UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

Refer to NMFS Consultation No.:
WCRO-2019-00561

January 23, 2020

Michael Beyer
State Environmental Coordinator
USDA Rural Development
1220 SW 3rd Avenue, Suite 1801
Portland, Oregon 97204

https://doi.org/10.25923/pdhx-ht35

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Brookings Wastewater System Improvements

Dear Mr. Beyer:

Thank you for your letter of May 15, 2019, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the U.S. Department of Agriculture – Rural Utility Service's funding of the Brookings Wastewater System Improvements.

Updates to the regulations governing interagency consultation (50 CFR part 402) became effective on October 28, 2019 [84 FR 44976]. This consultation was pending at that time, and we are applying the previous regulations to the consultation. As the preamble to the final rule adopting new 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 off the updated regulations and conclude the opinion is fully consistent with the updated regulations.

In this opinion, we concluded the proposed action is not likely to jeopardize the continued existence of Southern Oregon Northern California Coast coho salmon (*Oncorhynchus kisutch*), southern distinct population segment (DPS) Pacific eulachon (*Thaleichthys pacificus*), and southern DPS North American green sturgeon (*Acipenser medirostris*) or their designated critical habitat.

As required by section 7 of the ESA, we are providing an incidental take statement (ITS) with the opinion. The ITS describes reasonable and prudent measures NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this program. The ITS also sets forth nondiscretionary terms and conditions, including reporting requirements, that the Federal action agencies must comply with to carry out the reasonable and prudent measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of the listed species considered in this biological opinion.

The NMFS also reviewed the likely effects of the proposed action on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)), and concluded that the action would adversely affect the EFH of Pacific Coast salmon, Pacific Coast groundfish, and coastal pelagic species. Therefore, we have included the results of that review in Section 3 of this document, including two conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH.

Section 305(b)(4)(B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations. If the response is inconsistent with the EFH conservation recommendations, the action agency must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the effects of the program and the recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, we established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we request that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

Please direct questions regarding this opinion to Jeff Young, fish biologist in the Oregon Coast Branch of the Oregon Washington Coastal Area Office at 541.957.3389 or jeff.young@noaa.gov.

Sincerely,

Kim W. Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

cc: Sam Goldstein, USDA

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

Brookings Wastewater System Improvements

NMFS Consultation Number: WCRO-2019-00561

Action Agency: USDA Rural Utility Service

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?
Southern Oregon Northern California Coast coho salmon	Threatened	Yes	No	No	No
Green sturgeon	Threatened	Yes	No	Yes	No
Eulachon	Threatened	Yes	No	No	No

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 Salmon	Yes	Yes
Pacific Coast Groundfish	Yes	Yes
Coastal Pelagic Species	Yes	Yes

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

Issued By:

Kim W. Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

Date: January 23, 2020

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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

The 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 U.S.C. 1531 et seq.), and implementing regulations at 50 CFR 402.

Updates to the regulations governing interagency consultation (50 CFR part 402) became effective on October 28, 2019 [84 FR 44976]. This consultation was pending at that time, and we are applying the previous regulations to the consultation. As the preamble to the final rule adopting new 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 off 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). A complete record of this consultation is on file at the Oregon Coast Branch in Roseburg, Oregon.

1.2 Consultation History

On February 7, 2019, we met with the U.S. Department of Agriculture – Rural Utility Service (USDA RUS) to discuss the Brookings Wastewater System Improvements (proposed action) relative to the effects on ESA-listed species and consultation under section 7 of the ESA. In reviewing the proposed action, we coordinated with the engineering consultant to obtain the following information to conduct our review:

- The environmental assessment (EA), received on February 8, 2019.
- Brookings wastewater treatment plant (WWTP) whole effluent toxicity testing results, received on April 1, 2019.
- Brookings WWTP effluent performance data, received on April 1, 2019.

On May 15, 2019, we received a letter, and updated biological assessment (BA) from RUS requesting initiation of consultation under section 7 of the ESA for the effects of the proposed action on ESA-listed species, and designated critical habitat. In their letter, RUS determined that the proposed action was not likely to adversely affect ESA-listed species or their habitat (Table 1). We initiated consultation on May 15, 2019.

Table 1. Federal Register notices for final rules that list threatened and endangered species, designate critical habitats, or apply protective regulations to listed species considered in this consultation. Listing status: "T" means listed as threatened under the ESA.

Species		Listing Status	Critical Habitat	Protective Regulations
Marine and Anadromous Fish				
Coho salmon (*Oncorhynchus kisutch*)				
	Southern Oregon Northern California Coast	T 6/28/05; 70 FR 37160	5/5/99; 64 FR 24049	6/28/05; 70 FR 37160
North American green sturgeon (*Acipenser medirostris*)[1]				
	Southern	T 4/07/06; 71 FR 17757	10/09/09; 74 FR 52300	6/02/10; 75 FR 30714
Pacific eulachon (*Thaleichthys pacificus*)[2]				
	Southern	T 3/18/10; 75 FR 13012	10/20/11; 76 FR 65324	Not applicable

The USDA RUS' letter did not include an effects determination for designated EFH. The action area is designated as EFH for various life stages of groundfish (PFMC 2005), coastal pelagics (PFMC 1998), and Pacific salmon (PFMC 2014) and may adversely affect EFH for those species (see Section 3 of this document).

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). For EFH, Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910). The proposed action consists of the USDA's funding of improvements to the City of Brookings' (City) wastewater system to correct current deficiencies and extend the useful life of the collection system, pump stations and water treatment plant by reducing peak flows, improving reliability, providing a durable system and reducing ongoing operation and maintenance costs. The City has had problems with inflow and infiltration and reducing inflow and infiltration in the collection system will accommodate anticipated significant area growth. Improvements are to ensure the wastewater system infrastructure can accommodate the City's need for a functioning wastewater system into the future and beyond the life of the existing system.

1.3.1 Collection System Repairs and Improvements

Collection system repairs and improvements are intended to increase capacity and extend the useful service life of the wastewater collection system. The proposed improvements to the wastewater collection system includes continued evaluation of the collection system and completing repairs that will correct inflow and infiltration of the existing collection system.

[1] Hereafter referred to as 'green sturgeon'.
[2] Hereafter referred to as 'eulachon'.

Inflow and infiltration repairs are grouped into Priority 1 and Priority 2 repairs. Priority 1 repairs consist of repair of two catch basins, 17 leaking manholes, 67 identified leaking cleanouts, and further investigation and completion of appropriate point repairs within 3,000 specific feet of pipeline. Priority 2 repairs include the repair of two plugged house vents, and removal of five roof drain connections, further investigation and completion of appropriate point repairs within 4,000 feet of pipeline, and repair of 33 leaking laterals.

New sewer improvements to serve Lone Ranch vicinity and Harbor Sanitary District

These sewer improvements include installing an 18-inch relief interceptor along Wharf Street, replacing existing lines that are currently in poor condition, and installation of a 30-inch diameter sewer line that will increase the gravity flow capacity to the wastewater treatment plant. Additionally, the City will replace existing lines associated with the Lone Ranch Development (will be funded and constructed upon the resurgence of the housing market). These repairs are intended to increase capacity to accommodate future growth and extend the useful service life of the wastewater collection system.

Sewer main replacements or rehabilitation

The City will repair or replace defective and/or undersized sewer pipelines that are located in the older portion of Brookings. These repairs address inflow and infiltration reduction, potential pipeline failure (useful service life), and capacity issues.

1.3.2 Pump Station Repairs

Pump station repairs are grouped into three groups and will improve efficiency, eliminate overflows, and extend the useful service life of each pump station for the 20-year planning period. Each pump station project is summarized below:

- Project No. 1: This project would refurbish the pump guide rails for Buena Vista Loop, Cypress Cove, Mill Beach, and Dawson Tract No. 3, 4, and 5 pump stations to sustain adequate servicing during the 20-year planning period. It would also include installation of aboveground fuel storage tanks for Dawson Tract No. 4 and 5 pump stations and a moisture detection device at Dawson Tract No. 3 pump station. Properly maintaining pumps will extend the life expectancy of equipment, as well as provide for lower operation, maintenance, and energy costs.
- Project No. 2: This project would replace valves, control panels, and pumps at all pump stations in the City, repair all existing leaks at the Dawson Tract No. 4 and Beach Avenue pump stations, and purchase a high-pressure jet washing system. This project will improve energy efficiency, eliminate potential overflows, and reduce operation costs.
- Project No. 3: This project would refurbish pump station lighting, result in purchase of two back-up generators, and installation of soft-starters for each pump, which would improve cost and efficiency.

1.3.3 Wastewater Treatment Plant Upgrades

The City will upgrade the WWTP to address multiple deficiencies throughout the plant, which, if not addressed, will negatively affect maintenance efforts and the long-term ability to support the City's treatment needs and maintain permit compliance. Corrosion protection, equipment upgrades, and changes in process systems will reduce maintenance, improve performance and extend the useful life of the plant. Upgrades to the WWTP include coating and corrosion control; headworks upgrades consisting of replacement a mechanical bar screen, classifier, and degritter; primary clarifier rehabilitation; trickling filter rehabilitation; blower building rehabilitation; reaeration system rehabilitation; repairs to the older and newer secondary clarifiers including replacement of weirs and baffles and waste and return activated sludge pumps; UV system replacement; digester burner replacement; piping and overflow modifications to the digester; and temporary conversion of sludge storage tanks 2 and 3 to digesters.

1.3.4 Other Activities Caused by the Proposed Action

We considered whether or not the proposed action would cause any other activities and determined that the proposed action is reasonably certain to cause the Lone Ranch Development. New sewer improvements to serve the Lone Ranch vicinity, which will accommodate future growth in the area including the Lone Ranch Development, which would not occur but for the sewer improvements there.

The Lone Ranch development master plan approved by the City includes up to 1,000 residential units composed of townhomes, single-family detached homes, and condominiums with a clubhouse, neighborhood park, and small commercial area to serve the residents (Figure 1). Associated with the development would be the creation of impervious surfaces from the building of residential units, other buildings, roads, sidewalks, driveways, and parking lots. At this time, there is no reliable way to develop an accurate estimate of the acreage of total impervious surfaces created by the construction of the Lone Ranch Development. While the locations of stormwater discharge from the development are unknown at this time, we will give the benefit of the doubt to the ESA-listed species covered by this opinion and assume that discharge will occur in the Pacific Ocean near the development location through surface waters of drainages within the development site.

Figure 1. Conceptual plan for Lone Ranch Development.

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 for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214).

The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace 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.

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

- Identify the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.

- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.
- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

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.

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.

One factor affecting the status of ESA-listed species considered in this opinion, and aquatic habitat at large, is climate change. Climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. The largest hydrologic responses are expected to occur in basins with significant snow accumulation, where warming decreases snow pack, increases winter flows, and advances the timing of spring melt (Mote *et al.* 2014, Mote *et al.* 2016). Rain-dominated watersheds and those with significant contributions from groundwater may be less sensitive to predicted changes in climate (Tague *et al.* 2013, Mote *et al.* 2014).

During the last century, average regional air temperatures in the Pacific Northwest increased by 1-1.4°F as an annual average, and up to 2°F in some seasons (based on average linear increase per decade; Abatzoglou *et al*. 2014, Kunkel *et al.* 2013). Warming is likely to continue during the next century as average temperatures are projected to increase another 3-10°F, with the largest increases predicted to occur in the summer (Mote *et al.* 2014).

Decreases in summer precipitation of as much as 30% by the end of the century are consistently predicted across climate models (Mote *et al.* 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB 2007, Mote *et al.* 2013). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007, Mote *et al.* 2013). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western United States (Dominguez *et al.* 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote *et al.* 2014).

Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua *et al.* 2009). Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB 2007). Reduced flows will make it more difficult for migrating fish to pass physical and thermal obstructions, limiting their access to available habitat (Mantua *et al.* 2010, Isaak *et al.* 2012). Temperature increases shift timing of key life cycle events for salmonids and species forming the base of their aquatic foodwebs (Crozier *et al.* 2011, Tillmann and Siemann 2011, Winder and Schindler 2004). Higher stream temperatures will also cause decreases in dissolved oxygen and may also cause earlier onset of stratification and reduced mixing between layers in lakes and reservoirs, which can also result in reduced oxygen (Meyer *et al.* 1999, Winder and Schindler 2004, Raymondi *et al.* 2013). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier et al. 2008, Wainwright and Weitkamp 2013, Raymondi *et al.* 2013).

As more basins become rain-dominated and prone to more severe winter storms, higher winter stream flows may increase the risk that winter or spring floods in sensitive watersheds will damage spawning redds and wash away incubating eggs (Goode *et al.* 2013). Earlier peak stream flows will also alter migration timing for salmon smolts, and may flush some young salmon and steelhead from rivers to estuaries before they are physically mature, increasing stress and reducing smolt survival (McMahon and Hartman 1989, Lawson *et al.* 2004).

In addition to changes in freshwater conditions, predicted changes for coastal waters in the Pacific Northwest because of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Mote *et al.* 2014). Elevated ocean temperatures already documented for the Pacific Northwest are highly likely to continue during the next century, with sea surface temperature projected to increase by 1.0-3.7°C by the end of the century (IPCC 2014). Habitat loss, shifts in species' ranges and abundances, and altered marine food webs could have substantial consequences to anadromous, coastal, and marine species in the Pacific Northwest (Tillmann and Siemann 2011, Reeder *et al.* 2013).

Moreover, as atmospheric carbon emissions increase, increasing levels of carbon are absorbed by the oceans, changing the pH of the water. Acidification also affects sensitive estuary habitats, where organic matter and nutrient inputs further reduce pH and produce conditions more corrosive than those in offshore waters (Feely *et al*. 2012, Sunda and Cai 2012).

Global sea levels are expected to continue rising throughout this century, reaching likely predicted increases of 10-32 inches by 2081-2100 (IPCC 2014). These changes will likely result in increased erosion and more frequent and severe coastal flooding, and shifts in the composition of nearshore habitats (Tillmann and Siemann 2011, Reeder *et al.* 2013). Estuarine-dependent salmonids such as chum and Chinook salmon are predicted to be impacted by significant reductions in rearing habitat in some Pacific Northwest coastal areas (Glick *et al.* 2007).

Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances, and therefore these species are predicted to fare poorly in warming ocean conditions (Scheuerell and Williams 2005, Zabel *et al.* 2006). This is supported by the recent observation that anomalously warm sea surface temperatures off the coast of Washington from 2013 to 2016 resulted in poor coho and Chinook salmon body condition for juveniles caught in those waters (NWFSC 2015). Changes to estuarine and coastal conditions, as well as the timing of seasonal shifts in these habitats, have the potential to affect a wide range of listed aquatic species (Tillmann and Siemann 2011, Reeder *et al.* 2013).

The adaptive ability of these threatened and endangered species is depressed due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. Without these natural sources of resilience, systematic changes in local and regional climatic conditions due to anthropogenic global climate change will likely reduce long-term viability and sustainability of populations in many of these evolutionarily significant unit's ESUs (NWFSC 2015). New stressors generated by climate change, or existing stressors with effects that have been amplified by climate change, may also have synergistic impacts on species and ecosystems (Doney *et al.* 2012). These conditions will possibly intensify the climate change stressors inhibiting recovery of ESA-listed species in the future.

2.2.1 Status of Critical Habitat

This section describes the status of designated critical habitat affected by the proposed action by examining the condition and trends of the essential PBFs of that habitat throughout the designated areas (Table 2). These features are essential to the conservation of the ESA-listed species because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging). The action area is designated critical habitat for Southern Oregon/Northern California Coast (SONCC) coho salmon (*Oncorhynchus kisutch*) in Taylor, Duley, Ram, and Lone Ranch Creeks. The action area is designated critical habitat for green sturgeon in the Pacific Ocean at the WWTP outfall.

Table 2. Critical habitat, designation date, federal register citation, and status summary for critical habitat considered in this opinion.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Southern Oregon/Northern California Coast coho salmon	5/5/99 64 FR 24049	Critical habitat includes all areas accessible to any life-stage up to long-standing, natural barriers and adjacent riparian zones. SONCC coho salmon critical habitat within this geographic area has been degraded from historical conditions by ongoing land management activities. Habitat impairments recognized as factors leading to decline of the species that were included in the original listing notice for SONCC coho salmon include: 1) Channel morphology changes; 2) substrate changes; 3) loss of in-stream roughness; 4) loss of estuarine habitat; 5) loss of wetlands; 6) loss/degradation of riparian areas; 7) declines in water quality; 8) altered stream flows; 9) fish passage impediments; and 10) elimination of habitat
Southern DPS of green sturgeon	10/09/09 74 FR 52300	Critical habitat has been designated in coastal U.S. marine waters within 60 fathoms depth from Monterey Bay, California (including Monterey Bay), north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to its United States boundary; the Sacramento River, lower Feather River, and lower Yuba River in California; the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays in California; tidally influenced areas of the Columbia River estuary from the mouth upstream to river mile 46; and certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor), including, but not limited to, areas upstream to the head of tide in various streams that drain into the bays, as listed in Table 1 in USDC (2009). The critical habitat review team (CHRT) identified several activities that threaten the PBFs in coastal bays and estuaries and necessitate the need for special management considerations or protection. The application of pesticides is likely to adversely affect prey resources and water quality within the bays and estuaries, as well as the growth and reproductive health of Southern DPS green sturgeon through bioaccumulation. Other activities of concern include those that disturb bottom substrates, adversely affect prey resources, or degrade water quality through re-suspension of contaminated sediments. Of particular concern are activities that affect prey resources. Prey resources are affected by: commercial shipping and activities generating point source pollution and non-point source pollution that discharge contaminants and result in bioaccumulation of contaminants in green sturgeon; disposal of dredged materials that bury prey resources; and bottom trawl fisheries that disturb the bottom (but result in beneficial or adverse effects on prey resources for green sturgeon).

2.2.2 Status of ESA-listed Species

Table 3 below provides a summary of listing and recovery plan information, status summaries and limiting factors for the species addressed in this opinion. More information can be found in recovery plans and status reviews for these species. Acronyms appearing in the table include DPS (Distinct Population Segment) and ESU (Evolutionarily Significant Unit).

Table 3. Listing classification and date, recovery plan reference, most recent status review, status summary, and limiting factors for each species considered in this opinion.

Species	Classification Date	Recovery plan	Status Review		
Southern DPS of green sturgeon	Threatened 4/7/06	NMFS 2018	NMFS 2015	The Sacramento River contains the only known green sturgeon spawning population in this DPS. The current estimate of spawning adult abundance is between 824-1,872 individuals. Telemetry data and genetic analyses suggest that Southern DPS green sturgeon generally occur from Graves Harbor, Alaska to Monterey Bay, California and, within this range, most frequently occur in coastal waters of Washington, Oregon, and Vancouver Island and near San Francisco and Monterey bays. Within the nearshore marine environment, tagging and fisheries data indicate that Northern and Southern DPS green sturgeon prefer marine waters of less than a depth of 110 meters.	• Reduction of its spawning area to a single known population • Lack of water quantity • Poor water quality • Poaching
Southern DPS of eulachon	Threatened 3/18/10	NMFS 2017	Gustafson et al. 2016	The Southern DPS of eulachon includes all naturally-spawned populations that occur in rivers south of the Nass River in British Columbia to the Mad River in California. Sub populations for this species include the Fraser River, Columbia River, British Columbia and the Klamath River. In the early 1990s, there was an abrupt decline in the abundance of eulachon returning to the Columbia River. Despite a brief period of improved returns in 2001-2003, the returns and associated commercial landings eventually declined to the low levels observed in the mid-1990s. Although eulachon abundance in monitored rivers has generally improved, especially in the 2013-2015 return years, recent poor ocean conditions and the likelihood that these conditions will persist into the near future suggest that population declines may be widespread in the upcoming return years	• Changes in ocean conditions due to climate change, particularly in the southern portion of the species' range where ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success. • Climate-induced change to freshwater habitats • Bycatch of eulachon in commercial fisheries • Adverse effects related to dams and water diversions • Water quality, • Shoreline construction • Over harvest • Predation
Southern Oregon/ Northern California Coast coho salmon	Threatened 6/28/05	NMFS 2014	NMFS 2016	This ESU comprises 31 independent, 9 independent, and 5 ephemeral populations all grouped into 7 diversity strata. Of the 31 independent populations, 24 are at high risk of extinction and 6 are at moderate risk of extinction. The extinction risk of an ESU depends upon the extinction risk of its constituent independent populations; because the population abundance of most independent populations are below their depensation threshold, the SONCC coho salmon ESU is at high risk of extinction and is not viable	• Lack of floodplain and channel structure • Impaired water quality • Altered hydrologic function • Impaired estuary/mainstem function • Degraded riparian forest conditions • Altered sediment supply • Increased disease/predation/competition • Barriers to migration • Fishery- and Hatchery related effects

Chetco River population of SONCC coho salmon

The Chetco River population is functionally independent and in the northern sub-stratum of the coastal sub-basins strata (Williams *et al.* 2006). It is one of three historically independent populations within the northern coastal sub-stratum.

Estimates of the historical population size of SONCC coho salmon in the Chetco River vary widely. Chetco River coho salmon were historically "a fair sized run" (USFS 1996). Local residents described coho salmon in the Chetco River as formerly abundant and the target of a net fishery (Maguire 2001b). Coho salmon extensively used lower tributaries with estuarine tributary Tuttle Creek noted as having particularly large runs of coho salmon. The historical population has been estimated to be as high as approximately 68,000 adult spawners.[3] In contrast, a panel discussion of fisheries professionals estimated a historical population between 5,000 and 8,000.[4]

There is not sufficient reliable data to develop dependable abundance numbers. The overall population productivity for Chetco River coho salmon appears to be very low and current abundance is likely below the depensation threshold of 135 adults (NMFS 2014). The only available data on spawner returns comes from the Oregon Department of Fish and Wildlife (ODFW) Chinook salmon spawning surveys (1998-2012) which occasionally document coho salmon.[5] The ODFW estimates annual returns based on these surveys, but the reliability and utility of the data and the associated estimates is low because, the surveys did not target coho salmon, their geographic scope misses many of the coho spawning grounds, and coho salmon spawning may not occur at the same times as that of Chinook salmon (NMFS 2014).[6] The ODFW's estimated average adult returns over the last 5 years is 108 coho salmon. For the 5 years prior (2008-2012), the average annual return was 81 adults.[7] While this appears like a positive trend, the reliability of the ODFW spawning surveys is too low and variability of the resulting data is too high to be reasonably certain. These estimates were derived using three to nine surveys per year, detecting between one and five fish each year.

Little information is available for juvenile SONCC coho salmon abundance in the Chetco River, as well. Juveniles were found at only two locations and at very low densities within the basin during snorkeling surveys conducted in 2003 and 2004 (Jepsen and Rodgers 2004, Jepsen 2006).

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[3] E-mail from Tom Nickelson, Retired Oregon Department of Fish and Wildlife, to Chuck Wheeler, NMFS (December 10, 2005) (discussing the historical size of the Chetco River SONCC coho salmon population).

[4] Chetco River Watershed Council Fisheries Professionals Panel Discussion, Jim Waldvogel, Oregon and California Sea Grant Programs (July 25, 2006) (discussing the historical size of the Chetco River SONCC coho salmon population).

[5] E-mail from Steve Mazur, Oregon Department of Fish and Wildlife, to Chuck Wheeler, NMFS (September 12, 2018) (attaching Rogue Watershed District estimates of annual spawning escapement of coho salmon spawning in the coastal strata of the Oregon portion of the SONCC, 1998-2017).

[6] In years where estimates are zero, Chinook salmon surveyors did not see any coho salmon, did not distinguish the difference between Chinook salmon and coho salmon, or did not mark them down, as they were not the target of their work. It is highly unlikely that the actual number of spawners in those years was zero because adults returned three or six years later (indicating successful spawning the year in which a zero was recorded).

[7] This is a different conclusion than what was reached in NMFS No.: NWR-2011-58 with information available at that time. Variability in the most recent three years of data decreased the statistical significance of the trend to where no trend is detectable.

In a trapping operation on Jack Creek between March 9 and May 10, 2007, ODFW captured 69 out-migrant coho salmon smolts. Operation of this trap between March 13 and May 16, 2008 caught 163 coho salmon smolts. The trap did not provide enough data for ODFW to make estimates of the total outmigration for either year, but due to inefficiencies in trapping (Newcomb and Coon 2001) it is likely four to five times the number caught. In addition, low water levels stopped the trap in mid-May, while the coho salmon smolt outmigration likely lasts to mid-June.

Limiting Factors. The SONCC coho salmon recovery plan (NMFS 2014) compiled information from multiple sources including the expert panel on limiting factors for Oregon's SONCC coho salmon populations (ODFW 2008) and the Chetco River watershed assessment (Maguire 2001b). NMFS (2014) concluded the limiting factors for the Chetco River are degraded riparian forest conditions and lack of floodplain and channel structure. The plan (NMFS 2014) determined the life stage most limited is juveniles, and it is limited due to poor quality rearing habitat. Specifically, NMFS (2014) says:

> Juvenile summer rearing habitat is impaired by high water temperatures resulting from degraded riparian conditions and water withdrawals. Winter rearing habitat is severely lacking because of channel simplification, disconnection from the floodplain, degraded riparian conditions, poor large wood availability, and an estuary altered and reduced in size due to development, channelization, and diking. Large wood has been removed and is not naturally replacing at the rates required to maintain key components of habitat complexity.

Population Viability Criteria. Williams *et al.* (2008) developed a framework for assessing viability of SONCC coho salmon. The SONCC coho salmon viability framework incorporates five criteria intended as surrogates for the basic concepts of viability, that is, abundance, productivity, diversity, and spatial structure (*Williams et al.* 2008). The five criteria are: (1) Effective population size/total population size, (2) population decline, (3) catastrophic population decline, (4) spawner density, and (5) hatchery influence. Data on the last four generations of coho salmon informs this assessment and several of the criteria. Williams *et al.* (2008) established extinction thresholds for high, moderate, and low risk. For a given population, the highest risk score for any category determines the overall extinction risk. The Chetco River population is at high risk of extinction because the estimated average spawner abundance is less than one fish per intrinsic potential kilometer (IPkm)[8] in the three consecutive years of lowest abundance within the 12 preceding years (NMFS 2014).

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 for this proposed action includes the Pacific Ocean where wastewater effluent chemicals are increased above background concentrations, which includes but is not limited to the zone of initial dilution (ZID) (0.07 acre) and the regulatory mixing zone (RMZ) (6.5 acres). The action area also

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[8] The intrinsic potential of habitat suitable for coho salmon expressed in kilometers as modeled by Williams *et al*. (2006).

includes the City of Brookings where sewer line repair and replacement, pump station repairs or rehabilitation, infiltration and inflow repairs, and WWTP upgrades will occur and the Pacific Ocean where stormwater discharge associated with the Lone Ranch development is likely to occur. The exact locations of discharge are unknown, but because the development will occur around Lone Ranch, Duley, Ram, and Taylor Creeks, we assume that discharge will occur to the ocean through these ocean tributaries. Thus, the action area includes these tributaries from the stormwater discharge points to the Pacific Ocean.

2.4 Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

Specific information pertaining to total suspended solids (TSS) was not provided in the BA. In 2003, the Environmental Protection Agency (EPA) conducted an ecological assessment of marine waters on the continental shelf from the Mexican border to the Strait of Juan de Fuca in Washington (Nelson *et al.* 2008). The assessment included water column characteristics, sediment quality, fish tissue contaminants, and a status of benthic communities off the central coast of Oregon. For the samples taken in closest proximity to the action area, salinity, water temperature, and chlorophyll all were within the normal range.

The WWTP has a peak design capacity of 15.5 million gallons per day (MGD) with a design peak average flow of 10.9 MGD. The WWTP does not have an influent flow monitor so flow measurements are obtained from the effluent monitoring. Since 2011, average daily flows have been 0.81 to 1.1 MGD. Wintertime flows were considerably higher, with daily flows often over 2 MGD and peak flows of over 7.3 MGD.

Critical habitat in the action area

Lone Ranch, Duley, Ram, and Taylor Creeks are designated critical habitat for SONCC coho salmon. The PBFs in the action area are essential for SONCC coho salmon migration, rearing, and spawning. They are cover/shelter, food, riparian vegetation, safe passage, space, spawning gravel, substrate, water quality, water quantity, water temperature, and water velocity. The PBFs in the action area for SONCC coho salmon have been degraded by construction of Highway 101 contributing to delays or complete impairment of fish passage, timber harvest resulting in sedimentation and increased water temperatures, and rural development resulting in altered hydrology and degraded water quality associated with stormwater discharges in the action area.

The Pacific Ocean is designated critical habitat for green sturgeon. The PBFs in this coastal marine area are essential for green sturgeon growth and development, migration between estuarine and marine areas, and sexual maturation. They are food resources, migratory corridor, and water quality, which are summarized below.

Food resources. Prey species for subadult and adult green sturgeon primarily consist of benthic invertebrates and fish including crangonid shrimp, burrowing thalassinidean shrimp, amphipods, isopods, clams, annelid worms, crabs, sand lances, and anchovies (74 FR 52300). Prey species quality and abundance are likely reduced in the action area because of exposure to and bioaccumulation of contaminants associated with past and present wastewater effluent and stormwater discharges.

Water quality. The Pacific Ocean is not listed on the Oregon Department of Environmental Quality's 303(d) list for water quality limited water bodies in the vicinity of the WWTP outfall. No total maximum daily loads have been developed or are proposed for the Pacific Ocean in the action area. In 2003, the EPA conducted an ecological assessment of marine waters on the continental shelf from the Mexican border to the Strait of Juan de Fuca in Washington (Nelson *et al.* 2008). The assessment included water column characteristics, sediment quality, fish tissue contaminants, and a status of benthic communities off the central coast of Oregon. For the samples taken in closest proximity to the action area, salinity, water temperature, and chlorophyll all were within the normal range. Oregon's beaches and coastal areas typically have mild temperatures, with mean summer temperatures in the low 60s (degrees Fahrenheit [°F]) and mean winter temperatures in the low 40s (°F). Specific information pertaining to TSS was not provided in the BA. Typical TSS values in waters of the West Coast shelf ranged from zero to 10 milligrams per liter (mg/l) with the 50th percentile of 4.0 mg/l. These values represent data from the 2003 sampling of 137 stations from California, Oregon, and Washington collected during an ecological condition cruise (Nelson *et al.* 2008).

Past and present discharge of WWTP effluent and stormwater has introduced to the action area pollutants including biological oxygen demand (BOD), TSS, pH, bacteria, nutrients, and potentially toxic substances. The concentrations of these pollutants are likely elevated in the RMZ above thresholds for adverse effects to the water quality PBF.

Migratory corridor. Physical, chemical, or biological barriers that would impede or delay passage of subadult and adult green sturgeon to access feeding areas, holding areas, and thermal refugia and ensure passage back out to the ocean do not occur in the action area.

Species in the action area

Adult SONCC coho salmon will be present in the action area, as they will congregate in the nearshore areas prior to entering the estuary for their spawning migration, which in the Chetco River, occurs from October to January. Smolt SONCC coho salmon in the Chetco River migrate to the ocean from April to June. Following outmigration and ocean entry, coho salmon smolts that haven't moved offshore will likely reside in the coastal marine action area for several months before migrating north and thus be present in the action area.

The use of Lone Ranch, Duley, Ram, and Taylor Creeks by SONCC coho salmon is not documented, however, it is likely that prior to the construction of Highway 101 these tributaries were used for spawning, rearing, and migration by all life stages of SONCC coho salmon. Because of their proximity to the Chetco River, adult and smolt migration in these tributaries is likely as described above for the Chetco River. Eggs are present in the gravel beginning in

November until May when juveniles emerge and are present in the tributaries until the following spring when they migrate to the ocean as smolts. It is unknown to what extent these tributaries would be used today, thus we give the benefit of the doubt to the species and assume that all life stages of SONCC coho salmon use it as previously mentioned above.

Green sturgeon adult and sub-adult will be present in the action area, as they will migrate to and from the Chetco River estuary to feed. Green sturgeon congregate in coastal waters and estuaries, including non-natal estuaries. Lindley *et al.* (2008) tracked the migrating tagged green sturgeon along the west coast (Figure 2). It is apparent green sturgeon are migrating along the Oregon coast, but when they actually enter the action area is unknown. In addition to their exact location, these migrating fish are likely moving through the area at a high rate of speed (Lindley *et al.* 2008) and therefore not likely to stay within an individual action area very long. The most likely migration scenario where green sturgeon might enter the action area would be for green sturgeon that are headed into the Chetco River estuary. It is at this time an individual could be exposed to the mixing zones or stormwater discharges.

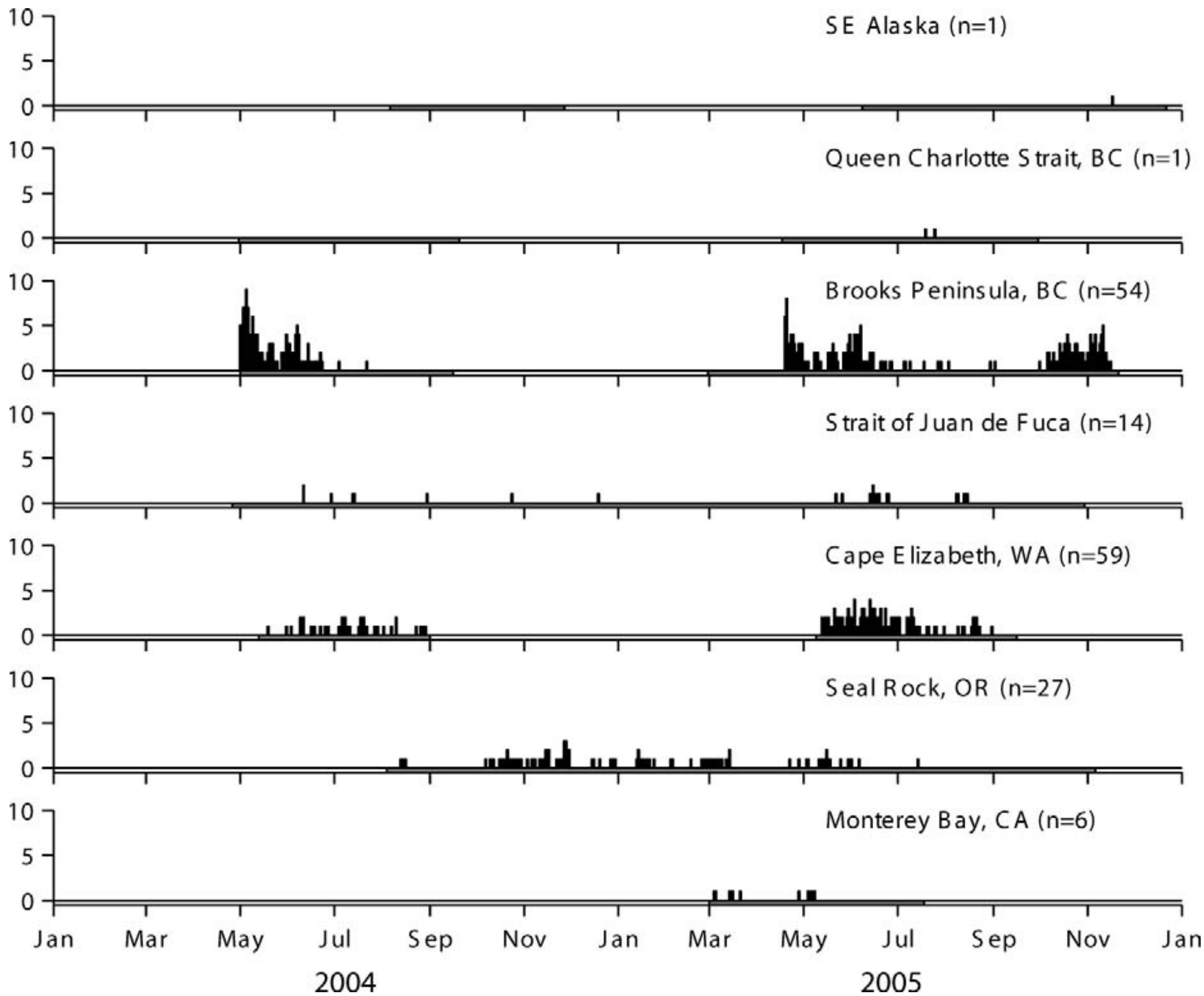

Figure 2. From Lindley *et al.* (2008) – detections of pinger-tagged green sturgeon by hydrophone arrays along the West Coast of North America (n = total number of unique fish observed at each location). Bar height indicates the number of unique fish observed per day.

Eulachon are generally distributed offshore and are not considered common in the nearshore environment of the Pacific Ocean where the action area is located. There is no supporting information to show presence within a few miles of the shore. However, Willson *et al*. (2006)[9] (as cited in Gustafson et al. 2010) lists the Chetco River as one Oregon drainage supporting a spawning run of eulachon. The ODFW has occasionally captured eulachon in rotary screw traps and estuary seining activities (WDFW and ODFW 2008) in the Chetco River basin. The most likely scenario where a eulachon would be present in the action area would be during adult spawning migration into the Chetco River and larval eulachon migration to the ocean after hatching. Evidence shows that adults return as early as December (WDFW and ODFW 2001) or

[9] Willson's conclusions were based on Emmett *et al.* (1991) and personal communication with Oregon Department of Fish and Wildlife biologists.

as late as May (WDFW and ODFW 2001) to spawn on the Columbia River. Based on this, we are reasonably certain that eulachon adults would return to the Chetco River between December and May. The eggs hatch within 20–40 days and larvae immediately wash downstream to estuarine and ocean areas.

Previously mentioned pollutant discharges have degraded aquatic habitat and resources important for growth and survival of SONCC coho salmon, green sturgeon, and eulachon in the action area. As a result, SONCC coho salmon, green sturgeon, and eulachon occurring in the action area have been adversely affected by the degraded condition of aquatic habitat. The response of these species is not immediately apparent, but can be observed in individuals' reduced growth, survival, and fitness, and overall abundance over the long-term in the action area. While the habitat in the action area is degraded, it provides support for SONCC coho salmon, green sturgeon, and eulachon individuals.

2.5 Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated and interdependent effects are those that will occur to the Pacific Ocean associated with the Lone Ranch development (stormwater discharge). The proposed action will extend the useful service life of the wastewater treatment system and perpetuate the effects of effluent discharge on SONCC coho salmon, green sturgeon, and eulachon into the future.

2.5.1 Effects on Critical Habitat

The proposed action will affect the Frontal Cape Ferrelo 5th field watershed (HUC# 1710031203), which is designated critical habitat for SONCC coho salmon. The PBFs for SONCC coho salmon in the action area are cover/shelter, food, riparian vegetation, safe passage, space, spawning gravel, substrate, water quality, water quantity, water temperature, and water velocity. The proposed action will also affect the Pacific Ocean 5th field watershed (HUC# 1710031203), which is designated critical habitat for green sturgeon. The PBFs for green sturgeon present in the action area are food resources, migratory corridor, and water quality.

Plant effluent

The City's effluent discharge is regulated under EPA's National Pollution Discharge Elimination System (NPDES, permit# 1001773) issued by the Oregon Department of Environmental Quality (ODEQ). The City's NPDES permit allows for two mixing zones: the acute mixing zone, also known as the ZID, and the chronic mixing zone, referred to as the RMZ. The ZID is a small area where acute criteria can be exceeded as long as it does not cause acute toxicity to organisms passing through it. The RMZ is an area where acute criteria must be met but chronic water quality criteria can be exceeded, and it must be designed to protect the integrity of the entire water body. The RMZ for the outfall is the portion of Pacific Ocean contained within a radius of

300 feet from the outfall's point of discharge. The ZID is the portion of the allowable mixing zone that is within 30 feet from the point of discharge. The outfall consists of 10 discharge ports, which are spaced 8 feet apart on alternate sides of the discharge pipe.

In general, discharge of municipal wastewater effluent adversely affects water quality in a receiving water body. The severity and extent of adverse effects are directly related to the level of treatment and the baseline water quality. Effluent contains trace amounts of many chemicals found in a variety of products that are disposed of via municipal sewer systems and through industrial discharges. Municipal effluents have been identified as sources of endocrine disrupting chemicals, pharmaceuticals and personal care products (PPCPs), persistent, bioaccumulative and toxic chemicals, and other compounds of anthropogenic origin in surface waters of the United States, and Europe (Lee *et al.* 2000, Molnar *et al.* 2000, Huang *et al.* 2001, Kolpin *et al.* 2002, Lazorchak and Smith 2004).

In addressing the effects of releasing these pollutants at the diffuser, we need to understand the relationship between the mixing zone, wave action, and incoming and outgoing tides at the outfall location. Contaminants will be dispersed in all directions due to wave action, the incoming tide, and the outgoing tide. Because of the dynamic nature of the ocean at the location of the outfall, contaminant dispersion will extend beyond the radial 300-foot RMZ distance. Outside of the mixing zone, released contaminants do not disappear, but their concentrations are much lower. Thus, concentrations of contaminants analyzed in more detail below may be acute in the ZID and chronic in the RMZ, but only at trace levels outside of the RMZ.

Effluent contaminants

The NPDES permit the City is operating under requires effluent monitoring to ensure compliance with permit limitations. Fecal coliform are bacteria originating in the intestines of warm-blooded animals. We searched current literature and found no connection between fecal coliform from warm-blooded animals and effects on the cold-blooded species or their critical habitats analyzed in this opinion. Fecal coliform will not cause any effects to listed species or critical habitat addressed in this opinion.

Biological Oxygen Demand. Organic materials released to the environment from wastewater effluent and other sources are not toxic in the aquatic environment, but if enough organic material is released they can reduce oxygen concentrations in the water. These materials undergo oxidative metabolism by bacteria. This oxidative capacity is estimated crudely as BOD. The NPDES permit limits average weekly BOD to 25 mg/l during the dry season (May through October) and 30 mg/l during the wet season (November to April). Using average daily flows and daily loads of BOD from 2013 and 2014 we roughly estimated instantaneous BOD values for each month. In 2013, BOD ranged from 9.82 to 21.11 mg/l and in 2014, BOD ranged from 6.82 to 19.34 mg/l.

Total Suspended Solids. TSS is a measure of the amount of particles suspended in solution. The NPDES permit limits WWTP to an average weekly TSS of 30 mg/l during the dry season (May through October) and 45 mg/l during the wet season (November to April). Using average daily flows and daily loads of TSS from 2013 and 2014 we roughly estimated instantaneous TSS values for each month. In 2013, TSS ranged from 9.46 to 28.22 mg/l and in 2014, TSS ranged from 8.04 to 23.99 mg/l.

pH. pH is the measure of alkalinity/acidity of water. The NPDES permit requires the WWTP to maintain discharge pH between 7.0 and 8.5 at the edge of the RMZ. The ODEQ performed a reasonable potential analysis (RPA) on pH to determine the reasonable potential for the plant to exceed the pH criteria using the accepted EPA ocean pH value of 8.1. The RPA showed that there was no reasonable potential to exceed the pH criteria. The results of the RPA showed that pH at the mixing zone boundary would be 7.705 to 8.103, respectively (ODEQ 2018).

Temperature. Oregon's beaches and coastal areas typically have mild temperatures, with mean summer temperatures from 15 to 19 degrees Celsius (°C) and mean winter temperatures from 4 to 8°C. The NPDES permit does not contain a limit for temperature, but the WWTP still cannot increase water temperature outside of the mixing zone. Oregon Administrative Rule 340-041-0028(7) limits the warming of ocean waters to 0.3°C or less. The ODEQ conducted an RPA for the probability for exceedance of temperature at the outfall or edge of the mixing zone. The RPA used the maximum temperature measured from the effluent of 22.14°C (71.85°F) (maximum 7-day average temperature) from monitoring records, which exceeds temperature threshold for adverse effects to water quality. The RPA determined that the temperature increase would be 0.03°C, which would not result in reasonable potential the temperature standard would be exceeded at the RMZ (ODEQ 2018). Nor would it meaningfully change the temperature outside the mixing zone. While temperature outside the mixing would not meaningfully change, in the mixing zone (6.5 acres), temperature would be increased the greatest (the temperature of effluent) at the outfall and within the ZID (0.07 acre), decreasing with distance away from the outfall. The 90th percentile value of temperature monitoring data from 2010 to 2017 is 21°C (ODEQ 2018). This means that 10% of the values exceeded 21°C.

Ammonia. The NPDES permit for this plant does not contain a limit for ammonia for this plant. However, the acute (6.7 mg/l) and chronic (0.95 mg/l) water quality standard must be met at the edge of the ZID and RMZ. The ODEQ performed an RPA on to determine the reasonable potential for the plant to exceed the ammonia criteria using the maximum measured ammonia concentration from monitoring records of 22.5 mg/l. The RPA showed that there was no reasonable potential to exceed the ammonia criteria and a limit was not placed in the permit. The results of the RPA showed that ammonia concentrations at the ZID and RMZ would be 1.4 and 0.6 mg/l, respectively. Ammonia dissolves in water and may directly exert a toxic effect on aquatic organisms. Ammonia ionization is regulated by water temperature and pH, where the toxic form (un-ionized) increases with increasing pH and temperature.

Metals. The City's NPDES permit implicitly allows for the discharge of persistent toxic chemicals, such as copper and zinc, because permit limits or treatment requirements are not specified in the permit. Potentially toxic constituents that typically sorb to suspended solids can settle out of the water column in, and beyond, the permitted mixing zone. In the absence of source controls or sufficient treatment, toxicant accumulation can occur in the outfall mixing zone sediments and vicinity, and these toxic contaminants remain perennially available to organisms for uptake and potential bioaccumulation. Metals may also dissolve in water and directly exert a toxic effect on aquatic organisms.

The ODEQ performed an RPA to determine the reasonable potential for the plant to exceed the criteria for specific metals including copper, mercury, selenium, and silver using the maximum measured concentrations from monitoring records. No other metals have criteria associated with them. The RPA showed that there was no reasonable potential to exceed the criteria for the aforementioned metals. The maximum measured concentrations from monitoring records show copper concentration of 33.3 micrograms per liter (µg/L) and zinc concentration of 87.8 µg/L. The results of the RPA showed that copper concentrations at the ZID and RMZ would be 4.67 and 1.95 mg/l, respectively.

Polybrominated Diphenyl Ethers. Polybrominated diphenyl ethers (PBDEs) are members of a broad class of brominated chemicals commonly used as flame retardants. The family of PBDEs consists of 209 possible substances, which are called congeners. They have been added to plastics, upholstery fabrics and foams in common products like computers, TVs, furniture and carpet pads. There are three main types of PBDEs used in consumer products, and each is made up of a mixture of brominated diphenyl ether (BDE) congeners including penta-BDE, octa-BDE and deca-BDE. Oregon passed legislation to restrict penta-BDEs and octa-BDEs (in 2006) and deca-BDEs (in 2009). However, their widespread use prior to these laws has resulted in a legacy of availability as the products that contain PBDEs break down through normal wear and tear and are discarded.

Once in the environment, PBDEs can last a long time depending on surrounding conditions such as the availability of water, organic compounds or sunlight. PBDEs, especially those with higher numbers of bromines such as deca-PBDE, can break down into lower brominated PBDEs, which are more bioaccumulative (Siddiqi *et al.* 2003). Recognized sources of PBDEs include wastewater discharges, surface runoff, atmospheric deposition, oil spills, and sewage overflows (Hart Crowser *et al.* 2007). PBDEs are found throughout the natural environment (air, soil, and sediments), and are building up in animals throughout the food chain (Alaee *et al.* 2003). PBDEs have been introduced into the marine environment by various processes, such as discharge of domestic sewage and industrial wastewater, agricultural inputs, runoff from nonpoint sources and atmospheric deposition (Alaee *et al.* 2003).

Pharmaceuticals and Personal Care Products. Any products used by individuals for personal, health or cosmetic reasons are considered PPCPs. They include medications, antibiotics, steroids, hormones, musk fragrances, perfumes, lotions and cosmetics. There are thousands of chemicals used in PPCPs. Pharmaceuticals and personal care products are an emerging environmental and human health issue and have been identified as constituents discharged into receiving waterbodies by municipal wastewater treatment plants (Ramirez *et al.* 2009, Lubliner *et al.* 2010, Reiner and Kannan 2010, Chase *et al.* 2012). There are no current regulatory requirements for testing these emerging chemicals, nor are water quality standards or other recognized benchmarks available.

PPCP presence in the environment depends upon their individual chemical structure and the frequency of their use. They are present at low concentrations in surface water, groundwater, soils, sediments, marine waters, and drinking water (Tien-Hsi *et al.* 2012). Researchers monitoring the environment find PPCPs virtually everywhere domestic wastewater is discharged (Ternes *et al.* 1999). PPCPs enter the environment as they pass through the human body or when unwanted PPCPs are disposed in the trash or down the drain. Other significant sources include livestock, aquaculture, pets, and agriculture.

Conventional wastewater treatment systems do not do a good job of removing or destroying PPCPs (Barbara *et al.* 2009). The current treatment process at Plant #2 does not completely remove all PPCPs (Rockwell 2011). The PPCPs with highest concentrations in the 2010 monitoring were sulfamethoxazole (2,360 and 5,280 nanograms per liter (ng/L)) and diphenhydramine (2,320 and 1,140 ng/L). The 2010 monitoring tested for musk fragrances, but most results were not reliable for reporting (Rockwell 2011). The lone exception was for galaxolide, which was under the detection level of 10 µg/L.

Stormwater discharge

Stormwater contaminants. Stormwater discharge associated with the Lone Ranch development will likely discharge through Duley (tributary to Lone Ranch Creek), Lone Ranch, Ram, and Taylor Creeks to the Pacific Ocean near the development. The development will result in impervious surfaces that do not currently exist on-site. The total acreage of impervious surfaces is difficult to determine without specific development plan, but the development will consist of up to 1,000 residential homes with associated driveways, sidewalks, and roads infrastructure. Currently this site is forested and vegetated. While, typically, residential developments are required to treat stormwater, it is uncertain what treatment technologies would be used or to what level stormwater would be treated. Therefore, we give the benefit of the doubt to the species and assume that stormwater will not be treated prior to discharge to Duley, Lone Ranch, Ram, and Taylor Creeks.

Stormwater runoff from impervious surfaces delivers a wide variety of pollutants to aquatic ecosystems, such as metals (e.g., copper and zinc), petroleum-related compounds (e.g., polynuclear aromatic hydrocarbons), and sediment washed off the road surface (Driscoll *et al.* 1990, Buckler and Granato 1999, Colman *et al.* 2001, Kayhanian *et al.* 2003). These pollutants also accumulate in the prey and tissues of juvenile salmon where, depending on the level of exposure, they cause a variety of lethal and sublethal effects including disrupted behavior, reduced olfactory function, immune suppression, reduced growth, disrupted smoltification, hormone disruption, disrupted reproduction, cellular damage, and physical and developmental abnormalities (Fresh *et al.* 2005, Hecht *et al.* 2007, LCREP 2007).

Summary of effects on critical habitat

Critical habitat in the action area supports SONCC coho salmon migration, rearing, and spawning in Lone Ranch, Duley, Ram, and Taylor Creeks. The PBFs essential for SONCC coho salmon in the action area are cover/shelter, food, riparian vegetation, safe passage, space, spawning gravel, substrate, water quality, water quantity, water temperature, and water velocity. The Pacific Ocean action area is critical habitat for green sturgeon and it supports their growth, development, seasonal holding, and movement between estuarine and marine areas. The physical or biological features essential for green sturgeon present in the action area are food resources, migratory corridor, sediment quality, water flow, water depth, and water quality.

The discharge of effluent and stormwater will contribute contaminants that will reduce water quality in the action area in the ocean mixing zone and Lone Ranch, Duley, Ram, and Taylor Creeks associated with the Lone Ranch development. The concentrations of contaminants near the outfall are likely to be acute in the ZID and chronic in the RMZ, but only at trace levels outside of the RMZ. Contaminant concentrations in the tributaries near the Lone Ranch development will be highest at the point of discharge, decreasing with distance away from the discharge point.

The proposed action will also affect the food and food resources PBFs because some of the contaminants (e.g. metals, PPCPs, and PBDEs) will be taken in by forage species and passed to SONCC coho salmon and green sturgeon when eaten. The proposed action will not affect any green sturgeon essential PBFs.

The effects on critical habitat are likely to be significant within 300 feet of the outfall (RMZ) (6.5 acres) and within Lone Ranch, Duley, Ram, and Taylor Creeks from the discharge points for the Lone Ranch development to the Pacific Ocean. Outside of those areas the effects, while adverse, are minor.

The SONCC coho salmon critical habitat unit affected by the proposed action consists of the Whalehead Creek – Frontal Cape Ferrelo 5th field watershed (HUC# 1710031203). This watershed extends from the Rogue River south to the Chetco River not including Hunter Creek or Pistol River watersheds and extends inland approximately 3 miles. This watershed contains numerous Pacific Ocean tributaries, of which the action area in Lone Ranch, Duley, Ram, and Taylor Creeks make a small portion. Overall, the adverse effects will be minor or affect only a small portion of the critical habitat, so that the proposed action will not degrade PBFs essential for SONCC coho salmon at the critical habitat unit scale.

The green sturgeon critical habitat area for coastal marine areas consists of the West Coast from Monterey Bay, California north to the Strait of Juan de Fuca (approximately 880 miles) from the coastline out to 60 fathoms. The 300-foot radius action area (9.75 acres) represents a very small portion of this and only 0.023% will have more than minor adverse effects. Overall, the adverse effects will be minor or affect a small portion of the critical habitat, so that the proposed action will not degrade physical or biological features essential for green sturgeon at the designated critical habitat unit scale.

2.5.2 Effects on Species

Exposure

In our analysis of the effects of the action on critical habitat, we found adverse effects on water quality and forage/food resources. To understand how listed species present in the action area respond to these effects, we must first understand how these species will be exposed to the effects. The presence of SONCC coho salmon, green sturgeon and eulachon in the action area is described in the *Environmental Baseline*, section 4 of this opinion. Based on this, exposure of adult and smolt SONCC coho salmon, adult and sub-adult green sturgeon, and adult and larval eulachon the effects of the proposed action in the action area will occur.

SONCC coho salmon. Adult and smolt SONCC coho salmon are highly mobile and are able to quickly move through the action area. The number of adult SONCC coho salmon exposed to the action area will be small as the action area is located approximately a mile and more (Lone Ranch) away from the mouth of the Chetco River in the shore zone. Most adults will remain in deeper waters while awaiting sufficient environmental conditions to move into the Chetco River. Those adults exposed to the action area are unlikely to require more than a day to traverse through the action area. Adults are much more likely to quickly swim through the RMZ or ZID because they will be migrating to the river to spawn. Thus, they will only be in the RMZ and ZID for a few minutes.

The number of smolt SONCC coho salmon exposed in the action area, while small, will likely be higher than the number of adults. After leaving the river, smolts that have not moved offshore will reside in the nearshore for several months. There is potential for some smolts to be in the action area for up to a few days. Smolts will likely swim through and feed in the RMZ, ZID, and stormwater discharge areas and may be present and exposed to effluent for up to a day.

Green sturgeon. Green sturgeon migrate between non-natal estuaries to feed and also feed in coastal marine areas. Green sturgeon likely migrate through the action area to and from the Chetco River to feed. Migrating fish are likely moving through the area at a high rate of speed (Lindley *et al.* 2008) and therefore not likely to stay within action area very long. Some individual green sturgeon may forage in the action area and remain a little longer, but not for a significant amount of time. Thus, green sturgeon may be present in the action area from a few minutes to a couple of hours.

Eulachon. Adult eulachon, while rare and infrequent in the Chetco River, will be exposed as they migrate to spawning grounds. Any individual adult will only expose itself to contaminants in the action area for a day or two as they swim through the action area to the river mouth. Similar to SONCC coho salmon adults, adult eulachon are much more likely to quickly swim through the RMZ or ZID (a few minutes) because they will be migrating to the river to spawn.

Eggs hatch in 20 to 40 days and larval eulachon, which are feeble swimmers, are carried downstream to the estuary and ocean within hours or days (McCarter and Hay 2003). While in the ocean, larval eulachon have restricted mobility and are distributed by currents, tidal action, and wave action. It is likely that some larval eulachon will be present in the action area for up to several days. There is also potential for a small number of larval eulachon to be present in the RMZ and ZID for a day or two.

Effluent contaminants

Biological Oxygen Demand. If enough organic material is released, oxygen concentrations in the water can decrease to levels that cause respiratory distress, lack of feeding and growth, and death in salmon (Davis 1975, Kramer 1987). Carter (2005) concluded that juvenile salmonids begin to avoid areas with dissolved oxygen lower than 6 mg/l and they consistently avoid areas with concentrations of 5 mg/l and lower. Davis (1975) listed a threshold of 6.43 mg/l dissolved oxygen for symptoms of oxygen distress in anadromous salmonids. Swimming performance of juvenile coho salmon declined markedly and almost linearly as the logarithm of dissolved oxygen concentrations declined from 7-8 mg/l to 2 mg/l (Dahlberg *et al.* 1968). Concentrations as low as 3 mg/l result in mortality of salmonids (EPA 1986). Subadult and adult green sturgeon occupy a wide range of dissolved oxygen levels, may need a minimum level of at least 6.54 mg/l. We searched for preferred dissolved oxygen levels for eulachon, but did not find any studies relative to the subject. Therefore, we assume their dissolved oxygen needs are similar to those for SONCC coho salmon.

Monitoring data for dissolved oxygen in the action area does not exist. However, the action area is located in the very nearshore where the conditions vary due to tidal fluctuations, wave height, and nearshore currents. Thus, the action area is dynamic in nature and dissolved oxygen concentrations vary from high to low, but unlikely remain high or low for a long period. BOD at the mixing zone boundary will range from 6.82 to 21.11 mg/l (from 2013 and 2014 data). BOD discharged at the outfall is likely to affect dissolved oxygen levels in the action area, but is unlikely to cause them to decrease to a point affecting the listed species addressed in this opinion.

Total Suspended Solids. Increases in TSS concentrations as low as 17 mg/l can increase inflammation of the gills and lead to respiratory stress, when juvenile coho salmon are exposed for periods as short as 4 hours (Berg and Northcote 1985). Increases in TSS as low as 30 mg/l can result in behavioral responses (e.g., changes in territorial behavior) of juvenile coho salmon exposed to suspended sediment pulses for periods as short as 4 hours (Berg and Northcote 1985). Increases in TSS at a concentration of 53.5 mg/l for a 12-hour period caused physiological stress and changes in behavior in coho salmon (Berg 1983). Suspended sediment concentrations at 1200 mg/l for a 96-hour period killed juvenile coho salmon (Noggle 1978). While adequate information exists to analyze the effect of TSS on coho salmon, little exists for green sturgeon or eulachon. In the absence of information we assume the thresholds for effects on green sturgeon and eulachon are similar to those for coho salmon.

We calculated instantaneous TSS values from 2013 and 2014 data that ranged from 8.04 to 28.22 mg/l. Based on the time that life stages of SONCC coho salmon, green sturgeon, and eulachon could be present in the RMZ and ZID, and the concentrations TSS, SONCC coho salmon smolts and larval eulachon could be exposed to TSS concentrations above the threshold for effects for more than 4 hours. Thus, TSS from the proposed action will likely injure individual smolt SONCC coho salmon and eulachon individuals.

pH. Under laboratory conditions, coho salmon tolerated a pH range of 6.1 to 8.2 (Dahlberg *et al.* 1968). Lethal levels for pH occur below 5 or above 9 (European Inland Fisheries Advisory Commission 1969). We assume that green sturgeon and eulachon tolerate pH ranges similar to coho salmon. The WWTP will maintain pH of the discharge between 7.0 and 8.5. In their evaluation of the WWTP's NPDES permit, the ODEQ performed an RPA on pH to determine the reasonable potential for the plant to exceed the pH criteria using a pH of 8.1 for the Pacific Ocean. The results of the RPA showed that pH at the mixing zone boundary would be 7.705 to 8.103, respectively (ODEQ 2018). Therefore, effluent pH is unlikely to be outside the range required for the threshold of effect documented above (6.1-8.2) for SONCC coho salmon, green sturgeon, and eulachon.

Temperature. The NPDES permit does not limit temperature. However, the WWTP cannot increase temperature by more than 0.3°C. The ODEQ's RPA for temperature showed that temperature increases at the mixing zone boundary would be up to 0.03°C. Thus, the WWTP will not increase temperature in the action area outside the RMZ to levels that would have adverse effects on SONCC coho salmon or green sturgeon. However, in the RMZ temperatures will be higher. The maximum temperature from monitoring records showed an effluent temperature of 22.14°C.

Griffiths and Alderice (1972) noted a marked reduction in swimming performance of juvenile coho salmon above 20°C (as cited in Hicks 2000). Hicks (2000), citied DeHart (1974) and Brett (1956) as reporting lethal levels of 25°C for juvenile coho salmon acclimated to 20°C (exposed to higher temperature for 7 days); however, at an acclimation of 5°C, Brett (1956) found the lethal level declined to 22.9°C (exposed for 7 days). This suggests that at lower acclimation temperatures, juvenile coho salmon may experience mortality at a lower lethal temperature than that reported by DeHart (1974) and Brett (1956). Coutant (1970) reported a lethal limit of 21 to 22°C for migrating adult fish collected from the Columbia River during the summer (as cited in Richter and Kolmes 2005). Erickson *et al.* (2002) reported temperatures at capture sites in the Rogue River ranged from 15 to 23°C, suggesting that this range was suitable for adult survival of green sturgeon.

Temperatures in the RMZ may reach lethal levels for adult coho salmon near the outfall in the ZID, however migrating adults will quickly move through the RMZ and ZID (a few minutes) and will not be exposed long enough to elicit an adverse response. Temperatures are not likely to reach lethal levels for juvenile SONCC coho salmon or green sturgeon. Temperature may exceed 20°C in the ZID, but juvenile SONCC coho salmon will not likely be exposed long enough for it to significantly affect their swimming performance in a meaningful way. Therefore, temperature increases in the action area are not likely to result in meaningful negative effects on the performance or survival of SONCC coho salmon or green sturgeon.

For adult eulachon, increases in temperature of 2.8 and 5.6°C resulted in 50 and 100% mortality, respectively, in 8 days, while temperatures elevated by 9°C for a single hour killed 50% of adult eulachon after 32 hours (Snyder and Blahm 1970 as cited in Gustafson *et al.* 2010). It is likely that at times the change in temperature between the Pacific Ocean and portions of the RMZ will be within the range reported above. The greatest potential for temperature increases in the lethal range will be at the outfall and ZID. Because adult eulachon are not expected to remain in the RMZ longer than a few minutes and the change in temperature will be localized to the ZID, any meaningful effects on adult eulachon will be unlikely.

We found no information about thermal tolerance of larval eulachon. We did find two studies about related species in the same family as eulachon (*osmeridae*). Rainbow smelt (*Osmerus mordax*) is a species with a circumpolar distribution that shares an anadromous life history with eulachon. Rainbow smelt larvae held in freshwater at 13°C were exposed to temperature increases of 11.3 to 19.4°C for exposure lasting 5, 30 and 60 minutes. The larvae survived a temperature change of up to 13.6°C (i.e., a temperature of 26.6°C) for up to 60 minutes (Barker *et al.* 1981).

Capelin (*Mallotus villosus*) is a circumpolar marine smelt that lives in high latitudes in the Atlantic and Arctic oceans. Most capelin spawn below the intertidal zone in the Barents Sea, but one population spawns in a long fjord in northern Norway in the intertidal zone. Davenport and Stene (1986) studied thermal tolerance of larval capelin from this population in laboratory experiments. They exposed groups of capelin eggs and larvae for 24 hours to seawater at temperatures ranging from 5 to 30°C. They also kept 24 larvae in sea water at 18°C for a longer period to assess longer-term survival. Finally, they exposed groups of capelin larvae to sea water that was gradually warmed from 5 to 30°C to assess short-term high temperature tolerance.

From 5 to 20°C, survival of capelin eggs and larvae exposed for 24 hours varied from 85% to 100%. At 22°C and higher, survival of both eggs and larvae declined dramatically. The authors concluded that a temperature above 20°C is lethal to capelin for exposures of this duration. Fish held at 18°C survived at a rate of 92% for the first 2 days, and then survival began to decline until all fish were dead on day 7. Fish in water that was gradually warmed survived up to 28°C, although they became motionless at temperatures above 25°C (Davenport and Stene 1986).

The research done on larval rainbow smelt by Barker *et al.* (1981) and on capelin by Davenport and Stene (1986) suggests that eulachon larvae may be able to tolerate exposures up to 20°C for exposures lasting somewhere between 1 and 24 hours. Based on the limited information available for these two allied species, temperatures in the RMZ and ZID will periodically exceed the 20°C threshold for adverse effects to larval eulachon. Considering the duration of presence of larval eulachon in the RMZ and ZID, it is likely that over the next several decades larval eulachon will experience an adverse response to temperatures at or above 20°C.

Ammonia. The chemical form of ammonia in water consists of two species, a larger component which is the ammonium ion (NH4+) and a smaller component which is the non-dissociated or un-ionized ammonia (NH3) molecule. The sum of the two forms is usually expressed as total ammonia-nitrogen. The ratio of un-ionized ammonia to ammonium ion, dependent upon both pH and temperature, generally increases 10-fold for each rise of a single pH unit, and approximately 2-fold for each 10°C rise in temperature over the 0 to 30°C range (Erickson 1985 as cited in EPA 2008). Ammonia is more toxic as the hydrogen ion concentration [H+] increases (pH decreases), at least below a pH of 7.3 (Armstrong *et al.* 1978, Tomasso *et al.* 1981 as cited in EPA 2008).

Acute effects of ammonia exposure likely are primarily neurological, resulting from severe metabolic alterations of the central nervous system (Smart 1978, Randall and Tsui 2002). The toxic symptoms observed in fish acutely exposed to ammonia include hyper-excitability, coma, convulsions and hyperventilation. Damage to the central nervous system of coho salmon from acute ammonia intoxication can result in convulsions and death (Randall and Tsui 2002). Reported mortality thresholds for ammonia range from 0.03 mg/l with a 2-day exposure (Herbert 1955) to 5 mg/l with a 3-day exposure (Holland *et al.* 1960).

Sublethal adverse effects from ammonia exposure include reduced food uptake and growth inhibition, diuresis and ion imbalance, inflammation and degeneration of the gills and other tissues, changes in the oxygen-carrying capacity of the blood, and increased susceptibility to disease (Russo 1985 as cited in EPA 2008). Other sublethal adverse effects on salmon from exposure to ammonia include changes in energy metabolism (Arillo *et al.* 1981) and ionic balance (Soderberg and Meade 1992), as well as damage to other body cells (Wicks *et al.* 2002). Physiological effects on salmonid fishes have occurred at concentrations as low as 0.005 mg/l (42-day exposure) (Burrows 1964). The physiological harm recorded in Burrows' study (1964) was gill hyperplasia, a condition that may result in bacterial gill disease. Gill hyperplasia is a response by epithelial cells and lamellae in the gills of fishes to irritations that may include uncontrolled cell growth, thinning, and fusion of lamellae (Burrows 1964, Post 1971, Dauba *et al.* 1992).

Reductions in growth of rainbow trout may occur as low as 0.0023 mg/l (120-day exposure) (Soderberg *et al.* 1983) or as high as 1.3 mg/l (365-day exposure) (Smith 1972). The NMFS assumes that growth reductions occurred throughout the exposure during the Soderberg *et al.* (1983) study and that gill hyperplasia occurred throughout the exposure in the study by Burrows (1964).

Several studies have documented negative changes in behavior that occur at sub-lethal concentrations of un-ionized ammonia, beginning at 0.05 mg/l (Woltering *et al.* 1978). Changes in gill permeability occurred at concentrations of non-ionized ammonia as low as 0.09 mg/l (Lloyd and Orr 1969). Because salt and water regulation in marine fish occurs at the gill surface, changes in the gill permeability can reduce the ability of fish to survive. These sub-lethal concentrations of ammonia caused malformation of trout embryos and histopathological changes (i.e., tissue changes characteristic of disease) in gills, kidneys, and livers of fish (Flis 1968, Smith and Piper 1975, Thurston *et al.* 1978, Soderberg 1985, Soderberg 1995). Salmonids that are exposed to these concentrations of ammonia reduce their feeding and thereby reduce their growth and survival (Soderberg 1995).

The RPA conducted by ODEQ used the maximum concentration ammonia measured from monitoring records (22.5 mg/l). The RPA determined that ammonia concentrations would be 1.4 mg/l at the ZID and 0.6 mg/l at the RMZ when periodically discharging the maximum measured concentration of ammonia. Once it leaves the outfall ports, un-ionized ammonia concentrations will quickly decrease, but still be sufficient in the RMZ and ZID to possibly adversely affect green sturgeon, eulachon, and SONCC coho salmon. However, only one of the life stages of any of the species will be within the ZID or RMZ long enough for the exposure to result in injury. Larval eulachon will be in the ZID and RMZ (1 to 2 days), and they are likely the most susceptible life stage. We are reasonably certain that over the course of the next several decades, individual larval eulachon will experience gill damage or mortality from ammonia. Outside of the RMZ, the concentration of ammonia and fish exposure duration are likely to be less than the lowest thresholds of adverse effect documented above (0.005 mg/l for a 42-day exposure or 0.03 mg/l for a 2-day exposure) for any life stage of all species.

Metals. Metals will be discharged to the Pacific Ocean through WWTP effluent. Metals have a number of similar toxic effects on fish because of their similar properties. Most metals tend to accumulate in the gill tissue, where the metals form precipitates with the mucus. This leads to decreased ventilation, coughing responses, decreased oxygen and carbon dioxide exchange, and a depletion of energy reserves. The depletion of energy reserves causes decreased swimming ability and a slower response to predators (LaLiberte and Ewing 2006).

Metals tend to accumulate within the body of the fish by binding to phosphate and sulfide groups of various proteins. When the sulfhydryl groups of enzymes are bound, the enzyme activity can be inhibited, potentially causing major disruption of physiological functions and a general decline in fish health (Leland and Kuwabara 1985, Kime 1998). At high enough concentrations, osmoregulatory and hormonal systems can cease to function (LaLiberte and Ewing 2006). Some metals also interfere with olfaction in salmonids (Klaprat *et al.* 1992). Salmon use olfaction as the major sensory input describing the environment around them. Olfaction has been shown to play important roles in predator avoidance (Brown and Smith 1997, Hiroven *et al.* 2000, Scholz *et al.* 2000), recognition of kin (Quinn and Busack 1985, Olsen 1992), homing of adults to natal streams (Wisby and Hasler 1954, Hasler and Scholz 1983, Stabell 1992), and spawning rituals of adults (Sorensen 1992, Olsen and Liley 1993, Moore and Waring 1996).

Heavy metals also interfere with the workings of the immune system in salmonids (Anderson et al. 1989) but the mechanism of interference is not clear (Kime 1998). Metals may affect the immune system directly or the response could result from a stress reaction that elevates cortisol, which subsequently results in immunosuppression (Schreck 1996). Suppression of the immune system increases susceptibility of salmonids to infection by bacteria, fungi, viruses, and parasites. Such infections decrease the vitality of the fish and increase the chances of mortalities due to osmotic imbalance, inability to feed, or predation (LaLiberte and Ewing 2006).

Two of the most studied metals are copper and zinc. Baldwin *et al.* (2003) exposed juvenile coho salmon to various concentrations of dissolved copper and found reduced olfactory sensory responsiveness. More recent research found reductions in the survival of individuals (Hecht *et al.* 2007, McIntyre *et al.* 2012). McIntyre *et al.* (2012) also determined that relatively brief (3 hours) exposures to dissolved copper eliminated the behavioral alarm response in coho salmon, leading to reduced evasion and reduced survival during predation trials. A review of dissolved zinc toxicity studies reveals effects including reduced growth, behavioral alteration (avoidance), reproduction impairment, increased respiration, decreased swimming ability, increased jaw and bronchial abnormalities, hyperactivity, and hyperglycemia. Juvenile fish are more sensitive. Avoidance of dissolved zinc in juvenile rainbow trout, brown trout, and cutthroat trout has been documented (Sprague 1968 and Birge et al. 1980 as cited in EPA 1987, Woodward *et al.* 1995). Lethal and sublethal endpoint of dissolved zinc toxicity have been tested on juvenile rainbow trout (Hansen *et al.* 2002, EPA 2007).

However, all of the above studies were conducted in freshwater. Toxicity of dissolved copper and dissolved zinc is reduced in saltwater due to several physiochemical parameters (EPA 2007). Therefore, while the types of effects in the above studies still apply, the threshold concentrations do not. To understand the effects of metals in the effluent and stormwater on listed species, we will look at EPA's current recommended saltwater aquatic life criteria, which were informed by research from the EPA's database of toxicity studies (ECOTOX) and compare those criteria to ODEQ's RPA for aquatic toxicity. EPA's recommended aquatic life criteria consists of separate criteria for acute and chronic effects. The ODEQ set water quality standards consistent with EPA's recommended aquatic life criteria and passed administrative rules which EPA approved on April 11, 2014.

The acute criterion is based on toxicity tests that kill 50% of the subjects in a given time (LC50). The ECOTOX database has only one saltwater LC50 study for dissolved copper pertaining to listed species considered in this opinion. It found concentrations as low as 329 µg/L killed 50% (LC50) of coho salmon smolts in 96 hours. For dissolved zinc, the only research on species close to those covered in this opinion was on 2-year old Atlantic salmon (*Salmo salar*). It found LC50 concentrations as low as 2,000 µg/L in 48-hour tests. The chronic criterion is typically based on "no observable effect concentration" (NOEC) toxicity tests. We found no saltwater NOEC tests in the ECOTOX database for listed species considered in this opinion, or even other salmonids.

Not only is it risky to base criteria concentrations on studies of other species, laboratory-derived toxicity tests have inherent shortcomings and implications in their use understanding ecological consequences for field-exposed fishes. LC50 data does not indicate the concentration at which acute toxic effects begin to kill fish, only the concentration that kills half the fish. Nor do LC50 tests consider latent mortality, which can range between 15 and 35% greater than the LC50 predictions (Zhao and Newman 2004). NOEC tests are summary statistics and not actual data (Crane and Newman 2000). Crane and Newman (2000) found the magnitude of effect that can go undetected within a NOEC statistic (95% confidence interval) can be greater than 30% on average. These factors create uncertainty that meeting the EPA-approved ODEQ aquatic life criteria for metals will fully protect the listed species in this opinion from acute effects in the ZID and chronic effects in the RMZ. Therefore, we assume concentrations of metals meeting the aquatic life criteria are still sufficient to adversely affect our listed resources when individuals reside in the mixing zones for durations similar to those in the toxicity tests above (48 to 96 hours).

The ODEQ's saltwater criteria for copper are 4.8 (acute) and 3.1 (chronic) µg/l and 90 (acute) and 81 (chronic) µg/l for zinc. The ODEQ's RPA for aquatic toxicity included analyses of copper. The RPA for copper yielded an acute concentration (ZID) of 4.67 µg/l and a chronic concentration of 1.95 µg/l at the RMZ. The ODEQ did not conduct an RPA for zinc, but we ran the calculation using an ambient concentration of 25 µg/l (Neff 2002), which yielded an acute concentration of 40.1 µg/l (ZID) and a chronic concentration of 30.95 µg/l at the RMZ. Thus, concentrations in the ZID and RMZ will be diluted and likely meet EPA-approved ODEQ aquatic life criteria. Because of the short duration of their presence in the RMZ and ZID, we are reasonably certain that the concentrations of metals in the ZID and RMZ are not sufficient to adversely affect any present coho salmon, adult eulachon, and green sturgeon. However, larval eulachon will be present in the RMZ and ZID for up to 2 days (48 hours) and will likely experience injury from copper and zinc associated with effluent discharge.

Metals from the WWTP are likely to be at trace levels throughout the action area outside of the RMZ. Metals typically sorb to suspended solids and can settle out of the water column in, and beyond, the permitted mixing zone. Accumulation of metals is likely to occur in sediments within the outfall mixing zone and the nearby vicinity. These contaminants likely will be consumed by invertebrate forage organisms residing in these areas, thereby entering the food chains of coho salmon and green sturgeon. Thus, we are reasonably certain that metals discharged from the WWTP will occur throughout the action area and become incorporated into the food chain at levels that will adversely affect SONCC coho salmon (smolts) and green sturgeon (subadults and adults). Adverse effects on these organisms are reasonably certain to include a variety of sublethal and behavioral effects that will reduce individual growth, fitness, and survival.

Polybrominated Diphenyl Ethers. PBDEs are poorly soluble in water and must be delivered to the fish either through very low water concentrations, through sediments, or indirectly through the food supply (Spacie and Hamelink 1985). Studying medaka (*Oryzias latipes*) and fathead minnow (*Pimephales promelas*) feeding, Muirhead *et al.* (2006) found that PBDE-47 is well absorbed from the fish gastrointestinal tract. A relatively slow decline in the medaka PBDE-47 body levels and correspondingly long biological half-life are indicative of the limited capacity of fish to excrete PBDE-47. Combined, these properties (efficient uptake and slow elimination) explain the tendency of PBDE-47 to bioaccumulate to significant levels in fish (WDOE and WDOH 2006).

Lema *et al.* (2007) found developmental disorders such as reduced growth, abnormal morphology, irregular cardiac function, and altered cerebrospinal fluid flow in zebrafish (*Danio rerio*) upon exposure to high concentrations of PBDEs (100-5000 μg/L). Brief exposure to PBDE-47 causes morphological abnormalities during development and growth of embryos in zebrafish (Lema *et al.* 2007). Chronic exposure to PBDE-47 can disrupt thyroid hormones and affect various key enzymes regulating the production of steroids and receptors in fish gonads (Muirhead *et al.* 2006). This alters the levels of hormones that stimulate the growth and activity of the gonads, which impairs fish reproduction (Muirhead *et al*. 2006). Exposure to 2.4 μg/L of PBDE-47 in the diet of fathead minnows for 21 days caused disruption of thyroid hormone in the brain (Lema *et al.* 2008).

Through discharge of effluent to the action area, the City will discharge PBDEs into the action area. Concentrations of PBDEs were not provided in the RUS's BA or EA. Nor did the ODEQ conduct an RPA for PBDEs for the City's NPDES permit evaluation. Thus, we do not know at what concentrations PBDEs will be at when they are discharged into the action area. However, because of their persistence in the environment and likely bioaccumulation into prey organisms of coho salmon and green sturgeon, we are still reasonably certain that PBDEs discharged from the WWTP into the action area will cause sublethal effects (i.e., reduced growth and survival) on individual smolt coho salmon and individual green sturgeon feeding in the action area.

Pharmaceuticals and Personal Care Products. There is considerable evidence that fishes can be adversely affected by PPCPs. These adverse effects typically interfere with reproduction or alter physiological characteristics (Mottaleb *et al.* 2015). Specific effects documented include male feminization, gill damage, liver damage, kidney damage, heart abnormalities, decreased territorial aggression, decreased ability to catch prey, reduced fecundity, and reduced growth (Corcoran *et al.* 2010).

Unfortunately, research is limited on these emerging contaminants and what research there is typically in a laboratory environment with contaminant concentrations higher than what is found in the natural environment (Corcoran *et al.* 2010). None of this research is on coho salmon. This makes predicting the effects of the proposed action difficult. The most reliable information for effects on fish is for 17 alpha-ethenylestradiol (EE2), which also is likely the most potent (Corcoran *et al.* 2010). Because information is lacking on other PPCPs, we will use EE2 as an indicator of effects for all these chemicals. Even though EE2 is likely the most potent, this assumption seems valid because concentrations of some of these other contaminants are likely to have additive effects with each other. Furthermore, several other PPCPs are lipophilic and therefore may bioaccumulate (Corcoran *et al.* 2010, Reiner and Kannan 2010).

Synthetic estrogen is used in birth control pills (EE2), is one of the more potent estrogens, and has been linked to the feminization of male fishes in waters receiving municipal wastewater (Thorpe *et al*. 2003). Male fish downstream of some effluent outfalls have been found to produce messenger ribonucleic acid (which carries information from DNA in the nucleus to the ribosome sites of protein synthesis in the cell) for vitellogenin (an egg-yolk precursor protein), protein associated with oocyte (an immature ovum or egg cell) maturation in females, and early-stage eggs in their testes (Jobling *et al.* 1998). This feminization has been linked to the presence of estrogenic substances such as natural estrogen (17 beta-estradiol, [E2]) and EE2. These substances are usually found in the aquatic environment at low parts per trillion concentrations, typically less than 5 ng/L (Zhou *et al.* 2007). Laboratory studies have shown decreased reproductive success of fish exposed to less than 5 ng/L of EE2 (Parrott and Blunt 2005).

Kidd *et al.* (2007) showed that chronic exposure of fathead minnows to low concentration (5-6 ng/L) of EE2 led to feminization of males through the production of vitellogenin mRNA and protein, and impacts on gonadal development as evidenced by intersex in males and altered oogenesis (egg cell production) in females. This exposure ultimately caused a near extinction of this fish species from the lake where they were being studied. Parrot and Blunt (2005) observed an increase in the ovipositor index (a female secondary sex characteristic) as the most sensitive early response 60 days post hatch when fish were exposed to EE2 concentrations greater than or equal to 3.5 ng/L in a laboratory setting. However, no significant changes were seen in fish exposed up to day 30. Kidd *et al.* (2007) observed elevated vitellogenin 7 weeks after the first estrogen additions to the experimental lake began in 2001.

We do not know the background concentration of EE2 in the action area and do not have information on the concentrations of EE2 in the effluent. Without data, we have no choice but to give benefit of the doubt to the listed species by assuming the level of EE2 in the action area with the addition from the WWTP will exceed 3.5 ng/L (the lowest identified threshold of effect). Based on this analysis of EE2, we also expect that concentrations of other PPCPs will also exceed a threshold of effect within the action area.

While the studies conducted by Kidd *et al.* (2007) and Parrott and Blunt (2005) used longer exposure periods than what SONCC coho salmon, green sturgeon, and eulachon use the action area for, we cannot predict how much the concentrations of PPCPs from the WWTP exceed the effect threshold in those studies. Because we do not have adequate monitoring information to predict the concentrations of PPCPs in WWTP effluent, to give benefit of the doubt to the species, we assume the concentrations are high enough for a duration that would cause sublethal effects to SONCC coho salmon, green sturgeon and eulachon.

Stormwater contaminants. Stormwater runoff from impervious surfaces delivers a wide variety of pollutants to aquatic ecosystems, such as metals (e.g., copper and zinc), petroleum-related compounds (e.g., polynuclear aromatic hydrocarbons), and sediment washed off the road surface

(Driscoll *et al.* 1990, Buckler and Granato 1999, Colman *et al.* 2001, Kayhanian *et al.* 2003). Stormwater pollutants are a source of potent adverse effects on coho salmon, even at ambient levels (Loge *et al.* 2006, Hecht *et al.* 2007, Johnson *et al.* 2007, Sandahl *et al.* 2007, Spromberg and Meador 2006). These pollutants also accumulate in the prey and tissues of juvenile salmon where, depending on the level of exposure, they cause a variety of lethal and sublethal effects including disrupted behavior, reduced olfactory function, immune suppression, reduced growth, disrupted smoltification, hormone disruption, disrupted reproduction, cellular damage, and physical and developmental abnormalities (Fresh *et al.* 2005, Hecht *et al.* 2007, LCREP 2007). Aquatic contaminants often travel long distances in solution or attached to suspended sediments, or gather in sediments until they are mobilized and transported by the next high flow (Anderson *et al.* 1996, Alpers *et al.* 2000a, 2000b).

Copper and zinc are two of the most common and most toxic components of stormwater. Research on their effects was discussed above. The concentrations tested in those studies are lower than common concentrations in stormwater outfalls, and thus indicate toxicity even after stormwater has been moderately diluted. The measured exposure times are also shorter than typical stormwater outfall discharge times.

Because we do not have information providing specific development scenarios, discharge points, stormwater management techniques, or the amount of impervious surfaces created from the Lone Ranch development we assumed that untreated stormwater would discharge to Duley (tributary to Lone Ranch Creek), Lone Ranch, Ram, and Taylor Creeks. Without specific presence and life history monitoring data, it is difficult to determine the number of individual SONCC coho salmon injured or killed from stormwater discharges associated with the Lone Ranch Development. Overall, adult SONCC coho salmon exposure to stormwater contaminant concentrations high enough for a duration long enough to cause injury or death is unlikely. Juvenile SONCC coho salmon from the discharge points downstream to the Pacific Ocean in Lone Ranch, Duley, Ram, and Taylor Creeks will likely be adversely affected by stormwater contaminants reducing growth, survival, and fitness. Green sturgeon and eulachon are unlikely to occur in these streams and therefore, will not likely be exposed in this area.

Summary of effects on species. The improvements and upgrades to the wastewater treatment system will reduce inflow and infiltration and increase capacity of the system to accommodate population growth, thus increasing the amount of effluent discharged over 20-year planning period. The WWTP will still discharge effluent contaminants that will adversely affect SONCC coho salmon, green sturgeon, and eulachon in the action area.

Contaminants that will adversely affect all life stages of SONCC coho salmon, green sturgeon, and eulachon include PBDEs, PPCPs, and metals through bioaccumulation of the food web. Effluent contaminants including temperature, ammonia, and metals will injure larval eulachon in the RMZ and ZID. Exposure to TSS in the RMZ and ZID for greater than 4 hours will injure SONCC coho salmon smolts and larval eulachon. Outside the RMZ and ZID, individuals of all life stages of each species will be exposed to minor, although sublethal effects from exposure to contaminants associated with effluent discharge. Stormwater discharges associated with the Lone Ranch Development will injure rearing juvenile SONCC coho salmon in Lone Ranch, Duley, Ram, and Taylor Creeks from the discharge point to the Pacific Ocean.

When we put the probability of presence and duration of exposure together with the severity of the effects, we find that every individual in the action area will be subject to some minor, sublethal effects, and a small number of individuals from each species will likely be injured or killed. On a population scale, the effects of the proposed action will not be measurable because too few individuals will be injured or killed for these species.

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). 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.

The State of Oregon projects the population of Curry County to grow slowly over the next 20 years (0.38%).[10] The generated amounts of human waste, PPCPs, petroleum-based chemicals, metals, and other byproducts of human existence are likely to increase at the same slow pace. However, technological advances (e.g., cleaner burning engines, more efficient wastewater treatment, treating currently untreated stormwater) and societal shifts (e.g., improved methods of disposing of unused pharmaceuticals, recycling, water conservation) likely will increase the efficiency of removing the contaminants from the environment.

Because the population growth rate is so low, the advances in keeping contaminants out of the environment are likely to outpace increased generation and overall reduce the amounts of contaminants discharged through the outfall. While the total amount of contaminants in effluent will be lower, degraded water quality will continue into the future and still contribute to adverse effects on SONCC coho salmon, SONCC coho salmon critical habitat, green sturgeon, green sturgeon critical habitat, and eulachon.

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

[10] Data from: https://www.oregon.gov/das/OEA/Pages/forecastdemographic.aspx. Accessed November 18, 2019.

species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

2.7.1 Critical Habitat

SONCC coho salmon

At the designation-wide scale, ongoing land management activities have degraded critical habitat for SONCC coho salmon from historical conditions. Habitat impairments recognized as factors leading to decline of the species were included in the original listing notice for SONCC coho salmon as: (1) Channel morphology changes; (2) substrate changes; (3) loss of instream roughness; (4) loss of estuarine habitat; (5) loss of wetlands; (6) loss/degradation of riparian areas; (7) declines in water quality; (8) altered streamflows; (9) fish passage impediments; and (10) elimination of habitat (62 FR 24588).

Climate change is likely to adversely affect the overall conservation value of designated critical habitat. The adverse effects are likely to include, but are not limited to, depletion of cold-water habitat and other variations in quality and quantity of tributary spawning, rearing and migration habitats.

Environmental baseline in the action area for SONCC coho salmon have been degraded by construction of Highway 101 contributing to delays or complete impairment of fish passage, timber harvest resulting in sedimentation and increased water temperatures, and rural development resulting in altered hydrology and degraded water quality associated with stormwater discharges in the action area. Food abundance and quality and water quality have been reduced by past discharges of stormwater and wastewater effluent.

The proposed action will result in reduced water quality in the action area caused by stormwater discharge associated with the Lone Ranch Development. Introduction of stormwater contaminants at chronic concentrations to Lone Ranch, Duley, Ram, and Taylor Creeks will result in reduced water quality and food abundance and quality in these tributaries from the discharge point to the Pacific Ocean.

Cumulative effects on critical habitat will come mostly from ongoing development and stormwater outflows associated with population growth and upstream land management activities. However, improvements in stormwater treatment methodologies and increased protections in land management including rural development and forest management will reduce the magnitude of adverse effects on critical habitat. Nonetheless, degraded water quality will continue into the future and still contribute to adverse effects on SONCC coho salmon critical habitat.

Based on our analysis of effects above, we are confident that the adverse effects of stormwater discharge from the Lone Ranch Development will affect a small portion of the critical habitat unit, and therefore will not appreciably diminish the value of critical habitat for the conservation of the species at the watershed level. Consequently, since the proposed action will not appreciably diminish the value of critical habitat for the conservation of the species at the watershed level, the proposed action will not diminish the value of the critical habitat at the designation level. Based on the above analysis, when considered in light of the status of the critical habitat, the effects of the proposed action, when added to the effects of the environmental baseline, and anticipated cumulative effects and climate change, critical habitat will remain functional, or retain the current ability for the PBFs to become functionally established, to serve the intended conservation role for the species.

Green sturgeon

The CHRT identified management activities that applied pesticides, disturbed bottom substrates, adversely affected prey resources, or degraded water quality as key, because they affect the physical or biological features of green sturgeon critical habitat. Of particular concern are activities that affect prey resources. Prey resources are affected by activities generating point source pollution and non-point source pollution that discharge contaminants and result in bioaccumulation of contaminants in green sturgeon.

Climate change is likely to adversely affect the overall conservation value of designated critical habitat. The adverse effects are likely to include, but are not limited to, reductions in water quality and loss of water quantity in spawning tributaries (spawning tributaries are located outside of the action area in California).

The environmental baseline for green sturgeon in the Pacific Ocean action area has been degraded by previous stormwater and wastewater effluent discharges, which have increased contaminants in the action area. Contaminants discharged through stormwater and wastewater effluent have bioaccumulated into the food web affecting green sturgeon food resources by reducing their abundance and quality.

The proposed action will result in continued reduced water quality in the action area caused by contaminants associated with the discharge of wastewater effluent. Effluent discharge will deliver contaminants that will continue to persist in the action area in the water column and the food web. Quality and function of food resources will be reduced due to the reduced abundance and quality of green sturgeon prey organisms in the action area.

Cumulative effects on critical habitat will come mostly from ongoing development and stormwater and effluent discharges associated with population growth. Because the population growth rate is so low, the advances keeping contaminants out of the environment are likely to outpace increased generation and overall reduce the amounts of contaminants released to the Pacific Ocean. Nonetheless, degraded water quality will continue into the future and still contribute to adverse effects on green sturgeon critical habitat.

Based on our analysis of effects above, we are confident that the adverse effects of the proposed action will affect a small portion of the critical habitat unit, and therefore will not appreciably diminish the value of critical habitat for the conservation of the species at the watershed level. Consequently, since the proposed action will not appreciably diminish the value of critical habitat for the conservation of the species at the watershed level, the proposed action will not diminish the value of the critical habitat at the designation level. Based on the above analysis, when considered in light of the status of the critical habitat, the effects of the proposed action, when added to the effects of the environmental baseline, and anticipated cumulative effects and climate change, critical habitat will remain functional, or retain the current ability for the PBFs to become functionally established, to serve the intended conservation role for the species.

2.7.2 Listed Species

SONCC coho salmon

In the 5-year review, we concluded that the ESU should remain listed as threatened because there has not been improvement in the status of SONCC coho salmon or a significant change in risk to persistence of the ESU (NMFS 2016). Of the 31 independent populations of SONCC coho salmon, 24 are at high risk of extinction and six are at moderate risk of extinction. Because the population abundance of most independent populations is below their depensation threshold, the SONCC coho salmon ESU is at high risk of extinction and is not viable. SONCC coho salmon occurring in the action area are part of the Chetco River population, which is currently at a high risk of extinction. Although there is not sufficient reliable data to develop dependable abundance numbers, the overall population productivity for Chetco River coho salmon appears to be very low and current abundance is likely below the depensation threshold.

Climate change is likely to adversely affect the survival and recovery of SONCC coho salmon. The adverse effects are likely to include, but are not limited to, depletion of cold-water habitat and other variations in quality and quantity of tributary spawning, rearing and migration habitats. Additionally, sea level rise, increased temperatures in the ocean, and ocean acidification are likely to reduce SONCC coho salmon survival.

The environmental baseline in the action area for SONCC coho salmon has been degraded by construction of Highway 101 contributing to delays or complete impairment of fish passage, timber harvest resulting in sedimentation and increased water temperatures, and rural development resulting in altered hydrology and degraded water quality and food abundance and quality associated with stormwater and wastewater effluent discharges in the action area. Habitat quality in the action area has been maintained in this degraded state in recent years, which has likely had a slight, negative effect on the abundance of the Chetco River population of SONCC coho salmon, although there is not sufficiently reliable data to develop dependable abundance numbers at this time.

The proposed action will adversely affect adult, smolt, and rearing juvenile SONCC coho salmon through discharge of contaminants associated with wastewater effluent and stormwater discharge. Concentrations of stormwater contaminants and duration of exposure will be sufficient to injure a small number of rearing juvenile SONCC coho salmon in Lone Ranch, Duley, Ram, and Taylor Creeks. A small number of adult and smolt SONCC coho salmon will be injured by exposure to PCPPs and TSS and bioaccumulation of effluent contaminants through consumption of contaminated prey organisms.

Cumulative effects on SONCC coho salmon will come mostly from ongoing development, land management activities, and stormwater discharges associated with population growth. Because the population growth rate is so low, the advances keeping contaminants out of the environment are likely to outpace increased generation and overall reduce the amounts of contaminants released to the Pacific Ocean. Nonetheless, degraded water quality and food will continue into the future and still contribute to adverse effects on SONCC coho salmon.

The effects of the proposed action will result in adverse effects and injury to a small number of adult, smolt, and rearing juvenile SONCC coho salmon. Additionally, cumulative effects will continue to adversely affect SONCC coho salmon individuals of each of these life stages. After reviewing the species status, environmental baseline, effects of the proposed action, and cumulative effects, we find the proposed action will not appreciably reduce the likelihood of the survival or recovery of the Chetco River population of SONCC coho salmon. Based on our conclusion that the Chetco River population's survival and recovery will not be impeded because of the proposed action, the proposed action will not appreciably reduce the likelihood of the survival or recovery of the SONCC coho salmon ESU.

Green sturgeon

Green sturgeon occurring in the action area are spawned south of the Eel River in California. When not spawning, green sturgeon are broadly distributed in nearshore marine areas from Mexico to the Bering Sea. The principal factor for the decline of green sturgeon is the reduction of its spawning area to a single known population limited to a small portion of the highly degraded Sacramento River. This limiting factor does not apply in the action area.

Climate change is likely to adversely affect the survival and recovery of green sturgeon. The adverse effects are likely to include, but are not limited to, loss of food resources and loss of quality and quantity of spawning habitat in the Sacramento River. Additionally, sea level rise, increased temperatures in the ocean and ocean acidification are likely to reduce green sturgeon survival.

The action area supports growth and development and safe passage through a migratory corridor for adult and sub-adult green sturgeon. The environmental baseline is degraded from discharges of stormwater and wastewater effluent. Contaminants from stormwater and wastewater effluent persist in the action area and have bioaccumulated into the food web.

The proposed action will adversely affect green sturgeon through discharge of contaminants associated with wastewater effluent and stormwater discharge. Concentrations of stormwater and effluent contaminants that they will affect green sturgeon prey organisms through bioaccumulation due to consumption of contaminated food. Consequently, a small number of green sturgeon will forage on affected prey organisms in the action area and be injured by ingestion of stormwater and effluent contaminants.

Cumulative effects on green sturgeon will come mostly from ongoing development, land management activities, and stormwater discharges associated with population growth. Because the population growth rate is so low, the advances keeping contaminants out of the environment are likely to outpace increased generation and overall reduce the amounts of contaminants released to the Pacific Ocean. Nonetheless, degraded water quality and food will continue into the future and still contribute to adverse effects on green sturgeon.

The effects of the proposed action will result in adverse effects and injury to a small number of green sturgeon. Additionally, cumulative effects will continue to adversely affect green sturgeon. After reviewing the species status, environmental baseline, effects of the proposed action, and cumulative effects, we find the proposed action will not appreciably reduce the likelihood of the survival or recovery of the southern distinct population segment of green sturgeon.

Eulachon

Eulachon in the action area migrate through the action area on their way to or from spawning grounds in the Chetco River. Eulachon have been observed in the Chetco River, but are thought to occur on an infrequent basis and in small numbers. The major species-wide threats to eulachon are impacts of climate change on oceanic and freshwater habitats, and fishery by-catch.

Climate change is likely to adversely affect the survival and recovery of eulachon. The adverse effects are likely to include, but are not limited to, loss in abundance and quality of food resources and changes in water quality and quantity of spawning tributaries. Additionally, sea level rise, increased temperatures in the ocean and ocean acidification are likely to reduce green sturgeon survival.

The action area supports larval, juvenile, and adult eulachon growth and development and eulachon migration. The environmental baseline is degraded from discharges of stormwater and wastewater effluent. Contaminants from stormwater and wastewater effluent persist in the action area and have bioaccumulated into the food web.

The proposed action will adversely affect eulachon through discharge of contaminants associated with wastewater effluent and stormwater discharge. Concentrations of stormwater and effluent contaminants will affect eulachon prey organisms through bioaccumulation due to consumption of contaminated food. Consequently, a small number of eulachon will forage on affected prey organisms in the action area and be injured by ingestion of stormwater and effluent contaminants.

Cumulative effects on eulachon will come mostly from ongoing development, land management activities, and stormwater discharges associated with population growth. Because the population growth rate is so low, the advances keeping contaminants out of the environment are likely to outpace increased generation and overall reduce the amounts of contaminants released to the Pacific Ocean. Nonetheless, degraded water quality and food will continue into the future and still contribute to adverse effects on eulachon.

The effects of the proposed action will result in adverse effects and injury to a small number of eulachon. Additionally, cumulative effects will continue to adversely affect eulachon. After reviewing the species status, environmental baseline, effects of the proposed action, and cumulative effects, we find the proposed action will not appreciably reduce the likelihood of the survival or recovery of the southern distinct population segment of eulachon.

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 SONCC coho salmon or destroy or adversely modify its designated critical habitat.

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 green sturgeon or destroy or adversely modify its designated critical habitat.

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 eulachon.

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.

The NMFS has not yet promulgated an ESA section 4(d) rule prohibiting take of threatened eulachon. Anticipating that such a rule may be issued in the future, we have included a prospective incidental take exemption for eulachon. The elements of this ITS for eulachon would become effective on the date on which any future 4(d) rule prohibiting take of eulachon becomes effective. Nevertheless, the amount and extent of eulachon incidental take, as specified in this statement, will serve as one of the criteria for reinitiation of consultation pursuant to 50 C.F.R. § 402.16(a), if exceeded.

Since we do not know the specific development scenarios, discharge points, stormwater management techniques, or the amount of impervious surfaces created from the Lone Ranch development, it is difficult to determine an appropriate indicator to rationally reflect the extent of incidental take and act as an effective reinitiation trigger. It is also difficult to determine monitoring scenarios that would be helpful in determining the effectiveness of the ITS in minimizing incidental take associated with this action. Thus, we are not issuing take for the adverse effects associated with discharge of stormwater from Lone Ranch development. We strongly recommend to the City that they seek consultation with us to be in compliance with the ESA as development at Lone Ranch proceeds.

2.9.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

- Larval eulachon and smolt SONCC coho salmon will be harmed from exposure to TSS in the RMZ and ZID.
- Larval eulachon will be harmed from exposure to increased temperatures, ammonia, and metals in the RMZ and ZID.
- All affected life stages of SONCC coho salmon, green sturgeon, and eulachon will be harmed from ingestion of prey organisms contaminated by effluent contaminants discharged to the action area.

Accurately quantifying the number of fish taken by these pathways is not possible. Much of the action area is too deep and velocities are too great to allow observation of injured or killed fish. Observation would also add significant additional stress and risk of injury to these fish. Most of the take will occur as sublethal effects that will not be observable without sampling the individuals. Furthermore, there are no methods available to monitor this death and injury because it will occur throughout the year over a large area. In such cases, we use a take surrogate or take indicator that rationally reflects the incidental take caused by the proposed action.

For wastewater effluent, we will use as a surrogate for the extent of take the concentrations of the contaminants with the best available information for monitoring and biological effects on fish; temperature, dissolved copper and dissolved zinc. The extent of take indicators for take associated with wastewater effluent are increases of temperature at the edge of the RMZ of less than 0.3°C, dissolved copper concentrations of 3.1 μg/L at the edge of the RMZ, and dissolved zinc concentrations of 81 μg/L at the edge of the RMZ. These can be calculated using effluent monitoring data and the dilution factors for the RMZ for these constituents. Concentrations of these constituents are good indicators of the take associated with wastewater effluent because the constituents are representative wastewater pollutants. In addition to being the most practical and feasible indicators to measure, their concentrations are proportional to the adverse effects of the proposed action. Also, there is already a monitoring program in place, which could measure metal concentrations. If either of these indicators of the extent of take are exceeded, reinitiation will be warranted.

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 action, 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).

1. Minimize incidental take from exposure to contaminants being discharged by the WWTP.
2. Monitor contaminant concentrations to document the effects of the action on ESA-listed species in the action area, and provide annual monitoring reports to NMFS.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the USDA RUS or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). The USDA RUS 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.

1. To implement reasonable and prudent measure #1 (contaminant discharge), the City of Brookings shall:
    a. Ensure effluent from the WWTP meets EPA-approved ODEQ aquatic life criteria, including:
        i. Do not increase temperature at the RMZ more than 0.3°C.
        ii. Do not exceed dissolved copper concentrations of 3.1 μg/l at the edge of the RMZ.
        iii. Do not exceed dissolved zinc concentrations of 81 μg/l at the edge of the RMZ.
        iv. Report any sampled exceedance of EPA-approved ODEQ aquatic life criteria concentrations to NMFS within 30-days, including a description of the remedy.

2. To implement reasonable and prudent measure #2 (monitoring), the City of Brookings shall:
    a. Monitor to determine if wastewater discharges are within the extent of take specified in the ITS, including:
        i. Semi-annual measurements of contaminant concentrations from wastewater discharges. At a minimum, the measurements shall include temperature, copper and zinc.
            1. If the samples are taken in the effluent pipeline prior to discharge, a dilution ratio may be used to determine the concentrations at the RMZ. The dilution ratio for the RMZ in the most recent mixing zone analysis in

the NPDES evaluation (2018) may be used, which are 157 for temperature and 43 for copper and zinc.

b. Submit an annual report to NMFS by January 30 of each year that includes the following information for the prior calendar year:
   i. Project name and location.
   ii. Contact name, address, and phone number.
   iii. Wastewater monitoring as described in 2.a. above.
   iv. Submit all reports to:

      ARA, Oregon-Washington Coastal Area Office
      NOAA Fisheries, West Coast Region
      Attn: WCRO-2019-00561
      1201 Lloyd Blvd, Suite 1100
      Portland, Oregon 97232-1274

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).

1. The USDA RUS should work with EPA to investigate treatment methods for municipal wastewater that more efficiently reduces metals, PBDEs, PPCPs, and other contaminants below adverse effects thresholds for aquatic organisms.
2. The USDA RUS should support the investigation of the re-use of treated municipal wastewater for appropriate municipal and agricultural needs such as irrigation. Such actions would not only alleviate effects on listed fish within mixing zones by decreasing contaminant discharge, but would also decrease the demand for clean freshwater in the municipality.

2.11 Reinitiation of Consultation

This concludes formal consultation for the City of Brookings wastewater system improvements.

As 50 CFR 402.16 states, reinitiation of formal consultation is required 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 agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat that was not considered in this 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 USDA RUS and descriptions of EFH for Pacific Coast groundfish (PFMC 2005), coastal pelagic species (PFMC 1998), and Pacific Coast salmon (PFMC 2014) in the fishery management plans developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

The proposed action and the action area for this consultation are described in Sections 1.3 and 2.3 of the accompanying opinion. The action area includes areas designated as EFH for coastal pelagic species, Pacific Coast groundfish, and Pacific salmon (Table 4).

Table 4. Species with designated EFH in the action area.

Groundfish Species	
Leopard Shark (southern OR only)	*Triakis semifasciata*
Soupfin Shark	*Galeorhinus zyopterus*
Spiny Dogfish	*Squalus acanthias*
California Skate	*Raja inornata*
Spotted Ratfish	*Hydrolagus colliei*
Lingcod	*Ophiodon elongatus*
Cabezon	*Scorpaenichthys marmoratus*
Kelp Greenling	*Hexagrammos decagrammus*
Pacific Cod	*Gadus macrocephalus*
Pacific Whiting (Hake)	*Merluccius productus*
Black Rockfish	*Sebastes melanops*
Bocaccio	*Sebastes paucispinis*
Brown Rockfish	*Sebastes auriculatus*
Copper Rockfish	*Sebastes caurinus*
Quillback Rockfish	*Sebastes maliger*
English Sole	*Pleuronectes vetulus*
Pacific Sanddab	*Citharichthys sordidus*
Rex Sole	*Glyptocephalus zachirus*
Rock Sole	*Lepidopsetta bilineata*
Starry Flounder	*Platichthys stellatus*
Coastal Pelagic Species	
Pacific Sardine	*Sardinops sagax*
Pacific (Chub) Mackerel	*Scomber japonicus*
Northern Anchovy	*Engraulis mordax*
Jack Mackerel	*Trachurus symmetricus*
California Market Squid	*Loligo opalescens*
Pacific Salmon Species	
Chinook Salmon	*Oncorhynchus tshawytscha*
Coho Salmon	*Oncorhynchus kisutch*

3.2 Adverse Effects on Essential Fish Habitat

The ESA portion of this document (Section 2.5.1) describes the adverse effects of this proposed action on SONCC coho salmon, eulachon, and green sturgeon habitat. This ESA analysis of effects is relevant to EFH. However, the presence of coho salmon, eulachon, and green sturgeon in the action area and mixing zone is transitory. Some of the Pacific Coast groundfish and coastal pelagic species with EFH may spend more time in the action area and at younger life stages than the ESA species. Effects on these species may be greater than analyzed above.

Pacific Coast groundfish and coastal pelagic species exhibit a marine life history and are more likely to be exposed to effluent at egg, larval, juvenile, sub-adult, and adult life stages for a longer period. They use the action area for breeding, feeding, growth and development, and migration. Younger life stages are likely more susceptible to effects of effluent contaminants and degraded water quality due to their incomplete physiological development. Thus, the effects of effluent contaminant discharge are of higher consequence to EFH for Pacific Coast groundfish and coastal pelagic species.

Based on information provided by the action agency, the analysis of effects presented in the ESA portion of this document, and the discussion above, we conclude that the proposed action will adversely affect designated EFH for Pacific salmon, Pacific Coast groundfish, and coastal pelagic species due to release of contaminants (see Section 2.5.1 for detailed discussion).

3.3 Essential Fish Habitat Conservation Recommendations

The following two conservation measures are necessary to avoid, mitigate, or offset the impact of the proposed action on EFH. Both of these conservation recommendations are a subset of the ESA terms and conditions.

1. Contaminant discharge. Minimize adverse effects on water quality and forage by managing wastewater effluent, as stated in term and condition # 1 in the accompanying opinion.
2. Monitoring. Ensure completion of a monitoring and reporting program to confirm the proposed action is limiting adverse effects on EFH, as stated in term and condition #2 in the accompanying opinion.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2, above, approximately 6.5 acres of designated EFH for Pacific Coast salmon, Pacific Coast groundfish, and coastal pelagic species.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, USDA RUS must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

The USDA RUS 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 affects the basis for NMFS' EFH Conservation Recommendations (50 CFR 600.920(l)).

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 USDA RUS. Other interested users could include the City of Brookings. Individual copies of this opinion were provided to the USDA RUS. 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, if applicable, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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