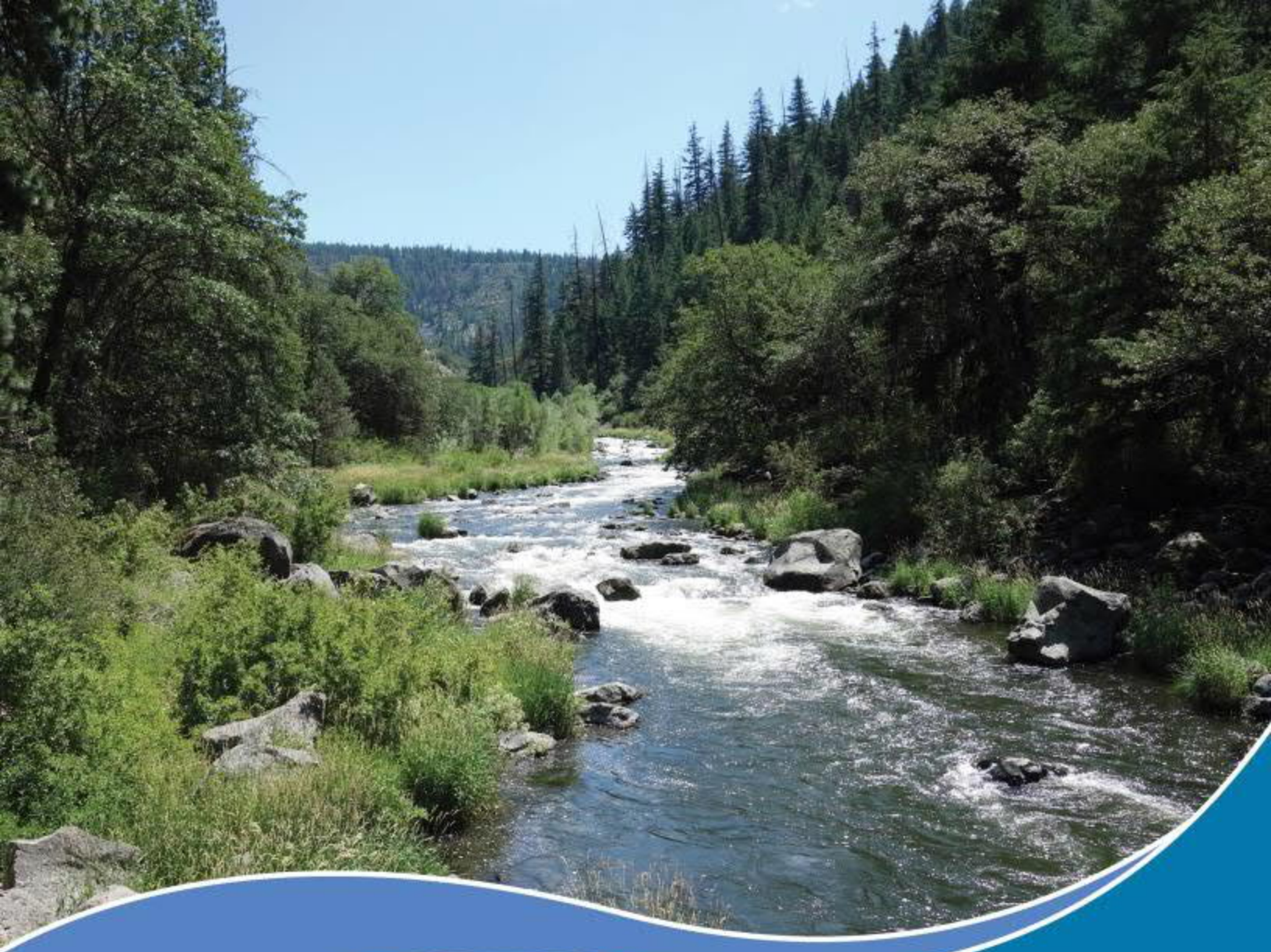

Definite Plan for the Lower Klamath Project

Appendix A – Risk Management Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Acronyms and Abbreviations

BOC	Board of Consultants
CA	California
CEQA	California Environmental Quality Act
CMAR	Construction Manager at Risk
cfs	cubic feet per second
DB	Design-Builder
DSOD	California Division of Safety of Dams
DWR	Department of Water Resources
EAP	Emergency Action Plan
FERC	Federal Energy Regulatory Commission
ID	Identification
KRRC	Klamath River Renewal Corporation
NEPA	National Environmental Policy Act
PFMA	Potential Failure Modes Analysis
QA	Quality Assurance
QC	Quality Control

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Chapter 1: Plan Objectives and Background

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1. PLAN OBJECTIVES AND BACKGROUND

1.1 Plan Objectives

The implementation of any project comes with uncertainty and risk that can affect schedule, budget, and project performance. This is even more applicable to large, multi-disciplinary and high profile projects. Successful implementation includes planning to identify and manage those uncertainties and risks. Section 7.2 of the Klamath Hydroelectric Settlement Agreement (KHSA), as amended, sets forth the essential elements of a risk management plan to be included in and implemented as part of the Definite Plan. These elements include the following:

- Insurance, performance bond, or similar measures as required by Appendix L to the KHSA
- Accounting procedures that will result in the earliest practicable disclosure of any actual or foreseeable cost overrun
- Appropriate mechanisms to modify or suspend performance of any task subject to such cost overrun; and
- Measures to reduce risks of cost overruns, delays, or other impediments to dam removal

This plan addresses these requirements as follows:

- Section 2 identifies the insurance, bonds and other surety arrangements to be secured by the Klamath River Renewal Corporation (KRRC) in compliance with Appendix L to the KHSA
- Section 3 identifies KRRC's preferred progressive design-build project delivery method and plan for a competitive process for selecting its dam removal contractor, and negotiation of construction agreements
- Section 4 includes a design and construction risk register and measures to reduce risks of cost overruns, delays, or other impediments to dam removal

The objective of this Risk Management Plan is to provide a tool and processes to identify and quantify the design and construction risks that are particular to the Lower Klamath Project (Project), assign those risks to the appropriate party, develop design and construction risk management strategies to reduce or eliminate the risk, and to manage and re-evaluate the risks as we progress through the project lifecycle.

1.2 Project Background & Overview

The proposed Project is described in Sections 4 through 7 of the Definite Plan, and generally includes the decommissioning and full removal of four dam developments (Iron Gate, Copco No. 1 and No. 2, and J.C. Boyle) on the Klamath River approximately 200 miles from the Pacific Ocean in the states of Oregon and California by the KRRC. Figure 1.2-1 provides an overview of the Klamath River watershed and the locations of the four dams. The Project objectives are to restore free-flowing river conditions and volitional fish passage by the complete removal of dams, power generation facilities, water intake structures, canals, pipelines, and ancillary buildings. The Definite Plan also describes a partial removal alternative which is presented for purposes of environmental review. Under the partial removal alternative, the objectives of a free-flowing river conditions and volitional fish passage would be achieved, but portions of each dam would remain in place, along with ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes.

Prior to removal of the dams and hydropower facilities, the KRRC will drawdown the water surface elevation in each reservoir as low as possible to facilitate accumulated sediment evacuation and to create a dry work area for facility removal activities. In order to meet drawdown timing and duration, specific infrastructure modifications are required at Iron Gate and Copco No. 1 dams in advance of drawdown. In general, drawdown will begin on January 1 of the drawdown year, and will extend through March 15 of the same year.

After drawdown is accomplished, dam and hydropower facility removal will begin, and the KRRC will stabilize remaining reservoir sediments to the extent feasible. Full reservoir area restoration will begin after drawdown, and extend throughout the year, and possibly into the subsequent year. Vegetation establishment could extend several years.

Other key project components include measures to address aquatic and terrestrial resources, road and bridge improvements, relocation of the City of Yreka's pipeline across Iron Gate Reservoir and associated diversion facility improvements, flood improvements downstream, as well as demolition of various recreation facilities adjacent to the reservoirs.

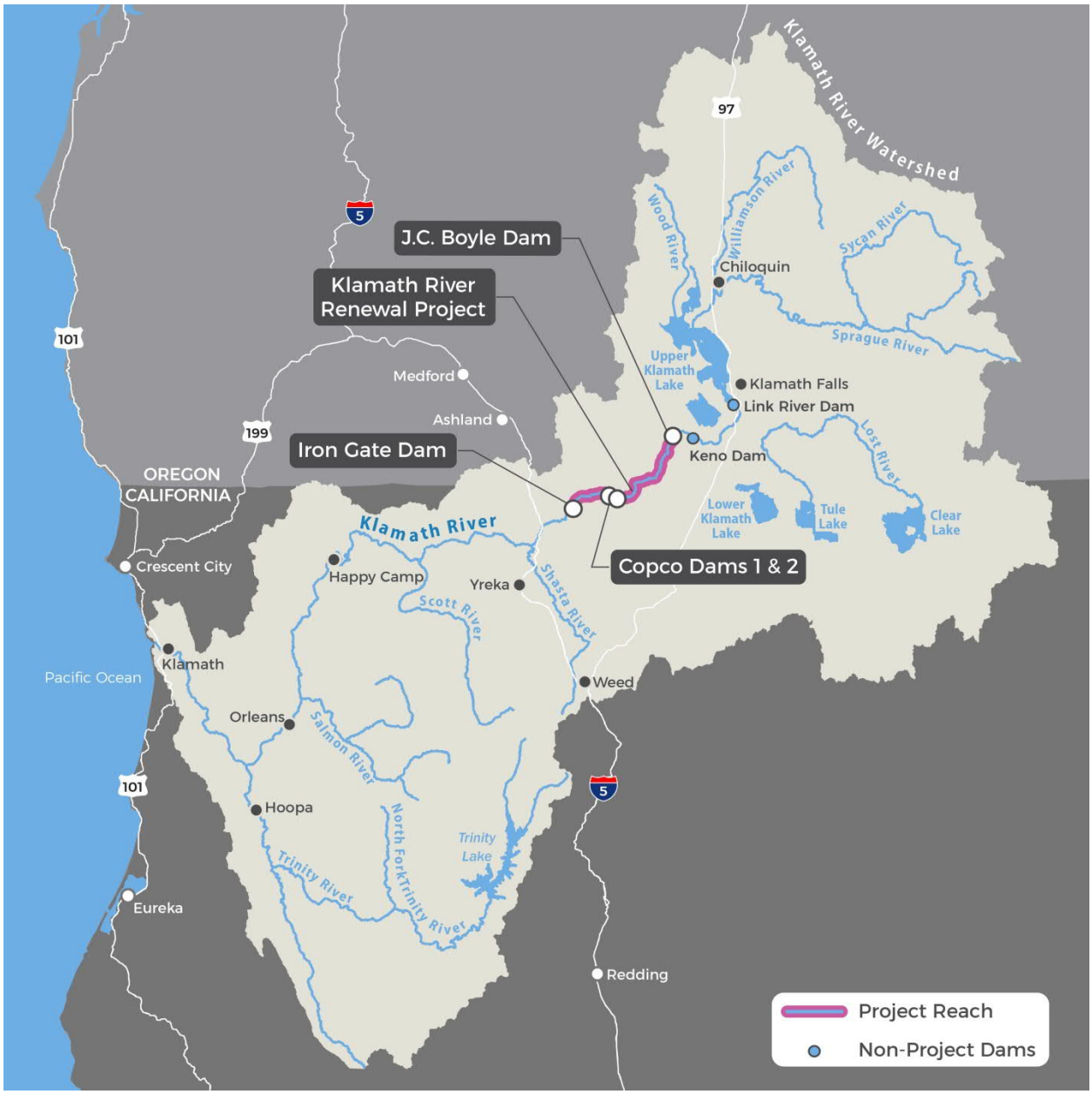

Figure 1.2-1 Klamath River Watershed and Facilities Locations

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Chapter 2: Insurance, Bonds and Other Surety Arrangements

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2. INSURANCE, BONDS AND OTHER SURETY ARRANGEMENTS

2.1 Overview

This section of the Risk Management Plan identifies the insurance, bonds and other surety arrangements that KRRC will maintain in fulfillment of its obligations under Appendix L of the KHSA and prudent business practices. KRRC developed this plan with specialized guidance and advice from Willis Towers Watson (Willis). Willis is a global firm that provides a wide range of insurance brokerage, reinsurance, and risk management consulting services1. Working with Willis as its insurance advisor, KRRC has established and will maintain a robust insurance program to minimize liability risks to the Project and to KRRC.

2.2 Insurance

2.2.1 Overview

KRRC will maintain two insurance programs, each of which will be designed to address different insurance needs and requirements over time. Prior to the commencement of dam removal activities, the insurance currently maintained by KRRC is best viewed as a corporate insurance program that is intended to address KRRC's general risks as a business entity (discussed below as the Corporate Insurance Program). The project-specific insurance needs and requirements in connection with the proposed Project cover a broader range of risks, and are directly responsive to the requirements of Appendix L to the KHSA (discussed below as the Project Insurance Program).

2.2.2 Timing

KRRC's Corporate Insurance Program is in place and is described below. KRRC's project-specific coverages will be established and implemented as part of the dam removal contractor procurement process. KRRC will incorporate these coverages in the RFP for KRRC's dam removal contractor and will be incorporated into the dam removal contract that is ultimately executed by KRRC and the dam removal contractor. KRRC has begun the process of introducing insurers to the Project, with an eye toward selecting the insurer or insurers that offer the best options for project coverage. This will be determined after the insurers have completed their review of the Project.

Once the scope, limits and providers of the project coverages have been finally determined, the actual insurance policies will be put in place in coordination with the beginning of the dam removal work to which

[1] Additional information regarding this firm may be found at https://www.willistowerswatson.com/en/about-us/overview

they relate, including certain preliminary site work. For example, insurance for design work will be in place at the time the dam removal contract becomes effective, as KRRC contemplates a design-build contract structure. Insurance for the actual removal activities may not be in place until removal work is ready to commence.

2.2.3 Corporate Insurance Program

KRRC intends its Corporate Insurance Program to address KRRC's general risks as a business entity and includes the following:

- $1,000,000 Commercial General Liability policy which is supplemented by a $5,000,000 Umbrella policy
- $10,000,000 Directors and Officers policy that protects the KRRC's board members
- Worker's Compensation and Employer's Liability policy with a $1,000,000 limit for the KRRC employee(s)
- Commercial Automobile policy with $1,000,000 in limits
- Commercial Property policy that covers the KRRC's scheduled property

KRRC's liability insurance policies name PacifiCorp, the State of Oregon, the State of California, and their respective officers, agents, employees, and members as additional insureds in accordance with the requirements of the Amended KHSA. Certificates of insurance evidencing that policies of insurance providing such provisions, coverages, and limits as set forth above are included as Appendix B.

2.2.4 Project Insurance Program

The Project Insurance Program will be an "owner controlled insurance program" or OCIP for purposes of securing certain project coverages. Under an OCIP, the owner establishes a Commercial General Liability and Umbrella insurance program in which contractors and subcontractors enroll for coverage, rather than requiring each contractor or subcontractor to procure insurance independently. The net result is a more comprehensive, seamless and efficient insurance program which precludes insurers from denying coverage based on a claim that a different insurer is responsible. By consolidating the risks into a single insurance program, this approach best removes cross-litigation costs caused by multi-party losses on a construction project. This is because the same policy essentially covers each contractor and subcontractor.

An OCIP also allows the project sponsor/owner to control and design the coverage it intends to procure and the cost of coverage. Specific decisions regarding which policies to purchase, when to purchase them, and what insurance limits to obtain are largely driven by the timing and structure of the dam removal. That said, KRRC sets forth below the current expectations regarding its project-specific insurance program.

While KRRC will base the final project-specific insurance requirements on KRRC's discussions with potential insurers and the development of the dam removal contractor RFP, KRRC expects to secure the following project-specific coverages:

- Commercial General Liability (CGL): KRRC will obtain primary Commercial General Liability coverage with limits of $2,000,000 per occurrence and $4,000,000 general aggregate. This policy will be dedicated to this Project. The policy will extend liability coverage to the dam removal contractor and all eligible subcontractors for their work at this Project. The policy will also respond to third-party damage from the construction activity after the Project. This tail coverage will last for ten years or to the statute of repose for the respective state of construction operations. This tail coverage will trigger once the Project has reached substantial completion.
- Umbrella Liability: The OCIP by an Umbrella Liability policy of $200,000,000 in limits will augment the liability coverage provided by KRRC's CGL policy. This policy will follow the terms and conditions of the underlying primary CGL. This Umbrella limit will cover all enrolled parties, which is an added value for smaller subcontractors that cannot afford such high limits.
- Worker's Compensation/Employer's Liability: KRRC will require that all contractors and subcontractors maintain at all times Worker's Compensation and Employer's Liability coverage. This coverage will be maintained in the amounts no less than the applicable statutory requirements for Worker's Compensation and $1,000,000 for Employer's Liability. Because this coverage is statutory, it is not efficient to include it in the OCIP, which each contractor and subcontractor will procure directly.
- Commercial Automobile Liability: KRRC will require that all contractors and subcontractors maintain auto liability insurance limits no less than $1,000,000 combined single limit per accident for bodily injury and property damage. This coverage will also be outside the OCIP and KRRC's contractors and subcontractors will procure it directly to cover all owned, leased and non-owned vehicles used in connection with the work.
- Builder's Risk/Inland Marine or Commercial Property Insurance: Builder's risk insurance is a type of insurance typically associated with vertical construction where an improvement is increasing in value and where the cost of restoration increases as the Project progresses, such as the construction of an office building. In procuring it for a dam removal project, a slightly unconventional analysis will apply to determining prudent limits of coverage. KRRC anticipates obtaining coverage for 100% of the replacement value of any salvaged material or property. KRRC will purchase builder's risk as a project-specific property coverage.
- Contractor's Pollution Liability (CPL): KRRC anticipates that coverage of up to $100,000,000 limits will be included as part of the project program. It will be a dedicated policy covering all contractors and subcontractors at the project site with no enrollment process.
- Fixed Site Pollution Liability: KRRC will acquire this coverage outside the OCIP and will go into effect when KRRC acquires title to the dam facilities and will be in an amount up to $100,000,000. It is the intent to underwrite this policy with the same insurers and in conjunction as the CPL policy to address any pre-existing environmental damages.

- Professional Liability/Errors and Omissions Insurance: This coverage will be required under the terms of KRRC's design contract procurement, whether on a stand- alone basis or as part of a design-build procurement. It will go into effect when KRRC retains the design professional. KRRC expects the coverage limits to be up to $25,000,000. In addition, KRRC will consider whether to purchase an Owner's Protective Professional Indemnity (OPPI) insurance policy as a back-stop to all the design professional's' liability available limits coverage. KRRC will make this decision based on the size, experience and financial strength of the selected design team and their respective insurance limits available to the Project. Coverage limits selected may be as high as 20-40% of the value of construction.

These policies name PacifiCorp, the State of Oregon, the State of California, and their respective officers, agents, employees, and members as additional insureds in accordance with the requirements of the KHSA. KRRC will provide certificates of insurance evidencing that policies of insurance providing such provisions, coverages, and limits as set forth above to PacifiCorp and the States before any contract for dam removal is effective and before dam removal work begins.

2.2.5 Independent Board of Consultants

The Board of Consultants (BOC) will review the forgoing insurance coverages. The BOC includes a member or members with expertise in insurance coverage and bonding for large and complex civil construction projects. KRRC will implement any further recommendations that the BOC may provide with respect to the foregoing insurance coverage.

2.2.6 Ongoing Evaluation

KRRC and Willis will review all policies of insurance on a not-less-than-annual basis to make sure that they are sufficient and cost effective relative to other insurance products and risk management tools as may subsequently become available.

2.3 Bonds

2.3.1 Requirements and Timing

Appendix L to the Amended KHSA addresses bonding requirements. Bond requirements include bid bonds, performance bonds (in an amount equivalent to original contract value) and payment bonds (in an amount equivalent to original contract value). These bonds will be secured in connection with awarding contracts to undertake decommissioning activities. One or more of KRRC's vendors and contractors will maintain these bonds (and/or parent company guaranty or standby letter of credit). KRRC will require that all bonds be obtained from financially sound surety companies.

2.3.2 Performance Bond

The performance bond securing the contractor's performance under the dam removal contract will be in the full amount of the dam removal contract. The contractor's surety company issuing the bond will determine the form of bond: however, AIA Form 312 is the predominant form in use at this time. To the extent alternate forms are used, they will be substantively similar.

2.3.3 Independent Board of Consultants

The BOC will review and approve its proposed bonding requirements. KRRC will implement any further recommendations that the BOC may provide with respect to bonding requirements. Because the performance bond backstops the dam removal contractor's performance, it cannot be issued until the dam removal contract is in place and will be issued at that time.

2.3.4 Ongoing Evaluation

As with insurance, KRRC and Willis will periodically review the amount and form of bonds (and/or parent company guaranty or standby letter of credit) to make sure that they are sufficient and cost effective relative to other products and risk management tools as may subsequently become available.

2.4 Specialty Corporate Indemnitor

2.4.1 Overview

Appendix L to the KHSA requires KRRC to identify and contract with a specialty corporate indemnitor (a Liability Transfer Corporation, or LTC) to protect the states of Oregon, California and PacifiCorp from potential liability that may be uninsurable or underinsured. KRRC will fulfill this requirement in consultation with the States and PacifiCorp and in connection with the design and implementation of the insurance program discussed above. KRRC will use this risk management tool to address certain risks not covered by KRRC's insurance Program. Parameters established by the KHSA to assess the sufficiency of a corporate indemnitor include:

- Appropriate capitalization (as agreed to by the States and PacifiCorp)
- Performance in projects of similar scope, magnitude, complexity and type
- Experience with federally regulated permitting processes
- Longevity in the industry

This requirement will be fulfilled in connection with the selection of the design-build contractor hired to implement the Definite Plan.

2.4.2 Structure and Timing

The LTC can be structured contractually, through third-party indemnities or potentially with additional special insurance products. The LTC may perform portions of the Project and will assume responsibility for various project risks, both during project execution and post-project (including the fulfillment of any long-term mitigation obligations established by the Definite Plan or regulatory approvals). The "gap" between the general responsibilities to be assumed by the general contractor and the program of required insurance has yet to be determined. Defining and filling this gap is an ongoing process, as KRRC seeks to better define construction costs, measures to lower construction costs, and measures to manage construction risk. KRRC expects to fulfill this requirement concurrently with the execution of the contract for dam removal.

2.4.3 Independent Board of Consultants

The BOC will review the potential and appropriate risks that may be transferred to a LTC. KRRC anticipates obtaining BOC guidance on this risk management tool concurrently with its efforts to identify a proposed contractor and negotiate a progressive design-build contract with a guaranteed maximum construction price. KRRC's final decision on how best to use this risk management tool is, however, subject to the approval of the states of Oregon, California and PacifiCorp, in consultation with the Federal Parties, whose approval may not be unreasonably withheld.

Chapter 3: Project Delivery Method

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3. PROJECT DELIVERY METHOD

3.1 Overview of Progressive Design-Build Delivery Method

KRRC is pursuing a competitive process for selecting its dam removal contractor, or design-builder. KRRC contemplates structuring the dam removal contract as a progressive design-build contract under which, after selection, the designated design-builder will then spend six to nine months studying the project area and designing its removal program before the final guaranteed maximum price is locked in. KRRC expects this design process to begin in the first quarter of 2019. When KRRC finalizes the cost of the dam removal work under the contract through the negotiation of a guaranteed maximum price, the circumstances that most often lead to cost overruns for which the owner remains responsible - unknown site conditions – while not eliminated will have been significantly narrowed even beyond where it is today. As a result, final pricing will be determined prior to KRRC's acceptance of the project license.

The progressive design-build contract KRRC expects to enter into will provide that one overall contractor will complete both design and deconstruction on an integrated basis and will assure that, absent contractually defined uncontrollable circumstances, the work will be performed with minimal cost overruns. Thus, any project costs incurred within the defined work scope that are in excess of the guaranteed price will be the responsibility of the project contractor, not KRRC.

In addition to committing to a guaranteed maximum price, the project contractor will agree to complete the Project and perform the work to specified technical standards by a guaranteed completion date. Proposers will be required to include detailed proposals on their proposed means and methods of dam removal, consistent with regulatory requirements. Means and methods that offer greater promise of lessening potential liability or lowering costs can be scored higher in determining the proposal offering the best value. Daily liquidated damages will be payable to KRRC for unexcused delays, and KRRC will not be responsible for any cost overruns except those caused by predetermined risks that are outside the project contractor’s ability to reasonably manage and control. A qualified construction-management entity will oversee the performance of the dam decommissioning and removal work under the project agreement.

This integrated project-delivery approach will be particularly useful for the Project because it will mitigate several elements of project-completion risk, in addition to the general price risk inherent in all construction projects. Integrated project delivery involves a self-selected team of highly qualified firms whose business interests are aligned, thus decreasing the risk of disputes among team members. By addressing multiple aspects of the work in a single contract, integrated project delivery also has the key advantage of creating one point of accountability for the Project, allowing KRRC to bring a claim against a single entity for any flawed work. Furthermore, considering that dam removal is a specialized area, integrated project delivery gives the prequalified entity the opportunity to make an innovative and cost-effective proposal to execute the work. Additional benefits of integrated project delivery include accelerated project delivery and improved project quality.

3.2 Risk Transfer

Risks transferred to the project contractor under the project agreement will include the risk of unexcused delays; unexpected work that the project contractor needs to perform to carry out the basic work scope; unavailability of materials; non-compliance with the decommissioning plan, applicable law and governmental approvals; intellectual property infringement; and the risk of exacerbating any existing hazardous substances or other pollution conditions. These risks are regarded in the industry as within the control of the project contractor team and are generally assumed contractually by the contractor without adding a risk premium to the contract price. KRRC will retain the risk of any delays caused by (i) uncontrollable circumstances (such as changes in law, force majeure, the discovery of cultural relics, and dam conditions unknown at the time the contract is entered into); (ii) any work scope changes directed by KRRC; and (iii) the inaccuracy of any information provided by KRRC to the project contractor that formed the basis of the decommissioning plan and that could not reasonably be verified by the project contractor.

3.3 Retained Risk; Project Contingency

If accurate information is supplied to the project contractor, no scope changes are requested by KRRC after contract execution, and no uncontrollable circumstances occur, the project contractor will be obligated to complete the Project for the guaranteed maximum price (which is based on competitively bid elements of the construction work) established at contract signing. On the other hand, if any of the risks retained by KRRC occur, KRRC as the project owner will bear the costs. Accordingly, the project budget will include an appropriate contingency reserve for any such risks, and KRRC will use insurance and other mechanisms to manage these risks.

Section 2.6 of Appendix P of the Definite Plan discusses contingency reserves, based on updated construction costs and are summarized here. A design contingency was set at 10% of the construction cost, which is a typical value for a level of design presented in the Definite Plan. In addition, KRRC used a value of 20% of the construction cost for construction contingencies for the dam removal estimates, which is a typical value for this stage of project development. KRRC applied the design and construction contingencies (total of 30%) as a percentage of construction cost and added to the overall estimate of project costs. Based upon current project cost estimates, KRRC applied design and construction contingencies of approximately $58 million and $68 million to the partial removal and full removal alternative estimates of project cost, respectively.

3.4 Contractor Selection Process

KRRC will choose the project contractor using a two-stage qualifications-based-selection (QBS) process. The first stage will involve a request for qualifications (RFQ), and the second stage will involve a request for proposals (RFP). QBS standards during the RFQ will include:

- Past performance of similar projects in scope, magnitude (complexity and size, such as but not limited to performance of work at multiple locations at the same time), and type (waterway work; environmentally regulated, etc.)
- Sufficient financial strength, including basic financial metrics such as corporate net worth and profitability
- Experience with federally regulated permitting processes
- Longevity in industry.

KRRC will invite three or four pre-qualified firms to make project submittals on a competitive proposal basis in response to a RFP issued by KRRC. KRRC will set forth the requirements for making project proposals in the RFP and will base them on the terms of the Definite Plan. KRRC will select the proposer submitting the best value proposal (best overall price and technical merit) to perform the work and enter into a comprehensive project agreement with KRRC. The states of California and Oregon and PacifiCorp will have the opportunity to review and comment on the selection process and resulting project agreement to assure that their interests are protected and that the project work will be properly carried out. KRRC may divide the work into two or three segments, contracted separately, as determined by KRRC to be in its best interests.

3.5 Performance Security; Indemnities

Section 2.3 addresses performance security and indemnities. The project contractor will furnish a conventional performance bond from a financially sound surety company, further assuring KRRC that the contractor will perform the project agreement as required. As an alternative, or in addition to a performance bond, KRRC may also ask the project contractor to provide a parent company guaranty or to furnish a standby letter of credit securing performance of the project agreement. KRRC will have the right to call upon any such guaranty or to draw on any such letter of credit if a project contractor fails to perform and use the proceeds to pay any non-performance damages it is owed under the project agreement. The project contractor will also indemnify KRRC for any loss or expense incurred by third parties resulting from an unexcused breach of the contract or any negligence or willful misconduct by the contractor. Each party, as is conventional in contracts of this nature, will waive the right to make a claim for punitive or consequential damages.

3.6 Construction Management

A qualified construction-management entity will provide oversight of the project contractor, including detailed design review and full construction-management services throughout the duration of the project agreement. The construction manager will participate in the contractor's design development meetings and will review all final design documents developed by the contractor. KRRC anticipates detailed reviews at the 60%, 90% and 100% completion levels, as well as review of final Construction Documents (plans, specifications, design report and cost estimate). The construction manager will be involved in recurring activities such as progress meetings, pay estimates, weekly progress reporting, and schedule updates. These recurring activities are the

basic machinery for transferring information, making decisions, and identifying potential risks during construction. The construction manager will meet weekly with the contractor to review the current status of completed work onsite. The contractor will prepare and KRRC will review and approve a written safety plan that the selected contractor would be required to follow, thus providing a uniform approach toward project safety.

3.7 Independent Board of Consultants

The BOC will review project documents as well as dam removal schedules, plans and specifications, staging sequence, and supporting engineering studies. KRRC will incorporate any recommendations with respect to the proposed project delivery method into its project documents, contractor selection process, and project management procedures.

Chapter 4: Design & Construction Risk Register

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4. DESIGN & CONSTRUCTION RISK REGISTER

4.1 Overview

This Section identifies construction risks (in the form of a risk register) and estimates their likelihood and consequences of occurrence, ranking those risks to determine which pose the greatest risk to the Project, and developing risk management strategies for the highest ranking risks. The risk register will be a living document prepared with the participation of the full project team (KRRC, consultants, stakeholders, etc.) eventually including the Design-Builder (DB) or Contractor. This draft plan is based on the Project as it has been described and developed in the Federal Energy Regulatory Commission (FERC) Definite Plan for Decommissioning (KRRC 2018) (Definite Plan).

The plan will be updated periodically by the full project team to add newly identified risks, and adjust risks that have been previously identified either upward or downward.

The risk register identifies design and construction risks as they are recognized throughout the duration of the Project. KRRC has assigned each identified risk its own unique Risk identification (ID) number and categorized into one of seven risk categories, which are described in further detail in Section 4.2. Risk ID numbers are not necessarily sequential, since they were derived from an initial broader list that may not have all moved forward. The register also includes specific information and data associated with each risk as follows:

- A description of the risk
- The root cause(s) of the risk
- The risk's relationship to the four phases of the Project
- The primary impact aspect of the risk
- The likelihood (probability) that the risk will occur
- A rating of the impact or consequence if the risk event occurred
- A risk score (rating) by combining the likelihood and related consequence
- A summary of risk management measures
- The assigned owner of the risk

As the risk register is further developed and implemented, responsible parties from the Owner and DB will be assigned to further define and implement risk management measures identified for each risk. As risks are avoided or mitigated, or as new relevant information is obtained, risk category, score and rating will be updated to reflect the latest information.

Since the risk register will evolve and KRRC will update it throughout the life of the Project, ongoing assessment and reporting will be necessary. Reporting and other continuing risk management activities are discussed in Section 4.8.

4.2 Risk Category

KRRC has categorized each risk into one of the following general categories:

1. Environmental – These are design and construction risks primarily related to environmental aspects of the Project. Environmental aspects and associated risks could involve existing or future biological, cultural or other environmental conditions/species, potential construction related effects such as air quality or noise, or potential downstream environmental effects.
2. Permitting – Risks that are primarily related to environmental compliance and permitting. This includes process-related considerations, requirements associated with compliance and acquisition of all necessary regulatory permits.
3. Design – These are risks primarily related to development of the project design and subsequent performance of associated Project features. Risks could involve performance failures as a result of incorrect assumptions or calculations, incomplete or inaccurate drawings and specifications, etc.
4. Procurement and Construction - Risks primarily related to the procurement of a DB or Contractor, and with actual construction of the Project including labor, equipment, material, existing conditions, subsurface conditions, site safety, etc. Procurement related risks could involve the procurement process and/or contract negotiation. Construction related risks could involve DB quality of work or production, as well as health and safety.
5. Operations and Maintenance - Risks primarily related to post-construction project performance and maintenance. The project team anticipates minimal long-term operations and maintenance requirements.
6. External - These are risks primarily related to events or conditions outside of the control of the Project, such as unforeseen site conditions, forces of nature (e.g. floods and wildfires), etc.
7. Organizational - These are risks primarily related to the project organization, governance and associated constraints such as financing/funding, access agreements, funding agreements, transfer agreements, etc.

4.3 Phases

Each identified risk will exist during particular phases of the Project. The Project phases include the following:

1. Planning: The period until KRRC selects a DB for implementation. Activities during the Planning phase include data collection, preliminary field investigations, preliminary design, permitting and regulatory consultation and application development, contract work packaging to define the

intended scopes of work to most efficiently achieve the project schedule and other project objectives, selection of the appropriate project delivery method for each contract work package, and procurement activities for selecting a DB for each work package. Such procurement activities will involve, depending on delivery method, development and preparation of the Requests for Qualifications and Proposals for a DB, evaluation of proposals, and negotiation of the associated contracts.

2. Design: Design is the period during which the detailed and final design of the Project is performed. Activities during this phase include field investigations for final design, final design, permitting activities, and regulatory review and approval of the final design documents.
3. Construction: The period during which construction activities to implement the final design actually take place. Activities during the Construction Phase include mobilization, preparation of the site, pre-reservoir drawdown construction activities, other early construction activities, dam and appurtenances demolition activities, followed by site restoration.
4. Post-Construction: The period following dam removal and site restoration.

The risk register shows each risk in relation to the four phases (see Figure 4.3-1 for example). Phases during which the risk could be realized are indicated by red, and earlier phases during which risk mitigation can be developed and implemented are indicated by yellow.

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase
19	Proc & Const	Construction	General changed field condition (geotechnical, existing utilities, hazardous materials, and biological resources) leads to redesign, project delays and/or cost overruns	Field condition differs from documented findings	M	M	A	
20	External	Construction	Wetter-than-expected weather during construction increases costs and causes delays	Climate change; Hydrology	M	M	A	

Note: M = period when management strategies are developed; A = period when risk may be actualized

Figure 4.3-1 Risk Register Phases Designation Example

4.4 Primary Aspect of Risk

For additional classification and subsequent data processing, KRRC categorized each identified risk as one of four primary risk aspects as follows:

1. Time: The consequence of the risk is greatest with respect to the project schedule.

2. Cost: The consequence of the risk is greatest with respect to the project budget.
3. Safety: The consequence of the risk is greatest with respect to the safety of workers and the public.
4. Environmental Impact: The consequence of the risk is greatest with respect to the environment.

Any risk will include more than one of the four aspects. The categorization by aspect is a tool to help assess the risk in these four different areas.

4.5 Risk Score and Rating

The risk score and rating is a function of the probability of the risk occurring and the consequence if the risk were to occur. Probability of occurrence is broken into five different categories to provide sufficient ranges of likelihood, as listed below:

- Probability Score of 5: Risk has a 60% or greater probability of occurrence, meaning it is very likely to occur
- Probability Score of 4: Risk has a 40 to 59% probability of occurrence, meaning it is likely to occur
- Probability Score of 3: Risk has a 20 to 39% probability of occurrence, meaning it is less likely to occur
- Probability Score of 2: Risk has a 10 to 19% probability of occurrence, meaning it is unlikely to occur
- Probability Score of 1: Risk has a less than 10% probability of occurrence, meaning it is very unlikely to occur

Consequence of the risk occurring is also broken into five different categories to provide sufficient ranges for the consequences of impact. Since impacts for various risks can apply to one or more aspects or categories, it can be difficult to quantify all risks using the same metric (e.g. cost increase in $, etc.). For that reason, engineering and management judgment is involved when assigning consequence of impact scores. A high level of coordination and collaboration among key project decision makers is necessary for assigning consequence of impact scores. Table 4.5-1 provides some general guidance on consequence of impact scores under aspect categories identified in Section 4.4.

The risk score is calculated by multiplying the probability of risk by the consequence of impact, and then categorizing or rating the risk as low, moderate, or high as shown on the risk score matrix in Table 4.5-2. As shown in the risk score matrix, any risk that has a consequence of impact score of 5 is categorized as a very high risk.

Table 4.5-1 Consequence of Impact Definition for Various Aspects

	CONSEQUENCE OF IMPACT				
PRIMARY ASPECT	Very Low (1)	Low (2)	Moderate (3)	High (4)	Very High (5)
Time	No or little impact to schedule	Schedule delay of less than 3 months	Schedule delay of 3 to <6 months	Schedule delay of 6 to 12 months	Schedule delay of more than 12 months
Cost	<$1M	$1M-$5M	$5M-$10M	$10M-$30M	$30M-50M
Safety	No or little impact to public safety	Number of individuals exposed to minor safety risk less than 5	Number of individuals exposed to minor safety risk greater than 5	Number of individuals exposed to serious safety risk less than 5	Number of individuals exposed to serious safety risk more than 5, or any life threatening risk (1 or more)
Environmental Impact	No significant impact to any environmental resource	Short-term impact that is insignificant	Short-term impact that is significant. Long-term impact that is insignificant.	Long-term significant impact to non-listed species	Long-term significant impact to fisheries or listed species

Table 4.5-2 Risk Score and Ranking Matrix

Probability of Occurrence	5 (60-100%)	5	10	15	20	25
	4 (40-59%)	4	8	12	16	20
	3 (20-39%)	3	6	9	12	15
	2 (10-19%)	2	4	6	8	10
	1 (1-9%)	1	2	3	4	5
		1	2	3	4	5
		Consequence of Impact				

4.6 Risk Status

As the Project develops and is implemented, the status of identified risks will be assigned using the following codes:

1. Open: risks that continue to pose a threat for the Project. These are risks that may or may not have occurred that will not expire until some future date
2. Managed: risks which have had risk management measures implemented such that the likelihood of occurrence or consequences of occurrence has been reduced to a level that the Project can accept in the event the risk occurs
3. Expired: risks that may, or may not, have occurred but no longer pose a threat to the Project. When a risk expires, the probability becomes zero thereby making the risk score zero

4.7 Risk Strategy

During development and implementation of the Project, KRRC will assign the risk strategy to identified risks using the following codes:

1. Manage: Risk management seeks to reduce the likelihood of the risk occurring and/or the consequence of the risk, should it occur.
2. Avoid: Avoidance of the risk eliminates the likelihood of the risk occurring and/or the consequence of the risk, should it occur.
3. Transfer: Transference of the risk makes the risk either partially or completely another party's responsibility.
4. Accept: Acceptance recognizes that the risk cannot be fully managed, avoided, or transferred.
5. Shared: Shared risk means that the liability associated with the risk can be partially transferred (as described above), but certain aspects of the risk remain with the KRRC and will need to be managed, avoided or accepted.

4.8 Continuing Risk Management

As mentioned above, KRRC will update the risk register throughout the life of the Project, involving ongoing assessment and reporting. The project team will manage and track the risk register through all phases of the Project.

Once KRRC selects a DB, they will be required to develop their own risk register, which will focus solely on the design and construction phases of the Project.

4.8.1 Risk Workshops

Subsequent to the initial identification of risks, KRRC will conduct a series of risk workshops at strategic points throughout the Project duration. The goal of these risk workshops will be to further update and refine risks, conduct evaluations and explore mitigation opportunities, while engaging new partners in the Project and the risk management process. Possible times for subsequent risk workshops may include:

- After the CEQA Draft Environmental Impact Report public review period ends
- After the Board of Consultants 2018 review of the Definite Plan is complete
- Upon engagement of Progressive Design-Builder for design work
- After key permits are issued (e.g. FERC Surrender order)
- Prior to first commencement of significant construction activities
- Midpoint of construction, or prior to significant phase(s) of construction

4.8.2 Monitoring and Control

During each risk management meeting, the attendees will review status, risk score and risk management opportunities for all risks active in the current project phase. Output of the risk management meeting shall be an updated risk register for distribution.

Responsibilities for meeting facilitation and reporting are as follows:

Phase	Responsible	Draft to PM	Final Version
Planning	Owner's Project Manager	-	✓
Design	DB/CMAR Project Manager	✓	-
	Owner's Project Manager	-	✓
Construction	DB/CMAR Project Manager	✓	-
	Owner's Project Manager	-	✓

Project monthly progress reports will include a list of open risks, the status of associated risk management actions, and any changes to action completion dates. A narrative will explain any significant exceptions to risk management action completion dates. KRRC will report any new risks.

KRRC will not delete expired risks (i.e. those that have occurred but no longer pose a threat to the Project) – these will remain on the risk register as closed items, or they will be transferred to a register of expired risks for record purposes.

Planning & Design Phases

At a minimum, KRRC will complete quarterly updates throughout the planning phase, with more frequent updates likely required during the detailed design and construction phases.

Construction Phase

KRRC will hold routine risk management meetings at least once every two months. The owners assigned to risks in the current project phase will attend these meetings.

4.8.3 Closing Risk Registers and Lessons Learned

Closing risk registers involves documenting all managed risks and final impacts on the overall Project. Impacts include, but are not limited to, impacts on project costs and schedule. KRRC will similarly document monitored but unmitigated risks. This information will be available for use on future projects, and can be used to adjust severity and probability indices, better define risk tolerance levels and improve risk management efforts.

The PM will prepare a Lessons Learned Report when the risk register is closed. The primary focus will be to identify activities which were highly effective, effective, partially effective, or not effective, and to recommend ways to improve overall effectiveness for risk management activities.

4.9 Risk Register

The current risk register is included as Appendix A. Each risk is categorized by project phase, and the root cause of each such risk is identified. The risk register identifies the primary aspects of each such risk, as well as probability, impact and weight, and provides an overall ranking for each risk. The risk register identifies a strategy for managing each risk, and risk management measures, where appropriate. Finally, the risk register identifies the risk owner and the status of each risk. As noted above, the risk register will evolve and be updated throughout the life of the Project, involving ongoing assessment and reporting.

Chapter 5: References

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5. REFERENCES

KRRC 2018. Definite Plan for the Lower Klamath Project, Klamath River Renewal Corporation. June 2018.

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Attachment A Risk Register

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Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
11	Proc & Const	Planning	Bid process or result (if traditional DB) or RFP selection (if progressive DB) is protested	DB(s) not selected protest bid	A				Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Develop fair bid evaluation process that is clearly defined in RFP; Consider bid preparation stipend: Clearly define bid protest process in RFP.	Owner	Open
12	Proc & Const	Planning	Procurement process fails to result in a contract	Negotiation of contract terms or price fails	A				Time	1 Very Unlikely (1-9%)	3 Moderate	3	Low	Manage	Use prequalification process that values similar experience in reaching cost agreements; Develop fair bid evaluation process that is clearly defined in RFP.	Owner	Open
16	Organizational	Design	Engineer's estimate lower than GMP for PDB or low bids for traditional DBB on smaller work packages	Project perceived as risky; Lack of competition	M	A			Cost	3 Less Likely (20-39%)	4 High	12	Med	Manage	Robust Engineer's estimate to include Monte Carlo analyses; Independent review of Engineer's estimate, Include adequate contingency for project risk; Utilize project delivery method that provides Contractor's progress cost estimates to control budget (PDB or CMAR). Close coordination and transparency on costs and associated assumptions during progress cost estimated prepared by DB or CMAR; Provide contract exit strategy that Owner can terminate for convenience and implement alternate delivery approaches.	Owner	Open
17	Proc & Const	Design	DB Designer/Contractor dispute leads to schedule delays and cost increases	Designer does not have sufficient budget or 'skin in the game'.	M	A	A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Consider contractual measures to maximize design/contractor collaboration such as require Designer to be a partner rather than a subcontractor and provisions that oblige Contractor to continue work even when dispute arises.	PDB	Open
18	Proc & Const	Design	Failure to agree to GMP during detailed design (if PDB or CMAR delivery method)	Disconnect between DB and Owner		A			Time	2 Unlikely (10-19%)	4 High	8	Med	Share	Robust Engineer's estimate to include Monte Carlo analyses; Independent review of Engineer's estimate, Include adequate contingency for project risk; Utilize project delivery method that provides Contractor's progress cost estimates to control budget (PDB or CMAR). Close coordination and transparency on costs and associated assumptions during progress cost estimated prepared by DB or CMAR; Provide contract exit strategy that Owner can terminate for convenience and implement alternate delivery approaches.	Owner / PDB	Open
19	Proc & Const	Construction	General changed field condition (geotechnical, existing utilities, hazardous materials, and biological resources) leads to redesign, project delays and/or cost overruns	Field condition differs from documented findings	M	M	A		Time	3 Less Likely (20-39%)	3 Moderate	9	Med	Manage	Comprehensive field investigation and documentation.	Owner	Open
20	External	Construction	Wetter-than-expected weather during construction increases costs and causes delays	Climate change; Hydrology	M	M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Accept	Consider defining anticipated rain days in contract as a number greater than average; Contract requirement for contractor plan for wetter-than-expected weather.	Owner / Force Majeure	Open
21	External	Construction	Flows higher than expected during instream construction window leads to schedule delays	Unanticipated river flows	M	M	A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Accept	Rigorous flow analyses during planning/design; Set performance requirement in contract (define return period of flow that contractor required to be prepared for).	Owner / Force Majeure	Open
22	External	Construction	Fire in watershed increases erosion and sediment	Lightning; Accidental; Arson; Combined with storm		M	A	A	Cost	2 Unlikely (10-19%)	3 Moderate	6	Med	Accept	Fire Management Plan has been developed and Contractor will be required to prepare their own Fire Management Plan.	Owner / Force Majeure	Open
23	External	Construction	Fire in watershed during construction causes construction delays	Lightning; Accidental; Arson; combined with storm		M	A		Time	3 Less Likely (20-39%)	4 High	12	Med	Accept	Develop and implement emergency response plan for fire management.	Owner / Force Majeure	Open
24	External	Construction	Earthquake damages temporary construction	Earthquake occurs near project	M	M	A		Cost	1 Very Unlikely (1-9%)	2 Low	2	Low	Accept	Consider specifying a contract defined design earthquake for temporary construction.	Owner	Open
25	Design	Construction	Design errors or omissions lead to Project delays or cost overruns	Design error.		M	A		Cost	3 Less Likely (20-39%)	2 Low	6	Med	Transfer	Comprehensive design review; proactive QA/QC.	Owner's Eng	Open
26	Proc & Const	Construction	Construction errors (quality control)	EOR fails to properly inspect or direct work in the field; QC failures	M		A		Cost	3 Less Likely (20-39%)	3 Moderate	9	Med	Transfer	Clear contract requirements; Owner review and enforcement of Contractor QA/QC Plan and rigorous Owner audit and spot testing to confirm results	PDB	Open
27	Proc & Const	Construction	DB unable to obtain construction permits (e.g. County encroachment permits) in time for construction	Poor planning, insufficient communication, difficulty negotiating requirements		M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Share	Owner coordination with Contractor for proactive communication with Counties; Contingency planning for delayed start during first year of construction	PDB	Open
29	External	Construction	Quantity overruns on earthwork, concrete demolition, etc.	Existing as-built data, exploratory data not adequate or accurate	M	M	A		Time	3 Less Likely (20-39%)	2 Low	6	Med	Accept	Obtain new topographic and bathymetric data for use by Designer and Contractor; Rigorous QA by Owner on design calculations and assumptions related to earthwork volumes	Owner	Open

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
31	Proc & Const	Construction	Public safety at construction site	Public safety measures insufficient to keep out public	M		A		Public Safety	1 Very Unlikely (1-9%)	5 Very High	5	High	Share	Development of appropriate health and safety qualifications, experience and other requirements during the procurement process, as well as active overview and enforcement of the Contractor's health and safety and site security plans. No public access to work areas.	Owner's Eng / PDB	Open
32	Design	Construction	Copco lake reservoir rim or local slope failure along access roads	Slope instability, inadequate access road condition assessment prior to construction. Design analyses unable to be made for all geologic conditions and slope geometries; insufficient data		M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Share	Comprehensive field investigation and design review; Develop plan to address slope failures along Copco Road if they were to occur during reservoir drawdown.	Owner / PDB	Open
33	Design	Construction	Failure of temporary cofferdams result in demolition delays	Conservative design of cofferdams; unanticipated foundation conditions		M	A		Time	2 Unlikely (10-19%)	2 Low	4	Low	Transfer	Comprehensive field investigation, review of original construction, and design review	PDB	Open
34	Design	Construction	Dam or similar structure fails during drawdown	Failure mode not investigated or analyzed properly		M	A		Public Safety	1 Very Unlikely (1-9%)	5 Very High	5	High	Transfer	Rigorous detailed design analysis surrounding dam safety during drawdown; Completion of the FERC Potential Failure Modes Analysis process; Close coordination with the FERC regional office and state dam safety authorities; Implement FERC Emergency Action Plan, as appropriate.	PDB	Open
35	Env	Construction	Release of hazardous material (other than from construction equipment) to river during construction	Contractor activities result in unanticipated release of hazardous material into river	M	M	A		Envir Impact	1 Very Unlikely (1-9%)	5 Very High	5	High	Transfer	Completion of the Phase 1 hazardous material assessments and follow-up evaluations, appropriate health and safety qualifications, experience and other requirements during the procurement process, implementation of BMPs to avoid or contain the release of hazardous material, as well as active overview and enforcement of the Contractor's Hazardous Material Management Plan.	PDB	Open
36	Design	Construction	Reservoir sediment more difficult to access than anticipated, causing construction delays (restoration)	Lack of material properties understanding	M	M	A		Cost	2 Unlikely (10-19%)	2 Low	4	Low	Share	Comprehensive investigation and testing during planning and detailed design phase (with DB or Contractor input).	Owner / PDB	Open
37	Env	Construction	Special-status species presence delays construction	Unanticipated species found onsite cause stop work	M	M	A		Envir Impact	2 Unlikely (10-19%)	4 High	8	Med	Manage	Pre-construction surveys; Design planning; Require work areas to be cleared prior to nesting season; Proactive surveys for nesting activity during nesting season; Proactive nesting mitigation measures during nesting season.	Owner / PDB	Open
38	Env	Construction	Bald and Golden Eagle present within restriction buffer that delays construction	Did not identify birds prior to construction	M	M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Transfer	Additional surveys to identify nest locations in the years leading up to construction; Implementation of the avoidance and minimization measures identified in the Definite Plan; Effective transfer of risk through Contract terms to Design-Builder.	PDB	Open
39	Env	Construction	Loss of significant freshwater mussels in 1st year of demolition	Suspended sediment and bedload movement.			A		Envir Impact	3 Less Likely (20-39%)	3 Moderate	9	Med	Manage	Obtain latest research on relocation techniques and bring in industry experts during detailed design; Implement risk management measures.	Owner / Force Majeure	Open
40	Permit	Construction	Construction mitigation permit requirements not satisfied	Limited environmental mitigation measures available do not meet time and budget constraints		M	A		Envir Impact	3 Less Likely (20-39%)	3 Moderate	9	Med	Transfer	Coordination between Designer, Contractor, and permitting agencies; Satisfy permit requirements.	Owner / PDB	Open
41	Env	Construction	Unanticipated non-burial related cultural resources (foundations, barns, etc.) discovered during reservoir drawdown or construction (beyond current allowance)	Non-burial cultural resource not disclosed or already known about	M		A		Cost	2 Unlikely (10-19%)	2 Low	4	Low	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with Native American groups and local historical societies; Development of treatment measures that would implemented following drawdown or during construction	Owner / Force Majeure	Open
42	Env	Construction	Known cultural resource damaged during construction	Mitigation measures fail to protect resource	M		A		Cost	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with tribes and local historical societies to assess potential damage and identify measures.	PDB	Open
43	Env	Construction	Unanticipated human burial sites, human remains, or funerary items discovered within reservoir areas during reservoir drawdown - requiring cessation of construction activities for a long duration.	Burial site not disclosed or already known about	M		A		Time	2 Unlikely (10-19%)	4 High	8	Med	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with Native American groups and local historical societies; Development of an Inadvertent Discovery Plan, Monitoring Plan, and NAGPRA Plan of Action, and rapid response plan to address the possibility of burial sites becoming exposed during drawdown.	Owner / Force Majeure	Open

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
44	Env	Construction	Unanticipated human burial site discovered during other construction activities - requiring cessation of construction activities for a short time (beyond current allowance)	Burial site not disclosed or already known about	M	M	A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with Native American groups and local historical societies; Development of an Inadvertent Discovery Plan, Monitoring Plan, and NAGPRA Plan of Action to address the possibility of burial sites being discovered during construction.	Owner / Force Majeure	Open
45	Proc & Const	Construction	Reservoir drawdown impacts water quality more severely than anticipated causing project regulatory shutdown	Permit conditions and/or inadequate modeling of water quality; duration of drawdown extends past March due to extreme weather	M	M	A		Envir Impact	2 Unlikely (10-19%)	4 High	8	Med	Accept	Perform comprehensive water quality studies prior to construction; Implement risk management measures needed to comply with water quality requirements.	Owner's Eng / PDB	Open
46	Design	Construction	Reservoir drawdown and subsequent operation results in greater than anticipated erosion at bridges or along channel creating passage barrier	Local hydrodynamics result in greater than modeled erosion or scour	M	M	A	A	Cost	2 Unlikely (10-19%)	2 Low	4	Low	Accept	Comprehensive design review; Design additional scour protection for bridges if determined to be needed; Develop monitoring and mitigation plan for during and post reservoir drawdown.	Owner's Eng	Open
47	Proc & Const	Construction	Reservoir dewatering and subsequent operations have greater than anticipated effects on diversion intakes for irrigation/livestock	Greater than predicted suspended sediment and bedload movement	M	M	A	A	Cost	3 Less Likely (20-39%)	2 Low	6	Med	Share	Comprehensive field investigation and design review; Develop plan for monitoring/mitigating intakes during reservoir drawdown.	Owner / PDB	Open
48	Design	Construction	Reservoir dewatering and subsequent operation has greater than anticipated effects on groundwater wells	Difficult to investigate and analyze groundwater relationships		M	A	A	Cost	2 Unlikely (10-19%)	2 Low	4	Low	Share	Comprehensive field investigation and design review; Implement Groundwater Well Management Plan for evaluating changes in groundwater post-reservoir drawdown and proactively mitigate impacted wells.	Owner / PDB	Open
49	Env	Construction	Reservoir dewatering and subsequent operations have greater than anticipated effect on downstream channel aggradation/flooding	Evacuated coarse sediment is greater than anticipated leading to increased channel aggradation and associated flooding		M	A	A	Cost	3 Less Likely (20-39%)	3 Moderate	9	Med	Accept	Rigorous assessment on transport and flooding during detailed design; Monitoring post-drawdown; Raise awareness that active channel management program needed; Implement measures to manage channel aggradation and flood risk.	Owner	Open
50	External	Construction	Public safety risk in downstream channel during reservoir drawdown	Outreach and public safety measures insufficient to keep out public creating potential risk to public safety during drawdown (increased flows)	M	M	A		Public Safety	1 Very Unlikely (1-9%)	5 Very High	5	High	Manage	Comprehensive education and outreach plan; Detailed review and QA of safety program; Development of a Reservoir Dewatering Awareness Plan that will include procedures for notifying public of the schedule and anticipated flows for reservoir drawdown.	Owner / PDB	Open
51	Design	Construction	Slope failure blocks river or diversion intake	Upstream shell material less pervious than assumed in design; error in rapid-drawdown slope stability analyses; design analyses unable to be made for all geologic conditions and slope geometries; insufficient data	M	M	A		Envir Impact	2 Unlikely (10-19%)	5 Very High	10	High	Share	Comprehensive field investigation and design review; Develop slope monitoring plan for implementation during drawdown; Stockpile riprap for repairs of slope if local failures occur.	Owner / PDB	Open
52	Proc & Const	Construction	Copco No. 1 and/or Iron Gate Dam large gate procurements delay gate installation resulting in delay of reservoir drawdown	Design error; scheduling error; manufacturer requires additional information; construction error		M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Manage	Early detailed design; Early involvement of the Contractor to initiate gate procurement activities including input from the gate fabricator; Contractual milestones with liquidated damages; Early Contractor input including planning underwater work to modify/demo the existing Iron Gate Dam gate structure.	PDB	Open
53	Proc & Const	Construction	Copco. No.1 and Iron Gate Dam tunnel modifications are more difficult to construct causing schedule and cost overruns	Changed site condition or design omission	M	M	A		Time	3 Less Likely (20-39%)	2 Low	6	Med	Share	Comprehensive field investigation and design review; Early Contractor input as well as transparent Contractor progress cost estimates based on proven means and methods.	PDB	Open
54	Proc & Const	Construction	Copco No. 1 or Iron Gate Dam diversion gate malfunctions during drawdown resulting in delay of reservoir drawdown	Design or Construction error		M	A		Time	1 Very Unlikely (1-9%)	5 Very High	5	High	Transfer	Proactive QA/QC during design; Include backup systems for operating the gates in the design and construction including special inspections and testing of the gates prior to drawdown.	PDB	Open
55	External	Construction	Copco No. 1 and/or Iron Gate Dam diversion tunnel intake blocked by debris during drawdown reducing flow capacity	Debris within reservoir blocks intake		M	A		Envir Impact	2 Unlikely (10-19%)	3 Moderate	6	Med	Share	Maximizing the size of the intakes to match the size of the gates; Design debris grating for intake with ability to clear debris from grating.	Owner / PDB	Open
58	Proc & Const	Construction	Copco No. 1 concrete demolition production not adequate to meet project schedule	Inadequate equipment, staff, environmental issues, unfavorable weather			A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Transfer	Contract requirements including milestones; Flexibility for 24-hr work 7 days per week; Obtain concrete cores for strength testing to inform DB assumptions regarding drilling and blasting; Early Contractor involvement to avoid shortages of labor and equipment.	PDB	Open
59	Proc & Const	Construction	Copco No. 2 cannot continue to generate power after January 2020	Insufficient water available in Klamath River or water quality too poor		M	A		Cost	2 Unlikely (10-19%)	3 Moderate	6	Med	Accept	Confirm allowable water quality for operation; Evaluate Klamath River flows for potential for too little water to better understand probability of occurrence.	Owner	Open

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
60	Proc & Const	Construction	Iron Gate Dam 16.5-ft x 18-ft diversion gate cannot be installed due to as-built drawings of gate guides not matching existing conditions	Unable to survey gate slot until demo complete		M	A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Share	Early gate fabrication and installation with sufficient float to allow time for gate modifications, if needed.	PDB	Open
63	Design	Construction	Iron Gate Dam embankment experiences slope failure of upstream shell during reservoir drawdown	Upstream shell material less pervious than assumed in design; error in rapid-drawdown slope stability analyses	M	M	A		Public Safety	1 Very Unlikely (1-9%)	4 High	4	Med	Share	Comprehensive field investigation and design review; Develop slope monitoring plan for implementation during drawdown; Stockpile riprap for repairs of slope if local failures occur.	Owner / PDB	Open
64	Proc & Const	Construction	Iron Gate Dam excavation production less than required to complete excavation by required date	Inadequate planning, equipment, staff, or unforeseen environmental issues, unfavorable weather			A		Public Safety	2 Unlikely (10-19%)	5 Very High	10	High	Transfer	Contractual milestones; Flexibility for 24-hr work 7 days per week; Higher cofferdams for planned breach; Early Contractor involvement to avoid shortages of labor and; Development and implementation by the Contractor of an effective FERC Emergency Action Plan (EAP).	PDB	Open
65	External	Construction	Iron Gate Dam or J.C. Boyle dam overtopped during excavation by storm water flows in excess of 100-year event resulting in dam failure	Climate change; increased variability in precipitation patterns	M	M	A		Public Safety	1 Very Unlikely (1-9%)	5 Very High	5	High	Accept	Require that the dam height during excavation not be less than needed to safely pass a 150-year event through the diversion tunnel; Completion of the FERC Potential Failure Modes Analysis process; Implement EAP, if necessary; Close coordination with the FERC regional office and state dam safety authorities.	Owner / Force Majeure	Open
66	Env	Construction	Iron Gate Hatchery shutdown due to inadequate water supply	New water supply or treatment facilities do not provide suitable supply for hatchery operations, resulting in lowered production	M	M	A	A	Envir Impact	3 Less Likely (20-39%)	3 Moderate	9	Med	Manage	Rigorous design of replacement supply; Pilot treatment technology; Proactive QA/QC during construction.	Owner	Open
68	Environmental	Post-Construction	Greater than anticipated effect on downstream biological resources	Effect of suspended sediment causes greater than anticipated impact to given species	M		A	A	Envir Impact	3 Less Likely (20-39%)	5 Very High	15	High	Manage	Develop appropriate aquatic resource measures through coordination with the regulatory agencies; Implement risk management measures to address effect on downstream resources.	Owner	Open
69	Environmental	Post-Construction	Limited recovery of fish species of concern	Fish recovery does not meet agency expectations	M	M	M	A	Envir Impact	2 Unlikely (10-19%)	2 Low	4	Low	Manage	Aquatic Resource (AR) measures included in Project.	Owner	Open
70	Environmental	Post-Construction	Bald and Golden Eagle net loss within 5 years of construction completion	Mitigation and rehabilitation measures provided insufficient protection				A	Envir Impact	3 Less Likely (20-39%)	4 High	12	Med	Accept	Proactively monitor species before and during construction; Implement additional risk management measures.	Owner	Open
71	Environmental	Post-Construction	Bat roosts do not meet success criteria requiring additional mitigation	Predictive model of bat roost effectiveness is incorrect	M	M	M	A	Envir Impact	2 Unlikely (10-19%)	1 Very Low	2	Low	Manage	Agency input into performance requirements in DB contract and design; Proactive QA/QC during construction.	Owner	Open
72	Environmental	Post-Construction	Habitat restoration goals not satisfied in field	Constructed project component does not meet agency expectations	M	M	M	A	Envir Impact	2 Unlikely (10-19%)	3 Moderate	6	Med	Transfer	Agency input into performance requirements in DB contract and design; Proactive QA/QC during construction.	PDB	Open
73	External	Post-Construction	Large seismic event up to design Maximum Credible Earthquake (MCE) occurs after project completion that results in blockage of Klamath River	Large seismic event causes catastrophic landslide or slope failure		M		A	Public Safety	1 Very Unlikely (1-9%)	2 Low	2	Low	Transfer	Develop clear design requirements for PDB contract; Work with dam safety authorities to set reasonable design criteria and associated durations.	Owner / Force Majeure	Open
78	Operational & Maintenance	Post-Construction	Unanticipated maintenance or repair required during regulatory monitoring and reporting period (e.g. plant establishment, tributary passage blockage, etc.)	Agency success criteria not met during post-construction period	M	M	M	A	Cost	3 Less Likely (20-39%)	3 Moderate	9	Med	Share	Development of management plans to clearly identify success criteria; Develop maintenance triggers and overall approval process; Comply with management plans.	Owner / PDB	Open
80	Proc & Const	Construction	J.C. Boyle Dam excavation production less than required to complete excavation by required date	Inadequate planning, equipment, staff, or unforeseen environmental issues, unfavorable weather			A		Public Safety	2 Unlikely (10-19%)	3 Moderate	6	Med	Share	Contractual requirements including milestones; Flexibility for 24-hr work 7 days per week; Higher cofferdams for planned breach; Early Contractor involvement to avoid shortages of labor and equipment.	PDB	Open
82	Env	Construction	Hydraulic oil or other hazardous material from construction equipment release to river during construction	Contractor mechanical equipment failure result in unanticipated release of hazardous material into river	M		A		Envir Impact	4 Likely (40-59%)	3 Moderate	12	Med	Transfer	Contractor required to develop a Spill Prevention, Control, Countermeasure (SPCC) Plan and active overview and enforcement of the SPCC Plan.	PDB	Open
87	Proc & Const	Construction	Plant pathogens reduce plants available for restoration work	Pathogens introduced at nurseries	M	M	A	A	Cost	3 Less Likely (20-39%)	2 Low	6	Med	Share	Contract requirements for nurseries and for care of plants; Quality Control/Quality Assurance.	PDB	Open
89	External	Construction	Reservoir ice impedes sediment flushing during reservoir drawdown	Ice on one or more reservoirs during drawdown might impede sediment erosion			A		Envir Impact	3 Less Likely (20-39%)	4 High	12	Med	Accept	None.	Owner / Force Majeure	Open
90	External	Construction	River channel locates in unexpected location during reservoir drawdown	Channel relocates on historic terrace rather than original channel			A		Cost	1 Very Unlikely (1-9%)	3 Moderate	3	Low	Accept	Contractor to develop a mitigation plan during design to move river into original channel.	Owner / Force Majeure	Open
91	External	Construction	Unknown fish passage barriers are found during drawdown	Unknown pre-existing barriers exposed during drawdown	M	M	A	A	Cost	4 Likely (40-59%)	1 Very Low	4	Med	Accept	Review of historic documents for evidence of barriers; Require Contractor to develop contingency plan to evaluate for barriers following reservoir drawdown and actions to remove barriers during dam removal.	Owner / Force Majeure	Open

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
93	Permit	Planning	Western Pond Turtle becomes Federally listed during permitting process	Project effect on listed species	A	A	A		Time	4 Likely (40-59%)	3 Moderate	12	Med	Manage	Proactive coordination with appropriate regulatory agencies on likely requirements and associated field work; Address contingency in consultations.	Owner / Force Majeure	Open
95	Env	Construction	Unanticipated human burial site discovered between Iron Gate Dam and Humbug Creek during reservoir drawdown and post construction (beyond current allowance)	Burial site not disclosed or already known about exposed due to erosion of channel banks during elevated flows during drawdown.	M		A	A	Cost	3 Less Likely (20-39%)	2 Low	6	Med	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with Native American groups and local historical societies; Development of an Inadvertent Discovery Plan, Monitoring Plan, and NAGPRA Plan of Action, and rapid response plan to address the possibility of burial sites becoming exposed.	Owner / Force Majeure	Open
96	Env	Post-Construction	Weeds outcompete native plants and site restoration goals are not met	Proliferation of weeds	M	M	M	A	Cost	2 Unlikely (10-19%)	2 Low	4	Low	Share	Contract warranty period; Post-construction maintenance requirements in contract.	Owner / PDB	Open
97	Environmental	Construction	Northern spotted owl, bald eagle or golden eagle nests during construction period, requiring restrictions on construction timing and activity.	Bird creates new nest during construction.	M	M	A		Time	2 Unlikely (10-19%)	1 Very Low	2	Low	Accept	Monthly monitoring during breeding season.	Owner	Open
103	External	Planning	Differing Site Condition claim during Yreka Water Supply Pipeline Crossing Construction.	Adequate geotechnical subsurface information is not readily available. Unanticipated subsoil conditions are encountered or claimed to have been encountered during construction.	M	M	A		Cost	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Conduct an adequate and thorough geotechnical exploration program in conformance with standard practice and describe subsoil conditions in terms of a geotechnical baseline report (GBR) and a geotechnical data report (GDR).	Owner	Open