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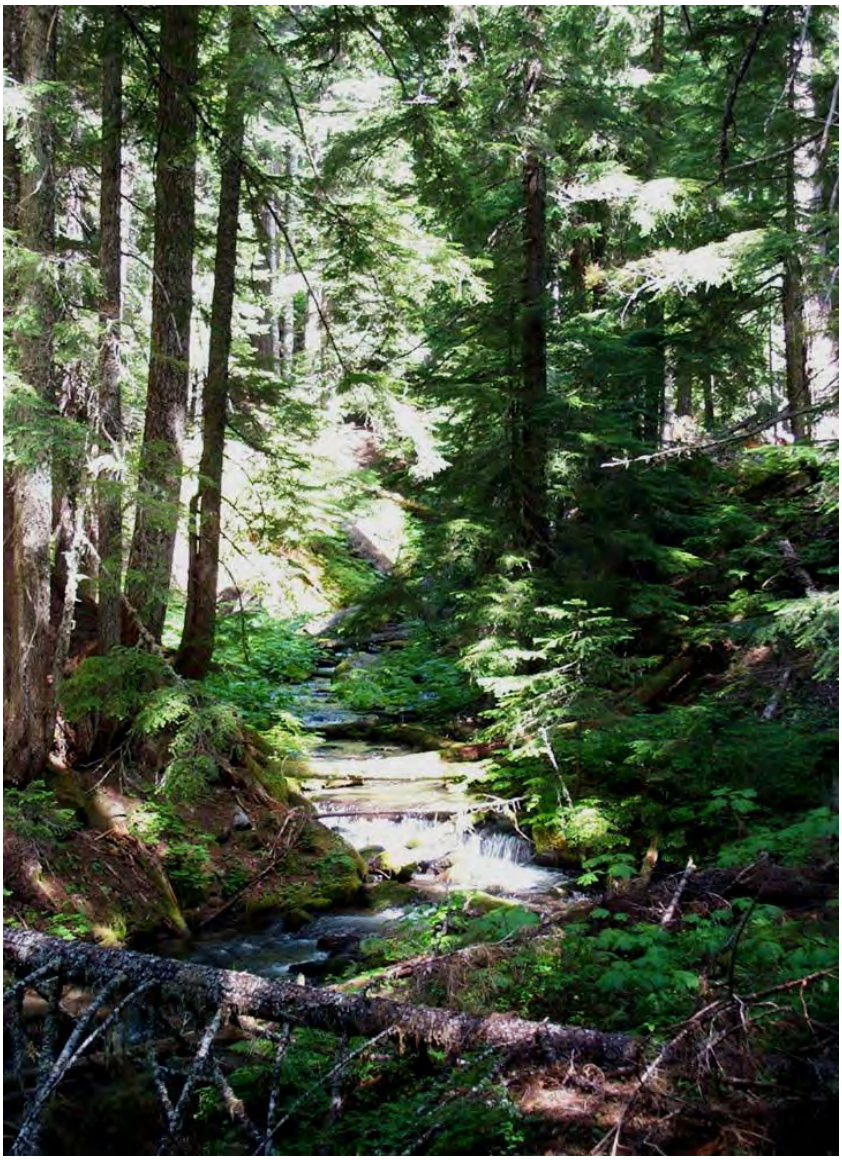
Still Creek Watershed Restoration Action Plan

Mt. Hood National Forest
Zigzag Ranger District



**All photos by Kathryn Arendt
except Sandy river photo pg.8**

Still Creek
Watershed Restoration Action Plan

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Developed from
Sandy River Basin Workgroup Products-
Anchor Habitat Assessment and
Aquatic Habitat Restoration Strategy

September 2011

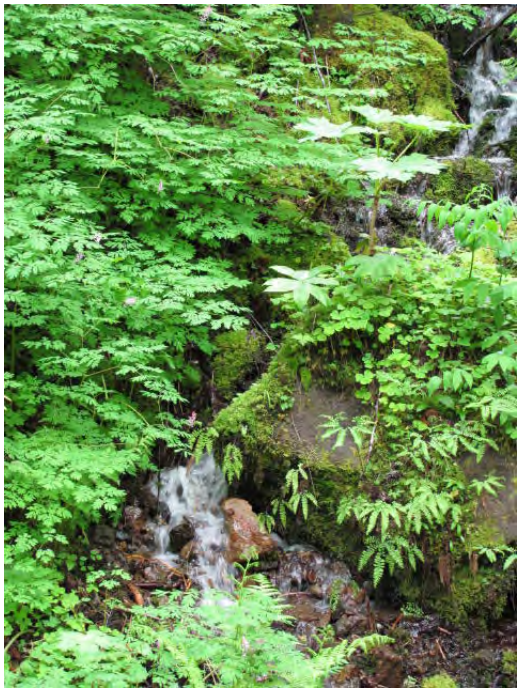
Mt. Hood National Forest
Zigzag Ranger District
Zigzag, Oregon

Reviewed and Approved By: _____ **Date:** 9/30/11

Bill Westbrook
District Ranger, Zigzag Ranger District
Mt. Hood National Forest

Executive Summary

Restoration of the Sandy River basin is a high priority for federal, state, local governments and agencies, as well as various non-profit organizations. In 2004, a collaborative stakeholder group known as the Sandy River Basin Working Group (SRBWG) convened to identify disproportionally important habitat (anchor habitat) within the Sandy River basin that is important for the persistence and restoration of federally listed salmon and steelhead populations. Many of the partners in the SRBWG had already been working together through the 1999 Sandy River Basin Agreement. The effort to identify anchor habitat resulted in the publication of "Salmon and Steelhead Conservation: An assessment of anchor habitat on the Sandy River, Oregon" published by Oregon Trout (SRBWG 2006). Still Creek was rated as a highest priority subwatershed in the Sandy River basin for recovery of wild stocks of threatened Chinook salmon, coho salmon, and winter steelhead as rated by the interagency Sandy River Basin Partners group.



The Sandy River basin anchor habitat process is fundamental in focusing restoration efforts of several of the major contributors to salmonid recovery in the Sandy River basin. Multiple entities spend over $2 million in the basin annually to restore aquatic habitat. While independent jurisdictions have prioritization schemes to guide investments in restoration activities, no single, comprehensive basin-wide strategy had been developed. These expenditures, for the most part, were made on a project-by-project, site-by-site basis by each responsible entity without coordination of the timing, sequencing, priority, and geographic focus of other participating entities. With the anchor habitat work as a foundation, the Sandy River Aquatic Habitat Restoration Strategy (SRBWG 2007) was published. Participating entities could now coordinate future investments in aquatic habitat restoration in a manner that leverages limited resources where they provide the greatest benefits to the long-term recovery and healthy functioning habitat in the basin.

The 2011 Still Creek Watershed Restoration Action Plan (WRAP) is an update to the 2007 Sandy River Basin Aquatic Habitat Restoration Strategy (SRBWG 2007) under the guidance of the national 2010 Watershed Condition Framework (WCF) (USDA 2010) – a comprehensive approach for proactively implementing integrated restoration in priority watersheds on national forests and grasslands. The WCF is comparable to the Sandy River Basin Aquatic Habitat Restoration Strategy in that it contains similar prioritization, identification of integrated suites of activities to improve watershed condition, and tracking of progress. The 2007 Sandy River restoration strategy and this 2011 Watershed Restoration Action Plan provide greater detail to the 1995 and 2004 Zigzag Watershed Analysis (which includes the Still Creek 6th field

watershed) by presenting a specific list of projects, timelines, and costs that restoration specialists, decision makers, and grant writers may use in promoting an interagency approach to improving aquatic resources in the Still Creek watershed. This 2011 Still Creek WRAP adjusts, updates, and/or adds essential projects to improve the subwatershed condition class, which addresses an outcome-based performance measure of progress toward restoring the productivity and resilience of the Still Creek watershed.

The goal of the Still Creek WRAP is to provide an operational scale tool for restoring the watershed by strategically focusing investments in essential watershed improvement projects and conservation practices at the 6th field watershed scale that tiers to the larger Sandy River Basin Restoration Strategy which all the Sandy River Basin Partners are heavily invested in. Working with our partners, implementation of the WRAP will strategically invest nearly 3.7 million dollars in the Still Creek watershed over the next 5 years. This investment is designed to accelerate the recovery of naturally functioning conditions within stream channels and riparian areas to restore production of juvenile and adult coho salmon, spring Chinook salmon, summer and winter steelhead, and cutthroat trout. The series of projects proposed as "Essential Projects" are intended to accomplish these goals by restoring riparian health and vigor by restoring flood plain resiliency with coarse woody debris and large wood floodplain structures designed to protect recovering pioneer riparian vegetation during peak flow events. Stream channels and aquatic habitat will be rehabilitated by installing and modifying existing large wood structures in specific locations along Still Creek that would give the most benefit to increasing aquatic habitat diversity and resiliency. In addition, these projects are designed to accelerate the recovery and diversity of riparian stands by maximizing the growth of conifers by thinning and under-planting riparian stands. A rapid response approach will be used to remove invasive plants that are now attempting to get established. Addressing under-sized culverts will reduce road-related sediment from entering the streams. Working with cabin owners along Still Creek as partners to replace open septic systems with functioning closed systems will improve water quality. Additionally, new wells for the cabins will replace existing direct water intakes that will lead to protecting fish in the stream. Implementation of these prioritized actions will have the following outcomes and performance based accomplishments:

- Restore natural watershed processes, including riparian function, in-channel habitat, road related impacts, and eradication of invasive plants to recover/improve production of ESA listed salmon and steelhead.
- Improve water quality in Still Creek by improving riparian forest health through additional shading to surface waters and through a reduction in sediment delivery from road related impacts.
- Provide education engagement opportunities for summer home owners/private landowners/general public to learn about watershed restoration.
- Provide jobs to local contractors, material suppliers, sport fishing industry.
- Maintain and strengthen partnership between the Mt. Hood national forest, coalition of Sandy River Basin Partners, summer home owners and private landowners.

Partners within the Sandy River basin fully support these proposed essential projects and are working with the Mt. Hood National Forest to achieve these outcomes to promote watershed recovery of the entire basin.

Contents

Background

The Sandy River is a tributary of the Columbia River, draining 508 square miles of the western flank of Mt. Hood. The Sandy River's mouth is within 20 miles of downtown Portland, Oregon, and much of the watershed is within an hour's drive of the metropolitan area. Despite its proximity to a major concentration of human development, most of the Sandy River's headwaters are protected by federally designated wilderness areas, congressionally reserved areas, or congressionally designated wild and scenic river corridors. The Salmon River, Little Sandy River, Still Creek, Cedar Creek, Gordon Creek, Bull Run River, and Zigzag River are major tributaries to the Sandy River. Roughly 73 percent of the watershed's area is in federal management (USDA and USDI 1994), 25 percent in private ownership (including industrial lands for commercial timber management), and two percent in state, city, and county ownership. The Sandy River is a 4th field watershed and is divided into six 5th field watersheds. The 5th field watersheds include: the Lower Sandy River, Middle Sandy River, Upper Sandy River, Bull Run River, Zigzag River, and Salmon River. The Still Creek 6th field watershed is located within the Zigzag River 5th field watershed.

The Sandy River supports several species of anadromous salmonids, including spring and fall Chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch*), and winter steelhead (*Oncorhynchus mykiss*). These salmon and steelhead populations, which historically numbered in the tens of thousands (Taylor 1998), have experienced significant declines during the last century. Within the last decade, the federal government and State of Oregon have listed all of these populations for protection under the state or federal Endangered Species Act (ESA).

Restoration of abundant salmon and steelhead populations and the habitat that supports them is a high priority for federal, state, and local governments and agencies, as well as various non-profit organizations. In January of 2004, a collaborative stakeholder group now known as the Sandy River Basin Working Group (SRBWG) convened to identify anchor habitat within the Sandy River basin that is important for the persistence and restoration of salmon and steelhead populations. Many of the partners had already been working together through the 1999 Sandy River Basin Agreement. In 2004, the Working Group gathered during a series of meetings and workshops to evaluate the basin and

identify key reaches of habitat. This identification would form the foundation of a technically sound strategy for restoring salmon and steelhead habitat based on the best technical information available and professional judgment. This effort resulted in the publication of the "Salmon and Steelhead Conservation: An assessment of anchor habitat on the Sandy River, Oregon" published by Oregon Trout (SRBWG 2006).

The anadromous fish restoration strategy developed by the working group focused on the remaining, relatively intact riverine habitat in the Sandy River basin that currently supports a disproportionate share of wild salmon and steelhead. This approach to restoration has been termed a habitat-based approach, a "refugia" approach, or an anchor habitat approach. These terms are synonymous. Anchor habitat is defined as distinct stream reaches that currently harbor specific life history stages of salmon and steelhead to a greater extent than the stream system at large. The Working Group crafted the anchor habitat definition from a survey of existing prioritizations and previous anchor habitat work. These areas of habitat are identified by the actual distribution of fish and can be crucial for their persistence during periods of environmental adversity (Frissell 1998). Restoration priorities should begin with identifying centers of productivity and downstream habitats that are critical for maintaining existing populations and life histories of key species (Frissell 1994).

The Sandy River basin anchor habitat process exists to coordinate and focus restoration efforts of several of the major contributors to salmonid recovery in the Sandy River basin. According to conservative estimates, multiple entities and jurisdictions spend over $2 million in the basin, on average, to restore aquatic habitat conditions for salmon and steelhead. While independent jurisdictions have prioritization schemes to guide investments in restoration activities, no single, comprehensive basin-wide strategy had been developed.

These expenditures, for the most part, had been made on a project-by-project, site-by-site basis by each responsible entity without coordination of the timing, sequencing, priority, and geographic focus of actions based on species' needs or actions of other participating entities. With the completion of the Sandy River Aquatic Habitat Restoration Strategy (SRBWG 2007), participating entities could now coordinate future investments in aquatic habitat restoration in a manner that leverages limited resources where they provide the greatest benefits to the long-term recovery and healthy functioning of salmon and steelhead habitat in the basin. Agencies and organizations that fund aquatic habitat restoration activities often require an overall basin-wide strategy that is closely linked to a comprehensive assessment. These funding entities also require partnerships, cost-leveraging, and demonstrable on-the-ground results. At a broad state-wide or regional scale, many of the funding agencies and organizations are developing their own policies and criteria to focus aquatic habitat restoration investments where there is a demonstrated need, articulated priorities, and clear restoration benefit. Funding for aquatic habitat restoration actions has become increasingly scarce and highly competitive in recent years, especially within public land management agencies. As a result, there has been a greater emphasis placed on funding high priority restoration actions in priority basins at the state-wide and regional scales. This shift is occurring for three reasons: 1) to demonstrate accountability and accomplish high priority restoration actions for whole watersheds in priority basins, 2) to focus available funding in a partnering and cost-leveraging manner, and 3) to achieve tangible, aggregated restoration benefits where they are most needed for rebuilding salmon and steelhead populations at the

watershed-scale as opposed to a "shotgun approach" where many different restoration actions are implemented over a broad landscape making it difficult to detect a restoration benefit. With this paradigm shift occurring and a recognized need for a more cohesive, comprehensive, and collaborative approach that builds upon the breadth and diversity of existing partnerships, all of the participating entities in the basin readily supported the development of such a strategy for the Sandy River basin.

The aquatic habitat restoration strategy for the Sandy River basin provides a geographic focus and hierarchical framework for directing future investments (staff time and funding) toward high priority restoration needs that will aid in rebuilding salmon and steelhead populations.

Specifically, the Sandy River Aquatic Habitat Restoration Strategy:

- Identifies priority watersheds in the basin (at the 5th, 6th, and 7th field scales) that provide the cornerstones for addressing freshwater habitat restoration needs of Sandy River basin salmon and steelhead populations.
- Establishes the hierarchy, or sequence, in which actions should be pursued in order to achieve maximum resource benefits.
- Describes the factors limiting salmon and steelhead abundance, productivity, spatial distribution, and diversity. Many of these factors also limit water quality.
- Defines specific restoration actions (and types of restoration actions where they are not known site-specifically) in priority watersheds necessary to address limiting factors.

Several species of salmon and steelhead have been listed as threatened under the Endangered Species Act (ESA) in the Sandy River basin since the late 1990s. The ESA listings spurred an effort in 1999 to bring entities in the basin together in a collaborative manner to work toward salmon and steelhead recovery. The original group was founded by six of today's 14 partners: The City of Portland, Portland General Electric (PGE), National Marine Fisheries Service (NMFS), Oregon Department of Fish and Wildlife (ODFW), U.S. Fish and Wildlife Service (USFWS), and U.S. Forest Service (USFS). Several other entities joined the effort and collectively completed several significant accomplishments furthering conservation and recovery efforts for salmon and steelhead populations in the basin. In chronology, these accomplishments include:

- Multi-party negotiations beginning in the late 1990s that led to a 2002 settlement agreement for PGE's decommissioning of the Marmot and Little Sandy dams in 2007 and 2008, respectively (PGE 2002a and PGE 2002b). These actions removed all major hydroelectric operations and impacts along the Sandy and Little Sandy rivers, reestablishing natural free-flowing characteristics of both rivers and access to 8.3 miles of blocked historical anadromous habitat in the Little Sandy River.
- A revision to ODFW's Sandy Basin Fish Management Plan in 2001. Prior to decommissioning in 2007, Marmot Dam served as a fish-sorting facility and allowed ODFW to manage the upper basin as a wild fish sanctuary (ODFW 2001). The plan revision established changes in hatchery practices within the basin anticipating the removal of Marmot Dam. The actual fish management plan was finalized in 2001 prior to the signed settlement agreement for decommissioning PGE's Marmot and Little Sandy dams. The Federal Energy Regulatory Commission (FERC) procedures and negotiations

guiding the license surrender application process began in the late 1990s, but were put on hold pending resolution of issues pertaining to hatchery practices and fish harvest in the basin central to the issue of fish-sorting at Marmot Dam.

- The 2004 completion of a basin-wide salmon and steelhead habitat assessment using the Ecosystem Diagnosis and Treatment (EDT) model by a group of local fisheries biologists known as the Sandy Tech Team (City of Portland 2004). The assessment compared current versus historical habitat conditions and identified factors limiting salmon and steelhead production. In addition, the Sandy Tech Team visited field sites and developed and catalogued over 100 aquatic habitat restoration actions throughout the basin to address limiting factors. These restoration actions were organized in a database and serve as the foundation for "known" restoration actions contained in this document.
- A multi-party agreement in principle (AIP) in 2004 that outlined operational changes and actions that served as the proposed action in the development of a habitat conservation plan (HCP) under Section 10 of the ESA to bring the City of Portland Water Bureau's municipal water supply operations in the Bull Run River watershed into compliance with the ESA (SRBP 2004). The habitat conservation was completed by the City of Portland, NMFS, and USFWS.
- Completion of the Sandy River Basin Total Maximum Daily Load Assessment by the Oregon Department of Environmental Quality in 2005 (ODEQ 2005). This assessment addressed segments of rivers and streams within the basin that are currently water quality limited or impaired. It provided the foundation for responsible agencies and entities to develop management plans outlining actions to be taken to restore water quality conditions such that they meet current standards for beneficial uses.
- Completion of the Sandy River Basin Anchor Habitat Assessment for Salmon and Steelhead Populations in 2006 by the Sandy River Basin Working Group, in coordination with the Sandy River Basin Partners (SRBWG 2006). The Assessment identified the most important segments of rivers and streams within the basin for the restoration of salmon and steelhead populations. It served as the foundation for the development of geographic focus areas for the Sandy River Aquatic Habitat Restoration Strategy (SRBWG 2007) and this Watershed Restoration Action Plan.

The organizations that contributed to the development of the Sandy River Aquatic Habitat Restoration Strategy are listed in Table 1.

Table 1. Organizations that contributed to the development of the Sandy River Basin Aquatic Habitat Restoration Strategy.

Association of Northwest Steelheaders, Sandy Chapter
Bureau of Land Management (BLM), Salem District
City of Portland Water Bureau
Clackamas County Department of Transportation and Development
East Multnomah County Soil and Water Conservation District
National Marine Fisheries Service
Oregon Department of Fish and Wildlife (ODFW), North Willamette Region
The Freshwater Trust (formerly Oregon Trout)
Sandy River Basin Watershed Council
The Nature Conservancy

U.S. Fish and Wildlife Service (USFWS), Oregon State Office
U.S. Forest Service (USFS), Mt. Hood National Forest

Current Effort – Watershed Restoration Action Plan (WRAP)
This watershed restoration action plan (WRAP) tiers to the 1995 Zigzag 5th Field Watershed Analysis (WA) (USDA 1995) – per direction under the Aquatic Conservation Strategy (ACS) of the 1994 Northwest Forest Plan (USDA and USDI, 1994). The 2007 Sandy River Basin Aquatic Restoration Plan (SRBWG 2006, SRBWG 2007) was completed to guide implementation of restoration in the priority Sandy River basin per direction under the 2005 R6 Aquatic Restoration Strategy (ARS) (USDA 2005) and later replaced as the 2008 R6 Aquatic Restoration Conservation Strategy (ARCS) (USDA 2008), a foundational Regional strategy for incorporation into forest plans.

The 2011 Still Creek WRAP is an update to the 2007 Sandy River Basin Aquatic Habitat Restoration Strategy (SRBWG 2007) under the guidance of the national 2010 Watershed Condition Framework (WCF) (USDA 2010) – a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands. The WCF is comparable to the ARCS components with similar prioritization, identifying integrated suites of activities to improve watershed condition and tracking progress, although it utilizes a model that has a slightly differing watershed condition outcome. The 2007 restoration strategy and this 2011 Watershed Restoration Action Plan provide greater detail to the 1995 Zigzag Watershed Analysis (which includes the Still Creek 6th field watershed) by presenting a specific list of projects, timelines, and costs that restoration specialists, decision makers, and grant writers may use in promoting a team and interagency approach to improving aquatic resources in the Still Creek watershed. This 2011 WRAP adjusts, updates, and/or adds essential projects as needed to improve the subwatershed condition class, which addresses an outcome-based performance measure of progress toward restoring the productivity and resilience of watersheds and their associated aquatic systems on National Forest lands. The Still Creek WRAP can be viewed as the operational scaled (6th field HUC) plan which tiers to the broader Sandy River Bain Restoration Strategy. This WRAP follows the 2011 WCF transition WRAP report format.

Summary

Watershed Name and HUC

Still Creek (HUC12 number 17080010201)

General Location

The Still Creek 6th field watershed (HUC6) is part of the larger Sandy River basin. Still Creek is a tributary of the Sandy River which flows into the Columbia River. The Sandy River drains 508 square miles of the western flank of Mt. Hood. The Sandy River's mouth is within 20 miles of downtown Portland, Oregon, and much of the watershed is within an hour's drive of the metropolitan area. Still Creek, the Salmon River, Little Sandy River, Cedar Creek, Gordon Creek, Bull Run River, and Zigzag River are major tributaries to the Sandy River. The 5th field watersheds (HUC5) within the Sandy River basin include: the Lower Sandy River, Middle Sandy River, Upper Sandy River, Bull Run River, Zigzag River, and Salmon River. The Still Creek 6th field watershed is located within the Zigzag River 5th field watershed. See map (Figure 1 and 2) on next page.

Figure 1. Still Creek 6th Field Watershed Vicinity Map.

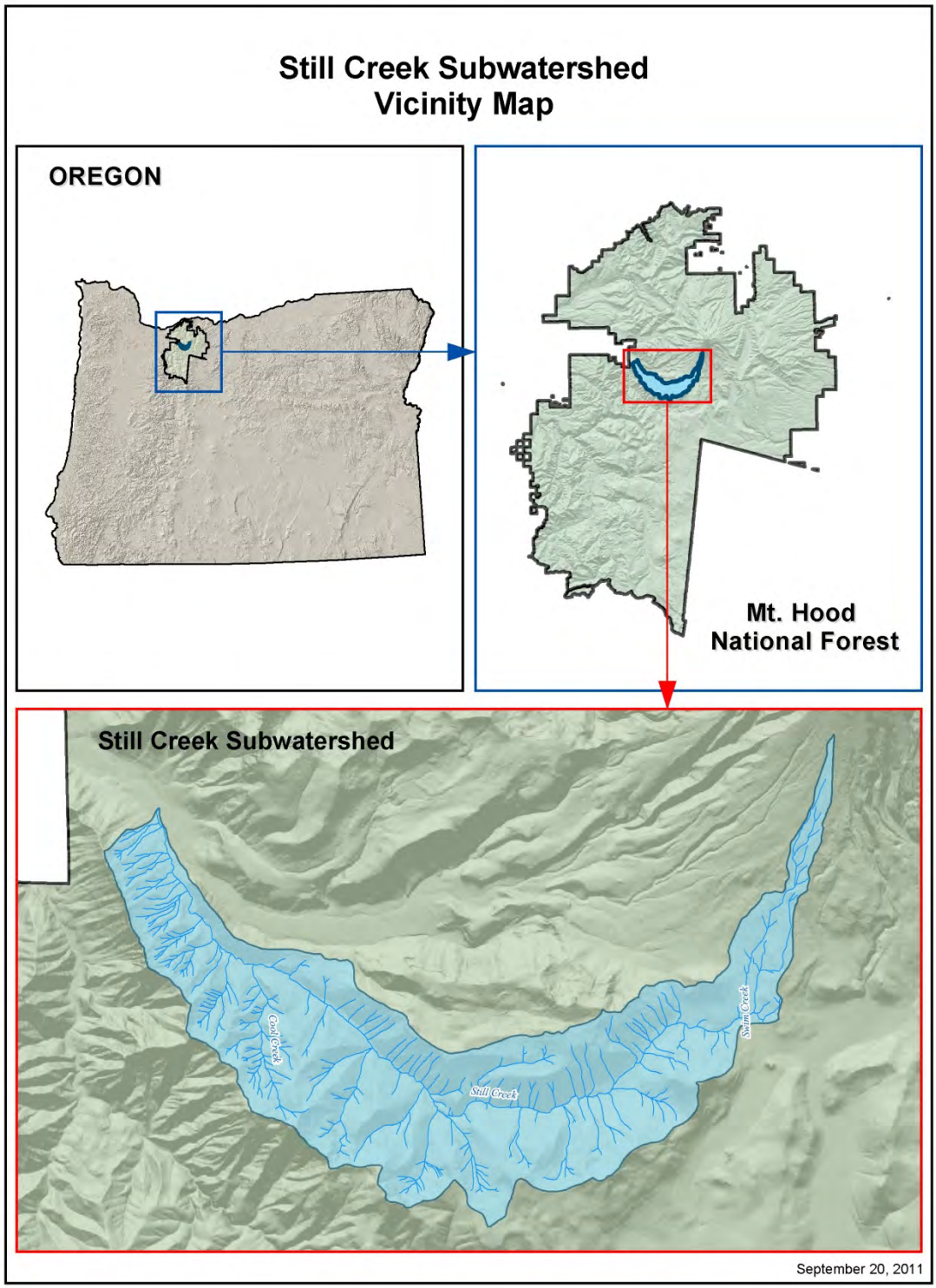
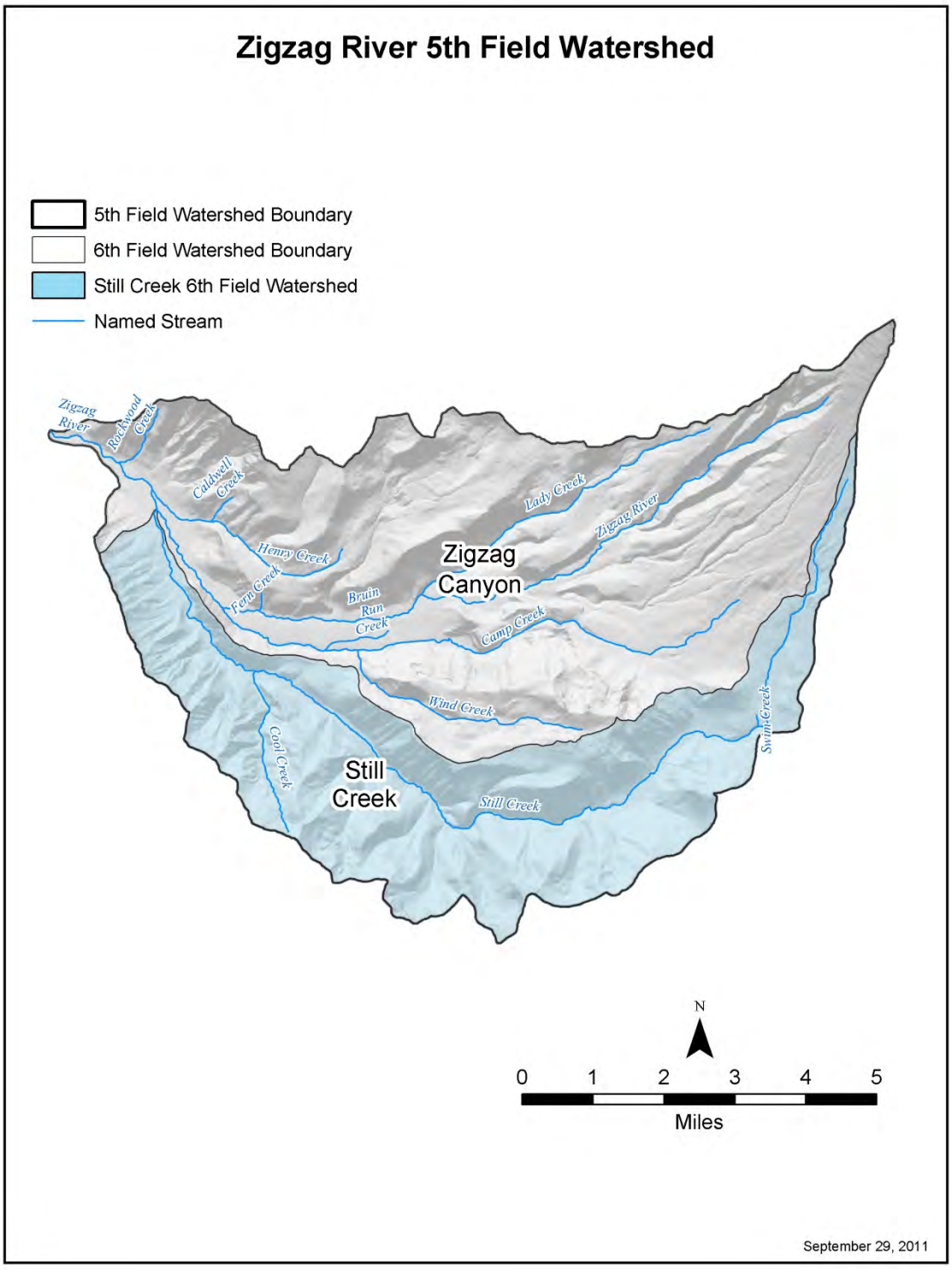


Figure 2. Zigzag 5th Field Watershed Map including Still Creek 6th Field Watershed.



Total Watershed Area

Total acres: 14409.3 acres
National Forest area within watershed: 99 percent

Watershed Characterization

General Physiography

The Still Creek 6th field watershed is located in the Zigzag River 5th field watershed. Other 6th field subwatersheds within the Zigzag River 5th watershed include the Zigzag River, Camp Creek, and Henry Creek 6th fields. The Zigzag River 5th field watershed is approximately 37,730 acres in size and is a tributary located in the upper portion of the Sandy River basin. The Still Creek Subwatershed is approximately 14,412 acres in size. Major tributaries within the Zigzag River watershed include Still Creek, Camp Creek, and Henry Creek. Still Creek originates below the Palmer Glacier from a series of springs on Mt. Hood's west side (USDA 1995). The spring fed system buffers peak flows and provides clear water habitat/refugia within the Still Creek 6th field watershed. Stream discharge into the Zigzag River, Camp Creek and Still Creek is fed by year-round snowpack that exists at the highest elevations (USDA 1995). Average daily discharges are substantially influenced by rates of snow accumulation and snowmelt within the Zigzag River watershed. Occasional spikes in the hydrograph during December and January are common from high flows associated with rain-on-snow events.

The elevation of the Zigzag River 5th field watershed ranges from 1,400 to 10,000 feet (USDA 1995). Annual precipitation ranges from 130 inches at its highest elevation to 65 inches in the lower Still Creek drainage. The landforms and soils within the watershed are formed on relatively young geologic surfaces. The geology of the toeslopes and sideslopes of the watershed's western portion consists of weak rocks that originated from volcanic debris flows. On the ridges above these slopes, more resistant volcanic rock caps the weaker material (USDA 1995). Three main vegetation zones occur within the watershed: Western Hemlock (*Tsuga heterophylla*), Pacific Silver Fir (*Abies amabilis*) and Mountain Hemlock (*Tsuga mertensiana*), typical of forest types west of the Cascade Crest. The watershed's current vegetative conditions are mainly even-aged, moderately dense stocked 80 to 100 year-old Douglas fir (*Pseudotsuga menziesii*) and western hemlock dominated stands. Approximately 29.8 percent of the watershed is in early seral stand conditions, 49.1 percent is in mid-seral stand conditions, 15.8 percent is in late-seral stand conditions and 5.4 percent is non-vegetated. This is mostly due to several large fires that burned over the watershed from 1917 to 1952 (USDA 2004).

European-Americans moved into the Zigzag River 5th field watershed in the mid-1800s via the Barlow Road. Today, several small towns are present along U.S. Highway 26, the original Barlow Road travel route. These include Government Camp, Rhododendron, Welches and Zigzag. Land ownership in the Zigzag River watershed is approximately 97 percent Forest Service and three percent private.

Land Use

Historically, the watershed was used by American Indians for hunting, fishing, and providing other foods such as huckleberries and white bark pine nuts. Pioneers passed through the watershed on the Barlow Road on their way to the Willamette Valley in the mid to late 1800's.

The watershed's ongoing importance in providing a wide variety of recreational opportunities started in the late 1800s. In 1926, the Secretary of Agriculture designated the land to the south of Mt. Hood and the Mt. Hood Loop Road (a portion of which is now U.S. Highway 26) as the Mt. Hood Recreational area, further highlighting the area's importance for recreation.

The Zigzag watershed provides a wide variety of recreational opportunities. Activities range from more primitive types of recreation, such as hiking, fishing, and backpacking, to more developed facilities such as ski areas, motels and other facilities to meet the needs of recreationists. The watershed's proximity to Mount Hood and its variety of recreational opportunities contribute to its popularity, particularly for residents of the nearby Portland metropolitan area. Recreational facilities within the Zigzag 5th field watershed include: three ski areas, 557 Recreational Residences, three developed campgrounds, six Organization Camps (for non-profit organizations), and a variety of hiking trails. The Mt. Hood Wilderness, encompassing 30 percent of the watershed, receives heavy use along the Pacific Crest National Scenic Trail and other access trails. Elsewhere, use in the wilderness is low, most likely due to the extremely rugged terrain on the slopes of Zigzag Mountain.

U.S. Highway 26, a major travel route between Portland and central Oregon, dissects and serves as primary access to the watershed. Private lands within the watershed include the communities of Government Camp, Rhododendron and the Faubion/Zigzag areas. Many of the full-time residents of the watershed either work locally or commute into the Portland metropolitan. Many homes in the area serve as vacation retreats by part-time residents.

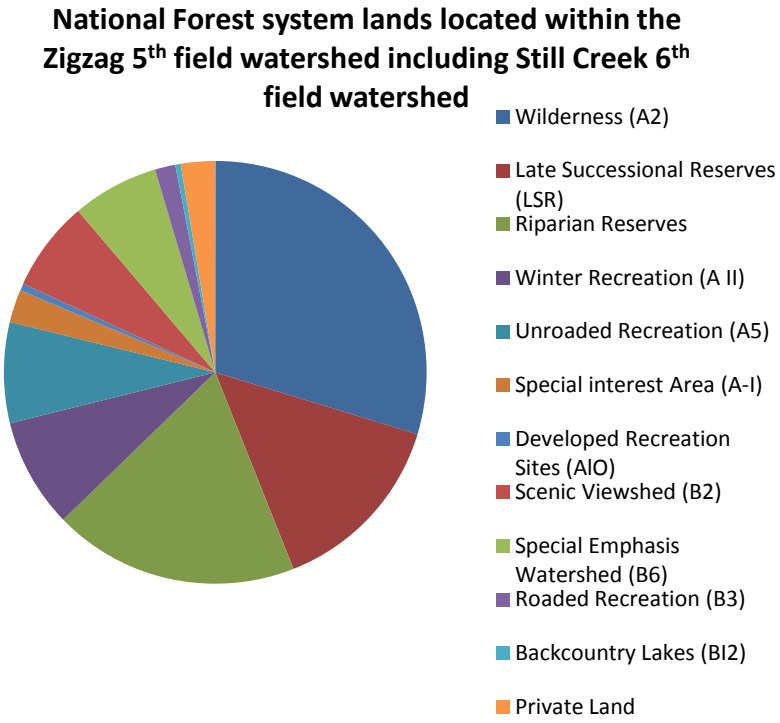
Much of the economic environment within the watershed is dependent upon-tourism. Local communities are increasingly providing a variety of recreational facilities and services such as motels, stores and restaurants to meet the needs of the area's visitors and its permanent and part-time residents. Harvest of timber and other forest products has played a minor role in meeting the economic needs of the area. Land ownership in the Zigzag watershed is 97 percent Forest Service and 3 percent private.

National Forest system lands located within the Zigzag 5th field watershed (including the Still Creek 6th field watershed) are designated as Wilderness (A2), Late Successional Reserves (LSR), Riparian Reserves, Winter Recreation (A II), Unroaded Recreation (A5) Special Interest Area (A-I), Developed Recreation Sites (AlO), Scenic Viewshed (B2), Special Emphasis Watershed (B6), Roaded Recreation (B3), and Backcountry Lakes (BI2) under the Mt. Hood National Forest Land Resource Management Plans (LRMP) as amended by the Northwest Forest Plan (USDA and USDI 1994). See Table 2 and Figure 3. Specific management direction for each of these land allocations can be found in the Mt. Hood National Forest LRMP (USDA 1990) and the Record of Decision (ROD) for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl, i.e., Northwest Forest Plan (USDA and USDI 1994).

Table 2. –Summary of Acres by Land Allocation

Land Allocations	Acres in Allocation
Wilderness (A2)	11,216
Late Successional Reserves (LSR)	5,375
Riparian Reserves	7,082
Winter Recreation (A II)	3,165
Unroaded Recreation (A5)	2,901
Special interest Area (A-I)	951
Developed Recreation Sites (AlO)	205
Scenic Viewshed (B2)	2,612
Special Emphasis Watershed (B6)	2,491
Roaded Recreation (B3)	588
Backcountry Lakes (BI2)	156
Private Land	988
Total acres	37,730

Figure 3. Mt. Hood National Forest LRMP Land Allocations within the Zigzag River 5th field watershed including Still Creek 6th field watershed.



General Overview of Concerns

General threats within the Still Creek 6th field watershed include threats to riparian structure and function, threats to aquatic/riparian species habitat, and invasive species threats. The following list details specific issues of concern and is followed by a general approach to resolve the issues within the Still Creek watershed.

- Issue of Concern: Water Quality
  Water quality is degraded in the Still Creek watershed as a result of sediment delivery to streams via roads. While road density is low (1.3 miles per square mile), 51 percent of the road system is within 300 feet of streams. The road surfaces and drainage network cause chronic sediment delivery to stream channels. Sediment delivery is also a result of heavily impacted riparian areas associated with summer homes and dispersed camping sites. Reduced ground cover, shrubs, and young trees result in increased bank erosion and sediment delivery. Water quality may also be impacted by some summer homes having open septic systems. During high water events it is likely that fecal contamination of surface and sub-surface water from the contents of the septic system are entering Still Creek. There is also a lack of marine-derived nutrients within the freshwater ecosystem of Still Creek.

- Issue of Concern: Water Quantity
  Water intake structures for summer homes have been observed near salmon and trout redds within Still Creek which reduces water quantity in this highly important spawning habitat.

- Issue of Concern: Habitat Fragmentation
  Undersized culverts, as well as log weirs, are present within the Still Creek watershed which results in fragmented habitats due poor passage conditions.

- Issue of Concern: Large Woody Debris
  Lack of large wood has led to decreased channel sinuosity, modified channel slope, reduced floodplain roughness, decreased pool densities, reduced off channel habitat, and has caused a reduction of spawning gravel retention. Lack of large woody debris is one of the most significant issues within the Still Creek watershed. Dominant tree species within the floodplain have been converted from conifer to deciduous species as a result of the 1964 flood events, historic fires, and hazard tree removal/clearing in the summer home areas. This conversion reduces the long term large wood delivery potential along channels within the watershed.

- Issue of Concern: Channel Conditions
  Large Woody Debris density is low and has resulted is reduced habitat complexity levels in certain stream reaches within the Still Creek watershed. Some of these channels also have a lack of floodplain connectivity, off channel habitats, reduced slack water hiding cover, little retention of sediment and nutrients, and little pool habitat. These conditions have resulted in impaired channel shape and function.

- Issue of Concern: Road Maintenance

There is a high density of stream crossings (six to ten culverts per mile) along Still Creek resulting in road related sediments entering the channel. The location of the road also intercepts debris torrents resulting in excess delivery of sediment to streams.

- Issue of Concern: Riparian Vegetation
  Dominant tree species within the floodplain project areas have been converted from conifer to deciduous species by the 1964 flood events, historic fires, hazard tree removal/clearing in the summer home areas, and through past timber harvest activities.

- Issue of Concern: Soil Erosion
  The watershed has several riparian areas that are heavily impacted as a result of summer home activities and dispersed camping sites. These areas have reduced ground cover, shrubs, and young trees resulting in increased bank erosion and sediment delivery.

- Issue of Concern: Terrestrial Invasives
  Past and present activities have introduced numerous invasive plants to the Still Creek watershed.

Proposed Restorative Work to address concerns:

The largest limiting factor for salmonid production in Still Creek is the lack of isolated side channels and off channel habitats (SRBWG 2007). Channelization and large wood removal on the lower Still Creek, following the 1964 flood event, led to the incision of the main stem channel and isolation of side channels, which became inaccessible to native fish. Rearing areas for anadromous salmonids have been exponentially reduced leading to an overall decrease in production. The removal of large wood further reduced the habitat complexity of the river, through loss of pool habitats, lack of gravel sorting structures, and reduced flood plain inundation.

General on-the-ground activities needed to address the above concerns (in terms of both watershed function and biological integrity/salmonid production) include the excavation of inlets to historic side channels and the addition of large wood to side channels/main channel at a rate of 125 to 250 pieces per river mile. The lack of large wood gives rise to several of the issues of concern listed above. Addition of wood will significantly improve channel complexity, in channel conditions, and flood plain roughness. Conifer trees (i.e., western red cedar and douglas fir) need to be planted to raise levels to 225 trees per acre throughout the riparian corridor not only to restore riparian function, but serve as a long term source for large wood recruitment. "Integrated" restoration including: instream restoration, riparian plantings, invasive plant removal, road restoration, and recreational resident compliance will all be accomplished over a 5-year period that collectively benefits the whole watershed. For specific projects and details, see "Specific Project Activities (Essential Projects)" section of this document.

Important Ecological Values

- High priority subwatershed in the Sandy River basin for recovery of wild stocks of threatened Chinook salmon, coho salmon, and winter steelhead as rated by the interagency Sandy River Basin Partners group.

- Still Creek subwatershed contains aquatic threatened and endangered species and designated critical habitat.
- Anchor habitat (see SRBWG 2006) for Chinook salmon, coho salmon, and winter steelhead.
- Second only to the Salmon River, Still Creek provides the highest densities of spawning and rearing habitat for salmonids in the Sandy River basin.
- Within a Wilderness Area.

Current Condition Class

- Still Creek Watershed Condition Class rating: 1
- Still Creek Watershed Condition Score:1.6*

Note: *<=1.66 equates to Functioning Properly; >1.66 to 2.33 equates to Functioning at Risk; 2.33 to 3.0 equates to Impaired or Functioning at Unacceptable Risk

Target Condition Class

- Target Condition Class: 1

Key Watershed Issues

Table 3. Attributes/Indicator with FS control to affect

ATTRIBUTES /INDICATOR	REASON FOR RATING
1.2 Water Quality	Sediment delivery to streams. FS roads causing chronic sediment delivery to stream channels. Heavily impacted riparian areas associated with summer homes and dispersed camping sites with severely reduced ground cover, shrubs, and young trees resulting in increased bank erosion and sediment delivery. Some summer homes have open septic systems. During high water events it is likely that fecal contamination of surface and sub-surface water from the contents of the septic system are entering Still Creek. Lack of marine-derived nutrients in freshwater ecosystems.
2.1 Water Quantity	Water intake structures for summer homes have been observed near salmon and trout redds.
3.1 Habitat Fragmentation	Undersized culverts, log weirs result in fragmented habitats due poor passage conditions.
3.2 Large Woody Debris	Lack of large wood has led to decreased sinuosity, modified channel slope, lack of floodplain roughness, decreased pool densities, less off channel habitat, and reduction of spawning gravel retention. Dominant tree species within the floodplain project areas have been converted from conifer to deciduous species as a result of the 1964 flood events and hazard tree removal/clearing in the summer home areas.
3.3 Channel	LWD density and habitat complexity levels are low. Lack of floodplain connectivity, off channel habitats, reduced slack water hiding cover, little retention of sediment and nutrients, little pool habitat. Impaired channel shape and function.
6.2 Road Maintenance	High density of stream crossing with six to ten culverts per mile along Still Creek resulting in road related sediments entering channel. Location of road intercepting debris torrents resulting in excess delivery of sediment to streams.
5.1 Riparian Vegetation	Dominant tree species within the floodplain project areas have been converted from conifer to deciduous species from 1964 flood events, historic fires, hazard tree removal/clearing, and through past timber harvest methods.
7.3 Soil Erosion	Heavily impacted riparian areas associated with summer homes and dispersed camping sites with severely reduced ground cover, shrubs,

	and young trees resulting in increased bank erosion and sediment delivery.
11.1 Terrestrial Invasives	Past and present activities have introduced numerous invasive plants to the Still Creek Watershed.

Table 4. Attributes/Indicator beyond FS control to affect – other parties needed to address

ATTRIBUTES /INDICATOR	**REASON FOR RATING**
1.2 Water Quality	Sediment delivery to streams – private roads, state Hwy 26 causing chronic sediment delivery to stream channels.
4.2, 4.3 Native/Exotic Species	High percentage of hatchery anadromous fish competing with and reducing fitness levels of wild populations.
6 Roads/Trails	Sediment delivery to streams – private roads, state Hwy 26 causing chronic sediment delivery to stream channels.

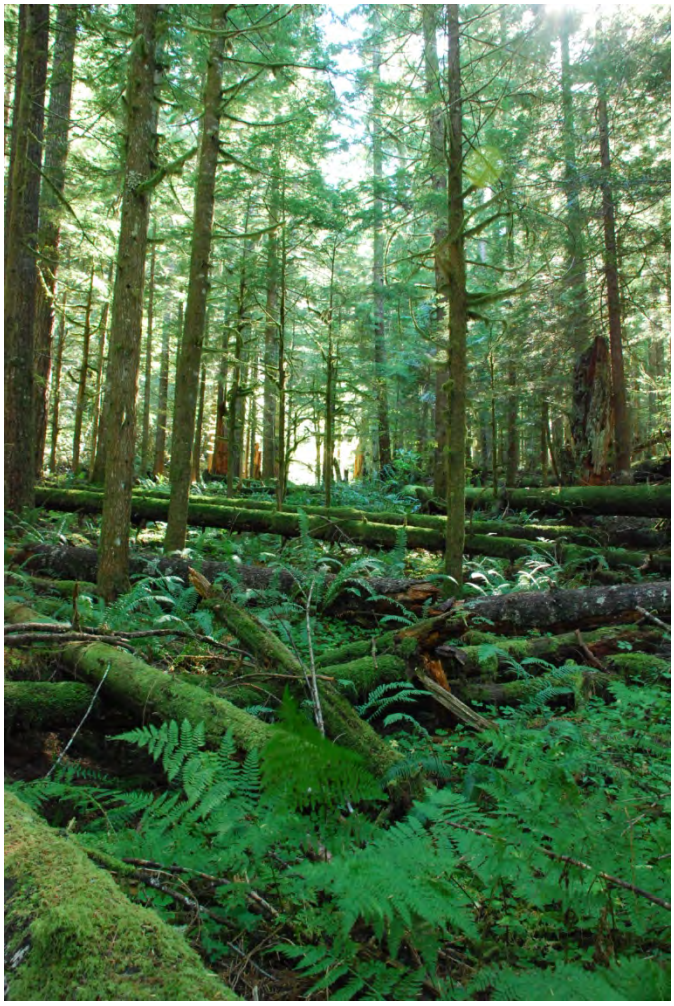
Watershed Characteristics and Conditions

General Context/Overview of the Watershed

General

The Zigzag River 5th field watershed is located on the west side of Oregon's Cascade Range, south of the Columbia River. The watershed is on the southwest slopes of Mt. Hood in north central Oregon, with elevations ranging from 1,400 to 10,000 feet. It encompasses 37,730 acres.

The Zigzag River 5th field watershed consists of three distinct stream systems: Still Creek, Camp Creek, and the Zigzag River. The Still Creek 6th field watershed is located within the Zigzag River 5th field watershed. The Zigzag River originates from Zigzag Glacier, carves its way through volcanic debris flow in the upper watershed, then travels westerly through the central portion of the watershed's volcanic debris, terminating in alluvium near its confluence with the Sandy River. Still Creek originates from Palmer Glacier and a series of springs on Mt. Hood's west side. Camp Creek originates from a series of springs and wetlands above the Government Camp area. The Camp Creek subwatershed includes a number of large wetlands, including the Multorpor Fen, which is the Zigzag watershed's largest wetland.



Climate

The Sandy River basin has a maritime climate, generally characterized by seasonal mild temperatures and wet winters. Approximate annual precipitation within the Zigzag watershed ranges from 130 inches at its highest elevations to 65 inches in the upper Still Creek drainage. The heaviest precipitation occurs during November through January and the lowest in July through August. Mt. Hood sustains year-round snowpack at its highest elevations. This directly affects stream discharge into the Zigzag River, Camp Creek and Still Creek by providing water storage over the winter, and then contributes this cold water flow during the summer. This improves base summer flows and moderates water temperatures.

Geomorphology

The landforms and soils within the watershed are forming on relatively

young geologic surfaces. The geology of the toeslopes and sideslopes of the watershed's western portion consists of weak rocks that originated from volcanic debris flows. On the ridges above these slopes, more resistant volcanic flow rock caps the weaker material.

The watershed's eastern portion is dominated by large fans of unconsolidated materials from the glaciated volcanic slopes of Mount Hood. A small number of glacial cirques occur within the watershed's north facing uplands. Numerous rock-outcrops, talus slopes and boulder fields also occur within the Zigzag River 5th field watershed.

Soils forming on the slopes of the Zigzag River are, in general, poorly developed and contain many rock fragments. Soils in the upper watershed lost organic matter and nutrition following a series of wildfires in the early part of this century. Soils forming on the gentle uplands near Wind Lakes basin of the Camp Creek watershed, as well as within the upper reaches of Still Creek, are deeper and contain less gravel and cobble.

Fire

Fire has served as a major influence within the Zigzag watershed. The majority of the fires were human-caused, with many deliberately set for such reasons as huckleberry field maintenance or improved hunting areas (USDA 1995). During this century, at least four significant fires of 1,000+ acres have burned. The largest recorded fire covered 10,000 acres in August, 1917. The Zigzag Burn, the most recent significant fire, covered 1,000+ acres in October, 1952. Available historic information reveals that stand replacement fires burned over much of the Zigzag watershed, as well as its surrounding (Eagle, Roaring River, and Salmon River) watersheds.

Vegetation

Three main vegetation zones occur within the watershed: Western Hemlock (33 percent of watershed), Pacific Silver Fir (51 percent of watershed), and Mountain Hemlock (11 percent of watershed). In addition, small areas of Subalpine and Alpine Zones (5 percent of watershed) occur near timberline. The Zigzag watershed's current vegetative condition is mainly even-aged, moderately dense stocked 80 to 100-year-old Douglas fir and western hemlock dominated stands. Approximately 85 percent of the watershed is in mid seral stands, a direct result of historic stand replacing fires. An estimated 15 percent of the watershed has areas with known infections of laminated root disease. Only a small percentage (7 percent) of the watershed consists of late seral stands. These older stands now occur in narrow patches along streams, and in larger blocks near Cool Creek. Stands located within Still Creek's eastern portion are in poor forest health. In this area, many trees have reduced crown size and vigor, needle loss and discoloration, and are experiencing mortality. Several factors attribute to these conditions, including: offsite seed sources, poor soil conditions inherent from repeated fire activity, and infestation of spruce budworm and Douglas-fir beetle.

Aquatic

The Zigzag River watershed supports both anadromous (sea-run forms) and resident species salmonids. Primary fisheries include summer steelhead (*Oncorhynchus mykiss*) and resident rainbow (*Oncorhynchus mykiss*) and cutthroat (*Oncorhynchus clarki*) trout. The watershed also supports winter steelhead, coho (*Oncorhynchus kisutch*) and spring Chinook salmon (*Oncorhynchus tshawytscha*) – contributing significantly to downstream fisheries in the lower Sandy River. Healthy populations of dace (*Rhinichthys sp.*), whitefish (*Prosopium williamsoni*)

and sculpin (*Cottidae sp.*) are also present. Higher up in the watershed, several small lakes and ponds support popular fisheries with cutthroat, rainbow, and brook trout (*Salvelinus fontinalis*). The watershed's high mountain lakes include: Enid, Mirror, Wind, Veda, Hidden, Devils and Five lakes.

Habitat conditions for salmonids range from low to high quality within the watershed. Habitat surveys have identified a wide diversity of habitat types, ranging from low gradient, wide meandering river channels to small, high-gradient glacier-fed creeks. In some areas within the watershed, fish habitat has been degraded. Large floods in 1964 and 1970s scoured channels and swept much of the large woody material out of the system. In the aftermath of these floods, the U.S. Army Corps of Engineers, Forest Service, other public agencies, and private individuals removed any remaining large logs and boulders from sections of Still Creek, Camp Creek and the Zigzag River.

Throughout the Still Creek 6th field watershed and the larger Zigzag 5th field watershed, moderate water quality concerns with turbidity, sediment, erosion and stream structure (i.e., large wood) exist. For the most part, these concerns are associated with unstable channels, sediment from road sanding, and the continued effects from stream cleanout efforts after the 1964 Flood.

Special Habitats and Species of Concern

The Zigzag watershed includes habitat for several "species of concern," all of which are tied to the Endangered Species Act, National Forest Management Act (NFMA) regulations, or Forest Service policy. The watershed also supports several sensitive plants (Regional Forester's Sensitive Species List), including: ground cedar (*Lycopodium complanatum*) (its largest population in the state is located on Tom, Dick and Harry Mountain in the Ski Bowl ski area of the Camp Creek subwatershed); fir clubmoss (*Huperzia sp.*)(six sites are known along Still Creek and within the subwatershed); bog clubmoss (*Lycopodiella inundata*)(Multorpor Fen within the Camp Creek subwatershed is one of only two sites in which it occurs within the entire Mt. Hood National Forest); and lesser bladderwort (*Utricularia minor*)(which grows within Enid Lake's drawdown zones within the Camp Creek subwatershed). In addition, two of Still Creek's tributaries have confirmed occurrences of Cope's giant salamander (*Dicamptodon copei*), another Regional Forester's Sensitive Species. The watershed also supports two known northern spotted owl pairs (*Strix occidentalis caurina*). This species is listed as Threatened by the U.S. Fish and Wildlife Service, and is protected under the Endangered Species Act.

The watershed includes approximately 3,000 acres of special habitats, including: wetlands, rock outcrops, talus slopes, and cliffs. In some cases, species of concern utilize these various special habitats. Cliff sites within the watershed are potential habitat for Peregrine falcons (*Falco peregrines*), listed by the U.S. Fish and Wildlife Service as an endangered species. Tom, Dick and Harry Mountain (within the Camp Creek subwatershed) has been identified as a site with high potential for peregrine falcon habitat. A peregrine falcon hacking site was located there from 1990 to 1994.

Various types of wetlands also occupy the watershed, including wet meadows with and without ponds, forested wetlands, and several high mountain lakes. Multorpor Fen represents an excellent example of a subalpine marsh. It contains several rare plants.

Watershed Conditions

The following watershed condition descriptions are largely taken from the 2009 Cool Creek Tract Recreational Residence Special Use Permit Re-Issuance Fisheries Biological Evaluation and Assessment (USDA 2009). Cool Creek is a main tributary of Still Creek within the Still Creek 6th field watershed.

Uplands/Hillslope

Changes in Peak/Base Flow

The Zigzag River Watershed Analysis (1995), pg. 4-71 assessed changes in peak flows within the 5th field watershed using methodology from the Washington Department of Natural Resources (DNR) Standard Methodology for Completing Watershed Analysis. This method assumes that the greatest likelihood for causing significant, long-term cumulative effects on forest hydrologic processes is through the influence of created openings from timber harvest and roads on snow accumulation and melt. Peak flows were calculated for the 2, 5, 10, 25, 50 and 100-year recurrence interval peak steam flow events. The threshold of concern is if peak flows change greater than 10 percent for any recurrence interval storm. The Zigzag watershed as a whole and all the associated sub-watersheds (including the Still Creek 6th field watershed) are well below the 10 percent threshold associated with adverse impacts.

Increases in peak stream flows associated with stream drainage network enhancement were also evaluated. Current research suggests that roads function hydrologically to modify stream flow generation in forested watersheds by altering the spatial distribution of surface and subsurface flow paths. Observations suggest roadside ditches and gullies function as effective surface flow paths which substantially increase drainage density during storm events. Current calculations estimate stream drainage network enhancement at 11.4 percent for the entire watershed (the threshold of concern is if peak flows change greater than 10 percent).

Peak stream flows in the Zigzag 5th field watershed appear to be on a decreasing trend. This is attributed to the increased canopy closure and extensive size of stands after significant fire events between 1900 and 1952 that resulted in less created openings. Stream drainage network expansion is of concern in this watershed and in the Still Creek subwatershed due to road ditch networks (USDA 1995).

Base flow trend conditions for the Zigzag River watershed cannot be made, as results were not significant at the 80 percent significance level. With the exception of Camp Creek less than 12 percent of the base flows of any subwatershed are allocated. Less than six percent of the base stream flows within the Still Creek watershed are allocated.

Drainage Network

Road cuts and ditches may intercept surface and shallow groundwater flows. The Zigzag River Watershed Analysis, pg. 4-76, states "...increases of greater than the 10 percent of stream drainage network expansion are the threshold of concern." Still Creek exceeded this threshold for concern (15.2 percent) for culverts spacing within 300 feet of the stream. Stream drainage

network expansion is of concern in the Still Creek area, where more than 50 percent of the roads are located within 300 feet of streams.

Road Density & Location

While road densities within the Zigzag River watershed are low, many roads in the watershed run parallel to major streams and have the potential to effectively contribute to reduced water quality and habitat degradation (USFS 1995). Examples include US Highway 26 and Forest Service roads 12, 35, 39, 27 and 19.

While road densities within the subwatershed are low (1.3 miles /square mile) 51 percent of the road network is within 300 feet of streams. The FS road 2612 runs parallel to Still Creek within the riparian reserves for much of its length. Tributaries coming off Hunchback Mountain into Still creek cross the FS 2612 road through culverts that intercept sediment and large wood during storm events.

Disturbance History

Fire has been a major influence within the Zigzag River 5th field watershed. At least four significant fires of 1,000 acres or more (total of 21,140 acres) have occurred within this watershed within the last century. Available historic information reveals fire has burned over much of the Zigzag River watershed, with some areas having burned at least three times since the early 1900s (USFS 1995). As a result of these fires at least 1,952 acres of off-site plantations have been planted or seeded within the watershed. These off-site plantations are often not adapted to local conditions and are less resilient to climatic events and other disturbances such as insect attack. These stands also demonstrate decreased growth rates and stagnated conditions (USFS 1995).

Approximately 15 percent of the Zigzag River watershed contains areas of known infections of laminated root disease. These areas with known infections are concentrated in the areas of Enola Hill (Camp Creek subwatershed), Cool Creek, and the west end of Still Creek. This disease is particularly destructive in stands dominated by Douglas-fir as this species is highly susceptible to the disease. Where laminated root disease is present, the resulting mortality and subsequent tree removal has resulted in brush fields or pockets of young small diameter (≤16 inches) trees dominated by alder and other hardwood species (USFS 1995). Due to these factors, late seral old grown (LSOG) stand levels within the 5th field watershed are at approximately 15.7 percent, the low end of the range of natural variation (USDA 1995).

Human disturbances have also played a role within the watershed over the last 100 or more years. Examples include road building, residential and commercial construction, stream clean out and channelization, intentional fire-setting at the turn of the century, as well as fire suppression in the last 40 years, and to a lesser degree, timber harvest.

Invasive weeds

Surveys completed in 2004 and 2005, documented invasive weeds such as knotweed (*Fallopia japonica*), scotch broom (*Cytisus scoparius*), vinca (*Vinca sp.*) and periwinkle (*Vinca sp.*)

occurring in small patches, usually 100 square feet or less, sporadically throughout summer home areas within Still Creek, Henry and Camp Creek subwatersheds (USFS 2004). The Still Creek watershed has also been analyzed and is included in the Final Environmental Impact Statement for Site-Specific Invasive Plant Treatments for the Mt. Hood National Forest and Columbia River Gorge National Scenic Area in Oregon, Including Forest Plan Amendment Number 16 (USDA 2007).

Riparian Conditions

Riparian Reserves

Canopy closure in the Zigzag River watershed is greater than 70 percent (USFS 1995). There are indications that fires, which burned approximately 86 percent of the watershed since the turn of the century, impacted riparian reserves. Most sub-watersheds, including Still Creek, within the Zigzag River watershed have a moderate to low concentrations of riparian reserves within the moderate large wood recruitment potential class. The entire Zigzag River watershed is well outside the range of historic conditions for late successional old-growth structure (LSOG) stand structure within the riparian reserves. Sub-watersheds vary from two to 20 percent late seral structure compared to the historic condition of 76 percent.

The Zigzag River watershed is dominated by mid-seral riparian stand conditions with remnant stringers of old growth sized trees. Located within a portion of the riparian reserves are numerous infrastructures such as US Highway 26 and FS roads 12, 20, 32, 27, 35, 39, 31. Also, more than 80 percent of the 554 recreational residences are located along approximately 10.5 miles of the estimated 25 miles of anadromous habitat within the Zigzag River 5th field watershed. Most of these are located on the first or second terrace causing little to no detectable affect to habitat or refugia. The one exception is the Cool Creek tract, located along Still Creek. Several of the 25 recreational residences are located within 200 feet of Still Creek or adjacent to a perennial side channel, within the 10 to 100-year floodplain. Furthermore, several of these cabins have

modified stand structure and composition on the associated lot to the cabin by pruning or cutting down of native vegetation or by planting ornamental trees and shrubs. Though this does occur sporadically throughout the recreational residence area, most occur along the outer edge of the riparian reserve or on terraces above the active floodplain.

Within the Still Creek subwatershed 16 percent of the riparian reserves are classified as late-seral stand conditions, 35 percent are in early-seral and 49 percent in mid-seral conditions. There are indications that the fires which burned approximately 86 percent of the watershed since the 1900's impacted the riparian reserves. Historic late-seral stand conditions within riparian reserves were estimated at 76 percent (USDA 1995). Stream shade provided by existing riparian stands is adequate, dominated by hardwood trees with some stands of mixed conifer or stringers of old growth sized trees. Future large wood recruitment has also been impacted by past fire history as well as other human actions.

Stream Bank Condition

Stream reaches with sensitivity to disturbance, sediment supply and/or stream bank erosion potential have been identified in the Little Zigzag River, Camp Creek, Wind Creek, Still Creek, and the Zigzag River. Many of these stream reaches flow through mudflow deposits consisting of poorly sorted material in a sandy matrix which lends to a highly erosive environment. These banks are prone to dry ravel once the bank angle becomes over-steepened and prone to erosion from the stream channel at the toe of the slope causing a failure. For the most part these are natural processes that occur in glacial valleys or in areas with glacial mudflow deposits.

Between river mile 0 and 3.2, Still Creek has a significant amount of unstable bank substrate where recreational residences have been built along both sides of the creek. Specifically, within the Cool Creek tract (approximately river mile 1.8-2.5 of Still Creek), there are at least three artificial boulder berms or dikes that have been constructed that have modified stream bank conditions and impinge the active stream channel. All of the remaining reaches contain some bank instability. There has been no recent (within the last 10 years) quantification of unstable banks within the Zigzag River watershed. Information provided is from ocular observation from Forest Service personnel.

Stream reaches within the Still Creek 6th field have varying levels of bank erosion. Primary factors associated with these areas are either by natural processes or by human activities. Natural processes include channel lateral or vertical migration, recruitment of large wood from existing stands of trees and other erosion agents. There are several areas where stream flow is over and through old mudflow deposits made up of unconsolidated sand, gravel and cobble that is highly erodible (USFS 1995). Other natural processes are associated with tributary debris torrents that recruit organic and inorganic material down valley causing the channel to laterally migrate.

Human caused stream bank instability is related to recreational residence foot traffic and recreational uses such as camp site development. Other actions include the construction and maintenance of at least three known boulder berms or dikes within the Cool Creek tract as well as dispersed campsites upstream of the confluence of Cool Creek along the banks of Still Creek. This area is popular for medium to large groups to camp. Still Creek campground located near RM 12 also has several areas of unstable stream banks relating to foot traffic and camping. It is

estimated that the total area of stable stream banks is within the 80 to 90 percent threshold for the 6th field.

Floodplain Connectivity

Streams within the Zigzag River 5th field watershed including the Still Creek 6th field have a history of large wood removal, channel cleanout and limited construction of artificial boulder or gabion bank revetments which has caused downcutting and impairment of floodplain connectivity. The presence of recreational and private residences in the floodplains of lower Still Creek is likely limiting natural access to floodplains. Though there has not been any quantification of length of side channels that have been cut off or reduced or their linkages to wetlands and floodplains, it is believed these processes have been reduced at the 5th field scale. For an in-depth analysis and discussion of effects to floodplain connectivity of the Cool Creek tract see the Recreational Residence Aquatic Assessment (2009).

Still Creek has a history of large wood removal and channel cleanout from past logging and flood 'repair' operations, which has likely caused downcutting and localized entrenchment leading to decreased floodplain connectivity. Connectivity has also been affected by summer home management and maintenance of associated infrastructures. For a more in-depth discussion see the Recreational Residence Aquatic Assessment (2009).

In-Channel Conditions

The Still Creek Subwatershed is approximately 14,412 acres in size, with the main Still Creek Channel being segmented into eight geomorphically unique stream reaches. Reach one begins at RM 0.0 and extends to RM 1.0. Reach two begins at RM 1.0 and extends to RM 3.2. Reach three begins at RM 3.2 and ends at RM 7.3. Reaches 1-3 constitute Anchor Habitat defined as "distinct stream reaches that currently harbor specific life history stages of salmon and steelhead to a greater extent than the stream system at large". Only Still Creek Reaches 1, 2 and 3 are designated as anchor habitats within the Zigzag River 5th field watershed. Other reaches within the watershed do provide important habitat, though not to a higher degree or concentration of other similar reaches and channel types within the basin. In channel conditions for reach 1-3 are described below.

Reach one is moderately entrenched with an average gradient of 2.5 percent. The dominant channel substrate is small boulder and cobble. The average bankfull channel width is 59 to 65 feet. The 1996 stream survey noted small amounts (1.1 pieces per mile) of large wood. The lack of large wood is primarily due to past stream clean-out activities, firewood and hazard tree removal and to a lesser degree, the slightly steeper stream gradient. Past restoration actions completed during 1982 and 1983 and again in 1996 was the primary reason any large wood was present. Though stream flow in Still Creek originates from subsurface flow associated with Palmer Glacier, its stream flow regime is heavily influenced by the numerous small tributaries located upstream. Consequently, the flow regime is more stable, similar to a spring-fed system and minimally turbid.

Reach two is slightly entrenched being well connected to its floodplain. Dominant channel substrate is gravel and small cobble. Average channel gradient is 1.5 percent with an average bankfull width of 44 to 46 feet. The stream flow regime is similar to that of reach one. The 1996 Still Creek Stream Survey noted 15.8 pieces of medium and large size in-channel large wood per mile. This low amount is attributed to past stream clean-out actions, hazard tree and firewood cutting and possible interruption of natural routing within Still Creek and from upstream sources.

Reach three is slightly entrenched and is well connected to its floodplain. Dominant channel substrate is gravel and small cobble. Average channel gradient is three percent with an average bankfull width of 44 to 46 feet. The stream flow regime is similar to reach one. The 1996 Still Creek Stream Survey noted small amounts of medium and large size in-channel large wood per mile.

Temperature

Stream temperature in the Zigzag River watershed is measured in Still Creek at RM 1.3 and the Zigzag River at the external National Forest Boundary. The 7-day moving average of daily maximum temperatures in Still Creek peaked at 14.40C in 2008, 15.60C in 2007 and 16.00C in 2006. The 7-day moving average of daily maximum temperatures in the Zigzag River peaked at 14.70C in 2006, 14.30C in 2007, and 11.30C in 2008.

Sediment

The 1988 Oregon Department of Environmental Quality assessment of non-point pollution indicates moderate problems with sediment and erosion for Camp Creek, Still Creek and Zigzag Rivers. These problems are attributed to unstable channels, loss of woody structure, road cuts, and highway sanding (USFS 1995). Glacial runoff contributing natural glacial fines also elevates levels of turbidity/sediment in addition to the anthropomorphically related increased sediment levels.

Both highways and roads have altered the sediment regime within the watershed. Highway sanding has direct effects to streams within the watershed. Camp Creek, Still Creek and the Zigzag and Little Zigzag rivers receive a high volume of sand through direct application, ditch runoff and culvert transport. Forty four percent of the roads within the watershed are within the delivery zone to streams, and have the potential to effectively deliver sediment from road

surfaces, cut and fill slopes. Undersized culverts along these roads contribute additional pulses of sediment during average winter storms. Roads within the delivery zone of streams have the potential to greatly alter the timing, volume and rate of sediment supply to stream channels (USFS 1995).

In the key depositional reaches of the watershed the sediment regime has been altered from natural rates. In Still Creek, natural rates of erosion are quite low, yet moderate amounts of sediment derived from human activities has been added to the system (USFS 1995). The timing of sediment delivery under undisturbed conditions would be limited to infrequent intense winter storms. On-site and in-stream recovery rates would be rapid. Sediment associated with roads is delivered during season flushing flows and peaks of winter storm flows. Sediment from roadside sanding is delivered during snowmelt events; winter runoff has been observed as well. (USFS 1995).

Still Creek receives a high volume of sand through direct application, ditch runoff and culvert transport. Most of this is delivered in Reaches 7 and 8, near the Still Creek campground and Highway 26 crossing. There is an estimated 694 tons per year of sediment delivery associated with road sanding and 328 tons per year associated with the existing road system in the Still Creek watershed (USFS 1995). Conversely, the watershed's natural rates of erosion are quite low (USFS 1995). The following is a summary table from the 1996 Still Creek Stream Survey for reaches 1-7:

Table 5. Fines in Still Creek.

Reach Number	River mile	Fines < 6 mm (% of total)
Reach 1	0-1.0	7
Reach 2	1.0-3.2	7
Reach 3	3.2-7.3	5
Reach 4	7.3-9.4	22
Reach 5	9.4-10.3	15
Reach 6	10.3-11.4	16
Reach 7	11.4-11.9	44

Chemical Contamination

The Oregon Department of Transportation (ODOT) uses magnesium chloride as a de-icing agent on US Highway 26 during the winter months. The average application rate is approximately 30 gallons per lane mile or about one ounce per square yard. Application timing is related to projected weather and the chances for snow or ice.

In addition to magnesium chloride de-icing, the Timberline Ski Area (Timberline) has operated a skiing venue for over forty years at the Palmer snowfield on Mt. Hood. Salt (sodium chloride) is applied to the Palmer snowfield during the summer months to condition the snow surface and maximize its use for skiing. Salt has been applied on the Palmer snowfield since the early

1950's, and has expanded since that time to accommodate increased skiing opportunities on the Palmer snowfield (USDA 2004).

Data suggest that between 54 percent and 76 percent of the chloride applied to the Palmer snowfield in the upper Salmon River drainage area passes the Salmon River 3445 and Still Creek 3600 sampling stations. Concentrations of chloride measured in Still Creek range between 4.9 mg/L and 22.9 mg/L. These concentrations are well below aquatic water quality standards (230 mg/L to 860 mg/L) for salt sensitive aquatic biota, and well the below drinking water standard of 250 mg/L.

Each of the 554 recreational residences within the Still Creek watershed has a septic system. As part of special use permit reissuance process each system needs to have a valid Clackamas County inspection and be functioning to the standard of the day it was built. Once cabins are sold or a system has failed they need to be updated to current county standards. Water quality related to septic systems for recreation residences was a key question during the Zigzag Watershed Analysis. Based on macroinvertebrate sampling as well as water quality samples taken, no adverse effects were detected (USDA 1995).

There are a number of recreational residences along Still Creek in the first three river miles that have one of four types of septic systems: outhouse, legacy system, pressure distribution and sand filter. Pressure distribution and sand filter systems are newer types and meet Clackamas County codes. Legacy systems generally include some sort of tank with an associated distribution system. As part of the permit re-issuance process permit holders are required to have their septic systems inspected to insure that they are functioning correctly. Outhouses and legacy systems can cause direct delivery of pollutants to the stream system through interaction with hyporheic flow, side channel or main channel flow. An example of this was documented during the November 2006 flood within the Cool Creek tract; lot number 121. During high stream flows the pit for the outhouse was full of water to within two feet of the seat, likely from hyporheic flow.

Water quality monitoring has been completed at a coarse scale, mostly above and below recreational residence tracts or only at the mouth of respective tributaries. Usual parameters assessed in these monitoring efforts include various bacteriological parameters to determine compliance with State Water Quality Standards and to assess any increases associated with failing septic systems. The most recent monitoring was completed in the summers of 2006-2008 associated with a study of salmon habitat in four clear water upper tributaries in the Sandy River basin completed by the University of Portland. For this study Enterococcus (a genus of lactic acid bacteria commonly associated with human fecal contamination) levels were assessed. The 2008 results indicate the stream stays within state standards and there is no statistically significant difference between samples collected above and below the Cool Creek tract. At this scale it is unlikely to pick up individual effects from one or two failing septic systems. Within the 1995 Zigzag River Watershed Analysis and the 2004 Zigzag River Watershed Analysis there were no adverse effects to water quality associated with recreational residence identified. This may be related to the scope or duration of past monitoring efforts.

Physical Barriers

There are no anadromous fish passage barriers on perennial streams within the Still Creek 6th field watershed. Several intermittent tributaries to Still Creek have culverts that are currently blocking passage to potentially suitable upstream habitat (USFS 1995). This habitat is likely only accessible during high river flow times of the year. USFS culvert replacement work over the last decade has corrected several of these barriers. The remaining culverts are largely in areas or tributaries that provide only steep channels or marginal habitat.

Substrate

The 1996 Still Creek Stream Survey identifies numerous reaches (2 out of 7) with excessive levels of fine sediment (surface fines less than 6 mm composing more than 20 percent of the substrate)(See Table 5 above). Excessive fine sediment is likely attributed to highway sanding and native surface roads.

The following is a summary table of dominate substrate from the 1996 Still Creek Stream Survey:

Table 6. Substrate in Still Creek.

Reach Number	Dominant Channel Substrate
Reach 1	Cobble
Reach 2	Cobble
Reach 3	Cobble
Reach 4	Cobble
Reach 5	Gravel
Reach 6	Cobble
Reach 7	Gravel

Large Wood

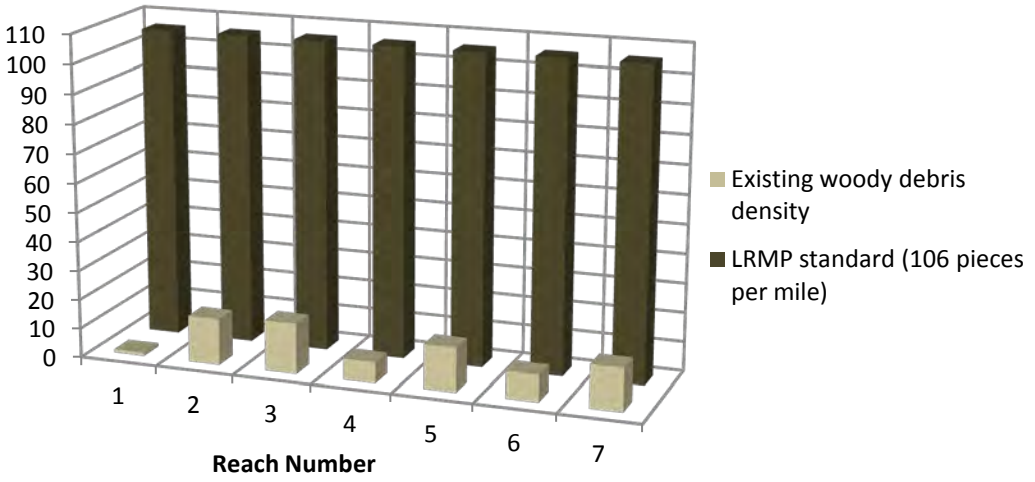
The Zigzag River 5th field watershed has a history of large wood removal and channel straightening and thus is well below the 80 pieces per mile (medium and large sized) standard. On the mainstem Zigzag River, there is an average of only 1.8 pieces of large wood per mile (USDA 1995). Large wood levels on the Little Zigzag River, Camp Creek, and Devil Canyon are also below the range of natural variation. The entire Zigzag River watershed is outside the range of historic condition for late seral stand structure within the riparian reserves (USDA 1995).

Still Creek is like other major tributaries within the upper Sandy River basin, such as the Zigzag River, the Upper Sandy River and the Salmon River, where large wood removal and channel straightening took place after the 1964 flood. The result has left these channels entrenched with little to no in-stream large wood, simplified habitat, and increased average stream velocities. Large wood for Still Creek ranged from 1.1 to 17.2 medium and large pieces per mile (USFS 1996). The Still Creek watershed has only two to 20 percent late seral structure as compared to the historic condition of 76 percent in riparian reserves (USDA 1995). There is a relatively even

distribution of moderate large wood recruitment potential in the subwatershed, largely due to fires that burned 86 percent of the land base at least once since the turn of the century.

Large wood density within Still Creek is below the Mt. Hood National Forest Land and Resource Management Plan (LRMP) (USDA 1990) standards of 106 medium and large pieces per mile. See Figure 4.

Figure 4. Comparison of existing large wood density with LRMP standards.



Another substantial contributing factor to low large wood densities is there are approximately 125 recreational residences located along the lower three miles of Still Creek. As part of the recreational residence program, any time a permittee identifies a tree as being a potential hazard, the tree is cut down. Until a few years ago these trees would be cut up for firewood or cut into bigger pieces and put in the river to be washed away during the next high flow event. The result has been simplification of in-stream, side channel and floodplain habitat. This has also been the case if logs or whole trees are mobilized into the recreational residence areas from upstream in Still Creek or from debris torrents from tributaries.

Pool Frequency

Pools are formed by substrate, large wood accumulations or by root masses from stream banks that scour depressions in the channel bottom. Pool frequency usually is inversely related to stream gradient (in healthy systems). Past anthropogenic actions have simplified the stream channels and floodplains and decreased future large wood recruitment. These include road building, logging, stream cleanout, firewood cutting, recreational residence construction and

hazard tree removal. Past fire history in the watershed in the early 1900s further exacerbated the situation by leaving most riparian stands in a mid-seral condition.

Frequency of pools for most reaches of Still Creek and its tributaries such as Cool Creek are well below the range or natural variation and LRMP standards. The number of pools per mile (all depths) compared with Columbia River Basin Project Implementation Guide (PIG) standards is depicted in Figure 5 and ranges from 11.2 to 23.2 pools per mile. The number of primary pools (>3ft depth) per mile in Still Creek range from 4.6 to 16 (See Figure 6).

Figure 5. Pools per mile (all depths) compared with Columbia River Basin Project Implementation Guide (PIG) standards.

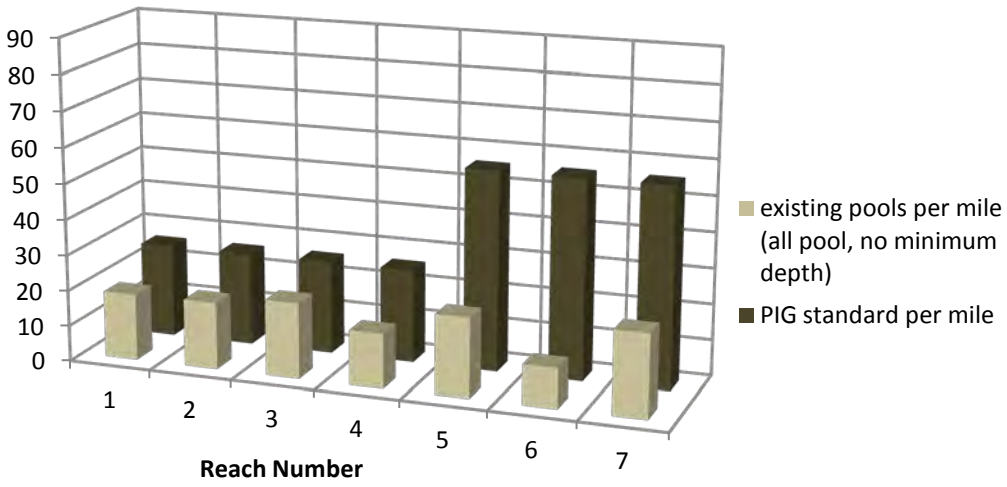
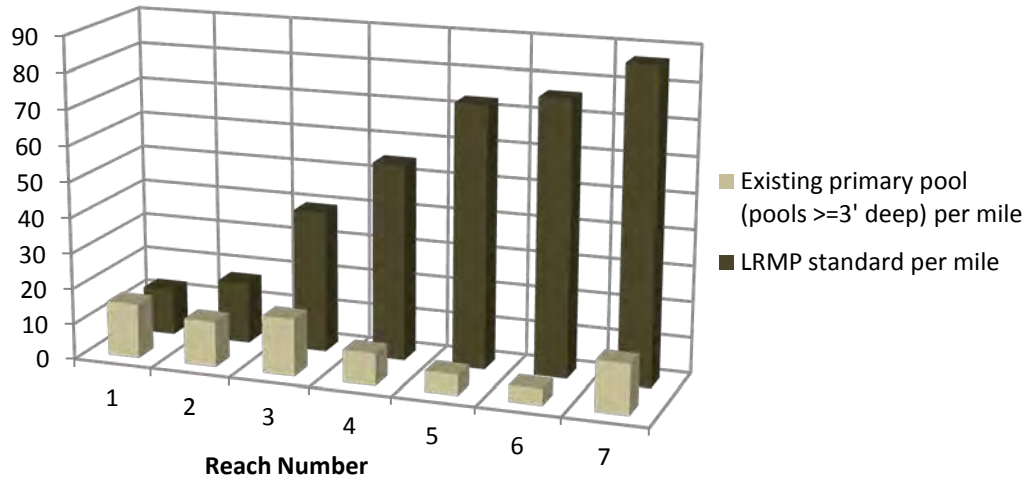


Figure 6. Comparison of existing primary pools (> 3' depth) per mile with LRMP standards.



Pool Quality

To assess pool quality, pool volumes within anadromous sections of the Zigzag River watershed were compared to two similar streams in the Bull Run River watershed that reflect undisturbed conditions (USDA 1995). It is understood that though similar streams were used for comparison, the Bull Run River watershed is a spring and snowmelt driven system whereas the Zigzag River watershed is a glacial system with spring and snowmelt components. The pool volumes representative of these undisturbed conditions in the Bull Run River watershed were 60,000 square feet/mile and 88,000 square feet/mile. Pool volumes in Camp and Still creeks are within or near the range of this natural variation.

Secondary factors of pool quality are good cover and cool water temperatures. Stream cover is provided by in-stream boulders and large wood, surface turbulence, and overhanging vegetation. Properly functioning pools include pool depths greater than three feet deep with good cover and cool water with minor reductions of volume by fine sediment. Based on a comparative assessment of pool volumes with two streams in the Bull Run River watershed (with minimal disturbance), Still Creek is within or near the range of natural variation for volume (USDA 1995). Based on the 1996 Still Creek Stream Survey, primary pools per mile range from 4.6 to 16.0 and Wolman pebble counts documented the lower reaches of Still Creek are within the range of natural variation for substrate in the lower reaches and possess a high fraction (up to 44 percent) of fine sediment in reaches 7 and 8 (river mile 11.4-12.8). Stream temperatures are at risk in Still Creek. Because large wood is not at functional levels, simplification of pool habitat is a likely result.

Off-channel Habitat

Analysis indicates that side channel habitat within the Zigzag River 5th field watershed is below undisturbed conditions. High quality side channel habitat with large wood functioning as a roughness element and cover appears to be lacking within the watershed. The 1996 stream survey indicates that access for fish out of Still Creek is possible in a maximum of 74 out of 94 identified tributaries (USFS, 1996). Twenty tributaries were identified as having gradients greater than 150 percent. Of the 74 available tributaries, 16 were dry at the time of the survey, but could provide suitable habitat during other times of the year. Off channel habitat opportunities have also been greatly decreased by channel straightening and plugging of side channels after the 1964 floods. In several reaches in the watershed straightened channels has resulted in downcutting and further abandonment of connectivity to the floodplain and side channels. Furthermore, with the removal of large wood, existing off channel habitat has been simplified and cover provided by these structures reduced.

Side channel and off channel habitat is critical to several life history stages of anadromous fish. High quality side channel habitat with large wood debris jams and single pieces providing roughness elements, cover and refugia during spawning, feeding and rearing of adult and juvenile fish is the desired condition. Available habitat has been greatly decreased in the Still Creek 6th field sub-watershed. Likely causes include: road building in and along riparian areas, past logging, recreational residence use, past fire history and firewood cutting. The lower reaches in Still Creek have a number of side channels that are accessible for most if not all year. However, there are others that have been filled or cut off from main river flows. Furthermore, most side channel fish habitat has been simplified by removing down large wood as well as conversion of riparian stands from a multi-layered overstory dominated by conifers to simple, single thread channels dominated by hardwood overstories or open areas with less conifer components. Several boulder berms and dikes have been created to protect infrastructures that have limited or stopped lateral channel migration and reactivation of some side channels. For a complete analysis of the current condition of side channel and off channel habitat associated with this project see the Recreational Residence Aquatic Assessment (USDA 2009).

Refugia

As part of the Sandy River basin, the Zigzag River 5th field watershed contains several reaches of Anchor Habitats. An Anchor Habitat is defined as "distinct stream reaches that currently harbor specific life history stages of salmon and steelhead to a greater extent than the stream system at large". Only Still Creek Reaches 1, 2 and 3 (river mile 0-3.2) are designated as anchor habitats within the Zigzag River watershed. Other reaches within the watershed do provide important habitat, though not to a higher degree or concentration as compared to other similar reaches and channel types within the basin. Of the approximate 170 miles of accessible anadromous salmonid habitat within the Sandy River basin, there are about 25 miles of accessible habitat within the Zigzag River 5th field watershed. Still Creek 6th field constitutes approximately 11.2 to 11.8 miles of accessible habitat, or approximately 45 percent. It is important to note that salmon and steelhead prefer low gradient sinuous river and side channel habitat, similar to Rosgen C channel types for some or most of their freshwater life history stages. Still Creek Reaches 2 and 3 (between river mile 1.0 and 7.3) contain approximately 5.3 river miles of the

less than 20 river miles available of this low gradient and sinuous habitat type in the entire Sandy River basin, or 26 percent.

Occupancy of low gradient reaches along Still Creek by cabins and associated infrastructure precludes large wood routing and deposition that leads to reactivation of side channels and abandonment of others as the stream migrates across the valley floor. Pockets of diverse habitat are created and flooded with water, providing complex habitat for all aquatic species. Having a stream that can freely move across the floodplain also allows for access to that floodplain during high water events, dissipating stream energy while depositing important gravel and new organic materials. Debris torrents from tributaries contribute critical materials to the channel and are a source for downstream gravel and large wood to the Zigzag and Sandy River.

The proximity of several cabins along side channels that are occupied by coho and steelhead may lead to interrupted spawning and rearing activities. Recreationist using trails and foot bridges near these channels can cause fish to move off redds or discourage spawning activities. An example of this is on the broad floodplain and two side channels near lots 121 to 125 (near river mile 1.5).

Width/Depth Ratio

Stream channels and floodplains in Still Creek have been simplified and modified due to channel cleanout that occurred after the 1964 flood. Furthermore, there are several areas where artificial boulder berms or dikes or gabion walls have been constructed to protect infrastructures. These structures were built to provide safety for recreational residences, roads and highways. Given the geology and landform and channel types within the Zigzag River watershed it is believed most reaches are within the range of natural variation for this parameter, though at the low end. The following table is a summary of width to depth ratios taken from Mt. Hood National Forest stream surveys.

Table 7. Still Creek width/depth ratios.

Stream Name and Reach Number	River mile	W/D Ratio
Still Creek 1	0-1.0	39.0
Still Creek 2	1.0-3.2	29.2
Still Creek 3	3.2-7.3	35.4
Still Creek 4	7.3-9.4	20.4
Still Creek 5	9.4-10.3	17.1
Still Creek 6	10.3-11.4	17.0
Still Creek 7	11.4-11.9	14.0

Limiting Factor Analysis for Anadromous Fish

Included as part of the 2004 Zigzag Watershed Analysis update (USDA 2004), a basin-wide analysis was completed using the Ecosystem Diagnosis and Treatment Model. The following

description of EDT is an excerpt from the Mobrand Biometrics website (http://www.mobrand.com/edt.htm):

The Ecosystem Diagnosis and Treatment (EDT) is a species habitat-relationship model developed for anadromous and resident salmonids. It has been developed over a number of years primarily by state, tribal, local and private interests in the Pacific Northwest. This type of mode links habitat characteristics to biological features of fish and wildlife species. In practice, EDT is a process for assembling and organizing watershed information as a basis for development and implementation of recovery and management plans. It is based on the premise that restoration of specific species will primarily involve restoration of their ecosystems. EDT provides a detailed depiction of the environment and an assessment of that environment with regard to performance of fish and wildlife populations. Environment includes physical habitat features as well as biological interactions such as predation and competition. Reach specific data for 46 parameters are loaded into the model for both existing (Patent) condition and historic (Template) conditions, based on range of natural variation. Model outputs allow for interpretation of variance between existing and historic conditions and cumulative adverse impacts to target juvenile salmonids. Cumulative impacts are tallied as fish move downstream through other reaches to the Columbia River, Pacific Ocean and then as they return as adults.

The Sandy River basin EDT model analysis was populated with stream survey data from Forest Service Level 2 stream surveys, ODFW physical habitat surveys, and BLM aquatic surveys. Initial analysis was completed by Mobrand Biometrics first in 2002 and updated in 2004 for the entire Sandy River basin. Table 8 displays model results for the Still Creek watershed with the three most limiting factors on production based on a comparison of existing aquatic conditions (Patent) and historic (Template) or those conditions that were believed to be within the Range of Natural Variability (RNV). Historic conditions are for habitat types that persisted prior to European settlement (approximately 1850's). The reader is encouraged to explore the entire Sandy River basin EDT analysis document to gain a basin-level understanding of fisheries issues.

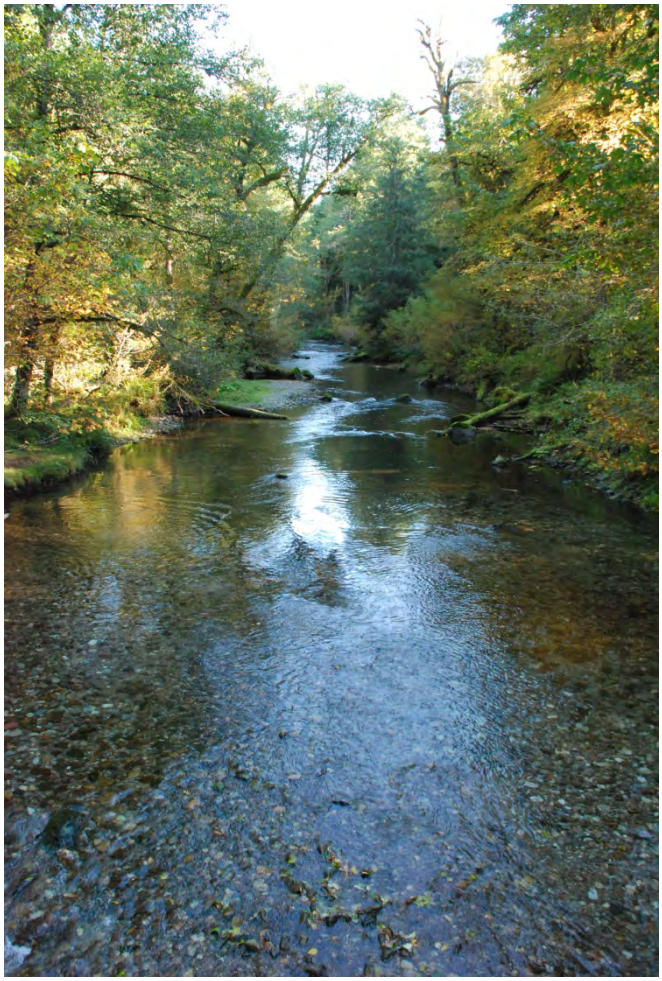
Table 8. Streams and reaches within the Still Creek watershed with the three most limiting factors outlined in EDT for coho and Chinook salmon and winter steelhead production.

Reach Name	River Mile	1. Limiting Factor			2. Limiting Factor			3. Limiting Factor		
		Chinook	Coho	Steelhead	Chinook	Coho	Steelhead	Chinook	Coho	Steelhead
Still Cr. 1	0-1.0	HD/HQ	HD	HQ	CS/FL/TE HT/SE/	SE/HQ	FL/HD PR/SE	-	CS/FL/HT	-
Still Cr. 2	1.0-3.2	HD	SE/HD	HD/ HT/SE	FL/HT/ SE	FL/HT	FL	-	-	PR
Still Cr. 3	3.2-7.3	HD/HQ	HD/ SE/HQ	HQ	CS/FL/ SE	FL/CS	FL/HD/SE	-	-	-
Still Cr. 4	7.3-9.4	HD	HD/ FL/HT	HD/ HT/SE	CS	-	FL	FL/HT/ SE	-	-
Still Cr. 5*	9.4-9.9*	-	-	HD	-	-	FL	-	-	CS

*Note: Anadromous fish production was only modeled in EDT on Still Creek to RM 9.9, although upper limits are believed to be to RM 14.4.

Key:

CS	Channel Stability	OB	Obstructions
CH	Chemical	OX	Oxygen
CO	Competition with Hatchery Fish	PA	Pathogen
COF	Competition with Other Fish	PR	Predation
FL	Flow	SE	Sediment Load
HD	Habitat Diversity	TE	Temperature
HA	Harvest	WI	Water Withdraws
NU	Nutrient load	HQ	Change in Habitat Quantity
HT	Harassment	-	Incomplete data or no limiting factor identified



Restoration Goals, Objectives, and Opportunities

Goal Identification and Desired Condition

Goal Identification

The goal of the Still Creek WRAP is to provide an operational scale tool for restoring the watershed by strategically focusing investments in essential watershed improvement projects and conservation practices at the 6th field watershed scale that tiers to the larger Sandy River Basin Restoration Strategy which all the Sandy River Basin Partners are heavily invested in. With the completion of the Sandy River Aquatic Habitat Restoration strategy (SRBWG 2007), participating entities now coordinate future investments in aquatic habitat restoration in a manner that leverages limited resources where they provide the greatest benefits to the long-term recovery and healthy functioning of salmon and steelhead habitat in the basin. The Still Creek WRAP builds on and refines the broader restoration plan. Disproportionately important salmon and steelhead anchor habitats will be restored to maximize the potential of the habitat for anadromous fish production. The projects are primarily targeted toward increasing habitat complexity and channel stability. Restoration work will continue until the essential projects are completed. Project planning and implementation will be integrated with Forest, District and partner priorities (the Sandy River Basin Partners).

Desired Condition

The desired condition for the Still Creek watershed is a resilient and properly functioning watershed which exhibits appropriate water quality and quantity, diverse and complex terrestrial, riparian and aquatic conditions, and self sustaining wild populations of anadromous and resident fish species.

Objectives

Alignment with National, Regional, and Forest Priorities.

The Still Creek watershed restoration action plan (WRAP) tiers to the 1995 Zigzag 5th Field watershed Analysis (WA) (USDA 1995) – per direction under the Aquatic Conservation Strategy (ACS) of the 1994 Northwest Forest Plan (USDA and USDI, 1994). The 2007 Sandy River

Basin Aquatic Restoration Plan (SRBWG 2006, SRBWG 2007) was completed to guide implementation of restoration in the priority Sandy River basin per direction under the 2005 R6 Aquatic Restoration Strategy (ARS) (USDA 2005). The 2005 strategy was later replaced with the 2008 R6 Aquatic Restoration Conservation Strategy (ARCS) (USDA 2008), a foundational regional strategy for incorporation into forest plans.

The 2011 Still Creek WRAP is an update to the 2007 Sandy River Basin Aquatic Habitat Restoration Strategy (SRBWG 2007) under the guidance of the national 2010 Watershed Condition Framework (WCF) (USDA 2010).

Alignment with State or local goals

The Sandy River Basin Aquatic Restoration Strategy (2007) is a cohesive, comprehensive, and collaborative approach that builds upon the breadth and diversity of existing partnerships, all of the participating entities in the basin readily supported the development of such a strategy for the Sandy River basin. The aquatic habitat restoration strategy for the Sandy River basin provides a geographic focus and hierarchical framework for directing future investments toward high priority restoration needs.

The strategy:

- Identifies priority watersheds in the basin (at the 5th, 6th, and 7th field scales) that provide the cornerstones for addressing freshwater habitat restoration needs of Sandy River basin salmon and steelhead populations.
- Establishes the hierarchy, or sequence, in which actions should be pursued in order to achieve maximum resource benefits.
- Describes the factors limiting salmon and steelhead abundance, productivity, spatial distribution, and diversity. Many of these same factors also limit water quality.
- Defines specific restoration actions (and types of restoration actions where they are not known site-specifically) in priority watersheds necessary to address limiting factors.

The 2011 Still Creek WRAP is an update to the 2007 Sandy River Basin Aquatic Habitat Restoration Strategy (SRBWG 2007) under the guidance of the national 2010 Watershed Condition Framework (WCF) (USDA 2010). This 2011 WRAP adjusts updates and/or adds essential projects as needed to improve the subwatershed condition class, which addresses an outcome-based performance measure of progress toward restoring the productivity and resilience of the watershed. The Still Creek WRAP can be viewed as the operational scaled (6^{th} field HUC) plan which tiers to the broader Sandy River Basin Restoration Strategy.

Opportunities

Partnership Involvement

As described in the background section of this document, a strong and productive partnership exists within the Sandy River basin. This coalition of partners has collectively completed several significant accomplishments furthering conservation and recovery efforts for salmon and steelhead populations in the basin through a robust restoration strategy (SRBWG 2007) that coordinates future investments in aquatic habitat restoration in a manner that leverages limited resources where they provide the greatest benefits to the long-term healthy functioning habitat in the basin. See www.sandyriverpartners.org.

All of the partners are committed to and heavily invested in the Sandy River Basin Aquatic Habitat Strategy. The Still Creek WRAP sharpens focus at a 6th field watershed scale and provides the operational footprint for completing restoration actions that are part of the broader basin-wide planning effort. The Sandy River basin partners meet bi-monthly to coordinate/strategize funding opportunities, plan projects, discuss implementation logistics, and maintain strong working relationships.

Agreements & Funding Partners

The Sandy River basin partners have a robust portfolio of agreements and funding already in place and out-year strategies prepared to continue funding streams and partnerships. Some of these instruments include: Challenge Cost Share Agreements, Whole Watershed Restoration Initiative (WWRI), Oregon Watershed Enhancement Board (OWEB), PayCo, USFS BLI's including NFWF, NFVW and CMLG, and 14 entities with internal funding opportunities (see below).

Restoration Planning and Implementation Partners

The following entities will continue to work together in both planning and implementation phases of WRAP execution.

Clackamas County	www.co.clackamas.or.us
Columbia Land Trust	www.columbialandtrust.org
METRO	www.oregonmetro.gov
Mt. Hood National Forest	www.fs.fed.us/r6/mthood
Multnomah County	www.co.multnomah.or.us
National Marine Fisheries Service	www.nmfs.noaa.gov
Nature Conservancy	www.nature.org
Northwest Steelheaders	www.sandysteelheaders.org
Oregon Depart. of Fish and Wildlife	www.dfw.state.or.us
Portland Water Bureau	www.portlandonline.com/water
Sandy River Basin Watershed Council	www.sandyriver.org
The Freshwater Trust	www.thefreshwatertrust.org/
USDI Bureau of Land Management	www.blm.gov/nhp
Western Rivers Conservancy	www.westernrivers.org

Outcomes/Output

Performance Measure Accomplishment

- Restore natural watershed processes, including riparian function, in-channel habitat, road related impacts, and eradication of invasive plants to recover/improve production of ESA listed salmon and steelhead.
- Improve water quality in Still Creek by improving riparian forest health through additional shading to surface waters and through a reduction in sediment delivery from road related impacts.
- Provide education engagement opportunities for summer home owners/private landowners/general public to learn about watershed restoration.
- Maintain and strengthen partnership between the Mt. Hood national forest, coalition of Sandy River Basin Partners, summer home owners and private landowners.

- Provide jobs to local contractors, material suppliers, sport fishing industry.

Socioeconomic Considerations

Work to be performed in the Still Creek 6th field watershed will contribute to the local communities' and broader Portland metropolitan socioeconomic success by:

- Providing jobs to local contractors by implementation of road and in channel work utilizing heavy equipment, such as front loaders, excavators, dump trucks, bull dozers, helicopters, yarders and log hauling trucks.
- Employing contractors to supply materials not readily available on the forest, such as rock, logs, culverts, tools, and other supplies.
- Hiring engineering firms with expertise in river restoration to design in stream structures appropriate for hydraulic conditions.
- Contracting work involving tree thinning/hauling/invasive species removal and riparian planting work.
- Continued interaction with summer home owners on forest land to help facilitate greater conservation awareness and continued collaboration with the Forest Service and other Federal agencies.
- Restoration of Still Creek will contribute to numerous efforts to conserve and restore severely depressed populations of salmon and steelhead. These species provide a fishery that not only employs local guides, but also fuels the local tackle retailers/manufactures, boat manufacturing companies, and numerous other small businesses that depend on angling revenue.
- During high flow events, Still Creek and tributaries are prone to cause property damage to summer homes and private residences. Restoring side channels, providing channel roughness, and restoring floodplain connectivity will minimize the effects of legacy management which sought to create a hydraulically smooth environment.
- This project contributes to the recovery of several species of ESA listed fish, which are part of the heritage of the Pacific Northwest.

Specific Project Activities (Essential Projects)

Background – Past restoration efforts and prioritization process

Past Restoration Efforts

Historically Still Creek provided high quality spawning and rearing habitat for coho, spring Chinook, winter and summer steelhead, and cutthroat trout. Still Creek has been identified as an anchor habitat for coho and winter steelhead that provides key spawning and rearing habitat due to the habitat and spring fed characteristics (SRBWG 2007).

The Zigzag Watershed Analysis (USFS 1995) covered the Still Creek 6th field watershed and was amended in 2004 to include a detailed road analysis. The watershed analysis identified restoration opportunities at the watershed scale that support broad ecosystem management objectives described in the Northwest Forest Plan. Other documents such as the Sandy River Basin Characterization Report and the Sandy River Basin Aquatic Habitat Restoration Strategy also identified habitat conditions, restoration opportunities, and evaluated limiting factors for fisheries production. Juvenile steelhead and coho densities have declined in recent years and are believed to be lower than those found in similar, less disturbed streams. Aquatic habitat conditions are believed to limit egg and fry survival, winter habitat for juvenile steelhead trout, and summer habitat for coho salmon, resulting in population declines for those species. The main cause of these declines is likely habitat degradation and loss of aquatic ecosystem function from roads, stream cleanouts, channel straightening, historic fires, and historic timber harvest along the stream corridor (SRBP 2005, SRBWG 2007, USFS 1995).

Throughout the 1990's large wood and boulders were added to Still Creek to increase aquatic habitat complexity. These structures were often a single log cabled to large boulders or key trees. Since that time, flood events have caused many of these structures to become mobilized and they now provide little habitat benefits. Many of these large pieces of wood are now parallel to the flow of the stream. However, some structures have accumulated woody debris and formed large pools and accumulated spawning sized gravel.

Loss of aquatic function from roads due to mass road failures and high amounts of road-related sediment are well documented. Decommissioning roads in the Sandy River basin has been one of the top priorities. From 2009 to 2011, 100 percent of the planned road decommissioning and road related restoration was completed. However, numerous stream crossings within the basin have undersized culverts that need maintenance or should be completely replaced with appropriate size culverts.

Prioritizing watersheds on the National Forest

Still Creek, located on the Mt. Hood National Forest, is a 6th field watershed in the Sandy River basin and is a top priority watershed for habitat improvements within the hierarchy of priorities of the SRBWG (2007). Still Creek watershed restoration would likely provide the biggest return on investment in the Sandy River basin. This watershed was identified by the SRBWG as an anchor habitat for coho salmon and winter steelhead trout (SRBWG 2007). Historically, Still Creek provided high quality spawning and rearing habitat for spring Chinook salmon, coho salmon, winter and summer steelhead trout, and cutthroat trout (SRBP 2005). Next to the Salmon River, Still Creek provides the highest densities of spawning and rearing habitat for salmonids in the Sandy River basin. The largest limiting factor to salmonid production in Still Creek is the lack of isolated side channels and off channel habitats (1st restoration priority; SRBWG 2007). Because Still Creek has already been identified as a priority restoration watershed (SRBWG 2007), the USDA Mt. Hood National Forest will implement the Watershed Condition Framework (WCF) restoration actions in this watershed. The Forest Service WCF is designed to proactively implement integrated restoration on priority watersheds and to enhance communication and coordination with partners (USDA 2011).

Prioritizing essential projects

The goal of the Still Creek watershed restoration action plan is to accelerate the recovery of naturally functioning conditions within stream channels and riparian areas to improve long and short term survival and restore production of juvenile and adult coho salmon, spring Chinook salmon, summer and winter steelhead, and cutthroat trout. The series of projects proposed as "Essential Projects" (Table 9) are intended to accomplish these goals by restoring riparian health and vigor by restoring flood plain resiliency with coarse woody debris and large wood floodplain structures designed to protect recovering pioneer riparian vegetation during peak flow events. Stream channels and aquatic habitat will be rehabilitated by installing and modifying existing large wood structures in specific locations along Still Creek that would give the most benefit to increasing aquatic habitat diversity and resiliency. In addition, these projects are designed to accelerate the recovery and diversity of riparian stands by maximizing the growth of conifers by thinning and under-planting riparian stands. A rapid response approach will be used to remove invasive plants that are now attempting to get established. Addressing under-sized culverts will reduce road-related sediment from entering the streams. Working with cabin owners along Still Creek as partners to replace open septic systems with functioning closed systems will improve water quality. Additionally, new wells for the cabins will replace existing direct water intakes that will lead to protecting fish in the stream. Partners within the Sandy River basin fully support and have prioritized these proposed essential projects for the recovery of the entire basin.

Essential Project Activities

Essential projects will directly address key attributes that are limiting factors described in this document. These projects will restore riparian health and vigor by restoring floodplain resiliency with coarse woody debris and large wood floodplain structures designed to protect recovering pioneer riparian vegetation during peak flow events. Aquatic habitat will be rehabilitated by installing and modifying existing large wood structures in specific locations along Still Creek that would give the most benefit by increasing aquatic habitat diversity and resiliency.

Restoration projects in this plan include instream habitat restoration, fish passage, riparian enhancements, culvert replacement, ditch line rehabilitation, and water quality improvements (Table 9). The instream habitat restoration includes the addition of large wood jams, re-watering historic side channels, and channel reconstruction. Large wood will also be added to the floodplain to add roughness and resiliency. Riparian enhancements include the thinning of red alders and crowded conifer stands, invasive plant removal, and decommissioning dispersed campsites. Fish passage will be returned to a large tributary by removing log weirs that have excessive jump heights and are limiting juvenile salmonid migration. Undersized culverts will be replaced to enhance fish passage and limit road-related sediments from entering the streams. Additionally, ditch lines will be rehabilitated to provide proper drainage while limiting unnatural sediment transport to the streams. Water quality improvements will be made in this watershed by replacing open septic systems with closed systems. Locations of "Essential Projects" are displayed in Figure 7.

Table 9. Specific project activities (Essential Projects). All project activities occur on the USDA, Mt. Hood National Forest in Still Creek 6th field sub-watershed.

Essential Project Number*	Project Name	Project Description	Output or improvement	Cost
CC-1	Cool Creek Confluence	Replace five log weirs in cool creek to increase fish passage (RM 3.13-3.14)	0.65 miles	$74,659
SC-1	Cabins Reach	Increase river complexity and remove dikes (RM 1.78-3.13)	1.35 miles	$504,357
SC-2	Straights Reach	Increase river complexity and floodplain connection (RM 3.13-3.42)	0.29 miles	$185,952
SC-3	Compression Reach	Increase river complexity and floodplain connection (RM 3.42-3.91)	0.49 miles	$397,621
SC-4	Mars Attacks Reach	Protect road prism to reduce sediment and increase river complexity (RM 3.91-4.10)	0.19 miles	$188,812
SC-5	Elder Growth Reach	Increase river complexity and floodplain connection (RM 4.10-4.41)	0.31 miles	$71,817
SC-6	Pumpkin Patch	Increase river complexity and floodplain connection (RM 4.41-4.98)	0.57 miles	$380,009
SC-7	Canyon Reach	Reduce river entrenchment and increase river complexity (RM 4.98-6.50)	1.52 miles	$450,625
SC-8	Headwater Nirvana	Reduce river entrenchment and increase river complexity (RM 6.50-8.00)	1.5 miles	$450,625
SC-9	Riparian Rehabilitation	Thinning alder and coniferous stands to release dominant conifers. Plant variety of conifers.	180 acres	$211,404
SC-10	Invasive Plant Removal	Remove invasive plants by hand pulling	20 acres	$40,000
SC-11	Campsite Rehabilitation	Rehabilitate riparian conditions at dispersed campsites reducing sediment input	5 acres	$20,000

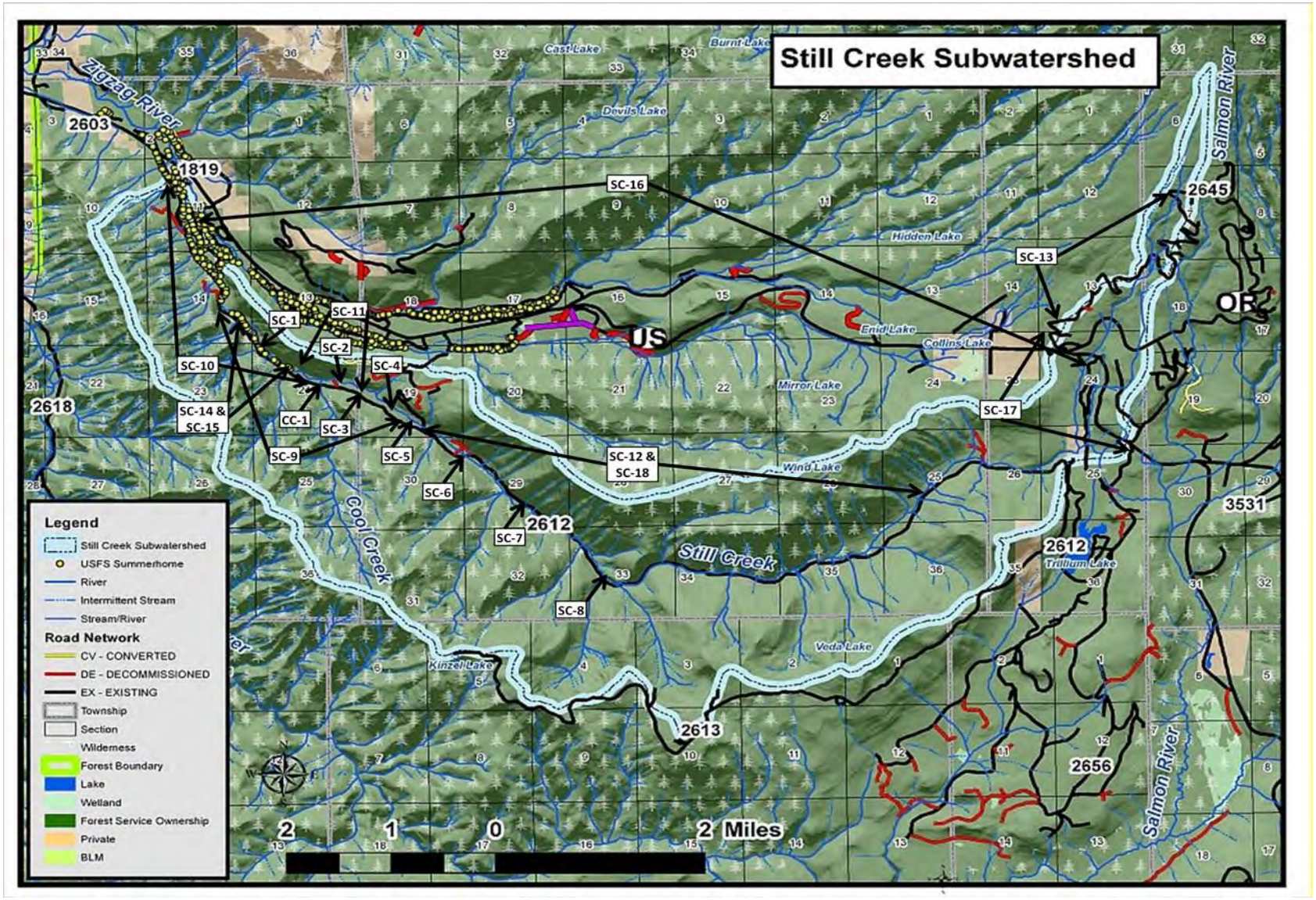
*CC = Cool Creek, SC = Still Creek

Table 9. Specific project activities continued.

Essential Project Number*	Project Name	Project Description	Output or improvement	Cost
SC-12	FS Road 2612 Culverts	Replace undersized culverts on FS 2612 to reduce fine sediment inputs	8 culverts	$115,000
SC-13	West Leg Road	Replace culverts and rehabilitate ditch line	4 culverts; 2.0 miles of ditch line	$43,000
SC-14	Cool Creek Tract water withdrawal	Replace direct water intakes in Still Creek with wells	12 wells	$58,000
SC-15	Recreational Residence Septic Replacement	Replace open septic systems with approved closed systems	10 septic systems	$75,000
SC-16	Marine Derived Nutrient Enhancement	Enhance marine-derived nutrients in Still Creek with surplus hatchery salmon	14 miles	$82,500
SC-17	US Highway 26 sediment traps	Sediment traps installed along Hwy 26 to capture road-related sediment from winter sanding operations	3 miles	$150,000
SC-18	Road 2612 Surface Enhancement	Spot rock Road 2612 to insure there is at least a 6 inch lift of gravel to minimize chronic sediment source	~8 miles	$200,000

*CC = Cool Creek, SC = Still Creek; Total cost of essential projects = **$3,699,381**

Figure 7. Essential project locations.



Essential Projects

Essential Project CC-1
Project Name: Cool Creek Confluence
Attribute Addressed: 1.2 Water Quality Problems – Summer Temperature, 3.1 Aquatic Habitat – Habitat Fragmentation, 3.2 Aquatic Habitat – Large Woody Debris, and 3.3 Aquatic Habitat – Channel Shape and Function
Project Description: The objectives of the Cool Creek Confluence project are to modify and replace five log weirs in Cool Creek. Cool creek, the largest tributary to Still Creek, provides year-round habitat for coastal cutthroat trout and resident rainbow trout and provides spawning and rearing habitat for winter steelhead trout and coho salmon. Weirs were constructed in 1984 to provide grade controls along the stream portions that were downstream of a culvert on FS Road 2612. Since that time, jump heights increased to >1.5 feet limiting upstream migration of juvenile salmonids. The weirs will be replaced with riffles and roughened channel cascades which will be used to restore more natural geomorphology and maximize upstream access for juvenile salmonids. The five log weirs will be removed with an excavator and replaced with ten large logs and 160 cubic yards of boulders to naturally stabilize Cool Creek. Riffles and cascades will be designed so that jump height will be less than 0.6 feet in height. Completion of this project will open 0.65 miles of stream habitat.
Land Ownership: NFSL
Partners Involvement: The Forest Service has a long history of partnerships. The Sandy River Basin Partners[1] (SRBP) have been instrumental in prioritizing projects within the Sandy River basin and giving direction to the types of restoration activities that would give the most benefit to threatened salmonids in Still Creek. The FS partnered with The Freshwater Trust and the SRBWC who have been instrumental in securing funds through OWEB, Ecotrust's WWRI, and Portland Water Bureau HCP grants. The Forest Service contracted TEAMS Enterprise for completing the designs of all instream and riparian rehabilitation projects. Partners from Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife, NOAA, U.S. Bureau of Land Management, METRO, The Nature Conservancy, The Freshwater Trust, SRBWC, Portland Water Bureau and FS staff from other National Forests have actively reviewed the designs for all instream and riparian habitat restoration projects. Portland Water Bureau and Portland General Electric (PGE) have been key organizations providing the funding needed to monitor pre- and post projects.
Timeline: NEPA analyses will be completed in 2011. Project implementation will be completed in 2012 and monitoring will continue for five years.
Estimated costs and Associated BLI: $74,659; NFWF

Essential Project SC-1
Project Name: Cabins Reach
Attribute Addressed: 1.2 Water Quality Problems – Summer Temperature, 3.1 Aquatic Habitat – Habitat Fragmentation, 3.2 Aquatic Habitat – Large Woody Debris, and 3.3 Aquatic Habitat – Channel Shape and Function
Project Description: The Cabins project area is a low gradient depositional reach and contains the lowest average stream thalweg slope (1.3 percent) of any of the project areas along Still Creek. A series of alluvial fans created from the northwestern basin tributaries segment the

reach with depositional constrictions. Three distinct fans push the stream channel to the eastern valley wall constricting and entrenching the stream corridor. These fan "pinch" points aggrade the stream channel head-ward and compress flood flows between the fan and the valley wall creating small segmented transport reaches. In addition to the alluvial fan constrictions, sporadic stream dikes and stream channel straightening were constructed throughout the reach to protect various cabins in the past which has reduced floodplain connectivity and entrenched additional stream segments. Low levels of downed woody debris are a result of poor riparian conditions and stream "clean-outs" (LWD removal) after various flood events such as the 1964 flood. The depositional areas below the alluvial fan pinch points are naturally dynamic however with poor riparian conditions and lack of downed woody debris have increased lateral stream channel migration and avulsion rates. Stream bank instability and terrace erosion rates are also high due to the accelerated channel instability resulting in high bank-full and low flow width to depth ratios and reduced pool quantity and quality. The accelerated channel migration rates and future floods pose a high risk to several cabins within the project area channel migration zone. The objectives of the Cabin Reach are to restore floodplain resiliency and accelerate the recovery of riparian vegetation, maximize pool quantity and quality, and off-channel rearing and spawning habitat. These objectives would be accomplished through construction of numerous LWD structures, dike removal, and construction or enhancement of off channel habitats. Nearly 400 logs will be used to construct approximately 21 LWD structures to achieve the objectives.
Land Ownership: NFSL
Partners Involvement: Refer to the Cool Creek Confluence (Essential Project CC-1) for the same partnership and action.
Timeline: Design work will be completed in 2012. NEPA analyses will be completed in 2015 and implementation in 2016.
Estimated costs and Associated BLI: $504,357; NFWF

Essential Project SC-2
Project Name: Straights Reach
Attribute Addressed: 1.2 Water Quality Problems – Summer Temperature, 3.1 Aquatic Habitat – Habitat Fragmentation, 3.2 Aquatic Habitat – Large Woody Debris, and 3.3 Aquatic Habitat – Channel Shape and Function
Project Description: The flood prone areas of the Straights Reach have very low levels of coarse woody debris. The lack of floodplain roughness has allowed the stream to lose sinuosity that has led to the increased gradient of the reach. The average slope of this project area is 3.3 percent; however, the thalweg slope of the Straights Reach is 4 percent. The increase in slope and loss of sinuosity has also significantly altered pool and riffle spacing. Reference riffle lengths ranged from 111-167 feet. The average riffle length within the Straights reach is 278 feet, with two riffles exceeding 350 feet. The objectives for the Straights Reach project area are designed to increase sinuosity and reduce channel slope, increase floodplain roughness, increase pool densities, increase off channel habitat, and increase spawning gravel retention. These objectives would be accomplished through segments of channel construction and the addition of LWD in the channel, floodplain, and off channel habitats. Five large wood jams will be constructed with 120 large pieces of wood; 200 foot alcoves constructed, 575 foot channel reconstruction, and the reconnections of a 550 foot historic side channel will be completed to meet the objectives of the Straights Reach project.
Land Ownership: NFSL

Partners Involvement: Refer to the Cool Creek Confluence for the same partnership and action.
Timeline: NEPA analyses will be completed in 2011. Project implementation will be completed in 2012 and monitoring will continue for five years.
Estimated costs and Associated BLI: $185,952; NFWF

Essential Project SC-3
Project Name: Compression Reach
Attribute Addressed: 1.2 Water Quality Problems – Summer Temperature, 3.1 Aquatic Habitat – Habitat Fragmentation, 3.2 Aquatic Habitat – Large Woody Debris, and 3.3 Aquatic Habitat – Channel Shape and Function
Project Description: The Compression Reach project area is characterized by a simplified stream channel with few pools, side channels or off channel habitat. Previous habitat enhancement efforts have improved conditions to some degree, however approximately half of the habitat structures have been damaged from previous peak flow events. The damaged structures have been dislodged from their original orientation or location and either were rotated parallel to the flow or deposited on the floodplain. Although these structures are not meeting their original objectives, most are still providing some habitat value or are providing roughness to the floodplain and helping to protect pioneer riparian vegetation. The objectives for the Compression Reach project area are to accelerate the recovery of aquatic habitat by restoring floodplain integrity, restoring side channels, alcoves, ground water channels, pool frequency, pool volume, and hiding cover. To meet these objectives, eight large wood jams will be constructed using 210 pieces of large wood. Two ground water alcoves will be constructed for a total of 280 feet. A 450 foot historic side channel will be reconnected to the main stem and another 500 feet of the main stem will be reconstructed.
Land Ownership: NFSL
Partners Involvement: Refer to the Cool Creek Confluence project (Essential Project CC-1) for the same partnership and action.
Timeline: NEPA analyses will be completed in 2011. Project implementation will be completed in 2012 and monitoring will continue for five years.
Estimated costs and Associated BLI: $397,621; NFWF

Essential Project SC-4
Project Name: Mars Attacks Reach
Attribute Addressed: 1.2 Water Quality Problems – Summer Temperature, 3.1 Aquatic Habitat – Habitat Fragmentation, 3.2 Aquatic Habitat – Large Woody Debris, and 3.3 Aquatic Habitat – Channel Shape and Function
Project Description: The Mars Attacks Reach is a relatively complex and dynamic site. This reach is a relatively un-entrenched depositional reach, downstream of the Elder Growth reach which is a moderately entrenched transport reach. The average thalweg slope of the Mars Attacks reach is 2 percent; the Elder Growth thalweg slope is 3.5 percent. Floodplain LWD and roughness are extremely low to non-existent. A series of habitat structures were constructed in this reach in the mid 1990's, some of which span the bankfull stream channel. The depositional nature of the reach, poor riparian, and floodplain roughness conditions, channel spanning structures and recent flood events have combined to aggrade the reach and have pushed the

stream laterally to the left bank, cutting a significant side channel into the FS 2612 road prism. It is very likely that subsequent events will threaten the road. Therefore, the objectives for the Mars Attacks Reach are to construct a series of treatments to allow and promote natural channel dynamics while at the same time protecting the road. To meet these objectives, 140 pieces of large wood will be used to construct large wood jams to protect the road prism and add river habitat complexity, two groundwater alcoves will be created (100 ft each), three side channels reconnected (300,330, and 800 ft), and two main channel will be reconstructed (330 and 350 ft).
Land Ownership: NFSL
Partners Involvement: Refer to the Cool Creek Confluence project (Essential Project CC-1) for the same partnership and action.
Timeline: NEPA analyses will be completed in 2012. Project implementation will be completed in 2013. Monitoring will begin in 2012 and continue for five years.
Estimated costs and Associated BLI: $188,812; NFWF

Essential Project SC-5
Project Name: Elder Growth Reach
Attribute Addressed: 1.2 Water Quality Problems – Summer Temperature, 3.1 Aquatic Habitat – Habitat Fragmentation, 3.2 Aquatic Habitat – Large Woody Debris, and 3.3 Aquatic Habitat – Channel Shape and Function
Project Description: The Elder Growth Reach is located immediately downstream of the FS 2612 bridge (RM 4.41) and continues to RM 4.11. This reach is characterized by a relatively steep gradient (3.5 percent), moderately entrenched channel bound by a mature riparian area. Due to the relative steepness and entrenchment, LWD less than 80 ft in length appears to become mobilized out of the reach during peak flow events and therefore LWD density and habitat complexity levels are relatively low. The objectives for the Elder Growth Reach are to increase LWD levels and habitat complexity by lining (pulling over) select mature conifers at specific geomorphic features to reduce entrenchment and increase floodplain connectivity, off channel habitats, increase slack water hiding cover, retain sediment and nutrients, and increase and maintain pool habitat. To meet these objectives, seven large wood jams will be constructed with ten logs at each site and two ground water alcoves (200 and 220 ft) will be constructed.
Land Ownership: NFSL
Partners Involvement: Refer to the Cool Creek Confluence project (Essential Project CC-1) for the same partnership and action.
Timeline: NEPA analyses will be completed in 2012. Project implementation will be completed in 2013. Monitoring will begin in 2012 and continue for five years.
Estimated costs and Associated BLI: $71,817; NFWF

Essential Project SC-6
Project Name: Pumpkin Patch Reach
Attribute Addressed: 1.2 Water Quality Problems – Summer Temperature, 3.1 Aquatic Habitat – Habitat Fragmentation, 3.2 Aquatic Habitat – Large Woody Debris, and 3.3 Aquatic Habitat – Channel Shape and Function
Project Description: The Pumpkin Patch project area (RM 4.41-4.98) is dominated by late-seral stands of Douglas fir, Hemlock, and red cedar. This reach is moderately to highly entrenched

with an average stream channel thalweg slope of 2.7 percent. There is evidence of past channel straightening and large wood removal within the project area; berms parallel to the channel on the floodplain and cut trees along the stream channel and very low densities of LWD throughout the reach. The Pumpkin Patch reach supported the highest densities of young of the year salmonids of any of the project areas during the time of the surveys. Restoration of this reach would enhance the existing production potential and restore high quality rearing habitat. Previous work in the 1990's added large wood to the upper end of this reach which did aggrade the stream bed elevation and reconnect some of the historic floodplains to some degree, however significant sections of the reach are still cut off from the floodplain, side channels and off-channel habitat. In recent years several mature old growth trees have fallen into the channel and have contributed significant complexity to the reach. The objectives in the Pumpkin Patch reach are to reconnect the floodplain to restore off-channel rearing and over-wintering habitat, and increasing the quantity and quality of pools within the reach. Over 300 large pieces of wood will be used to construct 15 large wood jams, which would add large wood to complement the existing old growth trees in the channel. Structures would also be constructed to emulate old growth key members to aggrade the channel, restore floodplain connectivity and reactivate side channels and off-channel rearing habitat. Side channels will also be enhanced and reconnected with the stream to provide additional rearing and overwintering habitat for coho, steelhead, and Chinook salmon.
Land Ownership: NFSL
Partners Involvement: Refer to the Cool Creek Confluence project (Essential Project CC-1) for the same partnership and action.
Timeline: NEPA analyses will be completed in 2013. Project implementation will be completed in 2014. Monitoring will begin in 2012 and continue for five years.
Estimated costs and Associated BLI: $380,009; NFWF

Essential Project SC-7
Project Name: Canyon Reach
Attribute Addressed: 1.2 Water Quality Problems – Summer Temperature, 3.1 Aquatic Habitat – Habitat Fragmentation, 3.2 Aquatic Habitat – Large Woody Debris, and 3.3 Aquatic Habitat – Channel Shape and Function
Project Description: The Canyon Reach is a transitional morphology break where the average channel slope increases from 2.7 percent in the Pumpkin Patch Reach to an average thalweg slope of 4.0 percent within the Canyon Reach. Riparian areas are similar to the Pumpkin Patch and consist of late-seral conifers. The Canyon reach is naturally highly entrenched with steep valley walls and a narrow channel migration zone. The objectives for this reach are designed to increase habitat complexity and provide slack water resting habitat for migrating and rearing steelhead and coho salmon adults and juveniles. 315 Logs will be used to construct 10 large wood jams to meet the objectives.
Land Ownership: NFSL
Partners Involvement: Refer to the Cool Creek Confluence project (Essential Project CC-1) for the same partnership and action.
Timeline: NEPA analyses will be completed in 2013. Project implementation will be completed in 2014. Monitoring will begin in 2012 and continue for five years.
Estimated costs and Associated BLI: $450,625; NFWF

Essential Project SC-8
Project Name: Headwater Nirvana Reach
Attribute Addressed: 1.2 Water Quality Problems – Summer Temperature, 3.1 Aquatic Habitat – Habitat Fragmentation, 3.2 Aquatic Habitat – Large Woody Debris, and 3.3 Aquatic Habitat – Channel Shape and Function
Project Description: Similar to the Canyon Reach, the Headwater Nirvana Reach has a relatively steep gradient with an average channel thalweg slope of 4.5 percent. Riparian conditions are also similar to both the Pumpkin Patch and Canyon project areas and are dominated with late-seral conifers. Several natural large wood accumulations have formed within the reach however LWD densities are still low relative to reference conditions. The objectives for this reach are to increase habitat complexity and provide slack water resting habitat for migrating and rearing steelhead and coho salmon adults and juveniles. 315 Logs would be used to construct 14 large wood jams to meet the objectives of the Headwater Nirvana Reach.
Land Ownership: NFSL
Partners Involvement: Refer to the Cool Creek Confluence project (Essential Project CC-1) for the same partnership and action.
Timeline: NEPA analyses will be completed in 2013. Project implementation will be completed in 2015. Monitoring will begin in 2012 and continue for five years.
Estimated costs and Associated BLI: $450,625; NFWF

Essential Project SC-9
Project Name: Riparian Rehabilitation
Attribute Addressed: 1.2 Water Quality – Summer Temperature, 3.2 Aquatic Habitat – Large Woody Debris, and 5.1 Riparian Vegetation – Vegetation Condition
Project Description: The objectives of the Riparian Rehabilitation project are to restore native riparian vegetation age structure and species composition in both the over-story and the understory canopies along Still Creek. Dominant tree species within the floodplain project areas have been converted from conifer to deciduous species through stand replacing fires, recreational residence activities, and past timber harvest. The first phase of riparian rehabilitation will be single tree release of existing conifers. Over story canopy will be thinned to allow 45-55 percent full sunlight depending on plant association types and understory and shrub density (USDA Forest Service 1992, Chan et al. 1996, 1997), and conifers will be individually selected and thinned to at least 10 meters to allow the best possible growing conditions (Emmingham and Maas 1994, Minore and Weatherly 1994, Maas and Emmingham 1995, Chan et al. 1996, Hibbs and Giordano 1996, Newton et al. 1996, Chan et al. 1997). Riparian rehabilitation is recommended in the Cabins, Straights, Compression, and Mars Attacks reaches. There are approximately 180 acres of riparian stands in need of rehabilitation within these project areas. Riparian rehabilitation would involve: 1) thinning high density coniferous stands from below (leaving the largest conifer, which will release dominant trees by thinning adjacent trees within an 8-10 m radius, 2) sapling to pole seral stage conifers growing in dense alder stands would also be released with all red alder growing above the crown of the conifer within a 10 m radius would be thinned to accelerate growth, and 3) under planting 13,000 native riparian trees at 15X15 foot

spacing intervals. The following species mix is recommended: 39 percent western hemlock (*Tsuga heterophylla*), 19 percent western red cedar (*Thuja plicata*), 14 percent big leaf maple (*Acer macrophyllum*), 9 percent grand fir (*Abies grandis*), 7 percent Douglas fir (*Pseudotsuga menziesii*), 7 percent Pacific yew (*Taxus brevifolia*), and 4 percent Pacific silver fir (*Abies amabilis*). There would be a 25 foot no cut buffer extending from the normal high water mark. Only alder and conifers would be thinned.
Land Ownership: NFSL
Partners Involvement: The FS will partner with SRBWC and Mt. Hood Community College – Project YESS and other volunteer groups such as Catlin Gables High School, HSBC Environmental Program, and Wilderness Volunteers.
Timeline: NEPA analyses and designs will be completed in 2012 and 2013. Implementation will occur each year from 2012 to 2016. Monitoring will continue for five years post-project.
Estimated costs and Associated BLI: $211,404; NFVW

Essential Project SC-10
Project Name: Invasive Plant Removal
Attribute Addressed: 5.1 Riparian Vegetation – Vegetation
Project Description: Riparian areas are critical to overall watershed health. Many of the rare and threatened species still present in Still Creek rely on riparian habitats at critical stages of their life histories. Due to their position in the landscape, riparian habitats are among the most threatened in the watershed. Located at the base of steep hillsides and receiving regular flooding, the riparian areas along Still Creek offer some of the most flat, fertile, picturesque, and easily exploitable lands. These areas are the first to be impacted by logging, roads, residential development, and recreation. These past activities have introduced numerous invasive plants to the Still Creek watershed. Invasive plants can outgrow, replace, and destroy native plants. Numerous invasive plants already exist in the Sandy River basin; however, low levels currently exist in the Still Creek watershed. Therefore, the objective of the Invasive Plant Removal Project is to rapidly respond to invasive plants that are initially getting established. Invasive plants will be removed by hand pulling such as Garlic mustard (*Alliaria petiolata*), Policeman's helmet (*Impatiens glandulifera*), English ivy (*Hedera helix*), and English holly (*Ilex aquifolium*).
Land Ownership: NFSL
Partners Involvement: Sandy Basin Vegetation Restoration Coalition[2] (SBVRC) have identified and mapped invasive plants throughout the Sandy River basin. The SBVRC has developed tools to assist private landowners and other agencies to remove invasive plants. The FS will also partner with SRBWC and Mt. Hood Community College – Project YESS to implement this project. Volunteer groups such as Catlin Gables High School, HSBC Environmental Program, and Wilderness Volunteers will assist in implementing this project.
Timeline: The majority of the planning and implementation will occur in 2012 as a rapid response to eliminate newly established invasive plants. Monitoring will occur the following year after implementation. Further invasive plant removal will occur the following years but at less intense rates.
Estimated costs and Associated BLI: $40,000; NFVW

Essential Project SC-11

Project Name: Campsite Rehabilitation
Attribute Addressed: 7.2 Soils – Soil Erosion and 5.1 Riparian Vegetation – Vegetation Condition
Project Description: Still Creek watershed is a popular area for recreation that includes: kayaking, hiking, fishing, and camping. Over the years, numerous user-created campsites and trails have been established in the riparian corridor associated with these activities. These areas have been heavily impacted, with severely reduced ground cover, shrubs, and young trees resulting in increased bank erosion and sediment delivery to Still Creek. The objectives of the Campsite Rehabilitation Project will be to fully decommission some of the campsites, remove trails, and reduce the size of other campsites. Three to five user-developed campsites will be fully decommissioned using hand tools and a mini-excavator. Hand tools will be used to de-compact the soil and plant a mix of native hardwoods, conifers, and shrubs. A mini-excavator will be used to place downed wood throughout sites to discourage future use. Trails will be removed by planting a mix of native plants throughout the impacted area and scattering large downed wood to discourage future use. The de-vegetated footprint of six user developed campsites will be reduced in size by restoring 2.5 acres with native trees and shrubs and placing downed large wood around the perimeter of these sites. Overall, 5 acres of riparian habitat will be restored in the Still Creek watershed by this project.
Land Ownership: NFSL
Partners Involvement: Sandy Basin Vegetation Restoration Coalition (SBVRC)
Timeline: Planning will occur in 2012, implementation will be conducted for three years from 2012 to 2014 with monitoring occurring the following year after implementation.
Estimated costs and Associated BLI: $20,000; NFVW

Essential Project SC-12
Project Name: FS Road 2612 Culverts
Attribute Addressed: 6.2 Roads – Maintenance
Project Description: The FS Road 2612 runs nearly the entire length of Still Creek. This road varies in distance from the stream, from a few feet to a few hundred yards. Numerous small tributaries cross this road through culverts on their route to Still Creek. The FS Road 2612 has a relatively high density of stream crossing with six to ten culverts per mile of the road. Most of these culverts are properly functioning allowing high stream discharge to pass natural sediment and wood debris and fish passage. However, a few of the culverts are not properly functioning leading to road related sediments entering the Still Creek. The objectives of this project are to replace eight culverts that will provide proper widths to allow natural sediment transport without impeding fish migration.
Land Ownership: NFSL
Partners Involvement: The Freshwater Trust and Sandy River Basin Watershed Council.
Timeline: NEPA analyses and planning will be conducted in 2013, implementation completed in 2014, and monitored in 2015 and following any major storm event.
Estimated costs and Associated BLI: $115,000; CMLG/CRMD

Essential Project SC-13
Project Name: West Leg Road

Attribute Addressed: 6.2 Roads – Maintenance
Project Description: West Leg Road is located in the headwaters of Still Creek watershed. The road is six miles long and was the original road to Timberline Lodge on Mt. Hood built in the 1930's. This road is in need of critical maintenance and repair. The objectives of the West Leg Road project are to replace four culverts with properly sized pipes as well as clean and rehabilitate two miles of the ditch line. Culvert replacement and ditch line rehabilitation will protect Still Creek from road related sediments entering the stream and reduce future erosion.
Land Ownership: NFSL
Partners Involvement: RLK Timberline Lodge will provide support to the West Leg Road project by implementing erosions control best management practices on Timber Line Ski Area reducing sediment and debris moving downstream. The FS will plan, implement, and monitor the West Leg Road project.
Timeline: NEPA analyses and planning will be conducted in 2014, implementation in 2015, and monitored in 2016 and following each major storm event.
Estimated costs and Associated BLI: $43,000; CMLG/CRMD

Essential Project SC-14
Project Name: Recreational Residence Water Withdrawals
Attribute Addressed: 1.2 Water Quality – Water Quality Problems and 2.1 Water Quantity – Flow
Project Description: Numerous recreational resident cabins (Cool Creek Tract) are located on the floodplain of Still Creek. Much of the residents in the Cool Creek Tract pump their water directly from Still Creek. Because of the alluvial conditions in this reach of Still Creek, suitable conditions do not exist for a water intake structure. Water intake structures have been observed near salmon and trout redds. Additionally, larval and juvenile salmonids may have been inadvertently drawn into the water intake. Therefore, the objectives of this project are to remove the direct water intakes in Still Creek and drill wells that will not adversely impact Still Creek watershed. Twelve wells will be dug to provide water for the Cool Creek residents.
Land Ownership: NFSL
Partners Involvement: Cabin owners and Clackamas County are key partners to the FS in completing new wells within the Cool Creek Tract. The FS conducts all NEPA analyses and provides oversight of the well construction. The cabin owners ensure that private contractors comply with the best management practices that ensure the protection of aquatic resources and control erosion. Cabin owners work with Clackamas County to ensure all permits are acquired and that the wells meet Clackamas County standards. The FS will ensure compliance and with the cabin owner will monitor post-disturbance sites for erosion and rehabilitate sites with native vegetation.
Timeline: An Environmental Assessment for permit reissuance in the Cool Creek Tract was completed in 2009. NEPA analysis for individual wells will begin in 2011 with the goal of two to three wells completed each year from 2012 to 2016.
Estimated costs and Associated BLI: $58,000; NFWF

Essential Project SC-15
Project Name: Recreational Residence Septic Replacement

Attribute Addressed: 1.2 Water Quality – Water Quality Problems
Project Description: Numerous recreational resident cabins (Cool Creek Tract) are located on the floodplain of Still Creek. Many are on islands surrounded by side channel and main channel flow that accesses the floodplain and a few of the cabins have open septic systems. During high water events it is likely that fecal contamination of surface and sub-surface water from the contents of the septic system are entering Still Creek. These conditions likely continue until dilution by with clean water renders it undetectable. Replacing existing open septic systems with fully sealed systems would alleviate this chronic infusion that occurs during most high water events. The objectives of this project are to install ten new septic systems that will be constructed in such a way and proximity so as to have minimal chances for failure during floods and other high water events. New septic systems will meet Clackamas County regulations with a 100 foot minimum setback from all perennial streams and a fully contained system with no adverse effects to water quality.
Land Ownership: NFSL
Partners Involvement: Cabin owners, Clackamas County, Oregon Department of Environmental Quality (ODEQ) are key partners to the FS in completing new septic systems within the Cool Creek Tract. The FS conducts all NEPA analyses and provides oversight of the construction. The cabin owners ensure that private contractors comply with the best management practices to ensure the protection of aquatic resources and control erosion. Cabin owners work with Clackamas County and ODEQ to ensure all permits are acquired and that the septic systems meet Clackamas County and ODEQ standards. The FS will ensure compliance and the cabin owner will monitor post-disturbance sites for erosion and rehabilitate sites with native vegetation.
Timeline: An Environmental Assessment for permit reissuance in the Cool Creek Tract was completed in 2009. NEPA analysis for individual septic systems will begin in 2011 with the goal of two systems completed each year from 2012 to 2016.
Estimated costs and Associated BLI: $75,000; NFWF

Essential Project SC-16
Project Name: Marine Derived Nutrient Enhancement
Attribute Addressed: 1.2 Water Quality – Water Quality Problems
Project Description: Salmon runs are a mechanism to bring marine-derived nutrients upstream into freshwater ecosystems. This project augments suppressed natural runs of salmon with surplus hatchery salmon carcasses as a restoration tool. Research has shown the benefits of the presence of carcasses at all trophic levels, extending from streams into the riparian zone and even further upslope. The objectives of the project are to treat Still Creek with surplus hatchery salmon carcasses to the maximum density allowed by the Oregon Department of Environmental Quality (2,500 lbs per mile of stream). The goal is to attain loading levels of up to 0.4 kg/square meter of surface area (Bilby et al. 2001).
Land Ownership: NFSL
Partners Involvement: Oregon Department of Fish and Wildlife, SRBWC, and Mt. Hood Community College – Project YESS volunteers assist with the storage, transportation, and placement of salmon carcasses in tributaries and the main channel within the Still Creek watershed.
Timeline: The FS along with its partners will plan, implement, and monitor the results each year.

Estimated costs and Associated BLI: $82,500; NFWF

Essential Project SC-17
Project Name: US Highway 26 sediment traps
Attribute Addressed: 1.2 Water Quality – Water Quality Problems
Project Description: At elevations around 4,000 feet on Mt. Hood, winter travel along US Highway 26 is treacherous. Oregon Department of Transportation spreads hundreds of tons of sand on US Highway 26 to reduce adverse winter road conditions. These sanding operations occur from October to May of each year. Although ODOT takes steps to remove excess sand from the highway during the summer months, on average 328 tons of sand enters the headwaters of Still Creek (USFS 1995). Still Creek runs under the highway near Government Camp, Oregon. Ditch lines funnel road-related sediment to the stream and other tributaries within the watershed. The objectives of this project are to construct sediment traps downstream of drain culverts, as well as in ditches, to retain sand and other road-related sediment before it enters the streams. Completing this project will address water quality attributes in the Still Creek watershed.
Land Ownership: NFSL
Partners Involvement: Oregon Department of Transportation (ODOT) will complete NEPA analyses and complete the project implementation. The FS will review the NEPA analyses and provide project oversight.
Timeline: ODOT will complete NEPA analysis and FS will review in 2014. ODOT will complete project implementation in 2015. Both the FS and ODOT will monitor results in 2016.
Estimated costs and Associated BLI: $150,000; CMLG/CRMD

Essential Project SC-18
Project Name: Road 2612 Surface Enhancement
Attribute Addressed: 1.2 Water Quality – Water Quality Problems
Project Description: The FS Road 2612 runs nearly the entire length of Still Creek. This road is anywhere from a few feet from the stream to a few hundred yards. Numerous small tributaries cross this road through culverts on their route to Still Creek. Resurfacing the road will significantly reduce road-related sediment input to Still Creek. The objectives of this project are to resurface FS 2612 road with a minimum of a six inch gravel lift thus stabilizing the road bed and surface and significantly reducing sediment entering Still Creek.
Land Ownership: NFSL
Partners Involvement: Hoodland Fire Department will perform road storm patrols to ensure that the road is properly functioning as this road is one of the main emergency egress routes on the west side of Mt. Hood.
Timeline: NEPA analyses and planning will be conducted in 2012 with implementation completed in 2013, and monitored in 2014 and following any major storm event.
Estimated costs and Associated BLI: $200,000; CMLG/CRMD

[1]Sandy River Basin Partners (SRBP) include: Clackamas County, Columbia Land Trust, METRO, Multnomah County, National Marine Fisheries Service, The Nature Conservancy, Northwest Steelheaders, Oregon Department of Fish and Wildlife, Portland Water Bureau, Sandy

River Basin Watershed Council, The Freshwater Trust, USDA, Mt. Hood National Forest, USDI, Bureau of Land Management, and Western Rivers Conservancy.

[2]Sandy Basin Vegetation Restoration Coalition (SBVRC) include: The Nature Conservancy, the Mt. Hood National Forest, the Sandy River Basin Watershed Council, City of Portland Metro, City of Portland Water Bureau, Salem District BLM District, Oregon Parks and Recreation, East Multnomah County Soil & Water Conservation District, and Clackamas County Soil & Water Conservation District.

Costs

Table 10. Essential Project funding needs by project category. All project activities occur on the USDA, Mt. Hood National Forest in Still Creek 6th field sub-watershed.

Project Name	Roads	Aquatic Organism passage	Instream	Riparian	Water quality
Cool Creek Confluence		$74,659			
Cabins Reach			$504,357		
Straights Reach			$185,952		
Compression Reach			$397,621		
Mars Attacks Reach			$188,812		
Elder Growth Reach			$71,817		
Pumpkin Patch			$380,009		
Canyon Reach			$450,625		
Headwater Nirvana			$450,625		
Riparian Rehabilitation				$211,404	
Invasive Plant Removal				$40,000	
Campsite Rehabilitation				$20,000	
FS Road 2612 Culverts	$115,000				
West Leg Road	$43,000				
Cool creek water withdrawal					$58,000
Rec. Residence Septic					$75,000
Nutrient Enhancement					$82,500
US Hwy 26 Sediment Traps	$150,000				
Road 2612 Surface Enhancement	$200,000				
TOTAL by category	$508,000	$74,659	$2,629,818	$271,404	$215,500

Total funds needed: $3,699,381

Figure 8. Funding needs by project type in the Still Creek 6th field sub-watershed located on the USDA, Mt. Hood National Forest from 2012 to 2016.

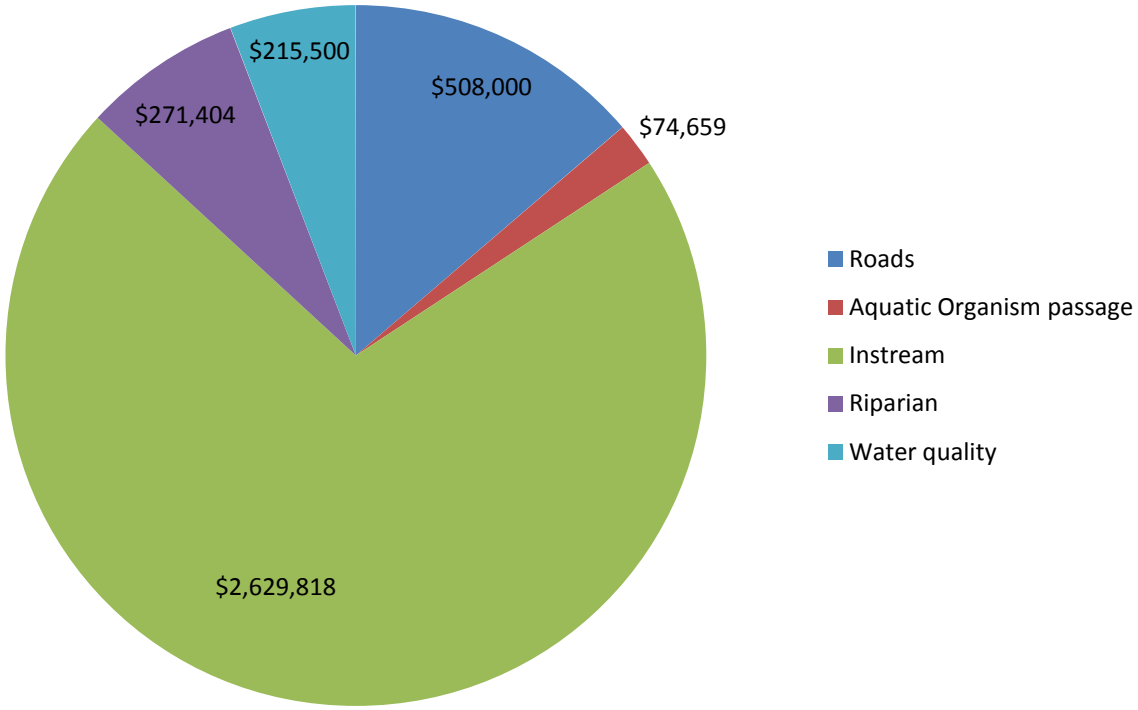


Figure 9. Funding needs by essential project in the Still Creek 6th field sub-watershed located on the USDA, Mt. Hood National Forest from 2012 to 2016.

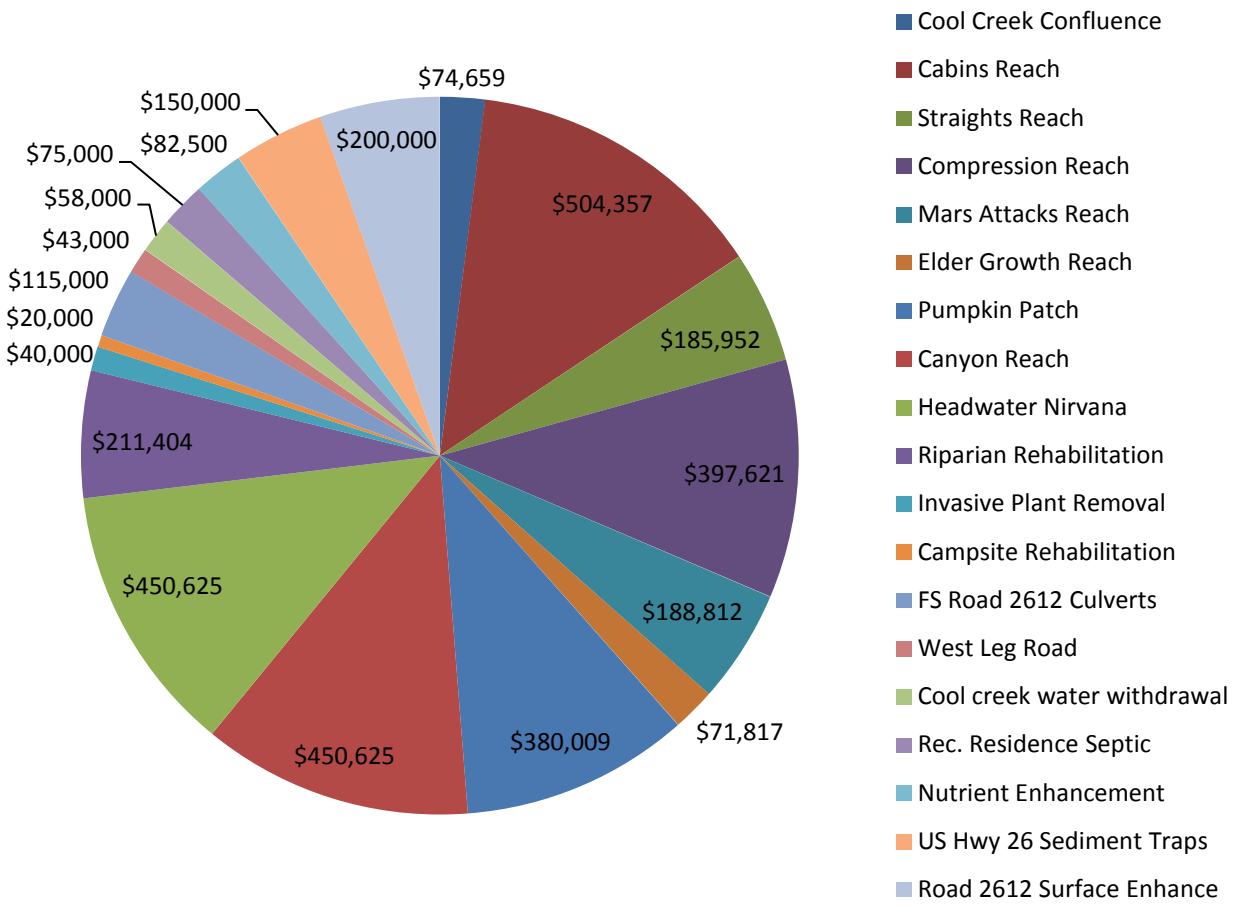


Table 11. Estimated Costs to plan, design, implement, and monitor projects in Still Creek 6th field watershed located on USDA, Mt. Hood National Forest from 2012 to 2016.

Essential Project Number	Project Name	Output	Funding (listed in thousands, 1 = $1,000)								
			Total Cost	Project Planning and Design		Project Implementation		Project Monitoring		Total	
				FS	Partners	FS	Partners	FS	Partners	FS	Partners
CC-1	Cool Creek Confluence	0.65 miles	74.7	16.3	9.9	8.2	12.2	8.5	19.5	33.0	41.7
SC-1	Cabins Reach	1.35 miles	504.4	57.4	58.3	162.3	198.4	8.5	19.5	228.2	276.2
SC-2	Straights Reach	0.29 miles	186.0	23.5	20.7	45.5	68.3	8.5	19.5	77.5	108.5
SC-3	Compression Reach	0.49 miles	397.6	24.9	22.8	128.8	193.2	8.5	19.5	162.2	235.5
SC-4	Mars Attacks Reach	0.19 miles	188.8	49.1	16.9	66.4	28.5	8.5	19.5	124.0	64.8
SC-5	Elder Growth Reach	0.31 miles	71.8	17.5	3.3	16.1	6.9	8.5	19.5	42.1	29.8
SC-6	Pumpkin Patch	0.57 miles	380.0	36.3	11.4	213.1	91.3	8.5	19.5	257.8	122.2
SC-7	Canyon Reach	1.52 miles	450.6	30.7	9.0	268.1	114.9	8.5	19.5	307.2	143.4
SC-8	Headwater Nirvana	1.5 miles	450.6	30.7	9.0	268.1	114.9	8.5	19.5	307.2	143.4
SC-9	Riparian Rehabilitation	180 acres	211.4	25.0	6.5	106.3	45.6	8.5	19.5	139.8	71.6
SC-10	Invasive Plant Removal	20 acres	40.0	2.5	2.5	15.0	15.0	5.0	0.0	22.5	17.5
SC-11	Campsite Rehabilitation	5 acres	20.0	1.0	1.0	8.0	8.0	2.0	0.0	11.0	9.0
SC-12	FS Road 2612 Culverts	8 culverts	115.0	10.0	0.0	100.0	0.0	5.0	0.0	115.0	0.0
SC-13	West Leg Road	4 culverts	43.0	5.0	0.0	36.00	0.0	2.0	0.0	43.0	0.0
SC-14	Water Withdrawal	12 wells	58.0	5.0	0.0	0.0	48.0	5.0	0.0	10.0	48.0
SC-15	Septic Replacement	10 tanks	75.0	5.0	0.0	0.0	65.0	5.0	0.0	10.0	65.0
SC-16	Nutrient Enhancement	14 miles	82.5	2.0	0.0	28.5	50.0	2.0	0.0	32.5	50.0
SC-17	US Hwy 26 Traps	3 miles	150.0	2.0	10.0	0.0	130.0	3.0	5.0	5.0	145.0
SC-18	Road 2612 Surface	8 miles	200.0	5.0	0.0	190.0	0.0	4.0	1.0	199.0	1.0
	TOTALS		3699.4	348.9	181.3	1660.4	1190.2	118.0	201.0	2127.0	1573.6

Timelines and Project Scheduling:

Essential projects in the Still Creek 6th field watershed are anticipated to be completed with adequate funding by 2017. The USDA, Mt. Hood National Forest along their numerous partners will be able to increase aquatic habitat complexity by reconnecting the floodplain to the mainstem river and increase large wood accumulations, all of which will increase flows to historic side channels, add and enhance pool habitats, provide refuge for all stages of salmonid life history, and accumulate spawning gravels. Fish passage will be restored. Riparian rehabilitation by thinning and planting will accelerate the complex age structure and variety of native plants need for a healthy watershed and a rapid response to non-native invasive plants control will protect the riparian rehabilitation projects. Addressing problematic culverts will protect the Still Creek watershed by limiting unnatural sediment delivery to the stream. Working with private cabin owners to address water withdrawals and septic systems will improve the health of the watershed.

Table 12. Estimated project implementation completion date for essential projects. Monitoring of projects may extend to later dates to measure biological and physical responses of the project treatments. All project activities occur on the USDA, Mt. Hood National Forest in Still Creek 6th field sub-watershed.

Project Name	Estimated Completion Date of Essential Projects
Cool Creek Confluence	2012
Cabins Reach	2016
Straights Reach	2012
Compression Reach	2012
Mars Attacks Reach	2013
Elder Growth Reach	2013
Pumpkin Patch	2014
Canyon Reach	2014
Headwater Nirvana	2015
Riparian Rehabilitation	2016
Invasive Plant Removal	2016
Campsite Rehabilitation	2014
FS Road 2612 Culverts	2014
West Leg Road	2015
Cool creek water withdrawal	2016
Rec. Residence Septic	2016
Nutrient Enhancement	2016
US Hwy 26 Sediment Traps	2016
Road 2612 Surface Enhancement	2014

Table 13. Timelines and scheduling for essential projects. All project activities occur on the USDA, Mt. Hood National Forest in Still Creek 6th field sub-watershed. Design consists of completion of inventories, planning, designs, and NEPA analyses. Implementation consists of completing all treatments necessary to meet the attributes addressed. Monitoring consists of pre- and post photos, channel surveys, smolt surveys, spawning surveys, stream temperature monitoring, or road storm patrol.

Project Number	Project Name	Project Task	Project Implementation Plan (listed in thousands, 1 = $1,000)											
			2012		2013		2014		2015		2016		Total	
			FS	Partners	FS	Partners	FS	Partners	FS	Partners	FS	Partners	FS	Partners
CC-1	Cool Creek	Design	16.3	9.9									16.3	9.9
		Implementation	8.2	12.2									8.2	12.2
		Monitoring	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	8.5	19.5
SC-1	Cabins Reach	Design	9.7						47.7	58.3			57.4	58.3
		Implementation									162.3	198.4	162.3	198.4
		Monitoring	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	8.5	19.5
SC-2	Straights Reach	Design	23.5	20.7									23.5	20.7
		Implementation	45.5	68.3									45.5	68.3
		Monitoring	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	8.5	19.5
SC-3	Compression Reach	Design	24.9	22.8									24.9	22.8
		Implementation	128.8	193.2									128.8	193.2
		Monitoring	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	8.5	19.5
SC-4	Mars Attacks Reach	Design	9.7		39.4	16.9							49.1	16.9
		Implementation			66.4	28.5							66.4	28.5
		Monitoring	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	8.5	19.5
SC-5	Elder Growth Reach	Design	9.7		7.8	3.3							17.5	3.3
		Implementation			16.1	6.9							16.1	6.9
		Monitoring	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	8.5	19.5
SC-6	Pumpkin Patch	Design	9.7				26.6	11.4					36.3	11.4
		Implementation					213.1	91.3					213.1	91.3
		Monitoring	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	8.5	19.5

Table 13. Timelines and scheduling for essential projects continued.

Project Number	Project Name	Project Task	Project Implementation Plan (listed in thousands, 1 = $1,000)											
			2012		2013		2014		2015		2016		Total	
			FS	Partners	FS	Partners	FS	Partners	FS	Partners	FS	Partners	FS	Partners
SC-7	Canyon Reach	Design	9.7				21.0	9.0					30.7	9.0
		Implementation					268.1	115.0					268.1	115.0
		Monitoring	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	8.5	19.5
SC-8	Headwater Nirvana	Design	9.7						21.0	9.0			30.7	9.0
		Implementation							268.1	115.0			268.1	115.0
		Monitoring	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	8.5	19.5
SC-9	Riparian Rehab	Design	9.7	6.5	15.3								25.0	6.5
		Implementation	21.3	9.1	21.3	9.1	21.3	9.1	21.3	9.1	21.3	9.1	106.3	45.6
		Monitoring	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	1.7	3.9	8.5	19.5
SC-10	Invasive Plant Removal	Design	2.5	2.5									2.5	2.5
		Implementation	8.0	8.0	2.0	2.0	2.0	2.0	1.5	1.5	1.5	1.5	15.0	15.0
		Monitoring	1.0		1.0		1.0		1.0		1.0		5.0	
SC-11	Campsite Rehab	Design	1.0	1.0									1.0	1.0
		Implementation	2.7	2.7	2.7	2.7	2.7	2.7					8.0	8.0
		Monitoring			1.0		0.5		0.5				2.0	
SC-12	FS Road 2612 Culverts	Design			10.0								10.0	
		Implementation					100.0						100.0	
		Monitoring							5.0				5.0	
SC-13	West Leg Road	Design					5.0						5.0	
		Implementation							36.0				36.0	
		Monitoring									2.0		2.0	

Table 13. Timelines and scheduling for essential projects continued.

Project Number	Project Name	Project Task	Project Implementation Plan (listed in thousands, 1 = $1,000)											
			2012		2013		2014		2015		2016		Total	
			FS	Partners	FS	Partners	FS	Partners	FS	Partners	FS	Partners	FS	Partners
SC-14	Water Withdrawal	Design	1.0		1.0		1.0		1.0		1.0		5.0	
		Implementation		9.6		9.6		9.6		9.6		9.6		48.0
		Monitoring	1.0		1.0		1.0		1.0		1.0		5.0	
SC-15	Septic Replacement	Design	1.0		1.0		1.0		1.0		1.0		5.0	
		Implementation		13.0		13.0		13.0		13.0		13.0		65.00
		Monitoring	1.0		1.0		1.0		1.0		1.0		5.0	
SC-16	Nutrient Enhance	Design	0.4		0.4		0.4		0.4		0.4		2.0	
		Implementation	5.7	10.0	5.7	10.0	5.7	10.0	5.7	10.0	5.7	10.0	28.5	50.0
		Monitoring	0.4		0.4		0.4		0.4		0.4		2.0	
SC-17	US Hwy 26 Traps	Design					2.0	10.0					2.0	10.0
		Implementation										130.0		130.0
		Monitoring									3.0	5.0	3.0	5.0
SC-18	Road 2612 Surface Enhance	Design	5.0										5.0	
		Implementation			190.0								190	
		Monitoring					2.0	0.5	1.0	0.5	1.0		4.0	1.0
		TOTALS	384.1	428.5	400.5	141.0	692.8	322.6	430.6	265.0	219.6	415.6	2,127	1,573

Restoration Project Monitoring and Evaluation

Post-project monitoring and evaluation is essential in determining the overall success of the essential projects. The FS service will conduct all the physical habitat monitoring using Rosgen Level 2 surveys that include: channel cross sections, longitudinal profiles, pebble counts, sediment surveys, and channel geometry. The FS along with its partners (Oregon Department of Fish and Wildlife, The Freshwater Trust, and SRBWG) will monitor biological indicators of essential projects by conducting extensive smolt monitoring, spawning surveys, and snorkeling surveys that will identify juvenile salmonid use of constructed side channels and alcoves. Beginning in 1990, Still Creek has standardized the monitoring of smolt out migrants using rotary traps. The strength of this long-term data set will be used to evaluate the biological success of these projects. Standardized spawning surveys have been conducted since the late 1990's. The partners will also assist in the mapping of invasive plant species, conduct rapid response to remove invasive plants, and monitor riparian treatments. The FS will conduct storm road patrols to evaluate the success of road projects.

Table 14. Project monitoring and evaluation. All project activities occur on the USDA, Mt. Hood National Forest in Still Creek 6th field sub-watershed.

Project Name	Parameters to be Monitored*	Who will monitor?	Frequency
Cool Creek Confluence	Rosgen Level 2, spawning surveys, and smolt surveys.	USFS and project partners	Pre- and post project for five years
Cabins Reach	Rosgen Level 2, spawning surveys, and smolt surveys.	USFS and project partners	Pre- and post project for five years
Straights Reach	Rosgen Level 2, spawning surveys, and smolt surveys.	USFS and project partners	Pre- and post project for five years
Compression Reach	Rosgen Level 2, spawning surveys, and smolt surveys.	USFS and project partners	Pre- and post project for five years
Mars Attacks Reach	Rosgen Level 2, spawning surveys, and smolt surveys.	USFS and project partners	Pre- and post project for five years
Elder Growth Reach	Rosgen Level 2, spawning surveys, and smolt surveys.	USFS and project partners	Pre- and post project for five years
Pumpkin Patch	Rosgen Level 2, spawning surveys, and smolt surveys.	USFS and project partners	Pre- and post project for five years
Canyon Reach	Rosgen Level 2, spawning surveys, and smolt surveys.	USFS and project partners	Pre- and post project for five years
Headwater Nirvana	Rosgen Level 2, spawning surveys, and smolt surveys.	USFS and project partners	Pre- and post project for five years
Riparian Rehabilitation	Canopy cover, survival and stocking rates, stream temperature	USFS and project partners	Post project five years
Invasive Plant Removal	Rapid response, pre- and post mapping	USFS and project partners	Post project five years
Campsite	Photo points, survival and	USFS and project	Post project five years

Rehabilitation	stocking rates	partners	
FS Road 2612 Culverts	Road storm patrol	USFS	Post project five years
West Leg Road	Road storm patrol	USFS	Post project five years
Cool creek water withdrawal	Post project inspections	USFS and project partners	Post project one year
Rec. Residence Septic	Post project inspections	USFS and project partners	Post project one year
Nutrient Enhancement	Spawning surveys, and smolt surveys.	USFS and project partners	Post project five years
US Hwy 26 Sediment Traps	Road storm patrol	USFS and project partners	Post project five years
Road 2612 Surface Enhancement	Road storm patrol cabin owner and emergency egress routes	USFS and project partners	Post project five years

***Description of parameters:** Rosgen Level 2 surveys consist of channel cross sections, longitudinal profiles, pebble counts, sediment surveys, and channel geometry. These measurements determine changes in physical stream characteristics, effectiveness in maintaining stream meander pattern, dimension, and profile. Photo points will be used to detect visual changes in amount of habitat and vegetation. Large wood surveys will be conducted to determine if wood is maintained in the project reaches and recruitment of new woody debris. Stream temperature will be monitored to detect decreases over time following treatments. Spawning and smolt surveys will be conducted to measure the biological responses to watershed treatments. Storm patrols will be conducted following large precipitation events to determine effectiveness of road and culvert treatments and determine maintenance needs. Invasive plants sites will be mapped and monitored to determine effectiveness of hand pulling treatments.

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