ENVIRONMENTAL ASSESSMENT

FOR HYDROPOWER LICENSE

Igiugig Hydrokinetic Project—FERC Project No. 13511-003

Alaska

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
888 First Street, NE
Washington, DC 20426

February 2019

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

Alaska DFG	Alaska Department of Fish and Game
Alaska SHPO	Alaska State Historic Preservation Office
BMP	best management practice
°C	degrees Celsius
APE	area of potential effects
Commission	Federal Energy Regulatory Commission
EA	environmental assessment
EFH	essential fish habitat
ESA	Endangered Species Act
ESCP	Erosion and Sedimentation Control Plan
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
ft/s	feet/second
IVC	Igiugig Village Council
kW	kilowatt
kWh	kilowatt hours
MMPA	Marine Mammal Protection Act
MWh	megawatt-hour
National Register	National Register of Historic Places
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act of 1966
NMFS	National Marine Fisheries Service
ORPC	Ocean Renewable Power Company
project	Igiugig Hydrokinetic Project No. 13511
SCADA	supervisory control and data acquisition
SHPO	State Historic Preservation Officer
TGU	turbine generator unit
USGS	U.S. Geological Survey

This page intentionally left blank.

ENVIRONMENTAL ASSESSMENT

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
Washington, DC

Igiugig Hydrokinetic Project
FERC Project No. 13511-003—Alaska

1.0 INTRODUCTION

1.1 APPLICATION

On November 15, 2018, the Igiugig Village Council (IVC) filed an application for a pilot project license with the Federal Energy Regulatory Commission (Commission or FERC) to construct and operate the proposed Igiugig Hydrokinetic Project (Igiugig Project or project). The 70-kilowatt (kW) project would be located on the Kvichak River in the Lake and Peninsula Borough, near the town of Igiugig, Alaska (Figure 1). The project would not occupy federal land. The estimated average annual generation of the project is 404 megawatt-hours (MWh).

1.2 PURPOSE OF ACTION AND NEED FOR POWER

1.2.1 Purpose of Action

The purpose of the proposed Igiugig Project is two-fold: (1) to evaluate the technical, economic, and environmental viability of Ocean Renewable Power Company's (ORPC's) design and the energy generation potential at the proposed project site in the Kvichak River; and (2) to provide a new source of hydroelectric power. Therefore, under the provisions of the Federal Power Act (FPA), the Commission must decide whether to issue a license to the IVC for the project and what conditions should be placed on any license issued. In deciding whether to issue a license for a hydroelectric project, the Commission must determine that the project would be best adapted to a comprehensive plan for improving or developing a waterway. In addition to the power and developmental purposes for which licenses are issued (such as flood control, irrigation, or water supply), the Commission must give equal consideration to the purposes of: (1) energy conservation; (2) the protection of, mitigation of damage to, and

enhancement of, fish and wildlife resources; (3) the protection of recreational opportunities; and (4) the preservation of other aspects of environmental quality.

Figure 1. Location of Igiugig Hydrokinetic Project (Source: application).

Issuing a pilot project license for the Igiugig Project would allow the IVC to generate electricity during its proposed 10-year license term, making electrical power from a renewable resource available to its customers. IVC's proposed monitoring programs would also provide important information on any unanticipated environmental effects of such riverine hydrokinetic energy developments, which could assist with the evaluation of similar projects.

This environmental assessment (EA) evaluates the environmental and economic effects of constructing and operating the proposed project: (1) as proposed by the applicant, and (2) with staff's recommended measures. Staff also considers the effects of the no-action alternative. The primary issues that are addressed include potential effects on fisheries resources, navigation, and cultural resources.

1.2.2 Need for Power

Igiugig has an isolated electric system, and the only power supply in the area is from a 40-kW diesel-fueled power plant. Diesel fuel is delivered to the community via plane or barge, with the potential for hazardous spills into the surrounding area.

Energy needs in Igiugig have grown due to construction of various municipal service facilities and are anticipated to increase with a growth in tourism. The future use of the project's power, its displacement of non-renewable fossil-fueled generation and subsequent avoidance of power plant emissions, and its contribution to a diversified generation mix demonstrate that the project would help meet a need for power in the region. The successful operation of the Igiugig Project would also help to demonstrate the viability of this energy industry segment.

1.3 STATUTORY AND REGULATORY REQUIREMENTS

A license for the project would be subject to numerous requirements under the FPA and other applicable statutes. We summarize the major regulatory requirements in Table 1 and describe them below.

Table 1. Major statutory and regulatory requirements for the Igiugig Hydrokinetic Project (source: staff).

Requirement	Agency	Status
Section 18 of the FPA (fishway prescriptions)	National Marine Fisheries Service (NMFS)	None filed.
Section 10(j) of the FPA	Alaska Department of Fish and Game (Alaska DFG)	Filed 10(j) recommendations on December 28, 2018.
Endangered Species Act Consultation	Fish and Wildlife Service (FWS)	There are no threatened or endangered species or critical habitat within the project boundary.
Marine Mammals Protection Act	NMFS	Staff determined that the proposed project would have no effect on marine mammals.
Magnuson-Stevens Fishery Conservation and Management Act	NMFS	There is no Essential Fish Habitat in the project area.
National Historic Preservation Act	Alaska State Historic Preservation Office (Alaska SHPO)	Staff determined that the proposed project would have no effect on historic properties.

1.3.1 Federal Power Act

1.3.1.1 Section 18 Fishway Prescriptions

Section 18 of the FPA states that the Commission is to require construction, operation, and maintenance by a licensee of such fishways as may be prescribed by the Secretaries of Commerce or the Interior. No fishway prescriptions were filed for the proposed Igiugig Project.

1.3.1.2 Section 10(j) Recommendations

Under section 10(j) of the FPA, each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and

state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project. The Commission is required to include these conditions unless it determines that they are inconsistent with the purposes and requirements of the FPA or other applicable law. Before rejecting or modifying an agency recommendation, the Commission is required to attempt to resolve any such inconsistency with the agency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

Alaska DFG timely filed, on December 28, 2018, recommendations under section 10(j), as summarized in table 10, in section 5.4, *Fish and Wildlife Agency Recommendations.* In section 5.4, we also discuss how we address the agency recommendations and comply with section 10(j). One of Alaska DFG recommendations is that IVC allow Alaska DFG employees access to the project area. We find this recommendation to be administrative in nature; and therefore, it is not analyzed in this EA.

1.3.2 Endangered Species Act

Section 7 of the Endangered Species Act (ESA) requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. On February 4, 2019, Commission staff generated an official species list on the U.S. Fish and Wildlife Service's Information, Planning, and Conservation (IPaC) website. The list indicates that no threatened, endangered, proposed, or candidate species and no designated critical habitat occur within the project boundary. Therefore, no further consultation is required under the ESA.

1.3.3 Marine Mammal Protection Act

The 1972 Marine Mammal Protection Act (MMPA) prohibits, with certain exceptions, the "take" (defined under statute to include harassment) of marine mammals in U.S. waters and the high seas. In 1986, Congress amended both the MMPA, under the incidental take program, and the ESA, to authorize incidental takings of depleted, endangered, or threatened marine mammals, provided the "taking" (defined under the statute as actions which are or may be lethal, injurious, or harassing) was small in number and had a negligible impact on marine mammals.

Harbor seals and beluga whales, neither of which are ESA-listed species, could occur in the vicinity of the proposed project; however, the likelihood of their presence is very low because harbor seals do not leave Lake Iliamna and beluga whales are not known to swim upstream to the project area. Based on our analysis of potential project effects on non-listed marine mammals (presented in section 3.3.2.2, *Environmental Effects, Aquatic Resources*), we conclude that the proposed project would have no effect on either species.

1.3.4 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act requires federal agencies to consult with NMFS on all actions that may adversely affect essential fish habitat (EFH). The proposed project area does not contain EFH for any species.

1.3.5 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) requires that every federal agency "take into account" how each of its undertakings could affect historic properties. Historic properties are districts, sites, buildings, structures, traditional cultural properties, and objects significant in American history, architecture, engineering, and culture that are eligible for inclusion in the National Register of Historic Places (National Register). On April 23, 2015, the Commission designated the applicant as the Commission's representative under Section 106. On December 21, 2018, the Alaska SHPO commented that the project has the potential to affect the Igiugig Archaeological District, which is eligible for listing on the National Register. On February 15, 2019, the Alaska SHPO determined that the project would have no effect on cultural resources in the project area.[1] Staff concurs with this determination.

1.4 PUBLIC REVIEW AND COMMENT

The Commission's regulations (18 C.F.R., §§ 5.1-5.16) require that applicants consult with appropriate resource agencies, tribes, and other entities before filing an application for a license. This consultation is the first step in complying with the Fish and Wildlife Coordination Act, the ESA, the NHPA, and other federal statutes. Pre-filing consultation must be complete and documented according to the Commission's regulations.[2]

1.4.1 Comments on the Draft License Application

On April 23, 2015, the Commission issued a notice that the IVC had filed a draft license application for the Igiugig Project. This notice set May 23, 2015, as the deadline for filing comments. In response to the notice, the following entities commented:

---

[1] *See* February 15, 2019 letter from Judith Bittner, Alaska State Historic Preservation Officer, to AlexAnna Salmon, Igiugig Village Council, filed with the Commission on February 15, 2019.

[2] The Commission waived sections 5.8 and 5.10 of its regulations, which specify the project scoping requirements for the Commission's Integrated Licensing Process, by letter issued August 17, 2015.

Commenting Entities	Date Filed
Bristol Bay Native Corporation	May 22, 2015
Iliamna Lake Contractors, LLC	May 22, 2015

On August 17, 2015, the Commission approved the use of the pilot project procedures.

1.4.2 Interventions

On November 29, 2018, the Commission issued a notice accepting IVC's application for a pilot project license. The notice set December 28, 2018, as the deadline for filing protests and motions to intervene. No protests or motions to intervene were filed.

1.4.3 Comments on the License Application

The November 29, 2018 notice also requested comments, recommendations, and terms and conditions. The following entities filed comments and recommendations:

Commenting Agency and Other Entities	Date Filed
Sarah J. Meitl (Alaska SHPO)	December 21, 2018
Alaska DFG	December 28, 2018
Bristol Bay Native Corporation	January 3, 2019
Lake and Peninsula Borough	January 18, 2019
Department of the Interior	February 4, 2019

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 NO-ACTION ALTERNATIVE

The no-action alternative is license denial. Under the no-action alternative, the project would not be installed, and environmental resources in the project area would not be affected.

2.2 APPLICANT'S PROPOSAL

2.2.1 Project Facilities

The proposed Igiugig Hydrokinetic Project would consist of: (1) an in-stream, 35-kW, approximately 52-foot-long, 12-foot-high, 47-foot-wide pontoon-mounted RivGen Power System Turbine Generator Unit (TGU) (Figure 2) to be installed during Phase 1 of the project; (2) an additional in-stream 35-kW pontoon-mounted TGU to be installed during Phase 2 of the project; (3) two anchoring systems (one installed during Phase 1 and the other installed during Phase 2), each consisting of a 6,600-pound anchor, chain, shackles, and 200 feet of mooring; (4) a 375-foot-long, coated and weighted combined power, data, and environmental monitoring underwater cable, connecting the TGU installed in Phase 1 to a junction box; (5) a 675-foot-long underwater cable, connecting the TGU installed in Phase 2 to the junction box; (6) a 710-foot-long, buried bundle of six cables connecting the junction box to the shore station; (7) a 10-foot-long by 8-foot-wide pre-fabricated shore station for housing project electronics and controls; and (8) appurtenant facilities. The project is estimated to have an annual generation of 202 MWh under Phase 1 of operations and a total annual generation of 404 MWh at a complete buildout under Phase 2.

2.2.2 Project Safety

As part of the licensing process, the Commission reviews the adequacy of the proposed project facilities. Special articles regarding project safety and operation would be included in any license issued, as appropriate. Commission staff would inspect the licensed project both during and after construction. Inspection during construction would concentrate on adherence to Commission-approved plans and specifications, special license articles relating to construction, and accepted engineering practices and procedures. Operational inspections would focus on the continued safety of the structures, identification of unauthorized modifications, efficiency and safety of operations, compliance with the terms of the license, and proper maintenance.

For the purposes of addressing potential environmental impact and project safety concerns, IVC is proposing the following Safeguard Plans:

- Project and Public Safety Plan

- Navigational Safety Plan
- Emergency Shutdown Plan
- Project Removal and Site Restoration Plan

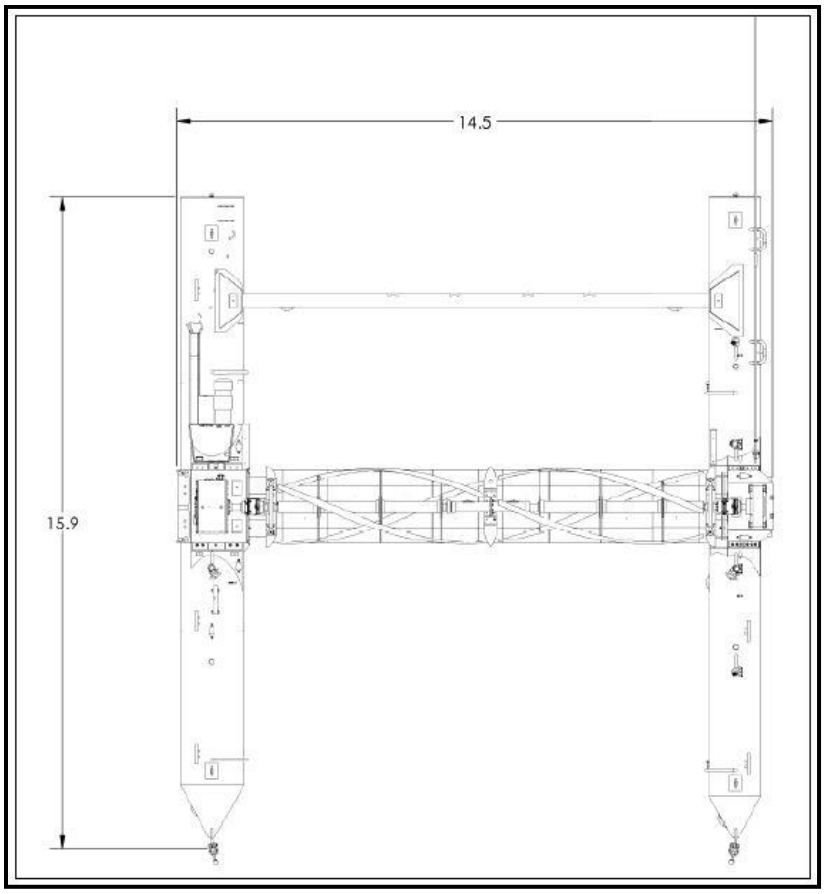

Figure 2. Top view of the RivGen® device (Source: application); dimensions are in meters.

2.2.3 Project Installation and Removal

Installation of the Igiugig Project would occur in two phases. The TGU would be ferried to the project site and assembled onshore before deploying. In each phase, one TGU would be installed with accompanying anchor and cabling. Anchors and moorings would be installed prior to deployment of the TGU device and remain in place throughout the duration of the project. The TGU is designed to be pushed into place utilizing non-specialized watercraft and subsequently attached to the anchor lines. Following deployment of the TGU and attachment to the anchor lines, the internal ballast tanks in the TGU pontoons would be flooded sequentially. As the tanks are filled, the TGU would settle to the river bottom where it would stay during operation. The submerged

cables, extending from the TGU to a junction box located on the unnamed island east of the deployment site, would be installed at approximately the same time as each TGU. The cable bundle extending from the junction box to the shore station would be installed and buried prior to deployment of each TGU. The shore station is a pre-fabricated structure that would be re-assembled on an existing gravel foundation where it was located during the 2014 and 2015 test deployments. The process would take between two and four weeks to complete.

IVC's proposed Project Removal and Site Restoration Plan details how the TGUs, anchors, cables, shore station, and other equipment would be removed at the conclusion of the license. As with installation, removal of the system would be conducted in phases. Each phase would consist of the removal of a segment of the system and subsequent remediation of any disturbed land.

In the first phase of removal, the TGUs would be disconnected mechanically from the mooring and electrically from the submerged cables. Retrieval of the TGUs would be accomplished by filling the ballast chambers with air and reversing the submergence sequence. Work boats and support vessels would be employed as-needed for the retrieval operation. In the second phase, moorings, anchors, and associated components would be lifted from the riverbed using a barge mounted excavator.

During the third phase, cables would be freed from their anchoring fixtures or trenches and recovered. The terrestrial portions of the cables would be excavated and removed. The resulting trench from cable excavation would be back-filled with the excavated material. Underwater cables would be removed with terrestrial and marine equipment as needed to free the cables from the sediment and remove them from the river. All cables would be disposed of and recycled when possible. The final phase would include removal of the shore station. Removal would be completed by the end of the license term if a new license is not sought.

2.2.4 Project Operation

The proposed project would operate year-round using the natural currents of the Kvichak River. The RivGen System is designed to generate electrical output over a range of river currents, operating in a stationary orientation. The turbine converts the kinetic energy of water flowing in currents into rotational motion and delivers that energy through a shaft into the generator. Each TGU device is composed of two turbines, which are mounted on the same driveshaft that turns the generator. The units are optimized to generate 35 kW at a flow velocity of 7.4 feet per second (ft/s). Over the course of the license term, IVC would monitor the operation of the RivGen Power System in several ways. Sensors on the TGUs would monitor water speed and direction, and turbine rotational speed. They would also detect leaks in sealed components including the generator, electronic cases, mechanical brake, and pontoon buoyancy chambers. Inside

the generator and electronics cases, sensors would monitor power generation, current, rotational speed, temperature, relative humidity, and oil pressure. Data collected from these various sensors would be coordinated in the supervisory control and data acquisition (SCADA) system located in the shore station.

In most cases, the project would be operated automatically via the SCADA system. Control of the system would be possible from both the shore station and remotely via private intranet connection. Manual controls located in the shore station and remote web-based monitoring would be provided for turbine functions and environmental monitoring. The cables would transmit electrical control power from the station to the TGU as well as data signals in both directions. The shore station would be monitored continuously by IVC personnel and project data would be available to ORPC via the intranet connection. Certain fault conditions would generate an alert which would be logged and may trigger automatic shutdown of the system. IVC-designated personnel would receive notification of these alerts and would be available to respond to alerts raised by the system.

2.2.5 Project Maintenance

IVC proposes to implement an Inspection and Maintenance Plan that details the inspection and maintenance activities it intends to complete throughout the term of the project license. These activities would fall under three main categories: system health monitoring, regular maintenance, and major maintenance. Project facilities, including the TGUs, pontoon support structures, environmental monitoring equipment, mooring systems, underwater cables, and shore station would undergo periodic inspection. The TGUs would be retrieved and inspected on a yearly basis during the beginning of the license term, with a possible extension of the interval once it is determined that all critical systems are operating appropriately. All inspections and maintenance would be documented prior to and following the inspection or maintenance event.

System monitoring of the project would be performed remotely. System information collected by sensors would be compiled by the SCADA system located in the shore station. Data would be stored, backed up, and automatically reviewed by the SCADA system to ensure that all parameters fall within acceptable limits. This system would be responsible for collecting, storing, processing, assessing, and transmitting data associated with fish monitoring for the project.

Regular maintenance on the TGUs would be performed following retrieval of the device while it floats on the surface of the river. Access to the TGUs would be facilitated by a small vessel. Maintenance operations would include visual inspection and simple repairs, and could take up to 20 days to complete.

Major maintenance on the project would occur at five-year intervals. Outside of the five-year intervals, a major maintenance event would be scheduled if the system health monitoring determines it is necessary. For major maintenance, the TGUs would be retrieved, disconnected from the mooring system, and brought to shore. Depending on the nature of maintenance required, work may be conducted on the water, near shore, somewhere on land, or in a dedicated facility.

2.2.6 Proposed Environmental Measures

IVC proposes to construct and operate the project with the following environmental protection, mitigation, and enhancement measures:

- To reduce erosion and sedimentation during burial and installation of the cables, develop and implement an Erosion and Sediment Control Plan.

- To monitor environmental effects and identify corrective actions, implement: (1) the Fish Monitoring Plan; and (2) the Adaptive Management Plan which includes annual project review meetings;

- To ensure safe operation of the project and protect the public, implement: (1) the Project and Public Safety Plan; (2) the Navigation Safety Plan; (3) the Emergency Shutdown Plan, which includes procedures to notify federal, state, and tribal agencies in the event of a negative interaction between the device and marine mammals; and (4) the Inspection and Maintenance Plan.

- To restore the project site at the end of the license term if a new license is not obtained, implement the Project Removal and Site Restoration Plan.

2.3 STAFF ALTERNATIVE

The staff alternative includes all of the above proposed measures, with the following modifications and additional measures developed by Commission staff:

- To protect water quality during project deployment, operation, and retrieval, develop and implement a Fuel and Hazardous Substances Spill Plan in consultation with Alaska DFG and file it for Commission approval.

- To protect fisheries resources, modify the Fish Monitoring Plan to include a provision to develop timing windows for instream deployment and for operation and removal activities in consultation with Alaska DFG if monitoring activities show negative effects to fish in the project area.

- To protect any newly discovered cultural resources during project construction, installation, maintenance or removal, stop all work, consult with the Alaska SHPO and implement the necessary measures to protect cultural resources, including the preparation of a HPMP, if necessary.

3.0 ENVIRONMENTAL ANALYSIS

In this section, we present: (1) a general description of the project vicinity; (2) an explanation of whether or not there would be cumulative effects; and (3) our analysis of the proposed action and other recommended environmental measures. Sections are organized by resource area. Under each resource area, historic and current conditions are first described. The existing condition is the baseline against which the environmental effects of the proposed action and alternatives are compared, including an assessment of the effects of proposed mitigation, protection, and enhancement measures, and any potential cumulative effects of the proposed action and alternatives. Staff conclusions and recommended measures are discussed in section 5.2, *Comprehensive Development and Recommended Alternative*.

3.1 GENERAL DESCRIPTION OF THE PROJECT AREA

The Igiugig Project would be deployed on the Kvichak River near the village of Igiugig, Alaska. The main source for the Kvichak River is drainage from Iliamna Lake. The village of Igiugig is at the outlet of Lake Iliamna, approximately 60 river miles upstream from where the Kvichak River empties into Bristol Bay (Figure 1). The site where the devices would be deployed is about 100 feet from the right bank (facing downstream) in a part of the river that is deep and has high water velocity (Figure 3). At this site, water depth is approximately 16 feet, river width is approximately 420 feet, substrate is scoured cobbles and gravel, and the maximum current velocity in the center of the channel is approximately 7.7 ft/s.

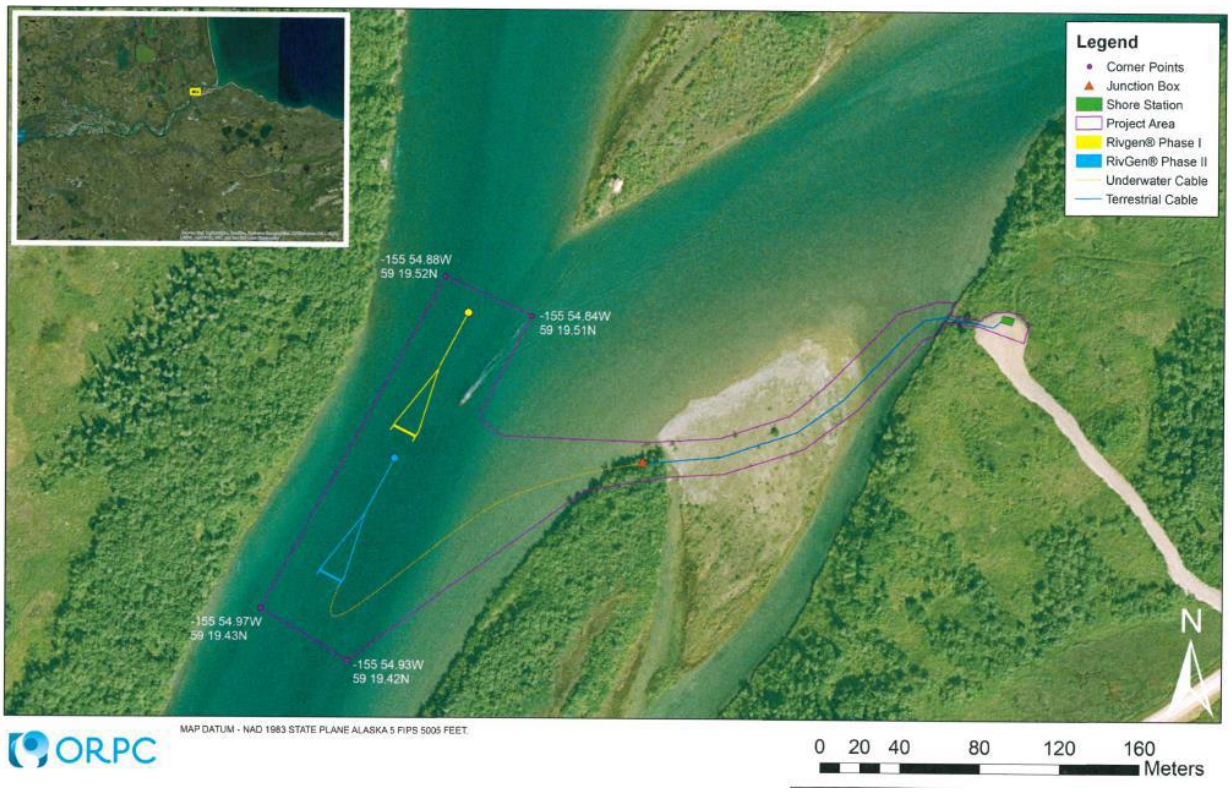

Figure 3. Project layout showing the location of the RivGen® Power System (Phase I) and the addition of the second RivGen® device (Phase II). (Source: application).

The total drainage basin for the river is approximately 6,500 m^2 and it has a mean elevation of 1,791 feet. Approximately 20 percent of the basin is in the form of lakes and ponds. Transitional forest composes about 64 percent of the basin, and the remainder is primarily wetlands. The average annual precipitation is 40 inches. Average annual snowfall in the basin is 70 inches. The record high and low temperatures for Igiugig are 31° C and -42° C. The average annual high and low temperatures are 26° C and -33° C. Typical summer temperatures range from -1° C to 19° C. Winter temperatures are between -16° C and -1° C.

3.2 SCOPE OF CUMULATIVE EFFECTS ANALYSIS

According to the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (40 C.F.R. § 1508.7), a cumulative effect is the impact on the environment that results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative effects can result from individually minor but collectively significant actions taking place over time, including hydropower and other land and water development activities.

Based on information in the license application, agency comments, other filings related to the project, and our independent analysis, we have not identified any resources that would be cumulatively affected by the project. The project is located in a remote watershed with very little existing or planned future developmental activity other than the existing hydro project.

3.3 PROPOSED ACTION AND ACTION ALTERNATIVES

In this section, we discuss the effect of the project alternatives on environmental resources. For each resource, we first describe the affected environment, which is the existing condition and baseline against which we measure effects. We then discuss and analyze the site-specific environmental issues.

Only the resources that would be affected, or about which comments have been received, are addressed in detail in this EA. Based on this, we have determined that geologic and soil resources; aquatic resources; recreation; navigation; aesthetics; and cultural resources may be affected by the proposed action and action alternatives. We have not identified any substantive issues related to terrestrial resources; threatened, and endangered species; or socioeconomics associated with the proposed action because the installation of the land-based components would have very minor effects on terrestrial habitat; no threatened or endangered species or critical habitat may occur within the project boundary; and installation and maintenance of the project would not require a sizeable workforce that would affect the local or regional economy or place a new demand on infrastructure or services. For these reasons, terrestrial resources; threatened and endangered species; and socioeconomics are not assessed in the EA. We present our recommendations in section 5.2, *Comprehensive Development and Recommended Alternative.*

3.3.1 General

Project Removal and Site Restoration Plan

IVC proposes to implement a Project Removal and Site Restoration Plan that describes: (1) procedures for removal of land-based project facilities, including restoration measures for the disturbed land areas; (2) procedures for removal of underwater facilities; (3) provisions for monitoring the effects of the removal activities; (4) an implementation schedule that provides for all removal and restoration activities to be completed by no later than the expiration date of the license; and (5) a financial assurance plan.

IVC anticipates that it will take approximately 12 days to decommission and remove the project. Seasonal conditions may prohibit removal until weather and safety allow proper removal. Crews will be able to work simultaneously to remove terrestrial and marine components. It is anticipated that it will take 5 days for removal of the shore

station and terrestrial portion of the cables and will take 2 days to return the cable corridor to existing grade.

Our Analysis

The Project Removal and Site Restoration Plan describes the sequence and removal procedures of both land and water-based project components. IVC would remove all onshore facilities, allowing the land to return back to its natural state. The onshore portions of the cables would be excavated and the resulting trenches backfilled. The RivGen devices would be removed by filling the ballast tanks with air and floating them back to the surface. This process would likely have minimal effect on aquatic resources. The project mooring, which consists of a 6,600-pound metal drag anchor that rests on the riverbed, would be pulled from the water using unspecified equipment. Removal of the anchor would result in habitat disturbance and sediment mobilization, but the effects would be short-term and minor. Implementation of the proposed Project Removal and Site Restoration Plan would help ensure protection of the environmental resources in the Kvichak River and on the shore near the village of Igiugig.

Emergency Shutdown Plan

Being a relatively new and untested technology, operation of the RivGen system could result in unanticipated adverse effects to the environment or the public. To address these circumstances, IVC proposes to implement an Emergency Shutdown Plan. The Emergency Shutdown Plan includes mechanisms to alert project personnel in the case an environmental or operational issue and allow for the immediate shut down of the project from an on-site or a remote location. In addition, the RivGen device would shut down automatically in the case of hardware failure.

Once the operation of the TGU has been stopped, the issue will be evaluated, and the appropriate action will be taken to mitigate the cause of the issue, including the possible removal of the TGUs if it is deemed to pose a risk to public safety. The plan also includes a requirement to notify FERC, Alaska DFG, NOAA, USFWS, the Coast Guard, U.S. Army Corps of Engineers, Igiugig Native Corporation, and the Bristol Bay Native Corporation within seven days of any incidents resulting in project shutdown.

The Lake and Peninsula Borough requests that it be added to the list of notified entities.

Our Analysis

The RivGen device has design features built in that allow the unit to be monitored and shut down by project personnel either on site or remotely. This would allow IVC to act quickly in the event of an emergency. The requirement to notify interested agencies would inform stakeholders as to issues identified with project operation and allow for the

identification of appropriate mitigative actions to take to prevent injury or minimize or eliminate threats to the extent possible. Including the Lake and Peninsula Borough as a consulted entity would improve notification procedures because they also have services available to respond to emergency situations.

3.3.2 Geologic and Soil Resources

3.3.2.1 Affected Environment

Terrestrial Geology

The proposed project would be located in the central portion of the Iliamna Quadrangle[3], an area of Alaska characterized by various periods of glaciation and the presence Iliamna Lake, one of the largest natural freshwater lakes entirely within the confines of the United States. Glacial deposition in the area can be attributed to the Wisconsin Glaciation event. While glacial episodes occurred at earlier time periods, any deposits formed prior to the Wisconsin Glaciation were covered or altered beyond recognition during the event. During this event, ice likely covered much of the Quadrangle but terminated approximately 20 miles west of the lake, as evidenced by moraines enclosing the lake basin and the basins of other large lakes in the area. The last glacial advance in the area ended approximately 200 years ago when glaciers retreated to their current extent. Melting of retreating glaciers are likely responsible for filling Lake Iliamna. Large recessional moraines in some of the mountain valleys are attributed to glacial stillstands.[4]

In many parts of the Iliamna Quadrangle, the mantle is thin and depth to bedrock is shallow. Most of the rocks within the project region are sedimentary, including sandstones, conglomerates, siltstones, and shale, and comprise the Tuxedni, Chinitna, and Naknek Formations. Bedrock exposures occur in the mountainous, eastern portion of the Quadrangle. There are no known bedrock exposures within the vicinity of the project, where the terrain is characterized by unconsolidated or poorly consolidated surficial deposits.

Seismic activity in the project area is relatively insignificant compared to other locations within the state of Alaska. The nearest faults documented by the U.S. Geological Survey (USGS) are located near Lake Clark, greater than 65 miles away from the project. There is no documented deformation of these faults. The USGS has documented earthquakes that have occurred in 1976, 1990, 2001, 2005, 2009, 2012,

---

[3] Quadrangles are topographic mapping designations used by the USGS. Each quadrangle is at a scale of 1:24,000 and represents approximately 7.5 minutes.

[4] A stillstand is a period of time during which a glacier is stationary.

2014, and 2016 within a 20-mile radius of the project site. All were measured at lower than 3.9 on the Richter Scale, classifying them as "Minor".

Riverine Geology

The applicant commissioned a physical characterization study in 2011 (Terrasond, 2011), which included visual observation, surveying, and sampling of the riverbed materials in the location of the proposed project. Visual observation indicated that scattered cobbles and small boulders sit atop coarse sands in the vicinity of the river mouth at the bottom of Lake Iliamna. Near the proposed project site, the central portions of the channel bottom appear to be small to large cobbles with an occasional small or medium boulder. The cobbles diminish near the water line of the river and transition to an assortment of gravels and sands. There is relatively little organic material in the shoreline bed.

In addition to visual observation, Terrasond collected 10 sediment samples from the riverbed near the proposed project location and characterized the samples based on size. The samples consisted primarily of larger sediments in the size range of gravel and cobbles. Moving bed tests completed by Terrasond did not yield any positive results.

3.3.2.2 Environmental Effects

Project installation, maintenance, operation, and removal would require land-disturbing activities associated with the burial and eventual removal of the terrestrial portion of the cable, which could result in soil erosion and sedimentation. A temporary disturbance to the riverbed would also result from the installation, maintenance, operation, and removal of the TGUs, anchor and mooring systems, and underwater cables. Operation of the TGUs could result in the scouring and mobilization of riverbed sediment.

Construction Effects on Terrestrial Soil Resources

The excavation and burial of the cable bundle from the junction box to the shore station during Phase 1 of construction would require ground-disturbing activities that could release sediment into the Kvichak River downstream of the proposed project area. The construction work would disturb approximately 0.9 acre of land, including the 710-foot-long. 8-foot-wide trench in which the cable would be buried. Because the shore station was previously assembled and installed, the potential for erosion associated with the shore station would be unlikely and limited to minor soil disturbance caused by machinery used to transport and install the facility. The cable would be buried using an excavator and covered using the excavated material. To minimize erosion and protect water quality, IVC proposes to develop an Erosion and Sedimentation Control Plan (ESCP) that includes best management practices (BMPs) designed to minimize the effect of sediment mobilization and transportation into the river.

Staff Analysis

An ESCP that contains BMPs as proposed by IVC would minimize project-related erosion and sedimentation and would minimize any adverse effects to aquatic resources. Such a plan should be based on site-specific conditions and final project designs. With effective erosion control measures in place, sediment from construction activities would not likely enter the Kvichak River. Once in operation, the project should have little or no effect on terrestrial geology and soils.

Construction and Scouring Effects on Riverine Geology

The deployment of the TGU units, anchor and mooring systems, and underwater cables in Phases 1 and 2 of installation would disturb approximately 3.7 acres of riverbed located at the proposed site of TGU deployment and along the route of the cables. Depending on the sediment size, the disturbed sediment could be washed downstream of the project site. The anchors and cabling would be laid prior to TGU deployment. Operation of the TGU could also dislodge riverbed sediment if they sufficiently alter flows.

Staff Analysis

Hydraulic effects of hydrokinetic energy generation systems on the distribution and magnitude of water flows around a project installation have not been fully characterized due to limited empirical or analytical information on these devices. An obstruction in the flow of water, such as would be expected to occur when a turbine is installed on the riverbed, would force the water in the current to flow around the object more quickly, increasing the velocity at the site of the obstruction. The increased water velocity could mobilize riverbed particles creating scour. Scour is the suspension and subsequent movement of sediments from a river bed resulting from the movement of water. Smaller size classes of sediments such as clay, silt, and sand are susceptible to scour due to their light weights. Larger and heavier sediment sizes such as gravel, cobble, and boulder are much less likely to be affected by scour.

Changes to the magnitude of currents in the immediate vicinity of the proposed project could create scour both at the TGUs and in the immediate vicinity. However, the majority of the upstream-facing cross-section of the device (Figure 4) can pass river flow without obstruction, which would not create conditions where scour may occur (Figure 4). The only portions of the device that would obstruct flow, increase water speed, and potentially create scour would be the pontoons. The pontoons are 4.6 feet in diameter, which represents a very small portion of the overall cross section of the river in the project area, and would not lead to a major increase of water speed. We expect scour around the project pontoons to be negligible.

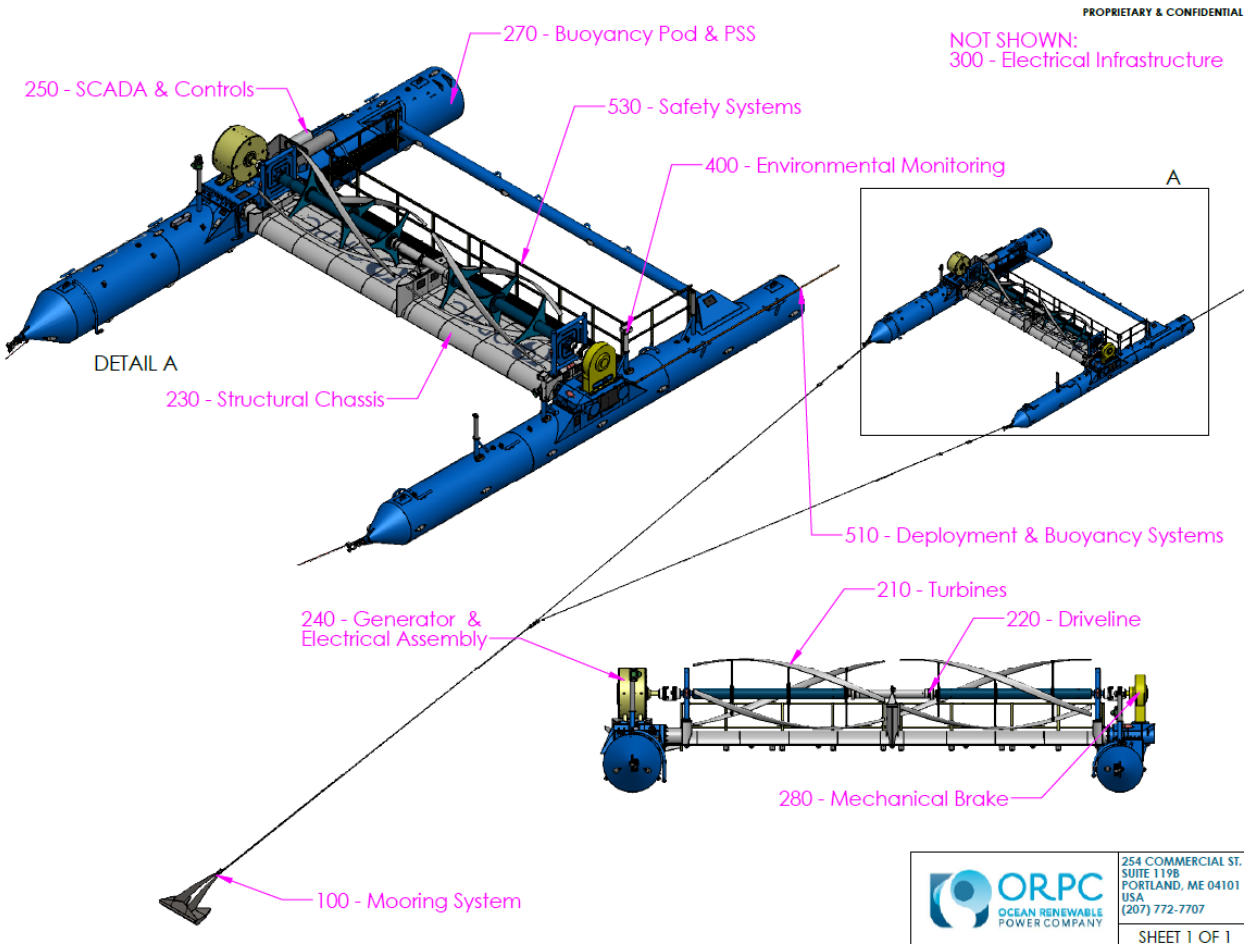

Figure 4. Cross-section of the RivGen device (source: application).

In addition, available information indicates that the majority of the riverbed is composed of coarse gravel, cobbles, and small to medium boulders, all of which require high river velocity for mobilization and are less prone to scour. The gravel, cobble, and boulders would also act as scour protection for any smaller sediment classes that may lie underneath.

3.3.3 Aquatic Resources

3.3.3.1 Affected Environment

Water Use

For the communities within the Kvichak River watershed, the subsistence way of life is a fundamental part of their cultural and physical wellbeing. Each year residents harvest, distribute, and consume many fish species found in the river. Historically, salmon have been the mainstay for subsistence, but a considerable portion of the subsistence take is also composed of non-salmon species that can be harvested year-round. Recent studies estimate that greater than 18,000 pounds of non-salmon fish are harvested regionally on an annual basis. Several different harvest techniques, including angling and nets, are employed as the fish move seasonally from their over-wintering grounds to summer spawning and feeding habitats.

The Kvichak River is a navigable waterway that allows a range of marine traffic from skiffs to barges. Float-equipped airplanes land on the river as well. Traffic, however, is minimal due to the heavy current and a lack of requisite access infrastructure. During the sport fishery season, anglers and outfitters utilize small river boats to transport fisherman and for fishing while drifting downstream. Beyond this, there is very little recreational boating, because of the challenges of the currents.

River Flow

Peak stages and discharges in the Kvichak River occur in the fall during September and October. The lowest stages and discharges are in the spring during April and May. River flow was measured in 2011 by a consultant for the state of Alaska's Department of Community and Economic Development (TerraSond, 2011) and again in 2014 by staff from the University of Washington (Thomson, 2014). The flow in the center channel of the river can approach 7.7 ft/s, with reductions near the riverbanks and in the shallows. The average flow velocity across the river as a whole is 4.5 ft/s. Flow data suggests that the river flow is approximately steady at any particular location in the river, with random turbulent fluctuations that are around 10 percent of the mean flow. The river level can rise and fall over a range of approximately 6.6 feet. The average annual water level ranges about 3.6 feet.

Water Quality

Water quality data for the Kvichak River in the vicinity of the project site is very limited. Based on the minimal amount of industrialization and land use in the project area, water quality is assumed to be relatively unaltered from its natural state. The water is extremely clear. During most of the year the river bed can be seen at depths up to 16 feet. However, there are times when the sediment load increases and visibility drops,

typically during periods of high wind from the east and extensive rain. The surrounding land is transitional forest and tundra with very few large trees. Thus, there is rarely any substantial amount of drifting material in the water

Fisheries Resources

Fish species in the Kvichak River that may be found in the project area are listed in Table 2. Each species has its own unique aspects of seasonal timing and behavior that influence the likelihood for encountering or being affected by the RivGen devices. Table 2 also shows anticipated seasonal presence of selected fish species near Igiugig.

In general, fish that are found in the project area use this stretch of river as a corridor for migration to spawning grounds, for over-wintering, and for feeding. Fish utilize areas of the river according to preferred habitat characteristics such as flow and food availability. Adult and juvenile fish tend to be located in environments where they have relatively low energy expenditure and high food availability. Adult fish tend to avoid the higher energy portion of the river, preferring near-shore and deeper habitat. Juvenile salmon migrating downstream to the ocean, conversely, prefer the high energy environments (surface and mid-channel) where they can swim with the river flow allowing them to conserve energy. Therefore, the location of the RivGen device(s) in the thalweg of the river makes it more likely to encounter downstream-migrating fish (such as juvenile salmon) than upstream-migrating fish (such as adult salmon).

Table 2. Fish species found in the project area (source: application)

Common name	Scientific name	Subsistence use?	Habitat use at project site	Seasonal timing
Alaskan brook lamprey	*Lampetra alaskense*	No	Migrant	unknown
Artic Alaskan lamprey	*L. camtschatica alaskense*	No	Migrant	unknown
Longnose sucker	*Catostomas catostomus*	Yes	Migrant	Spring
Northern pike	*Esox lucius*	Yes	Migrant/Resident	Spring/Fall
Alaska blackfish	*Dallia pectoralis*	Yes	Non-typical	Year-round
Rainbow smelt	*Osmerus mordax*	Yes	Migrant	Spring/Fall
Broad whitefish	*Coregonus nasus*	Yes	Non-typical	Fall
Humpback whitefish	*Coregonus pidschian*	Yes	Migrant	Fall
Least cisco	*Coregonus sardinella*	Yes	Migrant	Fall
Pygmy whitefish	*Prosopium coulteri*	Yes	Migrant	unknown
Round whitefish	*Prosopium cylindracuem*	Yes	Migrant	unknown
Arctic grayling	*Thymallus arcticus*	Yes	Migrant/Resident	Spring/Summer/Fall
Pink salmon	*Oncorhynchus gorbuscha*	Yes	Migrant	Summer
Chum salmon	*Oncorhynchus keta*	Yes	Migrant	Summer
Coho salmon	*Oncorhynchus kisutch*	Yes	Migrant	Summer/Fall
Rainbow trout	*Oncorhynchus mykiss*	Yes	Migrant/seasonal	Spring/Fall
Sockeye salmon	*Oncorhynchus nerka*	Yes	Migrant	Spring/Summer
Chinook salmon	*Oncorhynchus tshawytscha*	Yes	Migrant	Summer
Arctic char	*Salvelinus alpinus*	Yes	Migrant/seasonal	unknown
Dolly Varden trout	*Salvelinus malma*	Yes	Migrant/seasonal	Spring/Fall
Lake trout	*Salvelinus namaycush*	Yes	Non-typical	Year-round
Burbot	*Lota lota*	Yes	Non-typical	Year-round
Threespine stickleback	*Gasterosteus aculeatus*	No	Resident	Year-round
Ninespine stickleback	*Pungitius pungitius*	No	Resident	Year-round
Slimy sculpin	*Cottus cognatus*	No	Resident	Year-round

Sockeye salmon

While many fish found in the project area are of interest to residents and fisherman, sockeye salmon are the most important species found in the river. Bristol Bay, into which the Kvichak River flows, produces the greatest number of sockeye salmon (*Oncorhynchus nerka*) in the world. From 1991-2010, the region produced an average annual sockeye salmon run of 38 million fish; 21 percent of which came from the

Kvichak River. Commercial fishermen harvested and average of 26 million sockeye salmon annually from Bristol Bay over this time period, and 4 million annually from the Kvichak River.

Adult sockeye salmon return to the Kvichak River to spawn between mid-June and late July with the peak numbers of fish arriving in the last week of June to the first week of July. Spawning salmon tend to swim upstream near the banks of the river where they expend less energy due to the slower water flow. Females select spawning sites, dig nests (redds) with their tails, and deposit between 2,000 and 4,500 eggs into the redds. Males swim over the redds and fertilize the eggs. The eggs hatch during the winter, and the newly hatched salmon (alevins) remain in the gravel, living off the material stored in their yolk sacs until early spring. They then emerge as fry and spend 1 to 3 years in fresh water before reaching the smolt stage and migrating out to the ocean, usually in the spring (NOAA 2019).

The outmigration of sockeye smolts generally coincides with the melting of ice on Lake Iliamna which occurs normally in mid-May. On the Kvichak River, the entire duration of the outmigration of smolts occurs in a 2 to 3-week period with the majority of fish outmigrating during the last week of May. Studies have shown that more than 85 percent of outmigrating smolts on the Kvichak River begin their journey to the ocean over a period of 9 days. Alaska DFG estimates that between 15 and 342 million smolts outmigrate from the Kvichak River annually.

Typically, all salmon smolts tend to outmigrate in the thalweg where higher water velocity reduces the amount of energy smolts need to expend to reach the sea. IVC cites past studies of sockeye salmon smolt behavior on the Kvichak River that have indicated the majority of outmigrating smolts will migrate in the upper portion of the water column. Researchers using video and acoustic data found that all smolts traveled in the top 3 feet of water, and the majority of smolts were in the top one foot of water. Another study characterized vertical distribution of smolts down to 8 feet in depth, and then divided these data into two categories (dark, daylight) to check for diel differences in distribution. On the Kvichak River, the vertical distribution of smolts was consistent across years for both periods of daylight and darkness. During the periods of darkness, greater than 90 percent of smolts were detected in the upper 3 feet of water, and on average greater than 80 percent were found in the upper 1.5 feet. Daylight distribution of smolts tended to be a little deeper, but in all cases, greater than 81 percent were found in the top 6 feet of water.

Marine Mammals

Lake Iliamna is home to one of the two known harbor seal (*Phoca vitulina*) populations that reside in freshwater lakes year-round. Population estimates range from 105 in 2005 to 321 in 1998. Distribution is concentrated near the islands located in the

northeastern portion of the lake. Although there are no barriers to prevent the seals from leaving the lake, there has been no indication that seals move up or down the river.

Beluga whales (*Delphinapterus leucas*) are an important subsistence resource in the Bristol Bay region, where the population has been estimated to be approximately 2,000 animals. Approximately 300-400 of these animals have been known to swim into the Kvichak River. In a 2002/2003 tagging study, no whales were found upstream of Levelock, Alaska, which is approximately 40 miles downstream of the project area. IVC only reports one known anecdotal siting of a beluga whale in the river near Igiugig.

3.3.3.2 Environmental Effects

Water Quality

Deployment and operation of the Igiugig Project has the potential to introduce contaminants into the Kvichak River. The barges and boats used to deploy the device and the device itself could spill or leak fuel, lubricants, oil, or other contaminants into the river. Alaska DFG recommends that IVC develop and implement a Fuel and Hazardous Substances Spill Plan. The plan would include measures for clean-up in the event of spills or leaks of fuel, lubricants, oil, or other contaminants from the RivGen system or associated equipment. The plan would be developed in consultation with Alaska DFG.

Our Analysis

Development of protocols for the clean-up of hazardous substances prior to deployment of the RivGen system would help ensure that operators would be ready to respond in a timely manner to any spills or leaks from the system into the Kvichak River. Developing the plan in consultation with Alaska DFG would ensure that appropriate protective measures and responses would be in place to prevent and minimize water quality impacts from spills and leaks of hazardous substances from the project.

Fisheries Resources

Deployment and operation of the Igiugig Project has the potential to affect the presence, abundance, spatial distribution, and behavior, as well as injury and mortality, of fish and marine mammals in the Kvichak River. The project could cause fish to avoid the area completely, to attract fish to the structure itself, and possibly injure or kill them if they encounter the rotating blades or other moving parts. The RivGen system is a relatively new technology that is still in the demonstration phase. The possible effects on fish are not fully known at this time. As such, IVC proposes to implement a Fish Monitoring Plan and an Adaptive Management Plan (discussed further below) to monitor, evaluate and mitigate the possible effects of the RivGen system on aquatic animals.

IVC proposes to deploy the units in the thalweg of the river at a depth between 15 and 19 feet. The unit would sit approximately 11.5 feet high from the river bed. This would leave between 3.5 and 7.5 feet of water above the top of the device. IVC also proposes ensure that the final deployment location would provide a minimum of 3 to 5 feet of water between the top of the device and the water surface to minimize interactions with downstream migrating salmon smolts.

Fish Monitoring Plan

IVC proposes to monitor the RivGen device for potential fish interactions for one year to inform the regulatory process and provide the basis for future modifications based on observed effects. To do so, IVC would:

1. Document the presence and timing of fishes at the RivGen device by species and life stage;

2. Characterize salmon movements past the RivGen device during migration periods;

3. Describe the behavioral response of salmon that come into the vicinity of the RivGen device; and

4. Describe any observable acute effects from contact with the RivGen device, including disorientation, injury, or mortality during salmon migrations.

IVC would monitor fish interactions with the RivGen device by mounting four underwater cameras on the device and analyzing the resulting video. During priority windows identified by Alaska DFG (such as the sockeye salmon outmigration), cameras would record 10 minutes of footage every hour. During non-priority times, the frequency would be reduced to 10 minutes of footage every three hours. All video footage would be reviewed daily during priority periods. During non-priority periods, video footage would also be reviewed daily, but that frequency may be reduced if the Adaptive Management Team (outlined in the Adaptive Management Plan) recommends that less frequent video analysis is warranted. Video analysis would be done by experts from the Pacific Northwest National Laboratory and the University of Alaska Fairbanks using a software program developed specifically for this purpose. These monitoring and analysis systems were deployed and tested in 2015.

IVC would issue full summary reports on an annual basis to the appropriate regulatory agencies for technical review. After collecting monitoring data for a year, IVC would convene a meeting with the Adaptive Management Team (outlined in the Adaptive Management Plan) to collectively evaluate fish monitoring data and adjust future monitoring efforts based on known effects. Fish monitoring may only occur during the first year of Phase I deployment and the first year of Phase II deployment.

However, if the adaptive management team feels additional monitoring is necessary, video monitoring could be expanded to additional years.

IVC's Fish Monitoring Plan was developed in consultation with Alaska DFG. In its letter filed on December 28, 2018, Alaska DFG recommends that IVC implement its proposed Fish Monitoring Plan.

Staff Analysis

The RivGen device has already been deployed in the Kvichak River multiple times for testing purposes. The device was deployed from July 10 through September 15, 2015, during which time, fish behavior and interaction with the device was monitored by video camera and analyzed. Video footage was collected from five underwater cameras, 24-hours a day from July 19 through 25, and again from August 19-27, 2015.

Researchers reviewed blocks of video footage from portions of the 238 hours recorded during the 2015 deployment. They observed 359 unique interaction events between fish and the device. During these events, approximately 1,202 individual fish from at least six species interacted with the RivGen system. The majority of fish observations were of solitary fish; however, some schools of up to 100 fish encountered the device. Species composition varied between July and August and also between day and night. Salmon smolt were almost exclusively seen at night, and were more prevalent in July than August. Several fish moved directly through the RivGen turbine. The video footage showed no obvious physical injuries to fish, no actual contact between the turbines and fish, and no altered behavior by fish species near the RivGen device. Cameras, lights, and power system components all operated reliably.

This is not surprising considering the slow speed of the rotating blades and lack of areas where fish might become impinged. The blade rotation speed would be dependent of the flow velocity, but given historical velocity measurements in the Kvichak River, rotational speeds would rarely exceed 8.2 ft/s. Amaral et al. (2010) concluded that no mortality should occur for any fish at any size when rotating blades of hydrokinetic devices move at speeds less than 15 ft/s.

Video footage was not collected during the peak outmigration of sockeye salmon. Nonetheless, we do not anticipate adverse effects on out-migrating smolts because there would be at least 3 feet of water between the top of the turbines and the water surface and likely much more. As discussed above, recent studies have shown that the overwhelming majority of outmigrating sockeye salmon in the Kvichak River utilize the top 3 feet of water. While there were some differences between depths between night and day migrations, very few smolts were found deeper than 6 feet. If there is more than 6 feet of clearance between the top of the device and the water surface at low tide as is currently projected, the probability of negative effects on sockeye smolts would be unlikely. If the

clearance is as low as 3 to 5 feet, the possibility of the device negatively affecting outmigrating smolts becomes higher, but current video footage suggests that there should be no adverse effects on the outmigrating smolts.

We do not expect that deployment of the RivGen device over the course of the proposed license period would result in a different outcome than the observed during the 2015 season. However, given the relatively short sampling period, further monitoring would allow IVC, Alaska DFG, FWS, NMFS, and Commission to further monitor fish behavior in response to the units and to take corrective action if monitoring shows unanticipated adverse interactions (e.g., strikes, avoidance, increased predation). This information would allow the adjustment of operations through the mechanisms established in the adaptive management plan, or, if necessary, shutdown and removal of the device.

Timing of Instream Activities

The Kvichak River provides spawning and rearing habitat for numerous species of fish, many of which are only present for portions of the year. Project installation, operation, or maintenance activities could disrupt important life cycle phases resulting in adverse effects to aquatic species. Alaska DFG states that its main interest is protecting the upstream migration of adult sockeye salmon and downstream migration of sockeye smolts because of their importance to the local economy and community. However, Alaska DFG is also concerned about protecting all fish species in the Kvichak River and sockeye salmon would be used as a proxy to determine possible effects to other species.

To minimize these effects, Alaska DFG recommends that IVC be required to develop timing windows for project installation, construction, and maintenance in cooperation with an Alaska DFG habitat biologist, if the results of the Fish Monitoring Plan were to show a negative effect on fish in the project area. The Department of Interior recommends that the devices be shut down from May 21 through June 10 annually to eliminate the possibility of blade strike potential during the sockeye salmon outmigration.

Our Analysis

At specific times of the year, the Kvichak River is utilized by a variety of fish species for portions of their life cycle. Disruption to natural life cycle phases such as spawning, emergence of fry from riverbed gravel, and outmigration of smolts could result in negative effects to fish populations. These negative effects could be minimized by scheduling device deployment, operation, and maintenance activities during parts of the year when these critical life cycle phases are not occurring. However, we do not anticipate any adverse effects for the reasons discussed above.

The Fish Monitoring Plan proposed by IVC and recommended by Alaska DFG would provide a mechanism to determine if the project is negatively affecting the upstream migration of adult sockeye salmon and downstream migration of sockeye smolts and potentially other species. If the monitoring results show that adverse effects are occurring, the development and implementation of instream work timing windows could reduce or eliminate the negative effects on fish populations. Determining the timing of the work windows is best achieved in consultation with Alaska DFG and FWS given their expertise in local fishery resources.

At this time, the Department of Interior's recommendation to shut down operation from May 21 through June 10 to avoid negative effects on the sockeye salmon outmigration is premature. Our analysis shows that interaction between outmigrating smolts and the device is unlikely. In addition, the fish monitoring plan would provide for video monitoring during the outmigration season. If the video monitoring were to show negative interactions between the sockeye smolts and the device, the adaptive management team (discussed below) could help to identify mitigation actions to be implemented by IVC to the extent permitted by any license issued for the project.

Marine Mammals

IVC proposes a protocol to notify the appropriate regulatory agencies in the event a negative interaction between the units and harbor seals and beluga whales, as a part of its Emergency Shutdown Plan. The plan includes provisions for:

(1) reporting by phone any project-related conditions causing or that may cause injury or mortality to any marine mammal afforded protection under the MMPA, no longer than seven days after becoming aware of the threat or incident to the Commission, Alaska DNR, Alaska DFG, NMFS, FWS, Coast Guard, Army Corps of Engineers, Igiugig Native Corporation, Bristol Bay Native Corporation, and the Bristol Bay Native Association;

(2) consulting with the notified entities on the immediate course of action to take to prevent injury or minimize or eliminate the threat to the extent possible;

(3) proposing mitigative measures to the Commission, based on consultation with the agencies and tribe(s), and implementing any measures approved by the Commission; and

(4) filing a written report with the Commission and the aforementioned agencies and tribes no later than thirty days after becoming aware of any such threat or incident. The report would include: (a) the location, date, time, and causes of the condition to the extent known; (b) a description of any unusual occurrences or operating conditions preceding the condition; (c) an account of any measure(s) taken to immediately alleviate

the condition; (d) a description of any injuries or mortalities of the MMPA-protected species, or any adverse effects on other environmental resources, the public, or property as applicable; (e) a description of the measures recommend by the agencies and tribes; and (f) a description of the measures or actions that would be taken to prevent further such occurrences.

No stakeholders filed any comments concerning marine mammals.

Our Analysis

Harbor seals inhabit Lake Iliamna upstream of the project location; however, they are not known to occur in the Kvichak River. There is only one known anecdotal occurrence of a beluga whale in the project area. The nearest confirmed whale sighting is 40 miles downstream of the project location. Based on this, the chances of interactions between harbor seals or beluga whales and the devices would be rare or non-existent. In the unlikely event that IVC's video monitoring identifies a negative interaction, IVC would immediately implement the reporting protocol detailed above. Notification of the consulted entities by phone within seven days would allow the agencies to provide advice on corrective actions that could be taken in the short term to reduce the risk of reoccurrence. The filing of a more detailed report within thirty days would provide the consulted entities a record of negative mammal interactions and would serve as a source of information for the adaptive management team to recommend any operational changes or mitigative measures.

Adaptive Management Plan

IVC proposes to use an adaptive management strategy to modify its operations and monitoring methods based on each prior year's monitoring results. This adaptive management strategy would entail: (1) the filing of annual reports with the appropriate resource agencies that detail the results of the prior year's fish monitoring activities, (2) holding an annual meeting of project stakeholders to discuss the results, and (3) filing the results with the Commission with any recommendations for modifying it monitoring plans or project operations. Alaska DFG recommends that IVC hold the proposed annual meetings.

Staff Analysis

The use of the proposed adaptive management strategy would allow IVC to quickly and efficiently receive feedback and recommendations from the stakeholders for modifications to environmental protection plans as necessary to respond to unforeseen project-related effects on environmental resources. Such a strategy would be beneficial in this instance given the uncertainty of environmental effects from the relatively new generation technology proposed to be installed, operated, and maintained by IVC.

Reporting of Non-compliance Events

Alaska DFG recommended that within 7 days of the detection of an event not in compliance with license requirements, IVC notify Alaska DFG, the Commission, and other agencies and that IVC file a description of the event with the Commission within 30 days. Alaska DFG states that notification of non-compliance events that affect fish and wildlife resources is necessary to assess potential project effects.

Our Analysis

While such notification would alert Alaska DFG and the Commission to potential problems with the project and how IVC is dealing with those problems, the environmental protection plans proposed by IVC and recommended by staff already include reporting requirements for these situations, including taking immediate action to shut down and remove the project if needed. Therefore, separate reporting requirement would be duplicative and unnecessary.

3.3.4 Recreation

3.3.4.1 Affected Environment

The Kvichak River is a world-class sockeye salmon fishery, mostly in its upper 10 to 15 miles with concentrations near Igiugig in late June and July (NPS 2012). Sportfishing access is provided by air services from local transportation centers at the villages of Igiugig, Iliamna, and King Salmon, as well as from Anchorage and Kenai Peninsula communities. Most fishing occurs close to the riverbank where anglers wade waist deep in the water, stand on the river bank, or drift downstream close to shore in small boats. Strong currents discourage fishing in the middle of the river. The fishing season encompasses the summer months but may extend from late spring into early fall, with July being a popular time to fish the large runs of sockeye salmon. August and September are prime fishing times for trout fishing in the Kvichak River which is the only designated Trophy Rainbow Trout Area in Alaska. In 2016, the Alaska DFG estimated that there were 1,823 sport-fishing anglers that visited the river and 4,850 days fished (ADFG 2016).

The village of Igiugig has a sport-fishing access trail that leads from the village center to the banks of the Kvichak River. The trail was completed in 2001 and is approximately 800 feet long and 10 feet wide and runs between the airport service road and a 70-foot-wide turn-around near the river bank where the project's shore station is located. The trail is designed to accommodate a "four-wheeler" taxi/shuttle service for anglers traveling between the airport and the river. From the trail, anglers may also cross a gravel bar to an unnamed island where they can fish and set up tents (Alaska DFG 2015).

Moose and waterfowl hunting are also popular recreational activities in the Lake Iliamna area. Visitors fly-in or boat-in and stay at lodges in the area. Sea planes utilize the project reach of the Kvichak River to carry recreationists to and from hunting destinations. Six different commercial lodges operate directly out of Igiugig, while 25 other lodges outside of Igiugig provide outfitting services that take hunters to Lake Iliamna and the Kvichak River.

Existing land uses adjacent to the project include open space and residential, educational, medical and commercial uses. Igiugig has a 3,300-foot-long airport runway owned by the state located close to the project site. The village also owns a public dock that is used as a barge landing. Since there are no dedicated roads leading to Igiugig, the primary modes of transportation within Igiugig and nearby villages are boats in the summer and snow mobiles in the winter. All-terrain vehicles are used year-round (Igiugig 2010). A portion of the river bank where the project is located is leased by the Igiugig Native Corporation from the Alaska Municipal Land Trustee. The Alaska Native Claims Settlement Act of 1971 gives the Igiugig Corporation rights to the surface estate in this area while the regional corporation, Bristol Bay Native Corporation, has subsurface rights. The Igiugig Native Corporation's primary responsibility is to issue land permits. It has waived the land use permit for the proposed project.

3.3.4.2 Environmental Effects

Because the project turbines would be located in the middle of the river and at a depth of more than 3 feet below the water surface, bank fishing and the use of small boats or sea planes would not be impeded by the project when it is operating; however, fishing lines from anglers in the immediate location of the submerged facility could become entangled with the facility. During the periodic removal and re-installation of the facility, however, boaters and sea planes may need to avoid or maneuver around the area where these activities are being conducted. Such potential effects would occur only twice a year for a duration of about one week and overall would not adversely affect recreation in the project area. To ensure the protection of the public during installation and removal, IVC proposes to implement a Project and Public Safety Plan that includes: (1) notifying the public of the presence of the project, as well as the schedule for installation and removal activities through meetings and public websites, and signage at the shore station while cables are installed or removed; (2) installing signs on the riverbank indicating the location of the submerged hydrokinetic turbines and the location where the cable transitions from below ground to above-ground; (3) installing warning signs on either side of the Kvichak River both upstream and downstream of the submerged turbines; and (4) burying the terrestrial portion of the cable in all feasible locations. As part of this plan, IVC proposes to notify safety and health authorities in Igiugig, the U.S. Coast Guard, and the Alaska Office of Environmental Policy and Compliance in the event of any incident that would affect project or public safety. The Lake and Peninsula Borough recommends that it be added to the list of contacts in the Project and Public Safety Plan

to ensure that it is also kept informed of such events and appropriate measures are taken to address any emergencies or hazards. No entity has recommended any measures to protect or enhance recreation resources at the project.

Our Analysis

Project impacts on recreation would be minor and of short duration. Implementing the measures contained in IVC's Public Safety Plan would ensure that the public and governmental entities in charge of public safety are kept informed of any potential hazards or obstacles associated with the installation, maintenance and removal of the project, and allow IVC to identify appropriate corrective actions to minimize or eliminate hazards if they arise. Including the Lake and Peninsula Borough in the consulted entities would improve notification procedures because it also has services available to protect public safety.

3.3.5 Navigation

3.3.5.1 Affected Environment

The Kvichak River supports a variety of marine traffic from skiffs to barges. Float planes take off and land on the stretch of river where the project is located, usually delivering fuel shipments or transporting visitors. River traffic in the project area is light due to the heavy current that makes navigation and anchoring difficult, the lack of suitable places to anchor, and the shallow, braided stretches of river both upstream and downstream of the project location that prevents vessels with drafts greater than 3 feet from passing through. Each year about 30 commercial fishing boats travel through the proposed project area from Lake Iliamna to fishing grounds in Bristol Bay in June and return in July or August each year. Barge service via Bristol Bay is usually available from August to September each year. The village of Igiugig is also accessible by barge from Anchorage, Kenai, and Homer between May and October. Vessels that do anchor at Igiugig or nearby areas generally do not anchor in the river, but tie-off to trees or bushes on shore or pull anchors up to the river bank. The nearest mooring location to the project site is on the northern bank of the river directly across from an Alaska DFG boat landing in Igiugig about 0.5 mile upstream of the project site.

3.3.5.2 Environmental Effects

Construction vessels and the turbine unit would create a small obstacle to boaters and float planes in the center of the river during installation, maintenance and removal of the submerged project facilities. While boats generally do not anchor in the middle of the river at the project site due to the strong currents, any anchors deployed along the margins of the river could come into contact with project cables. To minimize such contact, IVC proposes to bury and shield the cable. In addition, commercial fishing lines or nets could become entangled with, or damaged by, the submerged hydrokinetic facilities.

To minimize potential impacts to navigation, IVC further proposes to implement its Navigation Safety Plan, which includes: (1) working with the U.S. Coast Guard to broadcast information to mariners about the project location so that they can avoid anchoring, dredging, or deploying fishing or other subsurface equipment in the area of the submerged project facilities to avoid entanglement or damage; (2) marking the area of each submerged turbine with three buoys;[5] (3) holding public meetings in Igiugig prior to installation of the turbines to describe in detail the location, depth and any associated navigation hazards; (4) issuing a navigation hazard message on marine radio at the start of the commercial fishing season; and (5) notifying the Village of Igiugig, the U.S. Army Corps of Engineers, the U.S. Coast Guard, and the public of any incident that would affect navigation in the project area. The Lake and Peninsula Borough recommends that it be added to the list of contacts in the Navigation Safety Plan to ensure that it is also kept informed of any navigation hazards and appropriate measures are taken to address these hazards. While IVC indicates that it provided its current Navigation Safety Plan to the U. S. Coast Guard in July 2015 for review, the Coast Guard has not commented on the revised plan.

Staff Analysis

While river traffic is generally light on the Kvichak River near the project site, float planes, barges, commercial fishing vessels, and boats may have to modify their routes to avoid activities related to installation, maintenance or removal of the project's turbines. Such effects on navigation would be short-term (twice a year for a week duration), localized, and minor because there is sufficient room to execute take offs and landings in the river reach adjacent to the project site and for boats to navigate around construction vessels. As shown in Figure 6, the stretch of river on either side of the project has a width between 70 to 115 feet of 4 to 6-foot-deep water that would allow enough room and depth for boats and float planes to safely navigate around the project area. Occasionally, during installation, removal, and maintenance activities, float planes

[5] The buoys would be removed during the winter months to avoid interaction with ice.

might need to schedule take offs to avoid project vessels that may cross their path. Once operating, the submerged project turbines would be located at a sufficient distance below water level to allow enough clearance (at least 3 feet) for safe passage of boats and would not be an obstacle to float planes taking off and landing.[6]

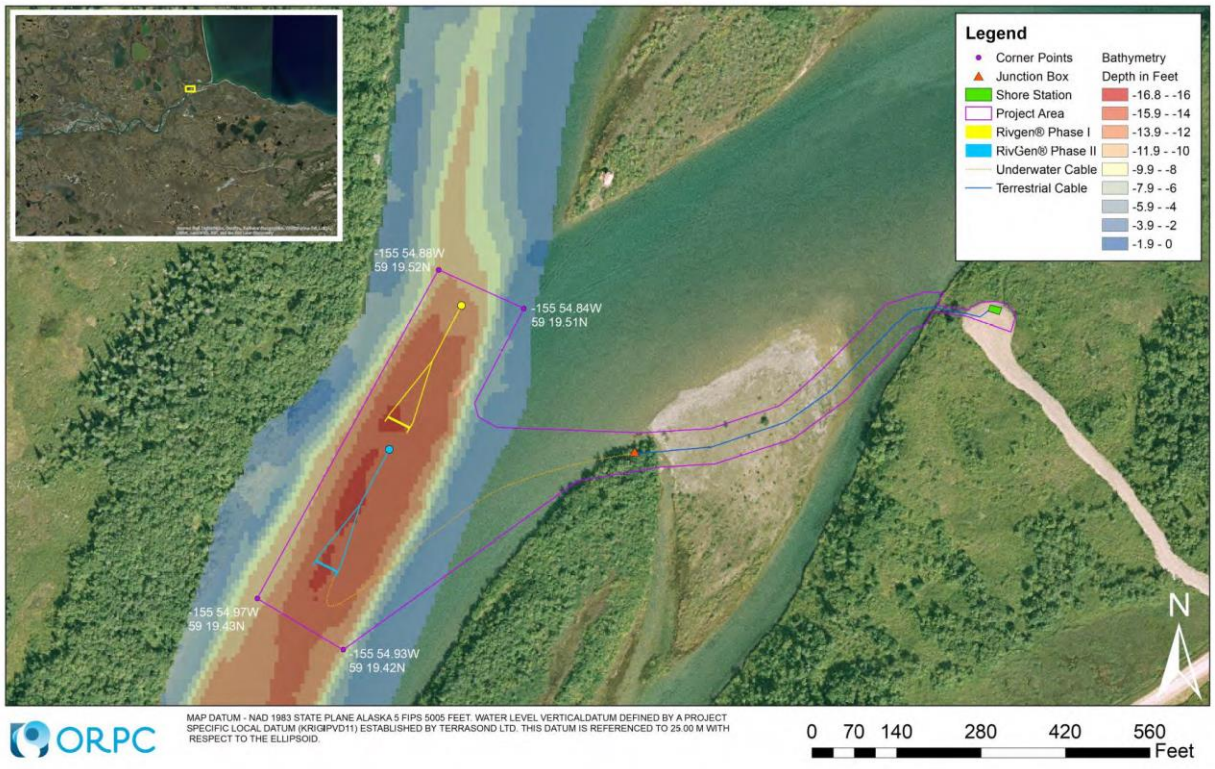

Figure 5. Water depths (in feet) at the Igiugig Hydrokinetic Project (source: application).

Implementing the measures in IVC's Navigation Safety Plan would help minimize these disruptions and maintain navigation safety by giving the proper advanced notification to mariners of potential navigation hazards, appropriately marking the presence of project facilities so they could be avoided, and responding appropriately to any unforeseen navigation hazards. Including the Lake and Peninsula Borough as a consulted entity would improve notification procedures because they also have services available to respond to hazardous situations.

[6] The project is 12.5 feet in height and the depth of the water at the project site is at 16 feet. Boats with drafts of more than 3 feet are generally unable to navigate the shallow waters of the Kvichak River in the Igiugig area.

3.3.6 Aesthetic Resources

3.3.6.1 Affected Environment

The project area is characterized by little to moderate topographic relief and wooded terrain. The predominant view within this area is the Kvichak River and its tree-lined north shore. The south shoreline is relatively developed with a runway, residences, a bulk fuel farm, water treatment plant and tank, and public boat landings and barge ramps.

3.3.6.2 Environmental Effects

To minimize visual impacts from the terrestrial portion of the project, IVC proposes to bury the terrestrial portion of the cable in all areas where it is feasible; however, there may be a short section where it crosses an un-vegetated island where burial may not be possible. IVC does not propose any other visual mitigation measures and no entity has recommended such measures. The shore station would be placed in an area where it would be visible to recreationists using the turn-around area at the end of the sport fishing access trail. IVC indicates that while painting the shore station to blend better with the surrounding environment would lessen its visibility, it does not propose to do so because it wants to keep it visible to avoid collision from vehicles that use the adjacent turnaround area.

Staff Analysis

The project would have minimal impact on visual resources because the project's generating equipment and most of the cabling would be submerged except during project installation and removal. The shore station would be installed in an already-cleared area on an existing gravel pad adjacent to an existing transformer and would not stand out significantly against the surrounding landscape which is relatively developed. While painting the shore station with non-reflective colors would reduce its contrast with the surrounding area, doing so would reduce its visibility to those maneuvering vehicles in the turnaround area, some of which could be carrying large loads which could collide with the station. Keeping the station visible would help to avoid such events. Portions of the above-ground cable, where it is not buried, would traverse already disturbed vegetation and would generally be screened from view from water users by the existing vegetation.

3.3.7 Cultural Resources

3.3.7.1 Affected Environment

Section 106 of the NHPA requires that the Commission evaluate the potential effects on properties listed or eligible for listing in the National Register. Such properties

listed or eligible for listing in the National Register are called historic properties. In this document, we also use the term "cultural resources" for properties that have not been evaluated for eligibility for listing in the National Register. Cultural resources represent things, structures, places, or archaeological sites that can be either prehistoric or historic in origin. In most cases, cultural resources less than 50 years old are not considered historic. Section 106 also requires that the Commission seek concurrence with the state historic preservation office (SHPO) on any finding involving effects or no effects on historic properties and allow the Advisory Council on Historic Preservation an opportunity to comment on any finding of effects on historic properties. If Native American (i.e., aboriginal) properties have been identified, section 106 requires that the Commission consult with interested Indian tribes that might attach religious or cultural significance to such properties.

Area of Potential Effects (APE)

Pursuant to section 106, the Commission must take into account whether any historic property could be affected by the issuance of a proposed license within a project's APE. The APE is determined in consultation with the SHPO and is defined as the geographic area or areas within which an undertaking may directly or indirectly cause alternation in the character or use of historic properties, if any such properties exist. The direct APE covers 0.75 acre and consists of all terrestrial areas within the project boundary. The indirect APE covers any areas outside the project boundary where the project is determined to be affecting historic properties.

Culture Historic Context[7]

Aboriginal Settlement

Early Anangula (7,000 – 9,000BP)

The Early Anangula phase is the earliest known eastern Aleutian culture from prehistoric times. Settlement patterns and cultures prior to this time remain largely unknown. Because no preserved bone or other organic materials have been found at eastern Aleutian sites, it is difficult to reconstruct the technology and environmental adaptations of this culture. Temporary shelters were likely used as evidenced by small depressions found with floors stained with charcoal and red ochre and accompanied by post holes. Artifacts found include flaked stone tools and waste debris from their manufacture, and a few ground stone tools such as abraders for wooden shafts, pigment grinders and stone oil lamps. The flaked stones consist of micro-blades, large blades and

[7] The culture historic context is taken and generalized from Gillispie 2018, National Park Service 2007, National Park Service, 2015, and Igiugig Village Council, 2018a, b.

burins. Bi-facially flaked stone tools, such as knives or weapon tips are not found during this time period. The location of early Anangula sites on the coast indicate a maritime subsistence orientation.

Late Anangula (7,000-4,000 B.P.)

All of the technology from the early Anangula phase is retained during this phase, but some new tools emerge such as stone tools shaped by flaking on both faces. One eastern Aleutian site from this period includes a large shell midden that includes bone and ivory parts for throwing boards, bird bone needles, and barbed harpoon points which indicate a maritime-adapted culture. Semi-subterranean houses appear during this time.

Margaret Bay (3,000-4,000 B.P.)

A wide variety of artifact types appear during the Margaret Bay phase, which include ground slate points and ground jet items used for beads and labrets. There is a decrease in large blade technology and new forms of finely-flaked stone tools similar to the Arctic Small Tool technology of the more northern Paleo-Eskimo culture appear. Houses increase in size with multiple rooms and are better built with stone-lined walls, indicating semi-permanent settlement patterns. The appearance of net sinkers during this time period indicates that the people began to rely more on fish as a food source. Later in this phase, new artifacts appear such as knives and weapon tips with stemmed and notched hafts, polished stone adzes, blades and chisels, toggling harpoon points, carvings of anthropogenic subjects, and whale bone masks.

Amaknak (1,000-3,000 B.P)

During the Amaknak phase there is a significant increase in the variety and complexity of technology along with changes in the style of artifacts. The Anangula period blades, burins and stone lamps[8] disappeared. New technologies appeared which included toggling harpoons, many new forms of knives and scrapers, a variety of elaborate barbed harpoon points and decorated hunting equipment, and boulder spall scrapers. Stone-lined houses increase in size and complexity and are more rectangular in shape. Large earthworks, possibly used for food storage or burial, appear on hillsides above villages.

Late Aleutian (1,000-European Contact)

The Late Aleutian phase begins around 1,000 years ago and continues until the Russians colonized the area in historic times. Village sites during this time are often

[8] Stone lamps consisted of stones with depressions where animal fat was burned either for light, heat, or cooking.

found on large middens that accumulated in size since the Amaknak period. Ground slate tools, especially ulu blades, are characteristic of this time period. Large collections of bone tools are found at some sites. Houses and other settlement patterns change during this time and subterranean longhouses appear. Evidence of warfare also appears, indicated by finds of sea stacks and refuge rocks.

Euro-American Settlement and Occupation

Russian fur hunters arrived at the Aleutian Islands in 1741 and made their way up to the head of the Alaskan peninsula. By the 1870s the Russians had established a base camp at the village of Katmai and were exploiting the local population by forcing them to hunt sea otters. Hunting and trapping of fur-bearing animals became a major industry in the Katmai area and remained so even after Russia sold Alaska to the United States in 1867. By the late 1880s, sea mammal populations had declined and the economy of the area shifted from the fur industry to commercial fishing. Local residents moved from villages near trading posts to new settlements near salteries (which later became canneries). Some small-scale mining also began.

Before the turn of the century, there were two distinct Central Yupik groups who lived in the project vicinity - the Kiatagmuit, who lived on the north bank of the Kvichak River, and the Aglurmiut, who occupied the majority of the Iliamna Lake area. In 1829, this combined population was about 900. The Kiatagmuit lived in the Village of Kakanak on the north bank of the Kvichak River 7 miles downstream of the project site and used the present site of Igiugig as a fish camp. At the turn of the century, they moved upstream and settled permanently in Igiugig along with residents from the nearby village of Branch. Laplander reindeer herders also settled in this area and established reindeer stations near Igiugig around 1905.

In 1912, the eruption of the Novarupta volcano displaced some native populations in the Katmai area and not only changed the physical landscape of this area but also the cultural landscape. The eruption created what became known as the "Valley of Ten Thousand Smokes" which was designated as a National Monument in 1918. As a result the Katmai area became a tourist attraction with the first "flightseeing" trip to the area in 1929. As tourists came to the area, they discovered other attributes of the area, including the fishery and wildlife resources. Since the 1950s, tourism has increased dramatically bringing in anglers and wildlife viewers. In 1980, the Katmai National Monument was expanded and became the Katmai National Park and Preserve.

Today, the population of Igiugig is primarily Yupik, Aleuts, and Athabascans, many of whom trace their ancestry to the villages of Branch, Newhalen, Kaskanak Flats, Big Mountain, and Kukaklek Lake. Commercial fishing and tourism are important economic drivers in the community of Igiugig and surrounding area, but the residents in this area also rely heavily on subsistence fishing and hunting for their livelihood.

Sockeye and coho salmon are a highly valued source of food, but Chinook salmon, chum salmon, rainbow trout, whitefish, Arctic grayling, and blackfish are also commonly eaten. Most residents utilize drift nets to catch salmon.

Archaeological and Historic Investigations

To determine whether the project would affect any existing archaeological or historic resources, IVC conducted a review in October 2012 of the Alaska Historic Resources Survey. The survey identifies two native settlements in the region: Levelock, situated on the west bank of the Kvichak River, and Igiugig. Fourteen cultural sites are identified in the Western Iliamna Lake and Kvichak River region. Of these sites, two are prehistoric, eleven are historic, and one is of mixed origin. None of these sites are located near or within the project's APE. Only one site in Igiugig is listed on the National Register – St. Nicholas Chapel, a Russian Orthodox church built in 1925 (National Park Service 2017). The structure is located near the shoreline downstream of the project site and outside of the APE.

3.3.7.2 Environmental Effects

Based on the lack of any documented sites within the APE during its October, 2012 survey, IVC determined that the project would have no effect on cultural resources. The Alaska SHPO concurred with IVC's "no effect" determination in 2012.[9] Nonetheless, IVC recognizes that land disturbing activities due to burying the terrestrial portion of the cable could uncover previously undiscovered cultural resources. If such sites are discovered, IVC proposes to notify the proper authorities for further investigation.

Sarah Meitl, Coordinator for Review and Compliance with Alaska's Office of History and Archaeology (which also serves as the Alaska SHPO), is concerned that the applicant's cultural resources review conducted in 2011 and 2012 may be based on outdated information. She comments that IVC did not take into account in its application for license that the proposed project is located "directly adjacent to" the Igiugig Archaeological District that has been found eligible for listing on the National Register. She indicates that the District is bounded on one side by the Kvichak River shoreline and that the shore station and the buried cables connecting the shore station to the Kvichak River have the potential to adversely affect the District. She states that the Alaska SHPO

[9] *See* October 4, 2012, letter from Alison Sterley, Cultural Resources Specialist, Alaska Energy and Engineering, to Judith Bittner, Alaska SHPO, with an October 31, 2012, "no effect" stamp from the Alaska SHPO, filed as part of the draft application for license on April 23, 2015.

concurrence of "no effect" in 2012 was not for the presently designed project which, unlike the project as proposed in 2012, includes on-shore facilities and activities. In a follow-up meeting between representatives of IVC and Sarah Meitl, all parties agreed that the terrestrial features of the proposed project are within the boundary of the District and could potentially affect the integrity of the District.[10] The Alaska SHPO determined on February 15, 2019 that the project would have no adverse effect on the Igiugig Archaeological District.

Staff Analysis

The Igiugig Archaeological District contains at least 21 identified sites, most of which are villages, including the village of Igiugig. The District represents the continual use and occupation of the area for at least 4,000 years (National Park Service 2017). In 2017, the National Park Service gave a grant of $43,479 to IVC to map, survey, and nominate "Old Igiugig" to the National Register (National Park Service 2017). IVC is currently in the process of nominating "Old Igiugig" to the National Register.

Although the project's shoreline facilities would be located within the Igiugig Archaeological District, the project would not adversely affect the historical properties that make the District eligible for listing on the National Register because the area of disturbance would be small and would not affect any historic structures within the District. The only possible indirect affect would be visual from the presence of the shore station and any above-ground portions of the cable; however, these project features would not stand out from other development already existing in the surrounding area (see section 3.3.8, *Aesthetic Resources*) and therefore would not detract from the historic properties of the District. We therefore concur with the Alaska SHPO's determination that the project would have no adverse effect on cultural resources in the project area.

If during construction, installation, maintenance, or removal of project facilities, previously undiscovered cultural resources are discovered within the District, a standard article of any license issued for the project would require the applicant to stop work and follow specific protocols and procedures. This would ensure that cultural resources are adequately protected over the term of any license issued for the project.

[10] *See* January 4, 2019, letter from Monty Rogers, Archaeologist and Owner, Cultural Alaska, to AlexAnna Salmon, Village Council President, Igiugig Village Council, filed with the Commission on January 14, 2019.

3.4 NO-ACTION ALTERNATIVE

Under the no-action alternative, the Igiugig Project would not be installed. There would be no changes to the physical, biological, or cultural resources of the area and electrical generation from the project would not occur.

4.0 DEVELOPMENTAL ANALYSIS

In this section, we look at the Igiugig Project's use of the Kvichak River for hydropower purposes to see what effect various environmental measures would have on the project's costs and power generation. Under the Commission's approach to evaluating the economics of hydropower projects, as articulated in *Mead Corp*.,[11] the Commission compares the current project cost to an estimate of the cost of obtaining the same amount of energy and capacity using a likely alternative source of power for the region (cost of alternative power). In keeping with Commission policy as described in *Mead Corp*, our economic analysis is based on current electric power cost conditions and does not consider future escalation of fuel prices in valuing the hydropower project's power benefits.

For each of the licensing alternatives, our analysis includes an estimate of: (1) the cost of individual measures considered in the EA for the protection, mitigation and enhancement of environmental resources affected by the project; (2) the cost of alternative power; (3) the total project cost (i.e., for construction, operation, maintenance, and environmental measures); and (4) the difference between the cost of alternative power and total project cost. If the difference between the cost of alternative power and total project cost is positive, the project produces power for less than the cost of alternative power. If the difference between the cost of alternative power and total project cost is negative, the project produces power for more than the cost of alternative power. This estimate helps to support an informed decision concerning what is in the public interest with respect to a proposed license. However, project economics is only one of many public interest factors the Commission considers in determining whether, and under what conditions, to issue a license.

4.1 POWER AND ECONOMIC BENEFITS OF THE PROJECT

Table 3 summarizes the assumptions and economic information we use in our analysis. This information, unless otherwise identified, was provided by the applicant in its license application and subsequent filings. We find that the values provided by the applicant are reasonable for the purposes of our analysis. Cost items common to all alternatives include taxes and insurance costs; estimated future capital investment required to construct, maintain, and extend the life of equipment and facilities; licensing costs; and normal operation and maintenance cost.

---

[11] See *Mead Corporation, Publishing Paper Division*, 72 FERC ¶ 61,027 (1995). In most cases, electricity from hydropower would displace some form of fossil-fueled generation, in which fuel cost is the largest component of the cost of electricity production.

Table 3. Parameters for the economic analysis of the Igiugig Project (Source: IVC and staff).

Parameter	Value	
Period of analysis (years)[a]	30	
Federal income tax rate (%)[b]	21	
Estimated first year of operation	2019	
	Phase 1	Phase 2
Initial construction cost ($)[c]	$1,500,000	$1,269,000
Future operation and maintenance ($/year)[d]	$141,500	$198,000
Licensing cost ($)[e]	$195,000	
Alternative energy value ($/MWh)[f]	$465	
Interest rate (%)[b]	6	

[a] Regardless of the potential license term (e.g., 10-year pilot, 30, 40 or 50 years), we perform a 30-year economic analysis.

[b] Estimated by staff.

[c] Phase 1 construction cost was provided by the applicant in the license application. Phase 2 construction cost was estimated by staff using the cost provided by the applicant and accounting for investment growth in project years 1 and 2.

[d] Cost provided by the applicant in the license application that includes insurance, administrative, and general costs.

[e] Cost provided by the applicant that includes all licensing costs incurred after the signing of a Memorandum of Understanding between ORPC and IVC on January 16, 2015.

[f] Calculated based on the cost per gallon and kWh per gallon generation efficiencies of diesel provided by the applicant in the license application.

4.2 COMPARISON OF ALTERNATIVES

Table 4 compares the installed capacity, annual generation, cost of alternative power, estimated total project cost, and difference between the cost of alternative power and total project cost for each of the alternatives considered in this EA: no action, IVC's proposal, and the staff alternative.

The Igiugig Project is a proposed pilot project. Pilot projects are small, short-term, removable, and carefully-monitored projects intended to test technologies, sites, or

both. From our comparison, both IVC's proposal and the staff alternative would have an initial annual cost that far exceeds the current power value. The costs associated with the project are not indicative of future and larger-scale projects.

Table 4. Summary of the annual cost of alternative power and annual project cost for the alternatives for the Igiugig Project (Source: staff).

	Applicant's Proposal	**Staff Alternative**
Installed capacity (kW)	70	70
Annual generation (MWh)	404	404
Annual cost of alternative power	$188,000	$188,000
(2018 $/MWh)[a]	465.40	465.40
Annual project cost	$318,120	$318,570
($/MWh)	787.42	788.54
Difference between the cost of alternative power and project cost[b]	($130,090)	($130,550)
($/MWh)	(322.01)	(323.14)

[a] Calculated based on the cost per gallon and kWh per gallon generation efficiencies of diesel provided by the applicant in the license application.

[b] A number in parentheses denotes that the difference between the cost of alternative power and project cost is negative, thus the total project cost is more than the cost of alternative power by that amount.

4.2.1 No-action Alternative

Under the no-action alternative, the project would not be constructed as proposed, and would not produce any electricity.

4.2.2 IVC's Proposal

IVC proposes to install two TGUs and associated facilities in the Kvichak River. Upon completion of the installation of both of the turbines, cables, and shore station, the project's installed capacity would be 70 kW, and would generate an average of 404 MWh of electricity annually. The average annual cost of alternative power would be $188,000, or $465.40/MWh. The average annual project cost would be $318,120, or about $787.42/MWh. Overall, the project would produce power at a cost that is $130,090 or $322.01/MWh, more than the cost of alternative power.

4.2.3 Staff Alternative

The staff alternative includes the same project facilities and operations as proposed by IVC and, therefore, would have the same capacity and energy attributes. Table 5 shows the staff recommended modifications and additions to IVC's proposed environmental protection and enhancement measures and the estimated cost of each. The average annual cost of alternative power would be $188,000, or $465.40/MWh. The average annual project cost would be $318,570, or about $788.54/MWh. Overall, the project would produce power at a cost that is $130,550 or $323.14/MWh, more than the cost of alternative power.

4.3 COST OF ENVIRONMENTAL MEASURES

Table 5 gives the cost of each of the environmental enhancement measures considered in our analysis. All costs are converted to equal annual (levelized) values over a 30-year period of analysis to give a uniform basis for comparing the benefits of a measure to its cost.

Table 5. Cost of environmental mitigation and enhancement measures considered in assessing the environmental effects of constructing and operating the Igiugig Project (Source: staff).

Enhancement/Mitigation Measures	**Entities**	**Capital Cost (2018$)**	**Annual Cost (2018$)**	**Levelized Annual Cost (2018$)[a]**
General				
1. Annual project review meeting as part of the Adaptive Management Plan.	IVC, Alaska DFG, Staff	$5,000[c]	$0	$350
2. Include the Lake and Peninsula Borough as a consulted entity in implementing the Emergency Shutdown Plan, the Project and Public Safety Plan, and Navigation Safety Plan.	Lake and Peninsula Borough, Staff	$0	$0	$0
Safeguard Plans				
3. Project and Public Safety Plan	IVC, Staff	$0[b]	$0	$0
4. Project Removal and Site Restoration Plan	IVC	$0[b]	$0	$0
5. Navigational Safety Plan	IVC, Staff	$0[b]	$0	$0

Enhancement/Mitigation Measures	Entities	Capital Cost (2018$)	Annual Cost (2018$)	Levelized Annual Cost (2018$)[a]
6. Emergency Shutdown Plan	IVC, Staff	$0[b]	$0	$0
7. Inspection and Maintenance Plan	IVC, Staff	$0[b]	$0	$0
Geologic and Soil Resources				
8. Develop an Erosion and Sediment Control Plan	IVC, Staff	$1,000[c]	$0	$70
Aquatic Resources				
9. Cease operation from May 21 through June 10 annually to protect outmigrating salmon smolts	Interior	$0	$10,900 [c]	$8,610
10. Fish Monitoring Plan	IVC, Alaska DFG, Staff	$50,000	$0	$3,490
11. Adaptive Management Plan	IVC, Staff	$0[c]	$0	$0
12. Develop a Fuel and Hazardous Substances Spill Plan in consultation with Alaska DFG and file it for Commission approval	Alaska DFG, Staff	$5,000[c]	$0	$350

Enhancement/Mitigation Measures	Entities	Capital Cost (2018$)	Annual Cost (2018$)	Levelized Annual Cost (2018$)[a]
13. Modify the Fish Monitoring Plan to include a provision to develop timing windows for instream deployment, operation, and removal activities in consultation with Alaska DFG, if monitoring shows negative effects to fish in the project area	Alaska DFG, Staff	$0	$0	$0
14. Notify the Commission, Alaska DFG, and other requesting agencies of non-compliance events	Alaska DFG	$0	$0	$0
Cultural Resources				
15. In the event that previously-unidentified cultural resources are discovered in the future, stop work and consult with the Alaska SHPO and prepare a HPMP, if needed	IVC, Staff	To be determined if any cultural resources are discovered during the license term.		

[a] The applicant provided estimated O&M costs, including monitoring costs, over the ten-year timeframe of the license procedures. As it is Commission policy to annualize all costs over a 30-year time frame, we have, where appropriate, converted the provided ten-year annual costs to a present value, and then annualized that value over a 30-year term.

[b] Cost included in the estimated cost to license the project, as plan was submitted with the license application.

[c] Cost estimated by staff.

[d] IVC estimated a cost of $50,000 incurred throughout the 10-year pilot license timeframe. The cost is levelized over the 30-year period of the analysis.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 COMPARISON OF ALTERNATIVES

In this section, we compare the developmental and non-developmental effects of the IVC's proposal, the staff alternative, and the no-action alternative.

We estimate the annual generation of the project under the two action alternatives identified above. Our analysis shows that the annual generation would be 404 MWh for the proposed action and the staff alternative.

We summarize the environmental effects of the project under the applicant's proposal and the staff alternative below. Under the no-action alternative, the project would not be constructed and environmental conditions would not be altered by the project.

5.2 COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Sections 4(e) and 10(a)(1) of the FPA require the Commission to give equal consideration to the power development purposes and to the purposes of energy conservation; the protection, mitigation of damage to, and enhancement of fish and wildlife; the protection of recreational opportunities; and the preservation of other aspects of environmental quality. Any license issued shall be such as in the Commission's judgment will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses. This section contains the basis for, and a summary of, our recommendations for licensing the Igiuigig Hydrokinetic Project. We weigh the costs and benefits of our recommended alternative against other proposed measures.

Based on our independent review of agency and public comments filed on this project and our review of the environmental and economic effects of the proposed project and its alternatives, we selected the staff alternative as the preferred option. We recommend this option because: (1) issuing a license to the Igiugig Village Council would allow them to test the generating equipment's dependability as a source of electrical energy for the region and evaluate the energy potential of the Kvichak River; (2) the 404 MWh of electric energy generated annually would come from a renewable resource, which would not contribute to atmospheric pollution; (3) the project poses very little risk to fish and wildlife resources; (4) the recommended environmental measures would adequately protect, mitigate, and enhance fish and wildlife, recreation, aesthetic and cultural resources affected by the project; (5) the recommended measures would ensure navigation is not interrupted; and (6) the monitoring proposed for the project would provide an improved understanding of the environmental effects of riverine energy projects, which would be instrumental in assessing the potential effects

of future projects of this type and identifying measures to minimize adverse environmental effects.

In the following section, we make recommendations as to which environmental measures proposed by IVC or recommended by agencies and other entities should be included in any license issued for the project. In addition to IVC's proposed environmental measures, we recommend the inclusion of some additional measures in any license issued for the project.

Measures Proposed by the Igiugig Village Council

Based on our environmental analysis of the IVC's proposal as discussed in section 3.0 and the costs discussed in section 4.0, we recommend including the following environmental measures proposed by IVC in any license issued for the project.

- To reduce erosion and sedimentation, develop and implement an Erosion and Sediment Control Plan.

- To monitor environmental effects and identify corrective actions, implement: (1) the Fish Monitoring Plan; and (2) the Adaptive Management Plan.

- To ensure safe operation of the project and protect the public, implement (1) the Project and Public Safety Plan; (2) the Navigation Safety Plan; (3) the Emergency Shutdown Plan, which includes procedures to notify federal, state, and tribal agencies in the event of a negative interaction between the device and marine mammals; and (4) the Inspection and Maintenance Plan.

- To restore the project site at the end of the license term if a new license is not obtained, implement the Project Removal and Site Restoration Plan.

Additional Measures Recommended by Staff

In addition to IVC's proposed measures, we recommend including the following measures in any license issued:

- To protect water quality, develop and implement a Fuel and Hazardous Substances Spill Plan in consultation with Alaska DFG and file it for Commission approval.

- To protect fisheries resources, modify the Fish Monitoring Plan to include a provision to develop timing windows for instream deployment and for

operation and removal activities in consultation with Alaska DFG if monitoring activities show negative effects to fish in the project area.

- To protect any newly discovered cultural resources during project construction, installation, maintenance or removal, stop all work, consult with the Alaska SHPO and implement the necessary measures to protect cultural resources, including the preparation of a HPMP, if necessary.

The following discussion provides the basis for our additional recommendations for licensing the Igiugig Hydrokinetic Project.

Fuel and Hazardous Substances Spill Plan

Deployment and operation of two RivGen devices could result in a degradation of water quality in the Kvichak River if one or both of the devices or boats used to deploy them were to inadvertently spill fuel or other hazardous substances into the river. To minimize the effects of any fuel or hazardous substances spill, Alaska DFG and staff recommend that IVC develop a Fuel and Hazardous Substances Spill Plan to ensure protocols are in place that would allow project personnel to respond to spills quickly, minimizing effects on water quality. We estimate that the cost to develop this plan would be $5,000 and the benefits of this plan to water quality and fisheries resources would outweigh the cost to develop the plan.

Instream Work Windows

The Kvichak River is utilized by many fish species for portions of their life cycle. Disruption to natural life cycle phases such as spawning, emergence of fry from riverbed gravel, and outmigration of smolts could result in negative effects to fish populations. While we do not expect any such negative effects based on currently available monitoring results, the available data is from a limited time period that does not include peak outmigration periods for sockeye salmon.

The Fish Monitoring Plan proposed by IVC and recommended by Alaska DFG would provide a mechanism to determine if the project is negatively affecting the upstream migration of adult sockeye salmon and downstream migration of sockeye smolts. If the results of monitoring show this occurring, the development and implementation of instream work timing windows could reduce or eliminate any negative effects on fish populations. Determining such work windows in consultation with Alaska DFG and FWS would help minimize adverse effects of fishery resources. We estimate that developing instream work windows in consultation with Alaska DFG, if warranted, would not add any additional cost to the project and would be protective of fisheries resources in the Kvichak River.

Consultation with the Lake and Peninsula Borough in Safeguard Plans

IVC, as part of its Project and Public Safety Plan, Navigation Safety Plan, and Emergency Shutdown Plan, proposes to notify various stakeholders of safety incidents. The Lake and Peninsula Borough requests that it also be added to the list of stakeholders to be contacted in these plans to ensure that such incidents are addressed appropriately. As we discuss in sections 3.3.1.2, 3.3.5.2, and 3.3.6.2 notifying the Lake and Peninsula Borough, in addition to other stakeholders identified in these plans, would ensure that all interested parties are kept informed of safety-related issues at the project and would enhance IVC's ability to identify appropriate mitigative actions to minimize or eliminate any hazards. Including the Lake and Peninsula Borough as a contact in the IVC's proposed safeguard plans would not result in any additional project costs and would ensure that all interested parties are involved in the process to identify and address any safety-related issues.

Protection of Cultural Resources

The project site would be located within the Igiugig Archaeological District which is eligible for listing on the National Register. As we discuss in section 3.3.7.2, the proposed project would not adversely affect the properties that make the District eligible for National Register listing; however, there is a possibility that project-related activities during construction, installation, maintenance, or removal of project facilities could uncover previously-unidentified cultural resources. In such an event, IVC would need to halt all land-clearing and land-disturbing activities and consult with the Alaska SHPO. If previously-undiscovered cultural resources are determined to be eligible for listing on the National Register, then IVC would need to prepare and file for Commission approval, a HPMP prepared in consultation with the Alaska SHPO. Following such protocols and procedures would ensure that cultural resources are protected for the duration of any license issued for the project.

Measures Not Recommended

Project Shutdown to Protect Sockeye Salmon Smolts

The Department of Interior recommends that the project not operate between May 21 and June 10 to avoid negative effects on the sockeye salmon outmigration. IVC objects to this work limitation, arguing that adverse effects are unlikely and that sufficient mechanisms are in place to quickly respond to significant adverse effects, including shutting down and removing the project.

Our analysis shows that interaction between outmigrating smolts and the device is unlikely because previous video monitoring of project operation showed no negative interactions with fish; most smolts would be able to effectively avoid the device by swimming over or around it; and if smolts were to swim through the device, the

likelihood of injury or mortality due to blade strike is low. If the video monitoring were to show negative interactions between the sockeye smolts and the device, the adaptive management team could help to identify mitigation actions to be implemented by IVC to the extent permitted by any license issued for the project.

Shutting down the project for this time period now would result in a loss of $8,610 annually from lost generation, but more importantly would prevent testing of the device during peak out migration periods and the ability to evaluate the practicality and long-term operation feasibility of the project in meeting village needs. Given the safe guards that would be in place, we do not recommend shutting down the project between May 21 and June 10, unless monitoring shows a negative effect on sockeye salmon smolts.

Reporting of Non-compliance Events

Alaska DFG recommends that within 7 days of the detection of an event not in compliance with license requirements, IVC notify Alaska DFG, the Commission, and other agencies and that IVC file a description of the event with the Commission within 30 days. Alaska DFG states that notification of non-compliance events that affect fish and wildlife resources is necessary to assess potential project effects. As discussed in Chapter 3, such reporting of non-compliance events is duplicative of the reporting requirements found in the environmental plans proposed by IVC and recommended by staff. For that reason, we find that an additional reporting requirement would be unnecessary.

5.3 UNAVOIDABLE ADVERSE IMPACTS

There would be localized, short-term disturbances to the riverbed during the installation of the devices. On-shore construction activities would disturb previously disturbed areas. On-shore construction activities would create visual effects, which could disturb recreationists in the project vicinity, but these effects would be minor and short-term. Fishermen and recreational boaters may need to work around project vessels during project installation, the devices during operation, on-site maintenance, and removal, but these activities will be short-term and minor.

5.4 FISH AND WILDLIFE AGENCY RECOMMENDATIONS

Under the provisions of section 10(j) of the FPA, each hydroelectric license issued by the Commission shall include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, and enhancement of fish and wildlife resources affected by the project.

Section 10(j) of the FPA states that whenever the Commission finds that any fish and wildlife agency recommendation is inconsistent with the purposes and the

requirements of the FPA or other applicable law, the Commission and the agency shall attempt to resolve such inconsistency, giving due weight to the recommendations, expertise, and statutory responsibilities of the agency. In response to the ready for environmental analysis notice, Alaska DFG submitted recommendations for the project on December 28, 2018. Table 6 lists Alaska DFG's section 10(j) recommendations, and whether the measures are recommended by staff. Recommendations that we consider outside the scope of section 10(j) have been considered under section 10(a) of the FPA and are addressed in the specific resource sections of this document and the previous section. [12]

Table 6. Analysis of fish and wildlife agency recommendations for the Igiugig Hydrokinetic Project (Source: staff).

Recommendation	Agency	Within the scope of section 10(j)	Annualized Cost	Adopted? and Basis for Preliminary Determination of Inconsistency
1. Implement the Fish Monitoring Plan	Alaska DFG	Yes	$3,490	Yes
2. Establish the timing of instream work in consultation with Alaska DFG	Alaska DFG	Yes	$0	Yes
3. Develop and implement a Fuel and Hazardous Substances Plan	Alaska DFG	Yes	$300	Yes
4. Notify the Commission and other requesting agencies of non-compliance events	Alaska DFG	No, not a specific measure to protect fish and wildlife	$0	No, recommendation is duplicative of reporting requirements included in the recommended plans

[12] On February 1, 2019 the Department of the Interior, on behalf of FWS, recommended that IVC shut down the project during the annual outmigration of sockeye salmon smolts. The letter did not specify that this recommendation was submitted under section 10(j), so staff considered it under section 10(a) of the FPA

Recommendation	Agency	Within the scope of section 10(j)	Annualized Cost	Adopted? and Basis for Preliminary Determination of Inconsistency
5. Allow Alaska DFG employees access to site with advance notification	Alaska DFG	No, not a specific measure to protect fish and wildlife	$0	Yes
6. Hold an annual project review meeting	Alaska DFG	No, not a specific measure to protect fish and wildlife	$350	Yes

5.5 CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a)(2)(A) of the FPA, 16 U.S.C. § 803(a)(2)(A), requires the Commission to consider the extent to which a project is consistent with the federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. Under section 10(a)(2)(A) of the FPA, federal and state agencies filed comprehensive plans that address various resources in Alaska. We determined that 15 comprehensive plans (listed below) are relevant to the project. We found no inconsistencies.

Alaska Administrative Code. 2012. 5 AAC § 39.222 Policy for the Management of Sustainable Salmon Fisheries. Juneau, Alaska.

Alaska Administrative Code. 2003. 5 AAC § 75.222 Policy for the Management of Sustainable Wild Trout Fisheries. Juneau, Alaska.

Alaska Department of Fish and Game. 2006. Management Plan for Invasive Northern Pike in Alaska. Anchorage, Alaska. 2006.

Alaska Department of Fish and Game. 2011. Alaska Anadromous Waters Catalog – South central Region. Anchorage, Alaska. June 1, 2011.

Alaska Department of Fish and Game. 2011. Alaska Anadromous Waters Catalog - Southwestern Region. Anchorage, Alaska. June 1, 2011.

Alaska Department of Natural Resources. 1993. Juneau State Land Plan. Juneau, Alaska. December 1993.

Alaska Department of Natural Resources. Alaska's Outdoor Legacy: Statewide Comprehensive Outdoor Recreation Plan (SCORP): 2009-2014. Anchorage, Alaska.

Alaska Department of Natural Resources. 2005. Bristol Bay Area Plan for State Lands. Anchorage, Alaska. April 2005.

Bureau of Land Management. 1981. South Central Alaska Water Resources Study: Anticipating Water and Related Land Resource Needs. Anchorage, Alaska. October 1, 1981.

National Park Service. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C. 1993.

U.S. Fish and Wildlife Service, et al. 2008. Alaska Shorebird Conservation Plan. Version II. Anchorage, Alaska. November 2008.

U.S. Fish and Wildlife Service. 2009. Alaska Seabird Conservation Plan. Anchorage, Alaska. 2009.

U.S. Fish and Wildlife Service. 2005. Regional Seabird Conservation Plan. Pacific Region, Portland, Oregon. January 2005.

U.S. Fish and Wildlife Service. 2002. Steller's Eider (*Polysticta stelleri*) Recovery Plan. Fairbanks, Alaska. September 2002.

U.S. Fish and Wildlife Service. Undated. Fisheries USA: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.

6.0 FERC FINDING OF NO SIGNIFICANT IMPACT

On the basis of our independent analysis, we conclude that approval of the proposed action, with our recommended measures, would not constitute a major federal action significantly affecting the quality of the human environment. Preparation of an environmental impact statement is not required.

7.0 LITERATURE CITED

Alaska Department of Fish and Game. 2016. Alaska Sportfishing Survey. Available at http://www.adfg.alaska.gov/sf/sportfishingsurvey/index.cfm?ADFG=region.results.

Alaska Department of Fish and Game. 2015. Recreational Angler Access Project. Available at http://www.adfg.alaska.gov/index.cfm?adfg-fishingsportangeraccesssouthcentral.kvichakriver.

Amaral S., B. McMahon, G. Allen. 2010. Laboratory Evaluation of Fish Survival and Behavior Associated with Passage Through Hydrokinetic Turbines. Pittsburgh (PA): Annual Meeting of the American Fisheries Society.

Gillispie, T. E. 2018. An Overview of Alaskan's Prehistoric Cultures. Alaska Department of Natural Resources, Office of History and Archaeology Report 173. Anchorage, Alaska. June 15, 2018.

National Oceanic and Atmospheric Administration (NOAA). 2019. Sockeye Salmon. Accessed on January 3, 2019, at https://www.fisheries.noaa.gov/species/sockeye-salmon.

National Park Service. 2017. National Park Service Announces $500,000 in Grants to Support Diversity in the National Register of Historic Places. December 27, 2017. Available at: https://www.nps.gov/orgs/1207/12-27-2017-underrepresented-communities-grants.htm. Accessed on January 10, 2019.

Rosenberg, D. 2005. Unpublished Steller's eider satellite telemetry data, Kodiak, Alaska. On file at U.S. Fish and Wildlife Service, Anchorage Field Office, Anchorage, Alaska.

TerraSond (2011). Kvichak River RISEC Project. Resource reconnaissance and physical characterization. Final Report. Prepared by TerraSond Ltd., Palmer, AK for Dept. of Community and Economic Development, AIDEA/AEA, Rural Energy Group, Anchorage, AK.

Thomson, J., Kilcher, L. & Polagye, B. (2014). Flow measurements during RivGen® deployment Igiugig, AK. 2014. U.S. Department of Energy, DE-EE0006397.

U.S. Fish and Wildlife Service (FWS). 2019. A consultation guide for southcentral Alaska: Map, critical habitat, overview. Accessed on January 10, 2019 at: https://www.fws.gov/alaska/fisheries/endangered/pdf/consultation_guide/49_spei_ch_overview.pdf.

U.S. Geological Survey (USGS). 2018. Latest Earthquakes. Accessed on December 13, 2018 at: https://earthquake.usgs.gov/earthquakes/map/.

_____. 2018. Quaternary Fault and Fold Database of the United States. Accessed on December 13, 2018 at: https://earthquake.usgs.gov/hazards/qfaults/.

8.0 LIST OF PREPARERS

Federal Energy Regulatory Commission

Ryan Hansen—FERC Project Coordinator, Aquatic Resources (Environmental Biologist; B.S., Biology, M.S., Environmental Science and Public Policy)

Julia Kolberg – Geologic and Soil Resources, Developmental Analysis (Environmental Engineer; B.S., Biological Systems Engineering)

Suzanne Novak –Recreation, Aesthetic and Cultural Resources; Navigation (Outdoor Recreation Planner; M.A. Recreation Resource Management)

Dianne Rodman—Rare, Threatened, and Endangered Species (Ecologist; M.S., Biology)

APPENDIX A

LICENSE ARTICLES RECOMMENDED BY STAFF

We recommend including the following license articles in any license issued for the project:

Article 2XX. *Administrative Annual Charges*. The licensee must pay the United States annual charges as determined in accordance with the provisions of the Commission's regulations in effect from time to time, effective as of the date of commencement of project operation, to reimburse the United States for the cost of administration of Part 1 of the Federal Power Act. The authorized installed capacity for that purpose is 70 kilowatts (kW). Under the regulations currently in effect, projects with an authorized installed capacity of less than or equal to 1,500 kW will not be assessed an annual charge.

Article 2XX. *Exhibit Drawings*. Within 45 days of the date of issuance of this license, as directed below, the licensee must file two sets of the approved exhibit drawings and geographic information system (GIS) data in electronic file format on compact disks with the Secretary of the Commission, ATTN: OEP/DHAC.

(a) The licensee must prepare digital images of the approved exhibit drawings in electronic format. Prior to preparing each digital image, show the FERC Project-Drawing Number (*i.e.*, P-13511-# through P-13511-#) in the margin below the title block of the approved drawing. The licensee must segregate Exhibit F drawings from other project exhibits (i.e., two compact disks containing the Exhibit G drawings and GIS data, and two compact disks containing only Exhibit F drawings), and **identified as Critical Energy Infrastructure Information (CEII) material under 18 C.F.R. § 388.113**. Each drawing must be a separate electronic file, and the file name must include: FERC Project-Drawing Number, FERC Exhibit Number, Drawing Title, date of this order, and file extension in the following format [P-13511-#, G-1, Project Boundary, MM-DD-YYYY.TIF].

Each Exhibit G drawing that includes the project boundary must contain a minimum of three known reference points (*i.e.*, latitude and longitude coordinates or state plane coordinates). The points must be in a triangular arrangement for GIS georeferencing the project boundary drawing to the polygon data, and based on a standard map coordinate system. The licensee must identify the spatial reference for the drawing (*i.e.*, map projection, map datum, and units of measurement) on the drawing and label each reference point. In addition, a registered land surveyor must stamp each project boundary drawing. All digital images of the exhibit drawings must meet the following format specification:

IMAGERY:	black & white raster file
FILE TYPE:	Tagged Image File Format, (TIFF) CCITT Group 4 (also known as T.6 coding scheme)
RESOLUTION:	300 dots per inch (dpi) desired, (200 dpi minimum)
SIZE FORMAT:	22" x 34" (minimum), 24" x 36" (maximum)
FILE SIZE:	less than 1 megabyte desired

b) Project boundary GIS data must be in a georeferenced electronic file format (such as ArcGIS shapefiles, GeoMedia files, MapInfo files, or a similar GIS format). The filing must include both polygon data and all reference points shown on the individual project boundary drawings. Each project development must have an electronic boundary polygon data file(s). Depending on the electronic file format, the polygon and point data can be included in single files with multiple layers. The georeferenced electronic boundary data file must be positionally accurate to ±40 feet in order to comply with National Map Accuracy Standards for maps at a 1:24,000 scale. The file name(s) must include: FERC Project Number, data description, date of this order, and file extension in the following format [P-13511, boundary polygon or point data, MM-DD-YYYY.SHP]. A separate text file describing the spatial reference for the georeferenced data: map projection used (*i.e.*, UTM, State Plane, Decimal Degrees, etc.), the map datum (*i.e.*, North American 27, North American 83, etc.), and the units of measurement (*i.e.*, feet, meters, miles, etc.) must accompany the filing. The text file name must include: FERC Project Number, data description, date of this order, and file extension in the following format [P-13511, project boundary metadata, MM-DD-YYYY.TXT].

Article 2XX. *Documentation of Project Financing*. At least 45 days before starting construction, the licensee must file with the Commission, for approval, the licensee's documentation for the project financing. The documentation must show that the licensee has acquired the funds, or commitment for funds necessary to construct, operate, maintain, and remove the project in accordance with this license. The documentation must include, at a minimum, financial statements, including a balance sheet, income statement, and a statement of actual or estimated cash flows over the license term which provide evidence that the licensee has sufficient assets, credit, and projected revenues to cover project construction, operation, maintenance and removal expenses, and any other estimated project liabilities and expenses.

The financial statements must be prepared in accordance with generally accepted accounting principles and signed by an independent certified public accountant. The licensee must not commence construction associated with the project before the filing is approved.

Article 2XX. *As-built Exhibits*. Within 90 days of completion of construction of the facilities authorized by this license, the licensee must file for Commission approval,

revised Exhibits A, F, and G, as applicable, to describe and show those project facilities as built.

Article 3XX. *Start of Construction*. The licensee must commence construction of the project works within two years from the issuance date of the license and must complete construction of the project within five years from the issuance date of the license.

Article 3XX. *Cofferdam and Deep Excavation Construction Drawings*. Should construction require cofferdams or deep excavations, the licensee shall: (1) review and approve the design of contractor-designed cofferdams and deep excavations prior to the start of construction; and (2) shall ensure that construction of cofferdams and deep excavations is consistent with the approved design. At least 30 days before starting construction of any cofferdams or deep excavations, the licensee shall submit one copy to the Commission's Division of Dam Safety and Inspections (D2SI) Portland Regional Engineer and two copies to the Commission (one of these copies shall be a courtesy copy to the Commission's Director, D2SI), of the approved cofferdam and deep excavation construction drawings and specifications, and the letters of approval.

Article 3XX. *Contract Plans and Specifications*. At least 30 days prior to the start of any construction, the licensee shall submit one copy of its plans and specifications and supporting design document to the Commission's Division of Dam Safety and Inspections (D2SI) Portland Regional Engineer, and two copies to the Commission (one of these shall be a courtesy copy to the Director, D2SI). The submittal to the D2SI Portland Regional Engineer must also include as part of preconstruction requirements: a Quality Control and Inspection Program, Temporary Construction Emergency Action Plan, and Soil Erosion and Sediment Control Plan. The licensee may not begin construction until the D2SI Portland Regional Engineer has reviewed and commented on the plans and specifications, determined that all preconstruction requirements have been satisfied, and authorized start of construction.

Article 3XX. *Navigation Safety Plan*. Upon license issuance, the licensee must implement the Navigation Safety Plan, filed November 15, 2018, with the following modification: the licensee must include the Lake and Peninsula Borough in the list of entities to be contacted in the event of a project-related incident that affects navigation. This plan may not be amended without prior Commission approval.

Article 3XX. *Project Inspection and Maintenance Plan*. Upon license issuance, the licensee must implement the Project Inspection and Maintenance Plan, filed November 15, 2018. This plan may not be amended without prior Commission approval.

Article 4XX. *Project and Public Safety Plan*. Upon license issuance, the licensee must implement the Project and Public Safety Plan, filed November 15, 2018, with the following modification: the licensee must include the Lake and Peninsula Borough in the

list of entities to be contacted in the event of a project-related incident that affects project or public safety. This plan may not be amended without prior Commission approval.

Article 4XX. *Project Removal and Site Restoration Plan.* The Project Removal and Site Restoration Plan, filed November 15, 2018, is approved. This plan may not be amended without prior Commission approval. Within 30 days of completing the site restoration, the licensee must file documentation of completion of project removal and site restoration activities. The plan need only be implemented if the licensee or no other party files an application to relicense the project by the application due date in accordance with 18 CFR 16.26.

Article 4XX. *Emergency Shutdown Plan.* Upon commencement of project operation, the licensee must implement the Emergency Shutdown Plan, filed November 15, 2018, with the following modification: the licensee must include the Lake and Peninsula Borough in the list of entities to be contacted in the event of an emergency shutdown. Within 5 days of the commencement of project operations, the licensee must file written notification of the commencement date of project operations with the Commission. This plan may not be amended without prior Commission approval.

Article 4XX. *Fuel and Hazardous Substances Spill Plan*. Within 45 days of the date of issuance of this license, the licensee must file, for Commission approval, a Fuel and Hazardous Substances Spill Plan. The plan must include, at a minimum: (1) protocols that would allow project personnel to respond to spills of fuel or hazardous substances in a quick and efficient manner minimizing effects on water quality; and (2) a reporting requirement to notify the National Marine Fisheries Service (NMFS), Alaska Department of Fish and Game (Alaska DFG), and the Commission of any project-related spills of hazardous substances.

The licensee shall develop the plan in consultation with NMFS and Alaska DFG. The licensee's filing shall include documentation of consultation, copies of comments and recommendations, and specific descriptions of how the agencies comments are accommodated. If the licensee does not adopt an agency's recommendation, the filing shall include the licensee's reasons based on project specific information. The Commission reserves the right to make changes to any plan submitted. Upon Commission approval, the plan becomes a requirement of the license, and the licensee must implement the plan or changes in project operations or facilities, including any changes required by the Commission.

Article 4XX. *Fish Monitoring Plan.* The Fish Monitoring Plan, filed November 15, 2018, is approved with the following modification:

If the results of the Fish Monitoring Plan show negative effects to fish in the project area, the licensee must consult with the Alaska Department of Fish and Game (Alaska DFG) on the development of instream work windows and must abide by them for

all further in-water work. Work may be conducted outside of the agreed upon windows with the approval of the Alaska DFG. If any work is conducted outside of the instream work window, whether approved by Alaska DFG or not, the licensee must notify the Commission as soon as possible, but no later than 10 days after each such incident.

This plan may not be amended without prior Commission approval.

Article 4XX. *Adaptive Management Plan.* The Adaptive Management Plan, filed November 15, 2018 is approved. This plan may not be amended without prior Commission approval.

Article 4XX. *Agency Access*. The licensee must provide free and unrestricted access to and across the project lands and waters and project works to representatives of the Alaska Department of Fish and Game who show proper credentials, to perform their official duties after appropriate advance notification is made.

Article 4XX. *Cultural Resources.* If the licensee discovers previously unidentified archeological or historic properties during the course of constructing, maintaining, or removing project works or other facilities at the project, the licensee must stop all land-clearing and land-disturbing activities in the vicinity of the properties and consult with the Alaska SHPO.

If a discovered cultural resource is determined to be eligible for the National Register of Historic Places, the licensee must file for Commission approval a historic properties management plan. The plan shall be prepared by a qualified cultural resource specialist after having consulted with the Alaska SHPO. The plan shall include the following items:

(1) a description of each discovered property indicating whether it is listed on or eligible to be listed on the National Register of Historic Places;

(2) a description of the potential effect on each discovered property;

(3) proposed measures for avoiding or mitigating effects;

(4) documentation of the nature and extent of consultation; and

(5) a schedule for mitigating effects and conducting additional studies.

The Commission may require changes to the plan. The licensee may not begin land-clearing or land-disturbing activities, other than those specifically authorized in this license, or resume such activities in the vicinity of a property discovered during construction, until informed by the Commission that the requirements of this article have been fulfilled.

Article 4XX. *Use and Occupancy*. (a) In accordance with the provisions of this article, the licensee must have the authority to grant permission for certain types of use and occupancy of project lands and waters and to convey certain interests in project lands and waters for certain types of use and occupancy, without prior Commission approval. The licensee may exercise the authority only if the proposed use and occupancy is consistent with the purposes of protecting and enhancing the scenic, recreational, and other environmental values of the project. For those purposes, the licensee must also have continuing responsibility to supervise and control the use and occupancies for which it grants permission, and to monitor the use of, and ensure compliance with the covenants of the instrument of conveyance for, any interests that it has conveyed, under this article. If a permitted use and occupancy violates any condition of this article or any other condition imposed by the licensee for protection and enhancement of the project's scenic, recreational, or other environmental values, or if a covenant of a conveyance made under the authority of this article is violated, the licensee must take any lawful action necessary to correct the violation. For a permitted use or occupancy, that action includes, if necessary, canceling the permission to use and occupy the project lands and waters and requiring the removal of any non-complying structures and facilities.

(b) The type of use and occupancy of project lands and waters for which the licensee may grant permission without prior Commission approval are: (1) landscape plantings; (2) non-commercial piers, landings, boat docks, or similar structures and facilities that can accommodate no more than 10 water craft at a time and where said facility is intended to serve single-family type dwellings; (3) embankments, bulkheads, retaining walls, or similar structures for erosion control to protect the existing shoreline; and (4) food plots and other wildlife enhancement. To the extent feasible and desirable to protect and enhance the project's scenic, recreational, and other environmental values, the licensee must require multiple use and occupancy of facilities for access to project lands or waters. The licensee must also ensure, to the satisfaction of the Commission's authorized representative, that the use and occupancies for which it grants permission are maintained in good repair and comply with applicable state and local health and safety requirements. Before granting permission for construction of bulkheads or retaining walls, the licensee must: (1) inspect the site of the proposed construction, (2) consider whether the planting of vegetation or the use of riprap would be adequate to control erosion at the site, and (3) determine that the proposed construction is needed and would not change the basic contour of the impoundment shoreline. To implement this paragraph (b), the licensee may, among other things, establish a program for issuing permits for the specified types of use and occupancy of project lands and waters, which may be subject to the payment of a reasonable fee to cover the licensee's costs of administering the permit program. The Commission reserves the right to require the licensee to file a description of its standards, guidelines, and procedures for implementing this paragraph (b) and to require modification of those standards, guidelines, or procedures.

(c) The licensee may convey easements or rights-of-way across, or leases of project lands for: (1) replacement, expansion, realignment, or maintenance of bridges or roads where all necessary state and federal approvals have been obtained; (2) storm drains and water mains; (3) sewers that do not discharge into project waters; (4) minor access roads; (5) telephone, gas, and electric utility distribution lines; (6) non-project overhead electric transmission lines that do not require erection of support structures within the project boundary; (7) submarine, overhead, or underground major telephone distribution cables or major electric distribution lines (69-kV or less); and (8) water intake or pumping facilities that do not extract more than one million gallons per day from a project impoundment. No later than January 31 of each year, the licensee must file with the Commission a report briefly describing for each conveyance made under this paragraph (c) during the prior calendar year, the type of interest conveyed, the location of the lands subject to the conveyance, and the nature of the use for which the interest was conveyed. No report filing is required if no conveyances were made under paragraph (c) during the previous calendar year.

(d) The licensee may convey fee title to, easements or rights-of-way across, or leases of project lands for: (1) construction of new bridges or roads for which all necessary state and federal approvals have been obtained; (2) sewer or effluent lines that discharge into project waters, for which all necessary federal and state water quality certification or permits have been obtained; (3) other pipelines that cross project lands or waters but do not discharge into project waters; (4) non-project overhead electric transmission lines that require erection of support structures within the project boundary, for which all necessary federal and state approvals have been obtained; (5) private or public marinas that can accommodate no more than 10 water craft at a time and are located at least one-half mile (measured over project waters) from any other private or public marina; (6) recreational development consistent with an approved report on recreational resources of an Exhibit E; and (7) other uses, if: (i) the amount of land conveyed for a particular use is five acres or less; (ii) all of the land conveyed is located at least 75 feet, measured horizontally, from project waters at normal surface elevation; and (iii) no more than 50 total acres of project lands for each project development are conveyed under this clause (d)(7) in any calendar year. At least 60 days before conveying any interest in project lands under this paragraph (d), the licensee must file a letter with the Commission, stating its intent to convey the interest and briefly describing the type of interest and location of the lands to be conveyed (a marked Exhibit G map may be used), the nature of the proposed use, the identity of any federal or state agency official consulted, and any federal or state approvals required for the proposed use. Unless the Commission's authorized representative, within 45 days from the filing date, requires the licensee to file an application for prior approval, the licensee may convey the intended interest at the end of that period.

(e) The following additional conditions apply to any intended conveyance under paragraph (c) or (d) of this article:

(1) Before conveying the interest, the licensee must consult with federal and state fish and wildlife or recreation agencies, as appropriate, and the State Historic Preservation Officer.

(2) Before conveying the interest, the licensee must determine that the proposed use of the lands to be conveyed is not inconsistent with any approved report on recreational resources of an Exhibit E; or, if the project does not have an approved report on recreational resources, that the lands to be conveyed do not have recreational value.

(3) The instrument of conveyance must include the following covenants running with the land: (i) the use of the lands conveyed must not endanger health, create a nuisance, or otherwise be incompatible with overall project recreational use; (ii) the grantee must take all reasonable precautions to ensure that the construction, operation, and maintenance of structures or facilities on the conveyed lands will occur in a manner that will protect the scenic, recreational, and environmental values of the project; and (iii) the grantee must not unduly restrict public access to project lands or waters.

(4) The Commission reserves the right to require the licensee to take reasonable remedial action to correct any violation of the terms and conditions of this article, for the protection and enhancement of the project's scenic, recreational, and other environmental values.

(f) The conveyance of an interest in project lands under this article does not in itself change the project boundaries. The project boundaries may be changed to exclude land conveyed under this article only upon approval of revised Exhibit G drawings (project boundary maps) reflecting exclusion of that land. Lands conveyed under this article will be excluded from the project only upon a determination that the lands are not necessary for project purposes, such as operation and maintenance, flowage, recreation, public access, protection of environmental resources, and shoreline control, including shoreline aesthetic values. Absent extraordinary circumstances, proposals to exclude lands conveyed under this article from the project must be consolidated for consideration when revised Exhibit G drawings would be filed for approval for other purposes.

(g) The authority granted to the licensee under this article must not apply to any part of the public lands and reservations of the United States included within the project boundary.