

Science and the evaluation of habitat restoration projects in the Columbia River Estuary 2012-2017

The Expert Regional Technical Group Process



BONNEVILLE POWER ADMINISTRATION

U.S. ARMY CORPS OF ENGINEERS

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Summary

This paper describes the science-based process that guides the selection of habitat restoration projects in the Columbia River Estuary, a critical nursery for juvenile salmon and steelhead. This rigorous evaluation process was developed by experts in the fields of estuarine and restoration ecology to help focus funding and other resources on habitat projects that provide the greatest benefits for salmon and steelhead. It includes expert review of proposed projects, combining physical metrics and professional judgment based on the best available science to objectively assess the ecological value for fish.

Why are the Bonneville Power Administration and the Army Corps of Engineers restoring habitat in the Columbia River Estuary?

These two agencies (the Action Agencies) pursue habitat conservation projects to help mitigate the impacts of federal dams on salmon and steelhead, as well as other fish and wildlife. These actions complement improvements and more effective spill at the dams designed to achieve 96 percent average dam survival for spring migrating fish and 93 percent for summer migrants. Scientists have increasingly recognized the estuary as an important area for restoration because its rich wetlands provide a last opportunity for juvenile fish to gain strength before entering the ocean. Stronger fish are more likely to survive the rigors of the ocean to return home to spawn as adults.

How do the agencies decide what projects to undertake?

The Action Agencies work with public and private partners to identify potential projects and then prioritize the projects based on their potential benefits for fish. The Biological Opinion for the Federal Columbia River Power System called for an Expert Regional Technical Group (ERTG), a panel of regional scientists and watershed experts, to develop an objective scientific basis for evaluating projects and quantifying those benefits.

How does the ERTG incorporate the latest science?

Many members of the ERTG have conducted research in estuarine science and habitat restoration and bring both their own expertise and other research in the fields to bear on project evaluations. The ERTG reviews the latest science (including members' own research) and uses the findings to develop standard scientific criteria for assessing the biological value of habitat restoration projects. The ERTG process is adaptive, using research and monitoring to refine the evaluation and selection of projects. The ERTG is the estuary equivalent of the expert panel process used to prioritize habitat projects in the tributaries.

How do the agencies use the ERTG's evaluations?

A technical model combines the ERTG's findings with physical metrics to estimate the benefits of projects in terms of improved salmon survival. The results help the agencies track their progress toward the goals of the Biological Opinion. They also use the findings to guide funding, technical support and other resources toward projects that science indicates have the greatest potential to improve survival of salmon and steelhead.

How much habitat has been restored so far?

Each year, the agencies fund and support many habitat projects for salmon and steelhead, which are implemented by tribal, state, and local partners and conservation organizations. Between 2008 and 2012, the agencies have:

- Improved and restored 150.8 acres of stream channels
- Reconnected 162 acres to tidal influence through dike modification
- Reconnected 6.8 acres to tidal influence through culverts
- Reconnected 296 acres to tidal influence through tidegates
- Planted and maintained 1,069.8 acres of native vegetation

Reconnecting tidal influence both restores wetland and shallow water habitat, allows juvenile fish to access the wetlands to take advantage of the food and refuge they provide and helps deliver food to young salmon in adjacent areas. The best available science indicates that these factors all contribute to improved salmon health and survival.

Background

Habitat protection

Habitat conservation has been a keystone of salmon and steelhead protection and other ecosystem conservation efforts in the Pacific Northwest for decades. Research and monitoring indicate that habitat protection and restoration have potential to improve survival, productivity, and abundance of salmon and steelhead in both in the short and long term. They also help address potential future impacts of climate change by improving ecosystem and salmonid resiliency.

Habitat protection and improvement are central elements of NOAA Fisheries' salmon recovery plans for the Columbia and Snake Rivers and the Northwest Power and Conservation Council's (Council) Fish and Wildlife Program, designed to offset the impacts of federal and non-federal dams in the Columbia Basin. Findings from the Skagit Intensively Monitored Watershed, a tidally influenced estuary environment in Puget Sound, substantiates the benefits of restoration by documenting improvements in habitat capacity and connectivity as measured by improved densities of rearing juvenile Chinook salmon .

Two independent panels, the Independent Scientific Review Panel (ISRP) and the Independent Scientific Advisory Board (ISAB) review elements of the Council's Fish and Wildlife Program. The ISRP reviews and makes recommendations on individual fish and wildlife projects funded by the Bonneville Power Administration (BPA). The ISAB provides independent scientific advice and recommendations to NOAA Fisheries, tribes and the Council regarding issues in the basin.

Importance of the estuary

Research has increasingly recognized the Lower Columbia River Estuary as an important component of the life cycle of many Columbia and Snake River salmon and steelhead. Juvenile fish migrating to the ocean rely on the estuary's prolific wetlands for food and shelter as they build strength before entering the ocean. Some research has suggested that young fish that arrive in the estuary at the right time to take full advantage of rich food sources such as insects are more likely to survive the ocean and return as adults. Operations of the hydroelectric system have been tailored

to help fish reach the estuary in the most opportune period.

However, some two-thirds of the estuary's original wetland habitat has been lost to development, with many areas diked and drained or otherwise cut off from tides and fish. That has limited the existing benefits of such habitat, but at the same time the large amount of lost habitat suggests great potential for benefits to fish from habitat restoration that could provide important benefits for fish. NOAA Fisheries' recovery plans include an "Estuary Module" outlining categories of needed improvements in estuary habitat to support salmon and steelhead recovery. The ERTG considers these categories when it evaluates a project's potential to boost juvenile fish survival.

The FCRPS Biological Opinion

Fish passage improvements represent the foundation of the 2008 Biological Opinion issued by NOAA Fisheries for the operation of federal dams on the Columbia and Snake Rivers, known as the Federal Columbia River Power System. This includes performance standards calling for safe passage of 96 percent of juvenile spring migrating fish. However the FCRPS BiOp also recognizes a need to look beyond the dams and provide additional "off site" mitigation for the impacts of the dams through habitat conservation and other measures.

Given the ecological importance of the estuary, the BiOp identifies the estuary as a high priority for habitat restoration that will significantly improve fish survival. It also calls for the latest science to inform that work. The FCRPS BiOp established an Expert Regional Technical Group to apply the latest science to estimate the biological value of habitat improvements and translate that into anticipated improvements in fish survival. The biological value to salmon and steelhead stocks depends in part on how much they use the estuary, with ocean-type species that spend more time in the estuary benefiting the most. .

Besides improvements in the hydroelectric system and habitat, the BiOp and related documents also account for improvements in hatchery and harvest management, providing an "All H" approach" to helping salmon throughout their life cycle. However the Action Agencies' largest investments are in improvements at the dams and in habitat, with more than \$15 million going toward estuary restoration annually and more than \$100 million per year going toward estuary and freshwater anadromous

fish habitat overall. Funding for research, monitoring and evaluation averages another \$25 million each year and helps refine habitat protection strategies.

Estuary priorities for fish

The BiOp identifies populations of Upper Columbia and Snake River chinook and steelhead as priorities for protection and calls for improvements to address “key limiting factors” — or threats to these populations — including estuarine migration and rearing habitat. Based on research regarding benefits for salmon, habitat modifications may target:

- Full reconnection of tidal influence through breaching dikes and levees.

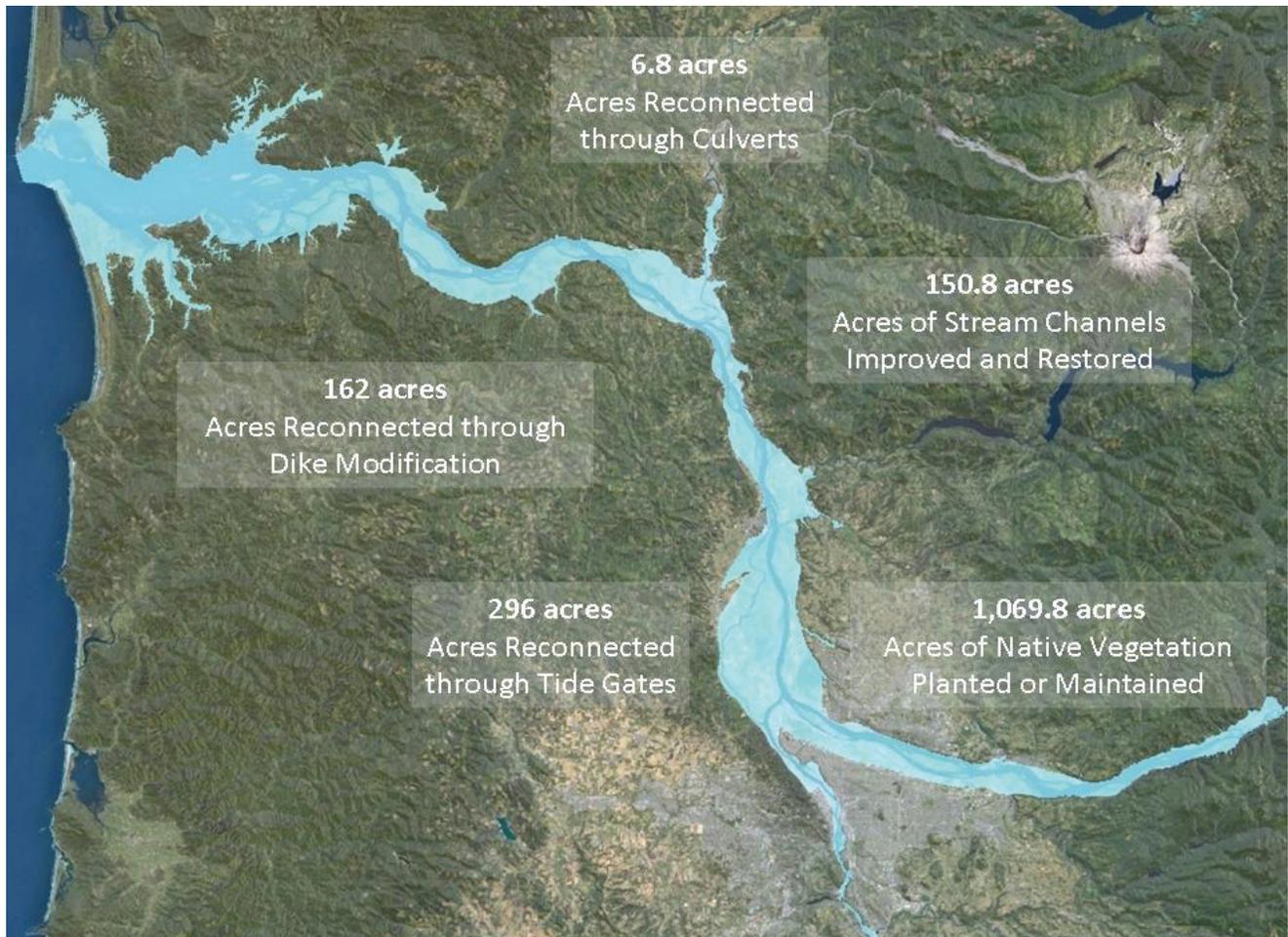
- Partial reconnection of tidal influence through culverts, bridges, and tidegates.
- Enhancing the quantity and quality of tidal channels.
- Removal of invasive species.
- Restoring riparian habitat conditions, such as planting native vegetation.

Habitat projects thus far have pursued all such types of improvements, with many projects encompassing several of these improvements at once.

Evolution of the Expert Regional Technical Group

The 2008 Biological Opinion for the FCRPS called for the ERTG to use the best available science to estimate

Estuary Habitat Cumulative Actions 2008-2012

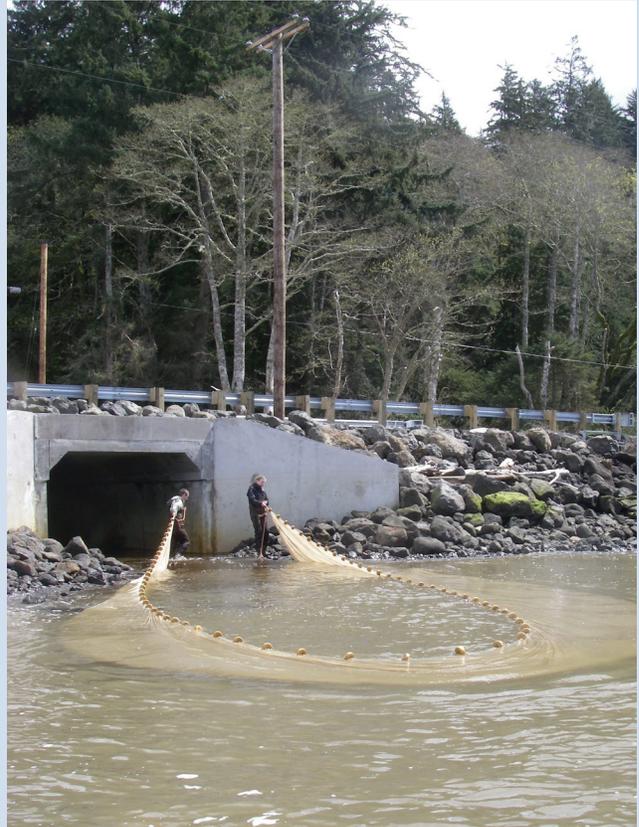


The SBU Calculator: A science-based technical model

The ERTG's SBU Calculator has been developed with the guidance and support of some of the most eminent scientists in the field of estuarine research. It is essentially a technical model that objectively determines the benefits of habitat improvements for fish, based on scientific principles. For example, the calculator considers the size of a prospective habitat project relative to overall goals in the estuary because research suggests that larger projects are more stable, likely to support more species and are easier for migratory fish to find and use.

The Calculator also includes factors to account for the likelihood of a project's ecological success in restoring natural processes, how well fish can access the project and the anticipated capacity of the habitat to support fish. Based on a review of the latest habitat science, the ERTG determined that the benefits of projects in certain types of habitat may be either undervalued or overvalued. For instance, off-channel restoration such as reopening diked areas appeared to be undervalued based on how many fish would likely use the areas. The ERTG accounted for this by adding a "weighting factor" to the Calculator to better represent the SBUs from different habitat types.

The development and application of the Calculator underscores the continuing role of science in refining habitat restoration strategies.



Seining fish to monitor their use of a new culvert that reopened access to habitat that had been blocked by a dike decades earlier. The culvert is on the north side of the Columbia River estuary, north of Astoria, Ore.

improvements in fish survival resulting from habitat restoration in the estuary. The ERTG's findings help the Action Agencies prioritize habitat projects to deliver the greatest benefits for juvenile fish. The ERTG's creation, formative work and major achievements all reflect current and emerging science and the latest results of research, monitoring and evaluation under the BiOp, as described below.

Forming the ERTG (June 2009 to July 2010)

Based on guidance in the BiOp, the Action Agencies set out to establish ERTG as a committee of scientists with strong expertise and credibility in habitat restoration, estuarine ecology and fisheries biology. State, tribal and federal agencies with roles in the estuary were invited to participate,

which resulted in a diverse group of scientists with extensive research experience. ERTG members completed site visits and discussed restoration with project sponsors and other stakeholders to become more familiar with habitat restoration activities and research, monitoring and evaluation.

Standardizing measures (February 2010 to December 2010)

The yardstick for measuring the value of habitat restoration is the survival benefit unit (SBU), a gauge of improved fish survival. The ERTG determined that the calculation of SBUs should be standardized for the sake of consistency, repeatability and transparency. The first step was creation of a standard template for descriptions of proposed projects. The ERTG also developed standard scoring

criteria for three factors that influence survival benefit units: the certainty of a project’s success, how accessible it will be to fish, and capacity of the habitat to support fish survival. Standardization increased the scientific rigor and transparency of the ERTG process.

Quantifying progress
(August 2009 to December 2010)

The ERTG’s most significant scientific contribution so far has been the development of a standard algorithm to quantify the SBUs of habitat projects. The algorithm, sometimes called the “SBU Calculator,” is essentially a technical model that combines the physical measures of projects and expert judgment to reflect the value of habitat restoration to fish. It replaces a subjective approach with one more solidly based on established science.

Providing guidance
(January 2011 to December 2011)

The ERTG provided clarifying guidance as the region gained experience with the SBU Calculator. Regional meetings of the ERTG and estuary stakeholders also

provide for guidance from the ERTG, documented in meeting notes. This demonstrates the ERTG’s role in clarifying and promoting scientific transparency and peer-review throughout the ERTG process.

Evaluating projects
(January 2011 to present)

The ERTG used the Calculator to evaluate a backlog of projects, many of which had been completed from 2007 to 2010 but not yet scored for SBUs. A major push occurred during 2011 when 20 projects were reviewed and scored. The resulting SBU reports document the ERTG’s scientific rationale for the assessment of each project, based on each category or “subaction” called for in the Estuary Module. The ERTG applies new information including the results of recent research and monitoring to its upcoming reviews, continually improving and refining the scientific basis for its work.

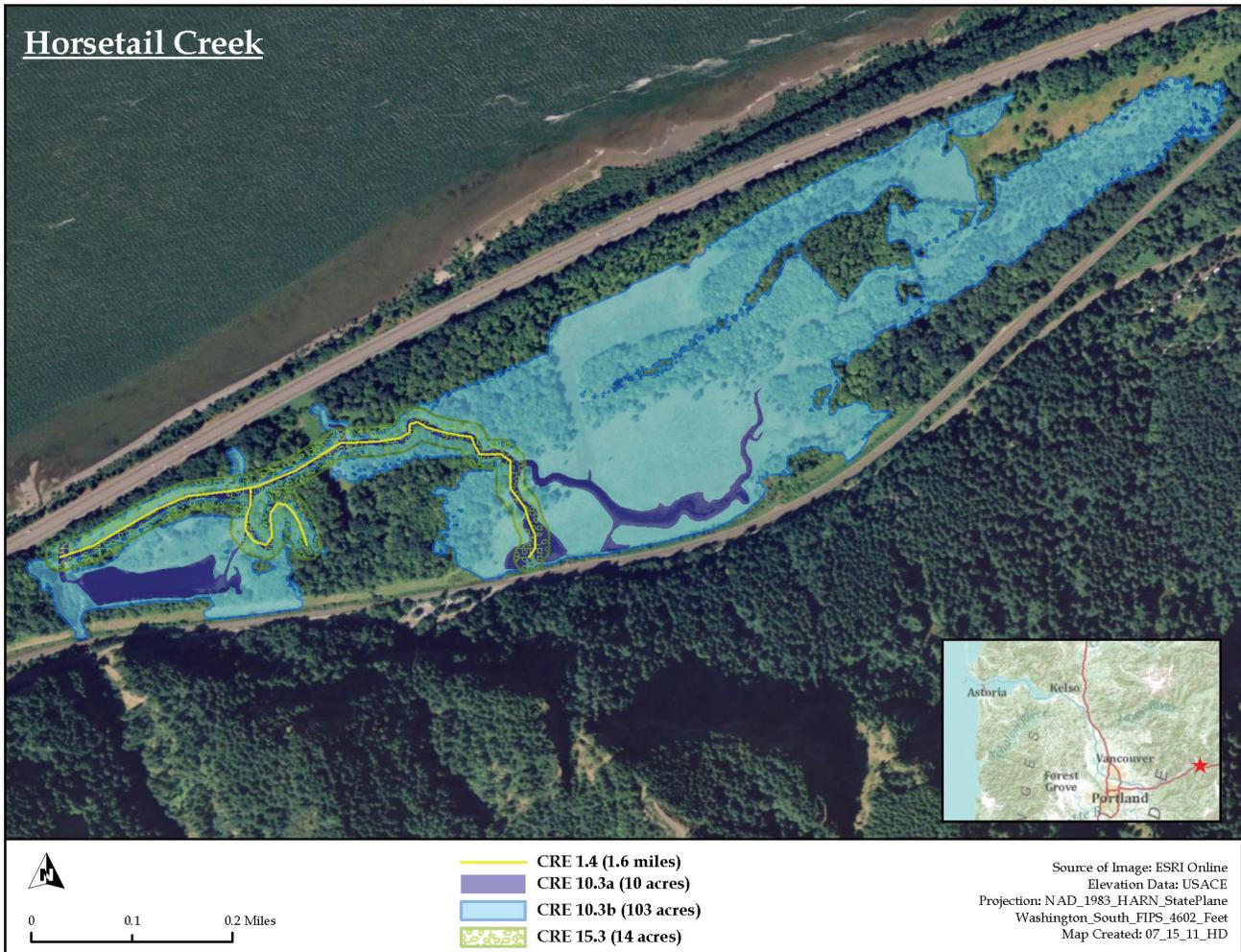
A steering committee led by BPA and the Corps coordinates the ERTG process, which also includes extensive involvement of NOAA Fisheries and other regional partners.

ERTG Participants

Current ERTG members bring a wealth of ecological, biological, hydrogeomorphical, and habitat restoration experience as outlined below.

NAME	AFFILIATION	POSITION	AREAS OF EXPERTISE
Dan Bottom	NMFS, Northwest Fisheries Science Center, Newport, OR	Research Fishery Biologist, Estuarine and Ocean Ecology Program	Estuarine ecology, salmon early life history, fish biology
Greg Hood	Skagit River System Cooperative, La Connor, WA	Senior Research Scientist, Research Department	Estuarine ecology, hydro-geomorphology, botany, wetland restoration
Kim Jones	ODFW, Fish Division, Corvallis, OR	Leader, Aquatic Inventories Project	Fish biology, habitat restoration, LCRE ecology
Kirk Krueger	WDFW, Habitat Program, Science Division, Olympia, WA	Senior Scientist, Salmon and Steelhead Habitat Inventory and Assessment Program	Salmon biology, stream ecology, quantitative assessment, statistics
Ron Thom	PNNL, Marine Sciences Laboratory, Sequim, WA	Technical Group Manager, Coastal Ecosystem Research	Restoration ecology, adaptive management, estuary ecosystem science

Horsetail Creek



The ERTG's Project Goal Map for the Horsetail Creek habitat restoration project.

Selecting projects for ERTG review

Initially the selection of habitat restoration projects in the Columbia River Estuary was relatively opportunistic. However, as the BiOp increased the commitment to estuary habitat restoration in 2008, a more comprehensive and strategic approach emerged.

A foundation of the new approach was the Columbia River Estuary Ecosystem Classification, a highly detailed geographic database of different habitat types throughout the estuary. Scientists then combined that habitat information with fish sampling data to determine how fish use the different habitat types — and which provide the most biological benefits. The result of that work was a

Landscape Planning Framework for the estuary that provides the Action Agencies and their partners the tools to test the value of proposed habitat projects — or even different versions of projects — for fish.

The expansion of estuary habitat restoration has also engaged many more partner organizations with land use planning interests and local ties in estuary communities. This in turn has helped the Action Agencies identify promising projects. The Action Agencies work with their partner organizations to evaluate the basic metrics of the projects such as the cost per SBU, which helps determine which projects have the best potential and should be evaluated by the ERTG.



How it works: Mill Road

The 50-acre Mill Road property on the north side of the Columbia River northeast of Astoria includes former wetlands that were diked and drained for agriculture but which have gone unused for about 15 years. BPA funded the acquisition of the land in 2004, with plans for future restoration. In 2011 the ERTG reviewed the project and used the SBU Calculator to estimate how many SBUs the restored property provides. Here's how.

First the ERTG assigned scores based on how effectively the project would fulfill the subactions called for by the NOAA Fisheries Estuary Module. For instance, the project included a half-mile of riparian restoration. The ERTG assigned a score of 3.8 out of 5 for the likelihood of project success because an existing road and riprap would still constrain some natural processes, a 3.8 for accessibility to fish because access would be improved but not perfect and a 3.8 for the capacity to support fish based on normal wetland capacity.

The project received higher scores under the subaction that includes removal of 500 feet of the dike, which would reopen 46.2 acres of wetlands. The ERTG assigned scores of 4 each for the likelihood of success and access by fish, falling short of a full score of 5 because some of the levee would remain in place. The restoration of normal wetland functions following removal of the dike received a score of 4. The ERTG also compiled scores for excavation of 700 feet of new tidal channel to reconnect another 1,000 feet of channel and native plant restoration.

The SBU Calculator then crunched the scores and physical dimensions of the project to determine the project would provide .397 SBUs for ocean-type fish and .128 for stream-type fish, which tend to move through the estuary faster. This will count towards habitat improvements on behalf of fish in the estuary.

How the ERTG assesses projects

Based on guidance in the BiOp, the Action Agencies designed the ERTG process for evaluating habitat projects to be transparent, adaptive and based on science. Regional meetings, dialogue and documentation of the ERTG's work all promote transparency. To protect the scientific integrity of the ERTG, members do not work with partners to develop the habitat projects they might later be called upon to evaluate. The ERTG scores projects in closed meetings so project sponsors cannot unduly influence the findings.

The standardized process follows these steps:

Initiation: First the Action Agency Steering Committee prioritizes and selects a prospective project for evaluation. The project sponsor then completes the project template developed by the ERTG by providing the details and supporting information the ERTG will need for evaluation and scoring. The template identifies which subactions from the Estuary Module – for instance, dike removal or native plant restoration – the project will address.

Project Review: The project sponsor submits the completed project template and any supporting materials to the ERTG for review. The sponsor then presents the details of the project at an ERTG meeting, followed by a discussion session and, usually, a site visit. Occasionally the ERTG requires a follow up meeting with the project sponsor to address open questions or issues.

Scoring: The ERTG reviews the template to confirm that it incorporates the appropriate subactions of the Estuary Module and that the associated physical measurements such as acres and miles are accurate. The ERTG then scores the project on a scale of one to five in three areas required by the SBU Calculator: the certainty of success, habitat access, and habitat capacity, as described in the



Columbia Stock Ranch near Goble, Oregon.

ERTG's standard scoring criteria. The ERTG facilitator compiles the data in an Excel spreadsheet, adds the necessary physical measurements such as size of the project, and runs the Calculator to determine how many SBUs it will provide. The ERTG process also calls for the development of a project goal map that highlights the restoration actions of each project and the area affected, providing stakeholders with a visual sense of the proposed improvements.

Review and Dissemination of Results: The ERTG and Steering Committee review and discuss the results, which are then disseminated with explanatory comments to the AAs, project sponsors and other interested parties.

Dialogue and Feedback: An opportunity is provided for dialogue and feedback between the ERTG, Steering Committee, project sponsors, and interested parties on a regular basis.

How the FCRPS Action Agencies use the results

The ERTG's findings and calculation of SBUs provide the Action Agencies with important, objective information to both measure and guide habitat restoration in the estuary.

First, the SBU calculations provide an objective yardstick to gauge the progress of the Action Agencies in delivering on

the commitments of the BiOp, which calls for specific percentage improvements in salmon survival through the estuary. This helps the agencies stay on track and develop an appropriate pipeline of prospective future projects to fulfill the BiOp requirements.

In addition, the project evaluation, ERTG feedback and scoring helps the Action Agencies better understand the anticipated benefits of certain types of projects and certain types of habitat. This helps the agencies focus future funding and other efforts where they will most benefit fish.

For example, the ERTG's review of science and scoring of projects has demonstrated that dollar-for-dollar, larger projects involving more acreage provide significantly greater benefits for fish because they are more secure, accessible and carry much greater capacity to support fish and other wildlife. The Action Agencies, in concert with Columbia Land Trust, relied on this finding in pursuing the 2012 purchase and upcoming restoration of the Columbia Stock Ranch, the largest acquisition of riverside habitat in the estuary in nearly 40 years.

The \$5.3 million price was such a significant commitment of funds that the Action Agencies took the additional step of asking the ERTG for a preliminary review of the proposed restoration project to document potential benefits. The Corps of Engineers is developing restoration plans for the property that will include removal of dikes to reopen wetlands.

Habitat Action Results

The 2008 FCRPS Biological Opinion committed the Action Agencies to achieve specific levels of survival benefit units for stream and ocean-type salmon in the estuary through 2018 (Reasonable and Prudent Alternative Action 35).

Habitat Actions, Strategies and Achievements 2008-2012

ESTUARY SUBACTION/STRATEGY	ACRES	MILES
Acquisition and protection of intact habitat	2,069.9	NA
Restoration of degraded off-channel habitats	150.8	NA
Full Reconnection of Tidal Influence	162.0	NA
Partial Reconnection of Tidal Influence	6.8	NA
Restoration of riparian areas	NA	18.1
Muted Reconnection of Tidal Influence	296.0	NA
Control of Invasive Species	1,069.8	NA

The ERTG's assessment and scoring of projects completed so far indicates that these accomplishments are translating into meaningful benefits for juvenile salmon and steelhead. While SBUs accumulated slowly in the early years of the Biological Opinion, the expanding body of science and feedback from the ERTG process have focused the Action Agencies on developing additional and larger restoration projects with even more significant benefits for fish. The Action Agencies therefore expect to accumulate SBU counts more rapidly in coming years.

The Importance of Research, Monitoring, and Evaluation

Under the BiOp, the AAs annually complete more than \$20 million worth of research and monitoring to evaluate fish and watershed conditions. This information refines the region's understanding of habitat and fish benefits and relationships, leading to better decisions about habitat projects over time. Ongoing research, monitoring, and evaluation work includes:

- Fish and habitat status and trend monitoring.
- Correlation and modeling to improve regional understanding of the positive relationship between habitat condition and fish survival.
- Development of the Estuary Classification mapping layers, which define different habitat types, to inform selection of the best habitat improvement actions.

- Habitat project “action effectiveness” research and evaluation to determine how fish and habitat actually respond to habitat improvement actions.
- The ERTG scoring process is specifically designed to consider and incorporate new scientific findings.

What we have learned

The ERTG process established under the FCRPS BiOp recognizes the rapid advancement of science surrounding estuary restoration and anticipates that the Action Agencies and their partners will learn and improve their approaches as they gain knowledge and experience. The ERTG supports that goal by bringing the expertise and research background of members to help interpret and incorporate new findings and evidence into the scoring of projects, which in turn helps the Action Agencies better select projects that deliver on the goals of the Biological Opinion.

Based on the projects evaluated so far, the ERTG has highlighted several restoration principles:

- Geographically larger projects provide more benefits than smaller ones
- Projects closer to the Columbia’s main stem, making them more accessible to fish, are better than those farther away
- Restoring remnant channels is better than excavating new ones
- Natural processes are preferable to engineered processes
- A holistic perspective that views projects on a landscape scale is better than narrow, site-specific perspective

The ERTG’s SBU Calculator reflects these principles and incorporates both quantitative inputs such as water surface elevation with scores based on the professional judgment of ERTG members. Professional judgment based on the latest science is a common, accepted and even necessary feature in processes to weigh habitat projects. The ERTG process strives to combine quantitative metrics with professional judgment consistently and without bias to make the most of restoration investments on behalf of fish in the Columbia River estuary.

The ERTG meets on a monthly basis, primarily to evaluate new projects and assess the need to update the process based on new scientific information.

The AAs work with regional scientists to produce a synthesis of research and monitoring findings in the estuary on an annual basis. This synthesis memo supports the ERTG process by providing a summary of relevant science that can inform the evaluation of habitat projects. The first synthesis memo was completed in 2012. Over time, the ERTG process will necessarily lead to changes in habitat action priorities based on new information.