UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Klamath River Renewal Corporation	**Project Nos. 14803-001;**
PacifiCorp	**2082-063**

AMENDED APPLICATION FOR SURRENDER OF LICENSE FOR MAJOR PROJECT AND REMOVAL OF PROJECT WORKS

EXHIBIT L
Sediment Deposit Remediation Plan

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

Sediment Deposit Remediation Plan

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February 2021

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1.0 Introduction

The Lower Klamath River Project (Lower Klamath Project) (FERC No. 14803) consists of four hydroelectric developments on the Klamath River: J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate (Figure 1-1). In September of 2016, the Renewal Corporation filed an *Application for Surrender of License for Major Project and Removal of Project Works,* FERC Project Nos. 2082-063 & 14803-001 (License Surrender). The Renewal Corporation filed the License Surrender application as the dam removal entity for the purpose of implementing the Klamath River Hydroelectric Settlement (KHSA). In November of 220, the Renewal Corporation filed its Definite Decommissioning Plan (DDP) as Exhibits A-1 and A-2 to its amended License Surrender application. The DDP is the Renewal Corporation's comprehensive plan to physically remove the Lower Klamath Project and achieve a free-flowing condition and volitional fish passage, site remediation and restoration, and avoidance of adverse downstream impacts (Proposed Action). The Limits of Work is a geographic area that encompasses dam removal related activities in the Proposed Action and may or may not expand beyond the FERC boundary associated with the Lower Klamath Project.

The Proposed Action includes the deconstruction of the J.C. Boyle Dam and Powerhouse (Figure 1-2), Copco No. 1 Dam and Powerhouse (Figure 1-3), Copco No. 2 Dam and Powerhouse (Figure 1-4), and Iron Gate Dam and Powerhouse (Figure 1-5), as well as associated features. Associated features vary by development, but generally include powerhouse intake structures, embankments, and sidewalls, penstocks and supports, decks, piers, gatehouses, fish ladders and holding facilities, pipes and pipe cradles, spillway gates and structures, diversion control structures, aprons, sills, tailrace channels, footbridges, powerhouse equipment, distribution lines, transmission lines, switchyards, original cofferdam, portions of the Iron Gate Fish Hatchery, residential facilities, and warehouses. Facility removal will be completed within an approximately 20-month period.

This Sediment Deposit Remediation Plan identifies the measures the Renewal Corporation will implement to monitor the deposition of sediments along the Klamath River, immediately north and south of the Klamath estuary, and at the Crescent City harbor. The Renewal Corporation has prepared 16 Management Plans for FERC's review and approval as conditions of a license surrender order. These Management Plans were developed in consultation with federal, state and county governments and tribes.

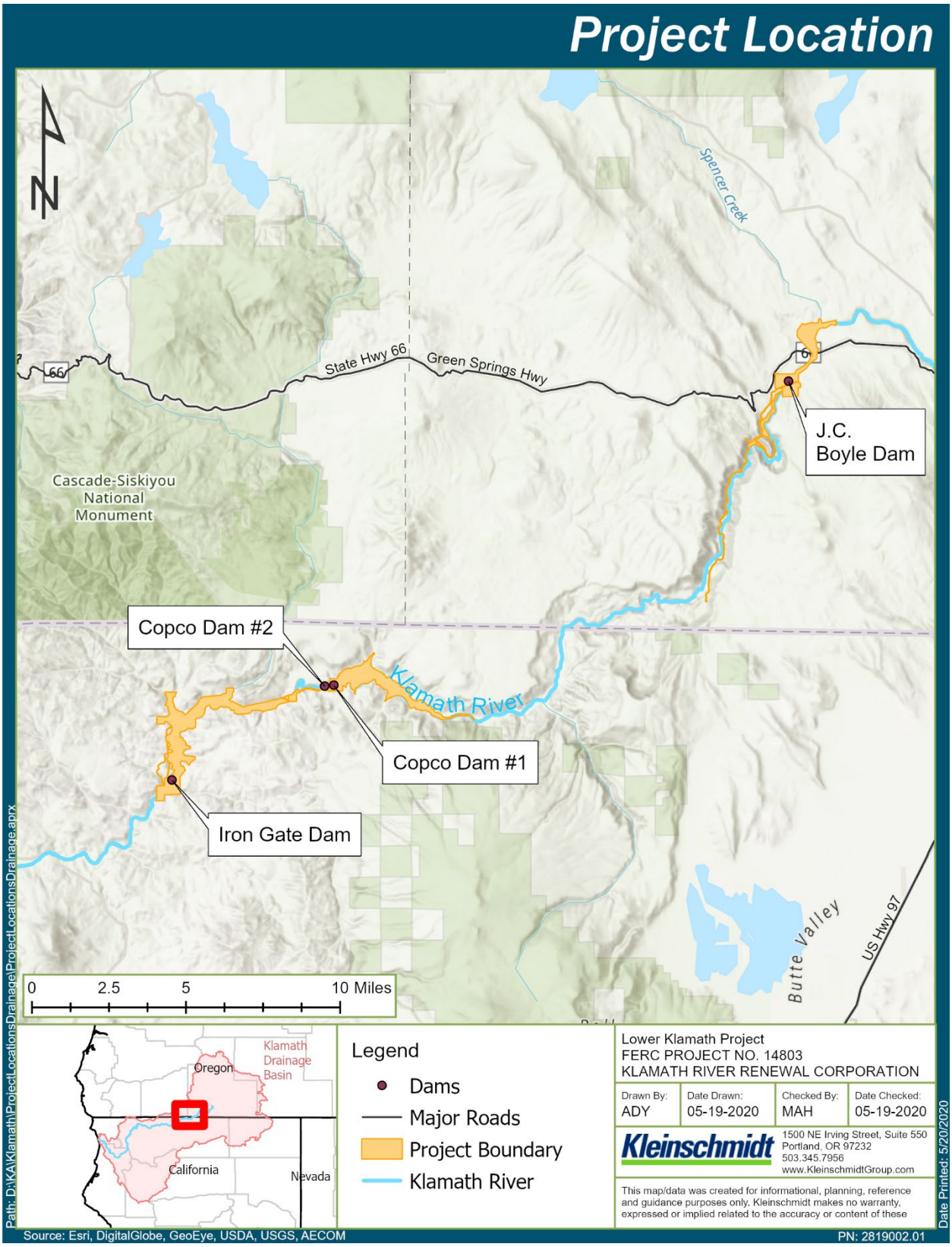

Figure 1-1. Lower Klamath Project Location

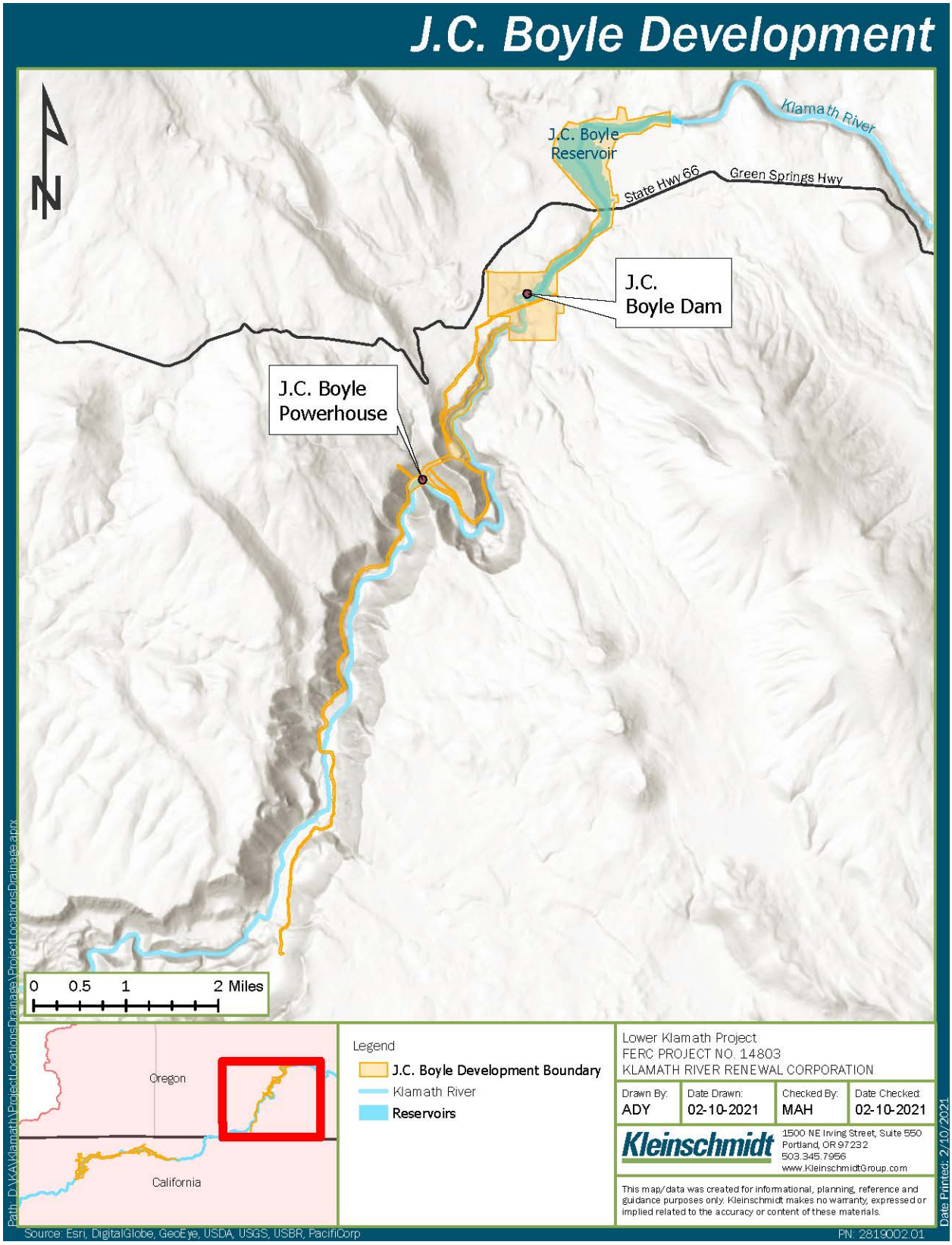

Figure 1-2. J.C. Boyle Development Facility Details

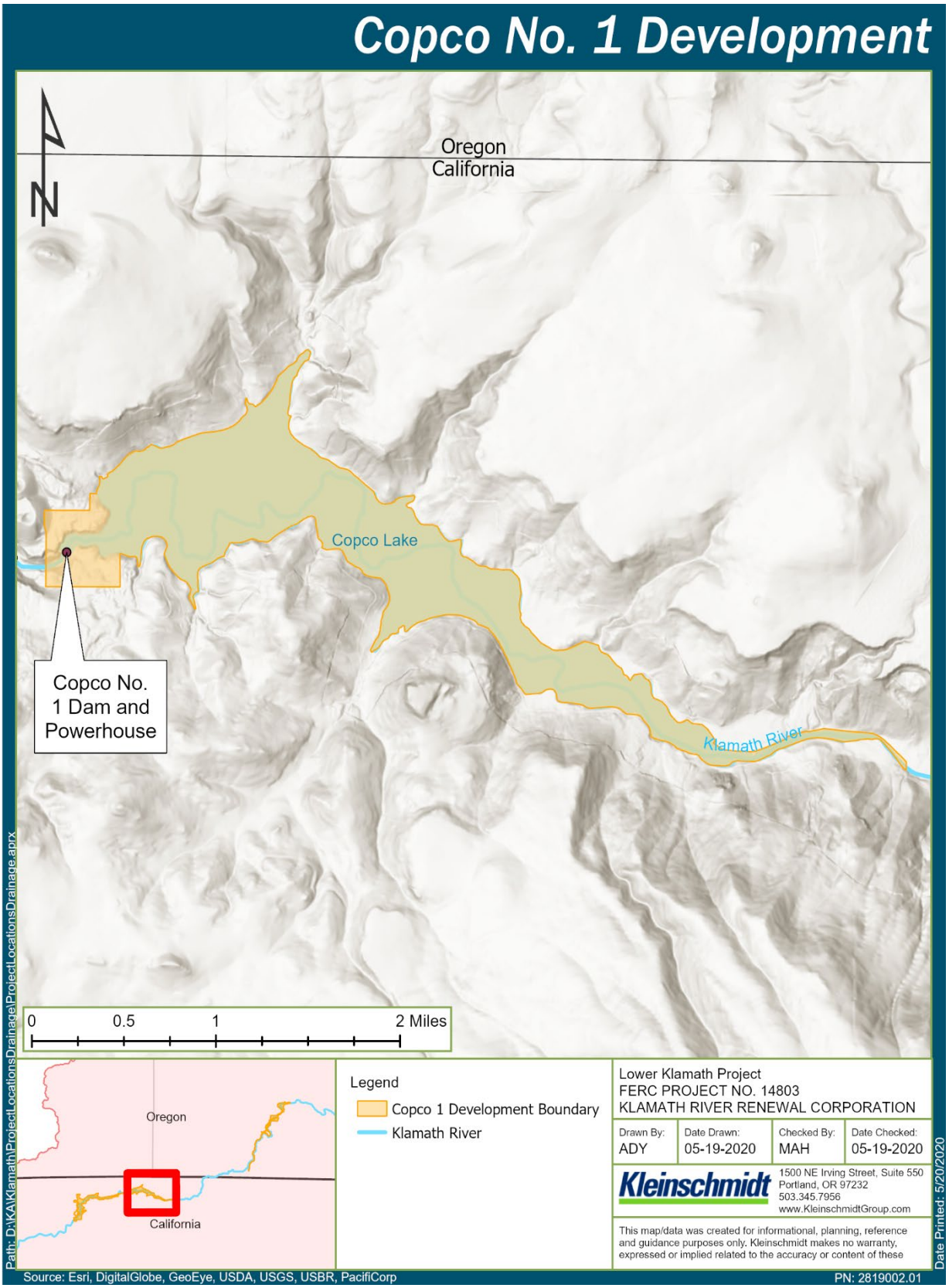

Figure 1-3. Copco No.1 Development Facility Details

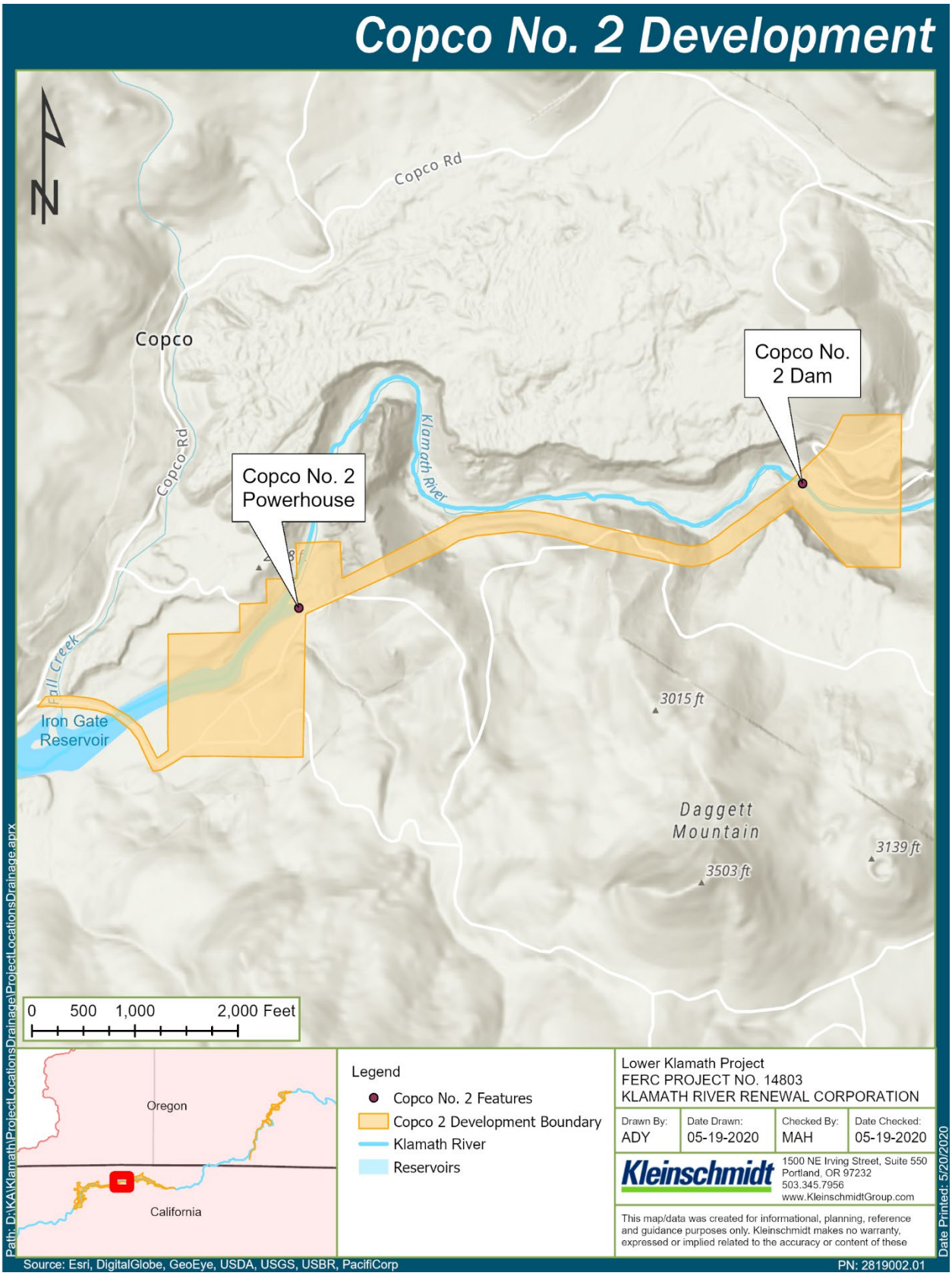

Figure 1-4. Copco No.2 Development Facility Details

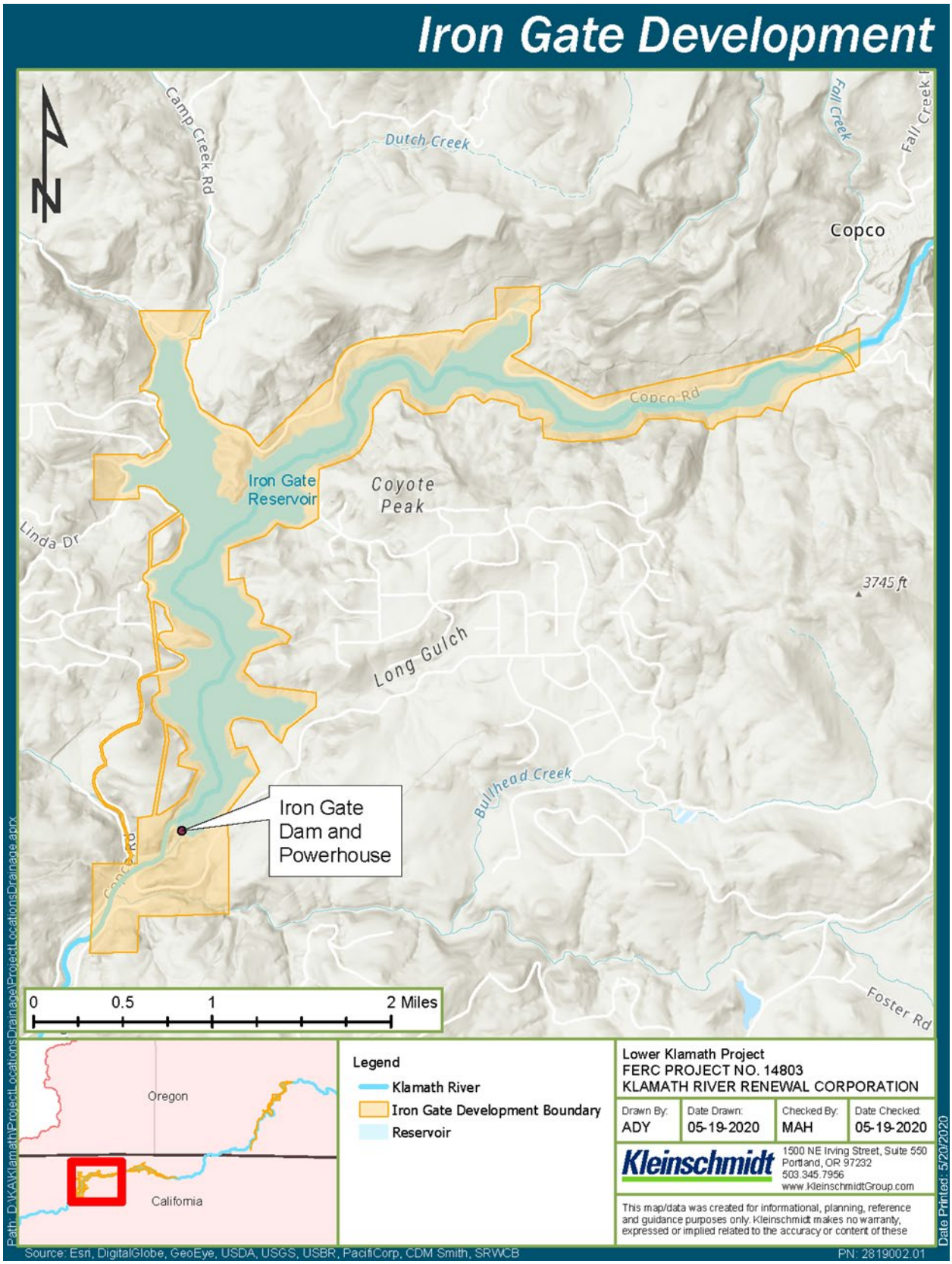

Figure 1-5. Iron Gate Development Facility Details

2.0 Regulatory Components

The Sediment Deposit Remediation Plan is one of 16 Management Plans implementing the DDP.

Table 2-1. Lower Klamath River Management Plans

1. Aquatic Resources Management Plan	9. Remaining Facilities Plan
2. Construction Management Plan	10. Reservoir Area Management Plan
3. Erosion and Sediment Control Plan	11. Reservoir Drawdown and Diversion Plan
4. Hatchery Management and Operations Plan	12. Sediment Deposit Remediation Plan
5. Health and Safety Plan	13. Terrestrial and Wildlife Management Plan
6. Historic Properties Management Plan	14. Waste Disposal and Hazardous Materials Plan
7. Interim Hydropower Operations Plan	15. Water Quality Monitoring Management Plan
8. Recreation Facilities Plan	16. Water Supply Management Plan

2.1 Organizational Structure

The Sediment Deposit Remediation Plan identifies the measures the Renewal Corporation will implement to monitor the deposition of sediments along the Klamath River, immediately north and south of the Klamath estuary, and at the Crescent City harbor. These proposed measures are part of the Proposed Action. The Sediment Deposit Remediation Plan includes the following sub-plans.

- Appendix A: California Sediment Deposit Remediation plan
- Appendix B: Del Norte Sediment Monitoring Plan

2.2 Special Regulatory Interests

The Renewal Corporation considered the following regulatory interests in the development of the Sediment Deposit Remediation Plan:

- Draft Del Norte MOU
- California Section 401 Water Quality Certification
- California Department of Fish and Wildlife MOU
- Oregon MOU

2.3 Regulatory Review Process

The Renewal Corporation will implement the Sediment Deposit Remediation Plan upon FERC approval, including any changes required in the FERC License Surrender Order.

2.4 Reporting

The Renewal Corporation will prepare and submit an Annual Report by February 15th of each year which will include information pertaining to implementation of the Sediment Deposit Remediation Plan.

Appendix A

California Sediment Deposit Remediation Plan

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

California Sediment Deposit Remediation Plan

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February 2021

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Table of Contents

1.0 Introduction

The California Sediment Deposit Remediation Plan described herein is a subplan of the Sediment Deposit Remediation plan that will be implemented as part of the Proposed Action for the Lower Klamath Project (Project).

1.1 Purpose of Sediment Deposit Remediation Plan

The purpose of the California Sediment Deposit Remediation Plan is to state the measures the Renewal Corporation will implement to assess and remediate sediment deposits along the Klamath River from below Iron Gate Dam to the mouth of the Klamath Estuary that are due to reservoir drawdown activities.

1.2 Relationship to Other Management Plans

The California Sediment Deposit Remediation Plan is supported by elements of the following management plans for effective implementation: Water Quality Monitoring and Management Plan and the Erosion and Sediment Control Plan. So as to not duplicate information, elements from these other management plans are not repeated herein but are, where appropriate, referred to in this California Sediment Deposit Remediation Plan.

2.0 Sediment Deposit Assessment and Remediation

The Renewal Corporation will assess visibly obvious sediment deposits along the Klamath River from below Iron Gate Dam to the mouth of the Klamath Estuary that may have been deposited during reservoir drawdown activities. The Renewal Corporation will only assess sediment deposits on parcels with a current or potential residential or agricultural land use, for which the property owner has notified the Renewal Corporation of a potential sediment deposit that may be associated with reservoir drawdown activities.

The Renewal Corporation will assess sediment deposits within 60 days of property owner notification to determine if the deposits are consistent with physical sediment properties associated with reservoir sediments. Such assessment will occur via appropriate agreement with the property owner. The Renewal Corporation will test sediment deposits consistent with the physical sediment properties of Project reservoirs for arsenic or remediate the deposits without testing. If testing is performed, the Renewal Corporation will test soil samples in the vicinity of the deposited sediments (e.g., from the adjacent riverbank and/or floodplain) for arsenic to determine the local background arsenic concentrations. If the measured arsenic concentrations in the deposited sediments are less than or equal to measured local background soil concentrations for arsenic, the Renewal Corporation will not take any additional actions. If the concentration of arsenic in the deposited sediments on the river banks and floodplain of the Klamath River exceed local background levels and human health residential screening levels established by the United States Environmental Protection Agency or California Environmental Protection Agency, the Renewal Corporation will remediate the deposited sediments to local

background levels through removal of the deposited sediments or soil capping, if sediment removal is infeasible or poses a greater risk than soil capping.

2.1 Sediment Deposits that Require No Further Action

If a reported sediment deposit does not require remediation based on the conditions described in Section 2.0, the Renewal Corporation will notify the property owner and submit a report to the FERC and the California State Water Resources Control Board (SWRCB). At a minimum, the report will include the location of the reported deposit, a summary of actions taken, and support for the determination that no further action is needed. If sampling was performed, the report shall also include, at a minimum:

- Estimated quantity of the reported sediment deposit.
- Arsenic testing method(s) used and the number, location, and depth of samples collected from the reported sediment deposit and surrounding soils.
- Arsenic concentrations associated with each sample.

The Renewal Corporation will provide additional information at the request of the FERC or the SWRCB.

2.2 Sediment Deposits the Require Further Action

If a reported sediment deposit requires further action based on the conditions described in Section 2.0, the Renewal Corporation will submit a California Sediment Deposit Remediation Plan to the SWRCB within 14 days for review and approval. The California Sediment Deposit Remediation Plan will include:

- Estimated location and quantity of the reported sediment deposit.
- If testing was performed, the arsenic sediment testing methods used and the number, location, depth, and concentration associated with each sediment samples collected from the reported sediment deposit and surrounding soils.
- Proposed remediation actions, including a schedule for remediation and any proposed post-remediation soil sampling. If soil capping is proposed, the Licensee shall provide documentation supporting why soil removal is infeasible or poses a greater risk than soil capping.

The Renewal Corporation will update this plan as appropriate during implementation and will file the updated and approved plan with the FERC. The Renewal Corporation will then implement the California Sediment Deposit Remediation Plan.

The Renewal Corporation will provide a report to the property owner, the FERC, and the SWRCB within 30 days of completing remediation activities. The report will include the location of the remediation, a summary of action(s) taken including the quantity of soil removed or area capped, and support for the determination that no further remediation is needed. Additionally, if post-remediation soil sampling was performed, the report will include, at a minimum: arsenic soil

testing method(s) used; the number, location, and depth of soil samples collected and their relation to the area remediated; and the associated arsenic soil concentrations.

Appendix B

Del Norte Sediment and Monitoring Plan

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

Del Norte Sediment Management Plan

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February 2021

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1.0 Introduction

The Del Norte Sediment Management Plan is a sub-plan of the Sediment Deposit Remediation Plan that will be implemented as part of the Proposed Action for the Lower Klamath Project (Project).

1.1 Purpose of Del Norte Sediment Management Plan

The purpose of the Del Norte Sediment Management Plan is to state the methodology and procedures the Renewal Corporation will implement within Del Norte County to quantify the potential impacts of sediment releases during the Proposed Action and establish the measures the Renewal Corporation will implement to address those impacts.

1.2 Relationship to Other Management Plans

The Del Norte Sediment Management Plan is supported by elements of the following management plans for effective implementation: Water Quality Monitoring and Management Plan. So as to not duplicate information, elements from these other management plans are not repeated herein but are, where appropriate, referred to in this Sediment Deposit Remediation Plan.

2.0 Background

The dam removal and reservoir drawdown planned as part of the Proposed Action will release sediment from J.C. Boyle, Copco No. 1, and Iron Gate reservoirs into the Klamath River below Iron Gate Dam. The drawdown period refers to the period when the reservoir water level will be lowered, with a corresponding sediment evacuation from the reservoirs. The reservoir sediment is primarily fine-grained silts and clays and is expected to be carried by Klamath River flows from Iron Gate Dam to the Pacific Ocean, with minimal deposition in the river itself. Depending on whether wet, dry, or average river flow conditions occur during the drawdown period, the amount of sediment released from the reservoir is estimated to vary from 1.5 to 2.3 million tons (SWRCB 2020). This sediment load represents an approximate increase of 24 to 55 percent over the current average annual Klamath River sediment discharge of 5.83 million tons (Stillwater Sciences 2010). Del Norte County has raised concerns about potential increased sediment deposition in Crescent City Harbor and Lower Klamath River boat ramps due to the increased river sediment loads from the reservoir drawdown.

2.1 Crescent City Harbor

2.1.1 Project Authorization

The existing federal project for the improvement of the Crescent City Harbor was authorized by the Rivers and Harbors Act of 1918. It was based on a report printed in House Document 434 of the 64th Congress, First Session, and provided for construction of a rubble mound outer breakwater. The Crescent City Harbor District is the non-federal sponsor for the project. The

United States Army Corps of Engineers (USACE) Environmental Assessment (USACE 2019) provides a full history of the documents authorizing improvements that make up the existing federal project.

2.1.2 Project Area

Crescent City Harbor is a small commercial harbor located on the northern California coast, approximately 280 miles north of San Francisco, 14 miles north of the Klamath River mouth, and 17 miles south of the Oregon border (USACE 2019). The south-facing harbor occupies a natural indentation in the coastline and is protected by a 4,700-foot-long rubble mound outer breakwater to the west; a 2,400-foot sand barrier to the east; a 1,600-foot inner breakwater to the south; and the topography of the coastline to the north (USACE 2019).

As shown in Figure A-1, the Inner Harbor contains two boat basins that are maintained by the Crescent City Harbor District (USACE 2019). The Commercial Small Boat Basin (outer boat basin) has temporary moorage space for approximately 20 vessels. The depths maintained in the outer basin range from -10 feet mean lower low water (MLLW) in the southern half adjacent to Whaler Island to -15 feet MLLW. The Recreational Small Boat Basin (inner boat basin) re-opened in March 2014 following damage from the March 2011 tsunami and is designed to resist the 50-year tsunami event, has 291 slips ranging in length from 30 feet to 70 feet, and is maintained to a depth of -15 MLLW.

2.1.3 Historical Maintenance Dredging

The dredging history of the Harbor is well documented (USACE 2019). The Crescent City Harbor Entrance and Inner Harbor Basin Channels were first dredged under the USACE Operations and Maintenance Program in 1936 and have been maintained on dredging intervals ranging from 1 to 17 years. Crescent City Harbor Basin and Channel areas and dredge maintenance depths are shown in Figure A-2, and Table 2-1 shows the years and volumes of the historical dredging.

Table 2-1. Crescent City Harbor Federal Channels Historical Dredged Volumes

YEAR	CHANNELS	VOLUME (CUBIC YARDS)
1936	Inner Harbor Basin and Entrance Channels	48,449
1937	Inner Harbor Basin and Entrance Channels	27,756
1938	Inner Harbor Basin and Entrance Channels	16,353
1939	Inner Harbor Basin and Entrance Channels	58,396

YEAR	CHANNELS	VOLUME (CUBIC YARDS)
1956/1957	Inner Harbor Basin and Entrance Channels	120,466
1964/1965	Inner Harbor Basin and Entrance Channels	187,372 (b)
1976	Inner Harbor Basin and Entrance Channels	61,013
1982	Inner Harbor Basin and Entrance Channels	125,319
1983	Inner Harbor Basin and Entrance Channels	40,221
1988	Inner Harbor Basin and Entrance Channels	62,192
1993	Inner Harbor Basin and Entrance Channels	37,487
1999/2000	Entrance Channel and Marina Access Channel	35,000
2009	Marina Access Channel	34,947
2011 (a)	Inner Harbor Basin and Entrance Channels	41,630
	Total	896,601
2019 (c)	Inner Harbor Basin and Entrance Channels	118,000

(Source: USACE 2019)

Note:
a) Due to funding, the Entrance Channel and Marina Access Channel were only dredged to -14 feet MLLW (with 1 foot of over-depth) in 2009.
b) The 1964 tsunami may have contributed to the larger-than-usual volume.
c) The most recent dredging occurred in 2019, with estimated volume as noted.

2.1.4 Project Maintenance Dredging Volumes

USACE estimated average shoaling and dredging rate for the Entrance and Inner Harbor Basin Channels using the historic dredged volumes from 1936 to 2000 (USACE 2019). Based on the USACE analysis, the average shoaling and dredging rate for the Entrance and Inner Harbor Basin Channels was approximately 12,000 cubic yards of material per year. Based on a 2005 hydrographic survey, the Marina Access Channel was estimated to shoal at an average rate of approximately 8,000 cubic yards per year since it was deepened in 2000. The combined average shoaling and dredging rate for the Entrance, Inner Harbor Basin, and the Marina Access Channels (Areas 4, 5 and 6 in Figure A-2) is approximately 20,000 cubic yards per year, which equates to approximately 100,000 cubic yards every 5 years (HydroPlan and Anchor QEA 2015).

2.1.5 Sediment Testing and Characterization

The majority of deposited sediments in the Crescent City Harbor are sourced from littoral transport of sediments into the harbor from north to south (USACE 2019). Composition of the sediment sources north and south of the Harbor are similar, with approximately equal (30 to 45 percent) proportions of rock fragments and quartz. Mean grain sizes range from fine to medium sands with large range of sediment size distribution, from very well sorted (i.e., very poorly graded) to very poorly sorted (i.e., very well graded) (USACE 2006).

The United States Environmental Protection Agency (USEPA) and USACE have conducted a comprehensive suite of physical, conventional, and chemical analyses and biological tests of sediment samples from the Crescent City Harbor federal channels based on applicable guidelines established in the Inland Testing Manual (USEPA/USACE 1998), the Ocean Testing Manual (USEPA/USACE 1991), and the Upland Testing Manual (USACE 2003). These sampling events indicate that the dredged material from the Entrance Channel predominantly consists of sand with little organic matter, while dredged material from the Marina Access Channel predominately consists of sand with moderate organic material, and dredged material from the Inner Harbor Basin Channel predominately consists of fine-grain material (silt) with high amounts of organic material. The percent sand and total organic carbon (TOC) of sediment dredged from the Crescent City Harbor federal channels in the past are presented in Table 2-2.

Table 2-2. Dredged Material Grain Size and TOC Composition

Date	Entrance Channel		Inner Harbor Basin Channel		Inner Harbor Basin and Access Channels		Marina Access Channel	
	% Sand	% TOC	% Sand	% TOC	% Sand	% TOC	% Sand	% TOC
1993	94	0.1	49	5.6	--	--	--	--
1998	72	1.2	34	8.7	--	--	--	--
1999	--	--	--	--	88.9	6.04	--	--
2003	--	--	--	--	76	1.81	--	--
2009	87.4	0.8	46.4	10.8	--	--	80.0	6.1

(Source: USACE 2019)
Note: Samples from the Inner Harbor Basin and Marina Access Channels were composited and analyzed.

As part of the development of the proposed Crescent City 2019 maintenance dredging program Environmental Assessment, the USACE (2019) submitted a consistency determination to the California Coastal Commission, which included the results of sediment testing used to characterize the existing material. A brief summary of the results indicated:

- Entrance Channel: greater than or equal to 80 percent sand with little or no organic matter content.

- Marina Access Channel: 75 to 80 percent sand with low organic matter content.
- Inner Harbor Basin Channel: much less than 80 percent sand with high organic matter content.

2.2 Lower Klamath River Boat Ramps

There are two boat ramps located on the Lower Klamath River in Del Norte County; Township Boat Ramp is located near the town of Klamath and Roy Rook Boat Ramp is near the town of Klamath Glen (Figure A-3). These boat ramps lie within Del Norte County and are used primarily for fishing access. These boat ramps are susceptible to inundation by sediment.

2.3 Estimated Sediment Releases from the Klamath River

2.3.1 Klamath Dam Removal and Reservoir Drawdown

Reservoir drawdown is scheduled to be initiated in January of the drawdown year, with all reservoir drawdowns and dam removal completed to support volitional fish passage on the mainstem Klamath River in November of the drawdown year. The rate of drawdown and associated sediment evacuation is dependent on the hydrologic conditions within the basin and final reservoir operation guidelines implemented by the Renewal Corporation.

The United States Bureau of Reclamation (USBR) completed the initial hydraulic and sediment transport modeling to support their alternatives analysis and environmental impact statement (EIS) development (USBR 2011). The Renewal Corporation has subsequently completed multiple updates and model run scenarios to support the regulatory analysis for the Proposed Action.

Based on these modeling efforts, USBR and the Renewal Corporation have found the following:

- The sediment found within the existing reservoirs at J.C. Boyle, Copco No. 1, and Iron Gate is fine-grained with a high organic material content. The sediment has little sand content and has a high water content and more than 84 percent of the total reservoir sediment volume is silt or finer.
- The rate and total volume of sediment evacuation are highly dependent on watershed hydrology during the drawdown year and associated river flow conditions available to flush accumulated sediment out of the reservoirs. During dry years, less sediment will be evacuated and transported downstream; during wet years, more sediment will leave the reservoirs.
- The maximum rate of flow and associated sediment concentration released below Iron Gate Dam will be determined by the hydraulic capacity of the existing diversion tunnel. The tunnel is the primary flow release structure once the spillway and powerhouse facilities are no longer operational.
- The total suspended solids below Iron Gate during the drawdown period is expected to vary from as low as 100 mg/l to more than 10,000 mg/l.

- The total maximum volume of sediment expected to be released during the dam removal is a fraction of the total sediment load that currently discharges at the Klamath River mouth, and the Trinity River watershed is and will continue to be the largest sediment source within the Klamath River Basin.

2.3.1.1 Project Reservoir Estimated Sediment Volume

The Renewal Corporation expects reservoir drawdown to release approximately 1.5 to 2.3 million tons of sediment, which represents 36 to 57% of the approximately 4.1 million tons of sediment stored in the reservoirs. This corresponds to a release of approximately 5.4 to 8.6 million cubic yards of the approximately 15 million cubic yards of sediment stored in the reservoirs (SWRCB 2020). In a wet year, more material will be eroded and released, and in a dry year, less material will be eroded and released from the reservoirs. The majority of this material is expected to be released from January through March of the drawdown year, with continued lower sediment releases through June of the drawdown year.

2.3.1.2 Klamath River Annual Sediment Loads

The estimated annual sediment delivery to the Klamath River from Keno Dam to the Pacific Ocean under existing conditions was estimated at 5.8 million tons (Stillwater 2010). The three tributaries that contribute the largest amount of sediment to the lower Klamath are the Scott River (814 mi^2 source area), Salmon River (751 mi^2 source area), and the Trinity River (2,274 mi^2 source area). The Scott River supplies approximately 607,300 tons per year (10.4 percent of the total basin delivery downstream of Keno Dam), more than doubling the supply to the Klamath River at its confluence. The Salmon River supplies 320,600 tons per year (5.5 percent of the total basin delivery downstream of Keno Dam), increasing supply to the Klamath River by 22 percent at its confluence. Tributaries in the Lower-Middle Klamath River collectively increase the delivery by 4.7 percent. The Trinity River supplies 3,317,300 tons (56.9 percent of the total delivery downstream of Keno Dam), more than doubling the supply to the Klamath River at its confluence. The existing sediment discharging into the Pacific Ocean has a larger grain-size distribution with limited fine-grained silts and clays compared to the expected drawdown period sediment profile to be released to the river below Iron Gate Dam.

2.3.1.3 Littoral Drift

The movement of the sediment as it leaves the Klamath River is an important factor in determining the potential sediment impact to Crescent City Harbor during the drawdown period. The concept of littoral cells or beach compartments is used as a key element in understanding these flow patterns and their impact on sand movement (Griggs 1987). These cells are distinct segments of the coastline and include three elements: (1) a source or sources of sediment, (2) littoral transport, and (3) a sink or depositional site for sediment. Along the California coast, input from coastal streams and rivers is the dominant source of sediment, with cliff or bluff erosion, dredging of harbors, marinas, and offshore sands of the inner shelf also serving as locally important sources (Griggs 1987). Littoral transport mechanisms and direction vary along the coast, and in some locations, appear to seasonally reverse direction.

Crescent City Harbor lies in the lee of Point St. George, which is a rocky headland. To the north, littoral drift appears to move both north and south. To the south of the harbor, a few streams discharge, and farther south, the Klamath River enters the ocean. Sand produced from these sources appears to move southward away from the harbor (Griggs 1987).

3.0 Proposed Monitoring Program

3.1 General Approach

To determine the potential sediment impact to Crescent City Harbor, the Renewal Corporation will focus on addressing the following questions.

1. What are the existing average shoaling and dredging sediment volumes and characteristics in the harbor?

2. What is the prevailing sediment movement pattern along the coastline in the vicinity of the harbor?

3. What are the estimated existing baseline sediment volumes and characteristics discharged from the Klamath River?

4. What are the estimated sediment volumes and characteristics discharged from the Klamath River during the dam removal and drawdown period?

5. Does the discharged sediment move north from the mouth of the Klamath River to Crescent City Harbor and deposit within the harbor channels, and if so, what is the incremental impact over baseline conditions?

An initial review of Questions 1, 2, 3, and 4 was presented in the previous sections and the measures proposed to assist in the impact analysis are presented in the following section.

3.2 Proposed Measures

In order to quantify the potential impacts to Crescent City Harbor from the Proposed Action, the Renewal Corporation proposes to monitor the movement of sediment between the Klamath River mouth and Crescent City Harbor. Three measures are proposed to evaluate impacts:

- Measure 1: Conduct baseline bathymetric surveys prior to drawdown.
- Measure 2: Monitor ocean currents during drawdown.
- Measure 3: Conduct bathymetric surveys after drawdown.

A brief description of each of these proposed measures is presented in the following sections. The Renewal Corporation and the County have agreed on an adaptive management approach for implementation of the monitoring measures. Adaptive management is a structured, iterative process of decision-making that considers new data as they become available. The objective of

the adaptive management process is to implement the optimum program considering all factors, including drawdown period, hydrologic year, available resources, and cost. Final design and implementation of the monitoring plan measures will be determined by the Renewal Corporation in close coordination with the County.

3.2.1 Measure 1: Baseline Bathymetric Surveys Prior to Drawdown

The focus of Measure 1 is to establish baseline sediment deposition rates for Crescent City Harbor that can be compared to deposition during and following dam removal (Measure 3). The Renewal Corporation will conduct multi-beam bathymetric surveys at the Crescent City Harbor locations listed below and depicted in Figure A-2:

- Harbor (Area 1 in Figure A-2)
- Inner Basin (Area 2 in Figure A-2)
- Outer Basin (Area 3 in Figure A-2)
- Marina Access Channel (Area 4 in Figure A-2)
- Inner Harbor Basin Channel (Area 5 in Figure A-2)
- Entrance Channel (Area 6 in Figure A-2)

The Renewal Corporation will conduct two sets of bathymetric surveys prior to drawdown, each spaced by approximately 12 months. The Renewal Corporation will use survey data for each monitoring area to develop a digital elevation model (DEM), then compare the DEMs on a cell-by-cell basis using a GIS spatial analysis program to determine baseline annual sediment deposition prior to the dam removal period.

The Renewal Corporation will provide bathymetric survey data to the County for review within 2 weeks of completion of quality assurance and preparation of draft maps. The Renewal Corporation will determine baseline conditions in coordination with the County and will provide associated reports, memos, and calculations to the County for review and comment prior to finalizing documents.

3.2.2 Measure 2: Monitor Ocean Currents During Drawdown

The Renewal Corporation will use acoustic doppler current profilers (ADCPs) mounted to buoys to determine oceanic current patterns during initial, peak, and terminal sediment deposition periods. The ADCPs will be attached to buoys and deployed between the Klamath River mouth and Crescent City Harbor in a proposed array of three rows of three ADCPs each, as depicted in Figure A-4 and summarized in Table 3-1. The Renewal Corporation will finalize current monitoring locations based on coordination with the County and regional experts.

Table 3-1. Proposed ADCP-Equipped Buoy Locations

Station No.	Approximate Latitude (deg)	Approximate Longitude (deg)
1	41.524707	-124.160322

Station No.	Approximate Latitude (deg)	Approximate Longitude (deg)
2	41.533235	-124.128613
3	41.539675	-124.102637
4	41.617272	-124.194723
5	41.626333	-124.160585
6	41.632653	-124.133581
7	41.704088	-124.210586
8	41.712113	-124.180159
9	41.716628	-124.160064

Data acquisition system details will be finalized prior to implementation in coordination with the County. An example of the proposed technology used for this analysis can be found at https://www.whoi.edu/what-we-do/explore/instruments/instruments-sensors-samplers/acoustic-doppler-current-profiler-adcp/.

3.2.3 Measure 3: Bathymetric Surveys After Drawdown

If current monitoring under Measure 2 indicates sediment transport to Crescent City Harbor, the Renewal Corporation will conduct additional bathymetric surveys in the areas described in Measure 1 (Section 3.2.1) to evaluate net sediment deposition volumes. To effectively capture sediment deposition, the Renewal Corporation will produce an estimate of the sediment travel time from Iron Gate Dam to the mouth of the river based on review of the reservoir drawdown hydraulic modeling and associated sediment modeling, updated for actual hydrologic conditions during the drawdown period. The Renewal Corporation will also monitor water quality and flow measurement stations along the Klamath River to assess real-time sediment movement from Iron Gate Dam to the mouth of the Klamath River. Water quality and flow measurement stations along the Klamath River are shown in Figure A-5 and are described in detail in the Water Quality Monitoring and Management Plan.

The Renewal Corporation will monitor sediment transport characteristics and remaining sediment in the reservoirs during reservoir drawdown and for 2 years post-drawdown. If sediment monitoring during the post-drawdown period indicates that additional sediment deposition in excess of baseline conditions is originating from upstream of the Iron Gate Dam and is being transported out of the Klamath River, then the Renewal Corporation will conduct bathymetric surveys in Crescent City Harbor for two (2) additional years. If required, adjustments to the monitoring period will be considered between the Renewal Corporation and the County using an adaptive management process.

The Renewal Corporation will collect bathymetric data at three time points at each monitoring area:

- Approximately 1 month after peak discharge from the mouth of the Klamath River.
- After completion of drawdown.
- Approximately 1-year post-drawdown.

Approximately 2 years post-drawdownThe Renewal Corporation will generate post-drawdown DEM surfaces and compared them to baseline DEM surfaces to provide a spatial representation of the sediment deposition changes and the net total sediment deposition volume for each monitoring area. The Renewal Corporation will provide bathymetric survey data to the County for review within 2 weeks of completion of quality assurance and preparation of draft maps.

In order to assess impact to Crescent City Harbor, a threshold volume must be established for each monitoring location. Based on discussions between the County and the Renewal Corporation, an incremental increase of 25 percent will be used to define the threshold volume of sediment deposit. Threshold volume calculations for each monitoring area are described in Sections 3.2.3.1 and 3.2.3.2.

3.2.3.1 Threshold Volume Calculation for Areas with Historic Dredging Data

The Entrance Channel, Inner Harbor Basin Channel, and Marina Access Channel have established historic dredge volumes, as discussed in Section 2.1.4. The estimated average annual dredged volume in the Entrance and Inner Harbor Basin Channels (Areas 5 and 6 in Figure A-2) is 12,000 cubic yards, and the average dredged volume in the Marina Access Channel (Area 4 in Figure A-2) is 8,000 cubic yards, for a total of 20,000 cubic yards. The threshold volume for this area is calculated as follows:

$$V_{Th} = V_{AA} + 0.25 * V_{AA}$$

where V_{Th} = Threshold Volume of Sediment, and
V_{AA} = Average Annual Dredged Volume

The threshold volume of sediment for the Entrance Channel, Inner Harbor Basin Channel, and Marina Access Channel is therefore 25,000 cubic yards. Threshold volume calculations and associated reports or memos will be provided to the County for review and comment prior to finalizing.

3.2.3.2 Threshold Volume Calculation for Areas without Historic Dredging Data

The Harbor, Inner Basin, and Outer Basin (Areas 1, 2 and 3 in Figure A-2) do not have established historic dredge volumes. Anticipated dredge volumes for these areas will be determined from the baseline surveys completed prior to drawdown (Section 3.2.1). Threshold volume for these areas is calculated as follows:

$$V_{Th} = V_{A} + 0.25 * V_{A}$$

where V_{Th} = Threshold Volume of Sediment, and
V_A = Annual Sediment Deposition Volume Measured during Baseline Monitoring Period

Threshold volume calculations and associated reports or memos will be provided to the County for review and comment prior to finalizing.

3.3 Documentation and Reporting

The monitoring measures discussed above may be modified prior to implementation as part of the adaptive management approach. The Renewal Corporation will document each measure for the pre-drawdown, drawdown, and post-drawdown activities. Data collected for each measure will be provided to the County for review within 2 weeks of completion of quality assurance. If real-time monitoring of currents is determined to be the best approach, the County will be given access to the database. Documents summarizing work activities and/or the results of each measure will be provided to the County for review and comment prior to finalizing. The Renewal Corporation will provide the County with a draft assessment of impacts and review the draft with the County to determine final impacts.

3.4 Impact Analysis

The monitoring measures outlined within this report will provide the required data collection and analysis to evaluate the impact to Crescent City Harbor. An impact to the harbor is defined as a volume of sediment greater than the threshold volume being deposited in the harbor as a result of the Proposed Action. Threshold volumes are defined under Measure 3 (see Section 3.2.3). To estimate impact to Crescent City Harbor, the Renewal Corporation will:

- **Step 1:** Determine if sediment released from the reservoirs is transported to Crescent City Harbor using current meters (Measure 2, Section 3.2.2). If current monitoring indicates transport to the harbor, proceed to Step 2. Otherwise, declare No Impact, and the impact analysis is complete.
- **Step 2:** Compare the harbor baseline bathymetry (Measure 1, Section 3.2.1) to the post-drawdown bathymetry (Measure 3, Section 3.2.3) to determine the total volume of sediment deposited during the monitoring period.
- **Step 3:** Compare the net volume of sediment deposited during the monitoring period to the established threshold volume for each monitoring area. If the net volume of sediment deposited during the monitoring period is greater than the threshold volume, proceed to Step 4. If the net volume of sediment deposited during the monitoring period is less than the threshold volume, declare No Impact, and the impact analysis is complete.
- **Step 4:** Determine the appropriate response to the impact (Section 4.0) to address the sediment deposition directly attributed to the reservoir drawdown and associated sediment evacuation.

4.0 Impact Response

4.1 Crescent City Harbor

If the Renewal Corporation determines that the Proposed Action has resulted in an adverse impact to Crescent City Harbor (see Section 3.4), the Renewal Corporation will bear the proportional and incremental incurred by the County and/or the Harbor District of dredging and removing such sediment. The County and the Harbor District will cause such dredging to occur in the ordinary course of its harbor maintenance practices, and at such time or times when such dredging customarily occurs. The Renewal Corporation will not bear any cost in excess of the incremental and proportional cost of additional dredging attributable to an impact of the Proposed Action.

4.2 Lower Klamath River Boat Ramps

The costs of performing quantitative sedimentation monitoring at the Lower Klamath River boat ramps of Township and Roy Rook exceed the costs to maintain the ramps by removing sediment. Therefore, the Renewal Corporation will make the conservative assumption that sediment deposited during the drawdown year and the following year is a result of the Proposed Action. The Renewal Corporation will pay $3,500 per boat ramp per year for maintenance and sediment removal during the drawdown year and the following year, for a total cost not to exceed $14,000 total.

5.0 References

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Appendix A

Figures

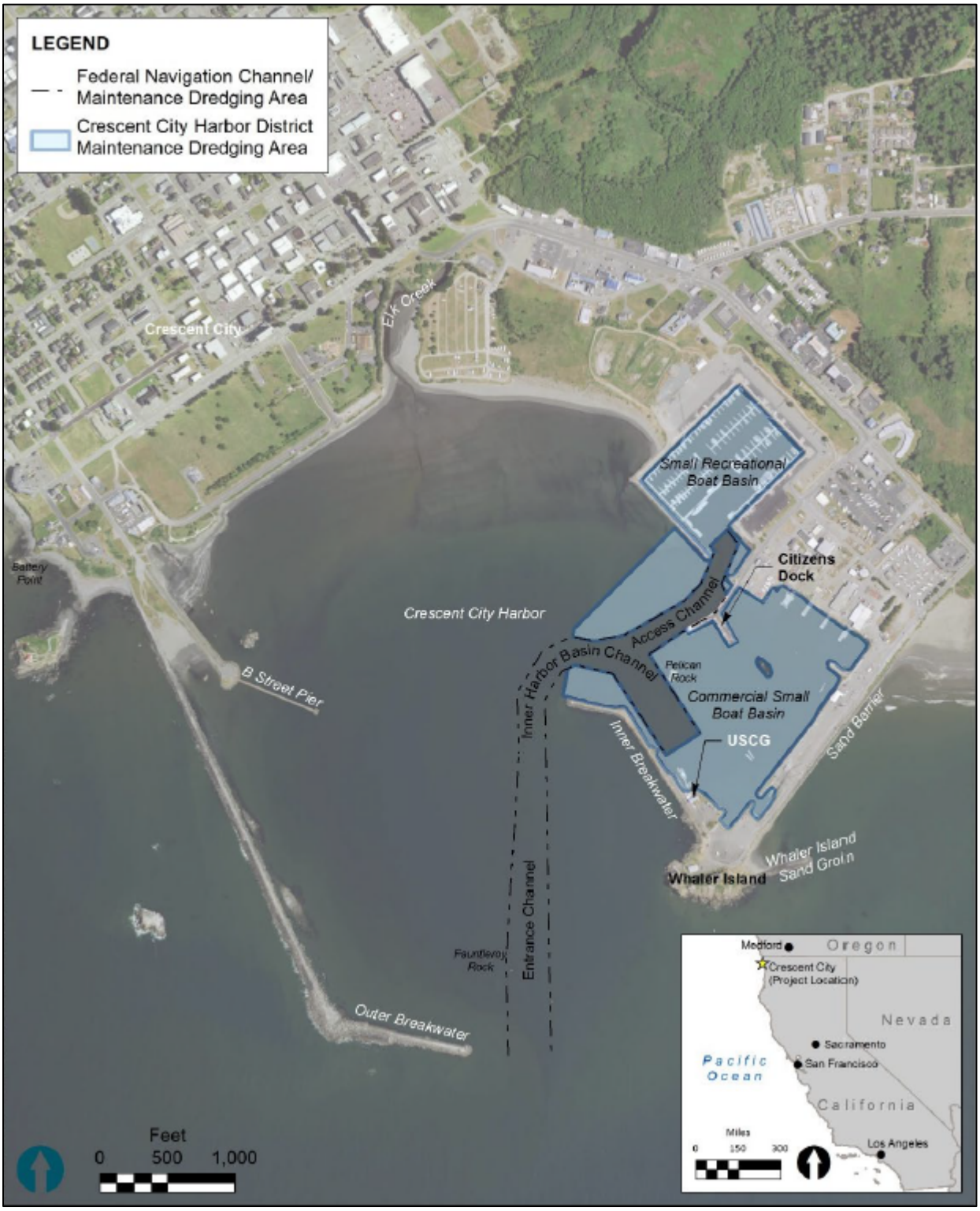

Figure A-1. Crescent City Inner Harbor (after USACE 2019)

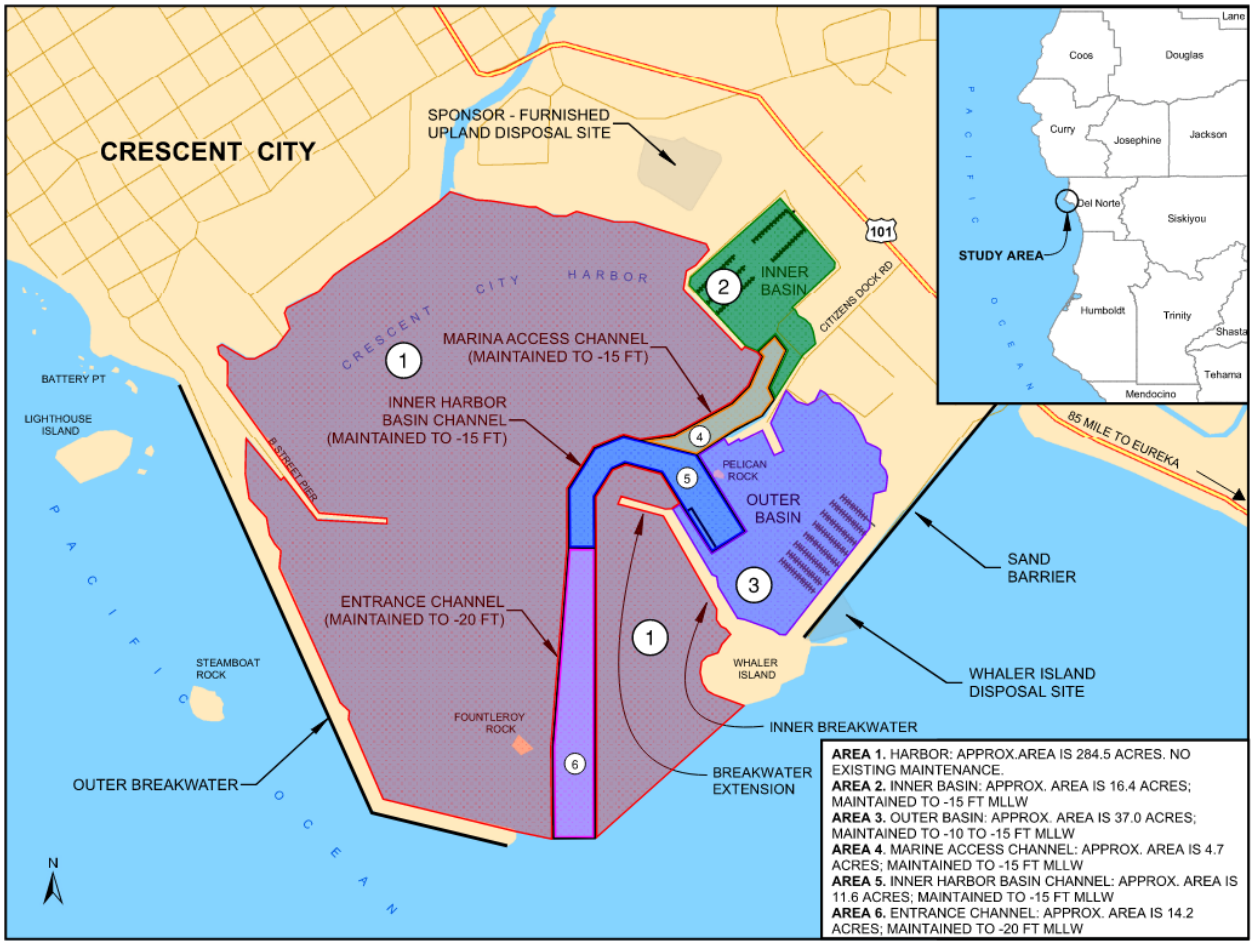

Figure A-2. Bathymetric Survey Areas: Crescent City Harbor (after USACE 2019)

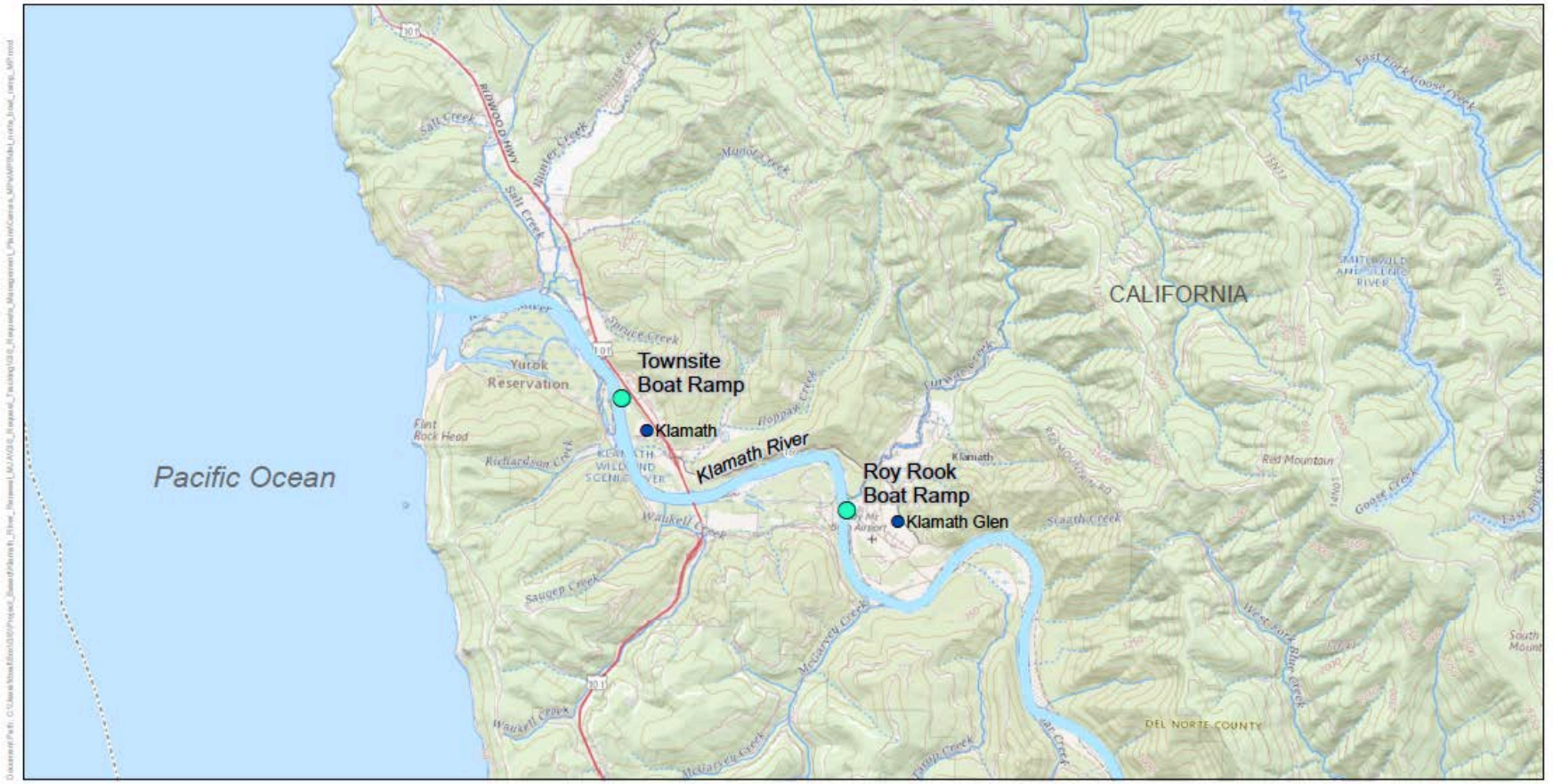

Figure A-3. Location of Boat Ramps on the Lower Klamath River

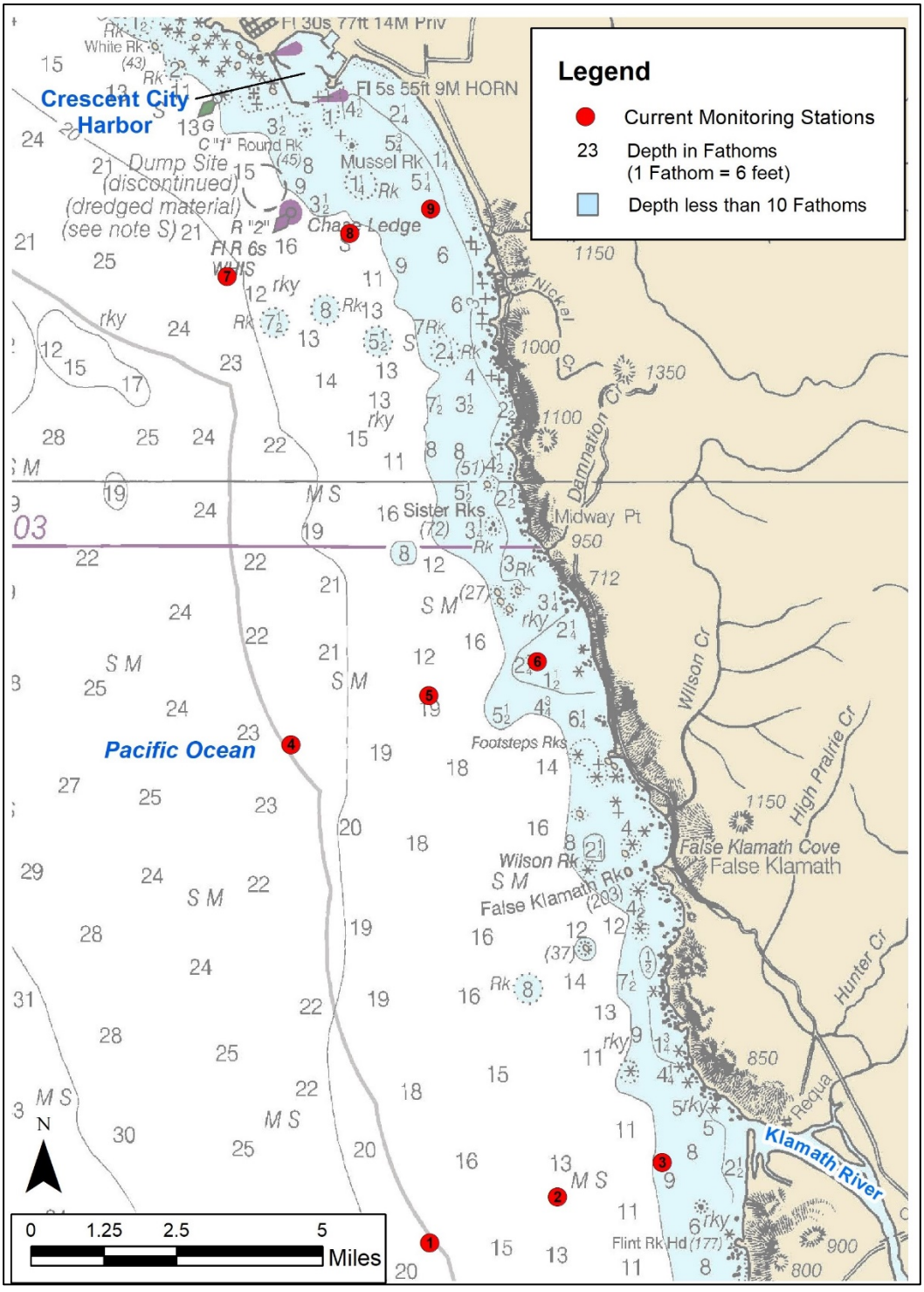

Figure A-4. Current Monitoring Station Configuration (after NOAA Chart 18602)

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Water and Sediment Quality Monitoring Stations

January 2021

PRELIMINARY DESIGN (NOT FOR CONSTRUCTION)

Monitoring Locations

- Continuous
- Continuous, Grab
- Continuous, Grab, Sediment
- Sediment

Klamath River

N

0 10 20 40 Miles

Notes

1. Coordinate System: WGS 1984 UTM Zone 10N

2.Data Sources: Klamath River: USGS National Hydrography Dataset; Surface Water Diversions: Camas LLC

3. Background: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed May, 2020.

Figure A-5. Monitoring Stations on the Klamath River