Puget Sound Partnership Climate Guidance:

Principles of adaptation and practical guidance for climate-smart recovery

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Aerial view of Puget Sound. © UW Climate Impacts Group, with aerial support provided by LightHawk.

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Executive Summary

The objective of the Puget Sound Partnership (the Partnership) Climate Guidance is to provide a primer on how to think about climate change impacts in a recovery context. To do this, we have developed two aspects to the document. The first is a set of "Principles of Adaptation for Puget Sound Recovery" and the second is a section on "Practical Guidance for Climate-Smart Recovery." Below, we touch on why you should read this guidance and what this guidance will do for you before delving into these principles and practical guidance. We consider this to be a first-generation working draft of a climate guidance for Puget Sound recovery. It delves into the decision-making process for ecosystem recovery at both the programmatic and project level. However, this draft is incomplete as it has not yet been put to the practical test of use by recovery professionals. We recommend that the draft as it stands be put to this practical test. Only such a test can identify which elements contained herein are useful and which are perhaps interesting, but do not provide actionable advice to recovery professionals. Running this guidance through the gauntlet of practical application will help define how future iterations of this guidance should be structured, which elements need more weight and examples, and which elements can be discarded.

The purpose of this guidance.

Advancing the recovery of Puget Sound requires meaningful and tangible consideration of how climate change could put your recovery efforts at risk. Changes in ambient climate conditions—warming land areas, changing precipitation, declining snowpack, shifting streamflow, warming streams, sea level rise, ocean warming, and ocean acidification—may place additional stress on the already stressed ecosystems you aim to recover. But these climate changes could also affect your solutions—the ecosystem recovery strategies and projects you may be putting forward.

But you do not need to be an expert in the science of climate change to make better recovery decisions. This guidance has aimed to make the issue of climate change as approachable as possible for the full range of recovery professionals by providing both broad principles to help guide your thinking about climate change and practical guidance for specific ways in which climate change can be integrated into your work at both the program- and project-level.

I. Why should I (or my team) read this guidance?

You and your team should read this guidance document because you are committed to advancing the recovery of Puget Sound, and climate change could put your recovery efforts at risk. Changes in ambient climate conditions—warming land areas, changing precipitation, declining snowpack, shifting streamflow, warming streams, sea level rise, ocean warming, and ocean acidification[1]—are placing additional stress on already stressed ecosystems and can directly and indirectly affect ecosystem recovery strategies and projects. Whether or not you have started considering climate change in your work, climate change poses potentially fundamental challenges to your primary objective: the recovery of Puget Sound.

Climate change at the project level. Any ecosystem recovery project that fails to consider climate threats risks failing to achieve the intended recovery benefits over the project lifetime as it is inundated by sea level rise, rendered impotent due to warming temperatures, or designed inappropriately for future streamflows. This is the equivalent of making sure that every single investment made in recovery is sensible given future climate conditions.

Climate change at the program level. Recovery programs, including the Action Agenda, Implementation Strategies (IS), Salmon Recovery Plans, the Science Panel Work Plan, and Local Integrating Organization (LIO) Ecosystem Recovery Plans, must look across watersheds, landscapes, species, and time to identify feasible pathways to recovery that go beyond what any single project can accomplish on its own. Programs that fail to consider climate threats may set unachievable objectives, incentivize inappropriate project types, develop incomplete Miradi results chains/theories of change, and more. This is the equivalent of ensuring that investments in project portfolios are sensible given future climate conditions.

It is important to note that the Partnership and the recovery community have a strong track record of identifying and addressing complex and challenging threats to Puget Sound, such as pollution, wetland destruction, watershed development, and deforestation. Many recovery professionals in the region believe that they are already considering climate change in their

[1] See the Puget Sound Partnership Climate Literature Review for a high-level summary of these threats

work – and some of this work is excellent. But fully integrating the implications of future climate conditions across all phases of a project and all aspects of program development is a complex endeavor that will likely require sustained attention. This guidance is intended to unpack the many nuanced ways in which climate change can, and perhaps, should be considered throughout recovery projects and programs.

The purpose of this guidance is to provide high-level principles and tangible, practical guidance to help illustrate how to think about climate change impacts in a recovery context. For an initial primer on the state of knowledge of climate change impacts, and information on where to look for more information, see the *Puget Sound Partnership Climate Literature Review*.[2] For recommendations on integrating climate change considerations into ISs, see the *Protocol for the Adaptive Management of Implementation Strategies for Climate Change*.[3]

II. What will this guidance do for me (or my team)?

This guidance was drafted to provide the Partnership staff and leadership, IS teams, Strategic Initiative Leads (SILs), Strategic Initiative Advisory Teams (SIATs), LIOs, and Lead Entities (LEs) with tangible guidance for how to think about climate change and how to integrate it into your ongoing work to ensure the long term effectiveness of all actions taken and strategies developed to support Puget Sound recovery. The goal here is to help you "ask the climate question" and take concrete steps to assess risks and plan accordingly.

If climate change affects the resource you are considering (e.g., salmon, coastal marshes, riparian wetlands, water quality or quantity), then you will want to understand and take those effects into account as you

Asking the climate question.

When we talk about "asking the climate question," we mean pausing in the pursuit of your primary recovery objective(s) to ask two questions. First: "Will climate change affect the resource(s) I am trying to protect, recover, or restore? If so, how?" Second, regardless of the answer to the first question: "Will climate change affect the project(s) I plan to implement? If so, how?"

[2] Mauger, G. and J. Vogel. 2020. Puget Sound Partnership Climate Literature Review: A tailored review of climate change science to inform recovery. Report prepared for the Puget Sound Partnership. Climate Impacts Group, University of Washington.
[3] Tillmann, PJ, and Michael Chang. 2020. Protocol for the Adaptive Management of Implementation Strategies for Climate Change. Prepared for the Puget Sound Partnership.

develop strategies or projects to protect, recover, or restore those resources. For example, when looking across landscapes or at a complete watershed from a program perspective, asking the climate question can help you understand additional key stressors that will affect the entire system, or specific locations, over the coming decades in order to ensure your portfolio of recovery projects will achieve the intended recovery targets, even as ambient climate conditions change or other climate changes impact your recovery context.

Separately you should ask if climate change will affect the project itself (e.g., land acquisition, bulkhead removal, wetland restoration, setback policy standards, zoning regulations). If climate change does not affect your recovery project, asking the climate question will confirm it. If it reveals that your project is vulnerable to climate change, asking the climate question will help you identify which climate change impacts to be concerned about so you can assess how to modify your action to ensure it performs as intended and provides lasting recovery benefits.

This guidance aims to support the Partnership staff and leadership, IS teams, SILs, SIATs, LIOs, and LEs in two ways. First, we provide some general ***principles of adaptation***. These are the big picture lessons that have been learned by adaptation practitioners across many contexts, including, but not limited to, ecosystem recovery and restoration.[4]

Second, we will provide some illustrative, but tangible, ***practical guidance*** on entry points for climate change consideration in restoration at both the program and project level. This guidance is less about climate change and more about how recovery decisions are made. This version of the climate guidance presents preliminary practical guidance that was co-produced with a limited number of Partnership-affiliated recovery professionals.

We recommend such practical guidance be co-produced[5] with recovery professionals at all levels of decision making — from agency heads to field operations staff. If the current practical

[4] The following documents provide examples of where some of these principles have been described. https://kresge.org/climate-adaptation; https://www.c2es.org/document/adapting-to-climate-change-a-call-for-federal-leadership/; https://www.nrel.gov/docs/fy16osti/64175.pdf

[5] Co-production is broadly defined such that science in service of applied societal needs is not a one-way street of physical or social scientists developing knowledge then received by managers or decision-makers. Instead, co-production envisions physical, social, or policy science work as a collaborative venture between scientists and managers or decision-makers in which the needs and skills of each come into play throughout that collaboration, including defining the research question, selecting a methodological approach, revising the research project as problems are encountered, and identifying which results are relevant and how to present them.

guidance proves useful, we recommend further refinement through the broadest feasible participatory process.

Please note that this guidance is not intended to stand on its own, but to work in tandem with the *Climate Literature Review* which provides background on climate change and how specific climate impacts affect each Puget Sound Vital Sign (VS) with an existing IS. It is also intended to complement the *Protocol for the Adaptive Management of Implementation Strategies for Climate Change*, which is more specifically tailored to the adaptive management of ISs.

What is "adaptation"?

Adaptation is a term used by the climate change community to describe actions taken to prepare for or respond to current or projected impacts of climate change. Adaptation is something that can occur naturally; for example, when some salmon species and/or runs adjust to warmer river temperatures through metabolic compensation or changed genetic expression. For your purposes as a recovery professional, adaptation will most commonly refer to the changes you need to make to recovery strategies and projects to ensure their performance under changing climate conditions. This is an intentional and human perspective on adaptation, but one critical to making progress in the face of changing climate conditions.

III. Principles of adaptation for Puget Sound recovery

1. **Put your recovery objectives first.** For the purposes of this guidance, climate change only matters insofar as it affects your recovery project or IS. Although there is a vast array of climate change information available to you, it is important to allow only climate change issues that directly or (perhaps) indirectly affect your recovery project or IS to enter your thinking. Though other information and research can be important to achieve other policy objectives, it may prove a distraction in considering climate change impacts for recovery objectives. This is why the *Climate Literature Review* is organized according to VS, enabling you to consume only the information relevant to your recovery objectives.

2. **Ask the "climate question".** Whenever you consider a recovery project or program, review the climate impacts relevant to the VS being addressed by the project or program (see the *Climate Literature Review*). Explicitly ask if *each* projected climate impact affects the near- and long-term viability of elements of your recovery program, such as specific actions, projects, or programmatic needs. If it does, you need to move to a deeper consideration of how and why your action or IS is affected.

3. **Take action in the face of uncertainty.** You already make decisions under conditions of deep uncertainty about population growth, technological advances, development patterns, and other issues that could fundamentally affect recovery ISs and projects. Treat climate uncertainty with the same cautious pragmatism—and adaptive management—you treat these other uncertainties. Waiting for the "science to get it right" on future climate scenarios may delay critical and time-sensitive decisions.

4. **Start now (or keep at it).** Puget Sound recovery is an on-going process, climate vulnerabilities already exist, and climate change is exacerbating these vulnerabilities. Waiting does not guarantee more or better information, but it does waste valuable time as recovery objectives slip out of reach. Furthermore, there are often tangible costs to inaction, as recovery from a diminished baseline implies more drastic and expensive action in the future.

5. **Talk about climate change explicitly.** Speak with your colleagues about how you are considering climate change, what you find confusing, and how you have found ways to ensure climate change will not negatively affect your recovery objectives. Avoid sweeping generalizations (e.g., "The climate crisis is a driving force of the 6th mass extinction!") and instead focus on concrete examples of problems (e.g., "I'm really struggling with how to think about the recovery of salmon when we know our project waterway will be getting X° warmer") and solutions (e.g., "Did you know that Douglas Fir seedlings sourced from southern Oregon are more heat adapted than those sourced in Washington?)" Write your experiences down in Near Term Action (NTA) reports, grant reports, IS adaptive management documents, in your project files on Miradi, ISs, Salmon Recovery Plans, NTA proposals, and anywhere else where learning opportunities present themselves. Such conversations and reporting not only normalize the issue, but allow for the diffusion of important innovations and practical lessons throughout the Puget Sound recovery community.

6. **Mainstream adaptation in planning and decision-making.** Integrating adaptation into current actions and strategies with existing funding streams, under current authorities, and with already assigned staff, is generally more efficient and effective than proposing separate "recovery climate adaptation actions" or "recovery climate adaptation strategies." Avoid thinking of climate change as an additional burden on

your already over-stretched calendar or project team. Consider it a fundamental consideration to ensure the effectiveness of your recovery project or IS, just like cost and feasibility considerations. You may even be able to access new funding sources by identifying your recovery project as a climate change adaptation project.

7. **Prepare for multiple climate futures.** As part of any recovery project or IS, planning around a single-scenario climate future can be appealing, but counter-productive in reaching recovery targets. Climate science may resolve or refine some issues over time, but there will always be a range among projected climate futures (see Appendix A of the *Climate Literature Review*). Preparing for an array of possible "climate futures"[6] will ensure that you select the most beneficial projects or programs to achieve desired recovery goals, even when observational climate trends are unclear or projections conflict. For example, among two roughly equivalent wetland restoration projects, one may provide benefits until sea level rise exceeds three feet, and another only until sea level rise exceeds 18 inches. Under such a situation, considering multiple climate futures allows you to choose the better recovery project for providing benefits over time despite the uncertainty of climate projections.

8. **Identify near- and long-term actions.** Adaptation to a changing climate may not require that all recovery projects be instituted now; some actions may require more study prior to action. Some may not be needed now but may be needed in the future as conditions change. Furthermore, some recovery projects may need to be instituted well in advance of when measurable benefits to a resource will be needed (e.g. adding tree cover to riparian habitats to create shade and decrease stream temperatures can take time to achieve the cooling objective because trees need time to grow). Contingency plans may be put in place (e.g. negotiating option agreements on properties that may become important for coastal marsh habitat migration if sea level rises more than expected), and implementation may depend on results from additional monitoring or analysis.

9. **Employ commonly used recovery techniques to mainstream adaptation.** Restoration actions like land acquisition, forest and riparian replanting, urban stormwater runoff management, restoring tidal wetlands, and removing bulkheads

[6] Note this principle is not proposing the use of technical scenarios like the Intergovernmental Panel on Climate Change's Representative Concentration Pathways (RCPs).

are well understood and can be adjusted to adapt to changing climate conditions. Consider the case of the Stossel Creek Restoration Project, an adaptive reforestation project that incorporates a greater diversity of tree species adapted to a warmer, drier climate and sourcing heat-adapted seedlings of local tree varieties.[7]

10. **Implement or prioritize no- and low-regret actions.** No-regret actions have no net costs (i.e., they pencil out positively in a cost-benefit analysis due to current benefits) and should be considered for immediate implementation (e.g, floodplain restoration can often be justified based on the reduced expected losses from historic flooding alone). Low-regrets actions may have some net costs but provide current benefits likely to improve your recovery objective due to known issues such as observed climate variability or anticipated climate change that are often not included in a conventional cost-benefit analysis. Since low-regrets actions can provide even greater benefits as the climate changes, they may merit favorable consideration in the present. For example, floodplain restoration provides immediate economic, environmental, and public safety benefits while also restoring processes that increase resilience to climate change (e.g., more side channel habitat, better groundwater exchange, increased riparian shading, improved ability to handle large flows).

11. **Look for and take advantage of any climate change opportunities.** Do not assume that all change is bad for Puget Sound; climate change may provide recovery professionals with new opportunities to support some recovery objectives. For example, one study projects that sea level rise will more than triple the extent of tidal flats in Puget Sound by 2100.[8] This may mean that recovery could focus on other habitats. While such opportunities may seem to be only silver linings in an otherwise dismal outlook for Puget Sound, attending to such opportunities is still advisable.

IV. Practical guidance for climate-smart recovery

Principles are all well and good, but when and how should you put these principles into action? In this section we discuss several promising entry points for considering climate change in

[7] http://nnrg.org/stossel-creek-case-study-adaptive-restoration-for-pacific-northwest-forests/

[8] Glick, P. et al., 2007. Sea-Level Rise and Coastal Habitats in the Pacific Northwest: An Analysis for Puget Sound, Southwestern Washington, and Northwestern Oregon. National Wildlife Federation.

various stages of recovery at both the program and project level. Keep in mind that you and your colleagues are more expert in the decision-making environment in which you operate. We consider these examples general and illustrative. Our hope is that they inspire you to discuss with willing colleagues how to make sure that your recovery programs and projects consider climate change appropriately to ensure recovery benefits or program alignment over their lifetime.

It is important to emphasize that considering climate change is not simply an activity to be conducted at the project level (see section 4.2), which puts the primary responsibility of considering climate change on recovery project proponents. Program-level decisions (see section 4.1) set the stage for dozens to hundreds of recovery projects. Incorporating climate considerations at the program level can have far reaching effects for Puget Sound recovery. Sharing responsibility for considering climate change across partners in the recovery system, including project proponents, Partnership staff and leadership, and state agency leads, is likely a more effective approach to ensure climate change is considered appropriately. Nevertheless, we discuss program-level and project-level consideration of climate change separately here, as they have some important differences.

IV. A. Program-Level Practical Guidance

For Puget Sound recovery, "program level" refers to the development of the Action Agenda, ISs, Salmon Recovery Plans, the Science Panel Work Plan, and LIO Ecosystem Recovery Plans that set an operational environment pertaining to many specific recovery projects. Such programs commonly cross geographies and jurisdictions looking, for example, at complete watersheds for opportunities to restore floodplains or recover salmon populations. The intent is to look at the big picture of the fully functioning ecosystem, and not to be constrained by the individual priorities of a particular land management agency, county, or other organization whose mission or geography may not correspond with a holistic view of recovery. The practical guidance below has been tailored to decisions made at this level under each of the major headers which are meant to encompass the major buckets into which program-level decisions fit.

IV.A.1 Program Planning

Planning is typically the first phase of any program design. It involves identifying problems, selecting goals, developing strategies that cross jurisdictions or landscapes, and sometimes the collection of baseline data in support of strategies. For the Partnership, the six primary recovery

goals are set in legislation: *abundant water, healthy water quality, healthy human population, vibrant human quality of life, thriving species and food web,* and *protected and restored habitat*.

Other goals are dictated by the Endangered Species Act (ESA), the Clean Water Act, or by treaty obligations with tribes. While making changes to these goals may not be feasible, it is still absolutely crucial that the Partnership lead by example by taking a meaningful look at the next layer of planning—strategies and plans for achieving these goals—to see if and how climate change considerations can be meaningfully addressed.

The detailed planning underneath the high-level legislated objectives is where program-level planning can be most effective. We include below some examples where considering changing climate conditions can make a significant difference in program planning. Remember, these examples are intended to be illustrative. You and your colleagues should draw on your own expertise to identify creative ways to apply the principles of adaptation outlined above within your own area of control or authority.

EXAMPLE OF A VITAL SIGN.

Prior to revision of the VSs in 2020, Chinook Salmon was a VS listed under the Thriving Species and Food Web goal. While this VS was dictated to some degree by the ESA listing of Chinook as well as the cultural significance of this species to tribes as well as treaty rights, Chinook are just one of five species of salmon in Puget Sound that are all culturally significant, commercially and recreationally important, and which are temperature sensitive cold-water fish. But by focusing on Chinook, and subsequently defining an indicator only for Chinook, this VS restricted the operating environment and effectively constrained considering other salmon species, trout, or charr in recovery programs and projects. This suggestion to reconsider the narrow focus of this VS on Chinook salmon only is consistent with a recommendation in the draft revisions to the VS, which proposes to change the "Chinook Salmon" VS to a new "Salmon" VS.

Vital Sign definition. When the Partnership establishes or revises one or more VS for each of the six legislated goals, it establishes a cognitive space that will inevitably draw the focus of attention to the VS selected at the expense of potential VS not selected (see example in box to left). There are many good reasons to choose one VS over another including data availability, cultural or political salience, knowledge and professional experience. We suggest that talking about climate change (Principle 5) and asking the climate question (Principle 2) of each VS chosen as well as

those eliminated may uncover important aspects of a changing climate to consider for Puget Sound recovery.

Indicator selection. At a more detailed level, the selection of one or more specific and measurable metrics to measure a VS is also a decision where talking about climate change (Principle 5) and asking the climate question (Principle 2) are important (see example in box below). Indicators are intended as a measure of the impact of pressures, or the human activities that lead to stressors on fish or other ecosystem endpoints.

EXAMPLE INDICATOR.

Prior to revision of the VSs in 2020, the only indicator for the Chinook Salmon VS was Chinook salmon population abundance. While the Chinook Salmon VS constrained consideration of other important salmon, trout, and charr species, this narrow indicator ensured that success was literally measured according to the recovery of only one salmon species, potentially at the expense of other species whose abundance was also important and which might fare better under changing climate conditions. This suggestion to expand the indicators under the Chinook Salmon VS is consistent with the suite of VSs recommended to and adopted by the Leadership Council in June 2020, which proposed indicators under the new "Salmon" VS for Chinook, coho, summer chum, and steelhead.

Recovery plan updates. Including climate change considerations in program-level planning documents, such as ISs, the Regional Salmon Recovery Plan, Watershed Salmon Recovery Plans, or LIO Ecosystem Recovery Plans all provide an opportunity to think about climate change from a regional perspective – something that is impossible on a project-by-project basis. This does not necessarily mean revisiting goals, VS, or indicators. It could be as simple as discussing the implications of projected climate change on the recovery goal or as complicated as a set of priorities for basin-wide, watershed-level, or ecosystem-based recovery. For example, a program-level plan could propose the acquisition of land only above a certain elevation due to sea level rise, promote assisted species migration as some habitats become unsuitable for certain species, or explicitly discuss including warmer-weather or saline adapted vegetation in restoration projects. Addressing these big picture issues can be daunting, but leading by example may prove crucial in increasing the adoption of climate considerations by project proponents.

Consider climate change in your theories of change. ISs and LIOs use the Miradi software to develop conceptual models (situational models) and results chains (theories of change). Climate change can be identified as a "direct threat" in the theory of change and then sub-categories

like storms, flooding, temperature extremes, changing precipitation regimes, etc., are all tags that can be applied to specific elements of the recovery strategy. Climate change can also be explicitly described in other aspects of logic models such as strategy descriptions, contributing factors (for conceptual/situational models), and intermediate outcomes (for results chains/theories of change).

Does climate change affect other salmon differently than Chinook?

Scientific research has suggested that chum salmon may be able to survive in warmer waters compared to their Chinook cousins and there is some evidence of variability within a salmonid species depending on the environmental conditions to which they are exposed. According to the Partnership website, "Although the indicator focuses on Chinook salmon populations specifically, it is intended to serve as an indicator of the health of all salmon and steelhead species in Puget Sound." But given the differential impact of climate change on salmonid species, a focus on Chinook alone may ignore differential vulnerability and adaptability of salmonid species to warming temperatures and obscure the relative

For example, the Shellfish Beds IS results chain/theory of change for Sub-strategies Addressing Multiple Pressure-Reduction Needs identifies four intermediate outcomes in support of the Strategy "Oversee strategic planning for Puget Sound recovery science." The first three intermediate outcomes listed below support the fourth intermediate outcome, which in turn supports "quality of shellfish maintained" and ultimately, the Vital Sign Harvestable Shellfish Beds:

- Ocean acidification research supported
- Ocean acidification monitoring expanded
- Mitigation opportunities and needs better understood
- Shellfish beds have increased resilience to ocean acidification

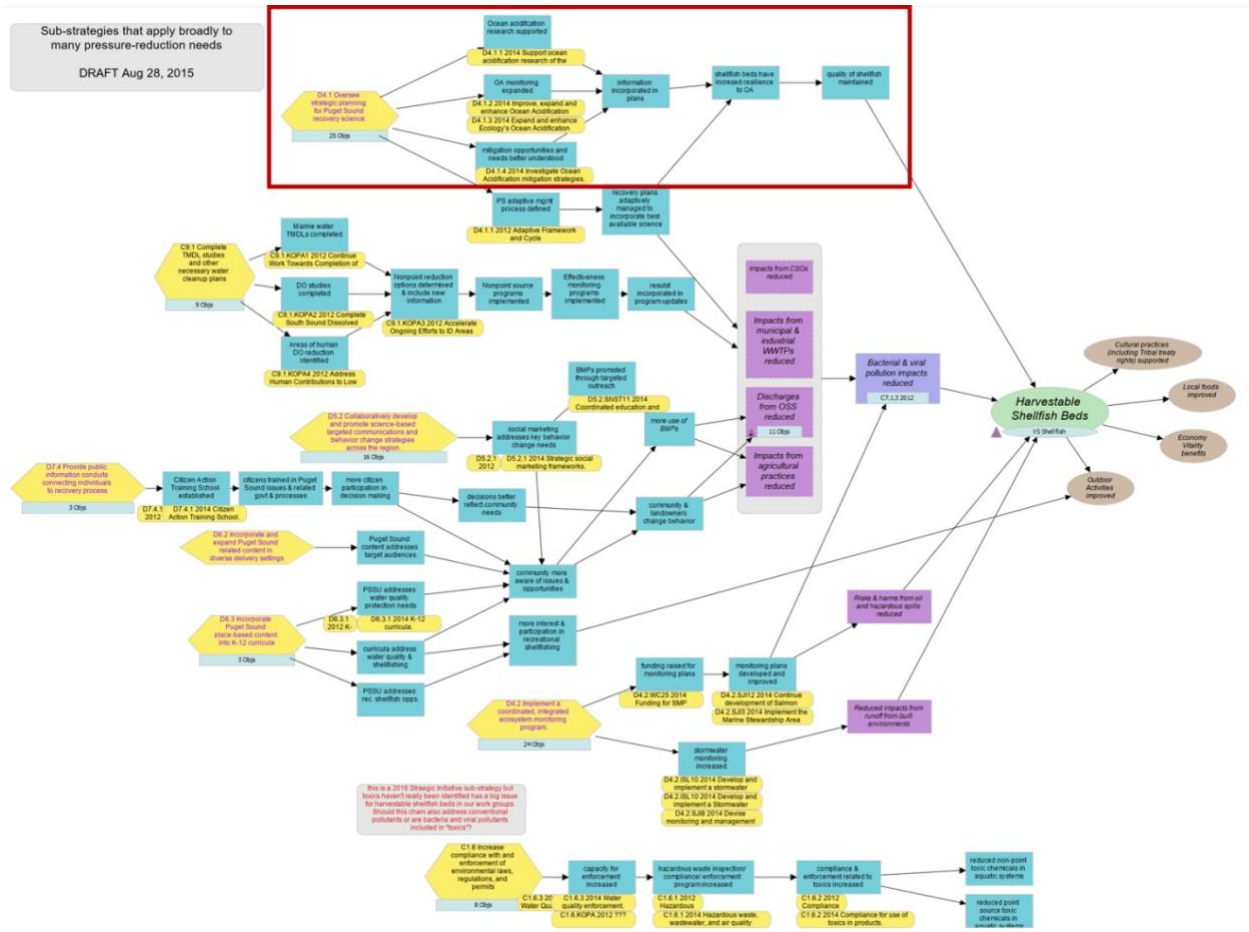

Figure 1.
As indicated by the red box, the Shellfish Beds IS explicitly identifies ocean acidification in its sub-strategy to "Oversee strategic planning for Puget Sound recovery science." Source: Implementation Strategy for Puget Sound's Shellfish Beds Recovery Target. 2015. Results Chain Appendix C. No author provided.

IV.A.2 Project Prioritization

Many programs, strategies, and plans in the Puget Sound recovery context include lists of projects suggested for prioritization and implementation. The inclusion of some projects and not others can and should be influenced by a range of factors such as political feasibility; legal constraints; the transparent prioritization of specific goals; fairness or representativeness across geographies, constituencies, partners, or jurisdictions; triple bottom line accounting of benefits and costs (i.e. social, environmental, and financial); and more.

In addition to these factors, we recommend explicitly considering the impacts of climate change when identifying and prioritizing projects because once these projects are identified in official

documents, they are often prioritized for funding and implementation. If you have not considered climate impacts, the anticipated benefits of a program or portfolio of projects can be considerably lower over time once climate change is taken into account. For example, you might consider restoring coastal wetlands in areas projected to be inundated by sea level rise.

Prioritizing restoration projects under the assumption that their benefits will continue to accrue over many decades is ill-advised. Instead, we recommend making a clear-headed decision about the relative value of such wetlands over the timeframe that they will function, especially considering changing climate conditions. One benefit of this approach is that it naturally leads to a temporal consideration of recovery benefits. Presumably, the same ecological and other benefits provided by to-be-inundated coastal wetlands will be needed 50 or 100 years from now. Critically considering benefits over time will allow triage projects to be implemented in the near term while also bringing new projects into the portfolio to ensure that benefits are sustained over the long term as climate impacts begin to materialize.

IV.A.3 Funding decisions

There is no more important explicit or implicit expression of priority than the expenditure of resources. At the program level, opportunity exists to ensure resources are expended in a way so project benefits will be realized under changing future climate conditions. This is true of the Puget Sound Acquisition and Restoration (PSAR) Fund, salmon recovery grants, and LIO managed NTA funds (typically $100k per year). In addition to program-level criteria for project funding, it is important to recognize the importance of integrating climate considerations in funding decisions at strategic and programmatic levels. For example, EPA funds SILs on a 5-year basis, but defers to the Partnership for the specifics of what is required of those roles. This is just one example of a programmatic-level opportunity to better integrate climate change into the day-to-day work of Puget Sound recovery at the programmatic level.

Climate funding criteria. If you are going to fund a project, you want to make sure that project will provide the intended recovery benefits not just today and tomorrow, but over the lifetime of the project. Project proponents are always responsive to explicit language in a request for proposals (RFP), but such language needs to be backed up by scoring or review criteria. Current Puget Sound recovery funds do have some climate change requirements in their RFPs. For example, the language in the PSAR Fund RFP states:

> *Demonstrate that you have sufficiently identified and considered how climate change will affect the project (hydrology, sediment regimes, sea level rise, or water supply). Does the*

> *project design adequately address the primary climate change concerns (or have a plan to evaluate them during the design process) that have the potential to decrease the effectiveness of the project? Is the project designed to be flexible and can it be modified over time as conditions change?*

Such language in an RFP is an important first step of awareness raising. But consider the language from the scoring criteria:

- Identifies known effects of climate change relative to project location, implementation and management, and
- Project design adequately addresses the primary climate change concerns

These criteria suggest simple 'yes/no' answers and are not sufficiently detailed to allow meaningful comparison across projects to determine which have more meaningfully addressed resilience to changing climate conditions. Asking more explicit questions, developing more detailed criteria, or requiring more explanation than yes/no (see the boxes on the next pages) can provide ranking personnel and review boards with better information to differentiate between projects that have meaningfully addressed climate change and those that have not.

EXAMPLE CRITERIA.

Ask a single, simple climate question.
Consider the effect of asking a single and simple climate question as a funding criterion, such as "Has your project considered the impacts of changing climate conditions?" Project proponents who have not considered climate change are put on notice that the issue is important to the funding entity. It will likely lead to some reconsideration of projects by proponents to ensure that they can answer yes to this question, which may even lead to some changes in project design or perhaps even to the scrapping of projects that cannot be justified under projections of future climate change. But still, the project proponents only have to be able to say "yes."

Consider a tiered set of questions/criteria.
While "Has your project considered the impacts of changing climate conditions?" may be an appropriate first question/criterion, consider asking more than one question or including more than one criterion to enable ranking personnel and review boards to understand the difference between projects that have adequately considered climate and those that have not. Consider the additional information that would be generated by asking "Describe how your project incorporates and addresses changing climate conditions" or "Please identify the greatest climate change risk to your project and how you address it."

Ask for a summary of potential climate impacts on a project.
An initial effort could be as simple as asking what climate change impacts might affect the proposed project. This forces a more serious consideration of climate change by project proponents and provides more detail to ranking personnel and review boards. You can even provide specific prompts, such as:

Is your project vulnerable to…	(yes/no)	How might this climate impact affect your project?
…sea level rise?		
…more acidic sea water?		
…reduced summer streamflow?		
…increased stream temperature?		
…shifts in peak stream flow timing?		

Ask what project modifications were made to address climate change impacts.
In the business world, corporate shareholders have applied pressure that has increasingly led business executives to voluntarily disclose climate change risks to business assets and operations. Similarly, Puget Sound recovery funding entities could strongly encourage or require an explicit statement of the climate change risks of individual recovery projects. For example:

"We selected a location for our wetland restoration project with a long, unobstructed expanse of land in public ownership. This ensures our coastal wetlands restoration project is resilient to rising sea levels because those wetlands can migrate inland and upland."

"We intend to reforest our acquired land with species adapted to a warmer climate as well as currently prevalent species. This ensures that ecosystem benefits will be realized in the present, but also over the 200+ year lifetime of this reforestation project, when climate projections suggest warmer ambient air temperatures and more severe heat and precipitation extremes."

IV.A.4 Funding Science and Information Provision

Another challenge is that the information needed to assess climate change impacts does not always exist. Although project proponents can often find creative ways to estimate impacts even with limited data, this can mean that there is very little consistency among proposals, making it hard to compare one proposal to another. In addition, larger-scale studies (e.g., covering all of Puget Sound, a specific watershed, etc.) can sometimes be a more efficient use of resources, while also leveling the playing field among all project proponents and providing program managers with a basis for prioritizing based on climate change risks. We recommend that funding programs set aside a modest percentage of their funds for studies that help provide the information basis needed to properly design recovery projects. These studies need not be uniquely focused on climate change. For example, the Estuary and Salmon Restoration Program (ESPR) Learning Program supports studies "improve our ability to select treatment locations and management measures, and help designers evaluate the consequences of alternative actions". Studies have included monitoring to evaluate the effectiveness of restoration projects, a catalogue of bluff erosion rates across Puget Sound, and a study investigating sediment delivery to the Nisqually Delta. A percentage of ESRP program funds are allocated for studies like these. Other programs could institute similar programs, each of which could fund relevant climate studies in addition to other learning projects of relevance to program goals. Finally, studies should take into account climate change even if not specifically focused on climate change

impacts. For example, one the bluff erosion studies funded by ESRP also estimated future rates of bluff erosion.

IV.A.5 Setting an Agenda

There may be an opportunity for the Partnership or other state agencies involved in Puget Sound recovery to set an agenda on climate change that supports more significant consideration of climate change across all recovery stakeholders.[9] For example, salmon recovery plans are focused on a 10-year timeframe and maximizing recovery outcomes in that timeframe. But most projects that take a serious look at climate change may not provide a near-term boost to salmon populations even if they provide the best long-term opportunity to protect and restore salmon.

This is not just an abstract thought experiment. Consider sitting on the Salmon Recovery Funding Board (SRF Board) and considering two projects. Project 1 considers sea level rise, and consequently, sites an estuary restoration project in an area that provides only a small wetland today that will grow in size as sea levels rise over the next 50 years. Project 2 does not consider sea level rise, and consequently, sites an estuary restoration project in an area that maximizes the size of a wetland over the next 10 years, but will be completely inundated in 50 years.

Do the project selection criteria that you use allow you to consider the trade-offs between these two projects? Are the salmon in such a dire state now that it is worth investing in 10 years of habitat recovery even if that recovery benefit dissipates over time? Is such a short-term project only valuable if pursued in conjunction with projects that provide the larger long-term habitat benefits? Is the salmon population stable enough or resources constrained to the point that only the long-term project is suitable for funding?

A second example: the Partnership or another agency could recommend specific criteria for risk tolerance such as all terrestrial projects must be designed to withstand a 10-year or 100-year storm in anticipation of climate-enhanced flooding (consider the example of design standards for replacing or constructing new culverts). Such a criterion would heavily persuade even resistant communities to take climate risks seriously even if they have political or economic

[9] Note that the Partnership's work on climate change is not happening in a vacuum. Many tribal, state, and federal agencies are already working on climate change adaptation programs or projects. Consider identifying existing climate change programs and see how those exiting efforts can be leveraged to set a Puget Sound Recovery agenda and vice versa.

reasons to resist a realistic assessment of climate risks. The more authority an entity has over resource allocation, the more such risks will be taken into account across the board (e.g., consider FEMA requirements for Hazard Mitigation Grants).

IV. B. Project-Level Practical Guidance

In addition to a demonstrative consideration of climate change at the program level—in identifying goals, strategies, across landscapes and watersheds, and in establishing strategies—there is much that can be accomplished by considering climate change at the project level. Like many other policy contexts, there is value in top-down or executive leadership (i.e., program-level climate consideration), but the reality is that more decisions occur at the project level, on the ground, and on a daily basis. This bottom-up leadership is just as crucial as the top-down.

We pause here to note the tendency to sometimes expect that somebody else will take care of the issue. For project-level personnel, climate change can often seem like a bigger problem than their project can take on. But as you will see below, asking the climate question (Principle 2) can be crucial to achieving your recovery objectives (Principle 1). And even when asking the climate question does not meaningfully impact your project, you can rest assured that you have done your due diligence at a minimum. But you may have contributed to the broader goal of climate-smart recovery by talking explicitly about climate change (Principle 5), identifying no- or low-regret projects (Principle 10) or taking advantage of opportunities presented by climate change (Principle 11).

We address the ways in which climate change may interact with project level decision making through a 7-step policy process framework adapted from a typology presented in the 1993 Restoring Wetlands in Washington guidebook.[10]

[10] https://fortress.wa.gov/ecy/publications/publications/93017.pdf

EXAMPLE GOAL:
Reduce polychlorinated biphenyl (PCB) concentrations in the Squaxin stock of Pacific herring.

Under the Toxics in Fish VS, you may focus your efforts on the above goal. In addition to other criteria that may have been considered in defining this goal (e.g., proximity of pollution sources, likelihood of disturbance to toxins in sediment, quality of baseline data, cultural importance, logistics of catching fish, different residence patterns), you should also consider the near- and long-term impacts of changing climate conditions on each element of your goal.

Will climate change affect PCBs?
Higher river flows and increased coastal flooding could lead to increased erosion in some places. Will this mobilize your focal pollutant? Will it affect polybrominated diphenyl ethers (PBDEs) similarly or differently? Does this suggest that PCBs or PBDEs are a better focus for your recovery goal?

Will climate change affect Pacific herring?
Perhaps ocean acidification or increased sea surface temperatures will impact your focal species. Do climate impacts on Pacific herring affect your recovery project? Does this suggest that adult coho salmon might be a better target species than Pacific herring? Or are the impacts on coho roughly the same or perhaps even worse from the standpoint of your recovery goal?

Will climate change affect your focal stock of fish?
Perhaps sea surface temperature will be more pronounced for the Squaxin stock (south Puget Sound) than for the Semiahmoo stock (north Puget Sound) or Port Orchard stock (central Puget Sound). Does this enhanced sea surface temperature suggest that one stock makes a better focal stock for your recovery goal?

IV.B.1 Project Planning

Planning is typically the first phase of any project design process or management cycle. It involves identifying problems, selecting goals, and sometimes the collection of baseline data in support of these activities. While project-level goals may be subordinate to regional goals and objectives as defined in Salmon Recovery Plans, Ecosystem Recovery Plans, or ISs, there is still considerable opportunity to integrate climate change into the planning stage of a project to ensure the highest likelihood of recovery success. We include below some examples where considering changing climate conditions can make a significant difference in project planning activities.

Goal selection. Any recovery program or project has a goal or objective (see example in box to left). Program goals often set the stage for project goals. Within the Puget Sound recovery context, program goals are typically expressed in ISs or Salmon Recovery Plans, whereas project goals are often expressed in project proposals (e.g., NTAs). When identifying and selecting a goal at both the program and the project level, it is particularly important to ask the climate question (Principle 2 above). Note that we are not suggesting the avoidance of challenging goals for important recovery objectives, just being realistic and

choosing targets that make sense in the context of climate change.

Selection of a reference site. Many restoration projects consider the historic wetland itself in its pristine or nearly pristine condition an ideal reference site. When remnant historic wetlands or old pictures, historic plant lists, or site descriptions are not available, another reference site is typically chosen - often one that is assumed to display characteristics that approximate the historical wetland.

Here, again, it is important to ask the climate question (Principle 2). Is the historic wetland viable under changing climate conditions? Do projected climate conditions suggest that a different reference site should be selected? Perhaps one adapted to a warmer or more acidic environment?

It is also important to put your recovery objectives first (Principle 1). It may not be appropriate, important, or even possible to replicate the exact wetland of the past. Instead, you are trying to restore the functional ecological, hydrological, biological, or cultural characteristics of that wetland. By focusing on these primary recovery objectives, it may be easier to identify climate-adapted reference sites that allow you to successfully move your recovery project forward.

Preparing for uncertain futures (Principle 7) may also prove important. Given the range of plausible future climate conditions, you may not be able to select a single set of wetland characteristics that will ensure the functional recovery your project is aiming for. Different projections of the future (e.g., 3°F warmer under one climate scenario versus 6°F under another) as well as change over time (20% more acidic waters in 2050, but 60% more acidic in 2100) may suggest the selection of a hybrid reference site that will allow some species to flourish while others to languish depending on which climate future manifests.

If climate considerations bring the selection of a reference site into enough question, you might consider identifying near- and long-term actions (Principle 8) that allow you to make progress on your recovery goal immediately but ensure long-term effectiveness. For example, you could identify a climate-informed reference site that allows you to make progress now, but also identify a different reference site or build in reference site revisions as certain climate thresholds are met.

Above all else, be sure to start now (or keep at it) (Principle 4) by taking action in the face of uncertainty (Principle 3), even though it may seem overwhelming thinking about all that climate

change means for reference site selection. More or better science will not resolve much of the uncertainty you face, and your recovery target will continue to be impacted by all the non-climate factors that made it a recovery priority in the first place.

Building support. It is best to involve stakeholders throughout the process of project development, from conception to implementation. Stakeholders bring on-the-ground knowledge about existing issues and possible solutions; their involvement ensures that key issues are not overlooked, provides opportunities for more creative problem-solving, and also helps to cultivate support for the work. Climate change is important to include because it can bring about new issues and render some solutions more effective than others. However, communicating about climate change also comes with risks. Stakeholders in recovery can include people with perspectives as varied as tribal members[11] and Chambers of Commerce, agricultural interests and environmental advocates, state agency personnel and individual project advocates. Stakeholder groups representing such varied life experiences, personal values, and professional roles could find the issue of climate change either divisive if handled poorly or community-building if handled well. Communicating carefully and thoughtfully about climate change impacts is crucial to the success of any effort to build support for a project.

IV.B.2 Project Selection

While project selection is not often considered part of a typical project management cycle, it is a step often encountered in recovery work where limited resources force the proposal of only one or a handful or projects among dozens. While some of this work is done at the program level and is described above in section IV.A.2, project proponents often find themselves in a situation of promoting the project that has the highest likelihood of being funded while also advancing recovery.

As in section IV.A.2 above, we recommend the explicit consideration of climate impacts in selecting one project among many to pursue. While climate impacts may not be the deciding factor in your selection, at a minimum considering climate will provide insight into which projects will provide sustainable benefits over time. But identifying climate smart recovery projects could go so far as opening doors to new funding sources.

[11] Note we speak here of tribal members; Tribal *governments* are legal co-managers of natural resources in Washington State and have legal authority unlike the other stakeholders mentioned here.

IV.B.3 Site Assessment

After planning, information is typically collected and evaluated to understand conditions at proposed recovery or restoration sites and reference sites. Such an assessment informs the feasibility, scope, and cost of recovery projects, and can help identify the key tasks that must be addressed in preliminary project design (IV.B.4). This step in the project management cycle also includes the collection of baseline data often necessary to clarify planning objectives (IV.B.1) and select among multiple potential projects (IV.B.2).

Site selection. Choosing a site for a recovery project can be a loaded conversation when considering climate change. Many issues, such as regulatory mandates, treaty rights, cultural significance, and vested economic interests all make any discussion of compensatory restoration, assisted migration, or the triage of threatened and endangered species a minefield. But we have successful local examples of such projects as illustrated by the I-90 Snoqualmie Pass East Project and the I-90 Wildlife Bridges.[12]

If the recovery goal is to improve habitat and/or connectivity for species or rare habitat types, ask whether those species and habitats are likely to be present at the site given future climate conditions and potential range shifts or loss of local population viability from future stressors. It may be advisable to prioritize potential sites that are within the potential future range of the species, or to prioritize key corridors linking present to future ranges.

If the recovery goal is to mitigate impacts elsewhere, consider the value of both the impacted sites and potential project sites not just now, but also in the future given climate change. While difficult in practice given the uncertainty in future climate projections, the current value of a site for conservation or threatened and endangered species is not necessarily equal to the future value. It might be wise to make offsets conservatively large and located where they will have the highest potential future value to recovery goals.

IV.B.4 Preliminary Design

A preliminary project design typically can be drafted for a recovery project after the first three steps in the project management cycle have been completed. It may be important to refine the project objectives establishing during planning (IV.B.1) to develop more specific and actionable criteria to guide project design. For example, specific criteria could include which species or

[12] https://www.youtube.com/watch?v=BGFIoLkEKP4

plant communities are planted in a reforestation project or what slope, aspect, and soil structure to design a coastal area or riparian wetland after bulkhead or levee removal.

Hydrologic design. Proper site preparation and management of water are critical to the success of projects attempting to reestablish native vegetation – more so than seeding or planting (see example in box to right). This includes considerations of soil saturation, water depth, and inundation frequency and duration. There are a number of techniques to physically alter these characteristics through site topography and grading, and the purposeful inclusion of shoreline and bottom irregularity. Once you have already selected a site (also asking the climate question), it is still important to continue to ask the climate question (Principle 2) in preliminary design.

Species selection. Many recovery projects involve the replanting of species or entire ecological communities in order to revegetate an area disturbed by human use

HYDROLOGIC DESIGN EXAMPLE:

Will projections of increased riverine flooding alter the hydrologic function of your restoration project? This is an empirical question that can be addressed by consulting the best available climate science. But the reality is that most PNW rivers will see substantially higher peak flows, and those flows will shift toward the winter months as watersheds increasingly move from snow dominant or mixed rain/snow watersheds to rain dominant. The restoration of an inland riverine wetland based only on historic conditions might be washed out in a matter of years or decades. But if you carefully consider the projected extent and duration of future flooding, you can purposefully add shoreline and topographic complexity to allow for greater levels of inundation than the historic record might suggest. This can help ensure that your project is designed to provide lasting recovery benefits over a long period of time.

SPECIES SELECTION EXAMPLE:

Will increased ambient air temperatures and drier soil conditions affect the plant communities planned for my reforestation project? Rather than attempt to maintain or restore past site conditions, it may be more practical and valuable to plant or introduce future-adapted species that were not necessarily historically present. If these species are still native to the region and still support the ecological functions desired, it may be sensible and appropriate to plant those future-adapted species. Separately, for situations in which the exact same plant community is desired, consider the genetic adaptations of species to site conditions as well, particularly for plants. Planting native vegetation historically present at the site from seedstock obtained from the local area may not provide plants genetically adapted to future site conditions. Instead, consider seeds/seedlings from seedlots sourced from other regions that more closely resemble projected future site conditions. Tools like the Seedlot Selection Tool (https://seedlotselectiontool.org/sst/) may be helpful.

(see example in box on next page). As indicated in the reference site discussion in the previous section, it may not be appropriate to focus planting exclusively on native species and endemic plants, as the climatological conditions that support those plant communities may change significantly in the future. We are in no way suggesting a cavalier attitude towards replanting, but careful consideration of future climate conditions may make the difference between a project that thrives as the climate changes and one that leads to a monoculture of only the most heat- or saline-tolerant species.

IV.B.5 Final Design and Implementation

Final design involves the translation of preliminary design conceptual ideas and information into detailed plans suitable for the individuals who will be implementing these designs. In most cases, there will not be new climate change considerations in moving from preliminary to final design. The challenge in this phase may come in when design concepts are reviewed by resource or regulatory agency staff who may suggest or require design changes based on their own goals or regulatory requirements (e.g., Washington State Department of Ecology for water quality or the Washington State Department of Fish and Wildlife or the United States Fish and Wildlife Service for fisheries resources) which may not be flexible enough to consider some climate change inspired project designs. Interfacing early and often with regulatory personnel can be especially crucial to ensure that unconventional climate change inspired project design will meet regulatory requirements.

Political, social, and cultural considerations may come into play in whether and how to communicate about climate change in project plans and specifications submitted for review. Talking explicitly about how project design has incorporated climate change considerations

could open up new financing opportunities or shut a project down completely. How to handle this delicate balancing act is likely to be context specific and require out-of-the-box thinking until climate change becomes a conventional consideration across all relevant and responsible government authorities.

IV.B.6 Monitoring

Monitoring is an important phase in the project management cycle aimed at ensuring that recovery projects achieve their intended recovery objectives. Unfortunately, this important role is typically under resourced and often neglected in favor of implementing more recovery projects. Adequate baseline data is necessary to compare post-project data, and such baseline data acquisition typically must be conducted over the course of at least a full year. But establishing complex ecosystems that serve important ecological functions often takes a decade or more. Most monitoring plans are short – 5 years or less, and thus focus on intermediate objectives, such as vegetation establishment, sediment mobility, or the presence of suitable habitat for spawning. Given the short timeframe typical of recovery monitoring, climate change will often play little or no role in near term monitoring. Nonetheless, it is important to state that long term monitoring projects are potentially crucial to understand the efficacy of unconventional recovery strategies aimed at restoring ecosystem function under changing climate conditions.

IV.B.7 Management of Recovery Sites

Many recovery projects involve modifications to the landscape that change over time. Without long term management of those projects, the intended recovery benefits could be lost to forces as varied as grazing cattle or catastrophic wildfire, invasive plants or coastal storm surge. Like monitoring, management is typically under-resourced and neglected in favor of implementing more recovery projects. Furthermore, the responsibility for long term management sometimes rests with the landowner, and not the project proponent, suggesting a greater degree of collaboration between the project implementer and the landowner in terms of how to do long term management in the face of changing climate conditions. Management issues specific to climate change are likely to arise over the longer term – as new climatological regimes take hold and begin to affect the recovery project – such as changing fire regimes, increases in drought, new historic low flows, increased ocean acidity, or greater frequency and extent of flooding. Engaging in climate-informed management of recovery sites includes but is not limited to:

Monitoring and evaluating recovery site vulnerability to more accurate projections of climate impacts (i.e. downscaled projections and/or projections derived from updated models or data). Doing so should enable you to better predict what management actions are needed to maintain

recovery benefits as well as when these actions will be needed to ensure recovery prior recovery gains are not lost,

Designing projects that (most likely) will have a decreased need to significantly manage recovery sites following project implementation. Do so by designing projects that prepare for multiple climate futures (Principle 7) as well as look for and take advantage of any climate opportunities (Principle 11).

V. Conclusion

Advancing the recovery of Puget Sound requires meaningful and tangible consideration of how climate change could put your recovery efforts at risk. Changes in ambient climate conditions—warming land areas, changing precipitation, declining snowpack, shifting streamflow, warming streams, sea level rise, ocean warming, and ocean acidification—may place additional stress on the already stressed ecosystems you aim to recover. But these climate changes could also affect your solutions—the ecosystem recovery strategies and projects you may be putting forward.

But you do not need to be an expert in the science of climate change to make better recovery decisions. This guidance has aimed to make the issue of climate change as approachable as possible for the full range of recovery professionals by providing both broad principles to help guide your thinking about climate change and practical guidance for specific ways in which climate change can be integrated into your work at both the program- and project-level.

But this guidance is ultimately only a first-generation working draft for Puget Sound recovery. It must be put to the practical test of use by recovery professionals to identify which elements are useful and which are perhaps interesting, but do not provide actionable advice to recovery professionals. Based on feedback from such a practical test, this guidance can be refined, expanded, or revised as needed to ensure the guidance is both useful, but also actually gets used.