Klawock Watershed Condition Assessment

Sponsored by:

Central Council Tlingit and Haida Tribes of Alaska
and
USDA Forest Service
Tongass National Forest
Craig Ranger District

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Abstract

A Proper Functioning Condition assessment (PFC) was conducted to determine the functionality of aquatic systems in the Klawock Watershed. The Central Council Tlingit and Haida Tribes of Alaska solicited the U.S. Forest Service (USFS) to conduct the assessment in response to local concerns regarding declining sockeye salmon numbers. The 45.5 square mile Klawock Watershed surrounds 2800-acre Klawock Lake and is managed by three Native corporations and the U.S. Forest Service—Craig Ranger District. An inventory of the watershed was conducted and critical features were mapped into a Geographic Information system (GIS). The watershed was divided into four distinct sub-basins and three composite sub-basins. 132 miles of stream were documented in the watershed; 68 miles are fish bearing. Streams were then delineated into distinct reaches for the Proper Functioning Condition (PFC) assessment based on channel type, management condition and natural breaks. A USFS interdisciplinary team conducted 82.5 miles of PFC assessment during the 1999 and 2000 field seasons. The aggregate rating for Half-mile Creek was Proper Functioning Condition. The more heavily managed Three-mile Creek Sub-basin was rated Functional at Risk. The aggregate functional rating for Inlet Creek and Hatchery Creek is PFC. However, Non-Functional and Functional At Risk reaches occur within each sub-basin. Additionally, PFC assessments were completed for the remaining composite sub-basins. A PFC assessment was also initiated on wetlands in 2000. Several factors were identified as limiting watershed functionality, including lack of large woody debris, inadequate riparian vegetation (structure and composition), and excessive channel erosion and deposition. Habitat restoration opportunities related to stream and road interactions, habitat connectivity, fish passage, large woody debris placement and riparian silviculture were identified as components that will move the watershed towards a more functional condition. Further study of watershed roads and associated stream crossings were initiated in 2001 and should be completed by summer of 2002. A comprehensive watershed restoration and management plan is being developed for the watershed in conjunction with the Klawock Watershed Council and the principle landowners, Klawock-Heenya, Inc., Shaan-Seet, Inc. and Sealaska, Inc.

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Prince of Wales Hatchery
Alaska Dept. Fish and Game Habitat Division (POW)

Introduction

The Central Council Tlingit and Haida Tribes of Alaska acquired a grant from the U.S. Environmental Protection Agency (EPA) to conduct an assessment of the Klawock Lake Watershed in 1999. This effort was initiated in part, due to the growing local concern about the status of Klawock River sockeye salmon. The Central Council requested assistance from the USDA Forest Service, Craig Ranger District in conducting a functional assessment of streams and wetlands in the Klawock Watershed. The Forest Service agreed to document watershed conditions and report findings to watershed stakeholders. The Klawock Watershed Council was created in 2000 to facilitate management of the watershed. This report provides the results of that assessment.

The Forest Service assembled a Watershed Assessment Team (WAT) composed of a hydrologist, hydrologic technician, soil scientist, and fisheries biologist. The team consulted with the Tribes and Craig Ranger District staff to identify issues critical to the future management of the watershed. The five issues identified were:

- **Protection and enhancement of salmonid fisheries and habitat with an emphasis on sockeye salmon.**
- **Protection of Klawock Lake and associated values.**
- **Maintaining quantity/quality of the Klawock municipal water supply.**
- **Flooding and impacts of past and future development on floodplains.**
- **Access and road maintenance within the watershed.**

To address these issues, the Team conducted the following:

- Tongass National Forest Tier 1 stream surveys to assess fish habitat distribution and availability.
- A Proper Functioning Condition Assessment (PFC) that quickly and efficiently determines the functionality of riparian and wetland areas.
- A small-scale watershed analysis to characterize key ecosystem processes, interactions, and functions.

Existing information was limited for the Klawock Watershed. Prior to conducting the PFC assessments, a significant effort was necessary in order to inventory the watershed and document watershed features such as streams, roads, wetlands, and timber harvest. Tier 1 surveys were conducted to document streams and available fish habitat. Results of the inventory efforts were mapped into a Geographical Information System (GIS) and comprehensive streams, wetlands, vegetation (harvest), and road layers were developed.

Four critical 3rd order sub-basins were identified early in the project. Tier 1 surveys were conducted on Half-mile, Three-mile and Hatchery Creeks. PFC assessments were conducted on Half-mile and Three-mile Creeks in 1999 and in the remaining stream network in 2000. A functional assessment on wetlands in the watershed was initiated in 2000.

In 2000, The Central Council Tlingit and Haida Tribes of Alaska identified the Klawock Watershed (6th field Hydrologic Unit Code (HUC)) as a critical watershed for assessment and restoration (Tlingit and Haida Central Council, 2000). Concurrently, the Tongass National Forest has identified the broader Harris River Watershed (5th field HUC) as a priority for watershed assessment and restoration. The Klawock Watershed is included in this broader Harris River HUC.

Prince of Wales Island in Southeast Alaska.

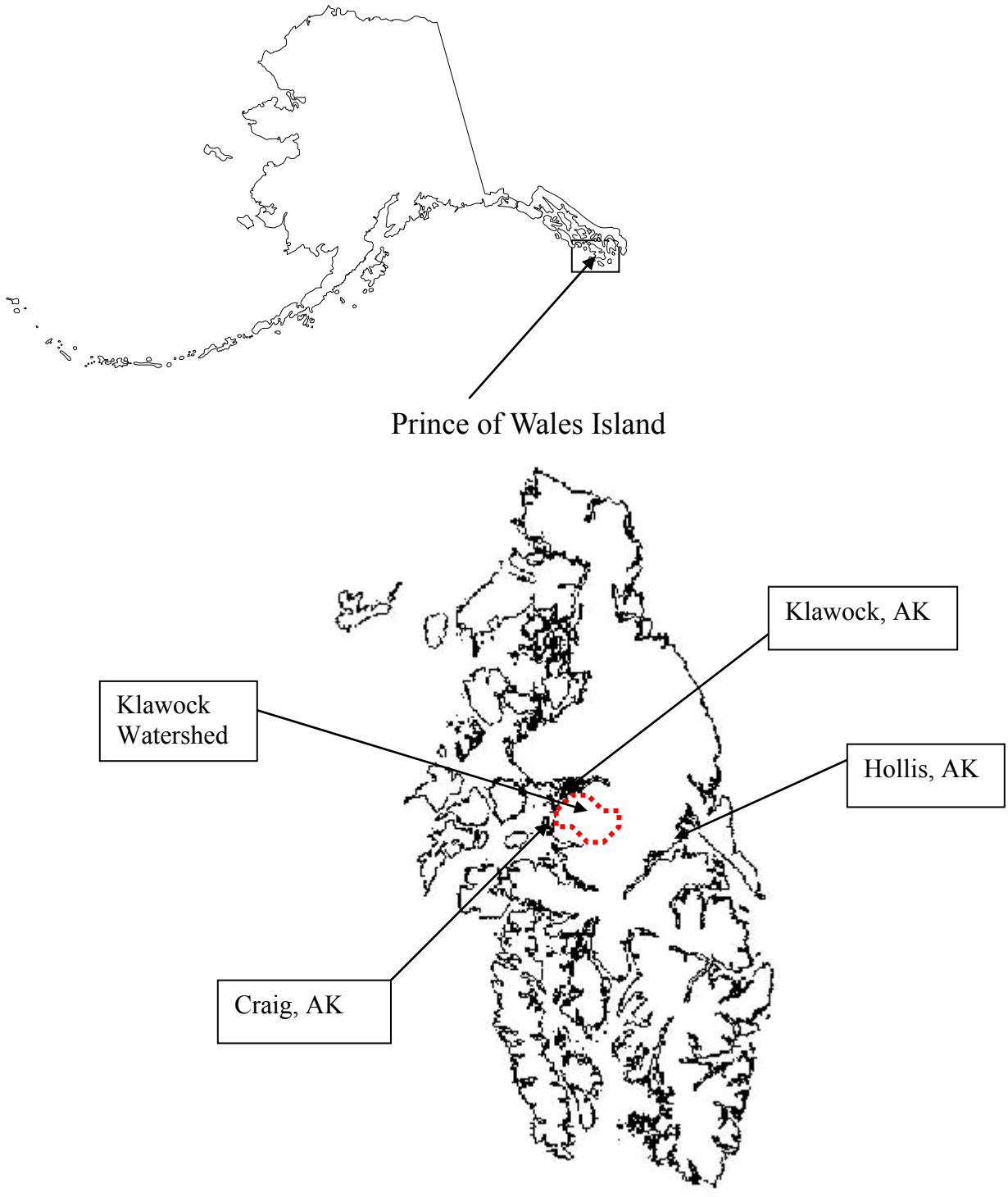


Figure 1. Location of Klawock Watershed on Prince of Wales Island.

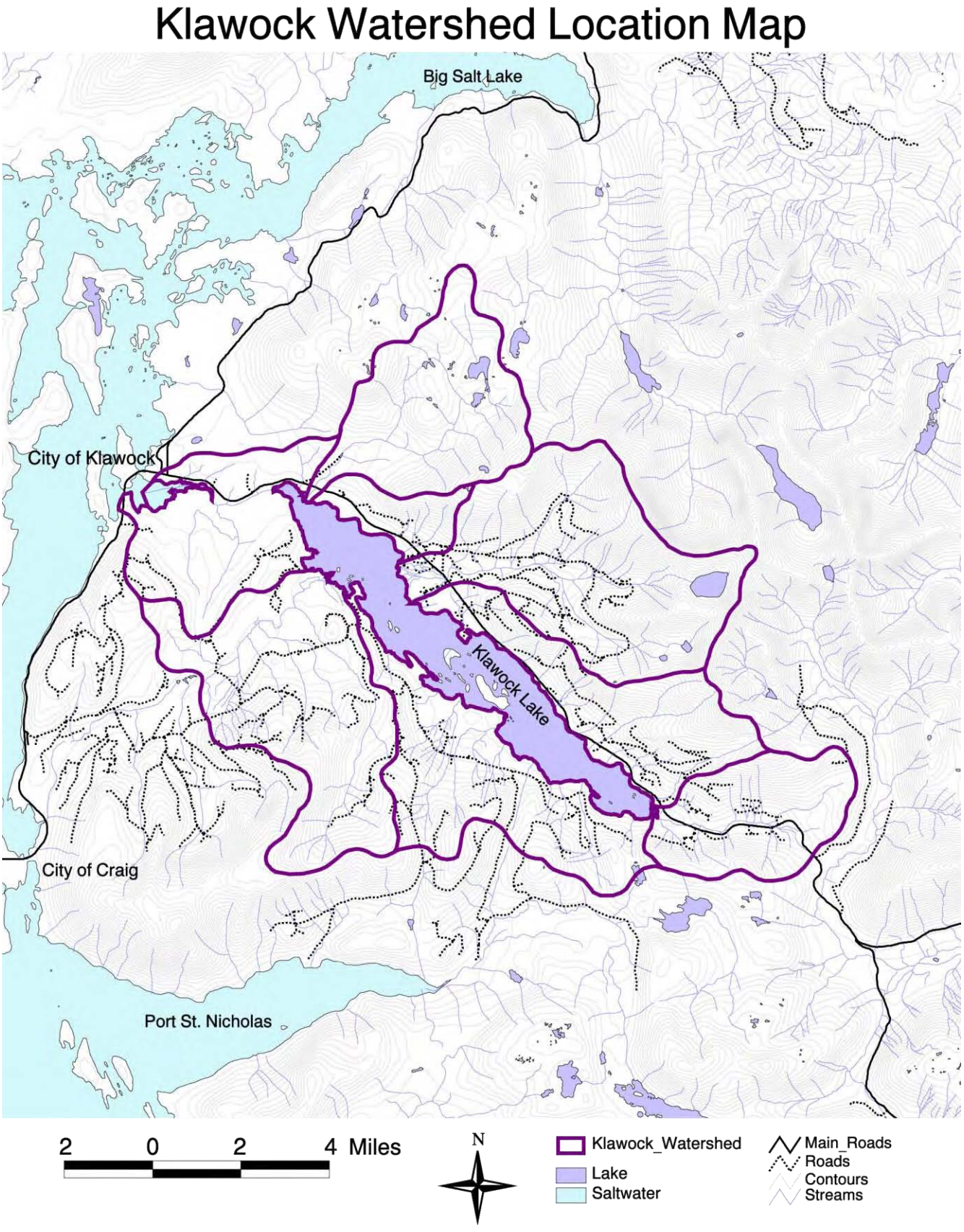


Figure 2. Klawock Watershed Location Map

Project Area Description

Location

The Klawock Watershed is located in southern Southeast Alaska on the west coast of Prince of Wales Island about 35 air miles west of Ketchikan. It is a small coastal watershed approximately 29,061 acres in size. At its center is 2,800-acre Klawock Lake. The Klawock River begins at the lake outlet on its western end, and flows about a mile to Klawock Harbor. The Klawock-Hollis Highway bisects the Klawock Watershed and connects the communities on the west side of the Prince of Wales Island to the Alaska State Ferry terminal in Hollis. The community of Klawock is located around Klawock Harbor and the estuary at the mouth of the Klawock River.

Ownership/Land Management/Uses

Ownership of the Klawock Watershed is mixed; the Forest Service manages approximately 8,118 acres of ridges and mountains north and east of the lake. Three different Native corporations manage the majority of remaining lands along with private lot-owners and the City of Klawock. (Figure 3, Table 1). Klawock-Heenya, Inc. (KHC) owns the majority of private land in the watershed; their lands are concentrated in the eastern portion the watershed. Shaan Seet, Inc. (SSI) manages land southeast of the lake; Sealaska, Inc. owns a small section of land in Half-mile Creek Sub-basin.

Table 1. Land/Water Ownership (management) in the Klawock Watershed.

Landowner	Total Acres	% of Total
Federal Lands		
USFS	8,118	28%
State Lands (Klawock Lake)	2,793	10%
Private Lands		
Klawock Heenya, Inc.	13,118	45%
Shaan Seet, Inc.	4,713	16%
Sealaska Corp.	24	<1%
*Other Private landowners	284	<1%
City of Klawock	11	<1%
Total	29,061	100%

*Numbers reflect best available data. Actual figure is higher.

Primary land use activities in the watershed include timber harvest, road building, land development, and recreation. Half-mile Creek serves as the water supply for the City of Klawock. Three-mile Creek is currently being evaluated as an additional water source.

Physical Features

The Klawock Watershed encompasses approximately 45.5 square miles. Klawock Lake nearly bisects the watershed and neatly divides the drainage into four major sub-basins for watershed assessment purposes (Figure 4). Steep forested slopes on the upper ridges give way to wetland bog complexes in the lower gradient areas. Fen wetlands exist around the lake and river. The watershed is bounded by the Klawock Range (elevation 3,640 feet) in the northeast, an unnamed peak north of Sunnahae Mountain (elevation 2,920 feet) in the south and the Pacific Ocean to the west.

The dominant topographic feature in the watershed is the mountain ridge, the highest on Prince of Wales Island, which borders the north side of the Klawock Watershed. The topography of the watershed is typical of Pleistocene glaciated valleys in the Alexander Archipelago. The major sub-basins in the Klawock Watershed have the typical U-shape with broad, relatively flat bottoms and steep sideslopes, which are topped by broad, rounded mountain ridges. Hanging side valleys, which contain cirque lakes or steep gradient mountain tributaries with numerous falls are common. Elevations range from sea level to

3,800 feet on the summit of an unnamed peak in Klawock Range, mountain ridges in the area average about 1,800 to 3,000 feet high.

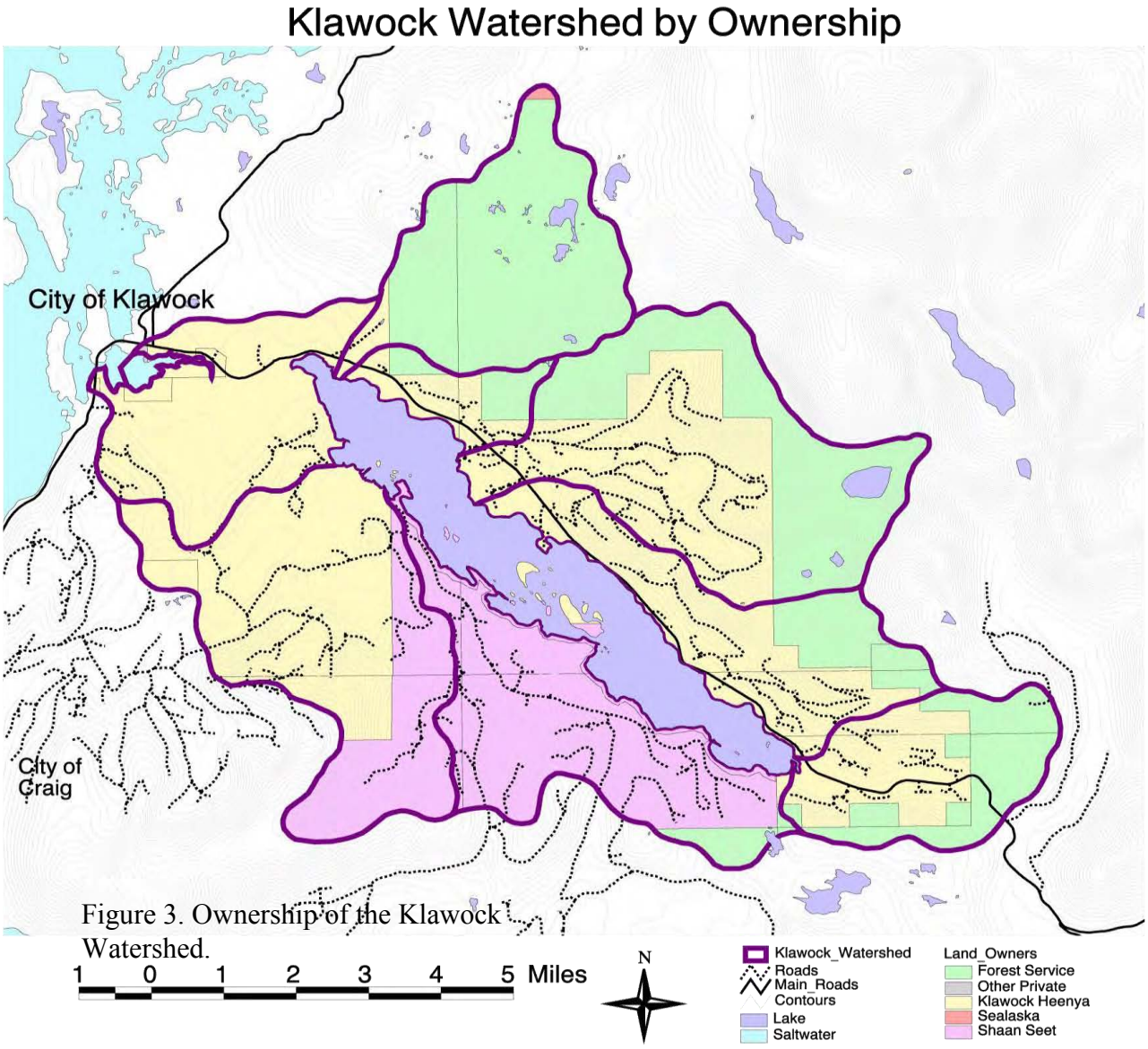


Figure 3. Ownership of the Klawock Watershed.

Figure 3. Klawock Watershed by major ownership.

Table 2. Summarization of major sub-basin features in the Klawock Watershed.

Sub-basin	Half-mile	Three-mile	Inlet	Hatchery	Klawock River	N.E	S.E	Watershed Total
Feature								
Acres	3,361	5,217	2,375	4,890	2,993	3,782	3,642	29,152
Wetlands	2,540	1,894	624	1,983	N/A	N/A	N/A	13,725
Streams	14	29	13.3	26.8	8.4	17.4	23	132*
Floodplains and Alluvial Fans	154	410	169	409	N/A	N/A	N/A	N/A
Lakes / Ponds	70	97.7	0.1	0	N/A	N/A	N/A	N/A
**Harvest	32	1,768	388	1,597	N/A	N/A	N/A	N/A
Roads	0.6	17.9	8.4	16.2	11.5	23.6	18.1	96.3

*Does not include all Class IV streams, **low estimate, actual numbers considerably higher.

Hydrology

The Klawock Watershed is comprised of four (3rd order or greater) major sub-basins (Figure 4). Half-mile Creek, Three-mile Creek, Hatchery Creek, and an unnamed stream draining into the east end of the lake (hereafter referred to as Inlet Creek) comprise 60 percent of the total land base. The remaining watershed acreage is comprised of minor watersheds (mostly 2nd order or smaller). These systems were combined into three composite sub-basins to facilitate analysis: Klawock River, Northeast and Southeast. The Half-mile and Three-mile Creek Sub-basins lie northeast of Klawock Lake and drain directly into Klawock Lake. The Hatchery Creek Sub-basin lies south of Klawock Lake. Inlet Creek drains a small sub-basin at the head of Klawock Lake and forms the east end of the watershed. The Klawock River flows out of Klawock Lake into a 160-acre estuary and into Klawock Bay. Klawock Harbor is outside the physical watershed.

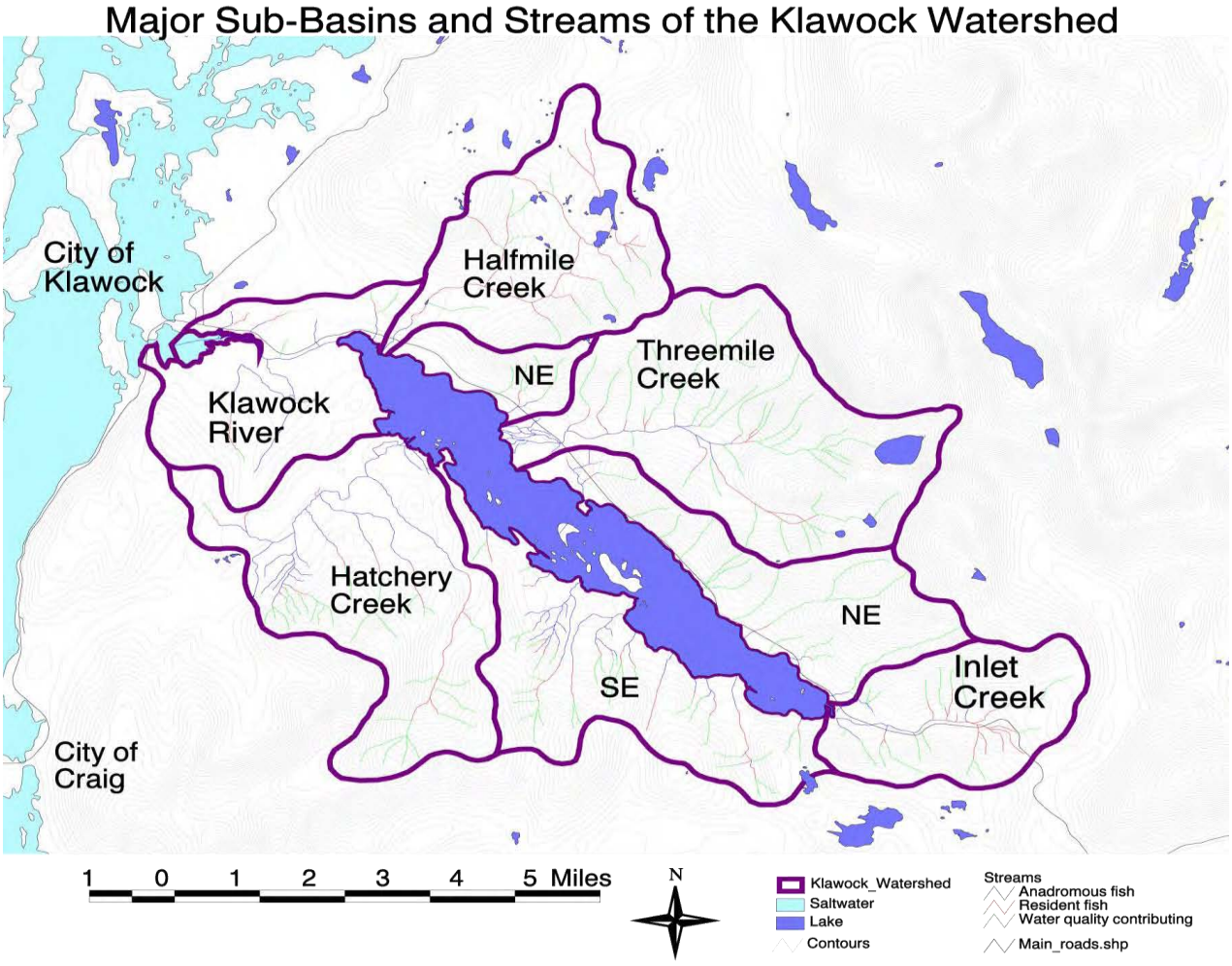


Figure 4. Major sub-basins and streams of the Klawock Watershed

The amount and seasonality of precipitation determines the extent of the stream network and runoff characteristics. At higher elevations in the Three-mile Sub-basin, more of the precipitation falls as snow and is stored for longer periods than at the lower elevations of the Hatchery Creek Sub-basin. Runoff varies greatly, depending upon the time of year. Spring snowmelt contributes to increased runoff between April and June. In some streams, spring runoff can often approach fall runoff levels, which generally is the period of highest stream flows. Two relatively low flow periods are characteristic of these systems. The first occurs between January and March during periods of snow accumulation and low temperatures, and the second is during mid-July to August, a period of relatively low precipitation.

Water quantity/quality data for the Klawock Watershed is limited. Average annual precipitation in the Klawock Lake area is approximately 120 inches (USDA Forest Service, 1978). The USGS collected discharge records for the Klawock River for water year 1977 (October 1976 through September 1977). Records from this period indicate a maximum discharge in November of 4010 ft^3/s (114 m^3/s) and a minimum discharge of 51 ft^3/s (1.44 m^3/s) in August (http://waterdata.usgs.gov/nwis-w/AK). Stream temperatures ranged from a maximum of 21.0^{0}C in August and a minimum of 2.0^{0}C in January.

Water quality data was gathered by the USGS for Klawock Lake on June 15 and July 12, 1977. Forty-three parameters were measured; all fell within current state water quality standards. Specific values for parameters measured can be found in the USGS water data report (USGS, 1978). The City of Klawock is currently gathering discharge and some water quality information at Three-mile Creek. This information will be used to assess the availability of water for municipal use. The Alaska Dept. of Fish and Game recently completed a broader biological study of Klawock Lake that included extensive limnological data (Lewis and Zedina, 2002).

Potential Effects of Timber Harvest on Streams

Timber harvest alters basin hydrology because it affects transpiration, interception and evaporation of rainfall, snow accumulation and melt, and soil structure and resultant water infiltration and subsurface transmission rates (MacDonald, 1991). Generally, the greater the percent of the watershed harvested, the greater the effects on stream flow. A study of the response of the Maybeso Watershed showed no significant changes in stream flow when 25 percent of the basin was harvested (James 1956, Meehan et al. 1969). An analysis of the Staney Creek basin showed increases in mean and summer low flow when harvest reached 20 to 25 percent of the basin area (Bartos, 1989 and Neal, 2000). This *could be* a beneficial impact since the low flow periods may show an increase in stream flow. It should also be noted that changes in stream flow would be less than the annual changes in stream flow due to natural variability of the system. Rainfall data for Craig, Alaska shows that in the last five years rainfall has varied from a low of 78 inches in 1996, to a high of 135 inches in 1999.

Conversely, vigorous second-growth stands can theoretically increase evapotranspiration rates and reduce streamflow. Low flows following timber harvest have been identified as possibly causing or exacerbating fish kills during periods of drought when streamflow is low and large numbers of adult salmon are returning to spawn. The direct cause of death of these adult spawning salmon is typically low oxygen levels caused by large numbers of fish in a smaller volume of water, combined with warm temperatures. Increased streamflow would provide bigger pools with more oxygenated water (probably at cooler temperatures) thereby increasing the survival of adult spawning salmon. Low flows also reduce available habitat for resident fish and rearing anadromous fish even when adult salmon are not present. Erosion of streambed gravels can occur when streamflow increases or there is a lack of structure (large woody debris (LWD)) in the streambed. Some of the drainages in the Klawock Watershed have had up to 75 percent to 90 percent of the area harvested in the last 20 years. Harvest of this magnitude may result in higher peak flows and lower low flows. The effects of timber harvest on streamflow would be greatest in the steeper sub-basins northeast of the lake due to more rapid runoff, more sediment production and lack of beaver ponds.

Streamflow may have increased in the Three-mile Creek sub-basin as a result of the 1,768 acres of timber harvest (low estimate) in the 5,217-acre sub-basin; harvest occurred in the late 1980s and early 1990s. Increased sediment load during and after timber harvest (and particularly during the 1993 storm event) would have accentuated high flows. Riparian area harvest on floodplains and alluvial fans has removed some of the large trees that would have fallen in the stream providing large woody debris structure to retain sediment and dissipate stream energy. The lack of sediment retaining LWD could exacerbate the erosion of the gravels caused by high flows. Changes in streamflow may have caused the coarsening of

the streambed noted in the floodplain reach of Three-mile Creek upstream of the road crossing and in many tributaries to Three-mile Creek and smaller streams draining the mountainous terrain northeast of Klawock Lake. Excess sediment from upstream reaches is rapidly burying the available LWD on the Three-mile Creek alluvial fan. Changes in streamflow would likely have less effect on channel morphology in the gentle terrain southwest of the Lake, especially in the Hatchery Creek sub-basin.

Currently, predominate vegetation in the Klawock Watershed consists of less than 15-year old second-growth. Evapotranspiration rates are probably less now than in the old-growth condition, causing more variable flows. Without thinning in young stands (15 to 25 years), the evapotranspiration rates may be more than the old-growth condition, thus causing a reduction in streamflow. Anecdotal evidence in southeast Alaska points to a less-flow-in-older-second-growth conclusion. However, the literature does not include studies of sufficient length to support this hypothesis. Large-scale timber harvest in southeast Alaska did not begin until the 1960s, so most second-growth is less than 40 years old. Future studies will prove or disprove this hypothesis. The Watershed Assessment Team (WAT) does not believe changes in low flows have been severe enough to affect spawning salmon survival. The WAT is not aware of any fish kills in Klawock Watershed streams. The Klawock system may be somewhat unique in that the 2,800 acre Klawock Lake is immediately downstream of some of the best spawning habitat in the watershed. Klawock Lake and the lower reaches of large tributaries may act as a refugium for spawning salmon during periods of low flow.

Changes in streamflow over time have probably occurred (based on PFC team observations). The factors affecting streamflow can be attenuated somewhat by thinning the second-growth at appropriate times, and with the recovery of vegetation in the riparian areas. Influxes of large wood similar to preharvest conditions cannot be expected until large wood is again present in the riparian areas that were harvested. Strategic placement of LWD where appropriate may facilitate this process.

Channel Condition Assessments (CCAs) are detailed surveys of small floodplain reaches that measure change in channel condition. CCAs are re-measured on a regular basis to establish consistency in measurements and to identify change. CCAs have been established in unmanaged watersheds and in managed watersheds. Comparisons across the forest indicate that three parameters are statistically different in managed watersheds. In managed watersheds, pool frequency and pool depth are typically less, and median grain size is larger. Although no CCA sites exist in the Klawock Watershed, the PFC team identified some of these characteristics in responding to questions on the lotic (stream) checklist. No appropriate CCA sites were identified in the watershed.

Analysis of pre and post harvest aerial photos indicates a recent increase in the number of beaver ponds in the watershed. This perceived increase has resulted from timber harvest and the additional beaver ponds may be moderating high and low flow events. Beaver have taken advantage of an increase in disturbance species (e.g. red alder) following disturbance. Timber harvest has caused disturbance on alluvial fans and floodplains where the organic soil mat is naturally thin. Alders compete well where mineral soil is exposed. The result is that beaver have converted some floodplain and alluvial fan reaches to palustrine reaches, thus reducing the amount of available spawning habitat. These slow moving ponded reaches have the ability to moderate streamflow and trap smaller size classes of bedload. These ponds may be starving the downstream floodplain and alluvial fan reaches of fresh bedload. This may also negatively affect valuable salmon habitat. This phenomenon warrants further evaluation.

The entire effect of beaver in the Klawock watershed is poorly understood. Some small streams on the southwest side of the lake have had almost all of the available spawning gravel converted to beaver ponds, i.e., floodplain to palustrine channel types. Examples of this are mainstem Hatchery, Swamp, Chutes and Ladders, Deadhead and Alder Creeks. Beaver have had less influence on streamflow and habitat in the higher-gradient sub-basins on the northeast side of the lake.

Geology, Geomorphology, and Soils

Geology is the foundation of terrestrial ecosystems. Combined with precipitation, the geology of an area will determine the quality of fish habitat, while precipitation will determine the extent of fish habitat. Glacial ice acting on severely foliated volcanic and sedimentary rock has shaped the Klawock Watershed.

In the Half-mile Creek Sub-basin, ice was relatively thick, flattening and rounding the rocks and leaving fairly thick deposits of till. The till and the smooth, gently sloping bedrock limits soil drainage and allow organic matter to accumulate. The soils in this area support large areas of muskegs and forested wetlands. In the upper Half-mile Sub-basin, streams have downcut through the till deposits and most streams are bedrock controlled. Streams of this type fall into the Moderate Contained or Large Contained Process group. Stream process groups are discussed on page 14.

In the Three-mile Creek Sub-basin, glacial ice scoured the landscape leaving steep valley slopes and cirque basins in hanging valleys. Elevations reach 3,800 feet in upper Three-mile, and the well-drained soils on the steep slopes are somewhat erosive. Most channels in the Three-mile Sub-basin belong to the High Gradient Contained Process group. Deposition of soil material eroded from the steep slopes occurs in a 152-acre alluvial fan/delta at the mouth of Three-mile Creek in Klawock Lake. Due to steep slopes and volcanic bedrock, soils in Three-mile Sub-basin are well drained and support hemlock and spruce forests.

In the Hatchery Creek Sub-basin, ice was thicker than in other parts of the Klawock Watershed. As a result, the area was more heavily eroded, and therefore the slopes not as steep. The valley is broad and till filled. Soils developed over the till are mostly poorly drained and support forested wetlands and muskegs. Karst terrain has developed in a limestone ridge in the southwest portion of the sub-basin. Soils on the karst and steeper slopes are well drained and support hemlock and spruce forests. Elevations reach up to 2,900 feet, but the dominant feature in the sub-basin is the broad, low valley. Erosion potential in this sub-basin is low when compared to Three-mile Creek. Stream channels are formed in till and alluvium. Most channels in Hatchery Creek belong to the Floodplain and Palustrine process groups. Beaver ponds have reshaped the Floodplain and Palustrine channels making the stream slow and placid. Sediment deposition occurs in the beaver ponds.

The geology and geomorphology of Inlet Creek Sub-basin is similar to Three-mile Sub-basin with one exception: conglomerate bedrock underlies the southeast side of this basin. Valley glaciation left steep slopes and exposed cliffs. Where the conglomerate bedrock is exposed to weathering, large boulders have calved off the cliffs and are deposited at the base of the slope. Examples of conglomerate boulders and cliffs can be seen in the harvested areas south of the highway, east of Klawock Lake. Most streams in the Inlet Creek Sub-basin belong to the High Gradient Contained Process group, and deposition occurs in a narrow floodplain in the valley bottom.

Wind Processes and Disturbance Regimes

Wind is a major disturbance factor in Southeast Alaska, altering the structure of the forest. Temperate rainforests are highly susceptible to wind damage because of the combination of shallow root systems, poorly drained soils, and high winds when they occur during peak rain events. The most common disturbance is blowdown of a single tree or small group of trees. Scattered windthrow of large over-mature trees is a prime cause of mortality and creates small openings in which the advance growth in the understory may develop.

Over 80 percent of the gale-force winds reported between the years 1953 and 1978, were from the south or southeast. Gale-force winds occur during every month of the year and come from all directions. However, the vast majority of gale-force winds come out of the southeast and occur during the fall and winter months when heavy rains have saturated the soils.

High wind events are a natural process in the Klawock Watershed. Disturbance along stream riparian areas is a primary source for instream large woody debris, in unaltered systems. Windthrow along stream riparian areas is a primary source for instream large woody debris, and maintains and creates fish habitat in systems that have been intensively managed. However, management activities such as clearcuts, roads, and selective harvesting within buffers can greatly increase the rate of blowdown along a stream and negatively impact future stream habitat conditions. Windthrow has significantly compromised stream buffers in the Klawock Watershed.

Wetlands

Approximately 37 percent (10,760 acres) of the Klawock Watershed is classified as wetland. At least nine different types of wetlands are found within the Klawock Watershed. Each wetland type has different soil and vegetative communities, occupy different landscape positions, and have somewhat different functions and values. The most common wetland types found in the Klawock Watershed are the Forested Wetland, Alpine Meadow, and Emergent Short Sedge. The various wetland types within the project area are shown in Table 3. Refer to Appendix D for a description of wetland types.

Table 3. Wetland Habitat types in the Klawock Watershed.

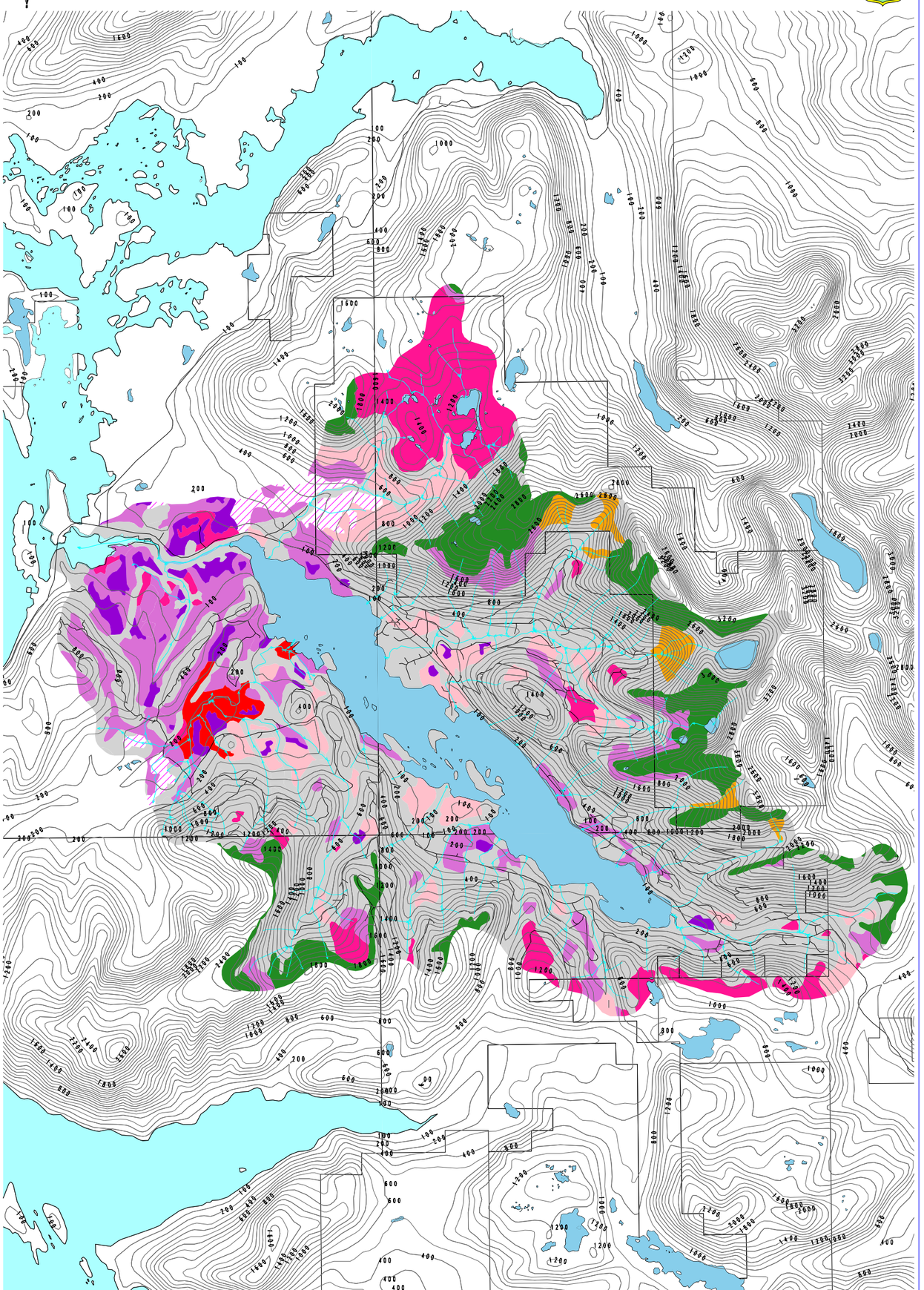
Wetland Habitat Type	Total Acres in Watershed	Percent of Watershed Acres
Forested Wetland (FW)	3,264	11%
Alpine Meadow (AM)	2,425	8%
Emergent Short Sedge (EM)	2,128	7%
Forested Wetland/Emergent Sedge Complex (FES)	1,621	6%
Sphagnum Moss/ True Bogs (MP)	604	2%
Forested Wetland/Moss Muskeg (FSS)	428	2%
Tall Sedge Fens (MT)	290	1%
*Estuary	160	N/A*
*Riverine	35	N/A*
Lakes and Ponds (Deepwater Habitats)	2,965	10%
Total Wetland Acres	**13,725**	**47%**
Upland Acres	15,425	53%
Total Watershed acres	**29,152**	**100%**

*Acres of Estuarine and Riverine wetlands are not included in the total acres of wetlands. These areas are below the mean high tide line where terrestrial inventories end. The Estuary includes the entire body of water between the mouth of the Klawock River and the highway.

Wetlands have physical, biological, and socio-economic importance. Physically, wetlands are important for flood conveyance, surface and groundwater regulation, sediment collection and temperature moderation. Wetlands also function to store nutrients and carbon, and to moderate pH. Biologically, they provide diversity and habitat for terrestrial, aquatic and marine wildlife and plant species. The socio-economic benefits derived from wetlands include wildlife viewing and harvest, commercial, subsistence, and sport fishing (critical salmon habitat provided by wetlands, estuaries, streams, and lakes), development sites (for example, buildings and roads), community water supplies, actual and potential recreation, and timber harvesting.

The biological significance of a wetland is related to the value of its functions, and, at least in part, to the relative scarcity of the wetland type in the landscape. This is especially true in terms of biological diversity on the landscape scale. The relatively scarce fens, true bogs and estuarine salt marshes in the Klawock Watershed have a greater biological significance than the more common bogs and forested wetlands that are widespread throughout the landscape. The results of the Lentic PFC assessments are included in the PFC results section.

Wetlands Types of the Klawock Watershed



Saltwater

AM Alpine Shrubland/ Emergenl Muskeg

EM Emergenl Short Sedge Wetland

FES Ford Wet/Emrgt Sedge Wet Complex < 50% Ford

FIA Ford Wet-Non-For Non-Wet Complex

FNW Ford Non-Wetland

R > 50% For Rocklands

FSS Ford Wet/Moss Muskeg Cplx

FW Forested Wetland

LA Lakes and Ponds

MP Moss Muskeg (Sphagum Peat)

MT Emergent TallSedge Muskeg

Freshwater

Existing Roads

Streams

100-ft Contours

Mapscale 1:78400 (0.9 Inch to Mile)
Created by Sally Warfield on 25 Feb 00 14:42:56 Friday /tsfiles/rel/library/gis/work3/klawock/plots/klawwb21tx

Floodplains and Alluvial fans

Floodplains and alluvial fans are important, in part, because they provide high value fish and wildlife habitat. Floodplains and alluvial fans are essential spawning areas, and floodplains often include smaller side channels that provide rearing habitat for salmon fry. Wildlife use floodplains for forage and travel corridors. The floodplain and alluvial fan soils typically support high volume spruce stands. Both landforms are also highly susceptible to impacts due to landform. Approximately 2,179 acres of floodplains and alluvial fans have been mapped in the Klawock Watershed.

The major floodplains in the Klawock Watershed are located near the mouth of Hatchery Creek, on Inlet Creek, and on Three-mile Creek upstream of the highway. There are also several large floodplains located in the S.E portion of the watershed mainly in Swamp and Chutes and Ladders Creeks. Deltas form where alluvial fans and floodplains discharge into standing water, such as a lake or ocean. The floodplain at the mouth of Hatchery Creek and the alluvial fans at the mouths of Three-mile and Half-mile Creeks have some characteristics of a delta.

Photo 1. Three-mile Creek alluvial fan, pre-harvest 1971. Photo 2. Three-mile Creek alluvial fan, post-harvest 1991. Notice extensive ponding on the north side of the alluvial fan.

Streams: Channel Types, Process Groups, and Stream Classes

Categorizing streams by channel types and process groups allows characterization and comparison of channel features and functions. For the purposes of inventory and assessment, streams were categorized into different process groups in accordance with the Tongass National Forest Channel Type Classification system (USDA Forest Service, 1992). The Tongass National Forest channel typing method was applied so that information would be consistent between State, Private and Public lands within the Klawock Watershed.

Process groups are designated based on similar stream characteristics. Within these process groups are individual channel types, which provide more specific characteristics of a stream channel. The Watershed Assessment Team used Tier 1 inventories and aerial photographs to validate and inventory channel type in the watershed.

Individual channel type classification units are defined by physical attributes, such as channel gradient, channel pattern, stream bank incision and containment, and riparian plant community composition. Stream channel substrate, gradient, large woody debris, sideslope characteristics, and riparian vegetation influence stream channel stability, sensitivity to disturbances, and sediment transport. Features of similar process groups are:

Floodplain (FP) and Palustrine (PA) process groups

- Low-gradient channels with low stream energy, which store fine sediment.
- Variable stability. Stream channels are generally sensitive to disturbance.
- High quality fish habitat.

Alluvial Fan (AF) process group

- Low to moderate gradient channels which periodically store and transport large quantities of sediment.
- Stability depends on large woody debris. Stream channels periodically change course.
- Lower gradients and large woody debris support fish habitat.

Moderate Gradient Mixed Control (MM), Moderate Gradient Contained (MC) and Large Contained (LC) process groups.

- Streams readily transport sediment.
- Stability depends on bedrock, riparian vegetation or large woody debris.
- Often good quality fish habitat.

High Gradient Contained (HC) process group

- Bedrock frequently provides channel stability, but adjacent sideslopes are often unstable.
- Large woody debris may store sediment, but may also form debris jams and initiate channel-scouring debris torrents.
- Limited fish habitat.

Estuarine (ES) process groups

- Depositional channels subject to tidal influence.
- Gravel, sand bars, and large woody debris are common features.
- High quality fish habitat.

The Klawock Watershed contains a range of channel types mostly in the High Gradient Contained, Floodplain, Moderate Gradient Contained, Moderate Gradient Mixed Control, and Palustrine process groups. A small amount of the Estuarine, Large Gradient Contained, and Alluvial Fan process groups are also included. Table 4 displays the distribution of process groups by sub-basin within the Watershed.

Table 4. Miles of Stream by Process Group for Sub-basins in the Klawock Watershed.

Process Group/ Miles of Stream	**Half-mile**	**Three-mile**	**Hatchery**	**Inlet**	**Klawock River**	**Northeast**	**Southeast**
Estuarine (ES)	0	0	0	0	0.7	0	0
Palustrine (PA)	0.1	0	7.4	0.3	1.0	0.3	1.4
Floodplain (FP)	0.4	0.3	2.9	3.2	3.2	0.7	4.6
Alluvial Fan (AF)	0	3.4	0.8	0.1	0	2.5	0.6
Large Contained (LC)	0	0	0	0	0.5	0.1	0
Moderate Gradient Mixed Control (MM)	0.5	2.4	1.9	0.7	1.4	1.1	1.7
Moderate Gradient Contained (MC)	3.5	0.7	1.6	1.3	1.1	0.1	0.5
High Gradient Channel (HC)	9.5	22.1	12.2	7.8	0.4	12.7	14.2
***Total miles**	**13.9**	**29**	**26.8**	**13.3**	**8.4**	**17.4**	**23**

*This figure dos not include all Class IV streams.

Stream Classification

Stream classification systems are used to categorize streams based on fish production values (Table 4). The State of Alaska and the Tongass National Forest use different stream classification systems. The Tongass National Forest stream classification system was applied for this project (USFS, 1992). Stream class definitions are as follows:

- **Class I**
  Streams with anadromous fish.
- **Class II**
  Streams with resident fish populations. In the Klawock watershed these streams are often barriered to anadromous fish passage by waterfalls but include short reaches of streams too steep for anadromous fish but not for resident fish.
- **Class III**
  Perennial and intermittent streams with no fish populations, but which have an immediate influence on downstream water quality or fish habitat capability.
- **Class IV**
  Other intermittent, ephemeral, and small perennial channels with insufficient flow or sediment transport capabilities to have an immediate influence on downstream water quality or fish habitat capability. These streams generally are shallowly incised into the surrounding hillslope. These streams are small and generally not included on stream maps.

Table 5. Total miles of mapped streams by stream class in the Klawock Watershed.

Stream Class	Miles
Class I	32
Class II	23.3
Class III	65
Class IV	11.7
****Total Stream Miles**	**132**

**Total does not include all Class IV streams.

Lakes

There are a total of 2,965 surface acres of lakes and ponds within the Klawock Watershed; the centerpiece is 2,800-acre Klawock Lake which is connected to saltwater via the Klawock River. Klawock Lake has an elevation of less than 100 feet above sea level. Sockeye, silver, chum and pink salmon use the lake, and spawn in the lake margins and streams draining into the lake.

Smaller lakes are scattered throughout the Klawock Watershed. Numerous ponds are located in the upper Half-mile Creek and lower Hatchery Creek sub-basins. Three-mile Creek Sub-basin contains three larger sub-alpine lakes totaling 98 acres. A small impoundment (~1 acre) maintained by the City of Klawock is located on lower Half-mile Creek.

Fish Habitat and Distribution

Fish Habitat

Existing information on fisheries habitat was limited. The Alaska Department of Fish and Game (ADFG) constructed maps of major streams (main stem Half-mile, Three-mile, Inlet, the stream north of Inlet Creek —Bluewater", and Hatchery Creek) in the watershed in 1977 and documented them in the anadromous stream catalog. Smaller fish bearing streams are not documented in the catalog.

As part of this assessment, field personnel surveyed the watershed for fisheries habitat during the summer of 1999 and 2000 to verify presence of resident and anadromous fish and their respective habitat. The

Tongass National Forest Tier 1 stream survey was conducted on approximately 90 percent of fish bearing streams in the Klawock Watershed (see page 17 for an explanation of Tier 1 survey procedures). A total of 132 miles of stream were inventoried and mapped in a GIS for the Klawock Watershed.

Fisheries

Streams in the Klawock Watershed contain important anadromous and resident fish habitats. The streams support four species of anadromous salmon: pink (*Oncorhynchus gorbuscha)*; chum (*Oncorhynchus keta);* sockeye (*Oncorhynchus nerka)*; and coho (*Oncorhynchus kisutch*); as well as resident coastal cutthroat trout *Oncorhynchus clarki*; rainbow/steelhead trout (*Oncorhynchus mykiss)*; and Dolly Varden char (*Salvelinus malma)* (ADFG Anadromous Stream Catalog, 1993).

These fish species are important to the subsistence, sport and commercial fisheries of the region, and are a major food source for some wildlife species. Subsistence and sport fishing use of fish species produced in Klawock Watershed is high; Klawock River sockeye are of paramount importance to local residents. The Klawock River is a popular sport fishing stream for locals and visitors. Sport fishing, boat recreation and lakeshore recreation occur in Klawock Lake. The target species in the lake are primarily coastal cutthroat trout, rainbow trout, and Dolly Varden char. Salmon produced within the watershed contribute to commercial and subsistence fisheries (seine, troll, and drift gillnet).

All of the major streams in the Klawock Watershed support salmon. ADFG does not regularly conduct surveys of tributary streams. Spawning surveys should be conducted as part of a biological assessment and continued as a monitoring tool. Three-mile and Hatchery Creek (T2 and T3) contain significant spawning and rearing habitat for coho, pink, steelhead, and sockeye salmon. Combined, these two systems contribute almost 50 percent (17.8 miles) of total salmonid habitat in the watershed. Only 0.6 miles of Half-mile Creek and 2.6 miles of the Inlet Creek sub-basin are accessible to salmon. The majority of pink salmon spawn in the Klawock River. Within the composite sub-basins, several smaller 3rd and 2nd order streams flowing into Klawock Lake support fish runs. Cumulatively, these streams contribute a significant amount of additional fish habitat in the watershed. The Chutes and Ladders and Swamp Creek systems in the S.E. sub-basin contribute over 5 miles of anadromous habitat to the Klawock System.

Some of the key spawning areas in addition to those listed above include: Klawock River and tributary 1, Alder, Salmon Salad, TR6, 7-mile (Non-Functional), and Bluewater Creeks. The available spawning area in Deadhead, Swamp, Chutes and Ladders, and Hatchery Creeks has been decreased by significant recent beaver pond development.

A privately owned salmon hatchery is located along the upper end of Klawock River. The Prince of Wales Hatchery currently raises coho, sockeye, and steelhead from broodstock obtained from the Klawock system. A weir at the hatchery provides a means of estimating escapement in the Klawock system. Since 1986, sockeye returns have been below the Alaska Department of Fish and Game‘s escapement goal of 10,000 adults to Klawock Lake. Historically, Klawock Lake supported large numbers of sockeye salmon. From 1886 through 1896 annual harvest of over 80,000 fish were reported (Sockeye Conference, 1999).

A majority of years, from 1887 until 1950, saw sockeye harvests of over 30,000 fish. After about 1960, combined escapement counts and subsistence harvest never exceeded 20,000 sockeye and only exceeded 10,000 (escapement goal) in six years. This documented decline in sockeye escapement and harvest is a primary cause of concern expressed by local residents.

ADFG conducted escapement counts for many years using weirs and aerial counts. The peak pink salmon count occurred in 1930 when 1,407,000 pink salmon were counted at a weir. The average pink salmon escapement count since 1960 has been around 50,000 fish. The Klawock River pink salmon run appears

healthy, as are most pink salmon runs in Southeast. Chum salmon counts ranged from 0 to 350,000 with an average of around 5,000. The hatchery initially concentrated on raising chum salmon but no longer works with this species. Coho salmon escapements were most accurately enumerated by counting coho passing the hatchery weir. The highest documented coho escapement was 17,000 fish in 1959 (Sockeye Conference, 1999). The average escapement count for coho has been around 3,700 fish, but most counts appear to be of only a portion of the run. Coho production has been emphasized by the hatchery through most of its period of operation. Steelhead escapements are largely unknown but likely around 500 fish. A 2002 ADFG report summarizes historic stock assessment and enhancement activities for the watershed (Lewis and Zedina, 2002).

Assessment Methods

Tier 1 Survey Methods

The Tier 1 survey is a reconnaissance level survey. The primary focus is to update the stream database spatial coverage. This improved coverage will provide information necessary to establish site-specific management recommendations and to facilitate implementation of riparian management prescriptions associated with channel type process groups. The survey also assists in identifying areas or concerns that warrant special consideration (off-channel habitat, spawning gravel, depositional areas or debris loading at road crossing sites, historical windthrow, average tree height and spacing, unstable slopes, presence and direction of blow-down, temperature concerns, fish passage needs, etc.).

The Tier 1 survey includes the following measurements or observations:

1. Verify or identify channel type at least to process group.
2. Add previously unmapped streams to the GIS spatial database.
3. Verify or identify fish value class as I, II, III, or IV (USDA, 1997b).
4. Note management concerns or issues.
5. Describe channel morphology: record gradient, bankfull width, bankfull maximum depth (optional), incision depth, and dominant (median) substrate class.
6. Record fish presence/absence, and record fish barrier data.

Tier I surveys were conducted in 90 percent of fish bearing streams in the watershed during the 1999 and 2000 field season. Most of the above information is included in Appendix B.

Proper Functioning Condition Assessment Methods

The Proper Functioning Condition assessment involves using a standard checklist to consistently assess the hydrology, soils and vegetation of riparian areas. The checklist and its summarization are used to classify the health or state of physical processes of the riparian-wetland area. The PFC assessment method was chosen because it could provide a quick and defensible method for assessing riparian and stream channel condition. Because the issues identified focused on fish, emphasis was placed on lotic (stream) environments. The PFC assessment for lentic (wetlands and standing water) systems was conducted in 2000. Experts from the National Riparian Service Team visited the project area, trained personnel, and assisted with project planning. A more detailed explanation of the PFC assessment methods and example of the checklist can be found in Appendix A.

Prior to conducting a PFC assessment, the watershed assessment team reviewed stream, soil, geology, timber harvest, road maps, and aerial photos to delineate each stream into reaches. The team also used maps and aerial photos to prioritize work by sub-basin. Once adequate baseline information was collected, the PFC team could accurately delineate and stratify stream reaches and wetland polygons for sampling and analysis. Assessment efforts were concentrated on the four major sub-basins, which make up 60 percent of the total land base: Half-mile Creek; Three-mile Creek; Hatchery Creek; and Inlet Creek. The assessment was expanded in 2000 to include all fish bearing streams in the watershed.

PFC Assessment Results

Lotic PFC Results

Stream PFC assessment was conducted on 9.5 miles of stream in 1999 and on 73 miles in 2000. The assessment was conducted on 100 percent of fish bearing and many Class III streams in the watershed (Figure 6). These Class III headwater channels were evaluated because of their proximity and influence to the target sub-basins. PFC assessment results are mixed; the aggregate rating for Half-mile Creek is Proper Functioning Condition. The more heavily managed Three-mile Creek Sub-basin is rated Functional at Risk due to several factors: lack of LWD (LWD dependent system); inadequate riparian buffers for channel maintenance and recovery; landslide impacts (excessive erosion and/or deposition). In 2000, a PFC assessment was conducted on the remaining streams and wetlands within the priority sub-basins. The aggregate functional rating for Inlet and Hatchery Creeks is PFC. However, there are reaches with Non-Functional (NF) and Functional-At-Risk (FAR) ratings in three of the four major sub-basins: Three-mile, Inlet and Hatchery Creeks. Results for the remaining composite systems are included in Table 6. Stream PFC ratings are described in more detail in the following PFC results by sub-basin section and in Appendix B (Individual Reach Descriptions).

Stream reaches rated PFC and FAR with an upward trend are considered stable and a change in management or restoration is not needed. Streams rated Non-Functional and Functional at Risk--Downward Trend cannot reach their potential without management intervention.

Table 6. Results of PFC analysis in the Klawock Watershed by sub-basin.

PFC Category	Three-mile	Half-mile	Hatchery	Inlet	Klawock River*	NE*	SE*
Miles of Streams	29.0	13.9	26.8	13.3	8.4	17.5	23
Class I and II	9.1	9.9	17.0	6.6	7.7	5	12.8
Percent Sampled Class I and II	100%	100%	100%	100%	100%	100%	100%
Percent Sampled total	33%	100%	69%	62%	93%	52%	73%
Non-functional	2.7	0	1.1	1.8	0	1.7	0
Functional-at-risk with downward trend	4.7	0	2.0	0.6	1.0	2.7	3.2
Functional-at-risk with no apparent trend	0.4	0	0.6	0.45	0	0	5.1
Functional-at-risk with an upward trend	1.1	0	0	0	0.3	0	0
Proper Functioning Condition	0.7	13.9	14.0	5.4	5.9	4.8	8.5
TOTAL MILES Analyzed PFC (82.65)	9.6	13.9	17.7	8.25	7.2	9.2	16.8

* Composite basins, not true sub-basins

Klawock Watershed PFC Assessment 2000

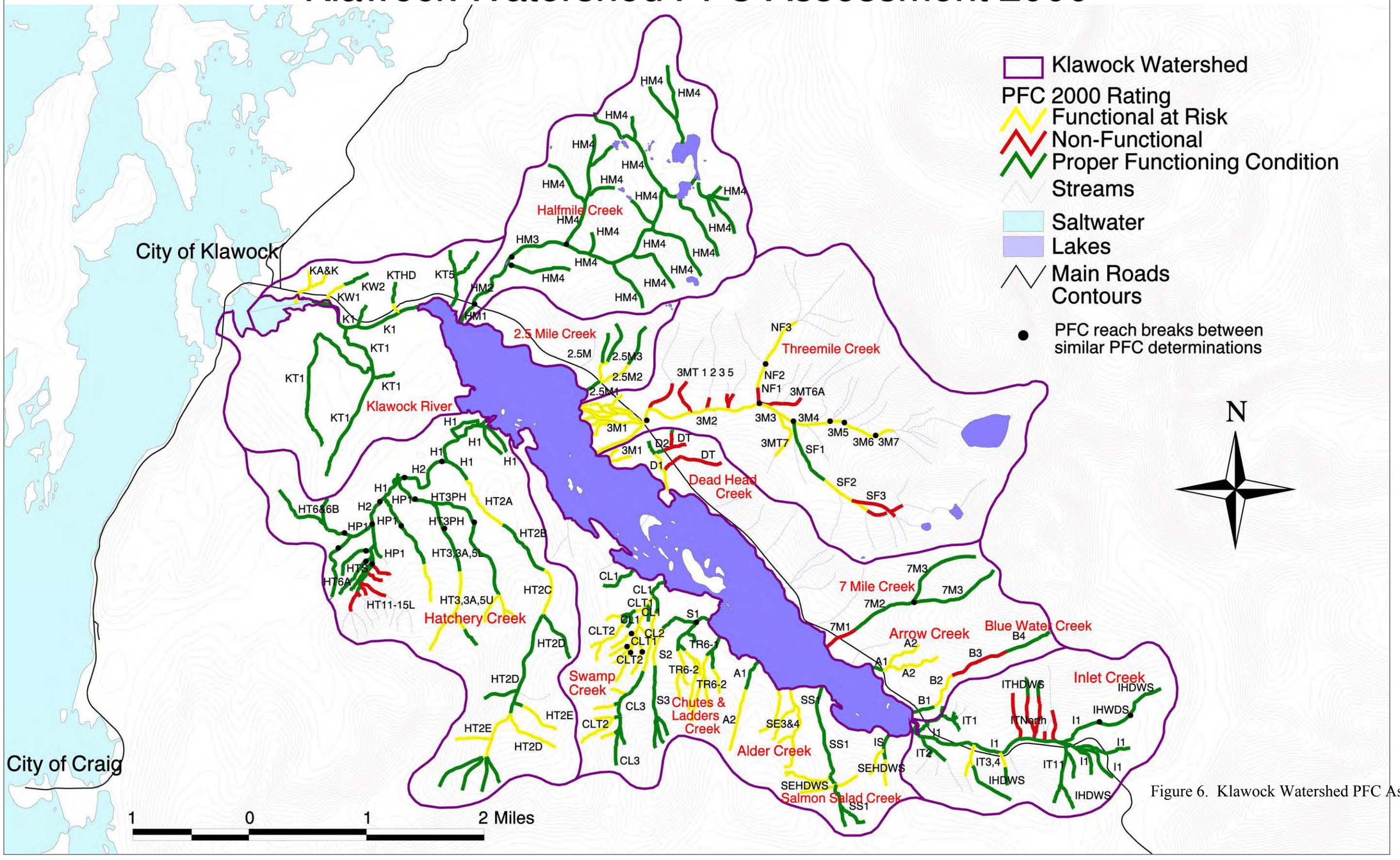


Figure 6. Klawock Watershed PFC Assessment.

Lentic PFC Results

The PFC team field-tested the lentic PFC checklist in the Klawock Watershed during the 2000 field season. The lentic checklist was developed by the National Riparian Service Team and a technical reference (Prichard et al, 1999). The PFC team used the lentic checklist to evaluate 21 wetlands sites. The 21 sites were chosen by stratifying wetlands by wetland types and potential impacts. Most impacts occurred on forested wetlands and to a lesser extent, emergent sedge wetlands. Harvest and road data indicated most other wetland types exhibited minor direct impacts.

The PFC Team decided that the lentic checklist does not address forested wetlands very well. The checklist is geared toward wind and wave energy and many of the wetlands in the Klawock Watershed are low energy systems with little or no standing water (mostly saturated soils). The PFC team *did* identify trends in wetland impacts in the Klawock Watershed.

Forested wetlands were either avoided, roaded, harvested with a cable yarding system, selectively harvested with a helicopter yarding system, or harvested by shovel yarding. Where wetlands were avoided they were almost always rated PFC. Where helicopter yarding was used to remove the higher value trees the wetlands were rated PFC. Where cable yarding was used and partial suspension achieved, the wetlands were rated either FAR up or PFC depending on the amount of residual trees and the age of the clearcut. It was easier to rate the older harvested forested wetlands PFC than recent clearcuts. This seems to make sense as there are less risks to a wetland with an established stand than one without woody vegetation.

Shovel yarding is a ground based yarding system that uses a hydraulic knuckleboom log loader to move logs to the road. Depending on the operator and site conditions, this yarding system can leave ruts in the soil, effectively altering soil drainage at the microsite. Where ruts are present (and suspected of making the microsite dryer) the PFC Team almost always answered question 6 —nǒ on the lentic checklist and the summary rating in a recent clearcut with ruts was almost always FAR down. Where ruts are present and the site was as wet or wetter than the pre-harvest condition the Klawock PFC Team rated the site FAR with an upward trend, because the site had the water to maintain wetland status, even though type conversion could occur.

The Klawock PFC Team also assessed wetlands with roads constructed through them and wetlands with road and clearcut impacts. In most wetlands with only road impacts, the impacts were almost always limited to an area within a few feet of the road prism. These findings match those of Swanston and others (Swantson, personal communication 1997 and McGee personal communication, 2000). These wetlands were rated PFC and pertinent notes made regarding the road. Where effects were noted the road was typically restricting water flow or diverting water flow. Impacts associated with roads were generally greater where road grades were steeper, and sideslopes steeper. On steeper ground more excavation is required and there are more opportunities to divert hillslope water down the inside ditchline.

Due to time constraints and the lack of a suitable second-growth layer (with harvest methods) the PFC team did not extrapolate the wetland PFC findings to other wetlands in the watershed, nor did the team attempt to draw conclusions about wetland functionality at the sub-basin scale.

The wetland assessment identified some restoration opportunities. Improving road drainage is the dominant theme. The PFC Team believes improving road drainage in the lotic systems will be priority over improving road drainage in the lentic systems, due to low energy gradients in the wetlands evaluated.

Table 7. Klawock Wetland PFC Assessment

Klawock Wetland PFC Assessments								Revised 9/27/2000
			NWI	General				
PFC		PFC	Wetland	Vegetation	Road	Harvest	Harvest	
Number	Sub Basin	Determination	Type	Status	Yes/No	Type	Method	Notes/ Restoration Opportunties
H-OG-1	Hatchery	PFC	PFO4B	OG	No	Selective	Helicopter	Rated PFC even though selective harvest.
H-SG-1	Hatchery	FAR up	PFO4B	CC	Yes	CC	Shovel	Road is ponding water (fish seen in clearcut) Shovel ruts in clearcut.
H-SG-2	Hatchery	PFC	PFO4B	SG	No	CC	Cable?	Fluvial spruce flat logged 15 years ago, flooded with beaver ponds.
H-SG-3	Hatchery	FAR down	PFO4B	SG	No	CC	Shovel	About 10 years old, heavy cribbing on shovel trails, Appears to be
								more mounds now with thimble-berry and spruce
H-SG-4	Hatchery	PFC	PFO4B	SG	No	CC	Cable	15 years old, little or no disturbance.
H-SG-5	Hatchery	PFC	PFO4B	SG	No	CC	Cable	15 years old, little or no disturbance. Bench near EF Hatchery
H-SG-6	Hatchery	PFC	PFO4B	SG	No	Selective	Helicopter	Big PFO4B on Bench, variety of harvest levels, selectively cut.
3M-OG-1	3-Mile	PFC	PSS1	OG	No	N/A	N/A	Domed Bog with scrub/shrub fringe, surrounded by recent clearcut
3M-SG-1	3-Mile	FAR down	PFO4B	CC	No	CC	Shovel	Shovel yarding with ruts and embedded slash on gently sloping
								Forested wetland logged in 1997. Microsite change via ruts and slash.
3M-SG-2	3-Mile	FAR down	PFO4B	CC	Yes	CC	Shovel	Shovel yarding on 0 to 30 percent slopes produced ruts 20 inches
								deep, diverting water. Spur road also inhibits flows. 1997 clearcut.
3M-SG-3	3-Mile	PFC	PFO4B	SG	Yes	CC	Cable	10 year old second growth on 30 percent slopes with a few
								non-merchantable residuals. Road bisects wetland on the contour
								but not inhibiting flows.
3M-OG-2	3-Mile	PFC	PFO4B/EM1B	OG	Yes	N/A	N/A	Road impacts limited to roadside. Road diverting water, Need to
								improve drainage.
3M-OG-3	3-Mile	PFC	PEM1B	OG	Yes	N/A	N/A	Tall sedge fen below road. Road impacts limited to roadside.
SE-SG-1	SE	PFC	PF04B	SG	NO	Selective	Helicopter	Selective cut of larger cedars on lakeshore
SE-SG-2	SE	PFC	PF04B	SG	NO	CC	Cable	5yr old clearcut little/no disturbance below hill and up westside of cut
SE-SG-3	SE	PFC	PF04B	SG	YES	CC	Shovel	>10 yr old cut-shovel patch flat-little/no disturbance* good regrowth
								recently logged <2yrs
SE-SG-4	SE	PFC	PF04B	SG	NO	Selective	Helicopter	Approx 20% canopy removed, barely merchantable cedar
SE-OG-1	SE	PFC	PF04B	OG	YES	N/A	N/A	Road impacts, some water diverted by inside ditch, fill slope supports
								upland plants
SE-SG-5	SE	PFC	PF04B	SG	YES	CC	Shovel	Road impacts, some water diverted by inside ditch, headcuts in road
								cut bank, water on road, water bars needed
SE-SG-6	SE	PFC	PF04B	SG	NO	Selective	Helicopter	Harvest varies, select cut to mini clearcut, much wood left on ground
SE-SG-7	SE	PFC	PF04B	SG	YES	Selective	Shovel	Shovel yard small patch of 10-15 yr old timber

Index to wetland PFC table.

Harvest Type:
Selective—selective harvest (typically removal of high value larger cedars in forested wetland)
OG—Old Growth/Unmanaged
CC--clearcut
General Vegetation Status:
OG--Old growth
CC—Clearcut
SG—Second Growth
Harvest Method:
Helicopter—helicopter harvest, no ground disturbance
Shovel--knuckle boom track mounted backhoe-moderate ground disturbing activity dependent upon operator
Cable—Mobile yarder –significant ground disturbing activity

PFC Assessment Results by Major Sub-basins

Half-mile Creek Sub-basin

Description/Current Condition
Half-mile Creek Sub-basin is located on the northwest side of Klawock Lake. Half-mile Creek Sub-basin covers 3,361 acres, contains numerous small muskeg ponds, and has a maximum elevation of 2,900 feet above sea level. The USDA Forest Service manages 3,190 acres in the upper sub-basin. The majority of this land is muskeg and is in a natural condition. Klawock Heenya, Inc. manages 147 acres of lowlands,

and the Sealaska Corporation manages 24 acres in the upper watershed. Half-mile Creek provides the domestic water supply for the community of Klawock. The city of Klawock maintains the reservoir and drawdown facilities. A small floodplain is located below the Klawock--Hollis Highway stream crossing.

Only 32 acres of timber have been harvested in the Half-mile Sub-basin. Approximately 0.8 miles of road have been constructed in the sub-basin. Human impacts are confined to the area of the sub-basin around and downstream of the water intake operations. The small road system is in fair condition. Where timber harvest occurred upslope of the highway, a buffer of trees was left below the slope-break on the stream. Selective timber harvest occurred downstream of the highway adjacent to the stream on an alluvial fan. Blowdown is scattered throughout the lower reach.

Table 8. Major features of Half-mile Creek Sub-basin.

Half-mile Creek Sub-basin	Acres	% of total	Miles
Total Acres	3361	100%	
Ownership			
Klawock Heenya, Inc.	147	4%	
USFS—Craig Ranger District	3190	95%	
Sealaska Corp.	24	<1%	
Sub-basin Features			
Harvest acres/ second growth**	32	1%	
Wetlands	2540	76%	
Harvested wetlands**	8	<1%	
Floodplains and Alluvial Fans	154	5%	
Lakes and Ponds	70	2%	
Roads			0.6 (0.1 m/sq.mile)
Total Stream Miles			14
Class I			0.7
Class II			9.2
Class III			4.1

**low estimate, based on preliminary information.

Tier 1 Survey Results

A Tier 1 stream survey was conducted on all 0.6 miles of Class I (anadromous fish) and on approximately four miles of Class II (resident fish) streams in the sub-basin. A 70-foot falls blocks anadromous passage upstream of the highway crossing at river mile 0.6. There are about 9.2 miles of resident fish habitat in the sub-basin. Numerous small tributaries that drain an extensive muskeg complex feed main stem Half-mile Creek. There are about 4.1 miles of Class III stream in the system. The most dominant channel types by process group are High Gradient Contained and Moderate Gradient Contained.

The ADFG anadromous stream catalog lists Half-mile Creek (stream # 103-60-10470-2007) as habitat for pink and coho salmon. A few sockeye salmon were observed in the stream during the field assessment. ADFG does not conduct regular escapement surveys in this sub-basin. Aerial photographs and aircraft reconnaissance were used to inventory stream class and channel type in the upper watershed where access and human impacts are limited. Several different types of wetlands have been mapped in the sub-basin. The dominant wetland types in Half-mile sub-basin are emergent short sedge, forested wetland emergent sedge, and alpine meadow. The emergent short sedge wetland is the broad ‗muskeg' complex in the upper watershed.

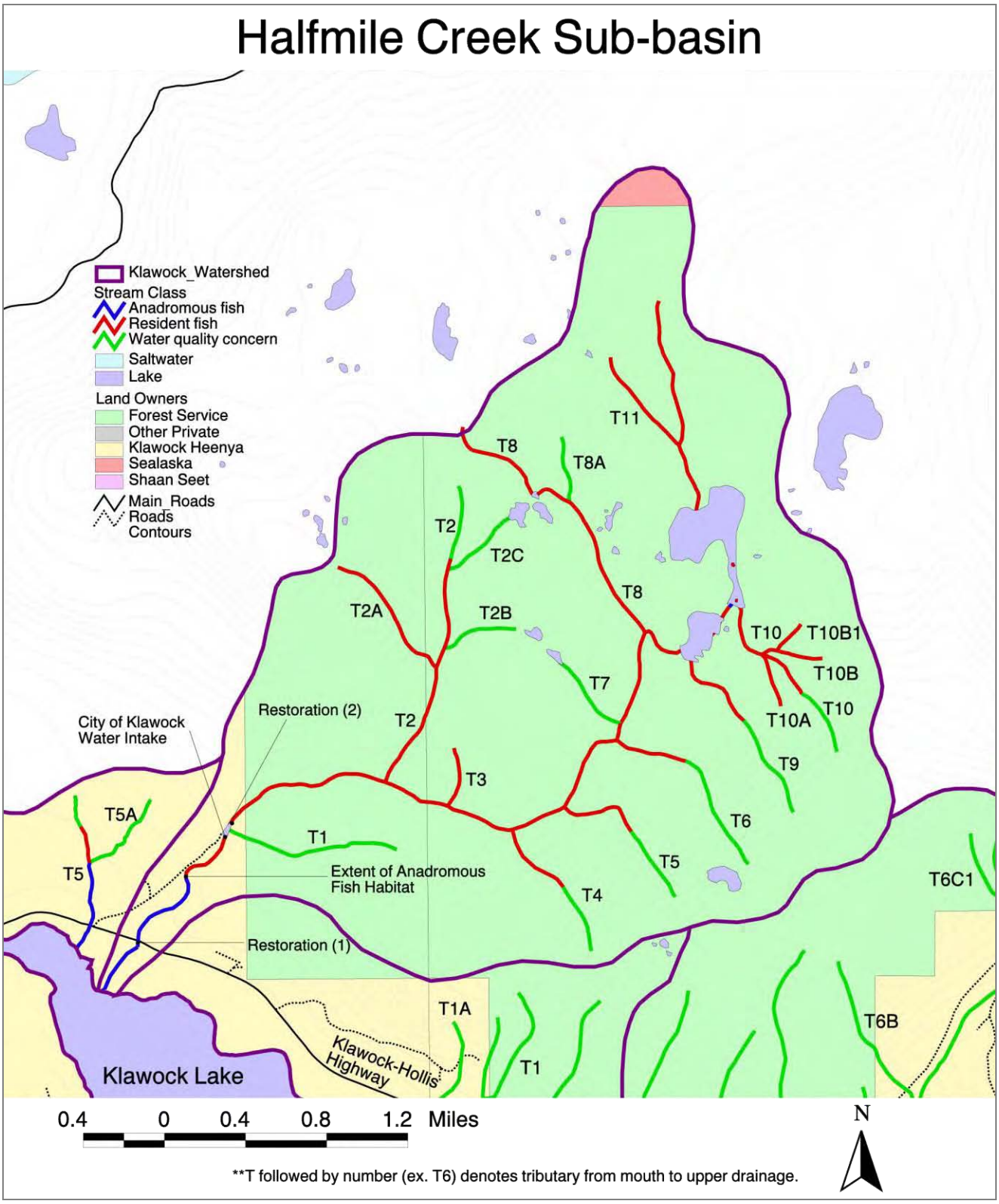


Figure 7. Major features of Half-mile Creek Sub-basin.

PFC Assessment Results
The PFC assessment was conducted on the lower portion of the Half-mile Creek Sub-basin where human disturbance exists. Half-mile Creek was delineated into four reaches for the purpose of conducting this assessment: HM1, HM2, HM3 and HM4. A PFC assessment was conducted in the lower managed portion of the sub-basin in 1999 and in the upper unmanaged section in 2000.

Table 9. PFC ratings summarization for Half-mile Creek.

Sub-basin	Reach	PFC Rating	Fish	Channel Type	Total Length (feet)
Half-mile	HM1	PFC	Y	FP 4	1,125
	HM2	PFC	Y	MM2, FP4, HC4	3,425
	HM3	PFC	Y	MM2, MC2	3,700
	HM4	PFC	Y	MC, HC, PA2	65,500 (12.4 miles)
					Total 14 miles

All four reaches rated Proper Functioning Condition. The aggregate rating for the sub-basin is PFC. The stream channel, floodplain, and/or wetland have the physical characteristics that provide stability through various flood events. This resiliency allows an area to produce desired values such as fish and wildlife habitat over time (Prichard et al, 1998). All reaches met the minimum criteria for a functional rating. There is concern regarding the effects of water withdrawal and the disruption of sediment transport due to the existing water intake operations. A discussion of the summary ratings and individual reach descriptions are included in Appendix B.

Restoration Opportunities for the Half-mile Creek Sub-basin
The Watershed Assessment Team identified several restoration opportunities during the assessment process. The potential restoration projects may help improve functionality of riparian areas. Two restoration opportunities were identified in Half-mile Creek Sub-basin; the second opportunity needs further evaluation. More detailed information exists in Appendix C.

Table 10. Restoration Opportunities for Half-mile Creek Sub-basin.

Project Numb.	Sub-basin	Stream	Location	PFC ID	Sum Det.	Length / Area	Issue / Opportunity	Proposed Restoration Activity
1	Half-mile	Half-mile	Highway crossing	HM1	PFC	0.2 mile	Fish passage improvements	Culvert inlet / outlet improvements
2	Half-mile	Half-mile	Reservoir	HM2	PFC	0.6 mile	Reservoir is altering natural delivery of bedload downstream to anadromous fish reaches and half-mile alluvial fan	Seed creek downstream of dam with dredged materials that are periodically removed from behind the small impoundment

Three-mile Creek Sub-basin

Description/Current Condition
Three-mile Creek Sub-basin is located on the northeast side of Klawock Lake. Three-mile Creek Sub-basin covers 5,217 acres, contains three small sub-alpine lakes, and has a maximum elevation of 3,900 feet above sea level. The upper watershed (mountain and ridge tops) is managed by the Craig Ranger District and is in a natural condition. Klawock Heenya, Inc. manages 2,736 acres of lowlands, encompassing all fish bearing streams within the sub-basin. A major alluvial fan is located below the highway at the mouth of Three-mile Creek. The alluvial fan is quite large, indicating the relatively high erosion potential and transport capability of this very steep sub-basin. Three-mile Creek has a well-defined main channel, a number of overflow and side channels, and extensive areas of beaver influenced ponds on the northwest side of the floodplain.

A housing development is located on the alluvial fan at the mouth of Three-mile Creek (Photo 1). A portion of this alluvial fan is inactive and has not been used by the stream in many years. During a large

rainstorm in mid October of 1999, the stream nearly accessed a historic channel through the middle of the subdivision. Because of this event, landowners constructed a berm to protect property. Three-mile Creek is being studied as a potential domestic water source for the community of Klawock and for surrounding industry. The community currently draws its water from neighboring Half-mile Creek.

Three-mile Creek Sub-basin has been managed for timber production. More than 1,768 acres of timber have been harvested (low estimate) and approximately 18.0 miles of road have been constructed in the sub-basin. The road system receives limited regular maintenance. Numerous landslides have occurred in the watershed. A large storm event in 1993 triggered several landslides in the sub-basin. Debris torrents have scoured four small fish bearing streams to bedrock and subsequently deposited large quantities of sediment and debris into main stem Three-mile Creek (Photo 3). In most cases a thin buffer of trees outline fish bearing streams. Selective harvest and windthrow have occurred within the buffer strips.

Photo 3. Debris torrent, upper Three-mile Creek.

Tier 1 Survey Results

A Tier 1 stream survey was conducted on 100 percent of Class I (anadromous fish) streams and 95 percent of Class II (resident fish) streams in the Three-mile Creek Sub-basin. Aerial photographs and aircraft reconnaissance were used to inventory stream class and channel type in the upper watershed. The Alaska Department of Fish and Game anadromous stream catalog lists Three-mile Creek (stream # 103-60-14070-2015) as habitat for pink, coho, and sockeye salmon. ADFG does not regularly conduct coho and sockeye escapement surveys in this sub-basin.

Three-mile Creek Sub-basin is a 3rd order watershed that contains approximately 29 miles of stream channel. The most dominant channel types by process group are High Gradient Contained, Alluvial Fan, and Moderate Gradient Mixed Control. There are 5.1 miles of Class I, 4 miles of Class II and approximately 20 miles of Class III streams mapped in the basin (Table 11). Main stem Three-mile Creek is approximately 4.7 miles in length and is fed by two major tributaries, North and South Fork Three-mile Creeks.

Table 11. Major watershed features of Three-mile Creek Sub-basin.

Three-mile sub-basin	Acres	% of total	Miles
Total Acres	5,217	100%	
Ownership			
Klawock Heenya, Inc.	2,735	52%	
USFS—Craig Ranger District	2,482	48%	
Private lots	N/A	N/A	
Sub-basin Features:			
*Harvest Acres/ Second Growth	1,768	34%	
Wetlands	1,894	36%	
*Harvested on Wetlands	111	2%	
Floodplains and Alluvial Fans	410	8%	
Lakes and Ponds	97.7	2%	
Roads			18 (2.2 mile/sq.m)
Total Stream Miles			29.1
Class I			5.1
Class II			4
Class III			20

*This information is based on preliminary data, actual numbers are considerably higher.

Approximately three miles of main stem Three-mile Creek is accessible to anadromous fish (Class I); a 30-foot falls blocks upstream passage at river mile 3.1. An additional 0.5 miles of main stem Three-mile Creek is accessible to resident trout (Class II). North and South Fork Three-mile support very limited anadromous habitat (less than one half mile combined). South Fork Three-mile (T8) contributes the majority of resident fish habitat in the remaining stream network. The dominant wetland types in Three-mile Creek Sub-basin are Alpine Meadows and Forested Wetlands. Alpine meadows blanket the high peaks in the sub-basin.

Figure 8. Major Features of Three-mile Creek Sub-basin.

PFC Assessment Results

A PFC assessment was conducted on all Class I and II streams and on some Class III streams in the Three-mile Creek Sub-basin. Three-mile Creek and its tributaries were delineated into 16 reaches for the PFC assessment. Main stem Three-mile Creek was delineated into seven reaches: 3M1 through 3M7. The South Fork (Trib 8) was divided into three reaches: SF1; SF2; and SF3. The North Fork (Trib 6) was divided into NF1, NF2 and NF3. Tributary streams with similar conditions were aggregated into one reach for assessment purposes. Tributaries 1,2,3,5 were grouped into one reach (3MT1,2,3,5).

Table 12. PFC rating summarization for the Three-mile Creek Sub-basin.

Sub-basin	Reach	PFC Rating	Fish	Channel Type	Location River Mile	Total Length (feet)
Three-mile						
Main stem	3M1	FAR D	Y	AF1	0.0	10,850*
	3M2	FAR D	Y	MM2, FP4	0.7	7,150
	3M3	FAR D	Y	MM1, MM2	2.2	2,200
	3M4	FAR U	Y	MM1, HC2	2.7	2,050
	3M5	FAR D	Y	HC2, HC6	2.9	1,100
	3M6	FAR NA	Y	HC6	3.2	2,050
	3M7	FAR D	N	HC2, AF1	3.6	1,475
Tributary						
T1,2,3,5	3MT1,2,3,5	NF	Y	MM1, HC2	NA	6,400
T6	NF1	NF	Y	AF2, HC2	NA	950
T6	NF2	FAR NA	Y	HC6	NA	1,175
T6	NF3	FAR NA	Y	HC2and6	NA	3,200
T6A	3MT6A	NF	Y	AF2, HC2and6	NA	2,500
T7	3MT7	FAR U	Y	MM1, HC2	NA	2,900
T8	SF1	PFC	Y	MC1, HC2and3	NA	3,775
T8	SF2	FAR U	Y	HC2, AF1	NA	2,900
T8	SF3	NF	Y	AF1and2, HC5and6	NA	4,750
						Total 10.5 miles

*denotes AF channel, multiple channels on pronounced alluvial fan.

Eleven reaches are rated Functional at Risk (FAR), one Proper Functioning Condition (PFC), and four Non-Functional (NF) (Figure 8, Table 12). The majority of stream reaches classified as FAR lacked future large woody debris recruitment potential, had excessive erosion and/or deposition, and lacked channel stability. Stream reaches rated NF clearly lacked stabilizing physical characteristics and cannot reach their potential without management intervention (Prichard et al, 1998). The key factors that determined the rating were upland watershed degradation, stream bank and upland harvest, lack of LWD now and future LWD recruitment, and absence of riparian/wetland plants. These reaches were harvested to the streambanks, consequently there is no future LWD recruitment available. A discussion of the individual reach descriptions and ratings are included in Appendix B.

Restoration Opportunities for the Three-mile Creek Sub-basin

The Watershed Assessment Team identified five restoration opportunities in the Three-mile Creek Sub-basin (Figure 8). These opportunities will help move streams back towards a functional condition, are relatively low cost, and were designed to meet specific objectives for the site. Below is a site-specific list of immediate restoration opportunities. The following list should not be considered comprehensive or prioritized. Detailed information exists in Appendix C.

Three-mile Creek Sub-basin is a priority for implementing restoration opportunities. Three-mile Creek contains the most sockeye and coho spawning habitat in the watershed. Risks to habitat disturbance from

landslides, deteriorating road systems, and accelerating channel erosion and deposition in Three-mile sub-basin is high. A comparison of these risks to potential disturbance of the high value fish habitat make it a high priority for restoration activities.

Table 13. Three-mile Creek Restoration Opportunities.

Project Numb.	Sub-basin	Stream	Location	PFC ID	Sum Det.	Length / Area	Issue / Opportunity	Proposed Restoration Activity
1**	3-mile	Trib 2	Lower 3-mile above confluence of mainstem	3MT1,2,3,5	NF	4-600' class I. 1600' class II	A spur road with log culvert in the creek is blocking fish passage	Remove a short section of spur road and log culvert. Remove logging debris, currently smothering the wetted channel.
2	3-mile	Trib 7	Road XXX, floodplain road between T4-7	3MT7 and others	FAR U	0.5 mile road, 3000' stream	Restore / improve fish passage class I and II	Remove 5 small stream crossings, short section of road (75-100 ft.) beyond tributary 7, add LWD.
3	3-mile	Trib 8	South Fork road crossing	SF3	NF	1600' habitat, 800' road	Fish passage, water diversion, ditchline erosion, culvert plugging and road washouts	Remove and/or replace non-functioning culverts.
4	3-mile	NA	Upper mainstem	3M7	FAR D	3,000 ft road	Several culverts are plugged and causing water diversions.	Remove and/or replace culverts and put roads in storage
5	3-mile	Several	Mainstem and tribs	Several, refer to Appendix C	Various	Approx. 25 Acres	Inadequate riparian buffers	Riparian Thinning, promote growth of large riparian trees.

**Partially completed by Klawock Heenya Inc. in 2001.

Inlet Creek Sub-basin

Description/Current Condition

The Inlet Creek Sub-basin is located at the east end of Klawock Lake. Inlet Creek Sub-basin covers 2,375 acres, contains a few small muskeg ponds, and has a maximum elevation of 2,400 feet above sea level. The upper sub-basin (mountain and ridge tops) is managed by the Forest Service and is in a natural condition. The Klawock-Heenya Corporation manages 1,180 acres of lowlands in the sub-basin. The highway crosses main stem Inlet Creek near the confluence with Klawock Lake. The ADFG anadromous stream catalog lists this stream (103-60-10470) as habitat for coho and sockeye salmon and steelhead trout. ADFG does not regularly conduct coho and sockeye escapement surveys in this sub-basin.

Approximately 388 acres of timber have been harvested (low estimate) and approximately 8.4 miles of road have been constructed in the sub-basin. The status of the road system is largely unknown; there are several documented problematic fish passage and road maintenance problems. No formal Road Condition Survey has yet been conducted. The Klawock-Hollis Highway bisects the sub-basin, basically following main stem Inlet Creek to the topographical divide with the Harris River. A few landslides have been documented in the sub-basin.

Tier 1 Survey Results

Tier 1 stream survey was conducted in 2000 on 90 percent of Class I and II streams in the sub-basin to verify presence of anadromous and resident fish and their respective habitat.

Table 14. Major features of Inlet Creek Sub-basin.

Inlet Creek sub-basin	Acres	% of total	Miles
Total Acres	2,375	100%	
Ownership			
Klawock Heenya, Inc.	1,180	50%	
USFS—Craig Ranger District	1,195	50%	
Sub-basin Features			
*Harvest Acres/ Second Growth	388	16%	
Wetlands	624	26%	
*Harvested on Wetlands	13	1%	
Floodplains and Alluvial Fans	169	7%	
Lakes and Ponds	0.1		
Roads			8.4 (2.2miles/sq.m)
Total Stream Miles (including Class IV)			13.3
Class I			2.6
Class II			4.0
Class III			6.2

*This information is based on preliminary data, actual data is believed to be considerably higher.

Inlet Creek Sub-basin is a 3rd order watershed that contains approximately 13.3 miles of stream channel. The most dominant channel types by process group are Floodplain, High Gradient Contained, and Moderate Gradient Mixed Control. There are 2.6 miles of Class I, 4.0 miles of Class II and 6.2 miles of Class III streams (Table 14). Main stem Inlet Creek is approximately three miles in length and is fed by several small tributaries. Approximately one mile of main stem Inlet Creek is accessible to anadromous fish (Class I). An additional 2 miles of main stem Inlet Creek is accessible to resident trout. Tributaries 1 and 2 contribute the majority of additional anadromous fish production in the sub-basin (Figure 9).

Several different types of wetlands have been mapped in the sub-basin. The dominant wetland types in Inlet Creek Sub-basin are Short Sedge, Alpine Meadows and Forested Wetland/Emergent Sedge. The Short Sedge and Forested Wetland/Emergent Sedge are located along the southern portion of the sub-basin. Alpine Meadows blanket the ridge tops in the north part of the sub-basin. No wetlands were assessed in this sub-basin.

PFC Assessment for Inlet Creek Sub-basin

A field PFC assessment was conducted on 10.9 miles of Class I, II and significant III streams in 2000. Inlet Creek and its tributaries were delineated into seven reaches for this assessment. Main stem Inlet Creek was delineated into one reach; Reach I1 includes tributary 10, 12 and 13. Tributary streams with similar conditions were aggregated into one reach for assessment purposes. Tributary 6, 7, 7A, 8, 8A, 9 and 9A were grouped into one reach (ITNorth). Tributary 3 and 4 were grouped into one reach IT3,4. Tributary 1, 2, and 11 were rated and delineated into separated reaches: IT1, IT2, and IT11 (Figure 9, Table 15).

The aggregate PFC rating for the basin is Proper Functioning Condition. Reach IT North was rated NF and reach IT3 and 4 was rated FAR-D. Several critical components of the PFC checklist were not met: reaches lacked adequate stream buffers; there is not adequate riparian vegetative cover to protect banks and dissipate energy during high flows; excessive erosion was documented; and plant communities are not an adequate source of coarse and/or LWD for maintenance and recovery (Prichard et al, 1999). Details of PFC ratings can be found in Appendix B.

Table 15. PFC rating summarization for Inlet Creek Sub-basin.

Sub-basin	Reach	PFC Rating	Fish	Channel Type	Total Length (feet)
Inlet					
Main stem	I1	PFC	Y	Various	21,225
	IT1	PFC	Y	PA2, PA5	4,100
Tributaries	IT2	PFC	Y	FP3, MM1	2,400
T3&4	IT3&4	FAR D	Y	MM1, AF2, FP3, HC2, 5&6	3,025
T6,7,7A,8,8A,9	IT North	NF	Y	MM1, HC2&5	9,825
	IHDWS	PFC	Y	Various	13,825
	IT11	PFC	Y	MM1, HC5	3,050
					Total 10.9 miles

Restoration Opportunities for the Inlet Creek Sub-basin

The Watershed Assessment Team identified four restoration opportunities in Inlet Creek Sub-basin (Figure 9). These opportunities will help move streams back towards a functional condition, are relatively low cost and were designed to meet specific objectives for the site. Refer to Appendix C for more detailed information.

Table 16. Inlet Creek Sub-basin Restoration Opportunities.

Project Numb.	Sub-basi	Stream	Location	PFC ID	Sum Det.	Length / Area	Issue / Opportunity	Proposed Restoration Activity
1	Inlet	Inlet	Mainstem + various	I1	PFC	Several miles	Fish passage, improve stream morphology	Improve culvert outlet pools in short term and/or replace culverts.
2	Inlet	Trib 3 & 4	Lower drainage 3,4	IT3&4	FAR D	2,000 ft. total, 1,000 ft. class I	Fish passage, habitat improvement, rehab upper road crossing	Upgrade culverts, add LWD to channel, reduce erosion.
3**	Inlet	7,7A	Upper/mid drainage north side of Inlet Cr.	IT North	NF	4,000 ft.	Road is encroaching on floodplain, stream habitat is degraded, LWD removed	Improve stream crossing (removed) and downstream fish habitat, place LWD in lower MM1 reaches to improve fish habitat.
4	Inlet	11,11A	Upper drainage, north side near highway x-ing	IT11	PFC	3,100 ft.	Fish passage, habitat improvement, road maintenance	Improve stream crossing (removed) and downstream fish habitat, place LWD in lower MM1 reaches to improve fish habitat.

**Partially completed in 2001 by Klawock Heenya Inc.

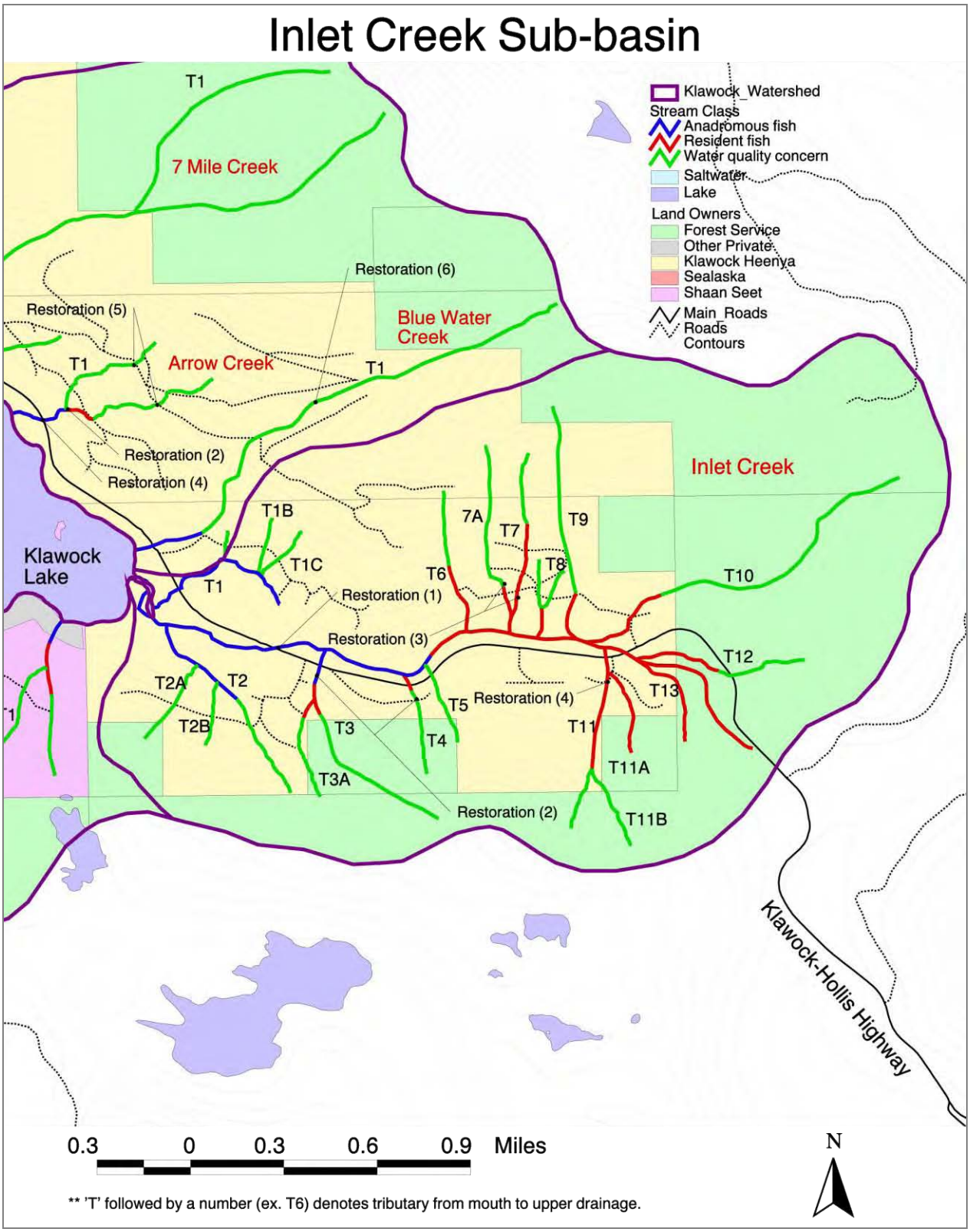


Figure 9. Major features of Inlet Creek Sub-basin.

Hatchery Creek Sub-basin

Description/Current Condition
The Hatchery Creek Sub-basin is located on the southwest side of Klawock Lake, south of the community of Klawock. The basin encompasses 4,890 acres, contains numerous beaver ponds, and has a maximum elevation of 2,400 feet above sea level. Klawock-Heenya, Inc. manages 3,300 acres of the sub-basin; Shaan Seet, Inc. manages 1,590 acres. The Hatchery Creek floodplain is over two miles long and averages about 1,200 feet in width. It contains a well-defined main channel, a number of overflow and side channels, and extensive areas of beaver influenced ponds.

Beaver ponds on the Hatchery Creek floodplain have greatly altered the soil and water regime of this floodplain. Old, and some new, beaver ponds extend almost the entire length of the main stem of Hatchery Creek, and old ponds are present on some of the tributaries. The beaver ponds reduce stream energy, raise soil water tables, and trap finer sediments that would typically be deposited on a floodplain. Beaver ponds generally create critical over-wintering habitat for coho fry and parr and can also raise stream temperature and aquatic productivity. Stream temperature in Hatchery Creek is not expected to be negatively affecting fish populations. Current beaver activity was documented in main stem Hatchery Creek and in several tributaries (T 3,4,6,7,8) during field surveys.

The PFC Team is concerned that the extent of beaver pond development on mainstem Hatchery Creek and its tributaries is negatively affecting fish habitat and riparian composition. The PFC Team noticed that beaver pond development has accelerated after floodplain harvest in several areas in the Hatchery Creek sub-basin. A comparison of the current condition of the Hatchery Creek system to historic air photos (1960, 1972, and 1985) indicates a large increase in beaver ponds post timber harvest (late 80s-90s) and the dominance of alder in the emerging vegetation. The *temporary* increase in pond development may negatively affect sockeye salmon indirectly by decreasing available spawning habitat. Significant reaches of historic spawning habitat are not currently available to fish. A similar trend can be extrapolated to the watershed scale; refer to a discussion on p. 9. The beaver ponds are seen as a loss of habitat rather than a fish passage problem. Although, very few fry, none in the upper ponded reaches were seen. Overall, it appears that the total amount of available spawning habitat for sockeye salmon has decreased over time. Spawning ground surveys would reveal the distribution of adult salmonids and utilization of habitat in the mid/upper sub-basin.

Approximately 1,597 acres of timber have been harvested and approximately 16.2 miles of road have been constructed in the sub-basin. The road system receives limited regular maintenance. Gentle topography predominates in the lowlands around main stem Hatchery Creek. However, a few landslides have occurred in the steep headwater area of the sub-basin. The potential for slope failures and stream crossing problems in the steep headwaters are possible as the road system deteriorates; however, most of the sub-basin has gentle slopes.

The riparian area along much of main stem Hatchery Creek consists of non-forested tall sedge fens and short sedge fens. Selective timber harvest did occur adjacent to the lower part of the main stem and trees were removed via helicopter yarding. Windthrow has occurred in the buffer left on the lower main stem. Timber harvest occurred up to the streambanks along the lower part of Tributary 1.

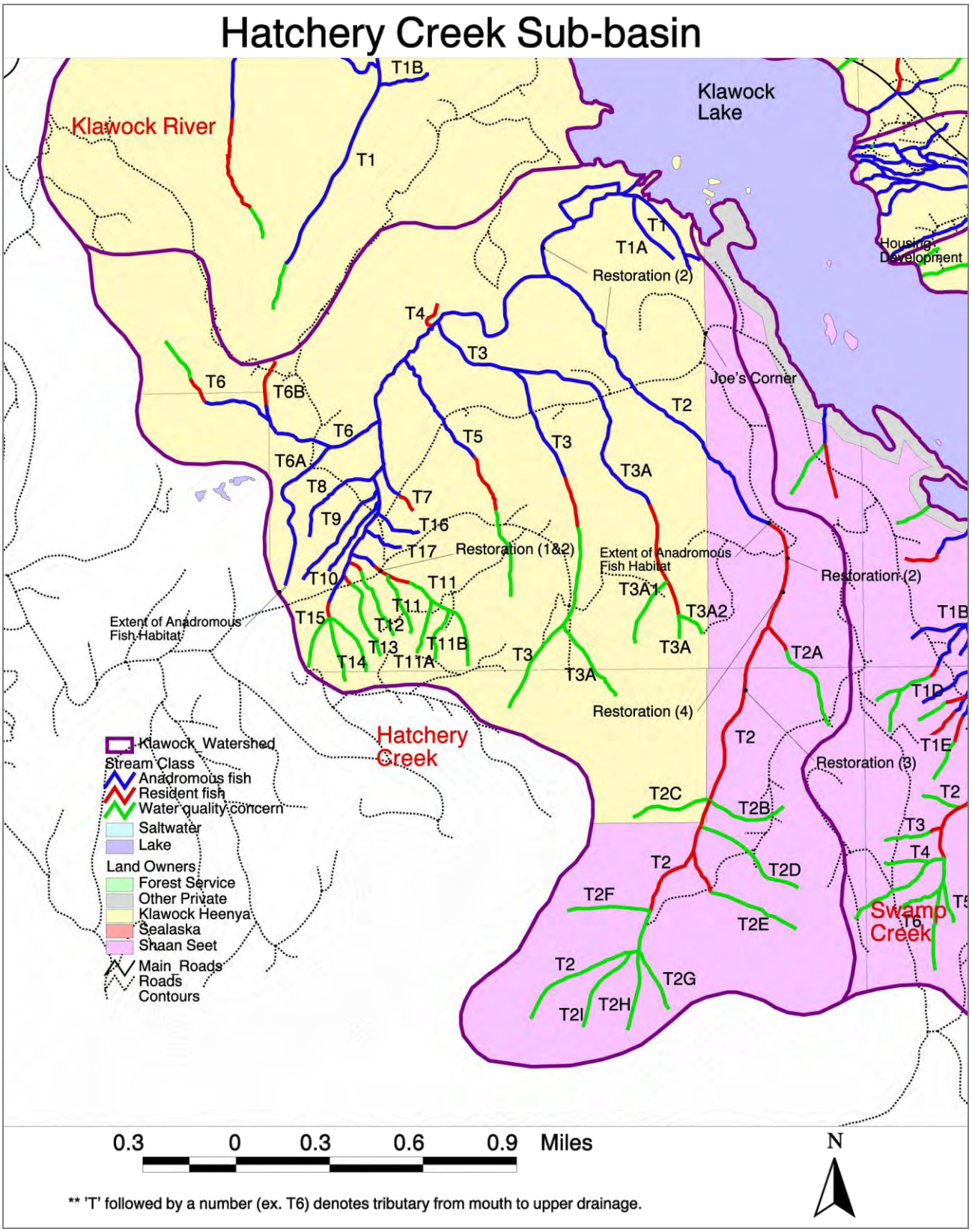


Figure 10. Major Features of the Hatchery Creek Sub-basin.

Tier 1 Survey Results
Tier 1 surveys were conducted on 85 percent of fish bearing streams in the sub-basin. Due to the homogeneity of habitat types, e.g., the predominance of unmanaged palustrine habitats, a partial survey was sufficient. Aerial photographs and aircraft reconnaissance were also used to inventory stream class and channel type in the upper watershed. The ADFG Anadromous Stream Catalog lists Hatchery Creek (103-60-14070-2010) as habitat for steelhead, pink, and coho salmon. ADFG does not conduct escapement surveys in the Hatchery Creek Sub-basin. The basin has tremendous value for coho rearing locally and within the Klawock Watershed.

Table 17. Major features of Hatchery Creek Sub-basin.

Hatchery Creek Sub-basin	Acres	% of total	Miles
Total Acres	4890	100%	
Ownership			
Klawock Heenya, Inc.	3300	67%	
Shaan Seet, Inc.	1590	33%	
Sub-basin Features			
*Harvest acres/ second growth	1,597	33%	
Wetlands	1983	41%	
*Harvested wetlands	183	4%	
Floodplains and Alluvial Fans	409	8%	
Lakes and Ponds	N/A		
Roads			16.2 (2.1m/sq. mile)
Total Stream Miles			26.8
Class I			12.7
Class II			4.3
Class III			9.8

*This information is based on preliminary data, actual numbers are considerably higher.

Hatchery Creek is a 3rd order watershed that contains approximately 27 miles of stream channel. The most dominant channel types by process group are High Gradient Contained, Palustrine, Moderate Gradient Contained, and Floodplain. Approximately 5.4 miles of main stem Hatchery Creek is accessible to anadromous fish. A significant portion of main stem Hatchery Creek and the lower segments of the major tributary are slackwater channel habitats (PA2 and PA5 channel types).

Numerous small tributaries that drain moderately-steep hillslopes feed main stem Hatchery Creek. Tributary T2 and T3 contribute the majority of the remaining fish habitat in the sub-basin, followed by T5 and T6 (Figure 10). T2 is approximately 5 miles long and 1.8 miles is accessible to anadromous fish—lower T2 is a large floodplain reach that contains significant spawning habitat. A series of falls blocks anadromous passage on Tributary 2 above the first stream crossing at river mile 1.8. Several different types of wetlands have been mapped in the sub-basin. The dominant wetland types in Hatchery Creek Sub-basin are Forested Wetlands, Alpine Meadows, and Tall Sedge Fens. The relatively scarce and high value Tall Sedge Fen wetlands are concentrated around the broad Hatchery Creek floodplain (Figure 10).

PFC Assessment for Hatchery Creek

A PFC assessment was conducted on over 21 miles of Class I and II streams and some Class III channels in 2000. Hatchery Creek and its tributaries were delineated into 16 reaches for the PFC assessment. Main stem Hatchery Creek was delineated into five reaches and includes sections of other streams of similar condition. The largest tributary, T2, was delineated into five reaches for the assessment: HT2A-E. Tributary streams with similar conditions were aggregated into like reaches for assessment purposes.

Table 18. PFC Rating Summarization for Hatchery Creek Sub-basin.

Sub-basin	Reach	PFC Rating	Fish	Channel Type	Total Length (feet)
Hatchery					
Main stem	H1	PFC	Y	FP4, PA1,2&5	14,950
	H2	PFC	Y	PA2&5	5,300
Tributary 2					
	HT2A	FAR N/A	Y	FP4	3,350
	HT2B	PFC	Y	AF1, & MC2	3,550
	HT2C	FAR D	Y	MM1	2,700
	HT2D	PFC	Y	MM1, MC2, HC3&5	11,350
	HT2E	FAR D	Y	MC2, HC2,3&5	10,925
Tributaries					
	HP(pal)1	PFC	Y	FP3, PA 1 & 5	8,900
	HT3PH	PFC	Y	PA 1 & 5	4,650
	HT3,3A,5L	PFC	Y	FP3, PA1, MM1, MC1&2, HC2	11,025
	HT3,3A,5U	FAR D	Y	HC2,3&6	11,300
	HT6,6A &6B	PFC	Y	PA2, FP4, MM1,HC2&3, MC1	9,775
	HTS(Swamp)	PFC	Y	PA 1& 5	9,150
	HT11-15L	NF	Y	AF1&2, FP3, MM1, HC2&6	5,975
					Total 21.3 miles

The aggregate rating for Hatchery Creek is PFC. Ten reaches were rated Proper Functioning Condition, 5 Functional at Risk, and one Non-Functional. The majority of stream reaches classified as FAR lacked future LWD recruitment potential, had excessive erosion and/or deposition, and/or exhibited channel instability. Stream reaches rated NF clearly lacked stabilizing physical characteristics. Some key factors that determined ratings were upland watershed degradation, stream bank and upland harvest, lack of LWD now and future LWD recruitment, and absence of riparian/wetland plants. Reaches rated FAR were harvested to the streambanks, consequently there is no future wood recruitment available. A discussion of the individual reach descriptions and ratings are included in Appendix B.

Restoration Opportunities for Hatchery Creek Sub-basin

The Watershed Assessment Team identified four restoration opportunities in the Hatchery Creek Sub-basin (Figure 10). These opportunities will help move streams towards a functional condition, are relatively low cost and were designed to meet specific objectives for the site. The following projects should not be considered comprehensive or prioritized.

Table 19. Restoration Opportunities for Hatchery Creek Sub-basin.

Project Numb.	Sub-basin	Stream	Location	PFC ID	Sum Det.	Length / Area	Issue / Opportunity	Proposed Restoration Activity
1	Hatchery	T11 & T15	Main road (east to west)	HT11-15L near Crab Creek divide	NF	2,000 ft. of road	Fish passage, water diversion, ditchline erosion, culvert plugging and road washouts.	Remove and/or replace non-functioning culverts, conduct road maintenance
2	Hatchery	Trib 2 & various	Multiple sites	H1, HT2A, HT2C, conifer release Tributary 11--AF portion, and HT11-15L (low gradient parts)	Various	Approx. 15 acres	LWD is lacking due to second growth stands adjacent to the streams	Thin second growth stands in riparian areas, provide a source of LWD to streams
3	Hatchery	Trib 2 area	Upper road system, parallels T2	HT2C, HT2D, HT2E, blown culvert in reach HT2C	Various	~3,000 ft. and road blowout	Water diversion, ditchline erosion, culvert plugging and road washouts.	Remove culverts and debris, re-contour stream crossing, conduct road maintenance
4	Hatchery	Trib 2	Upper road crossing (removed)	HT2C	FAR D	1,500 ft.	Riparian harvest and LWD removed from channel, floodplain encroachment	Place LWD in FP4 channel to improve fish habitat (class II), remove remaining road fill

Composite Sub-basins

Klawock River

Klawock River Sub-basin Description

The Klawock River is a composite Sub-basin connecting Klawock Lake to the Klawock estuary. The relief is low, vegetation is dominantly forested wetland and muskeg. The Klawock River is included in this sub-basin. The south side of the river is in a natural state. The north side of the river includes the Mary-Jackson subdivision and the Klawock IGA strip mall. Five small tributaries flow into the Klawock River drainage. Development, timber harvest and roads have impacted two streams. The Klawock-Hollis Highway bisects the four streams on the north side of the sub-basin. Two of five fish bearing streams are documented in the ADFG stream catalog. Coho, sockeye, steelhead and pink salmon likely utilize the other undocumented streams. Predominant stream process groups in the drainage include Palustrine, Floodplain, Mixed Moderate, and Mixed Contained. Total fish habitat is 7.7 miles. Approximately 20 percent of the drainage has been harvested. Klawock Heenya, Inc. is the primary landowner in the drainage. The state of Alaska-DOT manages the road corridor.

Photo 4. Klawock River near Prince of Wales Hatchery. Photo 5. Klawock River downstream of hatchery looking south, stream buffer blowdown visible.

Table 20. Major features of the Klawock River Composite Sub-basin.

Klawock River Sub-basin	Acres	% of total	Miles
Total Acres (composite sub-basin)*	2,993	100%	
Ownership			
Klawock Heenya, Inc.	2,888	96%	
City of Klawock	11.4	<1%	
State of Alaska	0.8	<1%	
Other Private	N/A	<1%	
USFS—Craig Ranger District	1.2	<1%	
Sub-basin Features			
Harvest acres/ second growth	N/A		
Wetlands (forested wetlands extensive)	N/A		
Roads			11.5 (2.5m/sq. mile)
Total Stream Miles			8.4
Class I			6.6
Class II			1.1
Class III			0.7

*Includes estuary

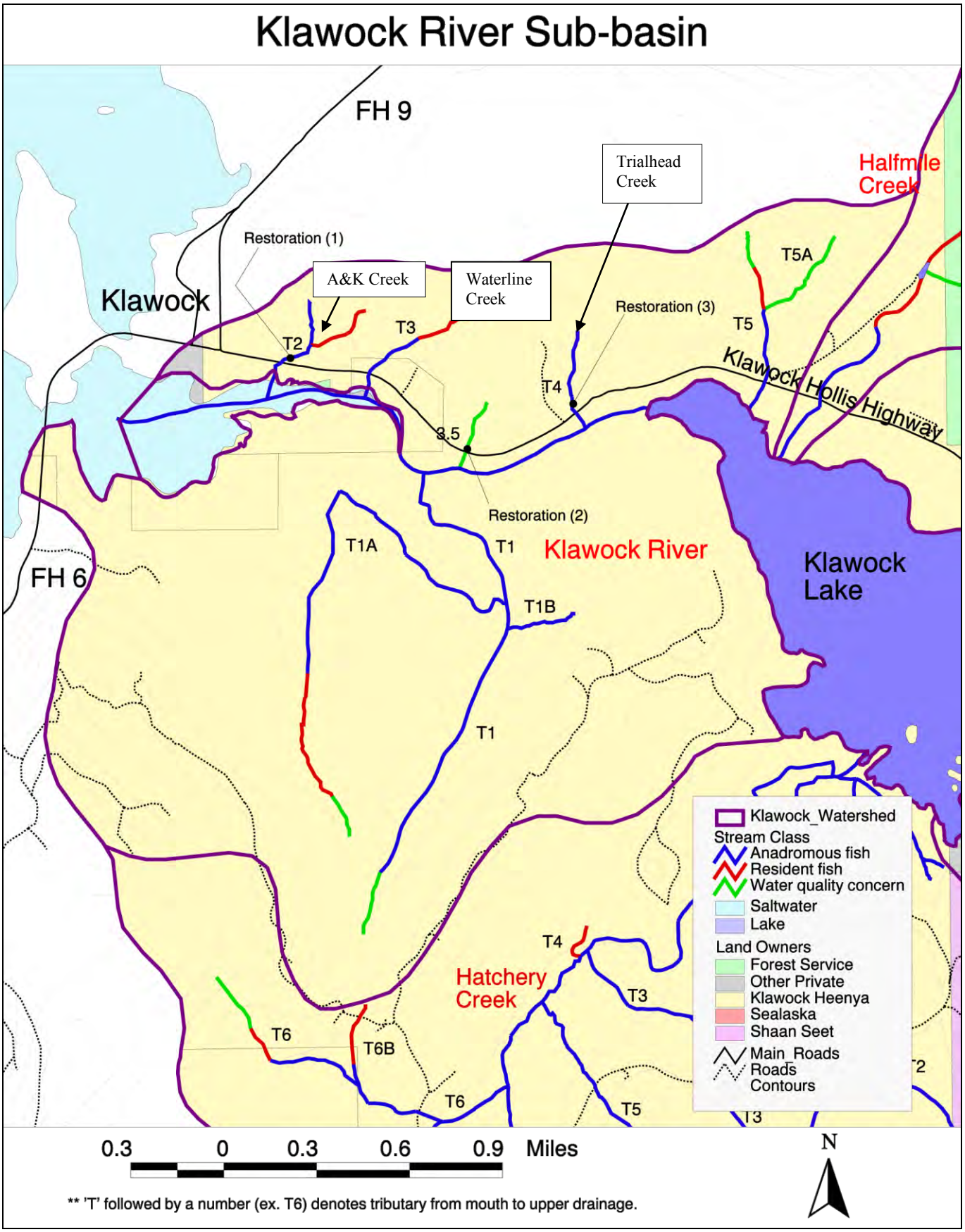


Figure 11. Klawock River Composite Sub-basin map

Tier 1 and PFC Results for Klawock River

A PFC assessment was conducted on 7.8 miles of Class I and II streams in the Klawock River Sub-basin. Klawock River Sub-basin and its tributaries were delineated into seven reaches for conducting the PFC assessment. Klawock River was delineated into one reach, K1 and Waterline Creek is delineated into two reaches, KW1 and KW2. The remaining reaches are; KT1, KA&K, KTHD, and KT5.

Table 21. PFC Rating Summarization for the Klawock River Sub-basin.

Sub-basin/ Stream	Reach	PFC Rating	Fish	Channel Type	Total Length (feet)
Klawock River					
Main stem	K1	PFC	Y	LC1	6,000
Tributaries	KT1	PFC	Y	PA, FP, MM, and MC	21,800
A&K	KTA&K	FAR D	Y	FP3, MM1	3,450
Trailhead	KTHD	FAR D	Y	FP3, MM1	1,865
Waterline	KW1	FAR U	Y	FP3, MM1	1,550
	KW2	PFC	Y	PA1	1,500
Trib 5	KT5	PFC	Y	MC1, MM1	5,200
					Total PFC 7.8

Three reaches were rated Functional at Risk, four Proper Functioning Condition, and none Non-Functional (Figure 11, Table 21). The majority of stream reaches classified as FAR lacked future LWD recruitment potential and exhibited excessive erosion and/or deposition. The presence of beaver dams (not active), the absence of riparian/wetland plants, predominance of disturbance species, lack channel stability, and upland watershed degradation were all documented. Additionally, disturbance from development on the north side of the Klawock River Sub-basin is a significant threat to sub-basin functionally. A discussion of the individual reach descriptions and ratings are included in Appendix B.

Restoration Opportunities in the Klawock River Sub-basin

The Watershed Assessment Team identified several restoration opportunities in the Klawock River Sub-basin. These opportunities will help move streams towards a proper functioning condition, are relatively low cost and were designed to meet specific objectives for the site. The following is a site-specific list of immediate restoration opportunities. The following list should not be considered comprehensive or prioritized.

Table 22. Restoration Opportunities for the Klawock River Sub-basin.

Project Numb.	Sub-basin	Stream	Location	PFC ID	Sum Det.	Length / Area	Issue / Opportunity	Proposed Restoration Activity
1	Klawock R.	A&K	Above Klawock-Hollis Highway	KA&K	FAR D	850' stream, ~5 acres (thinning)	Restore fish passage, inadequate riparian buffers	Upgrade culvert on highway, riparian thinning
2	Klawock R.	Waterline	Adjacent Klawock-Hollis Highway	KW1	FAR-U	2,000' res., 1,000' anad, ~5acres (thinning)	Improve passage and quality of anadromous and resident habitat	Upgrade culvert on highway, enhance outlet pool in short-term** (refer to PFC reach description in Appendix B), riparian thinning
3	Klawock R.	Trailhead	Around Klawock-Hollis Highway area	KTHD	FAR D	1600**, ~3acres (thinning)	Undersized culvert and 300' of poor riparian habitat	Upgrade culvert on highway, riparian thinning**** currently ready

Northeast Composite Sub-basin

Northeast Sub-basin Description

The Northeast sub-basin is a composite sub-basin including 5 small stream systems draining directly into the northeast side of Klawock Lake. The sub-basin includes 2.5 mile, Deadhead, Seven-mile, Arrow and Bluewater Creek systems. 2.5 mile Creek is located between Half-mile and Three-mile Sub-basins. The

remaining streams drain an area between the Three-mile Sub-basin and Inlet Creek Sub-basin. Deadhead Creek and 2.5 mile Creek drain relatively large footslope areas and lower mountainslopes. The remaining creeks drain larger mountain slopes and have small footslope areas. Seven-mile and Bluewater Creeks are large enough to have developed small alluvial fans. All of the streams contain fish habitat in the lower reach. The Klawock-Hollis Highway has impeded or reduced fish passage on all of these streams, cumulatively isolating over two miles of fish habitat (smaller Class I and II). The Alaska Department of Transportation manages the road right of way. Klawock-Heenya, Inc. manages most of the land in these sub-basins. Significant road building and timber harvest has occurred in the sub-basin.

Table 23. Major features of the Northeast Composite Sub-basin.

Northeast Composite Sub-basin	Acres	% of total	Miles
Total Acres (*composite sub-basin)	3,781	100%	
Ownership			
Klawock Heenya, Inc.	2,770	73%	
USFS—Craig Ranger District	1,006	27%	
Shaan Seet, Inc.	3.4	<1%	
State of Alaska	1	<1%	
Other Private	N/A	<1%	
Sub-basin Features			
Harvest acres/ second growth	N/A		
Wetlands	N/A		
Roads			23.6 (4m/sq. mile)
Total Stream Miles (does not include all Class IV)			17.2
Class I			4.3
Class II			0.7
Class III			12.2

Tier 1 and PFC results for the Northeast Sub-basin.

9.1 miles of PFC and Tier 1 Assessments were conducted on 100 percent of the fish bearing and some Class III streams in the Northeast Composite sub-basin. The five streams were divided into 15 reaches for assessment purposes. Eight reaches rated PFC, four rated FAR-Downward trend, and three rated Non-functional.

Stream reaches classified as FAR lacked future LWD recruitment potential, exhibited excessive erosion and/or deposition, and/or exhibited channel instability. Stream reaches rated Non-Functional clearly lacked stabilizing physical characteristics. Some key factors that determined ratings included: upland watershed degradation; stream bank and upland harvest; lack of LWD now and future LWD recruitment; and adequate riparian vegetative cover to protect banks and dissipate energy during high flows. Reaches rated Non-Functional were harvested to the streambanks, consequently there is no buffer or future wood recruitment available. The highway and logging roads present fish passage and erosion problems. Landslide and debris torrents were documented in the sub-basin. See Appendix B for detailed reach descriptions.

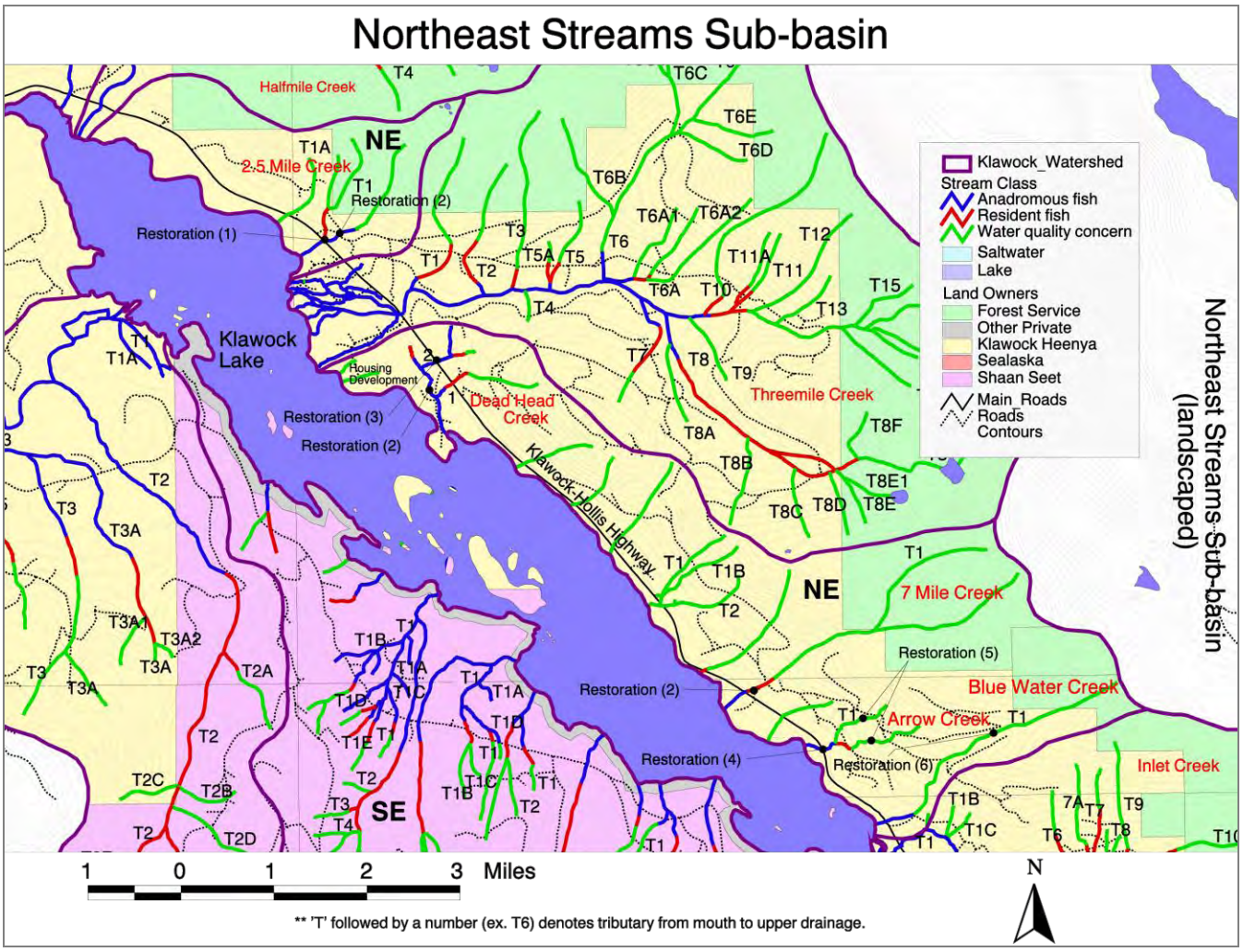


Figure 12. Major Features of the N.E Streams Sub-basin.

Table 24. PFC Rating Summarization for the N.E. Composite Sub-basin.

Sub-basin	Reach	PFC Rating	Fish	Channel Type	Total Length (feet)
2.5 mile	2.5M1	PFC	Y	FP3	900
	2.5M2	FAR D	Y	MM1, HC2, HC6	1,725
	2.5M3	PFC	N	HC6	4,750
Deadhead	DI	FAR D	Y	FP3, PA1, PA5	2,600
	D2	PFC	Y	LC	2,650
	DT	NF	Y	MM1, AF2, HC2, HC6	3,975
7-mile	7M1	NF	Y	AF1 & AF2	1,800
	7M2	PFC	N	HC6	3,650
	7M3	PFC	N	HC6	10,000
Arrow Ck	A1	PFC	Y	FP3	625
	A2	FAR D	Y	MM1, HC2, HC6	5,875
Bluewater	B1	PFC	Y	FP3, MM1, HC2	1,225
	B2	FAR D	N	HC5	2,150
	B3	NF	N	HC2	3,325
	B4	PFC	N	HC6	2,700
					Total Miles 9.1

Restoration opportunities for the Northeast Sub-basin

The PFC Team identified six restoration opportunities (some have multiple sites) in the Northeast Composite Sub-basin (figure 12). These opportunities will help move streams towards a proper functioning condition, are relatively low cost and were designed to meet specific objectives for the site. The following is a site-specific list of immediate restoration opportunities. The list should not be considered comprehensive or prioritized.

Table 25. Restoration Opportunities for Northeast Composite Sub-basin.

Project #	Sub-basin	Stream	Location	PFC ID	Sum Det.	Length / Area	Issue / Opportunity	Proposed Restoration Activity
1	NE Streams	2.5 Mile	Highway crossing	2.5M1	PFC	1,000 ft. class I 2,100 ft. class II	Restore fish passage, inadequate riparian buffers	upgrade culverts on highway
2	NE Streams	2.5 Mile, Deadhead 7-Mile, Arrow	upstream of highway	2.5M2, D1, 7M1, A2	FAR-D	4,000 ft.	Improve habitat and LWD recruitment	Riparian thinning and LWD placement
3	NE Streams	7-mile	Highway crossing	7M1	FAR D	700 ft.	Restore fish passage, Undersized and perched 8 ft. diameter culvert	Upgrade culvert on highway
4	NE Streams	Arrow	Highway crossing	A1	PFC	500 ft. class I and 850 ft. class II	Fish passage, inadequate culvert on highway	Improve gradient through culvert, add ditchblock and clean 3 cu. Yds. of material from inlet.
5	NE Streams	Arrow	Logging road crossings	A2	PFC	N/A	Erosion from undersized pipes on logging road	Remove pipes and stormproof road.
6	NE Streams	Bluewater	Logging roads and upper watershed	B2, B3	FAR-D, NF	5,700 ft.	Roads and landslides are contributing sediment to the stream.	Grass seed landslides, disturbed areas and roads. Stormproof and decommission roads.

Southeast Composite Sub-basin

Southeast Composite Sub-basin Description

The Southeast Sub-basin is a composite sub-basin that includes eight small streams that drain moderately steep mountain slopes and footslopes on the southeast side of Klawock Lake. The sub-basin includes: Inlet South Creek, Salmon Salad Creek, SE 3& 4 Creek, Alder Creek, TR6 Creek, Swamp Creek, and Chutes and Ladders Creek. All streams are located between Inlet Creek Sub-basin and Hatchery Creek Sub-basin. Typically, the lower half of each stream are gentle footslope channels that include fish habitat. Chutes and Ladders Creek, Swamp Creek and Salmon Salad Creek have substantial floodplain reaches and high value riparian habitat.

The ―StNicholas Tie-road" provides access to the southern portion of the watershed. Shaan Seet, Inc. manages most of the lands in this sub-basin for timber production. Significant road-building and harvest has occurred. Logging roads are diverting water and contributing sediment to streams in several headwater areas. Privately owned lots occupy nearly the entire lakeshore in this ―sub-basin". The lots extend about 400 feet from the lakeshore. Most of the lots are currently undeveloped, but future development and access could negatively impact streams and wetlands. The dominant stream process groups in the sub-basin are HC, FP, and MM. Similar to the Hatchery Creek system, beaver ponds are becoming more prevalent in the Chutes and Ladders, Swamp and Alder Creek systems. Refer to the discussion on p. 9 for more information on beaver activity.

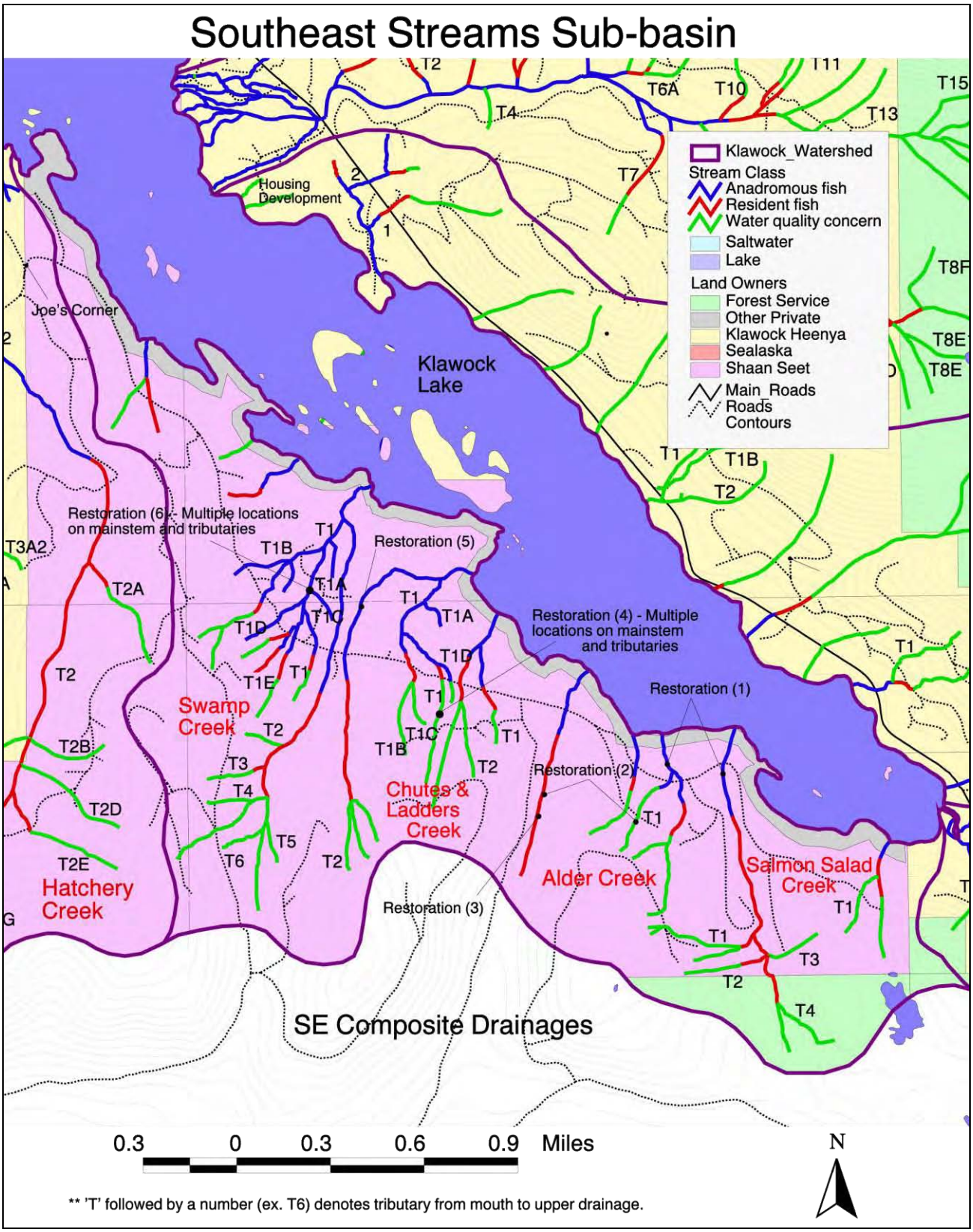


Figure 13. Major Features of the Southeast Sub-basins.

Table 26. Major features of the Southeast Composite Sub-basin.

Southeast Composite Sub-basin	Acres	% of total	Miles
Total Acres (*composite sub-basin)	3,641	100%	
Ownership			
Shaan Seet, Inc.	3,089	85%	
Other Private	280	8%	
USFS—Craig Ranger District	244	7%	
Klawock Heenya, Inc.	28	<1%	
Sub-basin Features			
Harvest acres/ second growth	N/A		
Roads			18.1 (3.2m/sq. mile)
Total Stream Miles (does not include all Class IV)			22
Class I			8
Class II			4.8
Class III			9.1

Tier 1 and PFC Results Southeast Composite Sub-basin

20 miles of Tier 1 and PFC assessments were conducted on 100 percent of Class I, II and some Class III streams in the Southeast Composite Sub-basin. Eight streams were divided into 15 reaches for the assessment. Two streams are grouped into one reach for assessment purposes: SE3 and 4. Nine reaches rated PFC and seven reaches rated FAR--Downward or Non-Apparent trend. Stream reaches classified as FAR lacked future LWD recruitment potential, exhibited excessive erosion and/or deposition, and/or exhibited channel instability. Other key checklist components that determined ratings included: upland watershed degradation; stream bank and upland harvest; and adequate riparian vegetative cover to protect banks and dissipate energy during high flows. Some reaches were harvested to the streambanks, consequently there is no buffer or future wood recruitment available. Several logging roads present fish passage and erosion problems. The lower reaches along the lake were generally rated PFC. Reaches in the mid-to-upper slopes did not have adequate buffers and, in some, cases LWD was removed from these systems.

Table 27. PFC rating summarization for Southeast Composite Sub-basin.

Sub-basin/ Stream	PFC Reach	PFC Rating	Fish	Channel Type	Total Length (ft)
Inlet South	IS	PFC	Y	FP3, HC2	1,400
Salmon Salad	SS1	PFC	Y	PA1, FP3&4, MM1, MC2, HC4&5	10,150
South East	SE3&4	FAR N	Y	FP3, MM1, HC2,5&6	11,300
Alder Creek	A1	PFC	Y	MM1	1,800
	A2	FAR D	Y	HC2	3,500
TR6	TR6-1	PFC	Y	FP3, MM1	5,700
	TR6-2	FAR N	Y	FP3, MM1, HC2,5&6	15,800
Swamp Creek	S1	PFC	Y	FP4, PA5	2,950
	S2	FAR D	Y	AF1, PA5	2,150
	S3	PFC	Y	HC2, HC6	7,350
Chutes & Ladders	CL1	PFC	Y	FP3&4, PA2, HC2	7,800
	CL2	FAR D	Y	FP4, MM1, AF1	3,325
	CL3	PFC	Y	HC2,4,5&6	7,800
	CLT1	FAR D	Y	FP3&4, PA5	7,950
	CLT2	FAR N	Y	FP3, HC2,5&6	16,825
					Total 20 miles

Restoration Opportunities in the Southeast Sub-basins

The PFC Team identified several restoration opportunities in the Southeast composite Sub-basins. Most opportunities involve riparian thinning, road maintenance and/or decommissioning and adding LWD to LWD-dependent streams where wood had been removed. In general, access to these streams is good for LWD placement.

This sub-basin is a priority for implementing restoration opportunities. Streams comprising the S.E composite sub-basin contain the second most amount of anadromous spawning habitat in the watershed. Risks to habitat disturbance from development, deteriorating road systems, inadequate stream buffers, and accelerating channel erosion (some deposition) in these systems is high. Comparing these disturbance risks to the high value fish habitat, make the southeast sub-basin a high priority for restoration activities.

Table 28. Restoration opportunities for Southeast Sub-basin.

Project #	Sub-basin	Stream	Location	PFC ID	Sum Det.	Length / Area	Issue / Opportunity	Proposed Restoration Activity
1	SE Streams	Salmon Salad, SE 3&4	750 ft. harvested reach on SS1, 1,000 ft. on SE 3&4	SS1	PFC	750 ft.	Stream lacks LWD now for the future	Add LWD to stream and thin streamside second-growth for future.
2	SE Streams	SE 3&4, Alder	Upper watershed	SE3&4	FAR-N, FAR-D	XX acres, XX ft. of roads, 1000 ft. stream	Roads contributing sediment and diverting water, lack of LWD.	Decommission roads in the upper part of the watershed, add LWD to MM1 section of SE3&4.
3	SE Streams	Alder	Upper HC2 channel	A2	FAR D	1,000 ft.	Stream lacks LWD now and in the future	Add LWD to stream and thin streamside second-growth for future.
4	SE Streams	TR6	FP and MM channels	TR6-2	FAR-D	8,350 ft.	Stream lacks LWD now and in the future. Upper road is contributing sediment and diverting water	Add LWD to stream, thin streamside second-growth for future. Many reaches, see Appendix C. Decommission upper road in headwaters
5	SE Streams	Swamp	Reach S2	S2	FAR-D	2,800 ft.	Stream lacks LWD now and in the future, no functional buffer	Thin streamside second-growth and conifer release. May be able to helicopter LWD into stream--poor access.
6	SE Streams	Chutes and Ladders	Reach CL2, CLT1, CLT2	CL2, CLT1, CLT2	FAR-D, FAR N, FAR-D	~3,000 ft LWD, XX acres of rip. Thinning/con. release	Lack of LWD, alders are suppressing conifers in streamside zone. Road/water interactions	Thin streamside second-growth and conifer release. Opportunity to place LWD in FP and MM channels. Stormproof upper roads

Future Studies, Information Needs, and Opportunities

This document represents the culmination of a two-year watershed assessment effort with the USFS Craig Ranger District and the Tlingit Haida Central Council of Alaska. A comprehensive watershed restoration and management plan is being developed for the watershed in conjunction with the Klawock Watershed Council and the principle landowners (Klawock-Heenya, Inc., Shaan-Seet, Inc., and Sealaska, Inc.)**.** Some additional issues and opportunities relative to the project are also documented. A project history and timeline follows:

Project History and Timeline

The following are the original components of the Klawock Watershed Project for **1999**:

1. Initiate watershed Proper Functioning Condition assessment (PFC). Process includes several steps:
   - Inventory watershed features
   - Update GIS layers
   - Perform aerial photo review
2. Perform functional assessment on major sub-basins (60 percent of watershed).
   - Klawock PFC Team trained by USFS/BLM National Riparian Service Team
   - 10 out of 40 miles of fish habitat assessed in 1999.
3. Suggest biological assessment to complement physical PFC assessment
4. Document findings (phase I report of Klawock Preliminary Watershed Assessment)
   - Report findings to watershed stakeholders, e.g., Klawock Watershed Council, Native corporations and IRAs, etc.

The following outlines **2000** project objectives and achievements:

1. Completed stream inventory of the remaining watershed
2. Applied PFC assessment to remaining sub-basins and all fish bearing streams.
3. Initiated functional wetland assessment within priority sub-basins using PFC methodology.
4. Completed landslide inventory for Three-mile sub-basin.
5. Federal subsistence program contracted with Alaska Department of Fish and Game (ADFG) to conduct biological assessment of the watershed. ADFG Commercial Fish Division initiated work in 2000:

   Synthesize information on salmon life histories, habitat usage, predation, and lake productivity. Information would assist in identifying potential factors limiting production of sockeye salmon. The following information, along with the known escapement through the hatchery weir, should determine factors limiting sockeye production (outmigration) from the Klawock system. This could help to focus efforts to increase sockeye runs towards historical levels in the system.
6. Document findings and prepare phase II report (Klawock Preliminary Watershed Assessment).
   - Present assessment findings to watershed stakeholders e.g., Klawock Watershed Council, Native corporations and IRAs, etc.

2001 project objectives and achievements:

1. Perform uplands assessment:
   - Initiated Road Condition Survey (RCS) to transportation system. Abbreviated RCS would efficiently determine problem areas and maintenance needs for roads and stream crossings and prioritize work.

- Trained local personnel.

2. Participate in newly created Klawock Watershed Council (KWC)
   - Several members of the Forest Service actively participate in a technical and advisory capacity for the KWC.
3. Facilitate project, develop and secure grants for continuing watershed work, development of watershed management and restoration plan and implementation of the plan.
   - Secured major funding from S.E. Seiners Association and US Environmental Protection Agency.
4. Complete Klawock Preliminary Watershed Assessment report for 2000 (phase II).

2002 Objectives:

1. Assist in development of watershed management plan for Klawock Watershed.
   - Incorporate assessment findings and represent interests of watershed stakeholders as expressed through Klawock Watershed Council into plan.
   - Continue to secure funding for watershed projects
2. Assist with watershed restoration planning and project design i.e., apply expertise on physical restoration work as opportunities arise.
3. Maintain partnership with ADFG Habitat and Alaska Department of Natural Resources (DNR) to conduct RCS in Klawock Watershed in 2002.
4. Continue with watershed data collection as funding and personnel are available e.g. documentation of timber harvest (GIS), spawning ground surveys, water quality monitoring and stream surveys (establish baseline for restoration activities).
5. Partner with ADFG, 4-H, and the Klawock, Craig, and SE Island School Districts to develop and present an outdoor/conservation education workshop for adult volunteers in the communities of POW. Adult volunteers will then take the program to young people in the schools and local communities.
6. Establish funding opportunities with Alaska DNR, Division of Forestry, Forest Stewardship Program, for Klawock-Heenya, Inc. and Seet-Seet, Inc. to develop land management plans for their lands within the watershed.

Ongoing Issues/Opportunities

Evaluate the effects of the causeway on the Klawock Estuary. Partnership efforts with NOAA, USFWS, and the U.S. Army Corp of Engineers are currently underway. Improving drainage may assist in restoring natural process and function to the estuary and improve fish passage and habitat.

Establish baseline for monitoring impacts to streams from future development. Community environmental planners are trained in water quality assessment and sampling. Expand project to involve Watershed Council and local community.

The Craig IRA has expressed an interest in conducting a watershed assessment in Crab Creek similar to that of the Klawock project. Some local support exists to combine assessment efforts and watershed councils to reflect Craig IRA and remaining Shaan Seet lands.

References

Prichard, Don, work group leader. 1998. A user guide to assessing Proper Functioning Condition and the supporting science for lotic areas. Tech. Ref. 1737-15. National Applied Resource Science Center. Denver, CO. 126p.

Prichard, Don, work group leader. 1999. A user guide to assessing Proper Functioning Condition and the supporting science for lentic areas. Tech. Ref. 1737-16. National Applied Resource Science Center. Denver, CO. 109p.

Prince of Wales Hatchery Association, 1999. Sockeye Conference, Klawock, AK.

KGIS. 1995. Ketchikan Area Geographical Information System. USDA Forest Service, Tongass National Forest, Ketchikan Area, Ketchikan, AK.

USDA Forest Service. 1979. Water Resources Atlas, Forest Service, Region 10. USFS, Juneau, Alaska.

USDA Forest Service. 1992. Channel Type Users Guide for the Tongass National Forest, Southeast Alaska. USDA Forest Service, Alaska Region, Technical Paper R10-TP-26, Juneau AK. 179p.

US Geological Survey. 1978. Water resources data for Alaska, Water Year 1977. Water Data Report AK-77-1. USGS, Anchorage, Alaska. 439p.

Kane, D., Belke, C., Geick, R., Mclean, R., 2000. Juvenile Fish Passage Through Culverts in Alaska: A Field Study. Report Number INE/WERC 00.05.

Tlingit and Haida Central Council, 1999. Southeast Alaska Tribal Unified Watershed Assessment.

James, G. A. 1956. The Physical Effect of Logging on Salmon Streams of Southeast Alaska. Station Paper No. 5. USDA Forest Service, Alaska Forest Resource Center, Juneau, Alaska.

Meehan, W. R., W. A. Farr, D. M. Bishop, and J. H. Patrick. 1969. Some effects of clearcutting on Salmon Habitat of Two Southeast Alaska Streams. Research Paper PNW-82. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Bartos, L. 1989. A new look at flows after logging. In: E. B. Alexander (ed.), pp. 99-98. Proceedings of Watershed '89, March 21-23, Juneau, Alaska. R10-MB-77. USDA Forest Service, Alaska Region, Juneau, Alaska.

MacDonald, L.H. 1991. Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska. EPA/910/9-91-001 U.S. Environmental Protection Agency, Seattle, Washington.

Lewis and Zedina, 2002. Alaska Department of Fish and Game. The History of Subsistence and Commercial Fisheries, Stock Assessment and Enhancement Activities, and Watershed Disturbances in the Klawock Lake Drainage on Prince of Wales Island, 2000 Annual Report.

Hannon, 2000. Hannon, John. USFS Fish Biologist, Craig Ranger District, personal communication

Mcgee, 2000 McGee, K. USFS Hydrologist personal communication, 2000).

Swanston, 1997. Swanston, F. USFS personal communication, 1997

Appendix A Proper Functioning Condition (PFC) Methodology

Proper Functioning Condition (PFC) is a qualitative method for assessing the condition of riparian-wetland areas. The term PFC is used to describe both the assessment process and the condition of a riparian wetland area. The methodology was developed by a national interagency team and documented in a series of Technical References, TR 9 through 16 (Prichard et al., 1993 through 1999). See the PFC user's guides for more details on the PFC process http://www.or.blm.gov:80/nrst/pfc.htm

The process involves the following steps:

1. Review existing documents--including maps, files and aerial photos.
2. Analyze the PFC definition--assess riparian/wetland based on a riparian area's capability and potential.
3. Assess Functionality--through document and field review. The rating is based on team discussion.
4. Institute the process--incorporate the information collected into a management plan.

The minimum national standards are achieved by using a standardized checklist. The PFC assessment, using the checklist, should work for most sites as long as the procedure is followed and definitions are understood. This is because the PFC was founded from rigorous science and is performed in an interdisciplinary setting.

The lotic (stream/moving water) checklist contains 17 items which were qualitatively assessed by the PFC Team. The lentic (lake/wetland) checklist contains 20 items. The appropriate form was used by the IDT to assess riparian-wetland conditions. Items on the checklist relate to stream channel stability and/or wetland functionality, and receive "yes" or "no" answers. In some cases, "not applicable" is used. The checklist and its summarization, which can be done quickly, are used to classify the health or state of physical processes of the riparian-wetland area or reach being studied into one of four categories:

- Functional – At Risk (FAR)
- Nonfunctional (NF)
- Proper Functioning Condition (PFC)
- Unknown

The preponderance of "yes" and "no" responses help the ID Team determine the proper classification, however there is no set number of "yes" and "no" answers to determine which category a water body falls into. Team discussion is an important part of classification.

The significance of the classification categories are:

PFC: The stream channel, floodplain, and/or wetland have the physical characteristics that provide stability through various frequency events. This resiliency allows an area to produce desired values such as fish and wildlife habitat over time.

FAR: The stream or wetland is functioning but is lacking enough vegetation, soils or landform characteristics to withstand various frequency events without significantly damaging the riparian corridor. FAR is the only category that is further stratified by trend (up, down, not apparent). A downward trend rating indicates deteriorating conditions that could become NF. Deteriorated conditions can be transmitted both up and downstream. Trends that are not apparent require further study.

NF: The stream or wetland is not stable because it lacks most of the stabilizing physical characteristics and may continue to deteriorate. The degraded area or reach cannot sustain long-term desired values and return to proper-functioning condition without intervention (change in management).

Unknown: Sufficient information to make a rating is lacking. Additional study or data collection is necessary.

The results of the PFC assessment will be analyzed and presented in a written report. The report will outline numbers of streams and wetlands in a particular category i.e., PFC, FAR, NF, or Unknown.

Classification of reaches using the PFC method will help the local planning group establish a common vocabulary for discussing desired conditions in regard to key riparian-wetland landscape elements. The need, type, and location of more detailed inventories (upland methods as well as riparian-wetland corridor methods) can be prioritized once the PFC assessment classifications are known in preparation for developing restoration and management alternatives.

PFC Standard Checklists
Standard Lotic PFC Checklist

Name of Riparian-Wetland Area: _____

Date:_____ Segment/Reach ID_____

Miles:_____ Acres:_____

ID Team Observers:_____

Yes	No	N/A	HYDROLOGY
			1) Floodplain above bankfull is inundated in "relatively frequent" events
			2) Where beaver dams are present they are active and stable
			3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
			4) Riparian-wetland area is widening or has achieved potential extent
			5) Upland watershed is not contributing to riparian-wetland degradation

Predominant Channel Type:

Yes	No	N/A	VEGETATION
			6) There is diverse age-class distribution of riparian-wetland vegetation(recruitment for maintenance/recovery)
			7) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery)
			8) Species present indicate maintenance of riparian-wetland soil moisture characteristics
			9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events
			10) Riparian-wetland plants exhibit high vigor
			11) Adequate riparian-wetland vegetative cover is present to protect banks and dissipate energy during high flows
			12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)

Predominant Seral Stage:

Yes	No	N/A	EROSION/DEPOSITION
			13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) are adequate to dissipate energy
			14) Point bars are revegetating with riparian-wetland vegetation
			15) Lateral stream movement is associated with natural sinuosity
			16) System is vertically stable
			17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Bedload Composition:
Substrate Embeddedness:

(Revised 1998)

Remarks

Reach Description:

_____
_____
_____

Fish species observed:

Restoration Opportunities:

Summary Determination

Functional Rating:

Proper Functioning Condition _____
Functional - At Risk _____
Nonfunctional _____
Unknown _____

Trend for Functional - At Risk:

Upward _____
Downward _____
Not Apparent _____

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes ___
No ___

If yes, what are those factors?

___ Flow regulations ___ Mining activities ___ Upstream channel conditions ___ Channelization ___ Road encroachment ___ Oil field water discharge ___ Augmented flows ___ Other (specify)_____

Lentic Standard Checklist

Name of Riparian-Wetland Area: _____

Date:_____ Area/Segment ID: _____Acres:_____

ID Team Observers:_____

Yes	No	N/A	HYDROLOGY
			1) Riparian-wetland area is saturated at or near the surface or inundated in "relatively frequent" events
			2) Fluctuation of water levels is not excessive
			3) Riparian-wetland area is enlarging or has achieved potential extent
			4) Upland watershed is not contributing to riparian-wetland degradation
			5) Water quality is sufficient to support riparian-wetland plants
			6) Natural surface or subsurface flow patterns are not altered by disturbance(i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)

Yes	No	N/A	VEGETATION
			8) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)
			9) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery)
			10) Species present indicate maintenance of riparian-wetland soil moisture characteristics
			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
			12) Riparian-wetland plants exhibit high vigor
			13) Adequate riparian-wetland vegetative cover is present to protect shorelines/soil surface and dissipate energy during high wind and wave events or overland flows
			14) Frost or abnormal hydrologic heaving is not present
			15) Favorable microsite condition (i.e., woody debris, water temperature, etc.) is maintained by adjacent site characteristics

Yes	No	N/A	EROSION/DEPOSITION
			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
			17) Saturation of soils (i.e., ponding, flooding frequency and duration) is sufficient to compose and maintain hydric soils
			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
			19) Riparian-wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
			20) Islands and shoreline characteristics (i.e., rocks, course and/or LWD) are adequate to dissipate wind and wave event energies.

(Revised 1998)

Remarks

_____
_____
_____
_____
_____

Summary Determination

Functional Rating:

Proper Functioning Condition _____
Functional - At Risk _____
Nonfunctional _____
Unknown _____

Trend for Functional - At Risk:

Upward _____
Downward _____
Not Apparent _____

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes ___
No ___

If yes, what are those factors?

___ Dewatering___ Mining activities ___ Watershed Condition
___ Dredging activities___ Road encroachment ___ Land ownership
___ Other (specify)_____

General Instructions

1) This checklist constitutes the **Minimum National Standards** required to determine proper functioning condition of lentic riparian-wetland areas.

2) As a minimum, an **ID team** will use this checklist to determine the degree of function of a riparian-wetland area.

3) An ID team **must review existing documents**, particularly those referenced in this document, so that the team has an understanding of the concepts of the riparian-wetland area they are assessing.

4) An ID team **must determine the attributes and processes important** to the riparian- wetland area that is being assessed.

5) Mark one box for each element. Elements are numbered for the purpose of cataloging comments. The numbers do not declare importance.

6) For any item marked "**No**," the severity of the condition must be explained in the "**Remarks**" section and must be a subject for discussion with the ID team in determining riparian-wetland functionality. Using the ``**Remarks**" section to also explain items marked ``**Yes**" is encouraged but not required.

7) Based on the ID team's discussion, "**functional rating**" will be resolved and the checklist's summary section will be completed.

8) Establish photo points where possible to document the area being assessed.

	Klawock River Sub-basin																													
	CHARACTERISTIC																													
	Non-Discernible (ND)	**K1**				**KA&K**				**KT1**				**KTHD**				**KT5**				**KW1**				**KW2**			
No.	HYDROLOGIC	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A
1	Floodplain above bankfull is inundated in "relatively frequent" events (1-3 years)	X				X				X				X				X				X				X			
2	Active and stable beaver dams				X				X	X						X					X			X				X	
3	Sinuosity, width/depth ratio, gradient in balance with landscape setting	X						X		X				X				X				X				X			
4	Riparian-wetland area is widening or has achieved potential extent	X						X		X				X				X				X				X			
5	Upland watershed is not contributing to riparian-wetland degradation	X						X		X				X				X				X				X			
	VEGETATIVE																													
6	Diverse age-class of riparian-wetland vegetation	X						X		X				X				X				X				X			
7	Diverse composition of riparian-wetland vegetation	X				X				X				X				X				X				X			
8	Species present indicate maintenance of riparian-wetland soil moisture	X				X				X				X				X				X				X			
9	Streambank vegetation is comprised of plants or plant communities that have root masses capable of withstanding high streamflow events	X				X				X				X				X				X				X			
10	Riparian-wetland plants exhibit high vigor	X				X				X				X				X				X				X			
11	Adequate vegetative cover present to protect banks and dissipate energy during high flows	X						X		X				X				X				X				X			
12	Plant communities are an adequate source of coarse and/or large woody material	X						X		X				X				X				X				X			
	EROSION/DEPOSITION																													
13	Floodplain and channel characteristics (i.e., rocks, large woody material) are adequate to dissipate energy	X						X		X				X				X				X				X			
14	Point bars are revegetating				X	X				X				X				X				X				X			
15	Lateral stream movement is associated with natural sinuosity	X						X		X				X				X				X				X			
16	System is vertically stable	X				X				X				X				X				X				X			
17	Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)	X						X		X				X				X						X		X			
	Summary of Determination																													
	Proper Functioning Condition	X								X								X								X			
	Functional at Risk					X								X								X							
	Non-functional																													
	Unknown																													
	Trend for Functional at Risk																													
	Upward																					X							
	Downward					X								X															
	Not Apparent																													

Half-mile Creek Sub-basin PFC Checklist

	CHARACTERISTIC	Half-mile Creek Stream Reaches											
			HM1				HM2				HM3		
No.	HYDROLOGIC	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A
1	Floodplain above bankfull is inundated in "relatively frequent" events (1-3 years)	X				X							X
2	Active and stable beaver dams			X					X				X
3	Sinuosity, width/depth ratio, gradient in balance with landscape setting	X				X				X			
4	Riparian-wetland area is widening or has achieved potential extent	X				X				X			
5	Upland watershed is not contributing to riparian-wetland degradation	X				X				X			
	VEGETATIVE												
6	Diverse age-class of riparian-wetland vegetation	X				X				X			
7	Diverse composition of riparian-wetland vegetation	X				X				X			
8	Species present indicate maintenance of riparian-wetland soil moisture	X				X							X
9	Streambank vegetation is comprised of plants or plant communities that have root masses capable of withstanding high streamflow events	X				X							X
10	Riparian-wetland plants exhibit high vigor	X				X				X			
11	Adequate vegetative cover present to protect banks and dissipate energy during high flows	X				X							X
12	Plant communities are an adequate source of coarse and/or large woody material	X				X				X			
	EROSION/DEPOSITION												
13	Floodplain and channel characteristics (i.e., rocks, large woody material) are adequate to dissipate energy	X				X				X			
14	Point bars are revegetating	X				X							X
15	Lateral stream movement is associated with natural sinuosity	X				X				X			
16	System is vertically stable	X				X				X			
17	Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)	X				X				X			
	Summary of Determination												
	Proper Functioning Condition	X				X				X			
	Functional at Risk												
	Non-functional												
	Unknown												
	Trend for Functional at Risk												
	Upward												
	Downward												
	Not Apparent												

Three-mile Creek Sub-basin PFC Assessment

	CHARACTERISTIC		**3M1**				**3M2**				**3M3**				**3M4**				**3M5**				**3M6**				**3M7**		
No.	HYDROLOGIC	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A
1	Floodplain above bankfull is inundated in "relatively frequent" events (1-3 years)	X				X				X				X							X				X	X			
2	Active and stable beaver dams	X				X				X							X				X				X				X
3	Sinuosity, width/depth ratio, gradient in balance with landscape setting		X				X							X				X				X				X			
4	Riparian-wetland area is widening or has achieved potential extent		X					X		X				X				X							X	X			
5	Upland watershed is not contributing to riparian-wetland degradation		X					X				X				X				X				X		X			
	VEGETATIVE																												
6	Diverse age-class of riparian-wetland vegetation		X			X					X			X						X		X					X		
7	Diverse composition of riparian-wetland vegetation	X				X				X				X				X				X				X			
8	Species present indicate maintenance of riparian-wetland soil moisture	X				X				X				X				X							X	X			
9	Streambank vegetation is comprised of plants or plant communities that have root masses capable of withstanding high streamflow events	X				X				X				X				X							X	X			
10	Riparian-wetland plants exhibit high vigor	X				X				X				X				X				X				X			
11	Adequate vegetative cover present to protect banks and dissipate energy during high flows			X				X				X		X						X					X			X	
12	Plant communities are an adequate source of coarse and/or large woody material			X				X				X		X						X			X		X			X	
	EROSION/DEPOSITION																												
13	Floodplain and channel characteristics (i.e., rocks, large woody material) are adequate to dissipate energy			X				X				X		X					X			X				X			
14	Point bars are revegetating				X				X				X				X				X				X				X
15	Lateral stream movement is associated with natural sinuosity	X				X				X				X				X				X				X			
16	System is vertically stable			X				X				X		X						X		X				X			
17	Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)			X				X				X				X				X		X						X	
	Summary of Determination																												
	Proper Functioning Condition																												
	Functional at Risk	X				X				X				X				X				X				X			
	Non-functional																												
	Unknown																												
	Trend for Functional at Risk																												
	Upward													X															
	Downward	X				X				X								X								X			
	Not Apparent																					X							

Three-mile Creek Tributaries Sub-basin PFC Assessment

	CHARACTERISTIC	3MT1,2,3,5				NF1				3MT6A				3MT7				SF1				SF2				SF3			
No	HYDROLOGIC	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A
1	Floodplain above bankfull is inundated in "relatively frequent" events (1-3 years)	X							X				X	X							X	X				X			
2	Active and stable beaver dams				X				X				X				X				X				X				X
3	Sinuosity, width/depth ratio, gradient in balance with landscape setting	X				X				X				X				X				X						X	
4	Riparian-wetland area is widening or has achieved potential extent	X				X				X				X							X	X				X			
5	Upland watershed is not contributing to riparian-wetland degradation			X				X				X		X						X				X				X	
	VEGETATIVE																												
6	Diverse age-class of riparian-wetland vegetation			X				X				X			X			X				X						X	
7	Diverse composition of riparian-wetland vegetation	X				X				X				X				X				X				X			
8	Species present indicate maintenance of riparian-wetland soil moisture			X					X				X	X							X	X				X			
9	Streambank vegetation is comprised of plants or plant communities that have root masses capable of withstanding high streamflow events	X				X				X				X				X				X				X			
10	Riparian-wetland plants exhibit high vigor	X				X				X				X				X				X				X			
11	Adequate vegetative cover present to protect banks and dissipate energy during high flows			X				X				X				X		X						X				X	
12	Plant communities are an adequate source of coarse and/or large woody material			X				X				X				X		X						X				X	
	EROSION/DEPOSITION																												
13	Floodplain and channel characteristics (i.e., rocks, large woody material) are adequate to dissipate energy	X						X				X		X				X				X				X			
14	Point bars are revegetating			X					X				X				X				X				X				X
15	Lateral stream movement is associated with natural sinuosity	X				X					X			X				X				X						X	
16	System is vertically stable	X				X					X			X				X				X						X	
17	Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)			X				X				X		X					X			X						X	
	Summary of Determination																												
	Proper Functioning Condition																	X											
	Functional at Risk													X								X							
	Non-functional	X				X				X																X			
	Unknown																												
	Trend for Functional at Risk																												
	Upward													X								X							
	Downward																												
	Not Apparent																												

Northeast Streams

No.	CHARACTERISTIC	2.5M1				2.5M2				D1				D2				DT			
	Non-Discernible (ND)																				
	HYDROLOGIC	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A
1	Floodplain above bankfull is inundated in "relatively frequent" events (1-3 years)	X				X				X				X				X			
2	Active and stable beaver dams				X				X			X					X				X
3	Sinuosity, width/depth ratio, gradient in balance with landscape setting	X				X				X				X						X	
4	Riparian-wetland area is widening or has achieved potential extent	X				X				X				X						X	
5	Upland watershed is not contributing to riparian-wetland degradation	X				X						X		X						X	
	VEGETATIVE																				
6	Diverse age-class of riparian-wetland vegetation	X						X				X		X						X	
7	Diverse composition of riparian-wetland vegetation	X				X				X				X				X			
8	Species present indicate maintenance of riparian-wetland soil moisture	X				X				X				X				X			
9	Streambank vegetation is comprised of plants or plant communities that have root masses capable of withstanding high streamflow events	X				X				X				X						X	
10	Riparian-wetland plants exhibit high vigor	X				X						X		X				X			
11	Adequate vegetative cover present to protect banks and dissipate energy during high flows	X						X		X				X						X	
12	Plant communities are an adequate source of coarse and/or large woody material	X						X				X		X						X	
	EROSION/DEPOSITION																				
13	Floodplain and channel characteristics (i.e., rocks, large woody material) are adequate to dissipate energy	X						X				X		X						X	
14	Point bars are revegetating	X							X	X				X							X
15	Lateral stream movement is associated with natural sinuosity	X				X				X				X				X			
16	System is vertically stable	X				X				X				X						X	
17	Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)	X				X						X		X						X	
	Summary of Determination																				
	Proper Functioning Condition	X												X							
	Functional at Risk					X				X											
	Non-functional																	X			
	Unknown																				
	Trend for Functional at Risk																				
	Upward																				
	Downward					X				X											
	Not Apparent																				

Northeast Streams (cont'd)

	CHARACTERISTIC																																							
	Non-Discernible (ND)	**7M1**					7M2				**7M3**				**A1**				**A2**				**B1**				**B2**				**B3**				**B4**			
No.	HYDROLOGIC	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A
1	Floodplain above bankfull is inundated in "relatively frequent" events (1-3 years)	X							X	X				X				X				X							X	X							X
2	Active and stable beaver dams				X				X				X			X					X				X				X				X				X
3	Sinuosity, width/depth ratio, gradient in balance with landscape setting			X		X				X				X				X				X				X					X			X				
4	Riparian-wetland area is widening or has achieved potential extent		X			X				X				X				X				X				X				X				X				
5	Upland watershed is not contributing to riparian-wetland degradation			X				X		X				X				X						X				X					X			X			
	VEGETATIVE																																							
6	Diverse age-class of riparian-wetland vegetation			X		X				X				X						X		X				X						X		X				
7	Diverse composition of riparian-wetland vegetation	X				X				X				X				X				X				X				X				X				
8	Species present indicate maintenance of riparian-wetland soil moisture	X				X				X				X				X				X				X				X				X				
9	Streambank vegetation is comprised of plants or plant communities that have root masses capable of withstanding high streamflow events	X							X	X				X				X				X							X			X		X				
10	Riparian-wetland plants exhibit high vigor	X				X				X				X				X				X				X				X				X				
11	Adequate vegetative cover present to protect banks and dissipate energy during high flows			X		X				X				X				X				X						X				X		X				
12	Plant communities are an adequate source of coarse and/or large woody material			X		X				X				X						X		X				X						X		X				
	EROSION/DEPOSITION																																							
13	Floodplain and channel characteristics (i.e., rocks, large woody material) are adequate to dissipate energy			X		X				X				X						X		X				X						X		X				
14	Point bars are revegetating				X				X				X	X							X	X							X				X				X
15	Lateral stream movement is associated with natural sinuosity			X		X				X				X				X				X				X				X				X				
16	System is vertically stable	X	X			X				X				X				X				X				X				X				X				
17	Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)			X				X		X				X				X				X						X				X		X				
	Summary of Determination																																							
	Proper Functioning Condition					X				X				X								X												X				
	Functional at Risk																	X								X												
	Non-functional	X																												X								
	Unknown																																							
	Trend for Functional at Risk																																							
	Upward																																							
	Downward																	X								X												
	Not Apparent																																							

Inlet Creek Sub-basin

	CHARACTERISTIC																														
	Non-Discernible (ND)	I1				**IT1**				**IT2**				**IT3&4**				**IT6,7,7A,7B,8,9**				**IHDWS**				**IT11**			
No.	HYDROLOGIC	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A
1	Floodplain above bankfull is inundated in "relatively frequent" events (1-3 years)	X				X				X				X				X							X	X			
2	Active and stable beaver dams			X				X				X					X				X				X			X	
3	Sinuosity, width/depth ratio, gradient in balance with landscape setting	X				X				X				X				X				X				X			
4	Riparian-wetland area is widening or has achieved potential extent	X				X				X				X				X				X				X			
5	Upland watershed is not contributing to riparian-wetland degradation	X				X				X						X				X		X							
	VEGETATIVE																												
6	Diverse age-class of riparian-wetland vegetation	X				X				X						X				X		X				X			
7	Diverse composition of riparian-wetland vegetation	X				X				X				X				X				X				X			
8	Species present indicate maintenance of riparian-wetland soil moisture	X				X				X				X				X				X				X			
9	Streambank vegetation is comprised of plants or plant communities that have root masses capable of withstanding high streamflow events	X				X				X				X				X				X				X			
10	Riparian-wetland plants exhibit high vigor	X				X				X				X				X				X				X			
11	Adequate vegetative cover present to protect banks and dissipate energy during high flows	X				X				X						X				X		X				X			
12	Plant communities are an adequate source of coarse and/or large woody material	X				X						X				X				X		X				X			
	EROSION/DEPOSITION																												
13	Floodplain and channel characteristics (i.e., rocks, large woody material) are adequate to dissipate energy	X				X				X						X				X		X				X			
14	Point bars are revegetating	X				X				X							X				X				X				X
15	Lateral stream movement is associated with natural sinuosity	X				X				X				X				X				X				X			
16	System is vertically stable	X				X				X				X				X				X				X			
17	Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)	X				X				X						X				X		X				X			
	Summary of Determination																												
	Proper Functioning Condition	X				X				X												X				X			
	Functional at Risk													X															
	Non-functional																	X											
	Unknown																												
	Trend for Functional at Risk																												
	Upward																												
	Downward													X															
	Not Apparent																												

Southeast Streams

	CHARACTERISTIC																																								
	Non-Discernible (ND)	**TR61**				**TR62**				**S1**				**S2**				**S3**				**CL1**				**CL2**				**CL3**					**CLT1**			**CLT2**			
No.	HYDROLOGIC	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	N/A	Yes	ND	No	Yes	ND	No	N/A
1	Floodplain above bankfull is inundated in "relatively frequent" events (1-3 years)	X							X	X				X							X	X				X				X					X			X			
2	Active and stable beaver dams				X	X				X						X					X			X				X						X			X	X			
3	Sinuosity, width/depth ratio, gradient in balance with landscape setting	X				X				X				X				X				X				X				X					X			X			
4	Riparian-wetland area is widening or has achieved potential extent	X				X				X				X				X				X				X				X							X	X			
5	Upland watershed is not contributing to riparian-wetland degradation	X				X				X				X				X				X				X				X					X			X			
	VEGETATIVE																																								
6	Diverse age-class of riparian-wetland vegetation	X						X		X						X		X				X						X		X							X			X	
7	Diverse composition of riparian-wetland vegetation	X				X				X				X				X				X				X				X					X			X			
8	Species present indicate maintenance of riparian-wetland soil moisture	X				X				X				X				X				X				X				X					X			X			
9	Streambank vegetation is comprised of plants or plant communities that have root masses capable of withstanding high streamflow events	X				X				X				X				X				X				X				X					X			X			
10	Riparian-wetland plants exhibit high vigor	X				X				X				X				X				X				X				X					X			X			
11	Adequate vegetative cover present to protect banks and dissipate energy during high flows	X				X				X						X		X						X				X		X					X			X			
12	Plant communities are an adequate source of coarse and/or large woody material	X						X		X						X		X				X						X		X							X			X	
	EROSION/DEPOSITION																																								
13	Floodplain and channel characteristics (i.e., rocks, large woody material) are adequate to dissipate energy	X				X				X						X		X				X						X		X					X					X	
14	Point bars are revegetating	X							X	X				X							X				X	X								X							X
15	Lateral stream movement is associated with natural sinuosity	X				X				X				X				X				X				X				X					X			X			
16	System is vertically stable	X				X				X				X				X				X				X				X					X			X			
17	Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)	X				X				X				X				X						X		X				X					X			X			
	Summary of Determination																																								
	Proper Functioning Condition	X								X								X				X								X											
	Functional at Risk					X								X																					X			X			
	Non-functional																																								
	Unknown																																								
	Trend for Functional at Risk																																								
	Upward																																								
	Downward													X												X									X						
	Not Apparent					X																																X			

Hatchery Creek Sub-basin

	CHARACTERISTIC																														
	Non-Discernible (ND)	**H1**				**H2**				**HT2A**				**HT2B**				**HT3C**				**HT2D**				**HT2E**			
No.	HYDROLOGIC	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A
1	Floodplain above bankfull is inundated in "relatively frequent" events (1-3 years)	X				X				X				X				X				X				X			
2	Active and stable beaver dams			X		X						X					X				X				X				X
3	Sinuosity, width/depth ratio, gradient in balance with landscape setting	X				X				X				X				X				X				X			
4	Riparian-wetland area is widening or has achieved potential extent	X				X				X				X				X				X				X			
5	Upland watershed is not contributing to riparian-wetland degradation	X				X						X		X				X				X				X			
	VEGETATIVE																												
6	Diverse age-class of riparian-wetland vegetation	X				X				X				X						X		X						X	
7	Diverse composition of riparian-wetland vegetation	X				X				X				X				X				X				X			
8	Species present indicate maintenance of riparian-wetland soil moisture	X				X				X				X				X				X				X			
9	Streambank vegetation is comprised of plants or plant communities that have root masses capable of withstanding high streamflow events			X		X						X		X						X		X				X			
10	Riparian-wetland plants exhibit high vigor	X				X				X				X				X				X				X			
11	Adequate vegetative cover present to protect banks and dissipate energy during high flows	X				X				X				X						X		X						X	
12	Plant communities are an adequate source of coarse and/or large woody material			X		X						X		X						X		X						X	
	EROSION/DEPOSITION																												
13	Floodplain and channel characteristics (i.e., rocks, large woody material) are adequate to dissipate energy	X				X				X				X				X				X				X			
14	Point bars are revegetating	X							X	X				X				X							X				X
15	Lateral stream movement is associated with natural sinuosity	X				X				X				X				X				X				X			
16	System is vertically stable	X				X				X				X				X				X				X			
17	Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)	X				X						X		X				X				X				X			
	Summary of Determination																												
	Proper Functioning Condition	X				X								X								X							
	Functional at Risk									X								X								X			
	Non-functional																												
	Unknown																												
	Trend for Functional at Risk																												
	Upward																												
	Downward																	X								X			
	Not Apparent									X																			

Hatchery Creek Sub-basin Tributaries

	CHARACTERISTIC																													
		HP1				**HT3,3A-PH**				**HT3,3A,5L**				**HT3,3A,5U**				**HT6,6A&6B**				**HTS(Swamp)**				**HT11-15L**			
No.	HYDROLOGIC	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A	Yes	ND	No	N/A
1	Floodplain above bankfull is inundated in "relatively frequent" events (1-3 years)	X				X				X				X				X				X				X			
2	Active and stable beaver dams	X				X							X				X	X				X							X
3	Sinuosity, width/depth ratio, gradient in balance with landscape setting	X				X				X				X				X				X						X	
4	Riparian-wetland area is widening or has achieved potential extent	X				X				X				X				X				X				X			
5	Upland watershed is not contributing to riparian-wetland degradation	X				X				X						X		X				X						X	
	VEGETATIVE																												
6	Diverse age-class of riparian-wetland vegetation	X						X		X						X		X						X				X	
7	Diverse composition of riparian-wetland vegetation	X				X				X				X				X				X				X			
8	Species present indicate maintenance of riparian-wetland soil moisture	X				X				X				X				X				X				X			
9	Streambank vegetation is comprised of plants or plant communities that have root masses capable of withstanding high streamflow events	X				X				X				X				X				X						X	
10	Riparian-wetland plants exhibit high vigor	X				X				X				X				X				X				X			
11	Adequate vegetative cover present to protect banks and dissipate energy during high flows	X				X				X				X				X				X						X	
12	Plant communities are an adequate source of coarse and/or large woody material	X						X		X						X		X					X					X	
	EROSION/DEPOSITION																												
13	Floodplain and channel characteristics (i.e., rocks, large woody material) are adequate to dissipate energy	X				X				X				X				X				X				X			
14	Point bars are revegetating				X				X	X						X		X							X				X
15	Lateral stream movement is associated with natural sinuosity	X				X				X				X				X				X						X	
16	System is vertically stable	X				X				X				X				X				X				X			
17	Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)	X				X				X				X				X				X						X	
	Summary of Determination																												
	Proper Functioning Condition	X				X				X								X				X							
	Functional at Risk													X															
	Non-functional																									X			
	Unknown																												
	Trend for Functional at Risk																												
	Upward																												
	Downward														X														
	Not Apparent																												

Appendix B - Individual Reach Descriptions and PFC Assessment By Sub-basin

Klawock River Sub-basin

A PFC assessment was conducted on 7.8 miles of Class I and II streams in the Klawock River Sub-basin. Klawock River Sub-basin and its tributaries were delineated into seven reaches for conducting the PFC assessment. Klawock River was delineated into one reach, K1, and Waterline Creek was delineated into two reaches, KW1 and KW2. The remaining reaches are; KT1, KA&K, KTHD, and KT5. Three reaches were rated Functional at Risk, four Proper Functioning Condition, and none Non-Functional (Figure 6, Table 21). The majority of stream reaches classified as FAR lacked future LWD recruitment potential and exhibited excessive erosion and/or deposition. Beaver dams were present but not active. The absence of riparian/wetland plants, predominance of disturbance species, lack of channel stability and upland watershed degradation were all documented. Additionally, disturbance from development on the north side of the Klawock River Sub-basin is a significant threat to sub-basin functionally. A discussion of the individual reach descriptions and ratings are included in Appendix B.

Mainstem Klawock River

Reach K1 extends approximately 6,000 -foot from the estuary to Klawock Lake. This reach is Class I (channel type LC 1). The channel is low gradient and moderately confined. Lateral channel migration is controlled by periodic bedrock outcrops along the stream bank. Recent timber harvest (post 1990s) has occurred on the south side of the stream and is concentrated in the middle and upper reach. Some blowdown has occurred (<20 trees adjacent the harvested areas). The area adjacent the north side of the river has been altered by human activities including old roads, abandoned home-sites and associated land clearing, development, and abandoned home sites. A foot trail traverses the entire length of the river to the estuary and receives significant use from local sport fisherman. The Klawock-Hollis Highway runs parallel to the river. The highway is >50 yards from the river at the shortest distance.

Streams of the Large Contained channel type are generally stable. No mass wasting or significant stream bank erosion was recorded. However, streambanks adjacent the foot-trail on the north side of the river exhibited some site specific erosion where people gain access to the stream. LC1 channels store and transport sediment. Silt, sand and fine gravels are typically flushed through LC1 channels. The majority of LWD in Klawock River was from recent blowdown; otherwise LWD accumulations would be naturally low. LWD volumes are relatively low in these channels. High flows in the river would naturally move all but the most stable wood accumulations downstream or push debris to channel margins.

The Klawock River is used by spawning pink, chum, and steelhead species and occasionally by coho. Spawning areas are limited due to predominately large substrates. LC1 channels have limited rearing potential, except in areas of LWD accumulations. Steelhead and Dolly Varden frequently use boulder-pool habitat in these channels for rearing. LC1 channels provide extensive overwintering habitat for steelhead trout (USDA Forest Service, 1992). Adequate salmon spawning and rearing habitat is available in the Klawock River. Five adult steelhead and numerous juvenile steelhead and Dolly Varden and coho fry were observed during the survey (USFS-CRD snorkel survey, May 26, 2000).

Reach K1 was rated Proper Functioning Condition. Reach K1 is within a relatively intact natural forested riparian area. The reach is minimally impacted by timber harvest. Pockets of higher volume spruce along the river were removed; a 66-foot buffer is left. The buffer on the south side of the stream has been compromised. The PFC Team determined there would likely be enough wood for future recruitment for a LC channel. The channel is stable and adequate LWD and vegetation is present to dissipate stream energy. This system is functioning —as best it can" in relation to the attributes and processes defined by landform (Prichard, Tech. Ref. 1737-15 1999).

Reach KT1 drains a small low relief basin south of mainstem Klawock River. KT1 is a natural system that is minimally impacted by development and/or timber harvest. KT1 is documented in the ADFG stream catalog as

103-60-10470-2006. The creek is habitat for coho, chum, and pink salmon. Coho fry were observed during the survey (8/1/2000). Predominant stream process groups in the drainage include PA, FP, MM and MC. Total fish habitat in the drainage is approximately 17,500 feet Klawock Heenya, Inc. manages the small drainage.

Reach **KT1** is minimally impacted by development and/or timber harvest. **KT1** is comprised of Trib 1, 1A and 1B. KT1 is the largest and only trib located on the south side of the Klawock River. Total reach length of KT1 is 21,800 feet Mainstem Trib 1 is FP4 and extends 2,175 feet to an old large beaver dam. Many coho fry were observed in this section. Gravels appeared to be smaller diameter than optimal for good spawning habitat (bedload transport is likely influenced from extensive palustrine section above). The stream continues PA1 to a large pond where Trib 1A and 1B intersect Trib 1.

The extensive palustrine systems in the drainage are associated with extensive wetlands on low relief valley bottom landforms. PA channels are storage sinks consisting of low velocity glides associated with wetlands and lakes. Stream energy is low; substrate is small, predominately organics and sand. Some spawning takes place but systems are primarily rearing area. Coho, sockeye, and dolly varden utilize this prime rearing habitat. These channels are important wetland/floodplain complexes that function to moderate runoff, store sediment, and bank nutrients (USDA Forest Service, 1992).

The stream is FP3 above the PA reach. Both Trib 1 and Trib 1B contain upper FP3 segments with excellent spawning habitat. A total of 10,595 feet of FP channel type occurs in the reach (2,175 feet FP4). Both the mainstem and Trib 1A transition to MM1 above the FP3 sections and then to MC1 towards the upper basin, draining the forested wetlands above. The entire upper reach is in a near natural condition. Some selective harvest occurred adjacent Trib 1 between the confluence with Trib 1A and the Klawock River.

Reach KT1 was rated Proper Functioning Condition.
The channel is stable, adequate LWD and vegetation is present to dissipate stream energy. The selective timber harvest is minimal and not extensive enough to disturb the functionality of the system. Adjacent riparian harvest of large trees does not appear to have affected channel stability. There is some localized disturbances due to windthrow and selective harvest in the lower portion of mainstem Trib 1. There were no observed erosion or deposition problems. Historic beaver ponds are not active. This drainage is excellent refugia within the Klawock Watershed.

A&K Creek

A&K Creek drains a small low relief basin in the NW portion of the watershed—Klawock River Sub-basin. A&K Creek is an urban system that is impacted from development, the state highway and timber harvest. The Klawock-Hollis Highway bisects the sub-basin 400 feet upstream of the Klawock River. A&K Creek is not documented in the ADFG stream catalog. The creek is likely habitat for pink and coho salmon. No fish were observed during the survey (8/1/2000). Predominant stream process groups in the system include FP and MM. Total historic fish habitat is approximately 1,250 feet Several private entities including Klawock Heenya, Inc. manage the small drainage. The State of Alaska Department of Transportation (ADOT) manages the road corridor and impassable culvert. Approximately 60 percent (estimate) of the drainage is harvested. This small drainage is delineated into one reach for purposes of this assessment - KA&K.

Reach KA&K extends 3,450 feet from its confluence with Klawock River. The reach is FP3 Class I anadromous to the highway crossing (300 feet) and transitions to MM1 up 1000 feet to the corner of A&K streets. The FP3 section meanders through the mature forest canopy adjacent mainstem Klawock River. The culvert at the highway blocks access to the poor habitat above. The channel functions to store and process sediments routed from the gentle hillslope of the Mary Jackson Sub-division. The stream is small, ~6 feet bankfull width, and sinuous in its lower reach. The lower section is in good condition, but the section above the highway has been physically altered. Fair to good rearing and spawning habitat exist in the lower section. Above the highway, the stream flows through a 5-10 year old clearcut and has been cleaned of LWD. The 18 inch culvert on the highway exceeds gradient and jump pool height requirements for passing resident and anadromous fish. The culvert should be replaced when the road is upgraded.

Reach KA&K was rated **Functional at Risk-Downward Trend.** Reach A&K above the highway has been significantly impacted by development. The impassable culvert, riparian harvest and poor habitat in this reach qualified it for a FAR Down rating for the following: 1) Inadequate supply of large wood adjacent to the stream; 2) existing plant communities were not an adequate source of coarse and/or LWD for maintenance and recovery; 3) future wood recruitment is limited in this reach; 4) there are no large trees adjacent to the stream and predominant age classes are early seral; 5) adequate riparian vegetative cover is not present to protect banks and dissipate energies during high flows—disturbance species predominate; 6) sinuosity and width to depth (W/D) ratio is out of balance with the landscape setting; 7) floodplain and channel characteristics are not adequate to dissipate energy; 8) lateral stream movement is not associated with natural sinuosity, and 9) excessive erosion is visible in MM1 and HC2 reaches. The channels are essentially roadside ditches above the corner of A&K streets. Impacts from the roads and additional development are a concern.

Waterline Creek

Waterline Creek drains a small basin in the NW portion of the Klawock Watershed. Waterline Creek is impacted by a state highway and timber harvest. The Klawock-Hollis Highway bisects the stream 300 feet above the Klawock River. "Waterline" Creek is not documented in the ADFG stream catalog. The creek is habitat for pink and coho salmon. Coho fry were observed above the culvert on the highway during the survey (8/1/2000). Predominant stream process groups in the basin include FP, MM, MC and PA. Total reach length is 3,100 feet and total fish habit is 2,300 feet. Klawock Heenya, Inc. manages the drainage. ADOT manages the road corridor. Approximately 20 percent of the drainage is harvested (estimate). This small drainage is delineated into two reaches for purposes of this assessment (KW1 and KW2).

Reach KW1 extends 1,550 feet from its confluence with the Klawock River. The reach is FP3, Class I, 500 feet beyond the highway crossing. The stream is small, 13 feet bankfull width and sinuous in its lower reach. Good rearing and spawning habitat exist in the lower section. The stream transitions to MM1 above the highway becoming PA1 at 1100 feet just below the harvest boundary. The culvert at the highway crossing is perched 3 inches and impedes fish passage. The 18" culvert exceeds gradient requirements for passing resident and anadromous fish. Ultimately, the culvert should be replaced when the road is upgraded. One-hundred-fifty feet of beaver pond exists in the harvested section of the reach. Beaver pond development in the harvested area may be exacerbated by riparian harvest.

Reach KW1 was rated **Functional at Risk-Upward Trend.**
Reach KW1 is within a relatively intact natural forested riparian area. The lower section between Klawock River and the highway is in good condition. The perched culvert, riparian harvest and poor habitat in this reach qualified it for a FAR-Upward Trend rating. Beaver ponds are not active and stable; no recent beaver activity was observed; a minimum of a buffer exists in this reach that is extremely compromised on the west side of the stream; There is a lot of blow down and logging debris in the stream; disturbance species and "tall" hemlock were a significant component of the remaining riparian buffer; The stream is not in balance with the water and sediment being supplied by the watershed and excessive erosion and deposition was documented in relation to the beaver dams. The stream was observed to be particularly turbid. The stream will improve as trees grow back on the adjacent riparian and uplands and beaver ponds stabilize, but is decades from reaching PFC**.**

Reach KW2 extends 1,500 feet upstream. This reach is primarily Class II and III but it may provide some rearing habitat for juvenile coho salmon. Coho fry were not observed in this reach. The PA1 section meanders through a forested wetland and is in a natural condition. Beaver ponds are present in the palustrine dominated channel type above the harvest impacts.

Reach KW2 was rated **Proper Functioning Condition.** No significant impacts were observed in this reach. Beaver ponds were present but not active. Impacts were limited to erosion from naturally destabilizing beaver ponds.

Trailhead Creek

Trailhead Creek drains a small low relief basin in the NW portion of the watershed. Trailhead Creek is an urban system that is impacted from development, a state highway, and timber harvest. The Klawock-Hollis Highway bisects the sub-basin 300 feet above the Klawock River. The ADFG stream catalog lists Trailhead Creek (103-60-10470-2005) as habitat for pink and coho salmon. No fish were observed during the survey (11/9/2000). Predominant stream process groups in the basin include FP, MM and PA. Total fish habit is approximately 1,600 feet. Klawock Heenya, Inc. manages the small drainage. ADOT manages the road corridor. Approximately 20 percent of the drainage is harvested (estimate).

Reach KTHD extends 1,850 feet from its confluence with Klawock River. The reach is FP3, Class I to the highway crossing and abruptly transitions to MM1 for a short distance (250 feet) before becoming PA1. The PA1 section meanders through a muskeg and is relatively undisturbed. The culvert at the highway crossing and the poor habitat above restrict anadromous fish from utilizing this habitat. Bankfull width is 6 feet and the stream is sinuous in its lower reach. Fair rearing and spawning habitat exist in the reach. The lower reach is in good condition. A small section of harvest occurred adjacent the creek around the area encompassing the road prism. The predominant seral stage in the reach is mature; a thick stand of young spruce (~25 yrs old) surrounds the road prism. Old beaver ponds are present immediately upstream of the highway crossing that would provide excellent rearing habitat. The 18 inch culvert on the highway is undersized and exceeds gradient requirements for passing resident and anadromous fish. The culvert outlet could also be improved. It would be beneficial to back up as much water as possible to decrease pipe velocities—culvert is not perched. Adult coho have been observed at the culvert outlet several years ago (Hannon, personal communication, 2000). Ultimately, the culvert should be replaced when the road is upgraded.

Reach KTHD was rated **Functional at Risk-Downward Trend.** Reach KTHD is within a relatively intact natural forested riparian area. An —island" of disturbance exists around the road prism constituting approximately 300 feet of the total fish bearing reach. The PFC team determined that this was enough impact to effect the entire reach. The culvert, small headcut, and poor habitat in this reach qualified it for a FAR Down rating. Existing plant communities were not an adequate source of coarse and/or LWD for maintenance and recovery. Future LWD recruitment is limited in this reach-there are no large trees adjacent to the stream and-no diverse age classes. The system did not meet the minimum requirements for PFC. The stream will improve as trees grow back on the adjacent riparian and uplands and the headcut stabilizes, but is decades from reaching PFC**.** Beaver ponds, though functional, were not active.

Klawock River--Tributary 5

Tributary 5 drains a small low relief basin in the NW portion of the Klawock Watershed. Trib 5 is a natural system that is minimally impacted by development and/or timber harvest. The Klawock-Hollis Highway bisects the sub-basin 400 feet above the Klawock River. The stream is not documented in the ADFG stream catalog. The creek is habitat for coho salmon. Sockeye, steelhead, and pink salmon may utilize the lower section of creek. The stream is small though similar to other small known fish bearing systems along the Klawock River including Trailhead Creek. Coho fry were observed above the culvert on the highway during the survey (8/1/2000). Total fish habitat is 2,400 feet. Predominant stream process groups in the drainage include MM and MC. Approximately 15 percent of the drainage has been harvested. Klawock Heenya, Inc. manages the small drainage. ADOT manages the road corridor.

Reach KT5 extends 5,200 feet from its confluence with Klawock River. The reach is MM1 Class I anadromous up to and across the highway for 1,350 feet just below a Class III trib that enters Trib 5 upstream right. The stream transitions to MC1, for another 1,000 feet draining the forested wetland system above. MM1 channels are sediment transport oriented. LWD volume is substantial, but has only moderate retention of sand and gravel size sediment in these reaches. These channels also contain a moderate amount of available spawning area (11 percent) (USDA Forest Service, 1992). The stream is small, 7 feet bankfull width, and straight. The entire reach is in excellent condition. A small section of harvest occurred adjacent the creek around the area encompassing the road prism. The predominant seral stage in the reach is mature; a thick stand of young spruce (~25 yrs old)

surrounds the road prism. The culvert at the highway crossing is perched 1.5 feet, restricting access to the habitat above. A notched log weir was placed behind the outlet pool to increase pool depth by ADFG. This log weir is marginally successful, most likely improving passage at high flows. The culvert should be replaced when the road is upgraded.

Reach KT5 was rated **Proper Functioning Condition.** Reach KT5 is within a relatively intact natural forested riparian area. An "island" of disturbance exists around the road prism constituting approximately 300 feet of the total fish bearing reach including the inadequate culvert. The channel is stable, adequate LWD and vegetation is present to dissipate stream energy. This system is functioning "as best it can" in relation to the attributes and processes defined by landform (Prichard, Tech. Ref. 1737-15 1999).

Half-mile Creek Sub-basin

A field PFC assessment was conducted on 0.6 miles of Class I streams and on one mile of Class II streams in the Half-mile Creek Sub-basin. Half-mile Creek was delineated into four reaches for this assessment: HM1; HM2; HM3 and HM4. All four reaches were rated Proper Functioning Condition (Figure 6, Table 8). Results of the assessment include a brief description of the reach followed by a discussion of how the rating was determined.

Reach HM1 extends 1,125 feet from Klawock Lake to the highway. This reach includes an alluvial fan/delta. The alluvial fan is the dominant depositional feature on Half-mile Creek. Selective timber harvest has occurred along this reach and across the alluvial fan. The alluvial fan requires large wood to stabilize stream banks in the loose alluvial soils. Reach HM1 contains adequate spawning habitat relative to the channel type. Adult sockeye, pink, chum (few) and coho fry were observed during the survey (8/25/99).

Reach HM1 was rated **Proper Functioning Condition**. The assessment team believes there is adequate large wood to provide streambank stability now and in the future. There is a risk of the remaining large trees blowing down, leaving no large wood for recruitment in the future, despite the high amount of wood presently in the channel. A reservoir is located upstream of Reach HM1. The PFC team discussed what effects the reservoir has on the stream channel. The team expressed concern about the withdrawal of water and how it affects in-stream flow and sediment delivery to reach HM1. The Team documented short stretches of even-aged riparian vegetation (alders) that may not be adequate to protect stream banks. There is also concern regarding future land development and floodplain encroachment, and instream flow reductions resulting from a potential drawdown. The highway is currently altering the morphology of this reach. Sediment deposition was noted upstream of the highway crossing and streambed erosion was noted downstream of the crossing. Floodplain connectivity is also somewhat impaired by the highway crossing.

Reach HM2 extends 3,425 feet upstream from the highway crossing to the small reservoir used to collect water for the City of Klawock. The reach is Class I (channel type MM2) to the falls and Class II (channel type FP4) above falls (600 feet) to the reservoir. Overflow channels are present and active, and the reach contains several island features above the falls. Reach HM2 is depositional in the floodplain portion and transitional (depositional and erosional depending on flow) in the MM2 portion. Riparian vegetation is patchy in response to the harvested units adjacent to the west bank of the stream. A slope-break buffer was left on the MM portion of the stream and the floodplain portion was not harvested, although the access road to the reservoir encroaches on the floodplain slightly.

This reach contains adequate spawning habitat relative to the MM2 channel type. Stream substrate increases in size to cobbles and small boulders as related to landform-increased gradient. Adult sockeye (2), pink, chum (few), and coho fry were observed during the survey (8/25/99). A large conglomerate of debris was observed below the falls at a nick point separating channel types. Reach HM2 ends 600 feet above falls.

Reach HM2 was rated **Proper Functioning Condition**. The PFC Team believes there is an adequate source of large wood along this reach to provide for stream function. There is risk that windthrow may result in a large influx of LWD, which would reduce future recruitment. However, harvest adjacent to the stream dates back to the late 1980s and windthrow to date has been negligible. The PFC Team discussed what effects the reservoir

has on the stream channel. The team expressed concern about the effects of the dam on instream flow and sediment delivery. The streambed below the dam is nearly dry at times of high municipal demand during the summer months (personal communication, City of Klawock utility employees). The stream lacked roughness in certain channel segments. Selected riparian thinning may facilitate recovery. The highway crossing at the start of the reach may be negatively impacting fish passage. The culvert structures influence bedload movement causing an aggradation of materials immediately upstream of the crossing. As a result, fish encounter a steeper inlet and shallow rapid flows upon exiting culverts. Enhancement of fish passage could be achieved by constructing an outlet control pool, partially with materials deposited upstream of the inlet.

Reach HM3 extends 3,700 feet from the head of the reservoir to a 30-foot falls below the confluence of the first significant tributary (T2). Reach HM3 is a Class II (resident fish) stream containing MM2 and MC2 channel types. These channel types are heavily influenced by bedrock and are primarily sediment transport systems. Several cut bank failures were noted in reach HM3. These failures are a natural source of sediment and woody debris along the steep (75 percent) channel sideslopes. Several slumps and associated debris jams were observed. Most LWD (LWD) was associated with debris jams; otherwise LWD distribution was low. Available spawning and rearing habitat is naturally low in MC2 channel types. The majority of the reach is within the unmanaged portion of the watershed. A minor amount of timber harvest occurred adjacent to the reservoir at the beginning of the reach.

Reach HM3 was rated **Proper Functioning Condition**. This system is functioning —as best it can" in relation to the attributes and processes defined by landform (Prichard, Tech. Ref. 1737-15 1999). The channel is stable, vegetation is present, and both are functioning relative to the bedrock-dominated landform. The amount of timber harvest (next to the reservoir) is minimal and not extensive enough to disturb the functionality of the system.

Reach HM4 encompasses the remaining unmanaged portion of Half-mile Creek Sub-basin. The reach is 65,500 feet (12.4 miles) in length, extending from the end of HM3 and incorporating the broad muskeg plateau that forms the headwaters of the drainage. Reach HM4 contains significant Class II habitat and is comprised of a variety of channel types, predominately MC, PA and HC. These channel types are heavily influenced by bedrock and are primarily sediment transport systems. Several small lakes are located in the upper drainage and support high value adfluvial resident trout populations.

Reach HM4 was rated **Proper Functioning Condition**. HM4 is in a natural condition. There are no known impacts in this reach.

Three-mile Creek Sub-basin

A PFC assessment was conducted on all Class I and II streams and on some Class III streams in the Three-mile Creek Sub-basin. Three-mile Creek and its tributaries were delineated into 16 reaches for the PFC assessment. Main stem Three-mile Creek was delineated into seven reaches: 3M1 through 3M7. The South Fork (Trib 8) was divided into three reaches: SF1, SF2, and SF3. The North Fork (Trib 6) was divided into NF1, NF2, and NF3 (Figure 6, Table 12). Tributary streams with similar conditions were aggregated into one reach for assessment purposes. Tributaries 1, 2, 3, 5 were grouped into one reach (3MT1, 2, 3, 5). Results include a brief description of the reaches and a discussion of how the rating was determined.

Main stem Three-mile Creek

Reach 3M1 extends 3,800 feet from Klawock Lake to the highway crossing; total reach length is 10,850 feet. This reach is Class I, channel type AF1. The alluvial fan is large (approx. 152 acres), and includes multiple channels that are accessed depending on streamflow. Typically, at least three channels have water and support fish. At this time, the western-most channel consists of beaver ponds and timber has been harvested to the streambanks. Selective timber harvest has occurred adjacent to the middle and southern most channels of reach 3M1. Significant blowdown is scattered throughout the reach. Fresh, mobile bedload deposits are frequent along the middle channel.

A housing development has started south of the southern-most channel. This housing development sits on top a historic overflow channel that is easily identifiable on historic air photos. Reach 3M1 functions to deposit sediment and dissipate stream energy. Large wood is absolutely necessary to hold streambanks and dissipate energy in reach 3M1. The City of Klawock is investigating the possibility of using Three-mile Creek as a supplemental domestic water source. The drawdown would occur upstream of reach 3M1. Adequate salmon spawning and rearing habitat is available. Adult sockeye and pink salmon, Dolly Varden, and coho salmon fry were observed during the survey.

Reach 3M1 was rated **Functional at Risk with a downward trend**. The current supply of LWD in the stream is more than is typically seen in most stream reaches. However, it appears that the LWD is becoming buried at a very fast rate by incoming sediment. Furthermore, there is an inadequate supply of large wood adjacent to the stream for future recruitment needs. It was apparent to the PFC Team that the stream was downcutting in a few areas but aggrading rapidly in most areas. Excessive sediment deposition was visible in many areas where the stream is not downcutting. At this time, it appears there is enough LWD and riparian vegetation is present to process the additional sediment from upstream sources. It is unlikely that enough large wood will be present to dissipate energy in the future.

The roads and rock fill associated with the highway crossing and the housing development on the southeast side of the fan denies the stream access to a large historic overflow channel during high streamflow events (as it did in October 1999). The team was also somewhat concerned that the streambed is shifting rapidly enough to bury salmon redds, thus affecting salmon production. The highway has altered the hydrology and morphology of this reach by impairing floodplain connectivity. The stream may be decades from reaching PFC and will respond accordingly as the upper watershed improves and bedload stabilizes.

Reach 3M2 extends 7,150 feet upstream from the highway crossing to a point 150 feet below the confluence with the North Fork Tributary (NF1). At this point, reach 3M2 intersects a small alluvial fan associated with the North Fork tributary. Reach 3M2 is predominantly an MM2 channel type with some interspersed FP4 segments. Other features include numerous side channels, beaver ponds, overflow channels, and some mid-channel bar deposits. The FP segments exhibited high sinuosity, multiple channels, and well-developed point bars. Most of this reach has a narrow buffer of trees left from harvest in the late 1980s. Windthrow is frequent in the upper portion of the reach. The team noted variable stream gradients, especially in the floodplain (upper) portion of the reach. The variable stream gradients were attributed to headcutting through debris dams. The stream was not vertically stable in these areas. The stream appears to be adjusting to the debris dams created shortly after landslides in the upper part of the basin. In some cases, debris dams were still intact and holding back large volumes of sediment. At this time, the amount of LWD is more than the team expected to see in this type of channel. Pre-harvest air photos show alder trees in the riparian area along the upper part of reach 3M2. The alders indicate that this reach has always been dynamic. Debris from landslides occurring in the steep headwater areas often ends up in reach 3M2. A few beaver dams occur on the edge of the floodplain away from the main channel in the upper part of the reach. A stream gage was established in the upper part of the reach, where the City of Klawock is studying the water source potential. Five small tributaries enter this reach (Class III and IV). One reach sharing similar features was delineated into one reach containing tributaries 1, 2, 3, 5. (3MT1, 2, 3, and 5). These areas are excellent spawning habitat. Adult sockeye, pink, chum (few) and coho fry were observed during the survey (9/1/99). Overall, this reach encompasses a fair amount of available spawning habitat.

Reach 3M2 was rated **Functional at Risk with a downward trend**. At this time, portions of reach 3M2 are not vertically stable. The stream appears to be processing a lot of sediment that is stored behind numerous debris dams. Although pre-harvest air photos indicate a long history of instability, the PFC Team believes the reach is more unstable now than is typical. Currently there appears to be an adequate amount of LWD in the stream to process the sediment, although the LWD is aggregated in debris dams. The riparian area may not have enough large trees available for LWD recruitment in the future. In areas where the stream is downcutting and headcutting through debris dams, the stream cannot access the floodplain. In these areas, vertical cutbanks are common and riparian trees are being undercut and sloughing into the stream at a rate faster than expected.

Reach 3M2 would also be affected by instream flow reductions resulting from a potential drawdown. In the short term, continuous flow reductions might help stabilize the excess sediment. In the long run, lower flows would mean less habitat for fish and possibly more sediment that would be subject to a high flow event. The reach will recover slowly as the upper watershed improves and the bedload stabilizes or is processed downstream. Thinning of streamside trees at the appropriate time may facilitate recovery if stream banks are stable.

Reach 3M3 extends 2,200 feet from the confluence with the North Fork (T6) to the confluence with the South Fork Three-mile (T8). Two small tributaries, 3MT6A and 3MT7 intersect this reach. Reach 3MT6A hosted a debris torrent that directly intersected this reach. The alluvial fan associated with North Fork Three-mile Creek influences the first 50 yards of the reach. Reach 3M3 is a Class I (MM1). Large channel-spanning sediment wedges occur throughout the reach. These wedges are held in place by LWD and often exceed 6 feet in thickness. These features usually result in the formation of low gradient deposition areas. In some areas the wedges have stabilized over time. This is evident from 30-year-old spruce stands on some wedges. In other areas, the wedges erode through and slowly transmit sediment downstream. Overall, the reach functions as a depositional area receiving and aggrading sediment. Reach 3M3 receives much of its sediment from the south fork and from reach 3M4 located directly upstream. These two reaches are deeply incised transport channels that extend about a mile upstream. A narrow, singletree buffer left during timber harvest in the late 1980s lines the stream along reach 3M3. Pre-harvest air photos indicate alder trees in the riparian area along reach 3M3. The alders indicate that the streambanks were not stable. It appears the long, deeply incised transport reaches immediately upstream have always yielded excess sediment to reach 3M3. Some localized vertical instability was observed near the toes of the sediment wedges. Coho fry were present during the survey. Reach 3M3 ends at confluence of South Fork Three-mile Creek (T8), approximately 2.7 miles up the drainage.

Reach 3M3 was rated **Functional at Risk with a downward trend**. Bedload accumulation appears to be more than what was historically present in reach 3M3. Landslides from the October 1993 storm event and road construction have contributed sediment to this reach. Although the amount of LWD in the stream appears adequate at this time, large trees on the streambank are in limited supply due to timber harvest in and adjacent to the riparian area. The road system in the upland watershed is deteriorating and may contribute to debris torrents in the future. It is likely that harvest within the deeply incised gorge along the south fork (upstream) has contributed sediment and debris to reach **3M3** and will likely continue to contribute sediment in the future. The stream is not in balance with the water and sediment being supplied by the watershed; excessive deposition associated with debris jams is occurring. Reach 3M3 will recover slowly as the upper watershed improves and the bedload stabilizes. Thinning of riparian second-growth may facilitate recovery. Road decommissioning may also prevent further upland watershed degradation in the future.

Reach 3M4 begins at the confluence with south fork Three-mile Creek and extends 2,050 feet past a 25 foot high falls (end of anadromous distribution) to a distinct change in vegetation and landform. Reach 3M4 can best be described as a shallow gorge 20 to 60 feet deep. Predominant channel types are MM1 and HC2. The bottom end of the reach has an accumulation of sediment similar to reach 3M3. A debris torrent down tributary 12 directly intersected this reach. A slope-break buffer was left along almost all of this reach; most trees remain standing. Reach 3M4 functions as a transport channel and does not need much LWD. Two small tributaries, T12 and T9 flow into reach 3M4.

Reach 3M4 was rated **Functional at Risk with an upward trend**. The amount of LWD reflects normal loading for this channel type. The buffer left on the stream appears capable of supplying adequate LWD over time in the future. Excessive bedload accumulation was noted at the bottom of the reach. The stream is not in balance with the water and sediment being supplied by the watershed. Deposition from upstream landslides exacerbated the debris accumulations at the bottom of the reach. Reach 3M4 is predominantly a transport channel and will flush excess sediment downstream. Reach 3M4 will recover as the upper watershed improves and the bedload stabilizes or moves downstream. Mitigation of the destabilizing factors in the upper watershed, primarily the road system, may also help facilitate recovery.

Reach 3M5 extends 700 feet upstream to an old stream crossing (removed log stringer bridge with abutments still in place) and up an additional 400 feet to where a small Class III tributary intersects the stream. This junction denotes the end of resident fish distribution and also the upper extent of the reach. Gradient increases to a sustained 20 percent above this point. Reach 3M5 is Class II HC2 with a total length of 1,000 feet.. Reach 3M5 functions as a deposition and transport channel. In this landscape position, the reach receives a lot of colluvium and sediment from upstream sources and has built a small alluvial area that is currently inaccessible due to downcutting. LWD is necessary for this reach to dissipate energy and stabilize streambanks. A single tree buffer lines the stream in the lower section of the reach, however windthrow has toppled all of the large trees and only small diameter hemlock trees remain. Currently, there is a lot of LWD suspended *over* this reach. There are no large trees available for LWD recruitment in the future. Downcutting has exposed some LWD that was apparently buried under 5 feet of sediment until recently. A piece of this LWD was dated to approximately 1,080 years before present. Upstream, reach 3M6 deposits a lot of sediment and debris into reach 3M5, which has formed two debris dams more than 10 feet high just upslope of the road. A debris torrent down T12 near the top of this reach also contributed to the formation of debris dams. It is apparent that similar dams have catastrophically released sediment in the past, resulting in the downcutting found in the lower part of reach 3M5.

Reach 3M5 was rated **Functional at Risk with a downward trend**. The excessive deposition in the upper part of reach 3M5 indicates that upland and upstream sediment sources are not yet stabilized. In the lower part of the reach, downcutting and windthrow has left much LWD suspended over the stream channel. The downcut channel cannot access overflow channels and must transmit all sediment and water downstream, even at high flows. There are no large trees adjacent to the stream to provide LWD in the future. The stream will recover slowly as the upper watershed condition improves and the bedload stabilizes. Thinning of riparian trees at the appropriate time may facilitate recovery.

Reach 3M6 begins at stream mile 3.3, 400 feet above the old bridge crossing and extends 2,050 feet upstream through a steep-walled 50 to 100 foot deep gorge ending at a 25 foot falls. Reach 3M6 is an HC6 channel with gradient 20 plus percent to the V-notch. Reach 3M6 functions to transfer sediment and debris downstream, and has little storage capacity for sediment or LWD. Very little LWD is needed for channel stability, as the channel is dominantly bedrock controlled. Timber harvest was selective below the slope-break. Currently the reach has a large amount of woody debris from logging slash and trees slumping into the stream from the steep gorge walls. There is a high frequency of small debris jams in the upper reach as is expected in this type of channel and landform.

Reach 3M6 was rated **Functional at Risk, trend not apparent**. Although reach 3M6 has more fine woody debris and sediment than is typical, the PFC team believes this reach can pass that additional load downstream during the next high flow event. Recovery of the reach is dependent upon improvement of the upper watershed (roads) and future landslide activity.

Reach 3M7 begins upstream of the V-notch and extends 1,475 feet to the USFS boundary. Reach 3M7 begins Class III (HC2) and continues to Class III (AF1) upstream of the log stringer bridge. The lower HC2 channel functions to transport sediment and debris downstream, and has little storage capacity for sediment and debris. Lots of recent LWD is lying in and/or across the channel, most likely from windthrow of the singletree buffer left on this stream. The upper part of the reach is an alluvial fan formed in colluvium from the cirque basin just upstream. Alluvial fans are fairly dynamic and need LWD to dissipate energy and provide bank stability. Selective harvesting of trees on the alluvial fan occurred up to the Forest Service boundary. The stream is currently braided and fresh deposits of sediment are evident. The road cuts across the toe of the fan and has intercepted some of the smaller side channels and rerouted them to the main channel.

Reach 3M7 was rated **Functional at Risk with a downward trend**. On the alluvial fan portion of the reach, LWD is mostly absent and the stream is braiding though loose colluvium. Large trees are mostly absent in the riparian area and there is little source of LWD for recruitment in the future. The stream may not be properly dissipating energy and there was visible stream bank erosion in the lower reach. The road at the toe of the fan is affecting water delivery. The stream will recover slowly with the limited wood recruitment from the upstream

watershed. Thinning of riparian vegetation at the appropriate time may help produce large trees sooner. Improvement of the road drainage will maintain water retention for downstream reaches.

Reach 3MT1, 2, 3, 5 are a group of tributaries (1, 2, 3, 5) that drain into the north side of lower Three-mile Creek. These streams are small mountain footslope channels that share similar physical characteristics and management. These streams are transitional channels that transport sediment at high flows and deposit sediment at low flows. These tributaries are Class I (MM1) as they intersect Three-mile Creek at gentle gradients and Class II (channel type HC2) as they extend upslope to steeper gradients. The ADFG anadromous stream catalog lists these streams as being used by coho salmon. Harvest adjacent to these streams occurred as early as the early 1980s and as late as 1997. These streams are small, typically three to six feet in width. MM1 streams need a moderate amount of LWD to function properly. Typically, there is no buffer on these streams and the streams currently contain a large amount of fine woody debris (logging slash). The buffer left for main stem Three-mile includes the first 50 to 100 feet of these tributaries. A spur road crossing on Tributary 2 left a log culvert in place. The log culvert constricts flows and blocks fish passage (obstruction removed by Klawock Heenya, Inc. in 2001). The channel is aggrading and may widen beyond the normal floodplain.

Reach 3MT1,2,3,5 was rated **Non-Functional**. The reach currently contains an excess of ―ifie" woody debris that is reducing water velocities and trapping more fine sediments than typical for this channel. The stream also appears to be eroding around the debris in places. Shade from logging debris may be affecting certain biological components of the stream including primary productivity. There are no large trees adjacent to the stream for LWD recruitment in the future. The stream will improve as trees grow back on the adjacent riparian and uplands, but is decades from reaching PFC. Removal of the fine woody debris would improve stream hydraulics, allowing the stream to dispose of fine sediments. Thinning of second-growth stands at the appropriate age may facilitate recovery.

North Fork Three-mile Creek (Trib 6)

North Fork Three-mile Creek is a 3rd order stream comprised of two miles of Class I/II/III channel (channel types AF2/HC2/HC6). The North Fork of Three-mile Creek (Trib 6) drains a large section of the 3-mile sub-basin. The system is steep and unstable. Several landslides are visible in this basin. The North Fork was delineated into three reaches for this assessment: NF1, NF2 and NF3.

Reach NF1 extends 1,000 feet up from the confluence of Three-mile Creek. Reach NF1 functions as a transport and depositional zone for North Fork Three-mile Creek. LWD is important in this reach, especially in the lower alluvial fan section. The reach currently retains little LWD due in part to landslides upstream that scoured the channel. A road crossed the reach at its mid point near the top of the alluvial fan. The road does not appear to be impairing channel migration or access. Timber harvest occurred in the 1980s and left a narrow buffer on reach NF1. The buffered area upstream of the road was windthrown by 1991. The landslide that scoured the stream probably occurred in October 1993.

Anadromous access ends at a 40-foot high falls at the end of the reach. The ADFG anadromous stream catalog lists this stream as being used by coho salmon. Resident fish may inhabit the upper reaches above the falls but this has not been verified. This stream is most likely marginal habitat for coho salmon due to its high gradient and lack of spawning habitat (gravel). It is highly likely that anadromous fish utilize the lower gradient reach near the confluence with Three-mile Creek.

Reach NF1 was rated **Functional at Risk with a downward trend**. Due to scouring from the recent landslides, reach NF1 is missing much of the LWD expected in this channel type. The scouring also caused some downcutting and "simplification" of the channel network on the alluvial fan portion of the reach. Due to adjacent timber harvest and windthrow, there is not an immediate source of LWD for the future. The trees within the deeply incised V-notch upstream may provide some LWD but probably not in the quantities that the stream is capable of using. The alluvial fan segment is expected to degrade and/or unravel before it gets better, unless there is an influx of LWD. The PFC Team could not confidently determine if the stream is vertically stable. The stream may be decades from reaching PFC. The stream will recover slowly as the upper watershed

improves and the bedload stabilizes. Thinning of second-growth stands adjacent to the stream at the appropriate time may improve recruitment of large trees for recovery.

Reach NF2 was rated **FAR--trend not apparent**
No individual reach description information is available for this reach.

Reach NF3 was rated **FAR--trend not apparent**
No individual reach description information is available for this reach**.**

Reach 3MT6A is a small Class I/II/III stream comprised of AF/HC2/HC6 channel types. Reach 3MT6A begins near the confluence of the North Fork and main stem Three-mile Creek and extends east-northeast following a recent landslide track. It has a total length of 4,200 feet.. A road crosses the reach about 1,700 feet from the beginning of the reach. Reach 3MT6A was scoured to bedrock in the upper part by a landslide that probably occurred during the October, 1993 storm event. Timber harvest occurred in the late 1980s and no buffer was left. This reach is predominantly a transport channel with depositional areas in the lower 500 feet. Little LWD remains in the channel.

No fish were trapped at the first road crossing but potential habitat exists to this point. The ADFG anadromous stream catalog lists this stream as being used by coho salmon 1,700 feet to the first road crossing. Juvenile coho salmon were observed in the lower reach during the survey (8/16/99).

Reach 3MT6A was rated **Non Functional.** Reach 3MT6A has been scoured to bedrock for much of its length. LWD and sediment is necessary for the stream to rebuild the channel complexity it once had. Sediment and LWD is present in the lowest part of the reach, however it is all in one large debris pile from the landslide. Due to harvest of streamside vegetation, there is no LWD source for recruitment in the future. The stream is decades from reaching PFC. The stream will recover slowly as the upper watershed improves. Thinning of adjacent second-growth stands at the appropriate time may facilitate recovery.

Reach 3MT7 is a small Class I/II stream comprised of MM1 and HC2 channel types. MM1 and HC2 channels function to transport materials downstream. MM1 channels are transitional channels between steep gradient mountain slopes and low gradient floodplains. The total length of reach 3MT7 is 2,900 feet.. Timber harvest occurred adjacent to the lower 70 percent of the stream channel in the late 1980s. Alder trees currently dominate the riparian plant community in the lower part of the reach. Reach 3MT7 flows through a muskeg area for about 30 percent of its length. Reach 3MT7 is crossed by two roads. The lower crossing is a log stringer bridge. The upper crossing is a culvert on the main access road. Approximately 900 feet of reach T7 Class I, an additional 700 feet is Class II. Coho fry were observed in the lower half of the tributary to the first road crossing (9/2/99). Two small Class III/IV tributaries intersect downstream left. Quality of habitat is high relative to stream size. Good rearing and spawning habitat is available in the lower reach below the first road crossing.

Reach 3MT7 was rated **Functional at Risk with an upward trend**. The MM1 portion of the reach has a fairly well developed channel with a small floodplain adjacent to the reach. The road and bridge are currently constricting flows and limiting the stream‘s access to the floodplain. Excess sediment deposition was noted just below the bridge. There is currently a reasonable amount of LWD in the stream. Future sources of LWD are lacking in the lower reach due to streamside harvest. Streambanks are relatively stable, but a minor amount of downcutting was noted. The streambanks may not be stable in a large flood event when LWD and access to the floodplain are necessary to dissipate energy and stabilize banks. Reach T7 will recover slowly as riparian vegetation matures. Thinning of the alder dominated stand adjacent to the stream at the appropriate time may facilitate growth of streamside trees that may become LWD. Removal of a short section of road and stream crossing will reconnect the stream with the floodplain.

South Fork of Three-mile Creek

South Fork of Three-mile Creek (3MT8) is a 3rd order stream containing 2.5 miles of stream comprised of various channel types. A total of three reaches were delineated for the purpose of this assessment: SF1, SF2,

and SF3. Five small Class III/IV ephemeral tributaries enter the South Fork of Three-mile Creek. The ADFG anadromous stream catalog lists this stream as utilized by coho salmon up to the V-notch and associated cascades, 1,600 feet up the stream from its confluence with main stem Three-mile Creek. This stream contains fair habitat for coho salmon. An additional 6,500 feet of Class II habitat is available upstream of the falls to the next road crossing. Resident Dolly Varden trout were trapped downstream of the road crossing but not upstream. Habitat exists above the road crossing to the next series of falls immediately below the alpine, but this habitat is not well connected. Culverts at the main road crossing impair fish passage. An additional 2,000 feet of fair to good resident fish habitat would be available if the culverts were removed. The area upstream of the road crossing has the characteristics of an alluvial fan. Two distinct stream channels bisect the feature including one mile of previously unrecorded Class II stream. Timber harvest in the basin occurred mostly in the late 1980s. Riparian vegetation is varied; reach SF1 is enclosed within a mature forest. Reaches SF2 and SF3 have a variable width buffer. Field reconnaissance and aerial photo interpretation revealed numerous slides intersecting the channel, which contribute large quantities of sediment to the stream.

Reach SF1 extends 3,775 feet upstream from the confluence with the main stem Three-mile Creek. Reach SF1 begins with a relatively low gradient, fluvial MC1 channel type, that changes to a gorge-like HC3, and transitions to an HC2 channel upstream of the V-notch. Reach SF1 ends 800 feet above the v-notch where timber harvest increases. SF1 flows through a 50 to 150 foot deep V-notch for most of its length. A bedrock cascade about 25 feet high occurs within this notch, 1,600 feet from the confluence with Three-mile. SF1 is Class I to the cascades and Class II upstream. Available spawning and rearing habitat is naturally low in these debris transport channel types.

Reach SF1 is dominantly a transport channel with a depositional area in the first 1,000 feet.. Reach SF1 functions to move materials downstream, and limited depositional areas were noted within the gorge. The gorge is wide enough that minor floodplain area exists within it. Small amounts of LWD are needed to stabilize the narrow floodplain areas within the gorge. Very large LWD is capable of spanning the stream and retaining sediment for the life of the LWD. Selective timber harvest occurred within the gorge-like V-notch for most of its length. Several landslides (cut-bank failures) were noted within the gorge section. These failures appear to be a natural source of sediment and woody debris along the steep channel sideslopes within the gorge. Several debris dams associated with these slumps were observed. Composition of the debris jams includes logging slash. Most LWD in reach SF1 is associated with debris jams; otherwise LWD distribution was low.

Reach SF1 was rated **Proper Functioning Condition**. The PFC Team had a difficult time applying a summary rating to the reach. Although the gorge is naturally unstable, ten cut bank failures within the gorge directly intersected the reach, indicating excessive sediment load. A landslide (debris torrent) in reach SF2 contributed much sediment to the stream and some of this sediment may have entered reach SF1. Road drainage problems (i.e., interception and re-routing of water from one channel to another) were also noted in the upper watershed. The stream appears to be transporting the excessive sediment downstream and does not appear to be eroding or downcutting. LWD recruitment is not critical for this reach. However, the stream requires some LWD recruitment. Streamside timber harvest has reduced the available supply of LWD for recruitment in the future. While reach SF1 appears to be resilient, landslide activity within this reach could be contributing to excess sediment in downstream reaches.

Reach SF2 extends 2,900 feet from the end of 3MTR81 to a distinct change in vegetation below the road crossing. This reach is Class II, comprised of HC2, MM2 and AF1 channel types. The MM2 channel type is predominant above the V-notch and intersects an alluvial fan towards the end of the reach. Reach SF2 primarily functions as a sediment deposition area with sediment storage limited by landform. Large wood is needed in this reach to stabilize sediment and streambanks. Selective timber harvest has occurred in the riparian area throughout the reach. A narrow buffer lines the creek on the north side of the stream and a selectively harvested forested wetland borders the south side of the stream. Significant blowdown is scattered throughout the reach. Adequate resident fish spawning and rearing habitat is available.

Reach SF2 was rated **Functional at Risk with an upward trend**. The PFC team is concerned about upland watershed degradation, particularly increased sediment inputs from landslides. Reach SF2 has an adequate

amount of LWD in the stream to handle the additional sediment at this time; however, windthrow *may* limit the amount of LWD recruitment in the future. Reach SF2 needs a consistent source of LWD to stabilize sediment and streambanks. The PFC Team determined that current plant communities are not an adequate source LWD for maintenance and recovery. The stream will respond positively as the upper watershed condition improves and riparian trees mature. Road decommissioning could help limit sediment sources in the near future.

Reach SF3 extends from a change in riparian vegetation downstream of the road to approximately 4,750 feet upstream to the USFS boundary. This reach is Class II, channel type AF1, and is highly dynamic as the stream braids through the alluvial fan landform. Four stream crossings occur at the road crossing. The channel is aggrading sediment in many areas and the stream channel changes location on a seasonal basis. Reach SF3 requires large wood and root systems of large trees to stabilize streambanks. A singletree buffer was left along most of the reach. Windthrow within this buffer has reduced the number of large trees available for LWD recruitment in the future. Many windthrown trees are lying in or across the channel. Timber harvest occurred on all portions of the alluvial fan except the buffer along the main channel. A debris torrent in Tributary15 has buried about 150 feet of the reach downstream of the road. Road drainage problems are numerous (i.e., fish passage, interception and re-routing of water from one channel to another). A stream crossing failure was documented on a return field visit following a large rainstorm in the fall of 1999. Dolly Varden trout were trapped downstream of the road crossing, but not upstream. About 2,000 feet of fish habitat exists upstream.

Reach SF3 was rated **Non-Functional**. There is a lack of large trees and LWD available to stabilize streambanks now and in the future. As root systems decay and the stream continues to aggrade, channels will likely continue to braid and stream depth will become shallower. The landslide in the lower reach has deposited a large volume of sediment in the stream. Excessive sediment/bedload deposition was observed throughout the stream channel. The sinuosity on the northern-most channel upstream of the road is not in balance with the landscape setting. The stream needs LWD now and in the future. The road system is contributing sediment and rerouting hillslope water. Ditch lines are eroding and the culvert crossings are not passing fish at most flows. Road decommissioning could improve watershed condition and allow resident fish access to another 2,000 feet of habitat. Thinning of trees in the riparian area at the appropriate time may facilitate recovery.

Northeast composite sub-basin

2.5 mile Creek

Reach 2.5M1 extends 900 feet from its confluence with Klawock Lake. The reach is FP3, Class I to the highway crossing. The channel functions to store sediment routed from above. LWD accumulations are frequent and channels retain significant volumes of fine sediment. These channels also contain moderate to high available spawning area (30 percent) (USDA Forest Service, 1992). The stream is 12 feet bankfull width and sinuous in its lower reach. Fair to moderate rearing and spawning habitat exist in the reach. A thin buffer lines the creek upstream to the highway. Approximately 40 percent of the drainage is harvested. The highway crossings are barriers to fish movement. One small Class II/III tributary intersects the stream downstream of the highway crossing.

Reach 2.5M1 was rated **Proper Functioning Condition.** The reach has lost at least 50 percent of the immediate forested riparian area. A significant amount of blowdown has occurred compromising a ~~th~~in" hemlock dominated buffer. An adequate supply of large wood adjacent to the stream is currently available. However, this may be decreased by future storm events. Plant communities were determined to be an adequate source of coarse and/or LWD for maintenance and recovery (Prichard, Tech. Ref. 1737-15 1999). The stream contains a moderate amount of LWD but there is a concern for an inadequate supply of wood in the future. Additionally, both culverts at the highway crossing block or significantly impede access for resident and anadromous fish. The culvert on the tributary is perched 3 feet and is significantly undersized to adequately pass resident fish and debris. The 36" corrugated metal pipe (CMP) on the mainstem creek is perched 2 inches and exceeds gradient requirements to pass fish; this culvert is also undersized. The two culverts block or impede access to 2,100 feet of total stream habitat-and 1000 feet of anadromous habitat. Riparian thinning is recommended.

Reach 2.5M2 encompasses the remaining managed portions of trib 1 and mainstem 2.5-mile Creek upstream of the highway. The reach consists of approximately 1,725 feet of MM1, HC2 and HC6 channel types. Approximately 2100 feet is fish bearing (1,000 feet previously Class I). A nesting pair of cutthroat trout were observed in the mainstem creek upstream of the highway. These streams are small mountain footslope channels that share similar physical characteristics and management. The streams are transitional channels that transport sediment at high flows and deposit sediment at low flows. These streams are Class II resident fish (channel type MM1 and HC2) as they extend upslope to steeper gradients. Harvest adjacent to these streams occurred in the mid 1980s. These streams are small, 7-10 feet in bankfull width. MM1 and HC streams require a moderate amount of LWD to function properly. These streams were not buffered nor do they currently contain adequate LWD. A spur road intersects both channels about 500 feet upstream of the highway. Both crossings are log stringer bridges and do not impede fish passage.

Reach 2.5M2 was rated Functional at Risk—Downward Trend. The reach contains insufficient amount of LWD. There are no large trees adjacent to the stream for LWD recruitment now or in the future. The stream will improve as trees grow back on the adjacent riparian and uplands. There are opportunities to immediately improve habitat and fish access by upgrading stream crossings at the highway. There may be some potential to place LWD in the lower MM1 reaches to improve fish habitat.

Reach 2.5M3 was rated Proper Functioning Condition. This reach is approximately 4,750 feet long and is comprised of the unmanaged Class III/IV headwater channels in the basin.

Deadhead Creek

Reach DI extends 2,600 feet from its confluence with Klawock Lake. The reach contains sections of PA1, FP3, and PA5 with PA5-beaver chain complex predominating. The reach includes the lower 700 feet of the AF1 portion of Trib 1. AF streams need high amounts of LWD. The reach is Class I anadromous to the highway crossing and beyond. The highway culvert blocks fish access to several hundred feet of fish habitat. The channel functions to store sediment routed from above. The stream measures 15 feet bankfull width and is sinuous in its lower reach. Fair to moderate rearing and spawning habitat exist in the lower reach. Stream substrate is small for anadromous fish. Currently, the reach is poor habitat. A very thin buffer (few non-merchantable leave trees) lines the creek upstream to the highway. Approximately 70 percent of the drainage is harvested. The culverts are blocking fish passage (discussed in reach DT). Two small Class II tributaries feed reach DI just downstream of the highway crossing. Trib 1 hosted a debris torrent during the 1993 storm event. There is approximately 1,600 feet of PA5 that did not exist previous to harvest. Harvest may be responsible for the transformation of spawning habitat--FP3 to slackwater rearing habitat (PA5).

Reach DI was rated **Functional at Risk—Downward Trend.** LWD accumulations are less than adequate in the FP section of the reach. Reach I has lost at least 60 percent of the immediate forested riparian area. Blowdown has compromised the already ―thin‖ hemlock dominated leave buffer. There is an inadequate supply of large wood adjacent to the stream. Plant communities are not an adequate source of coarse and/or LWD for maintenance and recovery (Prichard, Tech. Ref. 1737-15 1999). Alders and disturbance species predominate the riparian area. The stream contains a low amount of LWD but there is a concern for an inadequate supply of wood in the future. Floodplain and channel characteristics were determined not adequate to dissipate stream energy. Some bedload aggradation was documented in the lower AF1 portion of Trib1 at and above the confluence with mainstem Deadhead Creek. Riparian thinning is recommended. There are opportunities to immediately improve habitat and fish access by upgrading stream crossings at the highway.

Reach D2 encompasses the remaining unmanaged lower portion of mainstem Deadhead Creek and trib 2. This reach contains a short piece of LC1 channel that winds through a selectively harvested forested wetland. Total reach length is 2,650 feet. Approximately 1500 feet is resident fish habitat, 1,000 feet of which is upper anadromous habitat. The reach also includes the lower part of Trib 2 and the upper unmanaged portion of Trib 2 (Class IIIs). The portion of Trib 2 that was harvested is included in Reach DT.

Reach D2 was rated Proper Functioning Condition.
The reach is minimally impacted. Some selective harvesting occurred adjacent the reach. The stream is stable and properly functioning.

Reach DT encompasses the upper portion of Trib 1 and portions of Trib 2. These streams are predominately Class II MM1, AF2, HC2 and HC6 channels. Total reach length is 3,975 feet, of which 2,500 feet is resident fish habitat. These streams are small, 5 to 7 feet in wetted width. MM1, AF2 and HC streams need a moderate amount of LWD to function properly. These streams were not buffered and contain little LWD. Harvest adjacent to these streams occurred in the early 1990s. The Klawock-Hollis highway intersects these tribs approximately 600-800 feet upstream. A spur road intersects Trib 1 about 1,800 feet above the highway. Trib 1 hosted a debris torrent during the 1993 stream event. The channel was scoured above the highway and materials were deposited in the alluvial flat between mainstem Deadhead Creek and the highway. Impacts to Deadhead Creek are difficult to determine given that stream‘s alteration to beaver ponds (PA Channel Type). Trib 2 is smothered with logging debris that may be detrimental to fish habitat. Additionally, the culvert at the highway crossing on Trib 2 restricts access to resident and anadromous fish. Trib 1 is Class III below the highway crossing and Class II for 350 feet above the confluence with mainstem Deadhead.

The 36” culvert on Trib 2 is perched 1 foot and does not meet current fish passage standards. It is not known if fish utilize habitat above the road on Trib 2 but it was most likely historic habitat. Trib 2 was trapped using baited minnow traps on 11/9/2000 and no fish were caught (one set for 2 hours). The culvert blocks or impedes at least 1,500 feet total stream habitat and 500 feet of anadromous habitat.

Reach DT was rated Non-Functional. The reach has no functional stream buffer. Alder and other disturbance species predominate in the reach. Plant communities are not an adequate source of coarse and/or LWD for maintenance and recovery (Prichard, Tech. Ref. 1737-15, 1999). The stream contains a little LWD but there is a concern for an inadequate supply of LWD in the future. No fish were observed during the survey (10/24/2000) during seasonal upstream migration.

7Mile Creek

Reach 7M1 extends 1,800 feet from Klawock Lake to a steep cascades that defines the extent of fish habitat. Anadromous fish habitat ends at 1,150 feet where a large culvert under the highway blocks fish access. The reach becomes Class II for an additional 700 feet as gradient and confinement increase towards the V-notch. Total fish habitat extends to 1,850 feet. The reach is a combination of AF1 and 2 channel types. LWD is important in this reach, especially in the lower alluvial fan section. The riparian trees and adjacent uplands were cable harvested in the late 1980s. The stream received limited protection and was subject to windthrow. Some blowdown is scattered throughout the reach. Fresh, mobile and unsorted bedload deposits are frequent along the lower reach. Significant aggradation of bedload and debris exists upstream of the highway culvert and downcutting of the stream channel was recorded below the culvert. The stream crossing and associated road-fill has constricted the stream and alluvial fan, thus altering the function and capability of the reach. Another road crosses the reach at the top of the alluvial fan. The road does not appear to be impairing channel migration or access. An old rock pit dug during construction of the road may be altering the hydrology of the alluvial fan downstream of the highway.

Reach 7M1 was rated Non-Functional. Reach 7M1 has no functional stream buffer; no more than 5 percent of the riparian is in a mature stage. There is very limited LWD recruitment for the future. Alder and other disturbance species predominate in the reach. The stream reach upstream of the road is super-loaded with LWD, but the culvert blocks any downstream migration of material. The stream channel appears to be both vertically and laterally unstable in sections. Several sections of stream bank were actively eroding and visibly unstable. Downcutting was observed immediately below the culvert and significant aggradation of bedload was observed in the depositional reach from the lake up 600 feet In this reach, the bedload is predominately course; large cobble is the dominant substrate. The smaller gravels (used for spawning) appear to be deposited on the floodplain 30 yards to either side of the active channel. The additional amount of available material upstream (from landslides), channel erosion, and the increased frequency and duration of peak flows in the stream may be

responsible for the habitat alteration. The lower gradient portion of alluvial fans are high quality sockeye habitat (USDA Forest Service, 1992)**.** No fish were observed for two visits during fall upstream migration. The culvert at the highway crossing also blocks access for resident fish. The 8 foot culvert is perched 3 feet and is significantly undersized to adequately pass fish and debris.

Reach 7M2 begins at the furthermost extent of fish habitat and continues 3,650 feet up a steep V-notch to the USFS boundary. The channel is Class III high gradient contained (HC6). Average gradient in this reach exceeds 20 percent. The reach functions to transfer sediment and debris downstream, and has little storage capacity for sediment or LWD. Little LWD is needed for channel stability, as the channel is dominantly bedrock controlled. Most of this reach has a selectively harvested cable-yarded buffer left from harvest in the late 1980s. Windthrow of those trees is frequent in the upper portion of the reach and has accelerated bank instability in the inner gorge. At least six shallow landslides were recorded in the reach. Pre-harvest aerial photos indicate a stable inner gorge. Disturbance species currently dominate in the reach.

Reach 7M2 was rated **Proper Functioning Condition**. Currently, the reach has a moderate amount of woody debris from logging slash and trees slumping into the stream from the steep gorge walls. There is a high frequency of small debris jams in the upper reach as is expected in this type of channel and landform, but the PFC Team agrees that the amount of material exceeds the natural range of variability. The effects of wood-loading are unknown on future channel dynamics. Although the reach has more LWD and sediment than is typical, the PFC team believes this reach can pass that additional load downstream during subsequent high flow events.

Reach 7M3 consists of the unmanaged headwater channels in the basin. The land is managed by the USFS-CRD. The dominant process group is high gradient contained. These channels function to transport LWD and sediment to downstream reaches.

Reach 7M3 was rated Proper Functioning Condition. The reach may provide LWD to downstream reaches.

Arrow Creek

Reach A1 (Arrow Creek) is very short, extending 625 feet from its confluence with Klawock Lake. The reach is FP3 Class I anadromous to the highway crossing. The channel functions to store sediment routed from above. LWD accumulations are frequent and channels retain significant volumes of fine sediment. These channels also contain moderate to high available spawning area (30 percent) (USDA Forest Service, 1992). The stream is small, 13-foot bankfull width, and sinuous in its lower reach. Good rearing and spawning habitat exist in the reach. A small amount of selective harvesting (and windthrow) occurred on the east side of the creek. The predominant seral stage in the reach is mature. Old beaver ponds are present immediately upstream of the lake—providing excellent rearing habitat. Four salmon redds were observed during the survey (11/9/2000). The culvert on the highway is problematic.

Reach A1 was rated **Proper Functioning Condition.** Reach A1 is within a relatively intact natural forested riparian area. Some blow-down and selective harvesting has occurred on the east side of the stream. An adequate supply of large wood adjacent to the stream is currently available; however, this may be decreased by future storm events. Plant communities were an adequate source of coarse and/or LWD for maintenance and recovery (Prichard, 1999). The stream contains a moderate amount of LWD. Beaver ponds were not active though functional. The reach meets the minimum requirements for PFC. This short reach contains excellent habitat.

Reach A2 encompasses the remaining managed portions of mainstem Arrow Creek and Trib 1 above the highway. These two streams are small mountain footslope channels that share similar physical characteristics and management. The streams function to transport sediment at high flows and deposit sediment at low flows. Reach A2 consists of approximately 5,875 feet of MM1, HC2 and HC6 channel types. Approximately 850 feet is fish bearing (500 feet not accessible to anadromous fish). Resident trout were not observed in the mainstem creek upstream of the highway; a baited minnow trap was used to sample this reach. Harvest adjacent to these

streams occurred in the late 1980s. These streams are small, about 5 to 7 feet bankfull width. MM1 and HC streams need a moderate amount of LWD to function properly. These streams were not buffered nor do they currently contain much LWD. It is highly likely that in-channel LWD was removed during logging. A spur road intersects both channels about 1,250 feet above the highway. Both crossings are problematic and should be removed (Photos 35 and 36).

Reach A2 was rated Functional at Risk—Downward Trend. There is concern that the amount of harvest that has occurred in the drainage has increased peak flows and subsequently erosion in this reach. W/D ratios appeared to be higher in the lower reach just above the road—some aggradation was observed there. Some additional colluvium was noted in Trib 1 from unstable side slopes and windthrow. The reach contains an insufficient amount of LWD. Plant communities were not an adequate source of coarse and/or LWD for maintenance and recovery. The stream will improve as trees grow back on the adjacent riparian and uplands. The upper road crossings should be removed and the road considered for decommissioning. There may be some potential to improve fish habitat by placing LWD in the lower MM1 reaches. Currently, the only LWD available is the one clump of blow-down immediately upstream from the highway. Recovery of the reach is dependent upon improvement of the upper watershed (roads and drainage) and future landslide activity.

BlueWater Creek (BW)

Reach B1 extends 1,250 feet from Klawock Lake to steep cascades that mark the extent of Class I habitat. The reach becomes Class II for an additional 450 feet as the gradient and confinement increases towards the cascades. The predominant channel types are FP3, MM1, and HC2. The stream is 17 feet bankfull width and sinuous in its lower reach. The channel functions to route and store sediment from the steep drainage above. Excess deposition was documented below the highway culvert. LWD accumulations are frequent and channels retain significant volumes of fine sediment. These channels also contain moderate to high available spawning area (30 percent) (USDA Forest Service, 1992). The confluence of B1 and Klawock Lake occurs in a broad flat expanse influenced by *old* beaver activity. This area below the highway is in a natural state. A 66 foot buffer lines the creek upstream of the highway crossing to the steep cascades. A significant amount of blow-down was observed (>25 percent of the buffer) on the south side of the creek. An unusual amount of algal growth and/or suspended solids were observed in the channel; few macro-invertebrates were observed. Good spawning and rearing habitat exist in the lower FP3 reach below the first road crossing.

Reach B1 (BlueWater Creek) was rated **Proper Functioning Condition.** Reach B1 has lost at least 25 percent of its stream buffer. An adequate supply of large wood adjacent to the stream is currently available, however this may be decreased by future storm events. The stream reach above the road is super-loaded with LWD but there is a concern of an inadequate supply of wood in the future. The effects of wood-loading are unknown on future channel dynamics. It is important to point out that streams of this size may not need large amounts of LWD. The majority of harvesting occurred in this basin less than 10 years ago. Lack of recent beaver activity was also documented at the lake outlet. The absence of beaver may have reduced the amount of available rearing habitat for coho salmon and, to a lesser extent, steelhead trout. It was also determined that the upland watershed was contributing to riparian degradation. Excessive deposition was observed below the highway culvert. Recruitment of LWD from upstream resources is unlikely due to streamside harvest up to the Forest Service boundary. Two small slides were observed in the upper drainage basin. Water quality in BW Creek is currently being affected by erosion of fine textured sediments from glacial till. The till is exposed in a landslide and several cutbanks of BW creek. This till appears to be derived from limestone and is very fine textured. Clods of this till dropped in a stream will bleed sediment for hours.

While sediment deposition does not appear to be affecting spawning habitat, the fine textured sediment is coating rocks and reducing the clarity of the water. The sediment coating rocks in the stream may be affecting macro-invertebrate populations. BW Creek is within Alaska Department of Environmental Conservation state water quality standards. Turbidity measurements on a low flow day ranged from 2.5 to 3 NTUs through reach 1 and 2. A portion of the turbidity can be attributed to natural conditions, however, observations on November 2, 2000 indicate that turbidity is greater in the reach downstream of the landslide. It is possible the till in this landslide is from older glaciation and contains more iron and aluminum than younger tills. The chemical

makeup of the till may be causing the high suspension properties of the soil grains in water. The landslide and exposed cutbanks are located in reach BW3. A fine textured siltstone bedrock was also noted in road cutbanks in this reach. The culvert at the Klawock-Hollis highway crossing is functioning adequately although it may be slightly undersized and constricting the stream access to the very top of the alluvial fan.

Reach B2 extends 2,150 feet from the beginning of steep cascades to the upper road crossing. The channel is steep (HC5) and shallowly incised**.** Average gradient in this reach exceeds 25 percent. The reach functions to transfer sediment and debris downstream, and has little storage capacity for sediment or LWD. Little LWD is needed for channel stability, as the channel is dominantly bedrock controlled. This reach is similar in management to reach B1 but is not fish bearing. A non-merchantable slope break buffer lines the extent of the reach. Both in-stream and riparian characteristics appear to be stable. The riparian buffer is less intact than reach B1 and significantly compromised on the east side of the stream.

Reach B2 was rated Functional at Risk-Downward Trend. Currently, the reach has a large amount of woody debris from logging slash and trees falling into the stream from the adjacent slopes. There is a significant amount of debris (LWD and bedload deposits) in the reach; the amount of material most likely exceeds the natural range of variability. Although the reach has more LWD and sediment than is typical, the PFC team believes the reach can pass that additional load downstream during the next high flow event. The reach does not have adequate riparian vegetative cover to protect banks and dissipate energy during high flows. This reach is susceptible to high winds generated over Harris Pass and may further compromise the existing stream buffer and channel stability. Recovery of the reach is dependent upon improvement of the upper watershed (roads and drainage) and future landslide activity.

Reach B3 begins at the 2nd road crossing and continues up 3,325 feet to the USFS boundary. The channel is Class III high gradient contained (HC2). These streams are small mountain footslope channels. Bankfull width is approximately 16 feet Average gradient in this reach exceeds 6 percent. The reach functions to transfer sediment and debris downstream, and has limited storage capacity for sediment or LWD. These streams were not buffered nor do they currently contain adequate LWD. It is highly likely that in-channel LWD was removed during logging. The reach was cable yarded in the early 1990s. Accelerated bank erosion was visible in the channel. At least two shallow landslides were recorded in the reach. Pre-harvest aerial photos indicate a stable inner gorge. See discussion in B1. Re-vegetation of the landslide and disturbed areas on the stream bank could reduce the turbidity in BW Creek. Because of the parent material in this sub-basin, it is unlikely that water quality would ever perfectly match streams draining the more common coarser textured materials.

Reach B3 was rated **Non-Functional.** The reach contains insufficient amount of LWD. Plant communities are not an adequate source of coarse and/or LWD for maintenance and recovery (Prichard, Tech. Ref. 1737-15 1999). There are no large trees adjacent to the stream for LWD recruitment in the future—no diverse age classes, and the upland watershed is contributing to riparian degradation. The roads and landslides are leaching material into the stream. The road directly south of the stream has re-routed several small Class IV/V channels and needs maintenance. There is not adequate riparian vegetative cover to protect banks and dissipate energy during high flows. Floodplain and channel characteristics are not adequate to dissipate energy. The stream is not in balance with the water and sediment supplied by the watershed. Excessive erosion was documented.

Photo 6. Upper Bluewater Creek, reach B3.

Reach B4 consists of the unmanaged headwater channels in the basin.

Reach B4 was rated **Proper Functioning Condition.**

Inlet Creek Sub-basin

PFC write up and Tier 1 survey

A field PFC assessment was conducted on 10.9 miles of Class I, II and significant III streams in 2000. Inlet Creek and its tributaries were delineated into seven reaches for this assessment. Main stem Inlet Creek was delineated into one reach; Reach I1 includes tributary 10, 12 and 13. Tributary streams with similar conditions were aggregated into one reach for assessment purposes. Tributary 6, 7, 7A, 8, 8A, 9 and 9A were grouped into one reach (ITNorth). Tributary 3 and 4 were grouped into one reach IT3,4. Tributary 1, 2, and 11 were rated and delineated into separated reaches: IT1, IT2, and IT11 (Figure 6, Table 15). Results of the assessment include a brief description of the reaches and a discussion of how the rating was determined.

Main stem Inlet Creek

Reach I1 includes the entire main stem portion of Inlet Creek from Klawock Lake to above the 2nd highway crossing. Reach I1 also includes tributaries 10, 12 and 13. Total reach length is 21,225 feet Tributary 10, 12, and 13 share similar management and landform as main stem Inlet Creek. There is an anadromous barrier located at RM--5500 on main stem Inlet Creek; the remainder of the reach and the upper watershed is Class II. Total Class II habitat for reach I1 is 11,250 feet

Main stem Inlet Creek encompasses several channel types as it meanders from the Harris Divide to Klawock Lake. The upper reaches are typically more confined but include interspersed sections of floodplain and palustrine characteristics associated with old beaver dams. No recent beaver activity was observed during the survey. A sixty-six foot average buffer lines the creek as it meanders from the headwaters to the lake. Selective stream-side timber harvest has occurred above the second highway crossing immediately below Forest Service lands. Three significant areas of blowdown were noted on the main channel below the highway crossing. Downed trees indicated the origin of winds blowing northwest through the Harris Divide. A large patch of blowdown has also occurred midway up Trib 10 between the confluence and the 1st road crossing.

Main stem Inlet Creek encompasses several channel types including PA2, FP4, MM1, MC1 and 2, and HC6 (falls/cascades). The stream occupies multiple channels (depending on streamflow) to above the 2nd highway crossing. Approximately 1000 feet above this point, landform constricts the stream to a more confined reach

(MC1). Resident fish habitat continues to a series of cascades at RM--12,000 feet on USFS land. Adult Dolly Varden, and coho salmon fry were observed during the survey; coho fry were not seen above the falls. Tributary 10, 12, and 13 are all high value Class II resident fish streams. These tributaries are of similar composition, consisting of PA1, FP3, MM1, MC1 and HC2 channel types. These streams were minimally impacted and the upper portions are all on unmanaged USFS lands.

Reach I1 was rated **Proper Functioning Condition**. Reach I1 is within a relatively intact natural forested riparian area. Several large patches of blowdown were observed but the majority of the riparian buffer remains intact, especially on the upper portion of main stem Inlet and Trib 10. The PFC Team determined there would be enough wood for future recruitment for the channel type and landform. However, this may be decreased by future storm events. The majority of harvesting occurred in this basin less than 5 years ago. The lack of recent beaver activity in the lower basin was observed. This system is functioning —as best it can" in relation to the attributes and processes defined by landform (Prichard, Tech. Ref. 1737-15, 1999). The channel is stable, vegetation is present, and both are functioning relative to the landform. There was no observed erosion or deposition problems in reach I1. Though no visible disturbance was detected in reach I1, impacts were detected from uplands (erosion) for most of the tributary reaches. A "no" answer for question 5 (Upland watershed contributes to riparian degradation) in the hydrology section was recorded for ITNorth, and IT2 that contribute a large amount of drainage area to Inlet Creek Sub-basin.

Reach IT1 extends from the confluence of main stem Inlet Creek to the east end of a moderately sized muskeg in lower Inlet Creek Sub-basin. The reach is Class I anadromous; approximately 3,000 feet of IT1 is accessible to anadromous fish. This reach is a predominantly low gradient FP3 channel type with an additional 600 feet of MM1 channel type. The stream is small 9 feet bankfull width and sinuous. The channel functions to store sediment routed from above. LWD accumulations are frequent and channels retain significant volumes of fine sediment. These channels also contain moderate to high available spawning area (30 percent) (USDA Forest Service, 1992). Tributary 1 crosses the highway in its lower reach. Historic beaver activity was documented below the highway crossing. A 66 feet buffer runs adjacent the stream. Little windthrow was observed in this reach. Three small Class III tributaries intersect the stream downstream left. These streams are steep High Gradient Contained channel types and support no fish habitat. These channels are in good condition up to the 1st road crossing. Total reach length is 4,100 feet Adult Dolly Varden, and coho salmon fry were observed during the survey. Reach IT1 contains excellent fish habitat.

Reach IT1 was rated Proper Functioning Condition. A small amount of blowdown <1 acre was observed in this reach while the majority of the riparian buffer remains intact. The channel is stable, vegetation is present, and both are functioning relative to the landform. There is no observed erosion or deposition problems in reach I1. It is important to note that although no visible disturbance was detected in the reach from the upland watershed, harvest activities and associated road building has occurred relatively recently; the majority of harvesting occurred in this basin less than 5 years ago.

Reach IT2 extends from 2,400 feet from its confluence with main stem Inlet Creek. The reach is Class I anadromous and Class II resident fish to just below the 1st road crossing. Approximately 1,300 feet of IT1 is accessible to anadromous fish and an additional 800 feet of intermittent stream is accessible to resident fish. The predominant channel type in the reach is FP3 and MM1, the upper 500 feet is HC2 Class III. The stream is small, 11 feet bankfull width and sinuous in its lower reach. The channel functions to store sediment routed from above. LWD accumulations are frequent and channels retain significant volumes of fine sediment. These channels also contain moderate to high available spawning area (30 percent) (USDA Forest Service, 1992). The confluence of IT2 to main stem Inlet Creek occurs in a broad flat expanse influenced by old beaver activity. From this point a thin buffer lines the creek upstream 1300 feet to a point where the stream flows intermittently. There is no buffer beyond this point. The majority of Tributary 2's drainage basin has been harvested. Coho fry were observed in the lower half of the tributary to the point of intermittent flow. Two small Class III/IV tributaries intersect the stream downstream left. Fair to moderate rearing and spawning habitat exist in the lower FP3 reach below the first road crossing.

Reach IT2 was rated **Functional at Risk--Trend not Apparent.** Reach IT2 has lost at least 50 percent of the immediate forested riparian area. A significant amount of blowdown has occurred compromising the already —thin" leave buffer. The original riparian buffer appeared to become smaller on the upstream end. An adequate supply of large wood adjacent to the stream is currently available, however this may be decreased by future storm events. Plant communities were not an adequate source of coarse and/or LWD for maintenance and recovery. The stream is currently super-loaded with LWD but there is a concern for an inadequate supply of wood in the future. The effects of this super wood loading is unknown on future channel dynamics. It is important to point out that streams of this size may not need *large* amounts of LWD.

The majority of harvesting occurred in this basin less than 5 years ago. Lack of recent beaver activity was also documented at the confluence. The absence of beaver may have reduced the amount of available rearing habitat for coho salmon and to a lesser extent steelhead trout. The PFC team did not determine any instream impacts. However, at least 80 percent of the drainage has been harvested, several problematic road crossings were identified, and there may be a loss of future LWD recruitment from natural disturbances, i.e., slides and debris torrents.

Reach IT3&4 consists of two small tributary systems (T3 and T4) that drain into the south side of Inlet Creek. Total reach length is 3,025 feet These streams are small mountain footslope channels that share similar physical characteristics and management. The streams are transitional channels that transport sediment at high flows and deposit sediment at low flows. Both tributaries are predominately Class II resident fish (channel type MM1) as they intersect Inlet Creek at gentle gradients and HC2 as they extend upslope to steeper gradients. Total Class II habitat is 1,250 feet The lower portion of Tributary 3 is Class I for 650 feet Harvest adjacent to these streams occurred as early as the mid 1990s. These streams are small, typically 6-8 feet in bankfull width. MM1 and HC2 streams need a moderate amount of LWD to function properly. Typically, there is no buffer on these streams and they are lacking LWD. The buffer left for main stem Inlet Creek includes the first 50-100 feet of these tributaries—habitat below highway. The upper drainages of these small tributaries are unmanaged and are in the National Forest System.

Reach IT3&4(south side) was rated Functional at Risk—Downward Trend. The reach contains an insufficient amount of LWD; removal of LWD may have increased W/D ratios. The upland watershed is contributing to riparian degradation; the upper stream crossing is blown out and contributing sediment. There are no large trees adjacent to the stream for LWD recruitment in the future—no diverse age classes. Plant communities were not an adequate source of coarse and/or LWD for maintenance and recovery. The stream is not in balance with the water and sediment being supplied by the watershed. Predominant seral stage for the reach is early.

Photo 7. Lower Trib 4 of Inlet Creek, reach IT3&4 Photo 8. Road washout upper Trib 4, reach IT3&4.


Photo 9. Trib 7, reach ITNorth at first road crossing. Photo 10. Trib 6, upper WA, reach ITNorth.

Reach ITNorth consists of a group of tributaries (T6, 7, 7A, 8A, 8B, and 9) that drain into the north side of Inlet Creek. These streams are small mountain footslope channels that share similar physical characteristics and management. These are transitional channels that transport sediment at high flows and deposit sediment at low flows. All tributaries are Class II resident fish (channel type MM1) as they intersect Inlet Creek at gentle gradients and HC2 as they extend upslope to steeper gradients. Total reach length is 9,825 feet, total Class II habitat is 5,200 feet. Harvest adjacent to these streams occurred as early as the mid-1990s. These streams are small, typically 4-8 feet in bankfull width. MM1 and HC2 streams need a moderate amount of LWD to function properly. There is no buffer on these streams and the streams currently contain a large amount of fine woody debris (logging slash). The buffer left for main stem Inlet Creek includes the first 50-100 feet of these tributaries.

Reach IT North was rated Non-Functional. The upland watershed is contributing to riparian degradation. Channels are scoured and there are impacts from stream crossings and hydrologic connectivity. W/D ratios and sinuosity may be impacted (noted but not determined in assessment). There are no large trees adjacent to the stream for LWD recruitment in the future. There is not adequate vegetation to protect banks and dissipate energy. Plant communities are not an adequate source of coarse and/or large woody material. Trib 6&7 has been cleaned of LWD and is poor habitat. Trib 8 contains an excess of fine woody debris that is reducing water velocities and trapping more fine sediments than typical for this channel. The stream appears to be eroding around the debris in places. Shade from logging debris may be affecting certain biological components of the stream including primary productivity.

Reach IT11 flows into main stem Inlet Creek. The reach is Class II, 700 feet beyond the 1st road crossing. IT11 begins MM1 transitioning to HC2 after the 1st road crossing. Total reach length is 3,050 feet. Total fish habitat is 2,100 feet including trib 11A. The stream is small, 10 feet bankfull width, and relatively straight. The channel functions to transport sediment routed from above. LWD volume is substantial in these types of channels. A thin non-merchantable buffer lines the reach. The stream flows intermittently at the first road crossing (the stream was dry at the road at the time of survey (6/9/2000). The majority of tributary 11's drainage basin has been selectively harvested. Dolly Varden were observed in the lower half of the tributary to a point of intermittent flow. One small Class II/III tributary intersects the stream upstream left at 250 feet. Trib 11A is MM1 for 800 feet transitioning to HC2 for an additional 500 feet of resident fish habitat. Fish were also observed in Trib 11A upstream of the culvert. Reach T11 contains good fish habitat.

Reach IT11 was rated Proper Functioning Condition.
A non-merchantable riparian buffer containing > 2 age classes remains intact. Some localized channel disturbance was noted around the log stringer bridge and associated sill logs. The road and bridge are currently constricting flows and limiting the stream's access to the floodplain. Excess sediment deposition was noted just below the bridge. There is currently a reasonable amount of LWD in the stream. Streambanks appear to be relatively stable.

Southeast composite Sub-basin

Tier 1 and PFC Results Southeast Composite Sub-basin

20 miles of Tier 1 and PFC assessments were conducted on 100 percent of Class I, II and some Class III streams in the Southeast Composite Sub-basin. Eight streams were divided into 15 reaches for the assessment. Two streams are grouped into one reach for assessment purposes: SE3&4. Nine reaches rated PFC and seven reaches rated FAR--Downward or Non-Apparent trend (Figures 6 and 13, Table 7). Stream reaches classified as FAR lacked future LWD recruitment potential, exhibited excessive erosion and/or deposition, and/or exhibited channel instability. Other key checklist components that determined ratings included: upland watershed degradation, stream bank and upland harvest, and adequate riparian vegetative cover to protect banks and dissipate energy during high flows. Some reaches were harvested to the streambanks; consequently, there is no buffer or future wood recruitment available. Several logging roads present fish passage and erosion problems. The lower reaches along the lake were generally rated PFC. Reaches in the mid to upper slopes did not have adequate buffers and in some cases LWD was removed from these systems.

Inlet South

Reach IS (Inlet South) extends 1,400 feet from its confluence with Klawock Lake. The reach is FP3 and HC2 Class I and II. The stream is small, 13 feet bankfull width, and sinuous in its lower reach. Small amounts of quality rearing and spawning habitat exist in the reach. A small amount of selective harvesting (and windthrow) occurred on the east side of the creek. The predominant seral stage in the reach is mid-seral. This reach was assessed with the use of aerial photos. House lots have been sold along the lakeshore and future development could negatively affect the riparian area on this stream.

Reach IS was rated **Proper Functioning Condition.** Reach IS is within a relatively intact natural forested riparian area. Some blow-down and selective harvesting has occurred on the east side of the stream. An adequate supply of large wood adjacent to the stream is currently available; however, this may be decreased by future storm events. Plant communities were an adequate source of coarse and/or LWD for maintenance and recovery. The reach meets the minimum requirements for PFC.

Salmon Salad Creek

Reach SS1 extends 10,500 feet from its confluence with Klawock Lake. The reach is Class I and II to the upper extent of the reach. Approximately 2,200 feet of S1 is accessible to anadromous fish. The predominant channel types in main stem Salmon Salad Creek are FP4, MM1, and MC1. Three small Class IV tributaries in the upper drainage are HC2. The stream is of moderate size, about 40 feet bankfull width, and sinuous in the lower reach. The upper reach also contains some FP3 channel type above a bedrock nick-point at RM 3,300 feet. The lower channel functions to store sediment routed from above. LWD accumulations are frequent and channels retain significant volumes of fine sediment. Good rearing and spawning habitat exist in the lower FP4 section below the road crossing. A thin buffer lines the creek upstream to the bridge at the main road crossing. After this point, the buffer is seriously compromised. There are few standing trees; mostly residual hemlocks line the creek. There is, functionally, no buffer for 750 feet and little LWD in the channel. Beyond this point, the stream increases in confinement and a stable buffer exists through the remainder of the reach. A section of the stream (300 feet) is also well- harvested at the end of the reach. Several small tributaries intersect the creek at the upper end of the drainage. House lots have been sold along the lakeshore and future development could negatively affect the riparian area on this stream.

Reach SS1 was rated Proper Functioning Condition.
A riparian buffer containing > 2 age classes exists for the majority of the reach. Two sections within the reach total about 1,000 feet and do not have an adequate buffer. Overall, plant communities were determined to be an adequate source of coarse and/or LWD for maintenance and recovery (Prichard, Tech. Ref. 1737-15 1999). Recent beaver activity was documented in the upper reach of the FP3 section. Some localized channel disturbance was noted below the log stringer bridge. Overall, the stream is in balance with the water and sediment being supplied by the watershed. Some excess sediment deposition was noted just below the bridge. The road and bridge are also constricting flows and limiting the stream's access to the floodplain. There is currently an adequate amount of LWD in the stream except in the section with no buffer. Stream banks appear to be relatively stable. Two small slides occurred in the mid-reach, but these were not found to negatively impact the reach as a whole.

Small Streams Creek (SE3&4)

SE3&4 extends 4,150 feet from its confluence with Klawock Lake; total reach length is 11,300 feet The reach is FP3 Class I anadromous to the highway crossing. The streams are small <10m bankfull width and sinuous in the lower section. The first 450 feet of each stream are in good condition. The predominant seral stage in this section is mature. Coho fry were observed in stream 3 during the survey (9/15/2000). No fish were observed in stream 4. Reach 1 also encompasses the remaining more heavily managed fish bearing portions of stream 3 and 4 upstream of the tie road. These are small mountain footslope channels that share similar physical characteristics and management. The transitional channels transport sediment at high flows and deposit sediment at low flows (in lower FP3 sections). Reach 1 consists of approximately 3,250 feet of MM1 and HC2 channel types. These streams have little or no buffer, nor do they currently contain much LWD. There is no buffer for 1,600 feet of stream, and 1,400 feet of the reach has a non-merchantable hemlock buffer. It appears in-channel LWD was removed during logging. MM1 and HC2 channels need a moderate amount of LWD to function properly. A spur road intersects stream 4 about 1,100 feet above the first crossing. The main road crossing on stream 4 and upper road system needs to be evaluated. House lots have been sold along the lakeshore and future development could negatively affect the riparian area on this stream.

SE3&4 was rated Functional at Risk—Trend Not Apparent. There is concern that that the amount of harvest that has occurred in the drainage has increased peak flows and, subsequently, erosion in this reach. W/D ratios appeared to be higher in the lower reach just upstream of the road. Some aggradation was observed there. The reach contains an insufficient amount of LWD. Plant communities were not an adequate source of coarse and/or LWD for maintenance and recovery.

Alder Creek Sub-basin

Reach A1 extends 1,800 feet to a steep cascade from its confluence with Klawock Lake. The reach is Class I beyond an old log-stringer bridge. The entire reach is an MM1 channel type. The stream is of moderate size, about 25 feet bankfull width and slightly sinuous. Coho salmon fry were observed below the bridge during the survey (9/21/2000). Approximately 250 feet of FP3 channel type occurs at the confluence with the lake. Adequate rearing and spawning habitat exist in the lower section below the road crossing. Where located next to accessible lakes, these channels provide moderate quality spawning habitat for sockeye salmon and steelhead trout (USDA, 1992). The first 450 feet of the stream is in good condition. The predominant seral stage in this section is mature. However, a small 200 feet patch of salvage occurred in this section where all large diameter trees have been removed. Localized bank disturbance was documented in this area. The creek is buffered upstream from this point through the extent of the reach. The buffer is seriously compromised for about 400 feet around the bridge. Few standing trees remain; mostly small residual hemlocks line the creek. There is, functionally, no buffer for 400 feet and little LWD in the channel. Significant blowdown is scattered throughout the reach. Upstream from the bridge the stream increases in confinement and a stable buffer exists through the remainder of the reach. House lots have been sold along the lakeshore and future development could negatively affect the riparian area on this stream.

Reach A1 was rated Proper Functioning Condition.
Reach A1 has lost a significant amount of a functional riparian area in approximately 45 percent of the lineal reach. This leave buffer approaches the minimum amount required to maintain a PFC rating. A significant amount of blowdown has occurred compromising the already ―thin" hemlock dominated leave buffer. Plant communities were determined to be an adequate source of coarse and/or LWD for maintenance and recovery (Prichard, Tech. Ref. 1737-15 1999). Some localized channel disturbance was noted in the lower section of the channel next to the salvage patch. An adequate supply of large wood adjacent to the stream is currently available; however, this may be decreased by future storm events. Stream banks appear to be relatively stable



Photo 11. Alder Creek, Reach A1, at main road crossing. Photo 12. Reach A1 of Alder Creek upstream of bridge crossing. Note presence of LWD and stream bank stability.



Photo 13. Landslide intersects Alder Creek Reach A2. Photo 14. Reach A2 of Alder Creek.

Reach A2 encompasses the remaining more impacted upstream portion of Alder Creek above the steep cascades. Reach A2 extends 3,500 feet beyond the extent of anadromous habitat. The stream is small, approximately 20 feet in bankfull width. The reach is predominantly HC2 channel type and habitat for resident trout. The stream is a small mountain footslope channel that functions to transport sediment at high flows and deposit sediment at low flows. Harvest adjacent to the stream occurred in the early 1990s, resulting in a predominance of disturbance species throughout the reach. Alders proliferate between the cascades and the tributary junction. Larger High Gradient Contained streams need a moderate amount of LWD to function properly. These streams were not buffered nor do they currently contain adequate LWD. It appears in-channel LWD was removed during logging. Logging debris and debris from slides was observed in the reach. There is a high frequency of small debris jams in the upper reach as is expected in this type of channel and landform, but the team agrees that the amount of material exceeds the natural range of variability. A steep full-bench road

parallels the stream about 500 feet upslope. One Class III tributary parallels Alder Creek at RM 3 for 100 feet. Several slides were recorded in the drainage, at least three have intercepted Alder Creek and two others originated on the upper slopes and were intercepted by the "St. Nick Tie Road".

Reach A2 was rated Functional at Risk—Downward Trend. Reach A2 has been significantly impacted. The upland watershed is contributing to riparian degradation; landslides, and logging slash debris jams were documented. Greater than 65 percent of the drainage has been harvested. There are no large trees adjacent to the stream for LWD recruitment in the future, no diverse age class distribution, and a predominance of disturbance species. Alders and disturbance species did not constitute an adequate source of coarse and/or LWD for maintenance and recovery (Prichard, Tech. Ref. 1737-15 1999). Floodplain and channel characteristics were determined inadequate to dissipate energy. There is also a concern that the amount of harvest in the drainage has increased peak flows and subsequently stream channel erosion in this reach. Some localized downcutting was visible around debris jams. Recovery of the reach is dependent upon stability of the upper watershed (roads and drainage) and future landslide activity. Effects of harvest may not yet be completely visible.

TR6 Creek

Reach TR6-1 includes the lower "unmanaged" portion of mainstem TR6 Creek, Trib1 and the lower unmanaged portion of Trib 1 of Swamp Creek. Total reach length is 5,700 feet The reach is entirely Class I and meanders through a forested wetland before intersecting Klawock Lake. The predominant channel type in the reach is FP3 and MM1. The stream is small, about 16 feet bankfull width, and sinuous in the lower reach. The lower channel functions to store sediment routed from above. LWD accumulations are frequent and channels retain significant volumes of fine sediment. Good rearing and spawning habitat exist in the reach. The transitional MM1 channels transport sediment at high flows and deposit sediment at low flows (in lower FP3 sections). A small 250-foot patch of salvage occurred in this section where all large diameter trees have been removed. Localized bank disturbance was documented in this area. Some selective harvest and blowdown occurred in adjacent channels throughout the reach. The stream is migrating around the blowdown. House lots have been sold along the lakeshore and future lot development could compromise the integrity of the riparian area.

Reach TR6-1 was rated Proper Functioning Condition. The riparian area is intact, and stable for the majority of the reach; only moderate impacts were observed. Plant communities were determined to be an adequate source of coarse and/or LWD for maintenance and recovery. Some localized channel disturbance was noted in the lower section of the channel next to the salvage patch. An adequate supply and future recruitment of large wood adjacent to the stream is currently available. Stream banks appear to be relatively stable.

Reach TR6-2 is comprised of TR6, T1, T2 and Swamp Creek Trib 1. This reach is a conglomeration of small mountain footslope channels that share similar physical characteristics and management. These streams are transitional channels that transport sediment at high flows and deposit sediment at low flows. The majority of tributaries are Class II resident fish as they intersect reach TR6-1. Predominant channel types in the reach include FP3, MM1, HC2, HC5, and HC6. Total reach length is 15,800 feet The lower portion (700 feet) of Swamp Creek Trib 1 is Class I and 2,850 feet of the reach is Class II. Harvest adjacent to these streams occurred as early as the mid 1990s. Predominant seral stage in the reach is early. These channels are small, typically six to twelve feet bankfull width. MM and HC streams need a moderate amount of LWD to function properly. Typically, there is no buffer on these streams and the streams currently contain a large amount of fine woody debris (logging slash). It is highly likely that in-channel LWD was removed during logging.

Reach TR6-2 was rated Functional at Risk-Trend Not Apparent. The PFC Team did not have sufficient information to determine a trend. Most channels are stable but several vegetation components were not met in the checklist:1) there are no large trees adjacent to the stream for LWD recruitment in the future; 2) no diverse age class distribution, and 3) a predominance of disturbance species. Alders and disturbance species did not constitute an adequate source of coarse and/or LWD for maintenance and recovery. There is also concern that the amount of harvest in the drainage has increased peak flows and subsequently stream channel erosion in this reach. Some localized channel down-cutting was visible around debris jams. Recovery of the reach is dependent

upon stability of the upper watershed (roads and drainage) and future landslide activity. Effects of harvest may not yet be completely visible. The stream will improve as trees grow back on the adjacent riparian and uplands.

Swamp Creek

Reach S1 extends 2,950 feet from its confluence with Klawock Lake. The entire reach is FP4 Class I anadromous. The stream is of moderate size, having a variable bankfull width of >10m. The FP segment exhibits high sinuosity, multiple channels, and some well-developed point bars. Old beaver dams are common in the lower reach and the stream is in a dynamic state of transition between ponds and floodplain channel types. This condition provides excellent rearing habitat. New beaver activity was documented in the upper reach. Reach S1 functions to deposit sediment and dissipate stream energy. Large wood is a significant component to stable stream banks in these systems. LWD accumulations are frequent and channels retain significant volumes of fine sediment. These channels also contain moderate to high available spawning area (30 percent). Good rearing and spawning habitat exist in the reach. Predominant seral stage is mid-mature with some standing old-growth. Overall, the reach is in good condition. Selective harvesting (and windthrow) was documented above the first 1,000 feet of the reach. The lower part of this reach along the lakeshore has been subdivided and future house lot development could compromise the integrity of the riparian area.

Reach S1 was rated **Proper Functioning Condition.**
Reach SI is within a relatively intact natural forested riparian area. Some blow-down and selective harvesting has occurred but not to an extent that compromises riparian stability. Selective helicopter harvest removed many of the stream-side large spruce. An adequate supply of large wood adjacent to the stream is currently available. This may be decreased by future storm events. Plant communities were an adequate source of coarse and/or LWD for maintenance and recovery (Prichard, Tech. Ref. 1737-15 1999). The stream contains a large amount of LWD. The stream meets the minimum requirements for PFC. This reach is quality habitat for the Klawock Watershed and should be considered for retention as core refugia.

Reach S2 extends 2,150 feet from the end of reach S1 going across the road to reach S3.
Reach S2 encompasses the remaining more impacted transitional portion of Swamp Creek above the steep cascades. The lower section of the reach is FP4 and the upper portion is AF2. The upper reach is HC2 and habitat for resident trout. Harvest adjacent to the stream occurred in the early 1990s, resulting in a predominance of disturbance species throughout the reach. The reach has no functional buffer. Alders and disturbance species proliferate throughout the reach. FP and AF streams need a large amount of LWD to function properly. These streams were not buffered nor do they currently contain adequate LWD. In-channel LWD was removed during logging. The riparian trees were cabled yarded. A small section of stream, ~350 feet between channel types is beginning to unravel. This section of stream is not interacting with the floodplain in relatively frequent events, is actively downcutting, does not meet the vegetation requirements, and does not have adequate LWD. Banks are unstable and eroding and LWD is lacking throughout the middle portion of the reach.

Reach S2 was rated Functional at Risk—Downward Trend. Reach S2 has been significantly impacted. The reach has no functional conifer buffer. Beaver dams were present but not active in this reach. There are no large trees adjacent the stream for LWD recruitment in the future, no diverse age class distribution and a predominance of disturbance species. Alders and disturbance species do not constitute an adequate source of coarse and/or LWD for maintenance and recovery. Some localized downcutting was visible around debris jams. Effects of harvest may not yet be completely visible. Recovery of the reach is dependent upon the emergence of stable riparian vegetation. The stream will improve as trees grow back on the adjacent floodplain, but is decades from reaching PFC.

Reach S3 encompasses the remaining upstream section of Swamp Creek. Reach S3 extends 7,350 feet through the upper drainage. Reach S3 is Class II and mostly Class III. Total resident fish habitat in the reach is 2,300 feet. The reach is predominantly HC2 and contains some HC6 portions in the headwaters. Impacts to the reach are limited. A thin buffer remains on the lower west side of the stream and the remainder of the reach is selectively harvested. One Class III/IV HC6 tributary intersects Swamp Creek in the upper drainage.

Reach S3 was rated Proper Functioning Condition. The riparian area is relatively intact, and stable for the majority of the reach; only moderate impacts were observed. Plant communities were determined to be an adequate source of coarse and/or LWD for maintenance and recovery (Prichard, Tech. Ref. 1737-15 1999). Some localized channel disturbance was noted in the lower section of the channel next to the cable-yarded patch. Trees uprooted from blowdown have disturbed stream banks in this section. An adequate supply and future recruitment of large wood adjacent to the stream is currently available. Stream banks appear to be stable. The reach remains stable and does not exhibit impacts from roads or landslides. Effects of harvest may not yet be completely visible.

Chutes and Ladders Creek

Reach CL1 extends 2,200 feet from its confluence with Klawock Lake and encompasses 7,800 total feet of dynamic FP4 and PA5 Class I channel types. The stream is of moderate size, having a variable bankfull width of >10m. The Floodplain segment exhibits high sinuosity, multiple channels and some well-developed point bars. Old beaver dams are common in the lower reach and the stream is in a dynamic state of transition between ponds. This dynamic is providing excellent fish habitat. New beaver activity was documented in the upper reach. Reach CL1 functions to deposit sediment and dissipate stream energy. The dominant seral stage is mid-mature with some standing old-growth. Overall, the reach is in excellent condition, some selective harvesting and windthrow was documented. Also included in the reach is 2,100 feet of small FP3 channels on Trib 1. This section was similarly managed and impacts are limited to selective harvest in old road crossings. Housing development could encroach on the lower part of this stream‘s riparian area.

Reach CL1 was rated **Proper Functioning Condition.** Reach CL1 is within a relatively intact natural forested riparian area. Some blow-down and selective harvesting has occurred but not to an extent that compromises riparian stability. Selective helicopter harvest removed many of the large spruce. An adequate supply of large wood adjacent to the stream is currently available; this may be decreased by future storm events. Plant communities are an adequate source of coarse and/or LWD for maintenance and recovery. The stream contains a large amount of LWD. Inadequate riparian vegetative cover is present to protect banks and dissipate energy during high flows in the exposed transitional beaver ponds. Minimal recent beaver activity was noted. It was also determined that the stream was not in balance with the water and sediment being supplied by the watershed; excessive erosion from old beaver ponds was documented. The stream still meets the minimum requirements for PFC. This reach is quality habitat for the Klawock Watershed and should be retained as core refugia.

Reach CL2 extends 3,325 feet up the mainstem from reach CL1 across the tie-road to reach CL3. Reach CL2 encompasses the remaining more impacted transitional (headwaters to valley bottom) portion of Chutes and Ladders Creek. The lower section of the reach is FP4 and the upper portion is AF1 and MM1. Harvest adjacent to the stream occurred in the early 1990s, resulting in a predominance of alder throughout the reach. The reach has no functional buffer; seral stage is young. FP and AF streams need a large amount of LWD to function properly. In-channel LWD was removed during logging. The riparian trees were cabled yarded. A small section of stream ~350 feet between channel types is beginning to unravel. This section of stream is not interacting with the floodplain in relatively frequent events, is actively downcutting, and does not have adequate LWD; banks are unstable and eroding. This is a Class I anadromous stream.

Reach CL2 was rated Functional at Risk—Downward Trend. The reach has been significantly impacted. The reach has no functional conifer buffer. There are no large trees adjacent the stream for LWD recruitment now and in the future. Alders and disturbance species do not constitute an adequate source of coarse and/or LWD for maintenance and recovery. Adequate riparian vegetation was not present to protect banks and dissipate flows; plant communities were not an adequate source of LWD. Floodplain and channel characteristics were determined inadequate to dissipate energy. Effects of harvest may not yet be completely visible. It is highly possible that the downcut reach could grow. Minimal recent beaver activity was noted, as well as excessive erosion from old beaver ponds. Recovery of the reach is dependent upon the emergence of stable riparian vegetation.


Photo 15. Reach CL2 of Chutes and Ladders Creek. Photo 16. Reach CL2 below main road.
Both photographs depict FP transitioning to MM channel types. Note riparian composition, lack of LWD and cut banks.


Photo 17. Reach CL2, channel type MM1. Photo 18. Reach CL2 above channel type MM1 transitioning to HC 2. Note composition of riparian area and decrease in LWD between photos.

Reach CL3 encompasses the remaining upstream section of Chutes and Ladders Creek. The reach is predominantly HC2 and contains some HC6 portions in the headwaters. A steep HC6 cascade separates CL2 from CL3. Mainstem C&L Creek extends 4,600 feet through the upper drainage. Total reach length is 7,800 feet Reach CL3 is Class II and III. Total resident fish habitat in the reach is 4,100 feet Impacts to the reach are limited. A thin buffer remains on the lower west side of the reach and the remainder of the reach is selectively harvested. Two small Class III/IV HC6 tributaries intersect C&L Creek in the upper drainage.

Reach CL3 was rated Proper Functioning Condition.
The riparian area is relatively intact, and stable for the majority of the reach; only moderate impacts were observed. Plant communities were determined to be an adequate source of coarse and/or LWD for maintenance and recovery. Some localized channel disturbance was noted in the lower section of the channel next to the cable-yarded patch. Trees uprooted from blowdown have disturbed stream banks in this section. Stream banks appear to be stable and the reach does not exhibit impacts from roads or landslides.

Reach CLT1 (tribs-lower) Encompasses the anadromous section of T1 and some small tribs below the main road. Reach CLT1 extends 3,281 feet through the lower drainage meandering through beaver ponds and floodplain channel (FP3 and PA5). Total reach length is 7,950 feet Harvest adjacent to the stream occurred in

the early 1990s, resulting in a predominance of alders on the streambank. The reach has no functional buffer; seral stage is young. FP and AF streams need a large amount of LWD to function properly. In-channel LWD was removed during logging. The riparian trees were cabled yarded. Beaver ponds have proliferated following floodplain harvest. An analysis of the 1991 photos reveal few small beaver ponds. Currently there are several large ponds in the area. This conversion of habitat types from FP3 to PA5 may have negative consequences on sockeye salmon production. This hypothesis needs further evaluation.

Reach CLT1 was rated Functional at Risk-Downward Trend. The reach has been significantly impacted. The reach has no functional conifer buffer. There are no large trees adjacent the stream for LWD recruitment in the future. Alders and disturbance species do not constitute an adequate source of coarse and/or LWD for maintenance and recovery. Adequate riparian vegetation was not present to protect banks and dissipate flows. Floodplain and channel characteristics were determined inadequate to dissipate energy. Effects of harvest may not yet be completely visible. No recent beaver activity was observed and excessive erosion from old beaver ponds was documented**.** Recovery of the reach is dependent upon the emergence of stable riparian vegetation.

Reach CLT2 (tribs-upper) is comprised of portions of Trib 1, 1A, and 1B. This reach is a conglomeration of small mountain footslope channels that share similar physical characteristics and management. The majority of tributaries are Class II resident fish as they intersect reach CLT1. The entire reach is upstream of the mainline road. Predominant channel types in the reach include FP3, MM1, HC2 and HC6. Total reach length is 16,825 feet. Harvest adjacent to these streams occurred early in the 1990s. Predominant seral stage in the reach is early. These channels are small, typically six to ten feet bankfull width. MM and HC streams need a moderate amount of LWD to function properly. Typically, there is no buffer on these streams and the streams currently contain a large amount of fine woody debris (logging slash). It appears some in-channel LWD was removed during logging.

Reach CLT2 was rated Functional at Risk-Trend Not Apparent. The PFC Team did not have sufficient information to determine a trend. Most channels are stable but several vegetation components were not met in the checklist. There are no large trees adjacent to the stream for LWD recruitment in the future, no diverse age class distribution, and a predominance of disturbance species. Alders do not constitute an adequate source of coarse and/or LWD for maintenance and recovery. Floodplain and channel characteristics were determined inadequate to dissipate energy in much of the reach. Harvest in the drainage has increased and may have altered flows and subsequent loss of LWD may exacerbate channel erosion in this reach. Recovery of the reach is dependent upon stability of the upper watershed (roads and drainage) and future landslide activity. Effects of harvest may not yet be completely visible. The stream will improve as trees grow back on the adjacent riparian and uplands.

Hatchery Creek Sub-basin

A PFC assessment was conducted on over 21 miles of Class I and II streams and some Class III channels in 2000. Hatchery Creek and its tributaries were delineated into 16 reaches for the PFC assessment. Main stem Hatchery Creek was delineated into five reaches and includes sections of other streams of similar condition. The largest tributary, T2, was delineated into five reaches for the assessment (HT2A-E). Tributary streams with similar conditions were aggregated into like reaches for assessment purposes (Figure 6 and 10, Table 18).

Main stem Hatchery Creek

Reach H1 includes the first 3,000 feet of main stem Hatchery Creek, Tributary 1, 1A (5000 feet-PA1) and the first 1800 feet of lower Tributary 2; total reach length is 14,950 feet This reach is Class I, predominately channel types FP4 and PA2. Timber harvest has occurred adjacent the FP portions of the reach (70 percent of reach). Most of this reach has a narrow buffer of trees left from harvest in the late 1980s. Windthrow of those trees is frequent throughout the reach. Predominant seral stage is young with some standing old-growth. The FP segments exhibit high sinuosity, multiple channels, and well-developed point bars. Reach H1 functions to deposit sediment and dissipate stream energy. Large wood is a significant component to stable stream banks. Off-channel beaver ponds are frequent in this reach, especially adjacent lower tributary 2. Channel substrate is

more suitable for salmon spawning in tributary 2 than in the FP section of main stem Hatchery, which contains smaller gravels less suitable for anadromous fish. The main stem Hatchery portion of the reach is transitioning from an old PA to a Floodplain system. Dolly Varden and coho salmon fry were observed during the survey. Historic air photo interpretation reveals a well intact riparian zone and a lesser amount of beaver ponds adjacent Tributary 2 and main stem Hatchery. Proliferation of slackwater beaver ponds appears to be the result of floodplain harvest.

Reach H1 was rated **Proper Functioning Condition**. Plant communities do not appear to be an adequate source of coarse and/or large woody material. At this time, enough large wood and riparian vegetation is present to process the additional sediment from upstream sources but it is unlikely that enough large wood will be present to dissipate energy and process sediment in the future. The stream appears to be processing a lot of sediment and reacting to old beaver dams and excessive LWD. Historic beaver ponds are not active. A predominance of disturbance species was documented within the riparian area.

Reach H2 extends 5,300 feet upstream of H1 at the confluence of T2. The first 800 feet is PA5 and the remaining channel is PA2. Palustrine systems are associated with extensive wetlands on low relief valley bottom landforms. PA channels are storage sinks consisting of low velocity glides associated with wetlands and lakes. Stream energy is low, substrate is small, predominately organics and sand. Some spawning takes place but systems are predominately rearing habitat. Coho, dolly varden, and, to a lesser extent, sockeye, may utilize this prime rearing habitat. Channels are important wetland/floodplain complexes that function to moderate runoff, store sediment, and bank nutrients (USDA Forest Service, 1992). For purposes of this study, Palustrine channels are evaluated as such and not Tall Sedge Fen wetlands.

Reach H2 was rated Proper Functioning Condition. The channel is stable, vegetation is present, and both are functioning relative to the low relief landform. The amount of timber harvest is minimal and not extensive enough to disturb the functionality of the system. There was no observed erosion or deposition problems in reach H2. Some selective harvest (helicopter) has occurred on adjacent north hill slope.

Tributary 2

Tributary 2 of Hatchery Creek is the largest tributary in the Hatchery Creek system and also one of the largest and most important in the watershed. T2 is approximately 5 miles long; 1.8 miles is accessible to anadromous fish. A series of falls block anadromous fish passage above the first stream crossing at river mile 1.8. T2 was delineated into five reaches for the assessment: HT2A-E.

Reach HT2A extends 3,350 feet up tributary 2 from reach H1 across the ~~"~~main road" to reach HT2B. The reach encompasses the lower impacted floodplain portion of tributary 2. The lower section of the reach is FP4; the upper portion is AF1. Harvest adjacent to the stream occurred in the early 1990s, resulting in a predominance of disturbance species throughout the reach. The reach has a limited buffer; seral stage is young, with some standing residual trees. FP and AF streams need a large amount of LWD to function properly. The riparian was cabled yarded. The bridge near the upper reach is confining a small section of stream, degrading below and aggrading above. Several areas of abnormal bedload aggradation were observed in the reach. This may be a result of windthrow, localized bank instability, and/or upstream disturbance. Small sections of stream were observed not interacting with the floodplain. Minimal beaver activity was observed. Unstable old dams in and adjacent to streams were also observed.

Reach HT2A was rated Functional at Risk—Trend Not Apparent. There are few large trees adjacent the stream for LWD recruitment in the future, no diverse age class distribution, and a predominance of disturbance species. Future windthrow is possible. Alders and disturbance species do not constitute an adequate source of coarse and/or LWD for maintenance and recovery (Prichard, Tech. Ref. 1737-15 1999). Plant communities were also not an adequate source of LWD. Floodplain and channel characteristics were determined minimally adequate to dissipate energy. Effects of harvest may not yet be completely visible. The stream is not in balance with the water and sediment supplied by the watershed. There is excessive sediment below the bridge. Minimal

recent beaver activity was noted and some erosion from old beaver ponds was documented. Recovery of the reach is dependent upon the emergence of a stable riparian and sub-basin stability.

Reach HT2B begins above the first road crossing to the extent of anadromous fish habitat. The reach is 3,550 feet in length. This reach is Class I, channel type AF1, MM1, and MC1, and ends at a steep falls. The reach was selectively harvested (helicopter) recently and impacts are limited to windthrow and channel stability. The reach is quality fish habitat and has high value as spawning habitat at the sub-basin scale.

Reach HT2B was rated Proper Functioning Condition. The riparian area is mostly intact and stable for the majority of the reach. Only moderate impacts from windthrow were observed. Many large trees were removed from the riparian zone; plant communities were determined to be an adequate source of coarse and/or LWD for maintenance and recovery.

Reach HT2C extends 2,700 feet up from reach HT2B through a tractor-yarded floodplain to reach HT2D. The reach is Class II, channel type FP4 and MM1 in the upper portion. Harvest adjacent to the stream occurred in the early 1990s; alders and disturbance species proliferate throughout the reach. The reach has no functional conifer buffer; seral stage is young, with some standing residual trees. FP and, to a lesser extent, MM streams need a large amount of LWD to function properly. An old stream crossing near the upper reach extends into the floodplain. This crossing is confining a small section of stream, degrading below, and aggrading above. Several areas of abnormal bedload aggradation were observed in the reach. The stream appears to be overly sinuous in places and downcutting into the soft alluvial deposits.

Reach HT2C was rated Functional at Risk—Downward Trend. There are few large trees adjacent the stream for LWD recruitment and no diverse age class distribution. Future windthrow is possible. Plant communities are also not an adequate source of LWD and alders and disturbance species do not constitute an adequate source of coarse and/or LWD for maintenance and recovery. Floodplain and channel characteristics were determined minimally adequate to dissipate energy. Effects of harvest may not yet be completely visible. Recovery of the reach is dependent upon the emergence of a stable riparian and sub-basin stability.

Reach HT2D encompasses a long, more confined, upper valley section of the drainage. The reach is predominantly MM1 and MC2 toward the upper extent. Total reach length is 11,350 feet. Reach HT2D is Class II. Impacts to the reach are limited to some localized disturbance from windthrow and the abundance of disturbance species as a result of the selective harvesting (helicopter). Four small Class III/IV tributaries intersect the reach in the upper drainage.

Reach HT2D was rated Proper Functioning Condition.
The riparian area is relatively intact and stable for the majority of the reach. Only moderate impacts were observed. Plant communities were determined to be an adequate source of coarse and/or LWD for maintenance and recovery. Some localized channel disturbance was noted in the lower section of the channel from trees uprooted by blowdown. An adequate supply and future recruitment of large wood adjacent to the stream is currently available. Stream banks appear to be stable and the reach does not exhibit impacts from roads or landslides. Effects of harvest may not yet be completely apparent.

Reach HT2E encompasses the remaining confined upper valley section of the drainage. The reach is predominantly MC2 and HC2 toward the upper extent. Total reach length is 10,925 feet Reach HT2E is Class II but includes some Class III. Harvest adjacent to these streams occurred as early as the mid 1990s. The reach was cable yarded to the stream bank. Predominant seral stage in the reach is early. MC and HC streams need a moderate amount of LWD to function properly. Typically, there is no buffer on these streams and the streams currently contain a large amount of fine woody debris (logging slash). Two small Class III/IV tributaries intersect the reach in the upper drainage.

Reach HT2E was rated Functional at Risk-Downward Trend.
Most channels appear stable but several vegetation components in the checklist were not met. There are no large trees adjacent to the stream for LWD recruitment in the future, no diverse age class distribution, and a

predominance of disturbance species. Alders and disturbance species do not constitute an adequate source of coarse and/or LWD for maintenance and recovery. Floodplain and channel characteristics were determined to be minimally adequate. Recovery of the reach is dependent upon stability of the upper watershed (roads and drainage). Effects of harvest may not yet be completely visible.

Reach HP1(palustrine) includes the remaining nearly undisturbed palustrine sections of main stem Hatchery Creek, Tributaries 3, 5, 6, 6A, 7, 8 and 9. All three palustrine channel types are represented: PA1, 2 and 5. Total reach length is 8,900 feet The reach is predominately Class I. The reach is primarily tall sedge fen with some selective timber harvesting (helicopter) occurring on the timbered fringes. This reach is excellent rearing habitat. Minimal beaver activity was noted during the survey.

Reach HP1 was rated Proper Functioning Condition The channel is stable, vegetation is present, and both are functioning relative to the low relief landform. The amount of timber harvest is minimal and not extensive enough to disturb the functionality of the system.

Reach HT3PH (Palustrine Harvested) is comprised of portions of two tributaries which are predominately PA5 with a lesser amount of PA1 (1300 feet). Total reach length is 4,650 feet. Timber harvest has occurred within the 4,500 feet of riparian area and floodplains adjacent these creeks. Few trees comprise the inadequate stream buffer; many trees have been lost to windthrow. The average riparian and floodplain seral stage is young (10-20 years). Interpretation of historic aerial photographs reveal an intact and less beaver pond-influenced riparian. An undetermined portion of this reach has been converted from FP to PA as a result of timber harvest. Minimal beaver activity was noted in the upper reach.

Reach HT3PH (Palustrine Harvested) was rated **Proper Functioning Condition.**
Riparian timber harvest removed and altered the quantity and composition of plant communities. They do not appear to be an adequate source of coarse and/or large woody material for the channel. However, PA systems are less LWD-dependent than other channels.

Reach HT3,3A,5-L incorporates the middle sections of three tributaries. Tributaries 3, 3A, and 5 share similar types of management. The reach is 10,025 feet in length. These lower to mid valley Class I and II streams consist of various stream process groups including: FP, AF, MM, MC, and HC. This reach was selectively harvested recently and impacts are limited to windthrow and channel stability. Lower section of streams are quality fish habitat and may be valuable for spawning on a sub-basin scale.

Reach HT3,3A,5-L was rated Proper Functioning Condition. The channel is stable, vegetation is present, and both are functioning relative to the low relief landform. The amount of timber harvest is minimal and not extensive enough to disturb the functionality of the system. Adjacent riparian harvest of large trees does not appear to have affected channel stability. There is some localized disturbance due to windthrow and selective harvest. The stream should have enough recruitment of LWD in the future, despite the harvest of large trees on the riparian.

Reach HT3,3A,5-U incorporates the middle sections of three tributaries. Tributaries 3, 3A, and 5 share similar types of management. These mid to upper valley Class II and III streams consist of similarly managed HC channels. These streams were selectively harvested in the lower end and heavily harvested in the upper reach. Total reach length is 11,300 feet.. Harvest adjacent these streams occurred as early as the mid 1980s. Predominant seral stage in the reach is early. These channels are small, typically six to twelve feet bankfull width. HC streams need a moderate amount of LWD to function properly. Typically, there is no buffer on these streams, and streams currently contain a large amount of logging slash. It is highly likely that in-channel LWD was removed during logging.

Reach HT3,3A,5-U was rated **Functional at Risk-Downward Trend.** Most channels are stable but several vegetation components were not met in the checklist. There are no large trees adjacent to the stream for LWD recruitment in the future, no diverse age class distribution, and a predominance of disturbance species. Floodplain and channel characteristics were determined inadequate to dissipate energy in small sections of the

reach (upper road crossings on T 3,3A and possibly T5). Overall they are sufficient. Some localized disturbance around windthrow was visible. There is also a concern that the amount of harvest in the drainage has increased peak flows and subsequently stream channel erosion in the reach. Recovery of the reach is dependent upon stability of the upper watershed (roads and drainage) and future landslide activity. Effects of harvest may not yet be completely visible. The PFC Team determined that functionality would decline before recovery.

Reach HT6, 6A &6B includes the less impacted low gradient headwater system above reach HP1. This reach is Class I anadromous, predominately FP4 and PA2 channel types. Total reach length is 9,755 feet.. This reach includes some natural palustrine channel habitat (Tributary 6A) above the 7 bridges road. Selective timber harvest (helicopter) has occurred adjacent the FP portions of the reach. Predominant seral stage is young with some standing mature trees. The FP segments exhibit high sinuosity, multiple channels, and well-developed point bars. The reach functions to deposit sediment and dissipate stream energy. Large wood is a significant component to stable stream banks. Some windthrow of those trees is frequent throughout the reach. Beaver ponds are numerous in lower tributary 6 and throughout 6A. Small gravels may limit available salmon spawning in tributary 6. This reach contains excellent habitat.

Reach HT6, 6A &6B was rated Proper Functioning Condition. The channel is stable, vegetation is present, and both are functioning relative to the landform. There was no observed erosion or deposition problems in the reach.

Reach HTS (Swamp) includes the remaining harvested palustrine sections of main stem hatchery and sections of tributaries 8, 9, 10, and 15. All three palustrine channel types are represented: PA1, 2 and 5. The reach includes 9,150 feet of Class I and II habitat. The reach is predominantly tall sedge fen with timber harvesting occurring on the timbered fringes and floodplain. Much dead standing timber remains below "7 bridges road." Young trees are being flooded as a result of the new pond development. The average riparian and floodplain seral stage is young (10-20 years). Interpretation of historic aerial photographs reveal an intact and less beaver pond-influenced riparian. An undetermined portion of this reach has been converted to PA5 as a result of timber harvest. This reach is excellent rearing habitat. Minimal beaver activity was noted during the survey.

Reach HTS (Swamp) was rated Proper Functioning Condition.
Riparian timber harvest removed and altered the quantity and composition of plant communities. They do not appear to be an adequate source of coarse and/or large woody material for the channel. However, PA systems are less LWD dependent than other channels. The PFC Team spent considerable time deliberating question #12 of the PFC Lotic Checklist (Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)) for this reach.

Reach HT11-15L is a conglomeration of significantly impacted stream segments towards the upper extent of main stem Hatchery. HT11-15 includes the lower section of tributaries 11, 12, 13, 15 and two other small tributaries added later. All streams are small mountain footslope channels that share similar physical characteristics and management. These tributaries are Class I anadromous (FP3, AF1, AF2, MM1) as they intersect upper Hatchery Creek main stem at gentle gradients and Class II (channel type HC2 and HC6) as they extend upslope to steeper gradients. The "main road" bisects the lower part of several of the streams. The ADFG anadromous stream catalog lists these streams as being used by coho salmon; not all streams are documented in the ADFG catalog. These streams are small typically three to six feet in bankfull width. These streams need a moderate amount of LWD to function properly. Typically, there is no buffer on these streams and disturbance species predominate the riparian. The small alluvial fan on tributary 11 (Figure. 8) is of particular concern. This segment of stream is entrenched, downcutting, and has two diversions that significantly alter natural drainage patterns.

Reach HT11-15L was rated Non Functional. Tributary 11 exhibits significant hydrological problems: 1) there are no large trees adjacent to the stream for LWD recruitment in the future; 2) plant communities are not an adequate source of LWD, and 3) riparian cover to protect banks and dissipate energy is not adequate. Lateral and vertical instability is apparent in tributary 11. The road is causing numerous diversions off of T11 and T15.

There are opportunities to immediately improve habitat and fish access by upgrading the stream crossings. The two tributaries were harvested to the stream banks.

Appendix C - Restoration Opportunities by Sub-basin

Klawock River Sub-basin

1. A&K Creek

Issue
- Fish passage and inadequate riparian buffers.

Action
- Upgrade culvert on Klawock Hollis Highway and thin riparian area.

Objective
- Restore passage of 850 feet anadromous habitat and resident habitat.
- Improve condition of riparian habitat.

2. Reach KW1

Issue
- Fish passage and inadequate riparian buffers.

Action
- Upgrade culvert on Klawock-Hollis Highway or enhance outlet pool—short term/low cost solution and thin riparian area.

Objective
- Improve passage to 2000 feet (<1000 feet anadromous) fish habitat.
- Improve condition of riparian habitat.

3. Reach KT5

Issue
- Fish passage and inadequate riparian buffers.

Action
- Upgrade culvert on Klawock-Hollis Highway and thin riparian area.

Objective
- Restore passage of approximately 500 feet of anadromous habitat and 1000 feet of resident habitat.
- Improve condition of riparian habitat.

Photo 19. Reach KT5 (Trib 5) below highway crossing.

4. Reach KTHD (Trailhead)

Issue
- Fish passage and inadequate riparian buffers.

Action

- Upgrade culvert on Klawock-Hollis Highway and thin affected riparian area.

Objective

- Restore passage of approximately 500 feet of anadromous habitat and 1,000 feet of resident habitat or enhance outlet pool--short term/low cost solution.
- Improve condition of riparian habitat.

Half-mile Creek

1. Reach HM1, Klawock—Hollis Highway Stream Crossing.

Issue

- Streambed materials (gravel and LWD) have aggraded at the upstream portion of this road crossing. The accumulation of materials has increased streambed elevation upstream. The result is shallow water and steep gradients for fish at lower flows. Fish passage is difficult and the aggraded material is restricting flow volume in the culvert making it more susceptible to overtopping and road damage during high flow events (Photo 20). Opportunities to improve passage may exist through the Federal Highway Administration and/or Alaska DOT mitigation programs.

Action

- Remove and/or upgrade stream crossing. Remove stream bedload and LWD materials aggraded upstream of the crossing and place downstream of the crossing to construct an outlet control pool—additional larger material would be needed to supplement on-site materials. This action would serve to create a pool that would extend through the culverts, thereby improving fish passage at all flows.

Objectives

- Improve fish passage by increasing the size of the outlet pool, reducing stream flows and ‗jump height'.
- Reduce flow and gradient inside the culvert.
- Decrease chances of failure, flooding, and damage to road.

Photo 20. Klawock-Hollis road crossing at Half-mile Creek, reach HM1. Photo 21. City of Klawock municipal water supply reservoir on Half-mile Creek.

2. Reach HM2, Half-mile Creek bedload manipulation.

Issue

- Reservoir is altering natural delivery of bedload downstream to anadromous fish reaches and Half-mile alluvial fan.

Action *

- Seed creek downstream of dam with dredged materials that are periodically removed from behind the small impoundment.

Objectives

- Improve fish and aquatic habitat.

* This action requires further evaluation.

Three-mile Creek Sub-basin

1. Reach 3MT1,2,3,5, Main stem Three-mile Creek, Tributary 2.

Issue

- The log culvert that crosses Tributary 2 is blocking fish passage. The spur road ends less than 100 feet beyond the log culvert. Approximately 300 feet of stream channel is inaccessible to anadromous and resident fish; an additional 600 feet of stream channel could be accessed by resident fish. Logging debris currently covers 90 percent of the stream channel below the crossing (Photo 22). The logging slash has significantly altered natural stream channel composition, i.e., slowed stream velocity and trapped fine sediments.

Action *

- Remove the log culvert on the spur road and remove excess logging debris from about 1,200 feet of stream.

Photo 22. Tributary 2, lower Three-mile Creek, below road crossing.

Objective

- Reconnect over 1,000 feet of resident habitat and 300 feet of anadromous habitat.
- Reduce erosion and input of fine sediments from road fill around log culvert.
- Improve functionality of stream habitat, i.e., natural flow, sediment transport ability, habitat complexity, and primary production.

* Klawock Heenya, Inc. removed the log culvert in 2000.

2. Main stem Three-mile Creek, Tributary 7 and other crossings on "lower road" (parallels mid reach of main stem 3-mile).

Issue

- Short section of road (1,000 feet) contains 4 small, l mid-size crossing (Tributary 7). Three of five crossings are suspected to be Class II and impassable. All crossings are negatively affecting downstream fish habitat and water quality, some actively eroding around the fill and disconnecting small floodplains. The log stringer bridge abutments on Tributary 7 are in the floodplain, thus affecting stream and floodplain connectivity and constricting stream flow locally. The road and stream crossing structure have impaired the ability of the stream to access the adjacent floodplain. Some localized deposition of streambed materials is occurring below the bridge.

Action

- Removal of 5 small stream crossings, a short section of road (75-100 feet) beyond tributary 7, and placement of LWD in tributary 7 around removed log stringer bridge. Also potential to add LWD and apply stream bank stabilization techniques in and around other removed crossings.

Objective

- Increase and improve riparian habitat, reconnect streams with floodplains.
- Improve historic off channel aquatic habitat (Tributary 7).

3. South Fork Three-mile Creek, Tributary 8 (Reach SF3).

Issue

- The road crossing the South Fork is impeding resident fish passage to about 1,600 feet of high quality resident fish habitat. Adjacent culverts are also not functioning and these culverts are diverting water out of their natural stream channels into others. Water diversion is causing excessive erosion and increases the chances of the downstream culverts plugging and the stream overtopping the road. Culverts blocked by debris, rocks, and/or sediment can cause significant damage to the road and/or the stream. Recent flood flows (October, 1999) have caused the stream to overtop the road, causing erosion of the road prism (Photo 23).

Photo 23. Relief culvert plugged and subsequent stream crossing failure. Photo 24. Relief culvert failure.

Action

- Remove culverts and associated fills from the stream or replace culverts with properly sized culverts. Perform culvert maintenance on adjacent crossings.

Objective

- Removal or enhancement of culverts to improve access of 1,600 feet of stream.
- Improvement or removal of structures to decrease future management costs by reducing chances of losing the road.

4. Main stem Three-mile Creek, Upper Watershed Road System (Reach 3M7).

Issue

- Several culverts are currently not functioning. These culverts are diverting water out of the natural stream channels into other channels. Water diversion is causing erosion and increases the chances of debris torrents in high gradient streams. Culverts blocked by debris, rocks, and or sediment can cause significant damage to the road and/or the stream.

Action

- Clean culvert inlets or remove culverts entirely. Perform regular culvert maintenance.

Objective

- Improve stream network drainage.
- Reduce stream erosion.
- Decrease future management costs by reducing chances of failures and road damage.
- Maintain natural hillslope hydrology.

5. Thinning of riparian second-growth stands

Issue

- LWD is a hydrologic modifier and critical component of streams in the Three-mile Creek Sub-basin. In many streams, LWD is lacking, or is anticipated to be lacking in the future, due to second growth stands adjacent to the streams.

Action

- Mechanically thin second growth stands in riparian areas at the appropriate age (generally, between 15 and 35 years). Select for the most vigorous long-lived trees; larger diameter trees can be grown more quickly by thinning second-growth stands.

Objectives

- Improve channel stability and fish habitat.
- Improve forest health and vigor of trees to stabilize banks in riparian areas.
- Provide a source of LWD (to streams) more quickly than if left unmanaged.

6. Upper Three-mile Tributaries, North Side Road System (T6-T15).

Issue

- Several culverts are currently not functioning or have blown out. These culverts are diverting water out of the natural stream channels into other channels. Water diversion is causing erosion and increases the chances of debris torrents in high gradient streams. Culverts blocked by debris, rocks, and or sediment can cause significant damage to the road and/or the stream. Sediment debris piles from debris upslope landslides continue to leach fine sediments into fish streams at high flows. Road Condition Surveys will identify specific crossings and priority crossings.

Action

- Clean culvert inlets or remove culverts entirely. Perform regular culvert maintenance. Excavate debris piles away from stream channels. Potential to add LWD in FAR and NF stream reaches.

Objective

- Improve stream network drainage.
- Reduce stream erosion and input of fine sediments.
- Improve resident fish habitat.
- Maintain natural hillslope hydrology.

Photo 25. Three-mile Creek, Trib 11, riparian harvest, little LWD present. Photo 26. Debris torrent on roadway Trib 11).

Inlet Creek Sub-basin

1. Main stem Inlet Creek stream crossing improvements (Reach I1)

Issue

- Main stem Inlet Creek has two stream crossings on the Klawock-Hollis Highway. Both culverts currently pass fish but likely do not meet current ADFG fish passage standards for juvenile fish and resident trout. The culvert at the lower crossing may not pass juvenile salmon at higher flows. This culvert was a study site for a broader project that involved fish passage through culverts completed by the University of Alaska—Fairbanks (Kane et al, 2000). The upper culvert (resident habitat) may not pass adults or juveniles at high flows. More information is needed at these crossings.

Photo 27. Lower culvert main stem Inlet Creek. Photo 28. Upper stream crossing, main stem Inlet Creek.

Action

- Improve culvert outlet pools in short term and/or replace culverts.

Objective

- Improve fish passage for all life stages of fish.
- Enhance natural stream channel morphology and bedload transport.

2. Fish passage improvement on Tributary 3 and 4 (Reach IT3&4).

Issue

- Improve culvert outlet pools in short term and/or replace culverts, add LWD to reach T4

Action

- Two culverts impede access to 2,000 feet of total stream habitat and 1,000 feet of anadromous habitat. Neither culverts meet ADFG fish passage standards.
- Opportunity to place LWD in Trib 4 in the lower MM1 reaches to improve fish habitat.
- Clean up blown-out crossing on Trib 3 (Photo 29).


Photo 29. Stream crossing failure on Trib 3 of Inlet Creek. Photo 30. Lower reach of Trib 4, Inlet Creek.

Objective

- Improve fish passage for resident and anadromous fish.
- Reduce sedimentation and erosion below stream crossing.
- Enhance natural stream channel morphology and bedload transport.
- Improve channel stability and fish habitat.

3. Road encroachment on floodplain and degraded habitat in Trib 7 & 7A (Reach IT North)

Issue

- Road is encroaching on floodplain.
- Stream habitat is degraded, LWD removed from stream.

Photo 31. Inlet Creek, tributary 7.

Action *

- Improve stream crossing (removed) and downstream fish habitat.
- Place LWD in lower MM1 reaches to improve fish habitat.

Objective

- Reduce sedimentation and erosion below stream crossing.

- Improve habitat complexity i.e., pool depth, pool/riffle ratio, width/depth ratio.
- Improve channel stability and fish habitat.

* Partially completed by Klawock Heenya, Inc. in 2001.

4. Tributary 11, fish passage improvement (2), road maintenance, degraded fish habitat (Reach IT11)

Issue

- Two culverts impede access to 1,500 feet total stream habitat; T11 on the Klawock-Hollis Highway and Trib 11A upstream of the Trib 11 crossing. Culverts are perches 6" and 2" respectively and also exceed gradient requirements.

Action

- Remove culvert on Trib 11A, improve fish passage for resident fish.
- Potential to place LWD in the lower MM1 reaches to improve fish habitat.

Objective

- Improve fish passage for resident fish.
- Improve habitat complexity i.e., pool depth, pool/riffle ratio, width/depth ratio.

Hatchery Creek Sub-basin

1. Main road (east-west), reach HT11&15.

Issue

- Several road crossings along the main road impede passage of resident and anadromous fish. The road system at the head of the watershed, near the flat divide on Crab Creek is particularly troublesome. The road is causing numerous diversions off of T11 and T15. There are opportunities to immediately improve habitat and fish access by upgrading the stream crossings.

  Adjacent culverts are also not functioning and these culverts are diverting water out of their natural stream channels into others. Water diversion is causing excessive erosion and increases the chances of the downstream culverts plugging and the stream overtopping the road. Culverts blocked by debris, rocks, and/or sediment can cause significant damage to the road and/or the stream.

  These crossings will be better identified and prioritized after Road Condition Surveys are complete. No detailed culvert or road condition information is currently available.

Action

- Remove culverts and associated fills from the stream or replace culverts with properly sized culverts or bridges. Perform culvert maintenance on adjacent crossings.

Objective

- Removal or enhancement of culverts to improve access to approximately 2,500 feet of stream.
- Decrease management costs by reducing the potential for future maintenance.

2. Hatchery Creek Sub-basin riparian thinning

Issue

- LWD is a hydrologic modifier and critical component of streams. LWD is lacking or is anticipated to be lacking in the future due to second growth stands adjacent to the streams.

Action

- Mechanically thin second growth stands in riparian areas at the appropriate age (generally between 15 and 35 years); select for the most vigorous long-lived trees. Larger diameter trees can be grown more quickly by thinning second growth stands.

Objectives

- Improve channel stability and fish habitat—long term.
- Improve forest health and vigor of trees to stabilize banks in riparian areas.

- Provide a source of LWD (to streams) more quickly than if left alone.

Riparian thinning would benefit the following reaches/areas:

H1
HT2A
HT2C, also potential for conifer release
The alluvial fan on Tributary 11
HT11-15L (low gradient parts)

Specific projects and sites need to be evaluated. A thinning prescription should be developed with the intent of providing future LWD to the stream while minimizing riparian impacts.

3. Upper road system maintenance, parallels Tributary 2

Road maintenance/storm proof drainage system (example below) The road is causing numerous diversions off tributary 2. There are opportunities to immediately improve the condition of downstream fish habitat removing, upgrading, and performing maintenance on existing and old stream crossings and road way.

Adjacent culverts and ditches are also not functioning and these culverts are diverting water out of their natural stream channels into others. Water diversion is causing excessive erosion and increases the chances of the downstream culverts plugging and the stream overtopping the road. Culverts blocked by debris, rocks, and or sediment can cause significant damage to the road and/or the stream. These crossings will be better identified and prioritized after planned 2001 Road Condition Surveys are complete.

Various reaches:
HT2C
HT2D
HT2E of Tributary 2
(reach HT2C site specific example)

Issue
A CMP culvert plugged and failed on a large Class III tributary flowing into upper Tributary 2. This crossing failure is actively eroding and contributing fine sediment into reach HT2C (Photo 32). Tributary may be resident fish habitat.


Photo 32. Blown steam crossing on small stream draining in to Trib 2 upper Hatchery Creek. Photo 33. Hatchery Creek, reach HT2C.

Action
- Remove the culvert and debris and re-contour the stream crossing to match the natural channel.
- Perform road maintenance, ditch cleanout, remove old crossings, storm-proof existing culverts.

Objective

- Reduce erosion and sediment contribution, maintain channel stability.
- Improve stream ecology and channel condition.
- Decrease future management costs by reducing chances of failures and road damage.
- Maintain natural hillslope hydrology.

4. Tributary 2, reach HT2C, lower priority (riparian thinning portion addressed in #1.)

Issue

- Reach HT2C (Class II) was riparian harvested and LWD was removed from the channel.

Action

- Potential to place LWD in FP4 channel to improve fish habitat and channel condition.
- Pull road fill on old upper crossing pinching floodplain and possible historic side-channel.

Objective

- Increase and recruit LWD. LWD is a hydrologic modifier and critical component of stream functionality. LWD is lacking or is anticipated to be lacking in the future due to second growth stands adjacent to the streams.

Northeast Composite Sub-basin

1. 2.5 Mile Creek highway Culverts

Issue

- Two culverts under the highway block or impede access to 2,100 feet of habitat in 2.5Mile Creek.

Action

- Replace culverts to improve fish passage.

Objective

- Allow fish access to 1,000 feet of anadromous habitat, and another 1,100 feet of resident habitat.

2. Riparian thinning and LWD placement.

Issue

- Streamside second-growth is not providing an adequate source of LWD now or in the future.

Action

- Thin streamside second growth.
- Add LWD to reach 2.5M2.

Objective

- Improve fish habitat with LWD placements.
- Improve future sources of LWD through streamside tree thinning.

Riparian thinning would benefit the following reaches/areas:

2.5Mile, Reach 2.5M2 & 2.5M3
Deadhead, Reach D1&DT
7Mile, Reach 7M1&2
Arrow, Reach A2

Specific projects and sites need to be evaluated. A thinning prescription should be developed with the intent of providing future LWD to the stream while minimizing riparian impacts.

3. 7 Mile Creek Highway crossing.

Issue

- An 8-foot diameter culvert is perched 3 feet, creating a barrier to fish and LWD movement.

Action

- Replace the culvert with one that allows passage of fish upstream and debris downstream.

Objective

- Allow fish access to 700 feet of habitat and improve movement of LWD downstream.

Photo 34. 7-mile Creek culvert along Klawock Hollis Highway Crossing.

4. Arrow Creek Highway crossing (reach A1).

Issue

- The culvert under the highway appears to have excessive gradient for fish passage. The culvert is undersized for debris passage and 3 cubic yards of material has aggraded at the inlet. The inlet on the culvert needs a ditch block to prevent water diversion.

Action

- Improve gradient within the culvert.
- Remove aggraded material from the inlet.
- Create a ditch block.

Objective

- Improve fish passage.
- Prevent stream diversion and culvert plugging.

5. Arrow Creek Highway crossing (reach A2).

Issue

- Culverts are not functional and are facilitating the erosion of the road prism.

Action

- Remove culverts, storm-proof roads.

Objective

- Improve fish passage.
- Reduce erosion and habitat alteration.


Photo 35 and 36. Non-functional culverts upper Arrow Creek, reach A2.

6. Bluewater Creek Road decommissioning and erosion control (reach B2 and B3)

Issue

Logging roads and landslides in the upper end of the drainage are contributing sediment to streams.

Action

- Grass seed landslides, disturbed areas and roads
- Storm-proof and/or decommission roads.

Objective

- Improve water quality by controlling erosion from roads, landslides and disturbed areas.


Photo 37. Landslides visible from Upper Bluewater Creek. Photo 38. Water on road surface from failed cross drain, upper Bluewater road system.

7. Deadhead Creek Highway crossing (reach D1).

Issue

- A 36 inch diameter culvert is perched one foot creating a barrier to fish and LWD movement.

Action

- Replace the culvert with one that allows passage of fish upstream and LWD downstream.

Objective

- Allow fish access to 1,500 feet of habitat, 500 feet of anadromous and improve movement of LWD downstream.

Southeast Composite Sub-basin

1. Salmon Salad Creek and others (reach SS1).

Issue

- Stream buffer is compromised for about 750 feet by selective harvest.

Action

- Thin streamside second-growth.
- Add LWD to Reach SS1.

Objective

- Improve fish habitat with LWD placements.
- Improve future sources of LWD through streamside tree thinning .

2. Small Streams Creek (reach SE3 & 4).

Issue

- LWD was removed from the channel during harvest. Roads in upper watershed are contributing sediment and diverting water from natural channels.

Action

- Decommission roads in upper watershed.
- Place LWD in the lower MM1 section of stream 3 to improve fish habitat.

Objective

- Improve stability of the upper watershed (roads and drainage).

3. Alder Creek (reach A2).

Issue

- Stream lacks LWD now and in the future from streamside harvest and stream cleaning.

Action

- Thinning second growth stands
- Place LWD in Reach A2 to improve fish habitat and channel condition.

Objective

- Improve potential for larger trees in the buffer to provide future LWD for channel stability.

4. TR6 Creek

Issue

- Stream lacks LWD now and in the future. Upper road is contributing sediment and diverting water.

Action

- Thin second growth stands.
- Place LWD in Reach TR6-2 (FP and MM sections) near the road to improve fish habitat and channel condition.
- Storm-proof or decommission upper road.

Objective

- Improve channel condition and stability with LWD placement and through thinning to provide larger trees along the stream for future LWD.

5. Swamp Creek

Issue

- Stream lacks LWD now and in the future. Reach S2 has no functional buffer and lacks LWD. The channel is downcutting and is unstable.

Action

- Thin Reach S2 and/or conifer release at the appropriate age.
- Reach S2 lacks LWD, but access for LWD placement is poor and the cost benefit low.

Objective

- Improve riparian condition by thinning the riparian to provide future large trees that could become LWD to the stream.

6. Chutes and Ladders Creek

Issue

- Past harvest and road building have resulted in impacts to the stream particularly reach CL2, CLT1, and CLT2.

Action

- Conifer release may be beneficial for improving riparian vegetation (CL2).
- Stream crossing should be evaluated utilizing the RCS process (CL2).
- Place LWD in FP and MM reaches downstream of main road (CL2 & CLT1).
- Storm-proof or decommission upper road.
- Evaluate the amount of beaver ponds in relation to spawning habitat (entire basin).

Objective

- Improve stream channel stability and riparian condition.
- Evaluate condition of roads.

Photo 39. Reach CL2 below main road, FP channel type transitioning to MM channel type. Note riparian composition and lack of LWD. Photo 40. Reach CL2, channel type MM1.

Appendix D - Description of Wetland Types

Wetland Type	Total Acres in Watershed	Percent of Total	Acres Harvested	Miles of Road Through Wetlands
Forested Wetland (FW)	3264	30%	N/A	6.3
Alpine Meadow (AM)	2425	22%	N/A	0.7
Emergent Short Sedge (EM)	2128	20%	N/A	1.4
Forested Wetland Emergent Sedge Complex (FES)	1621	15%	N/A	5.2
Sphagnum Moss/ True Bogs (MP)	604	6%	N/A	0.4
Forested Wetland/ Moss Muskeg (FSS)	428	4%	N/A	0.1
Tall Sedge Fens (MT)	290	3%	N/A	0.1
*Estuarine Emergent (EE)	160		N/A	N/A
*Riverine (R)	35		N/A	N/A
Uplands (for reference)	15,326			
Grand Total	**10,760**	**100%**		**14.2**

Forested Wetland (FW): This wetland type includes forested wetland plant associations. Typically these are cedar-hemlock-blueberry plant associations including those with skunk cabbage and deer cabbage as a major ground cover component. Less typically, wetlands in this category are dominated by lodge pole pine. Forested wetlands typically occur on organic soils or shallow mineral soils underlain by compact till. This wetland is included within the palustrine forested wetland of the U.S. Fish and Wildlife Service wetland classification system. Forested wetlands in the Klawock Watershed typically occur on footslopes and gently sloping lowlands. These wetlands function as areas for recharge of groundwater and streams, as well as deposition and storage of sediment, nutrients and other chemicals**.** Approximately 3,264 acres of forested wetlands are mapped in the Klawock Watershed.

Alpine Meadow / Alpine Shrub Complex (AM): The vegetation is composed of heaths (crowberry, mountain heather, etc.) and dwarf shrubs (blueberry) on shallow, poorly drained organic soils. This wetland is included within the palustrine scrub-shrub wetland of the U.S. Fish and Wildlife Service wetland classification system. These wetlands function mainly as areas of snow storage and melt water discharge, and as summer habitat for terrestrial wildlife, particularly Sitka black-tail deer. Approximately 2,425 acres of this wetland type occur in the Klawock Watershed. These wetlands are located at elevations over about 2,500 feet, mainly on the steep peaks in the upper Three-mile sub-basin.

Emergent Short Sedge Muskeg (EM): This wetland includes fen communities dominated by short sedges. The soils are typically deep, poorly drained peats and mucks**.** These wetlands are included within the palustrine emergent wetland of the U.S. Fish and Wildlife Service wetland classification system. These wetlands store large amounts of groundwater and slowly distribute those waters downstream, particularly during periods of low stream flow. They provide waterfowl habitat, particularly for Vancouver Canada geese and sandhill cranes. They serve as terrestrial wildlife habitat for black bear, mink, deer, and pine martin. Approximately 2,128 acres of this wetland type are mapped in the Klawock Watershed, mainly in the Half-mile and Hatchery Creek sub-basins.

Forested Wetland/Emergent Sedge Complex (FES): These wetlands are a complex of forested wetland plant associations and emergent short sedge (muskegs) on poorly drained peat soils. These wetlands are included within the palustrine forested wetland and palustrine emergent wetland of the U.S. Fish and Wildlife Service wetland classification system. These wetlands function as areas of groundwater and surface water recharge, deposition and storage of sediment, nutrients, and other chemicals, waterfowl habitat, particularly Vancouver Canada geese and sandhill cranes, terrestrial wildlife habitat, including black bear, river otter, mink; and beaver foraging areas. About 1,621 acres of this wetland type are mapped in the Klawock Watershed, scattered throughout lowlands and middle slopes.

Sphagnum Moss/ True Bogs (MP): These are bogs characterized by deep, very-poorly drained accumulations of sphagnum moss. This wetland is included within the palustrine emergent wetland of the U.S. Fish and Wildlife Service wetland classification system. These wetlands function as areas for recharge of groundwater and streams and deposition and storage of sediment, nutrients, and other chemicals. These wetlands are relatively rare and unique within the project area and subsequently are of high value. Approximately 604 acres of this wetland type occur in the Klawock Watershed. These wetlands are distributed among lowland areas, and are mainly concentrated around the Klawock River. Sphagnum Moss/True Bogs are a valuable source of biological diversity. Due to their scarcity and the biological diversity they provide, sphagnum bogs are considered high value wetlands.

Tall Sedge Fens (MT): These wetlands include fen communities dominated by tall sedges, typically Sitka sedge. The soils are typically deep, very-poorly-drained peats or alluvial sediments. In the Klawock Watershed, many of these areas are old, dewatered beaver ponds. This wetland is included within the palustrine emergent wetland of the U.S. Fish and Wildlife Service wetland classification system. These fens occupy an intermediate landscape position and serve to filter large volumes of water flowing from adjacent hillslope soils to the downslope stream or lake system. Tall sedge fens often include small rearing streams and are important components to fish habitat. Tall sedge fens also provide waterfowl habitat, particularly for Vancouver Canada geese. Tall sedge fens are relatively scarce, only 290 acres of this wetland type are mapped in the Klawock watershed. Almost all of the tall sedge fens in the Klawock watershed are located in the Hatchery Creek sub-basin. In the Hatchery Creek sub-basin, the tall sedge fens are in a large complex of wetlands and lowlands that are somewhat unique to the Klawock Watershed. Tall sedge fens are considered high value wetlands, due to their scarcity and the valuable functions they provide.

Forested Wetland/ Moss Muskeg (FSS): These wetlands are a complex of Forested Wetlands (FW) and Sphagnum Moss/True Bogs (MP). This wetland complex is relatively rare and unique within the project area and subsequently is of high value. About 428 acres of this wetland type are mapped in Klawock Watershed. These wetlands are concentrated in the north end of the Half-mile Creek sub-basin and in the small sub-basin just west of Half-mile Creek. A few of these wetlands are located in the Hatchery Creek sub-basin.

Estuarine Emergent (EE): This wetland type supports mainly sedge and beach ryegrass communities. The soils are poorly drained silts, sands, and gravels. This wetland is included within the estuarine-intertidal wetland of the U.S. Fish and Wildlife Service wetland classification system. These wetlands are among the most unique, valuable, and scarce in the Klawock Watershed. They function as areas of flood conveyance; tidal/freshwater mixing zone; shoreline protection; dilution of chemicals and pollutants; deposition of sediment; and nutrient storage. They are very valuable shorebird, waterfowl, aquatic, marine, and terrestrial wildlife habitats, including providing important foraging habitat for black bear, mink, and river otter. They are probably the most biologically diverse sites within the Project Area. They are important sources of faunal and floral diversity. The extent of this wetland type has not yet been determined in the Klawock Watershed. Approximately 160 acres of Estuarine wetlands are located at the outlet of Klawock River and around the Klawock Estuary. Only the fringe of this estuary would classify as Estuarine Emergent.

Lakes and Ponds: These are open fresh water systems. These are the lacustrine wetlands or deepwater habitats in the US Fish and Wildlife Service wetland classification system. These areas function as important habitat for most aquatic species, including coho salmon and cutthroat trout, as well as functioning as flood control, discharge to streams, sediment and nutrient storage, and habitat for river otter, beaver, and waterfowl.

Appendix E - Glossary
Key Terms

Adfluvial--species or populations of fish that do not go to sea, but live in lakes and enter streams to spawn.

Aggradation--a modification of the earth's surface in the direction of uniformity of grade by deposition.

Alluvial fan channel--streams generally located on foot slope landforms in a transitional area between valley floodplains and steep mountain slopes where a fan-shaped deposit of sand, gravel and fine material is formed.

Alluvium--material deposited by rivers and streams including sediment laid down in river beds, flood plains, lakes, and at the foot of mountain slopes and estuaries.

Anadromous--fish that ascend from the sea to breed in freshwater streams.

Bedload--sand, silt and gravel, or soil and rock debris rolled along the bottom of a stream by moving water.

Bog--a wetland which has poorly drained, acidic, organic soils materials that support vegetation that can be either sphagnum moss or herbaceous plants or sedges, rushes, and forbs or may be a combination of sphagnum moss and herbaceous plants.

Buffer strip--Area adjacent to a stream or waterbody that is retained for ecological function.

Channel types--stream section classifications based on physical attributes such as channel gradient, channel pattern, streambank incision and containment, and riparian plant community composition.
Cirque--A semicircular feature found in glaciated mountains which is characterized by a steep, nearly vertical headwall, a concave floor, and a lip or threshold at the entrance.

Debris torrent--mass erosion process which occurs when a debris avalanche enters a high gradient stream channel, mixes with water, and continues downstream as a slurry of mud, LWD, and water. Debris torrents are usually confined within the stream channel until they reach the valley floor where the debris spreads out, inundating vegetation and forming a broad surface deposit.

Delta--a nearly flat alluvial deposit between diverging branches of the mouth of a river, often triangular in shape.

Discharge--the volume of water transported by a stream over a given period of time.

Ecosystem--a complete, interacting system of organisms together with their environment (for example a bog, forest, or lake).

Ephemeral--a stream that flows in direct response to rainfall and snowmelt but not during dry seasons. Its channel is above the level of the water table.

Estuarine--deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land, but which have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is diluted by freshwater runoff.

Estuary--relatively flat, intertidal, and upland area where saltwater meets freshwater, as at the heads of bays and the mouths of streams.

Fen--a wetland of slow-moving, nutrient rich, often alkaline water with sedge peat forming the substrate.

Glacial Till--gravel, boulders, sand, and finer materials transported and deposited by a glacier.

Hydric--of, pertaining to, or adapted to a wet or moist environment.

Hydrophytic vegetation--plants typically found in wetlands and dependent upon wetland moisture regimes for growth and reproduction.

Intermittent--A stream or body of water that does not flow continuously.

Karst--A type of topography that develops in areas underlain by soluble rocks, primarily limestone. Features may include sinkholes, collapsed channels, or caves.

Large Woody Debris (LWD) --any large piece of relatively stable woody material having a diameter of at least 4 inches and a length greater than 3 feet that intrudes into a stream channel; also called Large Organic Debris (LOD) or Large Woody Material (LWM).

Lentic--pertaining to or living in still water (lakes, ponds, etc.)

Lotic--pertaining to or living in moving water (streams, rivers, etc.)

Mitigation--measures designed to counteract environmental impacts or to make impacts less severe.

Muskeg--a common term used in Southeast Alaska to collectively describe wetlands dominated by sphagnum moss (bogs).

Perennial--A stream that has year round flow.

Process Group--broad stream classification groups which describe the interrelationship between watershed runoff, landform relief, geology, and glacial or tidal influences on fluvial erosion and deposition processes.

Resident fish--non-migratory fish that complete their entire life cycle in freshwater.

Riparian area--the area including a stream channel, lake or estuary bed, the water itself, and the plants that grow in and on the land next to the water.

Riparian ecosystem--land next to water where plants that are dependent upon a perpetual source of water grow.

Runoff--water which travels over the ground surface, through the upper soil layers and/or within the water table.

Sediment--solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth‘s surface either above or below sea level.

Soil productivity--capacity of a soil, in its normal environment, to produce plant growth, due to the soil's inherent chemical, physical, and biological properties.

Stream Order--First order streams are the smallest unbranched tributaries; second order streams are initiated by the point where two first order streams meet; third order streams are initiated by the point where two second order streams meet, and so on.

Sub-basin--area that contributes to a drainage or stream within a watershed.

V-notch--a very steep, deeply incised stream channel which is usually situated on steep mountain slopes or hill slopes. Has a characteristic ―V" shaped cross-section.

Watershed--area that contributes water to a drainage or stream.

Wetlands--areas that are inundated by surface or ground water with a frequency sufficient, under normal circumstances, to support vegetation that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Windthrow--areas where trees are uprooted, blown down, or broken off (windsnap) by storm winds.