U.S. Geological Survey Monitoring Network Sacramento-San Joaquin Delta and Suisun Bay, California Environmental Assessment

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Acronyms

APE	Area of Potential Effect
BAAQMD	Bay Area Air Quality Management District
CAA	Clean Air Act
Caltrans®	California Department of Transportation
CARB	California Air Resources Board
CFR	Code of Federal Regulations
CEQ	Council on Environmental Quality
CWA	Clean Water Act
dBA	A-weighted decibels
DOI	Department of the Interior
DWR	California Department of Water Resources
EA	Environmental Assessment
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Association
FWS	United States Fish and Wildlife Service
GHGs	Greenhouse Gases
HAPs	Hazardous Air Pollutants
HARs	Historic Architectural Resource
IpaC	Information, Planning, and Consultation System
NAQQS	National Ambient Air Quality Standards
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NEPA	National Environmental Policy Act
NWI	National Wetlands Institute
OSHA	Occupational Safety and Health Administration
PM	Particulate Matter
TES	Threatened and Endangered Species
USDA	U.S. Department of Agriculture
USGS	United States Geological Survey
USFWS	United Stated Fish and Wildlife Service
VOCs	Volatile Organic Compounds

2 Introduction

This Environmental Assessment (EA) has been prepared to evaluate the potential impacts for the construction, upgrade, and maintenance of a new and existing monitoring stations in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended (42 United States Code (U.S.C). 4321 et seq.); the regulations of the Council on Environmental Quality (CEQ) for implementing the procedural provisions of NEPA (40 CFR parts 1500–1508); the US Department of Interior (DOI) regulations for implementation of NEPA (43 CFR Part 46); the DOI's Departmental Manual Part 516; and USGS's National Environmental Policy Act. (USGS, 2016)

The U.S. Geological Survey (USGS) has operated and maintained a monitoring network in the Sacramento-San Joaquin Delta since the 1970's. Over time, as technology improved, and monitoring needs changed, the network has expanded to include more locations and additional parameters. The overarching goal is to collect flow, water quality, and fish movement data at stations throughout the region. To support this monitoring objective, there is a need for infrastructure maintenance or modification at some of our existing stations and a need for additional infrastructure at new locations.

To improve and maintain this network, the USGS is proposing to install pilings to support new infrastructure. Stations that are identified in Figure 1 will consist of 18-inch steel pilings that will house an electronics box, an aluminum mount with an acoustic doppler velocity meter (ADVM), one to several polyvinyl chloride (PVC) pipes to house pressure sensors and/or water quality sondes, solar panels, and navigational safety signage (Figure 2). Several pilings associated with acoustic telemetry stations will be configured in a similar manner, but house different equipment to track fish migration through the reach. The USGS is also upgrading existing monitoring stations, but these actions were analyzed under a categorical exclusion separate from this EA since there will be no new impacts for upgrading to existing infrastructure.

USGS is providing this EA for public review prior to making a final decision on the analysis of impacts. Following the review of all the comments and results outlined in this EA, USGS will publish a decision document to determine if an environmental impact statement is needed.

2.1 Location of Proposal

Locations of each station have been identified based on the scientific needs of the monitoring network. The project will occur in the Sacramento-San Joaquin Delta, the Lower Sacramento River, the lower San Joaquin River, and Suisun Bay within the counties of Sacramento, Yolo, Contra Costa, and San Joaquin. Locations of the monitoring stations are shown in Figures 1 Appendix B. Appendix C provides additional details on those locations.

Within the general region provided above, the project will occur only in navigable waters of riverine and estuarine deepwater systems. There will be no land-based staging as barges will be used and access will be from existing launch ramps. Some of the nearest cities across the project range are Sacramento, Stockton, Woodland, and Antioch. Access to the project areas are numerous but nearby major routes are I-5, Hwy-4, Hwy-12, and Hwy-160.

2.2 Name and Location of Preparing Office

This report was prepared by the USGS. See Section 7. for the list of preparers and reviewers.

2.3 Estimated Start Date of the proposed action

Implementation of the proposed project is expected to take 5 years/seasons with work occurring during the August 1 – October 15 work window. Table 1 includes the location totals for each priority; however, the final network design is contingent upon funding availability and finalization of the monitoring priorities.

Priority 1: These locations part of the long-term flow monitoring network, and the stations are in need of infrastructure maintenance or are newly funded stations that have infrastructure needs.

Priority 2: These locations are part of the long-term flow monitoring network but are of lower priority for upgrades or maintenance

Priority 3: These locations are either part of the long-term flow monitoring network or are potential new stations.

Priority 4: These locations are associated with some potential work in the Fremont Weir region and in the Deepwater Shipping Channel. This work has not yet been funded or finalized so the design details may change depending on the final project objectives.

Priority A: These are the high priority locations associated with the Acoustic Telemetry Network for monitoring fish migration. At this point funds for the infrastructure have not been identified.

Priority B: These are the second-tier priority locations associated with the Acoustic Telemetry Network for monitoring fish migration. At this point funds for the infrastructure have not been identified.

Table 1. Prioritization of Pilings

Priority	Number of Pilings for Work Window	Comment
Priority 1 Pilings	21	2 are contingent on funding
Priority 2 Pilings	7	
Priority 3 Pilings	3	1 is contingent on funding
Priority 4 Pilings	13	all are contingent on funding
Priority "A" Pilings	58	all are contingent on funding
Priority "B" Pilings	78	all are contingent on funding
Total Number of proposed pilings	**180**	

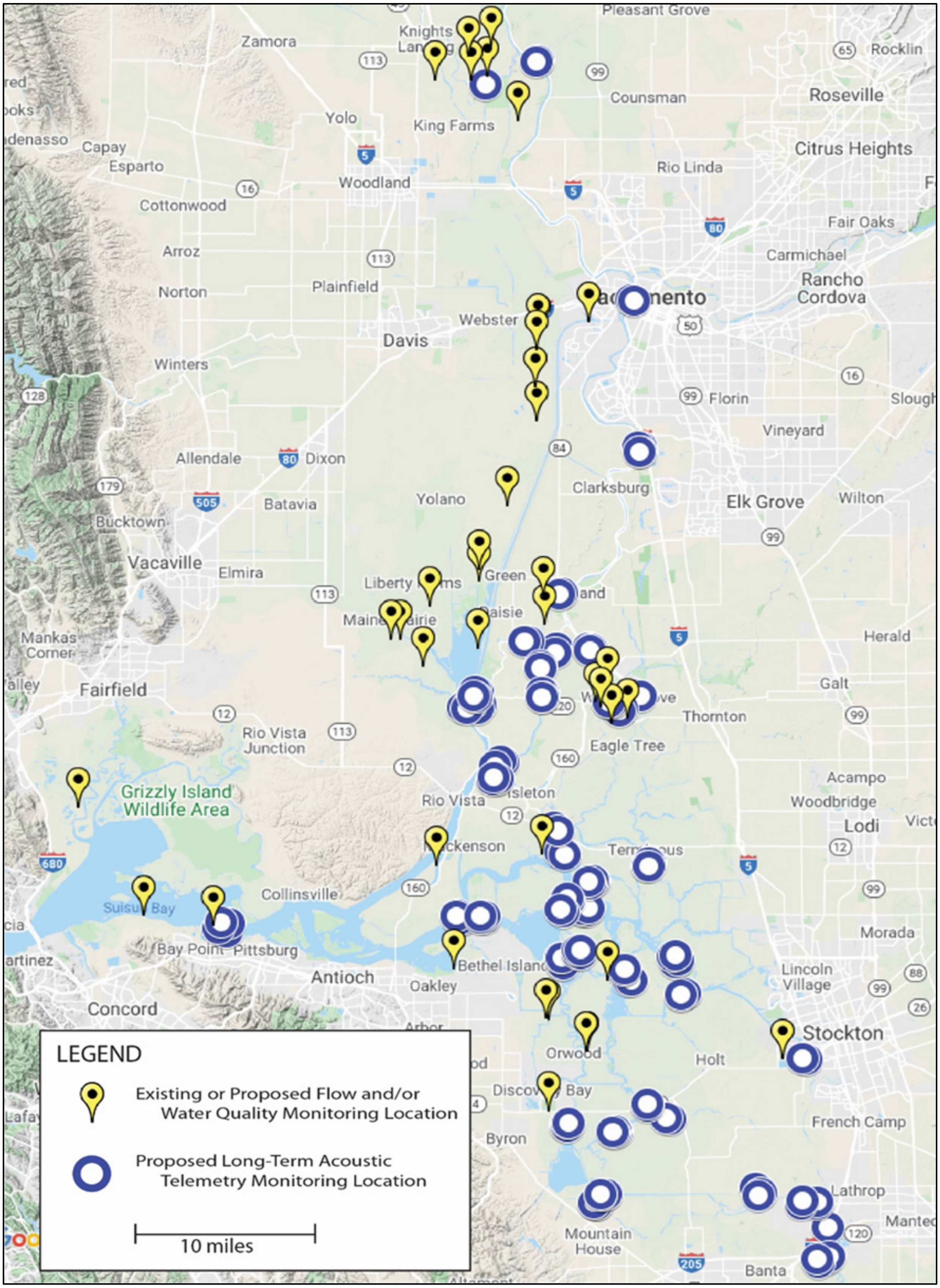

Figure 1: Regional Location Map – Central Valley and Suisun Bay, CA.

Figure 2. Standard Configuration of a Delta Flow and Water Quality Monitoring Station

3 Purpose and Need for Action

The main purpose of this project is to continue the USGS mission of collecting scientific data. The overarching goal is to collect flow, water quality, and fish movement data at stations throughout the region. To support this monitoring objective, there is a need for infrastructure maintenance or modification at some of the USGS existing stations and a need for additional infrastructure at new locations.

3.1 Description of proposed action

Stations will consist of 18-inch steel pilings that will house an electronics box, an aluminum mount with an ADVM, one to several PVC pipes to house pressure sensors and/or water quality sondes, solar panels, batteries, modems, dataloggers, and navigational safety signage. Acoustic telemetry stations will house equipment to monitor fish movement throughout the region and will consist of 1 to 4 pilings depending on the type of fish tracking required at each location. Pilings will be driven to a depth of 30 feet.

Vibratory pile driving will be used to minimize impacts to local fish populations. Navigational aids and signage will be included to ensure boating safety. Turbidity associated with the pile driving is expected to be minor due to the small area that will be disturbed (about 1.8 square feet per pile) during placement or removal. The use of containment basins on the barge to catch materials from pilings removed from action areas and working during low water/low current conditions, will minimize turbidity in the water column. The vibratory pile-driving hammer will slowly ramp up from a lower power for 15 seconds, followed by a 1-minute pause, repeated again, then started up to continuous pile driving. Each action area will be visually monitored for turbidity and for any accidental discharges.

As mentioned earlier, the project will occur only in navigable waters of riverine and estuarine deepwater systems. There will be no land-based activities or staging, and all access routes will be by existing, and commonly used, roads and launch ramps.

3.2 Decision to be Made

USGS is evaluating the project need, regulatory requirements, and potential environmental impacts of the monitoring network in this EA. The evaluation of direct and indirect impacts in this EA will be used to determine the significance of the impacts and potential mitigation needs to be incorporated into the project.

3.3 Legal Mandates

The proposed action requires compliance with the several federal, state, and local regulations. Examples of the regulations to comply with include the following:

- National Environmental Policy Act of 1969, as amended
- Clean Air Act (CWA), as amended
- National Historic Preservation Act, as amended
- Native American Graves Protection and Repatriation Act
- Archaeological and Historic Preservation Act
- American Indian Religious Freedom Act of 1978 (42 USC 1996)
- Archaeological Resources Protection Act

- Endangered Species Act, as amended
- Executive Order 11990, Protection of Wetlands
- Executive Order 13112, Invasive Species
- Executive Order 13751, Safeguarding the Nation from the Impacts of Invasive Species
- Migratory Bird Treaty Act, as amended
- Title VI of the Civil Rights Act, as amended
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations
- Farmland Protection Policy Act, as amended
- Americans with Disabilities Act (ADA), as amended
- Occupational Safety and Health Act, as amended
- Threatened and Endangered Species Act of 1983, as amended (16 USC 1531 et seq.)
- Rivers and Harbors Act

3.4 Environmental Permits

Environmental permits anticipated for the proposed action include: (a) General Permit, Section 401(a)(1) of the CWA issued by the Regional Water Quality Control Boards of San Francisco (Region 2) and Central Valley (Region 5); (b) "Section 404" permit, Section 404 of the CWA issued by the U.S. Army Corps of Engineers (ACOE); and (c) "Section 10" permit, Section 10 of the Rivers and Harbors Act. In addition to these permits, the USGS anticipates a "Letter of Concurrence" from the San Francisco Bay Conservation and Development Commission.

The barges that will be contracted to carry out the pile driving will be required to follow local air district permitting requirements for mobile and portable equipment where applicable.

4 Scoping and Issues

4.1 Internal Scoping

Internal team meetings of staff from USGS Environmental Management Branch, USGS California Water Science Center, USGS Administrative Operations, and the USGS Facilities Management Branch were held as part of the scoping process to identify potential areas of affected environment of significant concern, review project schedules, and determine potential interested parties to contact for comment on the proposed project.

4.2 External Scoping

The USGS has contacted the below interested parties and/or regulatory agencies to incorporate their input and requirements into the environmental review. Coordination included sending notice of intent letters and applications to the below parties and agencies and included a summary of the proposal and a description. The USGS is still coordinating and completing the consultation process for some of the organizations provided below. Their information and/or guidance received are being incorporated into the development of the proposed action and will be considered in the final environmental review and decision-making process.

- Advisory Council on Historic Preservation
- U.S. Army Corps of Engineers, Sacramento District-Regulatory Division
- U.S. Department of Interior – U.S. Fish & Wildlife Service Field Office
- San Francisco Bay Conservation and Development Commission
- California Regional Water Quality Control Board of San Francisco
- California Regional Water Quality Control Boards of Central Valley
- California Office of Historic Preservation
- California State Parks, Cultural Resources Division
- California Tribal Organizations to include: (a) Buena Vista Rancheria of Me-Wuk Indians, (b) Tule River Indian Tribe of the Tule River Reservation, (c) United Auburn Indian Community of the Auburn Rancheria of California, (d) Wilton Rancheria, I California Valley Miwok Tribe, (f) Scotts Valley Band of Pomo Indians (Scotts Valley Band of Pomo Indians of California), (g) Grindstone Indian Rancheria of Wintun-Wailaki Indians of California, (h) Yocha Dehe Wintun Nation, (i) Enterprise Rancheria of Maidu Indians of California, and (j) Mooretown Rancheria of Maidu Indians of California
- National Oceanic and Atmospheric Administration – National Marine Fisheries Service (NMFS)
- Native American Heritage Commission
- Institute of Nautical Archeology
- National Park Service, San Francisco Maritime National Historic Park
- U.S. Coast Guard, Office of Environmental Management (Washington, DC)

Consultation has concluded with the USFWS and the NMFS. Both agencies have provided documentation regarding sensitive species and habitat that is provided in Appendix D. The tribal organizations contacted have not provided any comments or concerns beyond the initial consultation letters emailed in April-2021; however, the USGS has exercised due diligence by calling and sending follow up letters asking tribes to comment. The USGS is conducting additional research and providing additional information to the CA SHPO for analyzing effects to historical properties that may exist in the water bodies; however, the USGS does not anticipate any adverse effects (see Section 5.5).

4.3 Issues Analyzed and Not Analyzed

As part of the scoping process, issues for detailed review were identified based upon the site, location, previous environmental reviews available, interested parties' input, and general knowledge of the project. Based upon these criteria, it was determined that the following resources and issues would be addressed in detail as part of this study:

- Earth Resources including geology and soils
- Biological Resources including vegetation and threatened and endangered species and wetlands
- Water Resources including surface water, floodplains, and groundwater
- Air Resources
- Cultural Resources
- Aesthetic Resources including noise and visual aesthetics
- Socio-Economic Resources
- Other Concerns including construction, greenhouse gases, hazardous materials, and transient encampments

Coastal zones, farmlands, and parks and recreational areas are not present in the proposed action study area; therefore, these topics were not reviewed in further detail.

5 Alternatives

Due to the context, size, and purpose of the project, multiple alternatives for the proposed action, other than the no action alternative, were not evaluated in detail. This section defines the no action alternative and the proposed action.

5.1 No Action Alternative

The No Action Alternative is defined as keeping the existing monitoring stations unchanged and not installing new pilings to support new stations and appurtenances.

The No Action Alternative would prevent the USGS from providing the scientific community, resource managers, and the public improved and valuable information for water flow and quality and fish movement. Combined, these data provide the means to better understand how local human activities and climate change influence fish populations, movement, and their habitat. Without the improved means to conduct comprehensive monitoring, scientists will have antiquated and insufficient equipment for modeling and reporting to protect and or improve aquatic resources in the project region. The no action alternative does not meet the project purpose or need and is not considered a viable alternative for the project.

5.2 Proposed Action

The development of the proposed action was identified through USGS need for monitoring station upgrades and expansion into potential locations, aging equipment and appurtenances, and technological advancements. Based on these considerations, the proposed action includes the installation of 180 new pilings to affix new monitoring stations.

The new additional monitoring stations would fulfil the need to conduct comprehensive and improved monitoring. The proposed action also provides benefits to local communities as better decisions can be made based on improved data. All stations will be very similar in standard configuration as shown in Figure 2. above. Although no alternatives for the project, there is some limited flexibility in the piling locations if needed to avoid impacts.

6 Affected Environment and Consequences

This section provides information on the existing environment and analysis of how the proposed action could potentially affect the environment. As noted in Section 3., there are no important farmlands, coastal zones, or parks or recreational areas present so impacts to these resources are not addressed in this section. This section includes the reviews and analyses of the proposed action to potentially impact Earth Resources, Biological Resources, Water Resources, Air Quality, Cultural Resources, Noise, Aesthetics, Socio-Economic Resources, Greenhouse Gases, Hazardous Materials, and Transient Encampments.

Under the No Action alternative, no USGS actions would take place and there would be no physical impact on the environment as a direct result from construction. The No Action Alternative is not feasible and was not reviewed in detail but was maintained to provide a comparison of impacts with the proposed action.

6.1 Earth Resources

6.1.1 Soils

Affected Environment

Using the National Wetlands Institute (NWI), classification and description of each wetland, soil type and information were obtained from embedded reports within the NWI database and the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey. The soil description is limited to hydric soils since all proposed project locations will be in stream channels or perennial water bodies and under saturated conditions. The NWI database describes the class as unconsolidated bottom for locations along riverine systems with rip-rap shores preventing substantial rooted plant growth and deepwater habitats with at least 25% cover of particles smaller than stones (l<6-7 cm), and a vegetative cover <30%. Water covers the substrate throughout the year in all years.

Environmental Consequences

There will be no impacts to vegetation or shores since there will be no work or activities occurring beyond the water bodies. Access to proposed areas will be by existing launch ramps that are commonly used by workers and the public.

Piling installation will disturb water bottom sediments and cause temporary increases in suspended sediment in the proposed action areas. Additionally, there would be temporary disturbances of sediment and increase turbidity during removal of pilings, lifting of the spuds, or setting and recovering anchors.

Avoidance, Minimization, and/or Mitigation

Turbidity associated with the pile driving is expected to be minor due to the small area that will be disturbed (about 1.8 square feet per pile) during placement or removal. The use of containment basins on the barge to catch materials from pilings removed from the proposed action areas, and working during low water/low current conditions, will minimize turbidity in the water column. The vibratory pile-driving hammer will slowly ramp up from a lower power for 15 seconds, followed by a 1-minute pause, repeated again, then started up to continuous pile driving. Each proposed action area will be visually monitored for turbidity and for any accidental discharges. “Good Site Management ‘Housekeeping’” requirements/conditions will be implemented and followed as per the 2017 CWA Section 401 General Order for the State Water Board Certified Nation-Wide Permits (California Water Boards 2017). The small resulting sediment plume is expected to settle out of the water column within a few hours.

6.1.2 Geology

Affected Environment

There is substantial information available on the geology of the general region, but for the purposes of this proposed action, the geology focus is the bottom of water bodies only. The Central Valley is a sediment-filled basin from erosion of the Sierra Nevada and partly from the coastal mountains. The topography of the region is uniformly broad and flat. The drainage systems consist of the Sacramento Valley and San Joaquin Valley. Geologic maps and models were previously created by the USGS (USGS 1986). River deposits are gravel, sand, silt, and minor amounts of clay deposited along channels, flood plains, and natural levees of major streams.

Environmental Consequences

There would be no change in geology from the actions of the proposed project.

Avoidance, Minimization, and/or Mitigation

No impacts are expected and therefore no additional measures are necessary.

6.2 Biological Resources

6.2.1 Threatened and Endangered Species, Critical Habitat, and Wildlife

USGS contacted the USFWS via the Information for Planning and Consultation (IPaC) system and the NMFS to determine if threatened, endangered, proposed or candidate species or proposed or final designated critical habitat occurs within the boundary of the proposed project area. The USFWS IPaC provided a full list of sensitive plants, fish, and wildlife not in any immediate project site but within the broader region adjacent to the sites (exceptions discussed below). These include threatened and endangered plant species provided by the USFWS IpaC; species researched in the embedded reports in the NWI Mapper; plant lists and wetland status found in the U.S. Department of Agriculture, Natural Resources Conservation Service; and species provided in the California Department of Fish and Wildlife (CDFW) vegetation classification and mapping reports for Central Valley and Bay and Delta (CDFW n.d.).

The USFWS lists the Delta Smelt Hypomesus transpacificus as threatened and one that may occur within the boundary of the project. The USFWS has provided a biological opinion through formal consultation (Appendix D). The USFWS "has determined that the project is not likely to adversely affect delta smelt critical habitat. Replacing or upgrading existing structures may slightly increase a structure's dimensions within and over the water but should not result in an overall loss of spawning habitat or result in changes to water quality or river flow. Where pilings will be removed, there will be no net structure footprint increase at those locations."

Through formal consultation the NMFS reviewed the likely effects of the project on threatened and endangered fish species and their essential habitat (Appendix D). There are habitat areas of particular concern for the Pacific Coast salmon and Pacific Coast groundfish such as complex channels and floodplain habitats. Other species under NMFS jurisdiction that occur within the proposed project areas include Steelhead O. mykiss, Central California Coast (Threatened), California Central Valley (Threatened); Chinook salmon O. tshawytchsa, Sacramento River winter-run (Endangered), Central Valley spring-run (Threatened); and Green sturgeon Acipenser medirostris (Threatened). The NMFS concluded "that the proposed action is not likely to adversely affect the ESA-listed Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCC steelhead, CCV steelhead, and sDPS green sturgeon and designated critical habitats within the action area." However, the NMFS concluded "that the project would adversely affect the essential fish habitat of the Pacific Coast salmon, Pacific Coast groundfish, but not the coastal pelagic species." The NMFS stated that "due to the localized nature of this project, adverse effects to essential fish habitat are expected to be temporary and localized. Therefore, given the small size of each pile and the short temporal duration of potential effects, NMFS has no practical essential fish habitat conservation recommendations to provide to avoid or reduce the magnitude of these effects."

Migratory birds may nest or roost on pilings. A certain amount of disturbance can be expected. Birds would be expected to respond to such disturbance by moving away temporarily, returning to the areas upon completion of project activities. The response to noise likely varies between bird species and is directly related to the levels of ambient noise and thresholds of tolerance to increased noise levels. The noise could displace bird species that use the adjacent areas.

Avoidance, Minimization, and/or Mitigation

The small resulting sediment plume is expected to settle out of the water column within a few hours. Studies of the effects of turbid water on fish suggest that concentrations of suspended sediment can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The TSS levels expected for pile driving or removal (5.0 to 10.0 mg/L) are below those shown to have adverse effect on fish (typically up to 1,000.0 mg/L; see summary of scientific literature in Burton 1993; Wilber and Clarke 2001) and benthic communities (390.0 mg/L (EPA 1986))" (NOAA n.d.).

As per the USFWS consultation letter, "Most spawning occurs from February through May in various places from the Napa River and locations to the east including much of the Sacramento-San Joaquin Delta. The USGS will conduct work within the Service's recommended in-water work window and will avoid effects to delta smelt during the spawning season and larval rearing. During this time, delta smelt are not anticipated to be within the central and south Delta and pile driving in those locations during the work window will not result in effects."

To discourage bird nesting and roosting upon completion, stations are typically setup to include harmless deterrents such as zip ties, fake owls, and sometimes small reflective material. Project activities would take place near the end of nesting season, between 1 August and 15 October, and thus would result in no adverse effects on active migratory bird nests or fledglings. The proposed conservation measures would include a "soft start" of pile-setting activity, which would give birds an opportunity to depart the area before the noise reaches its maximum volume. As a result of these conservation measures and project timing, the proposed action is not likely to adversely affect migratory bird species.

To prevent disturbances to wintering waterfowl and spawning Delta Smelt, in-water work is expected to start after August 1 and be completed before October 15 each year.

6.3 Water Resources

6.3.1 Surface Water

Affected Environment

Topography The majority of the proposed project sites are within riverine systems with one subsystem being tidal (Table 2). From the confluence of the Sacramento and San Joaquin Rivers, the project sites will be in the estuarine system of the Suisun Bay, with the subsystem being subtidal. The northern most part of the project will be in the Sacramento River.

The hydrology in the Sacramento – San Joaquin Delta is a balance between freshwater inflow from the upper reaches of the watershed, by twice-daily tides that propagate from the Pacific Ocean through San Francisco Bay, and water management actions including the State Water Project and Central Valley Project operations as exports and reservoir releases. All the proposed piling locations are in navigable waters.

Table 2. Water Bodies of the Proposed Project Locations

Aquatic Resource Name	Aquatic Resources Classification		Aquatic Resource Size (acre) Required for all resources	Aquatic Resource Size (linear feet) Required for only stream channels
	Cowardin	Location (lat/long)		
East Canal, Knights Landing	Riverine (R2UBHx)	38.786/-121.654	467.44	117,519
Yolo Bypass (Old River), Fresh Water Pond	Palustrine (PUBH)	38.7607171/-121.6595503	19.91	3,005
Sacramento River	Riverine (R2UBH)	38.765/-121.685	14, 675.32	1,332,013
Sacramento River, Downtown	Riverine (R2UBH)	38.57959798/-121.5096432	1, 500.01	121,711
Sacramento Deepwater Ship Channel	Riverine (R1UBVx)	38.404/-121.615	1,937.12	135,000
Sacramento/San Joaquin Rivers (Lower Perennial)	Riverine (R1UBV)	38.215/-121.605 (~center)	29,959.18	1,711,288
Cache Slough Complex	Riverine (R1UBVx)	38.32/-121.694	726.4	132,909
San Joaquin River	Riverine (R2UBH)	37.792/-121.308	3,027.3	586,295
Paradise Cut	Riverine (R2UBH)	37.761/-121.317	9.7	4,285
Sacramento/San Joaquin Confluence/ Suisun Bay	Estuarine and Marine Deepwater	38.068876/-122.016433	261,263.2	1,968,935

	(E1UBL)			
Victoria Canal	Riverine (R1UB)	37.87270963/-121.5290748	193.26	4,491
Grantline Canal	Riverine (R1UB)	37.81880452/-121.5411725	300.82	5,853
		Total	297,904.33	6,123,304

Environmental Consequences

Activities would not affect or destroy shallow water habitat, shaded riverine aquatic habitat or riparian habitat as defined by the USFWS (2004), as all activities will take place in the deeper, less productive, parts of the waterway. Piling installation will disturb water bottom sediments and cause temporary increases in suspended sediment in the proposed action areas. Additionally, there would be temporary disturbances of sediment and increase turbidity during removal of pilings, lifting of the spuds, or setting and recovering anchors.

Public use and activities such as boating, fishing, birding, and/or site seeing could be temporally disrupted from the use of the barge. These temporary disruptions may include barge presence and engine noise, vibratory hammer (sound impacts discussed below), and barge emissions.

Avoidance, Minimization, and/or Mitigation

Turbidity associated with the pile driving is expected to be minor due to the small area that will be disturbed (about 1.8 square feet per pile) during placement or removal. The use of containment basins on the barge to catch materials from pilings removed from the proposed action areas, and working during low water/low current conditions, will minimize turbidity in the water column. The vibratory pile-driving hammer will slowly ramp up from a lower power for 15 seconds, followed by a 1-minute pause, repeated, then started up to continuous pile driving. Each proposed action area will be visually monitored for turbidity and for any accidental discharges. The small resulting sediment plume is expected to settle out of the water column within a few hours.

The pilings are far from dense residential areas. The pilings in Suisun Bay are in open water one to two miles from the nearest infrastructure and will be adjacent to an active shipping channel with similar channel markers in place. The piling in Montezuma Slough is in the Suisun Marsh area, but there are existing siphons, gates, and other infrastructure in the area.

Noise impacts will be short in duration and will cease upon completion of construction. Placement of one piling is expected to take one hour while removal would be one-half hour. Signage will be included to ensure boating safety.

There would be no direct point source discharges into water. There are no expected nonpoint source pollutants. Equipment, tools, and materials will be inspected for cleanliness and/or any foreign matter prior to use. Cleaning would be conducted prior to placement on barges and involve physical removal, rinsing with water, and/or cloth wiping so that no runoff enters the water bodies. In the advent of an accidental spill or failed barge equipment, there will be containment devices aboard to control and remove any oil product. The USGS does not expect the project to affect conductivity, pH, odor, or other chemical or bacteriological parameters. Galvanic corrosion will be prevented by utilization of similar metals or use of non-reactive bushings to isolate dis-similar metals.

6.3.2 Floodplains

Affected Environment

The Central Valley has floodplains along all the water bodies of the proposed project; however, there will be no work in floodplains, and the actions of the proposal will not affect floodplains.

Environmental Consequences

The proposed action will not impact floodplains or floodways

Avoidance, Minimization, and/or Mitigation

No impacts are expected and therefore no additional measures are necessary.

6.3.3 Wetlands

Affected Environment

The proposed project areas are permanently flooded (stream channels and perennial waterbodies), and the NWI database describes the class as unconsolidated bottom that "includes all wetlands and deepwater habitats with at least 25% cover of particles smaller than stones (<6-7 cm), and a vegetative cover <30%". Water covers the substrate throughout the year in all years for each project site. In many locations along the riverine systems, rip-rap shores prevent substantial rooted plant growth. The NWI database states that vegetation, when present, will be "predominantly nonpersistent emergent plants or submersed and (or) floating plants (aquatic beds), or both."

Environmental Consequences

Piling installation will disturb water bottom sediments and cause temporary increases in suspended sediment in the proposed action areas. Additionally, there would be temporary disturbances of sediment and increase turbidity during removal of pilings, lifting of the spuds, or setting and recovering anchors.

Avoidance, Minimization, and/or Mitigation

Turbidity associated with the pile driving is expected to be minor due to the small area that will be disturbed (about 1.8 square feet per pile) during placement or removal. The use of containment basins on the barge to catch materials from pilings removed from the proposed action areas, and working during low water/low current conditions, will minimize turbidity in the water column. The vibratory pile-driving hammer will slowly ramp up from a lower power for 15 seconds, followed by a 1-minute pause, repeated, then started up to continuous pile driving. Each proposed action area will be visually monitored for turbidity and for any accidental discharges. The small resulting sediment plume is expected to settle out of the water column within a few hours.

6.3.4 Groundwater

Affected Environment

"The sediments of the Central Valley compose an aquifer system comprising confining units and unconfined, semiconfined, and confined aquifers. This aquifer system generally consists of alluvial deposits shed from the surrounding Sierra Nevada and Coast Ranges. The chief source of groundwater in the Central Valley is located within the upper 1,000 ft of deposits." (USGS 2009).

Environmental Consequences

No expected consequences due to depth of pile driving. There will be no discharges into groundwater.

Avoidance, Minimization, and/or Mitigation

No impacts are expected and therefore no additional measures are necessary.

6.4 Air Resources

Affected Environment

Since 1970, the federal Clean Air Act (CAA) and subsequent amendments have provided the authority and framework for EPA regulation of emission sources and the establishment of requirements for the monitoring, control, and documentation of activities that will affect ambient concentrations of certain pollutants that may endanger public health or welfare. The EPA has promulgated primary and secondary National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: carbon monoxide (CO), nitrogen dioxide (NO2), two size categories of particulate matter (PM10 and PM2.5), O3, sulfur dioxide (SO2), and lead. The proposed project areas are in nonattainment counties of varying classification.

1. Sacramento and Yolo Counties.
   a. 8-hour Ozone (2008) = Severe Nonattainment
   b. 8-hour Ozone (2015) = Moderate Nonattainment
   c. PM-2.5 (2006) = Moderate Nonattainment

2. Contra Costa.
   a. 8-hour Ozone (2008) = Marginal Nonattainment
   b. 8-hour Ozone (2015) = Marginal Nonattainment
   c. PM-2.5 (2006) = Moderate Nonattainment

3. San Joaquin.
   a. 8-hour Ozone (2008) = Extreme Nonattainment
   b. 8-hour Ozone (2015) = Extreme Nonattainment
   c. PM-2.5 (1997) = Serious Nonattainment
   d. PM-2.5 (2006) = Serious Nonattainment
   e. PM-2.5 (2012) = Moderate Nonattainment

The California Health and Safety Code Section 39607 and 39608 requires the California Air Resources Board (CARB) to establish designated criteria and make area designations for ten pollutants: ozone, suspended particulate matter (PM10 and PM2.5), carbon monoxide, nitrogen dioxide, sulfur dioxide, sulfates, lead, hydrogen sulfide, and visibility reducing particles. The attainment status for the counties in the proposed project areas are listed below.

1. Sacramento and Yolo Counties.
   a. Ozone = Nonattainment
   b. Carbon Monoxide = Attainment
   c. Nitrogen Dioxide = Attainment
   d. Sulfur Dioxide = Attainment
   e. PM_{10} = Nonattainment
   f. $PM_{2.5}$ = Nonattainment (Yolo county Unclassified)
   g. Sulfates = Attainment
   h. Lead = Attainment
   i. Hydrogen Sulfide = Unclassified

2. Contra Costa County.
   a. Ozone = Nonattainment
   b. Carbon Monoxide = Attainment
   c. Nitrogen Dioxide = Attainment
   d. Sulfur Dioxide = Attainment
   e. PM_{10} = Nonattainment
   f. $PM_{2.5}$ = Nonattainment
   g. Sulfates = Attainment
   h. Lead = Attainment
   i. Hydrogen Sulfide = Unclassified

3. San Joaquin County.
   a. Ozone = Nonattainment
   b. Carbon Monoxide = Attainment
   c. Nitrogen Dioxide = Attainment
   d. Sulfur Dioxide = Attainment
   e. PM_{10} = Nonattainment
   f. Sulfates = Attainment
   g. Lead = Attainment
   h. Hydrogen Sulfide = Unclassified
   i. $PM_{2.5}$ = Nonattainment

An estimation of barge emissions is provided in Table 3. It is assumed in the calculations that emissions are similar for maneuvering and pile driving. The USGS does not know the exact type, or engine/s, for the barge/s since a contractor has yet been selected. It is also unknown if the pile driver will run off hydraulic power or if it will be powered by the barge diesel-fired engine. The USGS has performed the following calculations given the best assumptions possible; however, emission rates are well below daily thresholds set by the California Environmental Quality Act, Air Quality Guidelines (BAAQMD 2010).

Table 3. Barge Emissions Estimation

Barge Emission Factor, g/kWh[1]					
Mode	TSP[2]	PM_{10}	$PM_{2.5}$	SO_x[3]	NO_x[4]
Underway	0.20	0.20	0.18	0.006	17.00
Maneuvering	1.12	1.12	1.01	0.020	49.64

Emission Rate for Monitoring System Installation, lb/day					
Activity	TSP	PM_{10}	$PM_{2.5}$	SO_x	NO_x
Tugboat Emission	0.58	0.58	0.52	0.01	29.32
CEQA Threshold	n/a	82.00	54.00	n/a	54.00

[1] g/kWh – Grams per kilowatt-hour
[2] TSP – Total Suspended Particles
[3] SO_X – Sulfur Oxide
[4] NO_X – Nitrogen Oxide

Environmental Consequences

USGS will not be constructing any emission sources as part of the project. Emission sources will mostly be from barge use and personal and or government vehicles to transport personnel and equipment. Air quality impacts from the construction of the project are expected to be limited to the construction period only. Potential impacts from these operations would be very minor and would vary from day to day depending on meteorological conditions such as wind or rain and minor differences in daily operating hours.

Avoidance, Minimization, and/or Mitigation

The project specifications require contractors to comply with state regulations. In some instances, barges would require local air district and/or CARB permits for the diesel engines required to power the auxiliary units, but this depends on engine size and type of fuel used. These types of permits are proof of compliance with regulated emission limits or restrictions. Personal and government vehicles must comply with routine emissions testing before obtaining annual registration.

6.5 Cultural Resources

Affected Environment

The USGS is currently researching archaeological resources that may fall within the area of potential effect for the proposed project locations. In doing so, the USGS has received some information and guidance from the California Office of Historic Preservation and the California State Parks Cultural Resources Division. The USGS has also researched previous bathometric surveys performed by the California Department of Water Resources (DWR n.d.) and researched several online articles and papers. Several tribes have also been contacted by formal invitations to be consulting parties on the project to ascertain tribal resources.

Thus far the USGS has discovered that two archeological sites in the Sacramento River are near two proposed locations (SRD 1 and SRD 2). This was obtained from the California State Parks Cultural Resource Division. The archeological sites could not be disclosed to the USGS so that they remain protected; therefore, a 50 ft. buffer is proposed as a mitigation measure.

One article in particular, *Analysis of the Tidal Range in the Sacramento San Joaquin Delta from 1857 to Present* (E. Szlemp. 2020), points out continual natural changes and human interferences, particularly dredging and farming.

Environmental Consequences

Though research and consultation has not been completed, the USGS does not anticipate any adverse effects to historic properties or cultural resources.

Avoidance, Minimization, and/or Mitigation

Remote sensing will be conducted prior to piling installation in suspect areas using a multibeam echosounder system. High-resolution bathymetric data will be collected in the reaches using an Odom™ multibeam echosounder system. The multibeam system includes a sonar head that is operated at 240 kilohertz (kHz) and collects soundings over a 120-degree swath. The geolocation of the sonar head is determined with a global positioning system (GPS) receiver, which also records the heading or direction of travel. A motion reference unit (MRU) is mounted directly behind the sonar head and is used to precisely measure the orientation of the sonar head and the angle of the sonar beams. A sound-velocity sensor is mounted near the sonar head to measure the speed of sound at the head, data needed to form the received beam correctly. Data streams from the GPS, MRU, sound-velocity sensor, and sonar are integrated and processed using a computer running hydrographic survey software. The USGS also has side scan sonars, single beam echosounders and underwater cameras that can also be used to assess underwater features as necessary.

A 10 ft. buffer will be established for all piling locations, but a 50 ft. buffer will be established for locations where a cultural resource is identified in the ongoing research. In some cases, if necessary, a proposed location would be moved so that a piling would not have any direct or indirect effects.

In the event that human remains and/or cultural materials are found during installation of the monitoring stations, all project-related construction would cease within a 50-foot radius in order to proceed with the testing and mitigation measures required pursuant to Section 7050.5 of the Health and Safety Code and Section 5097.94 of the Public Resources Code of the State of California. The California State Historic Preservation Officer would be contacted as soon as possible. Construction in the affected area would not resume until the regulations of the Advisory Council on Historic Preservation (36 CFR Part 800) have been satisfied.

6.6 Noise Sensitive Resources

Affected Environment

Potentially noise-sensitive receptors above water include recreationalists or outdoor enthusiasts and transient encampments scattered throughout the vicinity of the proposed new piling installation sites located along the shores of each water body. The proposed new pilings are far from dense residential areas.

The NMFS has established interim criteria for evaluating underwater noise impacts on fish as a result of pile driving. The criteria are defined in the Fisheries Hydroacoustic Working Group document *Agreement in Principal for Interim Criteria for Injury to Fish from Pile Driving Activities (NOAA 2008)*. The agreement identifies a peak sound pressure level of 206 decibels (dB) and an accumulated sound exposure level (SEL) of 187 dB as thresholds for injury to fish. For fish less than 2g, the accumulated SEL threshold is reduced to 183 dB. There has been no formal agreement on "behavioral" effects (NMFS 2009), however the threshold for behavioral effects is considered to be 150 dB root mean square (RMS) for monitoring purposes.

Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish (California Department of Transportation, 2015) provides sound level data on a variety of pile sizes and driver types. The installation of a 12-inch (in.) steel pile would result in an SEL of 155 and a peak of 171 dB when driven in less than 5 meters of water using a vibratory hammer. The installation of a 36 in. steel pile would result in an SEL of 170 and a peak of 180 dB when driven in approximately 5 meters of water using a vibratory hammer. Sound levels for the proposed 18 in. piling is expected to fall between these two reported values.

Environmental Consequences

Affects for above water receptors will have increases in noise generated during pile driving activities. Noise generated during pile driving would be commensurate with any construction site similar to building construction. The short-term noise levels outside of a pile driving area could cause temporary annoyance as far as several hundred feet away. The Occupational Safety and Health Administration set the eight-hour exposure limits to noise at 90 dBA. The World Health Organization (WHO) provides guideline values for noise annoyance. Continuous levels above 50 dBA will cause moderate human annoyance with serious annoyance at or above 55 dBA. (WHO n.d.). Specific sound levels are unknown for each type of barge, but using research conducted by The Pile Driving Contractors Association (Marr 2001), noise levels could be as high as 90 dBA at 300 ft. away for the noisiest pile driver. Using the Association's data for sound levels, average noise from a pile driver would be 90 dBA at a distance approximately 80 ft. away, 75 dBA at 500 ft., and 65 dBA at 1,000 ft. In comparison to roadway noise, the California Department of Transportation (Caltrans®) Traffic Noise Analysis Protocol (Caltrans® 2020) provides information to consider in determining adverse noise impacts. This includes not exceeding 86 dBA at 50 ft. from the job site activities 9 p.m. to 6 a.m.

Transient groups residing on shore or banks that are within 100 ft. of a piling installation would be potentially exposed to 90 dBA for one hour. The noise associated with pile driving will be limited only to the times when construction is active. Once the pilings are in place, the noise will cease and there will be no residual noise beyond a few seconds after the pile driving is complete that would impact receptors in the vicinity of the pile driving action.

The USGS anticipates minor and temporary disturbances to nearby wildlife. The piling driving noise is considered a temporary nuisance, and no long-term impacts are anticipated once complete. There will be no residual noise beyond a few seconds after the pile driving is complete.

Underwater impacts are not expected since the expected noise values fall below the NMFS reported values interim criteria for impact pile drivers.

Avoidance, Minimization, and/or Mitigation

Pile driving will occur only during daylight hours and noise from pile driving will be temporary. The vibratory pile driving hammer will slowly ramp up from a lower power for 15 seconds, followed by a 1-minute pause, repeated, then started up to continuous pile driving. Noise impacts will be short in duration and will cease upon completion of each pile driving and will be limited only to the times when installation is active. The total time required for the placement of one piling, which includes setup time, is expected to take one hour while removal would be one-half hour; therefore, continuous noise would be less than one hour for install and removal.

The USGS would inform receptors within 300 ft. in advance of pile driving and the impacts associated. For transient groups along the shore and communities within 500 feet of the construction, the contractor and the USGS scientist would provide notice to relevant county or local community organization a minimum of two weeks before construction, and if needed and feasible, reevaluate the piling location and/or implement noise abatement measures such as deflective shrouds on the barge.

Although quantified noise thresholds for nesting birds, as a result of vibratory pile driving, is not known, it is understood that if construction activity occurs within 0.25 miles of a nesting pair of birds, and the monitor deems that the activity will cause the birds to abandon the nest, work would stop and the USGS would contact the California Department of Fish and Wildlife to determine the most appropriate course of action to take.

6.7 Aesthetic Resources

Affected Environment

The proposed action has the potential to impact views of manmade channels and natural and unnatural settings for each new piling location but not for those existing. The proposed new pilings are located away from residential areas.

Environmental Consequences

A completed piling, with all equipment and appurtenances attached will be visible from the surrounding areas. There would be no additional consequences where existing monitoring stations are located. Recreationalist in commonly used rivers may notice a new piling near a popular fishing area or scenic route; however, major historical disturbances include farming, fires, housing and commercial development, transportation, bridges, and changes in hydrography. These historical occurrences throughout the proposed project region have had consequences that are generally common and accepted.

Avoidance, Minimization, and/or Mitigation

The proposed pilings for Suisun Bay are in open water between 1 and 2 miles from the nearest infrastructure and will be adjacent to an active shipping channel with similar channel markers in place. The piling in Montezuma Slough is in the Suisun Marsh area, but there are existing siphons, gates, and other infrastructure in the area. No other mitigation is proposed for visual effects.

6.8 Socioeconomics and Environmental Justice

As a result of the proposed action, the local economy will not be negatively impacted but would slightly benefit during the construction phase. Table 4. provides basic demographics for the region. An environmental justice report was obtained from the EPA (EPA 2021). See Appendix E for the report. Based on the report, location, and scope of the work, there is a not a concentrated area of impact to minority or low-income populations. This project would not have any disproportion impacts or environmental justice issues.

Table 4. Demographics for the proposed project (U.S. Census Bureau)

	USA	CA	Sacramento	San Joaquin	Yolo	Contra Costa
Per Capita Income, $	34,100	36,955	32,751	27,521	34,515	48,178
Poverty, %	10.5	11.8	12.6	13.6	16.9	7.9
Population	328,239,523	39,512,233	1,552,058	762,148	220,500	1,153,526
Population Density, #/sq mile	87.4	251.3	1,470.8	492.6	197.9	1,465.2
Unemployment as of Jan 2021, %	6.3	9.0	8.1	10.0	10.4	7.5

Avoidance, Minimization, and/or Mitigation

No impacts are expected and therefore no additional measures are necessary.

6.9 Invasive Species

Affected Environment

The water bodies of the proposed piling installation sites are the areas that could be affected; however, there are several invasive species within the region. Some invasive species would be affected by temporary suspended solids and noise. The introduction of new invasive species is very unlikely.

Environmental Consequences

Effects to existing invasive species would be similar to those previously discussed for biological resources (Section 5.2). No adverse impacts are expected for invasive species. Effects to aquatic resources could be detrimental if new invasive species were introduced.

Avoidance, Minimization, and/or Mitigation

Mitigation measures will be the same as those provided earlier for biological resources, water, and noise. As provided earlier, tools and equipment must be cleaned before use to ensure no cross-contamination or introduction of non-native species. It is expected that a local contractor will be assigned using local barges so that no out-of-state vessels would be necessary, as such could be prohibitively expensive.

6.10 Utilities

Affected Environment.

Conduits, communications lines and equipment, pipelines, and electrical lines are present at various locations beyond and adjacent to the water bodies. There are known underwater electrical lines in very close proximity in the proposed locations for Suisun Bay.

Environmental Consequences.

No environmental impacts are anticipated for water, gas, telephone or communication lines and devices. Overhead and underwater electrical powerlines are common and have the potential to impact the environment if disrupted. Beyond the human health and safety concerns from electrical disruptions, environmental impacts could involve fire, disruptions to critical infrastructure, and additional resources needed to maintain and/or restore power.

Avoidance, Minimization, and/or Mitigation

Overhead utilities would be avoided where present and piling locations would be relocated to prevent accidental contact. New piling locations would also be assessed and assigned where underwater utilities are within 50ft. of a proposed location. A USGS employee would be present at all times during installation and have a GPS and NOAA charts with coordinates and maps showing utility lines, especially for the underwater lines in Suisun Bay.

6.11 Hazardous Materials

Affected Environment

There is always the potential for any ship or barge to have an accident or failure which would result in oil or fuel being released to water bodies.

Environmental Consequences

Petroleum products being released into a river would result in adverse effects to limited aquatic resources and wildlife such as waterfowl. An uncontained spill would quickly travel downstream in limited quantities to various areas. Amounts of potential petroleum releases would be limited to fuel tanks and supplies on each barge.

Avoidance, Minimization, and/or Mitigation

Barge operators typically have spill containment training, but this will be verified by the USGS employee prior to work commencing. Additionally, the USGS employee would check the spill containment supplies and equipment prior to each workday.

6.12 Potential Adverse Effects from Greenhouse Gases

Greenhouse Gases (GHGs) include water vapor, CO2, methane (CH4), nitrous oxide, ozone, and several hydrocarbons and chlorofluorocarbons. Water vapor is a naturally occurring GHG and accounts for the largest percentage of the greenhouse effect. Next to water vapor, CO2 is the second-most abundant GHG. Uncontrolled CO2 emissions from power plants, heating sources, and mobile sources are a function of the power rating of each source, the feedstock (fuel) consumed, and the source's net efficiency at converting the energy in the feedstock into other useful forms of energy (e.g., electricity, heat, and kinetic). Nitrous oxide emissions are emitted during the combustion of fossil fuels

Based on the relatively small size of the affected area and current air quality conditions, it is expected that the proposed action would result in extremely low impacts on air quality. No mitigation is proposed.

7 Public Involvement

USGS will place this EA on the USGS Water Mission Area website with a 15-day public comment period. This comment period is provided to obtain public comment on both the environmental evaluation. Advertisements of the EA's availability will be provided with a press release, paid advertisements in the local papers, letters to the interested parties, and posting on the USGS Water Mission Area website.

Given the current information and analysis, USGS anticipates that there will be a "Finding of No Significant Impact' for the proposed action. However, following the 15-day comment period, USGS will review and address the comments received and incorporate them into the environmental review for inclusion in the decision making for the proposed action.

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9 Appendix A

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10 Appendix B

Monitoring Station Location Details

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
38.319827	-121.693627	SHG	Shag Slough	Delta Flow / Water Quality Monitoring	1	Upgrade: currently in sub-optimal location
38.551142	-121.582716	Toedrain-Near DWSC	Toe Drain near Deepwater Shipping Channel	Deepwater Ship Channel Monitoring	4	Expansion: Contingent on funding and final design
38.35188	-121.643986	TOEn	Toe Drain, north of Stair Step	Delta Flow / Water Quality Monitoring	1	Expansion / Upgrade: Optimize location for newly funded station
37.81879258	-121.537035	GLE_1	Grant Line Canal Exit	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.82009602	-121.536832	GLE_2	Grant Line Canal Exit	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.81880452	-121.541173	GLE_3	Grant Line Canal Exit	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.82007822	-121.541197	GLE_4	Grant Line Canal Exit	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.76149104	-121.317329	PC_1	Paradise Cut	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
37.76469788	-121.318818	PC_2	Paradise Cut	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.341588	-121.644045	CM 61	CM 61	Deepwater Ship Channel Monitoring	4	Expansion: Contingent on funding and final design
38.404771	-121.614544	CM 66	CM 66	Deepwater Ship Channel Monitoring	1	Upgrade: Current infrastructure often is too shallow for continuous data collection at low water
38.476812	-121.583741	CM 72	CM 72	Deepwater Ship Channel Monitoring	2	Upgrade: Current infrastructure is likely prone to failure
38.506292	-121.585194	CM 74	CM 74	Deepwater Ship Channel Monitoring	4	Expansion: Contingent on funding and final design
38.537641	-121.58415	CM 76	CM 76	Deepwater Ship Channel Monitoring	4	Expansion: Contingent on funding and final design
38.24751885	-121.668692	DWS_1	Deep Water Shipping	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.24792764	-121.670654	DWS_2	Deep Water Shipping	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
38.24325719	-121.670036	DWS_3	Deep Water Shipping	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.24358936	-121.671984	DWS_4	Deep Water Shipping	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.561409	-121.5303	DWSC Locks	Deepwater Shipping Channel near Locks	Deepwater Ship Channel Monitoring	4	Expansion: Contingent on funding and final design
38.550528	-121.581098	DWSC-Near ToeDrain	Deepwater Shipping Channel near Toe Drain	Deepwater Ship Channel Monitoring	4	Expansion: Contingent on funding and final design
38.765038	-121.689113	FRE 1	Fremont Weir Location 1	Fremont Weir Modeling	4	Expansion: Contingent on funding and final design
38.764891	-121.651811	FRE 2	Fremont Weir Location 2	Fremont Weir Modeling	4	Expansion: Contingent on funding and final design
38.767945	-121.635367	FRE 3	Fremont Weir Location 3	Fremont Weir Modeling	4	Expansion: Contingent on funding and final design
38.79366	-121.630418	FTR	Feather River	Fremont Weir Modeling	4	Expansion: Contingent on funding and final design
38.730298	-121.603891	PRCH	Sacramento River at Pritchard Lake Road	Fremont Weir Modeling	4	Expansion: Contingent on funding

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
						and final design
38.78108066	-121.606742	SBF_1	Sacramento Below Feather	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.78006855	-121.607449	SBF_2	Sacramento Below Feather	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.5792715	-121.508096	SRD_1	Sacramento River Downtown	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.57959798	-121.509643	SRD_2	Sacramento River Downtown	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.048927	-121.916708	ADVM_ConflNorth	ADVM North Shore Confluence	X2 Monitoring	1	Expansion: Contingent on funding and final design
38.04373112	-121.925709	CHPS_1	Chipps Island	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.05210254	-121.931777	CHPS_12	Chipps Island	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.05071596	-121.923813	CHPS_6	Chipps Island	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.04594157	-121.934539	CHPS_7	Chipps Island	Acoustic Telemetry	A	Expansion: Contingent

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
				(Fish Migration)		on funding and final design
38.058036	-121.98767	CM 20	CM 20	X2 Monitoring	1	Expansion: Contingent on funding and final design
38.149207	-122.05526	MTZw	Montezuma Slough west	Delta Flow / Water Quality Monitoring	3	Expansion: Contingent on funding and final design
38.2364005	-121.680326	CAL_1	Cache at Liberty	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.23457313	-121.682926	CAL_3	Cache at Liberty	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.23536733	-121.677885	CAL_4	Cache at Liberty	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.23341178	-121.679111	CAL_6	Cache at Liberty	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.24468276	-121.504286	DCC_1	Delta Cross Channel	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.24383123	-121.501088	DCC_3	Delta Cross Channel	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
38.012244	-121.670009	DSJ	Dutch Slough	Delta Flow / Water Quality Monitoring	1	Maintenance: Long term station
38.05553432	-121.66101	FAL_1	False River	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.05781647	-121.661372	FAL_2	False River	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.05534106	-121.665576	FAL_3	False River	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.05742195	-121.665425	FAL_4	False River	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.13247984	-121.589838	GAM_1	Georgianna Slough	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.1298796	-121.585691	GAM_3	Georgianna Slough	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.23354542	-121.519467	GEO_1	Georgianna Slough	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.23085977	-121.522248	GEO_3	Georgianna Slough	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
38.238861	-121.52374	GES	Sacramento River below Georgiana Slough	Delta Flow / Water Quality Monitoring	3	Maintenance: Long term station
38.235385	-121.518138	GSS	Georgianna Slough	Delta Flow / Water Quality Monitoring	2	Maintenance: Long term station
38.292072	-121.724706	HASS	Hass Slough	Delta Flow / Water Quality Monitoring	2	Upgrade: Optimize location current configuration is difficult to maintain
38.01643374	-121.582121	HC_1	Holland Cut	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.01647623	-121.58022	HC_2	Holland Cut	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.02166585	-121.583013	HC_3	Holland Cut	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.0218105	-121.580926	HC_4	Holland Cut	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.002379	-121.512194	HLT	Middle River at Holt	Delta Flow / Water Quality Monitoring	3	Maintenance: Long term station
38.284499	-121.64408	HWB	Miner Slough at Hwy 84 Bridge	Delta Flow / Water Quality Monitoring	4	Contingent on future funding

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
38.05451481	-121.68525	JP_1	Jersey Point	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.05828954	-121.688912	JP_4	Jersey Point	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.05355606	-121.686765	JP_5	Jersey Point	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.05740624	-121.690005	JP_8	Jersey Point	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.10276489	-121.490514	LPS_1	Little Potatoe Sl	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.10284781	-121.492195	LPS_2	Little Potatoe Sl	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.09990881	-121.493091	LPS_3	Little Potatoe Sl	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.0991284	-121.491874	LPS_4	Little Potatoe Sl	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.01774549	-121.464657	MAC_1	MacDonald Island	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
						and final design
38.01919006	-121.462101	MAC_2	MacDonald Island	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.02297921	-121.467043	MAC_3	MacDonald Island	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.02371991	-121.464168	MAC_4	MacDonald Island	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
37.942527	-121.533731	MDM-LB	Middle River at Middle River -- Left Bank	Delta Flow / Water Quality Monitoring	1	Maintenance: Long term station
37.942448	-121.532092	MDM-RB	Middle River at Middle River -- Right Bank	Delta Flow / Water Quality Monitoring	1	Maintenance: Long term station
38.29026637	-121.616378	ME_1	Miner Slough Entrance	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.2909251	-121.620387	ME_2	Miner Slough Entrance	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.00180607	-121.51281	MID_1	Middle River	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.00181466	-121.510654	MID_2	Middle River	Acoustic Telemetry	B	Expansion: Contingent

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
				(Fish Migration)		on funding and final design
38.01036226	-121.518603	MID_3	Middle River	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.01158549	-121.516798	MID_4	Middle River	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.109939	-121.578963	MOK	Mokelumne River	Delta Flow / Water Quality Monitoring	1	Upgrade: Currently on private property, unable to identify owner
38.1113652	-121.582051	MOK_1	Mokelumne River	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.11079421	-121.582743	MOK_2	Mokelumne River	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.10993086	-121.578505	MOK_3	Mokelumne River	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.10906331	-121.578842	MOK_4	Mokelumne River	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
37.8245463	-121.379417	MRE_1	Middle River Entrance	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
						and final design
37.82546042	-121.382062	MRE_2	Middle River Entrance	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.88445206	-121.469882	MRU_1	Middle River Union Island	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.88556332	-121.47425	MRU_4	Middle River Union Island	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.89479425	-121.493255	MRV_1	Middle River Victoria	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.89668796	-121.493722	MRV_3	Middle River Victoria	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.23638308	-121.665471	MSX_1	Miner Slough Exit	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.23367602	-121.66821	MSX_3	Miner Slough Exit	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.220595	-121.50745	NFM	North Fork Moklumne River	Delta Flow / Water Quality Monitoring	1	Expansion / Upgrade: Optimize location for newly funded station

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
37.969668	-121.574022	OBI-LB	Old River at Bacon Island -- Left Bank	Delta Flow / Water Quality Monitoring	1	Maintenance: Long term station
37.969447	-121.572281	OBI-RB	Old River at Bacon Island -- Right Bank	Delta Flow / Water Quality Monitoring	1	Maintenance: Long term station
37.82086178	-121.377446	OBM_1	Old River Below Middle River	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.81864705	-121.379327	OBM_3	Old River Below Middle River	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.890669	-121.571736	OH4	Old River at Highway 4	Delta Flow / Water Quality Monitoring	2	Maintenance: Long term station
37.81087292	-121.546242	OLT_1	Old River near Tracy	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.81137779	-121.545967	OLT_2	Old River near Tracy	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.81251045	-121.548952	OLT_3	Old River near Tracy	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.81278116	-121.548564	OLT_4	Old River near Tracy	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.81167793	-121.335825	ORE_1	Old River Entrance	Acoustic Telemetry	A	Expansion: Contingent

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
				(Fish Migration)		on funding and final design
37.815101	-121.334792	ORE_3	Old River Entrance	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.07068943	-121.57445	ORFT_1	Old River Franks Tract	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.07265959	-121.575593	ORFT_2	Old River Franks Tract	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.06073662	-121.580713	ORFT_3	Old River Franks Tract	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.06277053	-121.583044	ORFT_5	Old River Franks Tract	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.02517867	-121.564654	ORQ_1	Old River Quimby	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.02528583	-121.562736	ORQ_2	Old River Quimby	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.02816087	-121.564739	ORQ_3	Old River Quimby	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
38.02814894	-121.562578	ORQ_4	Old River Quimby	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.87812046	-121.577551	ORV_1	Old River Victoria Cut	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.87770996	-121.576449	ORV_2	Old River Victoria Cut	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.88106559	-121.575644	ORV_3	Old River Victoria Cut	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.88080645	-121.574757	ORV_4	Old River Victoria Cut	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.06109878	-121.559974	PP_1	Prisoners Point	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.0613408	-121.55535	PP_5	Prisoners Point	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.06320621	-121.560551	PP_6	Prisoners Point	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.06349679	-121.554433	PP_7	Prisoners Point	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
						and final design
38.08604267	-121.548332	PS_1	Potato Slough	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.08790107	-121.549618	PS_2	Potato Slough	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.08427751	-121.553099	PS_3	Potato Slough	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.08688132	-121.553808	PS_4	Potato Slough	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.23790457	-121.530151	SBG_1	Sacramento Below Georgianna	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.23849539	-121.530392	SBG_2	Sacramento Below Georgianna	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.23826187	-121.53373	SBG_3	Sacramento Below Georgianna	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.23881933	-121.533512	SBG_4	Sacramento Below Georgianna	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
38.26998947	-121.603869	SBM_1	Sutter Below Miner	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.26803693	-121.603055	SBM_3	Sutter Below Miner	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.28551207	-121.553838	SBS_1	Sacramento Below Steamboat	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.28500879	-121.554665	SBS_2	Sacramento Below Steamboat	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.28375854	-121.551456	SBS_3	Sacramento Below Steamboat	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.28315942	-121.552116	SBS_4	Sacramento Below Steamboat	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.17237753	-121.648206	SC_1	Sacramento above Cache Sl	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.17372262	-121.647859	SC_2	Sacramento above Cache Sl	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.17296028	-121.65286	SC_3	Sacramento above Cache Sl	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
						and final design
38.17452134	-121.651798	SC_4	Sacramento above Cache Sl	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.252488	-121.511813	SDC	Sacramento River above Delta Cross Channel	Delta Flow / Water Quality Monitoring	2	Maintenance: Long term station
38.45514037	-121.501105	SF_1	Sacramento at Freeport	Acoustic Telemetry (Fish Migration)	1	Expansion: Contingent on funding and final design
38.45489227	-121.502714	SF_2	Sacramento at Freeport	Acoustic Telemetry (Fish Migration)	1	Expansion: Contingent on funding and final design
38.45139809	-121.500517	SF_3	Sacramento at Freeport	Acoustic Telemetry (Fish Migration)	1	Expansion: Contingent on funding and final design
38.45134717	-121.502212	SF_4	Sacramento at Freeport	Acoustic Telemetry (Fish Migration)	1	Expansion: Contingent on funding and final design
38.225366	-121.491129	SFM	South Fork Mokelumne River	Delta Flow / Water Quality Monitoring	1	Expansion / Upgrade: Optimize location for newly funded station
37.935355	-121.331749	SJG	San Joaquin River at Stockton	Delta Flow / Water Quality Monitoring	1	Maintenance: Long term station
37.81169679	-121.319013	SJL_1	San Joaquin Lathrop	Acoustic Telemetry	A	Expansion: Contingent on funding

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
				(Fish Migration)		and final design
37.81384736	-121.319408	SJL_3	San Joaquin Lathrop	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
37.93509935	-121.330588	SJS_1	San Joaquin Stockton	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
37.93609712	-121.334241	SJS_3	San Joaquin Stockton	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.33154388	-121.581975	SSE_1	Sutter Slough Entrance	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.33067515	-121.584932	SSE_3	Sutter Slough Entrance	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.329026	-121.578128	SSS	Sutter Slough	Delta Flow / Water Quality Monitoring	1	Maintenance: Long term station
38.24688491	-121.601305	STBS_1	Steamboat below Sutter	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.24686391	-121.602503	STBS_2	Steamboat below Sutter	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.24353417	-121.601153	STBS_3	Steamboat below Sutter	Acoustic Telemetry	B	Expansion: Contingent on funding

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
				(Fish Migration)		and final design
38.24357229	-121.602682	STBS_4	Steamboat below Sutter	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.28497431	-121.586512	STE_1	Steamboat Slough Entrance	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.28029308	-121.5888	STE_3	Steamboat Slough Entrance	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.3046	-121.575584	STM	Steamboat Slough	Delta Flow / Water Quality Monitoring	2	Maintenance: Long term station
38.18825716	-121.642344	STX_1	Steamboat Slough Exit	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.18893422	-121.644178	STX_2	Steamboat Slough Exit	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.18377464	-121.649981	STX_3	Steamboat Slough Exit	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.1850033	-121.650526	STX_4	Steamboat Slough Exit	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
37.99131494	-121.454745	TRN_1	Turner Cut	Acoustic Telemetry	A	Expansion: Contingent on funding

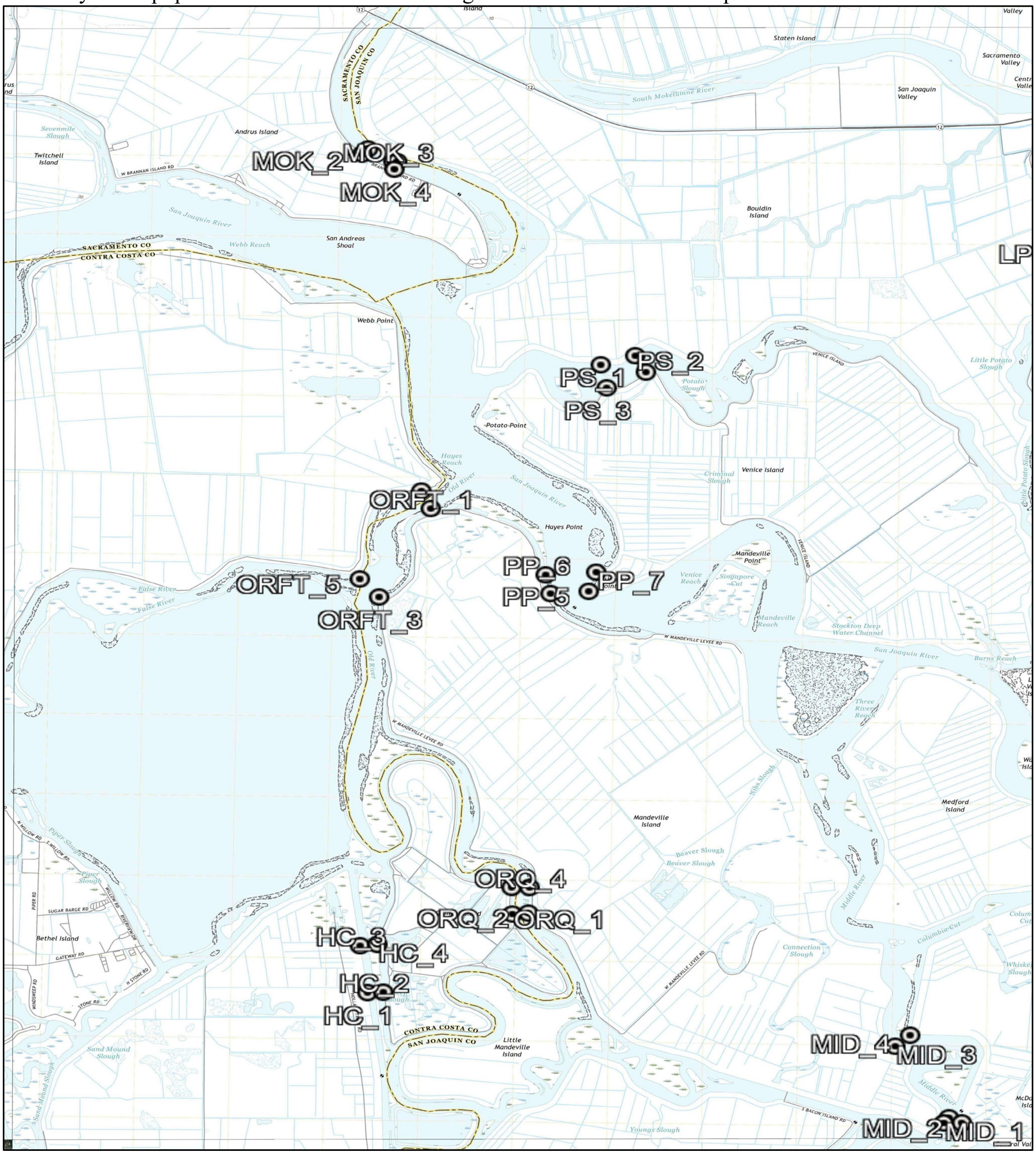
Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
				(Fish Migration)		and final design
37.99177553	-121.455379	TRN_2	Turner Cut	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
37.98950905	-121.458798	TRN_3	Turner Cut	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
37.99053454	-121.459368	TRN_4	Turner Cut	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design
38.099907	-121.686645	TSL	Threemile Slough	Delta Flow / Water Quality Monitoring	2	Maintenance: Long term station
38.269605	-121.701333	UCS	Upper Cache Slough	Delta Flow / Water Quality Monitoring	1	Upgrade: Optimatize location current configuration is difficult to maintain
38.291581	-121.734151	ULT	Ultais Creek	Delta Flow / Water Quality Monitoring	1	Expansion / Upgrade: Optimize location for newly funded station, original "self-contained" strategy failed.
37.79170246	-121.307773	MOS_Piling	Mossdale	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design

Latitude	Longitude	Short Name	Long Name	Project	Work Window Priority	Comment
37.76422894	-121.309377	SBP_1	San Joaquin below Paradise	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.7673356	-121.307418	SBP_3	San Joaquin below Paradise	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.785613	-121.65414	SUT BYPASS	Sutter Bypass	Fremont Weir Modeling	4	Expansion: Contingent on funding and final design
37.87296328	-121.525199	VC_1	Victoria Cut	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.87394762	-121.526083	VC_2	Victoria Cut	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.8717132	-121.528124	VC_3	Victoria Cut	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
37.87270963	-121.529075	VC_4	Victoria Cut	Acoustic Telemetry (Fish Migration)	B	Expansion: Contingent on funding and final design
38.7607171	-121.65955	YBF	Yolo Bypass below Fremont Weir	Acoustic Telemetry (Fish Migration)	A	Expansion: Contingent on funding and final design

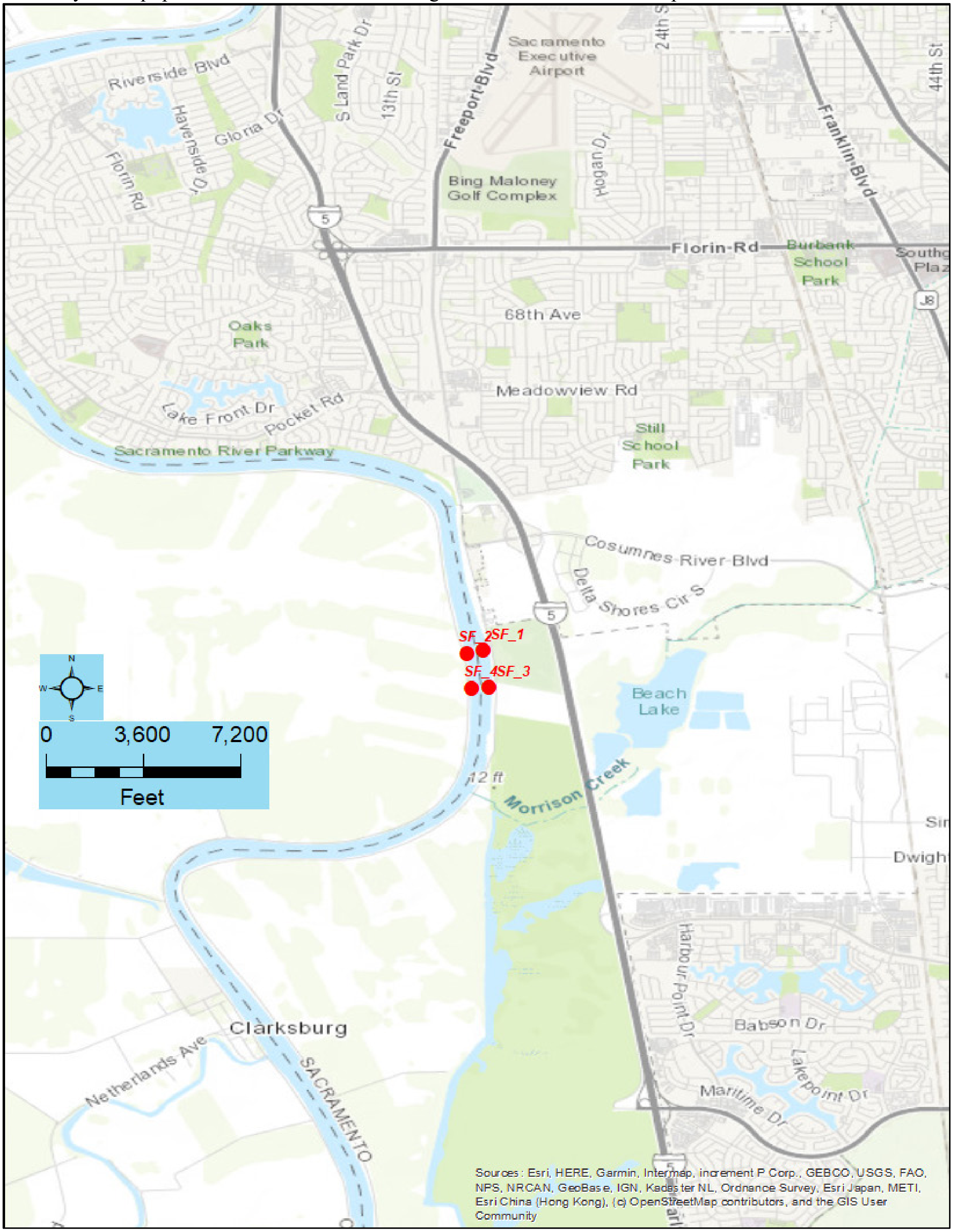
11 Appendix C

USGS 7.5' Quad Maps

Bouldin Island. Thirty total proposed pile driving location. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

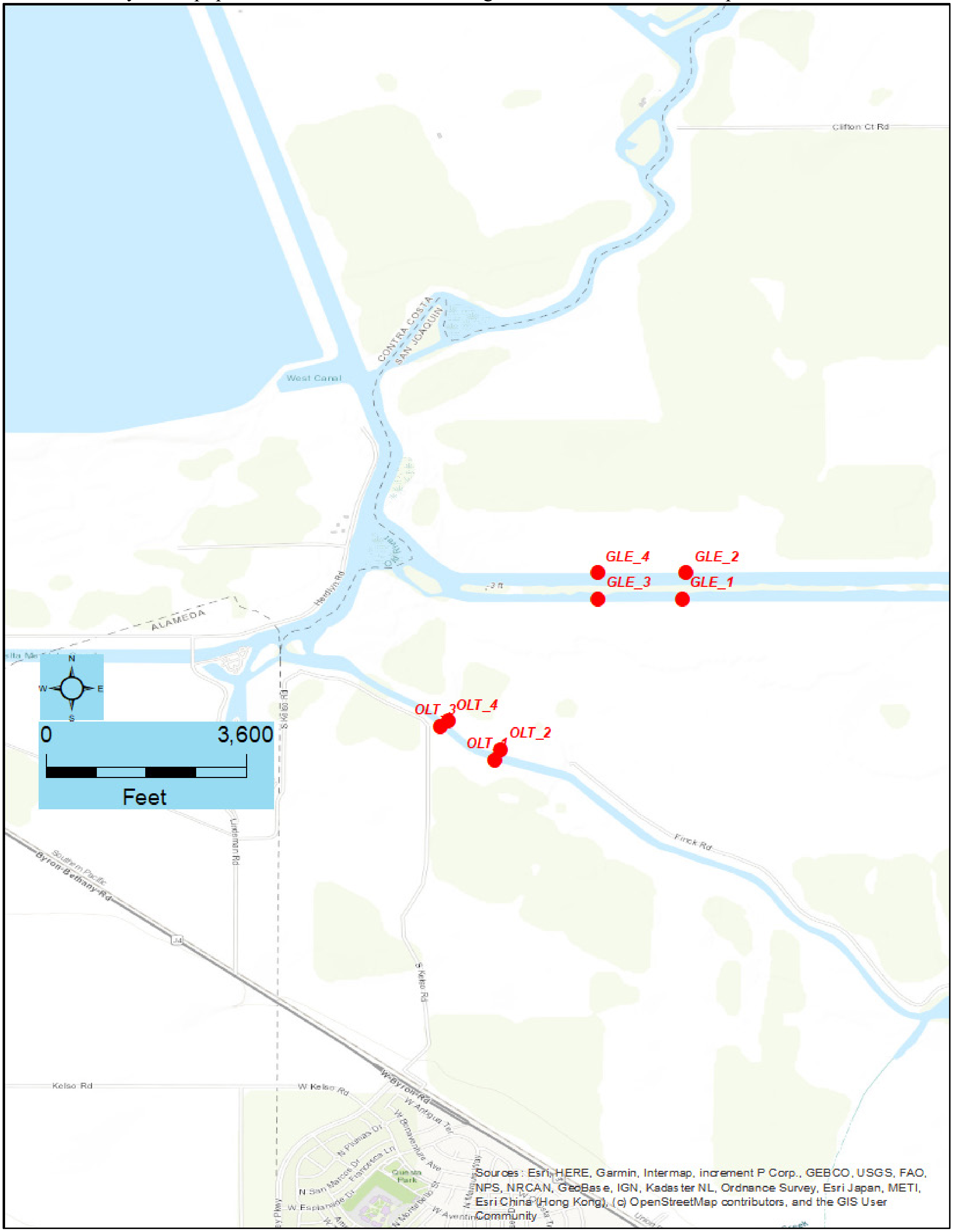


Clarksburg 1. Four total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

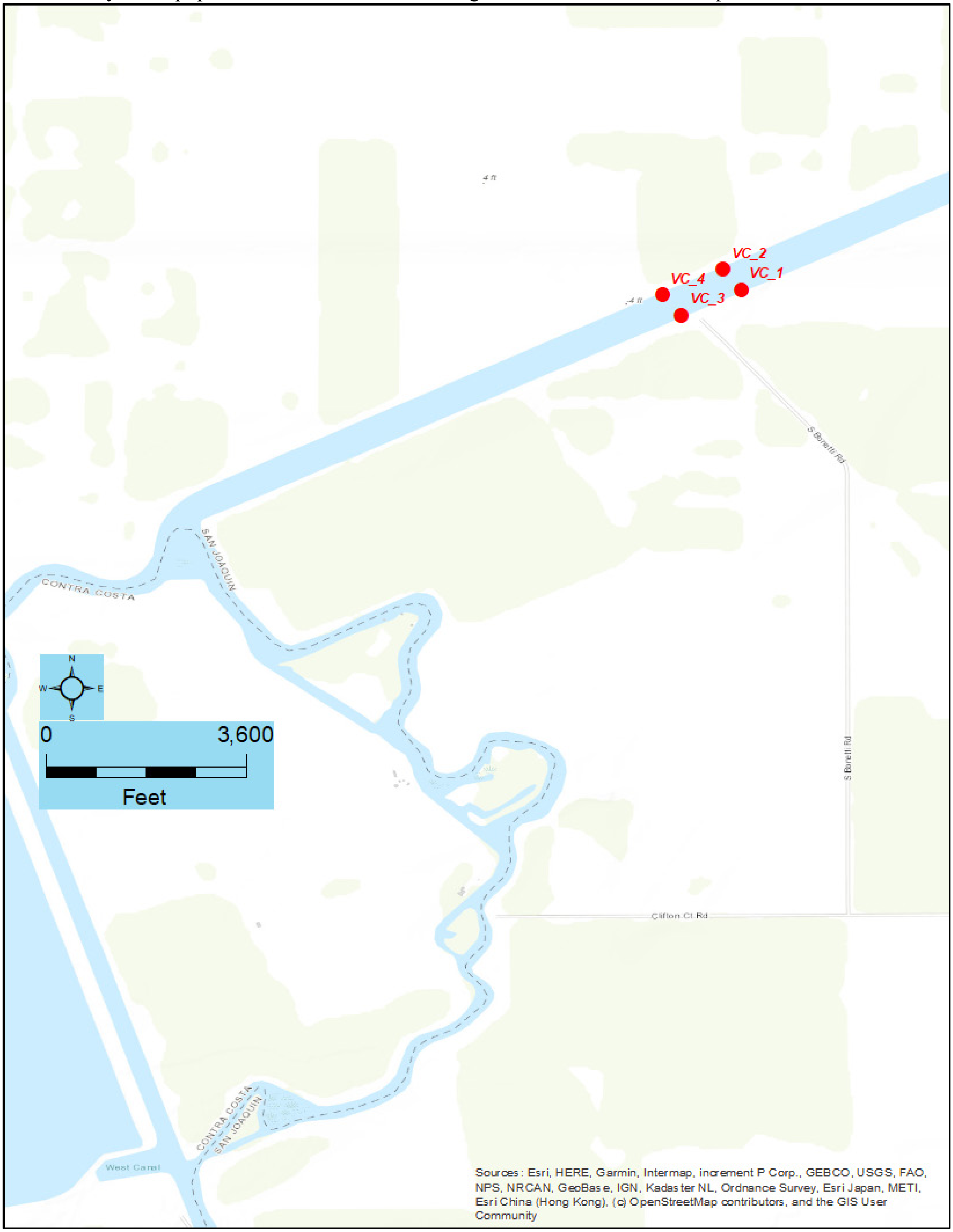


Clarksburg 2. Three total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

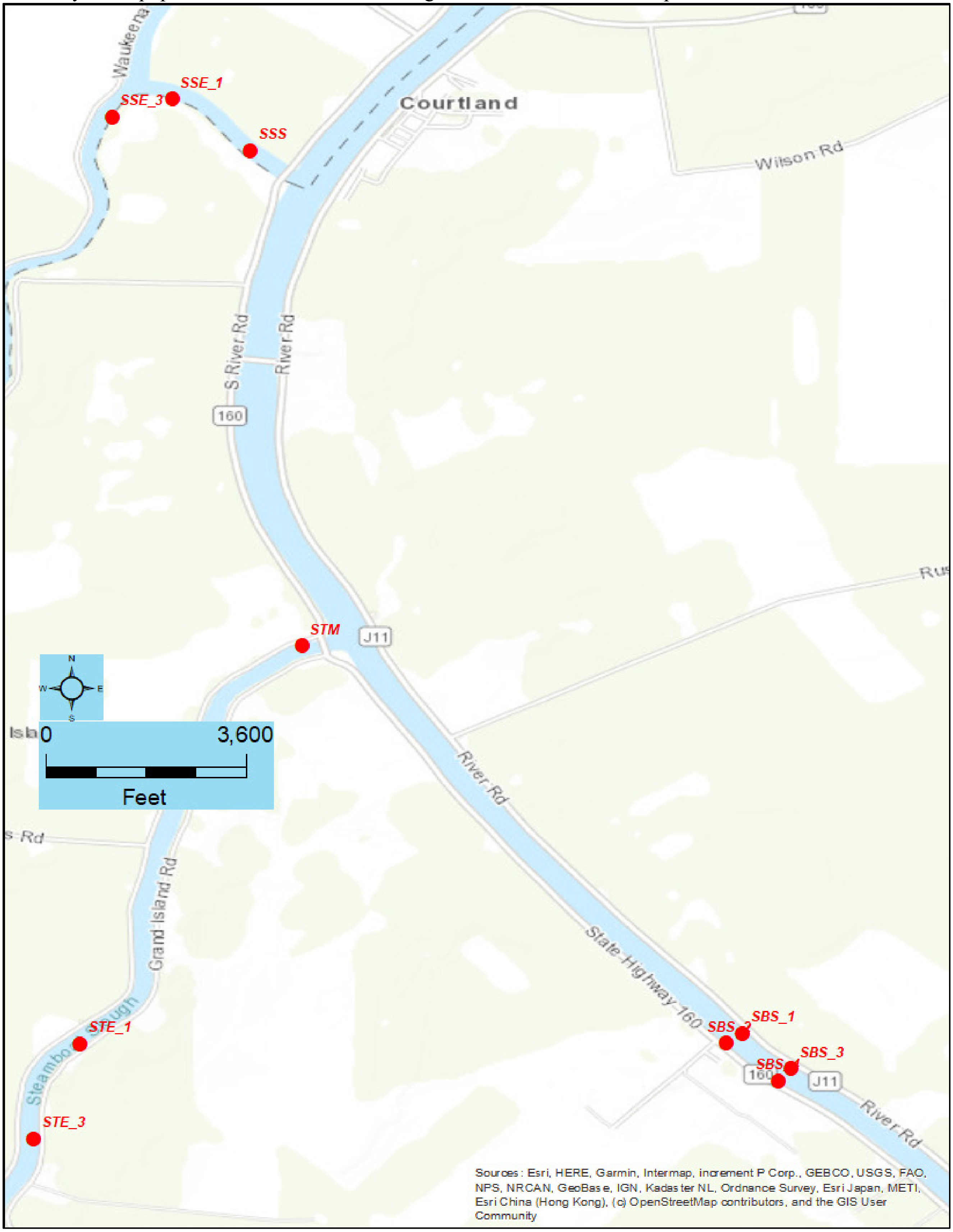
Clifton Court Forebay 1. Eight total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.



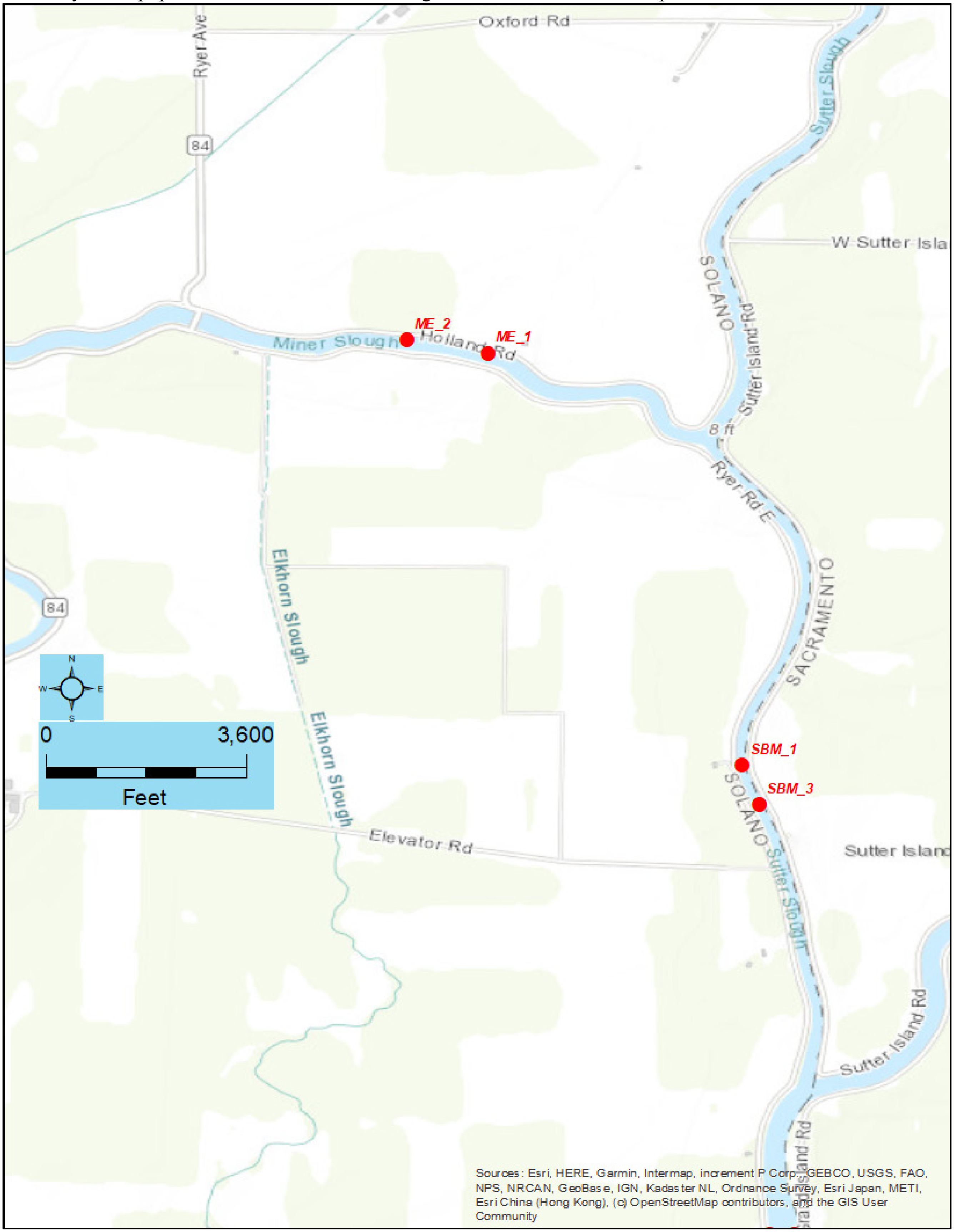
Clifton Court Forebay 2. Four total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.



Courtland 1. Ten total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.



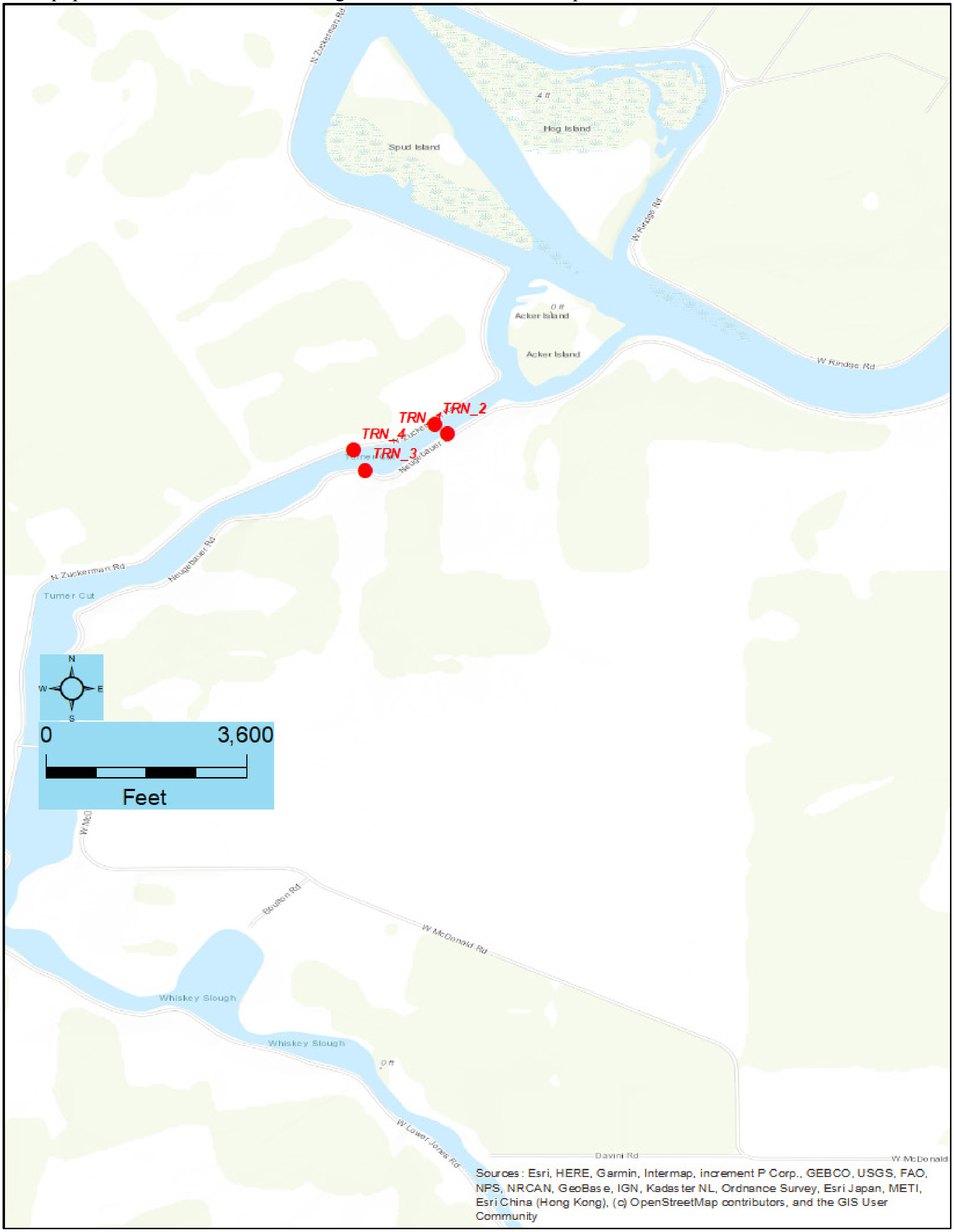
Courtland 2. Four total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.



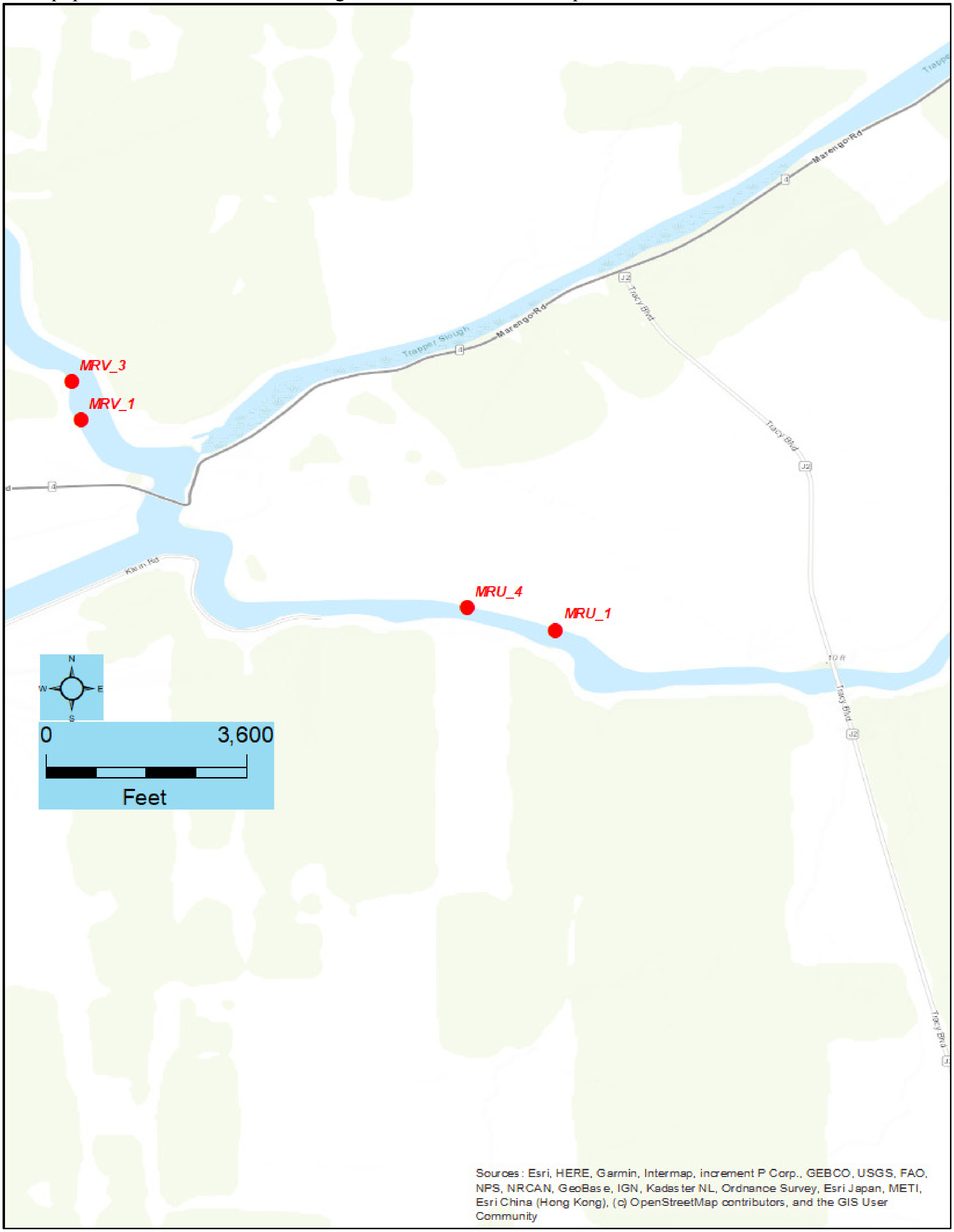
Locke. One total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

Fairfield, South. One total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

Holt 1. Four total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.



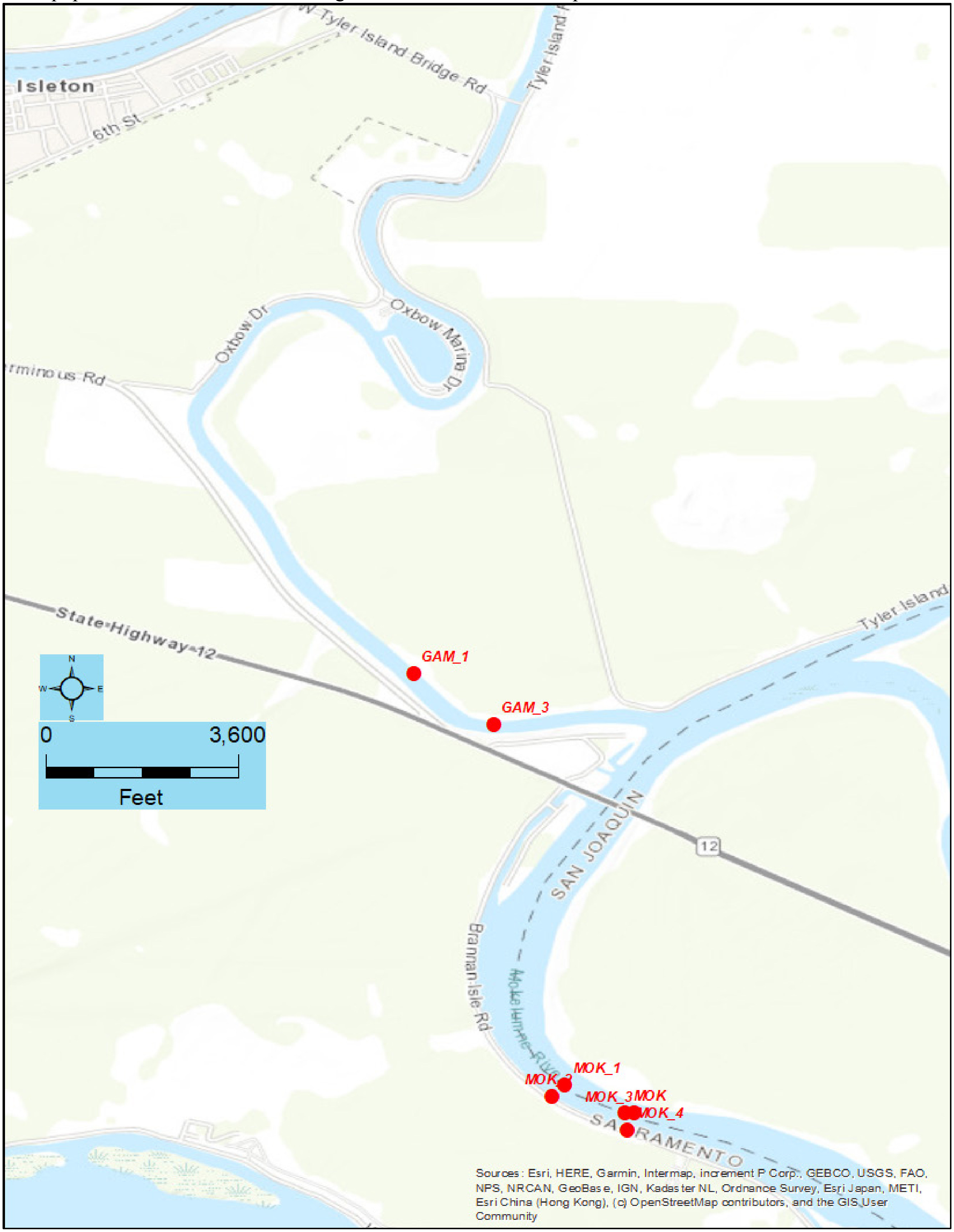
Holt 2. Four total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.



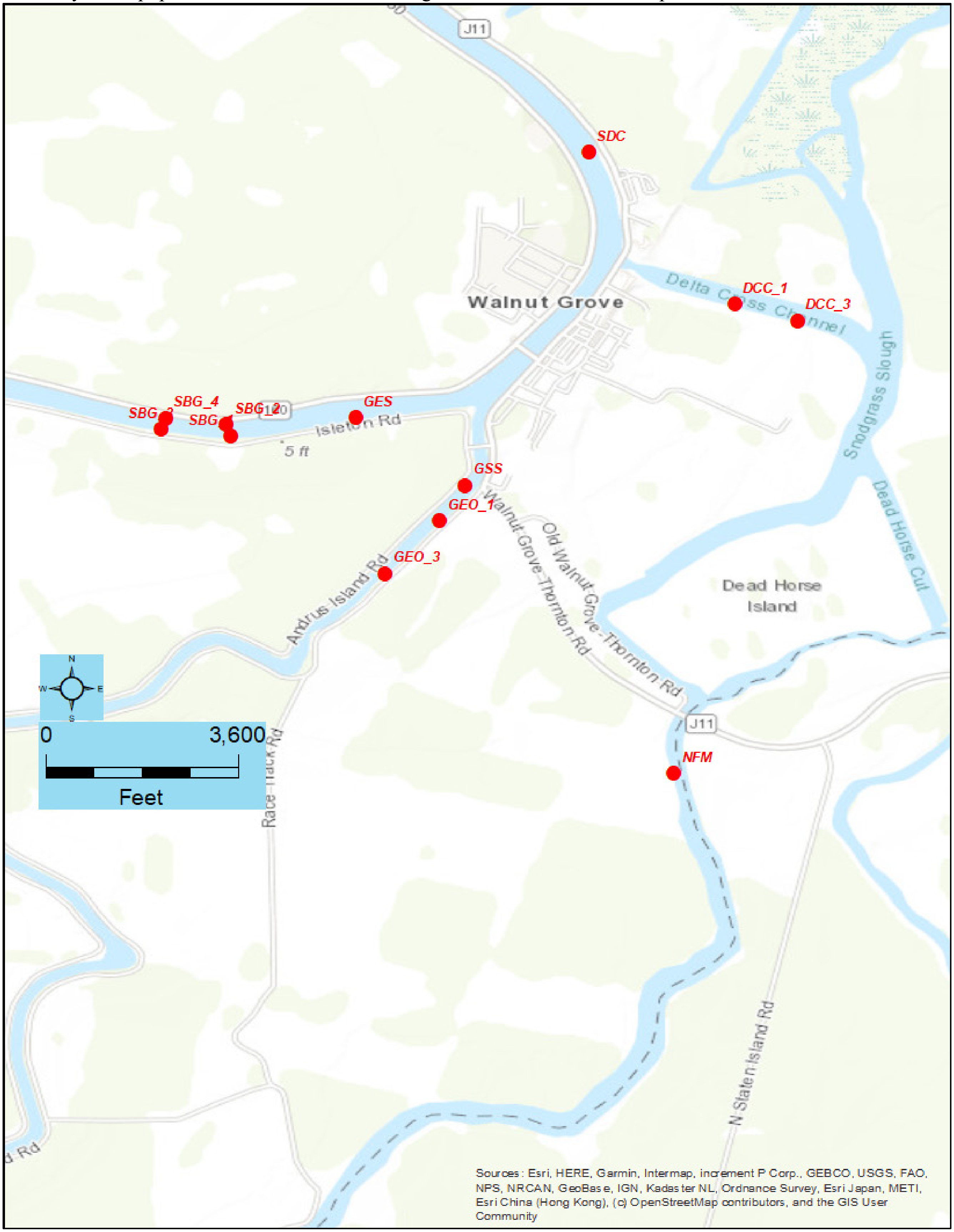
Honker and Suisun Bay. Six total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

Isleton 1. Four total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

Isleton 2. Seven total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

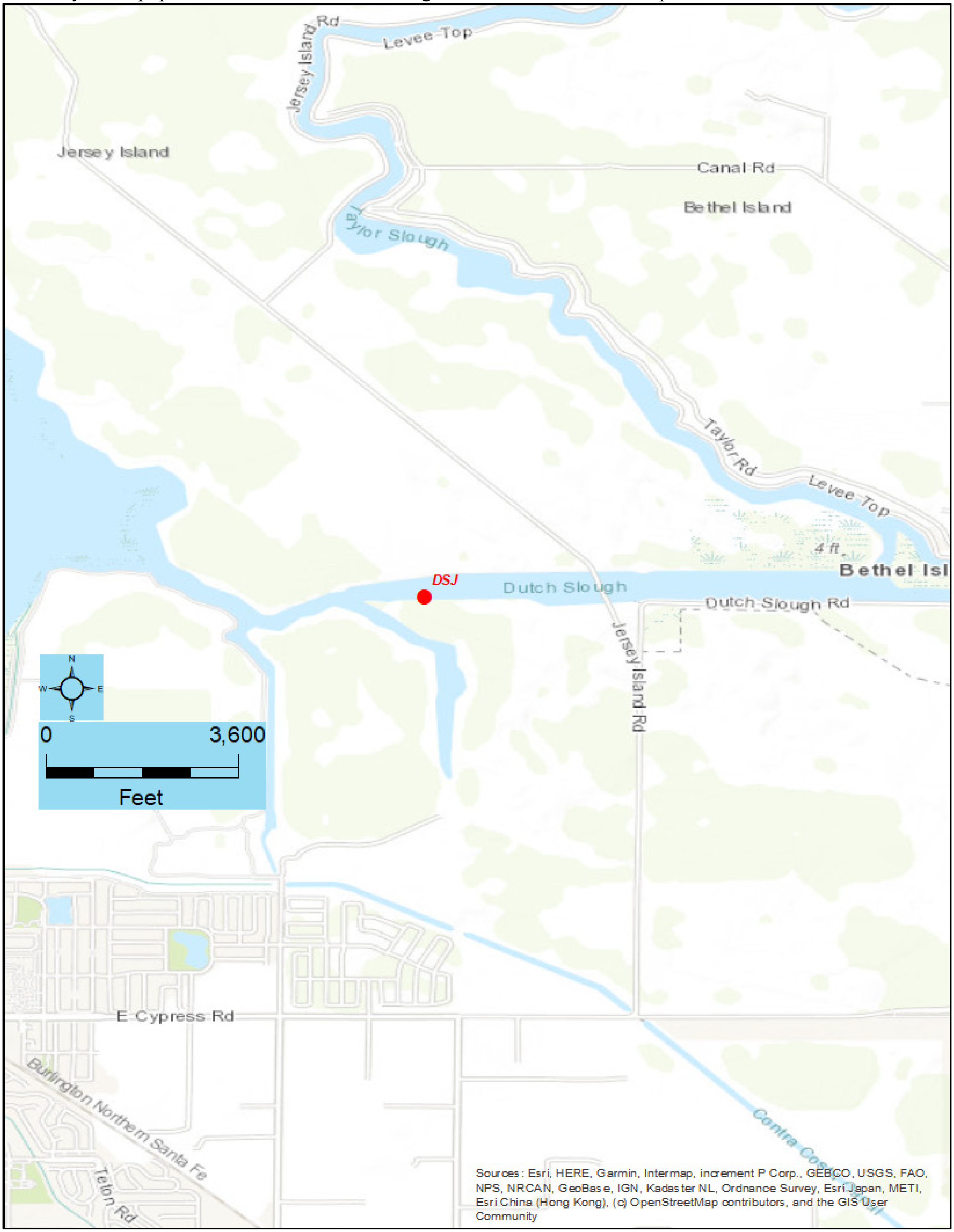


Walnut Grove. Twelve total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

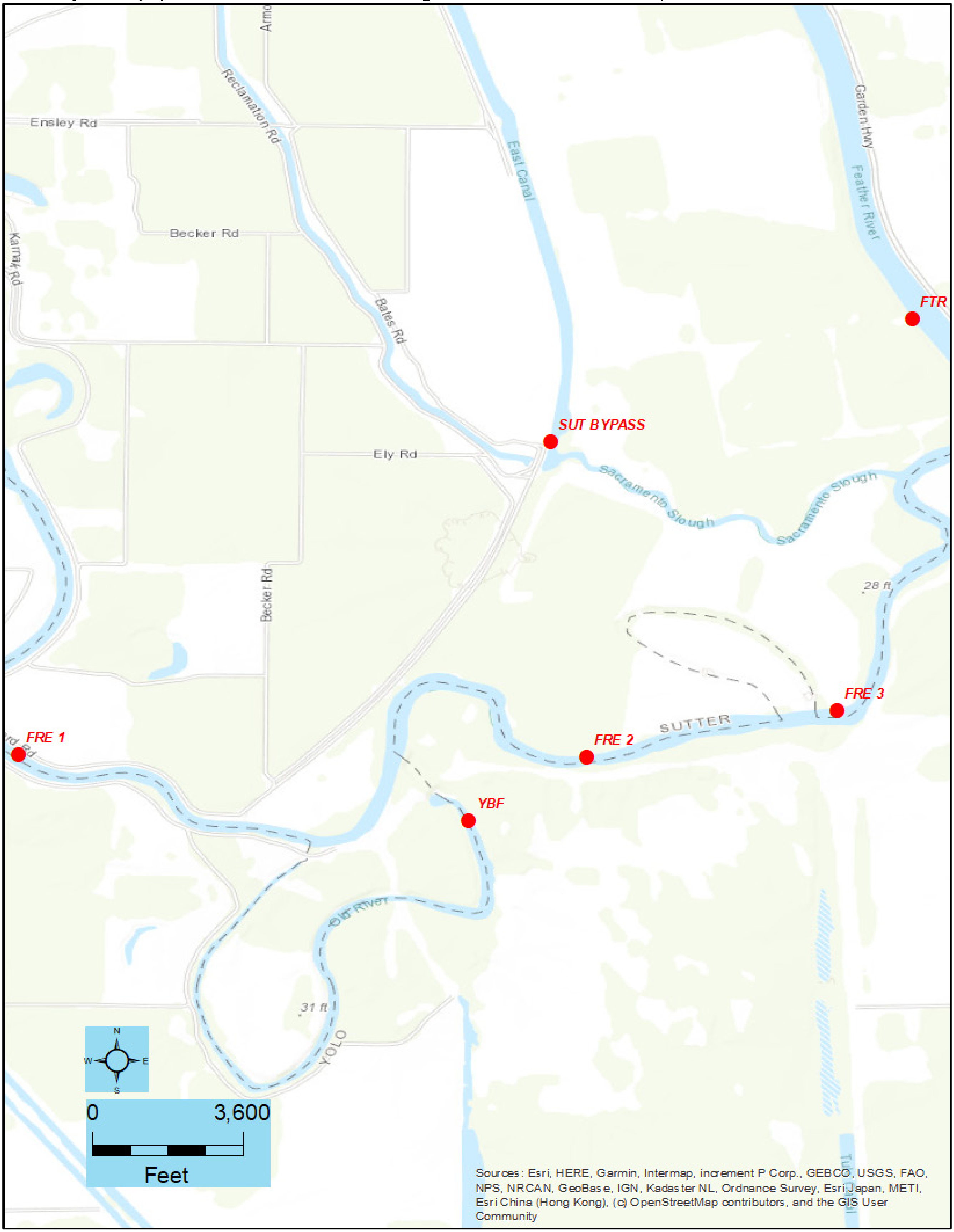


Jersey Island 1. Nine total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

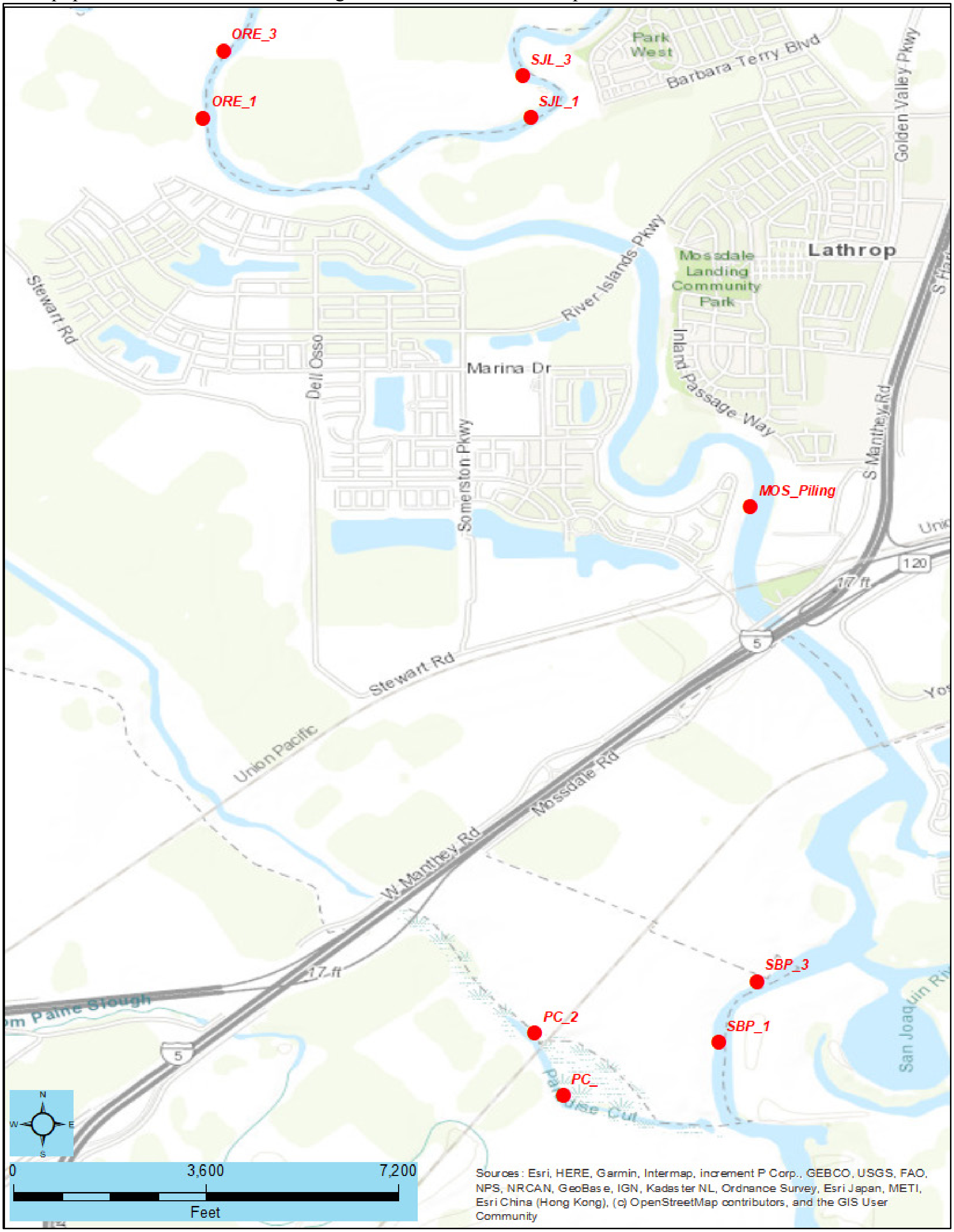
Jersey Island 2. One total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.



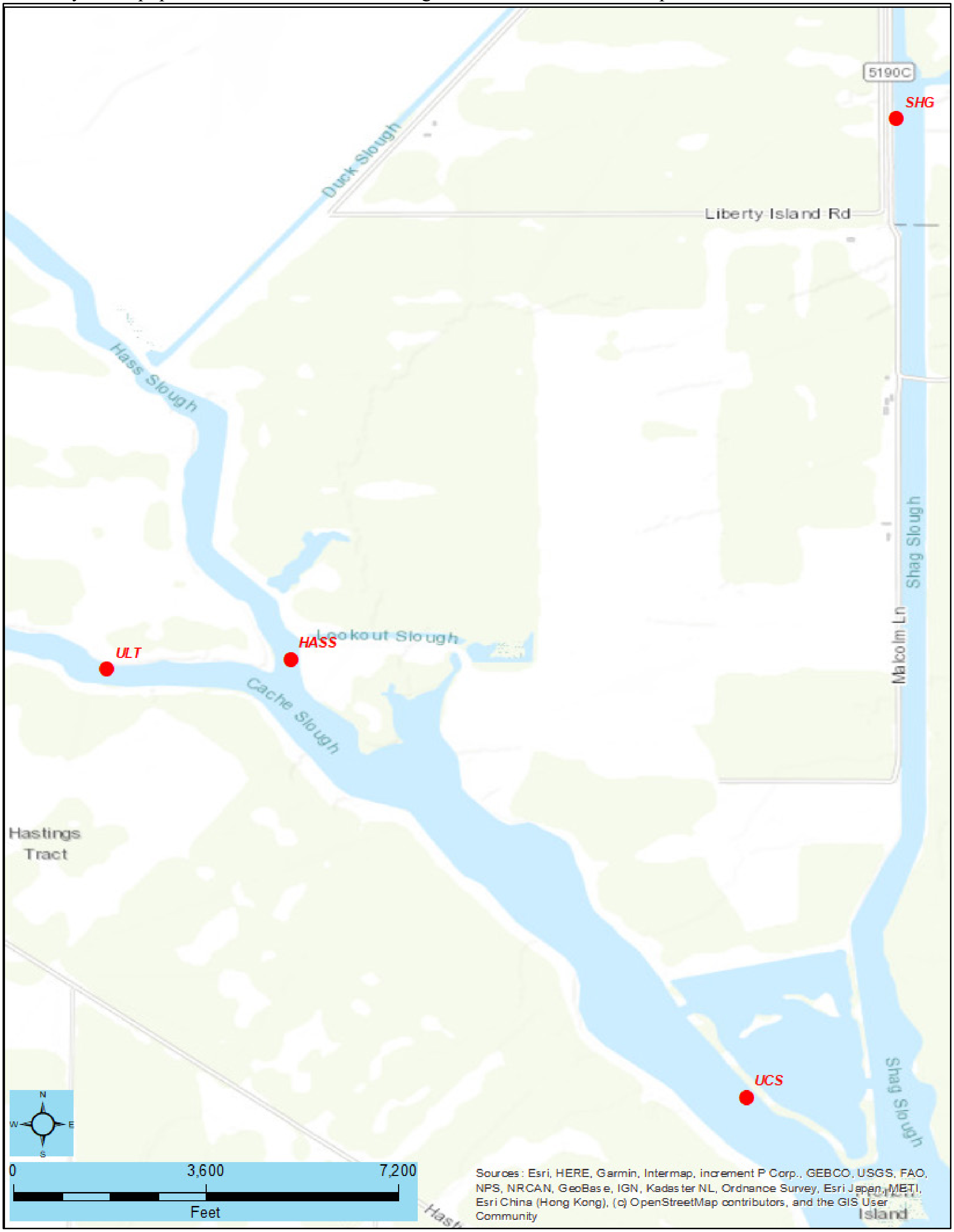
Knights Landing. Six total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.



Lathrop. Nine total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

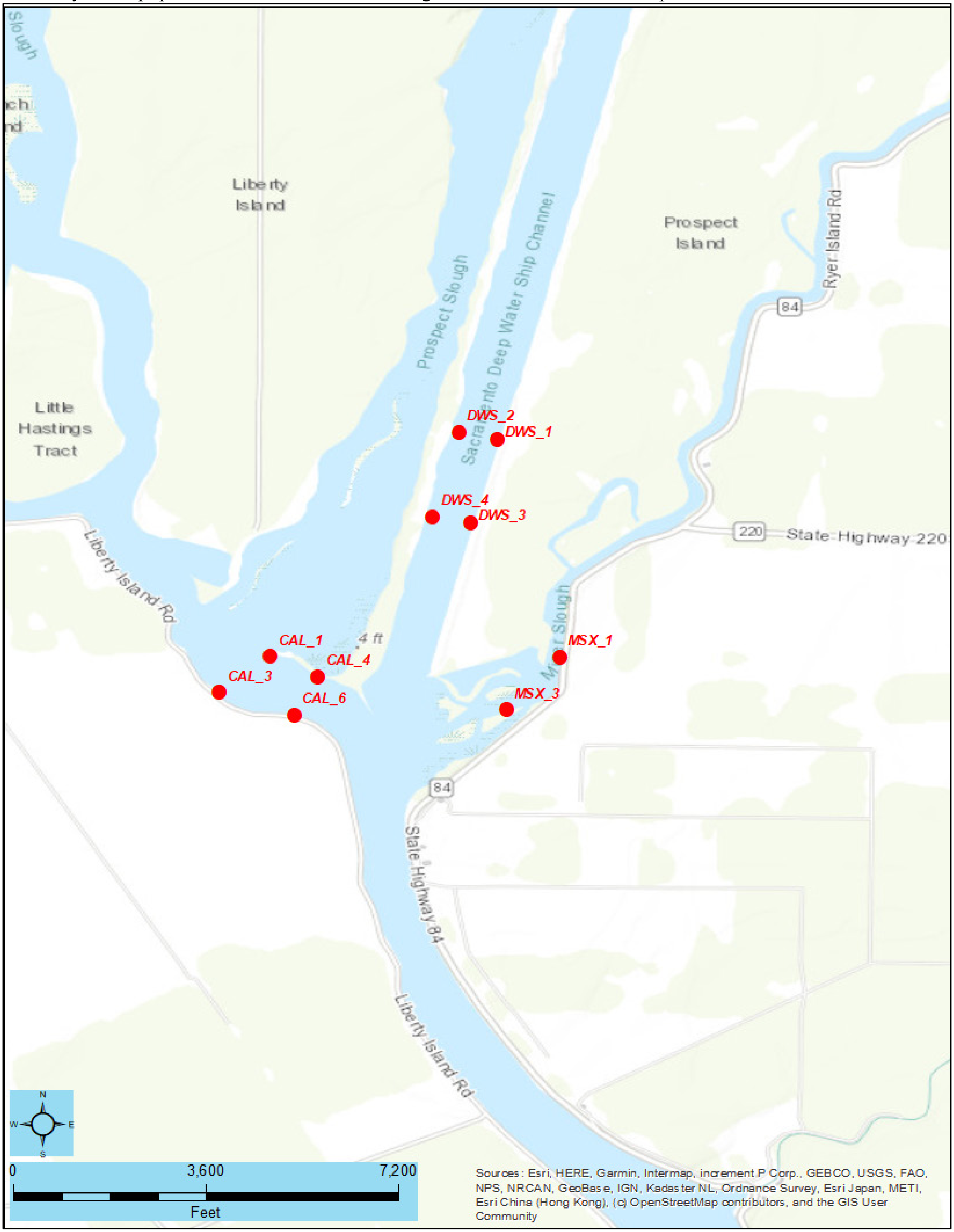


Liberty Island 1. Four total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

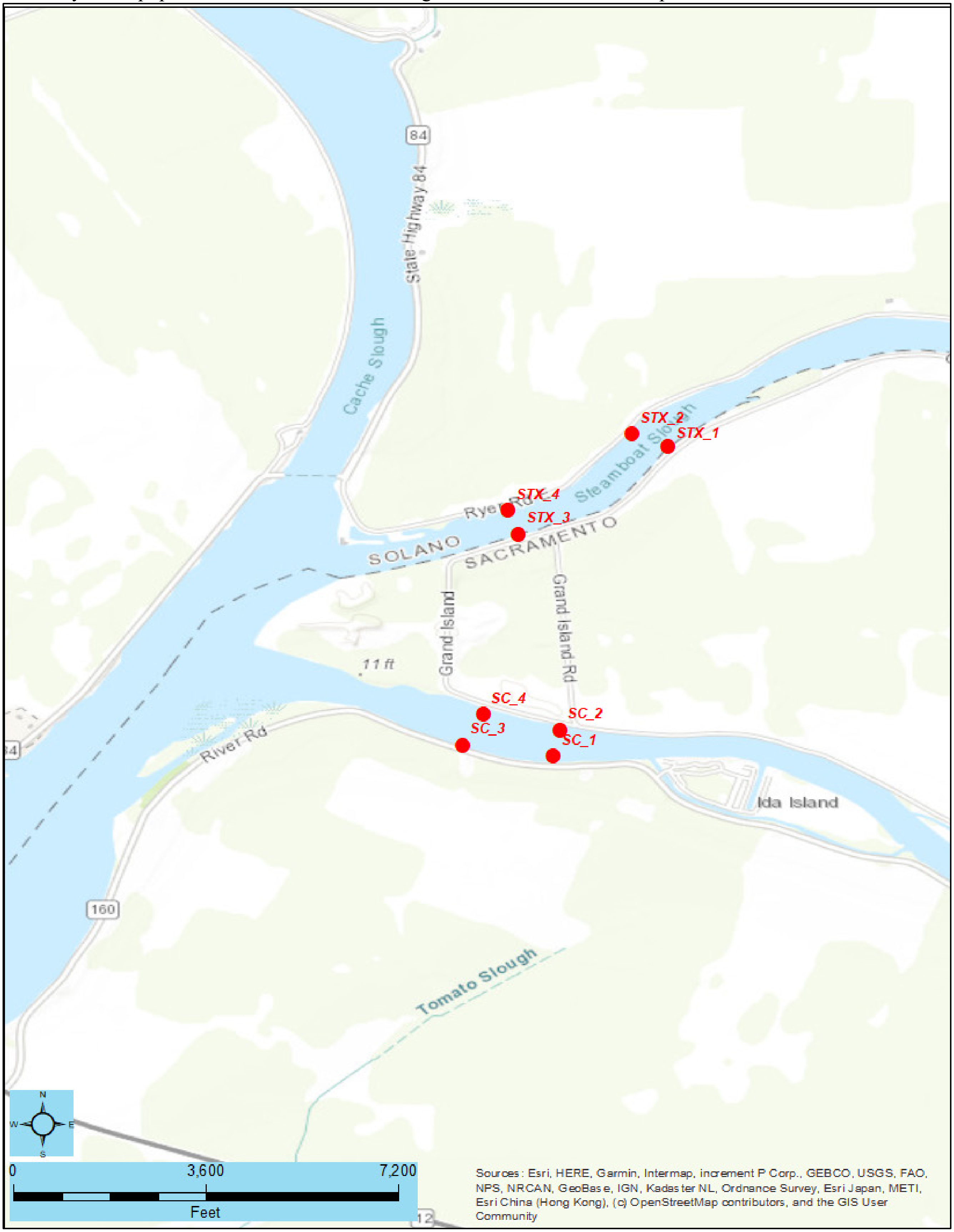


Liberty Island 2. Three total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

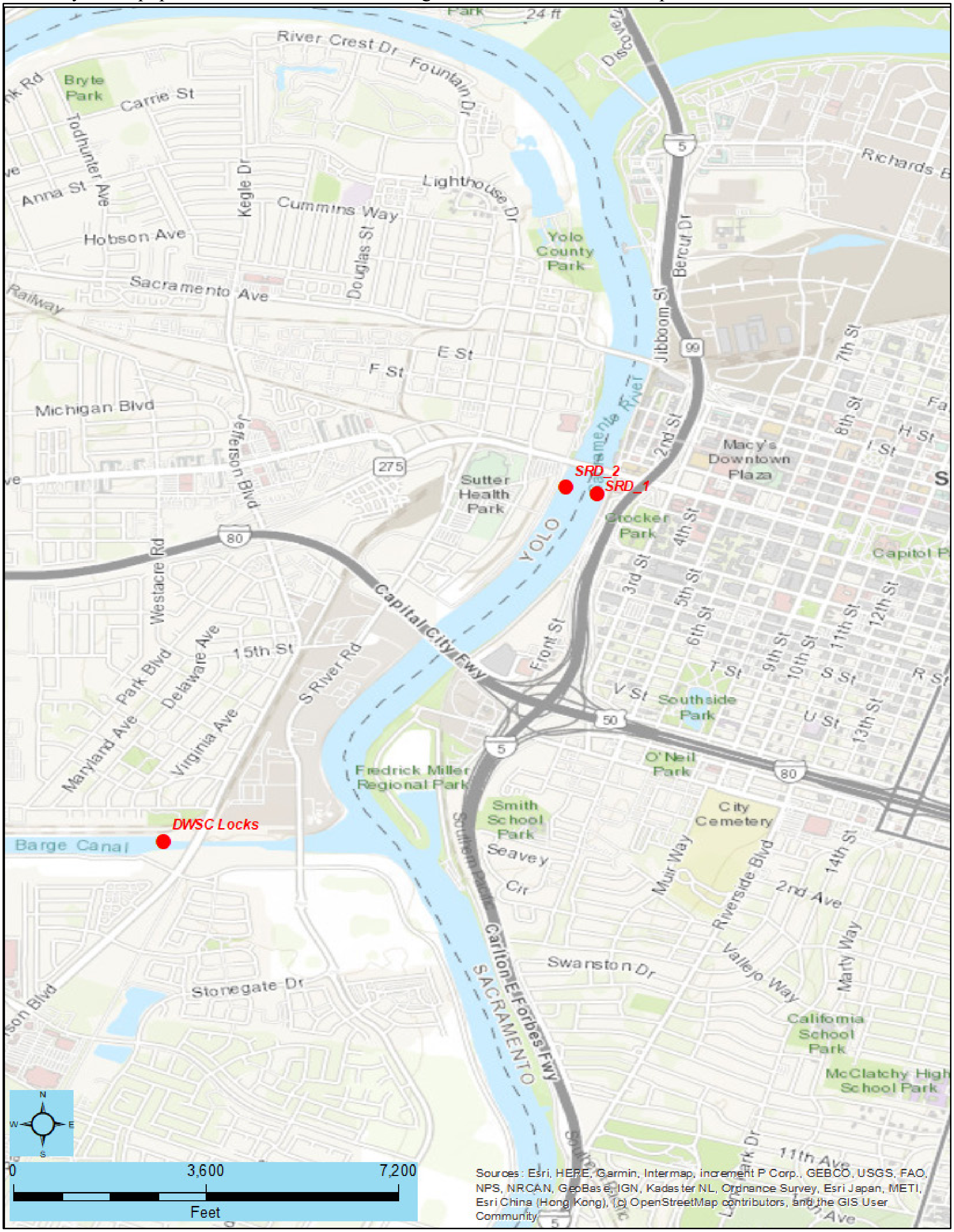
Rio Vista 1. Ten total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.



Rio Vista 2. Eight total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

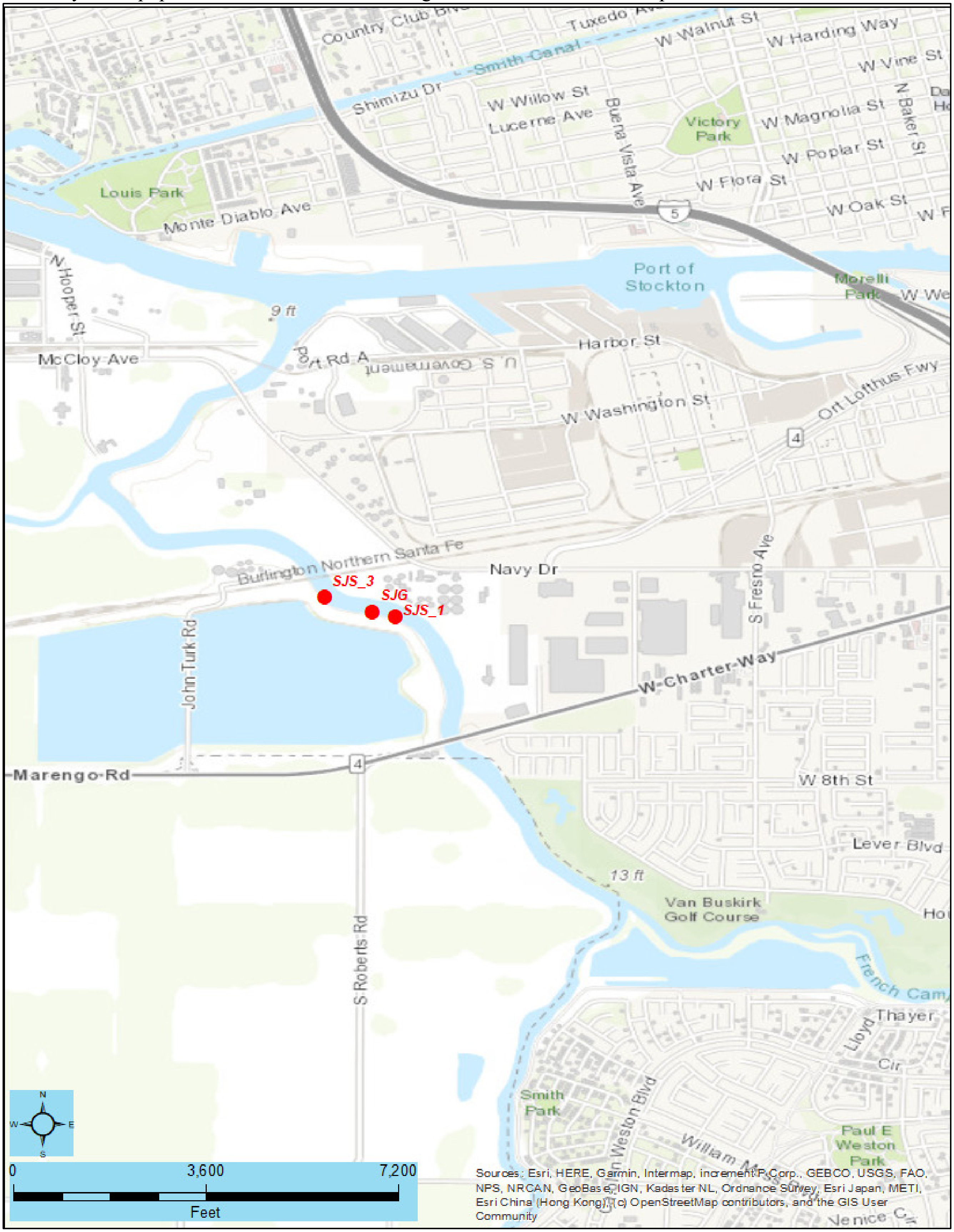


Sacramento West 1. Three total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.



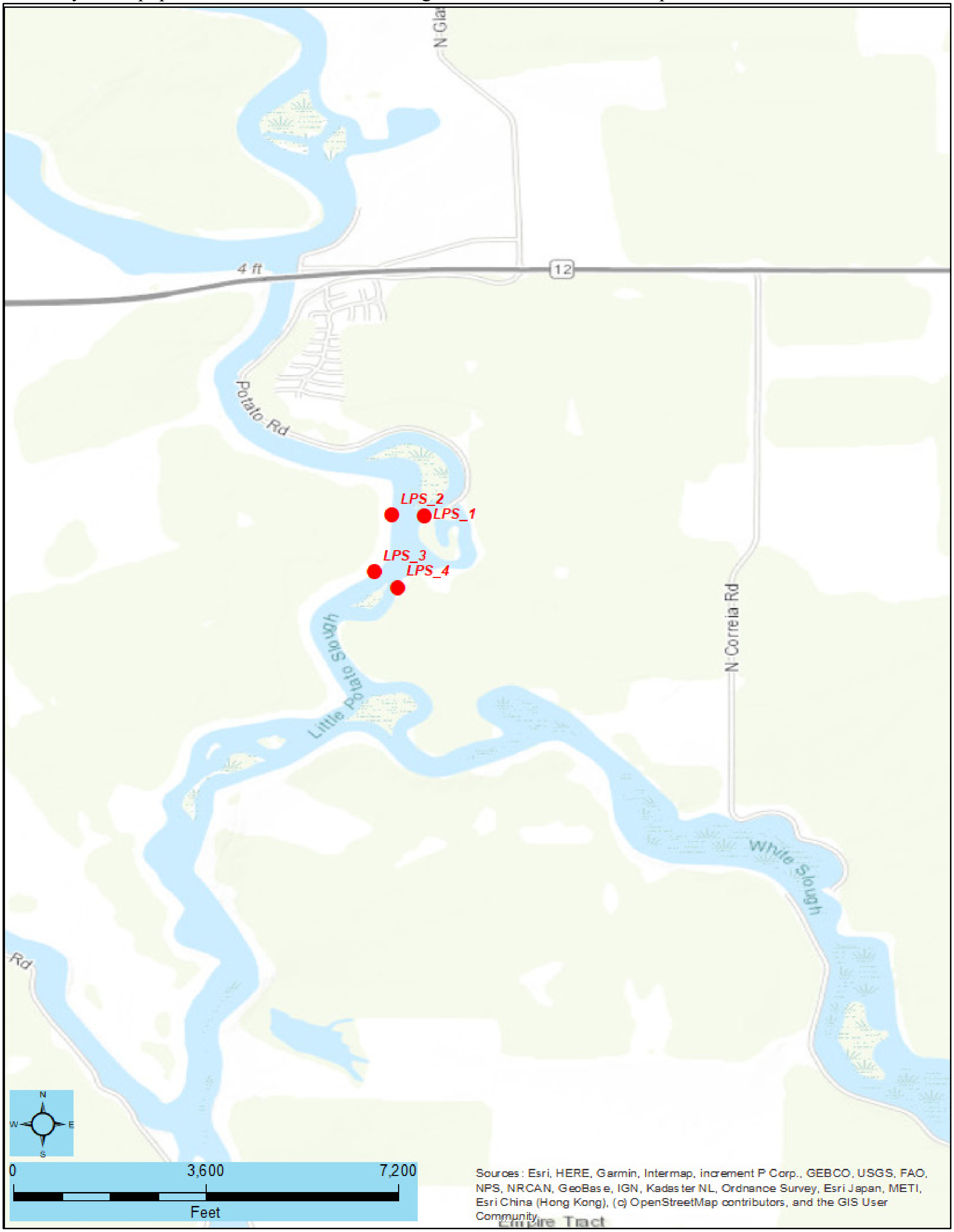
Sacramento West 2. Four total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

Stockton West. Three total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.



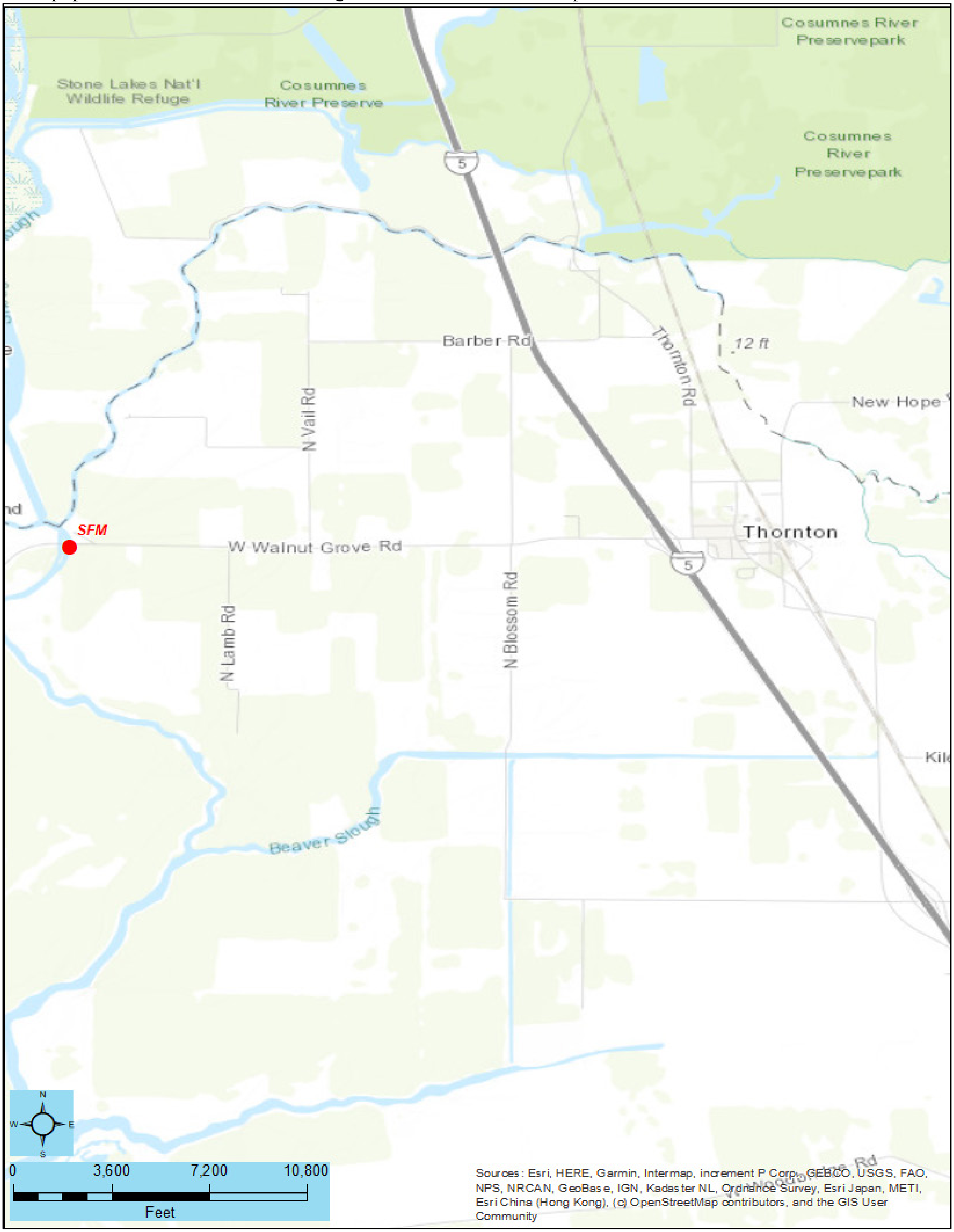
Taylor Monument. One total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

Terminous. Four total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.



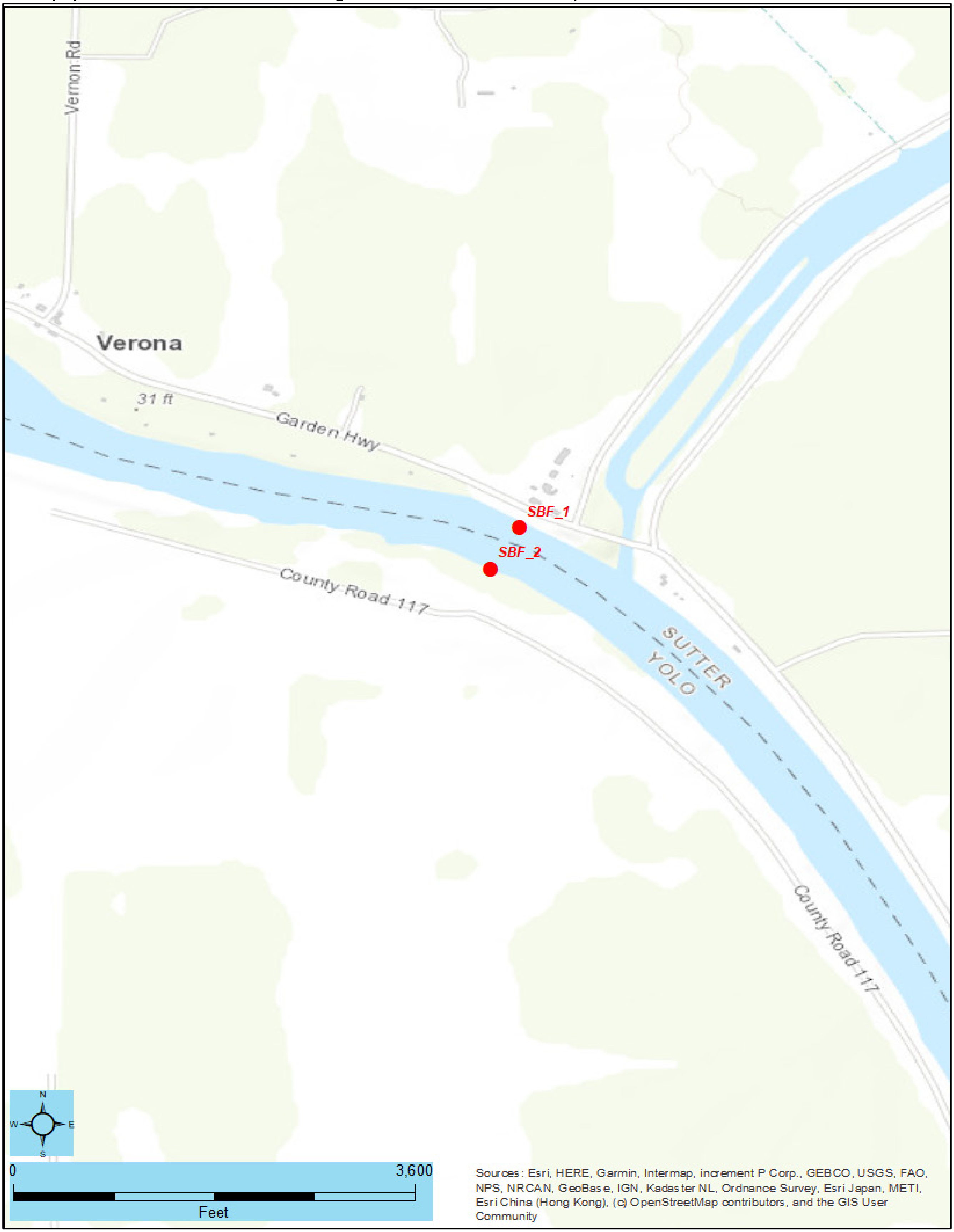
McDonald Island. Four total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

Thornton. One total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.



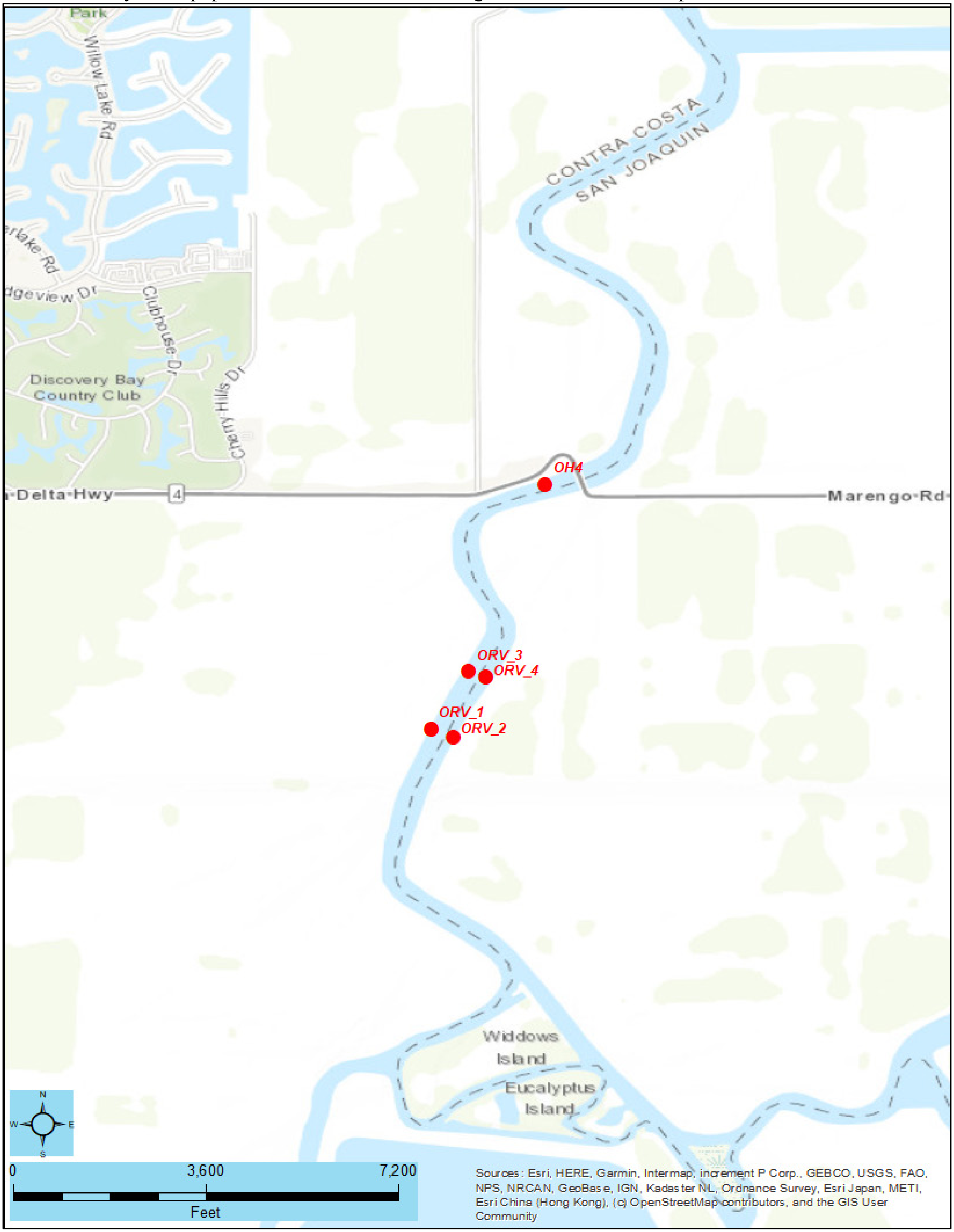
Union Island. Four total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

Verona. Two total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.



Bacon Island. Four total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8 to 30 feet deep.

South of Woodward Island. Five total proposed pile driving locations. Pilings are intended to monitor conditions in the waterway and equipment is intended to be submerged in water 8-30 ft. deep.



12 Appendix D

Consultation

National Marine Fisheries Service D-2
U.S. Fish and Wildlife Service D-18

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

Refer to NMFS ECO#: WCRO-2021-00367

March 9, 2021

Catherine Ruhl
Supervisory Hydrologist
United States Department of the Interior
U.S. Geological Survey California
Water Sciences Center6000 J Street,
Placer Hall California State
University
Sacramento, California 95819-6129

Re: Endangered Species Act Section 7(a)(2) Concurrence Letter and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the U.S.Geological Survey (USGS) Monitoring Infrastructure Project

Electronic transmittal only

Dear Ms. Ruhl:

On February 10, 2021, NOAA's National Marine Fisheries Service (NMFS) received your request for a written concurrence that the proposed installation of up to 180 pilings and removalof up to 11 pilings in the Sacramento–San Joaquin Delta, Suisun Bay, Lower Sacramento Riverand Lower San Joaquin River (Project) by the USGS is not likely to adversely affect (NLAA) species listed as threatened or endangered or critical habitats designated under the Endangered Species Act (ESA). This response to your request was prepared by NMFS pursuant to section 7(a)(2) of the ESA and implementing regulations at 50 CFR 402.

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(MSA) (16 U.S.C. 1855(b)), and concluded that the action would adversely affect the EFH of Pacific Coast Salmon, Pacific Coast groundfish, but not coastal pelagic species. Therefore, we have included the results of that review in this document.

This letter underwent pre-dissemination review using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the Environmental Consultation Organizer [https://eco.fisheries.noaa.gov]. A complete record of this consultation ison file at NMFS California Central Valley Office in Sacramento, California.

Consultation History

On July 14, 2020, NMFS received an inquiry from the USGS for advice regarding the processfor section 7 consultation on a future project concerning the installation of instrumentation pilings in the Sacramento-San Joaquin Delta.

NMFS and USGS had a virtual meeting on July 17, 2020 to discuss the proposed Project.

On July 20, 2020, NMFS received a draft Project summary and a list of the proposed locationsfor the pilings to review and provide comments back to the USGS.

On October 8, 2020, NMFS provided comments and advice to USGS regarding the draft Projectsummary and the steps forward to provide a complete consultation initiation package.

On February 10, 2021, NMFS received USGS' request to initiate informal section 7 consultation.

On February 19, 2021, NMFS requested clarification regarding elements of the proposed Projectfrom USGS via email.

On February 19, 2021, USGS provided its response to the clarification questions via email, andmet with NMFS via phone call to discuss and further clarify the Project actions. In addition, USGS sent KMZ files via email to NMFS with the proposed piling locations for the Project.
NMFS determined that there was sufficient information to initiate informal consultation uponreceipt of this additional information.

On February 25, 2021, the USGS provided a missing attachment to the original consultationrequest.

On March 5, 2021, NMFS requested additional information regarding the use of the impact piledriver and the characteristics of the deteriorated pilings to be removed.

Proposed Action and Action Area

The USGS proposes to install up to 180 new pilings and will remove 11 existing deterioratedpilings in the Sacramento-San Joaquin Delta, lower Sacramento and San Joaquin rivers, and Suisun Bay over the course of the next 5 years.

The USGS proposes to conduct the following work:

- Install up to 21 stations for flow and water quality monitoring;
- Install up to 23 stations for flow and water quality monitoring;
- Install up to 136 pilings for acoustic telemetry work; and
- Remove up to 11 deteriorated pilings that are unsafe. New piling installations with will replace those stations which had deteriorated pilings removed.

The proposed work for each piling includes:

- Installation of an 18-inch diameter steel piling using a vibratory pile-driving hammer;
- Installation of monitoring equipment and electronics; and
- Installation of safety equipment (signage and lights).

Construction Actions

Pilings and Infrastructure:

Installation of most of the pilings will be via a barge- mounted crane with a vibratory pile- driving hammer. At locations where the waterways will not support access for a tug and barge,piling installation will require using an all-terrain crane on the adjacent levee crown. The placement of each piling requires having adequate water depth for the instrumentation and sensors. Therefore, installation of pilings will occur off the bank in deeper water and would notaffect potential shallow water habitat, shaded riverine aquatic habitat, or riparian habitat.

Equipment used for water-based piling installation would include a tug, a barge- mounted crane with a vibratory pile-driving hammer, and a small workboat. Pilings installed using a barge-mounted crane would not require a land staging area. However,supporting land-based activity on thelevees may include a surveying crew and their work vehicles (i.e., pick-up trucks).

Pilings installed by land require construction equipment and support vehicles, which mayinclude an all-terrain crane with a vibratory pile-driving hammer, a crane support truck, work vehicles (pick-up trucks), a welding utility truck, and a small workboat. Pilings installed using an all-terrain crane would require a small staging area on top of the adjacent levee and would remain only for the duration of the construction activity.

After installation, pilings will stand between 20 and 30 feet (ft) above the mean high water level, in water ranging from 8 to 40 ft deep. Each piling will support an electronicsbox that will contain a datalogger, modem, batteries and associated components; solar panels; safety equipment including signage and lights; instrumentation mounts for staff plates, pressure sensors, water quality sondes, ADCPs, acoustic telemetry gear, and otherscientific monitoring equipment (Figure 1). USGS will install the scientific equipment and safety gear after installation of the piling.

Pile Driving:

Each piling tip will be driven approximately 30 feet below the mudline using a vibratory pile- driving hammer mounted on a barge adjacent to the site. The barge is held in place during construction and repair activities by anchors mounted on all four corners of the barge or by spudpiles driven into the channel bottom. It takes approximately 5 to 10 minutes to drive a pile to depth once it is placed into the positioning guides on the barge. Set up and positioning of the piling is estimated to take up to 60 minutes per piling. Removal of a piling by vibratory pile- driving hammer takes approximately 30 minutes per pile. Work would take approximately 1 day at each location. In locations identified as requiring multiple piles, such as those in the AcousticTelemetry Network for the fish monitoring, up to 4 pilings may be installed in a given day. If a piling needs to be removed at a location, it will be done later (at least one month later or in the subsequent work window) to ensure data continuity.

The vibratory pile-driving hammer will also be used to remove deteriorated pilings. Piles will be slowly shaken loose through vibration until the sediment surrounding the piling has become unconsolidated through liquefaction, thus allowing the entire piling to be pulled up and out of thesediment. Most sediment will remain in the hole left by the piling and will not adhere to the old piling during removal. This substantially reduces the amount of resuspended sediment in the water column, thus reducing the amount of turbidity associated with the removal of deteriorated pilings. The old, deteriorated pilings are either wood or steel and have diameters ranging from 14to 18 inches, but will be replaced by new 18-inch diameter steel pilings. Upon Project completion, the volume of water occupied by the instrument station will be approximately 40 cubic feet per piling. In the cases where a deteriorated piling will be removed, there will be no orminimal net change at those locations.

Project Timing:

The proposed work window would be August 1 to October15 in each year of the 5-year Project,starting in 2021. USGS anticipates that the total Project could require up to 30 workdays duringeach year of the Project, but could be less, depending on weather, site conditions, and other factors. Several of the piling locations are sites with two to four paired platforms in close proximity (e.g., acoustic telemetry receiver locations). In this situation, multiple piles will be installed in a single day, but never more than 4 pilings in a single day.

Conservation Measures:

USGS has proposed the following conservation and protection measures to limit therisk of Project-related impacts on threatened and endangered species and designated critical habitats:

1. Construction activities will be scheduled from August 1st through October 15th toavoid the migration seasons for listed anadromous salmonids in the action area.
2. Installation of new pilings and removal of deteriorated pilings will be done using a vibratory pile-driving hammer.
3. The vibratory pile-driving hammer will start with a “ramp up” at lower power for 15 seconds, pause for 1 minute, repeat that sequence, and then start up continuous driving, inorder to give wildlife time to move out of the area. If for any reason an impact hammer were required to drive the piling to the final tip depth after using the vibratory–driving hammer to start the piling, additional measures would be taken to ensure that peak underwater sound pressure levels remain below 180 decibels (dB) re: 1 micropascal squared-second. USGS has reported that in recent years, they have never had to utilizean impact pile-driving hammer to finish off the installation of the infrastructure pilings, but wish to include this as a contingency operation in their Project description. Should an impact pile-driving hammer become necessary, impact cushions on top of the pilings will be used to reduce the sound generated by the hammer strike. Like the vibratory pile-driving hammer, the impact hammer will beramped up to allow aquatic animals to leave the area.
4. Removal of existing pilings will occur slowly to break the friction bond between thepiling and surrounding substrate in order to minimize sediment disturbance and resulting turbidity.
5. A containment basin will be used on the barge to control spills and prevent them from entering the water.
6. Contained sediments will be disposed of at an appropriate upland disposal site.
7. Work will occur at low water or low current conditions, if possible, to minimize dispersal of disturbed sediment.
8. Standard construction best management practices will be in place on the barge and ateach land-based site to avoid debris or other contaminants from entering waterways.
9. Project activities would involve no dredging or sediment transport.

We considered, under the ESA whether or not the proposed action would cause any otheractivities and determined that it would not.

Action Area

The Project is located at 180 discrete sites located within Suisun Bay, the Sacramento-San Joaquin Delta, and portions of the lower Sacramento River and San Joaquin River within Solano,Contra Costa, Sacramento, San Joaquin, Sutter, and Yolo counties (Figure 2). At each site, the action area includes the barge and vessel footprint and a 100-meter (328 ft) diameter circle centered on each pile where the water column may be affected by vibratory pile driving hammer noise (extent of behavioral alterations; sound greater than 150 dB) and changes to water quality caused by construction activities.

Background and Action Agency's Effects Determination

The USGS determined the proposed Project is not likely to adversely affect (NLAA) federally listed as threatened California Central Valley (CCV) distinct population segment (DPS) of steelhead (*Oncorhynchus mykiss*), threatened Central California Coast (CCC) steelhead (*O. mykiss*) DPS, threatened Central Valley (CV) spring-run Chinook salmon (*O. tshawytscha*) evolutionarily significant unit (ESU), endangered Sacramento River winter-run Chinook salmon(*O. tshawytscha*) ESU, endangered CCC coho salmon (*O. kisutch*) ESU, and the threatened southern DPS of North American green sturgeon (*Acipenser medirostris*, sDPS green sturgeon).The USGS finding of NLAA is based on the Project's proposed avoidance measures and the minimal impacts of the Project to the aquatic habitat.

The USGS also determined that the Project may affect, but is not likely to adversely affect designated critical habitat for Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. Designated critical habitat does not occur in the action area for CCC coho salmon or CCC steelhead. The USGS determined that theProject is not likely to adversely affect EFH for Pacific Coast groundfish, and coastal pelagic species within the action area. In addition, NMFS has determined that EFH for Pacific Coast salmon occurs within the action area and will assess impacts to this EFH. Within the action area, there are Habitat Areas of Particular Concern (HAPCs) for Pacific Coast groundfish and PacificCoast salmon. These include complex channels and floodplain habitats within the Delta's waterways for Pacific Coast salmon and estuaries for both Pacific Coast salmon and groundfish.

Available information indicates the following listed species ESUs or DPSs under the jurisdictionof NMFS may be affected by the proposed Project (Table 2):

Table 2: ESA Listing History for species occurring within the action area and presence ofdesignated Critical Habitat.

Species	ESU/DPS	Original Listing Status	Current Listing Status	Critical Habitat Designated	Critical Habitat in Action area
Steelhead (*O. mykiss*)	Central California Coast DPS	8/18/1997 62 FR 43937 Threatened	1/5/2006 71 FR 834 Threatened	9/2/2005 70 FR 52488	No
Steelhead (*O. mykiss*)	California Central Valley DPS	3/19/1998 63 FR 13347 Threatened	1/5/2006 71 FR 834 Threatened	9/2/2005 70 FR 52488	Yes
Chinook salmon (*O. tshawytscha*)	Sacramento River winter-run ESU	1/4/1994 59 FR 440 Endangered	6/28/2005 70 FR 37160 Endangered	6/16/1993 58 FR 33212	Yes
Chinook salmon (*O. tshawytscha*)	Central Valley spring-run ESU	9/16/1999 64 FR 50394 Threatened	6/28/2005 70 FR 37160 Threatened	9/2/2005 70 FR 52488	Yes
Green sturgeon (*Acipenser medirostris*)	Southern DPS	4/7/2006 71 FR 17757 Threatened	4/7/2006 71 FR 17757 Threatened	10/9/2009 74 FR 52300	Yes

The life history of steelhead is summarized in Busby et al. (1996) and Chinook salmon life history is summarized in Myers et al. (1998). Sacramento River winter-run Chinook salmon, CVspring-run Chinook salmon, and CCV steelhead, primarily use the Suisun Bay and Sacramento- San Joaquin Delta estuary and lower reaches of the Sacramento and San Joaquin rivers as migration corridors. CCC steelhead use Suisun Bay as a migratory corridor. Some rearing occursas juvenile fish pass through these waterways. These anadromous salmonids pass downstream through the Suisun Bay and Delta estuary as juveniles as they migrate to the ocean or during spawning migration to upstream areas to reproduce as adults. The federally listed anadromous salmonid species have the greatest potential to occur in the action area primarily from Septemberthrough June, based on the timing of adult and juvenile migrations in and through the waterwaysof Suisun Bay and the Delta (Hallock et al. 1961, Fukushima and Lesh 1998, Moyle 2002)

The life history of sDPS green sturgeon in California is summarized in Adams et al. (2002) and NMFS (2005). The sDPS green sturgeon are anadromous, making upstream migrations to the Sacramento River in the spring, with peaks in April-June (Moyle et al. 1995). Adults return back downstream through the summer and into winter following spawning. As juvenile sDPS green sturgeon age, they migrate downstream and rear in the lower Delta and bays, spending from three to four years there before entering the ocean. Once in the ocean, sDPS green sturgeon rangein coastal waters from Mexico to the Bering Sea. The sDPS green sturgeon have delayed sexual maturity, somewhere between 13-20 years, and only spawn every two to five years. They have strong homing capabilities, which lead to high spawning site fidelity. Sub-adult and juvenile sDPS green sturgeon have been encountered in Suisun Bay and the Delta in all months of the year (Heublein et al. 2017); thus we presume that sDPS green sturgeon will be present year- round.

ENDANGERED SPECIES ACT

Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involvedin the action (50 CFR 402.02). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b). When evaluating whether the proposed action is not likely to adversely affect listed species or critical habitat, NMFS considers whether the effects are expected to be completely beneficial, insignificant, or discountable. Completely beneficial effects are contemporaneous positive effects without any adverse effects to the speciesor critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Effects are considered discountable if they are extremely unlikely to occur.

The effects of the proposed action are reasonably likely to include temporary increases in turbidity in the water column, elevated underwater sound levels during operation of the vibratoryand impact pile-driving hammer, and disturbance of benthic habitat. The construction work is scheduled to occur between August 1 and October 15, a period when ESA-listed salmonids arc least likely to be present in the action area, thereby minimizing potential exposure of Project- related effects on ESA- listed salmonids. Threatened sDPS green sturgeon may be in the action area year-around.

The use of a tugboat and barge to conduct pile driving may affect Chinook salmon, steelhead, and green sturgeon through exposure to increased underwater sound levels. Elevated underwatersound levels have the potential to affect behavior of fish and may result in physical injury such as tissue damage, hearing loss, or death (Popper and Hastings 2009). These alterations in behavior or physical injuries, may affect the ability of fish to feed or migrate, and may increase the chance of predation. Many of the piling locations are in or adjacent to a main shipping channels and larger waterways, regularly traveled by large ships and/or recreational vessels. Thus, the use of the tugboat and spud barge by this Project is not expected to result in sound levels above current background levels. Furthermore, the frequency of tug boat-barge trips to piling installation sites is not expected to exceed 30 days per work season during the 5 years of the Project. Trips will occur during the periods when ESA-listed salmonids are least likely to bepresent in the action area.

All of the pilings are anticipated to be installed or removed using a vibratory pile-driving hammer. Although included in the Project description as a contingency plan, USGS has indicatedthat impact pile-driving hammers have not been needed in recent installations for this type of steel instrumentation piling, and are not anticipated to be used in this Project, thus the likelihood of use is discountable. In the very unlikely event, an impact pile-driving hammer becomes necessary, the sound generated by an 18-inch diameter steel pile for 5 minutes, assuming one strike per second, and one pile per day, has the following characteristics:

- The $SEL_{accumulated}$ is 182.77 dB at 10 meters (33 ft) and the calculated distance to each ofthe applicable thresholds is as follows:
- Distance to 206 dB-peak = 0 meters
- Distance to 150 dB-RMS = 136 meters/ 446 ft
- Distance to 187 dB-$SEL_{accumulated}$ = 5 meters/ 16.5 ft (for fish > 2 g)
- Distance to 183 dB-$SEL_{accumulated}$ = 10 meters/ 32.8 ft (for fish < 2 g)

Pile-driving hammers have the potential to generate elevated levels of underwater sound. Fish may be injured or killed when exposed to very high levels of underwater sound, especially thosegenerated by impulsive sound sources such as pile driving with impact hammers. Pathologies offish associated with very high sound level exposure are collectively known as barotraumas.

These include hemorrhage and rupture of blood vessels and internal organs, including the swim bladder and kidneys. Death can be instantaneous, occur within minutes after exposure, or occur several days later. The sound characteristics derived for the use of an impact pile-driving hammer with an 18-inch diameter steel pile indicate that peak sound levels will remain below thethreshold for a single strike onset of physical injury (206 dB peak) at all distances. The anticipated acoustic effects from impact pile-driving indicates that the threshold for the onset of physical injury to fish larger than 2 grams (187 dB-$SEL_{accumulated}$) will extend a distance of 5 meters (16.5 ft) from the source, and for fish less than 2 grams (183 dB-$SEL_{accumulated}$) the distance is 10 meters (32.8 ft). ESA-listed Chinook salmon, steelhead, or green sturgeon weighing less than 2 grams are not expected in the action area during the proposed in-water workwindow of August 1 to October 15 of each work season.

This Project, however, proposes to use a vibratory pile-driving hammer to install pilings exceptunder very unusual situations, which are considered highly unlikely to occur. Vibratory pile- driving hammers generate lower sound levels and different sound wave forms that do not causephysical injury or mortality to fish (Buehler et al. 2015). The use of a vibratory pile-driving hammer by this Project to install and remove the pilings is expected to avoid generation of underwater sound levels that are harmful to fish.

Although no injury or mortality is anticipated during the use of a vibratory pile-driving hammer,elevated underwater sound levels may startle listed fish in the action area. Each piling may take as long as 30 minutes to remove and 60 minutes to install; however, the average time that pile driving is actually occurring during this process is typically much shorter, averaging only 5-10 minutes per piling. The vibratory pile-driving hammer would be ramped up, starting at lower power for 15 seconds, followed by a 1-minute pause, repeated again, then started up to continuous pile driving. If present in the action area during pile driving activities, ESA-listed Chinook salmon, steelhead, and green sturgeon could become startled by the elevated levels ofsound and temporarily leave the immediate vicinity of the piling installation. If individuals of those species react behaviorally to the sound produced by the vibrating hammer equipment, adequate water depths and carrying capacity in adjacent open water areas in Suisun Bay, the Delta, and lower Sacramento and San Joaquin rivers will provide sufficient area for fish to disperse and will not affect their fitness. NMFS expects that any effects to ESA-listed Chinooksalmon, steelhead, and green sturgeon associated with the ambient underwater sound levels generated as a result of the use of the tugboat, barge, or vibratory hammer will be insignificant.The use of the impact hammer is considered discountable based on previous experiences with piling installation by USGS.

The proposed Project has the potential to temporarily disturb sediment and increase turbidity during placement and removal of pilings, lifting of the spuds, or setting and recovering anchors. Increased turbidity could result in direct or indirect impacts to fish through gill damage, reduced capacity to take in oxygen, and reduced visual acuity effects that may cause ESA-listed Chinook salmon, steelhead, and green sturgeon to become more susceptible to predation and have reducedfeeding ability (Benfield and Minello 1996, Nightingale and Simenstad 2001). However, the amount of turbidity associated with the pile driving proposed by this Project is expected to be minor due to the small area that will be disturbed (about 1.8 square feet per pile) during pile placement or removal. In addition, the area of substrate disturbed each time a spud is used will be about 3.2 square feet. The Project sites are mostly subject to tidal movement, which has the potential to carry suspended particles upstream or downstream depending on the timing of activities during the tide cycle. The other remaining sites, which are on the lower Sacramento River adjacent to the Fremont Weir location and Verona are not subject to tidal effects, and are riverine. Thus, suspended particles are expected to move downstream with the ambient river flow. The minor and localized elevated levels of turbidity associated with this Project's underwater activities are expected to rapidly return to background levels with currents and tidal circulation. Also, the USGS's use of a containment basin on the barge to catch materials from pilings removed from Project sites, and working during low water/low current conditions, will minimize turbidity in the water column. Based on observations of similar construction activities in San Francisco Bay and the Delta, increased levels of turbidity associated with this Project's pile driving activities are expected to be minor, temporary, and localized. ESA-listed Chinook salmon, steelhead, and green sturgeon commonly encounter estuarine areas with fine sediment bottoms and moderate to high levels of turbidity; specifically, they are tolerant of levels of turbidity that exceed levels expected to result from this

Project. Therefore, NMFS anticipates effects of temporary degraded water quality in the form of localized and minor areas of elevated turbidity by Project activities to be insignificant to ESA-listed Chinook salmon, steelhead, and green sturgeon.

Disturbance of the substrate may affect benthic invertebrates, common prey for ESA-listed Chinook salmon, steelhead, and green sturgeon. Suisun Bay and the Delta support an abundantbenthic invertebrate community characterized primarily by polychaetes, amphipods, bivalves, and cumaceans (Thompson et al. 2007). Impacts to the benthic community are expected to be minor because the amount of substrate disturbance is small and construction activities will be of short duration and occur only once at each site. Due to the small area of disturbance by this Project, recolonization of benthic invertebrates is anticipated to be rapid post-construction. The disturbed area represents a very small proportion of available habitat within the action area, and any ESA-listed Chinook salmon, steelhead, and green sturgeon will have unimpeded access to sufficient adjacent areas in which to forage. Although a temporary loss of benthic invertebrates isanticipated during this Project, the temporary and minor reduction of the forage prey base is expected to be insignificant for ESA-listed Chinook salmon, steelhead and green sturgeon.

The action area is located within designated critical habitat for winter-run Chinook salmon, CVspring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. The designations of critical habitat for these species use the term primary constituent element (PCE) or essential features. The new critical habitat regulations (February 11, 2016, 81 FR 7214) replace this termwith physical or biological features (PBFs). Regardless of whether the original designation identified PCE, PBFs, or essential features, the shift in terminology does not change the approach used in conducting our analysis. In this letter, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The PBFs of designated critical habitat for Sacramento River winter-run Chinook salmon within the action area are: (1) access from the Pacific Ocean to appropriate areas in the upper Sacramento river, (2) habitat areas and adequate prey that are not contaminated, (3) riparian habitat that provides for successful juvenile development and survival, and (4) access downstream so that juveniles can migrate from spawning grounds to San Francisco Bay and the Pacific Ocean. The PBFs of designated critical habitat for CCV steelhead and CV spring-run Chinook salmon within the action area include freshwater and estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. For sDPS green sturgeon in freshwater and estuarine areas, the PBFs of designated critical habitat within the action area include food resources, water flow, water quality, migratory corridor, water depth, and sediment quality.

During Project activities, critical habitat will be temporarily affected by degraded water quality (increased turbidity) and disturbance of the substrate. As discussed above, effects to water quality are expected to be insignificant. Project activities (installation/removal of the piles and use of spuds and anchors) are expected to disturb the substrate of discrete areas of Suisun Bay, the Delta, and portions of the lower Sacramento and San Joaquin rivers. Disturbance may affect the benthic community, including some benthic invertebrates; however, these temporary disturbances of bottom substrate are limited to a very small area and all work will be completed within 30 workdays. Based on the above, the potential effects of this Project are considered insignificant, and are not expected to result in either a net change to existing habitat values in theaction area or result in adverse impacts to designated critical habitat.

Conclusion

Based on this analysis, NMFS concurs with USGS that the proposed action is not likely to adversely affect the ESA-listed Sacramento River winter-run Chinook salmon, CV spring-runChinook salmon, CCC steelhead, CCV steelhead, and sDPS green sturgeon and designated critical habitats within the action area.

Reinitiation of Consultation

Reinitiation of consultation is required and shall be requested by USGS or by NMFS, where discretionary Federal involvement or control over the action has been retained or is authorized bylaw and (1) the proposed action causes take; (2) new information reveals effects of the action thatmay affect listed species or critical habitat in a manner or to an extent not previously considered;
(3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the written concurrence; or (4) a new speciesis listed or critical habitat designated that may be affected by the identified action. This concludes the ESA consultation.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended topromote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the associated physical, chemical, and biological properties that are used by fish (50CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and mayinclude 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 may result from actions occurring within EFH or outside of it and may include direct, indirect, site- specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH (50 CFR 600.905(b)).

NMFS determined the proposed action would adversely affect EFH for Pacific Coast salmon, and Pacific Coast groundfish through increased turbidity, disturbance of benthic habitat, and elevated levels of underwater sound. EFH for Pacific Coast Salmon includes all runs of Chinooksalmon occurring within the action area, including Central Valley fall-run and late fall-run Chinook salmon ESUs. Migrations of adult fall-run Chinook salmon occur during the proposed Project and have the potential to be affected by transitory impacts to EFH for Pacific Coast salmon. The timing of other runs of Chinook salmon in the Central Valley do not overlap with the in-water work window of the Project. EFH for Pacific Coast groundfish includes multiple species utilizing the action area during any of their life stages. Pacific Coast groundfish will be present during the in-water work window of the Project and have the potential to be affected by transitory impacts to EFH for Pacific Coast groundfish. As discussed previously, disturbance during piling installation and removal activities may re-suspend substrate sediments into the water column, resulting in increased turbidity. If sediment loads remain high for an extended period of time, light penetration is reduced leading to a reduced rate of photosynthesis for subaquatic vegetation (Dennison 1987) and primary productivity (Cloern 1987). For this Project,suspended sediment resulting in increased turbidity levels is expected to be temporary and minorduring construction. Any increased turbidity level will subside quickly once the piling installation/ removal activities are complete. Also, disturbance of the substrate may lead to lossesof benthic invertebrates, which are prey species for various EFH species. However, EFH species can forage unimpeded in adjacent areas. These temporary disturbances of water quality, bottom substrate, and benthic invertebrates are limited to small areas. After each piling is installed/ removed, any disturbed areas will naturally refill with sediments and the benthic community is expected to rapidly recover due the small area affected. Pile driving will increase underwater sound pressures and will affect open water column habitat for fishes for up to 60 minutes at eachpile site, though the sound level is not expected to lead to environmental sound conditions in the water column that cause any injuries to fish. Adjacent habitats will be unaffected during pile driving activities, and the elevated sound pressure levels will have no permanent impact on EFH.Due to the localized nature of this Project, adverse effects to EFH are expected to be temporary and localized. Therefore, given the small size of each pile and the short temporal duration of potential effects, NMFS has no practical EFH conservation recommendations to provide to avoidor reduce the magnitude of these effects.

EFH for coastal pelagic species is determined by surface water temperatures above the thermocline, which will not be affected by the Project. Therefore, the Proposed Action will notadversely affect EFH for coastal pelagic species.

The USGS must reinitiate EFH consultation with NMFS if the proposed action is substantiallyrevised 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)]. This concludes the MSA consultation.

Please direct questions regarding this letter to Jeff Stuart, NMFS California Central ValleyOffice, at, J.Stuart@noaa.gov, or by phone at 916-930-3607.

Sincerely,

Garwin Yip Branch
Supervisor
Water Operations and Delta Consultations Branchcc:

To the File: ARN 15422-WCR2021-SA00061

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Figure 1: Standard configuration of a Delta Flow and Water Quality Monitoring Station

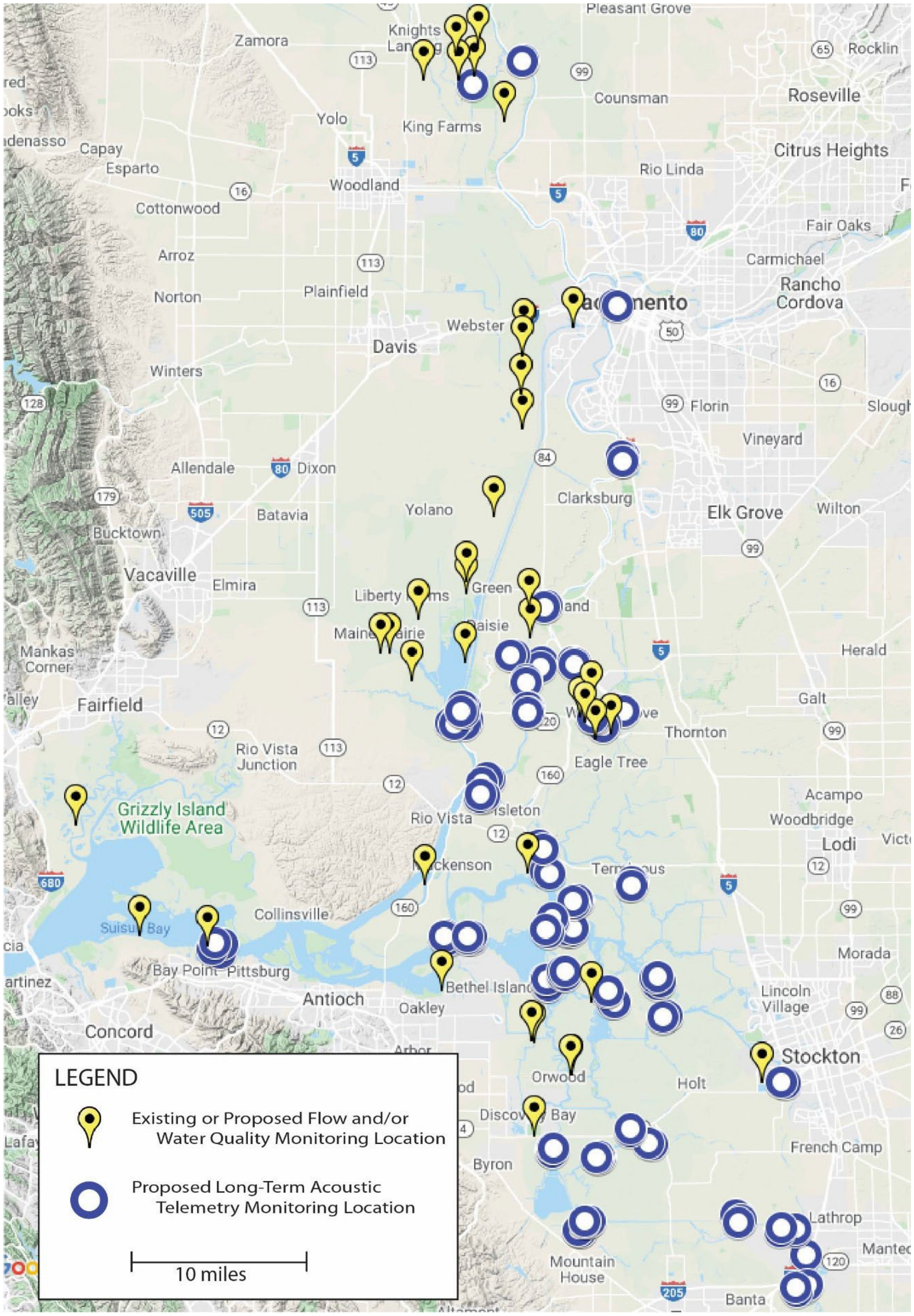

Figure 2: USGS Monitoring Network: Maintenance, Upgrades, and Expansion Locations

United States Department of the Interior

FISH AND WILDLIFE SERVICE
San Francisco Bay-Delta Fish and Wildlife Office
650 Capitol Mall, Suite 8-300
Sacramento, California 95814

In reply refer to:
08FBDT00-2021-F-0136

Memorandum

To: Ms. Catherine Ruhl, Supervisory Hydrologist, U.S. Geological Survey, Sacramento, California

DANIEL WELSH Digitally signed by DANIEL WELSH Date: 2021.07.02 09:17:30 -07'00'

From: Field Supervisor, U.S. Fish and Wildlife Service, San Francisco Bay- Delta Fishand Wildlife Office, Sacramento, California

Subject: Formal Consultation on the U.S. Geological Survey Monitoring Network: Maintenance, Upgrades, and Expansion Project

This letter is in response to the U.S. Geological Survey's (USGS) April 4, 2021 letter to the U.S.Fish and Wildlife Service (Service) requesting consultation on the effects of the U.S. Geological Survey Monitoring Network: Maintenance, Upgrades, and Expansion Project (project) in the Sacramento-San Joaquin Delta, Suisun Bay, and the San Joaquin River in Yolo, Sacramento, SanJoaquin, Contra Costa, and Solano counties, California on the federally threatened delta smelt (*Hypomesus transpacificus*) and its critical habitat. The Service received the email transmittal onApril 4, 2021. This response is in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act) and in accordance with the implementing regulations pertaining to interagency cooperation (50 CFR 402).

In reviewing this request, the Service has relied upon: (1) the USGS' April 4, 2021 letter andassociated documents and (2) other information available to the Service.

The Service has determined that the project is not likely to adversely affect delta smelt critical habitat. Replacing or upgrading existing structures may slightly increase a structure's dimensionswithin and over the water but should not result in an overall loss of spawning habitat or result in changes to water quality or river flow. Where pilings will be removed, there will be no net structure footprint increase at those locations.

The remainder of this document represents the Service's biological opinion on the effects of the proposed project on the delta smelt.

Consultation History

February-March, 2021:	The Service provided technical assistance to the USGS in developing the consultation documents.
April 4, 2021:	The Service received the consultation request, via email, from the USGS.

BIOLOGICAL OPINION

Description of the Proposed Action

The USGS has operated and maintained a monitoring network in the Sacramento-San Joaquin Delta since the 1970's. Over time, as technology improved, and monitoring needs changed, the network has expanded to include more locations and additional parameters. The overarching goalis to collect flow, water quality, and fish movement data at stations throughout the region. To support this monitoring objective, there is a need for infrastructure maintenance or modification at some of our existing stations and a need for additional infrastructure at new locations.

The USGS proposes to install or replace up to 180 pilings at locations across the Sacramento-SanJoaquin Delta, in the lower Sacramento River, and the lower San Joaquin River to support these monitoring activities (Figure 1; Table 1). Implementation of the proposed project is expected to take 5 years/seasons. The final network design is contingent upon funding availability and finalization of the monitoring priorities.

The location of the stations has been identified based on the scientific needs of the monitoring network. Stations that are identified in Figure 1 with the "yellow paddle" icons will typically consist of a 18-inch steel piling that will house an electronics box, an aluminum mount with anacoustic doppler velocity meter (ADVM), one to several polyvinyl chloride pipes to house pressure sensors and/or water quality sondes, solar panels, and navigational safety signage.
Acoustic Telemetry Stations that are identified in Figure 1 with the "blue circles" will consist of 1 to 4 pilings depending on the type of fish tracking required at each location. To date all of the acoustic telemetry stations have either been self-contained or have been tethered to shore. This isa maintenance intensive process and has also been prone to data loss due to vandalism and theft.

Each piling stands between 20 and 30 feet above the mean high-water level, in water ranging from 8 to 40 feet deep. Each pile will support an electronics box that will contain a datalogger,modem, batteries and associated components; solar panels; safety equipment including signageand lights; instrumentation mounts for staff plates, pressure sensors, water quality sondes, acoustic Doppler current profilers, acoustic telemetry gear, and other scientific monitoring equipment.

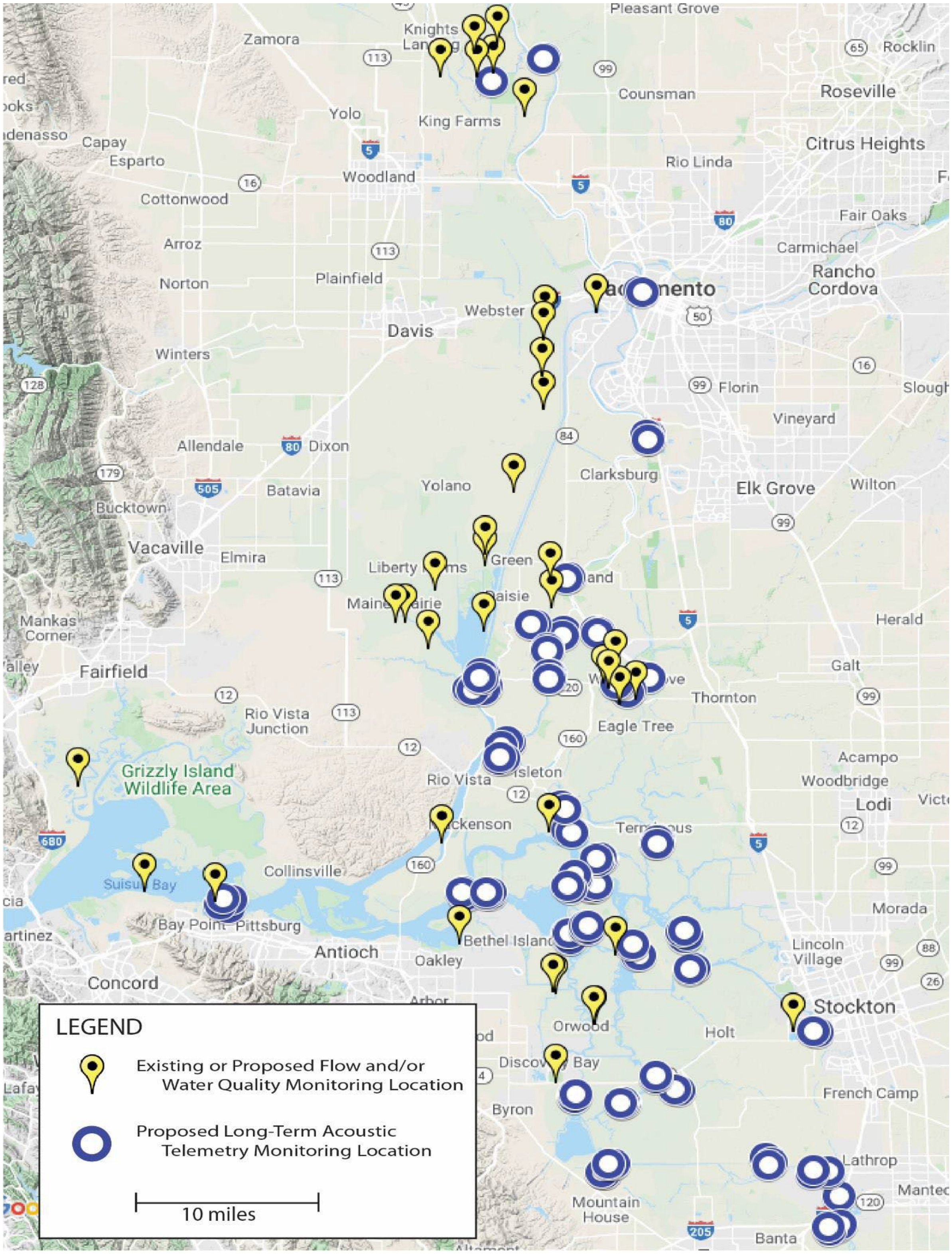

Figure 1: USGS Monitoring Network: Maintenance, Upgrades, and Expansion Locations

Table 1: Proposed locations for pilings to support US Geological Survey Monitoring Network: Maintenance, Upgrades and Expansion Project (modified from USGS submittal to omit 2021 priorities and comments)

Latitude	Longitude	Short Name	Long Name	Project
38.45134717	-121.5022119	SF_4	Sacramento at Freeport	Acoustic Telemetry (Fish Migration)
38.45139809	-121.500517	SF_3	Sacramento at Freeport	Acoustic Telemetry (Fish Migration)
38.45489227	-121.5027143	SF_2	Sacramento at Freeport	Acoustic Telemetry (Fish Migration)
38.45514037	-121.501105	SF_1	Sacramento at Freeport	Acoustic Telemetry (Fish Migration)
38.404771	-121.614544	CM 66	CM 66	Deepwater Ship Channel Monitoring
37.935355	-121.331749	SJG	San Joaquin River at Stockton	Delta Flow / Water Quality Monitoring
37.942448	-121.532092	MDM-RB	Middle River at Middle River -- Right Bank	Delta Flow / Water Quality Monitoring
37.942527	-121.533731	MDM-LB	Middle River at Middle River -- Left Bank	Delta Flow / Water Quality Monitoring
37.969447	-121.572281	OBI-RB	Old River at Bacon Island -- Right Bank	Delta Flow / Water Quality Monitoring
37.969668	-121.574022	OBI-LB	Old River at Bacon Island -- Left Bank	Delta Flow / Water Quality Monitoring
38.012244	-121.670009	DSJ	Dutch Slough	Delta Flow / Water Quality Monitoring
38.109939	-121.578963	MOK	Mokelumne River	Delta Flow / Water Quality Monitoring
38.220595	-121.50745	NFM	North Fork Moklumne River	Delta Flow / Water Quality Monitoring
38.225366	-121.491129	SFM	South Fork Mokelumne River	Delta Flow / Water Quality Monitoring
38.269605	-121.701333	UCS	Upper Cache Slough	Delta Flow / Water Quality Monitoring
38.291581	-121.734151	ULT	Ultais Creek	Delta Flow / Water Quality Monitoring
38.319827	-121.693627	SHG	Shag Slough	Delta Flow / Water Quality Monitoring
38.329026	-121.578128	SSS	Sutter Slough	Delta Flow / Water Quality Monitoring
38.35188	-121.643986	TOEn	Toe Drain, north of Stair Step	Delta Flow / Water Quality Monitoring
38.048927	-121.916708	ADVM_ConflNorth	ADVM North Shore Confluence	X2 Monitoring
38.058036	-121.98767	CM 20	CM 20	X2 Monitoring
38.476812	-121.583741	CM 72	CM 72	Deepwater Ship Channel Monitoring
37.890669	-121.571736	OH4	Old River at Highway 4	Delta Flow / Water Quality Monitoring
38.099907	-121.686645	TSL	Threemile Slough	Delta Flow / Water Quality Monitoring
38.235385	-121.518138	GSS	Georgianna Slough	Delta Flow / Water Quality Monitoring
38.252488	-121.511813	SDC	Sacramento River above Delta Cross Channel	Delta Flow / Water Quality Monitoring
38.292072	-121.724706	HASS	Hass Slough	Delta Flow / Water Quality Monitoring
38.3046	-121.575584	STM	Steamboat Slough	Delta Flow / Water Quality Monitoring
38.002379	-121.512194	HLT	Middle River at Holt	Delta Flow / Water Quality Monitoring
38.149207	-122.05526	MTZw	Montezuma Slough west	Delta Flow / Water Quality Monitoring
38.238861	-121.52374	GES	Sacramento River below Georgiana Slough	Delta Flow / Water Quality Monitoring
38.341588	-121.644045	CM 61	CM 61	Deepwater Ship Channel Monitoring
38.506292	-121.585194	CM 74	CM 74	Deepwater Ship Channel Monitoring
38.537641	-121.58415	CM 76	CM 76	Deepwater Ship Channel Monitoring
38.550528	-121.581098	DWSC-Near ToeDrain	Deepwater Shipping Channel near Toe Drain	Deepwater Ship Channel Monitoring
38.551142	-121.582716	Toedrain-Near DWSC	Toe Drain near Deepwater Shipping Channel	Deepwater Ship Channel Monitoring
38.561409	-121.5303	DWSC Locks	Deepwater Shipping Channel near Locks	Deepwater Ship Channel Monitoring
38.284499	-121.64408	HWB	Miner Slough at Hwy 84 Bridge	Delta Flow / Water Quality Monitoring
38.765038	-121.689113	FRE 1	Fremont Weir Location 1	Fremont Weir Modeling
38.764891	-121.651811	FRE 2	Fremont Weir Location 2	Fremont Weir Modeling
38.767945	-121.635367	FRE 3	Fremont Weir Location 3	Fremont Weir Modeling
38.79366	-121.630418	FTR	Feather River	Fremont Weir Modeling
38.730298	-121.603891	PRCH	Sacramento River at Pritchard Lake Road	Fremont Weir Modeling
38.785613	-121.65414	SUT BYPASS	Sutter Bypass	Fremont Weir Modeling
37.79170246	-121.3077733	MOS_Piling	Mossdale	Acoustic Telemetry (Fish Migration)
37.81167793	-121.3358253	ORE_1	Old River Entrance	Acoustic Telemetry (Fish Migration)
37.81169679	-121.3190129	SJL_1	San Joaquin Lathrop	Acoustic Telemetry (Fish Migration)
37.81384736	-121.3194079	SJL_3	San Joaquin Lathrop	Acoustic Telemetry (Fish Migration)
37.815101	-121.3347919	ORE_3	Old River Entrance	Acoustic Telemetry (Fish Migration)
37.93509935	-121.3305883	SJS_1	San Joaquin Stockton	Acoustic Telemetry (Fish Migration)
37.93609712	-121.3342413	SJS_3	San Joaquin Stockton	Acoustic Telemetry (Fish Migration)
37.98950905	-121.458798	TRN_3	Turner Cut	Acoustic Telemetry (Fish Migration)
37.99053454	-121.4593678	TRN_4	Turner Cut	Acoustic Telemetry (Fish Migration)
37.99131494	-121.4547447	TRN_1	Turner Cut	Acoustic Telemetry (Fish Migration)
37.99177553	-121.4553791	TRN_2	Turner Cut	Acoustic Telemetry (Fish Migration)
38.01774549	-121.4646567	MAC_1	MacDonald Island	Acoustic Telemetry (Fish Migration)
38.01919006	-121.4621007	MAC_2	MacDonald Island	Acoustic Telemetry (Fish Migration)
38.02297921	-121.4670434	MAC_3	MacDonald Island	Acoustic Telemetry (Fish Migration)
38.02371991	-121.4641676	MAC_4	MacDonald Island	Acoustic Telemetry (Fish Migration)
38.04373112	-121.9257088	CHPS_1	Chipps Island	Acoustic Telemetry (Fish Migration)
38.04594157	-121.934539	CHPS_7	Chipps Island	Acoustic Telemetry (Fish Migration)
38.05071596	-121.923813	CHPS_6	Chipps Island	Acoustic Telemetry (Fish Migration)
38.05210254	-121.931777	CHPS_12	Chipps Island	Acoustic Telemetry (Fish Migration)
38.0991284	-121.4918742	LPS_4	Little Potatoe Sl	Acoustic Telemetry (Fish Migration)
38.09990881	-121.4930914	LPS_3	Little Potatoe Sl	Acoustic Telemetry (Fish Migration)
38.10276489	-121.4905136	LPS_1	Little Potatoe Sl	Acoustic Telemetry (Fish Migration)
38.10284781	-121.492195	LPS_2	Little Potatoe Sl	Acoustic Telemetry (Fish Migration)
38.10906331	-121.5788415	MOK_4	Mokelumne River	Acoustic Telemetry (Fish Migration)
38.10993086	-121.5785047	MOK_3	Mokelumne River	Acoustic Telemetry (Fish Migration)
38.11079421	-121.5827433	MOK_2	Mokelumne River	Acoustic Telemetry (Fish Migration)
38.1113652	-121.5820513	MOK_1	Mokelumne River	Acoustic Telemetry (Fish Migration)
38.17237753	-121.6482058	SC_1	Sacramento above Cache Sl	Acoustic Telemetry (Fish Migration)
38.17296028	-121.6528597	SC_3	Sacramento above Cache Sl	Acoustic Telemetry (Fish Migration)
38.17372262	-121.6478587	SC_2	Sacramento above Cache Sl	Acoustic Telemetry (Fish Migration)
38.17452134	-121.6517976	SC_4	Sacramento above Cache Sl	Acoustic Telemetry (Fish Migration)
38.18377464	-121.6499807	STX_3	Steamboat Slough Exit	Acoustic Telemetry (Fish Migration)
38.1850033	-121.6505263	STX_4	Steamboat Slough Exit	Acoustic Telemetry (Fish Migration)
38.18825716	-121.642344	STX_1	Steamboat Slough Exit	Acoustic Telemetry (Fish Migration)
38.18893422	-121.6441778	STX_2	Steamboat Slough Exit	Acoustic Telemetry (Fish Migration)
38.23085977	-121.5222476	GEO_3	Georgianna Slough	Acoustic Telemetry (Fish Migration)
38.23354542	-121.5194673	GEO_1	Georgianna Slough	Acoustic Telemetry (Fish Migration)
38.23367602	-121.6682099	MSX_3	Miner Slough Exit	Acoustic Telemetry (Fish Migration)
38.23638308	-121.6654714	MSX_1	Miner Slough Exit	Acoustic Telemetry (Fish Migration)
38.23790457	-121.5301511	SBG_1	Sacramento Below Georgianna	Acoustic Telemetry (Fish Migration)
38.23826187	-121.5337303	SBG_3	Sacramento Below Georgianna	Acoustic Telemetry (Fish Migration)
38.23849539	-121.5303916	SBG_2	Sacramento Below Georgianna	Acoustic Telemetry (Fish Migration)
38.23881933	-121.5335115	SBG_4	Sacramento Below Georgianna	Acoustic Telemetry (Fish Migration)
38.24383123	-121.501088	DCC_3	Delta Cross Channel	Acoustic Telemetry (Fish Migration)
38.24468276	-121.5042857	DCC_1	Delta Cross Channel	Acoustic Telemetry (Fish Migration)
38.28029308	-121.5887997	STE_3	Steamboat Slough Entrance	Acoustic Telemetry (Fish Migration)
38.28315942	-121.5521156	SBS_4	Sacramento Below Steamboat	Acoustic Telemetry (Fish Migration)

38.28375854	-121.551436	SBS_3	Sacramento Below Steamboat	Acoustic Telemetry (Fish Migration)
38.28497431	-121.5865118	STE_1	Steamboat Slough Entrance	Acoustic Telemetry (Fish Migration)
38.28500879	-121.5540651	SBS_2	Sacramento Below Steamboat	Acoustic Telemetry (Fish Migration)
38.28551207	-121.5538382	SBS_1	Sacramento Below Steamboat	Acoustic Telemetry (Fish Migration)
38.33067515	-121.5849322	SSE_3	Sutter Slough Entrance	Acoustic Telemetry (Fish Migration)
38.33154388	-121.5819745	SSE_1	Sutter Slough Entrance	Acoustic Telemetry (Fish Migration)
38.78108066	-121.6067421	SBF_1	Sacramento Below Feather	Acoustic Telemetry (Fish Migration)

Pile Driving

Eighteen-inch diameter steel pilings are the standard dimension to be used as the mounting structures for the monitoring equipment. In some instances, smaller diameter pilings may be specified if design criteria indicate that a smaller piling will suffice. Pilings will be placed usinga barge-mounted crane with a vibratory hammer pile driver.

Equipment to be used for water-based pile installation would include a tug and barge mounted crane with a vibratory hammer and a small work boat. Piles installed using a barge crane will notdepend on a land staging area. The standard USGS workflow is to have all ancillary equipment (e.g. surveying equipment) available on a work boat and this will be the strategy for the installation work for this project as well.

Each pile would be driven approximately 30 feet below the mudline by a vibratory hammer mounted on a barge adjacent to the site. The barge would be secured in place during constructionand repair activities by anchors mounted on all four corners of the barge. It takes approximately 5 to 10 minutes to place a pile once it is guided into position. Work would take approximately 1 day at each location. After installation, the USGS will install the scientific equipment and safety gear. If a piling needs to be removed at a location, it will be done at a later date (at least one month later or in the subsequent work window) to ensure data continuity.

Due to the limited levee access, many of the sites cannot be accessed by land-based construction equipment and USGS is not proposing to access sites by land. At locations where the waterwaysmay not support a tug and barge, bathymetric surveys will be conducted and evaluated. If barge access is not possible, the USGS will reinitiate consultation with the Service after developing a revised strategy.

Pile Removal

Piling removal and placement would be conducted using standard Best Management Practices (BMPs) to reduce sediment disturbance and turbidity, such as working in low water/low currentwhere possible, removing the pile slowly, breaking the friction bond with surrounding sedimentbefore removing, using a containment basin on the barge to control spills back into the water, and disposing of contained sediments at an appropriate upland disposal site. Standard BMPs would be in place in order to limit the risk of debris or contaminants entering the water. Projectactivities would involve no dredging or sediment transport.

Timing

The proposed work window would be August 1 to October 15 in each year of the five-year project – starting in 2021. The total project could require up to 30 workdays during each year of the project, but could be less, depending on weather, site conditions, and other factors. Placementof a single-pile station is expected to take less than one day.

Conservation Measure

When the vibratory hammer is used, for either removal or placement of piles, it would "ramp up"at lower power for 15 seconds, pause for 1 minute, repeat that sequence, and then start up continuous driving, in order to give wildlife time to clear the area. Project activities would involve no dredging or sediment transport. If an impact hammer were required, additional measures would be taken to ensure that peak underwater sound pressure levels remain below 180decibels (dB) re 1 micropascal squared-second. If an impact hammer is used, the USGS will need to reinitiate consultation as the effects analysis provided only addresses use of a vibratory hammer.

Action Area

The Action Area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectlyby the Federal action and not merely the immediate area involved in the action." For the purposes of the effects analysis, the Action Area includes the waterways of the Sacramento-San Joaquin Delta, Suisun Bay, the lower Sacramento River, and the lower San Joaquin River as depicted in Figure 1.

Analytical Framework for the Jeopardy Determination

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

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

Status of the Species

Delta Smelt

Species Legal Status and Life Cycle Summary

The Service proposed to list the delta smelt as threatened with proposed critical habitat on October 3, 1991 (Service 1991). The Service listed the delta smelt as threatened on March 5, 1993 (Service 1993), and designated critical habitat for the species on December 19, 1994 (Service 1994). The delta smelt was one of eight fish species addressed in the *Recovery Plan forthe Sacramento–San Joaquin Delta Native Fishes* (Service 1996). A 5-year status review of the delta smelt was completed on March 31, 2004 (Service 2004). The review concluded that delta smelt remained a threatened species. A subsequent 5-year status review recommended uplisting delta smelt from threatened to endangered (Service 2010a). A 12-month finding on a petition to reclassify the delta smelt as an endangered species was completed on April 7, 2010 (Service 2010b). After reviewing all available scientific and commercial information, the Service determined that re-classifying the delta smelt from a threatened to an endangered species was warranted but precluded by other higher priority listing actions (Service 2010c). The Service reviews the status and uplisting recommendation for delta smelt during its Candidate Notice of Review (CNOR) process. Each year it has been published, the CNOR has recommended the uplisting from threatened to endangered. Electronic copies of these documents are available at https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=321.

The delta smelt is a small fish of the family Osmeridae. In the wild, very few individuals reach lengths over 3.5 inches (90 mm; Damon *et al.* 2016). At the time of its listing, only the basics ofthe species' life history were known (Moyle *et al.* 1992). In the intervening 26 years, it has become one of the most studied fishes in the United States. Enough has been learned about the delta smelt to support its propagation in captivity over multiple generations (Lindberg *et al.* 2013), to support the development of complex conceptual models of the species life history (Interagency Ecological Program (IEP) 2015), and mathematical simulation models of its life cycle (Rose *et al.* 2013a). Any synthesis of the now extensive literature on the delta smelt requires drawing conclusions across studies that had disparate objectives, but several syntheses have been compiled from existing information (Moyle *et al.* 1992; Bennett 2005; IEP 2015; Moyle *et al.* 2016). In this biological opinion, the Service relied on these previous syntheses where it remains appropriate to do so. We also relied on source study results and analyses of ourown to synthesize across a rapidly growing body of scientific information.

The delta smelt has a fairly simple life history because a large majority of individuals live only one year (Bennett 2005; Moyle *et al.* 2016) and because it is an endemic species (Moyle 2002), comprising only one genetic population (Fisch *et al.* 2011), that completes its full life cycle in the northern reaches of the San Francisco Bay-Delta (Merz *et al.* 2011; Figure 2). The schematic of this simple life cycle developed by Moyle *et al.* (2016) and published again by Moyle *et al.* (2018) is shown in Figure 3. Most spawning occurs from February through May in various places from the Napa River and locations to the east including much of the Sacramento-San Joaquin Delta. Larvae hatch and enter the plankton primarily from March through May, and mostindividuals have metamorphosed into the juvenile life stage by June or early July. Most of the juvenile fish continue to rear in habitats from Suisun Bay and marsh and locations east principally along the Sacramento River-Cache Slough corridor (recently dubbed the 'North Delta Arc'; Moyle *et al.* 2010). The juvenile fish (or 'sub-adults') begin to develop into maturing adults in the late fall. Thereafter, the population spatial distribution expands with the onset of early winter storms and the first individuals begin to reach sexual maturity by January in some years, but most often in February (Damon *et al.* 2016; Kurobe *et al.* 2016). Delta smelt do not reach sexual maturity until they grow to at least 55 mm in length (~ 2 inches) and 50% of individuals are sexually mature at 60 to 65 mm in length (Rose *et al.* 2013b). In captivity delta smelt can survive to spawn at two years of age (Lindberg *et al.* 2013), but this appears to be rare in the wild (Bennett 2005; Damon *et al.* 2016; Figure 3). The spawning microhabitats of the deltasmelt are unknown, but based on adult distribution data (Damon *et al.* 2016; Polansky *et al.* 2018) and the evaluation of otolith microchemistry (Hobbs *et al.* 2007a; Bush 2017), most deltasmelt spawn in freshwater to slightly brackish-water habitats under tidal influence. Most individuals die after spawning, but as is typical for annual fishes, when conditions allow, some individuals can spawn more than once during their single spawning season (Damon *et al.* 2016).In a recent study spanning 2 to 3 months, captive males held at a constant water temperature of 12°C (54°F) spawned an average of 2.8 times and females spawned an average of 1.7 times (LaCava *et al.* 2015).

Figure 2. Delta smelt range map. Waterways colored in purple depict the delta smelt distribution described by Merz *et al.* (2011). The Service has used newer information to expand the transient range of delta smelt further up the Napa and Sacramento rivers than indicated by Merz *et al.* (2011). The red polygon depicts theboundary of delta smelt's designated critical habitat. The inset map shows the region known as the North Delta Arc shaded light green.

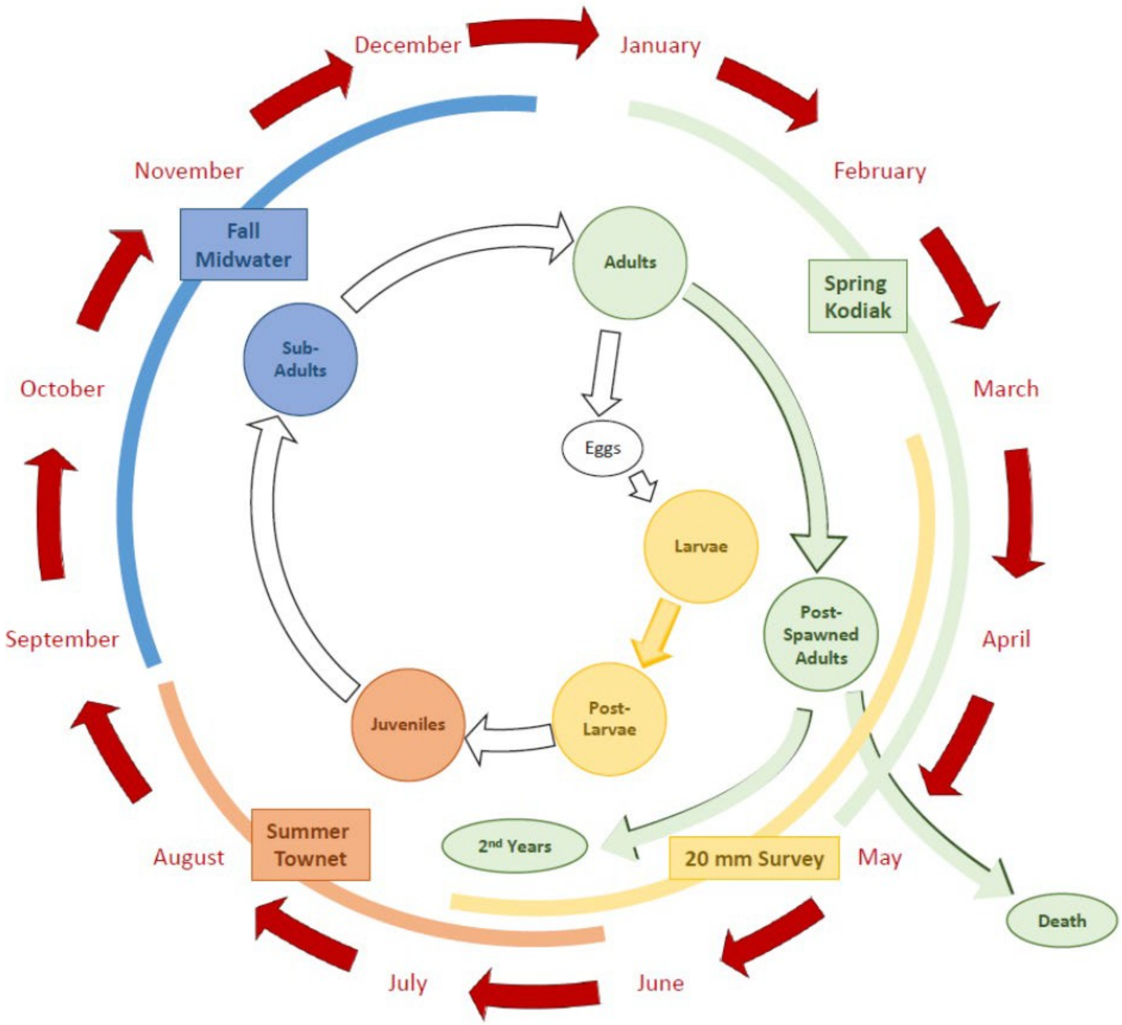

Figure 3. Schematic representation of the delta smelt life cycle. This conceptual model crosswalks delta smelt life stages with calendar months and current monitoring programs (prior to Enhanced Delta Smelt Monitoring) used to evaluate the species' status. Source: Moyle *et al.* 2016

Detailed Review of the Reproductive Biology of Delta Smelt

Delta smelt spawn in the estuary and have one spawning season for each generation, which makes the timing and duration of the spawning season important every year. Delta smelt are believed to spawn in fresh and low-salinity water (Hobbs *et al.* 2007a; Bush 2017). Therefore, freshwater flow affects how much of the estuary is available for delta smelt to spawn (Hobbs *etal.* 2007a). This is one mechanism in which interannual variation in Delta outflow could play arole in the population dynamics of delta smelt. Given the timing of delta smelt reproduction, Delta outflow during February through May would be most important for this mechanism.

During this time of year, variation in Delta outflow is largely driven by weather variation and regulated by the California State Water Resources Control Board (SWRCB) Decision-1641 (D-1641).

The locations of delta smelt spawning are thought to be influenced by salinity (Hobbs *et al.* 2007a), but the duration of the spawning season is thought to be driven mainly by water temperature (Bennett 2005; Damon *et al.* 2016), which is largely a function of regional air temperature (Wagner *et al.* 2011). Thus, the spawning season duration does not appear to be a freshwater flow mechanism, but rather, a climate-driven mechanism (Brown *et al.* 2016a). Delta smelt can start spawning when water temperatures reach about 10°C (50°F) and can continue until temperatures reach about 20°C (68°F; Bennett 2005; Damon *et al.* 2016). The ideal spawning condition occurs when water temperatures remain between 10°C and 20°C throughout February through May. Few delta smelt ≤ 55 mm in length are sexually mature and 50% of delta smelt reach sexual maturity at 60 to 65 mm in length (Rose *et al.* 2013b). During January and February, many delta smelt are still smaller than these size thresholds (Damon *et al.* 2016). Thus,if water temperatures rise much above 10°C in January, the “spawning season” can start before many individuals are mature enough to actually spawn. If temperatures continue to warm rapidlytoward 20°C in early spring, that can end the spawning season with only a small fraction of ‘adult’ fish having had an opportunity to spawn, and perhaps only one opportunity to do so.

Delta smelt were initially believed to spawn only once before dying (Moyle *et al.* 1992). It has since been confirmed that delta smelt can spawn more than once if water temperatures remain suitable for a long enough time, and if the adults find enough food to support the production of another batch of eggs (Lindberg *et al.* 2013; Damon *et al.* 2016; Kurobe *et al.* 2016). In a recent study spanning 2 to 3 months, captive males held at a constant water temperature of 12°C (54°F)spawned an average of 2.8 times and females spawned an average of 1.7 times (LaCava *et al.* 2015). As a result, the longer water temperatures remain cool, the more fish have time to matureand the more times individual fish can spawn. Most adults disappear from monitoring programsby May, suggesting they have died (Damon *et al.* 2016; Polansky *et al.* 2018).

The reproductive behavior of delta smelt is only known from captive specimens spawned in artificial environments and most of the information has never been published, but is currently being revisited in new research. Spawning likely occurs mainly at night with several males attending a female that broadcasts her eggs onto bottom substrate (Bennett 2005). Although preferred spawning substrate is unknown, spawning habits of delta smelt’s closest relative, the Surf smelt (*Hypomesus pretiosus*), are sand or small gravel (Hirose and Kawaguchi 1998; Quinn*et al.* 2012).

The duration of the egg stage is temperature-dependent and averages about 10 days before the embryos hatch into larvae (Bennett 2005). It takes the fish about 30-70 days to reach 20-mm inlength (Bennett 2005; Hobbs *et al.* 2007b). Similarly, Rose *et al.* (2013b) estimated that it takesdelta smelt an average of slightly over 60 days to reach the juvenile life stage. Metamorphosing“post-larvae” appear in monitoring surveys from April into July of most years. By July, most delta smelt have reached the juvenile life stage. Thus, subtracting 60 days from April and July indicates that most spawning occurs from February-May.

Hatching success is highest at temperatures of 15-16°C (59-61°F) and lower at cooler and warmer temperatures and hatching success nears zero percent as water temperatures exceed 20°C(Bennett 2005). Water temperatures suitable for spawning occur most frequently during the months of February-May, but ripe female delta smelt have been observed as early as January and larvae have been collected as late as July, suggesting that spawning itself may extend into Junein years with exceptionally cool spring weather.

Detailed Review of the Habitat Use and Distribution of Delta Smelt

Because the delta smelt only lives in one part of one comprehensively monitored estuary, its general distribution and habitat use are well understood (Moyle *et al.* 1992; Bennett 2005; Hobbs*et al.* 2006; 2007b; Feyrer *et al.* 2007; Nobriga *et al.* 2008; Kimmerer *et al.* 2009; Merz *et al.* 2011; Murphy and Hamilton 2013; Sommer and Mejia 2013; Mahardja *et al.* 2017a; Simonis andMerz 2019). The delta smelt has been characterized as a semi-anadromous species (Bennett 2005; Hammock *et al.* 2017) and Sommer *et al.* (2011) characterized the species as a partial diadromous migrant, recognizing individual variation in its life-history. However, both terms emphasize a life cycle in which delta smelt spawn in freshwater and volitionally move ‘downstream’ into brackish water habitat, which is only one endpoint among several individual life cycle strategies that have recently been confirmed through the use of otolith microchemical analyses (Bush 2017). In addition, semi-anadromy and partial diadromy are scale-dependent terms which have caused confusion among researchers and managers alike. For instance, some individual delta smelt clearly migrate between fresh and brackish water during their lives (Bush 2017). Other individuals could appear to have done so based on otolith microchemistry but in reality have moved very little and simply experienced annual salinity variation, which can be very high in much of the range of delta smelt (see Hammock *et al.* 2019). Other individual delta smelt are clearly freshwater and brackish-water resident throughout their lives (Bush 2017). As aresult, there are both location-based (*e.g.*, Sacramento River around Decker Island) and conditions-based (low-salinity zone) habitats that delta smelt permanently occupy. There are habitats that some delta smelt occupy seasonally (*e.g.*, for spawning), and there are habitats that afew delta smelt occupy transiently, which we define here as occasional use. Transient habitats include distribution extremes from which delta smelt have occasionally been collected, but were not historically collected every year or even in most years. Thus, the Service suggests the delta smelt may be best characterized as an upper estuary resident species with a population-scale distribution that expands and contracts as freshwater flow seasonally (and interannually) decreases and increases, respectively. This influence of freshwater flow inputs on delta smelt distribution could in turn influence mechanisms that affect the species' population dynamics when those mechanisms are linked to where the fish reside or how they are distributed in the estuary. We note that water temperature, turbidity, water diversion rates, prey availability, and possibly other factors would also affect these spatial recruitment and survival mechanisms.

Delta smelt have been observed as far west as San Francisco Bay near the City of Berkeley, as far north as Knight's Landing on the Sacramento River, as far east as Woodbridge on the Mokelumne River and Stockton on the Calaveras River, and as far south as Mossdale on the SanJoaquin River (Merz *et al.* 2011; Figure 2). These extremes of the species' distribution extend beyond the geographic boundaries specified in the critical habitat rule. However, most delta smelt have been collected from locations within the critical habitat boundaries. In other words, observations of delta smelt outside of the critical habitat boundaries reflect transient habitat use rather than permanent or seasonal habitat use. The Napa River is the only location outside of thecritical habitat boundaries that may be used often enough to be considered a seasonal habitat rather than a transient one.

The fixed-location habitats that delta smelt permanently occupy span from the Cache Slough complex down into Suisun Bay and Suisun Marsh (Figure 4). The reasons delta smelt are believed to permanently occupy this part of the estuary are the presence of fresh- to low-salinitywater year-round that is comparatively turbid and of a tolerable water temperature. These appropriate water quality conditions overlap an underwater landscape featuring variation in depth, tidal current velocities, edge habitats, and food production (Nobriga *et al.* 2008; Feyrer *etal.* 2011; Murphy and Hamilton 2013; Sommer and Mejia 2013; Hammock *et al.* 2015; 2017; 2019; Bever *et al.* 2016; Mahardja *et al.* 2019; Simonis and Merz 2019). Field observations are increasingly being supported by laboratory research that explains how delta smelt respond physiologically and behaviorally to variation in water quality that can vary with changes in climate, freshwater flow and estuarine bathymetry (e.g., Hasenbein *et al.* 2013; 2016b; Komoroske *et al.* 2014; 2016).

The principal variable-location habitat that delta smelt permanently occupy is the low-salinity zone (LSZ) (Moyle *et al.* 1992; Bennett 2005). The LSZ is a dynamic habitat with size and location that respond to changes in tidal and river flows (Jassby *et al.* 1995; Kimmerer *et al.* 2013; MacWilliams *et al.* 2015; 2016; Bever *et al.* 2016). The LSZ generally expands and movesdownstream as river flows into the estuary increase, placing low-salinity water over a larger and more diverse set of nominal habitat types than occurs under lower flow conditions. As river flows decrease, the LSZ contracts and moves upstream. This is perhaps the most frequently assumed freshwater flow mechanism in discussions about X2 regulations, but as shown by Kimmerer *et al.* (2009; 2013), it does not appear to be a major explanatory mechanism for most fishes including the delta smelt.

The LSZ often encompasses many of the permanently occupied fixed locations discussed above.It is treated separately here because delta smelt distribution tracks the movement of the LSZ somewhat (Moyle *et al.* 1992; Dege and Brown 2004; Feyrer *et al.* 2007; 2011; Nobriga *et al.* 2008; Sommer *et al.* 2011; Bever *et al.* 2016; Manly *et al.* 2015; Polansky *et al.* 2018; Simonis and Merz 2019). Due to its historical importance as a fish nursery habitat, there is a long researchhistory into the physics and biology of the LSZ. The LSZ is frequently defined as waters with a salinity range of about 0.5 to 6 ppt (Kimmerer 2004). This and similar salinity ranges reported bydifferent authors were chosen based on analyses of historical peaks in chlorophyll concentration and zooplankton abundance. Most delta smelt collected in California Department of Fish and Wildlife's (CDFW) 20-mm Survey and Summer Townet Survey (TNS) have been collected at salinities of near 0 ppt to 2 ppt and most of the (older) delta smelt in the Fall Midwater Trawl (FMWT) have been collected from a salinity range of about 1 to 5 ppt (Kimmerer *et al.* 2013).

These fish of different life stages do not tend to be in dramatically different places (Murphy and Hamilton 2013; Figure 4), suggesting that some of the change in occupied salinity with age is due to the seasonal increases in salinity that accompany lower outflow in the summer and fall.

Each year, the distribution of delta smelt seasonally expands when adults disperse in response towinter flow increases that also coincide with seasonal increases in turbidity and decreases in water temperature (Sommer *et al.* 2011; Figure 4). The annual range expansion of adult delta smelt extends up the Sacramento River to about Garcia Bend in the Pocket neighborhood of Sacramento, up the San Joaquin River from Antioch to areas near Stockton, up the lower Mokelumne River system, and west throughout Suisun Bay and the larger sloughs of Suisun Marsh. Some delta smelt seasonally and transiently occupy Old and Middle rivers in the south Delta each year, but face a high risk of entrainment when they do (Kimmerer 2008; Grimaldo *et al.* 2009). The expanded adult distribution initially affects the distribution of the next generationbecause delta smelt eggs are adhesive and not believed to be highly mobile once they are spawned (Mager *et al.* 2004). Thus, the distribution of larvae reflects a combination of where spawning occurred and freshwater flow when the eggs hatch.

In summary, the delta smelt population spreads out in the winter and then retracts by summer into what is presently a bi-modal spatial distribution with a peak in the LSZ and a separate peak in the Cache Slough complex. Most individuals occur in the LSZ at some point in their life cycleand the use of the Cache Slough complex diminishes in years with warm summers (Bush 2017). *Microhabitat Use*: The delta smelt has been historically characterized as a pelagic fish, meaning one with a spatial distribution that is skewed away from shorelines (Moyle *et al.* 1992; Sommer *et al.* 2007). This has led to some confusion among researchers and managers alike – usually perpetuating a strawman argument that delta smelt either occupy deep-water habitats or shallow-water habitats. Then, catch data from shallow habitats get used to refute the pelagic characterization, but catches in shallow-water say nothing more about a pelagic tendency than catches in deep water would say about a nearshore habitat tendency. The long-term monitoring programs used to characterize delta smelt status and trend are offshore sampling programs – meaning pelagic sampling programs, and surface-trawling appears to be particularly effective at capturing delta smelt away from shorelines (Mitchell *et al.* 2017). However, numerous studies have reported collecting delta smelt from nearshore environments using fishing gear like beach seines and fyke nets from locations that often had a water depth less than or equal to 1 meter (just over three feet) (e.g., Matern *et al.* 2002; Nobriga *et al.* 2005; Gewant and Bollens 2012; Mahardja *et al.* 2017b). Further, it has been established that onshore-offshore movements are onebehavior option delta smelt and other fishes can use to maintain position or move upstream in a tidal-flow influenced estuary (Bennett *et al.* 2002; Feyrer *et al.* 2013; Bennett and Burau 2015). Captive delta smelt have been shown to avoid in-water structure like submerged aquatic vegetation (SAV) (Ferrari *et al.* 2014). SAV tends to grow where tidal current velocities are low,which is a habitat attribute that has also been associated with wild delta smelt (Hobbs *et al.* 2006;Bever *et al.* 2016). Thus, the proliferation of SAV in areas that might otherwise be attractive to delta smelt represents a significant habitat degradation, not only because it creates structure in the water column, but also because it is associated with higher water transparency (Hestir *et al.* 2016), and a fish fauna that delta smelt does not seem to be able to coexist with (Nobriga *et al.* 2005; Conrad *et al.* 2016). Based on our review, the Service suggests that the characterization ofdelta smelt as an open-water fish appears to be accurate and does not imply occupation of a particular water column depth. The species does appear to have some affinity for surface waters (Bennett and Burau 2015; Mitchell *et al.* 2017), but like any microhabitat descriptor, this is not intended to reflect the location of all individuals because delta smelt are not limited to surface waters (Feyrer *et al.* 2013).

Although the delta smelt is generally an open-water fish, depth variation of open-water habitats is an important habitat attribute (Moyle *et al.* 1992; Hobbs *et al.* 2006; Bever *et al.* 2016). In thewild, delta smelt are most frequently collected in water that is somewhat shallow (4-15 ft deep) where turbidity is often elevated and tidal currents exist, but are not excessive (Moyle *et al.* 1992; Bever *et al.* 2016). For instance, in Suisun Bay, the deep shipping channels are poor quality habitat because tidal velocity is very high (Hobbs *et al*. 2006; Bever *et al.* 2016), but in the Delta where tidal velocity is slower, offshore habitat in Cache Slough and the Sacramento Deepwater Shipping Channel is used to a greater extent (Feyrer *et al.* 2013; CDFW unpublisheddata).

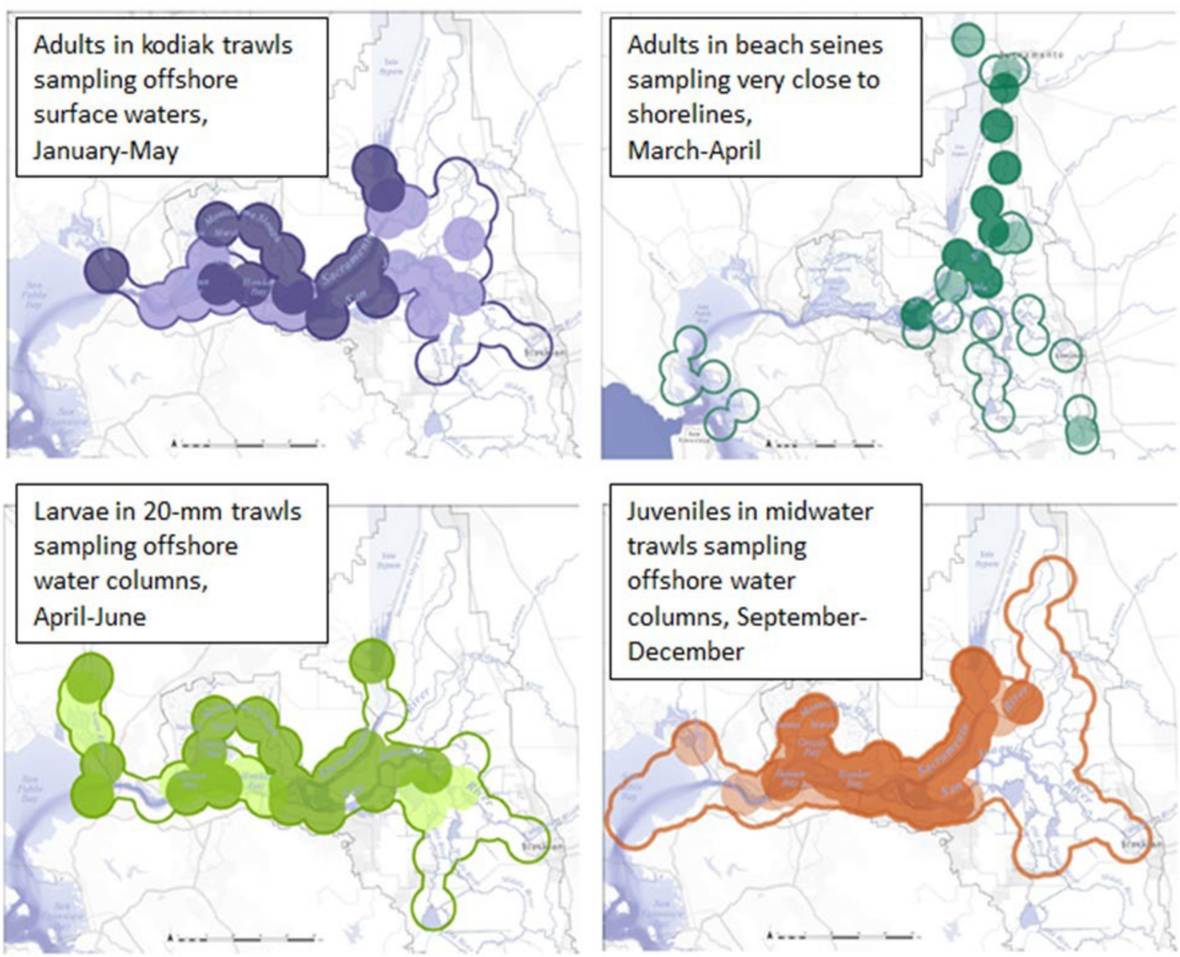

Figure 4. Maps of multi-year average distributions of delta smelt collected in four monitoring programs. Thesampling regions covered by each survey are outlined. The areas with dark shading surround sampling stations in which 90 percent of the delta smelt collections occurred, the areas with light shading surround sampling stations in which the next 9 percent of delta smelt collections occurred. Note the lack of sampling sites in Suisun Bay and marsh for the beach seine (upper right panel). Source: Murphy and Hamilton (2013).

Environmental Setting and History of Ecological Change in the Bay-Delta

This section briefly reviews environmental changes that have occurred since 1850; i.e., the California

Gold Rush to the present. This section is subdivided into three parts. The first describes the condition that is believed to have existed in 1850. The second covers a period from about 1920 to 1967, which is the year prior to the initiation of State Water Project (SWP) water exports from the Delta. The third sub-section covers 1968, the first year of Central Valley Project(CVP) and SWP dual operations, to the present.

Over the past few years, the scientific information developed to understand pre- and post-water project changes to the estuary's landscape and flow regime has grown substantially. However, aswith most scientific endeavors, there are some discrepancies that may affect some conclusions. For instance, Whipple *et al.* (2012) showed the difference between contemporary estimates of unimpaired Delta outflow that were used in the modeling studies reviewed below and measured data from the latter 19th century. These discrepancies can affect the conclusions about the naturalhydrograph of the Bay-Delta ecosystem and should be kept in mind when reviewing what follows. The information on ecosystem changes that have accrued through time provides contextfor the current status of the delta smelt.

The 1850 Bay-Delta estuary: The historical Delta ecosystem was a large tidal marsh at the confluence of two floodplain river systems (Whipple *et al.* 2012; Andrews *et al.* 2017; Gross *etal.* 2018; Figure 5). The Delta itself experienced flooding over spring-neap tidal time scales andseasonal river runoff time scales. This variability in freshwater input to the estuary was likely important to seasonal and interannual variability in the productivity of the ecosystem for the same reasons that smaller-scale tidal marsh plain and floodplain inundation are today.

Specifically, these flood cycles deliver organic carbon, but also increase the production of lowertrophic levels due to lengthened water residence times and greater shallow, wetted surface areas (Sommer *et al*. 2004; Grosholz and Gallo 2006; Howe and Simenstad 2011; Enright *et al*. 2013).When freshwater flows out of the Delta and into the estuary, it can generate currents that aggregate particulate matter like sediment and phytoplankton (Monismith *et al*. 1996; 2002; MacWilliams *et al*. 2015) – and presumably also did so in the pre-development ecosystem. Priorto the invasion of the overbite clam, these sediment and phytoplankton aggregations, which occurred near the 2 ppt isohaline, demarcated an important fish nursery region (Turner and Chadwick 1972; Jassby *et al*. 1995; Bennett *et al*. 2002).

The estuary's natural hydrograph reached its annual base flows (annual minimum inputs of freshwater) in August or September toward the end of California's dry summers (Figure 6). Freshwater inputs would generally increase during the fall as precipitation in the watershed resumed. Delta outflow reached a broad winter through spring peak fueled first by precipitation followed by additional contributions from melting snow. The annual peak of Delta outflow oftenspanned January through May before declining back to base flow conditions by the late summer.The year-to-year variation in Delta outflow was considerable, often varying by about an order ofmagnitude during each month of the year. Water flowing from the Delta mixed into larger open- water habitats in Suisun and San Pablo bays, which themselves were fringed with marshes and tidal creeks. This pre-development ecosystem was shallower than the modern system. As a result, salinity responded more rapidly to changes in freshwater flow than it does now and less freshwater flow was needed to move salinity isohalines than is presently the case (Andrews *et al.*2017; Gross *et al.* 2018). Like most native fish, the delta smelt evolved its life history to take advantage of this flow regime (Moyle 2002). In particular, its spawning period and early life stages overlap the months in which historical marsh-floodplain inundation and freshwater inputs to the estuary were highest, and water temperatures were cool, but not as cold as they are in the winter before spawning commences (see above for details of what is known about spawning andearly life stages of delta smelt).

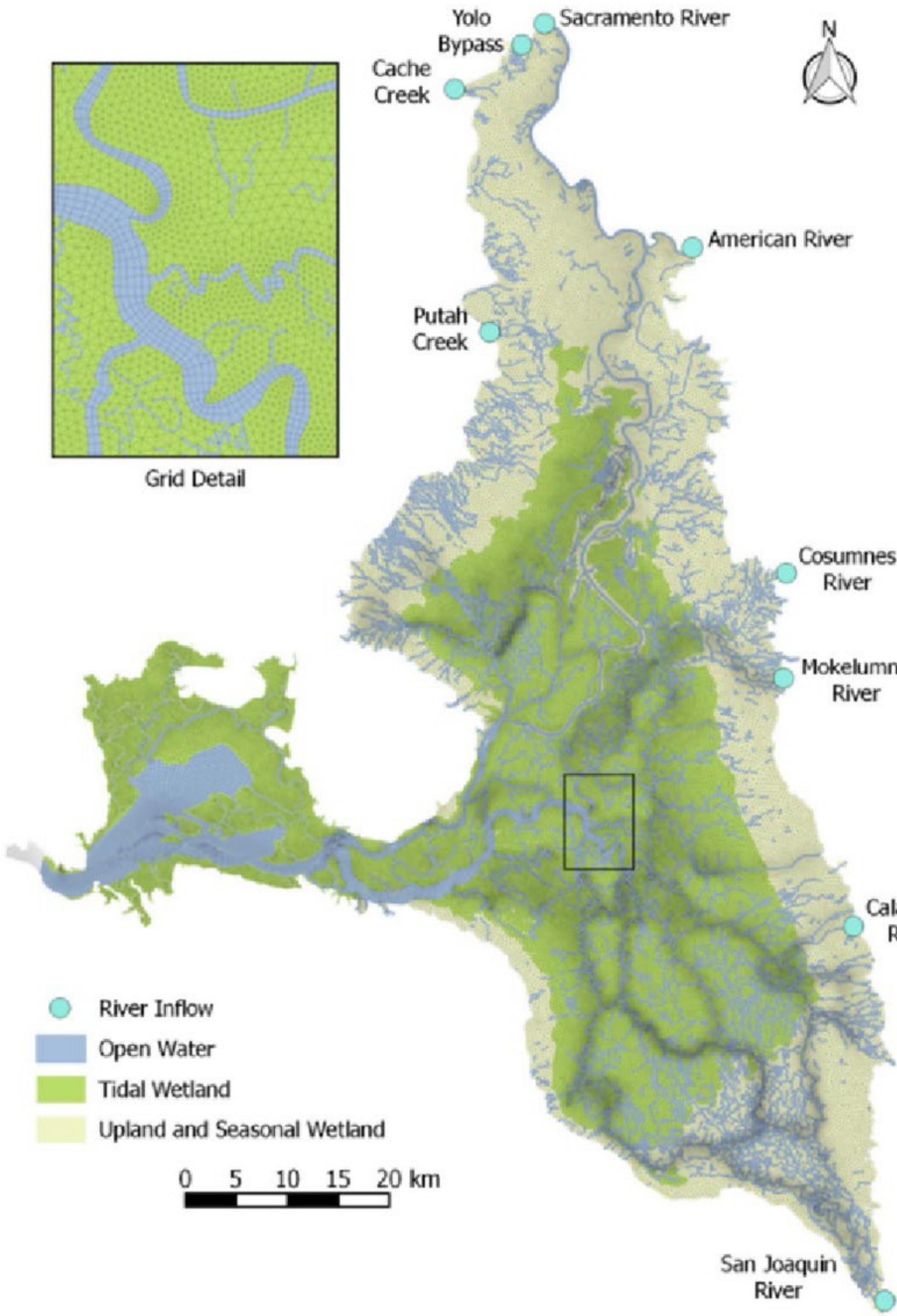

Figure 5. The circa 1850 Delta as depicted in the version of the UnTRIM 3-D hydrodynamic model described by Andrews *et al.* (2017). The model depicts an expansive tidal marsh area of approximately 2,200 square kilometers (km) or 850 square miles. Source: Andrews *et al.* (2017).

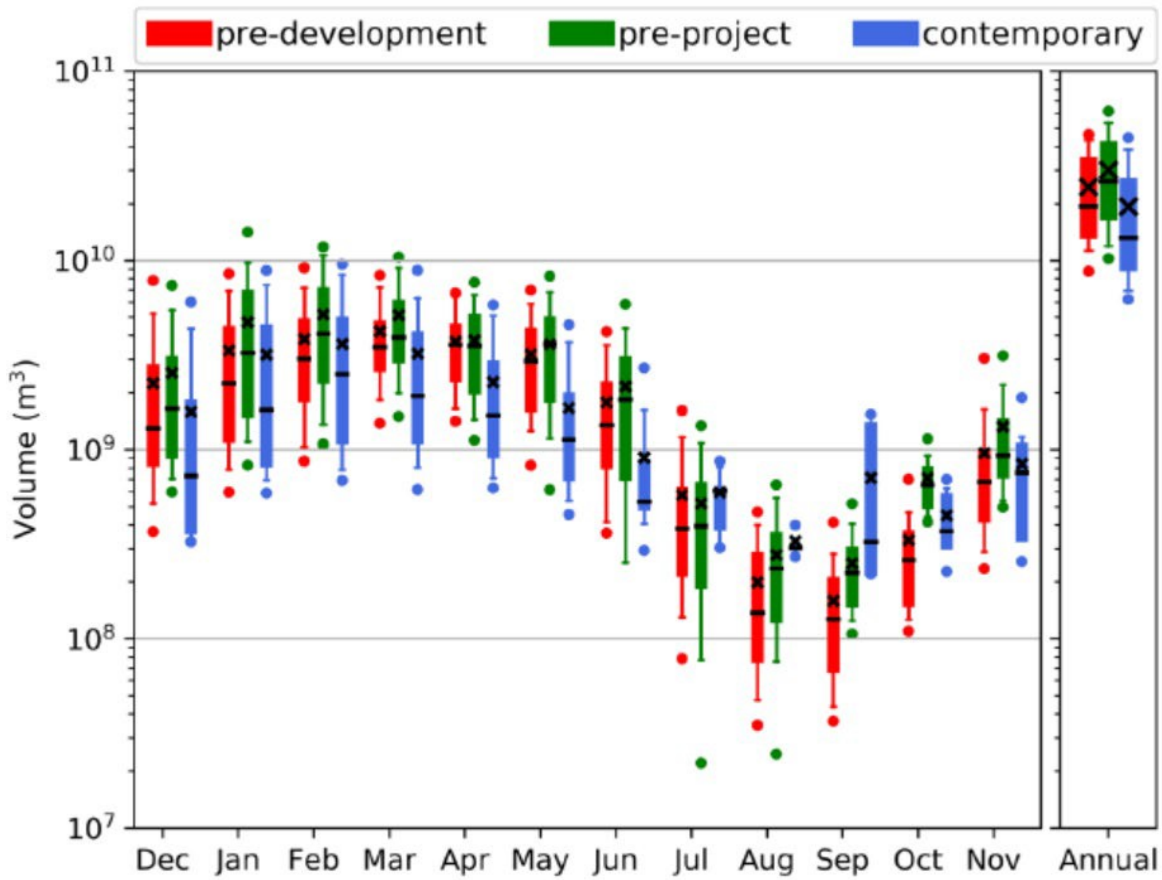

Figure 6. Boxplots of estimated Delta outflow by month for a pre-development Bay-Delta (circa 1850; red boxes), a pre-CVP and SWP Bay-Delta (circa 1920; green boxes), and a contemporary Bay-Delta (blue boxes;precise year not stated by the authors). Source: Gross *et al.* (2018). The inset labeled "Annual" on the x-axis isthe boxplot summary of the sum of monthly outflows. Gross *et al.* (2018) attributed the higher outflow in the pre-project era relative to the pre-development era to the levees that had been constructed in the system by 1920.

Many tidal river estuaries form frontal zones where inflowing fresh water begins mixing with seawater (Peterson 2003). In the Bay-Delta, a frontal zone of biological importance is the LSZ (Jassby *et al.* 1995). The LSZ is a mobile and variable habitat region that frequently overlaps the parts of the estuary where many delta smelt reside (as described above). In the Bay-Delta the location and associated function of the LSZ have historically been indexed using a statistic calledX2, which is the geographic location of 2 ppt salinity near the bottom of the water column measured as a distance from the Golden Gate Bridge (Jassby *et al.* 1995; MacWilliams *et al.* 2015; Figure 7). When Delta outflow is high, saline water is pushed closer to the Golden Gate, resulting in a smaller distance from the Golden Gate Bridge to X2. Conversely, when Delta outflow is low, salinity intrudes further into the estuary resulting in a larger distance from the Golden Gate Bridge to X2. These changes in how salinity is distributed affect numerous physicaland biological processes in the estuary (Jassby *et al.* 1995; Kimmerer 2002a,b; Kimmerer 2004; MacWilliams *et al.* 2015).

X2, rather than another salinity isohaline, was chosen as the low-salinity zone habitat metric because it is a frontal zone or boundary upstream of which, salinity tends to be the same from thesurface of the water to the bottom, and downstream of which, salinity varies from top to bottom (Jassby *et al.* 1995). That variability in the vertical distribution of salinity is indicative of currents that help to aggregate sinking particles like sediment and phytoplankton, and as recentlymodeled, zooplankton (Kimmerer *et al.* 2014a), near X2.

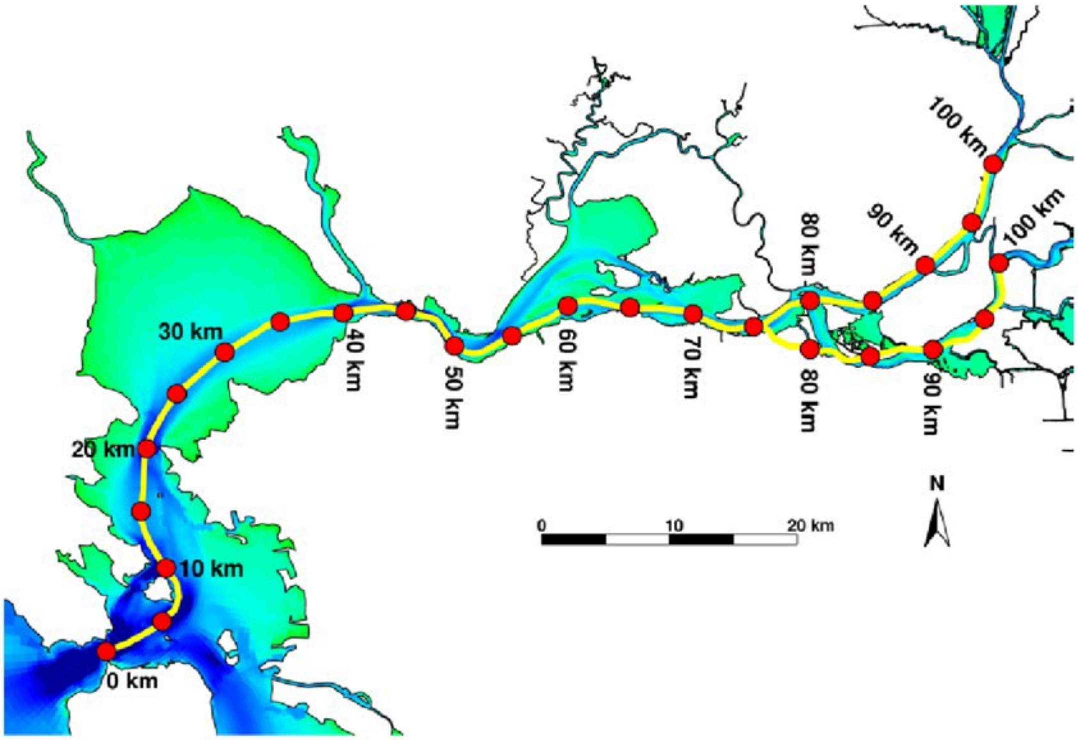

Figure 7. The northern reach of the Bay-Delta as depicted in the UnTRIM 3-D contemporary Bay-Delta model; greener colors represent shallower water and bluer colors represent deeper areas. The yellow lines depict the transect along which the location of X2 is estimated in the model and the associated red circles depict selected km distances from the Golden Gate Bridge along the northern axis of the estuary into the Sacramento and San Joaquin rivers for use in interpreting the variable locations of X2. Source: MacWilliams*et al.* (2015).

Pre-development outflows from the Delta were higher in the winter and spring than they are nowwhile summer and fall outflows may have been lower (Andrews *et al.* 2017; Gross *et al.* 2018; Figure 6). Thus, X2 also varied more within years in the circa 1850 estuary than it now does. In the pre-development estuary, X2 would remain in San Pablo Bay for months at a time in the winter-spring of Above Normal and wetter water year types before retreating landward (upstream) in the summer-fall. In the contemporary estuary, X2 spends nearly all of its wet season time in Suisun Bay (landward or 'upstream' of historical) and dry season time between Collinsville and Rio Vista (~ 80 to 95 km; Figure 7). These contemporary dry season locations ofX2 may be seaward or 'downstream' of historical locations (Gross *et al.* 2018).

There are no data on the timing and magnitude of biological productivity in the circa 1850 Bay-Delta, nor are we aware of any information on how delta smelt used the estuary at the time.

However, inferences can be made based on general ecosystem function in the northern hemisphere temperate zone and contemporary information. The input of basal food web materials like nutrients and detritus likely co-varied with the timing, duration, and magnitude of freshwater flows (e.g., Delta inflow; Jassby and Cloern 2000), which would likewise have affected the timing, magnitude, and duration of inundation of the system's expansive floodplains (e.g., Whipple *et al.* 2012; Figure 5). The production of planktonic and epibenthic invertebrates from floodplains, tidal wetlands, and open-water habitats that fuel the production of juvenile fishes that feed in open waters may have generally increased during the spring and peaked duringthe summer in concert with seasonal variation in water temperature (e.g., Heubach 1969; Orsi and Mecum 1986; Merz *et al.* 2016). The summer months are the warmest months in the Bay- Delta region and thus, they support the highest *average* metabolic rates of invertebrates and fish, which rely on water temperature to control their body temperature and metabolic rates. However, there was likely to have been considerable species-specificity to this generalization (e.g., Ambler*et al.* 1985; Gewant and Bollens 2005) because the Bay-Delta's native biotic community includes numerous cold-water adapted species.

The seasonal timing of delta smelt reproduction (February-May; detailed below) would have more broadly coincided with the general timing of peak freshwater flow into the Bay-Delta (Figure 6). The higher outflow and shallower average depth of the system resulted in frequent occurrence of the LSZ in San Pablo Bay during the wet season. Thus, it is likely that delta smeltreared in San Pablo Bay, taking advantage of its greatly expanded low-salinity habitat area (see MacWilliams *et al*. 2015), to much greater extent prior to development of the system than they are able to now. Lower flows in the summer-fall likely caused delta smelt distribution to seasonally retract back into Suisun Bay/marsh and the Delta; ecosystems which were likely much more productive at the time due to the expansive tidal marshes and greater connection between land and water (Whipple *et al*. 2012). Delta smelt's population-level demand for prey annually peaks at some combination of water temperature and growth of the population's biomass. This timing could be estimated from the model developed by Rose *et al.* (2013a), but we are not aware that such a calculation exists.

<u>1920-1967</u>: By 1920, most of the Delta's tidal wetlands had been reclaimed (Whipple *et al.* 2012; Figure 8). The data provided by Gross *et al.* (2018; Figure 5) suggest that Delta outflow may have been a little higher circa 1920 than it had been circa 1850 due to levee construction. However, this may (Hutton and Roy 2019) or may not be consistent with historical observations(Whipple *et al.* 2012). Regardless, Delta outflow and several other net flow metrics from withinthe Delta did begin to decline between the early 1920s and 1967 (Hutton *et al.* 2017a; 2019).

These changes occurred because of four factors: (1) water storage in the Bay-Delta watershed increased from about 4 million acre feet (MAF) to about 40 MAF because of the construction of dams upstream of the Delta, (2) the CVP began exporting water from the Delta in 1951, (3) non-project water diversions within and upstream of the Delta increased, and (4) shipping channels were dredged through the estuary and into the Sacramento and San Joaquin rivers. These changes facilitated a general water management strategy in California to store water during the wet season and re-distribute it during the dry season to provide a more reliable supply than was available naturally. In addition, the CVP and SWP have had to offset a considerable summertimewater deficit to protect the quality of their exported water and to protect water quality for senior water rights holders in the Delta. These uses would be highly impaired without water released from CVP and SWP reservoirs during the summer and fall (Hutton *et al.* 2017b).

During the 1930s to 1960s, the navigation channels were dredged deeper (~12 meters) to accommodate shipping traffic from the Pacific Ocean and San Francisco Bay to ports in Sacramento and Stockton and to increase the capacity of the Delta to convey floodwaters. Channel deepening interacted with the simultaneously increasing water storage to change the Bay-Delta ecosystem into one in which Suisun Bay and the Sacramento-San Joaquin River confluence region became the largest and most depth-varying places in the typical range of theLSZ. Even with these changes, the LSZ remained a highly productive fish nursery habitat for many decades (Stevens and Miller 1983; Moyle *et al.* 1992; Jassby *et al.* 1995).

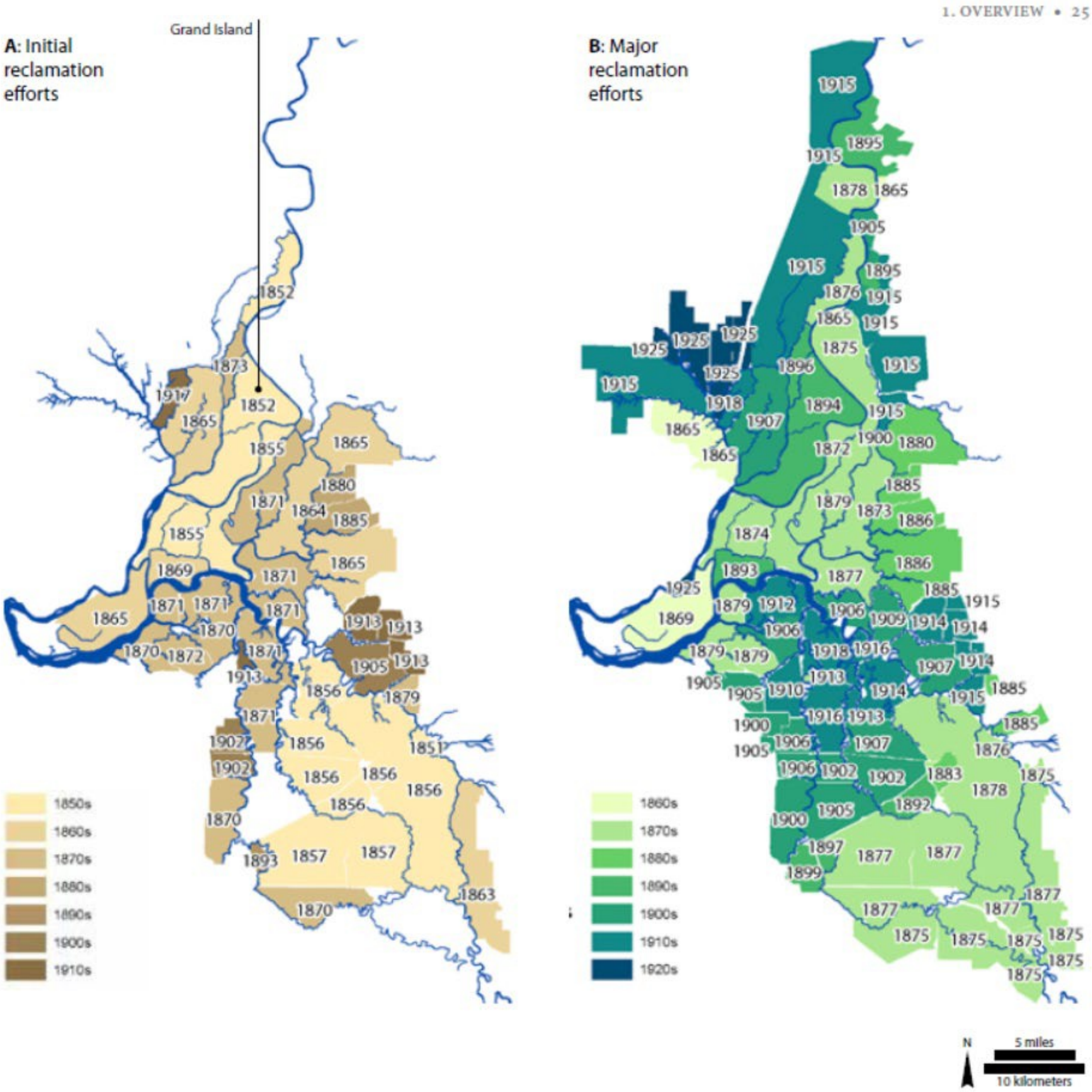

Figure 8. Maps of the Delta showing years of initial land reclamation attempts on the left and major land reclamation efforts on the right. Note that a large majority of the major reclamation efforts were underwayby 1915 and the last efforts in the vicinity of Liberty Island began in 1925. Source: Whipple *et al.* (2012).

<u>1968-present</u>: The SWP began exporting water from the Delta in 1968 and its exports generallyincreased until about 1989 (Figure 9). CVP exports reached present-day levels by the end of the1970s. During the 1980s water storage capacity in the Bay-Delta watershed reached its present-day level of a little over 50 MAF (Cloern and Jassby 2012; Hutton *et al.* 2017a). Thereafter, combined CVP-SWP exports began to increase in year-to-year variability, which increased the uncertainty about how much water would be supplied south of the Delta annually. This has combined with the increasing human demand for fresh water to result in a conflict between human water demand and environmental water uses, including the maintenance of the hydraulicsalinity barrier needed to protect exported water and other in-Delta water users from salinity intrusion (Hutton *et al.* 2017b; Reis *et al.* 2019).

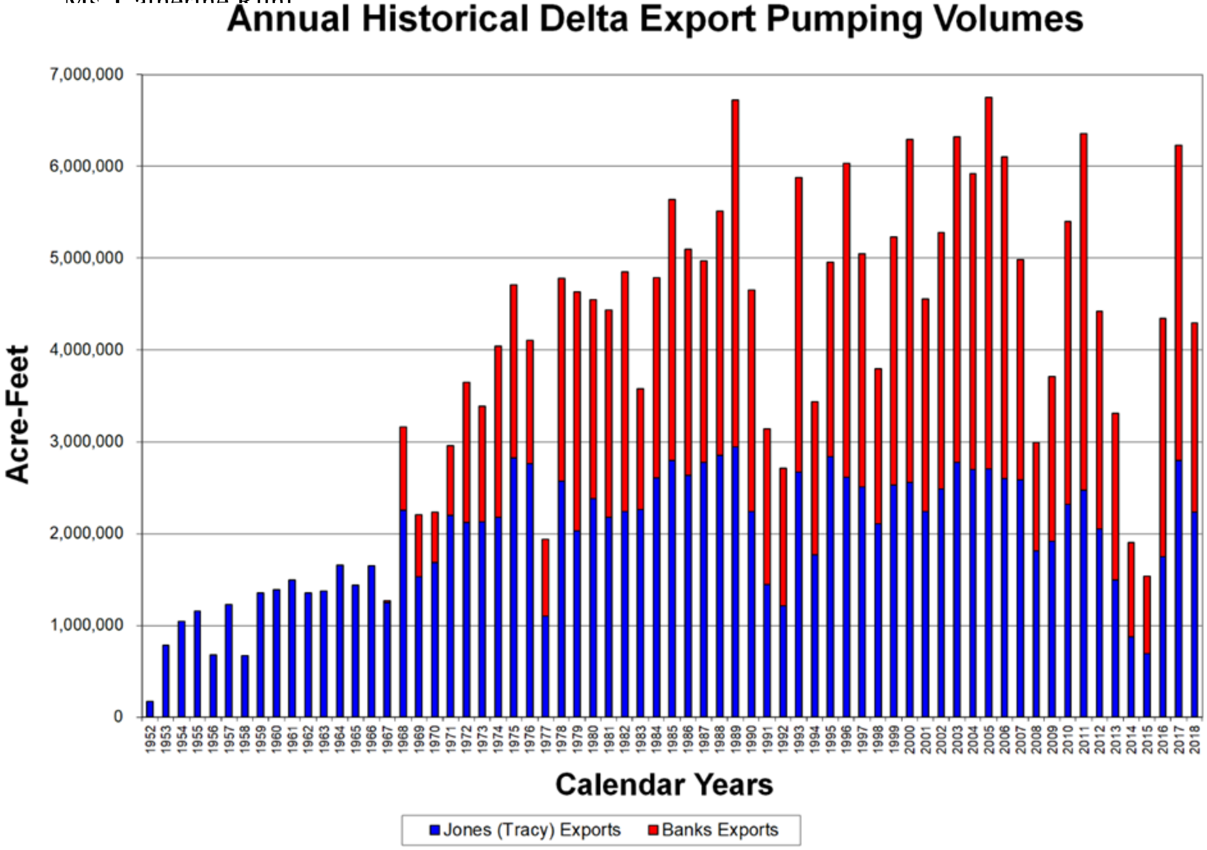

Figure 9. Time series of Central Valley Project and State Water Project exports from the Delta for 1952through 2018. State Water Project exports began in water year 1968. Source: DAYFLOW data base.

The changes discussed above have continued to lower Delta outflow (Hutton *et al.* 2017a,b; Reis*et al.* 2019; Figures 10 and 11), though D-1641 appears to have halted the trend for years in which the eight river index is lower than 20 MAF (middle panel of Figure 10). In Figure 10, exports were modeled as depletions of water from the system, so the more negative the number on the y-axis of the middle panel, the higher the exports. Thus, the graphic shows that in years when the eight river index is more than 20 MAF, exports continue to increase, but in years whenthe eight river index is lower than 20 MAF, exports have been trending lower. Both of these trends cause the higher year-to-year variability in water exports shown in Figure 9.

In general, major changes to the flow regime of an aquatic ecosystem are expected to be accompanied by ecological change (Benson 1981; Bunn and Arthington 2002; Poff and Zimmerman 2010; Gillson 2011), and that is what has been observed over time in the Bay and Delta (e.g., Matern *et al.* 2002; Moyle and Bennett 2008; Winder *et al.* 2011; Feyrer *et al.* 2015; Conrad *et al.* 2016). Delta outflow is a driver of many ecological mechanisms in the Bay-Deltaand an indicator of several others (Kimmerer 2002a). Thus, the changes to the estuary's freshwater flow regime have likely interacted with the changes to the estuary's landscape, specifically its deeper channels and greatly reduced land-water connections (Andrews *et al*. 2017), to lower the total biological productivity of the estuary. In addition, changes to the freshwater flow regime detailed above appear to have affected the reproductive success of fishesthat use the Delta and Suisun Bay as rearing habitats. The evidence for this is that the native fish assemblage had reproductive seasons timed to winter-spring peak flows, whereas currently dominant non-native species generally spawn later in the spring and into the summer when inflows to the Delta are generally high to support human water use, but outflow from the Delta isgenerally low (Moyle 2002; Moyle and Bennett 2008). Reis *et al.* (2019) recently described super-critical water years with respect to Delta outflow. Several studies have indicated that low flow years and droughts in particular result in low native fish production in the Bay-Delta (Meng*et al.* 1994; Jassby *et al.* 1995; Kimmerer 2002b; Feyrer *et al.* 2015). Droughts recur and may contribute to cumulative impacts to native fishes like delta smelt. For instance, recent droughts have been particularly problematic for delta smelt (Moyle *et al.* 2018). Thus, the frequency of these super-critical water years, which has been much higher since 1968 than it was from 1920- 1967 (Figure 11), is a conservation challenge that the Service and its partners have to contend with.

There are several fish species in the Bay-Delta that have historically been shown to have demonstrable positive population responses to freshwater flows into or out of the Delta. These include the well-described relationships for the survival of emigrating Sacramento basin Chinooksalmon (*Oncorhynchus tschawytscha)* smolts with Sacramento River inflows (Kjelson and Brandes 1989; Perry *et al.* 2010), the relationship of Sacramento splittail (*Pogonichthys macrolepidotus*) production to Yolo Bypass flow (Moyle *et al.* 2004; Feyrer *et al.* 2006), and the 'fish-X2' relationships for striped bass (*Morone saxatilis*), longfin smelt (*Spirinchus thaleichthys*), and starry flounder (*Platichthys stellatus*) (Turner and Chadwick 1972; Jassby *et al.* 1995; Kimmerer 2002b). The life-history of delta smelt with its affinity for fresh and low- salinity waters seems consistent with that of a fish one could expect to respond similarly to variation in Delta outflow or X2. Researchers searched for some form of analogous relationship for the delta smelt for several decades, but no persistent relationship was found (Stevens and Miller 1983; Moyle *et al.* 1992; Jassby *et al.* 1995; Kimmerer 2002b; Bennett 2005; Mac Nally *et al.* 2010; Thomson *et al.* 2010; Miller *et al.* 2012). Further, Rose *et al.* (2013a,b) did not find salinity variation *per se* to have much impact on predictions of delta smelt population growth rate. The larger predicted impact in their individual-based model related to flow was due to simulated entrainment in exported water (Rose *et al.* 2013b; Kimmerer and Rose 2018).

Although entrainment was predicted to lower the population growth rate, in and of itself, it couldnot convert a strongly positive growing population into a declining one without at least one additional factor impacting survival at the same time.

The IEP (2015) reported a correlation between February-May X2 and ratios of the 20-mm Survey index for delta smelt and either the Spring Kodiak Trawl (SKT) or FMWT indices of the parental stock that produced the 20-mm fish. This relationship emerged in data beginning at the time of the pelagic organism decline (POD) in 2002. This relationship is stronger when considered in terms of salinity at Chipps Island (He and Nobriga 2018), possibly because salinitycan be measured more accurately than Delta outflow when net freshwater flow is very low (Monismith 2016). Castillo *et al.* (2018) used a simulation based on SKT data to suggest a link between Delta outflow and adult delta smelt abundance. In addition, several teams have reportedstatistical associations of delta smelt spatial distribution and salinity that imply the population spatial distribution co-varies with Delta outflow, X2, or similar indices of freshwater input to theestuary (Feyrer *et al.* 2007; 2011; Nobriga *et al.* 2008; Kimmerer *et al.* 2009; 2013; Bever *et al.* 2016; Polanksy *et al.* 2018; Simonis and Merz 2019). The strength of this covariation and its management utility have been contested (e.g., Murphy and Hamilton 2013; Manly *et al.* 2015; Latour 2016; Polanksy *et al.* 2018) and supported (Sommer *et al.* 2011; Bever *et al.* 2016; Feyrer*et al.* 2016; Mahardja *et al.* 2017a) in several recently published papers.

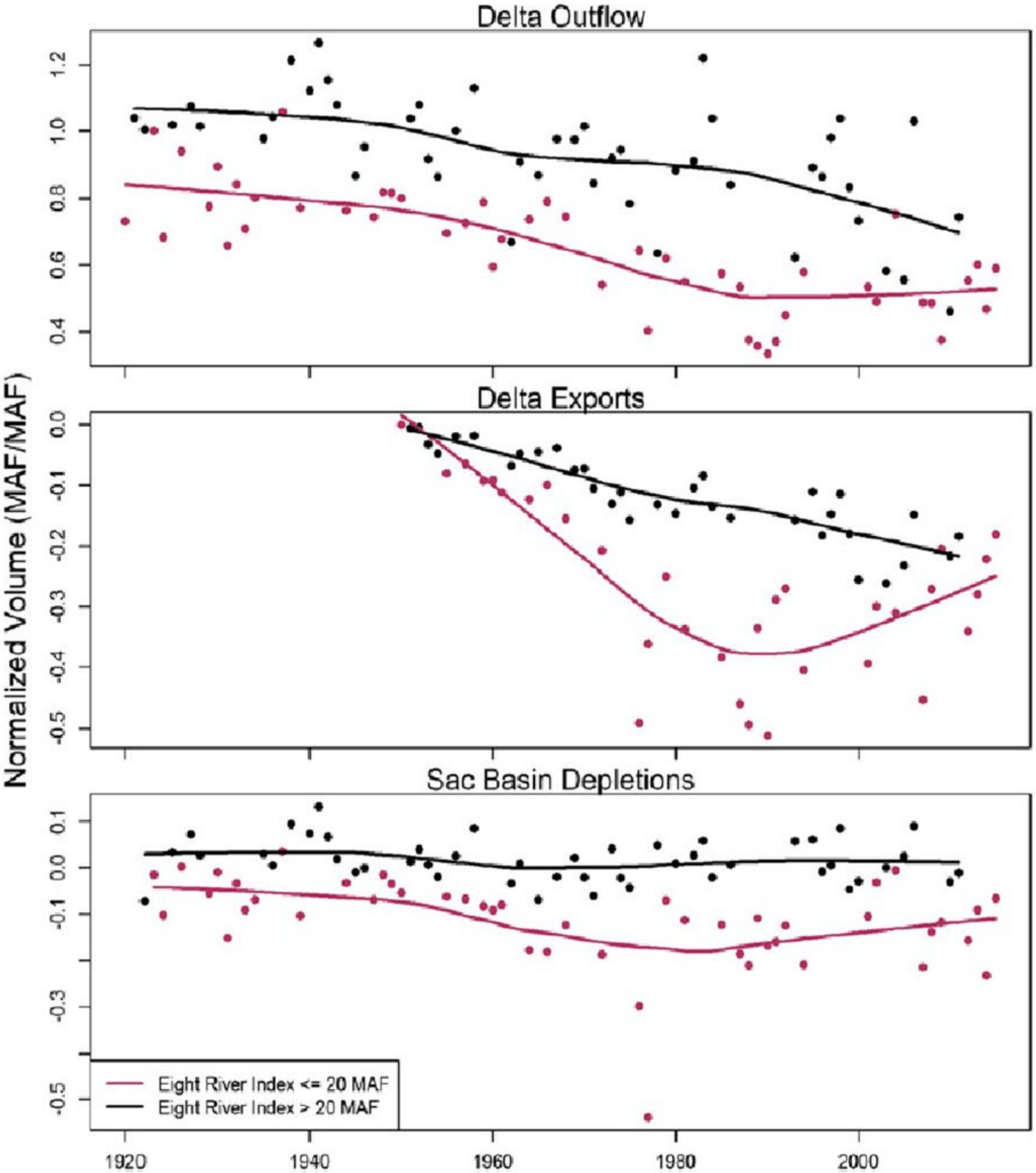

Figure 10. Time series (1922-2015) of statistical trend outputs of annual Delta outflow (top panel), Delta exports treated as depletions so increasing exports are represented by more negative values (middle panel), and water diversions from the Sacramento River basin upstream of the Delta (bottom panel). Black symbols and lines are for years in which the eight river index, a measure of water availability in the Bay-Delta watershed, was greater than 20 MAF. Red symbols and lines are for years in which the eight river index was less than or equal to 20 MAF. Source: Hutton *et al.* (2017b).

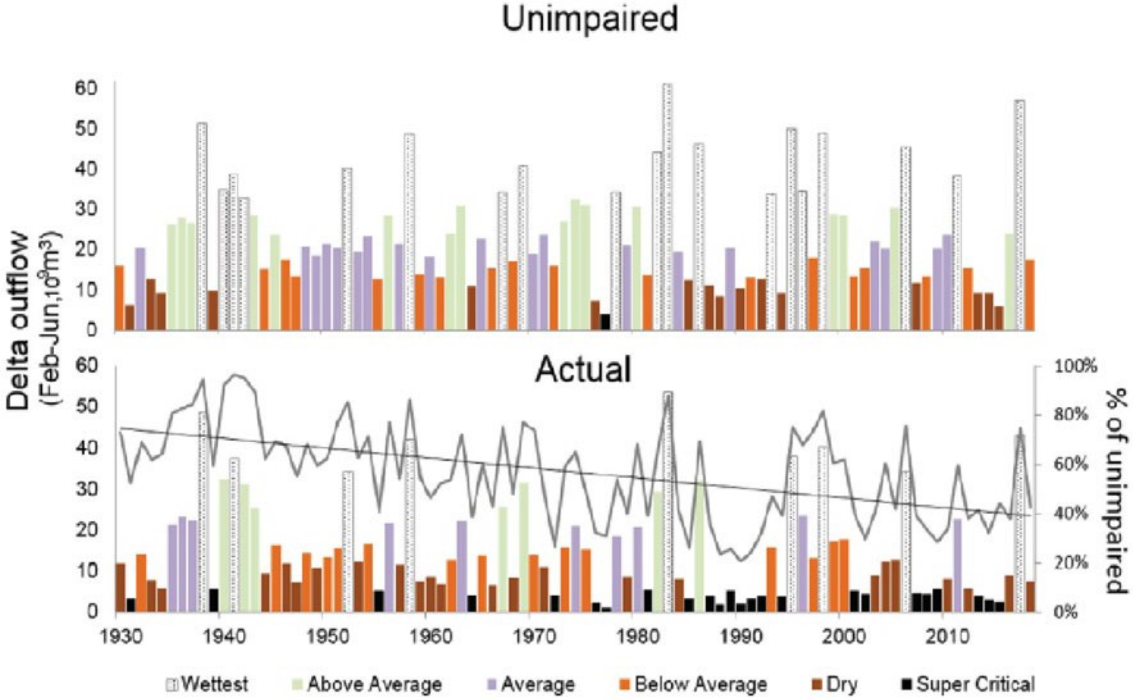

Figure 11. Time series of estimates of unimpaired (upper panel) and actual (lower panel) Delta outflow (February-June) color-coded according to six water year types, 1930-2018. The water year types based on basin precipitation are shown in the upper panel. In the lower panel, the water year types were re-assessedbased on their fraction of the estimated unimpaired outflow. The long-term trend in this fraction as "% ofunimpaired" is shown on the second y-axis of the bottom panel. Source: Reis *et al.* (2019).

Delta Smelt Population Trend

The CDFW's TNS (http://www.dfg.ca.gov/delta/data/townet/indices.asp?species=3) and FMWT Survey (http://www.dfg.ca.gov/delta/data/fmwt/indices.asp) are the two longest running indicators of the delta smelt's abundance trend. Indices of delta smelt relative abundance from these surveys date to 1959 and 1967, respectively (Figures 12 and 13). The FMWT index has traditionally been the primary indicator of delta smelt trend because it samples later in the life cycle, providing a better indicator of annual recruitment than the TNS (Service 1996). It has also sampled more consistently and more intensively than the TNS. The FMWT deploys more than 400 net tows per year over its four-month sampling season (September through December). The highest FMWT index for delta smelt (1,673) was recorded in 1970 and a comparably high index (1,654) was reported in 1980 (Figure 13). The last FMWT index exceeding 1,000 was reported in1993. The last FMWT indices exceeding 100 were reported in 2003 and 2011. In 2018, the FMWT index was zero for the first time. The TNS index for delta smelt has been zero four times since 2015. Thus, the TNS and FMWT have recorded a 40-50 year decline in which delta smelt went from a minor (but common) species to essentially undetectable by these long-term surveys(Figures 12 and 13).

Following the listing of the delta smelt, the CDFW launched a 20-mm Survey (1995) and a SKT Survey (SKT; 2002) to monitor the distribution and relative abundance of late larval stage and adult delta smelt, respectively. These newer indices have generally corroborated the trends implied by the TNS and the FMWT (Figures 12 and 13). The CDFW methods generate abundance indices from each survey but each index is on a different numeric scale. This means the index number generated by a given survey only has quantitative meaning relative to other indices generated by the same survey. Further, the CDFW indices lack estimates of uncertainty (variability) which limits interpretation of abundance changes from year to year even within eachsampling program. The Service recently completed a new delta smelt abundance indexing procedure using data from all four of these surveys (Polansky *et al.* 2019). The Service method improves upon the CDFW method because it generates abundance indices in units of numbers offish, including attempts to correct for different sampling efficiencies among surveys, and the method includes measures of uncertainty. Service indices of spawner abundance based on combined January and February SKT sampling are listed with their confidence intervals in Table 2. The estimates show the most recent 20 years of the delta smelt's longer-term decline in numbers of fish as best as they can be approximated with currently available information. The 2021 abundance estimate based on the January and February SKT sampling is 0 because no deltasmelt were caught during those sampling efforts. However, Service's more recent Enhanced Delta Smelt Monitoring (EDSM) surveys did collect delta smelt during January and February, although in low numbers. For both surveys, data collected from January and February of each year were combined to derive a single abundance estimate. EDSM is designed to complete Delta wide surveys at a weekly time scale while SKT does this at a monthly scale, so the Service calculated EDSM abundance estimates using all weekly survey data within the January-Februarytime interval (Table 3). While not 0 like the SKT based abundance, the EDSM calculated abundance estimate of spawning adults is an extremely low 267 individuals.

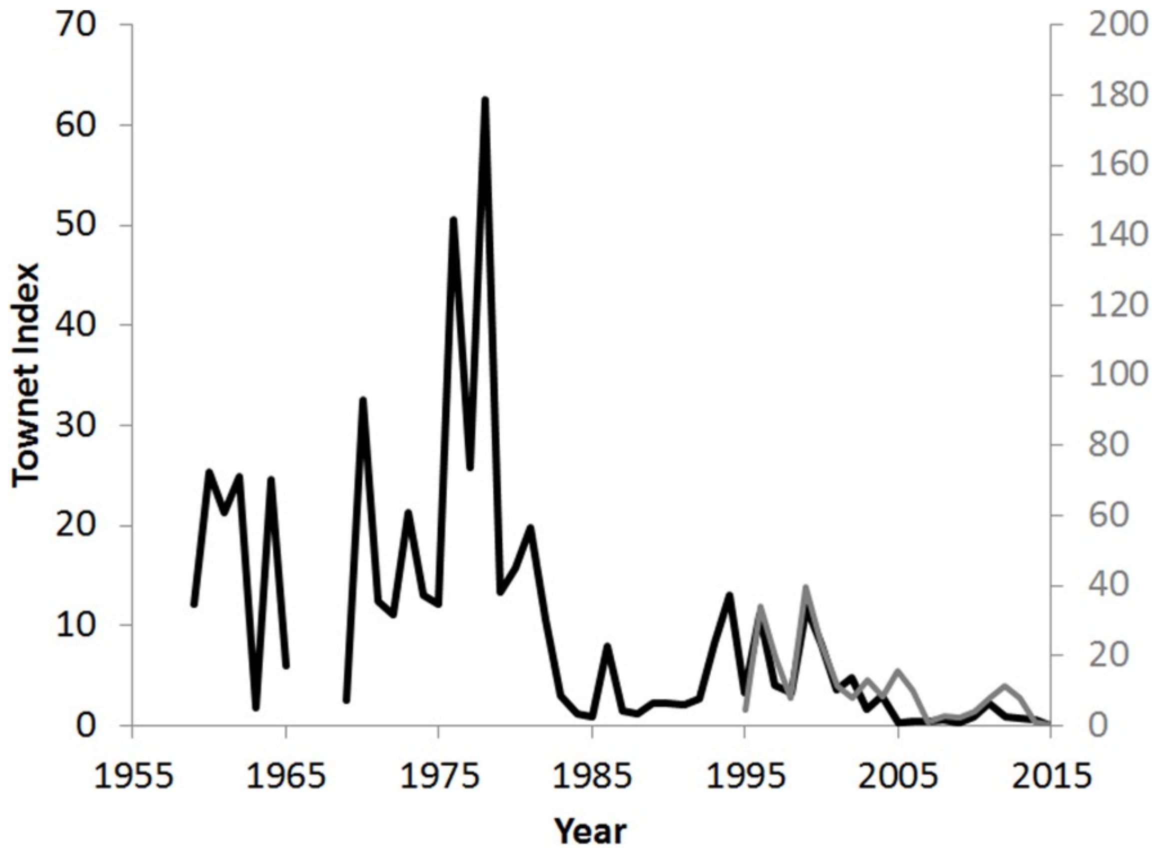

Figure 12. Time series of juvenile and larval delta smelt relative abundance as depicted by the California Department of Fish and Wildlife's TNS and 20-mm Survey, respectively. The TNS began in 1959 and the 20-mm Survey began in 1995. The second y-axis was scaled to better align the indices which are calculated on different numeric scales.

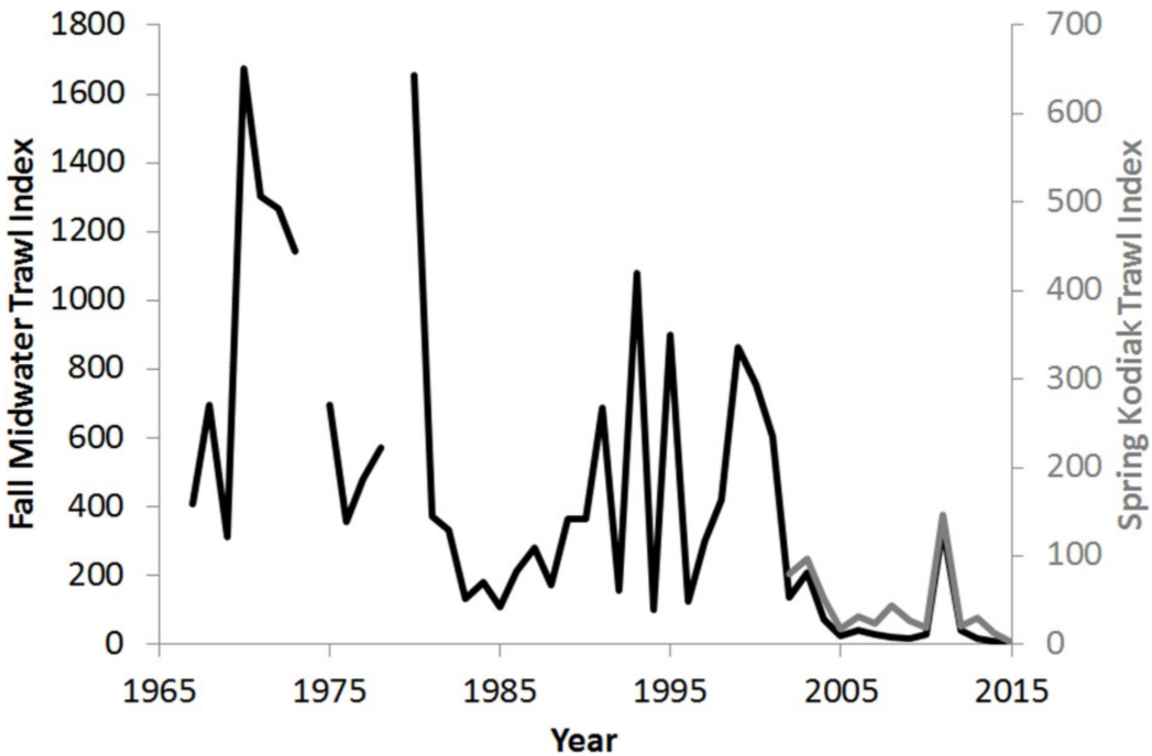

Figure 13. Time series of juvenile and larval delta smelt relative abundance as depicted by the California Department of Fish and Wildlife's FMWT and SKT Survey, respectively. The FMWT survey began in 1967and the SKT trawl survey began in 2002. The second y-axis was scaled to better align the indices which are calculated on different numeric scales.

Table 2. Estimates of adult delta smelt population size during January-February SKT of 2002 through 2021with 95% confidence intervals.

Year	Abundance Estimate	Standard Error	LowerBound (95% Confidence Interval)	UpperBound (95% Confidence Interval)	January (# Delta Smelt Caught in SKT Survey)	February (# Delta Smelt Caught in SKT Survey)	Year-to-Year Ratio
2002	1,093,244	195,329	760,332	1,523,294	262 (35)	394(39)	NA
2003	996,055	261,205	581,197	1,597,198	NA (0)	232 (39)	0.91
2004	966,981	262,190	553,729	1,573,002	380 (39)	300 (34)	0.97
2005	715,858	147,190	470,572	1,044,828	220 (39)	218 (40)	0.74
2006	272,327	42,400	198,681	364,438	44 (40)	84 (40)	0.38
2007	449,466	128,731	249,216	749,168	109 (40)	107 (39)	1.65
2008	509,428	188,396	236,859	963,839	132 (40)	36 (39)	1.13
2009	1,166,145	523,856	459,083	2,464,804	579 (40)	61 (42)	2.29
2010	251,863	54,580	161,753	374,582	88 (41)	57 (41)	0.22
2011	461,599	202,547	185,712	962,088	177 (42)	128 (40)	1.83
2012	1,177,201	328,682	662,728	1,939,836	320 (42)	287 (42)	2.55

2013	333,682	89,809	191,886	541,064	100 (41)	125 (41)	0.28
2014	308,972	91,474	167,858	522,884	148 (40)	55 (40)	0.93
2015	213,345	76,639	101,434	397,439	21 (39)	68 (39)	0.69
2016	25,445	9,584	11,661	48,622	7 (40)	6 (39)	0.12
2017	73,331	23,342	38,010	128,459	18 (38)	8 (41)	2.88
2018	26,649	21,397	5,215	82,805	10 (40)	4 (41)	0.36
2019	5,610	4,395	1,138	17,135	1 (40)	1 (39)	0.21
2020	5,213	3,644	1,241	14,710	1 (39)	1 (40)	0.93
2021	0	Not defined	Not defined	Not defined	0 (39)	0 (36)	0

Table 3. Enhanced Delta Smelt Monitoring (EDSM) Survey abundance estimates with columns as in Table 1.

Year	Abundance Estimate	Standard Error	LowerBound (95% Confidence Interval)	UpperBound (95% Confidence Interval)	January (# Delta Smelt Caught in ESDM Survey)	February (# Delta Smelt Caught in ESDM Survey)	Year-to-Year Ratio
2017	83,878	20,070	28,770	193,146	63 (477)	33 (684)	NA
2018	6,821	2,778	1,664	19,123	10 (772)	3 (610)	0.08
2019	4,482	1,062	1,546	10,288	18 (730)	7 (518)	0.66
2020	1,027	520	209	3,134	3 (691)	2 (606)	0.23
2021	267	189	41	928	2 (327)	0 (466)	0.26

Climate Change

Climate projections for the San Francisco Bay-Delta and its watershed indicate that changes willbe substantial by mid-century and considerable by the year 2100. Climate models broadly agree that average annual air temperatures will rise by about 2°C at mid-century and about 4°C by 2100 if current atmospheric carbon emissions accelerate as currently forecasted (Dettinger *et al.* 2016). It remains highly uncertain whether annual precipitation in the Bay-Delta watershed will trend wetter or drier (Dettinger 2005; Dettinger *et al.* 2016). The warmer air temperature projections suggest more precipitation will fall as rain rather than snow and that storms may increase in intensity, but will have more dry weather in between them (Knowles and Cayan 2002; Dettinger 2005; Dettinger *et al.* 2016). The expected consequences are less water stored inspring snowpacks, increased flooding and an associated decrease in runoff for the remainder of the year (Hayhoe *et al.* 2004). Changes in storm tracks may lead to increased frequency of floodand drought cycles during the 21st century (Dettinger *et al.* 2015).

As of 2009, sea level rise had not had much effect on X2 (Hutton *et al.* 2017b). However, additional sea level rise is another anticipated consequence of a warming global climate and if itis not mitigated, sea level rise will likely increase saltwater intrusion into the Bay-Delta (Rath *etal.* 2017). During the summer of 2015, variation in sea level interacted with very low Delta inflows to cause frequent recurrence of net negative Delta outflow (Monismith 2016).

Since the early 1980s, climate change is thought to have increased wind speed along the central California coast, resulting in a more frequent and longer lasting upwelling season (Garcia-Reyesand Largier 2010). Coastal upwelling causes colder deep water to rise to the ocean surface, bringing with it nutrients that stimulate the coastal food web. One effect of wind blowing over the estuary is that it resuspends sediment deposited in shallow areas like San Pablo Bay, GrizzlyBay, and Honker Bay (Ruhl *et al*. 2001). Thus, higher wind speeds blowing onto the coast mightbe expected to result in higher turbidity of the water in parts of the estuary. In contrast to this expectation, Bever *et al*. (2018) reported a recent reduction in wind speed over the Bay-Delta during 1995-2015, which these authors associated with lower turbidity in Suisun Bay. The Service notes these contrasting results for completeness but we cannot reconcile these opposing trends in wind speed at this time. We show below that Secchi disk depths (an indicator of water turbidity) have not increased since the mid-1980s near the (mobile) location of X2 even though suspended sediment concentrations in Suisun Bay have decreased since about 2000 (Schoellhamer 2011; Bever *et al*. 2018).

Central California's warm summers are already a source of energetic stress for delta smelt and warm springs can already severely compress the duration of their spawning season (Rose *et al.* 2013a,b). We expect warmer estuary temperatures to present a significant conservation challengefor delta smelt in the coming decades (Brown *et al.* 2013; 2016a; Figure 14). Feyrer *et al.* (2011)and Brown *et al.* (2013; 2016a) have evaluated the anticipated effects of projected climate change on several delta smelt habitat metrics. Collectively, these studies indicate the future will bring chronically compressed fall habitat, fewer 'good' turbidity days (defined by the authors as a mean turbidity greater than or equal to 18 Nephelometric Turbidity Units (NTU)), a spawning window of similar duration but that is shifted 2 to 3 weeks earlier in the year, and a substantial increase in the number of days delta smelt will need to endure lethal or near lethal summer watertemperatures.

The delta smelt lives at the southern limit of the inland distribution of the family Osmeridae along the Pacific coast of North America. The anticipated effects of a warming climate are expected to create increasing temperature related challenges for delta smelt at some future point.The amount of anticipated change to the regional climate expected in the near term is lower thanit is for the latter half of the century (Figure 14). Therefore, it is less certain that any measurablechange from current conditions will occur in the next approximately 10 years than by 2050 or 2100. For the time being, water temperatures are stressful to delta smelt, but not of themselves lethal in most of the upper estuary (Komoroske *et al.* 2015).

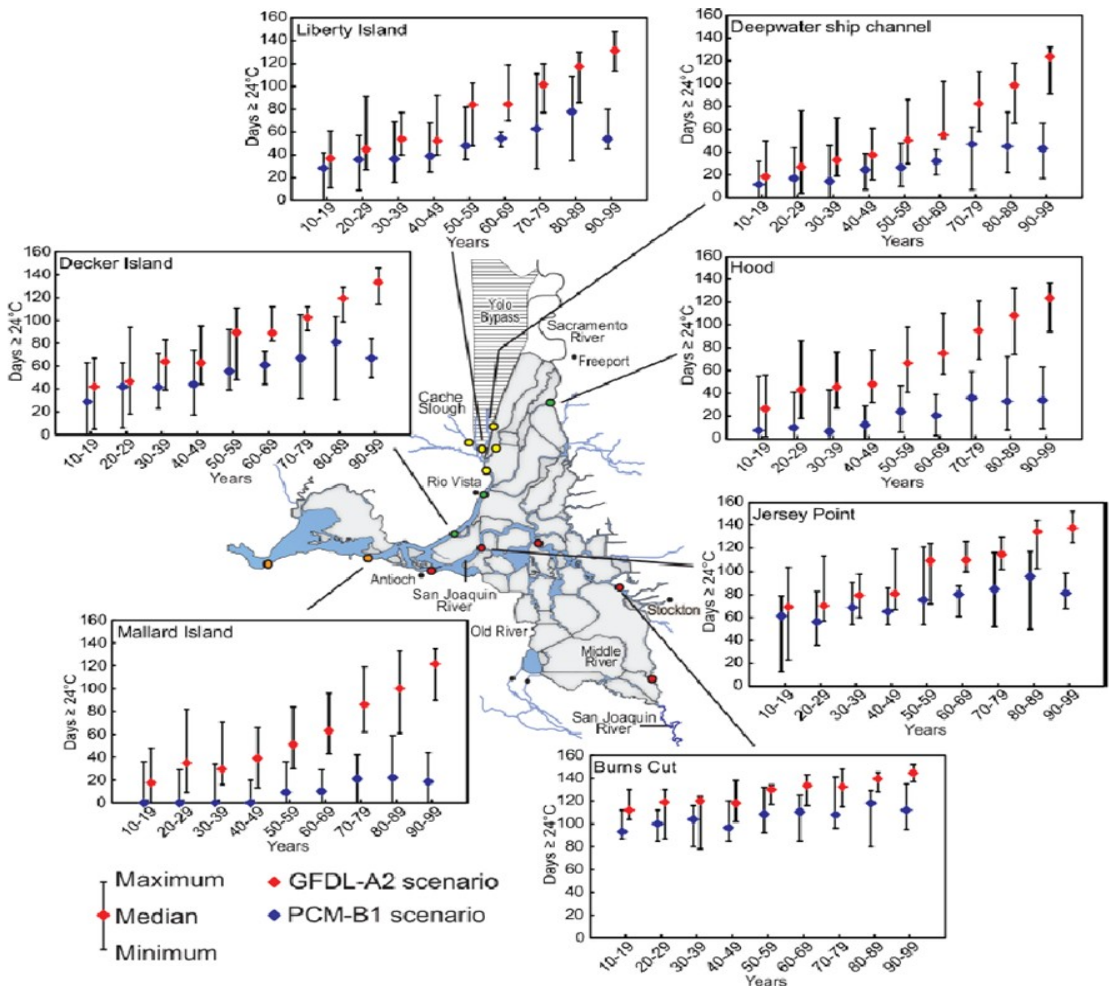

Figure 14. **Plots of median, maximum, and minimum number of days each year with an estimated average daily water temperature greater than or equal to 24°C (75°F) at selected sites in the Delta by decade for the21st century. The water temperature threshold reflects one chosen by the authors to represent near lethal conditions for delta smelt. Source: Brown *et al.* (2016a).**

Recovery and Management

Following Moyle *et al.* (1992), the Service (1993) indicated that SWP and CVP exports were theprimary factors contributing to the decline of delta smelt due to entrainment of larvae and juveniles and the effects of low flow on the location and function of the estuary mixing zone (now called the low-salinity zone). In addition, prolonged drought during 1987-1992, in-Delta water diversions, reduction in food supplies by nonindigenous aquatic species (specifically overbite clam and nonnative copepods), and toxicity due to agricultural and industrial chemicals were also factors considered to be threatening the delta smelt. In the Service's December 15, 2008 *Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP)* (2008 BO), the Reasonable andPrudent Alternative (RPA) required protection of all life stages from entrainment and augmentation of Delta outflow during the fall of Wet and Above-Normal years as classified by the State of California (Service 2008). The expansion of entrainment protection for delta smelt inthe 2008 BO was in response to large increases in juvenile and adult salvage in the early 2000s (Kimmerer 2008; Brown *et al.* 2009). The fall X2 requirement in the 2008 RPA was in responseto increased fall exports that had reduced variability in Delta outflow and lowered habitat suitability during the fall months and the 2008 proposed action was anticipated to reduce it further (Feyrer *et al.* 2011).

The Service's (2010c) recommendation to uplist delta smelt from threatened to endangered included a discussion of threats related to reservoir operations and water diversions upstream of the estuary as additional water operations mechanisms interacting with exports from the Delta to restrict the LSZ and concentrate delta smelt with competing and predatory fish species. In addition, Brazilian waterweed (*Egeria densa*) and increasing water transparency were considerednew detrimental habitat changes. Predation was considered a low-level threat linked to increasing waterweed abundance and increasing water transparency. Additional threats considered potentially significant by the Service in 2010 were entrainment into power plant diversions, contaminants, and reproductive problems that can stem from small population sizes. Conservation recommendations included: establish Delta outflows proportionate to unimpaired flows to set outflow targets as fractions of runoff in the Central Valley watersheds; minimize reverse flows in Old and Middle rivers; and, establish a genetic management plan for captive-reared delta smelt with the goals of minimizing the loss of genetic diversity and limiting risk of extinction caused by unpredictable catastrophic events. The Service (2012) recently added climate change to the list of threats to the delta smelt.

Maintaining protection of the delta smelt from excessive entrainment, improving the estuary's flow regime, suppression of nonnative species, increasing zooplankton abundance, and improving water quality are among the actions the Service has previously indicated are needed torecover the delta smelt.

There have been several recent papers suggesting it is time to consider supplementation of the wild delta smelt population with captive-bred fish as part of a broad-based conservation strategyto avoid extinction in the wild, also known as extirpation (Moyle *et al.* 2016; 2018; Hobbs *et al.*2017; Lessard *et al.* 2018). In 2019, pilot research conducted by the California Department of Water Resources (DWR) has demonstrated that captive-bred delta smelt held within steel enclosures can survive in the Delta for at least 30 days. This is long enough to show that the fishcan feed themselves and did not die from acute water toxicity in either of two locations tested thus far. The fish will be evaluated for chronic toxic exposure, but that work is not finished.

These results are promising and similar research is planned this year.

The status of the delta smelt is poor. The current estimated delta smelt population sizes are so low that it seems unlikely the species can be habitat- or food-limited even though both physical and food web-related habitat attributes have degraded over time. It is more likely that delta smelthave been marginalized by non-native fishes and invertebrates that compete with and prey on them. When fish populations reach very low levels, they can fall victim to demographic problems (often termed Allee effects in the scientific literature). These include problems concentrating enough individuals in particular locations for successful spawning, successful feeding, or maintaining large enough egg supplies, or shoals and schools of juvenile and adult fish to provide effective protection from predators (Liermann and Hilborn 2001; Keith and Hutchings 2012).

Summary of the Status of Delta Smelt

The relative abundance of delta smelt has reached very low numbers for a small forage fish in an ecosystem the size of the Bay-Delta and the species is approaching extinction in the wild (Moyle*et al.* 2016; 2018; Hobbs *et al.* 2017). The extremely low 2018-2020 abundance indices reflect decades of habitat change and marginalization by non-native species that prey on and out- compete delta smelt. The anticipated effects of climate change on the Bay-Delta and its watershed such as warmer water temperatures, greater salinity intrusion, lower snowpack contribution to spring outflow, and the potential for frequent extreme drought, indicate challenges to delta smelt survival will increase.

Environmental Baseline

Environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action Area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the Action Area, theanticipated 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. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the *Environmental Baseline*.

The Action Area encompasses the Delta and Suisun Bay and represents a large portion of the delta smelt's range. Delta smelt are likely to occur in Suisun Bay, the North Delta Arc, and portions of the lower Sacramento and San Joaquin rivers during the project's in-water work window. Delta smelt are not expected to be in the central and south Delta and portions of the Sacramento River above the City of Sacramento during the project's in-water work window. Asdiscussed in the *Status of the Species* section delta smelt abundance is historically low and continues to trend downward.

There have been numerous consultations on effects to delta smelt since the species was listed in1993. A number of select projects and consultations in the Action Area that have played significant roles in shaping the current conditions of the delta smelt and its habitat are listed below:

- The Service and National Marine Fisheries Service's (NMFS) 2019 biological opinionson the Reinitiation of Consultation on the Coordinated Operations of the CVP and SWP
- The Service's 2008 and NMFS' 2009 biological opinions on the Proposed CoordinatedOperations of the CVP and SWP
- The Service's previous biological opinion on the operation of the CVP and SWP dated February 1994, March 1995, July 2004, and a reinitiation of the 2004 BiOp in February2005
- California EcoRestore
- DWR's South Delta Temporary Barriers Project
- SWRCB's Water Quality Control Plan
- Central Valley Project Improvement Act
- 2014-2016 Drought Operations
- 2021 Drought Operations
- Channel Maintenance Dredging and Sand Mining Projects
- Levee Projects
- Aquatic Weed Control
- Suisun Marsh Plan
- Scientific Monitoring
- Use of cultured delta smelt for scientific research purposes

Effects of the Proposed Action

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

Pile Driving Noise

Underwater sound pressure waves can harass and harm fish species (Reyff 2003; Abbott and Bing-Sawyer 2002; California Department of Transportation 2001; Longmuir and Lively 2001; Stotz and Colby 2001). As the pressure wave passes through a fish, the swim bladder is rapidly squeezed due to the high pressure, and then rapidly expanded as the under-pressure component of the wave passes through the fish. This can cause adverse effects including rupture of the swimbladder, rupture of capillaries, internal hemorrhage, neurological stress, and auditory damage.
Extreme sound waves can cause instantaneous death, latent death within minutes after exposure,or can occur several days later.

Elevated noise levels can cause sub-lethal injuries affecting survival and fitness. Similarly, if injury does not occur, noise may modify fish behavior that may make them more susceptible topredation. Fish suffering damage to hearing organs may suffer equilibrium problems and may have a reduced ability to detect predators and prey. Other types of sub-lethal injuries can place the fish at increased risk of predation and disease. Adverse effects on survival and fitness can occur even in the absence of overt injury. Exposure to elevated noise levels can cause a temporary shift in hearing sensitivity (referred to as a temporary threshold shift or TTS), decreasing sensory capability for periods lasting from hours to days (Turnpenny *et al.* 1994; Hastings *et al.* 1996).

The Fisheries Hydroacoustic Working Group, an interagency working group that includes the Service, has established interim criteria for evaluating underwater noise impacts from pile driving on fish. These criteria are defined in the document entitled “Agreement in Principal for Interim Criteria for Injury to Fish from Pile Driving Activities” dated June 12, 2008 (Fisheries Hydroacoustic Working Group 2008). This agreement identifies a peak sound pressure level of 206 decibels (dB) and an accumulated sound exposure level (ASEL)[1] of 187 dB as thresholds for injury to fish ≥ to 2 grams (g). For fish less than 2g, the ASEL threshold is reduced to 183 dB. Although there has been no formal agreement on a “behavioral” threshold, NMFS uses 150 dB-root mean square (RMS) as the threshold for adverse behavioral effects. Pile driving with a vibratory hammer minimizes the amount of noise and turbidity generated by the activity and reduces traumas to fish.

Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish (California Department of Transportation 2015) provides sound level data on a variety ofpile sizes and driver types. The installation of a 12-inch steel pile would result in an ASEL of 155 and a peak of 171 dB when driven in less than 5 meters of water using a vibratory hammer. The installation of a 36-inch steel pile would result in an ASEL of 170 and a peak of 180 dB when driven in approximately 5 meters of water using a vibratory hammer. The USGS proposes to use 18-inch or 14-inch steel piles and expect the sound levels to fall between these two reported values which are lower than NMFS interim criteria for fish injury but above criteria for behavior effects. The underwater noise would be limited to the time it takes to remove or place each pile, which is generally between 10 and 45 minutes, depending on weather and soil conditions.

1 SEL is defined as the constant sound level acting for one second, which has the same amount of acoustic energy as the originalsound. Expressed another way, the sound exposure level is a measure of the sound energy in a single pile driver strike.

The USGS will conduct work within the Service's recommended in-water work window and willavoid effects to delta smelt during the spawning season and larval rearing. During this time, deltasmelt are not anticipated to be within the central and south Delta and pile driving in those locations during the work window will not result in effects. Pile driving in the remaining areas ofthe Action Area may result in temporary behavior effects to juvenile and sub-adults. However, by using the "ramp-up" technique, delta smelt may move away from the area before the pile is vibrated in place. Additionally, the amount of aquatic habitat relative to the monitoring station locations is relatively large and delta smelt would be afforded a significant portion of aquatic habitat in which to move from the area during proposed project activities.

Turbidity

Turbidity would increase during barge spudding or anchoring, pile removal and placement, but disturbed sediment would be limited both geographically and temporally, and would be dispersed quickly by the current. Barge and crane activity would be short-term as well, and would be consistent with general levels of commercial and recreational boat traffic in the area.

Habitat Modification

Upon project completion, the volume of habitat occupied by the stations will be on the order of 40 cubic feet per piling. In the cases where a piling will be removed, there will be no net changeat those locations.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action or future actions that implement planning effortsthat may have adverse effects are not considered in this section. These projects would have a Federal nexus and would require separate consultation pursuant to section 7 of the Act to addresseffects to delta smelt as appropriate.

Adverse effects to delta smelt and delta smelt critical habitat may result from point and non-pointsource chemical contaminant discharges within the Action Area. These contaminants include butare not limited to ammonia and free ammonium ion, numerous pesticides and herbicides from agricultural activities, and oil and gasoline product discharges. Oil and gasoline product discharges may be introduced into Delta waterways from shipping and boating activities and from urban activities and runoff. Implicated as potential stressors, these contaminants may adversely affect fish reproductive success and survival rates.

Accumulated SEL (ASEL) is the cumulative SEL resulting from successive pile strikes. ASEL is based on the number of pile strikes and the SEL per strike; the assumption is made that all pile strikes are of the same SEL. Peak sound pressure refers to thehighest absolute value of a measured waveform (i.e., sound pressure pulse as a function of time).

Conclusion

After reviewing the current *Status of the Species* status for the delta smelt, the *Environmental Baseline* for the Action Area, the *Effects of the Proposed Action*, and the *Cumulative Effects*, it isthe Service's biological opinion that the U.S. Geological Survey Monitoring Network: Maintenance, Upgrades, and Expansion Project, as proposed, is not likely to jeopardize the continued existence of the delta smelt. The Service reached this conclusion because the project- related effects to the species, when added to the *Environmental Baseline* and analyzed in consideration of all potential *Cumulative Effects*, will not rise to the level of reducing the likelihood of survival or recovery of this species based on the following: (1) the action results in small temporary disturbances over a 5-year period; (2) in-water work will avoid the spawning season and would occur when delta smelt may not be present in portions of the Action Area; (3) pile driving with vibratory hammer is not anticipated to result in injury or mortality; and (4) the low abundance of delta smelt reduces the risk of exposure to the temporary disturbances.

INCIDENTAL TAKE STATEMENT

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

The measures described below are nondiscretionary and must be implemented by the USGS so that they become binding conditions of this action, in order for the exemption in section 7(o)(2) to apply. The USGS has a continuing duty to regulate the activity covered by this incidental takestatement. If the USGS (1) fails to adhere to the terms and conditions of the incidental take statement and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the USGS must report the progress of the action and its impact on the speciesto the Service as specified in the incidental take statement [50 CFR § 402.14 (i)(3)].

Amount or Extent of Take

The Service anticipates incidental take of delta smelt will be difficult to detect and quantify because of the species' small size and cryptic nature and therefore it is not possible to provide precise numbers of delta smelt that could be harmed from the proposed project. There are numerical limitations with respect to detecting individual delta smelt in the wild, and for that reason, it is not practical to express the amount or extent of anticipated take of this species or monitor take-related impacts in terms of individual delta smelt. Due to the difficulty in quantifying the number of delta smelt that will be taken as a result of the proposed project, the Service is using habitat as a surrogate to quantify incidental take of the species. Therefore, to quantify the level of incidental take associated with the proposed project, the Service anticipatesthat all delta smelt within the immediate vicinity of the proposed pilings within the Delta but outside of the central and south Delta will be subject to incidental take in the form of harm by temporarily impairing essential behaviors. Harm is anticipated to be low because of: (1) the current low relative abundance and (2) small temporary disturbance spread out over the 5-year project. Because activities will occur during the proposed work window, take is not expected to occur in areas of the central and south Delta and north of the City of Sacramento and is therefore not exempted. Upon implementation of the *Reasonable and Prudent Measures*, incidental take associated with the project will become exempt from the prohibitions described under section 9 of the Act.

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated takeis not likely to result in jeopardy to the delta smelt.

Reasonable and Prudent Measure

The following reasonable and prudent measure is necessary and appropriate to minimize theeffects of the proposed project to the delta smelt:

1. The USGS shall minimize the potential for take of the delta smelt.

Term and Condition

In order to be exempt from the prohibitions of section 9 of the Act, the USGS shall ensure compliance with the following term and condition, which implement the reasonable and prudentmeasure described above. This term and condition is nondiscretionary.

1. The following Terms and Conditions implement Reasonable and Prudent MeasureNumber One (1):

    a. The USGS shall educate and inform staff and contractors involved in the project as to the *Description of the Proposed Action* including the *Conservation Measure*and the *Term and Condition* in this biological opinion.

Reporting Requirements

In order to monitor whether the amount or extent of incidental take anticipated from implementation of the project is approached or exceeded, the USGS shall adhere to the followingreporting requirements. Should this anticipated amount or extent of incidental take be exceeded, the USGS must reinitiate formal consultation as per 50 CFR 402.16.

1. The Service must be notified within 24 hours of the finding of any injured or dead listed species or any unanticipated damage to its habitat associated with the proposed project. Injured listed species shall be cared for by a licensed veterinarian or other qualified person. Notification will be made to the contact below in *Reporting Requirements*, and must include the date, time, and precise location of the individual/incident clearly indicated on a USGS 7.5 minute quadrangle or other maps at a finer scale, as requested by the Service, and any other pertinent information. When an injured or dead individual of the listed species is found, the USGS shall follow the steps outlined in the *Dispositionof Individuals Taken* section below.

2. Sightings of any listed or sensitive animal species shall be reported to the Service andCalifornia Natural Diversity Database (https://www.wildlife.ca.gov/Data/CNDDB/Submitting-Data).

3. The USGS shall submit an annual compliance report to the San Francisco Bay-Delta Fishand Wildlife Office within sixty (60) calendar days of the date of the completion of construction activities. This report shall detail: (i) dates that construction occurred; (ii) pertinent information concerning the success of the project in meeting the avoidance and minimization measures; (iii) an explanation of failure to meet such measures, if any; (iv) known project effects on the delta smelt, if any; (v) occurrences of incidental take of this listed species, if any; (vi) documentation of employee environmental education; and (vii)other pertinent information.

Disposition of Individuals Taken

Injured listed species must be cared for by a licensed veterinarian or other qualified person(s), such as the Service-approved biologist. Dead individuals must be sealed in a resealable plastic bag containing a paper with the date and time when the animal was found, the location where it was found, the name of the person who found it, and the bag containing the specimen frozen in afreezer located in a secure site, until instructions are received from the Service regarding the disposition of the dead specimen. The Service contact person is Jana Affonso, Assistant Field Supervisor of the Endangered Species Division at (916) 930-2664.

CONSERVATION RECOMMENDATIONS

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

1. Assist the Service and IEP with scientific monitoring efforts within the Delta and SanFrancisco Bay ecosystems.

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

REINITIATION - CLOSING STATEMENT

This concludes the consultation for the U.S. Geological Survey Monitoring Network: Maintenance, Upgrades, and Expansion Project. As provided in 50 CFR §402.16,

(a) Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and:

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

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

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

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

(b) An agency shall not be required to reinitiate consultation after the approval of a land management plan prepared pursuant to 43 U.S.C. 1712 or 16 U.S.C. 1604 upon listing of a new species or designation of new critical habitat if the land management plan has been adopted by the agency as of the date of listing or designation, provided that any authorized actions that may affect the newly listed species or designated critical habitat will be addressed through a separate action-specific consultation. This exception to reinitiation of consultation shall not apply to thoseland management plans prepared pursuant to 16 U.S.C. 1604 if:

(1) Fifteen years have passed since the date the agency adopted the land management planprepared pursuant to 16 U.S.C. 1604; and

(2) Five years have passed since the enactment of Public Law 115-141 [March 23, 2018] orthe date of the listing of a species or the designation of critical habitat, whichever is later.

Please address any questions or concerns regarding this response to Kim Squires, Section 7 Division Manager, at Kim_Squires@fws.gov. Please refer to Service file numbers 08FBDT00-2021-F-0136, in any future correspondence.

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13 Appendix E

Environmental Justice Report

EJSCREEN Report (Version 2020)

the User Specified Area, CALIFORNIA, EPA Region 9

Approximate Population: 90,572

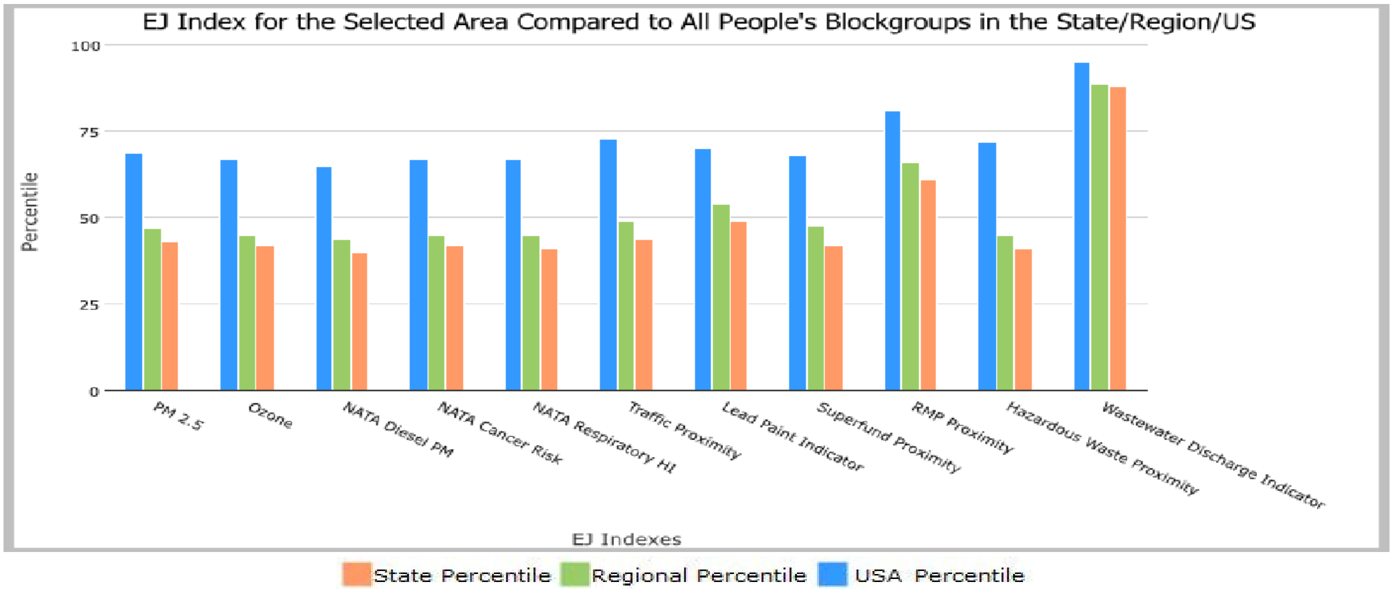
Input Area (sq. miles): 527.94

Selected Variables	State Percentile	EPA Region Percentile	USA Percentile
EJ Indexes			
EJ Index for PM2.5	43	47	69
EJ Index for Ozone	42	45	67
EJ Index for NATA* Diesel PM	40	44	65
EJ Index for NATA* Air Toxics Cancer Risk	42	45	67
EJ Index for NATA* Respiratory Hazard Index	41	45	67
EJ Index for Traffic Proximity and Volume	44	49	73
EJ Index for Lead Paint Indicator	49	54	70
EJ Index for Superfund Proximity	42	48	68
EJ Index for RMP Proximity	61	66	81
EJ Index for Hazardous Waste Proximity	41	45	72
EJ Index for Wastewater Discharge Indicator	88	89	95

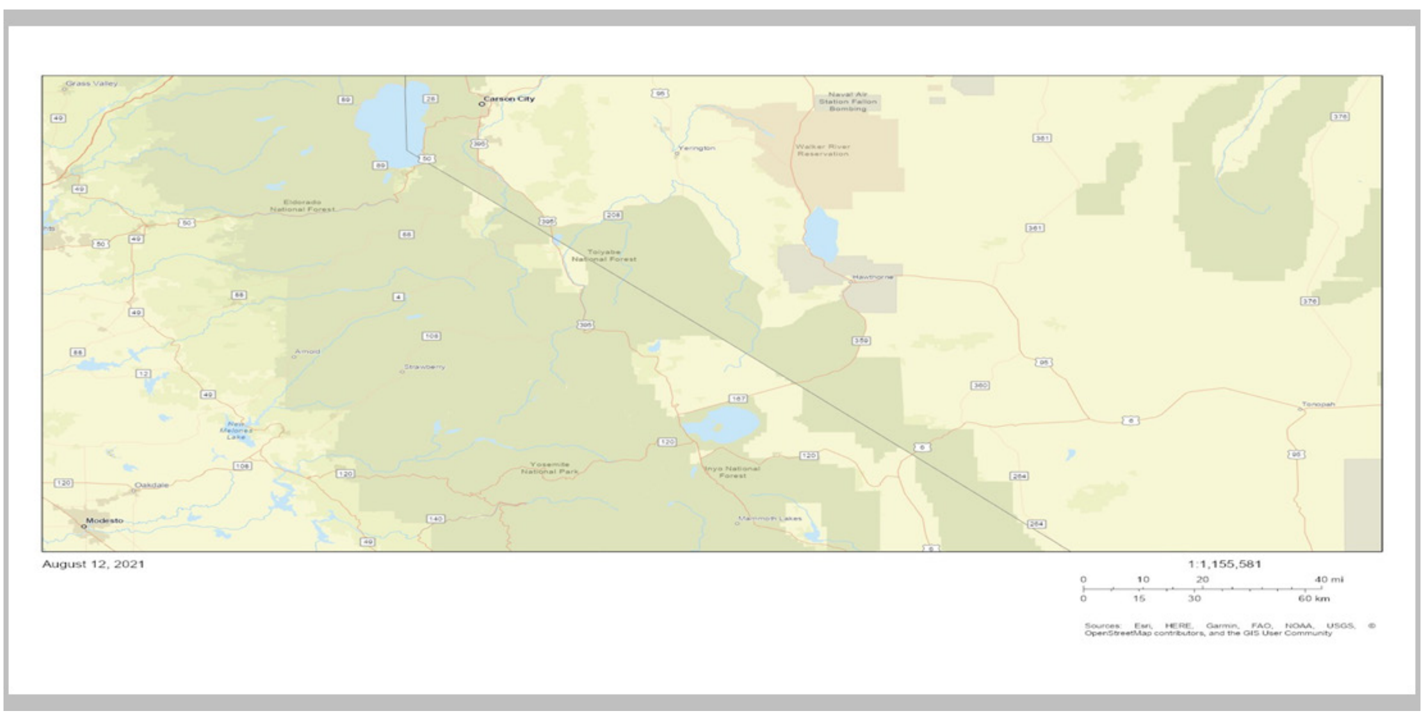
the User Specified Area, CALIFORNIA, EPA Region 9

Approximate Population: 90,572

Input Area (sq. miles): 527.94



This report shows the values for environmental and demographic indicators and EJSCREEN indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports.



Sites reporting to EPA	Number
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities	10

Selected Variables	Value	State Avg.	%ile in State	EPA Region Avg.	%ile in EPA Region	USA Avg.	%ile in USA
Environmental Indicators							
Particulate Matter (PM 2.5 in µg/m³)	10.9	10.6	54	9.99	63	8.55	93
Ozone (ppb)	44.7	49.2	35	50.1	28	42.9	69
NATA* Diesel PM (µg/m³)	0.284	0.467	27	0.479	<50th	0.478	<50th
NATA* Cancer Risk (lifetime risk per million)	32	36	33	35	<50th	32	50-60th
NATA* Respiratory Hazard Index	0.52	0.55	43	0.53	<50th	0.44	70-80th
Traffic Proximity and Volume (daily traffic count/distance to road)	270	2000	23	1700	31	750	55
Lead Paint Indicator (% Pre-1960 Housing)	0.14	0.29	43	0.24	52	0.28	45
Superfund Proximity (site count/km distance)	0.056	0.17	34	0.15	40	0.13	46
RMP Proximity (facility count/km distance)	1.2	1.1	71	0.99	75	0.74	81
Hazardous Waste Proximity (facility count/km distance)	1.3	6.2	19	5.3	25	5	56
Wastewater Discharge Indicator (toxicity-weighted concentration/m distance)	0.75	18	88	18	89	9.4	94
Demographic Indicators							
Demographic Index	41%	47%	40	46%	43	36%	64
People of Color Population	55%	62%	39	60%	43	39%	69
Low Income Population	27%	33%	47	33%	47	33%	47
Linguistically Isolated Population	5%	9%	41	8%	47	4%	71
Population With Less Than High School Education	12%	17%	48	16%	51	13%	61
Population Under 5 years of age	6%	6%	53	6%	53	6%	57
Population over 64 years of age	14%	14%	61	14%	59	15%	50

* The National-Scale Air Toxics Assessment (NATA) is EPA's ongoing, comprehensive evaluation of air toxics in the United States. EPA developed the NATA to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that NATA provides broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. More information on the NATA analysis can be found at: https://www.epa.gov/national-air-toxics-assessment.

For additional information, see: www.epa.gov/environmentaljustice

EJSCREEN is a screening tool for pre-decisional use only. It can help identify areas that may warrant additional consideration, analysis, or outreach. It does not provide a basis for decision-making, but it may help identify potential areas of EJ concern. Users should keep in mind that screening tools are subject to substantial uncertainty in their demographic and environmental data, particularly when looking at small geographic areas. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports. This screening tool does not provide data on every environmental impact and demographic factor that may be relevant to a particular location. EJSCREEN outputs should be supplemented with additional information and local knowledge before taking any action to address potential EJ concerns.

August 12, 2021