CHAPTER 2.0 ALTERNATIVES

2.1 Description of Programmatic Proposal

This chapter describes the proposed Icicle Strategy Program Alternatives (Program Alternatives) developed by the IWG to meet the objectives set forth in the Icicle Creek Guiding Principles that were discussed in detail in Chapter 1, Sections 1.5. Each of the five Alternatives described in this document were intended to fully meet the Guiding Principles, using a different combination of projects with individualized costs, benefits, and impacts.

2.1.1 Icicle Strategy Overview

As discussed in Section 1.4, the IWG is made up of a diverse set of stakeholders representing local, state, and federal agencies; tribes; irrigation and agricultural interests; and environmental organizations. The IWG developed a set of Guiding Principles that are the objectives for integrated water resource management in the Icicle Creek Subbasin. Figure 2-1 provides the Guiding Principles as well as metrics for each, which were discussed in greater detail in Chapter 1. This table is used to help compare how well the five Alternatives and the No-action Alternative evaluated in this PEIS meet or partially meet the Guiding Principles.

A key principle endorsed in the IWG Operating Procedures is that all projects in an Alternative move forward together as a group to ensure that the shared vision of improved water management in Icicle Creek was achieved, as opposed to a fragmented and partial solution that could lead to further conflict. If a particular project that is part of an Alternative becomes unfeasible (e.g. cannot be constructed, permitted, or funded), then the IWG agreed to reconvene and select a substitute project to address the Guiding Principle that suffered the shortfall. Projects can be phased, which will be necessary given funding and permitting constraints. However, the IWG would continue to support later phases of project development even as early project construction begins to show progress in meeting the Guiding Principles.

Figure 2-1. Guiding Principles with Metrics[1]

Icicle Workgroup Guiding Principles and Metrics

This summary describes the IWG Guiding Principles and how they are quantified for the development of an integrated project list. Full qualitative descriptions of the guiding principles are included in the IWG Operating Procedures. Metrics for guiding principles are subject to feasibility, funding, and permitting.

Guiding Principle	Metric	
Improve Instream Flows	Icicle Creek Historic Channel: • 60 cfs minimum flows (drought years) • 100 cfs minimum flows (non-drought years), short-term goal • 250 cfs minimum flows (non-drought years), long-term goal • 2,600 cfs maximum flow to preserve habitat function	Flow improvement needed (in projects) to meet total minimum flows: 40 cfs[1]
Improve sustainability of LNFH	• Meet *U.S. v. Oregon* and other agreements specifying fish production requirements • 57 cfs supply protected long-term (at least 20 cfs conservation goal) • Diverse source availability (temperature, pathogen-free) to maximize fish health • Structures minimize unintended fish passage impediments	
Protect Tribal and Non-Tribal harvest	• Catch per unit of effort (CPUE) improved • Maintain multi-species harvest opportunities • Tribal Impacts Assessment and Adaptive Management Plan being implemented, addressing attraction flows, sediment transport, fish migration/straying, site access and amenities	
Improve Domestic Supply	• 1,750 acre-feet of reliable year-round supply (2.5 cfs average, 5 cfs peak)	
Improve Agricultural Reliability	• Automate / Optimize Alpine Lakes Reservoirs for improved reliability (plus instream flow benefit) • Restore/repair Eightmile Lake Reservoir up to 2,500 acre-feet (900 ac-ft additional instream flow/domestic benefit) • Current interruptible agricultural users have firm supply in average water years / agriculture water bank (2 to 4 cfs)	
Enhance Icicle Creek Habitat	• Improve passage in Icicle Creek including to Upper Icicle Creek • Make investments in physical habitat improvement with consideration for high flow habitat and low flow refuge, minimize fish passage impediments, and improve limiting factor spawning/rearing • Offset project-related terrestrial impacts with land acquisition/easements	
Comply with State and Federal Law, and Wilderness Acts	• Identify and engage regulators in the process • Environmental review completed (project check) • All projects appropriately permittable (project check) • All diversions (LNFH, IPID, COIC) appropriately screened (project check)	

[1]Based on a review of historic stream gage records, the existing average low flow in historic channel in non-drought years is 65 cfs (16 of the most recent 20 years) and average drought low flows is 20 cfs (2001, 2003, 2005, 2015). To meet Guiding Principle flow targets, approximately 40 cfs in project flow benefit is needed.

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[1] Reference: http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/current-project/Guiding%20Principle%20Metrics%2002-04-2016.pdf

2.1.2 Identification of Preferred Alterative

Following the comprehensive scoping and public comment for the PEIS discussed in this Chapter, Ecology and Chelan County have selected Alterative 1 as the Preferred Alternative. The co-leads determined that the suite of projects and elements that comprise Alternative 1 have the best chance of meeting the Guiding Principles over time, have the highest likelihood of funding, and have the lowest environmental footprint of the other alternatives considered. Alternative 1 will achieve the following:

- Improve Instream Flows
- Improve Sustainability of LNFH
- Protect Tribal and Non-Tribal Harvest
- Improve Domestic Supply
- Improve Agricultural Reliability
- Enhance Icicle Creek Habitat
- Comply with State and Federal Law
- Comply with Wilderness Acts

There are anticipated environmental impacts from all alternatives considered under the PEIS, but overall Alternative 1 is the environmentally preferred alternative to meet the Purpose and Need of the Icicle Strategy. While the No-action Alternative and Alternative 3 have lower costs and impacts, they cannot fully meet the Purpose and Need. The overall effect of Alternative 1 is expected to be more beneficial than the No-action Alternative for both instream and out-of-stream water supplies while enhancing fish habitat.

2.2 Development and Analysis of Alternatives

The alternatives analyzed in this document are the result of ongoing studies and discussions with state and federal regulators on how to best manage water within the Icicle Creek Subbasin. Additionally, discussions with private stakeholders through IWG meetings, outreach meetings, and SEPA scoping helped shape these alternatives. This section explains how the projects and alternatives were selected for inclusion in this PEIS.

The IWG has been working since December 2012 to develop the Guiding Principles and the projects intended to address them. One of the first exercises conducted by the IWG was to assemble a master project list based on conceptual ideas by IWG members,

projects identified in the Wenatchee Watershed Plan, projects in various funding program queues, and projects in active appraisal or feasibility studies. In the first few months of the IWG (e.g., early 2013), over 60 potential projects had been identified that could assist in meeting the Guiding Principles. Early versions of these master project lists are available on Chelan County's website.

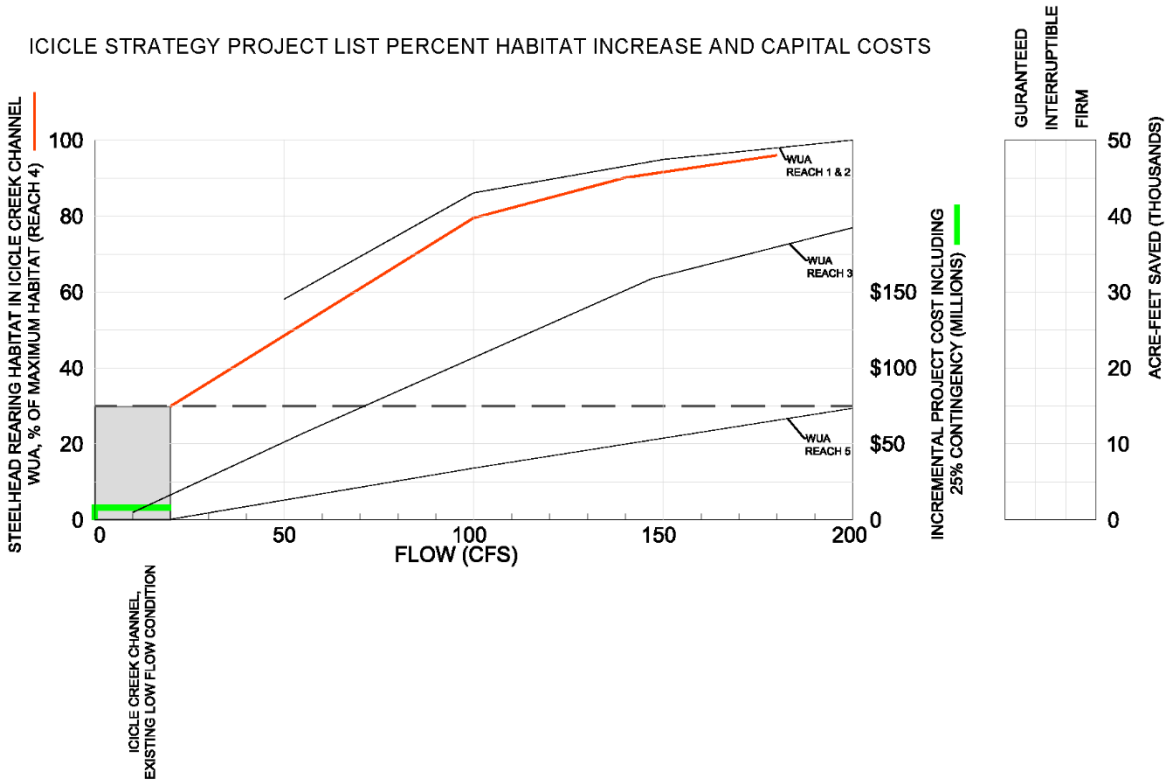
Following identification of potential projects, and concurrent with the IWG's efforts to put numeric standards to the qualitative Guiding Principles established in December 2012, the IWG developed a screening evaluation for projects. The method of evaluation included considering project benefit, water right pedigree,[2] and project costs. Then the IWG went through several iterative exercises where projects were aggregated to meet the Guiding Principles and provide a range of options based on the above listed factors (project benefit, water right pedigree, and project cost).

Figures 2-2 thru 2-5 illustrate this process. The projects are not listed in any specific order, and some project variations listed in these figures are not included in any of the Alternatives evaluated in the PEIS. These figures are for illustrative purposes to show how projects were evaluated and grouped into packages.

[2] Water Right pedigree refers to when water from a particular project will be available. **Guaranteed** water consists of water that will always be available based on permanently placing the water into the state TWRP. **Firm** water refers to water that will be on long-term donation or lease to the state Trust Water Right Program. For these projects, firm water is generally federally owned water and the water is not being permanently transferred to the TWRP because of laws prohibiting a permanent transfer. **Interruptible** water, in this scenario consists of water that may not be available every year for instream flows. This includes water made available for instream flows from the Alpine Lakes Reservoirs Optimization, Modernization, and Automation, because in low water years, when the district needs a larger portion of their water, the water will not be placed in the TWRP.

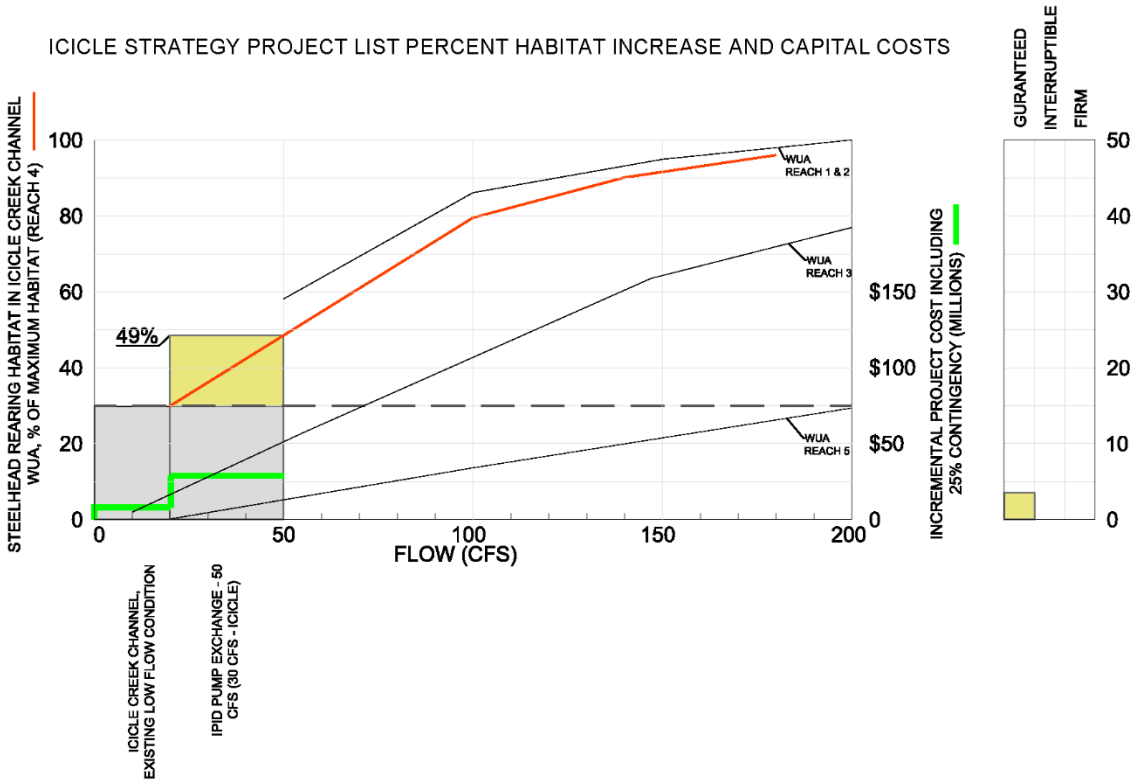
In Figure 2-2, the red line represents the WUA flow-habitat relationship for the historical channel (see Figure 2-34) and the gray bar represents an average low flow condition of 20 cfs in that reach. The note in the bottom left of the figure presumed a number of projects would also be included that did not provide flow benefit, but would address other Guiding Principles (e.g., screening, tribal fishery protection).

Figure 2-2. Minimum Flow (less the 20 cfs) and Instream Flow Goals (100 cfs) Overlaid by WUA for Spawning Steelhead in Icicle Creek Historical Channel



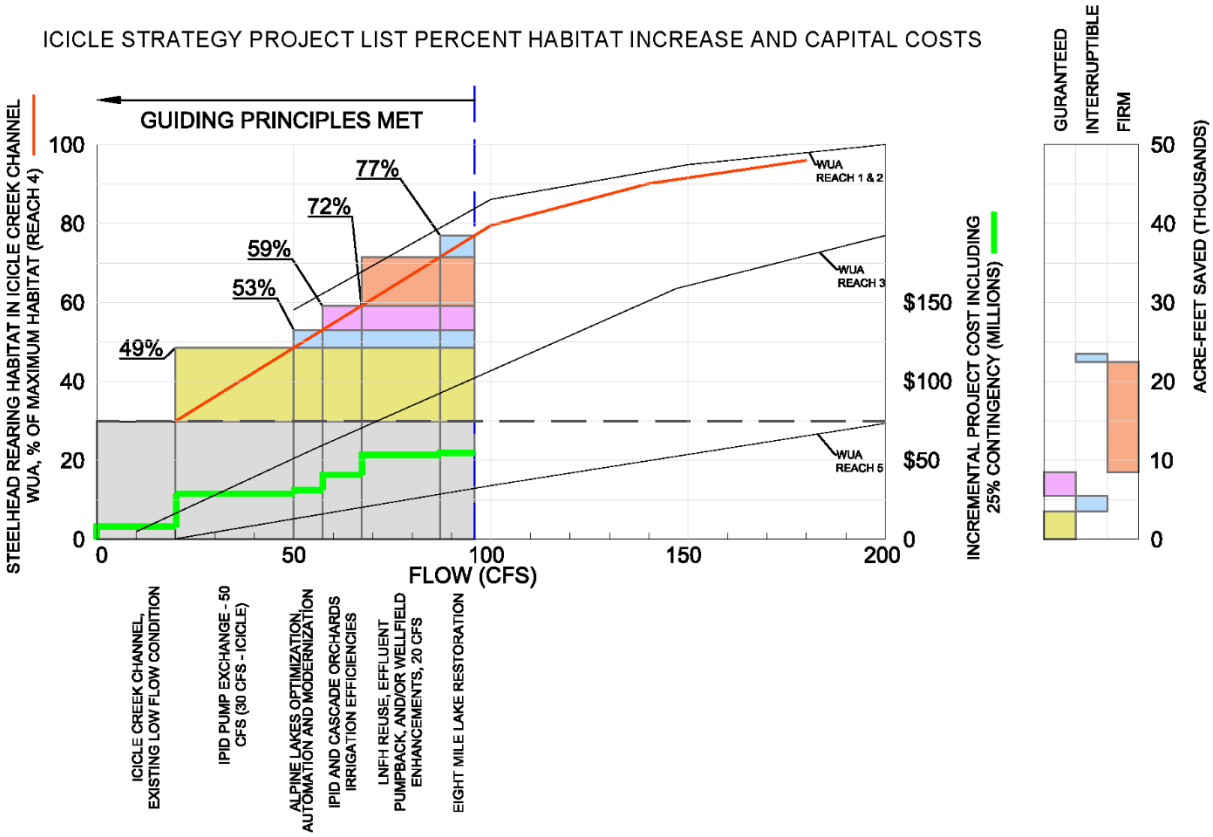
In Figure 2-3, the first project in this example was added, which was a potential pump exchange on the Wenatchee River that would provide up to 30 cfs benefit in Icicle Creek. Habitat improvement is tracked (49 percent improvement), cost is tracked (in the green line against the secondary Y-axis), and the pedigree of the water (guaranteed) appears in the stacked bar chart on the far right.

Figure 2-3. Comparison of Project Benefits and Costs to Flow and WUA, Step 1



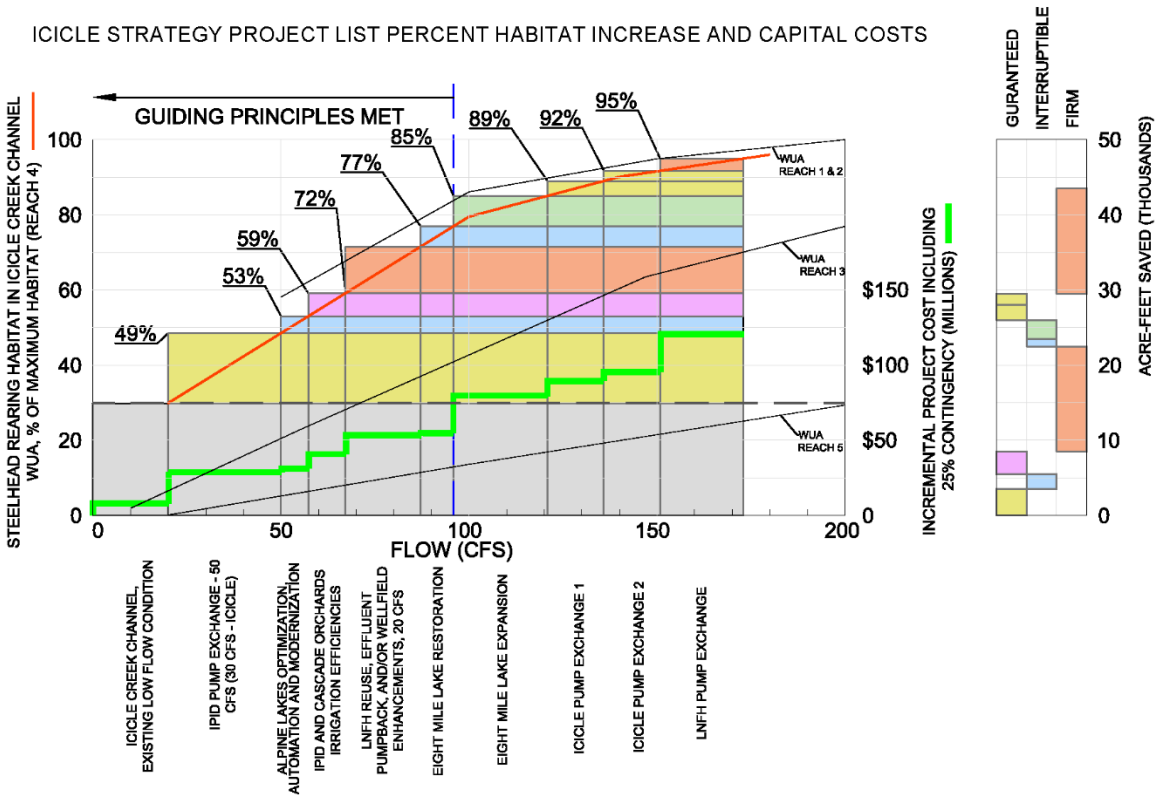
In Figure 2-4, a grouping of projects that would potentially meet the Guiding Principles (dashed vertical blue line) was created. Many combinations of such projects were considered. In each case, there is increasing habitat benefit, cost increases, and the pedigree of the water provided is matched to each project.

Figure 2-4. Comparison of Project Benefits and Costs to Flow and WUA, Step 2



In Figure 2-5, and in keeping with the long-term goal of 250 cfs, the IWG considered other projects that could be added beyond the short-term goal to further improve Icicle Creek. This also was evaluated because some projects to the left of the dashed vertical Guiding Principle line may become infeasible, which would necessitate consideration of other replacement projects.

Figure 2-5. Comparison of Project Benefits and Costs to Flow and WUA, Step 3



After several months of considering different project packages (or combinations of projects), ultimately the IWG assembled what would become known as the "Base Package," or Alternative 1 in this PEIS, and endorsed it for comment and consideration in environmental review. The IWG's endorsement of Alternative 1 was for the purpose of giving the public a specific set of projects to consider, with an openness for considering other project opportunities that could also meet all of the Guiding Principles.

2.2.1 Identification of Alternatives through SEPA Scoping

The IWG advanced their Base Package (Alternative 1) forward for programmatic environmental review by Ecology and Chelan County, who are acting as co-lead agencies. Prior to developing the PEIS, the IWG conducted outreach and scoping to

inform the PEIS extent and scope, and to solicit ideas for additional variations to Alternative 1 that would result in reasonable alternatives to meet the Guiding Principles.

SEPA scoping feedback and comments received during a public meeting held by the co-lead agencies (Chelan County and Ecology) and the IWG helped to shape the alternatives analyzed in this PEIS. Chelan County and Ecology began preparations for SEPA scoping for the Icicle Strategy in January 2016. They prepared an expanded Environmental Checklist, issued a Determination of Significance (DS), and launched Programmatic SEPA Scoping in February 2016. A checklist is sometimes not prepared when a DS is issued, but the co-leads decided a detailed environmental checklist would help the public and agencies understand the scope of the proposal and direct them to resources gathered by the co-leads to help inform the potential benefits and impacts of implementation of the Icicle Strategy.

The IWG held an early outreach meeting to gain other stakeholder perspectives in February 2015 at the Good Shephard Center in Seattle. Their presentation focused on the proposed improvements to instream flows and water supply, and habitat improvements such as groundwater augmentation, new/modified storage, water markets, and fish passage/screening, as well as development of specific projects such as the Alpine Lakes Optimization and Automation and the Eightmile Lake Storage Restoration.

On April 20, 2016, the IWG held a public open house at the Leavenworth Fire Hall in Leavenworth, Washington to encourage public participation in the SEPA process. The IWG presented information on their Guiding Principles and the alternatives they evaluated to create the Base Package of projects to meet them. Members of the public submitted comments based on the presentation. The SEPA Comment Period for public input ended on May 11, 2016; however, one late comment was accepted. Copies of the comments can be accessed at the Chelan County website.[3]

The co-lead agencies met and reviewed comments received during SEPA scoping. They reviewed each comment and prepared a comment responsiveness summary. This exercise helped shape the scope of investigations in the PEIS. It also helped inform the co-leads on alternative selection. The co-leads met with the IWG to review four additional alternatives, in addition to the no-action and base package alternatives, that would be considered in the PEIS and received its concurrence. For example, the IWG received several comments regarding projects focused on conservation, some requested having no action in the wilderness area, and others requested increasing storage options in the Icicle Creek Subbasin. To be responsive to these diverse comments and to ensure the best suite of projects was selected, the co-leads developed Alternatives 2, 3, and 4 that are composed of a mix of projects that had been reviewed or studied by the IWG since the inception of the work group.

[3] http://www.co.chelan.wa.us/natural-resources/pages/icicle-strategy-sepa-comments

Alternative 5 was developed during the drafting of the EIS based on stakeholder discussion and further study of conservation opportunities in the IPID through their irrigation comprehensive plan. Additionally, with further study and funding opportunities for some projects, the No-action Alternative was modified to include several projects common to other alternatives. However, these projects' focus and benefits would not be the same if action on the Icicle Strategy does not occur.

All action alternatives can meet the objectives of the Guiding Principles, but with different emphases, costs, benefits, and impacts.

A 60-day public comment was provided following the release of this draft PEIS. These comments were considered when developing the final PEIS.

2.3 Summary of Alternatives

The Icicle Strategy seeks to improve water resources management in the Icicle Creek Subbasin and achieve the specific metrics outlined in the Guiding Principles. This PEIS evaluates five alternatives that meet the Guiding Principles, along with a No-action Alternative. These alternatives are introduced here and discussed in further detail in Section 2.4. The following Section 2.5 provides a detailed narrative of each project included in the suite of projects used to create the alternatives.

Each action alternative is composed of a variety of several projects developed to help meet the IWG's Guiding Principles. In summary, the five alternatives include:

- **No-action Alternative:** The No-action Alternative is presented to show the impacts of not implementing the Icicle Strategy. Under the No-action Alterative, some projects may be developed on separate and different pathways by proponents other than the IWG, although it is unlikely all would be implemented. Funding for projects would be delayed or less competitive without an integrated solution, resulting in slower implementation of projects that do succeed without IWG support. Project beneficiaries may be different and not focused on meeting guiding principles. Projects that may be implemented, on their own independent timelines, could improve streamflow by approximately 32 cfs and 18,094 acre-feet.
- **Alternative 1 (Preferred Alternative):** The IWG has identified the first alternative as the Base Package, consisting of 12 elements that work in concert to achieve all of the Guiding Principles. The package is a mix of projects, including automating and optimizing reservoir releases at seven Alpine Lakes; efforts to make hatchery, irrigation, and domestic use more efficient; enhancement of habitat, fish passage, and fish screening; and protection of tribal and non-tribal fisheries. The suite of projects proposed under Alternative 1 (listed in Table 2-1) is estimated to cost $82.0 million, which includes a 25 percent contingency for all projects and an additional 25 percent contingency for projects within the ALWA.

These projects are anticipated to provide 89 cfs and 31,958 acre-feet of total water benefit (instream and out-of-stream), of which 88 cfs and 28,458 acre-feet instream flow benefit. This estimate of instream flow benefit includes reach benefit for out-of-stream uses that would occur downstream.

- **Alternative 2:** This alternative builds on the foundation of Alternative 1, but replaces the Alpine Lakes Optimization project with the IPID Dryden Pump Exchange project. Alternative 2 is estimated to cost $91.4 million, which includes a 25 percent contingency for all projects and an additional 25 percent contingency for projects within the ALWA. This alternative would provide 84 cfs and 27,978 acre-feet of total water benefit (instream and out-of-stream), of which 83 cfs and 24,478 acre-feet of instream flow benefit. This estimate of instream flow benefit includes reach benefit for out-of-stream uses that would occur downstream.
- **Alternative 3:** This alternative also builds on the foundation of Alternative 1, but focuses on project selection outside the ALWA through greater reliance on conservation and pump exchange projects. Because supply and demand cannot be matched well without storage, it also includes a legislative change for instream flow impacts that would occur when conserved water is not able to fully meet demand in-time and in-place. This is a requirement given recent Supreme Court clarity in the *Foster/Yelm* case. Alternative 3 is estimated to cost $89.0 million, which includes a 25 percent contingency. This alternative would provide 71 cfs and 24,378 acre-feet of total water benefit (instream and out-of-stream), of which 70 cfs and 23,578 of instream flow benefit. This estimate of instream flow benefit includes reach benefit for out-of-stream uses that would occur downstream.
- **Alternative 4:** This alternative provides a greater emphasis on development of water supplies, with enhancements to Eightmile Lake and storage improvements at the Upper Klonaqua and Snow Lakes. This alternative was selected to evaluate the value of greater flexibility in shaping water availability to meet future changes in both supply and demand. The estimated cost, which includes a 25 percent contingency for all projects and an additional 25 percent contingency for projects within the ALWA, is $87.8 million. However, it does not include cost estimates for the Upper Klonaqua Lakes Storage Enhancement project because costs are unknown at this stage of project development. This alternative would provide 132 cfs and 35,385 acre-feet of total water benefit, of which 131 cfs and 34,585 acre-feet of instream flow benefit. This estimate of instream flow benefit includes reach benefit for out-of-stream uses that would occur downstream.
- **Alternative** 5: This alternative builds on the foundation of Alternative 1, but provides a greater emphasis on out-of-basin water supplies. Under Alternative 5, the IPID Irrigation Efficiencies element would be replaced with the IPID Full Piping and Pump Exchange. Under the IPID Full Piping and Pump Exchange, the IPID diversion would be completely removed from Icicle Creek, and it would be replaced with three pump stations on the Wenatchee River. The estimated cost, which includes a 25 percent contingency, is $177.3 million. This alternative would provide 196 cfs and 58,958 acre-feet of total water benefit, and 195 cfs and 55,458

acre-feet of instream flow benefit to Icicle Creek. This estimate of instream flow benefit includes reach benefit for out-of-stream uses that would occur downstream.

This PEIS evaluates each alternative for probable significant adverse impacts, potential costs and benefits, mitigation measures, and probable required permit approvals at a programmatic level. The alternatives are discussed in further detail in Section 2.4.

Most of these alternatives use several of the same projects to meet the Guiding Principles because scoping did not reveal reasonable alternatives to meet them. For example, there was consensus on Guiding Principles such as screening, hatchery conservation improvements, and protection of tribal and non-tribal fisheries. Therefore, these are included in each of the five Alternatives. Table 2-1 provides a list of all projects by alternative and notes common projects. Sections 2.4 through 2.8 provide a detailed discussion of each alternative.

2.3.1 No-action Narrative Description

The No-action Alternative represents what might happen if no integrated, comprehensive strategy for managing water resources in Icicle Creek is adopted and implemented by the IWG to meet the Guiding Principles established by the IWG. Under the No-action Alternative, some projects may still be developed, but projects would be developed on separate timelines and for different purposes than those outlined in the Guiding Principles. Projects would likely be developed independently by members of the IWG or by proponents other than the IWG. Funding for projects would likely be delayed and projects may be less competitive for funding without an integrated strategy. Projects could be delayed or not implemented at all because of the lack of consensus-building at the local level. The No-action Alternative would fail to meet the instream flow Guiding Principle.

It is difficult to predict which of the projects might be constructed, delayed, or not implemented. However, based on the level of study and potential funding available for the various projects at the time of this PEIS, the following projects[4] are likely to implemented in some form under the No-action Alternative.

- **Alpine Lakes Optimization, Modernization, and Automation** modernizes and automates the outlet works and gate infrastructure at seven lakes. Under the Icicle Strategy, this project would be implemented for instream flow benefit. However, if the Icicle Strategy does not advance, it is probable that at some point IPID would implement this project to improve their operations as part of routine reservoir maintenance that all infrastructure owners consider. However, if IPID pursues modernization and automation of the gates on its own, releases for the purposes of benefiting instream flow would not be guaranteed and would more likely be optimized for agricultural use.

[4] Refer to Section 2.5 for full descriptions of projects.

Table 2-1
Alternatives Being Considered[5]

Projects	Proposed Alternatives					
	No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Conservation						
IPID Irrigation Efficiencies	○	●	●	●	●	
COIC Irrigation Efficiencies (Piping)	●	●	●	●	●	●
Domestic Conservation Efficiencies	○	●	●	●	●	●
LNFH Conservation and Water Quality Improvements	●	●	●	●	●	●
Pump Exchange						
IPID Dryden Pump Exchange	○	○	●	●		
Full IPID Pump Station						●
COIC Irrigation Efficiencies (Pump Exchange)	●	●	●	●	●	●
Modification/Restoration of Existing Storage						
Alpine Lakes Reservoir Optimization, Modernization and Automation	○	●			●	●
Eightmile Lake Storage Restoration	○	●	●	○	●	●
New Storage						
Eightmile Lake Storage Enhancement					●	
Upper Klonaqua Lake Storage Enhancement					●	
Upper and Lower Snow Lakes Storage Enhancement					●	
Habitat/Fisheries Improvements						
Tribal Fishery Protection	○	●	●	●	●	●
Habitat Protection and Enhancement	○	●	●	●	●	●
Fish Passage	●	●	●	●	●	●
Fish Screening	●	●	●	●	●	●
Legislative/Administrative Tools						
Water Markets		●	●	●	●	●
Instream Flow Rule Amendment	○	●	●	●	●	●
OCPI legislative fix from instream flow impacts				●		

○ Represents projects that might proceed if funding becomes available. However, under the No-action Alternative, project beneficiaries may be different and project timelines are unknown.

● Represents projects that are likely to occur as described, but could be replaced by another project that fulfills the same guiding principles if a design, funding, or permitting fatal flaw is identified.

[5] Projects with a hollow circle are not being proposed by the IWG. However, based on conversations with stakeholders, the co-leads believe these projects could proceed outside the IWG process if not selected as part of the preferred alternative.

- **IPID Irrigation Efficiencies** would likely continue to be explored and implemented if funding were available because IPID has continually worked to improve efficiency within the District. However, funding may be more limited if not included as part of an integrated water resource management strategy, which could limit the scope and magnitude of efficiency projects. Additionally, all water saved through irrigation efficiency upgrades would likely assist IPID in meeting agricultural reliability purposes only, rather than bolstering instream flows, unless funding is used for a specific project that requires a trust water right transfer or some other commitment to instream flows.

- **COIC Irrigation Efficiencies and Pump Exchange** funding opportunities will likely exist for this project if the Icicle Strategy is not implemented. The COIC project is already proceeding with design and environmental permitting based on the strength of consensus built by the IWG over the last 5 years. Funding for the project is primarily based on the potential benefit the project offers to Icicle Creek. The project would shift the point of diversion for COIC from Icicle Creek to a location near the confluence of Icicle Creek and the Wenatchee River. The project would also improve efficiency. The project would benefit Icicle Creek and assist in providing more reliable service to COIC.

- **Domestic Conservation** would likely continue to be explored and implemented if funding were available because the City of Leavenworth has already invested in conservation in the past and is required to pursue water use efficiency measures as part of conservation planning required by RCW 70-119A.180. The County also has addressed continuing rural conservation options by teaming with local water purveyors on how to incentivize or promote this idea. However, funding may be more limited if not included as part of an integrated water resource management plan, which could limit the magnitude of conservation projects. Regardless, water saved under the No-action Alternative would benefit the domestic uses in a similar manner as although potentially to a lesser degree than would occur for the other alternatives.

- **Eightmile Lake Storage Restoration** will occur because IPID has a long-term responsibility to maintain its infrastructure to provide reliable water service to its irrigation customers, while protecting public safety of those downstream of their dams. While the Eightmile Lake Dam is in need of repair, the District has prioritized other capital improvements over this project in recent years, including conservation and other dam maintenance, in part to allow for this project to be evaluated in more detail by the IWG. However, the need to make improvements has become more urgent because the outlet is collapsing and losing capacity. In addition, a fire in 2017 burned to the shoreline of the lake, likely changing the hydrology of inflow to the lake and raising concerns about the condition and safety of the dam. IPID declared an emergency on March 13, 2018, as a result of the 2017 fire and is actively coordinating with local, state, and federal agencies

on this project. If not implemented or funded as part of an integrated strategy, IPID would not be obligated to release any of this water for instream flow or domestic benefit as envisioned under multiple Alternatives considered in this PEIS. Instead that water would be retained for agricultural reliability and drought resiliency.

- **Habitat Protection and Enhancement** may occur at a reduced level. Prior to the IWG, Chelan County has worked on habitat improvements in lower Icicle Creek. This would likely continue, although funding may be more limited if not included as part of an integrated water resource management plan project and the extent of the habitat protection and enhancement could be lower.

- **Instream Flow Rule Amendment** may be sought if other required projects are completed (e.g., LNFH improvements and habitat enhancement), as envisioned under the original rule language in WAC 173-545-090. However, this may occur over a longer timeline.

- **LNFH Conservation and Water Quality Improvements** focuses on projects to reduce surface water use and improve access to groundwater. Projects required in the Biological Opinion would continue without the Icicle Strategy. These include consideration of water reuse, groundwater augmentation, and a pump back that would allow for changing operations at Structure 2 and the division of water between the historic and hatchery channels.

- **Fish Screen Compliance** upgrades will likely continue if the Icicle Strategy is not implemented. These upgrades are required by law, and grant funding has already been expended on the design of screening improvements for the City of Leavenworth and IPID diversions. Screening for COIC is included in the COIC Irrigation Efficiencies project, while screening for LNFH is required under the BiOp and will be the subject of NEPA environmental review. However, implementation may occur on a slower timeline based on funding and would not necessarily occur in a way that would benefit other projects included in the Icicle Strategy, such as Habitat Protection and Enhancement.

- **IPID Dryden Pump Exchange** may be implemented under the No-action Alternative. However, the project would likely be rescaled and focused, at least initially, on reducing diversions from Peshastin Creek and improving the reliability of water supply to the Peshastin Irrigation District (PID) Main Canal, which could result in no benefit or less benefit in Icicle Creek.

2.3.2 Alternative 1 (Preferred Alternative) Narrative Description

Alternative 1, also referred to as the Base Package, meets all the objectives defined in the IWG's Guiding Principles. These projects have been agreed to and moved forward by the IWG for review in this PEIS. While IWG members have reserved a final recommendation on Alternative 1 until resolution of the PEIS and consultation with the co-leads in 2018, this alternative represented the best recommendation available after 4 years of study by IWG members.

Alternative 1 includes the following projects[6]:

- **Alpine Lakes Reservoirs Optimization, Modernization, and Automation** modernizes and automates the outlet works and gate infrastructure at seven lakes. The intent is to improve management and releases of stored water at seven lakes in the Icicle Creek Subbasin based on changing conditions to meet the Subbasin's needs. It increases streamflow for fish and improves reliability and operation of stored water for agricultural use and the LNFH. (GP1; GP5)[7]
- **IPID Irrigation Efficiencies** explores options to improve irrigation delivery and on-farm efficiencies. Projects may include canal piping or lining and on-farm efficiency upgrades, which would improve drought resiliency and reliability to district users. Additionally, the IWG would work with IPID to voluntarily move water from users that do not use or need as much water to users that need additional water. This project also benefits fish by increasing streamflow. (GP1; GP5)
- **COIC Irrigation Efficiencies and Pump Exchange** proposes to change COIC's point of diversion from its existing location at RM 4.5 on Icicle Creek to a location on the right bank of the Wenatchee River near its confluence with Icicle Creek or on the left bank of Icicle Creek near its confluence with the Wenatchee River and implement other water saving measures, such as piping the delivery system. The augmented streamflow has the potential to improve reliability of water supply for agriculture, benefit fish passage and habitat, and maintain treaty and non-treaty harvests. (GP1; GP5)
- **Domestic Conservation Efficiencies** focuses on conservation projects in the City of Leavenworth and Chelan County and implements municipal and rural water efficiency projects such as a lawn buyback program that could incentivize reducing the amount of lawn homeowners irrigate, leak detection and repair, meter installation, and water use conservation to improve domestic supply. (GP4)
- **Eightmile Lake Storage Restoration** rebuilds the Eightmile Lake dam to restore usable storage to the historical and permitted high water storage elevation. This

[6] Taken from Icicle Strategy SEPA Checklist: http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA/Icicle%20Strategy%20SEPAChecklist%20Signed.pdf

[7] GP = Guiding Principal. See explanation in Table 2-2.

would increase streamflow for fish and meet the domestic water needs of the City of Leavenworth and surrounding rural areas in Chelan County and improves the reliability and drought resiliency for agricultural users (GP1; GP4; GP5). Additional water for the City of Leavenworth would be preferentially pursued on the Wenatchee River to reduce impacts to Icicle Creek, although in emergencies water could be supplied from Icicle Creek instead to meet the City's service obligations.

- **Tribal and Non-Tribal Fisheries** ensures that projects and actions taken do not have negative effects on tribal fishery activity in the Icicle Creek Subbasin. It monitors fishery effectiveness and implements actions for improvement, while protecting Tribal Treaty and federally protected harvest rights and non-tribal harvest at all times. (GP2)
- **Habitat Protection and Enhancement** identifies and implements stream restoration and protection projects such as riparian plantings, engineered log jams, and conservation easements to improve stream habitat and ecosystem health. (GP6)
- **Instream Flow Rule Amendment** modifies the instream flow rule's interim domestic reservation of 0.1 cfs to a final level of 0.5 cfs. This helps meet domestic water needs through 2050. As described in Chapter 173-545 WAC, the rule amendment requires instream flow and habitat restoration. This will improve domestic supply in the Icicle Creek subbasin. (GP4)
- **LNFH Conservation and Water Quality Improvements** focuses on projects to reduce surface water use and improve access to groundwater. These projects may include onsite reuse, an effluent pump back, and wellfield enhancements for year-round benefits. It would also increase streamflow for fish and improve access to reliable water for the hatchery's operations. These projects also improve water quality in Icicle Creek. (GP1; GP2)
- **Fish Passage** improves passage by assessing and removing barriers, so fish have better access to healthy habitats. This could include improved operation at Structure 2 and modification of channel morphology at the Boulder Field. Improved passage will increase the amount of habitat fish can access within the subbasin. (GP6)
- **Fish Screening** upgrades fish screens on diversions to meet current standards. This will bring the major diverters on Icicle Creek into compliance with Washington State and NMFS screening requirements and bring LNFH into compliance with the screening requirements set in the Biological Opinion (NMFS, 2015). These projects reduce fish mortality, which ultimately improves fish passage. (GP6; GP7)
- **Water Markets** creates an Icicle Water Market and seeds it with an initial 1,000 acre-feet of water for agriculture use in the Icicle Creek Subbasin and Wenatchee River Basins during shortages. (GP4)

Additional projects may be pursued outside of the Icicle Strategy if Alternative 1 is selected as the preferred alternative, such as the IPID Dryden Pump Exchange. However, project beneficiaries may be different and project timelines are unknown.

Table 2-2 shows how the projects included in Alternative 1 addresses the IWG's Guiding Principles. This suite of projects is expected to cost $82 million, provides 89 cfs and 31,958 acre-feet of total water benefit (88 cfs and 28,458 acre-feet of instream benefit).

Table 2-2
How Alternative 1 (Preferred Alternative) Meets Guiding Principles

Guiding Principle Number	Guiding Principles	How the Alternative 1 Meets the Guiding Principles
GP1	Improve Instream Flow	Meets goals of 100 cfs in average years and 60 cfs in drought years. Anticipated flow improvement is 88 cfs, in addition to base flows.
GP2	Improve Sustainability of LNFH	Meets goal of source redundancy and improved fish rearing and capacity, allowing LNFH to meet fish production goals. Also, improves water quality, and passage in Icicle Creek.
GP3	Protect Tribal and Non-Tribal Harvest	Meets goal of instream flow improvement balanced with preservation of fishery with adaptive management strategy in place, and potential amenity and access increases.
GP4	Improve Domestic Supply	Meets peak 2050 domestic demand
GP5	Improve Agricultural Reliability	Meets goal of 1,000 acre-feet for agricultural interruptible water rights.
GP6	Enhance Icicle Creek Habitat (includes fish passage and fish screens)	Meets goal of additional habitat improvement.
GP7	Comply with State and Federal Laws and Wilderness Acts	Meets goal by requiring project checks on all permits and an environmental review.

Because Icicle Creek experiences low flows most acutely in the late summer/early fall (see Section 3.3), it is insufficient to consider the instream flow Guiding Principle met if the annual quantities meet "average" drought or non-drought year conditions. Rather, it is appropriate to consider performance of the Alternatives on a weekly time-step and to consider both actual flows in an indicator drought and non-drought year, as well as how average conditions fair.

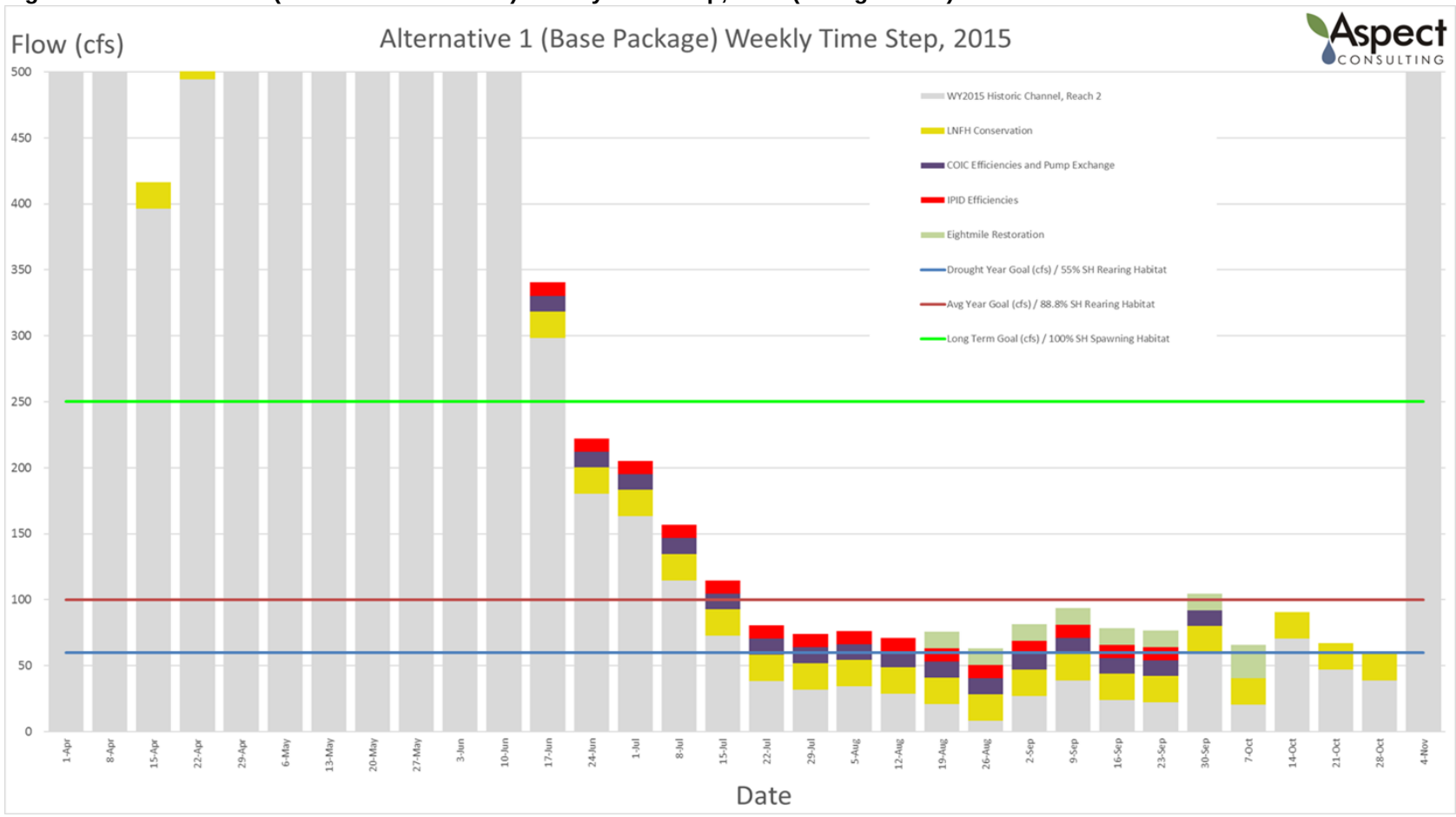
A representative year approach and weekly average flows were used to determine performance of the alternatives in meeting the instream flow goal. 2015 was selected as a representative drought year and 2014 as a representative non-drought year. Weekly average flows in all non-drought years (50 percent exceedance) and drought years (80

percent exceedance) over the last 20 years was also used. Based on these criteria, there were four drought years during the 20-year record (2001, 2003, 2005, and 2015)

Weekly flows in the historic channel were shown along with additional water supply made available from projects in each Alternative to compare to the Guiding Principles. Some projects provide a constant or fixed weekly flow benefit in proportion to their savings (e.g. conservation), while others are adaptive (e.g. storage). Where adaptation was possible, greater flow benefit is achieved by targeting releases to late summer/early fall. Both Alpine Lakes Reservoirs Optimization, Modernization, and Automation and Eightmile Lake Storage Restoration can be managed adaptively, and releases would be managed based on annual flow conditions. In the following figures, the gray bars represent flow and the colored stacked bars represent projected contributions of each project to streamflow.

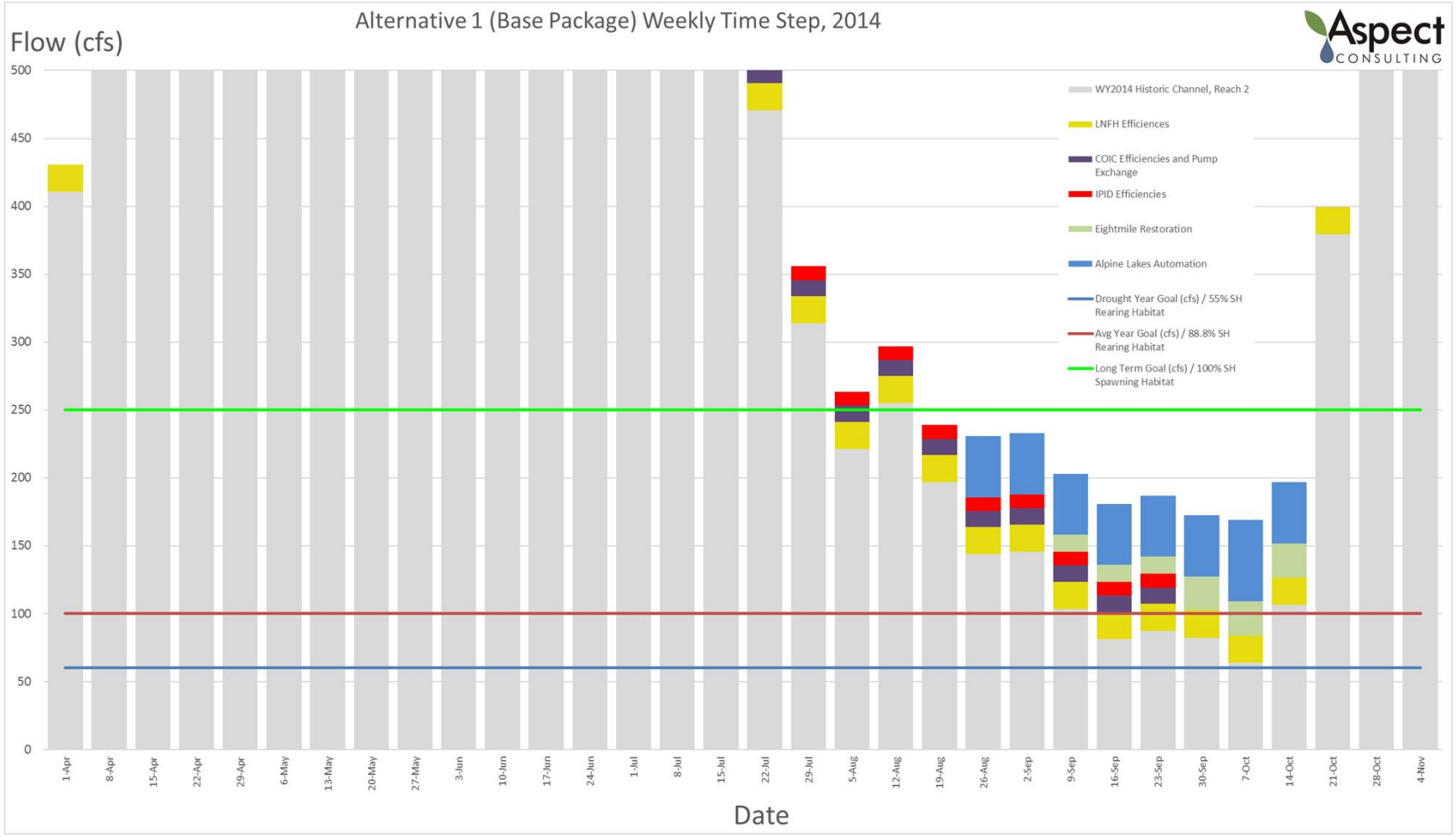
Figures 2-6, 2-7, 2-8, and 2-9 illustrate streamflow benefits in average drought and non-drought years, as well as the 2015 and 2014 water years with the Alternative 1 projects added. Under all these scenarios, the 100 cfs short-term non-drought and 60 cfs drought year flow restoration goals are met. Additionally, the purple line on the averaged flow charts represents the lowest weekly flow during the 20-year record for each weekly timestep. In the DPEIS this purple line was the same for drought and non-drought years. The FPEIS was revised so this line represents the lowest weekly average flows during non-drought years on the non-drought year graph and the lowest weekly average flows during drought years on the drought year graphs.

Figure 2-6. Alternative 1 (Preferred Alternative) Weekly Time Step, 2015 (Drought Year)[8]



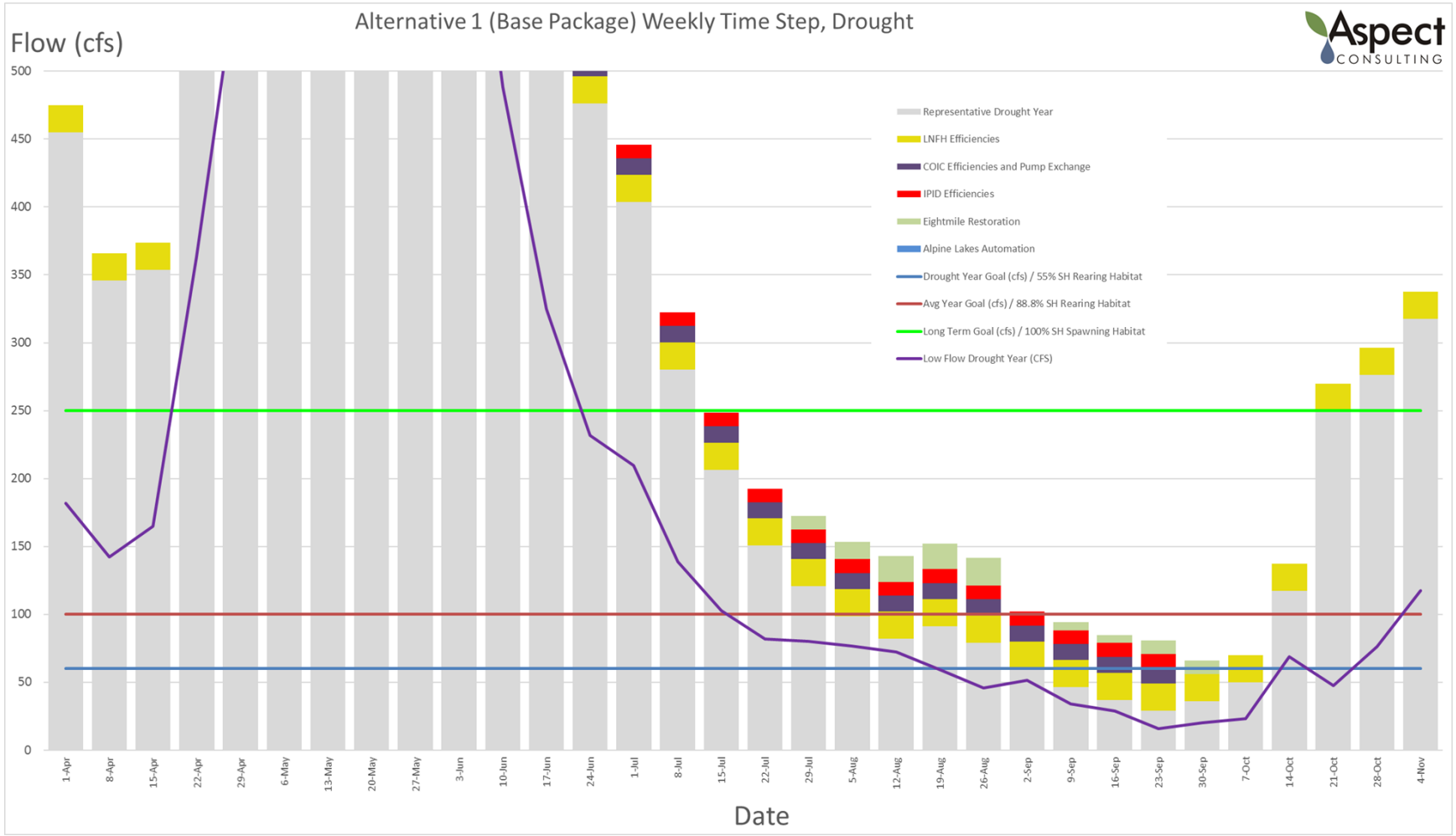
[8] Represent 2015 flows in Icicle Creek with estimated flow benefit achieved from Alternative 1 implementation

Figure 2-7. Alternative 1 (Preferred Alternative) Weekly Time Step, 2014 (Non-Drought Year)[9]



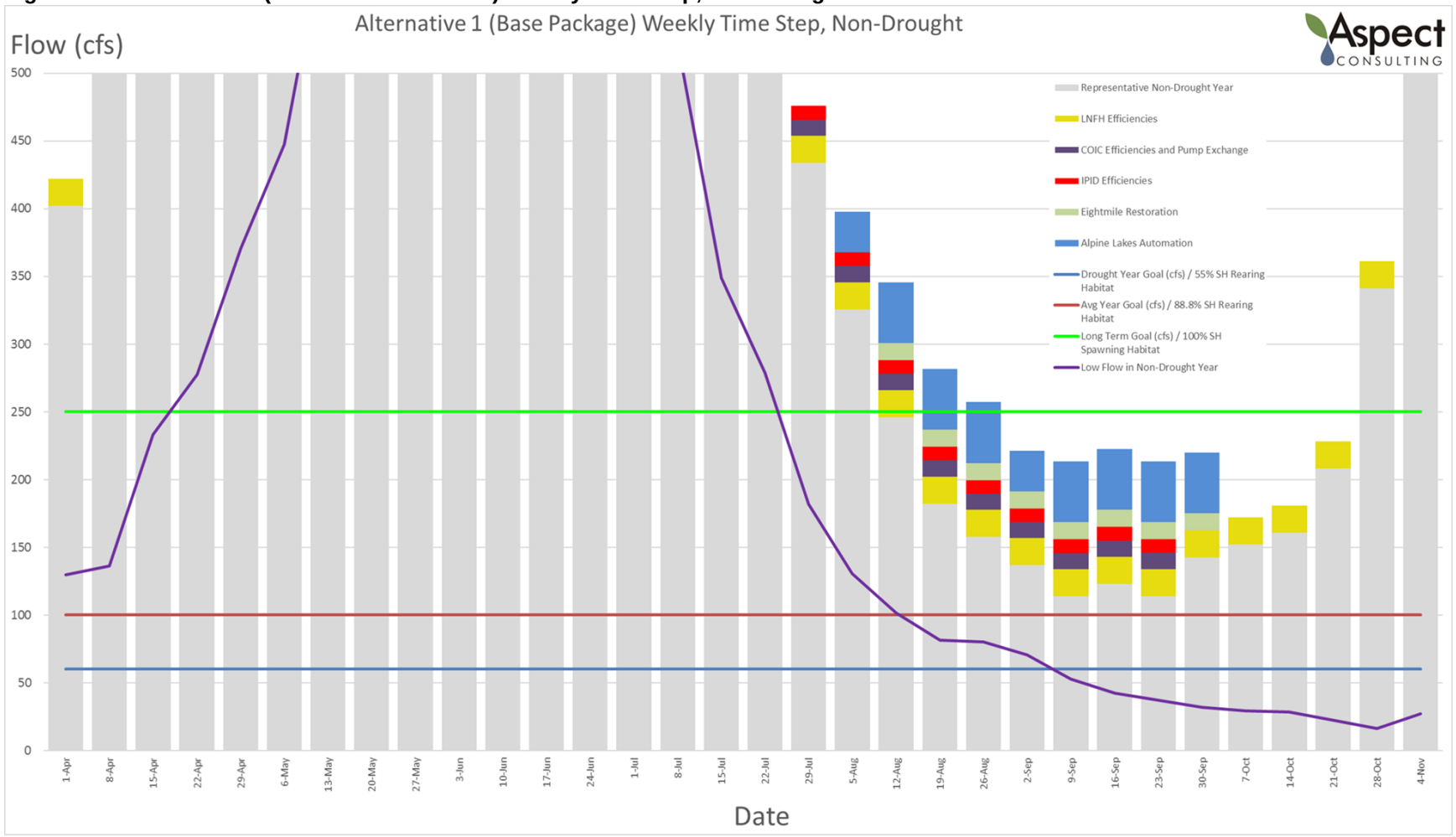
[9] Represent 2014 (46% exceedance) flows in Icicle Creek with estimated flow benefit achieved from Alternative 1 implementation.

Figure 2-8. Alternative 1 (Preferred Alternative) Weekly Time Step, Drought/Low Water Year Scenario[10]



[10] Represents averaged dry year flows (80% exceedance) in Icicle Creek with estimated flow benefit achieved from Alternative 1 implementation.

Figure 2-9. Alternative 1 (Preferred Alternative) Weekly Time Step, Non-Drought Scenario [11]



[11] Represent average flows in Icicle Creek during "non-drought" years (50% exceedance) with estimated flow benefit achieved from Alternative 1 implementation.

2.3.3 Alternative 2 Narrative Description

The IWG developed Alternative 2 in response to SEPA scoping comments that requested examination of pump station options and omission of the Alpine Lakes Optimization, Modernization, and Automation project. This alternative includes most of the projects from Alternative 1—with the exception of the Alpine Lakes Optimization, Modernization, and Automation—and adds the IPID Dryden Pump Exchange project.

Alternative 2 includes the following projects:

- **IPID Dryden Pump Exchange** would install a pump station on the right bank of the Wenatchee River near Dryden and a delivery pipeline that would extend through private orchards and driveways to the IPID canals. Water pumped from the Wenatchee River would allow for a corresponding reduction in diversions from Icicle and Peshastin Creeks, which would improve streamflow. The augmented streamflow has the potential to improve reliability of water supply for agriculture, benefit fish passage and habitat, and maintain treaty and non-treaty harvests. (GP1; GP5)
- IPID Irrigation Efficiencies (GP1; GP5)
- COIC Irrigation Efficiencies and Pump Exchange (GP1; GP5)
- Domestic Conservation Efficiencies (GP4)
- Eightmile Lake Storage Restoration (GP1; GP4; GP5)
- Tribal Fisheries Protection (GP3)
- Habitat Protection and Enhancement (GP7)
- Instream Flow Rule Amendment (GP4)
- Leavenworth National Fish Hatchery Conservation and Water Quality Improvements (GP2)
- Fish Passage (GP6)
- Fish Screening (GP6; GP7)
- Water Markets (GP5)

Additional projects may be pursued outside of the Icicle Strategy if Alternative 2 is selected as the preferred alternative, such as the IPID Dryden Pump Exchange. However, project beneficiaries may be different and project timelines are unknown.

Table 2-3 shows how Alternative 2 addresses the IWG's Guiding Principles. This suite of projects is expected to cost $91.4 million, provides 84 cfs and 27,978 acre-feet of total water benefit (instream and out-of-stream).

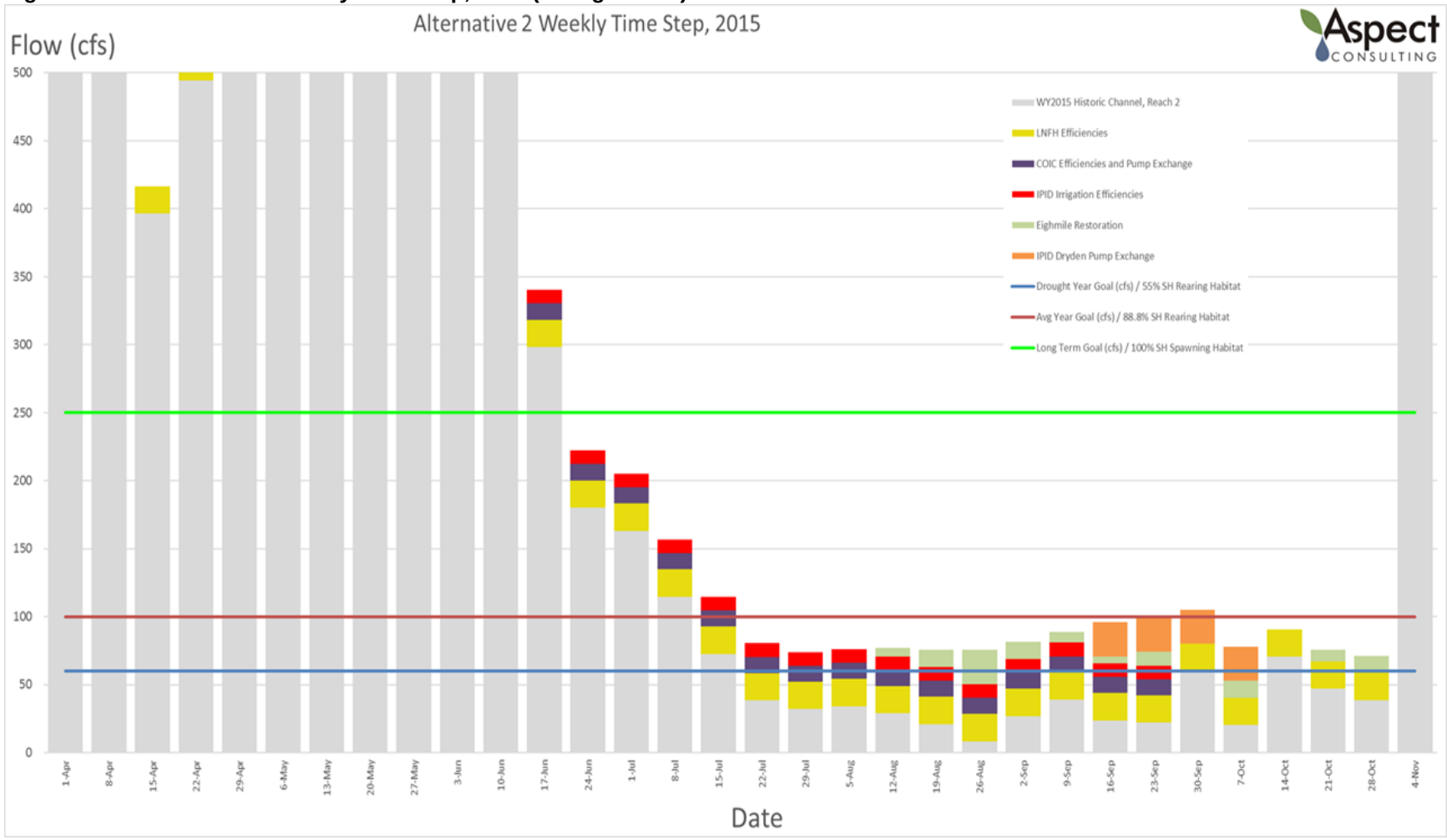
Table 2-3
How Alternative 2 Meets Guiding Principles

Guiding Principle Number	Guiding Principles	How Alternative 2 Meets the Guiding Principles
GP1	Improve Instream Flow	Meets goals of 100 cfs in average years and 60 cfs in drought years. Anticipated flow improvement is 83 cfs, in addition to base flow.
GP2	Improve Sustainability of LNFH	Meets goal of source redundancy and improved fish rearing and capacity, allowing LNFH to meet fish production goals. Also, improves water quality, and passage in Icicle Creek.
GP3	Protect Tribal and Non-Tribal Harvest	Meets goal of instream flow improvement balanced with preservation of fishery with adaptive management strategy in place, and potential amenity and access increases.
GP4	Improve Domestic Supply	Meets peak 2050 domestic demand
GP5	Improve Agricultural Reliability	Meets goal of 1,000 acre-feet for agricultural interruptible water rights.
GP6	Enhance Icicle Creek Habitat (includes fish passage and fish screens)	Meets goal of additional habitat improvement with adaptive management.
GP7	Comply with State and Federal Laws and Wilderness Acts	Meets goal by requiring project checks on all permits and an environmental review.

As shown in Table 2-3, the suite of projects proposed under Alternative 2 meets streamflow restoration goals established in the Guiding Principles. Figures 2-10, 2-11, 2-12, and 2-13 illustrate streamflow benefits in 2015, 2014, average drought (80 percent exceedance) and average non-drought (50 percent exceedance) years for Alternative 2. These figures show that the short-term instream flow goal of 100 cfs in non-drought years and 60 cfs in drought-years would be met under both scenarios.

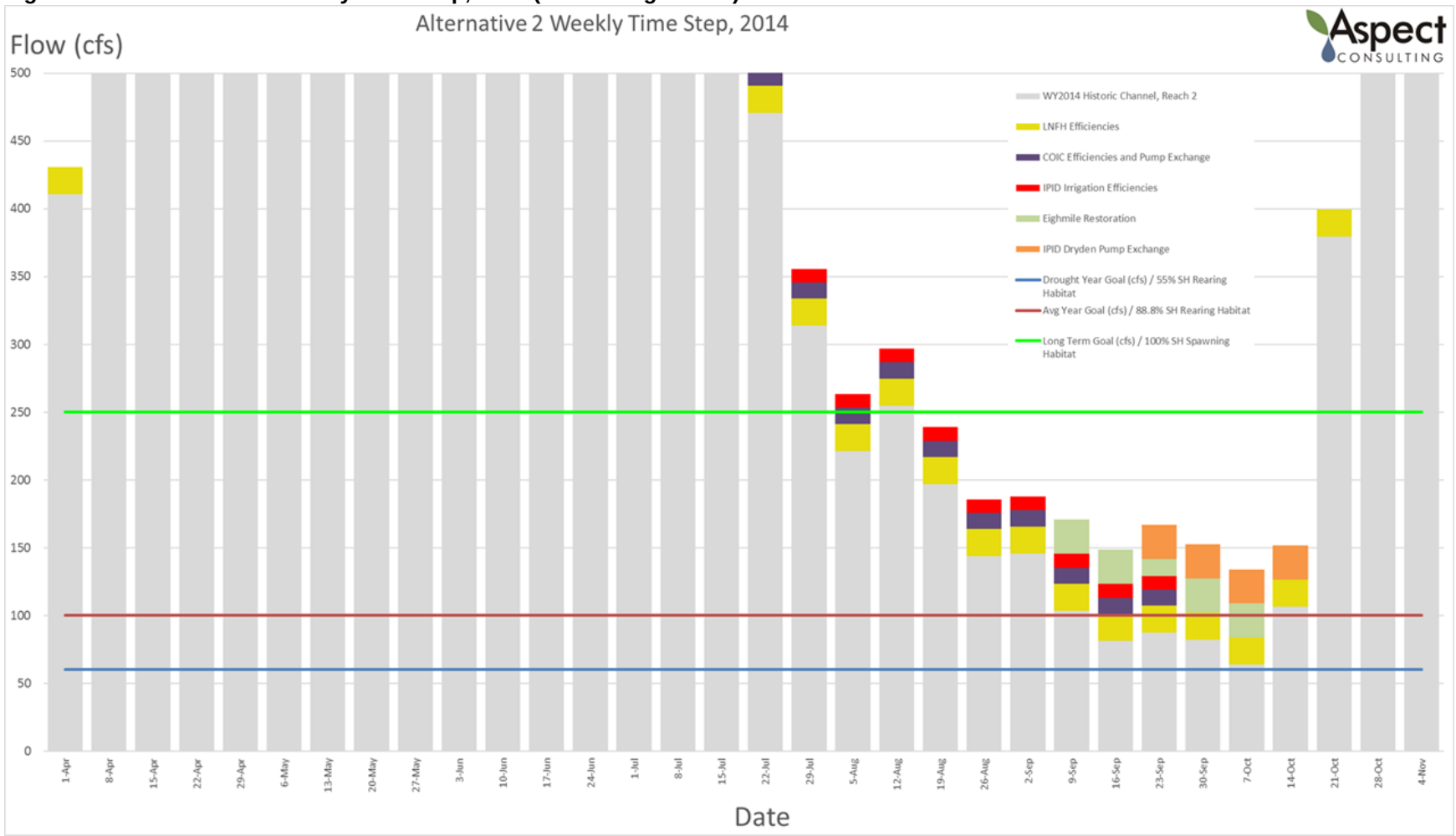
Some projects provide a constant or fixed weekly flow benefit in proportion to their savings (e.g. conservation), while others are adaptive (e.g. storage). Where adaptation was possible, greater flow benefit is achieved by targeting operation in late summer/early fall. Both IPID Dryden Pump Exchange and Eightmile Lake Storage Restoration can be managed adaptively, and releases would be managed based on annual flow conditions.

Figure 2-10. Alternative 2 Weekly Time Step, 2015 (Drought Year)[12]



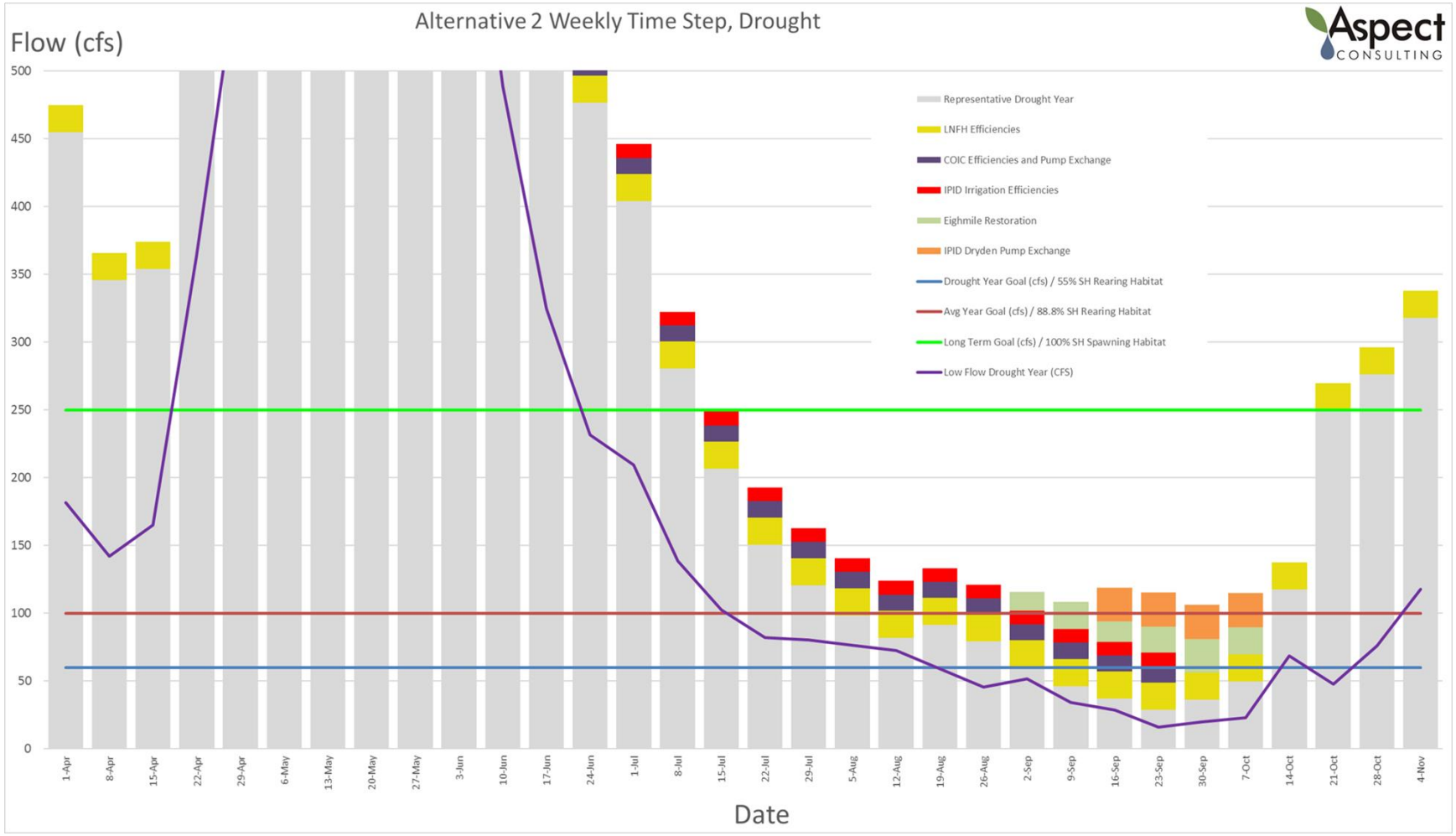
[12] Represent 2015 flows in Icicle Creek with estimated flow benefit achieved from Alternative 2 implementation.

Figure 2-11. Alternative 2 Weekly Time Step, 2014 (Non-Drought Year)[13]



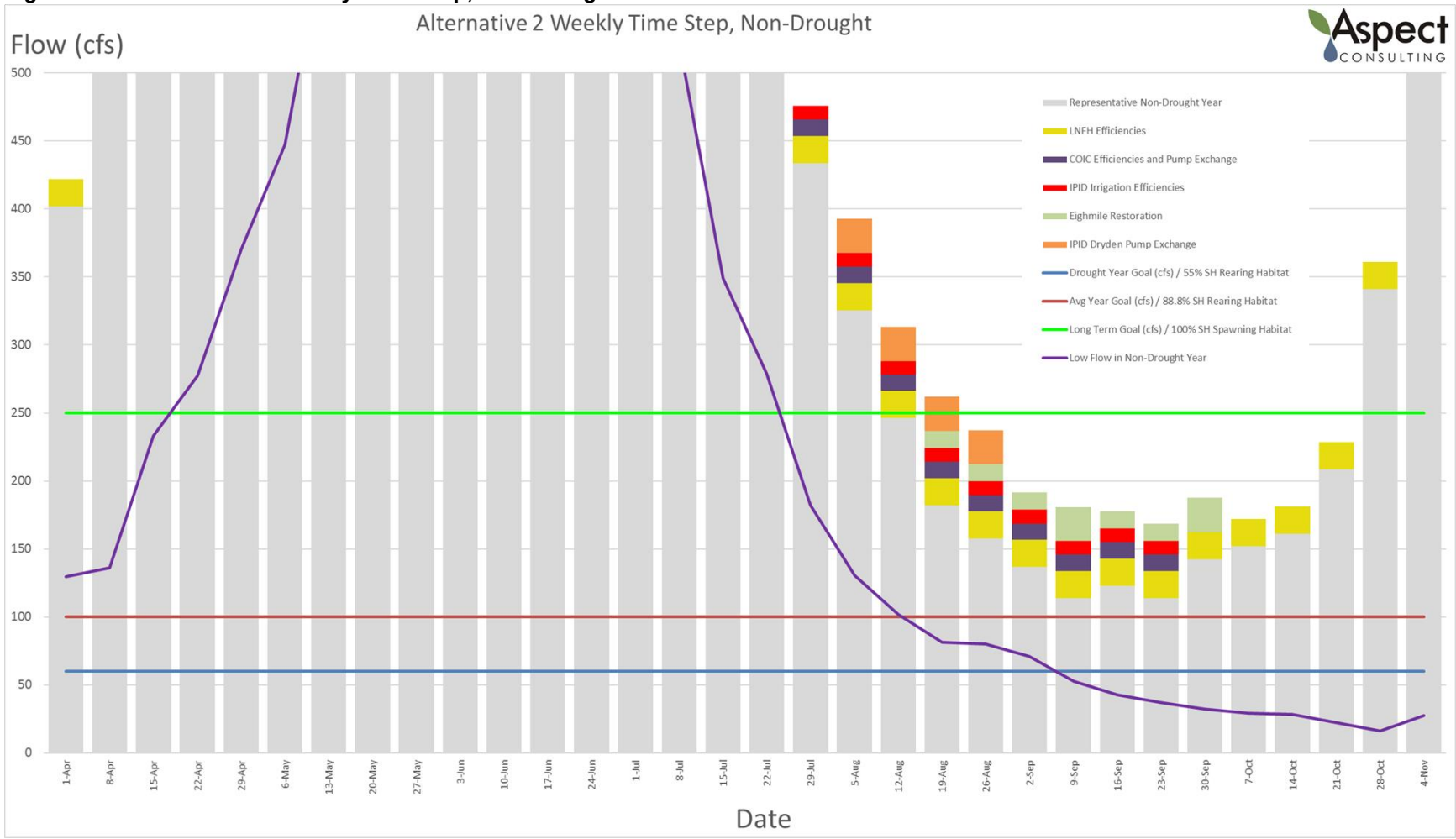
[13] Represent 2014 (46% exceedance) flows in Icicle Creek with estimated flow benefit achieved from Alternative 2 implementation.

Figure 2-12. Alternative 2 Weekly Time Step, Drought/Low Water Year Scenario[14]



[14] Represents averaged dry year flows (80% exceedance) in Icicle Creek with estimated flow benefit achieved from Alternative 2 implementation.

Figure 2-13. Alternative 2 Weekly Time Step, Non-Drought Scenario [15]



[15] Represent average flows in Icicle Creek during "non-drought" years (50% exceedance) with estimated flow benefit achieved from Alternative 2 implementation.

2.3.4 Alternative 3 Narrative Description

Alternative 3 is a response to SEPA scoping comments that expressed a desire for an alternative that excluded projects within the Alpine Lakes Wilderness Area. Alternative 3 includes most of the projects from Alternative 1, with the exception of the Alpine Lakes Optimization, Modernization, and Automation and the Eightmile Lake Storage Restoration. It calls for a legislative change to waive impacts to instream flows when conservation and pump-exchange-based supplies cannot perfectly meet demand required to provide domestic reliability. For example, conservation supplies are available from April to October in this Alternative, but the Guiding Principle for domestic reliability requires year-round supplies. Because instream flows are at times not met from November to March, this would impair instream flows if legislative approval was not provided. Ecology no longer has the authority to waive these kinds of impacts through an Overriding Consideration of the Public Interest (OCPI) determination under RCW 90.54.020 given clarity from the Supreme Court in cases like *Swinomish* and *Foster/Yelm*.

Alternative 3 includes the following projects:

- IPID Dryden Pump Exchange (GP1; GP5)
- IPID Irrigation Efficiencies (GP1; GP5)
- COIC Irrigation Efficiencies and Pump Exchange (GP1; GP5)
- Domestic Conservation Efficiencies (GP4)
- Tribal Fisheries Protection (GP3)
- Habitat Protection and Enhancement (GP6)
- Instream Flow Rule Amendment (GP4)
- Leavenworth National Fish Hatchery Conservation and Water Quality Improvements (GP2)
- Fish Passage (GP6)
- Fish Screening (GP6; GP7)
- Water Markets (GP5)
- Legislative Change for Instream Flow Impacts. Under this project, the IWG would seek a legislative change that would allow impairment to the Instream Flow Rule when increased flow from conservation do not line up temporally with demand. (GP4)

Additional projects may be pursued outside of the Icicle Strategy if Alternative 3 is selected as the preferred alternative, such as the Eightmile Lake Storage Restoration Project. However, project beneficiaries may be different and project timelines are unknown.

Table 2-4 shows how Alternative 3 addresses the IWG's Guiding Principles.

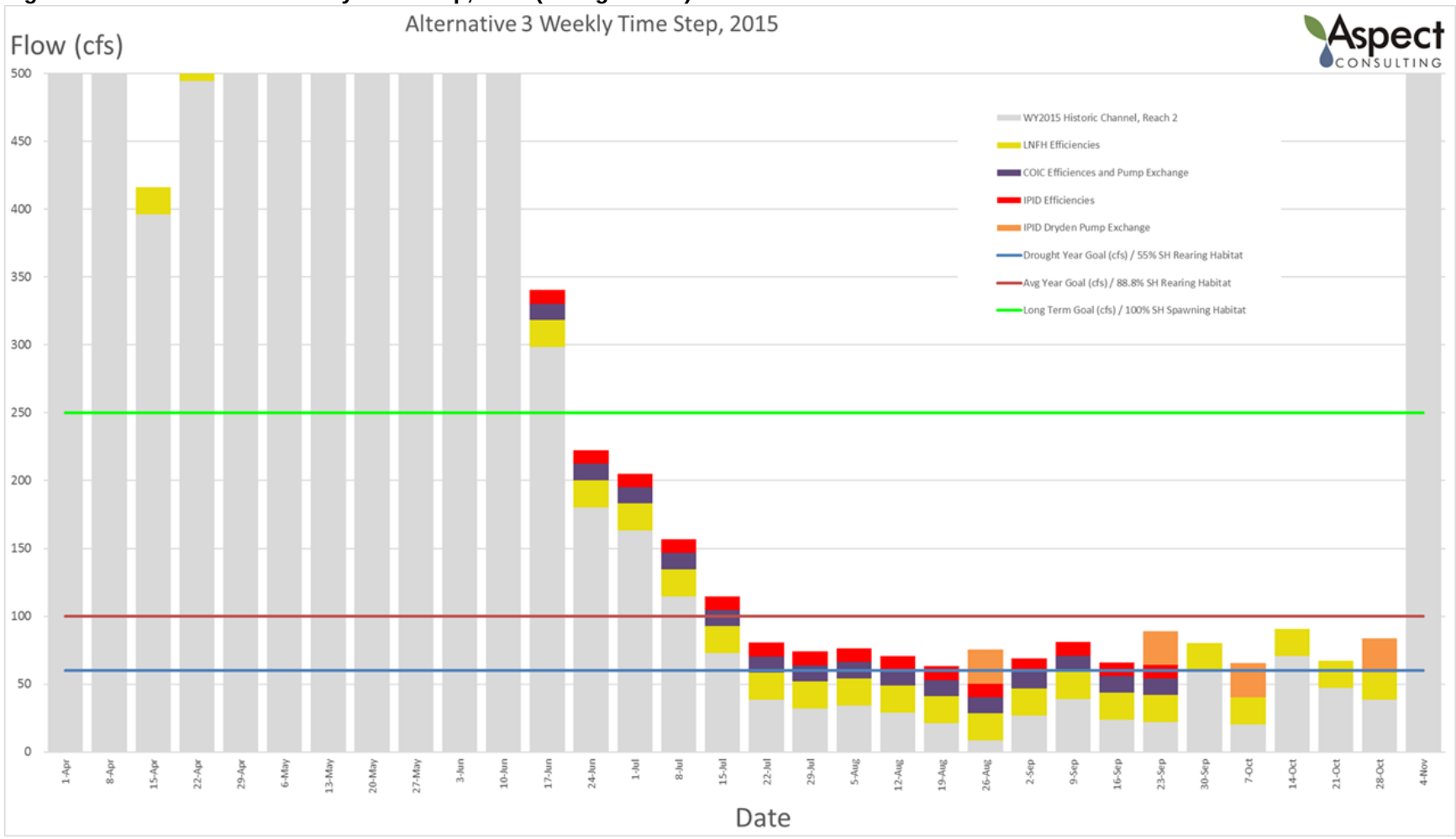
Table 2-4
How Alternative 3 Meets Guiding Principles

Guiding Principle Number	Guiding Principles	How Alternative 3 Meets the Guiding Principles
GP1	Improve Instream Flow	Meets goals of 100 cfs in average years and 60 cfs in drought years. Anticipated instream flow improvement is 70 cfs in addition to base flow.
GP2	Improve Sustainability of LNFH	Meets goal of source redundancy and improved fish rearing and capacity, allowing LNFH to meet fish production goals. Also, improves water quality, and passage in Icicle Creek.
GP3	Protect Tribal and Non-Tribal Harvest	Meets goal of instream flow improvement balanced with preservation of fishery with adaptive management strategy in place, and potential amenity and access increases.
GP4	Improve Domestic Supply	Meets domestic needs through legislation.
GP5	Improve Agricultural Reliability	Meets goal of 1,000 acre-feet for agricultural interruptible water rights.
GP6	Enhance Icicle Creek Habitat (includes fish passage and fish screens)	Meets goal of additional habitat improvement with adaptive management.
GP7	Comply with State and Federal Laws and Wilderness Acts	Meets goal by requiring project checks on all permits and an environmental review; Would require legislative action to comply with Instream Flow Rule.

As shown in Table 2-4, the suite of projects proposed under Alternative 3 meets streamflow restoration goals established in the Guiding Principles. Figures 2-14, 2-15, 2-16, and 2-17 illustrate streamflow benefits in 2015, 2014, average drought, and average non-drought years for Alternative 3. These figures show that the short-term instream flow goal of 100 cfs in non-drought years and 60 cfs in drought-years would be met under both scenarios.

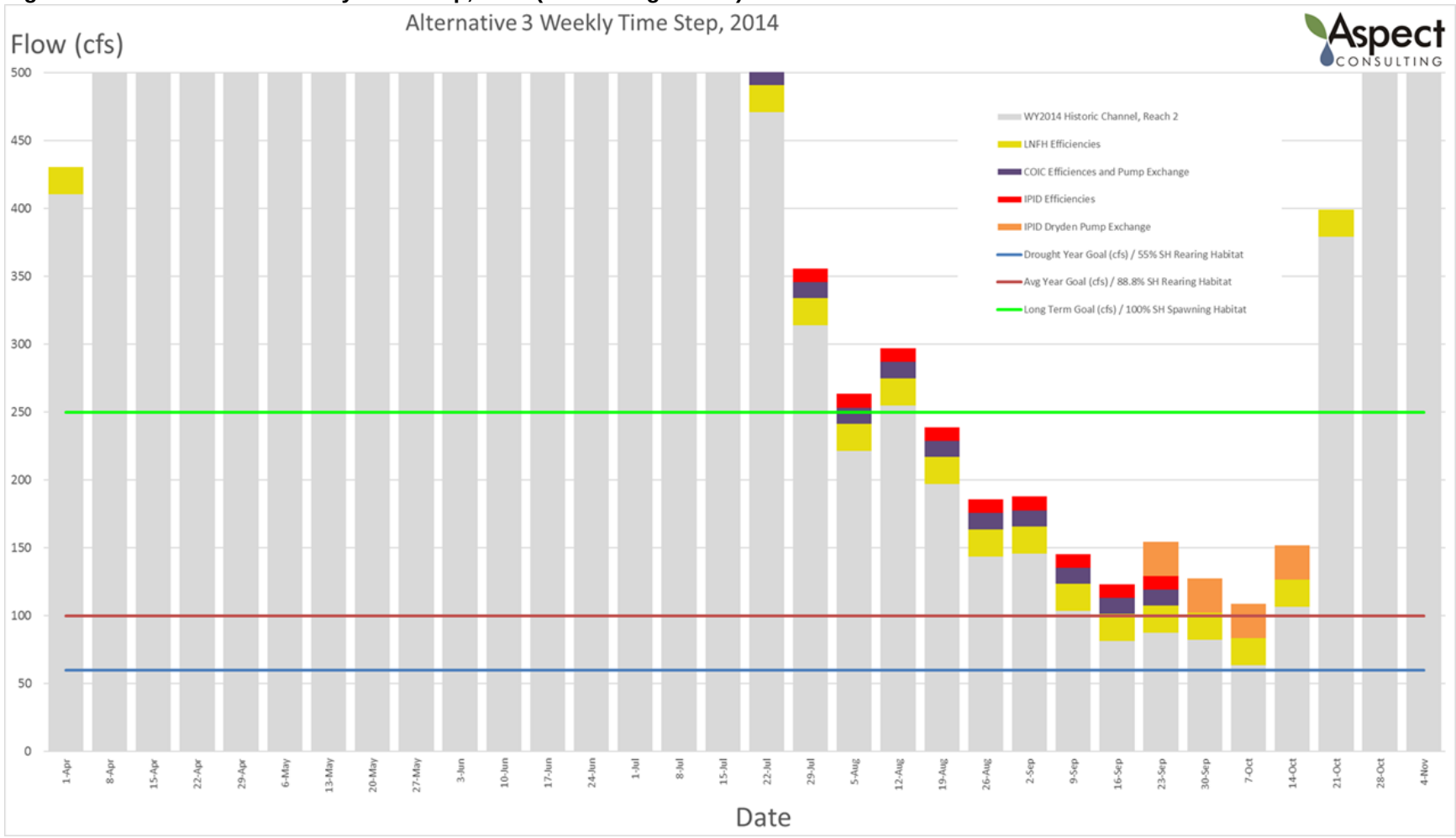
Some projects provide a constant or fixed weekly flow benefit in proportion to their savings (e.g. conservation), while others are adaptive (e.g. storage). Where adaptation was possible, greater flow benefit is achieved by targeting operation in late summer/early fall. IPID Dryden Pump Exchange can be managed adaptively, and releases would be managed based on annual flow conditions. However, depending on district operations and water year, the adaptability of this project may be limited in some year.

Figure 2-14. Alternative 3 Weekly Time Step, 2015 (Drought Year)[16]



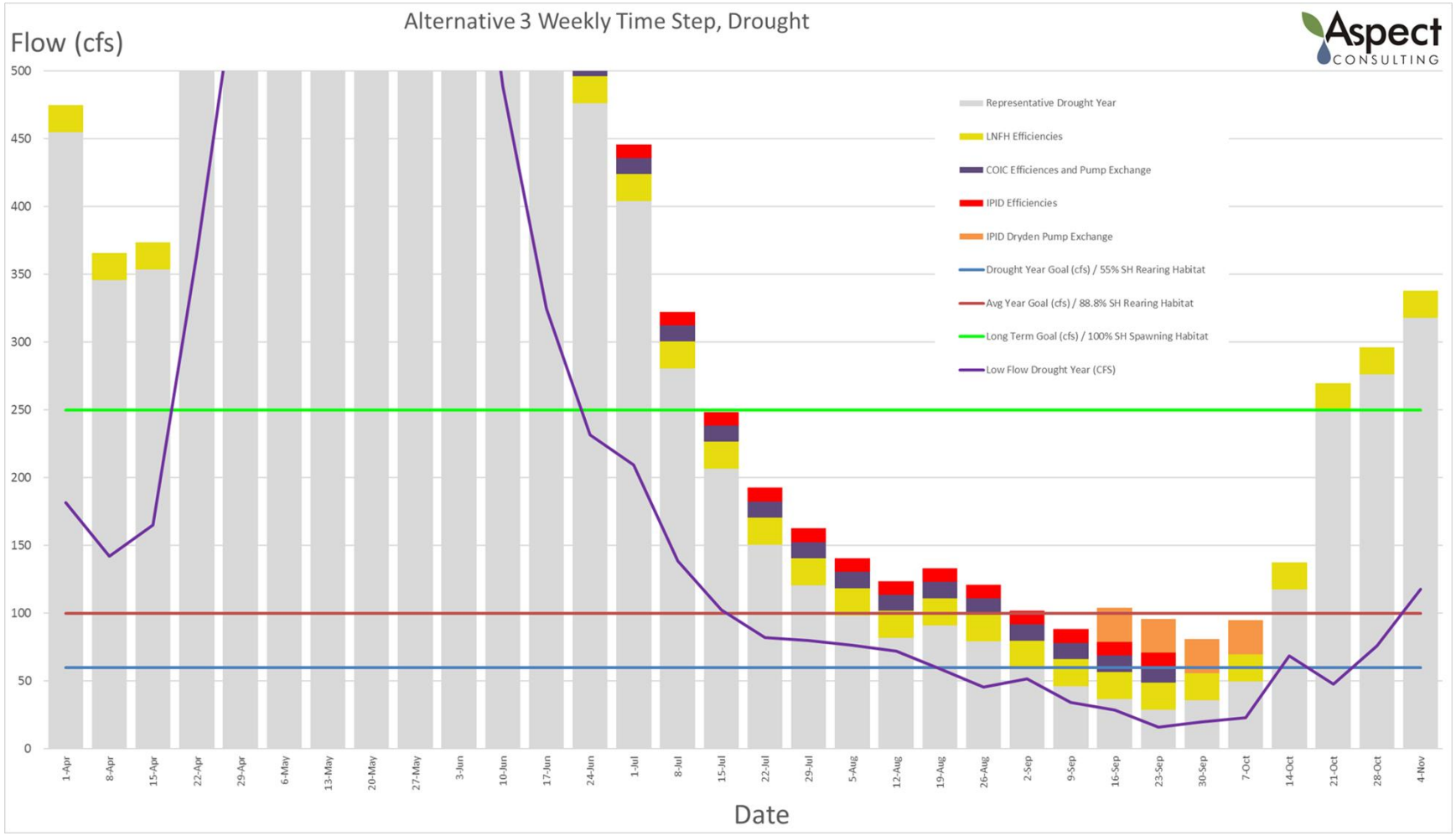
[16] Represent 2015 flows in Icicle Creek with estimated flow benefit achieved from Alternative 3 implementation.

Figure 2-15. Alternative 3 Weekly Time Step, 2014 (Non-Drought Year)[17]



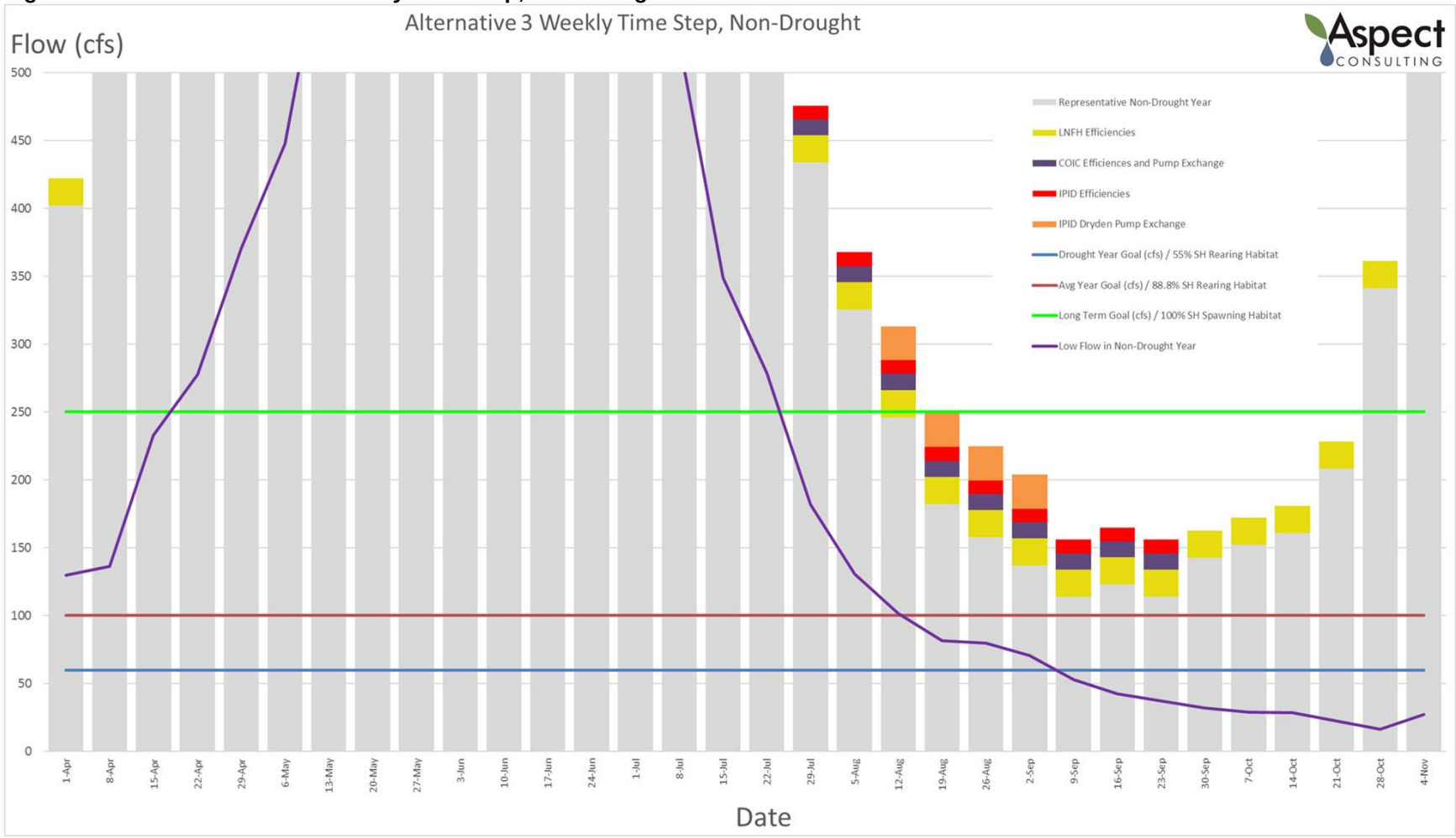
[17] Represent 2014 (46% exceedance) flows in Icicle Creek with estimated flow benefit achieved from Alternative 3 implementation.

Figure 2-16. Alternative 3 Weekly Time Step, Drought/Low Water Year Scenario[18]



[18] Represents averaged dry year flows (80% exceedance) in Icicle Creek with estimated flow benefit achieved from Alternative 3 implementation.

Figure 2-17. IWG Alternative 3 Weekly Time Step, Non-Drought Scenario [19]



[19] Represent average flows in Icicle Creek during "non-drought" years (50% exceedance) with estimated flow benefit achieved from Alternative 3 implementation.

2.3.5 Alternative 4 Narrative Description

Alternative 4 was created as a response to SEPA scoping comments that requested increased storage in the Icicle Creek Subbasin as an adaptive measure to climate change uncertainty and to better react to changes in future demand. This alternative has all the same projects as Alternative 1, but calls for increasing storage at Eightmile Lake to above the historical high water mark and enhancing storage and release at Upper Klonaqua and Upper Snow Lakes. Conservation was not reduced over that identified in Alternative 1 because it was necessary to meet other Guiding Principles (e.g., LNFH hatchery reliability, agricultural reliability).

- Alpine Lakes Reservoirs Optimization, Modernization, and Automation (GP 1; GP5)
- **Eightmile Lake Storage Enhancement** differs from the Eightmile Lake Storage Restoration project included in Alternatives 1, 2, and 5. It calls for increasing the useable storage to approximately 3,500 acre-feet by rebuilding the dam to raise the high-water storage elevation and increasing the available draw down. (GP1; GP4; GP5)
- **Upper Klonaqua Lake Storage Enhancement** takes advantage of potential storage in Upper Klonaqua Lake by installing infrastructure to draw down the lake. Options for draw down include tunneling, pumping, and siphon. Bathymetry suggests up to 2,448.2 acre-feet of water could be available for release. (GP1; GP4)
- **Upper and Lower Snow Lakes Storage Enhancement** would raise the dam on Upper Snow Lake to increase storage capacity by 1,079 acre-feet. (GP1; GP4)
- IPID Irrigation Efficiencies (GP1; GP5)
- COIC Irrigation Efficiencies and Pump Exchange (GP1; GP5)
- Domestic Conservation Efficiencies (GP4)
- Tribal Fisheries Protection (GP3)
- Habitat Protection and Enhancement (GP6)
- Instream Flow Rule Amendment (GP4)
- Leavenworth National Fish Hatchery Conservation and Water Quality Improvements (GP2)
- Fish Passage (GP6)
- Fish Screening (GP6; GP7)
- Water Markets (GP5)

Additional projects may be pursued outside of the Icicle Strategy if Alternative 4 is selected as the preferred alternative. However, project beneficiaries may be different and project timelines are unknown.

Table 2-5 shows how Alternative 4 addresses the IWG's Guiding Principles.

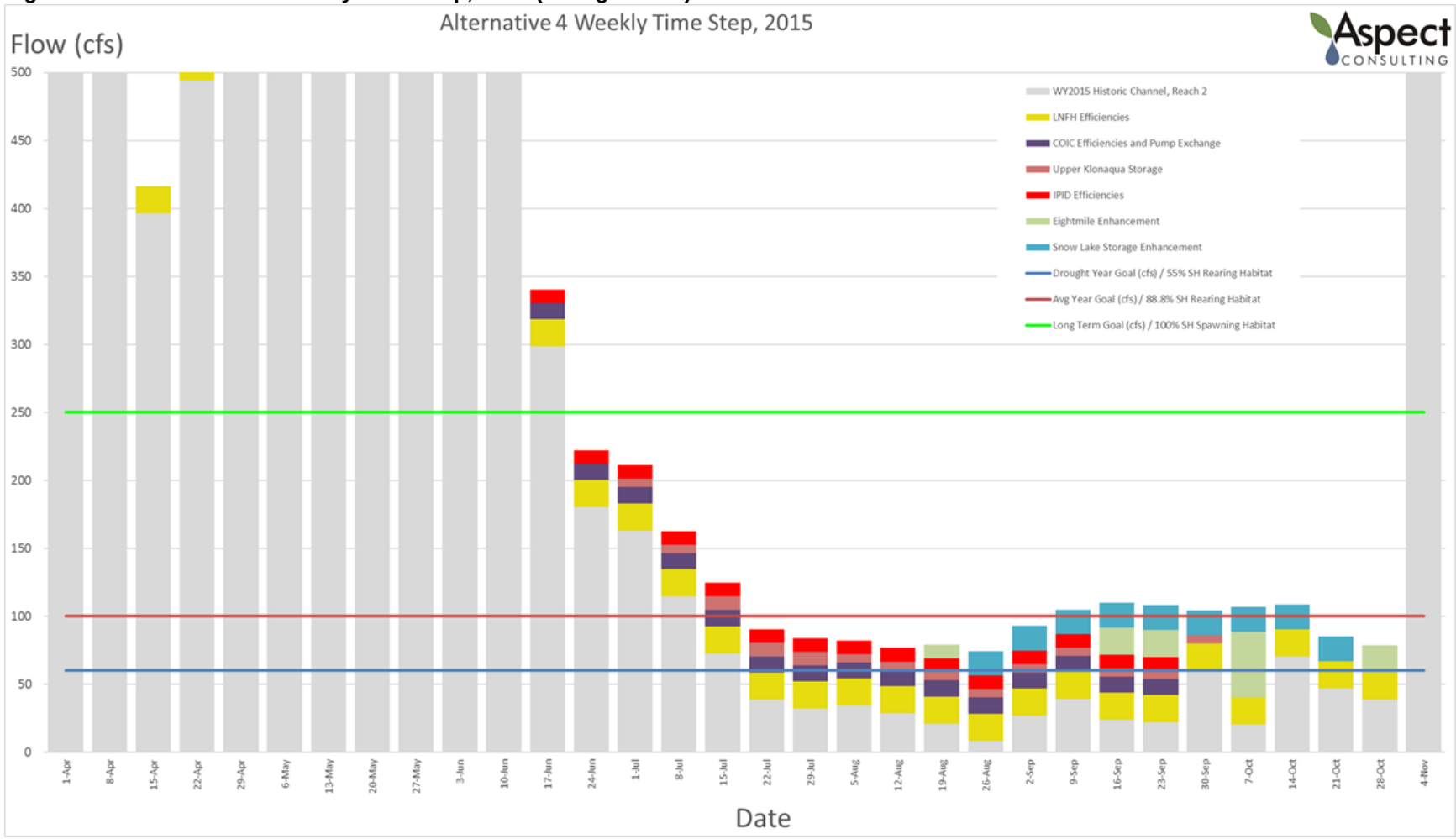
Table 2-5
How Alternative 4 Meets Guiding Principles

Guiding Principle Number	Guiding Principles	How Alternative 4 Meets the Guiding Principles
GP1	Improve Instream Flow	Meets goals of 100 cfs in average years and 60 cfs in drought years. Anticipated flow improvement is up to 131 cfs.
GP2	Improve Sustainability of LNFH	Meets goal of source redundancy and improved fish rearing and capacity, allowing LNFH to meet fish production goals. Also, improves water quality, and passage in Icicle Creek.
GP3	Protect Tribal and Non-Tribal Harvest	Meets goal of instream flow improvement balanced with preservation of fishery with adaptive management strategy in place, and potential amenity and access increases.
GP4	Improve Domestic Supply	Meets peak 2050 domestic demand
GP5	Improve Agricultural Reliability	Meets goal of 1,000 acre-feet for agricultural interruptible water rights.
GP6	Enhance Icicle Creek Habitat (includes fish passage and fish screens)	Meets goal of additional habitat improvement with adaptive management.
GP7	Comply with State and Federal Laws and Wilderness Acts	Meets goal by requiring project checks on all permits and an environmental review.

As shown in Table 2-5, the suite of projects proposed under Alternative 4 meets streamflow restoration goals established in the Guiding Principles. Figures 2-18, 2-19, 2-20, and 2-21 illustrate streamflow benefits in 2015, 2014, average drought, and average non-drought years for Alternative 4. These figures show the short-term goal set in the Guiding Principle of 100 cfs would be met in drought and non-drought years.

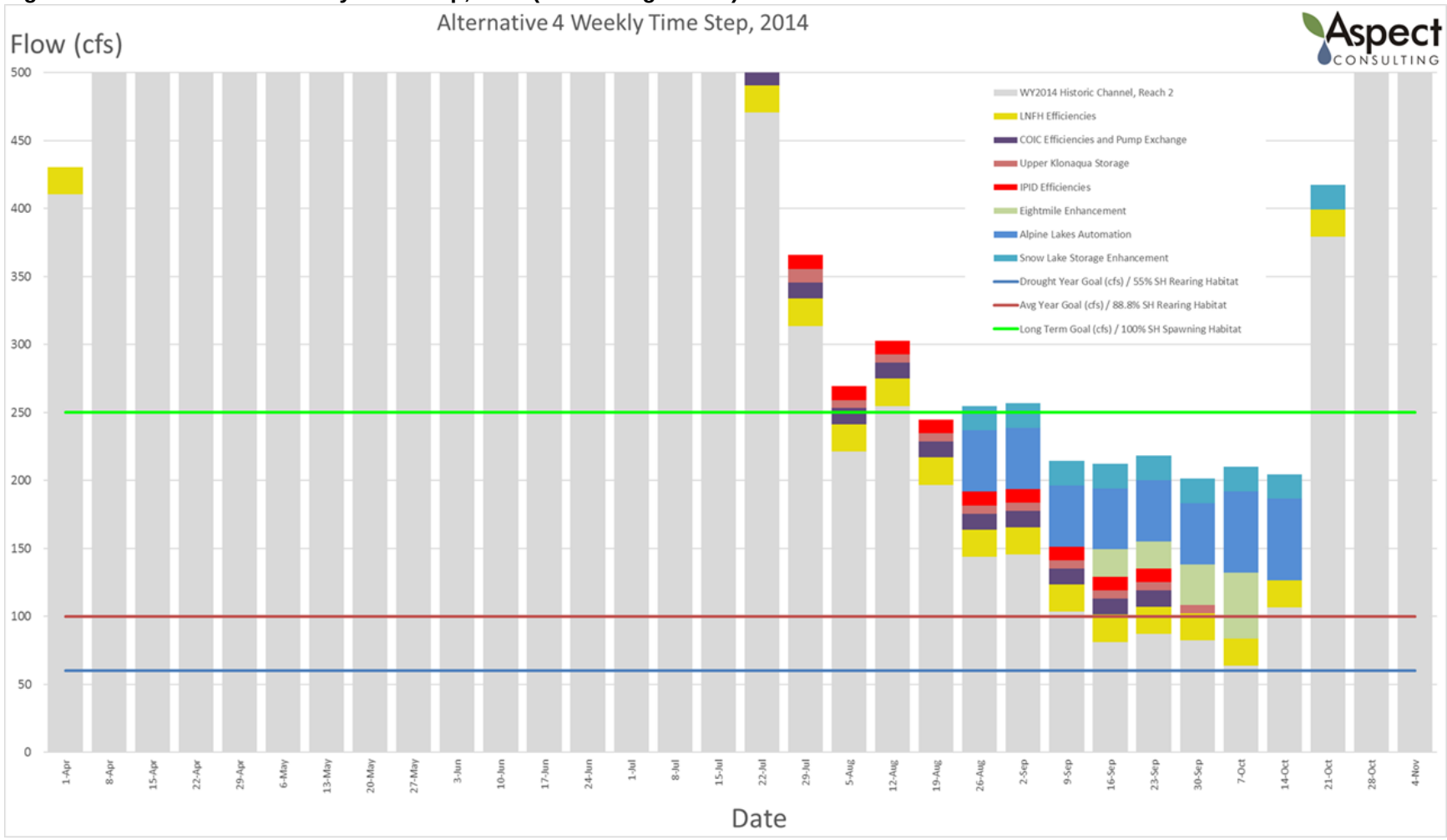
Some projects provide a constant or fixed weekly flow benefit in proportion to their savings (e.g. conservation), while others are adaptive (e.g. storage). Where adaptation was possible, greater flow benefit is achieved by targeting operation in late summer/early fall. Alpine Lakes Reservoirs Optimization, Modernization, and Automation and storage enhancement projects can be managed adaptively, and releases would be managed based on annual flow conditions.

Figure 2-18. Alternative 4 Weekly Time Step, 2015 (Drought Year)[20]



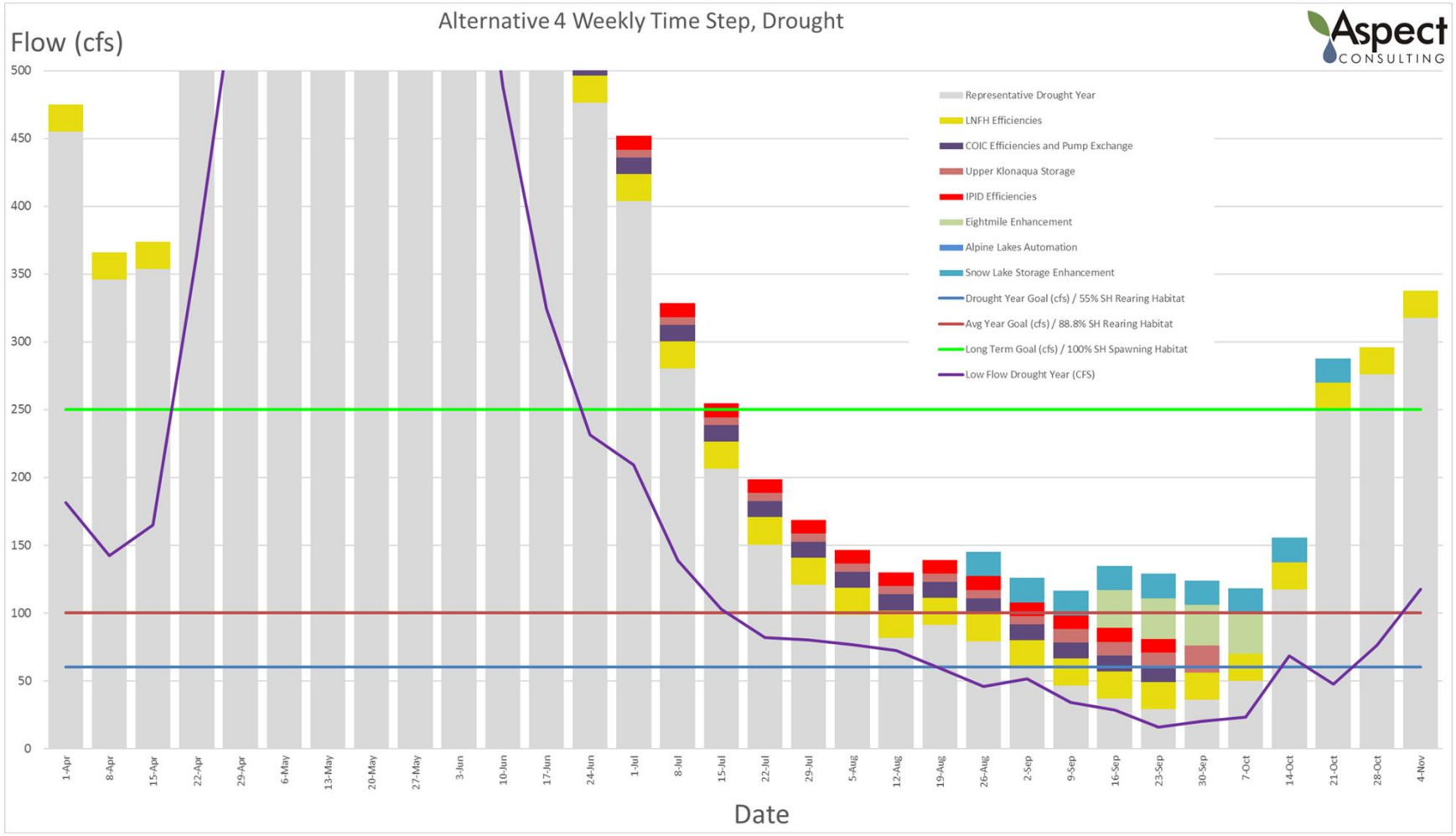
[20] Represent 2015 flows in Icicle Creek with estimated flow benefit achieved from Alternative 4 implementation.

Figure 2-19. Alternative 4 Weekly Time Step, 2014 (Non-Drought Year)[21]



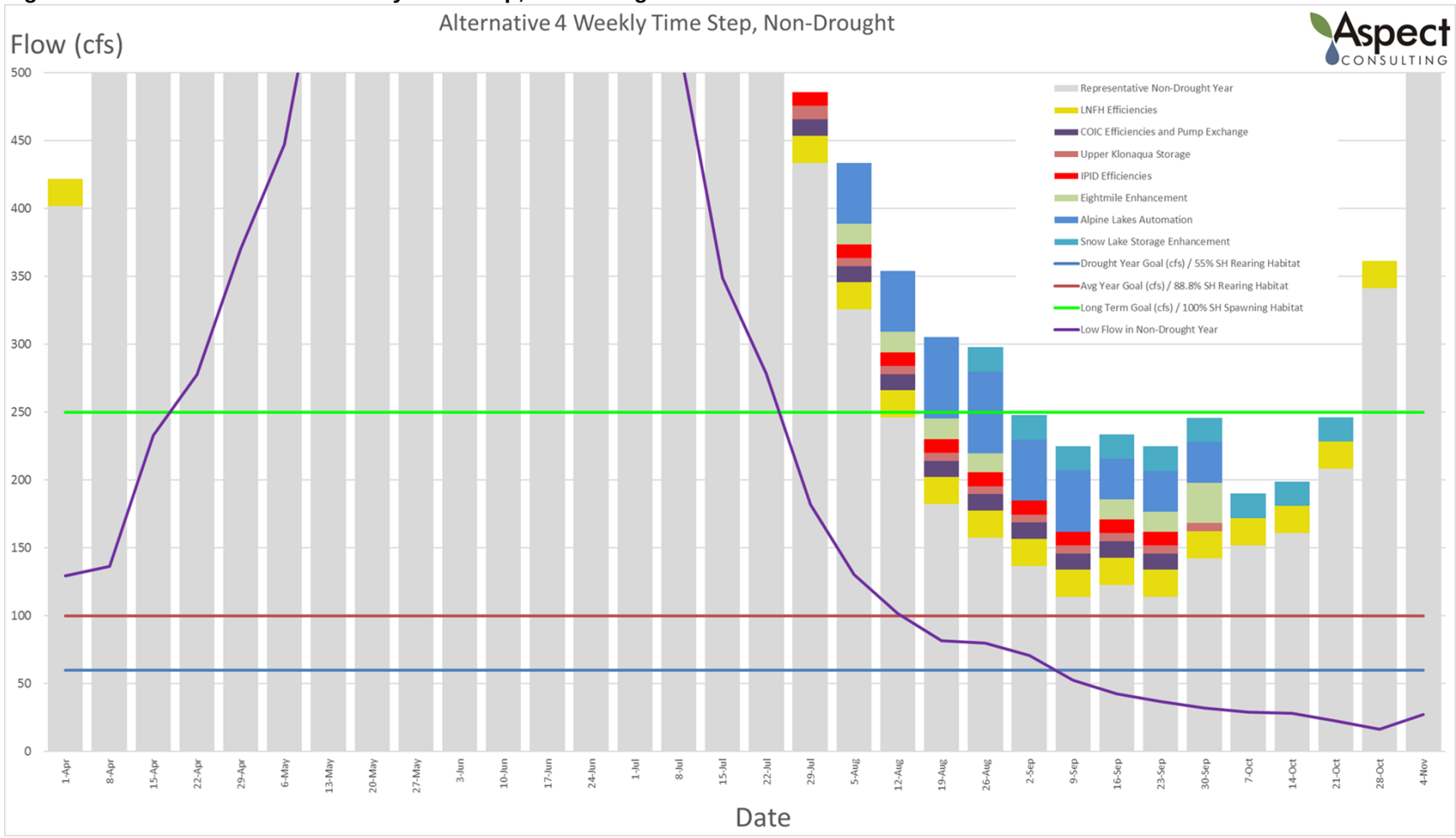
[21] Represent 2014 (46% exceedance) flows in Icicle Creek with estimated flow benefit achieved from Alternative 4 implementation.

Figure 2-20. IWG Alternative 4 Weekly Time Step, Drought/Low Water Year Scenario[22]



[22] Represents averaged dry year flows (80% exceedance) in Icicle Creek with estimated flow benefit achieved from Alternative 4 implementation.

Figure 2-21. IWG Alternative 4 Weekly Time Step, Non-Drought Scenario [23]



[23] Represent averaged flows in Icicle Creek during "non-drought" years (50% exceedance) with estimated flow benefit achieved from Alternative 4 implementation.

2.3.6 Alternative 5 Narrative Description

The IWG developed Alternative 5 in response to continued stakeholder input that suggested completely removing IPID's diversion from Icicle Creek to the Wenatchee River. As part of its irrigation comprehensive plan update, IPID completed a very cursory review of a project that would replace the IID and PID canal systems with a pressurized pipe delivery system supplied by pump stations on the Wenatchee River at three locations, referred to herein as the IPID Full Piping and Pump Exchange project. Alternative 5 includes the same projects as Alternative 1, except the IPID Irrigation Efficiencies project is replaced by the IPID Full Piping and Pump Exchange project. This alternative would not eliminate the need for operation and management of storage within the ALWA. IPID would need to continue to store and release water from reservoirs within the ALWA to ensure water was available in the Wenatchee River for their use because instream flows are insufficient on both Icicle Creek and the Wenatchee River in the summer to meet IPID out-of-stream uses without storage. Alternative 5 would provide up to 195 cfs of instream flow benefit in Icicle Creek in both drought and non-drought years.

Alternative 5 includes the following projects:

- **IPID Full Piping and Pump Exchange** would fully replace the IPID canal systems with a pressurized pipe delivery system. Three intake and pump station facilities would be constructed on the Wenatchee River to supply the new system. The existing surface water diversion facilities on Icicle Creek and Peshastin Creek would be removed. This project would increase stream flow in Icicle Creek by up to 117 cfs, improve reliability of water supply for agriculture, benefit fish passage and habitat, and maintain treaty and non-treaty harvests. (GP1; GP5)
- Alpine Lakes Optimization, Modernization, and Automation (GP1; GP5)
- COIC Irrigation Efficiencies and Pump Exchange (GP1; GP5)
- Domestic Conservation (GP4)
- Eightmile Lake Storage Restoration (GP1; GP4; GP5)
- Tribal Fishery Preservation and Management (GP2)
- Habitat Protection and Enhancement (GP6)
- Instream Flow Rule Amendment (GP4)
- Leavenworth National Fish Hatchery Conservation and Water Quality Improvements (GP1; GP2)
- Fish Passage (GP6)
- Fish Screen Compliance (GP6; GP7)
- Water Markets (GP4)

Table 2-6 shows how Alternative 5 addresses the IWG's Guiding Principles.

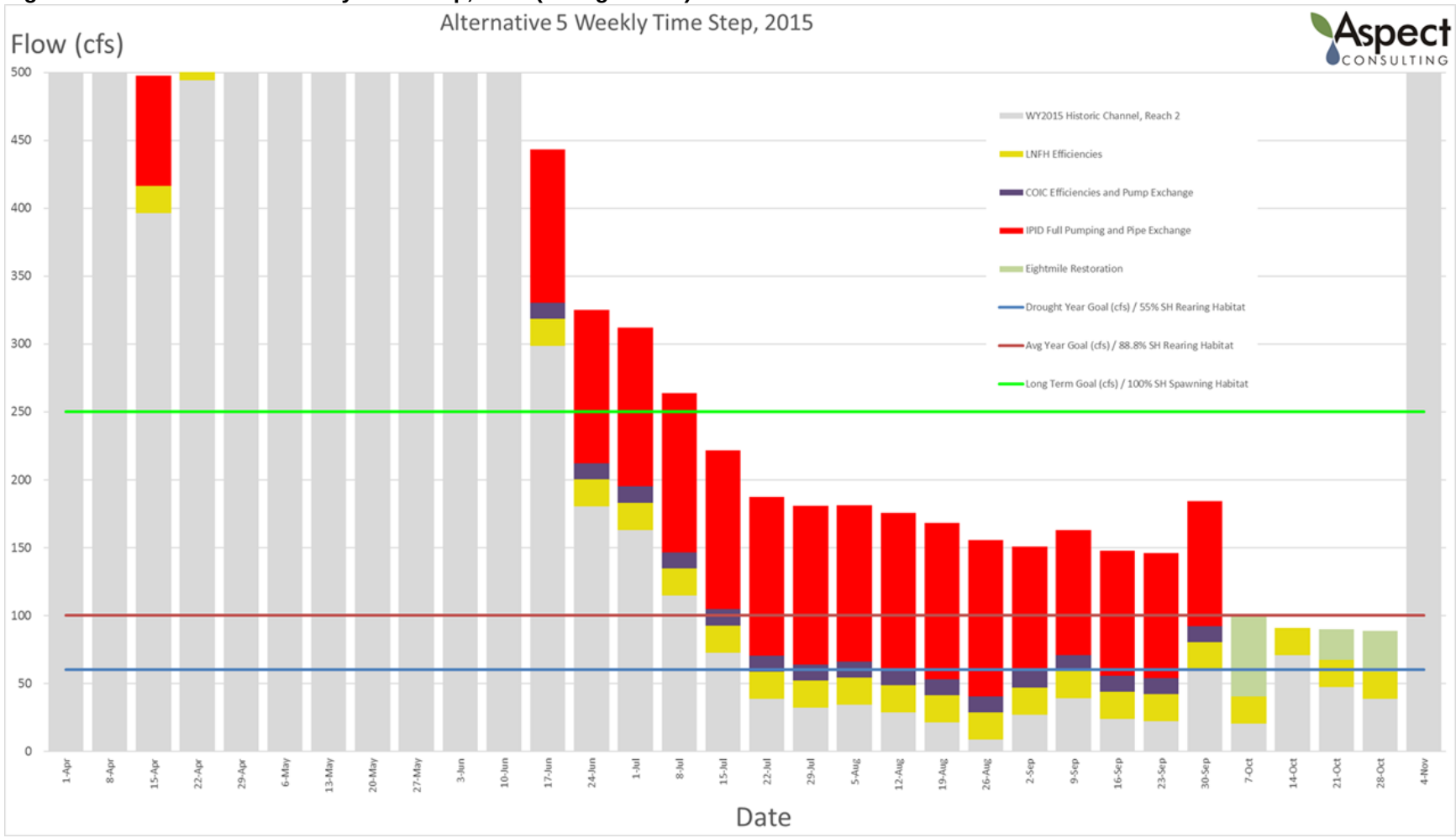
Table 2-6
How Alternative 5 Meets Guiding Principles

Guiding Principle Number	Guiding Principles	How Alternative 5 Meets the Guiding Principles
GP1	Improve Instream Flow	Meets goals of 100 cfs in average years and 60 cfs in drought years. Anticipated flow improvement is 195 cfs.
GP2	Improve Sustainability of LNFH	Meets goal of source redundancy and improved fish rearing and capacity, allowing LNFH to meet fish production goals. Also, improves water quality, and passage in Icicle Creek.
GP3	Protect Tribal and Non-Tribal Harvest	Meets goal of instream flow improvement balanced with preservation of fishery with adaptive management strategy in place, and potential amenity and access increases.
GP4	Improve Domestic Supply	Meets peak 2050 domestic demand
GP5	Improve Agricultural Reliability	Meets goal of 1,000 ac-ft for agricultural interruptible water rights.
GP6	Enhance Icicle Creek Habitat (includes fish passage and fish screens)	Meets goal of additional habitat improvement with adaptive management.
GP7	Comply with State and Federal Laws and Wilderness Acts	Meets goal by requiring project checks on all permits and an environmental review.

As shown in Table 2-6, the suite of projects proposed under Alternative 5 meets streamflow restoration goals established in the Guiding Principles. The main benefit Alternative 5 adds is much higher streamflow benefit than provided in the other alternatives, albeit at a much higher cost, which is discussed in more detail in Section 2.9. Figures 2-22, 2-23, 2-24 and 2-25 illustrate streamflow benefits in 2015, 2015, average drought, and average non-drought years for Alternative 5. These figures show that the short-term instream flow goal of 100 cfs in non-drought years and 60 cfs in drought-years would be met under both scenarios.

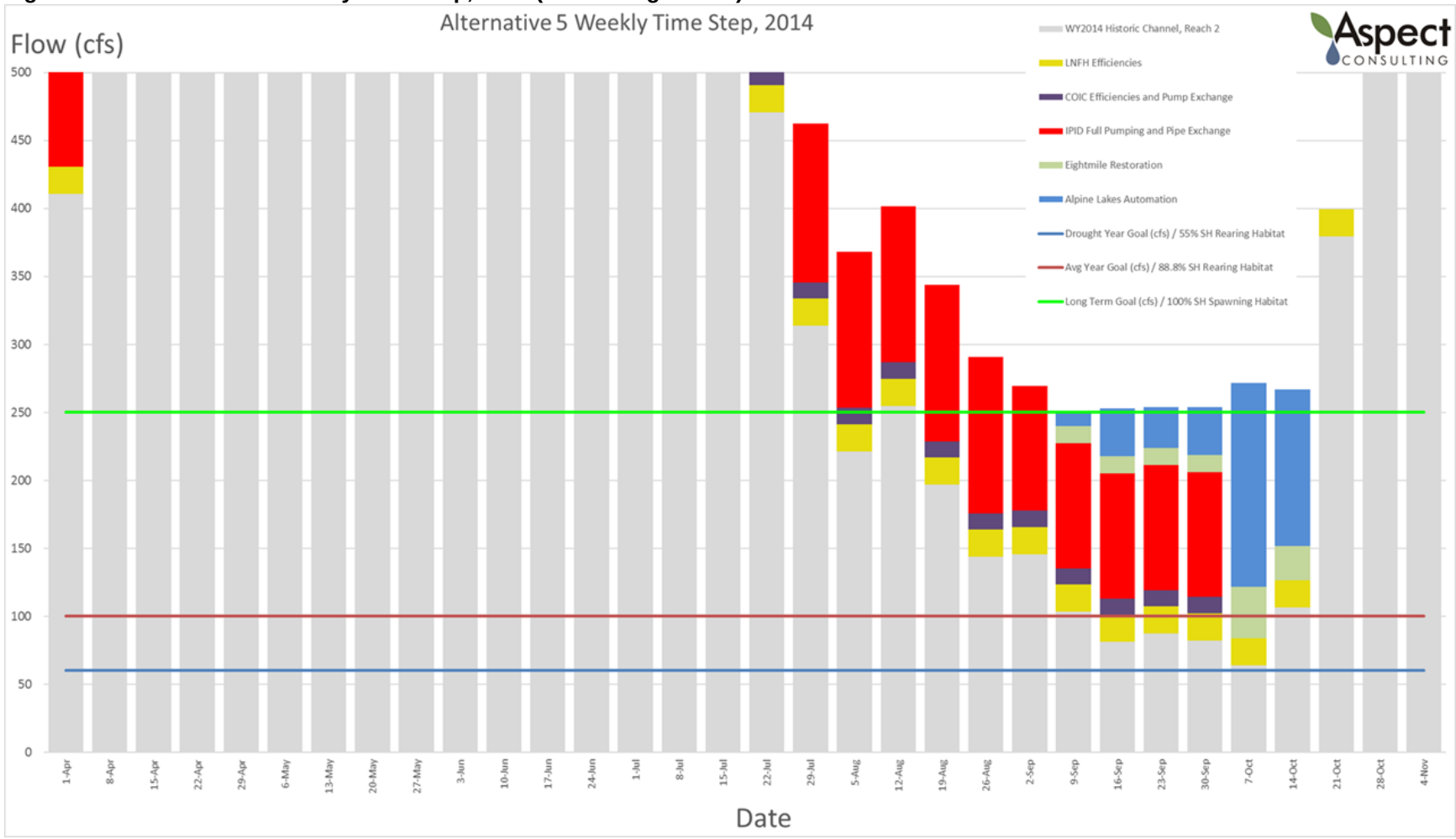
Some projects provide a constant or fixed weekly flow benefit in proportion to their savings (e.g. conservation), while others are adaptive (e.g. storage). Where adaptation was possible, greater flow benefit is achieved by targeting releases to late summer/early fall. Both Alpine Lakes Reservoirs Optimization, Modernization, and Automation and Eightmile Lake Storage Restoration can be managed adaptively, and releases would be managed based on annual flow conditions.

Figure 2-22. Alternative 5 Weekly Time Step, 2015 (Drought Year)[24]



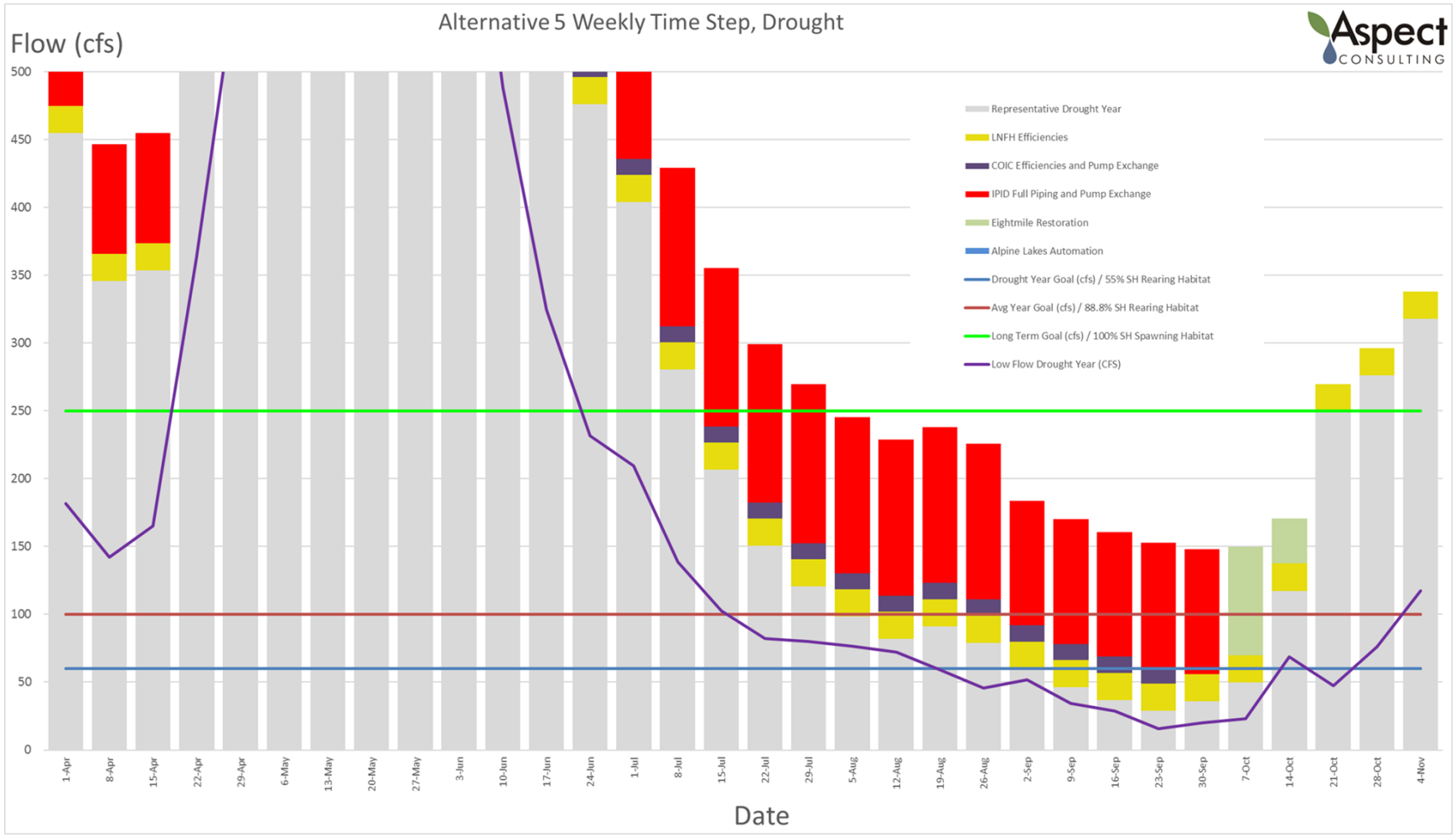
[24] Represent 2015 flows in Icicle Creek with estimated flow benefit achieved from Alternative 5 implementation.

Figure 2-23. Alternative 5 Weekly Time Step, 2014 (Non-Drought Year)[25]



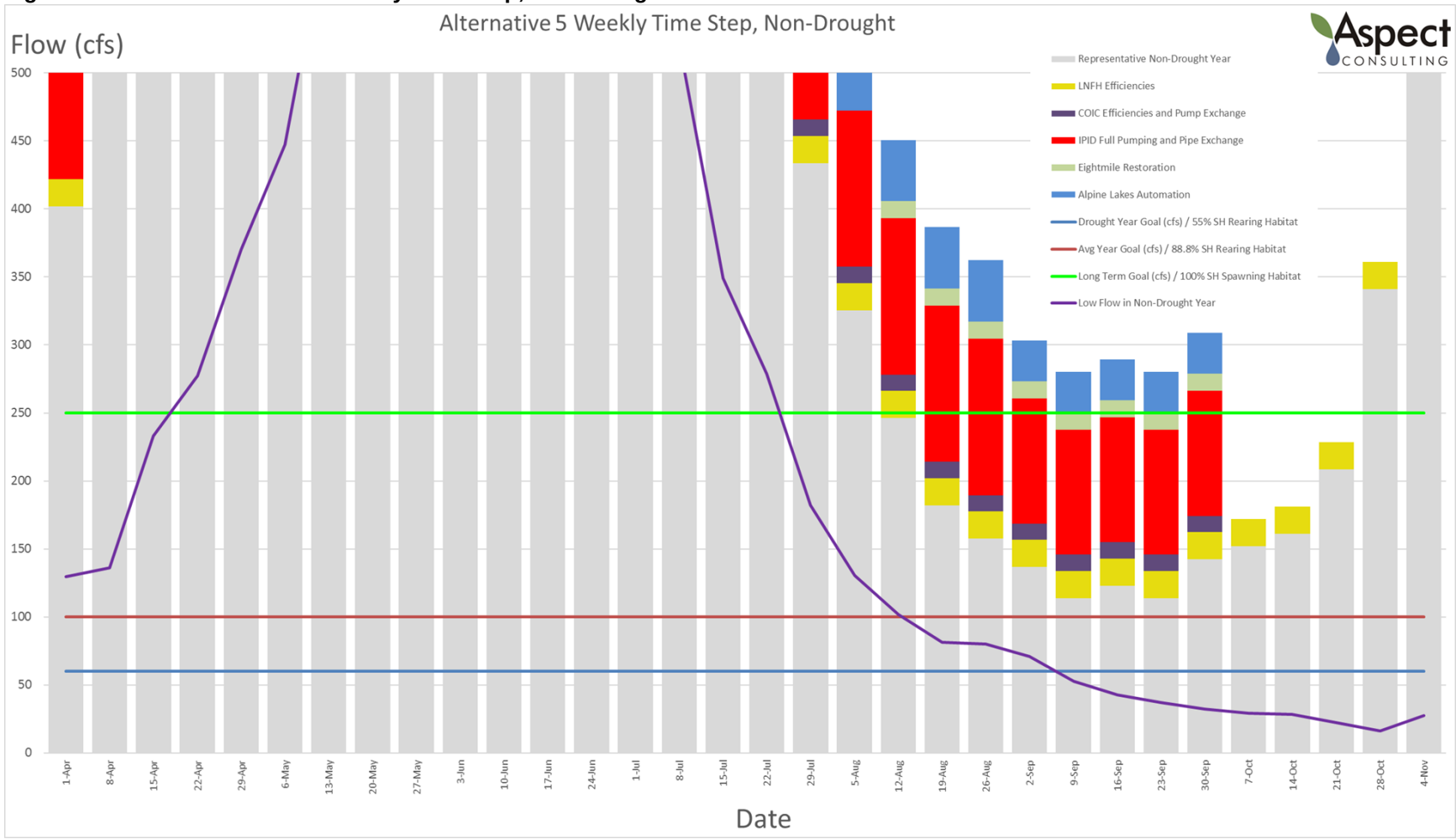
[25] Represent 2014 (46% exceedance) flows in Icicle Creek with estimated flow benefit achieved from Alternative 5 implementation.

Figure 2-24. IWG Alternative 5 Weekly Time Step, Drought/Low Water Year Scenario[26]



[26] Represents averaged dry year flows (80% exceedance) in Icicle Creek with estimated flow benefit achieved from Alternative 5 implementation.

Figure 2-25. IWG Alternative 5 Weekly Time Step, Non-Drought Scenario [27]



[27] Represent averaged flows in Icicle Creek during "non-drought" years (50% exceedance) with estimated flow benefit achieved from Alternative 5 implementation.

2.3.7 Previous Studies for Developing the Alternatives

Since the creation of the IWG, several studies have been conducted and used to develop the projects identified in the alternatives, along with those no longer under consideration.

The IWG conducted focused evaluations on key elements of the Guiding Principles. Past studies that contributed to the creation of the projects that compose the Alternatives are provided in Section 1.11 of this document.

2.4 No Action Alternative

The No-action Alternative represents the likely results expected if an integrated approach to water resource management does not continue in the Icicle Creek Subbasin. Under the No-action Alternative, projects could be developed independent of the other projects identified as part of one or more of the alternatives evaluated by this PEIS. However, there would be no coordinated, integrated effort to better manage and improve water resources in the Icicle Creek Subbasin.

The IWG's collaboration with local and state agencies addresses some of the ongoing issues affecting water flow and quality in the Icicle Creek watershed. Without the participation of the IWG and a coordinated effort to implement projects developed as part of the Icicle Strategy, these partnerships would be weakened, and any enhancements developed by the efforts of a single entity may not be as effective as if they were implemented and managed with multiple projects in an adaptive and coordinated manner with stakeholder input. The No-action Alternative has the potential to further complicate the following issues or leave them unresolved.

Instream Flows Goal Will Not Be Met: Under the No-action Alternative, the instream flow goals of 100 cfs during non-drought years, and 60 cfs during drought years would not be met and there would be no coordinated effort to achieve these goals. While some projects that provide instream flow benefit would likely continue toward implementation, most of the projects would not be developed with instream flow benefit as a primary goal. Projects would likely focus on other beneficial purposes, like water supply reliability, or may be marketed to out-of-stream or out of basin uses. The maximum anticipated instream flow increase under the No-action Alternative is estimated to be 31.9 cfs, based primarily on the assumption that LNFH and COIC projects would move forward and provide instream flow improvements.

Resumption of Leavenworth v. Ecology: The City of Leavenworth filed a declaratory judgement action in Chelan County Superior Court seeking a determination of the maximum annual quantity of surface water diversion from Icicle Creek. The City of Leavenworth claims their surface water certificate states their diversion should be 1,085

acre-feet per year. Ecology maintains that the City of Leavenworth agreed to a limit of 275 acre-feet per year based on a prior settlement. The Court ruled partially in favor of Ecology in 2012, and the City of Leavenworth appealed. This case is currently on hold while the City of Leavenworth and Ecology try to resolve this issue through the IWG. The IWG's Guiding Principles address the City of Leavenworth and surrounding area's domestic supply concerns and calls for 2,300 to 4,100 acre-feet of reliable year-round supply. Under the No-action Alternative, projects designed to improve domestic supply, mainly Eightmile Lake Storage Restoration or Legislative Changes to OCPI, would likely not be implemented or would be implemented without providing benefit for domestic supply. Without the projects that would increase domestic water supply, the City's diversion amount will remain in contention.[28]

Losing benefit from IPID participation: IWG member IPID manages water storage and releases from Klonaqua, Square, Colchuck, and Eightmile Lakes, and has shared storage in the Snow Lake system (Upper and Lower Snow Lake, and Nada Lake). Several of the projects proposed in the Alternatives include optimization and storage restoration or enhancement efforts on these lakes to increase instream flow benefits for the entire watershed. If these projects are implemented independent of the Icicle Strategy, there is not a guarantee that IPID would manage lake releases for instream flow enhancement. Additionally, the IWG will not have the opportunity to influence the design or aesthetics of any future updates or improvements that IPID may make to its dams and outlet facilities at these Alpine Lakes.

LNFH loses State partnership: The LNFH is actively collaborating with Ecology and WDFW as part of the Icicle Strategy to assess hatchery operations and look for ways to improve and enhance the infrastructure to make it more sustainable, increase instream flow, improve water quality, and benefit fish health and habitat. Synergy will be lost in this process if the collaboration ends and projects are not addressed under the Icicle Strategy. Implementing the Guiding Principles as part of this strategy also has the potential to resolve issues around water quality and quantity that have been the cause of past and ongoing litigation for the LNFH. Although the litigants of past and ongoing court cases involving the LNFH are not active participants in the IWG, improved hatchery operations, improved instream flow in the historical channel, screen compliance, and improved habitat are all litigation issues that would likely persist to a greater extent (or on a slower pathway to compliance) under the No-action Alternative. However, even if the benefits of the IWG partnership are lost, LNFH is still responsible for implementing projects agreed to in the Biological Opinion, which is described in Section 1.5.2, and improvements at LNFH are still expected to occur under the No-action Alternative.

Restricted long-term growth in the City of Leavenworth and Icicle Subbasin: One of the IWG's priorities is to meet current and future domestic water supplies for the City of

[28] http://www.ecy.wa.gov/programs/wr/cwp/images/pdf/LeavenworthvEcology.pdf

Leavenworth and surrounding basin through 2050. Without a sustainable plan for addressing growth in the City of Leavenworth and rural Chelan County, there is no guarantee that the water supply will keep up with demand as the population rises. Past water planning efforts were focused on near-term growth. Without an integrated strategy, projects aimed at increasing domestic supplies would likely not be implemented or would be implanted to a lesser extent, and water resource planning needed to address long-term growth would be less coordinated and not as effective at meeting future water supply needs.

Reduced or delayed improvement to agricultural reliability: Several of the projects proposed by the IWG have an added benefit of improving agricultural reliability. If the Icicle Strategy does not move forward, it is unlikely the Water Markets Project would be implemented. The 56 interruptible water users in the basin would continue to face hardship when low streamflows prevent them from irrigating. IPID and COIC may see improvements to their water supply and delivery system reliability if improvements to those systems are implemented independent of a coordinated Icicle Strategy, but it is anticipated that these improvements would proceed at a slower pace.

Possible fish screening process delays: The Icicle Strategy includes upgrading fish screens at major surface water diversions along Icicle Creek to comply with current fish passage requirements. The City of Leavenworth, IPID, and LNFH/COIC have diversions that are in need of screen upgrades. These upgrades would likely need to happen whether any other projects presented in the IWG's alternatives are implemented as a comprehensive Icicle Strategy or not. Under the partnership of the IWG, these entities and others have an established connection to WDFW to assist in screen design, and a means to find funding that would help offset costs associated with new screens. Without the IWG and a coordinated Icicle Strategy, each entity would have to go through the fish screen design and implementation process independently, creating the potential for a more expensive and lengthy implementation process.

This No-action Alternative is presented as a means of comparing the impacts of the Icicle Strategy to those of continuing on without an integrated strategy and the benefits of the IWG partnership.

Short- and long-term effects of the No-action Alternative are presented in Chapter 4.

2.5 Alternative 1 (Preferred Alternative)

This section provides a project-by-project summary of the elements of the Alternative 1 with references to previous planning documents and studies where greater detail can be found.

2.5.1 Alpine Lakes Optimization, Modernization and Automation

This project is designed to change operations at existing dams to make water available for instream flow and more reliable for irrigation district users. The project would increase the frequency of lake draw down, but minimum reservoir water levels would remain the same. In non-drought years, this project would provide 30 cfs and 5,465 acre-feet for instream flow benefit. The following section describes the project background and implementation in greater detail.

IPID and USFWS operate seven alpine lakes in the Icicle Creek Subbasin to augment water supply for irrigation and fish propagation. IPID operates Klonaqua, Square, Eightmile, and Colchuck Lakes, and the USFWS manages Upper and Lower Snow Lakes and Nada Lake. The reservoirs are all enhanced natural lakes with small dams and other control infrastructure at their outlets. These dams and associated infrastructure, such as control gates or valves and low-level outlet pipes or tunnels, were installed in the 1920's though 1940's, allowing IPID and the USFWS to capture and store additional runoff during the winter and spring for release during the late summer low-flow period. Flows released from Square, Klonaqua, Eightmile, and Colchuck Lakes allow IPID to maintain irrigation diversions during the late summer low-flow period on Icicle Creek. Flows released from the Snow Lakes and Nada Lake supply water to LNFH and allow the USFWS to meet instream flow obligations. Nada Lake and Upper and Lower Snow Lakes are operated primarily for water supply to LNFH and to maintain instream flows. IPID also has storage rights in Upper and Lower Snow Lakes for irrigation. Storage and release of water from the Alpine Lakes are authorized by state-issued water rights. Table 2-7 provides a summary of the water rights for IPID and USFWS.

Table 2-7
IPID and USFWS/USBR Storage and Diversion Rights, Icicle Creek Subbasin

Water Source	Certificate Number	Certificate Holder	Priority Date	Cert Qi (cfs)	Cert Qa (afy)	Adj Qi (cfs)	Adj Qa (afy)
Icicle & Snow Creek	S4-35002JC	IID	1910 (Class 2)	1.7525	---	83.33	---
Icicle & Snow Creek	S4-*35002ABBJ	IID/PID	1910 (Class 2)	81.577	---	83.33	---
Icicle Creek	1082	PID	1919 (Class 5)	34.38	---	34.38	---
Icicle Creek	1824	USBR	1942	42	---	---	2,500
Klonaqua Lake	1227	IID	1926 (Class 5)	25	---	25	2,500
Eightmile Lake	1228	IID	1926 (Class 5)	25	---	50	2,500
Colchuck Lake	1229	IID	1926	50	---	NA	NA
Square Lake	5527	IID	1926	10	2,000	NA	NA
Snow Lake	1591	IID	1926	25	---	NA	NA
Snow Lake	1592	IID	1926	---	1,000	NA	NA
Snow Lake	1825	USBR	1942	---	16,000	NA	NA

Notes:
Cert – quantities documented on the certificate
Adj – additional information contained in the adjudication record
Qi – instantaneous quantity
Qa – annual quantity
cfs – cubic feet per second
afy – acre feet per year
IID – Icicle Irrigation District
PID – Peshastin irrigation District
USBR – United States Bureau of Reclamation
--- none listed
NA – not applicable, these rights were not subject to the 1927 adjudication
[1] Right confirmed for 83.33 cfs through adjudication. The right was subsequently split and a change to place of use was completed for 1.7525 cfs
[2] Documented total storage constructed at Snow Lake is 12,000 acre-feet, shared by USFWS and IPID. Under a separate agreement, IPID is entitled to 750 acre-feet of the Snow Lake storage

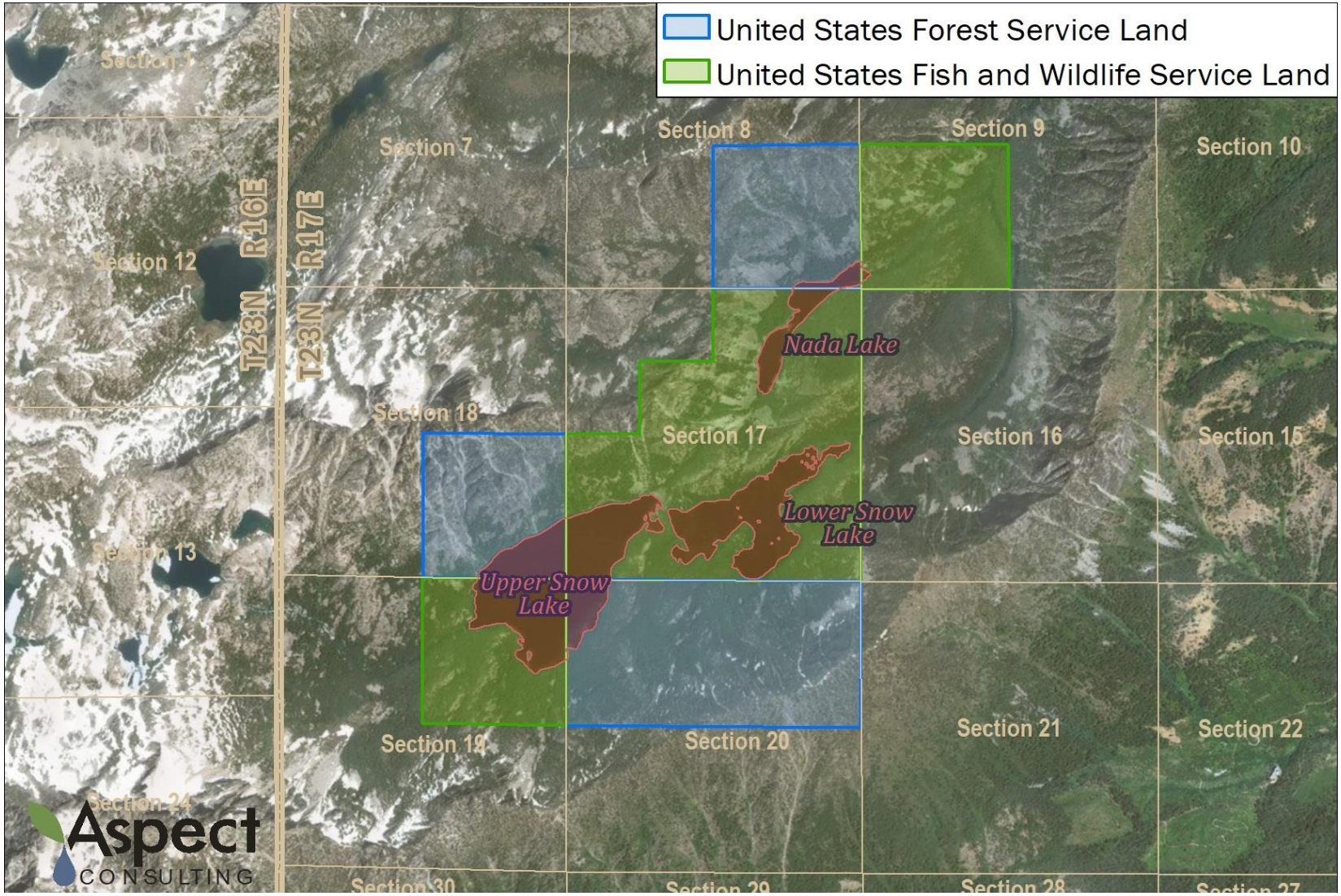
These storage water rights and dams were developed many decades prior to the establishment of the ALWA in 1974. IPID held deed to lands associated with Eightmile, Colchuck, and Klonaqua Lakes. The USFS identified these lands for acquisition shortly after the establishment of the wilderness area. IPID and USFS entered into a land exchange agreement in 1986, which culminated with transferring the properties to USFS in 1990. As part of that exchange, IPID received the following easement, which pertains to Eightmile, Klonaqua and Colchuck Lakes:

> "a nonexclusive, perpetual easement across, through, along, and upon the property described herein for the purposes of maintenance, repair, operation, modification, upgrading and replacement of all facilities presently located in or upon the property described herein, together with a nonexclusive right of ingress to and egress from all such facilities for all such purposes, in accordance with Rules and Regulations of the Secretary of Agriculture, 36 CFR 251.17 and 251.18, attached hereto and made a part hereof, in such manner as not unreasonably to interfere with its use by the United States, its authorized users or assigns, or cause substantial injury thereto.
>
> The Grantor [IPID] may exercise the rights hereunder by any means reasonable for the purposes described, including but not limited to the use of motorized transportation and equipment, or aircraft. These rights include the right to regulate water level of all facilities located upon the property described herein. In performing maintenance, repair, operation, modification, upgrading, and replacement of facilities located in or upon the property described herein, the Grantor will not without prior written consent of the Forest Service, which consent shall not unreasonably be withheld, materially increase the size or scope of the facilities."

Additionally, the USFS issued agriculture irrigation and livestock watering easements for Square Lake and those portions of Colchuck Lake that were not covered by the easement described above. These easements grant IPID the right to operate and maintain their water facilities with consultation and concurrence from the USFS. Before the issuance of these easements, Square Lake was operated under a special use permit, after it was determined Square Lake was not under the jurisdiction of Washington State DNR because of navigability criteria. IPID easements and an easement map are available in Appendix F.

The USFWS maintains ownership of the lakes they operate (Upper Snow, Lower Snow, and Nada Lakes). In 1939, USBR acquired portions of Section 17 and 19, Township 23 North, Range 17 East W.M., adjacent to Snow and Nada Lakes. In 1930, IPID acquired an easement from the State of Washington to overflow the bed and shores of Snow Lake. That easement was transferred to USBR in 1941, and then to USFWS in 1949. Ownership of these properties were never transferred to the USFS. However, the USFS owns lands adjacent to the shoreline of Upper and Lower Snow Lakes located in Section 18 and 20 of Township 23 N, Range 17 East W.M. Figure 2-26 shows USFWS lands in green and USFS lands in blue.

Figure 2-26. Ownership of Lands Adjacent to Upper and Lower Snow Lakes and Nada Lake



Source: Provided by USFWS

The Alpine Lakes Optimization, Modernization, and Automation project would improve instream flows and provide reliable irrigation water supply by automating releases and allowing for more frequent, optimized releases from the lakes than historical operations. Water released from the Alpine Lakes would enhance instream flows in tributaries to Icicle Creek, Icicle Creek itself, and the Wenatchee River to the confluence with the Columbia River.

Currently, gates or valves on reservoir outlets are operated manually to release stored water and are accessed by hiking in or by helicopter. Therefore, the gate or valve openings are set infrequently, and reservoir releases are not optimized to meet water demands. For example, all the lakes currently operate by gravity and flow release volumes change as the lake level drops. If IPID requires an additional 10 cfs from a lake in July, they may set the initial release to 15 cfs, and by the time they return to re-adjust it, it may have diminished to 5 cfs. Initially, that extra water is surplus to IPID's need, and as the lake draws down, IPID's needs are under-supplied.

In non-drought water years, one lake is typically drawn down by IPID on a rotational basis for maintenance purposes, with each lake being drawn down approximately once every three to five years. Maintenance activities include clearing debris (e.g., logs, rocks) from inlet and outlet pipes, burning encroaching brush, exercising and inspecting valves and gates, repairing dam surfaces from erosion or spalling, and other activities. In drought years, all lakes are drawn down to supplement IPID's irrigation supply. Depending on the severity of the drought, IPID may augment its supplies from a combination of some or all of the five lakes in which it has water rights.

The current infrastructure can be seen in Figures 2-27 through 2-33. Proposed changes are illustrated in Figure 2-34 and discussed in detail later in this section.

Figure 2-27. Automation Impacts – Eightmile Lake

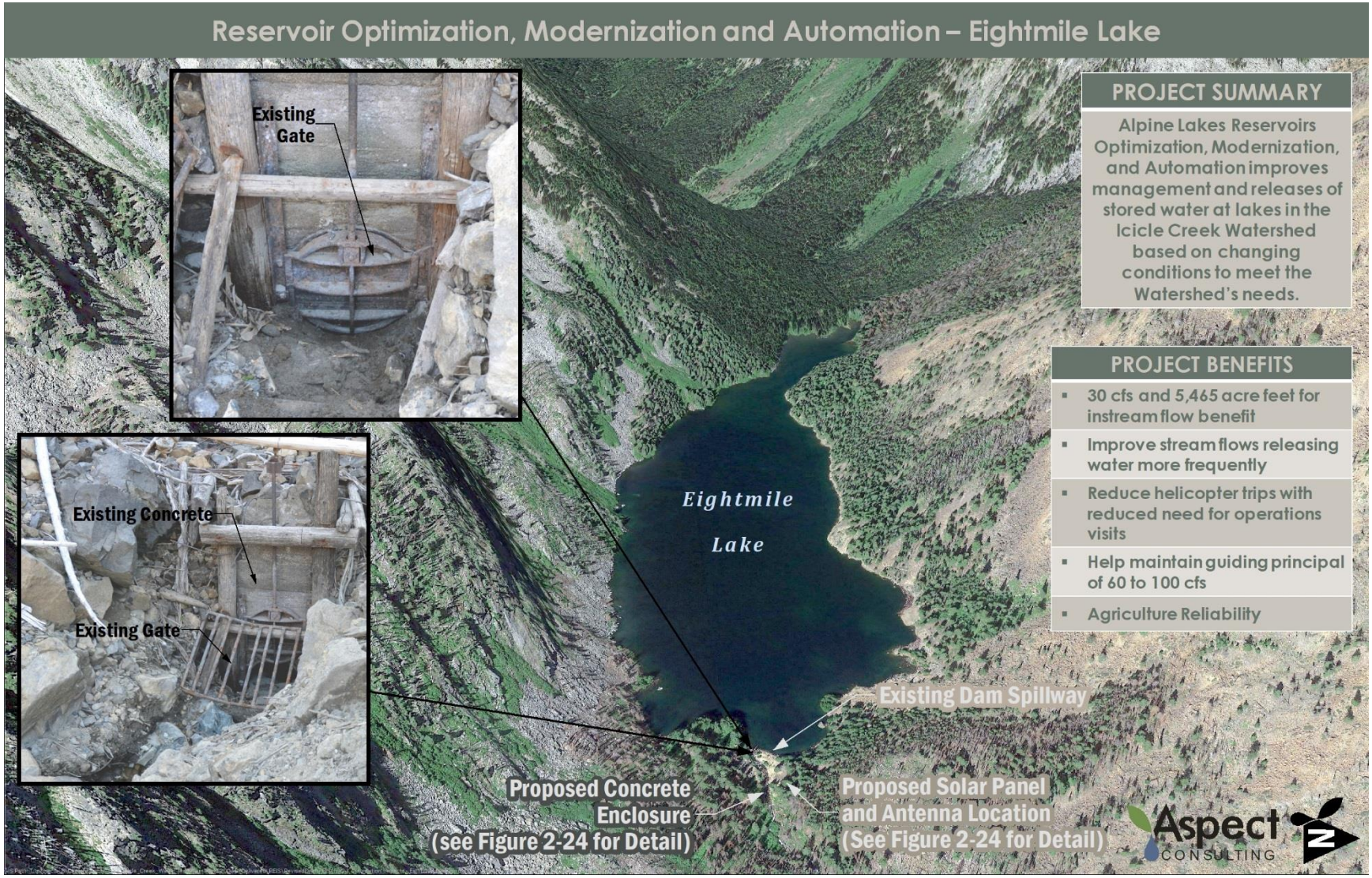


Figure 2-28. Current Alpine Lakes Infrastructure, Eightmile Dam (2015)

Figure 2-29. Automation Impacts – Klonaqua Lake

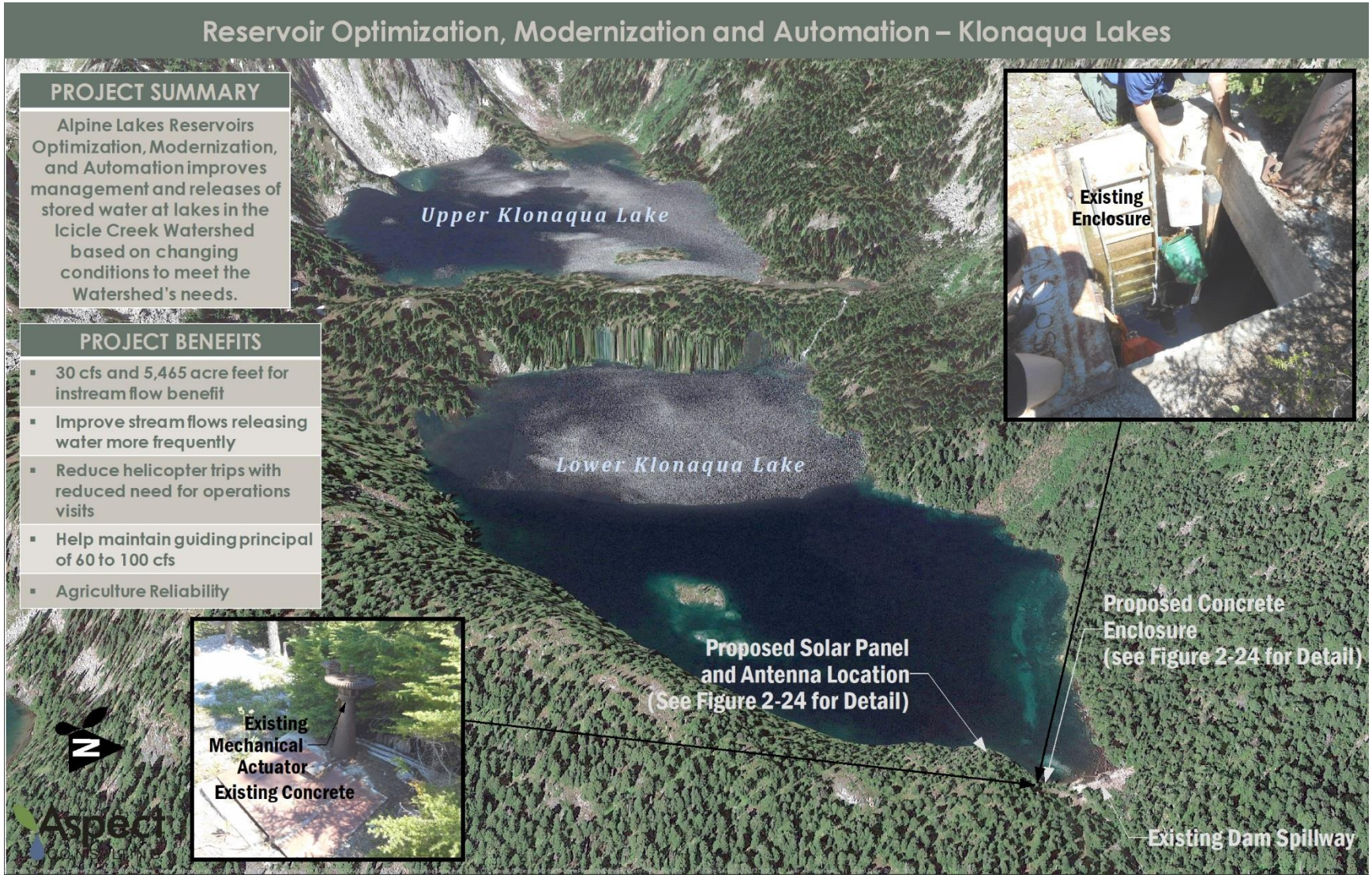


Figure 2-30. Automation Impacts – Colchuck Lake

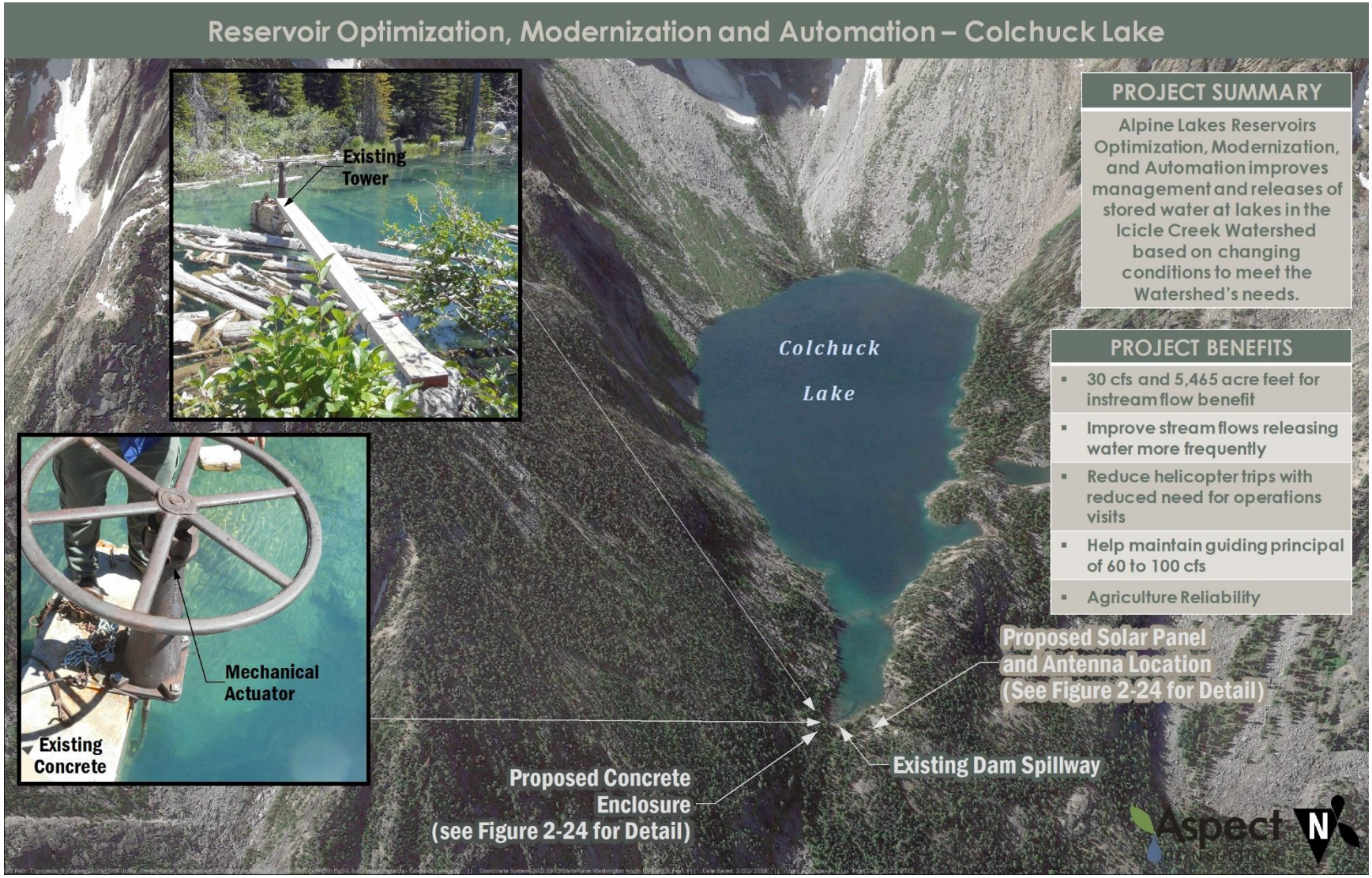


Figure 2-31. Automation Impacts – Square Lake

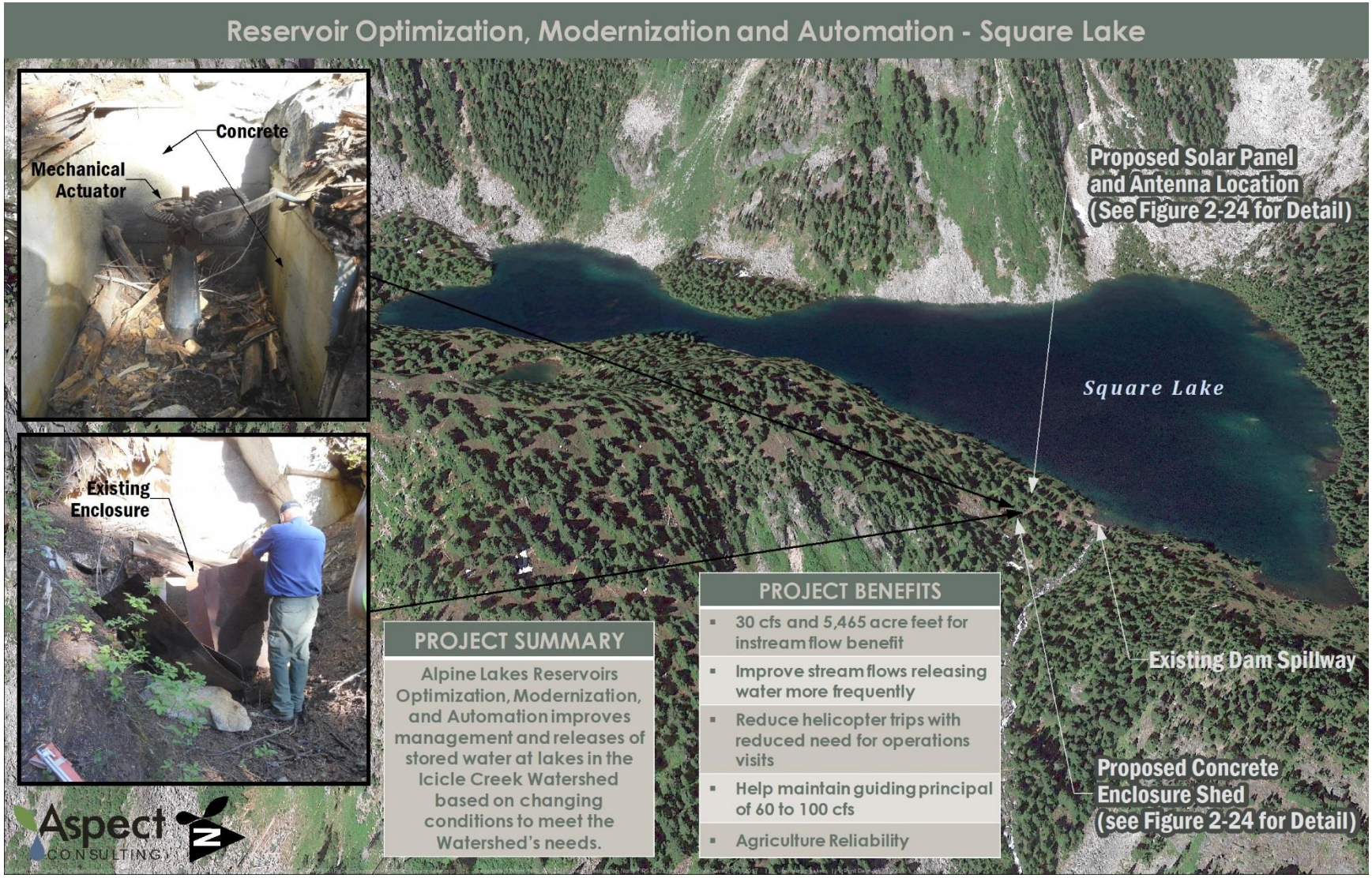


Figure 2–32. Current Alpine Lakes Infrastructure, Square Lake Dam

Under the proposed project, instead of lakes augmenting water supply on a rotational basis (one per year), all lakes would be drawn down to normal low-pool elevations annually, thus creating additional instream flow benefits. Operational lake levels would not be altered under this project. Flow in Icicle Creek near LNFH would be monitored, and before flows drop below a Guiding Principle target (e.g., 60 cfs or 100 cfs depending on water year), water from the lakes would be released to maintain the target flow.

Existing control gates and valves would be upgraded or replaced to allow for automated control rather than hiking or flying into the lakes to operate them. Basic monitoring equipment would be installed (e.g., lake level monitoring, outlet flow release monitoring). Telemetry systems would also be installed to allow for remote monitoring and operation.[29] Figure 2-34 provides an example of what this telemetry and monitoring equipment might look like based on current operations by LNFH at Nada Dam. Where warranted, the gate or valve at the lake outlet would be replaced. The control gate or valve at each lake would be retrofitted with a motorized actuator that would operate the gate or valve automatically. A solar panel and batteries would be installed to power the actuator. An antennae and other telemetry equipment would also be installed to allow for remote communication and control of the actuator by IPID or USFWS. Some provision to winterize the equipment would also be made. This project would use radio repeaters located on either Wedge Mountain or Icicle Ridge, both of which are outside the Wilderness Area.

[29] Taken from: http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA%20Open%20House/Handouts/AlpineLakes_final_reduced.pdf

Figure 2-33. Automation Impacts – Snow Lakes

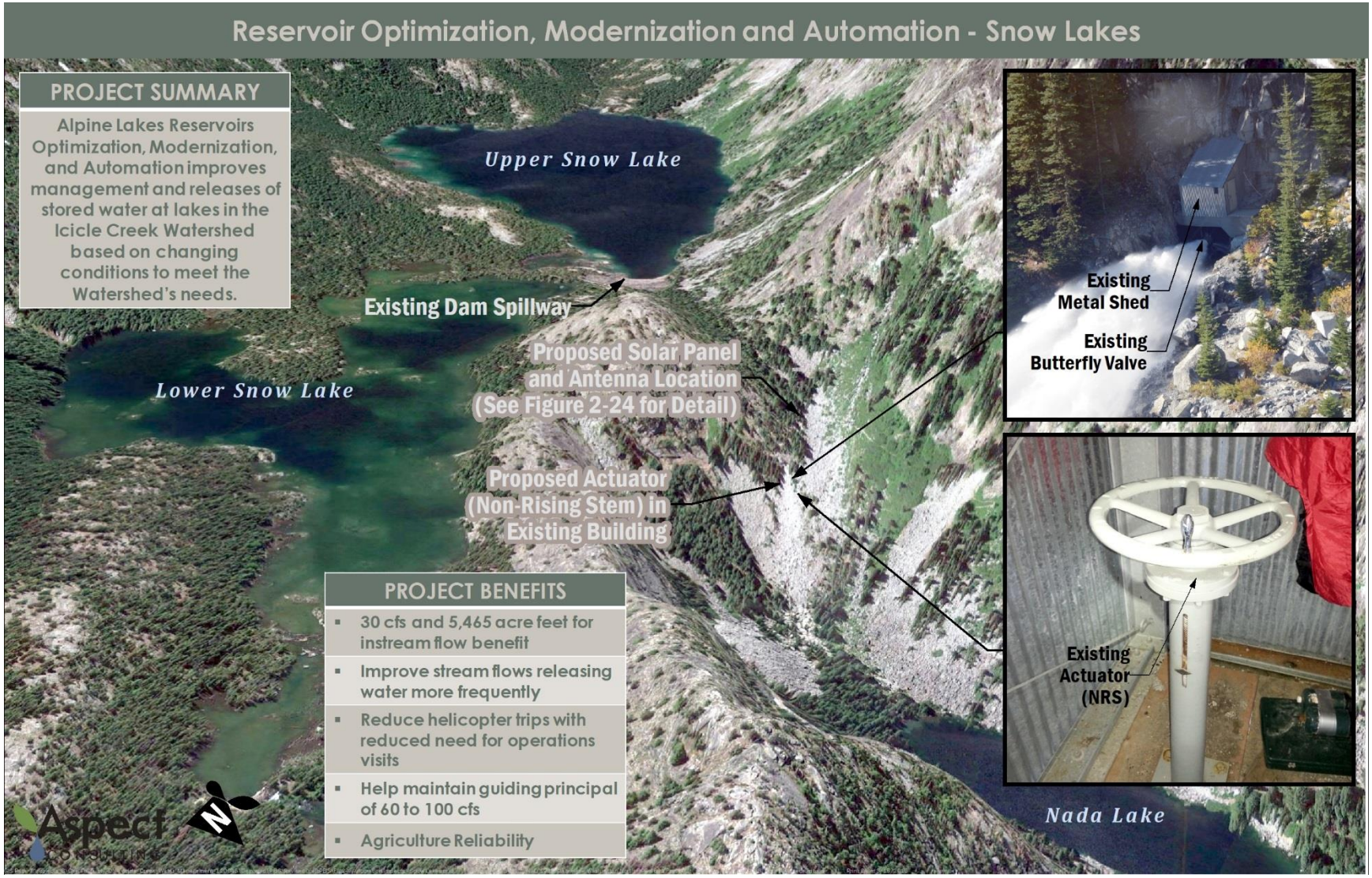
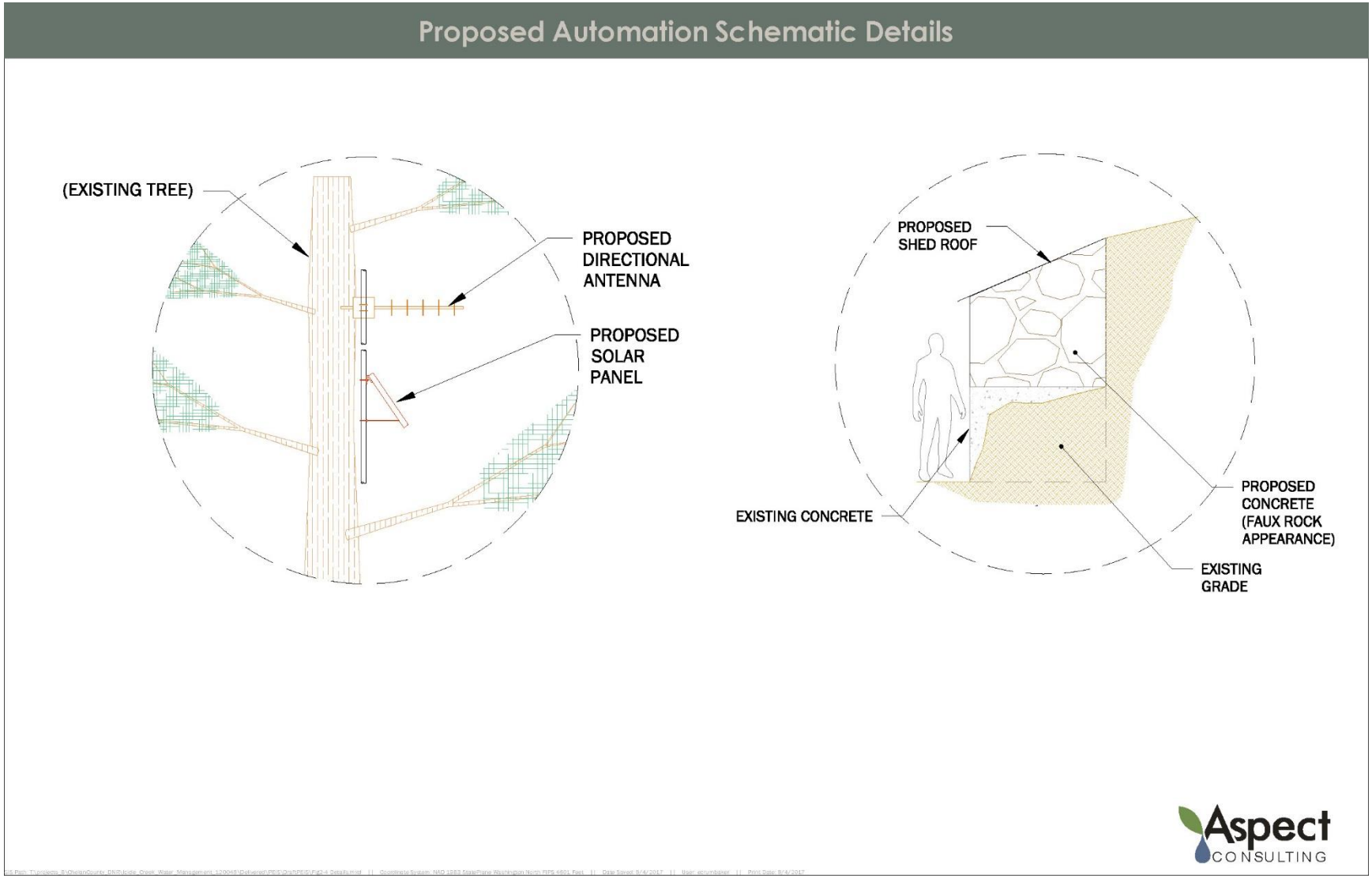


Figure 2-34. Proposed Automation Schematic Details



The IWG previously evaluated whether these releases would adversely affect future IPID supplies under drought and climate change scenarios. IPID was initially concerned that if it released water from all the lakes, and if the following year was a drought year, then its supplies in the next water year would be diminished. Based on the appraisal study, an additional 5,465 acre-feet would be available for release into Icicle Creek for instream flow benefit with 100 percent refill reliability in Colchuck, Eightmile, Klonaqua, and Square Lakes. The usable storage volume would not increase, but the amount released during a typical year would increase (e.g., future normal years would mimic historical IPID drought year operations). The estimated instream flow benefits of 5,465 acre-feet could be managed as 30 cfs over 92 days, or some different combination of rate and time depending on the type of water year and when the fish needed the water. Under this project, Nada and Snow Lakes refill reliability would drop from 97 percent to 93 percent, for a slightly increased risk in future drought years.

The estimated project costs for study and construction are $784,519 (Aspect, 2015), and updated to 2018 dollars using the RS Means Historical Cost Index. The estimated cost per acre-foot is $144.

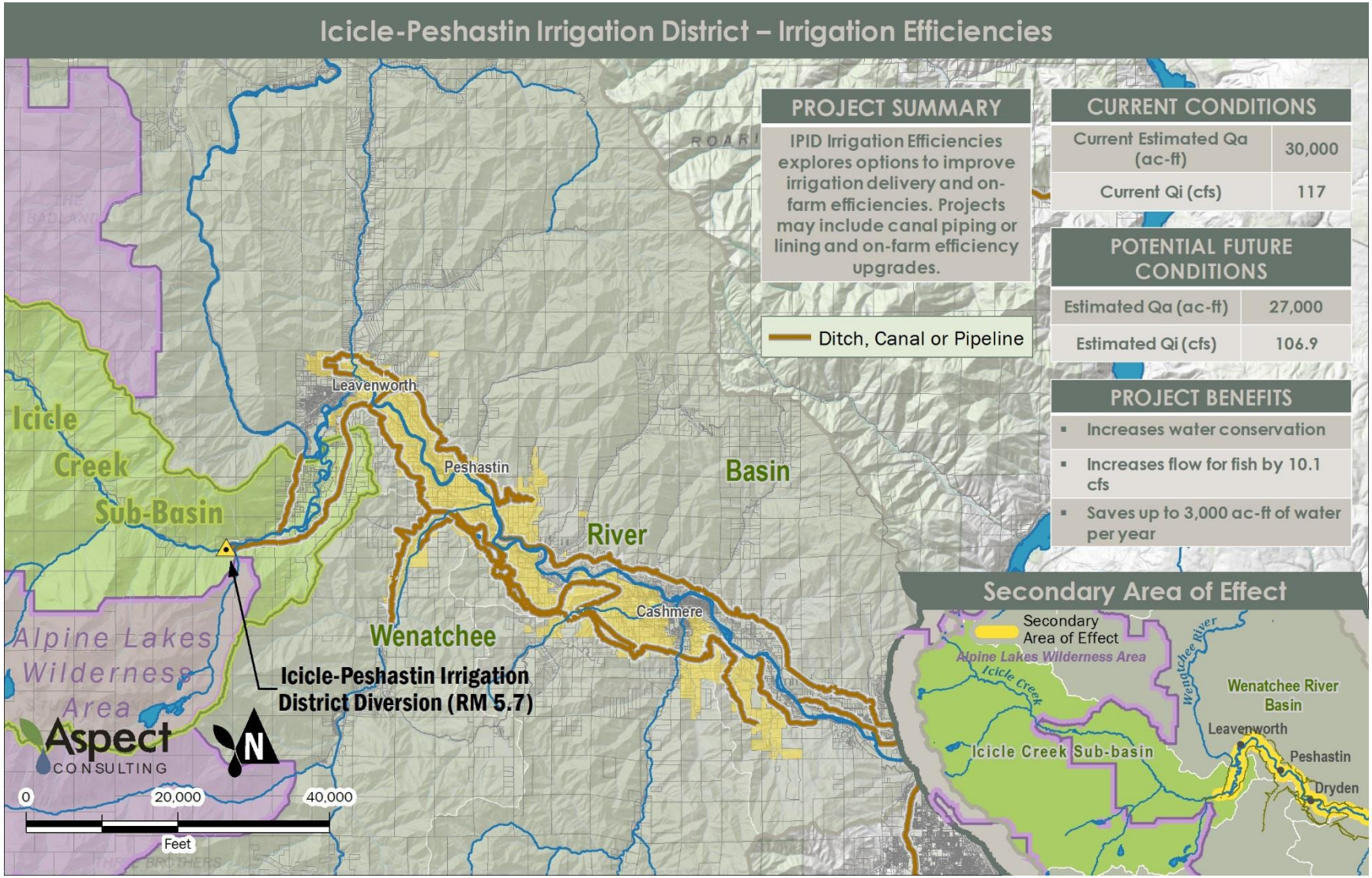
More specific details about this project are available in the *Alpine Lake Optimization and Automation Appraisal* (Automation Appraisal Study) (Aspect, 2015) and the *Icicle Creek Flow Augmentation Pilot Study and Alpine Lakes Automation Feasibility Study* (Flow Augmentation and Automation Feasibility), (Aspect, 2017), and the Alpine Lakes Optimization and Automation Feasibility Study (Appendix D).

2.5.2 IPID Irrigation Efficiencies Project

The IPID Irrigation Efficiencies Project includes traditional irrigation efficiency upgrades, such as canal lining or piping of irrigation ditches. The IWG anticipates that 10 percent water savings or 10.1 cfs (3,000 acre-feet annually) could be achieved from implementing efficiency upgrades that will be identified in the IPID Comprehensive Water Conservation Plan. Comprehensive Water Conservation Plans were prepared for Icicle and Peshastin Irrigation Districts in 1993 (Klohn Leonoff, Inc. 1993). An integrated update to both district's plans, known as the IPID Comprehensive Water Conservation Plan, was completed in 2018 and provides specific conservation options (Anchor QEA, 2018).

IPID provides irrigation to 8,065 acres in the Wenatchee Basin. Of this acreage served, approximately 80 to 90 percent is in orchard, less than 5 percent is rotational crops or hay, and approximately 5 to 10 percent provides outdoor irrigation water for residential land (Aspect, Icicle Conservation Summary, 2014). IPID's system is a gravity fed canal with points of diversion located on Icicle Creek at RM 5.7 and on Peshastin Creek. A large portion of the canal is lined or piped, although there are several partially lined or unlined sections in the upper reaches of the canal system. IPID's diversionary water rights from Icicle Creek total approximately 117 cfs. See Figure 2-35 for additional explanation of the IPID irrigation efficiencies.

Figure 2-35. Irrigation Efficiencies



IPID has implemented several efficiency projects in the last 20 years:

Canal to Pipeline Conversion. The project converted 9,900 linear feet of unlined canal into a piped system and was completed in 2011. The piped section includes the end of the Peshastin Irrigation District Canal from Brender Creek to the downstream end near Pioneer Street in Cashmere. The project was partially funded by Ecology's Office of the Columbia River with a total project cost of $2 million. The project has resulted in an estimated savings of 1.2 cfs and 360 acre-feet of water savings from Peshastin Creek.

On-Farm Efficiencies. Presently, on-farm efficiency is nearly maximized throughout IPID. In order to live within the narrow allotment of 6.75 gpm per acre and remain competitive with their crops, the majority of water users have converted to micro-spray or drip systems that result in extremely high water use efficiencies. Per Ecology Guidance Document 1210 (Ecology, 2011), application efficiencies for micro-spray and drip systems average 85 and 88 percent, respectively. Some farmers have implemented soil moisture sensors in attempts to further reduce on-farm water use; however, there are some farmers that have complained this has led to poor crop results and can be difficult to manage.

Canal Lining. IPID has a long history of lining their canals and repairing leaking portions of already lined canals. Presently, only a small portion of their canals remain unlined.

IPID's Comprehensive Water Conservation Plan was recently updated. The purpose of a Comprehensive Water Conservation Plan is to identify opportunities for conservation, improve the operation of the system, and increase efficiency. The previous Icicle Irrigation District Comprehensive Water Conservation Plan and the Peshastin Irrigation District Comprehensive Water Conservation Plan were over 20 years old. The updated IPID Comprehensive Water Conservation Plan identifies new opportunities for irrigation efficiency upgrades and infrastructure improvements to reduce water diversions from Icicle Creek.

Conservation projects that might be identified in the IPID Comprehensive Water Conservation Plan and implemented to improve efficiency include additional canal lining or piping and on-farm efficiency upgrades. Based on preliminary estimates, it is anticipated that IPID could achieve up to a 10 percent water savings, which equates to approximately 10 cfs (3,000 acre-feet annually). Additionally, the IWG would work with IPID to voluntarily move water from users that do not use or need as much water to users that need additional water. This program could be used to target individuals who are using irrigation water for residential lawns and on-farm efficiency upgrades. While IPID already has a mechanism to move water within the district through their board of equalization, the goal of this program would be to expend knowledge of this program and help improve participation through incentives. Additionally, some commenters in the PEIS suggested that lawn irrigation was not the highest and best use of water in the Icicle Creek Subbasin. Creating a program where lawn irrigation is converted and restored to agricultural production assists in meeting the agricultural reliability Guiding Principle.

Cost for conservation improvements are expected to be approximately $7.5 million. The cost of improvements will be further estimated as part of the update to the IPID Comprehensive Water Conservation Plan. The total cost per acre-foot is estimated at $2,543.[30]

2.5.3 COIC Irrigation Efficiencies and Pump Exchange Project

The COIC Irrigation Efficiencies Project consists of installing a piped and pressurized system, and replacing the current gravity fed point of diversion with a pump station downstream on the Wenatchee River or Icicle Creek near their confluence. The COIC project would restore 11.9 cfs (3,640 acre-feet annually) to lower Icicle Creek.

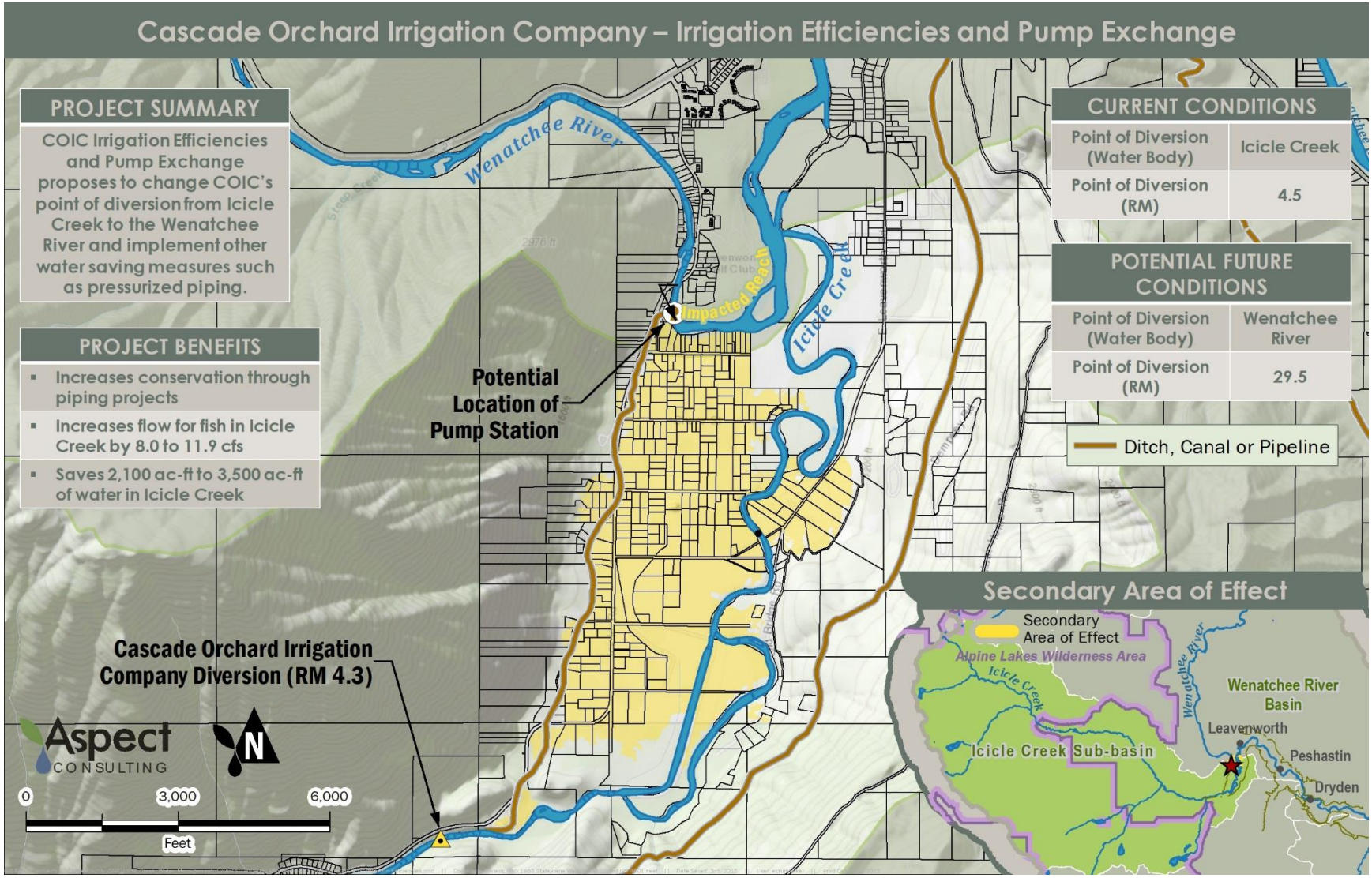
COIC currently shares a point of diversion with LNFH on Icicle Creek at RM 4.5. It provides water to irrigators in the lower reaches of the Icicle Creek Subbasin, near the confluence of Icicle Creek with the Wenatchee River. Proposed conservation measures in COIC's irrigation system, subject to COIC shareholder approval, would add up to 11.9 cfs and 3,640 acre-feet per year to the lower 4.5 miles of Icicle Creek. Implementation of this project would also allow for a smaller screen at the LNFH diversion. See Figure 2-36 for additional explanation of the COIC irrigation efficiencies.

COIC is exploring the option of moving their point of diversion to the right bank of the Wenatchee River just upstream of its confluence with Icicle Creek or to the left bank of Icicle Creek just upstream of its confluence with the Wenatchee River, which would leave more water in the lower 4.5 miles of Icicle Creek. Improvements would also include replacement of the open ditch system with a closed-pipe canal and laterals to improve efficiency. COIC recently completed an alternatives analysis to explore various conservation project options, including the following:[31]

Option 1: Option 1 would result in construction of a pressurized delivery system supplied by a pump station near the confluence of the Wenatchee River and Icicle Creek. COIC's portion of the diversion facilities shared with LNFH on Icicle Creek would no longer operate. Saved water from the existing diversion to the new diversion would be put into the State's trust water rights program. The alternative would benefit the critical reach of Icicle Creek by moving COIC's diversion and associated water right downstream. If diversions up to the limit allowed by the water right were moved to the new point of diversion, the benefit to flows in Icicle Creek would be as much as 11.9 cfs.

[30] http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA%20Open%20House/Handouts/IPID%20Conservation_final_reduced.pdf
[31] Details taken from http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA%20Open%20House/Handouts/COIC_final_reduced.pdf

Figure 2-36. COIC Irrigation Efficiencies and Pump Exchange



In addition to leaving flow in lower Icicle Creek, the improvements would also increase the efficiency of the COIC system. A range of design capacities, from 4 cfs to 8 cfs, were evaluated for this alternative to cover the range of potential future water needs. It is likely that a pressurized system would need to be sized to deliver a flow rate near the middle of that range. This efficiency measure would reduce the historical diversion quality by 4 to 8 cfs.

The Opinion of Probable Costs developed in the *COIC Alternatives Analysis Study* (Anchor QEA, December 2015) indicates that total project costs for a 6 cfs capacity system would be approximately $2.5 to $2.8 million. The costs have since been updated for an 8 cfs system at $4.7 million dollars.

During May-June of 2016, an 6-8 cfs pump station was chosen by over 70 percent of the vote from COIC shareholders. The advisory group recommended additional contingencies, including an additional shareholder vote to approve selection of a preferred pump station site. In January of 2017, COIC shareholders gave preliminary approval to up to 3 alternatives for a pump station site.

Option 2: Option 2 would evaluate COIC's current water use patterns to identify efficiency improvement opportunities, landscaping changes, irrigation timing, or other conservation measures that could create savings and that might make water available for future uses at COIC or be marketed for municipal and/or mitigated uses. This alternative is not intended to be a stand-alone alternative; Option 2 would be considered in addition to Option 1.

Option 2 was calculated by estimating annual consumptive quantities of existing crops and associated irrigation practices from Ecology Guidance Document 1210 (Ecology, 2011) and Policy 1120. Assuming total irrigated area within COIC is close to the 419 acres of potential irrigation shown in the analysis, up to 733 acre-feet of consumptive use is occurring at COIC. Additional research will be required to assess actual consumptive use, type of water application systems used in each parcel, and more refined data on actual transpiration using precise measurements from tensiometers and associated technology.[32]

The COIC shareholders approved the project sponsor to identify locations for a pump station and implement system improvements that are generally consistent with those identified for Option 1. Potential pump station sites have been evaluated and narrowed to three locations, as follows:

- On the right bank of the Wenatchee River approximately 0.8 miles upstream of the confluence with Icicle Creek near the Icicle Road Bridge.

[32] Alternative summaries from Anchor QEA, 2016, Alternatives Evaluation Study – Public Release version – Cascade Orchards Irrigation Company, prepared for Cascade Orchards Irrigation Company, December 2015

- On the right bank of the Wenatchee River approximately 0.3 miles upstream of the confluence with Icicle Creek.
- On the left bank of Icicle Creek approximately 0.7 miles upstream of the confluence with the Wenatchee River.

COIC is working with project sponsor, Washington Water Trust, to further study the feasibility of these sites and determine the best approach for implementing the proposed efficiency project. In June 2017, a conceptual design report was completed to further analyze the project and evaluate potential options (Anchor, 2017).

2.5.4 Domestic Conservation

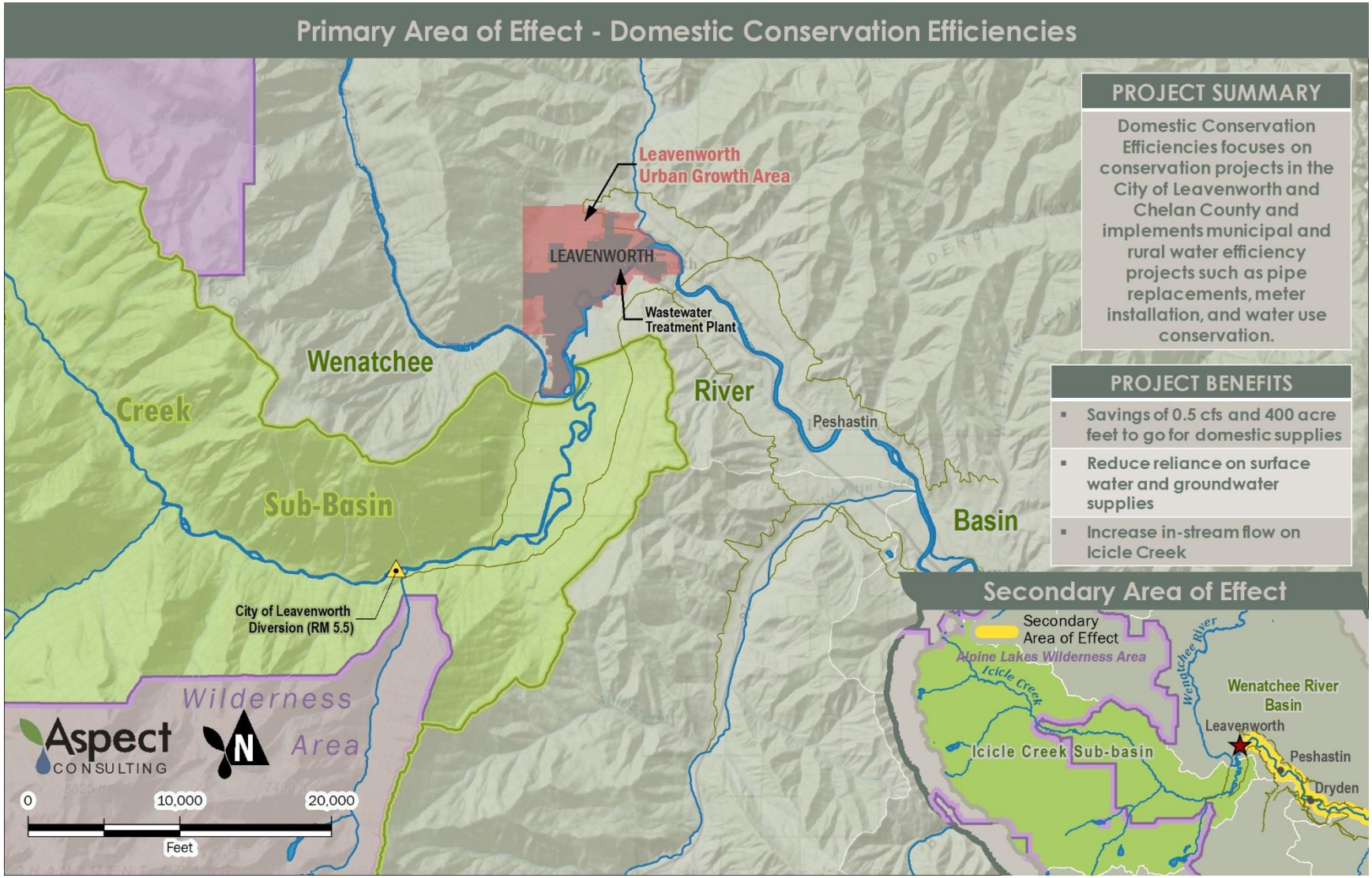
The Domestic Conservation Project focuses on implementing conservation for domestic users within the City of Leavenworth and rural areas of the Icicle Creek Subbasin. Based on primary estimates, the IWG anticipates savings of 0.5 cfs and 400 acre-feet, all of which would go toward domestic supply. See Figure 2-37 for additional explanation of domestic efficiencies.

City of Leavenworth: The City of Leavenworth provides domestic water for citizens, visitors, and commercial uses from Icicle Creek and City wells. The City of Leavenworth currently provides water to 2,981 units, with the average Equivalent Residential Use at 304 gallons per day. Over the past 20 years, the City of Leavenworth has reduced water use while increasing the number of connections it serves. To accomplish this water savings, Leavenworth has spent $3.6 million dollars on capital improvements and implemented several voluntary conservation programs. Combined, these efforts have yielded 56 million gallons in water savings (171.86 acre-feet).

Future conservation projects identified by the IWG include a lawn buyback program that could incentivize reducing the amount of lawn homeowners irrigate, leak detection and repair or replacement of leaky water mains, replacing residential meters, evaluating a conservation-oriented rate structure, expand conservation education and xeriscape programs, and rebates for efficient residential fixtures. Additionally, City of Leavenworth is exploring opportunities for reclaimed water.

Rural Water Users: Other residents of the Icicle Creek Subbasin outside the City of Leavenworth rely on domestic wells to supply their water. Under a rural water conservation program, Chelan County would implement conservation education, xeriscaping programs, and rebates for permanent conservation efforts (e.g., lawn buy-back programs or efficient residential fixture retrofits).

Figure 2-37. Domestic Conservation Efficiencies



The estimated cost of the city and rural project is $1 million for pipe replacement and rural conservation, which would save 400 acre-feet of water. Additionally, there would be approximately $1 million for new meters and conservation-oriented rate structures. This is anticipated to produce additional savings; however, behavior change based on price of water is difficult to predict, so those water savings are not included in this prediction. The estimated cost per acre-foot for domestic conservation is $2,500. [33]

This municipal and domestic project's efforts would increase water conservation and help supply water for the population projections in the area through 2050 and meets Guiding Principles to improve domestic supply.

2.5.5 Eightmile Lake Storage Restoration

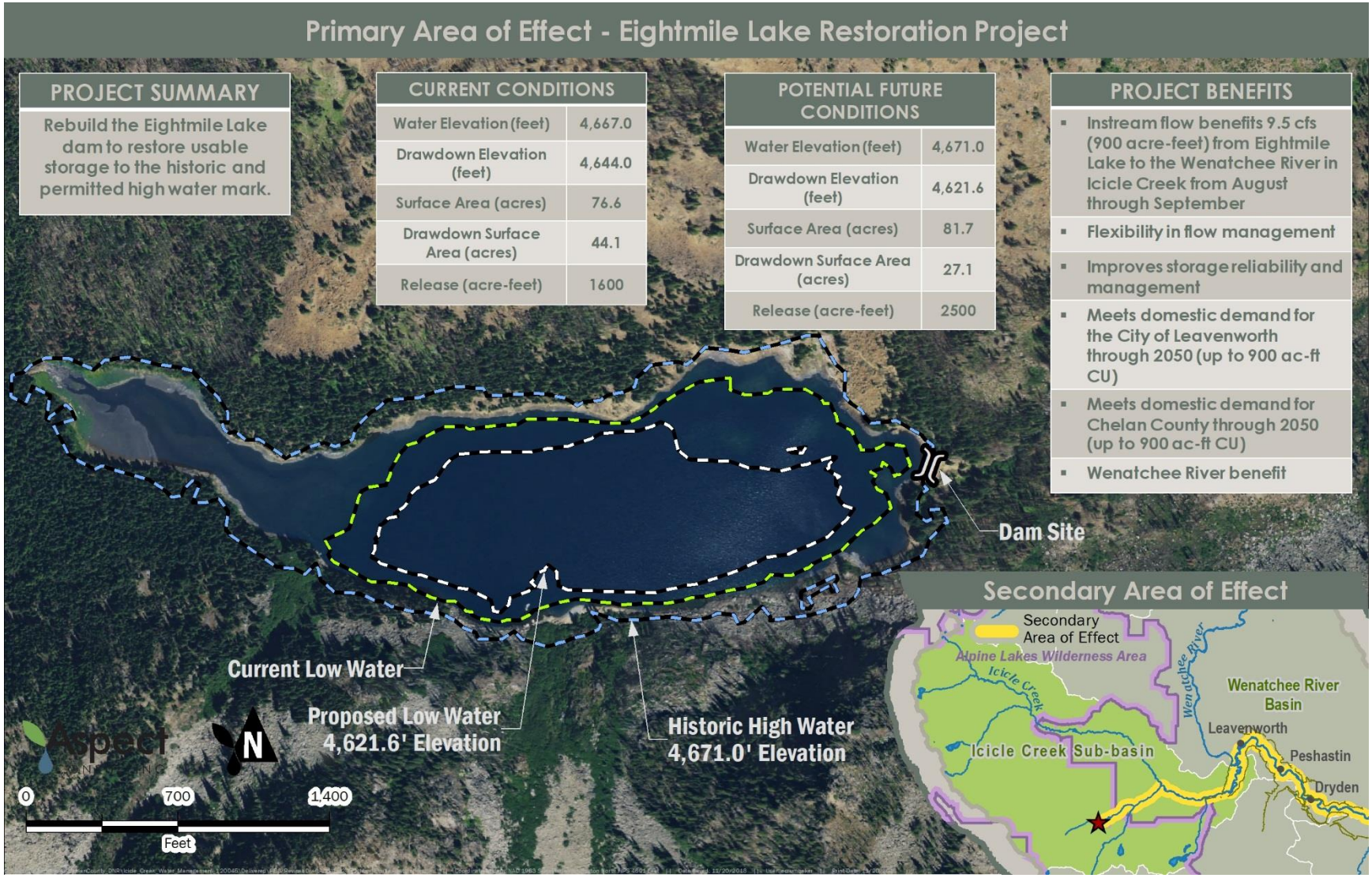
Eightmile Lake is one of four Alpine Lakes managed by IPID. A small dam, gate, and low-level outlet pipeline constructed in the 1920s at the lake outlet allow for controlled releases. IPID releases water from Eightmile Lake and the other managed Alpine Lakes in the late summer low-flow period to provide additional flows in Icicle Creek for irrigation.

The small dam structure consists of a rock masonry and concrete structure abutting an earth and rock embankment. Erosion of the embankment portion of the dam has reduced the controlled release volumes from Eightmile Lake to less than 1,400 acre-feet, although in some years approximately 1600 acre-feet is released if Eightmile Lake releases are prioritized ahead of the other lakes due to continued leaks from the reservoir. IPID has water rights that allow for storage of 2,500 acre-feet annually. Other existing operation challenges include damage to and deterioration of the outlet gate, which has made operation of the gate very challenging, and collapse of a portion of the low-level outlet pipeline, which has significantly reduced capacity of the pipeline in recent years. The reduction in the capacity of the low-level outlet pipeline is an urgent concern for IPID, because a loss of release capacity at Eightmile Lake could impair IPID's ability to meet late summer irrigation demands.

The Eightmile Lake Storage Restoration Project (Figure 2-38) would replace the dam, low-level outlet pipeline, and controls. The new rebuilt/restored dam would restore the amount of water impounded and the new low-level outlet would allow for additional draw down below current levels. Cumulatively, this new infrastructure these would restore the usable storage capacity of the lake to the volume that was available historically and allowed by IPID's water right (2,500 acre-feet). The project would also allow for automation and optimization of releases from the lake. This would provide 12.6 cfs and 900 acre-feet (out of the 2,500 acre-feet stored) of additional volume for controlled release. Project beneficiaries are instream flow and domestic, and releases

[33] http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA%20Open%20House/Handouts/ConservationEfficiencies_final.pdf

Figure 2-38. Eightmile Lake Restoration



could be managed year-round based on flow and weather conditions. Because releases will be utilized to mitigate consumptive domestic use when the instream flow rule is not met, the quantity made available for domestic use will be stretched to 3,600 acre-feet when accounting for natural flow availability.

The Eightmile Lake Storage Restoration Project includes the following construction activities:

- Rebuild and restore the dam at Eightmile Lake with a spillway/high water surface elevation that matches the historical spillway/high water surface elevation (approximately 4,671 feet)
- Extend the new low-level outlet pipeline into the lake to facilitate operational draw down for access of the full volume allowed by IPID's water right of 2,500 acre-feet.[34] The low level-outlet pipe would operate as a siphon as the lake draws down and would allow for a maximum draw down to an elevation of just under 4,621 feet.

More specific detail on this project is provided in the *Eightmile Lake Restoration Feasibility Study* provided in Appendix C of this document.

The estimated project cost for this option is $1.6 million, or $1,422 per acre-foot.

Shortly before the release of the draft PEIS, IPID declared a state of emergency on March 13, 2018, due to potential failure of the Eightmile Dam. Concern's regarding potential failure were raised by Ecology's Dam Safety Office and the USFS following the Jack Creek fire during the summer of 2017. The Jack Creek fire intensely burned a vast area of the Eightmile watershed. Because of the intensity of the fire, hydrophobic soils have developed within the watershed, which may lead to a significant increase in runoff. This could lead to increased erosion on the earth portion of the dam, which could undermine the structure. A dam failure could contribute an addition 15,000 cfs to Icicle Creek during a natural high flow event (approximately 10,000 cfs). This would result in flooding and pose a potential risk to the approximately 200 people who reside downstream near the Icicle Island area.

Because of the timing of IPID's emergency declaration, the PEIS does not contemplate this action's impacts on the proposed alternatives. This may be evaluated further in the project-level environmental review, as negotiations between IPID, USFS, and Ecology's Dam Safety Office are ongoing regarding future construction at the dam. It was also suggested in comments received on the draft PEIS that IPID may not have the right to restore Eightmile Lake. Adequate permitting and compliance with local, State, and Federal Laws and Wilderness Acts is a cornerstone of compliance with the Guiding

[34] http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA%20Open%20House/Handouts/EIGHTMILE_final_reduced.pdf

Principles. The IWG has a process in place to adapt to any project that is unfeasible following selection of a Preferred Alternative at the programmatic environmental review stage.

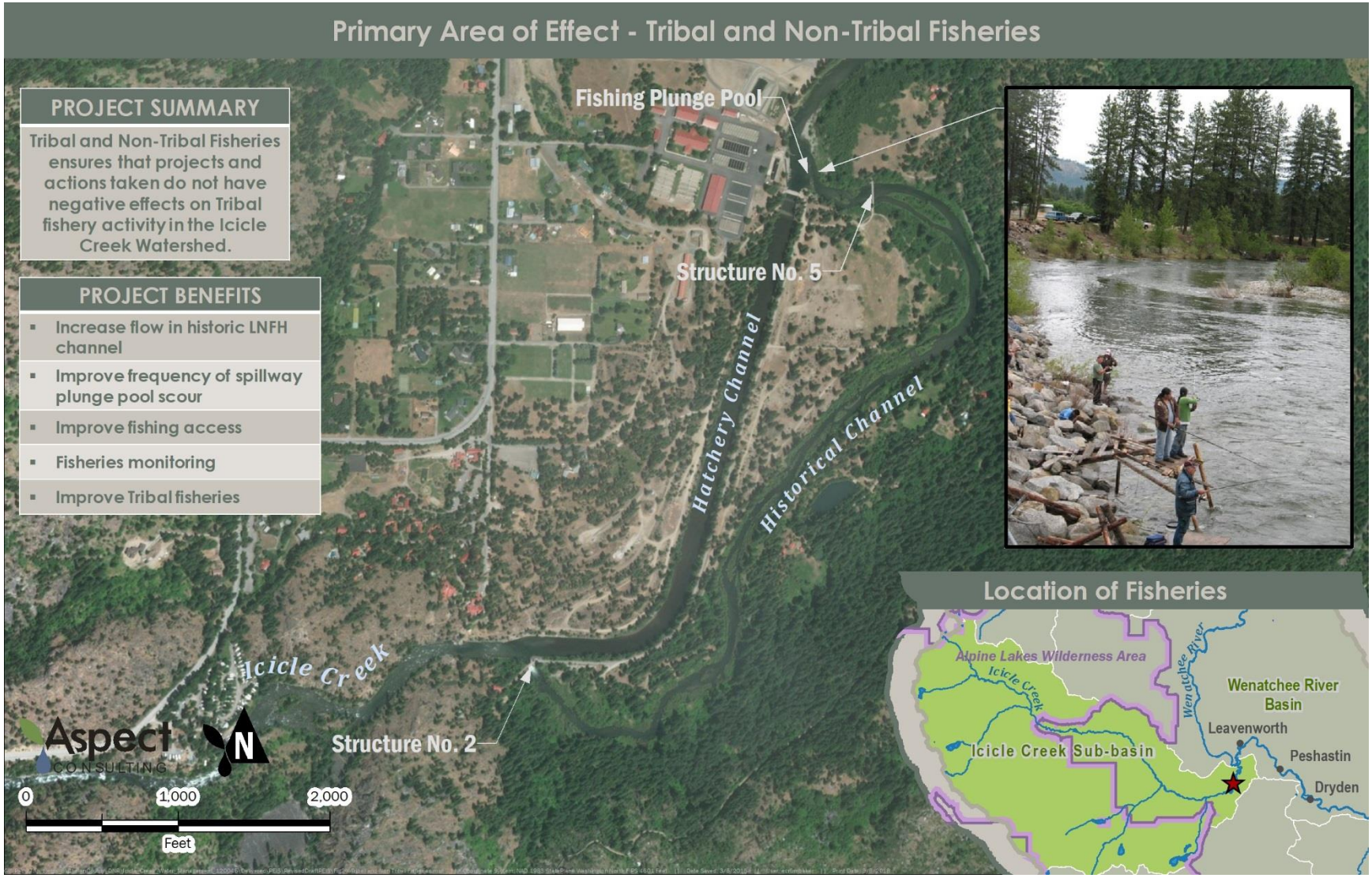
2.5.6 Tribal Fishery Preservation and Enhancement

Yakama Nation and the Confederated Tribes of the Colville Reservation exercise federally protected fishing rights on Icicle Creek. From early May through mid-July of each year, Yakama and Colville tribal members fish near the LNFH at several locations, including the plunge pool at the base of the spillway to the hatchery channel. The purpose of this project is to ensure that other projects implemented as part of the Icicle Strategy do not have negative effects on the tribal fisheries and protect federally protected tribal treaty harvest rights and non-tribal fishing. See Figure 2-39 for additional explanation of Tribal fishery protection and enhancement.

To accomplish this, the IWG commissioned a report analyzing the impacts of increasing flow in the historical channel and reducing flow in the Hatchery Channel (Anchor QEA, 2015). This report found that:

- When the radial gates at Structure 2 are fully opened, water backs up into the Hatchery Channel when the flow in Icicle Creek is approximately 300 cfs.
- When the radial gates at Structure 2 are fully opened, water does not spill over the Hatchery Channel Spillway until the flow in Icicle Creek is approximately 990 cfs.
- If the LNFH closed one of the gates at Structure 2, the flows at which water would back up into the Hatchery Channel and begin to spill over the Hatchery Channel spillway would be roughly half of what would be required with both gates fully opened. Keeping one of the gates closed allows the Hatchery Channel to remain full for several more weeks during a typical year. Since this study, independently controlled radial gates were installed.
- The LNFH uses Structure 5 to control water levels and restrict upstream migration of fish in the historical channel during the May 15 to July 17 harvest period when the fish count above this structure is greater than 50 Chinook. However, in recent years fish counts above Structure have not exceeded 50 fish. This operation is discussed in greater detail in Section 3.7.
- Scour in the pool downstream of the spillway is primarily initiated during peak flow events, such as those that would occur during a flood with a return period of 2 years or more. Scour would occur at flows as low as the 2-year flow and the scour pools downstream of the Hatchery Channel would be maintained.

Figure 2-39. Tribal and Non Tribal Fisheries



- The restrictions on gate operation at Structure 2 are primarily intended to limit flows to the Hatchery Channel during low-flow periods. It is the current understanding that the gates at Structure 2 have typically remained open during peak flows when the Hatchery Channel fills and overflows with the gates fully opened. Consequently, the peak flows and corresponding conditions that cause scour at the bottom of the Hatchery Channel spillway are not likely to be impacted by the current restrictions.
- Bedload sediment in Icicle Creek (based on a subsurface gravel bar sample having a D50 of 11.5 mm) will be transported at the 10-year event downstream of the spillway. The coarser surface gravel bar sediment sample (D50 of 63.3 mm) will be transported when flows reach approximately a 100-year event.
- Because the restrictions on gate operation at Structure 2 are primarily intended to limit flows to the Hatchery Channel during low-flow periods and sediment transport primarily occurs during peak flow events, sediment transport downstream of the spillway will not likely to be impacted by the current restrictions.
- The integrated list of projects being evaluated by the IWG are intended to maintain a minimum flow during non-drought years in Icicle Creek of at least 100 cfs. Increasing the flow to 100 cfs in Icicle Creek during the late summer low-flow period should not affect scour and sediment transport through the pool downstream of the Hatchery Channel spillway because scour and sediment transport are initiated by peak flows that occur earlier in the year.
- Turbulence and air entrainment are caused by the strength of the hydraulic jump that occurs when flow exits the spillway. It appears that flow rates in excess of 500 cfs in the spillway provide the largest water surface fluctuations and air entrainment, and are the conditions noted by LNFH staff where air bubbles and turbulence provide some cover for salmon.

Figures 2-40 and 2-41 provide examples of cover provided by turbulence and air entrainment at the plunge pool during two different flow scenarios, 700 cfs and 1,700 cfs. These photos illustrate how turbulence increases, providing improved cover from predators for fish, as flow increases.

Figure 2-40. 700 cfs at Plunge Pool

Figure 2-41. 1,700 cfs at Plunge Pool

If flows in the Hatchery Channel are too low to generate turbulence and air entrainment, LNFH may wish to evaluate other methods for inducing turbulence or air entrainment. Potential methods may include the following:

- Diverting flows around or through the spillway with a pipe or pipes that could discharge into the pool downstream at a high enough elevation to cause air entrainment from the falling water
- Creating a bubble curtain with a mechanical device
- Discharging effluent or pump back water at the head of the spillway or into an elevated pipe to increase turbulence and air entrainment
- Using sprinklers or spray jets to cause turbulence at the head of the scour pool

These kinds of improvements will be further evaluated during the next phase of study, which would include development of an adaptive management plan. The plan would provide further study on data gaps and potential improvements identified in the Tribal Fisheries Analysis report, and would develop alternatives for attraction and retention of fish in tribal fishing areas during the harvest periods that is coordinated with changing operations at LNFH and increased flow. Fishery effectiveness monitoring would also be a key component of the project, as well as access and amenity improvements. It may also be possible to improve fishing access, the fishing experience, or CPUE through further study. Continued monitoring of the scour pool through additional periodic bathymetry monitoring could also help clarify potential impacts of increased instream flow.

This project fulfills the IWG's Guiding Principle to protect tribal treaty and federally protected harvest rights at all times by maintaining or improving the tribal fisheries on Icicle Creek.

The estimated cost for this project is $500,000.[35]

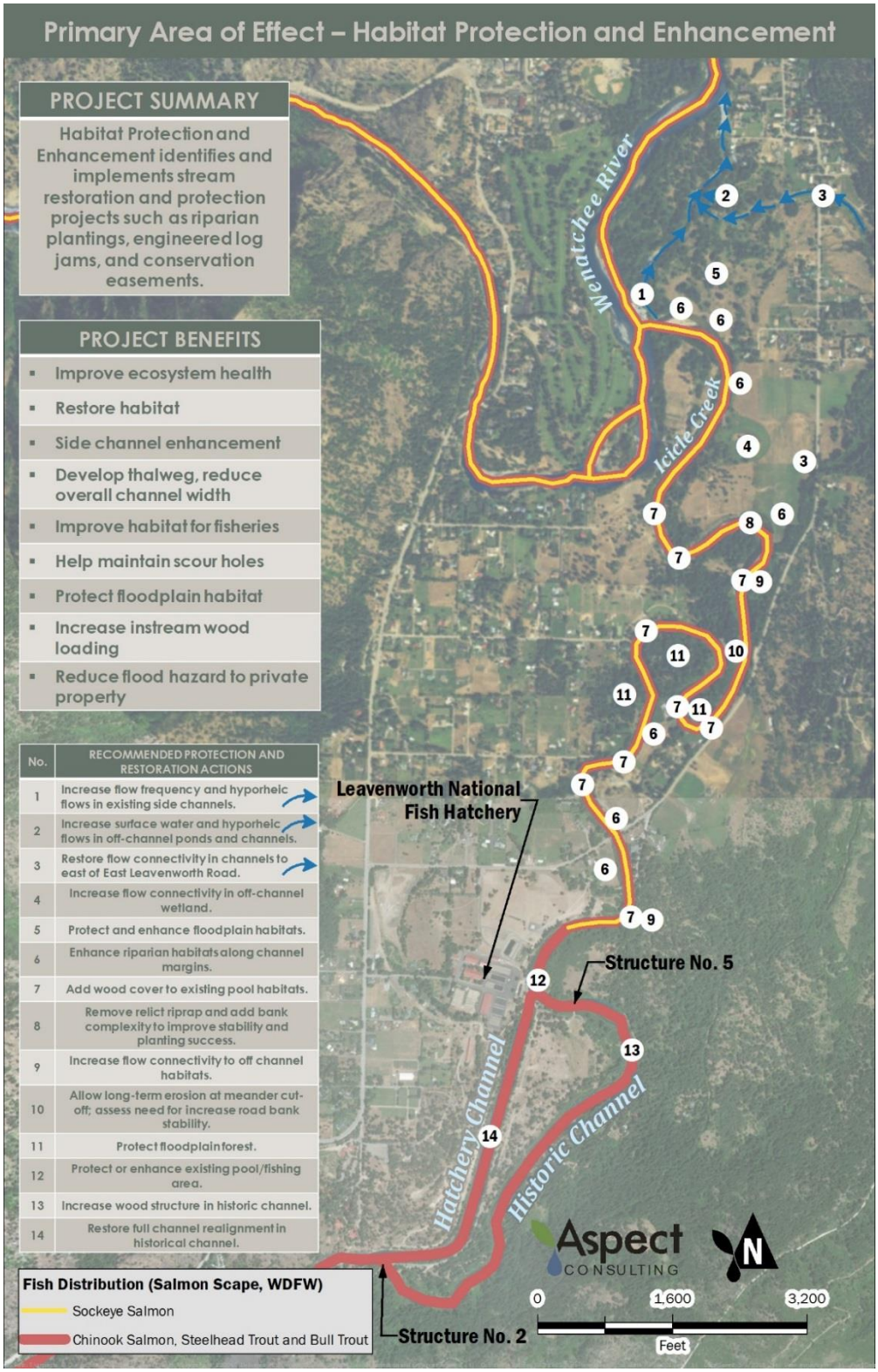
2.5.7 Habitat Protection and Enhancement

The IWG is planning habitat improvement projects throughout Icicle Creek. This element is intended to improve ecological function within the Icicle Creek Subbasin, and provide mitigation for project impacts in each Alternative (including short-term construction impacts) identified during project level review. Figure 2-42 provides detail of potential habitat protection and enhancement actions within the subbasin. IWG worked with USFWS, WDFW and Chelan County to assess geomorphic, hydrologic, and hydraulic conditions at sites along the creek and identified potential improvements for each. These include:

Lower Reach: Potential projects include side channel enhancement and floodplain connection.

[35] http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA 20Open 20House/Handouts/TribalFisheries_final_reduced.pdf

Figure 2-42. Habitat Protection and Enhancement



Near LNFH Structure 5: Potential projects include engineered log jams, riparian plantings, and using rock or large woody debris to reinforce the existing island, develop a thalweg, and reduce overall channel width.

Historical Channel: Potential projects include thinning out trees and then placing whole trees with root wads into the channel.

Near LNFH Structure 2 (head gate dam): Potential projects include placing large rock structures downstream of the dam to induce and/or maintain existing scour holes.

Past projects within the area include acquisitions and conservation easements, planting projects undertaken with private landowners, and reconnecting an historical channel as a side channel habitat.

More recently, Chelan County commissioned a report to provide the scientific basis for identification and development of stream restoration and protection actions for Icicle Creek from RM 0.0 to RM 4.3 (NSD, 2017). This study examined channel incision, sediment supply and transport, the current role of wood, and habitat for juvenile and adult salmonids. This study resulted in recommendations for habitat improvements, including protection of floodplain habitat, reconnecting the floodplain with off-channel habitat, removing lateral constraints on the channel, increasing instream wood loading, and restoring riparian habitat. Table 2-8 provides a list of recommended restoration and protections actions from this report.

Table 2-8
Recommended Restoration and Protections Actions by Biological Benefit

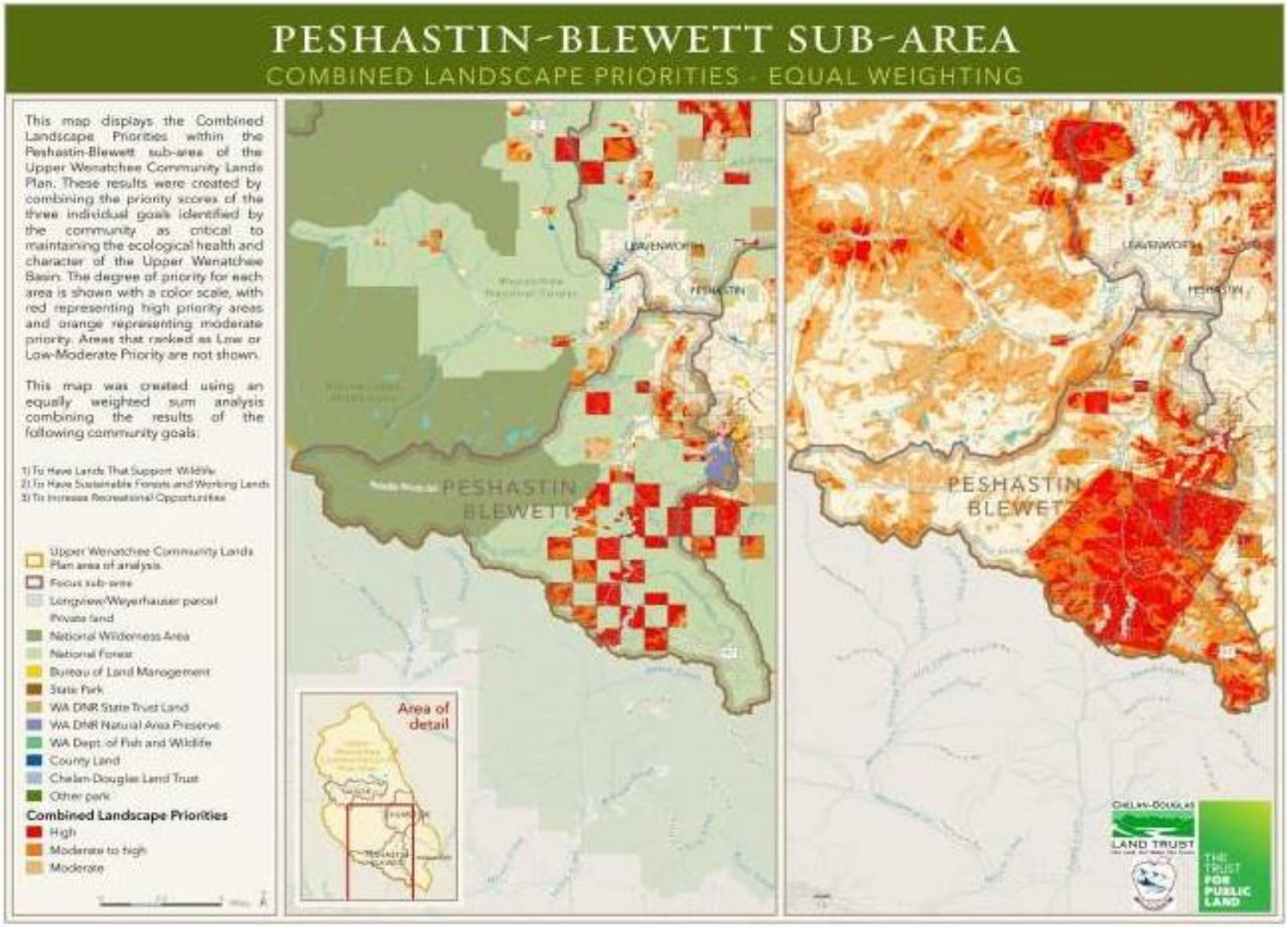
Biological Benefit	Location	Action	Feasibility	Prioritization & Sequencing Rationale
High	RM 0.0 – 1.0	Floodplain protection; Establish a stream corridor; Land acquisition	High	Provides long-term benefits associated with preventing human disturbance to floodplain habitats over a combined 150 acres of active floodplain; allows for increasing floodplain flooding and channel migration without risk to human structures and property; increases ability to implement instream actions adjacent to the properties with less risk to private property.
Medium	RM 1.3 – 2.0	Floodplain protection; Establish a stream corridor; Remove bank armoring; Acquisition	Moderate	Provides long-term benefits associated with preventing human disturbance to a combined 22 acres of floodplain habitats; allows for increasing floodplain flooding and channel migration without risk to human structures and property; increases ability to implement instream actions adjacent to the properties with less risk to private property.
High	RM 0.0/ Confluence	Reconnect Floodplain and off-channel habitat; Large woody material placement	Moderate	Provides immediate benefits addressing key off-channel habitat needs within 2,800 linear feet of existing channel. Can be implemented in conjunction with adjacent protection and riparian actions, such as installing Large woody material.
High	RM 3.0 – 4.3/LNFH Channel	Reconnect floodplain and off-channel habitat; Large woody material placement	Moderate	Install large wood structure within the historical channel. Wood installation will provide immediate improvements for cover, complexity, and pool formation. This action is appropriate given potential actions to increase flow and/or for full channel realignment.
Medium	RM 0.0 – 3.0	Large woody material placement	Moderate	Provides immediate instream habitat and floodplain benefits. Implement in association with riparian restoration efforts and with efforts to reduce channel confinement.

Biological Benefit	Location	Action	Feasibility	Prioritization & Sequencing Rationale
High	RM 1.1	Reconnect floodplain and off-channel habitat; Large woody material placement	Moderate	Small off-channel area (3 acres) with existing pond and channel features. Restoration can be paired with in-channel wood loading to improve site hydraulics and increase cover.
Medium	RM 1.0	Large woody material placement; Riparian restoration; Remove bank armoring	Moderate	Repair of degraded meander can be completed in conjunction with Protection actions. Install large wood structure, remove relict bank protection, and establish floodplain riparian community.
High	RM 3.0 – 4.3 LNFH	Reconnect floodplain and off-channel habitat; Flow improvement	Low	Actions to improve flow into the historical channel include modifications to Structure 2 and/or full channel reconnection. This will require direct coordination with LNFH operations, tribal fishery interests, and adjacent private landowners. This is likely a long-term and low feasibility action with high benefits.
Medium	RM 0.4	Reconnect floodplain and off-channel habitat	Moderate	Off-channel area (8.5 acres) will required either floodplain excavation or in-channel wood placement to improve inundation regime. Restoration can be paired with Protection and Riparian Restoration actions.
Medium	RM 0.1 – 0.3	Riparian restoration	High	Actions can be paired with Lower Icicle Protection actions. Action should be implemented with instream large woody material (LWM) loading to protect plantings and with irrigation to improve planting performance.
Medium	RM 2.1 – 2.6	Riparian restoration	High	Actions will require willing private landowners. Action should be implemented with instream LWM loading and irrigation to improve planting performance.

Biological Benefit	Location	Action	Feasibility	Prioritization & Sequencing Rationale
Medium	RM 2.7	Reconnect floodplain and off-channel habitat; Large woody material placement	Moderate	Small off-channel area (3 acres) will required either floodplain excavation or in-channel wood placement to improve inundation regime. No existing pond or off-channel features.
Low	RM 0.0 – 1.0	Reconnect floodplain and off-channel habitat; Install culverts within East Leavenworth Road	Low	Requires additional analysis of effects to adjacent landowners; likely difficult to greatly increase inundation regime because of elevated floodplain even with new culverts in East Leavenworth Road. Need to combine with Protection Act

The IWG plans to coordinate land acquisition projects with the Upper Wenatchee Community Land Plan (UWCLP) to protect land within the Icicle Creek Subbasin. The UWCLP is a community driven plan to conserve forest lands throughout the Upper Wenatchee Basin. Throughout the UWCLP study area, the Lands Plan identified 99,657 acres as high priority land for conservation, with 45,164 acres of that being high priority wildlife land, 11,786 acres of high priority recreation land, and 20,160 acres of high priority working lands. For the habitat protection projects, lands would be selected that are adjacent to the Icicle Creek Subbasin, which could expand habitat connectivity or access for wildlife. Additionally, this action could increase recreational access to the Icicle Creek Subbasin. Figure 2-43 provides a view of priority landscapes identified in the Icicle Creek area. This is a combined, equal-weighted priority map that includes various landscape priorities, include wildlife habitat, recreational opportunities, and sustainable forest and working landscapes.

Figure 2-43. Combined Landscape Priorities for the Icicle Creek Area



Source: Upper Wenatchee Community Lands Plan, September 2016

This project meets and advances the objectives set out in the Guiding Principles to enhance the Icicle Creek habitat by improving instream habitat and ecosystem health, and conserve land in the upper reaches of the Icicle Creek Subbasin.

Approximately $2.5 million would be budgeted for instream habitat and land acquisition projects.[36] Specific decisions on habitat protection and enhancement projects will be made after selection of the preferred alternative, so that projects can be tailored to mitigation needs for the selected alternative.

2.5.8 Instream Flow Rule Amendment

Amending the Wenatchee Instream Flow Rule Chapter 173-545 WAC would provide an additional 0.4 cfs and 400 acre-feet for domestic supply.

The Wenatchee Instream Flow Rule, which establishes an instream flow water right and sets reserves for the Wenatchee River and each of its major tributaries, including Icicle Creek, was established based on the recommendations of the Wenatchee Watershed Planning Unit and public input received during the rule-making process. Within the Wenatchee Instream Flow Rule a reservation of water was established for future domestic use in the Icicle Creek Subbasin. Currently, the reserve is set at 0.1 cfs, but to supply projected demand this reserve needs to be increased. The Wenatchee Instream Flow Rule provides for a reserve increase of up to 0.5 cfs in the Icicle Creek Subbasin so long as it is within the limitation of the 4.0 cfs reserve for the Wenatchee Basin (WAC 173-545-090(d)(iv)). To increase the Icicle Creek Subbasin reserve, instream flow and habitat improvement projects must be implemented in Icicle Creek.

This project is being coordinated with instream flow and habitat projects, and is intended to amend the reserve to meet demand projected through 2050. To increase the Icicle reserve a formal rule amendment must occur.

An amendment to the instream flow rule fulfills the Guiding Principle to improve domestic supply by making water available to meet demand projections through 2050. The estimated cost for this project is $50,000. [37]

[36] http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA%20Open%20House/Handouts/Habitat_final.pdf
[37] http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA%20Open%20House/Handouts/InstreamFlowRule_final.pdf

2.5.9 Leavenworth National Fish Hatchery Conservation and Water Quality Improvements Project

The LNFH Conservation and Water Quality Improvements Projects will provide 20 cfs and 14,454 acre-feet year-round in Reach 4 for instream flows.

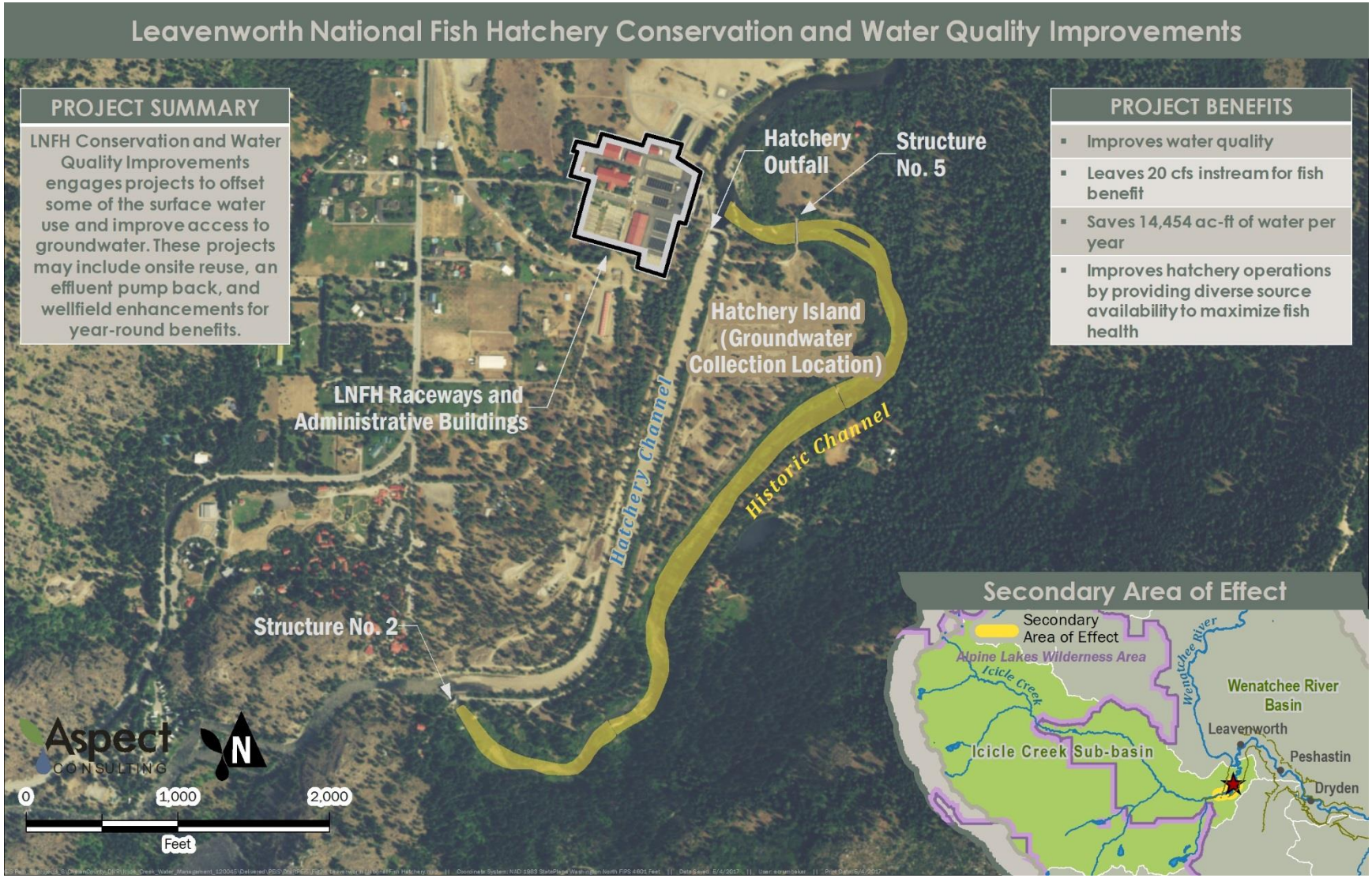
The LNFH relies on both a surface water diversion from Icicle Creek at RM 4.5 (42 cfs) and groundwater wells located near the hatchery canal (14.9 cfs) to produce the water necessary for their fish production year-round. The hatchery also relies on 16,000 acre-feet of storage to supplement surface water diversion during low-flow periods (July through early October). To maintain groundwater supplies in LNFH's shallow wells, flows from Icicle Creek are diverted to the Hatchery Channel for groundwater recharge. These flows are controlled by LNFH Structure 2.

The Leavenworth Fisheries Complex Planning Report (McMillen Jacobs, 2016) investigated a range of alternatives for improving operations and meeting fish production targets at three hatcheries, including the LNFH. It included an evaluation of the LNFH site, assessing land issues, water quality and quantity, biological risks and benefits, and policy and socioeconomic considerations. From this assessment, the study identified alternatives for cost-effective, viable improvements to the existing fish production facilities that develop the water supply to fully utilize and preserve existing water rights, modernize or replace aging/obsolete infrastructure, and develop fish culture technologies to increase fish health, efficiency of fish production energy, and water use. See Figure 2-44 for additional explanation on LNFH improvements.

The report's recommended plan for LNFH identifies high-priority projects over the next 10 years, with $2.5 to $5 million per year expenditures. The high-priority projects include:

- Modify or replace existing surface water intake screen that incorporate NOAA-compliant screens.
- Implement short-term phosphorous management measures.
- Repair or replace failing surface water transmission pipes.
- Construct a new surface water filtration and disinfection facility to treat a portion of incoming surface water supply. Installation of a water chiller is scheduled for spring of 2017.
- Replace outdated spawning facilities.
- Provide back-up power to Wells No. 1, 2, 3, and 7 to ensure continuous supply for the critical incubation and rearing.
- Construct new rearing vessels with roof covers.
- Install an effluent pump-back system to pump water into the Hatchery Channel and recharge the wellfield. The results would be a reduction of water currently diverted from Icicle Creek for that purpose.

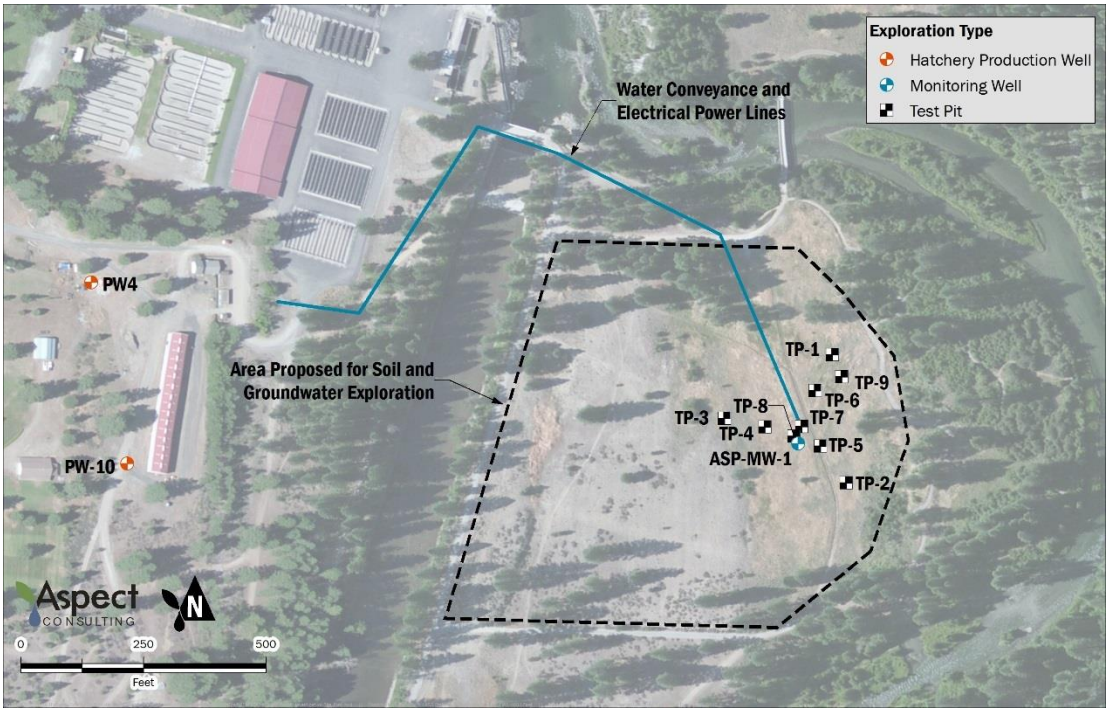
Figure 2-44. Leavenworth National Fish Hatchery



The IWG has investigated several improvements identified in *The Leavenworth Fisheries Complex Planning Report* (LNFH Planning Report) (USFWS, 2016), including upgrading screens and intake piping at the LNFH point of diversion (more information provided in the screening section below), groundwater augmentation, effluent pump back, and circular reuse tanks to achieve water conservation and quality goals established in the Guiding Principles.

To better understand groundwater augmentation options, geophysical investigation of the LNFH property and an adjacent Chelan County-owned parcel was completed in 2014 and 2015 as an initial step to identify areas for potential groundwater supply development (Aspect, 2015). These investigations found good conditions for groundwater collectors, such as shallow depth to groundwater, saturated coarse gravel and cobbles, and nearby surface water to recharge and maintain water levels. Additionally, a pump test of a drilled well on Hatchery Island indicated the well could provide sustainable yields. Developing groundwater sources could reduce surface water diversions and support a sustainable LNFH by providing cool, pathogen-free water for fish propagation. The groundwater supply development goal identified in the Leavenworth Fisheries Complex Planning Report is 8 cfs of additional capacity, with project development costs estimated at $3 million, with implementation occurring over the next 10 years (McMillen Jacobs, 2016). Figure 2-45 provides an overview of the geophysical investigation conducted.

Figure 2-45. Groundwater Investigation Site Plan



Source: Leavenworth National Fish Hatchery Groundwater Investigation Memo. Aspect Consulting, 2015.

In 2015, historical low flows in Icicle Creek led LNFH to run an emergency effluent pump back pilot program. Effluent pump back involves effluent water from the hatchery back into the Hatchery Channel to recharge the shallow groundwater wells that provide water to the hatchery. Under prior operating conditions, the gates at Structure 2 were lowered to divert water from Icicle Creek into the Hatchery Channel. The water in the Hatchery Channel recharges shallow groundwater wells that are a critical part of the LNFH groundwater supply. When the Hatchery Channel is not wetted, the shallow groundwater wells run dry.

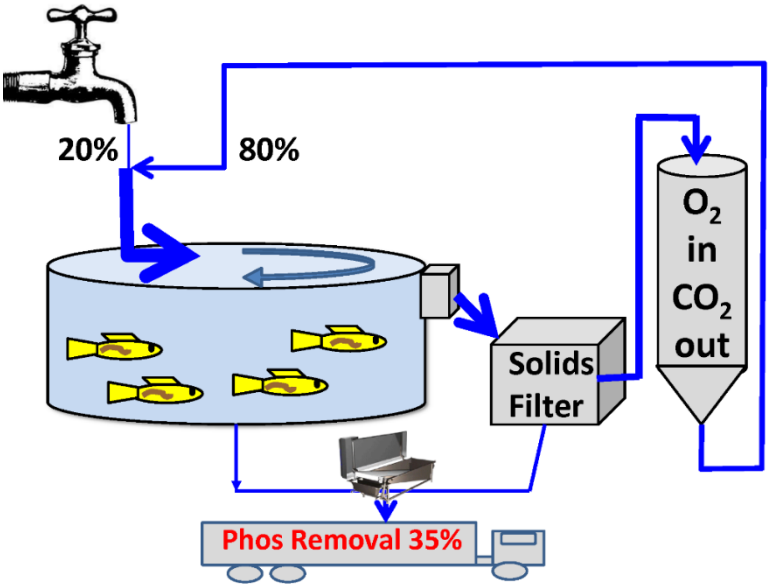
Due to low flows and high water temperatures in 2015, LNFH implemented an emergency pilot of a pump back operation that uses the clean, run-through water to keep the Hatchery Channel wetted. Under the 2015 pilot program, temporary pumps were installed at the bottom of the fish ladder, adjacent to the spillway, where effluent water is discharged to Icicle Creek and pumped into the Hatchery Channel. The results of the pilot program found that the pump back increased groundwater levels in the adjacent aquifer, prevented Reach 4 from being a "losing reach," and decreased total phosphorous discharge at the outfall (Anchor QEA, 2016; McMillen Jacobs, 2016). If effluent pump back were implemented on a permanent basis, project costs are estimated at between $839,000 and $998,000 (Anchor QEA, 2016). The *Leavenworth Fisheries Complex Planning Report* calls for implementation to occur between 2017 and 2018 (McMillen Jacobs, 2016). Figure 2-46. is a photo from the pilot program. The photo on the left is the temporary piping from the fish ladder to the Hatchery Channel. The photo on the right is of the Hatchery Channel from near the top of the fish ladder.

Figure 2-46. Effluent Pump Back Pilot Program

2.5.9.1 Circular Tanks

Circular tanks offer several advantages over the current LNFH raceways. This includes improved water quality and controllable swimming velocities that may increase fish fitness and survival. Additionally, circular tanks reuse water, significantly reducing water demand. The estimated cost of installing new circular tanks at LNFH is $4.5 to $6.4 million depending on the alternative selected, with implementation scheduled between 2019-2023 (McMillen Jacobs, 2016). LNFH completed a circular tank/water reuse feasibility study in Spring of 2017. Figure 2-47 illustrates how circular tanks operate.

Figure 2-47. Circular Tanks for Fish Rearing



These improvements meet the IWG's Guiding Principles to improve instream flow, support a sustainable LNFH, and enhance Icicle Creek habitat and fish passage. It has instream flow benefits of up to 20 cfs in Icicle Creek and provides a reliable water supply for hatchery operations.

The hatchery is prepared an implementation plan to meet requirements set in the 2015 Biological Opinion and implement improvements identified in the planning report (NMFS, 2015; UWFWS, 2017). Some of these projects are not part of the improvement projects put forward by the IWG, and are not considered in this report.

Cumulatively, IWG sponsored projects are estimated to cost $20 million dollars, or $1,383 per acre-foot. [38]

[38] http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA%20Open%20House/Handouts/LNFH_final.pdf

2.5.10 Fish Passage

The IWG has identified the need for fish passage improvements at LNFH and in Upper Icicle Creek. They have proposed several potential projects that would improve upstream fish passage at these locations.

The historical channel suffers from passage issues during low-flow conditions because of channel morphology. When flows drop below 200 cfs, passage is limited for fluvial bull trout. When flows drop below 120 cfs, passage is limited for mid-size fish, such as steelhead. When flows drop below 30 to 40 cfs, passage is limited for juvenile salmonids.

The IWG seeks to improve passage in the historical channel (Reach 4) by increasing streamflow. With the long-term goal of increasing minimum streamflow in the historical channel to 250 cfs, passage through this reach would be provided for these species at various life stages. Habitat improvement, described above, is also designed to improve passage by improving channel conditions throughout this reach and lower reaches. See Figure 2-48 for additional explanation of fish passage improvements.

Structure 5 at LNFH is also a structural fish barrier. However, this barrier is by design and is an operational requirement for LNFH to collect broodstock. Additionally, the operation of Structure 5 enhances the tribal fishery. During broodstock collection, pickets are placed in Structure 5 to prevent large fish from migrating upstream, but allows small and juvenile fish passage. Structure 5 is operated for broodstock collection from mid-May through June. In addition to the intentional barrier provided by Structure 5, Icicle Creek's channel is wide at this point, so low flows can lead to shallow conditions that pose a passage barrier. Channel changes or restricting flow with Structure 5 could help increase stream depth during low-flow events, improving passage.

LNFH Structure 2 is a headgate located at RM 3.8 designed to control flow into the Hatchery Channel. Because of the design of this structure, the velocity of water moving through the structure can prevent upstream migration. When both gates are open, this structure does not provide passage for juvenile salmonids; limits passage for rainbow trout, bull trout, and lamprey when flow is above 64 cfs; and limits steelhead and salmon passage when flow is above 512 cfs. Independently operated radial gates have been installed on Structure 2, which improves passage issues. The IWG proposes to improve Structure 2 (or replace with a passive structure) to allow for improved fish passage while retaining the ability to split flows between the hatchery canal and the historical channel in a way that maintains the existing tribal fishery conditions at the plunge pool, improves ecosystem health of the historical channel, and meets the LNFH's operational needs. Figure 2-49 shows Structure 2.

Figure 2-48. Fish Passage and Fish Screening

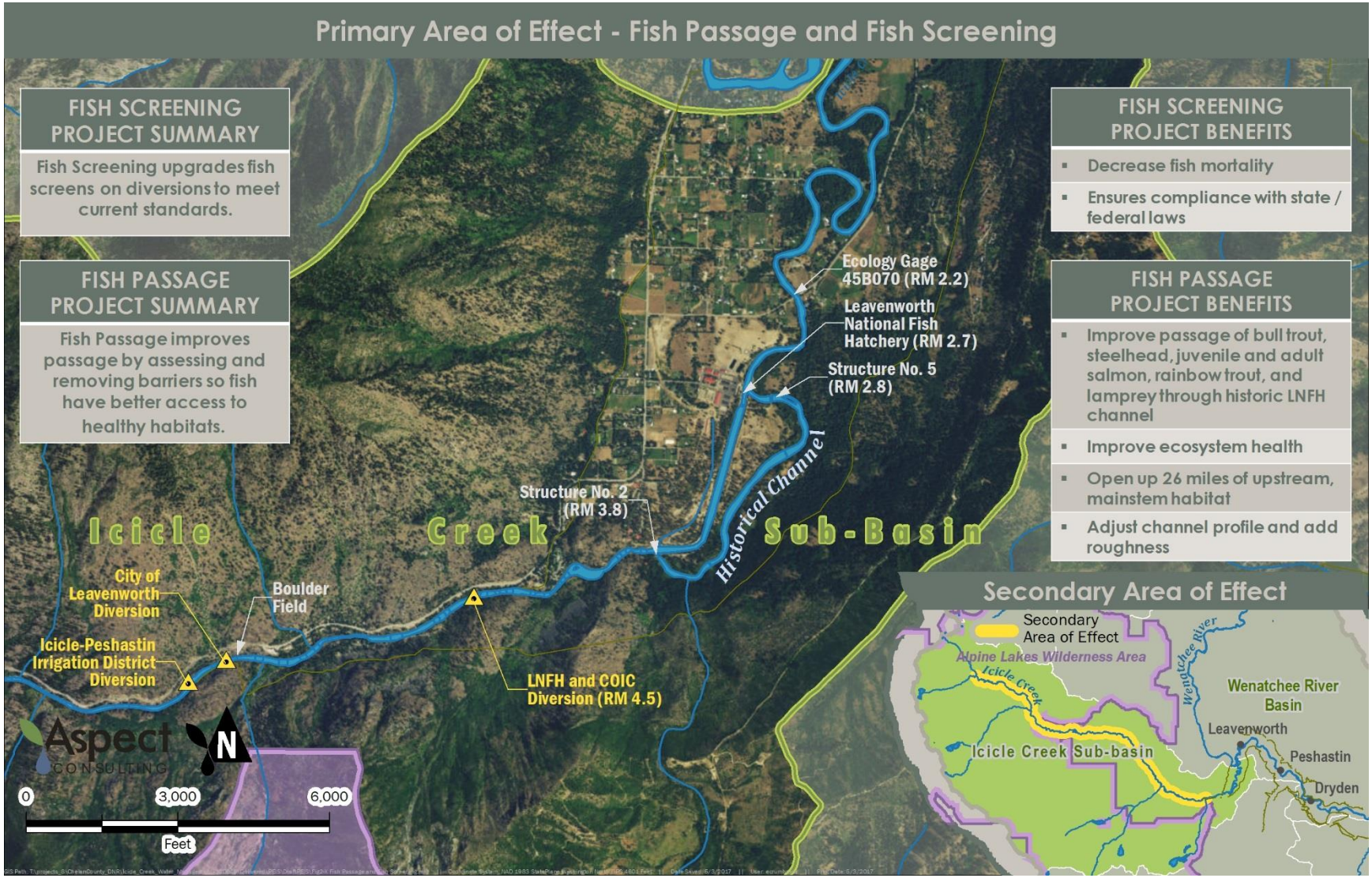


Figure 2-49. Structure 2

Source: The Leavenworth Fisheries Complex Planning Report (McMillen Jacobs, 2016).

In addition to operational and infrastructure changes the LNFH, modifications to the boulder field located at RM 5.6 would provide passage and access to approximately 26 miles of upstream, mainstem habitat. The boulder field has been identified as having anthropogenic origin (EcoAssets, 2013). Primary passage concerns include gaps between boulders being filled by smaller sized substrate and woody debris that blocks passage and affects surface and subsurface flow and velocity (EcoAssets, 2013). A passage assessment at the boulder field has been completed and passage improvement locations identified. Passage improvements at the boulder field can be broken into two categories—middle boulder field and upper boulder field. Options considered for the middle boulder field passage include a channel profile adjustment, installing a roughened channel, installing vertical slot fishways, or installing a low-flow pool and weir fishway. Options considered for upper boulder field passage include a pool and chute fishway and constructed riffle. Costs for the various passage measures range from $260,000 to $1 million (EcoAssets, 2013). The preferred alternatives recommended in the EcoAssets study were the channel profile adjustment for the middle reach and a pool and chute fishway in the upper reach, with estimated costs of $770,000 and $258,000, respectively. Figure 2-50 provides an example of a pool and chute fishway.

Figure 2-50. Example of pool and chute fishway

Source: Icicle Creek Boulder Field Fish Passage Assessment (EcoAssets, 2013).

Trout Unlimited, a IWG member leading the boulder field passage project, is currently working on design options. NEPA will be required for this project, and will likely result in an Environmental Assessment with the Army Corps of Engineers (USACE) acting as lead agency. Chelan County Community Development will act as SEPA lead agency. Those environmental review documents are expected to evaluate potential impacts on the tribal fishery that could result from increased passage attraction above LNFH. Currently, many fish that migrate upstream of Structure 2 return downstream to the scour pool for harvest because of unsuitable upstream habitat.

Improving fish passage meets the Guiding Principles of enhancing Icicle Creek habitat and passage, and supporting a sustainable LNFH.

The estimated costs of implementing these projects is approximately $6 million.[39]

[39] http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA%20Open%20House/Handouts/PassageImprove_final.pdf

2.5.11 Fish Screen Compliance

There are three large diversions on Icicle Creek with screens that do not meet current requirements. The IWG is recommending upgrades to these screens to comply with current NMFS and state standards. These screening projects will help decrease fish mortality in Icicle Creek.

The LNFH and COIC have a shared diversion located at RM 5.4. The Biological Opinion for LNFH requires this diversion's screen be upgraded to meet current fish passage requirements. LNFH and COIC are considering various operational changes that would reduce screen sizing, and LNFH is exploring water reuse options. COIC is considering moving their point of diversion to a location near the confluence of the Icicle Creek and the Wenatchee River and implementing other efficiency upgrades. The COIC completed an Alternatives Analysis in March 2015 (Anchor QEA, WWT, 2015) to evaluate potential changes to their supply. New diversion facilities for COIC would be designed with screens meeting current NMFS standards. If COIC moves forward with improvements that change the location of their diversion, COIC would no longer share a diversion with LNFH and LNFH would then size and design diversion improvements to meet only meet the needs of LNFH.

Depending on screen size and other intake structure improvements made to the LNFH diversion, cost estimates range from approximately $5.2 to $12.4 million. The implementation schedule for this project depends on environmental review and implementation of water efficiency upgrades. However, the 2015 Biological Opinion required screening within 8 years of the Biological Opinion date (MNFS, 2015).

In addition to upgrading the screens, the Icicle Strategy includes improvements the intake structure at LNFH. As part of this project, dilapidated sections of intake piping would be replaced. This will improve operations at LNFH and help facilitate the screen upgrade. USFWS is pursuing additional intake structure upgrades, descriptions of which are available in the *Leavenworth Fisheries Complex Planning Report* and the anticipated Leavenworth Fisheries Complex Implantation Plan. Figure 2-51 is a photo of the current screening facilities for LNFH and COIC.

Figure 2-51. LNFH/COIC Fixed Plate Screen (left) and COIC Bypass Screen (right)

The City of Leavenworth and IPID points of diversion are both located at RM 5.7, across Icicle Creek from one another. IPID owns and operates a small diversion structure that spans the creek at that location. The IPID diversion facilities are on the right bank (looking downstream) and include a diversion channel, operational spillways, a flow measurement flume, paddle wheel-driven rotating drum fish screens, and a bypass spillway. The facilities do not meet current NMFS standards and have potential to result in stranding or injury to fish.

The City of Leavenworth operates a diversion on the left bank (looking downstream) just upstream of the IPID diversion structure. City of Leavenworth facilities consist of a reinforced concrete diversion structure with a vertical, fixed plate screen. These facilities also have potential to cause injury and mortality to fish associated with stranding or entrainment in existing diversion facilities.

These projects are associated with the boulder field fish passage projects. Currently, only limited opportunistic passage occurs through the boulder field. The proposed fish passage improvements would enhance passage for anadromous and resident migratory species, including ESA-listed steelhead and bull trout. The IWG has identified the need to bring the IPID and City of Leavenworth screening facilities into compliance with current NMFS standards prior to improving passage through the boulder field. Screening upgrades have been identified as a potential early action item for the IWG, but would have to be coordinated with boulder field passage projects. Both the City of Leavenworth and IPID have been working with WDFW on securing funding for screen design. The current project estimate for screening these two diversions is approximately $5 million. However, improved estimates are expected later this year.

This project decreases fish mortality and brings major diversions up to current screening standards. In keeping with the Guiding Principles, it supports a sustainable LNFH and ensures compliance with state and federal laws.

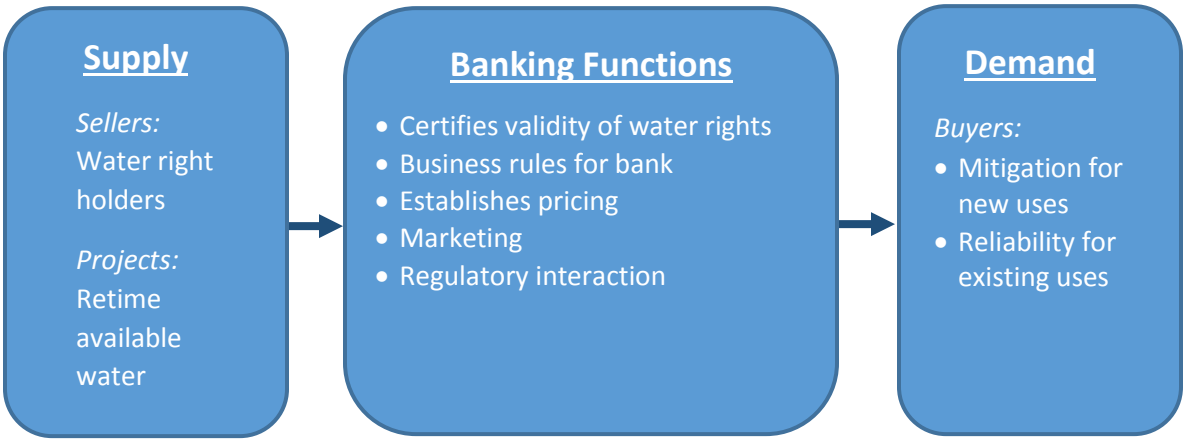
The screening improvements cost estimate range from $10.4 to $17.6 million, with additional costs for upgrading the intake structure.[40]

2.5.12 Water Markets

There are 56 agricultural water users in the Icicle and Wenatchee Basins that are curtailed in water-short years. Under this project, the IWG would create a voluntary Icicle Water Market to improve agricultural reliability for these water users, providing 3.4 cfs and 1,000 acre-feet to irrigators with interruptible water rights in the Icicle and Wenatchee basins.

Water markets allow people and farms who face water use restrictions to purchase mitigation credits to allow water use. Water banks and markets are part of the critical portfolio of tools needed to help address the complexities of water management—including drought risk, surface water-groundwater interactions, and legal and regulatory disputes and restrictions over water markets—thereby allowing scarce water resources to be allocated more efficiently. Figure 2-52 provides an overview of the water banking process.

Figure 2-52. Water Banking Process Overview



The overall goal of a water market is to facilitate water transfers using market forces. These goals include:

- Making water supplies available when and where needed during times of drought;
- Improving streamflows and preserving instream values during fish critical periods;
- Reducing water transaction costs, time, and risk to purchaser;
- Facilitate fair and efficient reallocation of water from one beneficial use to another;

[40] http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA%20Open%20House/Handouts/ScreenImprovements_final_reduced.pdf

- Providing water supplies to offset impacts related to future development and the issues of new water rights;
- Facilitating water agreements that protect upstream community values while retaining flexibility to meet critical downstream water needs in times of scarcity

In Washington, water markets are generally established through purchasing a water right and placing the water right into the Trust Water Rights Program (TWRP), where it can offset impacts of new users. After a water right is placed in the TWRP for mitigation and instream flow enhancement, a Trust Water Right Agreement (TWRA) is developed that specifies where and how new uses can be mitigated by the trust water right. Once the TWRA is developed, mitigation credits can be issued for new water users as specified by the TWRA.

Rather than providing mitigation for new uses, the Icicle Water Market would allow water to be moved to existing interruptible agricultural farms during water-short years. The Water Market would be seeded through a purchase of 1,000 acre-feet of senior irrigation water rights. These senior water rights would be enrolled in the TWRP, and Ecology would enter into a TWRA with the bank manager, likely Chelan County, to establish where, when, how, and what quantity of the trust water right could be used as mitigation. This would also include the development of a suitability map. Once the TWRA is established, Chelan County would develop its own business rules about price and restrictions. These business rules would be based on interviews with the 56 potential program participants regarding interest in the program and price points.

The estimated project cost is $3 million, or $3,000 per acre-foot.[41]

2.5.13 Costs and Benefits for Alternative 1 (Preferred Alternative)

The purpose of this section is to describe the costs and benefits of the projects that make up Alternative 1. This is not a cost-benefit analysis, but rather a summary of the predicted costs and benefits of Alternate 1. Cumulatively, these projects meet all of the Guiding Principles.

Alternative 1 has a total project benefit of 89 cfs and 31,958 acre-feet of total water (instream and out-of-stream water). The estimated cost is $65.6 million, $82.0 million when including a 25 percent contingency. With the contingency, the price per acre foot is estimated at $2,567per acre-foot. The average cost per acre-foot of water developed by

[41] http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA%20Open%20House/Handouts/WaterMarkets.pdf

the Office of Columbia River is approximately $500/acre-foot. Table 2-9 provides a breakdown of each project by describing the benefits and costs associated with each. These costs are subject to change as projects progress through feasibility and design, and a more complete picture of costs are developed.

Table 2-9
Summary of Alternative 1 Costs and Benefits[42]

Project	Total Water Developed		Project Cost ($ M)	Cost (per ac-ft)	Instream Flows (cfs)	LNFH	Fish Harvest	DM Supply	Ag Reliability	Habitat	Comply with Laws
	cfs	ac-ft									
Alpine Lakes Optimization & Automation	30	5,464	0.98	179	30				x		x
IPID Irrigation Efficiencies	10	3,000	7.50	2,500	10				x		x
COIC Irrigation Efficiencies & Pump Exchange	12	3,640	4.50	1,236	12				x		x
Domestic Conservation	0.5	400	1.00	2,500	-			x			x
Eightmile Lake Storage Restoration	13	3,600	2.00	556	13			x	x		x
Tribal & Non-tribal Fishery Preservation and Enhancement	-	-	0.50	-	-		x				x
Habitat Protection & Enhancement	-	-	2.50	-	-					x	x
Instream Flow Rule Amendment	0.4	400	0.05	125	-			x			x
LNFH Conservation & Water Quality Improvements	20	14,454	20.00	1,384	20	x					x
Fish Passage	-	-	6.00	-	-					x	x
Fish Screen Compliance	-	-	17.60	-	-					x	x
Water Markets	3	1,000	3.00	3,000	3				x		x
Totals	**89**	**31,958**	**65.6**	**2,054**	**88**	**x**	**x**	**x**	**x**	**x**	**x**
Contingency			**82.0**	**2,567**							

[42] An additional 25 percent contingency was added to projects within the ALWA in response to comments on the draft PEIS to account for additional costs that might be incurred for construction and mitigation measures. This is in addition to project contingencies already calculated and discussed. Project costs will likely be refined as project planning and design progress.

2.5.14 Timeline

The proposed timeline to implement Alternative 1 is below.

- Spring 2016 – Programmatic SEPA Scoping
- Summer 2016-Summer 2018 – Programmatic EIS Development
- Summer 2018 – Draft PEIS
- Winter 2018/2019 – Final PEIS, Preferred Alternative Selection
- Winter 2018-Spring 2019 – Project Level Environmental Review Scoping and NEPA Integration (Depending on Alternative Selected), Applicable design or feasibility studies on projects
- Summer 2019-Summer 2020 – Project Level Environmental Review (if applicable)
- Spring 2019-Fall 2028 – Project Construction/Implementation

There was a 60-day public comment period following the release of the draft PEIS, from May 31 to July 30, 2018. If it is determined that project-level SEPA scoping is necessary, there will also be opportunities for public comment during the scoping and following release of the draft and final project EIS.

2.6 Alternative 2

Alternative 2 was developed in response to SEPA scoping comments and includes a mix of projects that meet the Guiding Principles. It includes many of the projects included in Alternative 1—with the exception of the Alpine Lakes Optimization, Modernization, and Automation project—and adds the IPID Dryden Pump Exchange project. The projects included in Alternative 2 are described below.

2.6.1 IPID Dryden Pump Exchange

The IPID Dryden Pump Exchange project would supply a portion of IPID water from the Wenatchee River as opposed to Icicle and Peshastin Creeks. This project would provide an average water savings of 25 cfs and 1,484 acre-feet.

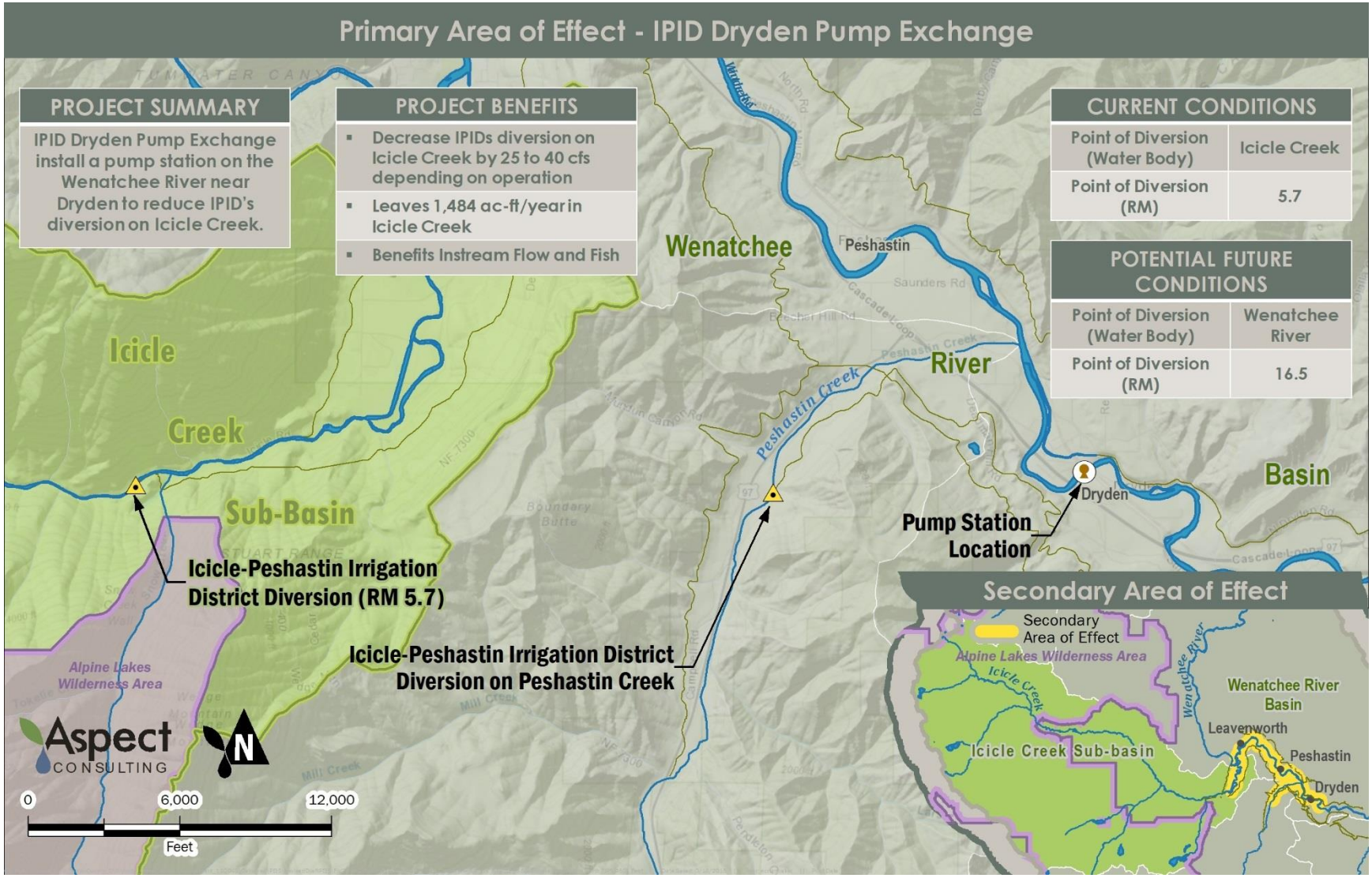
In December 2012, Anchor QEA submitted an *Appraisal Study of the Peshastin Irrigation District Pump Exchange* (Anchor QEA, 2012) project to Ecology and Chelan County Natural Resources. The Pump Exchange project sought to find ways to increase flow in Peshastin Creek downstream of the IPID diversion on Peshastin Creek to improve late summer fish passage, spawning, and rearing conditions in lower Peshastin Creek. The Appraisal Study evaluated five pump exchange options that would divert water

through a pump station on the right bank (looking downstream) of the Wenatchee River near Dryden, Washington.

An options comparison was presented to IPID and a preferred option was selected that would include a pump station on the right bank of the Wenatchee River near the Highway 2 bridge, immediately west of Dryden and a delivery pipeline that would extend through private orchards and driveways to the PID and IID canals. Based on the review of project options with IPID, this location was selected as the preferred project because of more favorable hydraulic conditions at the proposed diversion location, a lower projected project cost, and the potential for improving the reliability of the IPID system by providing an alternate source of supply downstream, of the most vulnerable part of the system.

Additional alternatives for pump exchange projects were evaluated by Trout Unlimited, with the assistance of Forsgren Associates, in 2014, as part of the *Icicle Irrigation District Instream Flow Improvement Options Analysis Study* (Forsgren Associates 2014). These included options for pumping directly to the Icicle Irrigation District Canal from the Wenatchee River. A memorandum titled, Icicle and Peshastin Irrigation Districts Pump Exchange Summary of Additional Analysis (Anchor QEA 2015) compared the various alternatives that had been considered by IPID and provided a detailed description of the preferred alternative identified by IPID. The other alternatives considered by IPID were not moved forward in this PEIS, as described in Section 2.10. See Figure 2-53 for additional explanation of the IPID Dryden pump exchange.

Figure 2-53. IPID Dryden Pump Exchange



The current concept for the proposed pump exchange, as identified in the 2015 memorandum, would include the following:

- A pump station located on the right bank of the Wenatchee River, just southwest (upstream) of U.S. Highway 2, approximately 7,250 feet downstream of the confluence of Peshastin Creek with the Wenatchee River (approximately RM 16.5)
- Four vertical turbine pumps, each designed to deliver approximately 12.5 cfs at a total dynamic head (TDH) of 246 feet (500 horsepower each)
- A 1,240-foot, 42-inch-diameter delivery pipeline that would extend south and east through an existing orchard, and then south and west up a steep hillside to the PID Canal
- A delivery structure at the PID Canal approximately 19,560 feet downstream of the diversion at Peshastin Creek
- Replacement of approximately 2,350 feet of the existing PID Canal downstream of the delivery structure with a 48-inch-diameter gravity pipeline to increase the conveyance capacity of the canal to at least 50 cfs
- Construction of a 15.5-acre-foot re-regulation pond with a high water surface elevation of 1,144 feet at a bend in the PID Canal approximately a 1/2 mile east of the proposed delivery structure
- Construction of a pump station on the east bank of the re-regulation pond to deliver flows to the IID Division 3A Canal
- Two vertical turbine pumps, each designed to deliver approximately 12.5 cfs at a TDH of 195 feet (400 horsepower each)
- A 1,300-foot, 30-inch-diameter delivery pipeline that would extend south and east through an existing orchard and up an existing access road to the IID Division 3A Canal
- A delivery structure at the IID Division 3A Canal approximately 200 feet downstream of the siphon outlet

The intent of the IPID Dryden Pump Exchange Project is to meet multiple goals of the IWG's Guiding Principles. This project has the potential to:

- Augment streamflow in Icicle Creek below the IID diversion at RM 5.7 by as much as 40 cfs during the late summer, with the average flow increase in Icicle Creek of 25 cfs. The project also has the potential to augment streamflow in Peshastin Creek below the IPID diversion at RM 2.4.
- Improve the reliability of water supply for agriculture.
- Benefit fish passage and habitat and treaty and non-treaty harvest.

The total estimated project implementation cost, including the items listed above, is $8.5 million, including a 30 percent contingency to account for project elements that are not

understood or have not been well defined at this early stage in the planning process. Long-term costs for operations and life cycle replacement of project elements were also estimated. IPID has indicated that for the project to move forward, long-term operating and life-cycle replacement costs would need to be paid for through grant funding as part of the overall cost of the project because the only beneficiary is instream flows. The present value of the long-term operating and replacement costs were estimated at approximately $5.7 million to $8.8 million, depending on the duration of pumping (estimated from 15 days to 90 days). The resulting total project, including implementation cost and present value of long-term operating and replacement costs, would range from approximately $14.2 million to $17.3 million. O&M costs and the lack of a permanent funding are issues for this project. IPID is continuing to work with Chelan County to develop the pump exchange project concept and has secured funding for a preliminary design evaluation of a portion of the project that would initially target delivering flows to the Peshastin Irrigation District Canal through a pump station on the Wenatchee River near Dryden. One issue that was identified but not incorporated into this programmatic level environmental review is the cost of power costs for projects like Dryden Pump Exchange (or the pump exchange in Alternative 5). Converting gravity diversions to pump stations will consume power indefinitely, and was a factor in considering alternatives.

2.6.2 IPID Irrigation Efficiencies

The IPID irrigation efficiencies for this alternative are the same as is described in Section 2.5.2.

2.6.3 COIC Irrigation Efficiencies and Pump Exchange

The COIC irrigation efficiencies and pump exchange for this alternative are the same as is described in Section 2.5.3.

2.6.4 Domestic Conservation

The domestic conservation alternative is described in Section 2.5.4.

2.6.5 Eightmile Lake Storage Restoration

The Eightmile Lake Storage Restoration is described in Section 2.5.5.

2.6.6 Tribal Fishery Preservation and Enhancement

The tribal fishery preservation and enhancement alternative is described in Section 2.5.6.

2.6.7 Habitat Protection and Enhancement

The habitat protection and enhancement alternative is described in Section 2.5.7.

2.6.8 Instream Flow Rule Amendment

The instream flow rule amendment alternative is described in Section 2.5.8.

2.6.9 Leavenworth National Fish Hatchery Conservation and Water Quality Improvements

The LNFH conservation and water quality improvements alternative is described in Section 2.5.9.

2.6.10 Fish Passage

The fish passage alternative is described in Section 2.5.10.

2.6.11 Fish Screen Compliance

The fish screen compliance alternative is described in Section 2.5.11.

2.6.12 Water Markets

The water market alternative is described in Section 2.5.12.

2.6.13 Costs and Benefits for Alternative 2

The costs and benefits for Alternative 2 are described in Table 2-10. However, this is not a cost-benefit analysis, but rather a summary of the predicted costs and benefits of Alternate 2. Cumulatively, these projects meet all of the Guiding Principles by improving streamflow, LNFH sustainability, protecting tribal and non-tribal fishers, improving domestic supply and agricultural reliability, and enhancing Icicle Creek habitat.

Alternative 2 has a total project benefit of 84 cfs and 27,978 acre-feet of total water (instream and out-of-stream water). The current cost estimate is approximately $91.44 million, including a 25 percent contingency. This amounts to $3,268 per acre-foot. As noted above, the average cost per acre-foot of water developed by the Office of Columbia River is approximately $500/acre-foot. Table 2-9 provides a breakdown of each project in Alternative 2 and the benefits and costs associated with each. These costs are subject to change as projects progress through feasibility and design, and a more complete picture of costs are developed.

Table 2-10
Summary of Alternative 2 Costs and Benefits[43]

Project	Total Water Developed		Project Cost ($ M)	Cost (per ac-ft)	Instream Flows (cfs)	LNFH	Fish Harvest	DM Supply	Ag Reliability	Habitat	Comply with Laws
	cfs	ac-ft									
IPID Dryden Pump Station	25	1,484	8.50	5,728	25				x		x
IPID Irrigation Efficiencies	10	3,000	7.50	2,500	10				x		x
COIC Irrigation Efficiencies & Pump Exchange	12	3,640	4.50	1,236	12				x		x
Domestic Conservation	0.5	400	1.00	2,500	-			x			x
Eightmile Lake Storage Restoration	13	3,600	2.00	556	13			x	x		x
Tribal and Non-Tribal Fishery Preservation and Enhancement	-	-	0.50	-	-		x				x
Habitat Protection and Enhancement	-	-	2.50	-	-					x	x
Instream Flow Rule Amendment	0.4	400	0.05	125	-			x			x
LNFH Conservation and Water Quality Improvements	20	14,454	20.00	1,384	20	x					x
Fish Passage	-	-	6.00	-	-					x	x
Fish Screen Compliance	-	-	17.60	-	-					x	x
Water Markets	3	1,000	3.00	3,000	3				x		x
Totals	**84**	**27,978**	**73.15**	**2,615**	**83**	**x**	**x**	**x**	**x**	**x**	**x**
Contingency			**91.44**	**3,268**							

[43] An additional 25 percent contingency was added to projects within the ALWA in response to comments on the draft PEIS to account for additional costs that might be incurred for construction and mitigation measures. This is in addition to project contingencies already calculated and discussed. Project costs will likely be refined as project planning and design progress.

2.6.14 Timeline

The proposed timeline to implement the projects that compose Alternative 2 is below.

- Spring 2016 – Programmatic SEPA Scoping
- Summer 2016-Summer 2018 – Programmatic EIS Development
- Summer 2018 – Draft PEIS
- Winter 2018/2019 – Final PEIS, Preferred Alternative Selection
- Fall 2018-Spring 2019 – Project Level Environmental Review Scoping and NEPA Integration (Depending on Alternative Selected), Applicable design or feasibility studies on projects
- Summer 2019-Summer 2020 – Project Level Environmental Review (if applicable)
- Spring 2019Fall 2028 – Project Construction/Implementation

There was a 60-day public comment period following the release of the draft PEIS, from May 31, to July 30, 2018. If it is determined that project-level SEPA scoping is necessary, there will also be opportunities for public comment during the scoping and following release of the draft and final project EIS.

2.7 Alternative 3

Alternative 3 focuses on areas outside of the ALWA. It includes most of the projects from Alternative 1, with the exception of the Alpine Lakes Optimization, Modernization, and Automation project and the Eightmile Lake Storage Restoration. It also calls for legislative action to allow an OCPI to address domestic use and instream flow impacts.

It should be noted that while Alternative 3 does not include projects within the ALWA, maintenance and construction activities needed for IPID's management of the lakes will continue but water would not be released to meet the Guiding Principles (mainly instream flow).

The projects in Alternative 3 are described below.

2.7.1 IPID Dryden Pump Exchange

The Peshastin Irrigation District pump exchange alternative is described in Section 2.6.1.

2.7.2 IPID Irrigation Efficiencies

The IPID irrigation efficiencies for this alternative are the same as is described in Section 2.5.2.

2.7.3 COIC Irrigation Efficiencies and Pump Exchange

The COIC irrigation efficiencies and pump exchange for this alternative are the same as is described in Section 2.5.3.

2.7.4 Domestic Conservation

The domestic conservation alternative is described in Section 2.5.4.

2.7.5 Tribal Fishery Preservation and Enhancement

The tribal fishery preservation and enhancement alternative is described in Section 2.5.6.

2.7.6 Habitat Protection and Enhancement

The habitat protection and enhancement alternative is described in Section 2.5.7.

2.7.7 Instream Flow Rule Amendment

The instream flow rule amendment alternative is described in Section 2.5.8.

2.7.8 Leavenworth national Fish Hatchery Conservation and Water Quality Improvements

The LNFH conservation and water quality improvements alternative is described in Section 2.5.9.

2.7.9 Fish Passage

The fish passage alternative is described in Section 2.5.10.

2.7.10 Fish Screen Compliance

The fish-screen compliance alternative is described in Section 2.5.11.

2.7.11 Water Markets

The water market alternative is described in Section 2.5.12.

2.7.12 Legislative Change to OCPI

In order to meet the domestic supply Guiding Principle under Alternative 3, there would need to be a legislative change to waive impacts to instream flows when conservation and pump-exchange-based supplies cannot perfectly meet demand required to provide domestic reliability. For example, conservation supplies are available in April to October in this Alternative, but the Guiding Principle for domestic reliability requires year-round supplies. Because instream flows are at times not met from November to March, this would impair instream flows if legislative approval was not provided. Ecology no longer has the authority to waive these kinds of impacts through an OCPI determination under RCW 90.54.020 given clarity from the Supreme Court in cases like *Swinomish* and *Foster/Yelm*.

A legislative change would include having a bill introduced and passed by the state legislature that would allow for impacts to the instream flow rule when domestic demand and flow improvement projects cannot be timed perfectly.

This would provide enough water for Icicle Creek Subbasin and City of Leavenworth population growth through 2050. The project costs would be approximately $25,000. Additional water for the City of Leavenworth would be pursued on the Wenatchee River to reduce impacts to Icicle Creek.

2.7.13 Costs and Benefits for Alternative 3

The purpose of this section is to describe the costs and benefits of this alternative. However, this is not a cost-benefit analysis, but rather a summary of the predicted costs and benefits of Alternate 3. Cumulatively, these projects meet all of the Guiding Principles by improving streamflow, LNFH sustainability, protecting tribal and non-tribal fishers, improving domestic supply and agricultural reliability, and enhancing Icicle Creek habitat.

Alternative 2 has a total project benefit of 71 cfs and 24,378 acre-feet of total water (instream and out-of-stream water). Currently, costs are estimated at approximately $89.0 million, including a 25 percent contingency. This amounts to $3,650 per acre-foot. As noted above, the average cost per acre-foot of water developed by the Office of Columbia River is approximately $500/acre-foot. Table 2-11 provides a breakdown of each project by describing the benefits and costs associated with each. These costs are subject to change as projects progress through feasibility and design, and a more complete picture of costs are developed.

Table 2-11
Summary of Alternative 3 Costs and Benefits[44]

Project	Total Water Developed		Project Cost ($ M)	Cost (per ac-ft)	Instream Flows (cfs)	LNFH	Fish Harvest	DM Supply	Ag Reliability	Habitat	Comply with Laws
	cfs	ac-ft									
IPID Pump Exchange	25	1,484	8.50	5,728	25				x		x
IPID Irrigation Efficiencies	10	3,000	7.50	2,500	10				x		x
COIC Irrigation Efficiencies	12	3,640	4.5	1,236	12				x		x
Domestic Conservation Efficiencies	0.5	400	1.00	2,500	-			x			x
Tribal Fishery Protection	-	-	0.50	-	-		x				x
Habitat Protection and Enhancement	-	-	2.50	-	-					x	x
Instream Flow Rule Amendment	0.4	400	0.05	125	-			x			x
LNFH Conservation and Water Quality Improvements	20	14,454	20.00	1,384	20	x					x
Fish Passage	-	-	6.00	-	-					x	x
Fish Screening	-	-	17.60	-	-					x	x
Water Markets	3	3,000	3.00	3,000	3				x		x
Legislative Change to OCPI	-	-	0.03	-	-			x			x
Totals	**71**	**24,378**	**71.2**	**2,919**	**70**	**x**	**x**	**x**	**x**	**x**	**x**
Contingency			**89.0**	**3,650**							

2.7.14 Timeline

The proposed timeline to implement the projects that compose Alternative 3 is below.

- Spring 2016 – Programmatic SEPA Scoping
- Summer 2016-Summer 2018 – Programmatic EIS Development
- Summer 2018 – Draft PEIS

[44] Project costs will likely be refined as project planning and design progress.

- Winter 2018/2019 – Final PEIS, Preferred Alternative Selection
- Fall 2018-Spring 2019 – Project Level Environmental Review Scoping and NEPA Integration (Depending on Alternative Selected), Applicable design or feasibility studies on projects
- Summer 2019-Summer 2020 – Project Level Environmental Review (if applicable)
- Spring 2019-Fall 2028 – Project Construction/Implementation

There was a 60-day public comment period following the release of the draft PEIS, from May 31 to July 30, 2018. If it is determined that project-level SEPA scoping is necessary, there will also be opportunities for public comment during the scoping and following release of the draft and final project EIS.

2.8 Alternative 4

Alternative 4 was developed in response to SEPA scoping comments expressing a desire for increased storage in the Icicle Creek Subbasin to improve reliability of water supply and resiliency against climate change. This alternative includes many of the same projects included in Alternative 1. It also includes rebuilding control facilities at Eightmile Lake Reservoir to increase storage beyond its historical capacity, enhancing storage and releases from Upper Klonaqua, and rebuilding control facilities at Upper and Lower Snow Lakes to increase storage available from those lakes. The projects included in Alternative 4 are described below.

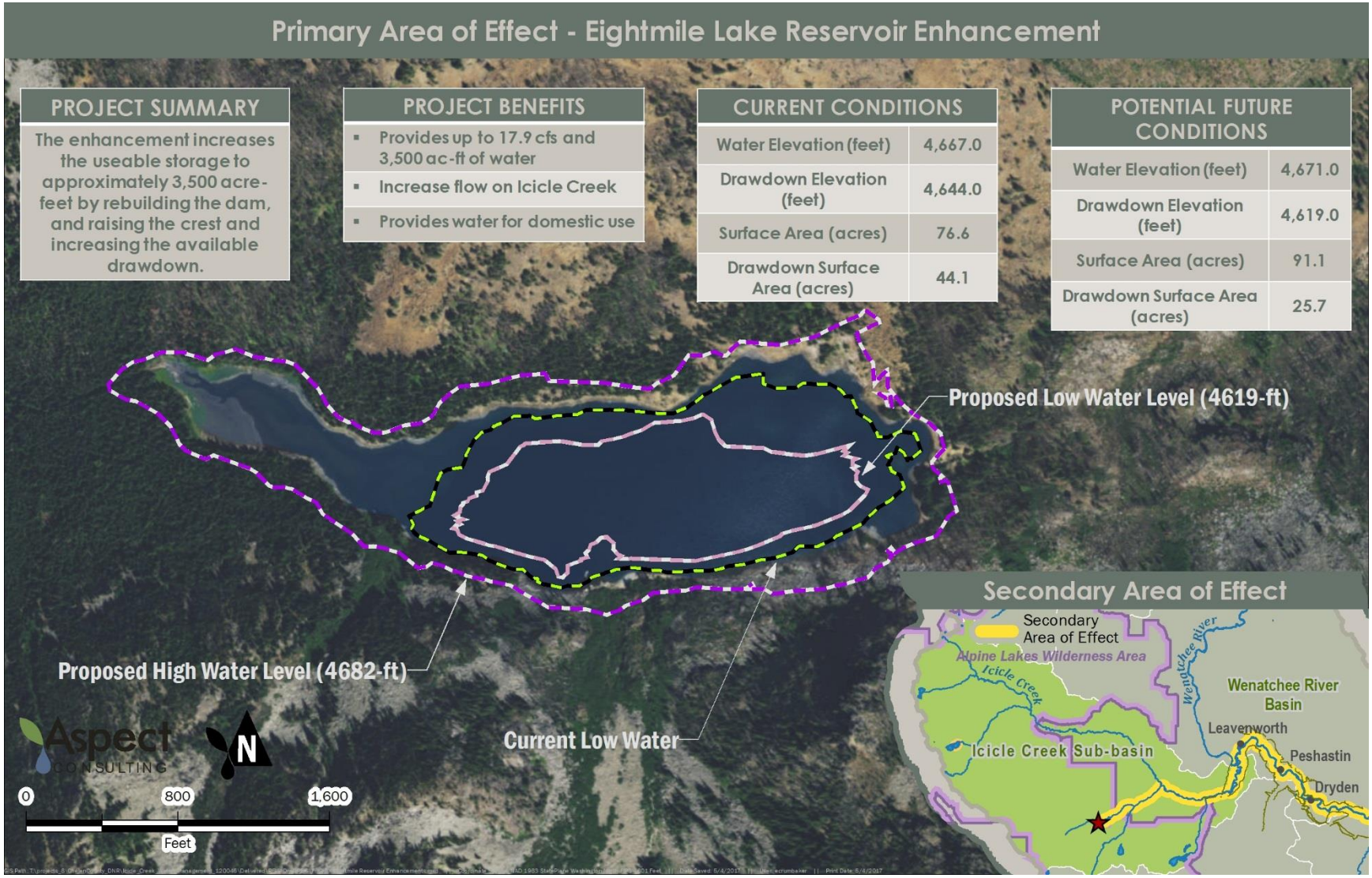
2.8.1 Alpine Lakes Optimization, Modernization and Automation

The Alpine Lakes optimization, modernization and automation alternative is the same as is described in Section 2.5.1.

2.8.2 Eightmile Lake Storage Enhancement

Eightmile Lake Storage Enhancement project proposes to replace the existing dam, low-level outlet pipeline, and controls at Eightmile Lake with facilities that would increase the useable storage capacity to 3,500 acre-feet, which represents a 1,000-acre-foot increase over the volume that can currently be captured and released under IPID's water right. The project would increase the useable storage by increasing the dam height and draw down level. This project would provide up to 17.9 cfs and 1,900 acre-feet of water for instream flow and domestic use. IPID would continuing using up to 1,600 acre-feet of water from Eightmile Lake. See Figure 2-54 for additional information on the Eightmile Lake storage enhancement.

Figure 2-54. Eightmile Reservoir Enhancements



The IWG evaluated four storage scenarios at Eightmile Lake as part of the *Appraisal Study, Eightmile Lake Storage Restoration*. These scenarios included installing a siphon to increase draw down, rebuilding the dam to restore the maximum water surface elevation to its historical level, and rebuilding the dam to increase storage. These project alternatives would provide 2,000 acre-feet, 2,500 acre-feet, and 3,500 acre-feet, respectively, of usable storage. The IWG proposed restoration to 2,500 acre-feet as part of its Base Package of projects, which would include restoration of the dam to allow water to be stored at the historical spillway/high water surface elevation, and extension of the low-level outlet pipe into the lake to facilitate draw down to an elevation of 4,621 feet. This Eightmile Lake Storage Restoration project is included in Alternative 1, Alternative 2, and Alternative 5; it is described in Section 2.5.5.

The Eightmile Lake Enhancement project included in Alternative 4 would increase usable storage to 3,500 acre-feet, and would include the following improvements:

- Rebuild the dam at Eightmile Lake with a spillway/high water surface elevation of 4,682.0 feet, or 11 feet higher than the historical spillway/high water surface elevation (4,671.0 feet).
- Extend the new low-level outlet pipeline into the lake to facilitate operational draw down of the water surface elevation to minimum elevation of 4,619.0 feet.

These improvements would increase the volume available for release and allow for an additional release of 17.9 cfs over a 60-day period.

The maximum inundation area, approximately 91.1 acres, would be larger than the historical maximum inundation area. Most of the newly inundated area would be along the existing, relatively steep shoreline. The water surface area at the new maximum draw down elevation would be approximately 25.7 acres, which is approximately 18.4 acres less than the water surface area at the current minimum water surface elevation.

The Eightmile Lake Enhancement project meets many of the Guiding Principles adopted by the IWG. Instream and out-of-stream flow improvements would benefit ecosystem health and habitat. It also has the potential to benefit operations at the LNFH if the lake was managed to allow for winter low-flow period releases. The enhancements and improvements create over 1,900 acre-feet of new supply for instream flow and municipal use, and automates and optimizes releases to improve reliability for agricultural use and stream flows. Compliance with state and federal laws, including Wilderness Act of 1964 and the Alpine Lakes Area Management Act of 1976, would be required for project permitting and construction.

The cost to implement the Eightmile Lake Enhancement is $3.9 million (Anchor QEA, 2015), as updated using the RS Mean Historical Cost Index. This cost equates to $2,053 per acre-foot of additional storage created. The long-term costs to operate and maintain the new facilities, including regular maintenance, repairs, servicing and inspections, and on-site start-up and shut-down each season, is approximately $18,500 per year.

2.8.3 Upper Klonaqua Lake Storage Enhancement

The Upper Klonaqua Storage Enhancement project proposes to draw down Upper Klonaqua Lake and would provide up to 20 cfs and 2,448 acre-feet[45] of water for instream flow and domestic benefit.

Upper Klonaqua Lake is located just west of Lower Klonaqua Lake in the Icicle Creek Subbasin of WRIA 45 (Wenatchee Basin) and is used, along with several other area lakes, to augment water supply for the IPID. Both the Upper and Lower Klonaqua Lakes are managed by the IPID, and flows released from both lakes allow the IPID to maintain irrigation diversions and meet instream flow obligations. Access to waters stored in Upper Klonaqua Lake may help to provide more reliable instream flows during critical times of year such as late summer/fall.

Bathymetry and topographic surveys were completed at Upper Klonaqua Lake in September and October 2014 by Gravity Consulting to better understand the volume of water stored in Upper Klonaqua Lake. The survey measured the water surface elevation difference between Upper and Lower Klonaqua Lakes at approximately 115.8 feet. The survey estimated the difference in high water surface elevations between the two lakes at approximately 97 feet.

Releases from Lower Klonaqua Lake are controlled by a gate through a low-level outlet pipeline, which is operated by an actuator at the crest of the existing embankment dam. During the years when Klonaqua Lakes are actively managed, IPID personnel hike more than 10 miles (one way) to the Lower Klonaqua Lake to open the gate in July. IPID personnel return to close the gate in late September or October when the lake is drawn down and the irrigation season is over.

Three conceptual options are under consideration by IPID for allowing access to water stored in Upper Klonaqua Lake that is conveyed to Lower Klonaqua Lake and from there through the existing system to Icicle Creek and IPID uses:

Tunneling. A tunnel option would involve drilling and blasting through the bedrock outcrop between the upper and lower lakes. The tunnel could then be equipped with an automated gate valve to control releases to the lower lake. Based on the bathymetry survey, the preferred location for tunneling would be along the southern portion of the bedrock ridge, where the slope of the lakebed is steep and is not affected by the high bedrock that is apparent in the northeast portion of the lake.

Siphoning. Siphoning would involve the use of a pipe for hydraulic conveyance over an intermediate high point by gravity using differential pressure between a

[45] Five release volumes were calculated in the *Bathymetry and Topographic Survey of upper Klonaqua Lake and Conceptual Release Options memorandum* (Aspect, 2014). 2,448 acre-feet represents water possibly made available under the largest draw down scenario of 50 feet.

reservoir surface and an outlet. While it may be possible to implement a siphon to achieve some additional draw down potential, the maximum siphon lift at the high lake elevations would be limited and is likely on the order of 10 to 15 feet. Siphoning would also have inherent operational and maintenance issues associated with initiating and maintaining a siphon. Appropriate infrastructure, including a priming or vacuum pump and generator, would be some of the considerations for a detailed feasibility study and design of a siphoning option.

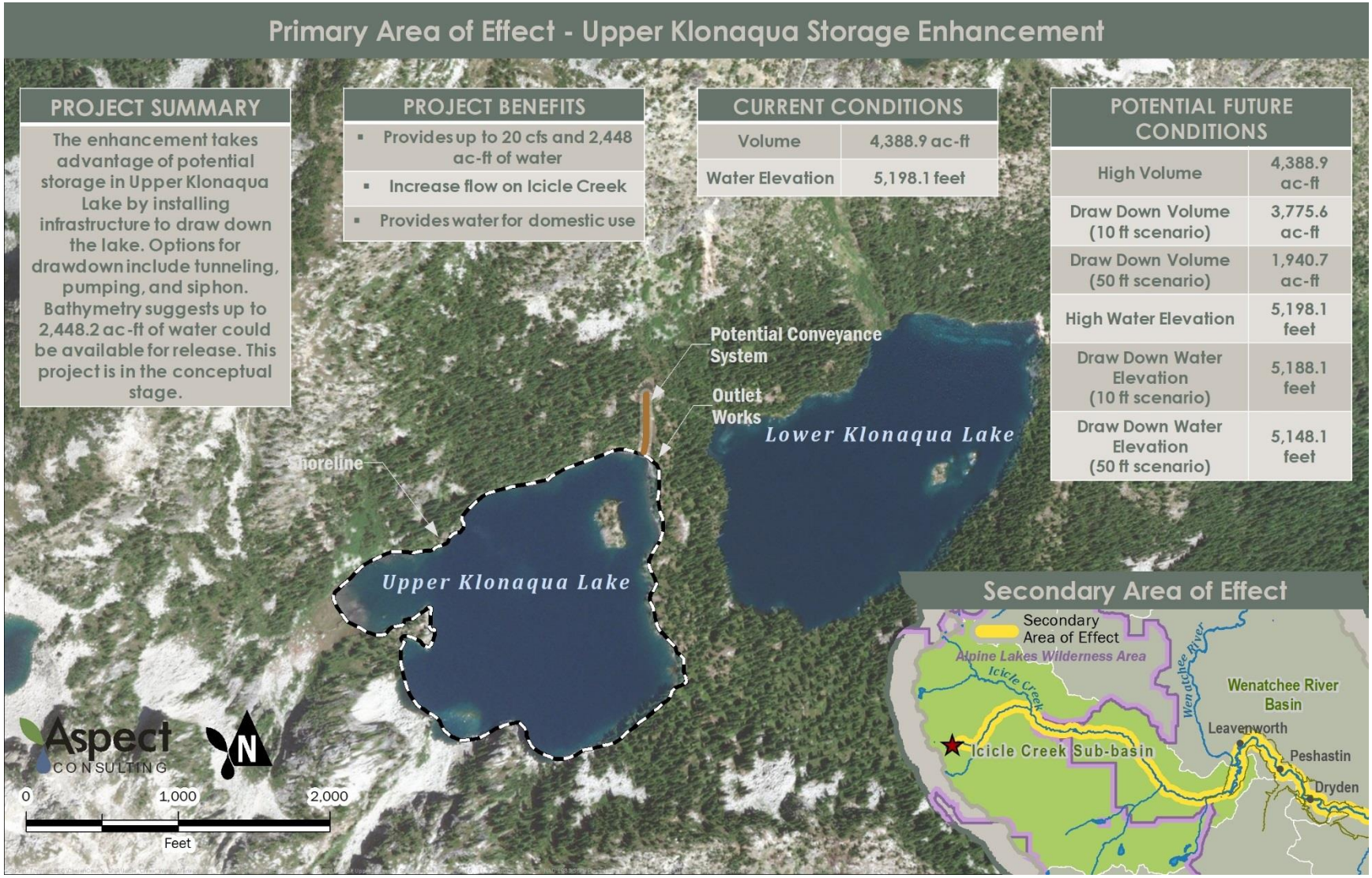
Pumping. Pumping would involve the installation of either a permanent or semi-permanent facility at the lake to lift the water over the land between the two lakes. Submersible pumps or vertical turbine pumps could provide the greatest potential draw down but would require on-site power generation (likely a diesel generator). End-suction, engine driven pumps could also be utilized, but would allow for lesser draw down (similar to siphon limitations) and would provide limited benefit beyond submersible pump or siphoning options. Fuel consumption with a pumping option would be a significant consideration. For example, a 10 cfs pumping system with 50-foot lift capacity may require a 60-kW diesel generator. A generator this size would have a fuel consumption of over 100 gallons of diesel per day. Other fairly significant potential environmental impacts would need to be considered and evaluated with this option, including noise, emissions, spill/leak potential, etc. Physical operation of the pump, including labor, would also need to be considered.

Any of the above options would require detailed feasibility studies, and design and permitting analyses. See Figure 2-55 for additional information on Upper Klonaqua Lake storage enhancement. Release of additional storage from Upper Klonaqua Lake could help meet the Guiding Principles adopted by the IWG, such as additional instream flow augmentation and additional domestic/municipal supply. This project has the potential to increase storage to 2,448 acre-feet, and provide between 5 and 20 cfs of flow benefit. This project is at the conceptual stages and no cost estimates have been developed.

2.8.4 Upper and Lower Snow Lakes Storage Enhancement

The Upper and Lower Snow Lakes Storage Enhancement project would increase available storage in the Snow Lakes System, providing up to 18 cfs and 1,079 acre-feet for instream flow and domestic benefit.

Figure 2-55. Upper Klonaqua Storage Enhancement



Upper and Lower Snow Lakes are situated within the ALWA of the Icicle Creek Subbasin with a combined surface area of approximately 189.3 acres, maximum water surface elevations of 5,420 feet (Upper Snow Lake) and 5,415 feet (Lower Snow Lake), and a tributary basin area of 3,060 acres. The USFWS manages both lakes, and flows released from them supply water to the LNFH (operated by USFWS) and meet instream flow obligations. The combined existing active, useable storage capacity in these lakes is estimated at 12,900 acre-feet, 750 acre-feet of which is released for IPID. Water released from Upper Snow Lake is conveyed through a tunnel to Nada Lake.

The lakes are operated jointly to increase late summer flows in Snow Creek, which is a tributary to Icicle Creek. The increased flows to Icicle Creek help supply the LNFH's operational requirements (approximately 40 cfs between June and October) and supplement flow in Icicle Creek.

The *Water Storage Report, Wenatchee River Basin* (Anchor QEA, Feb. 2011) provided results of a preliminary feasibility analysis of the potential for increasing water storage in the Snow Lakes. Increasing the storage capacity would allow for additional releases during the late summer or during dry years to improve flows in Icicle Creek and the lower Wenatchee River. The additional storage would also improve operations of fish rearing facilities at the LNFH.

The Upper and Lower Snow Lakes Storage Enhancement project would combine some of the recommendations made as part of the feasibility analysis to increase storage available for release from these lakes. The project would also automate releases from the Snow Lakes by making use of additional water storage capacity (within the existing water rights) by improving infrastructure to allow for more water to be captured and released. This would be achieved by implementing additional improvements identified in the *Water Storage Report, Wenatchee River Basin* (Anchor QEA, 2011) to increase storage and automate releases from the Snow Lakes, including:

- **Replace Upper and Lower Snow Lake dams and increase the dam crest elevation by 5 feet at both locations.** The dam structures at Upper and Lower Snow Lakes would be replaced as described in the *Water Storage Report, Wenatchee River Basin* (Anchor QEA, 2011). The new dams would have a crest elevation 5 feet higher than the existing structures.
- **Install a new low-level outlet at Lower Snow Lake that would allow for 3 additional feet of draw down.** The low-level outlet pipe at Lower Snow Lake would be installed 3 feet lower than the existing low-level outlet to increase storage.
- **Replace the low-level outlet pipes and gates at both lakes.** The low-level outlet pipe at both Upper and Lower Snow Lakes would be replaced. A new flap gate would be installed at the inlet to the low-level outlet at Upper Snow Lake to allow water to flow only from Lower Snow Lake to Upper Snow Lake when Upper Snow Lake has been drawn down and is lower than Lower Snow Lake. A new slide gate would be installed on the inlet to the low-level outlet pipe at Lower Snow Lake and

the gate would be automated and connected to telemetry to allow for remote control and optimization of releases.

- Automate the low-level outlet gate at Lower Snow Lake and the existing valve on the penstock that discharges water from Upper Snow Lake to Nada Lake. This includes installation of motorized actuators on release gates and valves, installation of solar panels and battery packs as power supply for motorized actuators, installation of controls and communications equipment at each actuator, and weatherproof enclosures.
- **Install telemetry to allow for remote operation of the automated gate and valve.** This includes using radio telemetry and repeater stations to remotely control water releases.

The preliminary evaluation determined that raising the existing dams or constructing new dams to raise the water levels in Upper and Lower Snow Lakes by 5 feet and drawing down Lower Snow Lake by 3 feet would increase the total storage capacity of the two lakes by approximately 1,079 acre-feet. The additional storage, combined with improvements designed to provide remote control of the outlet valve, would allow for the release of an additional 18 cfs for 30 days or 9 cfs for 60 days to Icicle Creek via Snow Creek to support LNFH operations and increase instream flows in Icicle Creek and the Lower Wenatchee River. See Figure 2-56 for additional information on the Upper Snow Lake storage enhancement.

The overall cost of the project was estimated to be $1.4 million (Anchor QEA, 2011) as update with the RS Means Historical Cost Index, approximately $1,297 per acre-foot of additional storage.

2.8.5 IPID Irrigation Efficiencies

The IPID irrigation efficiencies for this alternative are the same as is described in Section 2.5.2.

2.8.6 COIC Irrigation Efficiencies and Pump Exchange

The COIC irrigation efficiencies and pump exchange for this alternative are the same as is described in Section 2.5.3.

2.8.7 Domestic Conservation

The domestic conservation alternative is described in Section 2.5.4.

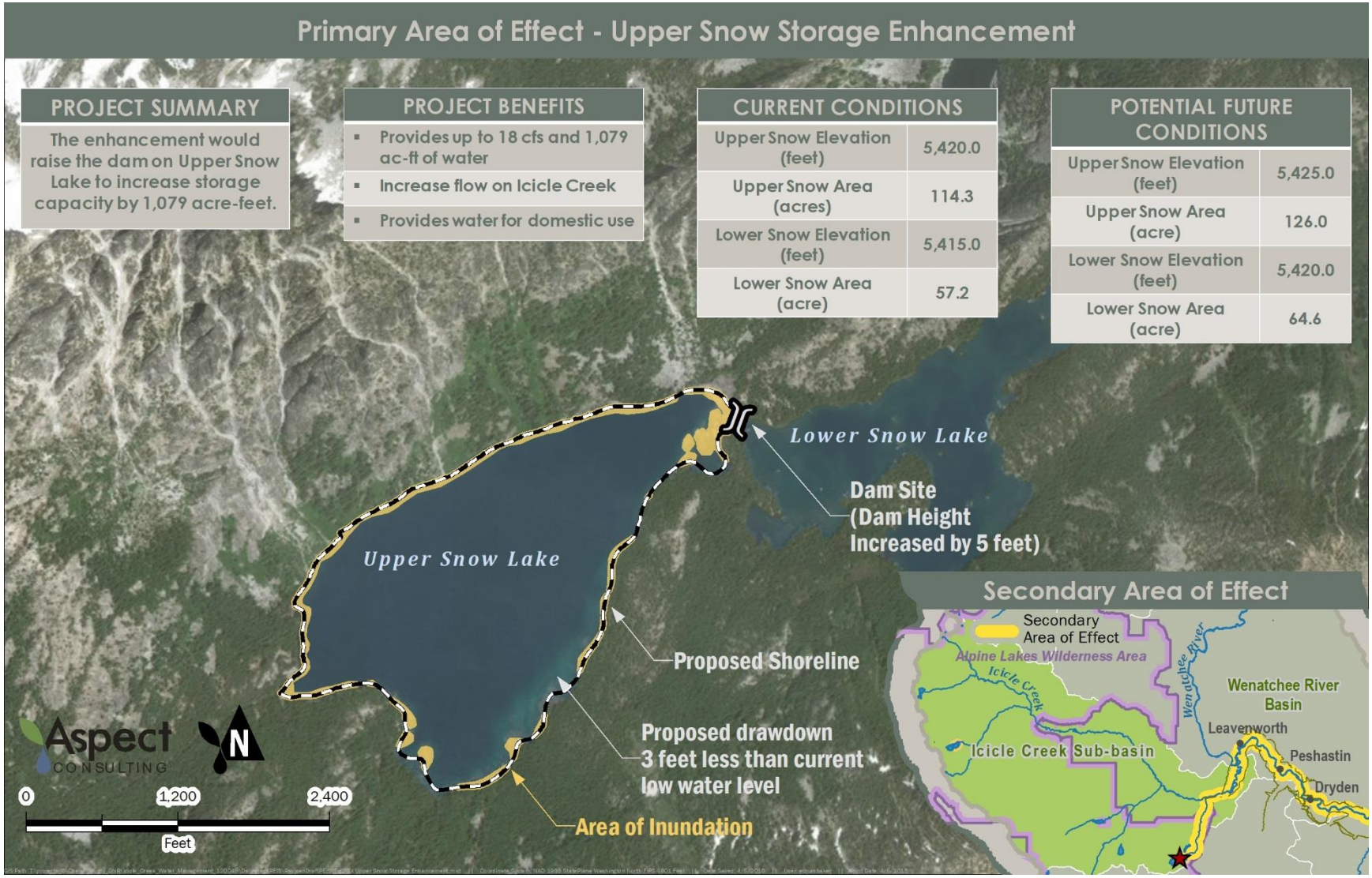
2.8.8 Tribal Fishery Preservation and Enhancement

The tribal fishery preservation and enhancement alternative is described in Section 2.5.6.

2.8.9 Habitat Protection and Enhancement

The habitat protection and enhancement alternative is described in Section 2.5.7.

Figure 2-56. Upper Snow Storage Enhancement



2.8.10 Instream Flow Rule Amendment

The instream flow rule amendment alternative is described in Section 2.5.8.

2.8.11 Leavenworth National Fish Hatchery Conservation and Water Quality Improvements

The LNFH conservation and water quality improvements alternative is described in Section 2.5.9.

2.8.12 Fish Passage

The fish passage alternative is described in Section 2.5.10.

2.8.13 Fish Screen Compliance

The fish screen compliance alternative is described in Section 2.5.11.

2.8.14 Water Markets

The water market alternative is described in Section 2.5.12.

2.8.15 Costs and Benefits for Alternative 4

The costs and benefits for Alternative 4 are described in Table 2-12. However, this is not a cost-benefit analysis, but rather a summary of the predicted costs and benefits of Alternate 4. Cumulatively, these projects meet all of the Guiding Principles by improving streamflow, LNFH sustainability, protecting tribal and non-tribal fishers, improving domestic supply and agricultural reliability, and enhancing Icicle Creek habitat.

This alternative would provide an estimated by 132 cfs and 35,385 acre-feet of total water (instream and out-of-stream) and cost approximately $87.8 million (including a 25 percent contingency). The estimated cost per ac-ft is $2,482. However, this cost estimate does not include the potential costs of the Upper Klonaqua Storage Enhancement project because cost estimates have not been produced for this project. The average cost per acre-foot of water developed by the Office of Columbia River is approximately $500/acre-foot. Table 2-12 provides a breakdown of each project in Alternative 4 and the benefits and costs associated with each. These costs are subject to change as projects progress through feasibility and design, and a more complete picture of costs are developed.

Table 2-12[46]
Summary of Alternative 4 Costs and Benefits

Project	Total Water Development		Project Cost ($M)	Cost (per ac-ft)	Instream Flows (cfs)	LNFH	Fish Harvest	DM Supply	Ag Reliability	Habitat	Comply with Laws
	cfs	ac-ft									
Alpine Lakes Automation	30	5,464	0.98	179	30				x		x
IPID Irrigation Efficiencies	10	3,000	7.50	2,500	10				x		x
COIC Irrigation Efficiencies	12	3,640	4.50	1,236	12				x		x
Domestic Conservation Efficiencies	0.5	400	1.00	2,500	0			x			x
Eightmile Lake Storage Enhancement	18	3,500	4.9	1,393	18			x	x		x
Snow lake Storage Enhancement	18	1,079	1.75	1,622	18			x	x		x
Upper Klonaqua Lake Storage Enhancement	20	2,448	unknown	-	20			x	x		x
Tribal Fishery Protection	-	-	0.50	-	0		x				x
Habitat Protection and Enhancement	-	-	2.50	-	0					x	x
Instream Flow Rule Amendment	0.4	400	0.05	125	0			x			x
LNFH Conservation and Water Quality Improvements	20	14,454	20.00	1,384	20	x					x
Fish Passage	-		6.00	-	0					x	x
Fish Screening	-		17.60	-	0					x	x
Water Markets	-	1,000	3.00	3,000	3				x		x
Totals	**132**	**35,385**	**70.3**	**1,985**	**131**	**x**	**x**	**x**	**x**	**x**	**x**
Contingency			**87.8**	**2,482**							

[46] An additional 25 percent contingency was added to projects within the ALWA in response to comments on the draft PEIS to account for additional costs that might be incurred for construction and mitigation measures. This is in addition to project contingencies already calculated and discussed. Project costs will likely be refined as project planning and design progress.

2.8.16 Timeline

The proposed timeline to implement the projects that compose Alternative 4 is below.

- Spring 2016 – Programmatic SEPA Scoping
- Summer 2016-Summer 2018 – Programmatic EIS Development
- Summer 2018 – Draft PEIS
- Winter 2018/2019 – Final PEIS, Preferred Alternative Selection
- Fall 2018-Spring 2019 – Project Level Environmental Review Scoping and NEPA Integration (Depending on Alternative Selected), Applicable design or feasibility studies on projects
- Summer 2019-Summer 2020 – Project Level Environmental Review (if applicable)
- Spring 2019-Fall 2028 – Project Construction/Implementation

There was a 60-day public comment period following the release of the draft PEIS from May 31, to July 30, 2018. If it is determined that project-level SEPA scoping is necessary, there will also be opportunities for public comment during the scoping and following release of the draft and final project EIS.

2.9 Alternative 5

Alternative 5 was developed following further study on piping and conservation options for IPID and based on ongoing discussions with stakeholders about the potential for reducing diversions from Icicle Creek. This alternative includes all projects proposed under Alternative 1, except the IPID Dryden Irrigation Efficiencies project would be replaced by the IPID Full Piping and Pump Exchange project. The IPID Full Piping and Pump Exchange project would replace the IPID canal systems with a pressurized pipe delivery system. Three intake and pump station facilities would be constructed on the Wenatchee River to supply the new system. The existing surface water diversion facilities on Icicle Creek and Peshastin Creek would be removed. Even though the diversion would be completely removed from Icicle Creek, IPID would still need to store and release water from their lakes within the ALWA to ensure that water was available in the Wenatchee River for its use. Without releases from the lakes, water supply shortages to IPID would exist in both average and drought years, and these shortages would increase with climate change. The projects included in Alternative 5 are described below.

2.9.1 IPID Full Piping and Pump Exchange Project

The IPID Full Piping and Pump Exchange would eliminate the surface water diversions on Icicle Creek and Peshastin Creek by constructing of three surface water intake and

pumping facilities on the Wenatchee River and fully piping and pressurizing the IPID delivery system. System updates proposed for this project are summarized in Table 2-13. The conceptual configuration would place the new piping infrastructure in the existing canal easements, mostly within existing canal alignments. However, other configurations would need to be evaluated to optimize the efficiency and cost of the system. The conceptual configuration described in Table 2-13 is illustrated in Figure 2-57.

Table 2-13
Summary of Improvement Concept Evaluated for IPID Full Piping and Pump Exchange

Characteristic	Pump Station A	Pump Station B	Pump Station C
Existing Infrastructure Replaced	IID Diversion 1, 2, 4, and 5 Canals, Gibbs Ditch	IID Diversion 3A Canal and PID Canal	IID Diversion 3B Canal
Pump Station Location	Wenatchee River, Near Leavenworth Siphon	Wenatchee River, Upstream of Dryden Dam	Wenatchee River, Near Cashmere WWTP
Capacity[1]	52 cfs	57 cfs	24 cfs
Pumping Head	372 feet	257 feet	574 feet
Booster Station	No	Yes	No
Re-regulating Pond Location	No	In bend in PID Main Canal, near Dryden	No
Re-regulating Pond Size	N/A	15.5 acre-feet	N/A
Pipe Sizing	12-inch to 36-inch	8-inch to 48-inch	20-inch to 30-inch

Notes:
1. The capacity was determined by estimating the number of shares served by each system and multiplying by 6.75 gpm per share, which is the maximum amount of IPID delivers to its customers at each customer turnout. A 5-percent allowance was added on to the calculated flow rate to allow for leakage and loss in the distribution system.

BPS: Booster Pump Station

Cfs: Cubic Feet per second

IID: Icicle Irrigation District

PID: Peshastin irrigation District

PS: Pump Station

WSEL: Water Surface Elevation

WWTP: Wastewater Treatment Plant.

Each system shown in Figure 2-57 would consist of a surface water intake and pump station that would deliver water through a network of pressurized delivery pipelines to water users. System B would pump water into a re-regulation pond at the elevation of the existing PID Canal and two booster pump stations would be constructed to lift the water to the elevation of the IID Canal. The current IPID points of diversion on Icicle Creek and Peshastin Creek would be removed.

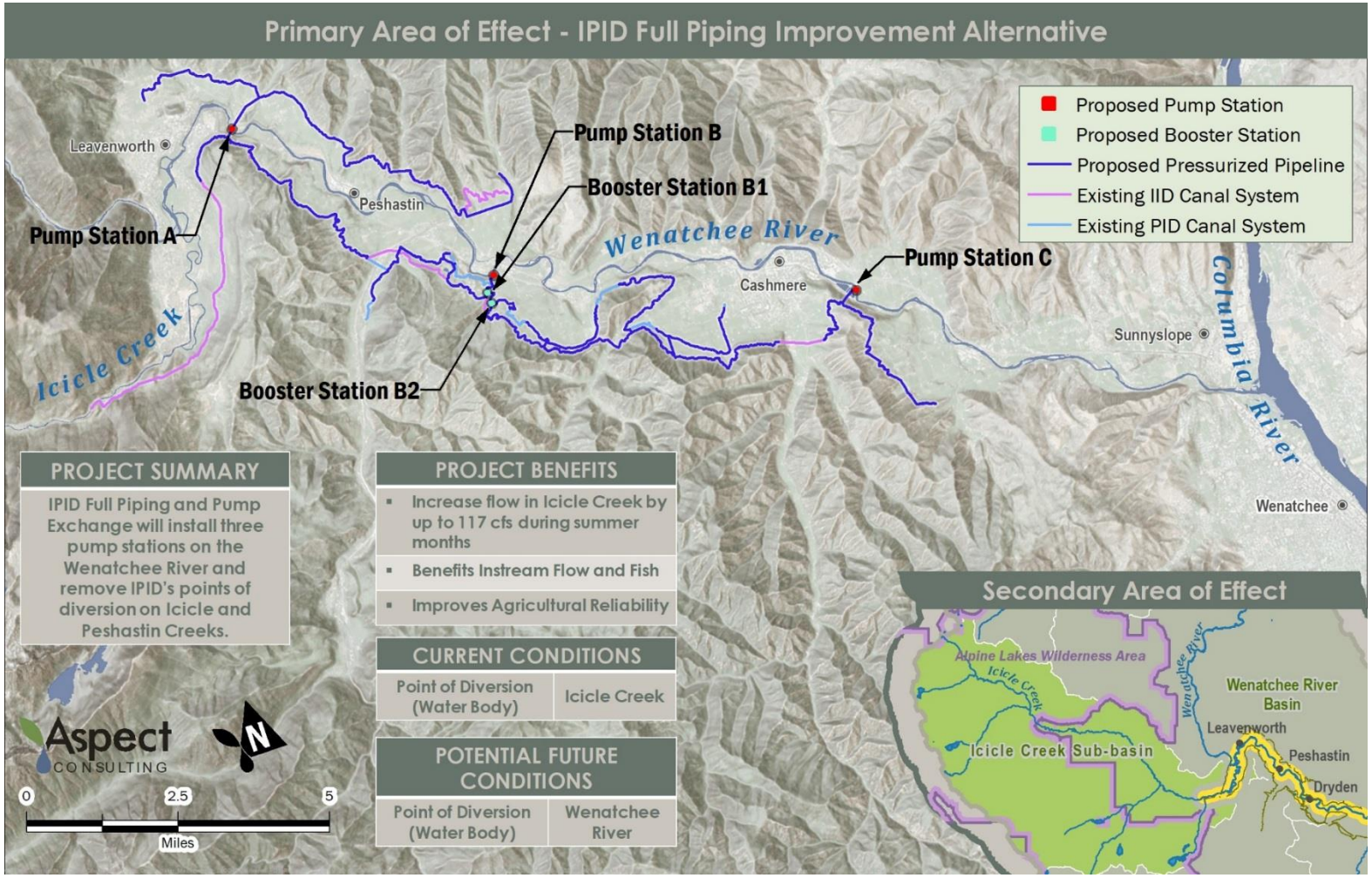
A total of more than 39 miles of pressurized pipeline would be installed to replace the open ditches that IPID currently operates. This would result in a more efficient system, with reduced evaporative loss, seepage, and operational spills.

The project would result in one customer on the IID Diversion 1 Canal to be converted to an individual well system because it would take a long length of dead-end pipe to reach that customer.

A concept-level opinion of probable costs was developed in the *IPID Conservation Plan -Full Piping Improvement Option Memorandum* (Anchor, 2018). This included construction costs and long-term O&M costs. The estimated construction cost, including contingency costs to account for project elements that are not understood or have not been defined at this stage, is between $72.5 million and $83.7 million. Annual O&M, is estimated at between $775,000 and $821,000.

The IPID Full Piping and Pump Exchange estimated water savings is 117 cfs and 30,000 acre-feet.

Figure 2-57. IPID Full Piping and Pump Exchange



2.9.2 Alpine Lakes Optimization, Modernization and Automation

The Alpine Lakes Optimization, Modernization and Automation project is the same as is described in Section 2.5.1.

2.9.3 COIC Irrigation Efficiencies and Pump Exchange

The COIC Irrigation Efficiencies and Pump Exchange for this alternative are the same as is described in Section 2.5.3.

2.9.4 Domestic Conservation

The Domestic Conservation project is described in Section 2.5.4.

2.9.5 Eightmile Lake Storage Restoration

The Eightmile Lake Storage Restoration project is described in Section 2.5.5.

2.9.6 Tribal Fishery Preservation and Enhancement

The Tribal Fishery Preservation and Enhancement project is described in Section 2.5.6.

2.9.7 Habitat Protection and Enhancement

The Habitat Protection and Enhancement project is described in Section 2.5.7.

2.9.8 Instream Flow Rule Amendment

The Instream Flow Rule Amendment project is described in Section 2.5.8.

2.9.9 Leavenworth National Fish Hatchery Conservation and Water Quality Improvements

The LNFH Conservation and Water Quality Improvements project is described in Section 2.5.9.

2.9.10 Fish Passage

The Fish Passage project is described in Section 2.5.10.

2.9.11 Fish Screen Compliance

The Fish Screen Compliance project is described in Section 2.5.11.

2.9.12 Water Markets

The Water Market project is described in Section 2.5.12.

2.9.13 Costs and Benefits for Alternative 5

The costs and benefits for Alternative 5 are described in Table 2-14. However, this is not a cost-benefit analysis, but rather a summary of the predicted costs and benefits of Alternate 5. Cumulatively, these projects meet all of the Guiding Principles by improving streamflow, LNFH sustainability, protecting tribal and non-tribal fishers, improving domestic supply and agricultural reliability, and enhancing Icicle Creek habitat.

Alternative 5 is expected to result in a total of 196 cfs and 55,458 acre-feet of instream and out-of-stream water. The current cost estimate is approximately $177.3 million, including a 25 percent contingency. This amounts to $3,007 per acre-foot. As noted above, the average cost per acre-foot of water developed by the Office of Columbia River is approximately $500/acre-foot. Table 2-14 provides a breakdown of each project in Alternative 5 and the benefits and costs associated with each. These costs are subject to change as projects progress through feasibility and design, and a more complete picture of costs are developed.

2.9.14 Timeline

The proposed timeline to implement the projects that compose Alternative 5 is below.

- Spring 2016 – Programmatic SEPA Scoping
- Summer 2016-Summer 2018 – Programmatic EIS Development
- Summer 2018 – Draft PEIS
- Winter 2018/2019 – Final PEIS, Preferred Alternative Selection
- Fall 2018-Spring 2019 – Project Level Environmental Review Scoping and NEPA Integration (Depending on Alternative Selected), Applicable design or feasibility studies on projects
- Summer 2019-Summer 2020 – Project Level Environmental Review (if applicable)
- Spring 2019-Fall 2028 – Project Construction/Implementation

There was a 60-day public comment period following the release of the draft PEIS from May 31, to July 30, 2018. If it is determined that project-level SEPA scoping is necessary, there will also be opportunities for public comment during the scoping and following release of the draft and final project EIS.

Table 2-14
Summary of Alternative 5 Costs and Benefits[47]

Project	Total Water Developed		Project Cost ($ M)	Cost/ (ac-ft)	Instream Flows (cfs)	LNFH	Fish Harvest	DM Supply	Ag Reliability	Habitat	Comply with Laws
	cfs	ac-ft									
IPID Full Piping & Pump Exchange	117	30,000	83.7	2,790	117				x		x
Alpine Lakes Optimization and Automation	30	5,464	0.98	179	30				x		x
COIC Irrigation Efficiencies & Pump Exchange	12	3,640	4.50	1,236	12				x		x
Domestic Conservation	0.5	400	1.00	2,500	-			x			x
Eightmile Lake Storage Restoration	13	3,600	2.00	556	13			x	x		x
Tribal and Non-Tribal Fishery Preservation and Enhancement	-	-	0.50	-	-		x				x
Habitat Protection and Enhancement	-	-	2.50	-	-					x	x
Instream Flow Rule Amendment	0.4	400	0.05	125	-			x			x
LNFH Conservation and Water Quality Improvements	20	14,454	20.00	1,384	20	x					x
Fish Passage	-	-	6.00	-	-					x	x
Fish Screen Compliance	-	-	17.60	-	-					x	x
Water Markets	3	1,000	3.00	3,000	3				x		x
Totals	**196**	**58,958**	**141.8**	**2,406**	**195**	**x**	**x**	**x**	**x**	**x**	**x**
Contingency			**177.3**	**3,007**							

2.10 Pairing and Phasing

Some projects evaluated in this PEIS have received considerable evaluation to date, while others are at the conceptual or preliminary stages. In some cases, project proponents had already been working on projects that were then integrated into an alternative considered

[47] An additional 25-percent contingency was added to projects within the ALWA in response to comments on the draft PEIS to account for additional costs that might be incurred for construction and mitigation measures. This is in addition to project contingencies already calculated and discussed. Project costs will likely be refined as project planning and design progress.

in the PEIS (e.g., pump exchanges, Alpine Lake automation, boulder field passage). In other instances, investments parallel to the PEIS process seemed appropriate because the projects had broad consensus and support (e.g., COIC Irrigation Efficiency and Pump Exchange) and were included in all the alternatives. As the PEIS process concludes, the co-leads and the IWG will meet to determine how best to phase and pair projects to meet Guiding Principles. Several factors are likely to play into such decisions include:

- Project level environmental review and the level of additional analysis required prior to project permitting.
- Whether there is a federal nexus for the project that necessitates NEPA compliance.
- Whether funding is available for the project.
- Permitting timelines.
- Whether there is balance in the projects being moved forward so all Guiding Principles show progress.

2.11 Alternatives Eliminated from Further Study

During development of the Icicle Strategy, the IWG considered numerous options to address water resources management in the Icicle Creek Subbasin. As their work progressed, it became apparent some of the projects under evaluation did not adequately meet or were in direct conflict with the Guiding Principles. There were also options that did not receive consensus-based support from the IWG members, and per the group's Operating Procedures, were not pursued further.

Initially the IPID Full Piping and Pump Exchange was not considered in any of the alternatives in this PEIS because it did not receive consensus-based support based on O&M cost estimates. However, based on stakeholder input and further study, an alternate configuration was developed. This, along with hopes to find funding support of O&M costs, moved the IPID Full Piping and Pump Exchange into further consideration, resulting in the development of Alternative 5.

The following sections describe the projects that have been eliminated from consideration.

2.11.1 Reservoir Removal

During the SEPA scoping, some commenters recommended removing all of the reservoirs within the Icicle Creek Subbasin to restore the area to a more natural state. The IWG did not further consider this proposal in the PEIS for several reasons.

The reservoirs in the Alpine Lake Wilderness Area support LNFH and IPID operations. IPID serves approximately 85 percent of the irrigated land in the Wenatchee Valley from

Cashmere up to the Cascade Range (USFS, 1981). These lands are primarily in commercial orchard production and are the foundation of the local economy. Without the drought year supply provided by these reservoirs, orchard production would likely be significantly impacted. Additionally, this proposal does not align with the Guiding Principles. Removing the reservoirs from the Alpine Lakes Wilderness would reduce streamflow, decrease domestic and agricultural reliability, and would make meeting the Guiding Principles nearly impossible in the future as climate change predictions call for less snowfall and more rainfall in the Icicle Subbasin. Additionally, taking away private property rights would not align with the Guiding Principle that calls for complying with state and federal laws.

2.11.2 Water Right Relinquishment

Some PEIS commenters suggested creating an alternative that would pre-judge previously adjudicated and valid water rights, suggesting some portion of IPID's water rights or the major diversionary rights are relinquished and no longer valid. The disposition of the water rights of IPID, COIC, the City or any other water right holder is generally determined during a water right permitting action by Ecology. Water right relinquishment is not determined during a programmatic environmental review. Water Resources POL 1120 was developed by Ecology based on State case law and describes when an extent and validity analysis occurs on a water right. An extent and validity analysis occurs when Ecology tentatively determines the past beneficial use of a water right, whether sufficient causes for non-use provided in RCW 90.14.140 apply and determines the portion of the water right that remains valid. In Washington State, only the superior court can make a final determination on the extent and validity of a water right.

If any project is infeasible during project-level environmental review, permitting, feasibility, or funding, then processes exist to replace projects to ensure Guiding Principles are met.

2.11.3 Removing Leavenworth National Fish Hatchery

Removing the LNFH was also suggested by commenters during the SEPA scoping period. This option was also not explored further by the IWG as it lacked broader support from area stakeholders and does not align with the Guiding Principles. LNFH was constructed in the 1940s to provide mitigation for the loss of natural fish production as a result of the construction and operation of Grand Coulee Dam. The USFWS and USBOR recently conducted an alternatives analysis to determine the best possible method for meeting fish production targets. This included analyzing whether to relocate or upgrade existing facilities. The analysis concluded that upgrading LNFH rather than removing it was the best alternative based on costs and production. Removing LNFH would not align with the Guiding Principles to protect tribal harvest and improve sustainability at LNFH.