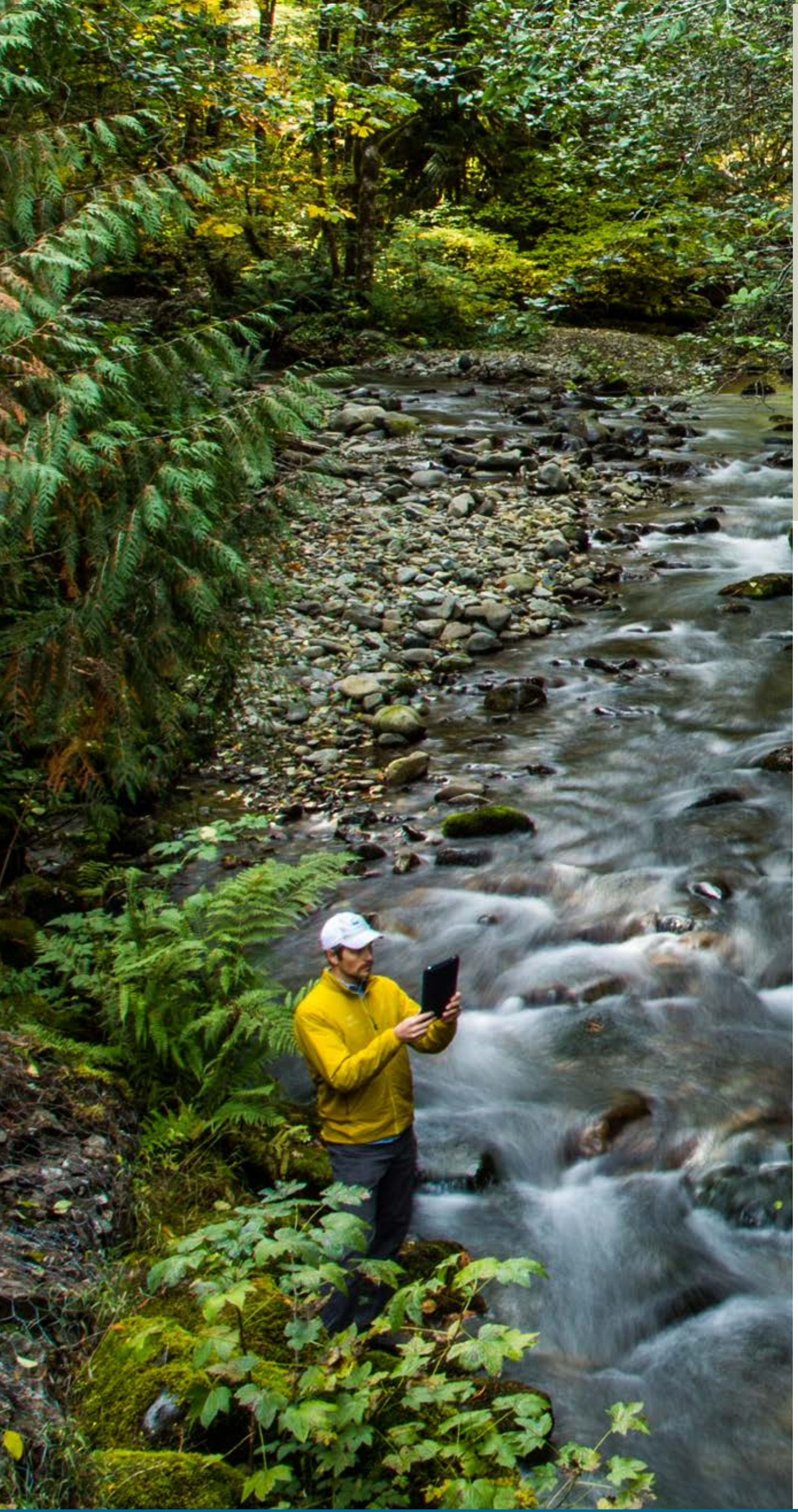
The Freshwater Trust®

Changing the course of conservation.

Uplift Report® 2015

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Why does Quantified Conservation matter?

We believe if it's worth doing, it's worth measuring. When we take a meticulous approach to restoration, the result is a more comprehensive and accurate assessment of the benefits of those actions.

So we've built all of our projects around a Quantified Conservation approach. Quantified Conservation is about ensuring every restoration action taken translates to a positive outcome for the environment. It's about methodically tracking the ways in which our restoration actions will improve water quality and quantity.

By quantifying the benefits of our projects, we can measure baseline ecosystem conditions, model the water quality benefit associated with the restored conditions, and monitor environmental gain over time. This approach will allow us to better target investments in nature and fix more rivers faster.

Modeling, measuring, and monitoring

To quantify environmental benefits, we rely on modeling and measurement. Models are a representation of a system using mathematical simulations of biological, chemical and physical mechanisms. These simulations utilize the best available science and understanding of natural systems. When we incorporate project site information, models allow us to predict conditions at a site that often cannot be directly measured. For example, using a soil erosion model, we can predict the loss of sediment from an agricultural field throughout the entire year, something that can be challenging to measure directly.

When modeling conditions at a project site, site-level information is essential. Field staff collect valuable information, such as habitat characteristics, vegetation type and distribution, land management practices and instream flow. These factors are measured in the field and then used to select the most appropriate model parameters to better represent conditions at the project site.

Incorporating field data into a model gives us a better understanding of site conditions. Additionally, the model representation of the project site allows us to test different restoration scenarios before implementation. We can simulate future site conditions, allowing us the opportunity to refine project designs and prioritize projects to get the greatest environmental benefits from the limited pool of restoration funding.

The Quantified Conservation approach does not end with project implementation. Long-term monitoring allows us to track the progress of a restoration site. Are the trees growing as expected? Is the water temperature changing as projected? The monitoring data we collect is used to measure outcomes, refine models, and test the efficacy of different restoration techniques.

See the models we are currently using for restoration sites on pages 6-9.

> "Quantified Conservation is about ensuring every restoration action taken translates to a positive outcome for the environment."

How is it applied?

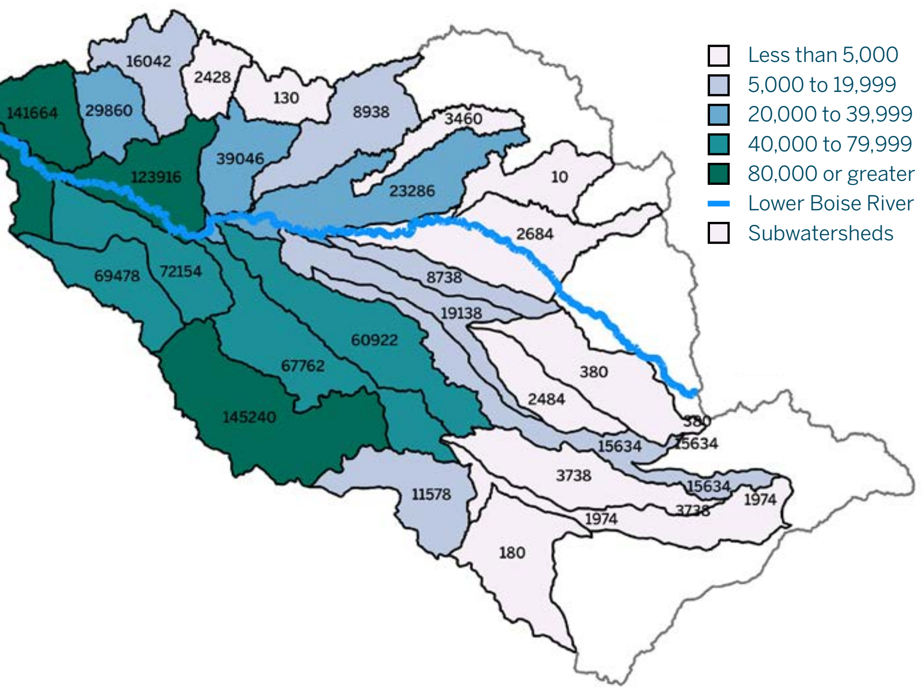
Let's look at an example of how Quantified Conservation can be used to address runoff from agricultural fields.

We know some fertilizers, pesticides and herbicides applied to agricultural fields to increase crop production do not stay where they're put. A portion of these nutrients washes into streams and rivers and leaches into groundwater. This can result in nutrient enrichment, or eutrophication, which leads to excessive algae and plant growth, and degrades water quality. When plants and algae die, they sink to the bottom of a waterbody and decompose. The decomposition process consumes the oxygen in the water faster than it can be replenished. Over time, waterways with high rates of plant and algae growth are likely to become oxygen starved, or hypoxic. Waters without oxygen can result in fish kills and be harmful to human and animal health. For example, as a result of excess nutrients from the Mississippi River and its tributaries, the Gulf of Mexico now has a dead zone spanning more than 5,000 square miles.

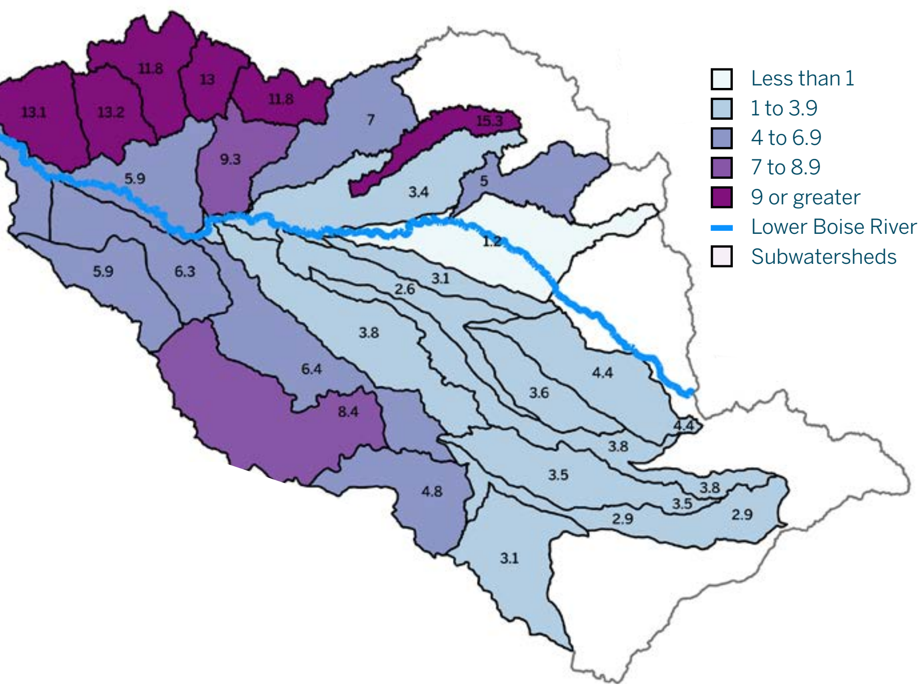
Island Press published President Joe Whitworth's book on Quantified Conservation. See more at thefreshwatertrust.org/quantified

Many conservation actions can address nutrient loading, including implementing agricultural best management practices, such as cover cropping,

TOTAL PHOSPHORUS IN SUBWATERSHED, IN POUNDS



AVERAGE PHOSPHORUS LOADING, IN POUNDS PER ACRE



Analysis of phosphorus loading by subwatershed from surface irrigated fields in an Idaho basin. Conservation or land management actions to reduce phosphorus loading may include cover crops, no-till, and filter strips, as well as irrigation upgrades from flood irrigation to sprinkler or drip irrigation. Each action is modeled to estimate the quantifiable reduction in pounds of phosphorus that can be achieved.

changing tillage practices, installing buffer strips, and restoring streamside buffers along fields. The implementation of these actions does not need to be a "best guess" exercise.

With the Quantified Conservation approach, we use specific models, such as the Nutrient Tracking Tool, to calculate the range of environmental benefits associated with changes in agricultural practices. As part of a watershed analysis, each agricultural field and land management action can be modeled. Analysis of all fields in a watershed employing a variety of land management actions allows us to identify the fields that have the greatest risk of soil erosion and nutrient loss. Through modeling, we can calculate how much nitrogen or phosphorus could be reduced through restoration or a best management practice. By evaluating the watershed with a consistent set of tools, we can develop a prioritized plan for reducing the pounds of phosphorus and nitrogen leaving specific fields.

Nutrients are not the only parameters we focus on for quantification. In addition to quantifying reductions in excess nitrogen and phosphorus, we also quantify reductions in excess sediment, thermal loading and water temperature, as well as beneficial increases in streamflow and stream habitat function. Since 2012, we have tracked these key parameters for the restoration projects we have designed and implemented.

See full list of 2015 restoration projects with metrics on pages 10-11.

How does quantification evolve?

We are building a new framework for doing restoration, and we recognize that not all the pieces will fit perfectly at the beginning. The results we are sharing in this report are modeled estimates based on our current understanding of the science and best available models at this time — not exact measurements. In the future, the models we use may change. Our understanding of the science may also broaden such that our results may need to be updated. The Quantified Conservation approach is a work in progress, yet the "act now and refine as we go" way has its advantages. It allows us to test our models and actions, giving us the data we need to refine them. The only way to create a strong and lasting system is to be open to new information and methods. This is also how we increase the pace and scale of restoration and be assured it is having the greatest benefit possible for a watershed. The ultimate goal is to develop a holistic understanding of freshwater environments and the benefits of restoration actions.

Where are we headed?

By using the Quantified Conservation approach, we are aiming to systematically improve the health of our freshwater resources. Restoration professionals, natural resources agencies, grant makers, regulators, regulated entities, environmental scientists and other stakeholders can rally around the field-tested models and the quantifiable units for tracking environmental benefits.

Small individual actions on a landscape can add up to big problems for our waterways. Each irrigator may take a small amount of water from the stream, but when these actions are combined, that diverted water can eventually mean a dry creek. Each farmer applies a small amount of nitrogen to a field of crops, but when combined, too much nitrogen can run into the rivers and choke out aquatic life and impair a drinking water supply.

But we also know the actions of individuals can add up to a big solution. When many farmers in a region improve irrigation and land management practices, excess nutrients and sediment entering a waterway can be reduced. When many landowners plant trees along a river for shade, the thermal load on the river can be reduced.

The whole of these carefully measured restoration actions is greater than the sum of its parts. Our Uplift Report helps us track this growing sum as we achieve real gains for the environment.

What has been the environmental response so far?

Prioritized restorations actions in key reaches of a watershed are not only captured numerically but demonstrated through positive responses from the environment. Here are a few examples from our projects:

ACTION	OUTCOME
Restored 15 cubic feet per second (cfs) of flow to the Lostine River	Increased streamflows improved instream habitat conditions so that more than 1,000 spring Chinook returned to spawn in the Lostine River in 2015.
Reconnected 1,021 feet of historic side channels in Still Creek	This created habitat that was immediately accessed by salmon for spawning in 2015.
Planted 39,055 trees and shrubs on the Rogue River to reduce solar load by 337,260,000 kilocalories per day, to date	Trees planted along a streambank will shade the stream, reducing the incoming solar load. This will help maintain the cooler water temperatures needed for native cold-water fish.
Planted riparian buffers to reduce 23,000 pounds of sediment runoff into Cedar Creek	Riparian buffers filter agricultural runoff and reduce streambank erosion, keeping sediment out of the stream and spawning substrate free of fine sediment.

The Freshwater Trust is a nonprofit organization with a mission to preserve and restore freshwater ecosystems.

With more than 30 years of on-the-ground experience, we continue to look for innovative ways to fix imperiled rivers and streams. With the latest tools and methods, we can attain efficiencies that facilitate real environmental gains with less cost, in less time.

ACKNOWLEDGEMENTS

The Freshwater Trust would like to thank the following partners who developed the tools and calculators to measure the ecological uplift in this report.

ESA Vigil-Agrimis, Inc.
National Fish & Wildlife Foundation
Oregon Department of Environmental Quality
Oregon State University
Skidmore Restoration Consulting, LLC
Texas Institute for Applied Environmental Research
United States Department of Agriculture
United States Environmental Protection Agency
Watercourse Engineering, Inc.

Case Study

Nutrient Tracking Tool: Cedar Creek

Goal

Reduce nitrogen, phosphorus and sediment runoff from agricultural uses

Action

Plant buffer strip of native riparian vegetation

Cedar Creek is located northeast of Springfield in Lane County, Oregon and flows into the McKenzie River. While home to sensitive species, including spring Chinook, native trout, Western pond turtles and American beaver, the water quality of the basin has been negatively impacted by farming and gravel extraction.

Agriculture can disturb soil and often requires fertilizers or pesticides. When it rains, runoff carries nutrients and soil off the land and into nearby waterways. An overabundance of nutrients promotes excessive plant and algae growth, reducing water quality and harming native species. Excess sediment can decrease water clarity and fill in the streambed substrate that salmon use to build their redds. One way to mitigate these impacts is to plant a buffer of native vegetation along the waterway to reduce and filter runoff.

Before restoration, the riparian areas of the Cedar Creek site were dominated by invasive Himalayan blackberry and reed canary grass that were crowding out the native species. In 2015, The Freshwater Trust and McKenzie Watershed Alliance installed 6,150 native trees and shrubs along approximately half a mile of Cedar Creek. The project shades the stream while providing an important buffer from the adjacent agricultural uses and improves habitat.

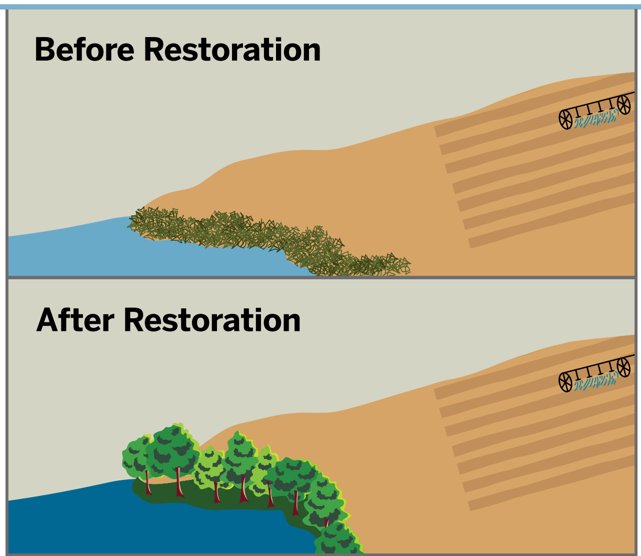
We used the Nutrient Tracking Tool (NTT) to quantify the reduction in nitrogen, phosphorus and sediment from a conservation action like planting trees. To estimate the water quality benefits from the new plantings, we combined management information from the landowner, including current agricultural practices at the site, type of crops, tillage practices and irrigation practices, with other datasets, such as soils, local climate data and remote sensing elevation data.

NTT models the change in nutrients and sediment by comparing a pre-project scenario featuring the invasive vegetation to a modeled post-project condition with a native forest buffer. The difference between these scenarios represents the reduction in nitrogen, phosphorus and sediment in pounds per year.

Results

We also calculated the reduction in solar loading as a result of increased shade from taller native trees, such as cottonwoods. Once the trees mature, solar loading will be reduced by approximately 13 million kcals/day in July and August. Cooler water has more oxygen and protects the incubation of eggs, increasing survival rates of native fish.

Cedar Creek, River Mile 2.5 Nutrients and Sediment Reduced			
Nutrient Tracking Tool			
Units of measure →	Pounds per year		
	Phosphorus	**Nitrogen**	**Sediment**
Before (pre-project)	20	402	27,800
After (post-project)	10	286	4,800
UPLIFT	**10**	**116**	**23,000**



Case Study

Shade-a-lator: Neil Creek

Goal

Protect water quality by reducing nutrient loads from livestock

Action

Construct fencing and off-channel watering and plant riparian buffer

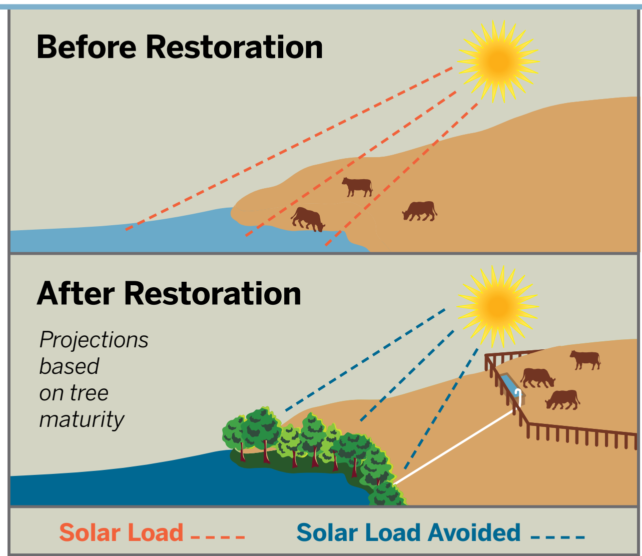
Neil Creek is located in the Rogue River basin of southern Oregon. It supports some of the most productive fishery habitat in the Bear Creek watershed. While home to threatened coho salmon and other wildlife, the creek's riparian area was choked with invasive weeds. Livestock from a nearby ranch also had access to the stream year-round.

Allowing livestock in streams increases the nutrients entering a waterway. An overabundance of nutrients promotes excessive plant and algae growth, reducing water quality and harming native species.

Additionally, invasive weeds decrease biodiversity and crowd out native species. A healthy riparian area provides shade to keep water temperatures cool and stabilizes streambanks to reduce erosion.

In 2015, The Freshwater Trust and its partners began working with an active ranch along Neil Creek to improve the conditions of the waterway. This project includes 14 acres of riparian restoration along approximately one mile of the creek. The riparian plantings include a mixture of native trees and shrubs to shade the stream, provide habitat for wildlife, and serve as a source of large wood and organic matter. The project also includes fencing and watering troughs to exclude cattle from the stream.

We used the Shade-a-lator model to quantify the reduction in solar loading on Neil Creek. We examined pre-project conditions, including current vegetation height, canopy density and plant distribution, to model the amount of solar radiation that reaches Neil Creek prior to the riparian plantings. We then modeled a post-project scenario based on mature vegetation height and abundance to determine the amount of solar radiation that will no longer reach the creek. The difference between the scenarios represents the uplift from the project: approximately 4 million kilocalories per day from July through August. Reducing solar loads helps improve stream conditions for aquatic species that depend on cold water to rear and spawn.



Neil Creek, River Mile 2 Solar Load Avoided	
Shade-a-lator	
Unit of measure →	Kilocalories per day
Before (pre-project)	6,800,000
After (post-project)	3,020,000
UPLIFT	**3,780,000**

We also calculated nutrient and sediment uplift using the NTT model. This model considers on-farm drainage patterns, project designs, and farm management practices to determine nutrient and sediment uplift related to riparian restoration.

Results

Case Study

Water Temperature Transaction Tool: Rock Creek

Goal

Reduce summer water temperatures by increasing flow

Action

Implement flow agreement with landowner to restore instream flow

Rock Creek is located in Central Oregon's Upper John Day Basin. Hot, dry summers and irrigation withdrawals have led to excessively high water temperatures during summer months. Since it is home to federally threatened Mid-Columbia summer steelhead, the creek has been identified by state and federal agencies as a high-priority for flow restoration.

In 2015, we partnered with Antone Ranch, a 37,000-acre ranch along Rock Creek, on a significant flow restoration agreement. Through a water-use agreement that combines full-season shutoffs – no irrigation for the entire season – and split-season shutoffs – irrigation ceases in July – the brokered deal reduced irrigation on roughly two-thirds of the ranch's 1,100 acres of irrigable land.

The long-term goal is to increase juvenile steelhead production by increasing stream discharge. Increased streamflow reduces the mid-summer water temperatures and provides better quality habitat for juvenile fish.

The Freshwater Trust operated nine streamflow and water temperature gages in the Rock Creek watershed for two irrigation seasons. The data provided empirical evidence of temperature reductions due to instream flow increases from the water-use agreement.

We also used the Water Temperature Transaction Tool (W3T) to model temperature improvements. W3T uses river and landscape characteristics to estimate hourly solar radiation and overall heat loss or gain from the water. W3T also incorporates the measured streamflow and temperature inputs, along with meteorological and riparian vegetation information. From these inputs, W3T calculates temperature changes in a river reach.

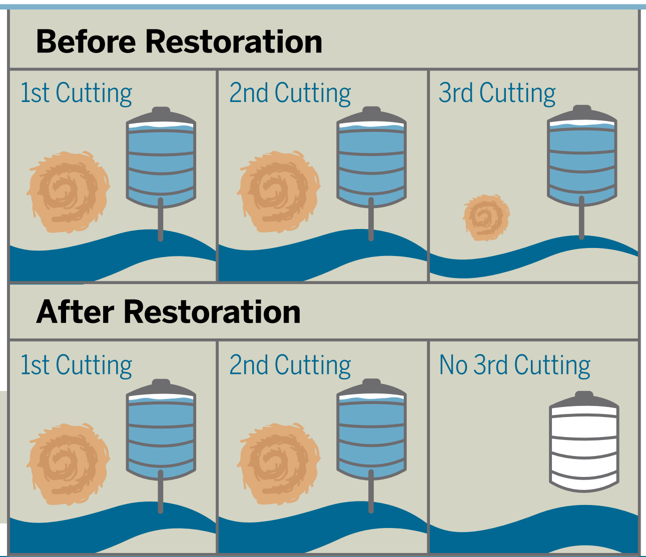
Further methods of quantification are being added. A multi-year study was initiated to evaluate the impacts of improved flow conditions on macroinvertebrates. Additionally, the regional fisheries biologist will conduct biennial juvenile steelhead surveys to quantify the increased rearing capacity of the stream as a result of this flow transaction.

The Rock Creek project is part of the Columbia Basin Water Transactions Program.

Results

Rock Creek Decreased Water Temperature (Daily Max.)	
Water Temperature Transaction Tool	
Unit of measure →	Degrees Celsius
Before (pre-project)	16.9
After (post-project)	16.4
UPLIFT	**0.5**

With split-season shutoff, the ranch forgoes a late-season cutting of forage crop to leave irrigation water instream in exchange for compensation greater than the value of the crop.



Case Study

Stream Function Assessment Methodology: Salmon River

Goal

Improve habitat for wild fish and other aquatic species

Action

Construct large wood habitat structures, place additional large wood and boulders instream, simulate emulated landslides, and enhance existing alcoves

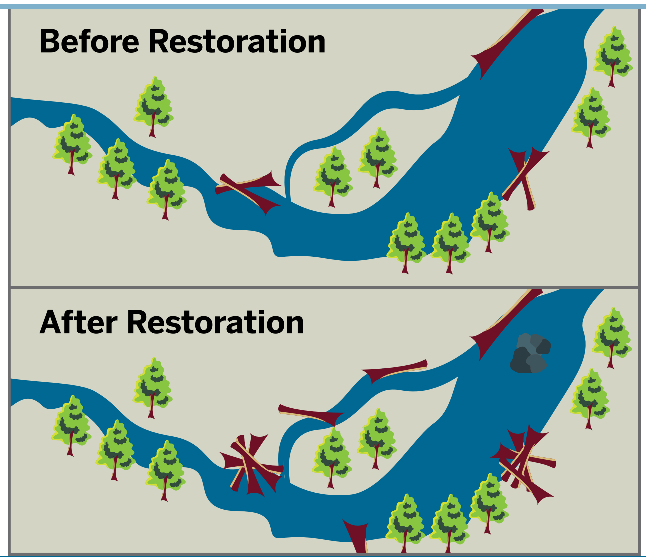
The Salmon River, a tributary of the Sandy River, flows off the southwestern face of Mount Hood in Oregon's Cascade Range. The river provides crucial spawning and rearing refuge for endangered Chinook, coho and steelhead. Despite its designation as a National Wild and Scenic River, past land management activities have severely degraded instream habitat. Sections of the river were straightened and diked, and large wood was removed. Habitat complexity decreased, and populations of coho and chum salmon, winter steelhead and spring Chinook declined.

Since 2005, we have been part of a collaborative effort to restore habitat complexity in the Salmon River. Restoration actions implemented in 2015 include large wood structure placement, large wood and boulder augmentation and side-channel enhancements. These actions will increase available spawning and rearing habitat for endangered salmon and steelhead.

To quantify the instream benefits achieved by the restoration actions implemented on the Salmon River, we used the Stream Function Assessment Methodology, a rapid assessment tool that evaluates stream functions and values. The methodology considers stream and streamside characteristics along with the ecological and societal benefits of that stream. Stream attributes, such as linear feet of side-channel habitat, the number of pieces of large wood, and the frequency and size of pools, are entered into the calculator. The tool generates scores for hydrologic, geomorphic, biologic and water quality functions, which is then used to quantify ecological outcomes.

In 2015, we completed projects along the Salmon River, resulting in 3,993 feet of increased habitat complexity by placing 80 boulders to increase channel roughness, emulating one landslide deposit to increase gravel deposition and organic material, and constructing five large wood structures. The structures will enhance instream habitat complexity.

Results



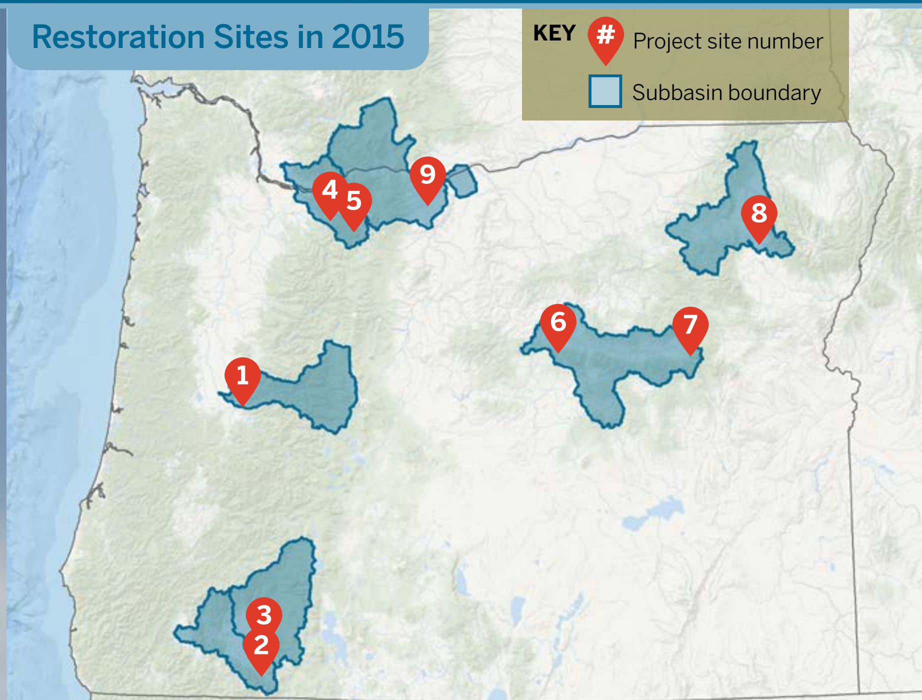
Salmon River, River Mile 0.91–1.42 & 1.22–1.84 Increased Stream Function for Aquatic Species	
Stream Function Assessment Methodology	
Unit of measure →	Functional linear feet of stream
Before (pre-project)	3,474
After (post-project)	3,500
UPLIFT	**26**

The Stream Function Assessment Methodology values were combined for the listed project locations. The tool is limited in its ability to express the benefits of certain restoration actions. For this reason, 26 functional linear feet is a conservative number.

Uplift is a term used to describe the environmental benefits of a restoration action. Uplift is calculated by modeling the conditions of an ecosystem prior to a restoration project, and then modeling the conditions that will result after a project has been implemented. The difference represents the environmental benefit of that action expressed in units of degrees Celsius, kilocalories per day, functional linear feet or pounds per year.

Uplift from 2015 Projects

Restoration Sites in 2015



Flow Restoration Deals in 2015

105 million gallons per day left instream

162 cubic feet per second left instream

15 streamflow & temperature gages added

134 total active flow deals in 2015

40 new flow deals in 2015

Restoration Site Name Subbasin Name	Outcomes →	Flow Added	Flow Attributed to Transaction	Affected River Miles
	Units of measure →	Cubic feet per second	Percentage of total flow	River miles
6 **Rock Creek –** Upper John Day		12.2	100%	12
7 **Reynolds Creek –** Upper John Day		3.7	36%	2
8 **Catherine Creek –** Upper Grande Ronde		3.3	62%	10
9 **Fifteenmile Creek –** Middle Columbia-Hood		5.4	100%	39

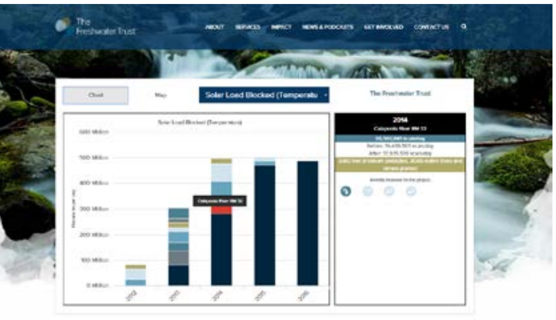
Restoration Site Name Subbasin Name	Outcomes →	Phosphorus Reduced	Nitrogen Reduced	Sediment Reduced	Solar Load Avoided	Increased Stream Function	Water Temperature Decreased (Daily Max)	Restoration Actions
	Tool used →	Nutrient Tracking Tool			Shade-a-lator	Stream Function Assessment Methodology	Water Temperature Transaction Tool	
	Units of measure →	Pounds per year (lbs/yr)	Pounds per year (lbs/yr)	Pounds per year (lbs/yr)	Kilocalories per day (kcals/day)	Functional linear feet (FLF)	Degrees Celsius (°C)	
1 **Cedar Creek RM 2.5** McKenzie	**Before** (pre-project)	20	402	27,800	38,100,000			**2,199** feet of stream protected **6,150** native trees and shrubs installed
	After (post-project)	10	286	4,800	25,120,000			
	UPLIFT	**10**	**116**	**23,000**	**12,980,000**			
2 **Neil Creek RM 2 (Phase 1)** Middle Rogue	**Before** (pre-project)	9	164	12,000	6,800,000			**1,569** feet of stream protected **6,000** native trees and shrubs installed
	After (post-project)	1	9	600	3,020,000			
	UPLIFT	**8**	**155**	**11,400**	**3,780,000**			
3 **South Fork Little Butte RM 1.92 & 3.32** Upper Rogue	**Before** (pre-project)				37,970,000	2,590		**1,459** feet of side channel habitat restored **27** large wood structures **3,957** feet of stream restored
	After (post-project)				29,050,000	2,755		
	UPLIFT				**8,920,000**	**165**		
4 **Salmon River RM 0.91–1.42 (Phase 2) & 1.22–1.84** Lower Columbia – Sandy	**Before** (pre-project)					3,474		**998** feet of side channel habitat restored **5** large wood structures, **3,993** feet of stream restored
	After (post-project)					3,500		
	UPLIFT					**26**		
5 **Still Creek RM 4.0–4.5 & 6.5–7.3** Lower Columbia – Sandy	**Before** (pre-project)					5,684		**1,021** feet of side channel habitat restored **8** large wood structures **7,454** feet of stream restored **80** boulders placed instream
	After (post-project)					6,315		
	UPLIFT					**631**		
6 **Rock Creek** Upper John Day	**Before** (pre-project)	24	116	29,400			16.9	**12.2** cfs of water leased (100% of total flow)
	After (post-project)	9	79	15,000			16.4	
	UPLIFT	**15***	**37***	**14,400***			**0.5**	
7 **Reynolds Creek** Upper John Day	**Before** (pre-project)	14	160	210,000			20.5	**3.7** cfs of water leased (36% of total flow)
	After (post-project)	7	69	88,400			20.4	
	UPLIFT	**7***	**91***	**121,600***			**0.1**	
8 **Catherine Creek** Upper Grande Ronde	**Before** (pre-project)	63	414	117,000			17.0	**3.3** cfs of water leased (62% of total flow)
	After (post-project)	10	105	13,400			16.0	
	UPLIFT	**53**	**309**	**103,600**			**1.0**	
Quantified Uplift for 2015 Projects		**93 lbs/year**	**708 lbs/year**	**274,000 lbs/year**	**25,680,000 kcals/day**	**822 FLF**	**1.6 °C**	**3,768** feet of stream protected **12,150** native trees and shrubs installed **3,478** feet of side channel habitat restored **40** large wood structures **15,404** feet of stream restored **80** boulders placed instream **19.2** cfs of water leased
CUMULATIVE QUANTIFIED UPLIFT 2012 – 2015		**206 lbs/year**	**1,589 lbs/year**	**467,100 lbs/year**	**497,650,000 kcals/day**	**9,592 FLF**	**6.4 °C**	

Note: The values presented here are modeled estimates of the environmental benefits of our 2015 projects.

Check out the interactive version of our uplift results at www.thefreshwatertrust.org

* *Soil data are not available for county, therefore a nearby proxy was used to estimate the nutrient and sediment uplift.*

The Freshwater Trust®
700 SW Taylor Street, Suite 200
Portland, OR 97205



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