical Habitat

2.5.2.1 ISMP

Although the proposed winter ISMP action will mimic a natural breach, it will cause the lagoon to open earlier than would naturally occur. The proposed summer closure action will cause the lagoon to close earlier than naturally would occur but is expected to improve the quality and quantity of habitat in the lagoon for summer rearing juvenile steelhead.

Winter Reduction of Lagoon Habitat – As described above in Section 2.4.1.3 Past Implementation of the ISMP, the time differential between when sandbar management occurred and the conservative projections for when a natural breach would have occurred, has ranged between 0 and 25 days, with most occurring in 4 days or less, and the most likely (or median) occurring on the same day. This means that in most years, the lagoon WSE responds rapidly to high river inflow and or wave overwash which results in a breach (or need for imminent mechanical assistance prior to flooding). However, for years where there is a more gradual rate of inflow, a high lagoon WSE, and high sandbar elevations to accommodate greater WSEs, implementation of the ISMP to avoid flooding will result in the premature and partial draining of the lagoon. The early draining reduces habitat availability that would have otherwise continued to provide foraging areas for juvenile steelhead and more deep water habitat to better avoid predation. Following a mechanical breach, habitat quality within the remaining areas of the lagoon is not expected to be noticeably reduced.

With the exception of extreme drought years, the Carmel Lagoon typically opens to the ocean at some point during the winter season. The impacts to the critical habitat present in the lagoon (i.e., loss of habitat space and changes in water quality) from an ISMP breach are generally the same as if the sandbar opened naturally. The influence of the ISMP on critical habitat would be based primarily on the timing differential between the ISMP and when a natural breach would occur. NMFS assumed the timing of ISMP implementation for flood risk reduction will resemble observed recent trends (Table 3 and Table 4). These estimates are conservative due to the use of a high minimum sandbar elevation (15.4 feet NAVD 88) as a criteria, when in reality, the low point in the sandbar is almost never 15.4 feet NAV 88. The collection of more precise measurements of sandbar elevations just prior to breaching would refine our estimates of the time differentials. Based on the above, over the next 10 years, NMFS expects the ISMP will result in the lagoon being opened 10 days or more, earlier than a natural, or unassisted, breach no more than 3 out of 10 years. For the remaining 7 years, NMFS expects the sandbar will either breach on its own or open via the ISMP within 10 days or less of a natural breach. In time, construction of the SRPS will allow the sandbar to be managed on the northern end of the beach which would further reduce the amount of lagoon draining (i.e., it will maintain a perched condition).

We do not expect the exposure of seawater to a formerly fresh or brackish lagoon following breaching would decrease the availability of estuarine prey species for steelhead (*e.g*., benthic and epibenthic forage species such as amphipods, isopods, and mysids). There will likely be some reduction in total prey numbers, and although NMFS cannot predict the specific amount of reduction, the reduction in prey numbers is likely to only minimally adversely affect critical habitat. This expectation is based on the mechanical breach mimicking a natural breach that would otherwise likely occur and result in a similar reduction in habitat space.

The reduction of foraging habitat and prey species could slightly modify rearing PBFs to the extent that juvenile steelhead potential growth opportunities could be reduced in some years. Under the most common observed scenario (4 days or less), even if growth rates in the lagoon were exceptional (e.g., 0.5 to 1 mm per day, see Hayes et al. 2008; Jankovitz 2018), an early, but inevitable, disturbance to the lagoon habitat volume would result in insignificant impacts to steelhead growth (0-4 mm) and would be unlikely to diminish their chance of survival. Maximum growth rates are more associated with transitional periods (e.g., spring or early summer) when water temperatures are moderate and food abundance is high (Hayes et al. 2008). In winter (December –February), water temperatures are typically at their coolest and therefore metabolic demands and food consumption and conversion are lower than spring (Hokanson et al. 1977; Myrick and Cech 2005).

After a sandbar breach, the draining of the lagoon reduces the amount of deep water habitat present. This reduces the amount of escape cover for steelhead and can potentially expose juvenile steelhead to increased predation risk. As described above, implementation of the ISMP is likely to result in an earlier draining of the lagoon. NMFS expects the premature opening may result in only minor increases in predation, particularly in years with greater time differential between ISMP implementation and a natural breach. More often than not, the lagoon’s response and exposure to steelhead from implementation of the ISMP will be similar, if not identical, to natural sandbar breaches as described above in section 2.5.1 Effects on S-CCC steelhead.

<u>Summer Enhancement of Lagoon Habitat</u> – As described above, the MCRMA will mechanically close the lagoon in spring or early summer following winters where they implemented the ISMP for winter flood risk. The intent of the seasonal sandbar closure is to enhance rearing habitat quantity and quality in the lagoon by trapping the declining freshwater inflow in the lagoon. The effects of this activity on the quantity and quality of habitat in the lagoon are largely beneficial in that it maximizes lagoon water column depths, reduces or eliminates water column stratification, and it provides a greater area and duration of inundated marsh and riparian vegetation that can be used as foraging and cover by juvenile steelhead.

2.5.2.2 SRPS

<u>Construction</u> – During construction, the northern-most portions of the sandbar and adjacent bluff beneath Scenic Road would be disturbed by equipment access, excavation, and wall construction. Much of the footprint shown in Figure 10 is above the ordinary high water mark and therefore is not within designated critical habitat for the S-CCC steelhead DPS. NMFS does

not anticipate construction-related disturbances will result in impacts to critical habitat in the lagoon because the work will occur at a time of year when these areas are dry and no habitat dewatering is proposed (only isolated pockets of groundwater may be encountered during excavation). The placement of rock fill near the parking lot is not expected to appreciably diminish the quality or extent of lagoon rearing habitat because inundation of this area is extremely infrequent and for very brief periods (at maximum flood stage), and because under most conditions the rock will be buried by sand and resemble the surrounding dune, sandy beach habitat. NMFS does not expect there to be observable changes in turbidity in the nearshore environment during construction. Due to the porosity of the sand dunes, any rainfall onto the disturbed area of the beach and bluffs will be absorbed in the sand and therefore not expected to create plumes of turbid runoff to the nearshore environment or the lagoon.

Figure 10. The Carmel Lagoon on September 10, 2018 with the approximate footprint of the SRPS mid-slope toe wall alternative displayed. The footprint of the full-height seawall would follow more closely to Scenic Road and farther inland from the beach. See also Figure 1 and Figure 2. Photo source: Google Earth.

Lagoon function – The protection of Scenic Road will allow for greater flexibility with respect to sandbar management. Recently, sandbar management actions on the north end of the beach have been avoided due to the threat of scour and subsequent road failure. Once Scenic Road is protected, this will allow the MCRMA to implement sandbar management activities along the northern end of the beach when feasible. When the sandbar is opened along the northern end of the beach (e.g., 1993, 2005) it will allow for the formation of a longer outflow channel the development of a more perched formation. In turn, this will reduce the rate and degree of lagoon WSE drawdown, and the long, protective barrier beach limits the direct exchange of saltwater with the lagoon (Figure 11). As described above, the perched lagoon is expected improve critical habitat by providing a greater abundance of residual depth in the lagoon which facilitate better rearing habitat for juvenile steelhead (e.g., predator refuge and continued foraging habitat) and limit the potential reduction of winter foraging habitat during an ISMP event. The slower rate and overall reduced draw down would further reduce the chances of habitat conditions developing that could stranding juvenile steelhead within the outer marshes of the lagoon, or entrain juvenile steelhead into the ocean.

Figure 11. The Carmel Lagoon with the sandbar opened on the northern end of the beach. The photo illustrates how the lagoon maintains a perched condition with a protective barrier beach when the outlet channel is at the northern end of the beach. Photo source: Carmel River Steelhead Association, http://www.carmelsteelhead.org/.

2.6 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02 and 402.17 (a)). 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 ESA.

By 2022, California-American Water must reduce its overutilization of waters from the Carmel River. With the implementation of WR 2016-00016, California-American Water diversions from the Carmel River basin would be reduced to 3,376 acre feet/year. The reduction in water extraction from the basin is expected to improve streamflow conditions in the lower river. Specifically, there is likely to be more years, or portions within years, where the surface flows in the river remain connected to the lagoon. This is expected to improve emigration success for smolts and adults to the lagoon, delay the need for implementation of the summer closure action, and help maintain better water quality conditions in the lagoon. In water years where streamflow remains connected throughout summer and fall, the river may serve as refuge for degraded water quality in the lagoon caused by the deposition and decay of marine-derived debris (e.g. kelp) (Hagar Environmental Sciences 2003; Hayes et al. 2011).

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline vs. cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4).

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat for the conservation of the species.

The Carmel River is a Core 1 (highest priority) population for the recovery of the threatened S-CCC steelhead DPS (NMFS 2013). Although steelhead are present in most streams of the DPS (Good et al. 2005), their populations are significantly less than historical estimates and have become more fragmented, unstable, and vulnerable to stochastic events (Boughton et al. 2006). Most of the approximately 1,251 miles of critical habitat are degraded (70 FR 52488). Severe habitat degradation and the compromised genetic integrity of some populations pose a serious risk to the survival and recovery of the S-CCC steelhead DPS (Good et al. 2005), and therefore the DPS is likely to become endangered in the foreseeable future (Good et al. 2005; 76 FR 76386; Williams et al. 2016; 81 FR 33468).

Steelhead in this DPS have declined in large part as a result of land use activities such as agriculture, mining, and urbanization activities which collectively have contributed to the loss, degradation, and fragmentation of habitat (NMFS 2013). Other anthropogenic influences have included the spread of diseases and invasive species, and increased predation rates. Presently, the greatest threats to the S-CCC steelhead DPS populations are the continued degradation of habitats, passage impediments, and both surface and groundwater use (NMFS 2013). Natural environmental variation (floods and droughts) have also periodically reduced or degraded spawning, rearing, and migratory habitats. The DPS recently experienced one of the worst droughts on record (2012 to 2016), and in 2016 a significant wildfire (Soberanes Fire) burned large areas of the Santa Lucia Mountain Range—including parts of the Carmel River watershed. The threats from projected climate change, including changes in ocean productivity, are likely to exacerbate the effects of environmental variability on steelhead populations and their freshwater and estuarine habitats in the future. As a result, climate change is now recognized as a new and more serious threat to the recovery of the S-CCC steelhead DPS (Williams et al. 2016).

The Carmel River once supported one of the largest steelhead runs in the S-CCC steelhead DPS, however by 1975, the annual run had declined by an estimated 75 percent (NMFS 2013). These declines have largely been attributable to over-utilization of groundwater within the basin, floodplain development, and habitat loss, fragmentation and degradation—including in the lagoon. There are signs of improvement for the population. As noted above, two old standing dams that impeded steelhead passage in the watershed have been removed, Old Carmel River Dam (2015) and San Clemente Dam (2016). During the winter of 2018-19, the number of adult steelhead that returned to the watershed was the largest in nearly a decade with over 120 adults collected and transported over Los Padres Dam (Figure 7; Ohms and Boughton 2019). The large adult return resulted in substantial numbers of juvenile steelhead produced throughout the watershed (Seghesio, E., NMFS, personal communication, August 2019).

The proposed action includes two components—continued implementation of the ISMP and construction of the SRPS. The components will affect the PBFs of critical habitat for S-CCC steelhead in the lagoon, including temporary and seasonal changes in rearing habitat quantity and quality. In 2011, the MCRMA took over responsibility of sandbar management for flood control and, with guidance from NMFS, developed the ISMP to avoid or minimize impacts to steelhead and their habitat within the lagoon. The ISMP includes both winter and summer actions. The winter actions are designed to encourage the lagoon to breach itself through a pre-graded outlet channel that is angled across the beach thereby attempting to mimic natural sandbar breaching processes. This revised method maximizes the volume and WSE in the lagoon prior to opening to the ocean, and encourages the WSE in the lagoon to decline more gradually during the initial draining phase. Summer closure actions are implemented to enhance lagoon habitat quantity and quality by impounding declining freshwater inflow to the lagoon at the beginning of the dry season which prolongs deeper and more optimal water quality conditions in the lagoon for steelhead.

2.7.1 Summary of Effects on Survival and Recovery of S-CCC Steelhead

Winter management of the sandbar for flood protection may cause a small number of juvenile steelhead (no more than 30 annually) to die as a result of stranding within the marsh during the draining of the lagoon. However, NMFS does not expect the number of individuals that die as a result of stranding to differ significantly from the numbers that would die during a natural breach, and in most years NMFS expects no fish will die as a result of the winter ISMP actions. NMFS expects most, or all, juvenile steelhead will avoid standing because the ISMP is designed to mimic natural processes and encourage a more gradual reductions in WSE as the lagoon begins to drain, and because steelhead have evolved utilizing dynamic lagoon habitats that naturally experience periods of rapid filling and draining. The potential loss of a small number of juvenile steelhead relative to the number of juveniles that rear successfully within the lagoon and elsewhere in the watershed will not diminish the abundance, productivity, diversity, or spatial structure of the Carmel River steelhead population, nor the recovery potential for the S-CCC steelhead DPS as a whole.

Under some conditions, the ISMP will cause non-lethal harm to juvenile steelhead by prematurely reducing habitat quantity and therefore their opportunities for continued growth. This would occur during instances when the lagoon fills more gradually and reaches flood stage with more storage space (or freeboard) remaining in the lagoon. If water quality is suitable, the expanded lagoon would otherwise continue to provide opportunities for continued growth by winter rearing juvenile steelhead and smolting steelhead. However, NMFS expects that when necessary, the lagoon will continue to be managed within a few days of when the sandbar would have been expected to breach naturally and that premature sandbar openings estimated at 10 days or more will continue to be rare occurrences. Therefore, in most years, the impact to potential growth will be minimized or avoided. These impacts will be further minimized once the SRPS is constructed which will allow the ISMP to occur on the north end of the beach and thereby facilitate a perched lagoon configuration, or higher minimum WSE post draining.

Opening of the sandbar provides an opportunity for adult steelhead to enter the watershed from the ocean and begin their upstream migration towards their spawning grounds. If the ISMP is implemented during periods with minimal streamflow in the lower Carmel River the seaward flow of water may trigger adult steelhead to enter the lagoon (or lower river) where they would have to wait until streamflow increases. Based on analysis of past sandbar management actions and river flows (1993 to present), these conditions are rare and generally occur during periods outside of the normal adult migration period. In addition, the lagoon and lower sections of the river provide suitable holding habitats for adult steelhead in the form of deep off-channel habitat (South Arm of the lagoon) and complex scour pools beneath dense overhanging vegetation along the margins of the lower Carmel River. Such delays for adult steelhead migration are expected to remain rare and limited to timeframes when adult steelhead are typically not migrating and when runoff and streamflow in the lower river is incapable of providing for upstream migration. Therefore, NMFS does not expect there to be any discernible impacts to adult steelhead or future recovery of the Carmel River population or the S-CCC steelhead DPS.

Due to the nearly annual drying of the lower river in early summer, the ISMP includes a summer closure action to enhance summer-fall rearing habitat quantity and quality in the lagoon. The MCRMA will implement a summer closure if a sandbar management action was implemented the previous winter. While manually closing the sandbar can enhance summer rearing habitat in the lagoon, it may also block access to the ocean for emigrating adults (kelts) and smolts. Therefore, implementation of this action can present a trade-off between substantially improving summer/fall rearing habitat in the lagoon for a larger cohort of juvenile steelhead versus the potential threat of capturing the end of the out-migrating cohort of kelts and smolts. Implementation of this action will be conducted in coordination with NMFS, and is limited to when streamflow in the lower river is less than 20 cfs. In some recent years, the sandbar has formed naturally when streamflow in the lower river was greater than 20 cfs and remained closed due to high percolation rates through the sandbar (see Table 7). Also, successful adult migration through the lower Carmel River is achieved when flows are 30 cfs or greater. Therefore NMFS does not expect there to be many adult steelhead still moving into the lagoon when the streamflow criteria for the summer closure are met. Because the summer closure action will occur under conditions very similar to a natural closure (see Table 7), NMFS expects the frequency and number of adult and smolt steelhead captured in the lagoon as a result of the summer closure action will remain low and very similar to the frequency and numbers of a natural closure. The summer closure, however, is expected to maximize lagoon depths and the amount of freshwater within the lagoon, which will benefit steelhead rearing habitat quality and quantity, reduce predation rates (deeper and more complex lagoon) and improve overall survival and fitness of the population of steelhead.

The construction of the SRPS is expected to avoid impacts to steelhead due to the proposed seasonal work window and because the construction area will be dry. The presence of a protection structure along Scenic Road will increase the MCRMA’s flexibility for sandbar management by allowing the formation of outlet channels on the north end of the beach. In doing so, this will further minimize adverse impacts to steelhead and their habitat by facilitating a longer and more protective outflow channel, and by maintaining a perched lagoon configuration during draining. The perched configuration will maintain a higher water surface elevation while the sandbar is open, which will reduce the amount of potential habitat lost during draining, and it will reduce the volume and magnitude of saltwater exchange into the lagoon during periods when the sandbar is open. Collectively, this will reduce the risk of juvenile steelhead stranding and predation, reduce the amount of lost habitat with each draining, and maintain more optimal water quality conditions for juvenile steelhead and therefore help contribute to the recovery of the Carmel River population.

2.7.2 Summary of Effects on the Value of Critical Habitat for S-CCC Steelhead

As described above, implementation of the ISMP and construction of the SRPS are expected to result in temporary and seasonal impacts to the quality and quantity of habitats utilized by steelhead in the Carmel Lagoon, particularly the PBFs for rearing habitat. The design of the winter management action is intended to avoid flooding of adjacent residential property while minimizing subsequent impacts to habitat quality by enabling the lagoon to fill and crest through the sandbar on its own through a pre-graded area of the sandbar. Although mimicking a natural process, these actions would induce a premature opening of the sandbar and draining of the lagoon. All sandbar breaches (natural or assisted) result in a temporary but substantial loss of habitat space used by winter-rearing juvenile steelhead and smolts. However, the ISMP would cause this loss of rearing space to occur anywhere from 0 to 25 days (as estimated since 1993) prior to when a natural breach would have occurred, with most occurring within 4 days or less of a natural breach. This premature exposure to reduced habitat space (i.e., critical habitat) is likely to translate into minor reductions in prey availability for juvenile steelhead and a small increase in predator success, particularly in years with earlier implementation (i.e., > 10 days prior to a natural breach).

The existing threats to Scenic Road from river and wave scour have forced the MCRMA to avoid implementing the ISMP on the northern end of the beach. Existing information and past breaches on the northern end of the beach have demonstrated that the lagoon maintains a longer and more protective outflow channel and a perched lagoon configuration that minimizes lagoon WSE drawdown and loss of habitat space during a breach. Collectively, the SRPS and the use of the ISMP protocols are expected to greatly minimize or avoid adverse impacts to critical habitat from sandbar management (or any breach). Construction of the SRPS will occur outside of waters used by steelhead during the dry season and therefore will not disrupt the conservation values or PBFs of steelhead rearing or migration in the Carmel Lagoon.

The intent of the summer closure action is to improve rearing habitat conditions in the lagoon during the dry season by mechanically closing the sandbar and trapping the declining freshwater inflow to the lagoon. The creation of a deeper and fresher lagoon impoundment provides more optimal rearing habitat for summer rearing juvenile steelhead. Since 2012, the summer closure has been conducted on three occasions and under similar environmental conditions as the natural closures during this same timeframe (Table 7). Implementation of this action is expected to occur at a similar frequency and under similar conditions as those observed since 2012. NMFS expects implementation of this action will continue to minimize the more deleterious impacts of upstream over utilization of waters from the Carmel River basin that cause the lower river to dry in most years and earlier than natural.

NMFS' recovery plan for the S-CCC steelhead DPS identifies critical recovery actions for the Carmel River population which includes the following:

"*Identify, protect, and where necessary, restore estuarine and freshwater rearing habitats (including supplemental water to the estuary, management of artificial sandbar breaching at the river's mouth, and provision of spawning gravel and large woody debris within the lower mainstem)*" (NMFS 2013, Page 7-12 and 7-13).

The ISMP was developed and finalized (Corps et al. 2013) after the completion of the S-CCC steelhead recovery plan. Implementation of the improved sandbar management strategy (i.e., ISMP) and future ability to allow the lagoon to breach on the northern end of the beach will contribute positively towards the continued restoration of the estuarine habitats in the Carmel Lagoon. Due to the importance of the Carmel River population for the recovery of the S-CCC steelhead DPS, NMFS expects the work to restore the Carmel Lagoon and the essential habitat it provides will improve the resiliency and recovery potential for the remainder of the S-CCC DPS.

2.7.3 Climate Change and Future Restoration Actions

Regarding future climate change effects in the action area, California may be subject to warmer average summer air temperatures and reduced annual precipitation totals. In general, reductions in the amount of precipitation is expected to reduce streamflow levels in central coast watersheds. Seasonally closed lagoons, like Carmel, may also experience changes in productivity due to changes in freshwater inflow and nutrient cycling, changes in the frequency and duration of open sandbar conditions, and changes in the amount of sediment delivered from the upper watershed. Scientists find it difficult to separate future climate change impacts from ongoing natural variability during short timeframes (like a decade) because the climate change signal during these brief periods is very small (Cox and Stephenson 2007; McClure et al. 2013).

This biological opinion evaluates the effects of the ISMP over the next 10 years. The above effects of climate change will not be discernable from recent natural variability within that timeframe (i.e., severe droughts, floods, and fires). The short-term adverse effects of the ISMP and SRPS would have completely elapsed prior to realization of the longer-term climate change effects discussed above in the status of the species. However, some ongoing, anthropogenic activities that are currently major stresses on steelhead recovery and the health of their critical habitat will be reduced in the near future. Streamflow dynamics in the Carmel River, including the frequency and duration of inflow to the lagoon during the dry season, are expected to improve. California-American Water must implement actions to eliminate is unauthorized diversions from the Carmel River by December 31, 2021. The substantial reduction in groundwater pumping will improve streamflow to and water quality within the Carmel Lagoon, improve migration success for post-spawned kelts and smolts prior to sandbar closure, and will likely reduce, or postpone, the need for the summer closure action.

Future restoration actions in and around the lower Carmel River are expected to provide some level of climate change resiliency for the lagoon and the estuarine habitats within. The Carmel River Floodplain Restoration and Environmental Enhancement project is expected to occur immediately upstream of State Route 1 and will include opening sections of levee along the lower river (left bank), grading and enhancement of floodplain topography, and the replacement of sections of State Route 1 with an open causeway that will facilitate floodwater access into the upstream end of the South Arm of the Carmel Lagoon. Across the river and just upstream, plans are underway for the restoration of the former Rancho Cañada Golf Course, now owned and managed by Monterey Peninsula Regional Parks District as part of the Palo Corona Regional Park. Portions of the property will be enhanced to increase access and opportunity for floodplain connectivity, which is extremely limited along the lower Carmel River. Collectively, these projects will provide a corridor of protected, large open-space areas. As sea-levels rise and habitats/ecosystems are shifted inland, these enhanced open space areas near the current riverine-estuarine interface will provide space for estuarine habitat to evolve.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of threatened S-CCC steelhead.

After reviewing and analyzing the current status of the critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to destroy or adversely modify S-CCC steelhead designated critical habitat.

2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a 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. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take, or harm, is reasonably certain to occur as a result the ISMP. The number of threatened steelhead that may be affected by the proposed project is expected to be small, and limited to the juvenile life stage.

Incidental take is anticipated to occur as a result of stranding during the rapid draining of the lagoon. NMFS estimates a small number of juvenile steelhead (30 individuals or less annually) may die as a result of stranding. Counting all juvenile steelhead injured or killed by standing as a result of the ISMP is not feasible due to their small body size, the difficulty of observing dead or injured fish in the low visibility of the lagoon or surf zone, the large area and dense vegetation, and the prevalence of natural scavengers. Because fish stranding is closely linked to rapid changes in WSE resulting from lagoon draining, NMFS will use observed changes in WSE (i.e., the rate of lagoon draining) as a surrogate for the amount of incidental take. For the ISMP, NMFS will assume the rate of draining will not exceed a 25 percent increase above the maximum rate observed and as presented in Table 5 in the above biological opinion. Draining rates will vary each year (as shown in Table 5) due to natural conditions and the specific configuration of sandbar management. In NMFS' best professional judgement, a draining rate more than 25 percent above the maximum observed since 2012 would be likely to increase the rate of stranding to above 30 individuals.

NMFS assumes most juvenile steelhead in the lagoon will not be killed as a result of the ISMP, but in some years juvenile steelhead may be harmed by notable premature reductions in habitat quantity, or availability. As described above in the biological opinion's Effects section, we define notable premature reductions in habitat quantity as an ISMP event that results in the first sandbar breach of the season and that occurs 10 days or more prior to a projected natural breach date. Such instances are less common as the ISMP is typically implemented within 4 days or less of when a natural breach would have occurred. NMFS assumes this premature reduction in habitat quantity will impact winter juvenile steelhead rearing—feeding and growth. Because it is impossible to know the exact extent to which winter juvenile steelhead are foraging at the time of implementation, NMFS will use the frequency of the notable premature reductions in habitat quantity as a surrogate for the amount of incidental take. Specifically, based on the observations described above in the biological opinion, NMFS does not expect more than three notable premature draining actions over a ten year period. Once the SRPS is constructed, the impact of any premature sandbar management is expected to be further minimized because the amount or extent of lagoon draining and changes to water quality will be further reduced as describe above in the biological opinion.

To summarize, the extent of incidental take is likely to be exceeded if any of the following occur:

- Based on the available data from recent ISMP events, the likelihood of biologists encountering stranded, live juvenile steelhead is very low. However, if stranded juvenile steelhead are encountered incidental take will be exceeded if more than 30 juvenile steelhead require rescue.
- If an ISMP event results in a lagoon draining rate that is higher than a 25 percent increase above the maximum rate stated in Table 5 of the biological opinion.
- If the first sandbar opening of the year is an ISMP action conducted 10 days or more prior to when a natural breach would have been expected in more than 3 years during the next 10 year period.

2.9.2 Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed actions, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of S-CCC steelhead:

1. Undertake measures to ensure that harm and mortality to S-CCC steelhead resulting from project implementation are low.
2. Prepare and submit reports, which summarize annual implementation of the ISMP, and post-construction site conditions for the SRPS.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the Corps or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). The Corps or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

The following terms and conditions implement reasonable and prudent measure 1:

- The Corps, the applicant, or their consultant, will ensure a qualified biologist with expertise in the areas of anadromous salmonid biology, including handling, collecting, and relocating salmonids; salmonid/habitat relationships; and biological monitoring of salmonids is available to conduct capture and relocation activities for any stranded fish. The Corps, the applicant, or their consultant, will ensure that all biologists working on the project are qualified to identify steelhead and conduct fish collections in a manner which minimizes all potential risks to steelhead.

- Any steelhead captured will be handled with extreme care and kept in water to the maximum extent possible during relocation activities. All captured steelhead must be kept in cool, shaded, and aerated water protected from excessive noise, jostling, or overcrowding any time they are not in the estuary, and steelhead will not be removed from this water expect when released. To avoid predation, the biologists will have at least two containers and segregate small, or young, juveniles from larger, or older age-classes, and other potential predators. Captured steelhead will be relocated as soon as possible downstream of (i.e., towards the lagoon's main embayment) the pipeline crossing.

- If any steelhead are found dead or injured, the biologists will contact NMFS biologist, Joel Casagrande, by phone immediately at (707) 575-6016 or the NMFS North Central Coast Office located in Santa Rosa, California at (707) 575-6050. The purpose of the contact is to review the activities resulting in take, determine if additional protective measures are required, and to ensure appropriate collection and transfer of steelhead mortalities and tissue samples. All steelhead mortalities will be retained. Tissue samples are to be acquired from each salmonid mortality per the methods identified in the NMFS Southwest Fisheries Science Center Genetic Repository protocols (contact the above NMFS staff for directions) and sent to: NOAA Coastal California Genetic Repository; Southwest Fisheries Science Center; 110 McAllister Way; Santa Cruz, California 95060. The steelhead mortalities (following acquisition of genetic sample material) are to be retained, placed in an appropriately-sized sealable plastic bag, labeled with the date and location of collection, and fork length, and be frozen as soon as possible. Frozen steelhead mortalities will be retained by the biological monitor until specific instructions are provided by the NMFS contact named above. Tissue samples are to be stored at ambient temperature. The biological monitor may not transfer steelhead mortalities to anyone other than the NMFS contact identified above without obtaining prior approval from NMFS' Central Coast Branch Chief. Any such transfer will be subject to such conditions as NMFS deems appropriate.

The following terms and conditions implement reasonable and prudent measure 2:

- **ISMP Monitoring Report –** Within 14 days of implementing ISMP activities, the MCRMA will submit a report to NMFS summarizing: (1) attempted and/or completed ISMP actions, (2) steelhead observations and their dispositions, (3) changes in hydrologic conditions (e.g., river inflow, tide levels and water surface elevation before, during, and after implementation), and (4) the range of measured elevations of the sandbar within 5 days prior to implementation of the ISMP winter action.

- **Scenic Road Protection Structure Post-Construction Report –** On or before January 15 following the completion of the SRPS, a report must be submitted to NMFS that provides a comprehensive summary of the construction, a description of any unforeseen project impacts (if applicable), and measures taken to resolve the unforeseen impacts (if applicable). The report will include photos of the area during prior to, during and following construction.

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02). NMFS has no conservation recommendations at this time.

2.11 Reinitiation of Consultation

This concludes formal consultation for the Carmel Lagoon Scenic Road Protection Structure and Interim Sandbar Management Plan Project.

As 50 CFR 402.16 states, reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) 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 (4) a new species is listed or critical habitat designated that may be affected by the action.

3 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the Corps and descriptions of EFH for the Pacific Coast Groundfish and the Coastal Pelagic Species Fishery Management Plans (PFMC 2014; PFMC 2011) developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

EFH managed under the Pacific Coast Groundfish Fishery Management Plan (FMP) (PFMC 2016) and Coastal Pelagic Species FMP (PFMC 2019) may be adversely affected by the project. Project construction will be limited to a relatively small portion of the lagoon habitat. Areas of the Carmel Lagoon are known to support Pacific Coast Groundfish species such as Starry Flounder (*Platichthys stellatus*). The boundary of EFH for the Coastal Pelagic Species FMP is defined as all marine and estuarine waters from the shoreline along the coasts of California, Oregon, and Washington offshore to the limits of the Exclusive Economic Zone and above the thermocline where sea surface temperatures range between 10°C to 26°C (PFMC 2019). The Carmel Lagoon may provide potential habitat for these species, however, because the lagoon is closed to the ocean seasonally, the function and value of the habitat for Coastal Pelagic Species may be limited when the sandbar is closed. Species managed under the Coastal Pelagic Species FMP, such as northern anchovy (*Engraulis mordax*) and Pacific sardine (*Sardinops sagax caerulea*), are not known to occur within the Carmel Lagoon.

The lagoon, a type of estuary, is identified as a Habitat Area of Particular Concern (HAPC). HAPCs are considered high priority areas for conservation, management, or research because they are rare, sensitive, stressed by development, or important to ecosystem function. Although these habitats are particularly important for healthy fish populations, other EFH areas that provide suitable habitat functions are also necessary to support and maintain sustainable fisheries and a healthy ecosystem. The HAPC designation does not necessarily mean additional protections or restrictions upon an area, but they help to prioritize and focus conservation efforts. Federal projects that may adversely affect HAPC are more carefully scrutinized during the consultation process.

3.2 Adverse Effects on Essential Fish Habitat

NMFS determined the proposed action, specifically the ISMP, would adversely affect EFH for Pacific Coast Groundfish. Species that are federally managed under the Pacific Coast Groundfish FMP may depend on the natural function of the sandbar at the mouth of Carmel Lagoon. The sandbar management and re-establishment/summer management activities described in the proposed project would adversely affect EFH by altering the timing of the sandbar's natural function. For example, if the configuration of the sandbar was open in April, artificially closing the sandbar earlier could limit juvenile starry flounder from accessing marine resources for prey and their continued development.

Although adverse effects to EFH are likely, the proposed avoidance and minimization measures are anticipated to limit project effects to a minimal level. For example, closing the sandbar in spring to optimize lagoon water levels for S-CCC steelhead is expected to occur at a time that is relatively similar to the timing of natural sandbar closure, and grading the sandbar during winter is intended to facilitate a more natural breach. Therefore, these actions are not expected to appreciably diminish the value of the lagoon or its habitat quality for species managed under the Pacific Coast Groundfish FMP or those offshore under the Coastal Pelagic Species FMP. In fact, while it may briefly truncate the window for these species to move between the marine and estuarine environments, the benefits to water quality within the lagoon from the summer closure action are expected to improve water quality for Pacific Coast Groundfish. The capture of more freshwater in the lagoon is intended to reduce the extent and duration of vertical water column stratification. Under stratified conditions, the water column can become anoxic at depth. These conditions are especially problematic for groundfish species, such as starry flounder, which are restricted to the bottom of the lagoon. Construction of the SRPS is not expected to adversely affect EFH for either the Pacific Coast Groundfish or the Coastal Pelagic Species FMPs because construction will be limited to working in the dry and disruption of waters and flooded habitats used by these fisheries will be avoided. As noted in the biological opinion, the SRPS is expected to facilitate management actions that would further reduce impacts to the EFH habitat in the lagoon by allowing for implementation of the ISMP at the northern end of the beach.

3.3 Essential Fish Habitat Conservation Recommendations

There are no practical EFH Conservation Recommendations to provide because impacts to EFH are expected to minor, temporary, localized, or addressed through avoidance and minimization measures.

3.4 Supplemental Consultation

The Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that effects the basis for NMFS' EFH Conservation Recommendations (50 CFR600.920(1)).

4 DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these

DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the Corps and the MCRMA. Other interested users could include State Parks, the California Department of Fish and Wildlife, the U.S. Fish and Wildlife Service, the Central Coast Regional Water Quality Control Board, and the public. This opinion will be available through the NOAA Institutional Repository (https://repository.library.noaa.gov/), after approximately two weeks. The format and naming adheres to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion and EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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