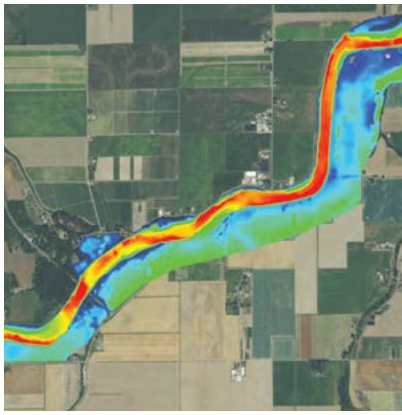

Estuary Restoration Strategic Assessment

A Summary Report of the Skagit Hydrodynamic Modeling Project

INTRODUCTION

IN THE SKAGIT RIVER, the futures of salmon and people are intertwined. The Estuary Restoration Strategic Assessment sets a course to balance the needs of fish, farmers, and flood risk reduction.

Chinook salmon are a cornerstone of the Skagit River's tribal culture, economy, and ecosystem. As with many watersheds in Puget Sound, a majority of the Skagit's tidal wetlands were diked and drained over a hundred years ago to make way for farms and towns. Young salmon, or smolts, find food and shelter in estuarine waters as they prepare to go to sea; loss of estuary habitat is one of several factors that contributed to the decline of this important species.

To recover Chinook, the Skagit delta needs to provide habitat for 1.35 million more smolts annually, which is predicted to require 2,700 acres of estuary restoration and improving access to existing habitats.[1]

Local communities and businesses also rely on the delta. Farmers grow crops in the rich soils, producing valuable food, flower bulbs, and seeds, and driving the local economy. Thousands of people live, work, and recreate on the delta, with the number rising every year. Aging flood and drainage infrastructure combined with a changing climate are increasing flood risk.

The Skagit Farms, Fish and Flood Initiative (3FI) is addressing these challenges by creating and implementing mutually beneficial solutions. The goal is to ensure long-term viability of agriculture and salmon while reducing the risk of destructive floods. 3FI also aims to support implementation of the Skagit Tidegate Fish Initiative, an agreement that links the maintenance of critical drainage infrastructure to estuary restoration to ensure that both needs are being achieved.

Under the umbrella of 3FI, representatives from salmon recovery, flood risk reduction, and agricultural groups collaborated to develop the Estuary Restoration Strategic Assessment (ERSA). Using scientific modeling and analysis, they evaluated the potential benefits and impacts of more than twenty project concepts for estuary restoration. In a collaborative decision-making process placing equal weight on farms, fish, and flooding, they used data to develop recommendations for restoration actions that will increase estuarine habitat for salmon while providing benefits and minimizing negative impacts for farms and flood risk reduction.

The ERSA combines best available science, local knowledge, and community values to achieve shared goals. The following pages summarize the process used to develop the ERSA and present the recommendations, lessons learned, and next steps for implementation.

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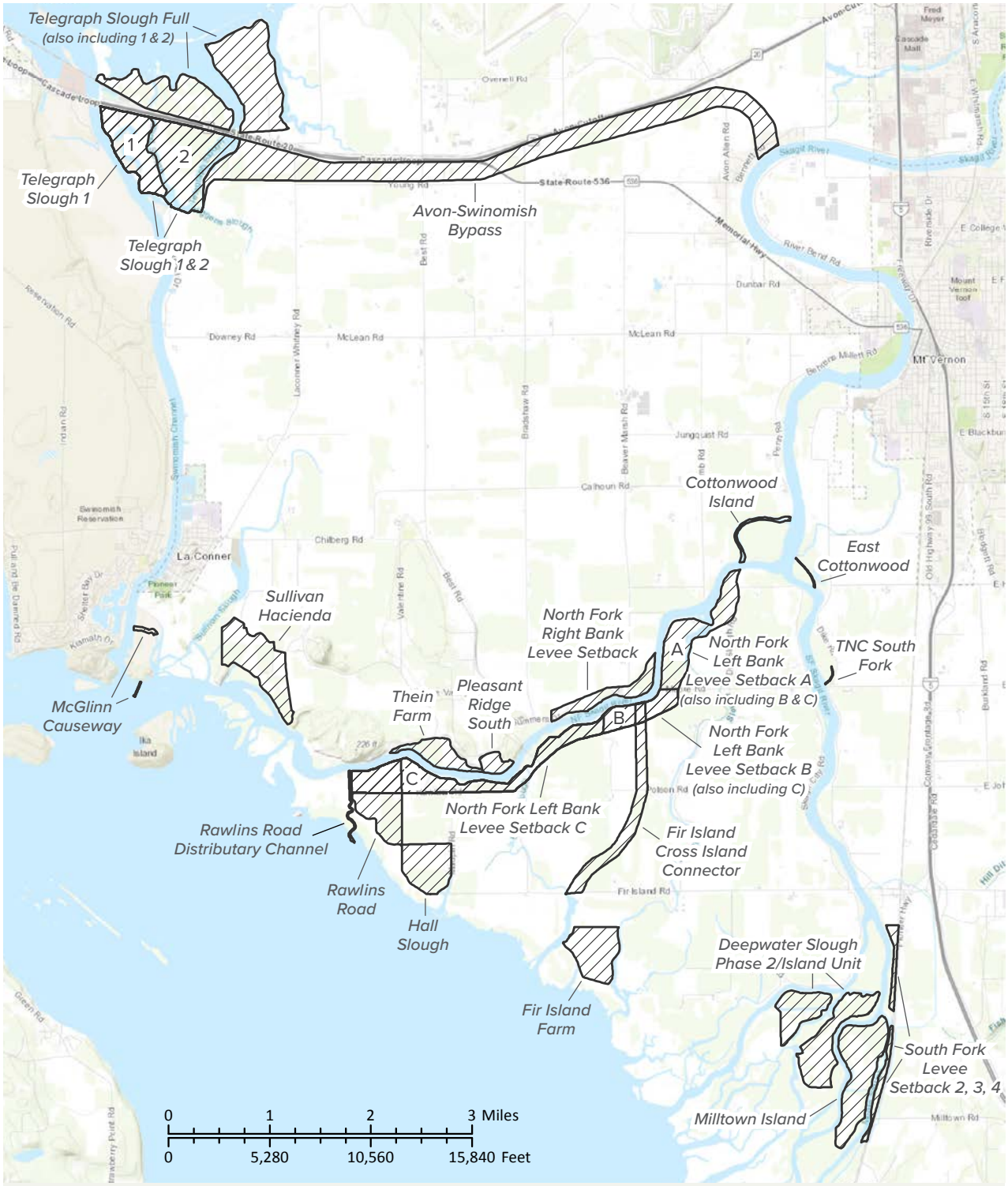
1. *Skagit Chinook Recovery Plan* (2005)



STUDY AREA

The Estuary Restoration Strategic Assessment focused on tidally influenced portions of the Skagit River watershed, including Skagit Bay, the Swinomish Channel, and southern Padilla Bay. Drawing on previous studies and incorporating new ideas, the project team worked to identify all project concepts, regardless of type or size, for inclusion in the analysis. The resulting list included twenty-three individual project concepts and three combined project concepts. The project team shared the list with community members and subject matter experts for review to ensure accuracy and completeness. This map shows the locations of all project concepts that were analyzed. Three types of projects were included: (1) dike setbacks or removals to restore inundation with dike construction to protect adjacent lands, (2) hydraulic projects to change flow patterns by excavating new channels, and (3) alteration of existing channels waterward of dikes to increase backwater flow.

APPROACH

A project team with **DIVERSE** participants created a **SCIENTIFICALLY** sound decision-making process based on community **VALUES.**

COLLABORATION AND TRANSPARENCY

The ERSA project team was led by scientists from the National Oceanic and Atmospheric Administration (NOAA) Restoration Center, The Nature Conservancy, and Washington Department of Fish and Wildlife. The co-leads invited a wide array of organizations from salmon recovery, flood risk reduction, and agricultural interests to join. Representatives from fourteen organizations actively participated as members of the project team. The diversity of perspectives represented on the project team was critical to ensure that the final results were meaningful and well supported. The project team strived for a collaborative, thoughtful, and transparent process that used best available science. The project team engaged with people in the broader community to gain additional input and perspectives.

ESTABLISHING CLEAR OBJECTIVES

The project team set out to understand the benefits and impacts that could result from each of the project concepts. The goal was to use this information to develop a strategic approach for prioritizing project concepts for implementation.

Quantitative analysis was an important part of the process. It enabled participants to understand how their priorities were incorporated in decision-making toward, and ultimately the final recommendations. Groups of representatives from each of the three interests—farm, fish, and flood—chose the objectives for their interest. The objectives encompassed both benefits to be maximized and impacts to be minimized from estuarine restoration. For each of their objectives, the interest groups developed quantitative indicators that could be used to analyze

PROJECT TEAM

The ERSA project team included individuals from:

- NOAA Restoration Center
- Seattle City Light
- Skagit Conservation District
- Skagit County Consolidated Diking Improvement District #22
- Skagit County Dike District #3
- Skagit County Dike District #17/Dike District Partnership
- Skagit Watershed Council
- Skagitonians to Preserve Farmland
- The Nature Conservancy
- Washington Department of Fish and Wildlife
- Western Washington Agricultural Association
- Upper Skagit Tribe
- United States Geological Survey

how much each restoration project concept would contribute toward the objectives.

Each interest group had one hundred points to allocate among their objectives, allowing weighting of high-priority objectives. By allocating a hundred points for each of the three interests, the analysis placed equal weight on fish, farms, and flood risk reduction, when calculating multi-interest scores.

The interest groups shared with the entire project team their reasons for choosing objectives and indicators, and for weighting or not weighting objectives. This discussion allowed everyone to better understand the perspectives of the other groups, building trust and a common knowledge base.

Levees and dikes protect Skagit farmland from flooding.

OBJECTIVES AND SCORING SYSTEM FOR RESTORATION PROJECT CONCEPTS

Farm Interest Objectives

BENEFITS (60 PTS)
- Maximize fish/acre farmland (20 pts)
- Support regulatory agreements (20 pts)
- Prioritize public lands (20 pts)

IMPACTS (40 PTS)
- Minimize farmland loss (20 pts)
- Avoid preserved farmland (20 pts)

Fish Interest Objectives

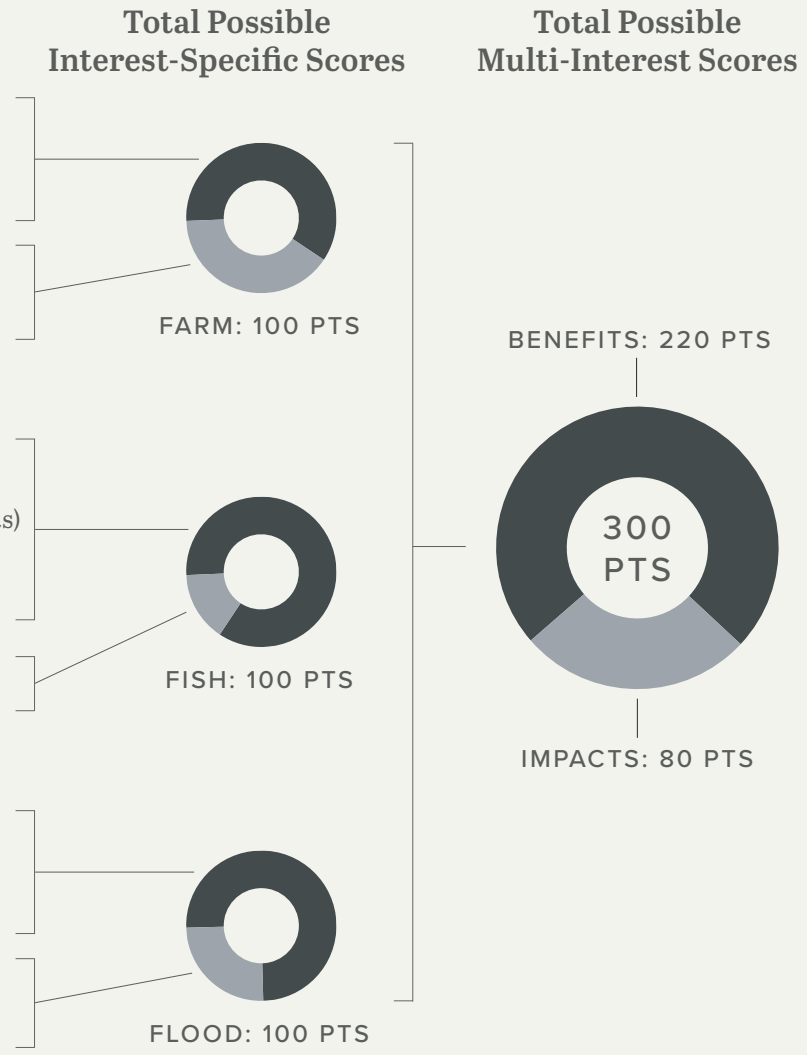
BENEFITS (85 PTS)
- Increase number of smolts (25 pts)
- Restore tidal and riverine processes (15 pts)
- Increase suitable channel habitat (15 pts)
- Increase connectivity (15 pts)
- Restore diverse habitat types (15 pts)

IMPACTS (15 PTS)
- Minimize loss of existing habitat (15 pts)

Flood Interest Objectives

BENEFITS (75 PTS)
- Reduce flood water elevations (25 pts)
- Reduce risk of levee failure (25 pts)
- Improve drainage (25 pts)

IMPACTS (25 PTS)
- Minimize new levee systems where none existed (25 pts)



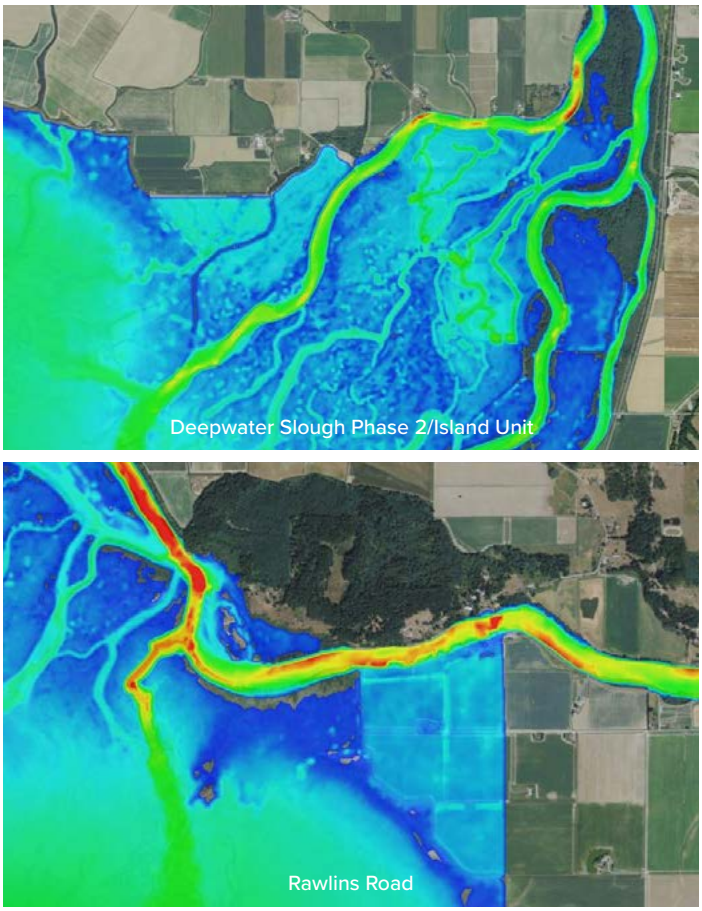
ANALYZING POTENTIAL OUTCOMES WITH BEST AVAILABLE SCIENCE

Scientists and technical experts worked with the project team to quantify the indicators for each project concept using best available science, including updated models and analytical methods.

Since release of the Skagit Chinook Recovery Plan in 2005, improvements have been made in models used to predict tidal channel formation on restored sites, which in turn affects the predicted number of smolts a site can hold. Incorporating the improved models was critical, as the updated predictions significantly increased smolt numbers for two sites and lowered those for two others.

New geographic information system (GIS) analyses, models of sedimentation patterns, knowledge of local tidal and river flood and drainage patterns, and vegetation community predictions also informed calculations of indicators.

This work was an iterative process between experts and the project team. Input from members of each interest group helped ensure that the models reflected real-world conditions. Through this process, the team refined indicators to better convey the effects of restoration and to ensure that they provided meaningful information to each interest group.



Technical experts used a hydrodynamic model to predict water depths, as part of the indicators analysis for each project concept.

THE ANALYSIS PROCESS

1. Identify estuary restoration project concepts based on previous studies
2. Define objectives and indicators for fish, farm, and flood interests
3. Determine technical analyses needed to measure indicators
4. Complete technical analyses for each project concept
5. Calculate indicators from technical outputs
6. Assess: Are the indicator results meaningful? Do they provide the information needed for decision making?
   - No → return to step 3
   - Yes → proceed to step 7
7. Refine framework for assessing benefits and impacts
8. Calculate interest-specific scores for each project concept
9. Calculate multi-interest scores for each project concept
10. Group the project concepts based on their multi-interest scores
11. Develop management recommendations for each group of project concepts

MULTI-INTEREST SCORES FOR EACH PROJECT CONCEPT

The indicator measurements were used to produce a multi-interest score for each project concept. The purpose of the multi-interest score is to indicate the total anticipated benefits and impacts for the three interest areas—fish, farms, and flood risk reduction—collectively, rather than separately.

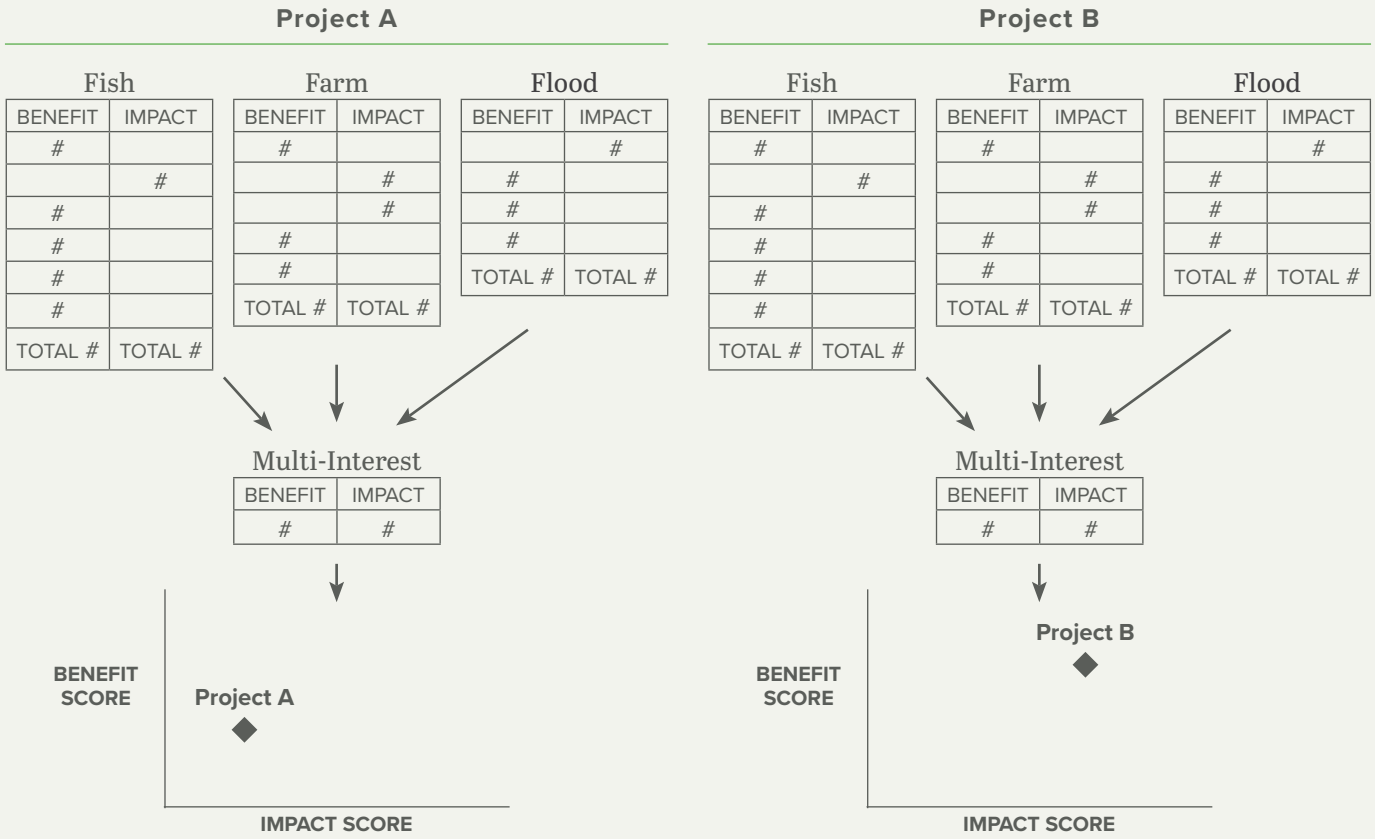
First, the values calculated for each indicator across all project concepts were standardized on a scale from zero to one, so that results from different types of indicators could be summed into a total score. To reflect the weight assigned by the interest groups to each objective, the standardized value for an indicator was multiplied by the number of points allocated to its corresponding objective. For example, a project that received a 1.0 score for the objective to "Maximize fish/acre farmland" would receive all of the possible 20 points, and a project with a 0.5 score would receive 10 points.

A levee protects adjacent farmland from flooding.

The benefit and impact scores within each interest were summed, and then the multi-interest score was calculated by summing the interest-specific scores.

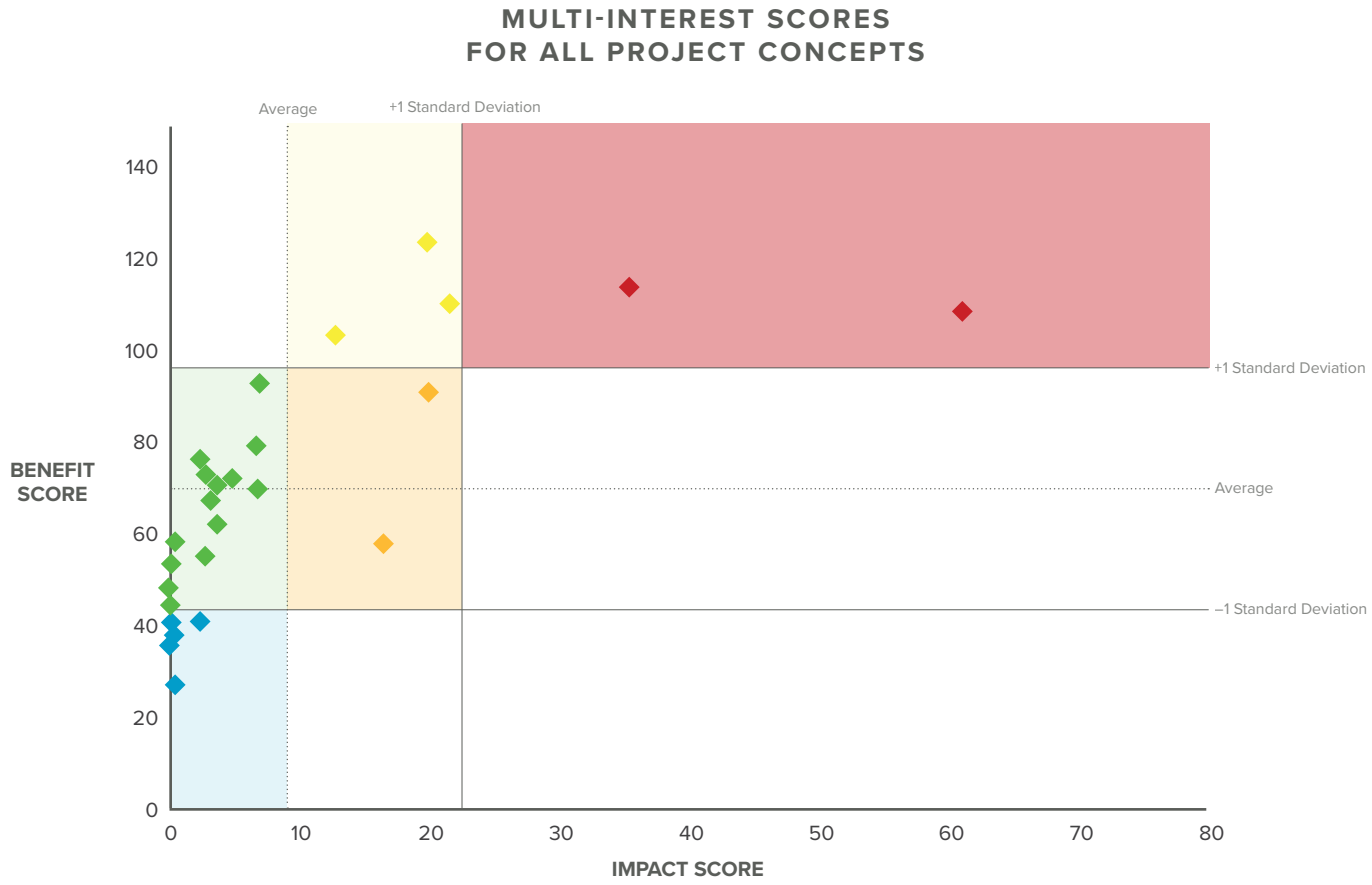
The process of calculating multi-interest scores is illustrated in the figure below.

CALCULATING MULTI-INTEREST SCORES



For each project concept, the benefit and impact indicator scores for fish, farm, and flood interests were summed to generate single-interest total scores, and then multi-interest scores. The multi-interest scores were graphed for comparison to other project concepts, as shown in this conceptual diagram for two hypothetical projects.

Approach



This graph shows the multi-interest scores for all project concepts in the ERSA analysis. Each diamond represents a project concept. The colors indicate groups of project concepts for management purposes, based on their levels of benefits and impacts (low, medium, or high). The ERSA project team recommends the green management group (low impacts, medium benefits) as the priority for implementation.

VISUALIZING TRADEOFFS

To visualize how the project concepts compared in their benefits and impacts, the project team plotted the multi-interest benefit score for each project concept against its multi-interest impact score, as shown above.

DEFINING MANAGEMENT GROUPS

Based on the averages and standard deviations of the benefit and impact scores, the project team categorized the multi-interest scores as high, medium, or low. This placed the project concepts into five distinct groups for planning and management purposes.

CUMULATIVE IMPACTS AND CLIMATE CHANGE

All restoration project concepts except the two projects in the red management group were modeled to identify potential cumulative impacts and begin preliminary analysis of climate change impacts. Cumulative effects analyses revealed no major impacts on the flow distribution between the North and South Forks of the Skagit River or on the performance of individual project concepts.

These findings provide a starting point for evaluating how the benefits of project concepts may change over time. Additional analysis of climate change, including modeling a wider array of sea level rise and river flow scenarios, needs to be completed to better understand potential changes to these projects and address future needs for drainage and diking infrastructure.

RECOMMENDATIONS

To support successful outcomes, the project team recommends a **CLEAR FRAMEWORK** for implementation and a **TIMELINE** for each management group.

PROJECT IMPLEMENTATION PATHWAY

Advancing estuary restoration from concepts to completed projects with monitored outcomes requires a clear framework. To support specific recommendations for each management group, the project team identified a typical pathway for project implementation. The pathway has well-defined phases and applies to projects on both public and private lands. Monitoring project outcomes provides valuable information about progress toward recovery goals for decisions about future project implementation.

Project implementation pathway showing phases to advance a restoration project from concept to implementation and monitoring.

AN IMPLEMENTATION STRATEGY FOR EACH MANAGEMENT GROUP

Using the implementation pathway as a framework, the project team developed a specific implementation strategy for each management group. The strategies were tailored based on the management group's levels of benefits and impacts (high, medium, low). Not all steps in the management pathway are included in the implementation strategies for some groups, and within each group not all projects are expected to advance at the same pace. Additionally, some project concepts may never advance because of project-specific factors.

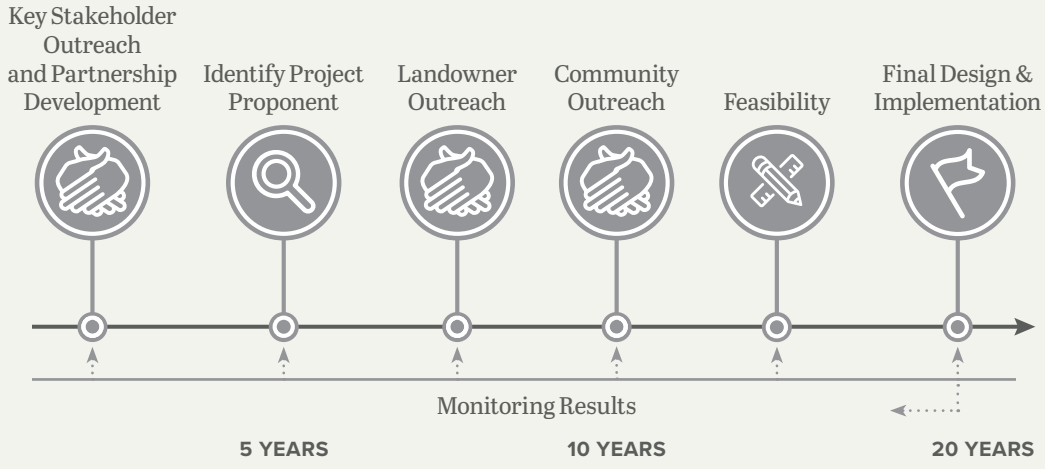
GREEN MANAGEMENT GROUP: HIGHEST PRIORITY

The project team recommends the green group of project concepts as the highest priority for collaborative implementation by fish, farm, and flood groups. These projects are anticipated to have moderate levels of benefits across interests and relatively low impacts. Therefore, they have the greatest potential to advance the goals of each interest while minimizing negative impacts.

With thirteen individual or combined project concepts, this is also the largest group. Some of the projects are already in the implementation pathway due to landowner willingness. As of 2019, Fir Island Farm had been completed, additional restoration actions at Milltown Island were in the feasibility and design phase, and Deepwater Slough Phase 2/Island Unit was in the stakeholder outreach phase.

Project	Acres
Fir Island Farm*	140
Milltown Island**	222
Deepwater Slough Phase 2/Island Unit**	268
McGlinn Causeway	7
North Fork Left Bank Levee Setback C	275
North Fork Right Bank Levee Setback	86
Rawlins Road	191
South Fork Levee Setback 2, 3, 4	56
Sullivan Hacienda	205
Telegraph Slough 1	185
Telegraph Slough 1 & 2	495
McGlinn Causeway & Telegraph Slough 1	192
McGlinn Causeway & Telegraph Slough 1 & 2	501

* Completed (actual acres restored: 131) ** In progress (2019)



Recommended timeline for projects in the Green Management Group.

The Fir Island Farm restoration project in the Green Management Group has been completed with 131 acres of estuary habitat restored.

YELLOW & ORANGE MANAGEMENT GROUPS

Five individual or combination project concepts had either high benefits/moderate impacts or moderate benefits/moderate impacts. Because of the higher likelihood of impacts from these projects, the project team recommends that outreach to key stakeholders and the development of multi-interest partnerships not begin immediately to allow time for less impactful actions from the green group to be implemented.

Project	Acres
Fir Island Cross Island Connector	150
North Fork Left Bank Levee Setback B	370
McGlinn Causeway & Telegraph Slough Full	1,055

Project	Acres
Hall Slough	134
Telegraph Slough Full	1,055

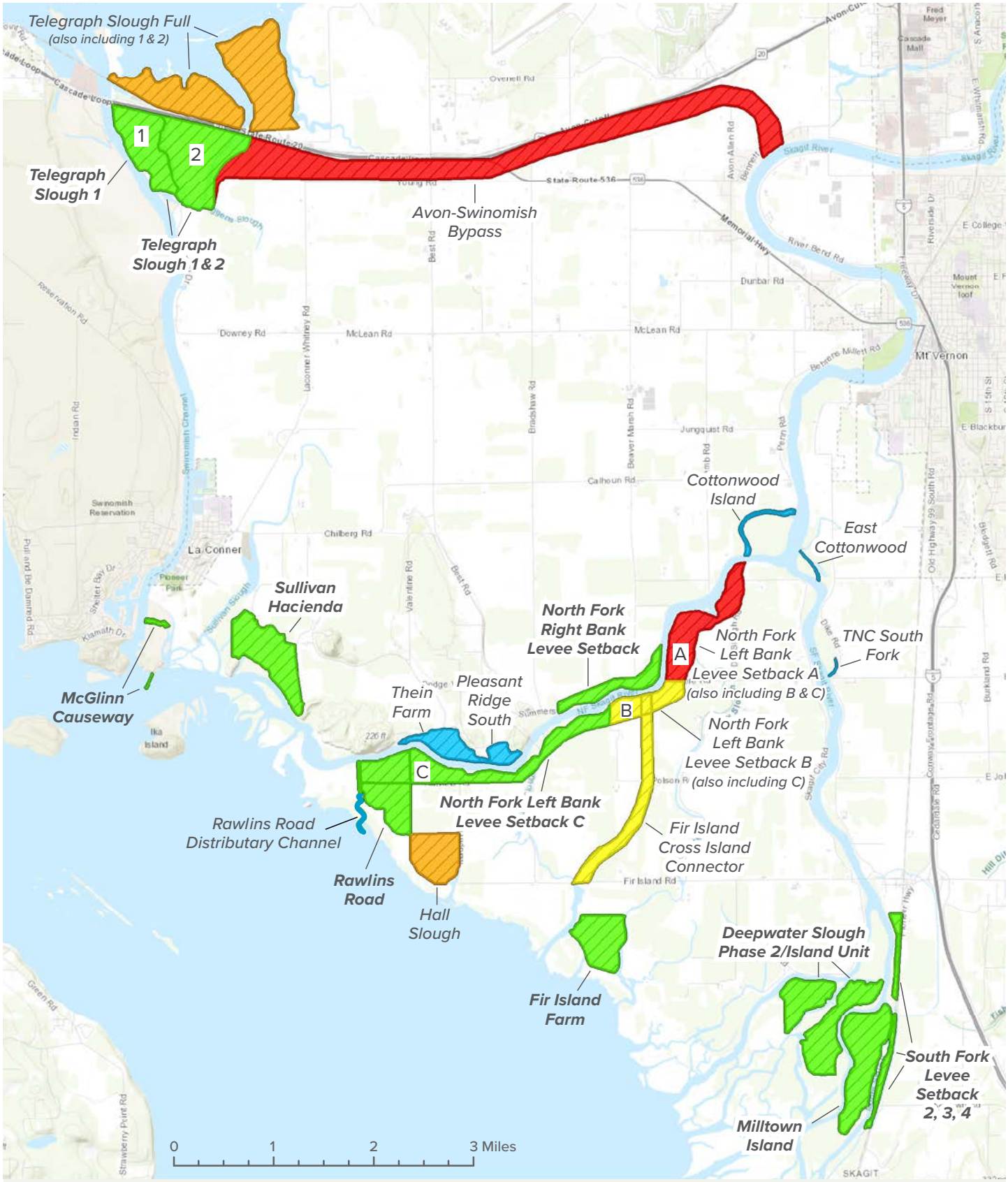
BLUE MANAGEMENT GROUP

The blue group includes six project concepts with low multi-interest benefits or strong benefits for only one interest group and therefore are not recommended to be a focus of multi-interest work. Because they are anticipated to have low impacts, however, they may be advanced by one interest group should the benefits be valuable enough.

Project	Acres
Cottonwood Island	15
East Cottonwood	2
Pleasant Ridge South	30
Rawlins Road Distributary Channel	8
Thein Farm	78

RED MANAGEMENT GROUP

The two project concepts in the red group—Avon-Swinomish Bypass and North Fork Left Bank Levee Setback A—are anticipated to have the highest total impacts as well as the highest impacts to any single interest. The project team recommends not advancing these projects toward implementation due to the high levels of impacts. These project concepts were excluded from cumulative impacts analyses.



PRIORITIES FOR IMPLEMENTATION

The project team recommends the green group of project concepts as the highest priority for collaborative implementation. The yellow and orange groups should not move ahead immediately due to the likelihood of higher impacts. Blue project concepts may be advanced as single-interest actions. The red group should not be advanced at this time.

MOVING FORWARD

STRONG COLLABORATION of fish, farm, and flood interest groups and **MONITORING** of project outcomes are essential for successful estuary restoration.

THROUGH PARTNERSHIPS, ADVANCE THE PROJECTS IN THE GREEN MANAGEMENT GROUP

The project team recommends that the focus over the next five years should be on engaging key stakeholder groups and developing multi-interest partnerships to advance project concepts in the green group. Project footprints may be modified to address concerns related to climate change, agricultural drainage, coastal resiliency, and offsite impacts that were too detailed and complex to include in the ERSA analysis.

The Skagit County Drainage and Irrigation Districts are a key stakeholder group for this effort. The twelve districts are signatory to the Skagit Tidegate and Fish Initiative (TFI), a framework that balances estuary restoration for Chinook salmon recovery and the need to maintain critical drainage infrastructure. The districts agreed to work with the restoration community to make the landowner contacts necessary to secure permissions, easements, or ownerships to implement restoration projects and to work with landowners to understand habitat restoration goals.

Additionally, the commissioners of the Skagit Dike, Drainage and Irrigation Districts are themselves key landowners as they own and maintain the infrastructure that will need to be removed or realigned during restoration. By providing crucial knowledge of the complex diking and drainage systems that need to be considered in the design of restoration projects, the commissioners can help ensure that multiple benefits are achieved. Restoration practitioners will work together with the Districts to engage private landowners and advance projects from concept to design and implementation.

The project team anticipates these collaborative efforts may focus on a few, well-supported projects at any one time; therefore, individual project timelines will be staggered. The timeline for implementing projects will also be influenced by monitoring programs that measure progress toward Chinook recovery goals and allow for adaptive management in the Skagit delta.

SUPPORT PROJECTS ALREADY IN THE IMPLEMENTATION PATHWAY

As of 2019, two projects in the green group were being advanced: Deepwater Phase 2/Island Unit (outreach and partnership development) and additional restoration actions at Milltown Island (feasibility and design). Outreach to district commissioners and the local community, including agricultural and salmon recovery entities, is being incorporated in these two projects. Continued support through partnerships and funding to advance these two projects through the implementation pathway is a priority.

MONITOR COMPLETED PROJECTS AND SUPPORT ADAPTIVE MANAGEMENT

Monitoring the outcomes of completed restoration projects and sharing results broadly is a critical need voiced by all interest groups. Understanding how completed projects are achieving, or not achieving, the goals of each interest will help improve the design and approaches used for future projects. Monitoring information from past projects informs all steps in the implementation pathway.

Project monitoring is also crucial for adaptive management to ensure that the anticipated benefits are achieved and unforeseen impacts are addressed. Monitoring to support adaptive management should address multi-interest goals. At the Milltown Island project, monitoring has shown that the site has not achieved the desired channel network connectivity and density, and therefore needs additional actions to achieve its full potential for supporting Chinook smolts. Wiley Slough has had ongoing infrastructure problems related to the tidegates and dikes that need to be corrected to meet its infrastructure goals.

CONCLUSION

ERSA provides a strategic approach for achieving **SALMON RECOVERY**, **FLOOD RISK REDUCTION**, and **AGRICULTURAL VIABILITY**.

The Skagit Chinook Recovery Plan notes that long-term estuary restoration projects "are socially complex and resource intensive so will need to include elements of mutually understood benefits for most, if not all, interest groups involved." Focusing on restoration project concepts with moderate benefits and low impacts (Green Management Group), building off existing multi-party agreements, and continuing collaborations across the three interests creates a pathway for success on the Skagit delta.

LESSONS LEARNED FOR DEVELOPING WELL-SUPPORTED ACTIONS

The goal of the ERSA project was to develop "well-supported actions to achieve long-term viability of Chinook salmon and community flood risk reduction in a manner that protects and enhances agriculture and drainage". To achieve this goal, the ERSA project team used a process and analyses that were themselves well supported by participants representing the three interests.

Several components of the process were integral for buy-in across interests and the development of critical partnerships for this and future actions.

- All interests were allocated equal portions of the multi-interest score.
- Representatives of interest groups developed the objectives and indicators for their interest and decided whether weighting of objectives was needed.
- Interest groups shared why they had selected objectives and indicators, leading to common understanding across interests.
- All parties had time to review, understand, and comment on the modeling and scientific analyses.
- Throughout the process, participants adjusted

Conclusion

objectives and indicators to ensure that they were meaningful and informative.

- Benefits and impacts were clearly identified, and impacts were acknowledged.
- Concerns of the project team members were identified and addressed; additional concerns were documented so they can be addressed at later stages.

By creating a process that engaged all interests, incorporated their views, and weighted their needs equally, the ERSA project built strong support for its recommendations and for continued collaboration.

The relationships that were developed are critical to the next phase of work, as the groups advance projects through the implementation pathway to maximize benefits and minimize or offset impacts.

PROJECT TEAM

Development of the Estuary Restoration Strategic Assessment required multiple years of intensive effort and would not have been possible without the dedication of project team members.

The project team included individuals from:

- NOAA Restoration Center
- The Nature Conservancy
- Washington Department of Fish and Wildlife
- Seattle City Light, Skagit Conservation District
- Skagit County Consolidated Diking Improvement District #22
- Skagit County Dike District #3
- Skagit County Dike District #17/Dike District Partnership
- Skagit Watershed Council
- Skagitonians to Preserve Farmland
- Western Washington Agricultural Association
- Upper Skagit Tribe
- U.S. Geological Survey

SKAGIT FARMS, FISH AND FLOOD INITIATIVE

NOAA Restoration Center
Skagit County Dike District #17/Dike District Partnership
Skagitonians to Preserve Farmland
Washington Department of Agriculture
Washington Department of Fish and Wildlife
Western Washington Agricultural Association

SCIENTIFIC AND TECHNICAL EXPERTS

Pacific Northwest National Labs (hydrodynamic modeling)
U.S. Geological Survey (sediment study)
Skagit River System Cooperative (tidal channel and smolt estimates)
The Nature Conservancy (GIS analyses)

FUNDERS

Environmental Protection Agency/National Estuary Program
NOAA Restoration Center
Private donors through The Nature Conservancy
Salmon Recovery Funding Board/Recreation and Conservation Office/Skagit Watershed Council

Funding for this publication was provided by the Estuary and Salmon Restoration Program of the Washington Department of Fish and Wildlife.

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Editorial & Design: Peter Taylor, Waterview Consulting