FISH HABITAT ASSESSMENT IN THE OREGON DEPARTMENT OF FORESTRY UPPER NEHALEM AND CLATSKANIE STUDY AREA

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Upper Nehalem and Clatskanie Study Area

Project Description

A collaborative project between the Oregon Department of Forestry (ODF) and the Oregon Department of Fish and Wildlife (ODFW) was initiated to synthesize aquatic habitat and fisheries information for the upper Nehalem and Clatskanie River drainages to assist in the development of operational management plans, stream habitat restoration projects, habitat conservation planning, and watershed analysis. The project summarizes the condition of stream habitat, the distribution and abundance of salmonid fishes, and the potential for restoration. The ODFW Aquatic Inventories Project has conducted stream habitat surveys as part of its basin survey project and habitat assessment project under the Oregon Plan for Salmon and Watersheds. The goal of these surveys was to document the status and trends of stream conditions in coastal drainages. These surveys in conjunction with fish distribution, fish presence, potential barriers to passage, and past restoration activities form the basis of the analyses.

The Upper Nehalem and Clatskanie River study area is in northwestern Oregon (Map 1). The Nehalem basin drains into the Pacific Ocean, while the Clatskanie River flows into the Columbia River. The Nehalem project area, as delineated by ODF ownership, is comprised of segments of each drainage rather than watershed boundaries. Within this study area, ODF ownership is located primarily in the mid and upper portions of the Nehalem watershed. The project area is approximately 63018 hectares. Map 2 depicts the 5^{th} field HUs and Oregon Department of Forestry "6^{th} field" management basins. The management basins are nested within the 5^{th} field HUs. Table 1 lists the major river basins, 5^{th} field hydrologic units, streams, and ODF Management basins, and it corresponds with Maps 2, 3, and 4 . Streams within the Nehalem project area on which ODFW had habitat surveys and salmonid spawning surveys are depicted on Map 4. The study area in the Nehalem is located within three 5^{th} field hydrologic units (HUs): 170020201, 170020202, and 170020203 (Maps 3). HU 170020201 is the upper portion of the Nehalem drainage, and includes the upper Nehalem River, Wolf Creek, Clear/Robinson creeks, and Upper and Middle Rock Creek watersheds. HU 170020202 is in the Nehalem, and includes Fishhawk Lake Creek, Northrup, Deep, and Sager Creek watersheds. It also includes Oak Ranch Creek watershed to the eastern edge of the Nehalem drainage. HU 170020203 is also in the Nehalem, and includes Beneke, Fishhawk, Cow/Quartz, and Buster Creek watersheds.

Other land ownerships in the drainage include private industrial, private non-industrial, public, agricultural, and urban and rural residential (Map 5). Land use in the drainage is dominated by forest and agricultural-related activities. ODF owns a small portion of the Clatskanie basin including segments of mainstem Clatskanie River, Little Clatskanie River, and Carcus Creek. Landuse in the drainage is dominated by forest-related activities.

The majority of the Nehalem River is underlain by a mixture of volcanic and sedimentary lithology. The Nehalem study area is comprised of Tillamook volcanic, Cowlitz formation (marine sandstone, siltstones, and mudstones), and tuffaceous siltstone and sandstones, which is revealed in the channel geology types as a mix of pebbles and boulders, sand, or a mix of the two (Map 6). The eastern most part of the study area, including the Clatskanie River, is Columbia River basalt and marine sedimentary and tuffaceous rocks. Overall, the gradient of streams in the Nehalem and Clatskanie River basins was low to moderate (0-5%), with higher gradients found in some of the upper stream reaches. Upland vegetation in the drainage is dominated by conifer trees of varying sizes and ages. Currently, surveys indicate predominant coniferous tree sizes are in the 15 – 50cm size classes.

The area delineated by ODF is referred to as the Nehalem project area; the area delineated by ODFW for this aquatic assessment is termed the Nehalem study area. Because of the limited amount of ODF land on fish bearing streams and aquatic surveys on ODF land in the Clatskanie basin, summaries reflect the Nehalem basin unless otherwise stated. If information is presented for land out of the project area, it is specifically stated.

GIS coverages – sources and scales

Three digitized maps layers were used for different features of this synthesis (Map 7). The primary layer is the 1:100,000 USGS stream layer. It is a standardized and routed coverage, and has a unique latitude and longitude field associated with each stream (Hupperts 1998). Fish distribution and aquatic habitat data are joined to the 1:100,000 coverage. The Coastal Landscape and Analysis and Modeling Study (CLAMS: http://www.fsl.orst.edu/clams/) provided a 1:24,000 coverage and a standardized 6th field Hydrologic Unit coverage. The CLAMS coverages displayed all streams at a 1:24,000 scale, and determined the valley width, mean annual flow, channel size, and gradient of streams less than 10% gradient (Map 8). The highest resolution coverage was developed for Oregon Department of Forestry (ODF) at the 1:12,000 scale. We used this layer to display a generalized (no species information) map of salmonid distribution. Because of the different development processes, the data cannot be integrated across scales, but are displayed in the same projection (Map 7).

Fish Distribution and Abundance

Coho salmon (*Oncorhynchus kisutch*), fall and early-run fall Chinook salmon (*O. tshawytscha*), chum salmon (*O. keta)*, and winter steelhead (*O. mykiss*) occur in the mainstem and tributaries of the Nehalem basin (Maps 9 and 10). Additionally, resident and anadromous cutthroat trout (*O. clarki clarki*) (Figure 11) and Pacific lamprey (*Lampetra tridentata*) are present. Coho and fall Chinook salmon, winter steelhead, cutthroat trout, and Pacific lamprey also occur in the Clatskanie basin. Non-salmonid native species are present in both basins, however their distributions are not documented.

ESA Designations

Two fish species are listed under the federal Endangered Species Act in the Nehalem basin and four species are listed in the lower Columbia River and tributaries (http://www.nwr.noaa.gov/). Coho salmon are listed as threatened, while winter steelhead are considered a species of concern in the Nehalem basin. Coho salmon, Chinook salmon, chum salmon, and winter steelhead trout are listed as threatened in the lower Columbia River including the Clatskanie River drainage. Cutthroat are considered sensitive and are currently under review in the lower Columbia River including the Clatskanie. Others species are not listed at this time.

Fish Populations in the Nehalem Basin

Chum and fall Chinook salmon spawn and rear in the low gradient portions of the basin, and into the lower reaches of tributaries (Map 9). Chinook salmon return to the Nehalem River beginning in July. Two runs of Chinook are described for the Nehalem River, an early-fall run and a fall run (Boechler and Buckman 1992). The early run Chinook spawn primarily in October in the mainstem Nehalem River above Humbug Creek and in Rock Creek. The fall run Chinook salmon spawn later in the mainstem below Humbug Creek and in tributaries to the lower and upper river, primarily in November but sometimes into late December. Peak counts of Chinook salmon throughout these reaches were 50 fish and 90 fish per mile in 2002 for the early-fall and fall Chinook respectively.

Coho salmon reside extensively throughout the mainstem and larger tributaries of the Nehalem and Clatskanie drainages (Map 10). Coho salmon begin returning to the Nehalem watershed in October and early November after spending 6 months to 1.5 years in the ocean. The peak spawning period occurs between mid-November and mid-January. Coho are distributed throughout the entire Nehalem River watershed except for the upper reaches of the tributaries due to barriers or high gradient. Coho prefer to spawn in the smaller tributaries and have been observed in the upper reaches of the mainstem as well. Spawning surveys have been conducted in the Nehalem basin from 1989 to 2003 by the ODFW Coastal Salmon Inventory Project. The number of coho salmon observed throughout these reaches has varied dramatically from 1989 to 2003 (Maps 12 and 13). Map 13 depicts the small watersheds (6^{th} field hydrologic units) in the Nehalem basin which demonstrated higher than average abundances from 1989-2000. Highlighted HUs show the percentage of years that the average number of adult coho salmon was greater than 4 fish per mile for the 12 year period. Coho were abundant in Louisignot, Wolf, Upper Rock, Fishhawk, and Buster Creek watersheds. Coho populations increased beginning in 1999 because of improved ocean conditions (Map 12), with average spawning counts consistently above 20 fish per mile.

Winter steelhead reside extensively throughout the mainstem and larger tributaries of the Nehalem and Clatskanie drainages (Map 10). Winter steelhead are distributed throughout the Nehalem in the study area. Data are limited but accessibility to historic spawning and rearing areas is thought to be complete. Spawning surveys conducted under the ODFW Coastal Salmon Inventory Project documented abundances of adult steelhead in the mainstem and tributaries of the Nehalem River and mainstem and tributaries of Rock Creek. An average of 2.2 and 7.4 redds per mile were counted in tributaries to mainstem Nehalem and Rock Creek respectively in 2003. In 2004, average densities were 4.7 and 20.7 redds per mile in Nehalem River and Rock Creek respectively. Steelhead redd counts ranged from 0 to 52 redds per mile depending on year and location.

Pacific lamprey distribution has yet to be mapped, and surveys targeting Pacific lamprey are few. However, Pacific lamprey redds and adults were counted as a part of the ODFW steelhead surveys. In 2003, 30 redds per mile were counted in the mainstem and tributaries to the Nehalem River and 22 redds per mile in Rock Creek and tributaries. The average redd counts per mile were lower in 2004 at 14 (range: 0-133) and 18 (range: 0-84) in the Nehalem River and Rock Creek drainages, respectively.

Anadromous and resident cutthroat trout are not the focus of any population monitoring program; therefore, counts of adults are unknown, although they are present in most streams in the ODF study area (Map 11).

A summary of salmonid fish populations in North Coast basins, including the Nehalem, was developed by Talabere and Jones (2004) to identify the 6th field HUs that supported higher than average densities of salmon during 1989 - 2000. The maps depict the small watersheds that had above average densities for more than 50%, 75%, and 90% of the 12 years (Maps 13 and 14; Table 2). Watersheds in the Nehalem study area were most important for coho salmon, but selected watersheds were also important for winter steelhead and fall Chinook. The Oregon Department of Forestry, in consultation with ODFW, designated 4 watersheds within the Nehalem as Salmon Anchor Habitats to recognize the importance of these 6th field watershed to salmon populations. They include Upper Nehalem River, Upper Rock Creek, Fishhawk Lake Creek, and Buster Creek watersheds (Table 2).

Fish Populations in the Clatskanie Basin

Data on adult salmonids and lamprey in the ODF study area in the upper Clatskanie River is very limited. Fall Chinook and chum salmon are not present in the study area. Very few coho salmon return to the Clatskanie drainage, and the habitat is considered to be underutilized. However, coho salmon have been observed spawning from mid-November to early January in the segments of the Clatskanie and Little Clatskanie rivers flowing through ODF lands. Steelhead are present in the upper Clatskanie and Little Clatskanie rivers, although little data exists to document usage. Adults were observed spawning in the ODF study area in the Clatskanie and Little Clatskanie from mid-March to mid-April during 2004. Pacific lamprey were also present in the ODF study area in the mainstem Clatskanie just upstream from the confluence with Carcus Creek; redds were observed from mid-April to mid-May.

Historic Fish Distribution

Lacking historic fish distribution information, we used a map of stream size and gradient developed by the Coastal Landscape Analysis and Modeling Study (CLAMS: http://www.fsl.orst.edu/clams/) to identify areas above current fish distribution that could have potentially supported salmon in the past. We assumed that fish distribution in the Nehalem and Clatskanie basins would be limited by stream gradient if impediments such as physical barriers or poor habitat were not present. Comparing current maps of fish distribution with the CLAMS generated maps of intrinsic potential (representing potential historic distribution) indicates that historic fish composition and distribution may be similar to present conditions (Maps 8 - 11).

The map of high intrinsic potential indicates the areas that may have had the highest level of productivity for juvenile coho salmon in the past (Map 15). The areas on ODF land of high intrinsic potential are few. Buster and Walker Creeks appear to have the most extensive and longest section of high intrinsic potential on ODF land. The Nehalem study area has many large sections of high intrinsic potential; this includes much of the lower gradient reaches of the mainstem Nehalem River, Louisignont, Fishhawk, and Deep Creeks, as well as other areas. These sections downstream of and bordering ODF boundaries suggest that streams in the state forest may support the spawning fish populations while the best winter rearing habitat for juvenile coho salmon lies immediately below the forest boundary. The character of aquatic habitat and riparian stands on forest lands may dictate the flow of sediment and large wood to the reaches below.

Salmon and Lamprey life history in coastal basins

Chinook salmon return early September to early November with peak spawning activity observed in mid November to mid December. Chinook salmon prefer to spawn in larger streams at the tail crest of pools and glides and tend to use larger substrate in which to build redds. The fry emerge in early spring. Some will migrate immediately to the estuary while others will remain in freshwater until early summer. After spending the summer and early fall in the estuary they will migrate to the ocean. Most will remain in the ocean an average of 3 to 4 years and then come back to their native streams to repeat the cycle. Habitat requirements for adult Chinook are clean, ample gravel for spawning, cold, clean, well-oxygenated water, and deep pools for cover. Juvenile Chinook need cool, clean water, pools, and large wood debris for cover while in their freshwater environment. Estuaries and associated wetlands provide vital nursery areas for the juvenile fish prior to their departure to the open ocean.

Coho salmon begin returning to the watershed in October and early November after spending 6 months to 1.5 years in the ocean. The peak spawning counts occur between mid November and mid January. Coho prefer to spawn in the smaller tributaries and have been observed in the upper reaches of the mainstem as well. The fry emerge in early spring and remain in their freshwater environment for a complete year. Thus, due to this life history trait, high quality habitat conditions are desirable in order to insure over-winter survival. Attributes such as off channel habitat which provide refuge high velocity winter flows, large wood debris to provide cover from predators, and low levels of fine sediment in spawning grave provide this. Habitat attributes important to coho salmon are scour pools, slackwater pools, off channel habitat, and large wood debris.

Winter steelhead return to their natal streams from November to April after spending from 1 to 3 years in the ocean and unlike other Pacific salmonids, some may survive after spawning and return to the ocean and become repeat spawners. Spawning occurs in the winter and early spring, and when the fry emerge they remain close by or occasionally migrate to the upper or lower reaches of streams and rivers. Like other salmon species, juveniles and adults rely on streams, rivers, and marine habitat during their lifecycle. Juveniles usually stay in their freshwater environment for two years before migrating to the ocean in the spring. Habitat requirements include clean, ample gravel for spawning, cold, clean, well oxygenated water, deep pools and large wood debris for cover.

Coastal cutthroat trout may exhibit four main life history strategies; an anadromous form that migrates to the estuary and/or ocean before returning to freshwater to spawn, an adfluvial form that migrates from a lake to smaller tributaries to spawn, a fluvial form that migrates to small streams from other parts of the watershed to spawn, and a resident form that both resides and spawns in small streams. Both anadromous and resident cutthroat trout are found throughout the mainstem and tributaries of the Nehalem and Clatskanie basins but specifically resident cutthroat tend to be found in the upper headwater reaches of the tributaries. Anadromous adults enter streams during the fall. These adults will spawn from December through May depending on water conditions. Fry emerge from the gravel in about 2 months. The young utilize slow flowing backwater areas, low velocity pools, and side channels for rearing. Young cutthroat can spend 1 to 9 years in fresh water before they migrate to the estuaries and ocean in the spring, but most commonly it is three years from emergence. Adults usually spend less than one year in the ocean before returning to spawn. Like steelhead, sea-run cutthroat trout usually survive after spawning and will return to the ocean in late March or early April. In freshwater, adult cutthroat typically reside in large pools while the young reside in riffles.

Pacific lamprey are anadromous. Mating pairs construct a nest by digging together using rapid vibrations of their tails and by moving stones using their suction mouths. Adults die within days of spawning and the young hatch in 2-3 weeks. The juveniles swim to backwater or eddy areas of low stream velocity where sediments are soft and rich in dead plant materials. They burrow into the muddy bottom where they filter the mud and water, eating microscopic plants (mostly diatoms) and animals. The juvenile lamprey will stay burrowed in the mud for 4 to 6 years and stay in the same habitat, rarely migrating within the stream system. They metamorphose into adults averaging 4.5 inches long. Lamprey migrate to the ocean in late winter during periods of high water. After 2 to 3 years in the ocean they will return to freshwater to spawn.

Habitat Survey Approach and Methods

ODFW Aquatic habitat surveys were conducted in the Nehalem and Clatskanie drainage from 1992 – 2004 (Map 16; Table 3). Due to the lack of coverages available for drainages in the lower Columbia River and due to the minute amount of surveyed ODF land within the Clatskanie basin, summaries reflect the Nehalem basin unless otherwise stated.

The habitat surveys describe the channel morphology, riparian characteristics, and features and quality of instream habitat during summer flow, following methods described in Moore et al. (1999) (http://osu.orst.edu/Dept/ODFW/freshwater/inventory/publicatn.htm). Each habitat unit is an area of relatively homogeneous slope, depth, and flow pattern representing different channel forming processes. The units are classified into 22 hierarchically-organized types of pools, glides, riffles, rapids, steps, and cascades, as well as slow-water and off-channel pool habitat. Length, width, and depth were either estimated or measured for each habitat unit. In addition, water surface slope, woody debris, shade, cover, and bank stability were recorded. Substrate characteristics were visually estimated at every habitat unit. Estimates of percent silt, sand, and gravel in low gradient (1-2%) riffles were be used to describe gravel quantity and quality. The surveys also provided an inventory of site-specific features including barriers to fish passage (e.g., falls or culverts), mass hillside failures, and beaver activity.

Riparian transects describe tree type and size, canopy closure, and ground cover associated with the floodplain, terraces, and hillslopes adjacent to the stream. Each transect measures 5 meters in width and extends 30 meters perpendicular to the channel on both sides of the stream.

Descriptions of channel and valley morphology followed methods developed at Oregon State University and described in detail in Moore et al. (1999). Valley and channel morphology defined the stream configuration and level of constraint that local landforms such as hillslopes or terraces imposed upon the stream channel (Gregory et al. 1989; Moore and Gregory 1989). The channel was described as hillslope constrained, terrace constrained, or unconstrained. Channel dimensions included active (or bankfull) channel width and depth, floodprone width and height, and terrace widths and height. These descriptions of channel morphology have equivalents within the OWEB and Rosgen channel typing system (Rosgen 1994).

Two survey designs were used within the Nehalem and Clatskanie study area. Surveys conducted in 1992 – 2000 in the Nehalem and Clatskanie drainage followed a basins, or census, survey design. The basins survey followed methodology proposed by Hankin (1984) and Hankin and Reeves (1988). The sampling design is based on a continuous walking survey generally from the mouth or confluence of a stream to the upper reaches. Each stream is stratified into a series of long sections called reaches and into short habitat units within each reach. Within a watershed, field crews survey major streams and a selection of small tributaries. The methodology provides flexibility of scale, allowing information to be summarized at the level of microhabitat, associations of habitat, portions or reaches of streams, watersheds, and subunits within regions. The continuous-survey approach provides field-based estimates of habitat conditions throughout a stream, describe habitat and hydrologic relationships among streams or landscape features, and permit stream-wide estimates of fish distribution and abundance.

The second survey design (referred to as OR Plan) was intended to provide estimates of habitat conditions across a broad geographic region. To accomplish this, we randomly selected sites each year from 1998-2004 in coastal drainages north of the Nestucca River. Of the total, 19 sites fell within the Nehalem study area and are reported here. Field protocol was similar to the basins surveys except that sites were 500 meters to 1,000 meters in length. The randomly selected sites were combined with the basins survey reaches to describe aquatic conditions in the study area.

Analysis

Habitat data were summarized at the reach (basins surveys) or site (OR Plan surveys) scale to describe channel morphology, habitat structure, sediment supply and quality, riparian forest connectivity and health, and in-stream habitat complexity. Individual attributes include:

Channel morphology	Channel dimensions
	Channel constraint features, if any
	Gradient
	Percent secondary channels
	Floodplain connectivity
Pool habitat	Percent pool
	Percent slow, backwater, and off-channel pools
	Deep Pools (>1m deep)
	Complex pools (contain > 3 pieces large wood)
Large Wood	Pieces of large wood (>0.15 diameter and >3m length)
	Volume of large wood (m^3)
	Key pieces of wood (>0.6m diameter and >12m length)
Substrate	Percent fines, gravel, cobble, boulder, bedrock
	Percent fines and gravel in low gradient riffles
Riparian	Shade
	Density of conifer trees, by size category
	Density of hardwood trees, by size category

Results are presented in tables and as frequency distribution graphs, and in GIS coverages. Values were standardized as a percent or by reach length. Habitat attributes were expressed as reach or site averages or displayed at the habitat unit level. Information from a reference database was used to provide a standard point of comparison. The basins and OR Plan surveys were integrated into coverages in a Geographical Information System (Jones et al 2001). The basins surveys were routed and displayed at the channel reach and habitat unit scales, and the random surveys were displayed as points with reach summary data.

Individual stream survey reports for the Nehalem and Clatskanie are available from the Aquatic Inventories Project in Corvallis

Metadata for the GIS coverages is available online at
http://oregonstate.edu/Dept/ODFW/freshwater/inventory/index.htm

An interpretation guide for aquatic habitat data is available online at
http://oregonstate.edu/Dept/ODFW/freshwater/inventory/index.htm

Habitat quality

Individual habitat attributes portray a view of stream characteristics. They provide a point of comparison to view the relative differences between streams and reaches within a drainage network. We integrate habitat attributes in three different fashions, considering fish, landscape, or historic perspectives. The first is in comparison to a historic context, expressed in the character of streams located in minimally human disturbed areas. These sites are referred to as reference sites, and while they provide a general context and range of stream attributes. These compare current conditions with minimally human-influenced conditions. They are not intended to be prescriptive in nature.

The second and third perspectives express stream quality in terms of potential carrying capacity of a reach for juvenile coho salmon (Habitat Limiting Factors Model) and potential survival of coho salmon at each life stage (HabRate). Again, each model provides a comparison of stream attributes from a salmonid biology perspective.

Reference conditions

Reference values (Table 6) were derived from streams in areas with low impact from human activities. We used a reference database that is most similar to the lower gradient streams predominant in the Nehalem and Clatskanie study area. A total of 124 reference sites, surveyed between 1992 and 2003, were selected within the Oregon Coast Coho ESU (from Sixes River to the Necanicum, including the upper Umpqua in the Cascade ecoregion) to represent conditions within the range of coho salmon. A summary of reference site characteristics follows.

Reference sites were selected using methods outlined in Thom et al. (2001). A thorough discussion of the site characteristics and locations of the reference sites used in this report will be available at ftp://nrimp.dfw.state.or.us/OregonPlan/ (in press). Sites were initially selected based on land use and riparian classifications usually associated with low human impact (e.g. wilderness or roadless area, late-successional or mature forest). Each site was inspected using USGS 7.5 minute topographic maps for human-caused stressors such as roads, development, and forest management.

Attribute	Value
Number of Reaches or Sites	124
Distance Surveyed - Total (km)	161.9
Reach or Site Length (m)	
Mean (median)	1306 (971)
Range	174 - 6776
Active Channel Width (m)	
Mean (median)	9.28 (7.28)
Range	1.5 – 31.5
Gradient (%)	
Mean (median)	2.8 (2.3)
Range	0.5 – 19.2
Ownership	primarily federal
Ecoregions	Coastal 80% Cascades 20%
Geology	Sedimentary 72% Volcanic 21% Mixed 7%

While few of the sites were completely absent of human influence, we assumed that the reference sites represented a natural range of conditions. The range of data for each reference stream variable was subdivided into quartiles, 0-25%, 25-75%, and 75-100%. The value within each of the three quartiles was labeled as either low, moderate, or high. Thus, we considered that the 25th and 75th quartile breakpoints represented the values we considered low or high within a natural context. The middle 50% quartile was considered a moderate or average level. We used these values not to predict historic conditions in the Nehalem and Clatskanie study area, but to more broadly represent the potential range of historic conditions in lower gradient (<5%) fish-bearing streams in coastal Oregon. Figure 1 displays the gradient and active channel width of the reference streams against the Nehalem and Clatskanie study area by both study area and 5th field HU. Figures 2 – 7 display important habitat parameter values for the reference reaches against the three HU in the upper Nehalem project area.

Habitat Limiting Factors Model (HLFM)

The HLFM model estimates the potential carrying capacity of stream habitat and identifies the limiting factors for coho salmon production (Nickelson et al 1992, Nickelson 1998). We used this model to quantify critical habitat factors for juvenile coho salmon during the summer and winter and to highlight differences between reaches. The HLFM model focuses on the amount of pool habitat in a reach, particularly the beaver pool and off-channel pool habitat. Summer habitat capacity is a function of the amount of total pool habitat; winter habitat is governed by the amount of beaver and off-channel pool habitat.

Stream capacity to support juvenile coho salmon during the summer was considered high if the value exceeded 2,430 fish per kilometer and low if the value was below 1250 fish per kilometer. Similar values for capacity to support winter parr were 1950 and 1000 fish per kilometer. Habitat quality was measured as the average number of juvenile fish per square meter in a kilometer of stream. The breakpoints for low and high quality were 0.15 and 0.38 fish per m^2 in the summer, and 0.12 and 0.30 fish per m^2 in the winter.

We used data from winter surveys to estimate winter capacity for juvenile coho when available. Otherwise, summer habitat conditions were applied to a predictive model to estimate habitat capacity during the winter.

HabRate

HabRate (Burke et al. 2001) describes the quality of aquatic habitat in relation to survival of Coho salmon at a particular life stage. HabRate was based on our interpretations of the published literature. Habitat requirements for discrete early life history stages (i.e. spawning, egg survival, emergence, summer rearing, and winter rearing) were summarized and used to rate the quality of reaches as poor, fair, or good, based on attributes relating to stream substrate, habitat unit type, cover and structure (large wood, undercut banks), and gradient. Reach level summaries of stream habitat were entered into a computer spreadsheet, and interpreted by logical statements to provide a limiting factor assessment of potential egg-to-fry and fry-to-parr survival for each reach. The model is a decision making tool that is intended only to provide a qualitative assessment of the habitat potential of stream reaches within a basins context. Information not common to standard stream survey designs, such as seasonal flow or temperature extremes were excluded from this analysis. Model output ranks habitat quality from 1 to 3: poor, fair, and good.

The primary difference between the HLFM and HabRate models is that HabRate considers the influence of large wood in structuring habitat complexity, whereas HLFM model emphasizes the importance of beaver ponds and alcove habitat. Both models provide an assessment of habitat features that influence the survival of Coho salmon juveniles from parr to smolt. We include the finding from both models to describe habitat quality.

An evaluation of incorporates the biological significance of stream habitat attributes and knowledge of salmonid life history. The reference benchmarks are a useful point of comparison for determining whether the value of a physical stream characteristic is high or low relative to the range of natural conditions. Fish habitat models, HLFM and HabRate, view the physical habitat from a salmon biology perspective. Values of high or low capacity reflect the importance of physical features to the productive capacity of habitat for coho salmon. Values of high or low quality describe the influence of habitat on the survival of coho salmon during a particular life stage, or from one life stage to the next.

Aquatic Habitat Conditions

Aquatic Habitat overview

The ODFW Aquatic Inventories Project has conducted aquatic habitat surveys in the Nehalem and Clatskanie Basins since 1991. There are approximately 288 kilometers of surveyed stream habitat associated with 181 identified reaches within the ODF Nehalem project area. Analysis of the habitat conditions within the project area was approached according to fifth field HUC (hydrologic unit code) designations (Map 3). Of the three HU within the study area, 1700020203 had the most reaches and thus kilometers of stream surveyed (n=99, approximately 149 km), followed by 1710020202 (n=45, approximately 80km), and lastly 1710020201 (n=37, approximately 59km). Tables 3a through 5b provide a list of all stream reaches and habitat conditions of selected attributes within the Nehalem study area according to their 5th field HUC designation. Most of the streams surveyed in the project area were small to moderate sized tributaries, based on active channel width. The active channel width (bankfull width) on the surveyed streams ranged from 1.8m to 20.8m (average of 6.7m and a median of 6.7m). The gradient ranged from 0.3% to 27% (average of 4.1% and median of 2.7%). Of the 288 kilometers of stream surveyed, only 67km had an average gradient greater than 5 percent. Of the 67km, approximately 20km had an average gradient greater than 9 percent.

Thirteen core habitat attributes considered important for successful spawning, rearing, and survival throughout various fish life history stages were analyzed. These core attributes are identified as the amount of pool habitat, quantity of deep pools per kilometer, percent of slackwater habitat, percent of secondary channel area, percent of fines and gravel substrate found in riffle units, percent bedrock substrate, large wood pieces, volume, and key pieces, shade, and large conifers in the riparian zone. The values derived from these core attributes are compared to habitat breakpoints of the reference stream reaches and conditions. Reference sites provide a general context and range of stream attributes of minimally human-influenced sites. They are intended to provide a point of comparison to view the relative differences between streams and reaches within a drainage network. Reference values are not meant to be prescriptive, that is, to indicate the value each reach of stream must attain.

Table 7 compares the average and median values of the 13 core attributes in relation to the reference reach habitat breakpoints. In addition, Figures 2 through 8 are cumulative frequency graphs of these attributes within the 5th field HUs which help visualize the condition of the habitat relative to the reference conditions. With the exception of fines in riffles and large conifers within the riparian zone, the habitat conditions for all core attributes within the Nehalem project area are within the moderate to high categories. There did not appear to be a significant difference between each designated area in regards to the reach values relative to benchmark conditions for most of the habitat parameters. All three of the 5th field HUs within the Nehalem project area had a moderate abundance of pool habitat, deep pools, and slow water pools. The area of secondary channel habitat was moderate. The amount of gravel in the streambed met or exceeded habitat breakpoints. Structural complexity was moderate to high as there was a significant amount of large wood pieces and volume within the surveyed area. Shade levels were moderate to high throughout the three 5th field HUs. There was a high amount of fine sediments embedded within riffle habitat and the number of large riparian conifers within the project area was low with only a few reaches meeting the high level criteria.

Although the means and medians of the habitat conditions indicate the majority of stream habitat is in fair to good condition it should be pointed out that there are individual reaches within the project area that rate exceedingly well in comparison to the reference habitat breakpoints. Tables 8 through 11 display highlighted reaches where at least 5 of the core attributes met or exceeded the high (desirable) benchmark values for that individual reach. The use of these tables in conjunction with the high quality habitat identified from HabRate and HLFM modeling (Map 21 and Figure 9) is a preliminary step for identifying restoration opportunities and priorities.

Relationship of fish populations to aquatic habitat

The surveys described components and processes that contribute to the structure and productivity of a stream and fish community. The Aquatic Inventories Project selected attributes to describe important indicators of sediment supply and quality, instream habitat complexity, and riparian forest community. These variables were summarized for reaches and sites on ODF lands within the Nehalem project area in Table 7. As mentioned earlier, we also used cumulative frequency distribution graphs to examine the survey data on ODF lands (Figures 2 through 8). The frequency distribution graphs are useful for determining medians and percentile values and for comparing the differences in distribution of values between multiple databases. These graphs also illustrate the habitat values with comparison to reference conditions.

The response of salmonid fishes to the character of aquatic habitat varies by life stage and time of year. Adult fish seek deep pools for holding areas while preparing to spawn and need gravel and cobble substrate that is free of fine materials to build redds and deposit eggs. Furthermore the redds require a steady flow of oxygenated water to allow the eggs and alevins to mature. Increasing amounts of fine sediments (<2mm) increases the mortality of eggs in the gravel (Everest et al. 1987). The amount of silts and fines associated with riffles is an indicator of embeddedness in spawning areas. A high percentage of fine sediment can settle (embed) in the interstitial spaces of the gravel and armor it such that it is difficult for spawning fish to dig an adequate redd (nest), and prevent oxygenated water from reaching the eggs. The average amount of fine sediment of each 5th field HU was in excess of the habitat breakpoint derived from the reference reaches. However, twenty seven reaches (33km) of the 181 (288km) identified in the project area had individual sediment values that met or were below the breakpoint (Table 9). Fine sediment values less than 8% are desirable. Data analysis indicates that the average amount of gravel and cobble are at moderate levels within the Nehalem and Clatskanie study area. Thirty seven reaches (66km) had gravel levels that met or exceeded good (desirable) habitat breakpoints (Table 8).

After emergence in the spring, salmonid fry typically remain in freshwater for a few weeks to two years before migrating to the ocean, depending on species. Edge cover and backwater habitats are particularly important to the survival of fry in the spring, though less so as they grow and move into larger pools during the summer. The distribution of juvenile salmonids is limited primarily by the availability of pool habitat, food resources, and acceptable water quality. In the winter, coho salmon parr prefer complex pool habitat which has low velocity refugia from high winter stream flow. This habitat is often found in the form of off-channel alcoves, dam pools, and beaver ponds (Nickelson 1992). Complex off-channel habitats are also important in these large stream reaches during the winter. Large wood is an important structural component contributing to the complexity of these preferred habitats (Sedell 1984). Juvenile coho salmon extend their distribution downstream in the winter to inhabit areas previously limited by high water temperature, including tidally influenced wetlands. Juvenile steelhead and cutthroat trout are more opportunistic in regards to habitat type, residing in pools, riffles, rapids, and cascades. Additionally, pools provide resting places and over-wintering habitat for fish. Deep pools, those greater than or equal to 1 meter deep, provide temperature refugia and provide year-round cover. All 5th field HUs within the Nehalem project area averaged a moderate level of deep pools in relation to the habitat breakpoint derived from the reference reaches (greater than 3 pools greater than 1 meter deep per kilometer). Slackwater pools include backwater habitat, dammed pool, and beaver ponds. A high level is greater than 7% of total available habitat; fifty five reaches met or exceeded this breakpoint (80km). The average amount of pool habitat for each 5th field HU was moderate to high in comparison to the reference reaches (a high level is greater than 45% of total habitat). The higher gradient reaches are dominated by fast water habitat types.

Instream wood serves many functions in a stream channel. The wood helps to scour deep pools, provide cover and nutrients, trap sediment, and provide cover from predators. Wood acts as an obstacle at higher flows, forcing the stream to cut new channels, to scour new pools, and to create undercut banks. The pools in the Nehalem study area are relatively simple, with low to moderate amounts of large wood. Overall, the rating of summer habitat for coho salmon is high for habitat capacity (large and abundant pool habitat), and fair for quality (deep, complex pools, availability of off channel and slow water pool habitat) (Figure 8). Channel morphology and amount of secondary channel indicate relatively high connectivity to the floodplain. Secondary channels increase the potential habitat available to fishes, particularly to juveniles. Often the habitat has slower moving water than the primary channel. It provides over-wintering and summer rearing habitat for juvenile fish. An acceptable level of secondary channels is 5.3% or more of the total channel area; sixty three reaches met or exceeded this breakpoint (104km).

Riparian vegetation is indirectly an important component of fish habitat. The riparian trees stabilize the bank, are a recruitment source of woody debris, buffer against flood impacts, and provide shade. Stabilized stream banks are more likely to develop undercut banks, which serve as important cover for fish and are less likely to contribute fine sediments. The canopy cover (shade) in all reaches rated high in relation to the reference conditions. The higher shade cover is due to a riparian composition consisting predominantly of hardwood species (red alder) 3-30 cm dbh and a narrow active channel. There were very few conifers observed in the riparian zones of any of the reaches. This is a limiting factor for recruitment of large wood (greater than 60 cm dbh) into the channel and thus a limiting factor for increasing pool and channel complexity. All trees are important and contribute to the river system. Conifers are particularly important as they tend to grow larger than deciduous trees; therefore, they remain in the river system longer before deteriorating.

Individual attributes in the Nehalem suggest the habitat is in good condition to support salmonids. However, when more than one attribute is considered within a given reach, the results are not as positive using the HLFM and HabRate models (Figure 9, Map 21). The level of fine sedimentation is excessively high, affecting the survival of eggs in the gravel and emergence of alevins from the gravel. Summer habitat capacity and quality is generally good because of the abundance of pools, particularly in HU 1710020202, although the overall capacity and quality of winter habitat in all the HUs is low. Forty to sixty percent of the habitat is in low quality and capacity during the winter. In addition, 50 – 60 percent of the spawning habitat is low quality in HU 1710020201 and 1710020202 in contrast to only 25% in low quality in HU 1710020203. The Beneke Creek watershed (HU 1710020203) had a number of high quality spawning and rearing areas. Some high quality reaches were present in all HUs in the study area.

Flood surveys

ODFW Aquatic Inventories Project surveyed a selection of stream reaches following the large flood event that occurred during February 1996 (Jones et al. 1998). We surveyed two sets of sites: sites on ODF lands that were selected by ODF and a random selection of sites that had been surveyed during the previous 5 years.

The flood sampling design was structured to allow analysis of the stream survey results to address the following questions:

- What is the degree and extent of habitat alteration associated with the floods?
- How did flood impacts on stream habitat vary by region, land use, and stream channel characteristics?
- What were the characteristics of stream reaches that demonstrated positive or negative habitat responses to the flooding?
- What land use and management practices were associated with positive or negative impacts on stream habitat?
- Were there different impacts relative to the habitat requirements of the different salmon species? In other words, were there net gains for Coho habitat but net losses for chinook?
- Based on the observations and results of this study, what options are available for improved habitat management in streams influenced by the floods?

Sixty one-kilometer reaches were surveyed in the North Coast; 16 were within the Nehalem basin; 4 within the Nehalem project area. The data were evaluated and placed into categories according to level of flood impact. Highly impacted reaches showed evidence of debris torrents at the scale of full valley floor scour or deposition extending for more then 7 channel widths in length. Characteristics of moderately impacted reaches include various large scale channel modifications, such as channel relocation, new channel formation, deposition of new gravel bars. Reaches with low impact ranged from no perceivable impact, high water impact (clearing of litter from low terraces and floodplain), or scour and deposition patches (localized scouring or deposition) (Map 20).

Of the 16 randomly selected sites in the Nehalem, surveyors observed mass failures on the hillsides along 8 of the stream reaches. Additionally, 11 of the 16 sites had a moderate or high influence from the flood. Five of the sites experienced a low level of impact, and one site had both a moderate and low level of impact along the one kilometer reach. Within the project area, four streams were surveyed both before and after the 1996 flood. Of these, three experienced significant flood effects and one showed no effect. In general, streams on the north coast of Oregon experienced some large scale debris torrents, channel morphology adjustments, and redistribution of habitat units, sediment, and wood. Despite the low number of surveys in this area, it appears that streams in the Nehalem River basin and the Nehalem study area are susceptible to and showed a high level of effect in the stream channel from the 1996 flood event.

Barriers

Barriers and potential barriers to anadromous and resident fish exist in most riverine systems due either to human-caused or natural processes. A barrier, which includes culverts, dams, velocity barriers, natural falls, lack of sufficient water flow, etc., is defined as an impediment to the movement of any fish at any life stage. The Nehalem basin has 9 recorded barriers, as determined by Streamnet (Map 20 and Table 12). These barriers are found both within and outside known fish distribution. Fish distribution may extend beyond a partial barrier because the barrier may be specific to a species or life stage, or at a particular time of year.

The Streamnet barrier database incorporated the culvert inventory database; therefore, culverts in the dataset are those which do not meet acceptable fish passage criteria, not necessarily those which prevent all fish at all times. Of the 9 listed barriers, 4 are culverts. These barriers are rated as to the degree, or lack thereof, of fish passage. Two are thought to have complete blockage, 1 is thought to be non-blocking, and 1 has unknown passage. Movement may be prevented due to high velocity of water through the culvert, incorrectly sized culvert, culvert deterioration, or debris blocking the culvert. Data are not available to assess fish presence above all of the potential barriers.

Anadromous fish distribution ends at or below each of the listed barriers (Map 23). Two streams with impassable culverts (Record ID 1141 and 1169) have no mapped fish distribution. The barrier on NF Quartz Creek prevented coho salmon passage, but allowed steelhead to pass above the falls. Resident cutthroat trout, lamprey, and sculpin may be present above the natural and human-caused barriers.

Additionally, aquatic habitat survey crews also documented many potential barriers to migratory fish. They identified culverts with corrosion and steps ranging from 0.7 – 13.5 meters high. However, anadromous and resident salmonid fishes were found above each of these potential barriers. Passage above the falls on South Fork Quartz Creek (13.5m high) is unknown, as fish distribution coverages are not mapped for that stream. Professional opinion and field surveys indicate that the fall is a barrier to fish.

The amount of aquatic habitat with restricted access or passage problems in the Nehalem and Clatskanie drainage based on Streamnet barrier data may total 13.6 kilometers (Table 12).

Information as to species and life stage affected is not available in the database. Conducting field surveys to improve documentation is recommended, although passage does not appear to be a major issue.

Restoration

Restoration is a technique and process used in an attempt to improve stream habitat in the short term and to achieve long-term recovery goals. The goals of restoration range from improving spawning and rearing habitat, to improving natural stream processes. Treatment projects focus on improving summer and winter rearing for juvenile salmonids, improving spawning habitat, increasing nutrients in the stream, reducing sedimentation and bank erosion, and replanting native streamside vegetation. Instream habitat improvement projects to improve rearing conditions for juvenile salmon target increasing complexity of pools (large wood additions) and creating off-channel and slow water pool habitat. The quality of existing pools could be increased by recruitment of gravel, addition of wood pieces, or increased shade levels. Monitoring is a critical aspect of the restoration effort, as it is important to gauge whether the methods employed helped to achieve the desired effects. Achieving noticeable response may take several high flow events; biological response could take longer.

Since 1995, 55 instream projects have been completed on ODF lands (Table 13) in the Nehalem and Clatskanie River basins. The projects on ODF lands focused on instream enhancement, passage issues, and road/drainage improvements in the Nehalem and Clatskanie River. Eleven projects placed large wood in the streams, 26 improved the road and drainage system, and eighteen improved fish passage.

Of these, three sites (Northrup Creek – two sites, North Fork Wolf Creek) were monitored by ODFW. In each case, large wood structure was added to the stream to improve stream structure and complexity, to allow the stream to better interact with the floodplain, and to improve overall stream habitat. Since these are fairly recent sites and winter flows have been relatively benign, substantial changes in pool area or gravel recruitment have not been observed.

In 1997, 98 stream reaches on ODF land in the Nehalem watershed were identified for instream enhancement (Table 14 and Map 24; Thom and Moore. 1997). The majority of these selected stream segments for restoration were in the Jewell area of the Nehalem Basin, from Beaver Creek near Birkenfeld to Humbug Creek., stream segments important for coho salmon. A number of sites on ODF land were also selected upstream and downstream of this area. Candidate streams were selected based on numerous criteria, through both in-house techniques and field verifications (Table 15). Overall, stream areas suitable for coho habitat enhancement are those areas flowing through an unconstrained valley, gradient <5%, moderate size - channel width 4-12 meters, and either have or are adjacent to a known coho population area. Some habitat enhancement work was conducted on a number of streams including Fishhawk Creek, Hamilton Creek, and Humbug Creek, and the mainstem Nehalem and Clatskanie River prior to 1997. Since 1997, two of the high priority sites and 15 of low to moderate priority sites (as designated by Thom and Moore 1997) on ODF land have had treatments applied (Map 25). Most of the sites have addressed passage issues, which have improved access to previously blocked (partially or completely) habitat. The balance have used large wood placement to enhance instream habitat.   It is useful to note that over 80 potential restoration reaches remain from the original list identified in 1997.

Map 24 and Table 14 display reaches of stream that have a potential to respond to instream restoration treatments. Relatively few of the reaches selected in 1997 (Thom and Moore 1997) have been treated. The priorities (high, medium, and low) and locations are still appropriate, although sites should be verified in the field. To date, most treated restoration sites have not been formally monitored. Documentation of site location and condition of past projects will help direct future restoration at these or adjacent sites. Criteria for instream restoration treatments within the mainstem Nehalem and Clatskanie River will require consideration of the dynamics of the large river system. Map 25 depicts Thom’s 1997 priority locations with restoration sites funded by OWEB since 1997. There are high priority areas which need consideration for future restoration.

Summary of Fish Populations and Aquatic Habitat Conditions in the Oregon Department of Forestry Upper Nehalem and Clatskanie Study Area

Fish distribution

What fish species are documented in the watershed?

- Coho salmon, fall and early-run fall Chinook salmon, winter steelhead, resident and anadromous cutthroat, and Pacific lamprey are present in the Nehalem basin. Coho salmon, fall Chinook salmon, winter steelhead, resident and anadromous cutthroat, and Pacific lamprey are present in the Clatskanie basin. The occurrence and distribution of other native fishes is not documented.

Are any of these species currently state- or federally listed as endangered, threatened, or candidates?

- Coho salmon is listed as threatened, while winter steelhead are considered a species of concern in the Nehalem basin (see NOAA Fisheries web site for current status - http://www.nwr.noaa.gov/). Coho salmon, Chinook salmon, chum salmon, and winter steelhead trout are listed as threatened in the lower Columbia River including the Clatskanie River drainage. Cutthroat are considered sensitive and are currently under review in the lower Columbia River including the Clatskanie.

Are there any fish species that historically occurred in the watershed that no longer occur there? Map potential historical fish distribution.

- No species have been extirpated from the Nehalem and Clatskanie study area.
- We believe current distribution is similar to historical distribution. However, the abundance of anadromous salmonids is very low in the Clatskanie River basin.

Which salmonid species are native to the watershed, and which have been introduced?

- All of the aforementioned salmonid species are native to the watershed. Non-native fish, including non-native salmonid stocks, may be present but have not been documented.

Are there potential interactions between native and introduced species?

- Because no introduced species have been documented, there are no known interactions between native and introduced fish.

Current habitat conditions

Show current condition of key habitat characteristics.

- Habitat surveys were conducted beginning in 1991, and are divided by 5th field HU number.
- Habitat characteristics are listed in Table 7, graphed in Figures 2 through 8, and examples mapped in Maps 17, 18, and 19.

Compare to benchmarks and/or reference streams for each characteristic.

- Reference sites provide a general context and range of stream attributes of minimally human-influenced sites, and are intended to provide a point of comparison to view the relative differences between streams and reaches within a drainage network. Reference values are not meant to be prescriptive, that is, to indicate the value each reach of stream must attain.

- Key benchmarks are presented in Table 7 and individual stream reaches are compared to these benchmarks in Tables 3A through 5B.
- The amount of pool habitat, number of deep pools, and area of secondary channel in the surveyed reaches is moderate to high, and the number of pieces of wood in and associated with the streams is similar to reference conditions. However, the number of key pieces of wood and the volume of large wood is moderate in comparison to reference conditions. The average amount of fine sediment is high for all 5th field HUs within the project area, although 27 individual reaches (33km) met or exceeded the high reference conditions. Streamside vegetation contains few large conifers, with only 13 reaches (14km) meeting or exceeding the high reference conditions. The amount of shade varies with stream size but overall averaged moderate to high for all reaches.

What stream reaches have high, moderate, and low levels of key pieces of large wood (>24-in) in the channel.

- Fourteen of 181 reaches within the Nehalem project area rated as having a high number of keypieces and thus met or exceeded the high breakpoints for large wood debris volume and number of pieces (Table 11).

What is the condition of the fish habitat in the watershed (by 5th field) according to existing habitat data?

- Summer rearing habitat for juvenile coho salmon is ample, given the high percent of pool habitat and area of low gradient (<5%) stream area in the project area. However, summer rearing would benefit from additional pool depth and complexity.
- Winter capacity and quality is low in 40-60% of the stream reaches in the study area. Off-channel habitat and deep, complex pools are limited.
- The amount of spawning gravel are at a suitable level throughout most reaches. However, most reaches had high levels of fine sediment which could embed the gravel reducing opportunity for egg survival. Spawning habitat is good overall only in HU 1710020203.
- High quality reaches for salmonid production are present in all three HUs.

In summary, the Nehalem project area has an average of moderate to high levels of core attribute habitat when compared to reference breakpoints. A number of individual reaches rate as meeting or exceeding high quality habitat breakpoints (Tables 8 through 11). These tables in conjunction with the other analysis within this report will help identify restoration opportunities.

How many miles of fish-bearing or potentially fish-bearing streams are blocked by culverts, and where are these blockages?

- Nine fish barriers were identified on ODF lands. Four of these are culverts which may warrant closer inspection. Two of the culverts are noted as impassable, one is noted as non-blocking, and the status of the remaining one is unknown. The other potential barriers are natural waterfalls. It is possible that other barriers that have not been noted here do exist.

- The amount of aquatic habitat with restricted access in the Nehalem and Clatskanie drainage based on Streamnet barrier data is approximately 13.6 kilometers. The amount on ODF land resulting from passage problems may total 10.0 kilometers. Documentation as to the species and life stage affected by each barrier is limited. Field surveys to improve documentation is recommended, although passage does not appear to be a major issue.

Are there watersheds where the current level of instream wood is a limiting factor for achieving properly functioning aquatic systems?
- Several reaches in the Nehalem study area meet the LWD reference conditions (Table 11). Additional large wood would increase the opportunity for complex instream habitat, creation of off-channel habitat, and sediment sorting.
- Large wood is a limiting factor in the Nehalem and Clatskanie for creation of high quality winter rearing habitat for salmonids.

Analyze restoration potential

Which reaches have the most potential to increase fish populations?
- Site selection will require an in-depth analysis of the unit level GIS and Oregon Plan site data coupled with field verification. Habitat complexity and floodplain connectivity requires the placement of large wood in selected stream segment to create complex pool and bank overflow opportunities. Taking advantage of the existing secondary channels will accelerate the process. The North Coast Guide to Restoration Site Selection from 1997 identifies over 80 potential reaches on ODF land that have not yet been treated.
- Reduction of fine sediment will require a detailed hydrologic study to determine source, transport, and storage of sediment in the basin. The data available through the stream surveys only identify areas collecting excessive amounts of fine sediment.
- Site verification prior to restoration planning is necessary because some of the surveys are 10 years old, and proper implementation depends on site-specific factors.

Which reaches have the most potential to meet or exceed benchmark levels?
- All of the reaches have the potential to meet many of the benchmark conditions over time. Restoration and protection strategies can expedite the opportunity to improve aquatic habitat complexity, sediment, and riparian structure in the Nehalem and Clatskanie drainage.

What is the magnitude of possible additional habitat with restoration of access?
- Four culverts restrict passage on ODF lands. Surveys are needed to document the quantity and quality of habitat for salmonid species above the culverts.

What is the relative priority of barriers for removal, replacement, or repair?
- The ODF and Streamnet barrier databases do not provide a lot of detail. Site checks are necessary to verify the nature and extent of the passage issues.

Describe the types and locations of potential enhancement projects?
- Based on the intrinsic potential information (valley width, stream gradient, active channel width), many of the streams on ODF land are good candidates for enhancement activities. With the exception of the smallest tributaries and the headwaters areas, most streams are low

gradient, in moderate to wide channels and valleys. Many streams would benefit from the addition of large woody debris, which would entrap substrate, scour deep pools, and provide cover for fish. Examples include the Buster Creek system, the Beneke Creek system, and Sager Creek system.

- Enhancement activities can be more effective when a watershed approach is utilized. For example, rather than constructing one or two habitat structures in each of ten widely scattered locations, constructing these same structures in one watershed can enhance a longer continuous section of stream. With riparian plantings and the removal of a passage barrier, a whole stream could be improved.
- Priorities related to fish habitat are discussed above – improving habitat complexity, floodplain connectivity, and reduction of fine sediment.
- Riparian plantings to increase the number, size, and species of conifer trees in the riparian zone would benefit floodplain stability, and increase shade levels and long-term large wood recruitment. Riparian enhancement for larger and greater mix of conifer species will again require site visits to identify appropriate floodplain and terrace sites within the Nehalem River corridor.
- The riparian surveys are a sample (not a census) of conditions along the Nehalem River, and hence only indicate the need for restoration.

Describe confidence level in restoration analysis.

- The aquatic surveys, between 1992 and 2002, described the overall conditions within each reach at the time of the survey. Restoration recommendations were based on existing habitat surveys (although selected attributes of the habitat data may out of date for this use), channel and valley configuration, and digital elevation models. Because successful restoration depends on site-specific characteristics, we recommend: 1) site visits prior to final planning, 2) analysis of habitat data (available in GIS and database) at the habitat unit scale, 3) re-examination of gradient and valley form, 4) more comprehensive road and barrier information, and 5) more detailed description of riparian conditions.

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Tables, Figures, and Maps

Table 1. ODF Nehalem Clatskanie study area by HU and ODF management designations.

Basin	5th field HU	ODFW surveyed streams	ODF 6th Field Management Basin
Clatskanie			
	17087000303	Clatskanie	Wilark
		none	East District Iso Tracts
Nehalem			
	1710020201	none	Gales Creek
		Rock Creek	McGregor
		North Fork Wolf Creek	
		Clear Creek	
		none	Upper Salmonberry
		Bear Creek	Wheeler
		Carlson Creek	
		Louisignont Creek	
		South Fork Nehalem River	
		South Fork Rock Creek	
		Upper Nehalem River	
		Wolf Creek	
		none	Quartz
		none	East District Iso Tracts
	1710020202	Fishhawk Creek	Fishhawk
		Trestle Creek	
		Warner Creek	
		Louisignont Creek	Louisignont
		Cow Creek	Northup
		Northup Creek	
		Northup Creek Tributary	
		Deep Creek	Sager
		Deep Creek Tributary	
		Sager Creek	
		Oak Ranch Creek	Wilark
	1710020203	Beneke Creek	Beneke
		Bull Heifer Creek	
		Bull Heifer Creek Tributary A	
		Gilmore Creek	
		Gilmore Creek Tributary	
		Trailover Creek	
		North Fork Walker Creek	
		Buster Creek	Buster
		Buster Creek Tributary	
		Cow Creek	
		Klines Creek	
		Moores Creek	
		Nettle Creek	
		North Fork Quartz Creek	
		North Fork Rock Creek	
		Osweg Creek	
		South Fork Walker Creek	
		Stanley Creek	
		Walker Creek	
		Crawford Creek	Crawford
		Fishhawk Creek	Hamilton
		Fishhawk Creek Tributary	
		Hamilton Creek	
		Quartz Creek	Quartz
		South Fork Quartz Creek	
		Slaughters Creek	Sager
		none	Sweethome
	1710020204	none	none
	1710020205	none	none
	1710020206	none	none

Table 2. Salmon Habitat and Diversity Watersheds: Species abundance within the Nehalem basin.
Coho, Fall Chinook, and Chum: based on 1989 – 2000 spawning survey data.
Steelhead: based on professional judgment of ODFW biologists and steelhead status review (Chilcote 1997).
Summer Chinook (from spawning counts in 1988 and 1989) and the Oregon Department of Forestry (ODF) Salmon Anchor Habitats are indicated in the table, but not on maps.
Colors and percentiles on map match percentiles listed below.
Study Area refers to ODF Nehalem Habitat Assessment project area.

Ref. #	Sub-watershed Name	Coho	Fall Chinook	Summer Chinook	Chum	Steelhead	ODF- Salmon Anchor Habitat	Within Study Area
6	Upper Nehalem River	>75					X	X
7	Wolf Creek	>75					X	X
8	Clear/Robinson Creek	>75						X
9	Beaver/Cedar Creek			X				
10	Upper Rock Creek	>75				X	X	X
11	Middle Rock Creek	>75				X		X
12	Lower Rock Creek			X		X		
13	Pebble Creek							
14	East Fork Nehalem River							
15	Crooked Creek							
16	Oak Ranch Creek			X				X
17	Ford/Lundgren Creek			X				
18	Deer Creek							
19	Calvin Creek							
20	Fishhawk Lake Creek	>90				X	X	X
21	Northrup Creek							X
22	Deep Creek							X
23	Middle Nehalem River							X
24	Fishhawk Creek							X
25	Beneke Creek							X
26	Cow/Quartz Creek		> 90	X				X
27	Buster Creek	>75	>75				X	X
28	Cronin Creek	>75	>90					
29	Humbug Creek	>75	>90					
30	Upper Salmonberry River							
31	Middle Salmonberry River					X	X	
32	N. Fk. Salmonberry River							
33	Lower Salmonberry River		>75					
34	Upper N.Fk. Nehalem River	>90					X	
35	Middle N.Fk. Nehalem River	>90	>90					
36	Lower N.Fk. Nehalem River	>75			>75			
37	Lost/Helloff Creek		>75					
38	Cook Creek		>90			X	X	
39	Lower Nehalem River				>75			
40	Foley Creek	>75			>90		X	
41	Nehalem Bay							
42	Upper Little Nestucca River							

Table 3A (page 1 of 2)

ODF NEHALEM PROJECT AREA: HUC 1710020203
REACH SUMMARY

STREAM	SURVEY DATE	REACH LENGTH (m)	% AREA IN SIDE CHANNELS	GRADIENT	VWI	*VALLEY FORM	*CHANNEL FORM	*LAND USE DOM	*LAND USE SUB-DOM	SHADE %	BEDROCK %	FINES IN RIFFLES %	GRAVEL IN RIFFLES %	LARGE BOULDERS #/100m
BENEKE CR	7/7/1999	1065	5.9	4.7	3.3	CT	CA	YT		86	11	40	14	0.3
BENEKE CREEK	7/19/2001	6774	6.0	0.3	38.2	CT	CT	LG	AG	73	11	9	39	3.2
BENEKE CREEK	7/29/2001	2056	8.5	2.2	24.1	CT	CA	ST	AG	76	8	7	40	19.8
BENEKE CREEK	8/1/2001	2536	5.1	2	7	MT	CA	ST	YT	84	9	10	27	49.6
BENEKE CREEK	8/7/2001	1981	4.2	3.3	3.7	MT	CA	ST	LT	91	23	13	41	50.8
BENEKE CREEK	8/9/2001	1225	12.7	5	2.8	MT	CT	ST	YT	98	6	19	24	83.8
BENEKE CREEK	8/14/2001	1300	8.7	10.1	7.5	MT	CA	PT	ST	92	2	46	51	51.8
BENEKE CREEK	8/15/2001	633	10.7	18.4	1.2	SV	CH	PT	LT	85	0	95	5	19.3
BENEKE CREEK	8/24/1993	3049	4.4	0.4	20	CT	CT	AG		86	20	8	42	6.0
BENEKE CREEK	8/26/1993	6584	7.2	0.5	16.8	MT	CA	AG		87	8	9	55	4.8
BENEKE CREEK	9/10/1993	3349	13.6	0.7	7.5	MT	CT	TH		82	6	12	44	21.1
BULL HEIFER CREEK	6/22/1998	535	8.7	2.7	6.5	MT	CA	ST		90	5	32	22	6.4
BULL HEIFER CREEK	8/20/2001	1007	11.1	2.8	6	MT	CA	ST	LT	91	6	25	25	104.9
BULL HEIFER CREEK	8/22/2001	1564	3.3	7.3	2.8	MT	CA	LT	ST	94	2	58	21	74.7
BULL HEIFER CREEK TRIB A	8/27/2001	2227	8.1	4.7	5.5	MT	CT	ST	LT	95	7	34	24	150.4
BUSTER CR	8/16/1999	967	5.5	0.9	10.8	CT	CT	YT		84	2	37	33	0.0
BUSTER CR TRIB	8/20/2001	848	0.0	0.8	12.9	MT	US	ST		64	0	87	13	0.0
BUSTER CREEK	8/7/1997	1192	9.1	1.3	1.9	MV	CH	ST		93	4	8	60	8.2
BUSTER CREEK	8/11/1997	1668	4.6	1.4	1	MV	CH	ST		92	15	5	39	27.6
BUSTER CREEK	8/11/1997	524	15.9	1.5	6.2	CT	CA	ST		93	10	5	48	8.6
BUSTER CREEK	8/12/1997	772	45.0	2.2	5	MT	UA	YT	ST	91	1	9	53	18.1
BUSTER CREEK	8/14/1997	1473	8.6	1.2	2.4	CT	CA	ST	YT	89	3	18	57	39.0
BUSTER CREEK	8/14/1997	934	2.4	0.3	8.5	CT	CT	ST	YT	91	0	9	92	0.2
BUSTER CREEK	8/18/1997	1802	3.4	0.7	9.8	MT	US	ST	YT	88	0	9	85	0.7
BUSTER CREEK	8/19/1997	1053	3.7	0.7	9.2	MT	US	ST	YT	95	1	9	86	0.8
BUSTER CREEK	8/19/1997	1307	8.4	0.9	6.4	CT	CT	YT	ST	92	5	10	78	0.1
BUSTER CREEK	8/21/1997	306	13.7	1.1	7.5	MT	US	ST		94	5	7	78	0.0
BUSTER CREEK	8/21/1997	1944	3.1	1.6	11.2	CT	CT	ST		91	1	39	55	2.4
BUSTER CREEK TRIB (NC-2390)	8/12/2002	885	2.9	1.2	8.5	MT	US	ST		88	0	94	6	0.0
BUSTER CREEK TRIB A	6/25/1998	562	1.8	0.6	6.2	MT	CA	ST		90	0			0.0
BUSTER CREEK TRIB C (NC-2356)	8/14/2002	496	3.1	7.5	2	MV	CH	YT		100	2	0	50	0.4
BUSTER CREEK TRIBUTARY A1	6/11/2002	1237	3.2	5.7	4.3	CT	CA	LT	ST	100	9	55	38	0.0
BUSTER CREEK TRIBUTARY A3	6/10/2002	545	0.3	2.5	3.2	MT	US	MT	ST	99	1	64	36	0.0
BUSTER CREEK TRIBUTARY A3	6/10/2002	652	4.8	8.5	2.1	SV	CH	MT	ST	99	12	65	25	0.0
COW CR	8/23/2000	583	5.9	6.1	2.9	CT	CT	ST		91	19	9	22	2.4
COW CREEK	8/1/1995	2999	11.4	1.4	6.2	CT	CT	RR		80	0	14	48	3.4
COW CREEK	8/7/1995	1949	8.1	2.7	3.1	CT	CA	TH	ST	85	5	13	47	8.0
COW CREEK	8/9/1995	3656	7.0	6.1	1.2	MV	CH	TH	ST	94	24	18	43	24.8
COW CREEK (NC-1149)	8/20/2003	1000	8.7	5.1	2.4	CA	CT	ST		85	21	13	34	81.0
CRAWFORD CR	8/23/2001	952	0.3	2.2	3.9	CT	CA	ST	MT	85	0	68	23	0.7
FISHHAWK CREEK (JEWEL)	10/4/1995	3464	2.4	1.5	4.9	WF	US	ST	LT	85	7	23	29	1.7
FISHHAWK CREEK (JEWEL)	10/4/1995	843	1.9	5.5	1.8	MV	CH	LT	ST	92	0	16	30	0.2
FISHHAWK CREEK TRIB A	10/10/1995	823	0.8	2.5	3	CT	CA	LT	ST	88	9	18	31	0.7
FISHHAWK CREEK TRIB A	10/10/1995	1603	0.9	4	2.2	MV	CH	YT	TH	75	2	21	35	0.0
GILMORE CR	8/24/2000	650	3.4	3.3	2.5	CT	CA	ST		91	2	15	15	0.0
GILMORE CREEK	9/11/2001	1616	7.4	3.2	6.1	CT	CA	ST		88	3	48	36	2.2
GILMORE CREEK	9/17/2001	700	6.3	10	1.7	MV	CH	ST		91	6	53	40	3.3
GILMORE CREEK (NC-2154)	8/19/2003	1004	5.4	4.5	3.4	CT	CA	ST		92	11	40	40	6.9
GILMORE CREEK TRIB A	9/18/2001	2001	0.0	2.5	5.5	MT	CT	ST		87	1	40	43	0.2
GILMORE CREEK TRIB A	9/19/2001	1022	3.5	9.4	1.8	MV	CH	ST		93	8	22	65	5.5
HAMILTON CREEK	9/14/1993	1095	8.0	1.3	6.6	MT	CT	TH	YT	86	10	20	30	2.8
HAMILTON CREEK	9/14/1993	2540	5.5	2.3	2.7	MT	CA	TH	YT	89	5	20	34	8.6
HAMILTON CREEK	9/16/1993	2019	7.5	3.4	2.1	MV	CH	TH		99	9	22	19	11.6

* see methods for explanation of abbreviations.

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STREAM	SURVEY DATE	REACH LENGTH (m)	% AREA IN SIDE CHANNELS	GRADIENT	VWI	*VALLEY FORM	*CHANNEL FORM	*LAND USE DOM	*LAND USE SUB-DOM	SHADE %	BEDROCK %	FINES IN RIFFLES %	GRAVEL IN RIFFLES %	LARGE BOULDERS #/100m
HAMILTON CREEK TRIB A	9/23/1996	783	2.5	3.4	3.8	MT	US	LT		98	16	17	26	8.6
HAMILTON CREEK TRIB A	9/25/1996	1364	7.7	4.5	2.1	MV	CH	YT	LT	90	7	15	32	14.9
HAMILTON CREEK TRIB A	9/25/1996	326	5.4	9.4	1.5	MV	CH	LT		98	7	15	22	5.2
HAMILTON CREEK TRIB A1	9/23/1996	1070	4.8	6.9	2.5	MV	CH	LT		99	6	19	63	9.3
HAMILTON CREEK TRIB B	9/24/1996	405	15.0	8.9	1.2	MV	CH	ST	LT	96	2	10	30	51.9
HAMILTON CREEK TRIB B	9/24/1996	621	3.5	5.2	2.1	MV	CH	YT	ST	79	5	15	28	12.9
HAMILTON CREEK TRIB B	9/24/1996	963	2.6	8.6	1.6	MV	CH	YT	LT	99	6	15	30	9.6
KLINES CREEK	7/19/1995	2613	3.9	2	6.8	CT	CT	LG		79	0	20	65	1.5
KLINES CREEK	7/24/1995	3836	19.9	6.8	1.8	MV	CH	LT		90	1	16	61	11.0
KLINES CREEK	7/31/1995	1172	4.7	6.8	1.9	MV	CH	ST		88	0	0	0	0.0
MOORES CREEK	7/12/1995	1415	5.1	2.6	4.2	MT	UA	YT		82	0	29	46	0.3
MOORES CREEK	7/17/1995	2193	3.0	7	1.9	MV	CH	ST		89	0	23	49	3.1
NETTLE CREEK	6/20/2000	395	24.6	6.4	10.7	MT	US	ST		95	0	29	37	0.0
NETTLE CREEK	6/21/2000	297	2.6	10.7	5.7	MT	US	YT	ST	85	2	27	57	0.0
NETTLE CREEK	6/26/2000	734	1.0	12.9	1.8	MV	CH	YT		79	1	27	38	0.0
NETTLE CREEK	6/28/2000	1406	1.9	9.2	2.2	MV	CH	ST		95	0	22	53	1.5
NORTH FORK QUARTZ CREEK	7/22/1996	1159	13.6	5.5	1.6	MV	CH	ST		99	5	30	43	19.8
NORTH FORK WALKER CREEK	7/13/1994	2063	7.8	9	1.8	MV	CH	ST		100		7	31	7.6
OSWEG CREEK	7/13/1998	520	8.6	16.1	5	CT	CA	ST	MT	96	0	86	13	9.2
OSWEG CREEK	8/21/1995	1680	27.4	9.4	1.2	MV	CH	YT		94	0	22	63	16.5
OSWEG CREEK	8/22/1995	1028	1.3	8.9	1.1	MV	CH	ST		94	0	30	65	1.8
QUARTZ CREEK, SURVEYED AS NF	7/16/1996	2090	8.9	3.1	4.1	MT	CA	RR		82	2	21	33	3.8
QUARTZ CREEK, SURVEYED AS NF	7/17/1996	995	9.9	5.4	1.8	MV	CH	ST		86	1	22	31	34.2
QUARTZ CREEK, SURVEYED AS NF	7/18/1996	572	2.3	12.7	1	SV	CH	ST		84	19	38	37	55.8
SLAUGHTERS CREEK	7/27/1997	548	1.7	2.6	1	MV	CH	MT		97		36	55	11.1
SLAUGHTERS CREEK	7/28/1997	594	6.0	2.7	1.4	MV	CH	MT	YT	89		22	66	0.5
SOUTH FORK QUARTZ CREEK	7/23/1996	373	0.0	12.7	2.7	MV	CH	SR		94	9	7	33	193.8
SOUTH FORK QUARTZ CREEK	7/24/1996	870	2.4	3	3.6	MT	CA	ST		97	5	28	45	47.8
SOUTH FORK WALKER CREEK	7/18/1994	285	1.1	5.9	1	MV	CH	ST		98	13	9	42	15.1
STANLEY CREEK	9/4/1997	582	4.4	3.1	7.2	MT	US	ST		98	7	5	58	27.7
STANLEY CREEK	9/8/1997	281	1.9	3.9	1.8	MV	CH	ST		95	14	10	62	26.0
STANLEY CREEK	9/8/1997	542	15.7	2.5	2.5	MT	US	ST		100	17	37	45	56.5
STANLEY CREEK	9/9/1997	1466	4.2	8.6	2	SV	CH	ST		95	14	6	51	116.2
STANLEY CREEK	9/11/1997	519	12.0	6.3	3.4	MT	US	YT	ST	90	1	15	53	9.2
TRAILOVER CREEK	9/24/2001	2026	2.4	2.9	9.2	CT	CT	ST		85	6	22	48	0.1
TRAILOVER CREEK	8/30/1994	1425	4.0	2.8	5.8	CT	CA	LT		92	1	30	34	0.1
TRAILOVER CREEK	5/13/1997	2870	1.8	7.8	1.3	MV	CH	YT	ST	90		27	53	4.8
WALKER CREEK	6/20/1994	8013	2.9	0.6	14.6	CT	CA	YT		89	14	9	63	1.6
WALKER CREEK	6/23/1994	2182	11.9	1.1	13.4	MT	CA	YT		76	6	11	47	2.3
WALKER CREEK	6/30/1994	2269	7.7	1.6	2.6	MT	CA	LT	ST	91	25	6	42	8.8
WALKER CREEK	7/5/1994	270	0.0	1.4	2	MV	CH	ST		97	6	3	28	15.9
WALKER CREEK	7/5/1994	688	5.3	2	2.9	MT	CA	YT		86	23	5	31	11.5
WALKER CREEK	7/6/1994	2104	13.6	3	1.4	SV	CH	ST		97	20	12	35	5.9
WALKER CREEK	8/29/1997	1994	0.7	0.6	12.4	CT	CT	YT		77	0	55	43	0.1
WALKER CREEK	9/1/1997	3288	2.0	0.6	4.2	CT	CA	ST		95	3	16	81	1.6
WALKER CREEK (NC-2130)	8/7/2002	1009	0.5	0.7	6	CT	CA	ST		73	1	17	77	5.2

* see methods for explanation of abbreviations.

Table 3B (page 1 of 2)

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REACH SUMMARY

STREAM	REACH LENGTH (m)	ACTIVE CHANNEL WIDTH (m)	CHANNEL WIDTHS/ POOL	PERCENT POOLS	PERCENT SLACKWATER POOLS	POOLS >1m DEEP/km	RESIDUAL POOL DEPTH (m)	WOOD DEBRIS PIECES #/100m	WOOD DEBRIS VOLUME (m3)/100m	KEY PIECES #/100m	CONIFER TREES TOTAL/1000ft	RIPARIAN CONIFERS #>20in dbh /1000ft	RIPARIAN CONIFERS #>35in dbh /1000ft
BENEKE CR	1065	5.2	57.9	3.3	0.4	0.8	0.53	14	46	3.2	650	0	0
BENEKE CREEK	6774	14.8	4.2	74.0	2.4	8.2	0.9	10	14	0.3	75	27	7
BENEKE CREEK	2056	9.7	2.7	65.4	3.2	13.1	0.72	18	20	0.6	102	20	0
BENEKE CREEK	2536	10.5	3.6	44.1	7.7	5.4	0.62	29	29	0.9	329	49	12
BENEKE CREEK	1981	7.6	5.1	34.3	11.2	0.5	0.39	34	46	1	219	98	12
BENEKE CREEK	1225	6.3	6.1	16.9	1.7	0.6	0.29	20	54	1.9	549	46	0
BENEKE CREEK	1300	3	9.3	9.4	0.3	0	0.23	30	79	3.8	442	168	0
BENEKE CREEK	633	2.5	144.7	0.3	0.0	0	0.19	14	37	1.9	914	427	0
BENEKE CREEK	3049	19.9	4.9	39.8	0.4	3.7	0.7	14	12	0.5	0	0	0
BENEKE CREEK	6584	16.3	7	26.6	1.6	4.2	0.8	30	28	1	18	6	6
BENEKE CREEK	3349	14.2	2.9	40.8	10.9	2.6	0.6	49	50	1.2	163	42	6
BULL HEIFER CREEK	535	8.8	4	27.9	12.4	3	0.53	28	49	2.6	163	0	0
BULL HEIFER CREEK	1007	7.5	3.8	28.4	0.1	0.8	0.38	29	41	1.9	142	0	0
BULL HEIFER CREEK	1564	4.2	5.5	44.8	38.4	1.2	0.44	21	55	1.2	599	295	51
BULL HEIFER CREEK TRIB A	2227	6.3	4.5	30.0	14.6	1.5	0.44	26	49	1.1	183	52	0
BUSTER CR	967	13	2.4	74.1	0.4	6.7	0.58	28	37	2.3	61	20	20
BUSTER CR TRIB	848	4.7	8.2	94.8	91.5	1.2	0.62	11	11	0.2	1097	0	0
BUSTER CREEK	1192	15.7	3.1	49.6	0.0	6.1	0.6	18	41	1.8	549	61	0
BUSTER CREEK	1668	16.6	3.4	47.8	0.2	5.7	0.8	14	21	0.5	168	30	0
BUSTER CREEK	524	12.5	3.1	65.6	1.7	2.7	0.6	17	32	1	30	0	0
BUSTER CREEK	772	20.8	2.8	32.8	0.0	1.8	0.5	26	26	0.4	274	0	0
BUSTER CREEK	1473	12.7	3.8	62.0	14.2	5.8	0.6	21	26	0.6	224	20	0
BUSTER CREEK	934	11.5	5.3	91.6	30.0	9.3	0.7	15	17	0.6	0	0	0
BUSTER CREEK	1802	11.2	2.9	80.5	1.8	7.6	0.7	16	19	0.3	198	15	15
BUSTER CREEK	1053	8.9	3.7	83.1	2.2	7.3	0.7	18	19	0.2	508	81	20
BUSTER CREEK	1307	8.4	3.5	85.6	1.3	2.7	0.6	15	23	0.7	325	20	0
BUSTER CREEK	306	7.1	4.5	76.7	0.0	2.8	0.5	24	42	0.7	183	0	0
BUSTER CREEK	1944	3.7	5	78.8	20.7	0.5	0.3	18	30	1.3	137	15	0
BUSTER CREEK TRIB (NC-2390)	885	3.4	6.9	64.6	14.0	0	0.29	23	40	1.6	264	0	0
BUSTER CREEK TRIB A	562	5.2	6.4	73.0	73.0	21.4	0.34	45	259	4.8	264	102	0
BUSTER CREEK TRIB C (NC-2356)	496	3.9	22.4	2.4	0.0	0	0.05	16	35	1.6	0	0	0
BUSTER CREEK TRIBUTARY A1	1237	2.1	10.3	40.6	9.3	0.7	0.36	26	44	1.1	500	85	0
BUSTER CREEK TRIBUTARY A3	545	3	6.5	64.7	1.3	0	0.47	29	97	1.3	945	244	0
BUSTER CREEK TRIBUTARY A3	652	2.7	10.9	48.7	3.1	0	0.38	16	40	0.6	1006	213	0
COW CR	583	6.8	13.7	11.9	0.0	1.5	0.53	22	7	0	122	41	0
COW CREEK	2999	11.1	3.3	35.1	11.7	0.3	0.4	4	3	0.1	70	0	0
COW CREEK	1949	7.8	11.8	9.4	0.2	0.4	0.3	23	19	0.5	41	0	0
COW CREEK	3656	6.4	9.3	11.9	0.1	0.2	0.4	21	42	1.4	504	28	0
COW CREEK (NC-1149)	1000	7.7	6.8	14.0	0.0	1.7	0.53	35	38	0.5	81	0	0
CRAWFORD CR	952	5.1	6.3	77.1	67.8	1.1	0.58	17	18	0.2	406	0	0
FISHHAWK CREEK (JEWEL)	3464	8.4	5.7	44.5	5.9	7.6	0.7	19	36	0.7	139	52	17
FISHHAWK CREEK (JEWEL)	843	3	20.7	22.4	4.6	0	0.3	18	57	1.4	305	122	0
FISHHAWK CREEK TRIB A	823	5.1	9.2	32.5	5.5	0	0.5	21	50	2.2	305	30	0
FISHHAWK CREEK TRIB A	1603	4.9	15.9	22.1	4.7	1.2	0.5	25	57	1.6	305	30	0
GILMORE CR	650	4.8	11.5	32.7	16.4	1.4	0.52	20	10	0	183	20	20
GILMORE CREEK	1616	5.8	4.2	72.4	44.1	2.8	0.45	28	19	0.2	207	0	0
GILMORE CREEK	700	3.9	32.3	12.7	0.0	0	0.21	41	23	0.1	366	0	0
GILMORE CREEK (NC-2154)	1004	10.7	8.7	34.3	28.3	0	0.35	24	28	0.3	61	0	0
GILMORE CREEK TRIB A	2001	5	7	89.2	84.6	2.4	0.55	27	23	0.2	134	0	0
GILMORE CREEK TRIB A	1022	3.6	16.5	24.9	0.0	0	0.27	37	28	0.2	625	46	0
HAMILTON CREEK	1095	10	3.6	50.1	4.6	3.3	0.5	13	15	0.3	91	0	0
HAMILTON CREEK	2540	7.5	6.2	29.4	3.0	1.4	0.5	15	22	0.3	326	60	12
HAMILTON CREEK	2019	5.8	7.6	17.7	0.3	0	0.4	23	31	0.8	229	48	24

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STREAM	REACH LENGTH (m)	ACTIVE CHANNEL WIDTH (m)	CHANNEL WIDTHS/ POOL	PERCENT POOLS	PERCENT SLACKWATER POOLS	POOLS >1m DEEP/km	RESIDUAL POOL DEPTH (m)	WOOD DEBRIS PIECES #/100m	WOOD DEBRIS VOLUME (m3)/100m	KEY PIECES #/100m	CONIFER TREES TOTAL/1000ft	RIPARIAN CONIFERS #>20in dbh /1000ft	RIPARIAN CONIFERS #>35in dbh /1000ft
HAMILTON CREEK TRIB A	783	7.4	4.6	30.3	1.5	1.2	0.5	18	32	0.1	0	0	0
HAMILTON CREEK TRIB A	1364	5.8	6.8	32.8	4.2	0.6	0.4	27	69	2.4	305	20	0
HAMILTON CREEK TRIB A	326	2.2	148.2	4.8	0.0	0	0.3	17	26	0.6	853	0	0
HAMILTON CREEK TRIB A1	1070	2.4	18.6	21.7	0.0	0	0.3	17	47	1.6	213	0	0
HAMILTON CREEK TRIB B	405	8.2	9.9	8.0	0.4	0	0.4	17	48	1	792	61	0
HAMILTON CREEK TRIB B	621	5.9	10.5	16.6	0.0	1.5	0.5	35	63	2.3	305	0	0
HAMILTON CREEK TRIB B	963	6.4	7.9	14.7	0.6	0	0.4	25	55	1.3	213	30	0
KLINES CREEK	2613	4.9	7.6	45.2	15.0	0.7	0.3	2	3	0.2	30	30	10
KLINES CREEK	3836	3.8	24.1	30.0	21.9	0	0.3	18	37	1.9	433	47	0
KLINES CREEK	1172	4.7	254	2.9	3.0	0	0.4	19	55	3.3	305	61	0
MOORES CREEK	1415	4.3	16.7	12.2	0.6	0	0.2	8	15	0.9	142	81	20
MOORES CREEK	2193	3.2	122.7	1.2	0.0	0	0.3	19	32	1	1097	30	0
NETTLE CREEK	395	4.1	20.5	13.4	0.0	0	0.28	9	4	0	61	61	0
NETTLE CREEK	297	4.1	6.5	6.5	0.0	0	0.23	32	23	0	91	61	0
NETTLE CREEK	734	3.4	27.5	2.2	0.0	0	0.28	38	31	0.8	366	61	0
NETTLE CREEK	1406	3.5	72.2	1.5	0.0	0	0.35	21	41	1	1768	305	122
NORTH FORK QUARTZ CREEK	1159	6.6	8.5	17.2	0.8	0.7	0.43	36	67	2.6	0	0	0
NORTH FORK WALKER CREEK	2063	5.4	22.4	6.1		0	0.3	35	82	1.3	739	8	8
OSWEG CREEK	520	1.8	83.9	1.4	0.3	0	0.15	29	81	3.1	284	81	0
OSWEG CREEK	1680	3.9	30.1	6.1	1.1	0	0.3	23	27	1	112	20	0
OSWEG CREEK	1028	2.1	0	0.0	0.0	0	0	15	16	0.6	61	0	0
QUARTZ CREEK, SURVEYED AS NF	2090	12.6	8.9	6.8	0.0	1.3	0.5	20	14	0	406	0	0
QUARTZ CREEK, SURVEYED AS NF	995	12.3	6.8	6.9	0.0	2.8	0.52	34	36	0.7	30	30	0
QUARTZ CREEK, SURVEYED AS NF	572	8.5	5.9	25.9	0.0	11.7	0.92	51	60	0.7	122	0	0
SLAUGHTERS CREEK	548	3.4	9.6	28.5		0	0.2	30	76	3.6	30	30	0
SLAUGHTERS CREEK	594	3.1	7.9	34.5		0	0.2	30	63	1.5	447	122	20
SOUTH FORK QUARTZ CREEK	373	7.5	7.1	10.5	0.0	0	0.42	34	32	0.3	183	0	0
SOUTH FORK QUARTZ CREEK	870	3.7	17.3	16.0	0.1	1.1	0.55	5	2	0	183	0	0
SOUTH FORK WALKER CREEK	285	6	4.9	19.4	0.0	0	0.3	56	112	4.2	61	0	0
STANLEY CREEK	582	6.7	3.8	26.6	0.7	0	0.2	11	19	0.7	91	0	0
STANLEY CREEK	281	8.6	2.7	32.9	1.9	0	0.2	26	28	0.4	244	0	0
STANLEY CREEK	542	8.4	3.4	31.1	0.0	1.5	0.3	27	92	0.7	386	102	0
STANLEY CREEK	1466	7.1	4.3	25.7	0.5	0.6	0.3	40	67	1.2	549	61	0
STANLEY CREEK	519	6.3	4.3	22.4	0.2	0	0.3	43	54	1.3	152	0	0
TRAILOVER CREEK	2026	5.6	4	74.3	55.9	2.8	0.41	45	22	0.1	96	35	9
TRAILOVER CREEK	1425	4.9	300.1	2.8	2.8	0	0	43	57	1.7	163	18	0
TRAILOVER CREEK	2870	3.8	26	10.3		0		36	33	1	305	12	0
WALKER CREEK	8013	9.9	4.9	54.0	1.9	8.3	0.6	12	8	0	146	20	0
WALKER CREEK	2182	6.7	8.2	42.9	20.7	4	0.6	15	13	0.6	268	0	0
WALKER CREEK	2269	10	5.1	27.2	2.4	0.4	0.6	19	32	1.2	98	61	12
WALKER CREEK	270	10.5	4.3	44.8	0.0	0	0.5	13	12	0	305	244	0
WALKER CREEK	688	8.6	6	24.8	1.1	0	0.5	22	52	2.5	61	0	0
WALKER CREEK	2104	8.4	6.7	16.4	5.7	0.4	0.4	45	92	2.1	76	15	0
WALKER CREEK	1994	5	11	96.4	56.4	7.3	0.5	14	20	0.6	98	12	0
WALKER CREEK	3288	3.7	6.7	91.4	11.9	0.6	0.4	23	50	2	523	122	5
WALKER CREEK (NC-2130)	1009	4.6	7.7	93.8	72.5	7.9	0.67	11	9	0	81	0	0

Table 4A

ODF NEHALEM PROJECT AREA: HUC 1710020202
REACH SUMMARY

STREAM	SURVEY DATE	REACH LENGTH (m)	% AREA IN SIDE CHANNELS	GRADIENT	VWI	*VALLEY FORM	*CHANNEL FORM	*LAND USE DOM	*LAND USE SUB-DOM	SHADE %	BEDROCK %	FINES IN RIFFLES %	GRAVEL IN RIFFLES %	LARGE BOULDERS #/100m
COW CREEK	8/7/2000	2769	4.1	2.6	5.3	CT	CA	ST		92	14	16	26	3.3
COW CREEK	8/9/2000	2854	3.5	2.2	6.5	CT	CA	ST		87	4	49	41	0.1
COW CREEK	8/15/2000	783	1.0	13.4	1.3	SV	CH	ST		90	1	22	67	0.0
DEEP CREEK	8/8/1994	13932	0.3	0.4	17.8	CT	CT	YT	TH	87	5	45	46	0.3
DEEP CREEK	8/9/1994	4108	0.8	0.8	11.2	CT	CT	TH	MT	87	2	34	58	0.9
DEEP CREEK	8/15/1994	3599	0.9	0.9	8.5	CT	CT	TH	YT	88	17	33	48	2.4
DEEP CREEK	7/27/1999	1991	1.0	0.5	3.6	CT	CA	ST		85	21	23	33	0.7
DEEP CREEK	7/28/1999	472	0.8	0.9	1	OV	CH	ST		89	7	23	35	11.9
DEEP CREEK	7/28/1999	245	1.9	0.3	5	CT	CA	ST		90	1	35	40	0.0
DEEP CREEK (TRIB)	7/28/1999	310	4.0	0.5	3	CT	CA	ST		87	3	23	35	0.3
DEEP CREEK (TRIB)	7/29/1999	893	2.4	2.7	3	CT	CT	ST		91	12	21	35	0.0
DEEP CREEK (TRIB)	7/29/1999	385	1.6	3.8	1.3	MV	CH	ST		90	10	28	33	0.0
DEEP CREEK (TRIB)	9/9/1999	357	0.0	0.3	8	CT	CT	ST		92	0			0.0
DEEP CREEK SURVEYED AS TRIB A	9/13/1999	498	0.0	1.8	2.8	CT	CT	ST	YT	90	6	60	36	4.6
FISHHAWK CR (NC-2308)	9/8/2004	532	0.0	3.2	6.4	CT	CT	ST	YT	70	10	24	33	
FISHHAWK CREEK (ABOVE LAKE)	7/31/1996	2158	3.4	1.7	1.5	MV	CH	YT	ST	96	15	30	33	2.5
FISHHAWK CREEK (ABOVE LAKE)	8/1/1996	1576	4.8	0.3	3.8	CT	CT	ST		84	7	62	28	0.0
FISHHAWK CREEK (ABOVE LAKE)	8/28/1996	1422	4.0	2.3	3	MT	CA	YT		54	7	36	40	0.2
FISHHAWK CREEK (ABOVE LAKE)	8/28/1996	1035	5.9	4.3	1.6	MV	CH	YT	ST	69	3	33	50	3.0
LOUISGNONT CR	8/22/2000	877	0.9	0.6	4.5	CT	CT	ST	YT	94	2	38	47	0.0
LOUSIGNONT CREEK	8/16/2000	2605	3.8	1.5	4.7	CT	CT	YT	ST	90	4	22	60	0.1
LOUSIGNONT CREEK	8/23/2000	2202	5.6	5.8	8.4	CT	CT	YT	ST	93	7	13	26	0.0
LOUSIGNONT CREEK	8/29/2000	1166	2.8	7.7	4.4	CT	CT	YT	ST	92	3	62	34	0.3
NORTHRUP CR	9/10/2001	1090	7.8	1.3	5.4	MT	CA	ST		93	17	10	46	0.4
NORTHRUP CREEK	7/5/2000	831	5.3	0.8	12.9	CT	CT	ST		77	6	15	39	0.4
NORTHRUP CREEK	7/6/2000	4170	1.7	1.1	8.1	CT	CT	ST		74	9	26	59	0.8
NORTHRUP CREEK	7/18/2000	2440	8.6	1.6	4.9	CT	CA	ST		82	19	16	39	4.1
NORTHRUP CREEK	7/24/2000	3489	7.1	7.8	2	MV	CH	ST		86	9	20	41	2.4
NORTHRUP CREEK	7/31/2000	932	0.8	13.9	1.1	MV	CH	ST		98	10	19	26	1.3
NORTHRUP CREEK TRIBUTARY A	8/2/2000	2219	6.6	1.5	4.2	CT	CA	ST		83	3	24	58	1.8
NORTHRUP CREEK TRIBUTARY A	8/3/2000	556	3.3	27	2	MV	CH	ST		85	17	41	35	0.0
OAK RANCH CREEK	7/31/1995	2845	2.1	1.4	3.4	CT	CA	ST	TH	87	1	16	36	12.5
SAGER CR	8/9/2000	1073	5.4	3.2	1.3	OV	CH	ST		60	0	71	17	3.2
SAGER CREEK	9/14/1995	2625	0.0	0.8	2.4	CT	CT	LT	ST	84	5	64	23	2.4
SAGER CREEK	10/2/1995	3709	0.4	1.9	1.9	MV	CH	ST	YT	73	2	86	10	0.6
SAGER CREEK (NC-2365)	8/21/2003	1075	1.1	5.1	1.5	MV	CH	ST	TH	86	5	0	0	5.5
TRESTLE CREEK	8/14/1997	823	0.5	1.6	3.9	MT	US	LT		91	0	97	2	2.8
TRESTLE CREEK	8/14/1997	296	1.3	8.5	1	MV	CH	LT		94	0	65	30	0.0
WARNER CREEK	9/9/1996	827	3.9	2.7	4.8	CT	CA	YT	ST	87	16	17	46	3.3
WARNER CREEK	9/9/1996	606	4.5	2.2	1	MV	CH	YT	ST	82	8	43	43	4.5
WARNER CREEK	9/10/1996	1070	4.0	2	2.4	CT	CA	YT	ST	89	0	30	66	0.3
WARNER CREEK	9/10/1996	1282	2.7	5.1	1.2	MV	CH	ST	YT	91	1	28	58	1.3
WARNER CREEK TRIB A	9/12/1996	524	0.7	7.7	1.9	MV	CH	ST		92	16	20	30	3.1
WARNER CREEK TRIB B	9/11/1996	399	0.0	8.1	1	MV	CH	YT	ST	88	1	35	33	4.5
WARNER CREEK TRIB C	9/11/1996	226	0.0	13.3	1	MV	CH	YT	ST	75	1	34	52	0.0

* see methods for explanation of abbreviations.

Table 4B

ODF NEHALEM PROJECT AREA: HUC 1710020202
REACH SUMMARY

STREAM	REACH LENGTH (m)	ACTIVE CHANNEL WIDTH (m)	CHANNEL WIDTHS/ POOL	PERCENT POOLS	PERCENT SLACKWATER POOLS	POOLS >1m DEEP/km	RESIDUAL POOL DEPTH (m)	WOOD DEBRIS PIECES #/100m	WOOD DEBRIS VOLUME (m3)/100m	KEY PIECES #/100m	CONIFER TREES TOTAL/1000ft	RIPARIAN CONIFERS #>20in dbh /1000ft	RIPARIAN CONIFERS #>35in dbh /1000ft
COW CREEK	2769	6.7	6	30.2	1.0	0.3	0.43	25	27	1	163	20	10
COW CREEK	2854	4.7	14.1	44.5	0.8	0.3	0.49	38	65	2.6	61	20	0
COW CREEK	783	3	55.3	73.0	73.0	2.4	0.77	23	47	3.4	427	122	61
DEEP CREEK	13932	9.8	7.2	68.5	11.5	5.3	0.6	10	19	0.7	230	0	0
DEEP CREEK	4108	11	9.4	47.2	17.4	3.8	0.8	6	16	0.9	610	0	0
DEEP CREEK	3599	14.4	10.7	13.3	25.8	1.1	0.6	5	16	0.6	508	0	0
DEEP CREEK	1991	6.3	7.9	46.3	0.8	0	0.48	53	115	7.4	716	30	0
DEEP CREEK	472	7.5	4.2	66.0	0.9	0	0.39	77	192	9.5	853	183	0
DEEP CREEK	245	5.1	4.5	94.4	9.6	3.9	0.51	28	56	3.7	549	61	0
DEEP CREEK (TRIB)	310	5	2.6	82.7	2.0	0	0.43	62	116	5.2	61	0	0
DEEP CREEK (TRIB)	893	3.9	26.6	46.9	2.2	0	0.4	6	12	0.7	183	0	0
DEEP CREEK (TRIB)	385	2.8	7.8	71.6	5.0	5.2	0.5	65	155	9.9	427	0	0
DEEP CREEK (TRIB)	357	3.8	18.8	95.0	95.0	0	0.26	21	14	0.3	183	183	0
DEEP CREEK SURVEYED AS TRIB A	498	4.7	11.8	71.0	0.0	0	0.3	17	35	2.8	549	366	0
FISHHAWK CR (NC-2308)	532	5	5.1		16.6	0	0.31	21	22	0.6	264	81	0
FISHHAWK CREEK (ABOVE LAKE)	2158	9.2	4.4	58.5	2.9	9.5	0.8	36	59	1.9	61	30	15
FISHHAWK CREEK (ABOVE LAKE)	1576	6.2	5.9	71.8	10.8	14.6	0.8	14	21	0.8	122	30	0
FISHHAWK CREEK (ABOVE LAKE)	1422	8	3.6	66.4	46.2	4.5	0.5	31	56	3.4	533	46	0
FISHHAWK CREEK (ABOVE LAKE)	1035	5.8	4	47.0	7.9	0	0.4	33	106	5.7	508	61	41
LOUISGNONT CR	877	6.4	3.7	79.7	18.1	1.1	0.44	25	25	0.9	1630	20	20
LOUSIGNONT CREEK	2605	6.7	3.9	64.5	14.9	1.1	0.52	23	33	1.7	70	26	9
LOUSIGNONT CREEK	2202	4.1	20.1	13.8	0.7	0	0.35	23	39	2	122	61	0
LOUSIGNONT CREEK	1166	1.9	128.3	5.7	0.0	0	0.53	25	29	0.6	366	0	0
NORTHRUP CR	1090	10.5	3.1	69.9	13.7	0	0.41	20	7	0.1	0	0	0
NORTHRUP CREEK	831	12.3	2.2	63.8	1.1	12.8	0.68	21	20	0.7	0	0	0
NORTHRUP CREEK	4170	8.1	3.6	66.9	2.2	10.5	0.7	22	16	0.6	73	12	0
NORTHRUP CREEK	2440	8.7	5.4	29.7	1.1	0.3	0.47	29	27	0.4	0	0	0
NORTHRUP CREEK	3489	6.8	19.8	7.2	0.5	0.8	0.57	29	43	0.7	198	15	0
NORTHRUP CREEK	932	2.5	0	0.0	0.0	0	0	14	30	0.9			
NORTHRUP CREEK TRIBUTARY A	2219	4.7	13.2	28.7	10.7	0	0.45	28	53	2.3	61	20	0
NORTHRUP CREEK TRIBUTARY A	556	3.3	0	0.0	0.0	0	0	34	34	0.2	488	0	0
OAK RANCH CREEK	2845	6.6	6.5	47.3	17.4	1.7	0.4	9	15	0.8	44	0	0
SAGER CR	1073	5.1	14.6	66.0	62.6	5.4	0.65	19	52	3.9	284	81	0
SAGER CREEK	2625	6.8	10.7	74.2	20.2	1.9	0.6	11	22	0.5	102	0	0
SAGER CREEK	3709	4.1	11.5	80.4	54.5	2.7	0.4	17	50	1.6	200	0	0
SAGER CREEK (NC-2365)	1075	4.2	29.1	17.7	3.6	0	0.45	17	35	0.7	325	20	20
TRESTLE CREEK	823	3.5	59.4	10.5	0.0	0	0.4	24	44	2.1	610	0	0
TRESTLE CREEK	296	2.3	0	0.0	0.0	0	0	32	80	3	0	0	0
WARNER CREEK	827	8.2	3.9	49.7	16.3	3.4	0.4	22	22	0.7	30	0	0
WARNER CREEK	606	7.6	4.4	39.7	0.2	3.1	0.6	46	44	1.7	152	0	0
WARNER CREEK	1070	6	5.1	50.3	9.4	2.6	0.6	28	25	0.5	274	0	0
WARNER CREEK	1282	5	7.1	31.9	0.6	0.7	0.5	37	42	1.5	203	0	0
WARNER CREEK TRIB A	524	4	8.7	22.3		0	0.4	31	34	0.8	427	0	0
WARNER CREEK TRIB B	399	4.3	13.3	13.5		0	0.4	35	60	3	61	0	0
WARNER CREEK TRIB C	226	2.3	19.7	20.2		0	0.4	64	103	6.6	183	0	0

Table 5A

ODF NEHALEM PROJECT AREA: HUC 1710020201
REACH SUMMARY

STREAM	SURVEY DATE	REACH LENGTH (m)	% AREA IN SIDE CHANNELS	GRADIENT	VWI	*VALLEY FORM	*CHANNEL FORM	*LAND USE DOM	*LAND USE SUB-DOM	SHADE %	BEDROCK %	FINES IN RIFFLES %	GRAVEL IN RIFFLES %	LARGE BOULDERS #/100m
BEAR CREEK	5/26/1997	853	2.2	1.9	4.5	MT	CA	ST		93	3	31	38	0.9
BEAR CREEK	5/26/1997	989	2.1	1.9	1.1	MV	CH	LT		92	6	56	32	1.2
BEAR CREEK	5/27/1997	822	1.0	2.6	2.7	MT	CA	ST	LT	88	5	67	31	0.6
CARLSON CREEK	8/29/1995	2968	0.1	2.8	1.8	OV	CH	ST	LT	87	2	60	20	0.5
CLEAR CREEK	7/7/1994	1691	4.1	2.4	5.6	CT	CA	TH	YT	90	0	55	35	0.1
DELL CREEK	7/11/1994	1302	3.8	1.7	2.4	OV	CH	ST		92	1	1	62	0.4
DELL CREEK	7/13/1994	457	1.8	2	5.8	MT	CT	ST		80	0	5	48	0.0
DERBY CREEK	9/22/1998	530	23.7	5.7	4.2	MT	US	ST	LT	90	0	33	26	149.6
LOUISIGNONT CREEK	8/18/1993	2600	9.7	0.9	6.1	CT	CA	LT	YT	93	6	32	58	1.1
LOUISIGNONT CREEK	8/24/1993	2911	19.4	1.7	4.9	MT	UA	LT	MT	98	0	37	49	0.0
LOUISIGNONT CREEK	8/26/1993	3420	7.4	4.8	1.7	SV	CH	LT	MT	97	6	40	38	4.8
LOUSIGNONT CR	6/30/1999	397	3.6	3.4	1.3	SV	CH	ST		79	0	44	29	0.0
LOUSIGNONT CREEK (NC-1268)	7/2/2002	442	10.3	6.1	3.9	MT	US	LT		90	0	10	48	0.7
N. FK. LOUSIGNONT CR (NC-1289)	8/12/2004	872		0.9	5.5	CT	CT	ST		76	0	63	35	
NORTH FORK ROCK CREEK	7/15/1993	1387	7.8	1.1	4.1	CT	CA	ST	ST	96		3	47	13.2
NORTH FORK ROCK CREEK	7/19/1993	1553	40.3	1	9.6	WF	US	ST	ST	94		9	50	4.0
NORTH FORK ROCK CREEK	7/21/1993	453	0.6	4.8	3.3	MV	CH	ST	ST	94		4	29	22.5
NORTH FORK WOLF CREEK	8/24/1992	1293	0.8	1.2	14.9	CT	CA	ST		87	29	24	43	3.9
NORTH FORK WOLF CREEK	8/24/1992	1514	1.3	1.7	2.6	SV	CH	ST		87	23	23	43	3.8
NORTH FORK WOLF CREEK	8/31/1992	1454	4.2	2.4	2	SV	CH	ST		87	13	26	65	2.7
NORTH FORK WOLF CREEK	9/1/1992	722	4.5	1.5	6.2	WF	US	ST		88	0	26	59	0.0
NORTH FORK WOLF CREEK	9/2/1992	1172	6.2	3.6	1.8	MV	CH	ST		98	2	44	46	1.3
OLSON CR (NC-1046)	9/1/2004	1053		0.8	2.1	MV	CH	ST		73	0	62	39	
ROCK CREEK	7/1/1993	582	6.8	0.6	3	CT	CT	TH	ST	99	7	8	32	75.4
ROCK CREEK	8/11/1993	669	4.4	2.9	1.5	MV	CH	ST		95	3	5	20	323.5
ROCK CREEK	8/12/1993	794	2.7	0.9	13.3	WF	US	ST		69	1	1	36	0.1
SOUTH FORK NEHALEM RIVER	9/12/1995	1396	2.3	4.3	1.3	MV	CA	ST	LT	94	1	30	47	3.8
SOUTH FORK NEHALEM RIVER	9/13/1995	1877	4.2	15	1.2	MV	CH	ST	LT	94	13	23	28	7.2
SOUTH FORK ROCK CREEK	8/3/1993	4670	1.8	2.3	12.1	MT	CT	ST	ST	95		2	35	14.9
SOUTH FORK ROCK CREEK	8/4/1993	188	0.0	7.5	1	SV	CH	ST	ST	99		0	67	58.5
SOUTH FORK ROCK CREEK	8/4/1993	490	0.0	3.1	7.8	CT	CT	ST	ST	97		4	66	0.8
SOUTH FORK ROCK CREEK	8/5/1993	2756	0.3	5.1	2.4	SV	CH	ST	TH	90		2	47	17.8
UPPER NEHALEM RIVER	8/31/1995	6079	4.5	2.3	2.6	CT	CA	LT		96	6	29	36	7.8
UPPER NEHALEM RIVER	9/11/1995	3517	3.1	9.1	1.9	MV	CH	LT		97	12	61	25	1.7
WOLF CREEK	7/15/1997	1690	5.0	3.5	1.2	MV	CH	LT		88	15	15	34	3.8
WOLF CREEK	7/15/1997	2455	2.2	6.3	1	SV	CH	MT		85	14	11	34	7.8
WOLF CREEK	7/16/1997	905	0.4	10.8	1	SV	CH	YT	LT	63	27	15	55	11.5

* see methods for explanation of abbreviations.

Table 5B

ODF NEHALEM PROJECT AREA: HUC 1710020201
REACH SUMMARY

STREAM	REACH LENGTH (m)	ACTIVE CHANNEL WIDTH (m)	CHANNEL WIDTHS/ POOL	PERCENT POOLS	PERCENT SLACKWATER POOLS	POOLS >1m DEEP/km	RESIDUAL POOL DEPTH (m)	WOOD DEBRIS PIECES #/100m	WOOD DEBRIS VOLUME (m3)/100m	KEY PIECES #/100m	CONIFER TREES TOTAL/1000ft	RIPARIAN CONIFERS #>20in dbh /1000ft	RIPARIAN CONIFERS #>35in dbh /1000ft
BEAR CREEK	853	5.8	7.7	47.2	8.5	5.6	0.6	35	28	0.8	213	0	0
BEAR CREEK	989	6.8	9.5	48.4	6.8	2.9	0.6	38	31	0.6	671	0	0
BEAR CREEK	822	2.5	10.4	89.4	88.3	3.3	0.5	31	22	0.5	396	30	0
CARLSON CREEK	2968	11.5	8.1	53.8	42.5	0.7	0.5	15	23	0.4	1240	203	20
CLEAR CREEK	1691	5.3	6.1	47.4	1.2	2.3	0.5	22	65	1.1	213	0	0
DELL CREEK	1302	5	5.5	60.3	12.8	0	0.4	44	34	0.5	290	12	0
DELL CREEK	457	2.9	16.5	18.5	6.5	0	0.4	32	28	0	701	0	0
DERBY CREEK	530	3.6	10	18.9	0.9	0	0.39	23	15	0.2	691	41	0
LOUISIGNONT CREEK	2600	10.3	3	65.4	2.0	2.5	0.6	23	16	0.2	260	30	0
LOUISIGNONT CREEK	2911	10	3	38.4	4.4	0.2	0.5	23	21	0.6	253	79	12
LOUISIGNONT CREEK	3420	6.9	6.8	25.8	0.6	0.9	0.4	41	59	1.5	441	121	0
LOUSIGNONT CR	397	3.7	8.3	15.3	2.5	0	0.43	39	82	4.3	1321	0	0
LOUSIGNONT CREEK (NC-1268)	442	4.7	5.4	16.6	0.8	0	0.3	23	29	0.5	325	122	0
N. FK. LOUSIGNONT CR (NC-1289)	872	7.3	5.2		87.2	0	0.41	20	17	0.7	467	41	0
NORTH FORK ROCK CREEK	1387	7.7	3.5	49.9			0.5	54	155		670	0	0
NORTH FORK ROCK CREEK	1553	3.5	7.9	59.8			0.4	39	78		483	0	0
NORTH FORK ROCK CREEK	453	3.5	10.8	25.9			0.4	51	91		1116	121	0
NORTH FORK WOLF CREEK	1293	9.1	3.8	61.8	9.3	3	0.4	7	7	0.2		0	0
NORTH FORK WOLF CREEK	1514	7.7	5.5	33.0	0.1	4.5	0.4	16	13	0.3		0	0
NORTH FORK WOLF CREEK	1454	6.7	5.4	46.0	0.2	2.5	0.5	29	29	1.5		0	0
NORTH FORK WOLF CREEK	722	4.3	6	55.9	0.7	0	0.5	22	44	2.8		0	0
NORTH FORK WOLF CREEK	1172	6.9	3.8	40.9	1.7	0.8	0.4	31	54	3.9		0	0
OLSON CR (NC-1046)	1053	10.1	7.5		88.2	1.9	0.48	21	33	0.6	1138	0	0
ROCK CREEK	582	17	8.6	9.8	1.2	3	0.6	6	12	0.4		0	0
ROCK CREEK	669	8.5	19.7	26.2	18.6	4.2	0.8	11	35	2.4	845	60	0
ROCK CREEK	794	8.2	9.7	38.6	10.5	7.8	1	9	14	0.4	0	0	0
SOUTH FORK NEHALEM RIVER	1396	9.6	15.1	12.1	0.0	1.4	0.7	28	38	0.7	610	122	0
SOUTH FORK NEHALEM RIVER	1877	11	89.9	1.2	0.0	0	0.4	23	44	0.9	549	122	0
SOUTH FORK ROCK CREEK	4670	7.1	8.3	27.6			0.6	20	28		338	48	0
SOUTH FORK ROCK CREEK	188	4	11.8	20.7			0.5	54	86		1448	241	0
SOUTH FORK ROCK CREEK	490	6.3	5.2	52.0			0.5	19	22		1207	91	30
SOUTH FORK ROCK CREEK	2756	4	19.1	14.8			0.4	31	65		748	133	42
UPPER NEHALEM RIVER	6079	14	9.5	15.8	0.0	2.9	0.7	15	18	0.4	315	91	0
UPPER NEHALEM RIVER	3517	10	34.4	17.7	3.3	0	0.5	26	59	2.2	549	213	30
WOLF CREEK	1690	7	11	16.3	1.3	4.7	0.7	30	16	0.1	366	0	0
WOLF CREEK	2455	6.9	24.4	8.2	0.6	0	0.5	22	28	0.9	701	0	0
WOLF CREEK	905	2.4	190.7	2.1	0.0	0	0.6	19	39	1.4	549	0	0

Table 6. Habitat benchmarks based on reference streams within the distribution of coho salmon.

Parameter	Definition	Low break point	High break point
percent pools	percent primary channel area represented by pool habitat	<19%	>45%
deep pools/km	pools > 1m deep per kilometer of primary channel	=0	4
percent slackwater pools	percent primary channel area - slackwater pool habitat (beaver pond, backwater, alcoves, isolated pools).	=0%	>7%
percent seccondary channels	percent total channel area represented by secondary channels	<0.8%	>5.3%
pieces lwd/100m	# pieces of wood > 0.15m diameter X 3m length per 100 meters primary stream length	<8	>21
volume lwd/100m	volume (m3) of wood > 0.15m diameter X 3m length per 100 meters primary stream length	<17	>58
key pieces lwd/100m	# pieces of wood > 60 cm diameter X > 12 meters long per 100 meters primary stream length	<0.5	>3
percent fines in riffles	visual estimate of substrate composed of <2mm diameter particles	>22%	<8%
percent gravel in riffles	visual estimate of substrate composed of 2-64mm diameter particles	<26%	>54%
percent bedrock in stream	visual estimate of substrate composed of solid bedrock	>11%	<1%
# conifers > 50 cm dbh	number of conifer trees larger than 50 cm dbh within 30m both sides of stream per 305m of primary stream length	<22	>153
# conifers > 90 cm dbh	number of conifer trees larger than 90 cm dbh within 30m both sides of stream per 305m of primary stream length	=0	>79
percent shade	percent of 180 degree sky; includes topographic and tree shade	<76%	>91%

Table 7

Habitat survey reach values and habitat parameter breakpoints relative to 2004 Reference Conditions.

		Habitat variables for Nehalem River 5th field HUC's within ODF Nehalem Project Area							
		1710020203 149km n=99		1710020202 80km n=45		1710020201 59km n=37		All HUC's 288km n=181	
Parameter	Habitat Breakpoints	average	median	average	median	average	median	average	median
	Low <19%								
percent pools	Moderate	35%	29%			41.0%	27.6%	38.0%	32.6%
	High >45%			46.5%	47.2%				
	Low 0								
deep pools/km	Moderate	2.1	0.6	2.2	0.3	2	1.1	2.1	0.7
	High >3								
	Low 0								
% slackwater pools	Moderate		1.5%		4.2%		1.8%		1.8%
	High >7%	9.8%		13.7%		13.5%		11.4%	
	Low <0.8								
% secondary channel area (m2)	Moderate		4.8%	2.7%	2.2%	5.2%	3.6%	5.2%	3.8%
	High >5.3	6.4%							
	High >22%	24%		34%	29%	31%	24%	27%	22%
% fines in riffles	Moderate		18.4%						
	Low <8%								
	Low <26%								
% gravel in riffles	Moderate	42%	40%	38%	36%	40%	38%	41%	39%
	High >54%								
	High >11%								
% bedrock	Moderate	6.3%	5.0%	6.8%	5%	6.6%	3%	7%	5%
	Low <1%								
	Low <8								
pieces LWD/100m	Moderate								
	High >21	23.8	21.6	28	24.5	27.3	22.7	25.4	22.8
	Low <17								
volume LWD/100m	Moderate	39.3	32.4	47.3	35.1	44	29.4	41.4	33
	High >58								
	Low <0.5								
key pieces/100m	Moderate	1.1	0.9	2.2	1	1.7	0.6	1.4	0.8
	High >3								
	Low <22		20		0		12		20
# conifers >50cm dbh	Moderate	45		33.8		42		43.6	
	High >153								
	Low 0		0		0		0		0
# conifers >90cm dbh	Moderate	4.3		4		3.8		4.1	
	High >79								
	Low <76%								
% shade	Moderate	89%		85%	87%	87%		89%	90%
	High >91%		91%				92%		

Table 8

HABITAT PARAMETERS THAT MEET OR EXCEED PREFERED BREAKPOINTS IN RELATION TO GRAVEL IN RIFFLES

5TH FIELD HUC	STREAM NAME	SURVEY DATE	PRIMARY LENGTH	SECONDARY CHANNEL	GRADIENT %	VWI	ACW (m)	VALLEY TYPE	CHANNEL FORM	LAND USE1	LAND USE2	% FINES IN RIFFLES	**% GRAVEL IN RIFFLES**	PERCENT POOL	PERCENT SLACK WATER	DEEP POOLS >1m DEEP/km	LWD PIECES/100m	LWD VOLUME/100m	KEY PIECE LWD/100m	CONIFERS >50cm dbh	CONIFERS >90cm dbh
1710020201	DELL CREEK	7/11/1994	1302	3.8	1.7	2.4	5	OV	CH	ST		**1**	**62**	**60.3**	**12.8**	0	**44.2**	33.8	0.5	12.1	0
	NORTH FORK WOLF CREEK	9/1/1992	722	4.5	1.5	6.2	4.3	WF	US	ST		26	**59**	**55.9**	0.7	0	**22**	43.5	2.8	0	0
	NORTH FORK WOLF CREEK	8/31/1992	1454	4.2	2.4	2	6.7	SV	CH	ST		26	**65**	**46.0**	0.2	2.5	**28.9**	29.1	1.5	0	0
	SLAUGHTERS CREEK	7/28/1997	594	**6.0**	2.7	1.4	3.1	MV	CH	MT	YT	22	**66**	34.5		0	**29.6**	**63.3**	1.5	122	20
	SLAUGHTERS CREEK	7/27/1997	548	1.7	2.6	1	3.4	MV	CH	MT		36	**55**	28.5		0	**30.3**	**76.1**	**3.6**	30	0
	SOUTH FORK ROCK CREEK	8/4/1993	188	0.0	7.5	1	4	SV	CH	ST	ST	**0**	**67**	20.7			**53.6**	**86.1**		**241.4**	0
	SOUTH FORK ROCK CREEK	8/4/1993	490	0.0	3.1	7.8	6.3	CT	CT	ST	ST	**4**	**66**	**52.0**			19	21.6		90.5	30.2
	WOLF CREEK	7/16/1997	905	0.4	10.8	1	2.4	SV	CH	YT	LT	15	**55**	2.1	0.0	0	18.6	38.9	1.4	0	0
1710020202	DEEP CREEK	8/9/1994	4108	0.8	0.8	11.2	11	CT	CT	TH	MT	34	**58**	**47.2**	**17.4**	**3.8**	5.7	16.2	0.9	0	0
	LOUISIGNONT CREEK	8/18/1993	2600	**9.7**	0.9	6.1	10.3	CT	CA	LT	YT	32	**58**	**65.4**	2.0	2.5	**22.5**	16.4	0.2	30.2	0
	LOUSIGNONT CREEK	8/16/2000	2605	3.8	1.5	4.7	6.7	CT	CT	YT	ST	22	**60**	**64.5**	**14.9**	1.1	**23.3**	32.7	1.7	26	9
	NORTHRUP CREEK	7/6/2000	4170	1.7	1.1	8.1	8.1	CT	CT	ST		26	**59**	**66.9**	2.2	**10.5**	**21.9**	16.3	0.6	12	0
	NORTHRUP CREEK TRIBUTARY A	8/2/2000	2219	**6.6**	1.5	4.2	4.7	CT	CA	ST		24	**58**	28.7	**10.7**	0	**27.9**	52.7	2.3	20	0
	WARNER CREEK	9/10/1996	1070	4.0	2	2.4	6	CT	CA	YT	ST	30	**66**	**50.3**	**9.4**	2.6	**28.3**	24.5	0.5	0	0
	WARNER CREEK	9/10/1996	1282	2.7	5.1	1.2	5	MV	CH	ST	YT	28	**58**	31.9	0.6	0.7	**37.1**	41.8	1.5	0	0
1710020203	BENEKE CREEK	8/26/1993	6584	**7.2**	0.5	16.8	16.3	MT	CA	AG		9	**55**	26.6	1.6	**4.2**	**30**	28.4	1	6	6
	BUSTER CREEK	8/21/1997	306	**13.7**	1.1	7.5	7.1	MT	US	ST		**7**	**78**	**76.7**	0.0	2.8	**23.9**	41.6	0.7	0	0
	BUSTER CREEK	8/7/1997	1192	**9.1**	1.3	1.9	15.7	MV	CH	ST		**8**	**60**	**49.6**	0.0	**6.1**	18.2	40.5	1.8	61	0
	BUSTER CREEK	8/14/1997	1473	**8.6**	1.2	2.4	12.7	CT	CA	ST	YT	18	**57**	**62.0**	**14.2**	**5.8**	**21**	25.8	0.6	20	0
	BUSTER CREEK	8/19/1997	1307	**8.4**	0.9	6.4	8.4	CT	CT	YT	ST	10	**78**	**85.6**	1.3	2.7	15.2	23	0.7	20	0
	BUSTER CREEK	8/19/1997	1053	3.7	0.7	9.2	8.9	MT	US	ST	YT	9	**86**	**83.1**	2.2	**7.3**	17.9	19.3	0.2	81	20
	BUSTER CREEK	8/18/1997	1802	3.4	0.7	9.8	11.2	MT	US	ST	YT	9	**85**	**80.5**	1.8	**7.6**	16.3	18.5	0.3	15	15
	BUSTER CREEK	8/21/1997	1944	3.1	1.6	11.2	3.7	CT	CT	ST		39	**55**	**78.8**	**20.7**	0.5	17.6	29.6	1.3	15	0
	BUSTER CREEK	8/14/1997	934	2.4	0.3	8.5	11.5	CT	CT	ST	YT	9	**92**	**91.6**	**30.0**	**9.3**	14.9	16.9	0.6	0	0
	COW CREEK	8/15/2000	783	1.0	13.4	1.3	3	SV	CH	ST		22	**67**	**73.0**	**73.0**	2.4	**22.9**	46.8	**3.4**	122	61
	GILMORE CREEK TRIB A	9/19/2001	1022	3.5	9.4	1.8	3.6	MV	CH	ST		22	**65**	24.9	0.0	0	**36.5**	27.7	0.2	46	0
	HAMILTON CREEK TRIB A1	9/23/1996	1070	4.8	6.9	2.5	2.4	MV	CH	LT		19	**63**	21.7	0.0	0	16.7	47	1.6	0	0
	KLINES CREEK	7/24/1995	3836	**19.9**	6.8	1.8	3.8	MV	CH	LT		16	**61**	30.0	**21.9**	0	17.9	37	1.9	47	0
	KLINES CREEK	7/19/1995	2613	3.9	2	6.8	4.9	CT	CT	LG		20	**65**	**45.2**	**15.0**	0.7	2.1	2.7	0.2	30	10
	NETTLE CREEK	6/21/2000	297	2.6	10.7	5.7	4.1	MT	US	YT	ST	27	**57**	6.5	0.0	0	**32**	22.9	0	61	0
	OSWEG CREEK	8/21/1995	1680	**27.4**	9.4	1.2	3.9	MV	CH	YT		22	**63**	6.1	1.1	0	**22.7**	27.4	1	20	0
	OSWEG CREEK	8/22/1995	1028	1.3	8.9	1.1	2.1	MV	CH	ST		30	**65**	0.0	0.0	0	14.8	15.8	0.6	0	0
	STANLEY CREEK	9/4/1997	582	4.4	3.1	7.2	6.7	MT	US	ST		**5**	**58**	26.6	0.7	0	11.3	19.2	0.7	0	0
	STANLEY CREEK	9/8/1997	281	1.9	3.9	1.8	8.6	MV	CH	ST		10	**62**	32.9	1.9	0	**25.7**	28	0.4	0	0
	WALKER CREEK	6/20/1994	8013	2.9	0.6	14.6	9.9	CT	CA	YT		9	**63**	**54.0**	1.9	**8.3**	11.5	8.2	0	20	0
	WALKER CREEK	9/1/1997	3288	2.0	0.6	4.2	3.7	CT	CA	ST		16	**81**	**91.4**	**11.9**	0.6	**22.6**	49.6	2	122	5
	WALKER CREEK (NC-2130)	8/7/2002	1009	0.5	0.7	6	4.6	CT	CA	ST		17	**77**	**93.8**	**72.5**	**7.9**	10.6	8.5	0	0	0

Values in bold meet or exceed breakpoint for that particular attribute.

Table 9A

HABITAT PARAMETERS THAT MEET OR EXCEED PREFERED BREAKPOINTS IN RELATION TO PERCENT POOLS

5TH FIELD HUC	STREAM NAME	SURVEY DATE	PRIMARY LENGTH	SECONDARY CHANNEL	GRADIENT %	VWI	ACW (m)	VALLEY TYPE	CHANNEL FORM	LAND USE1	LAND USE2	% FINES IN RIFFLES	**% GRAVEL IN RIFFLES**	PERCENT POOL	PERCENT SLACK WATER	DEEP POOLS >1m DEEP/km	LWD PIECES/100m	LWD VOLUME/100m	KEY PIECE LWD/100m	CONIFERS >50cm dbh	CONIFERS >90cm dbh
1710020201	BEAR CREEK	5/27/1997	822	1.0	2.6	2.7	2.5	MT	CA	ST	LT	67	31	**89.4**	**88.3**	**3.3**	**30.7**	22.2	0.5	30	0
	BEAR CREEK	5/26/1997	989	2.1	1.9	1.1	6.8	MV	CH	LT		56	32	**48.4**	6.8	2.9	**38.1**	30.6	0.6	0	0
	BEAR CREEK	5/26/1997	853	2.2	1.9	4.5	5.8	MT	CA	ST		31	38	**47.2**	**8.5**	**5.6**	**35.3**	27.7	0.8	0	0
	CARLSON CREEK	8/29/1995	2968	0.1	2.8	1.8	11.5	OV	CH	ST	LT	60	20	**53.8**	**42.5**	0.7	15.2	22.7	0.4	**203**	20
	CLEAR CREEK	7/7/1994	1691	4.1	2.4	5.6	5.3	CT	CA	TH	YT	55	35	**47.4**	1.2	2.3	**21.5**	**65.4**	1.1	0	0
	DELL CREEK	7/11/1994	1302	3.8	1.7	2.4	5	OV	CH	ST		**1**	**62**	**60.3**	**12.8**	0	**44.2**	33.8	0.5	12.1	0
	NORTH FORK ROCK CREEK	7/19/1993	1553	**40.3**	1	9.6	3.5	WF	US	ST	ST	9	50	**59.8**			**38.5**	**78**		0	0
	NORTH FORK ROCK CREEK	7/15/1993	1387	**7.8**	1.1	4.1	7.7	CT	CA	ST	ST	**3**	47	**49.9**			**54**	**154.7**		0	0
	NORTH FORK WOLF CREEK	8/24/1992	1293	0.8	1.2	14.9	9.1	CT	CA	ST		24	43	**61.8**	**9.3**	**3**	7.3	6.9	0.2	0	0
	NORTH FORK WOLF CREEK	9/1/1992	722	4.5	1.5	6.2	4.3	WF	US	ST		26	**59**	**55.9**	0.7	0	**22**	43.5	2.8	0	0
	NORTH FORK WOLF CREEK	8/31/1992	1454	4.2	2.4	2	6.7	SV	CH	ST		26	**65**	**46.0**	0.2	2.5	**28.9**	29.1	1.5	0	0
	SOUTH FORK ROCK CREEK	8/4/1993	490	0.0	3.1	7.8	6.3	CT	CT	ST	ST	**4**	**66**	**52.0**			19	21.6		90.5	30.2
1710020202	DEEP CREEK	7/28/1999	245	1.9	0.3	5	5.1	CT	CA	ST		35	40	**94.4**	**9.6**	**3.9**	**28.2**	55.9	**3.7**	61	0
	DEEP CREEK	8/8/1994	13932	0.3	0.4	17.8	9.8	CT	CT	YT	TH	45	46	**68.5**	**11.5**	**5.3**	9.6	19.1	0.7	0	0
	DEEP CREEK	7/28/1999	472	0.8	0.9	1	7.5	OV	CH	ST		23	35	**66.0**	0.9	0	**77.4**	**192.1**	**9.5**	**183**	0
	DEEP CREEK	8/9/1994	4108	0.8	0.8	11.2	11	CT	CT	TH	MT	34	**58**	**47.2**	**17.4**	**3.8**	5.7	16.2	0.9	0	0
	DEEP CREEK	7/27/1999	1991	1.0	0.5	3.6	6.3	CT	CA	ST		23	33	**46.3**	0.8	0	**52.6**	**115.4**	**7.4**	30	0
	DEEP CREEK (TRIB)	9/9/1999	357	0.0	0.3	8	3.8	CT	CT	ST				**95.0**	**95.0**	0	20.7	13.7	0.3	**183**	0
	DEEP CREEK (TRIB)	7/28/1999	310	4.0	0.5	3	5	CT	CA	ST		23	35	**82.7**	2.0	0	**61.9**	**116.3**	**5.2**	0	0
	DEEP CREEK (TRIB)	7/29/1999	385	1.6	3.8	1.3	2.8	MV	CH	ST		28	33	**71.6**	5.0	**5.2**	**65.3**	**155.4**	**9.9**	0	0
	DEEP CREEK (TRIB)	7/29/1999	893	2.4	2.7	3	3.9	CT	CT	ST		21	35	**46.9**	2.2	0	6	11.8	0.7	0	0
	DEEP CREEK SURVEYED AS TRIB A	9/13/1999	498	0.0	1.8	2.8	4.7	CT	CT	ST	YT	60	36	**71.0**	0.0	0	16.5	35.1	2.8	**366**	0
	FISHHAWK CREEK (ABOVE LAKE)	8/1/1996	1576	4.8	0.3	3.8	6.2	CT	CT	ST		62	28	**71.8**	**10.8**	**14.6**	14	20.7	0.8	30	0
	FISHHAWK CREEK (ABOVE LAKE)	8/28/1996	1422	4.0	2.3	3	8	MT	CA	YT		36	40	**66.4**	**46.2**	**4.5**	**31.2**	56.3	**3.4**	46	0
	FISHHAWK CREEK (ABOVE LAKE)	7/31/1996	2158	3.4	1.7	1.5	9.2	MV	CH	YT	ST	30	33	**58.5**	2.9	**9.5**	**36**	**58.6**	1.9	30	15
	FISHHAWK CREEK (ABOVE LAKE)	8/28/1996	1035	**5.9**	4.3	1.6	5.8	MV	CH	YT	ST	33	50	**47.0**	**7.9**	0	**33.2**	**105.9**	**5.7**	61	41
	LOUISGNONT CR	8/22/2000	877	0.9	0.6	4.5	6.4	CT	CT	ST	YT	38	47	**79.7**	**18.1**	1.1	**25.1**	25.2	0.9	20	20
	LOUISIGNONT CREEK	8/18/1993	2600	**9.7**	0.9	6.1	10.3	CT	CA	LT	YT	32	**58**	**65.4**	2.0	2.5	**22.5**	16.4	0.2	30.2	0
	LOUSIGNONT CREEK	8/16/2000	2605	3.8	1.5	4.7	6.7	CT	CT	YT	ST	22	**60**	**64.5**	**14.9**	1.1	**23.3**	32.7	1.7	26	9
	NORTHRUP CR	9/10/2001	1090	**7.8**	1.3	5.4	10.5	MT	CA	ST		10	46	**69.9**	**13.7**	0	20.3	6.6	0.1	0	0
	NORTHRUP CREEK	7/6/2000	4170	1.7	1.1	8.1	8.1	CT	CT	ST		26	**59**	**66.9**	2.2	**10.5**	**21.9**	16.3	0.6	12	0
	NORTHRUP CREEK	7/5/2000	831	**5.3**	0.8	12.9	12.3	CT	CT	ST		15	39	**63.8**	1.1	**12.8**	**21.2**	20	0.7	0	0
	OAK RANCH CREEK	7/31/1995	2845	2.1	1.4	3.4	6.6	CT	CA	ST	TH	16	36	**47.3**	**17.4**	1.7	9.1	15.1	0.8	0	0
	SAGER CR	8/9/2000	1073	**5.4**	3.2	1.3	5.1	OV	CH	ST		71	17	**66.0**	**62.6**	**5.4**	18.5	51.7	**3.9**	81	0
	SAGER CREEK	10/2/1995	3709	0.4	1.9	1.9	4.1	MV	CH	ST	YT	86	10	**80.4**	**54.5**	2.7	16.9	49.7	1.6	0	0
	SAGER CREEK	9/14/1995	2625	0.0	0.8	2.4	6.8	CT	CT	LT	ST	64	23	**74.2**	**20.2**	1.9	11.4	21.9	0.5	0	0
	WARNER CREEK	9/10/1996	1070	4.0	2	2.4	6	CT	CA	YT	ST	30	**66**	**50.3**	**9.4**	2.6	**28.3**	24.5	0.5	0	0
	WARNER CREEK	9/9/1996	827	3.9	2.7	4.8	8.2	CT	CA	YT	ST	17	46	**49.7**	**16.3**	**3.4**	**21.8**	21.8	0.7	0	0

Values in bold meet or exceed breakpoint for that particular attribute.

Table 9B

HABITAT PARAMETERS THAT MEET OR EXCEED PREFERED BREAKPOINTS IN RELATION TO PERCENT POOLS

5TH FIELD HUC	STREAM NAME	SURVEY DATE	PRIMARY LENGTH	SECONDARY CHANNEL	GRADIENT %	VWI	ACW (m)	VALLEY TYPE	CHANNEL FORM	LAND USE1	LAND USE2	% FINES IN RIFFLES	**% GRAVEL IN RIFFLES**	PERCENT POOL	PERCENT SLACK WATER	DEEP POOLS >1m DEEP/km	LWD PIECES/100m	LWD VOLUME/100m	KEY PIECE LWD/100m	CONIFERS >50cm dbh	CONIFERS >90cm dbh
1710020203	BENEKE CREEK	7/19/2001	6774	**6.0**	0.3	38.2	14.8	CT	CT	LG	AG	9	39	**74.0**	2.4	**8.2**	9.5	14.3	0.3	27	7
	BENEKE CREEK	7/29/2001	2056	**8.5**	2.2	24.1	9.7	CT	CA	ST	AG	**7**	40	**65.4**	3.2	**13.1**	18.1	19.6	0.6	20	0
	BUSTER CR	8/16/1999	967	**5.5**	0.9	10.8	13	CT	CT	YT		37	33	**74.1**	0.4	**6.7**	**27.8**	37.4	2.3	20	20
	BUSTER CR TRIB	8/20/2001	848	0.0	0.8	12.9	4.7	MT	US	ST		87	13	**94.8**	**91.5**	1.2	10.5	10.9	0.2	0	0
	BUSTER CREEK	8/14/1997	934	2.4	0.3	8.5	11.5	CT	CT	ST	YT	9	**92**	**91.6**	**30.0**	**9.3**	14.9	16.9	0.6	0	0
	BUSTER CREEK	8/19/1997	1307	**8.4**	0.9	6.4	8.4	CT	CT	YT	ST	10	**78**	**85.6**	1.3	2.7	15.2	23	0.7	20	0
	BUSTER CREEK	8/19/1997	1053	3.7	0.7	9.2	8.9	MT	US	ST	YT	9	**86**	**83.1**	2.2	**7.3**	17.9	19.3	0.2	81	20
	BUSTER CREEK	8/18/1997	1802	3.4	0.7	9.8	11.2	MT	US	ST	YT	9	**85**	**80.5**	1.8	**7.6**	16.3	18.5	0.3	15	15
	BUSTER CREEK	8/21/1997	1944	3.1	1.6	11.2	3.7	CT	CT	ST		39	**55**	**78.8**	**20.7**	0.5	17.6	29.6	1.3	15	0
	BUSTER CREEK	8/21/1997	306	**13.7**	1.1	7.5	7.1	MT	US	ST		**7**	**78**	**76.7**	0.0	2.8	**23.9**	41.6	0.7	0	0
	BUSTER CREEK	8/11/1997	524	**15.9**	1.5	6.2	12.5	CT	CA	ST		**5**	48	**65.6**	1.7	2.7	17.2	31.8	1	0	0
	BUSTER CREEK	8/14/1997	1473	**8.6**	1.2	2.4	12.7	CT	CA	ST	YT	18	**57**	**62.0**	**14.2**	**5.8**	**21**	25.8	0.6	20	0
	BUSTER CREEK	8/7/1997	1192	**9.1**	1.3	1.9	15.7	MV	CH	ST		**8**	**60**	**49.6**	0.0	**6.1**	18.2	40.5	1.8	61	0
	BUSTER CREEK	8/11/1997	1668	4.6	1.4	1	16.6	MV	CH	ST		**5**	39	**47.8**	0.2	**5.7**	14	21.3	0.5	30	0
	BUSTER CREEK TRIB (NC-2390)	8/12/2002	885	2.9	1.2	8.5	3.4	MT	US	ST		94	6	**64.6**	**14.0**	0	**22.9**	39.7	1.6	0	0
	BUSTER CREEK TRIB A	6/25/1998	562	1.8	0.6	6.2	5.2	MT	CA	ST				**73.0**	**73.0**	**21.4**	**45.4**	**259.2**	**4.8**	**102**	0
	BUSTER CREEK TRIBUTARY A3	6/10/2002	545	0.3	2.5	3.2	3	MT	US	MT	ST	64	36	**64.7**	1.3	0	**29**	**97.2**	1.3	**244**	0
	BUSTER CREEK TRIBUTARY A3	6/10/2002	652	4.8	8.5	2.1	2.7	SV	CH	MT	ST	65	25	**48.7**	3.1	0	16.4	39.9	0.6	**213**	0
	COW CREEK	8/15/2000	783	1.0	13.4	1.3	3	SV	CH	ST		22	**67**	**73.0**	**73.0**	2.4	**22.9**	46.8	**3.4**	122	61
	CRAWFORD CR	8/23/2001	952	0.3	2.2	3.9	5.1	CT	CA	ST	MT	68	23	**77.1**	**67.8**	1.1	17	17.8	0.2	0	0
	GILMORE CREEK	9/11/2001	1616	**7.4**	3.2	6.1	5.8	CT	CA	ST		48	36	**72.4**	**44.1**	2.8	**27.5**	18.7	0.2	0	0
	GILMORE CREEK TRIB A	9/18/2001	2001	0.0	2.5	5.5	5	MT	CT	ST		40	43	**89.2**	**84.6**	2.4	**27**	23	0.2	0	0
	HAMILTON CREEK	9/14/1993	1095	**8.0**	1.3	6.6	10	MT	CT	TH	YT	20	30	**50.1**	4.6	**3.3**	13.3	14.9	0.3	0	0
	KLINES CREEK	7/19/1995	2613	3.9	2	6.8	4.9	CT	CT	LG		20	**65**	**45.2**	**15.0**	0.7	2.1	2.7	0.2	30	10
	TRAILOVER CREEK	9/24/2001	2026	2.4	2.9	9.2	5.6	CT	CT	ST		22	48	**74.3**	**55.9**	2.8	**45**	21.7	0.1	35	9
	WALKER CREEK	8/29/1997	1994	0.7	0.6	12.4	5	CT	CT	YT		55	43	**96.4**	**56.4**	**7.3**	14.3	20.3	0.6	12	0
	WALKER CREEK	9/1/1997	3288	2.0	0.6	4.2	3.7	CT	CA	ST		16	**81**	**91.4**	**11.9**	0.6	**22.6**	49.6	2	122	5
	WALKER CREEK	6/20/1994	8013	2.9	0.6	14.6	9.9	CT	CA	YT		9	**63**	**54.0**	1.9	**8.3**	11.5	8.2	0	20	0
	WALKER CREEK (NC-2130)	8/7/2002	1009	0.5	0.7	6	4.6	CT	CA	ST		17	**77**	**93.8**	**72.5**	**7.9**	10.6	8.5	0	0	0

Values in bold meet or exceed breakpoint for that particular attribute.

Table 10

HABITAT PARAMETERS THAT MEET OR EXCEED PREFERED BREAKPOINTS IN RELATION TO LOW SILT/FINES IN RIFFLES

5TH FIELD HUC	STREAM NAME	SURVEY DATE	PRIMARY LENGTH	SECONDARY CHANNEL	GRADIENT %	VWI	ACW (m)	VALLEY TYPE	CHANNEL FORM	LAND USE1	LAND USE2	**% FINES IN RIFFLES**	% GRAVEL IN RIFFLES	PERCENT POOL	PERCENT SLACK WATER	DEEP POOLS >1m DEEP/km	LWD PIECES/100m	LWD VOLUME/100m	KEY PIECE LWD/100m	CONIFERS >50cm dbh	CONIFERS >90cm dbh
1710020201	DELL CREEK	7/11/1994	1302	3.8	1.7	2.4	5	OV	CH	ST		**1**	**62**	**60.3**	**12.8**	0	**44.2**	33.8	0.5	12.1	0
	DELL CREEK	7/13/1994	457	1.8	2	5.8	2.9	MT	CT	ST		**5**	48	18.5	6.5	0	**32.0**	28.2	0	0	0
	NORTH FORK ROCK CREEK	7/21/1993	453	0.6	4.8	3.3	3.5	MV	CH	ST	ST	**4**	29	25.9			**51.4**	**90.6**		120.7	0
	NORTH FORK ROCK CREEK	7/15/1993	1387	**7.8**	1.1	4.1	7.7	CT	CA	ST	ST	**3**	47	**49.9**			**54.0**	**154.7**		0	0
	ROCK CREEK	8/11/1993	669	4.4	2.9	1.5	8.5	MV	CH	ST		**5**	20	26.2	**18.6**	**4.2**	11.4	35.3	2.4	60.3	0
	ROCK CREEK	8/12/1993	794	2.7	0.9	13.3	8.2	WF	US	ST		**1**	36	38.6	**10.5**	**7.8**	9.3	14.0	0.4	0	0
	ROCK CREEK	7/1/1993	582	**6.8**	0.6	3	17	CT	CT	TH	ST	**8**	32	9.8	1.2	**3**	5.7	12.1	0.4	0	0
	SOUTH FORK ROCK CREEK	8/5/1993	2756	0.3	5.1	2.4	4	SV	CH	ST	TH	**2**	47	14.8			**30.8**	**65.4**		132.7	42.2
	SOUTH FORK ROCK CREEK	8/4/1993	490	0.0	3.1	7.8	6.3	CT	CT	ST	ST	**4**	**66**	**52.0**			19.0	21.6		90.5	30.2
	SOUTH FORK ROCK CREEK	8/4/1993	188	0.0	7.5	1	4	SV	CH	ST	ST	**0**	**67**	20.7			**53.6**	**86.1**		**241.4**	0
	SOUTH FORK ROCK CREEK	8/3/1993	4670	1.8	2.3	12.1	7.1	MT	CT	ST	ST	**2**	35	27.6			20.3	27.7		48.3	0
1710020202	SAGER CREEK (NC-2365)	8/21/2003	1075	1.1	5.1	1.5	4.2	MV	CH	ST	TH	**0**	0	17.7	3.6	0	16.8	35.3	0.7	20	20
1710020203	BENEKE CREEK	7/29/2001	2056	**8.5**	2.2	24.1	9.7	CT	CA	ST	AG	**7**	40	**65.4**	3.2	**13.1**	18.1	19.6	0.6	20	0
	BENEKE CREEK	8/24/1993	3049	4.4	0.4	20	19.9	CT	CT	AG		**8**	42	39.8	0.4	**3.7**	14.3	12.3	0.5	0	0
	BUSTER CREEK	8/7/1997	1192	**9.1**	1.3	1.9	15.7	MV	CH	ST		**8**	**60**	**49.6**	0.0	**6.1**	18.2	40.5	1.8	61	0
	BUSTER CREEK	8/11/1997	1668	4.6	1.4	1	16.6	MV	CH	ST		**5**	39	**47.8**	0.2	**5.7**	14.0	21.3	0.5	30	0
	BUSTER CREEK	8/11/1997	524	**15.9**	1.5	6.2	12.5	CT	CA	ST		**5**	48	**65.6**	1.7	2.7	17.2	31.8	1	0	0
	BUSTER CREEK	8/21/1997	306	**13.7**	1.1	7.5	7.1	MT	US	ST		**7**	**78**	**76.7**	0.0	2.8	**23.9**	41.6	0.7	0	0
	BUSTER CREEK TRIB C (NC-2356)	8/14/2002	496	3.1	7.5	2	3.9	MV	CH	YT		**0**	50	2.4	0.0	0	16.1	34.9	1.6	0	0
	KLINES CREEK	7/31/1995	1172	4.7	6.8	1.9	4.7	MV	CH	ST		**0**	0	2.9	3.0	0	18.6	55.3	**3.3**	61	0
	NORTH FORK WALKER CREEK	7/13/1994	2063	**7.8**	9	1.8	5.4	MV	CH	ST		**7**	31	6.1		0	**35.3**	**81.9**	1.3	8	8
	SOUTH FORK QUARTZ CREEK	7/23/1996	373	0.0	12.7	2.7	7.5	MV	CH	SR		**7**	33	10.5	0.0	0	**33.8**	32.0	0.3	0	0
	STANLEY CREEK	9/9/1997	1466	4.2	8.6	2	7.1	SV	CH	ST		**6**	51	25.7	0.5	0.6	**40.4**	**67.3**	1.2	61	0
	STANLEY CREEK	9/4/1997	582	4.4	3.1	7.2	6.7	MT	US	ST		**5**	**58**	26.6	0.7	0	11.3	19.2	0.7	0	0
	WALKER CREEK	6/30/1994	2269	**7.7**	1.6	2.6	10	MT	CA	LT	ST	**6**	42	27.2	2.4	0.4	18.6	32.4	1.2	61	12
	WALKER CREEK	7/5/1994	270	0.0	1.4	2	10.5	MV	CH	ST		**3**	28	44.8	0.0	0	12.6	11.5	0	**244**	0
	WALKER CREEK	7/5/1994	688	**5.3**	2	2.9	8.6	MT	CA	YT		**5**	31	24.8	1.1	0	**21.8**	52.4	2.5	0	0

Values in bold meet or exceed breakpoint for that particular attribute.

Table 11

HABITAT PARAMETERS THAT MEET OR EXCEED PREFERED BREAKPOINTS IN RELATION TO LARGE WOOD DEBRIS PIECES AND VOLUME

5TH FIELD HUC	STREAM NAME	SURVEY DATE	PRIMARY LENGTH	SECONDARY CHANNEL	GRADIENT %	VWI	ACW (m)	VALLEY TYPE	CHANNEL FORM	LAND USE1	LAND USE2	% FINES IN RIFFLES	**% GRAVEL IN RIFFLES**	PERCENT POOL	PERCENT SLACK WATER	DEEP POOLS >1m DEEP/km	LWD PIECES/100m	LWD VOLUME/100m	KEY PIECE LWD/100m	CONIFERS >50cm dbh	CONIFERS >90cm dbh
1710020201	CLEAR CREEK	7/7/1994	1691	4.1	2.4	5.6	5.3	CT	CA	TH	YT	55	35	**47.4**	1.2	2.3	**21.5**	**65.4**	1.1	0	0
	LOUSIGNONT CR	6/30/1999	397	3.6	3.4	1.3	3.7	SV	CH	ST		44	29	15.3	2.5	0	**39.1**	**81.5**	**4.3**	0	0
	NORTH FORK ROCK CREEK	7/15/1993	1387	**7.8**	1.1	4.1	7.7	CT	CA	ST	ST	**3**	47	**49.9**			**54**	**154.7**		0	0
	NORTH FORK ROCK CREEK	7/21/1993	453	0.6	4.8	3.3	3.5	MV	CH	ST	ST	**4**	29	25.9			**51.4**	**90.6**		120.7	0
	NORTH FORK ROCK CREEK	7/19/1993	1553	**40.3**	1	9.6	3.5	WF	US	ST	ST	9	50	**59.8**			**38.5**	**78**		0	0
	SLAUGHTERS CREEK	7/27/1997	548	1.7	2.6	1	3.4	MV	CH	MT		36	**55**	28.5		0	**30.3**	**76.1**	**3.6**	30	0
	SLAUGHTERS CREEK	7/28/1997	594	**6.0**	2.7	1.4	3.1	MV	CH	MT	YT	22	**66**	34.5		0	**29.6**	**63.3**	1.5	122	20
	SOUTH FORK ROCK CREEK	8/4/1993	188	0.0	7.5	1	4	SV	CH	ST	ST	**0**	**67**	20.7			**53.6**	**86.1**		**241.4**	0
	SOUTH FORK ROCK CREEK	8/5/1993	2756	0.3	5.1	2.4	4	SV	CH	ST	TH	**2**	47	14.8			**30.8**	**65.4**		132.7	42.2
	UPPER NEHALEM RIVER	9/11/1995	3517	3.1	9.1	1.9	10	MV	CH	LT		61	25	17.7	3.3	0	**26.3**	**58.6**	2.2	**213**	30
1710020202	DEEP CREEK	7/28/1999	472	0.8	0.9	1	7.5	OV	CH	ST		23	35	**66.0**	0.9	0	**77.4**	**192.1**	**9.5**	**183**	0
	DEEP CREEK	7/27/1999	1991	1.0	0.5	3.6	6.3	CT	CA	ST		23	33	**46.3**	0.8	0	**52.6**	**115.4**	**7.4**	30	0
	DEEP CREEK (TRIB)	7/29/1999	385	1.6	3.8	1.3	2.8	MV	CH	ST		28	33	**71.6**	5.0	**5.2**	**65.3**	**155.4**	**9.9**	0	0
	DEEP CREEK (TRIB)	7/28/1999	310	4.0	0.5	3	5	CT	CA	ST		23	35	**82.7**	2.0	0	**61.9**	**116.3**	**5.2**	0	0
	FISHHAWK CREEK (ABOVE LAKE)	7/31/1996	2158	3.4	1.7	1.5	9.2	MV	CH	YT	ST	30	33	**58.5**	2.9	**9.5**	**36**	**58.6**	1.9	30	15
	FISHHAWK CREEK (ABOVE LAKE)	8/28/1996	1035	**5.9**	4.3	1.6	5.8	MV	CH	YT	ST	33	50	**47.0**	**7.9**	0	**33.2**	**105.9**	**5.7**	61	41
	LOUISIGNONT CREEK	8/26/1993	3420	**7.4**	4.8	1.7	6.9	SV	CH	LT	MT	40	38	25.8	0.6	0.9	**40.7**	**58.5**	1.5	120.7	0
	TRESTLE CREEK	8/14/1997	296	1.3	8.5	1	2.3	MV	CH	LT		65	30	0.0	0.0	0	**32.1**	**79.7**	**3**	0	0
	WARNER CREEK TRIB B	9/11/1996	399	0.0	8.1	1	4.3	MV	CH	YT	ST	35	33	13.5		0	**34.8**	**60.2**	**3**	0	0
	WARNER CREEK TRIB C	9/11/1996	226	0.0	13.3	1	2.3	MV	CH	YT	ST	34	52	20.2		0	**64.2**	**103.4**	**6.6**	0	0
1710020203	BENEKE CREEK	8/14/2001	1300	**8.7**	10.1	7.5	3	MT	CA	PT	ST	46	51	9.4	0.3	0	**29.9**	**79.2**	**3.8**	**168**	0
	BUSTER CREEK TRIB A	6/25/1998	562	1.8	0.6	6.2	5.2	MT	CA	ST				**73.0**	**73.0**	**21.4**	**45.4**	**259.2**	**4.8**	102	0
	BUSTER CREEK TRIBUTARY A3	6/10/2002	545	0.3	2.5	3.2	3	MT	US	MT	ST	64	36	**64.7**	1.3	0	**29**	**97.2**	1.3	**244**	0
	COW CREEK	8/9/2000	2854	3.5	2.2	6.5	4.7	CT	CA	ST		49	41	44.5	0.8	0.3	**38.4**	**64.5**	2.6	20	0
	HAMILTON CREEK TRIB A	9/25/1996	1364	**7.7**	4.5	2.1	5.8	MV	CH	YT	LT	15	32	32.8	4.2	0.6	**27.4**	**68.5**	2.4	20	0
	HAMILTON CREEK TRIB B	9/24/1996	621	3.5	5.2	2.1	5.9	MV	CH	YT	ST	15	28	16.6	0.0	1.5	**34.8**	**63**	2.3	0	0
	NORTH FORK WALKER CREEK	7/13/1994	2063	**7.8**	9	1.8	5.4	MV	CH	ST		**7**	31	6.1		0	**35.3**	**81.9**	1.3	8	8
	Osweg Creek	7/13/1998	520	**8.6**	16.1	5	1.8	CT	CA	ST	MT	86	13	1.4	0.3	0	**29**	**81.2**	**3.1**	81	0
	QUARTZ CREEK, SURVEYED AS NF	7/18/1996	572	2.3	12.7	1	8.5	SV	CH	ST		38	37	25.9	0.0	**11.7**	**50.5**	**59.8**	0.7	0	0
	SOUTH FORK WALKER CREEK	7/18/1994	285	1.1	5.9	1	6	MV	CH	ST		9	42	19.4	0.0	0	**56.1**	**112**	**4.2**	0	0
	STANLEY CREEK	9/9/1997	1466	4.2	8.6	2	7.1	SV	CH	ST		**6**	51	25.7	0.5	0.6	**40.4**	**67.3**	1.2	61	0
	STANLEY CREEK	9/8/1997	542	**15.7**	2.5	2.5	8.4	MT	US	ST		37	45	31.1	0.0	1.5	**27.1**	**92**	0.7	102	0
	WALKER CREEK	7/6/1994	2104	**13.6**	3	1.4	8.4	SV	CH	ST		12	35	16.4	5.7	0.4	**45.3**	**92.4**	2.1	15	0

Values in bold meet or exceed breakpoint for that particular attribute.

Table 12. Barriers and associated features (as identified by Streament) within the Nehalem project area.

Stream LLID	Stream name	Record id	Barrier type	Passage*	Adult passage**	Comments
1233366459998	Fishhawk Creek	51717	falls	99	ends at or below	
1235018459336	Fishhawk Tributary	1447	culvert	99	ends below	Bad joint in middle. Upper half of pipe is steep, lower is flat. Juvenile salmonids above
1234481459012	Stanley Creek	53112	falls	99	ends at or below	
1235539458919	Cow Creek	55374	falls	99	ends at or below	
1235579458459	NF Quartz Creek	55373	falls	99	ends at or below	
1234237457779	unknown	1283	culvert	4	Steelhead above ends at or below	Top 6' of this culvert are steep, remaining 94' are level. Not likely to be a problem.
1233362457299	Nehalem tributary	55368	cascades/gradient/velocity	99	ends at or below	gradient estimated at 60%
1233902457131	Reliance Creek	1141	culvert	1	fish use not mapped	0.6 miles from Washington County line. Impassable.
1233520457110	Nehalem tributary	1169	culvert	1	fish use not mapped	Washington County culvert #1666. Impassable.

*Passage 1=complete 2=partial 4=nonblocking 99=unknown

** Migratory fish passage (coho, fall and spring chinook, winter steelhead) as mapped by Streamnet.

Table 13. OWEB funded instream restoration projects on ODF land in the Nehalem basin, highlighting some actions and goals and the species benefitting from the restoration project.

				Targeted Species			
Stream name	Year	Project Description	Project Goals	coho	steelhead	chinook	cutthroat
Buster Cr	1996	anchored log structures	improve rearing habitat, over-winter habitat	x	x		
Buster Cr	1998	1 culvert replaced	improve refuge cover				
Buster Cr	1998	peak flow passage improvements surface drainage improvements sidecast pulled back	improve road/upslope drainage & stability decrease erosion/stream sedimentation decrease runoff contaminents				
Buster Cr	2003	peak flow passage improvements surface drainage improvements	improve road/upslope drainage decrease erosion/stream sedimentation decrease runoff contaminents	x	x	x	x
Buster Cr, trib of	2002	2 culverts replaced					x
Buster Cr, trib of	2003	1 culvert replaced with culvert					x
Cow Cr	2001	2 culverts replaced with bridge		x			x
Cow Cr	2003	2 culverts removed and not replaced peak flow passage improvements road sidecast pulled back road vacated, road grass seeded	improve fish passage upslope stability, road/upslope drainage	x			x
Deep Cr	2003	peak flow passage improvements surface drainage improvements	improve road/upslope drainage decrease runoff contaminents	x			x
East Fork Hamilton Cr	1999	peak flow passage improvements surface drainage improvements	improve road/upslope drainage & stability decrease erosion/stream sedimentation decrease runoff contaminents				
East Sager Cr	1999	1 culvert removed and not replaced peak flow passage improvements road vacated	improve fish passage upslope stability, road/upslope drainage	x			x
East Sager Cr / Sager Cr	1996	peak flow passage improvements surface drainage improvements	improve road/upslope drainage & stability decrease erosion/stream sedimentation decrease runoff contaminents				
Fishhawk Cr	1998	off-channel habitat riparian tree planting 1 culvert removed and not replaced	improve fish passage	x	x		x
Fishhawk Cr	1999	peak flow passage improvements surface drainage improvements road vacated	decrease erosion/stream sedimentation decrease washout potential at stream crossings				
Fishhawk Cr, trib of	1999	peak flow passage improvements surface drainage improvements road vacated	improve road/upslope drainage & stability decrease erosion/stream sedimentation decrease runoff contaminents				
Fishhawk Cr, trib of	2002	peak flow passage improvements road vacated	decrease erosion/stream sedimentation decrease washout potential at stream crossings decrease road density				
Fishhawk Cr, tribs of	2001	peak flow passage improvements road vacated	improve road/upslope drainage decrease erosion/stream sedimentation decrease washout potential at stream crossings				x
Hamilton Cr	1995	instream large wood placement weirs, off-channel habitat bank stabilization boulder placement 1 culvert removed and not replaced	improve stream structure and complexity improve streambank stabilization improve fish passage and off-channel habitat	x			
Hamilton Cr	1998	1 culvert replaced		x	x		x
Hamilton Cr	2000	peak flow passage improvements surface drainage improvements sidecast pulled back road vacated, road grass seeded	improve road/upslope drainage & stability decrease erosion/stream sedimentation decrease runoff contaminents decrease washout potential at stream crossings decrease road density				

Table 13 (cont). OWEB funded instream restoration projects on ODF land in the Nehalem basin, highlighting some actions and goals and the species benefitting from the restoration project.

Stream name	Year	Project Description	Project Goals	Targeted Species coho	steelhead	chinook	cutthroat
Hamilton Cr	2003	1 culvert replaced with bridge			x	x	
Little Clatskanie R, trib of	1998	4 culverts replaced		x	x		x
Louisgnont Cr, Grub Cr, Warner Cr	2001	peak flow passage improvements road survey, road vacated surface drainage improvements	improve road/upslope drainage decrease erosion/stream sedimentation decrease runoff contaminents				
Louisgnot Cr, trib of	1995	instream large wood placement	improve stream structure and complexity	x			
Lousignout Cr, trib of	2002	peak flow passage improvements surface drainage improvements road vacated	improve road/upslope drainage decrease runoff contaminents				
Moores Cr	2003	1 culvert removed and not replaced surface drainage improvements road vacated	improve fish passage Road/upslope drainage				x
Nehalem R, trib of	1996	peak flow passage improvements surface drainage improvements	improve road/upslope drainage decrease erosion/stream sedimentation decrease runoff contaminents				
Nehalem R, trib of	1998	peak flow passage improvements surface drainage improvements	improve road/upslope drainage & stability decrease erosion/stream sedimentation decrease runoff contaminents				
Nettle Cr	2000	1 culvert replaced					x
Nettle Cr, trib of	2002	1 culvert replaced					x
North Fork Wolf Cr	2001	instream large wood placement	improve stream structure and complexity improve stream interaction with floodplain improve gravel recruitment, over-winter habitat improve rearing habitat	x	x		x
North Fork Wolf Cr, trib of	1997	peak flow passage improvements Voluntary Riparian Tree Retention surface drainage improvements	improve stream structure and complexity improve over-winter habitat improve rearing habitat	x	x		x
North Fork Wolf Cr, trib of	2001	instream large wood placement	improve rearing and over-winter habitat	x			x
North Fork Wolfe Cr	1997	anchored log structures					
Northrup Cr	2003	peak flow passage improvements surface drainage improvements	improve road/upslope drainage decrease erosion/stream sedimentation decrease runoff contaminants	x	x	x	x
Northrup Cr And trib Cow Cr	2002	instream large wood placement	improve stream structure and complexity improve stream interaction with floodplain improve gravel recruitment, over-winter habitat improve pools, spawning & rearing habitat	x	x		x
Northrup Cr, Louisgnont Cr	2001	11 culverts removed and not replaced 1 culvert replaced with embedded or flat culvert road survey, road relocated peak flow passage improve surface drainage improve. road sidecast pulled back	fish passage road/upslope drainage	x	x		x
Rock Cr, trib of	1998	peak flow passage improvements surface drainage improvements	improve road/upslope drainage decrease erosion/stream sedimentation decrease runoff contaminants				
Rock Cr, trib of	1999	3 culverts replaced peak flow passage improvements surface drainage improvements	fish passage, decrease erosion/stream sedimentation upslope stability, road/upslope drainage decrease runoff contaminants				
Sager Cr (Hamilton Cr and Bull-Heifer Cr)	1995	1 culvert removed and not replaced peak flow passage improvements surface drainage improvements road vacated	improve fish passage upslope stability, road/upslope drainage				

Table 13. OWEB funded instream restoration projects on ODF land in the Nehalem basin, highlighting some actions and goals and the species benefitting from the restoration project.

				Targeted Species			
Stream name	Year	Project Description	Project Goals	coho	steelhead	chinook	cutthroat
Sager/Strum/Buster/Walker/Fishhawk Cr	1997	peak flow passage improvements surface drainage improvements	improve road/upslope drainage & stability decrease erosion/stream sedimentation				
Sager/Strum/Buster/Walker/Fishhawk Cr	1997	sidecast pulled back 5 large landslides stabilized	decrease runoff contaminents				
Smith Cr	1998	anchored log structures 1 culvert replaced	improve fish passage	x	x		x
South Fork Lousignont	2000	instream large wood placement	improve stream structure and complexity improve stream interaction with floodplain improve gravel recruitment, over-winter habitat improve pools, spawning & rearing habitat	x	x		x
South Fork Rock Cr	2000	instream large wood placement	improve stream structure and complexity improve stream interaction with floodplain improve gravel recruitment, over-winter habitat improve pools, spawning & rearing habitat	x			
South Fork Rock Cr, tribs of	1998	peak flow passage improvements surface drainage improvements	improve road/upslope drainage decrease erosion/stream sedimentation decrease runoff contaminants				
Squaw Cr	2001	1 culvert removed and not replaced		x			x
Stanley Cr	2000	peak flow passage improvements surface drainage improvements	improve road/upslope drainage & stability decrease erosion/stream sedimentation decrease washout potential at stream crossings				
Upper North Fork Clear Cr	1997	peak flow passage improvements Voluntary Riparian Tree Retention surface drainage improvements	improve road/upslope drainage decrease erosion/stream sedimentation decrease washout potential at stream crossings decrease stream temperature improve streambank stabilzation				
Walker Cr & West Fork Walker Cr	2000	peak flow passage improvements surface drainage improvements	improve road/upslope drainage & stability decrease erosion/stream sedimentation decrease washout potential at stream crossings decrease runoff contaminants				
Walker Cr, Northrup Cr/ Big Cr	2002	peak flow passage improvements surface drainage improvements road vacated	improve road/upslope drainage & stability decrease erosion/stream sedimentation decrease runoff contaminants decrease road access				
Walker Cr, trib of	1998	peak flow passage improvements surface drainage improvements	improve road/upslope drainage & stability decrease erosion/stream sedimentation decrease runoff contaminents				
Walker Cr, trib of	1999	1 culvert replaced					x
Walker Cr, tribs of	2002	peak flow passage improvements surface drainage improvements	improve road/upslope drainage decrease erosion/stream sedimentation decrease runoff contaminents				
Warner Cr	2002	1 culvert replaced with open bottom arch culverts					x
Warner Cr	2002	peak flow passage improvements surface drainage improvements road vacated	improve road/upslope drainage & stability decrease erosion/stream sedimentation decrease runoff contaminents decrease washout potential at stream crossings decrease road density flood/slide repair				

Table 14. Potential instream enhancement sites for the Upper Nehalem River basin ranked according to priority level.

Stream name	Length (m)	Length (ft)	Channel Width	. Priority	Access	Habitat Survey	Work '90-'96	Field Verified	ODF District	Potential project extent From	To	Treated Since 1997?	Type	Miles affected
South Fork Rock Creek	2200	7216	4-12m	1	H	yes		X	FG	HWY 26	Shields Rd	Y	Large wood	0.8
South Fork Rock Creek	1780	5840	4-12m	1	H	yes		X	FG	Mouth	HWY 26			
Olson Creek	1274	4178	4-12m	2	M			X	FG	ROCK CREEK	END OF COHO			
Rock Creek	1832	6010	12-20m	2	M	yes		X	FG	North Fork Rock Creek	TJ/			
Rock Creek Trib C	401	1317	4-12m	2	M			X	AST	ROCK CREEK	END OF COHO	Y	Replaced culverts	1.5
Wolf Creek	5200	17057	12-20m	2	H			X	FG	NEHALEM RIVER	NORTH FORK WOLF CREEK			
Wolf Creek	1429	4687	4-12m	2	M			X	FG	NORTH FORK WOLF CREEK	WOLF CREEK FALLS			
North Fork Wolf Creek	4213	13820	4-12m	2	M	yes	96	X	FG	WOLF CREEK	END OF COHO	Y	Large wood	1.0
North Fork Wolf South Trib	1602	5253	4-12m	2	U				FG	NORTH FORK WOLF CREEK	END OF COHO			
North Fork wolf Creek Trib B	1375	4512	4-12m	2	M				FG	NORTH FORK WOLF CREEK	END OF COHO			
North Fork wolf Creek Trib B	86	281	4-12m	2	M				FG	NORTH FORK WOLF CREEK	END OF COHO			
Lousignont Creek(Timber)	1998	6555	4-12m	2	M	yes		X	FG	CARLSON CREEK	END OF COHO	Y	Large wood	2.0
Lousignont Creek(Timber)	1704	5588	4-12m	2	H	yes		X	FG	CARLSON CREEK	END OF COHO	Y	Large wood	
North Fork Lousignont Creek	3402	11159	4-12m	2	M			X	FG	LOUISIGNONT CREEK	END OF COHO			
South Fork Louisignont Trib A	1104	3622	4-12m	2	U				FG	SOUTH FORK LOUISIGNONT CI	END OF COHO			
Nehalem River	2158	7077	4-12m	2	M	yes		X	FG	HANS CREEK	END OF COHO			
South Fork Nehalem River	1343	4405	4-12m	2	M	yes		X	FG	HANS CREEK	END OF COHO			
Step Creek	536	1758	4-12m	2	M			X	FG	NEHALEM RIVER	END OF COHO			
Nehalem River	422	1385	4-12m	3	L	yes		X	FG	HANS CREEK	END OF COHO(DOTY POND?)			
Upper Nehalem River Trib B	598	1963	4-12m	3	L				FG	NEHALEM RIVER	END OF COHO			
Selder Creek	1859	6099	4-12m	4	N				AST	ROCK CREEK	END OF COHO			
Olson Creek	832	2730	4-12m	4	N			X	FG	ROCK CREEK	END OF COHO			
North Fork Rock Creek	1950	6395	4-12m	4	N	yes		X	AST	Large TJ/	End of Coho			
North Fork Rock Creek Trib B	1096	3596	4-12m	4	N				AST	Mouth	End of Coho			
South Fork Rock Creek	1001	3284	4-12m	4	N	yes		X	FG	Above Shields Rd	End of Coho			
Bear Creek(Rock Creek)	1622	5319	4-12m	4	H	yes		X	FG	SOUTH FORK ROCK CREEK	END OF COHO			
North Fork Wolf Creek	1429	4688	4-12m	4	N	yes		X	FG	WOLF CREEK	END OF COHO			
Lousignont Creek(Timber)	1528	5013	4-12m	4	N	yes		X	FG	NORTH FORK LOUISIGNONT CI	CARLSON CREEK			
Carlson Creek	1567	5138	4-12m	4	M	yes		X	FG	SOUTH FROK LOUISGINONT CI	END OF COHO			
Carlson Creek	914	2999	4-12m	4	N	yes		X	FG	SOUTH FROK LOUISGINONT CI	END OF COHO			
Nehalem River	6869	22530	12-20m	4	U				FG	CASTOR CREEK	STEP CREEK			
Nehalem River	756	2480	12-20m	4	M	yes		X	FG	STEP CREEK	HANS CREEK			
Nehalem River	972	3189	12-20m	4	M	yes		X	FG	STEP CREEK	HANS CREEK			
Nehalem River	1500	4918	4-12m	4	N	yes		X	FG	STEP CREEK	HANS CREEK			
Nehalem River	875	2869	4-12m	4	N	yes		X	FG	HANS CREEK	END OF COHO(DOTY POND?)			
Step Creek	972	3189	4-12m	4	N				FG	NEHALEM RIVER	END OF COHO			
Derby Creek	280	917	4-12m	4	N				FG	NEHALEM RIVER	END OF COHO			

Priority:1 = High, 2 = Moderate, 3 = Low, 4 = Very Low, 5 = Federal Land (no priority); Access: H = High, M = Moderate, L = Low, U = Unknown;ODF District: AST = Astoria, FG = Forest Grove, TILL = Tillamook.

Table 14 (cont). Potential instream enhancement sites for the Jewell area of the Nehalem River basin ranked according to priority.

										Potential project extent		Treated		
Stream name	Length (m)	Length (ft)	Channel Width	. Priority	Access	Habitat Survey	Work '90-'96	Field Verified	ODF District	From	To	Since 1997?	Type	Miles affected
East Humbug Creek	3428	11245	4-12m	1	H			X	AST	1ST RD X-ING	END OF ROAD ACCESS			
Buster Creek	1789	5866	4-12m	1	H		96	X	AST	WALKER CREEK	STANLEY CREEK			
Buster Creek	3280	10758	4-12m	1	H			X	AST	STANLEY CREEK	END OF ROAD ACCESS			
Walker Creek	5892	19326	4-12m	1	H	yes		X	AST	2ND WALKER CR RD X-ING	END OF ROAD ACCESS	Y	Culvert replaced	0.1
East Humbug Creek	1738	5699	4-12m	2	U				AST	END OF ROAD ACCESS	END OF COHO			
Quartz Creek	1985	6511	4-12m	2	U	yes			AST	NEHALEM RIVER	HIGH GRADIENT REACH BELOW S FK			
Moores Creek	655	2150	4-12m	2	H	yes				NEHALEM RIVER	END OF COHO	Y	Culv. removed, road vacated	0.2
Buster Creek	888	2914	4-12m	2	M			X	AST	END OF LOWER RD ACCESS	END OF COHO	Y	Culvert replaced	1.0
Walker Creek(Buster Creek)	1253	4111	4-12m	2	M			X	AST	BUSTER CREEK	TJ UPSTREAM OF WAGE RD			
Stanley Creek	1259	4131	4-12m	2	U				AST	BUSTER CREEK	END OF COHO			
Hamilton Creek	3399	11149	4-12m	2	M	yes	95	X	AST	FISHHAWK CREEK	END OF ROAD ACCESS	Y	Culvert replaced	1.9
Grub Creek	950	3115	4-12m	2	U				AST	NEHALEM RIVER	END OF COHO			
Squaw Creek	4495	14745	4-12m	2	U				AST	NEHALEM RIVER	END OF COHO	Y	Culvert removed	1.1
West Branch Squaw Creek	1248	4095	4-12m	2	U				AST	SQUAW CREEK	END OF COHO			
Northrup Creek	709	2324	4-12m	2	H			X	AST	ODF BOUNDARY	COW CREEK	Y	Culvert replaced	0.2
Northrup Creek	5912	19391	4-12m	2	M			X	AST	COW CREEK	END OF COHO	Y	Large wood	1.5
Sager Creek	2513	8241	4-12m	2	M	yes		X	AST	NEHALEM RIVER	EAST SAGER CREEK			
East Sager Creek	1696	5564	4-12m	2	M			X	AST	SAGER CREEK	END OF COHO	Y	Culv. removed, road vacated	1.0
Deep Creek	403	1322	4-12m	2	U			X	AST	TJ AT T6N-R6W-12	END OF COHO			
Deep Creek	3099	10165	4-12m	2	U	yes			AST	TJ/ AT T5N-R5W-19NW	TJ AT END OF DEEP CREEK RD.			
Deep Creek Trib C	402	1319	4-12m	2	U				AST	TJ AT T6N-R6W-12	END OF COHO			
Warner Creek	1515	4970	4-12m	2	U	yes			AST	FISHHAWK CREEK	END OF COHO	Y	Culvert replaced	2.5
Buster Creek Trib A	167	547	4-12m	3	H				AST	BUSTER CREEK	END OF COHO	Y	Culvert replaced	0.3
Beneke Creek	1609	5279	4-12m	3	L			X	AST	BULL HEIFER CREEK	TJ AT T6N-R7W-11C			
Cow Creek	2908	9537	4-12m	3	H			X	AST	NORTHRUP CREEK	200M ABOVE COW CR ROAD	Y	Culverts replaced	3.9
Cow Creek(Vinemaple)	1383	4537	4-12m	4	N	yes		X	AST	END OF ROAD ACCESS	END OF COHO(FALLS)			
Klines Creek(South)	1107	3630	4-12m	4	N	yes		X	AST	NEHALEM RIVER	END OF COHO			
Buster Creek	3844	12607	12-20m	4	U			X	AST	NEHALEM RIVER	/TJ AT T5N-R6W-30NW			
Buster Creek	2783	9128	4-12m	4	N			X	AST	END OF LOWER RD ACCESS	END OF COHO			
Buster Creek Trib B	1908	6257	4-12m	4	N				AST	BUSTER CREEK	END OF COHO			
Buster Creek Trib C	1077	3532	4-12m	4	N				AST	BUSTER CREEK	END OF COHO (BELOW RD X-ING)			
Walker Creek(Buster Creek)	2014	6606	4-12m	4	N			X	AST	WALKER CREEK	END OF COHO			
Walker Creek(Buster Creek) Trib	1473	4832	4-12m	4	N			X	AST	WALKER CREEK	END OF COHO			
Hamilton Creek	2302	7551	4-12m	4	N	yes		X	AST	END OF ROAD ACCESS	END OF COHO			
Beneke Creek	5163	16934	12-20m	4	H	yes		X	AST	GILMORE CREEK	WALKER CREEK			
Beneke Creek	1600	5249	4-12m	4	N				AST	END OF ROAD ACCESS	BULL HEIFER CREEK			
Bull Heifer Creek	500	1640	4-12m	4	N				AST	BENEKE CREEK	END OF COHO			
Beneke Creek	222	729	4-12m	4	N				AST	BULL HEIFER CREEK	TJ AT T6N-R7W-11C			
Gilmore Creek Trib A	1929	6326	4-12m	4	N				AST	GILMORE CREEK	END OF COHO			
Trailover Creek	1645	5395	4-12m	4	N	yes			AST	WALKER CREEK	END OF COHO			
Walker Creek	2712	8896	4-12m	4	N			X	AST	/TJ AT T5N-R6W-20	END OF COHO			
Walker Creek	6001	19682	4-12m	4	N	yes		X	AST	END OF ROAD ACCESS	END OF COHO			

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Table 14 continued. Potential instream enhancement sites for the Jewell area of the Nehalem River basin ranked according to priority level.

Stream name	Length (m)	Length (ft)	Channel Width	. Priority	Access	Habitat Survey	Work '90-'96	Field Verified	ODF District	Potential project extent From	To	Treated Since 1997?	Type	Miles affected
Crawford Creek	1343	4403	4-12m	4	N				AST	NEHALEM RIVER	END OF COHO			
Grub Creek	1336	4383	4-12m	4	N				AST	NEHALEM RIVER	END OF COHO			
Nehalem River Trib B	756	2478	4-12m	4	N				AST	NEHALEM RIVER	END OF COHO			
Northrup Creek	576	1889	4-12m	4	N			X	AST	COW CREEK	END OF COHO			
Cow Creek	1907	6256	4-12m	4	N			X	AST	200M ABOVE COW CR RD	END OF COHO			
Sager Creek	2854	9360	4-12m	4	N	yes		X	AST	EAST SAGER CREEK	END OF COHO			
Lousignont Creek(Birkenfeld)	4233	13884	4-12m	4	N				AST	NEHALEM RIVER	END OF COHO			
Deep Creek	1287	4223	4-12m	4	N				AST	TJ AT T6N-R6W-12	END OF COHO			
Deep Creek Trib B	3179	10427	4-12m	4	N				AST	DEEP CREEK	END OF COHO			
Deep Creek Trib C	804	2638	4-12m	4	N				AST	TJ AT T6N-R6W-12	END OF COHO			
Fishhawk Creek(Birkenfeld)	3116	10222	12-20m	4	H			X	AST	END OF AG LAND USE	FISHHAWK LAKE	Y	Off Channel, Riparian, Culvert	0.4
Warner Creek	680	2232	4-12m	4	N	yes			AST	FISHHAWK CREEK	END OF COHO			
Slaughters Creek	1536	5039	4-12m	4	U				AST	NEHALEM RIVER	END OF COHO			
West Branch Squaw Creek	635	2083	4-12m	4	N				AST	SQUAW CREEK	END OF COHO			

Priority:1 = High, 2 = Moderate, High, M = M High, M = Moderate, L = Low, U = Unknown;ODF District: AST = Astoria, FG = Forest Grove, TILL = Tillamook.

Potential instream enhancement sites for the Middle Nehalem River basin ranked according to priority level.

Stream name	Length (m)	Length (ft)	Channel Width	. Priority	Access	Habitat Survey	Work '90-'96	Field Verified	ODF District	Potential project extent From	To	Treated Since 1997?	Type	Miles affected
Oak Ranch Creek	3287	10781	4-12m	1	H	yes		X	FG	ROCK PIT ABOVE APIARY RD X	CAMP WILKERSON			
Oak Ranch Creek	2502	8207	4-12m	2	U	yes		X	FG	CAMP WILKERSON	TJ AT T5N-R3W-21NW			
Oak Ranch Creek	1518	4979	4-12m	2	U				FG	TJ AT T5N-R3W-21NW	END OF COHO			
Oak Ranch Creek	902	2957	4-12m	4	N			X	FG	CAMP WILKERSON	TJ AT T5N-R3W-21NW			
Pebble Creek	2162	7091	4-12m	4	N			X	FG	WEST FORK PEBBLE CREEK	END OF COHO			
Dell Creek	1810	5936	4-12m	4	N	yes			FG	PEBBLE CREEK	END OF COHO			

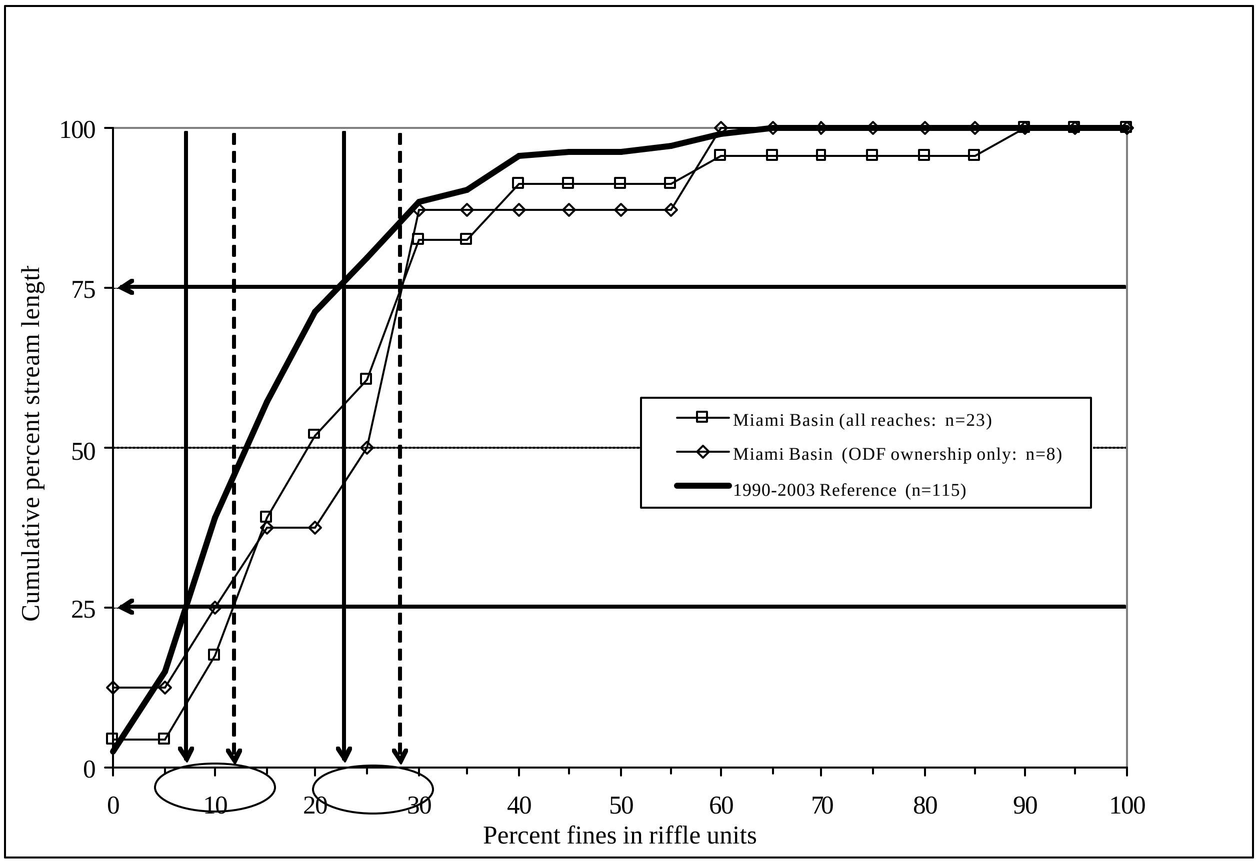
Priority:1 = High, 2 = Moderate, 3 = Low, 4 = Very Low, 5 = Federal Land (no priority); Access: H = High, M = Moderate, L = Low, U = Unknown;ODF District: AST = Astoria, FG = Forest Grove, TILL = Tillamook.

Table 15. Criteria for selecting restoration sites

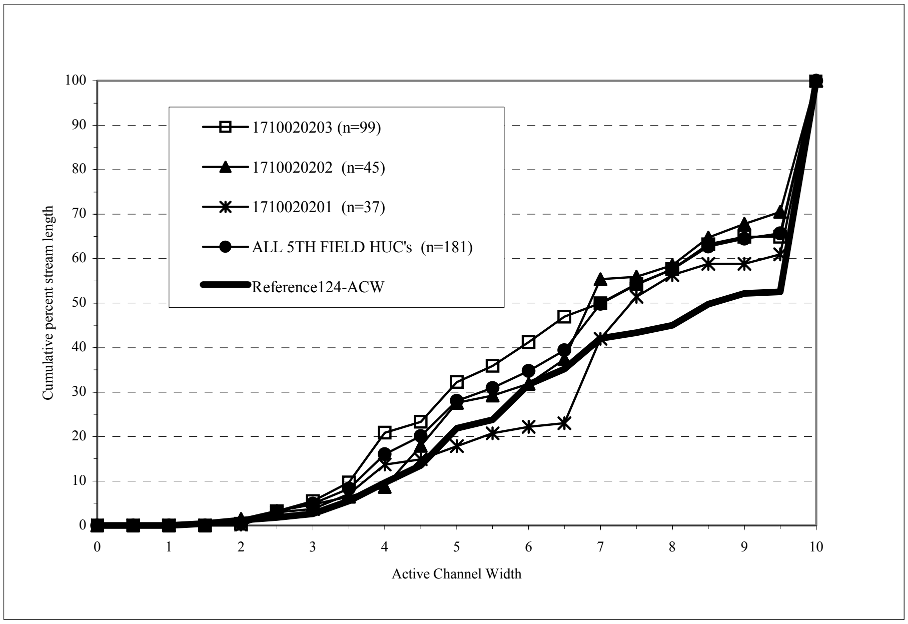
Best stream reaches for restoration	Poor stream reaches for restoration	Rational	Solution
low gradient (<5%)	high gradient (>5%)	Structures placed in steep reaches will probably get washed down stream.	Although the overall gradient may be steep, it may be possible to locate flats or benches of low gradient. Instream work should be limited to such areas.
moderate channel size (<12m)	large channel size (>12m)	Structures placed in wide channels will probably get washed down stream.	Large channel restoration should use very large pieces of wood that partially extend into the channel.
moderate valley type	steep valley shape	Streams in steep valleys are constrained by the valley walls. During high flow events, there is limited over-wintering habitat potential.	Instream structures should be limited to sections of wider valley where stream energy can be dissipated.
water temperature cool enough for juvenile salmon summer survival	water too warm for juvenile salmon summer survival	Fish have water temperature tolerances.	Efforts to restore or improve streamside shading may result in water temperature suitable to salmonids.
water supply adequate to support young salmon summer survival	inadequate water supply to support young salmon summer survival	Fish need adequate water supply for survival	Although inadequate water supply during the summer, these reaches may provide over-wintering opportunities. However, if the stream is too steep, has inadequate water parameters, or not adjacent to summer rearing areas, there is little restoration potential. Restoration efforts in such streams should carefully assess winter rearing potential.
unobstructed access by juvenile and adult salmon during migration	restricted access to juvenile and adult migration	Salmon need access to the stream system	Streams blocked by culverts or other physical properties make them desirable for restoration.

How to read and interpret cumulative distribution frequency graphs.

The vertical solid (reference) and dashed (Miami basin) lines transect their respective cumulative frequency plots at the 25th and 75th percentiles. The vertical lines at the 75th percentile correspond with 22% (solid) and 28% (dashed) values on the x-axis. This indicates that 75% of the reference stream length surveyed had ≤22% fines in the riffles, compared to ≤28% fines for the Miami basin. These figures show that the difference between the reference and the Miami basin surveys (at the 75th percentile) is low. At the 25th percentile the reference surveys indicate that 25% of the stream length surveyed had ≤8% fines in riffles compared to ≤12% fines for the Miami basin. Comparing ODF land ownership to the reference surveys yield similar results, though at the 25th percentile the value is more similar to the reference value. In this example, the values that are equal to or less than the reference values at the 25th percentile are considered low. Values that meet or exceed reference values at the 75th percentile are considered high.



ODF NEHALEM PROJECT AREA



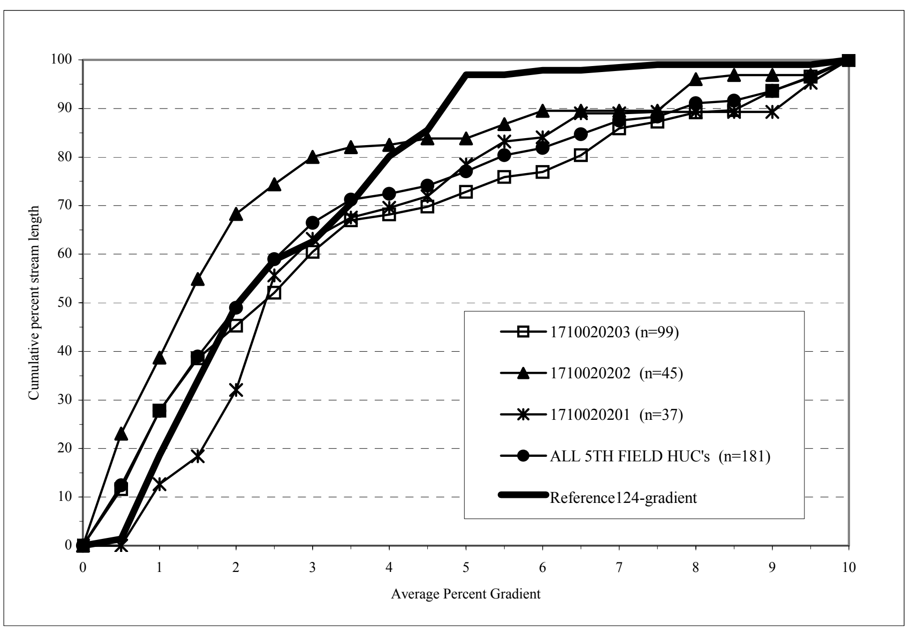
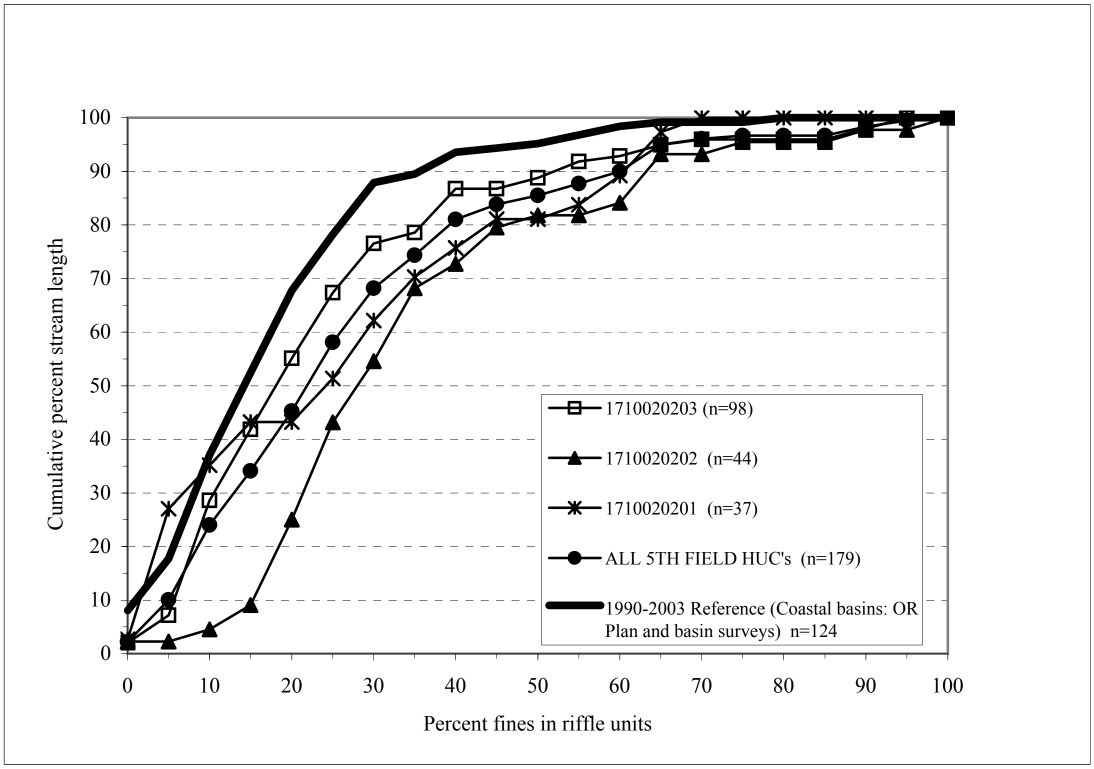


Figure 1. Comparison of active channel width and gradient in reaches in the Upper Nehalem study area to the reference reaches.

ODF NEHALEM PROJECT AREA



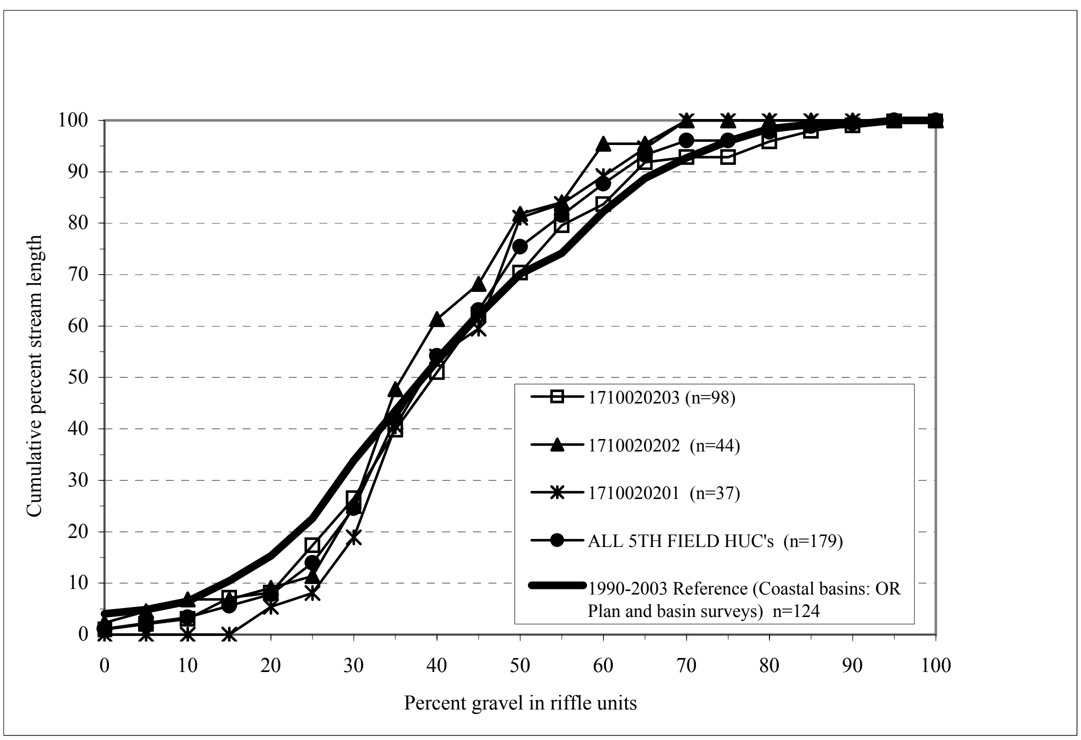
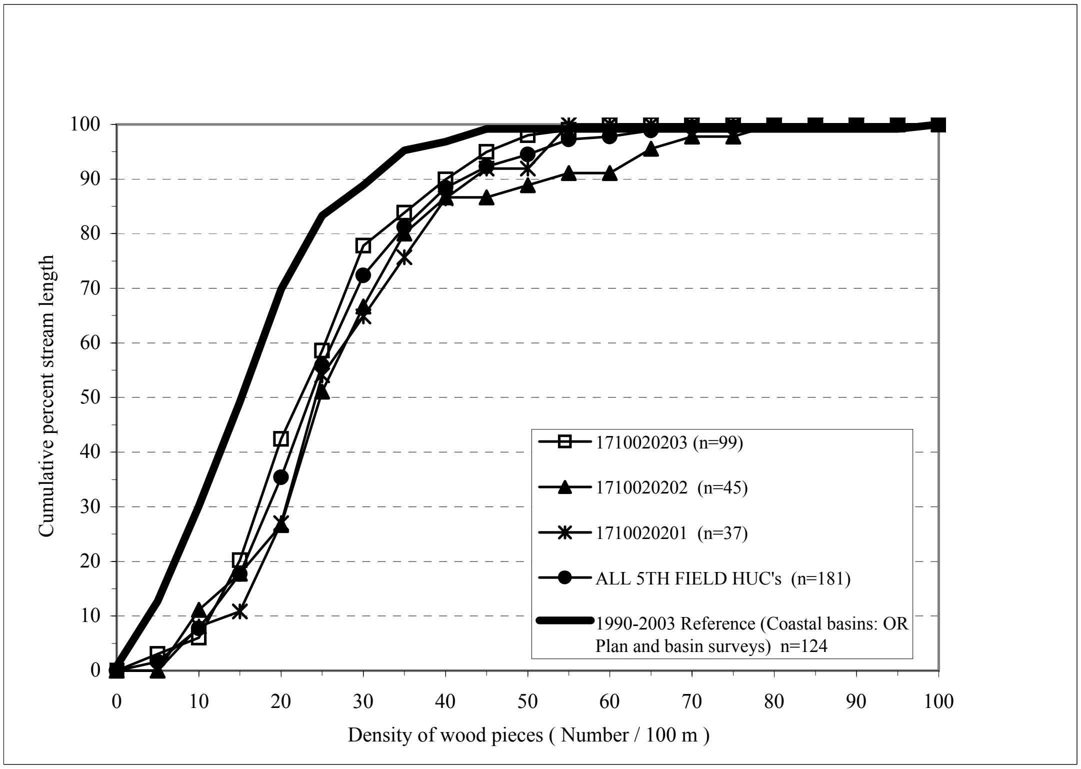


Figure 2

ODF NEHALEM PROJECT AREA



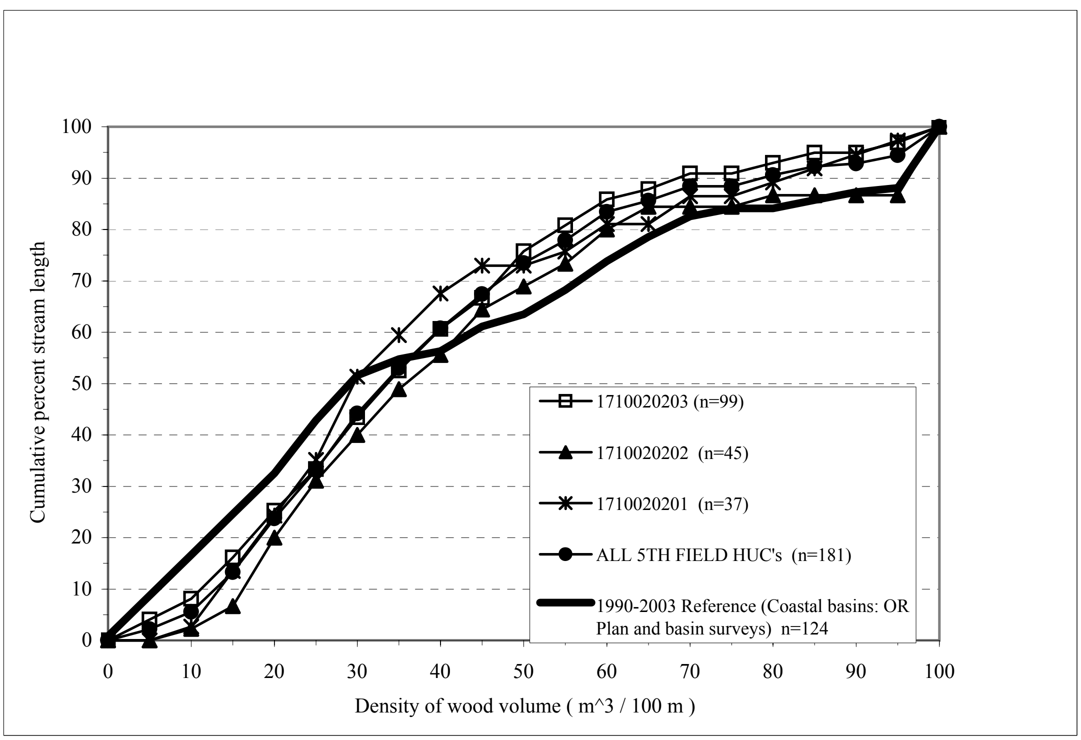
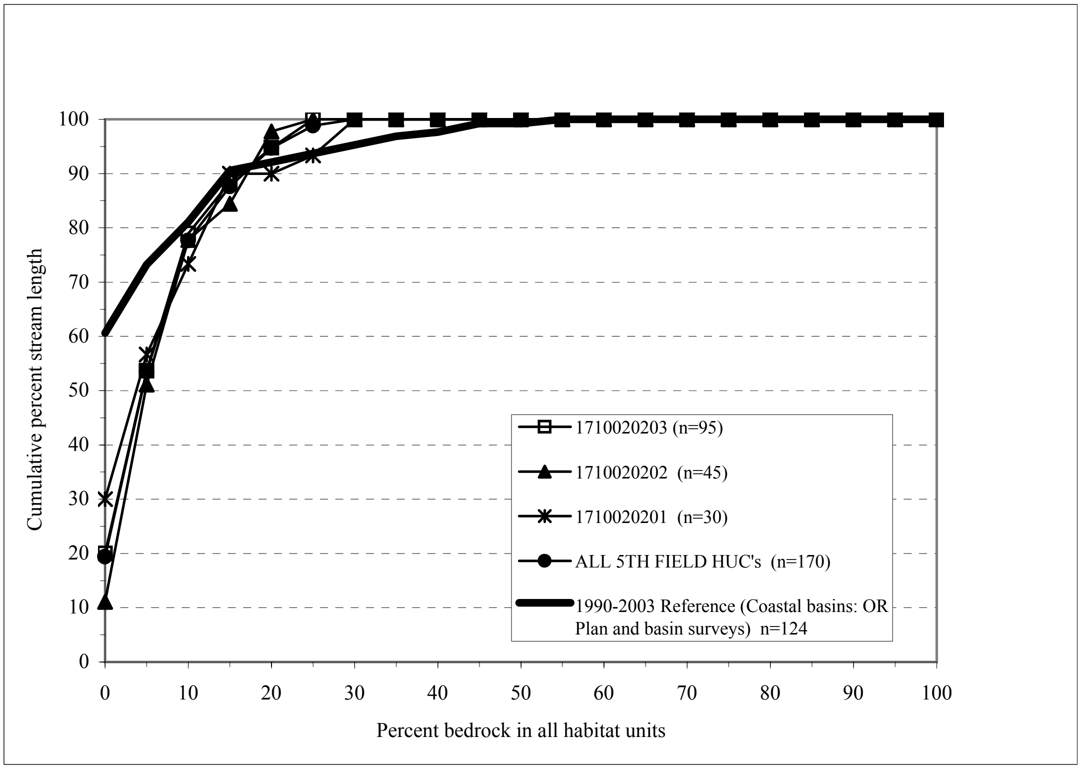


Figure 3

ODF NEHALEM PROJECT AREA



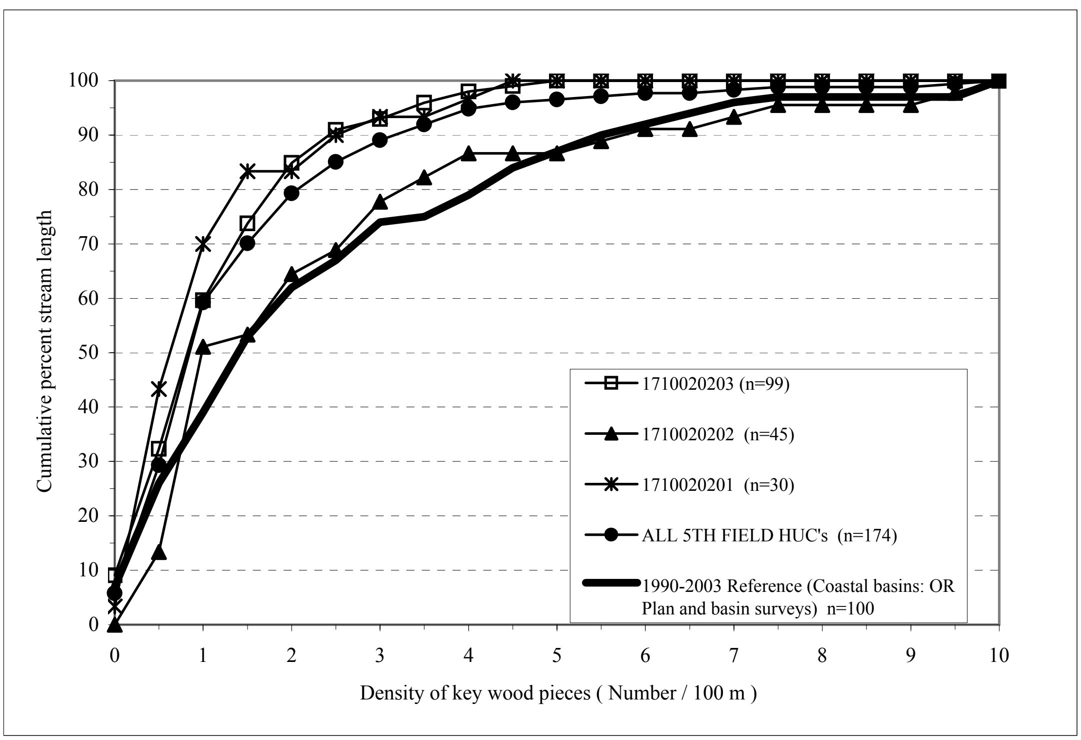
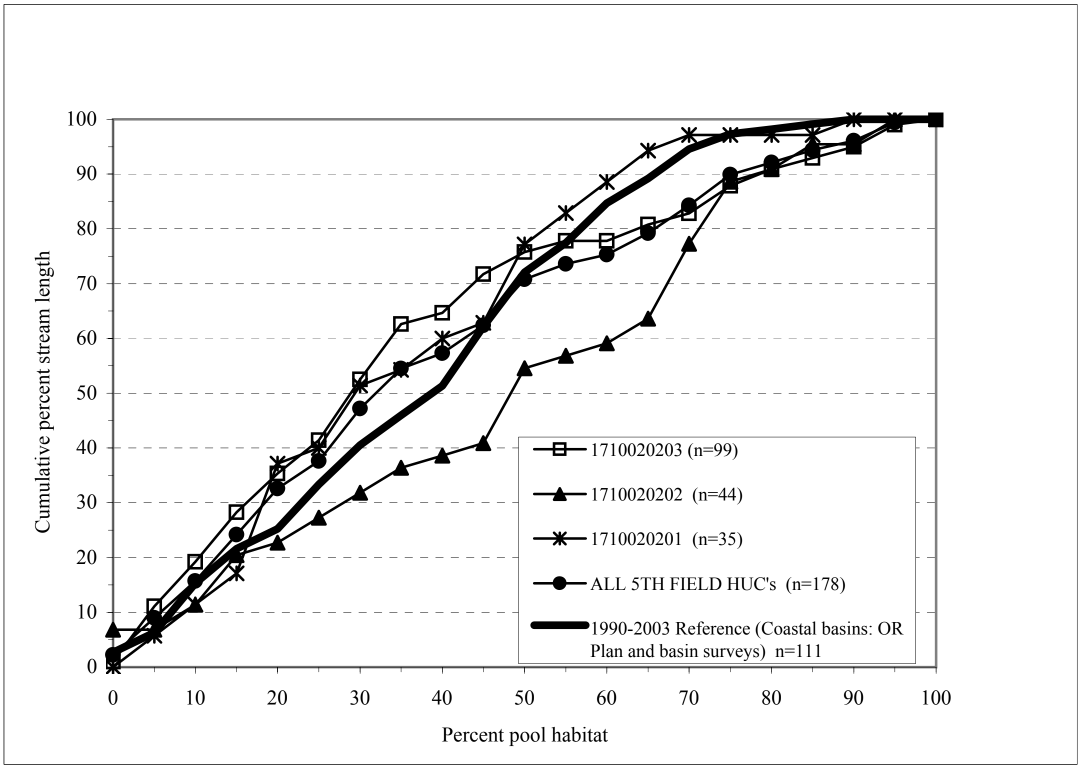


Figure 4

ODF NEHALEM PROJECT AREA



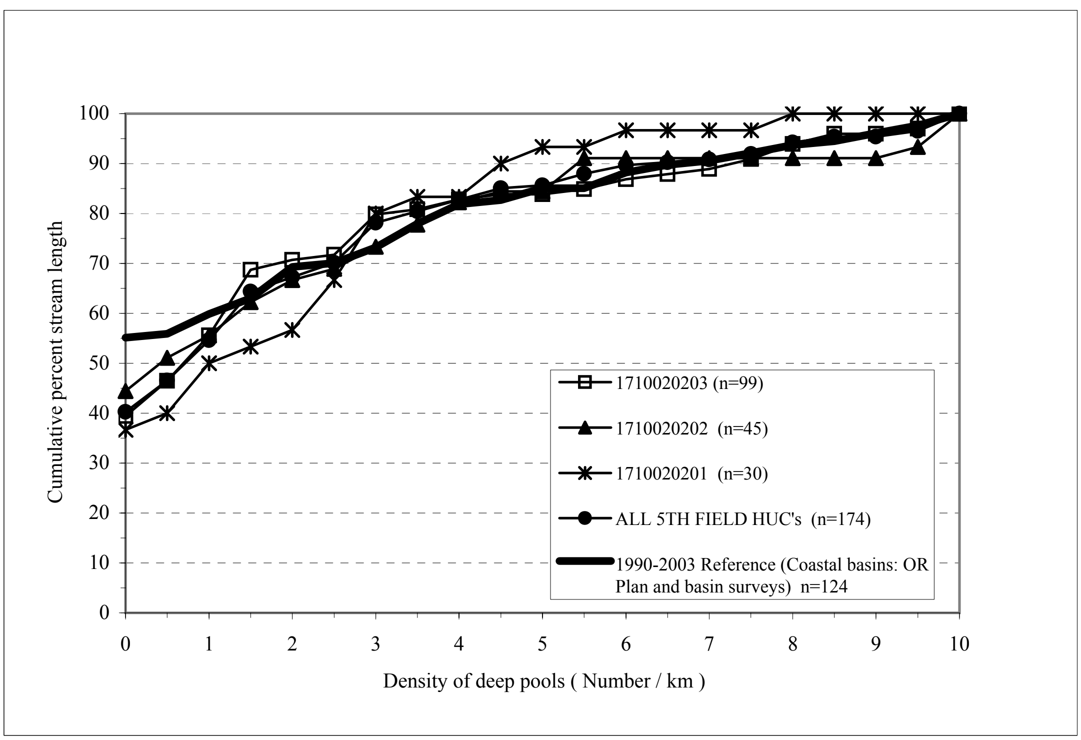
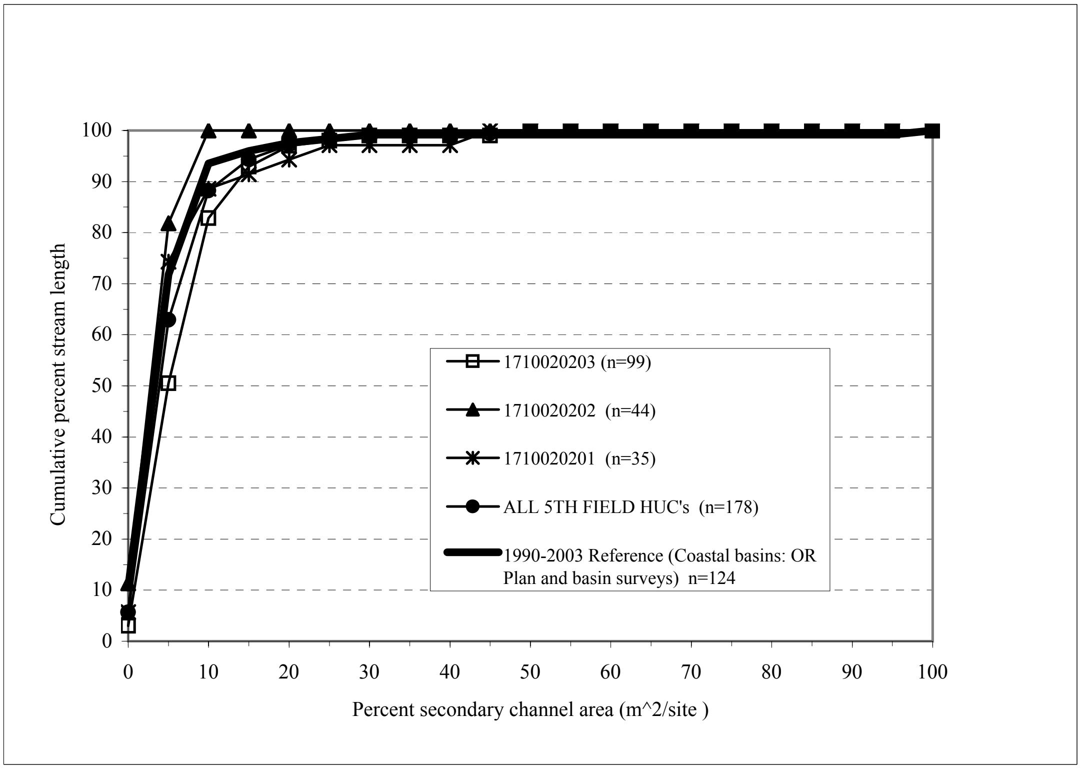


Figure 5

ODF NEHALEM PROJECT AREA



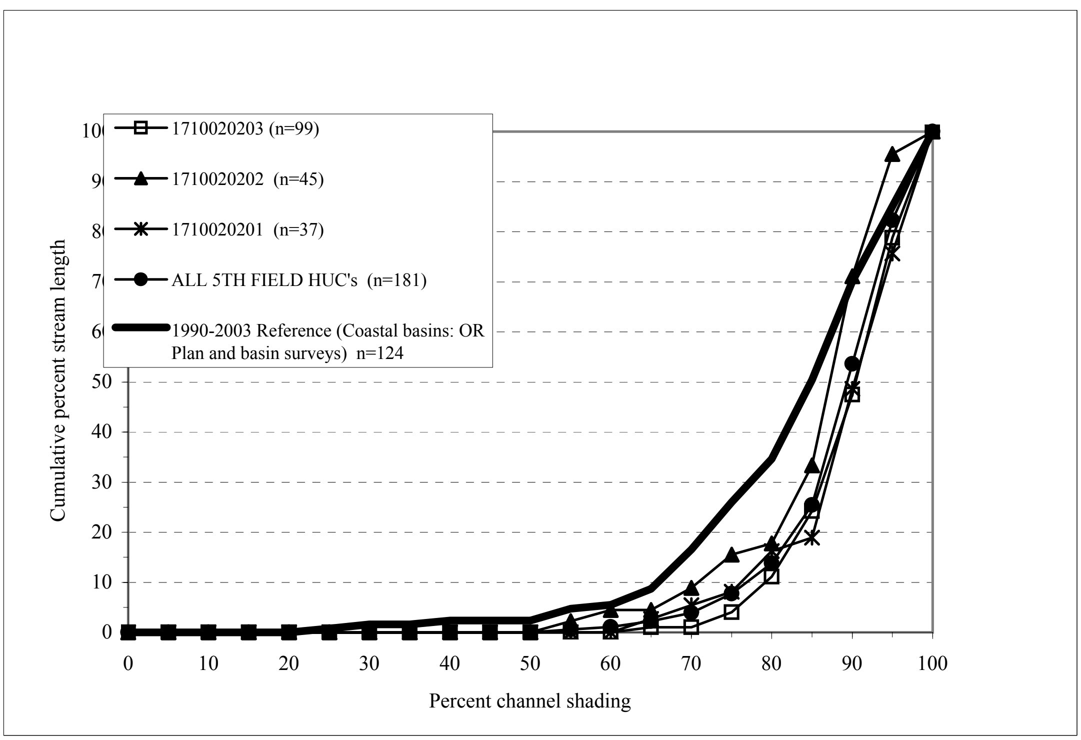
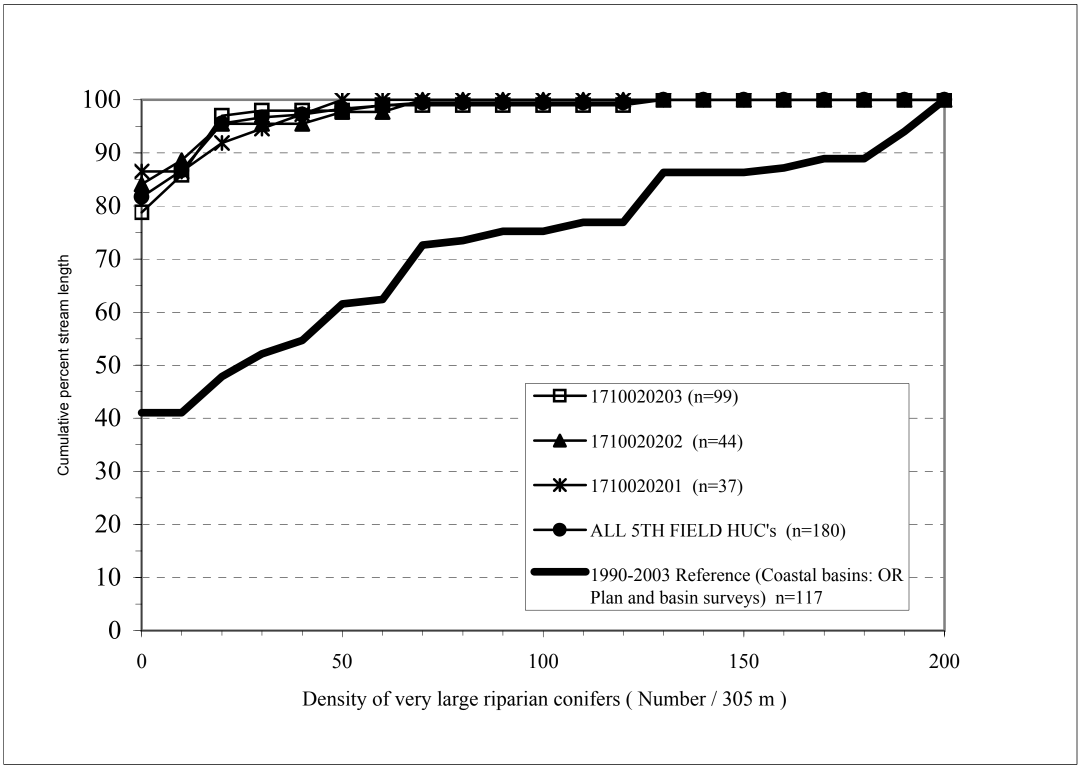


Figure 6

ODF NEHALEM PROJECT AREA



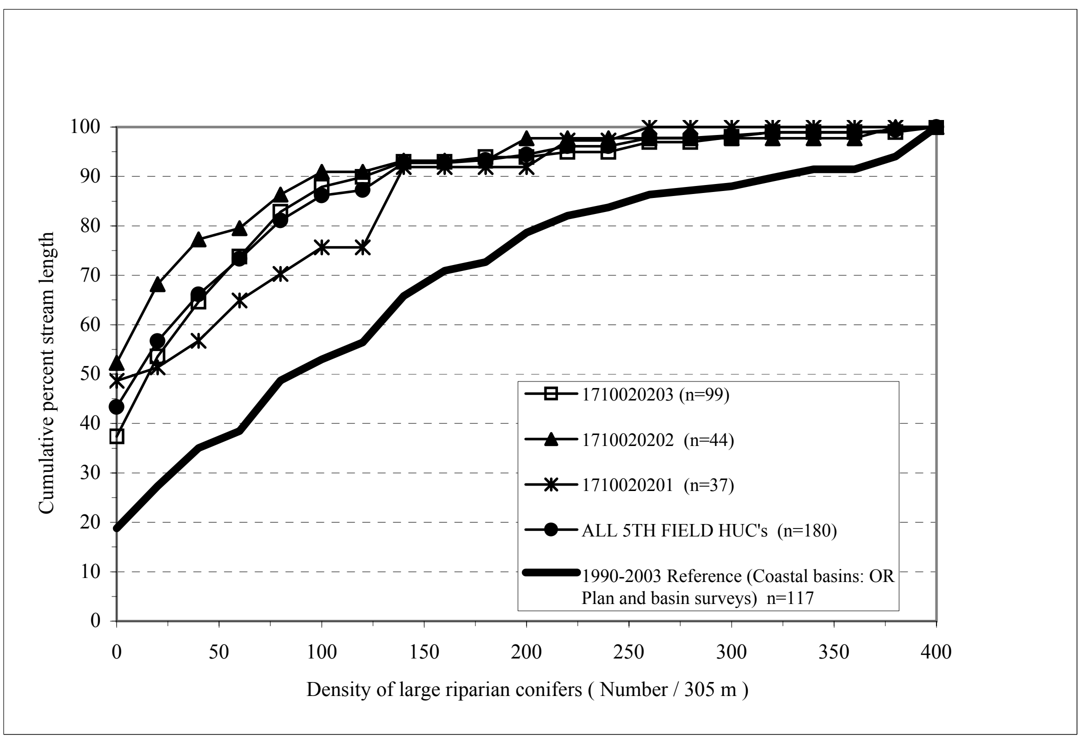


Figure 7

ODF NEHALEM PROJECT AREA

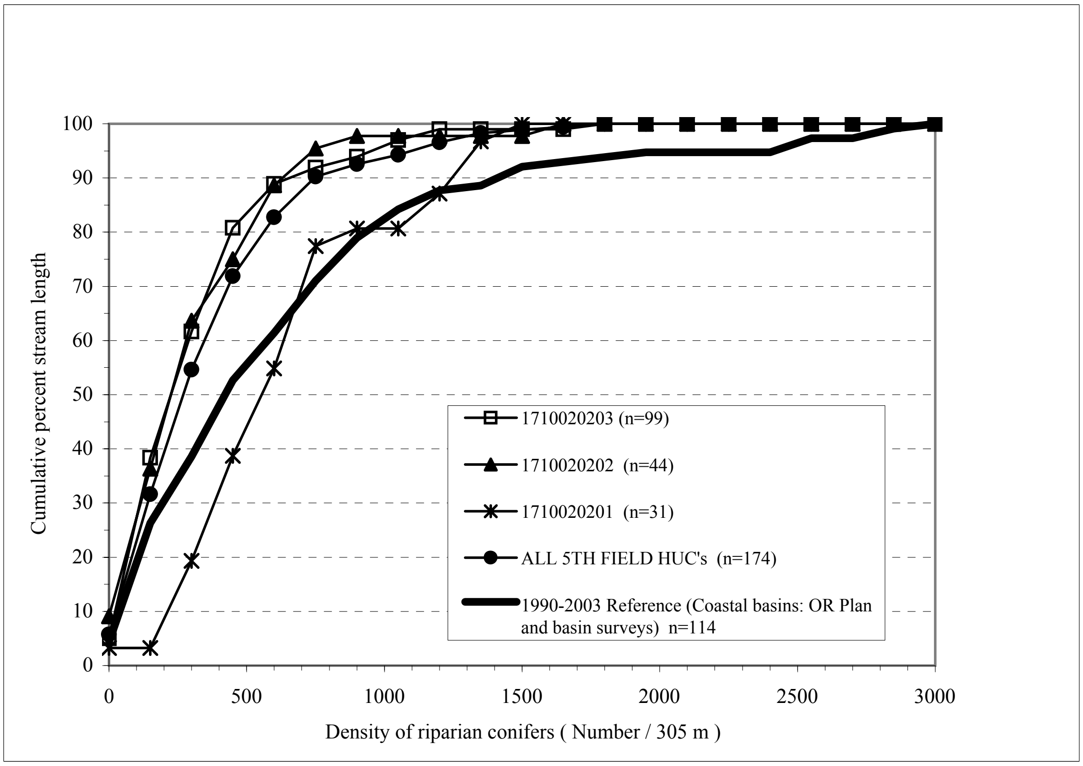


Figure 8

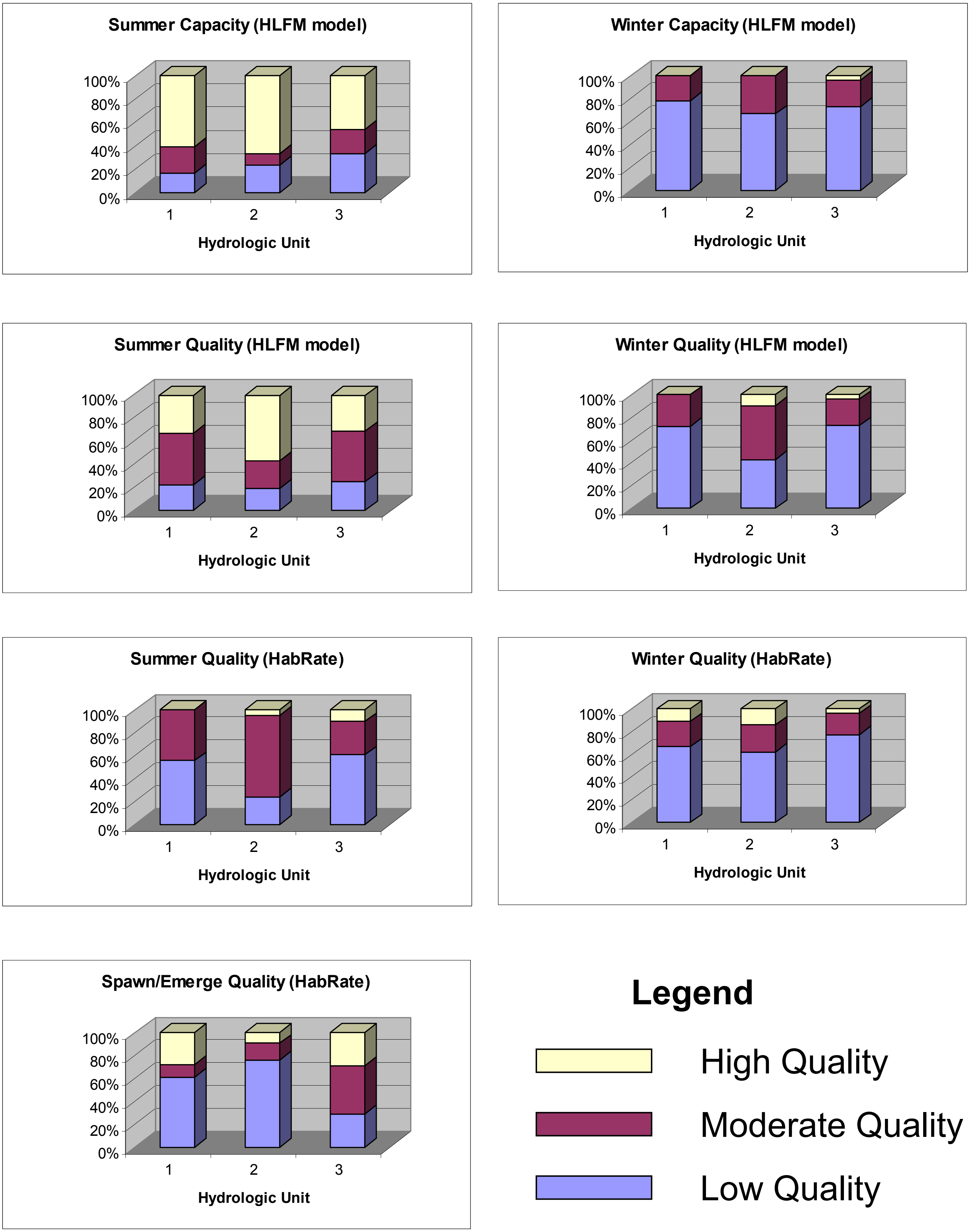
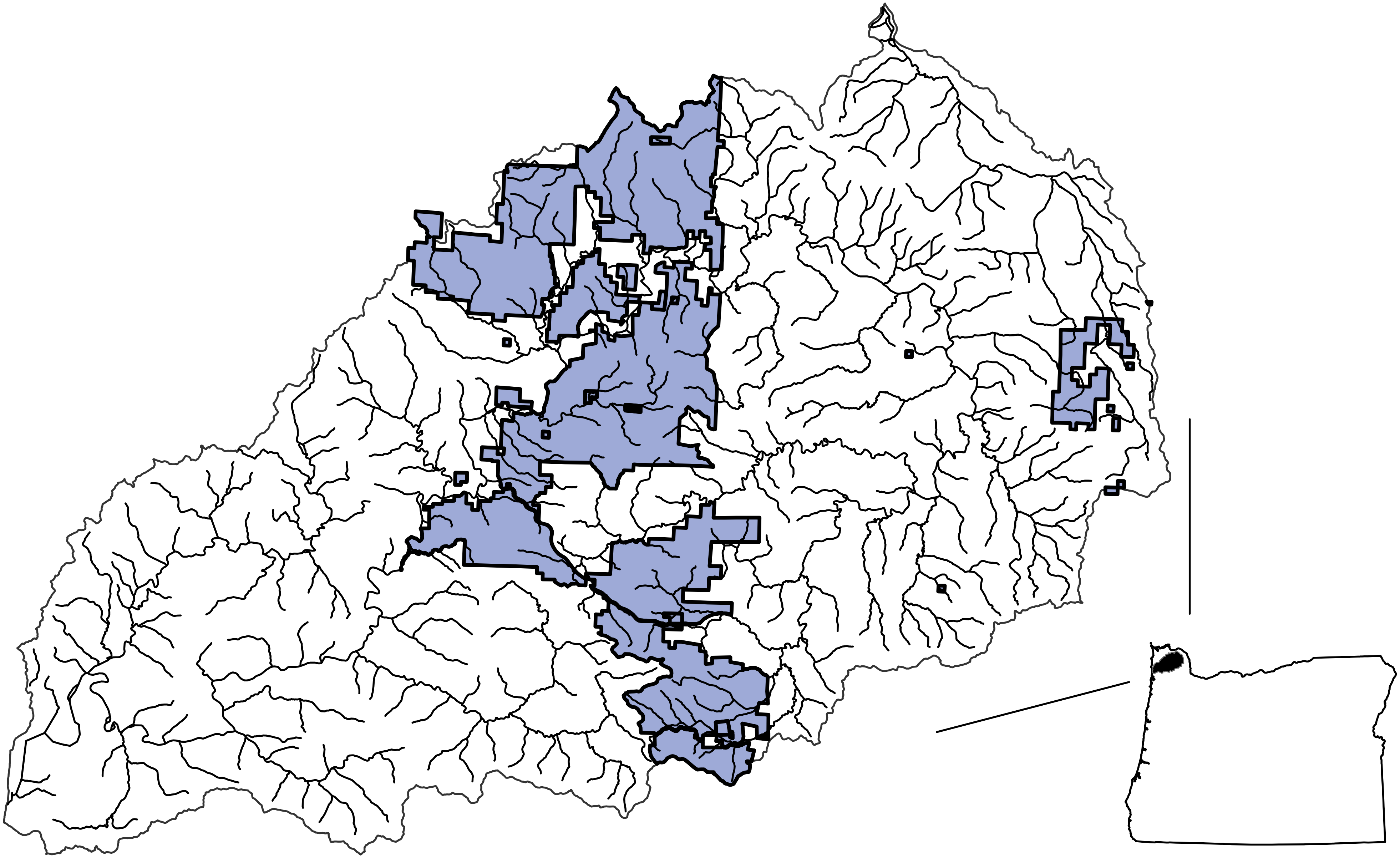
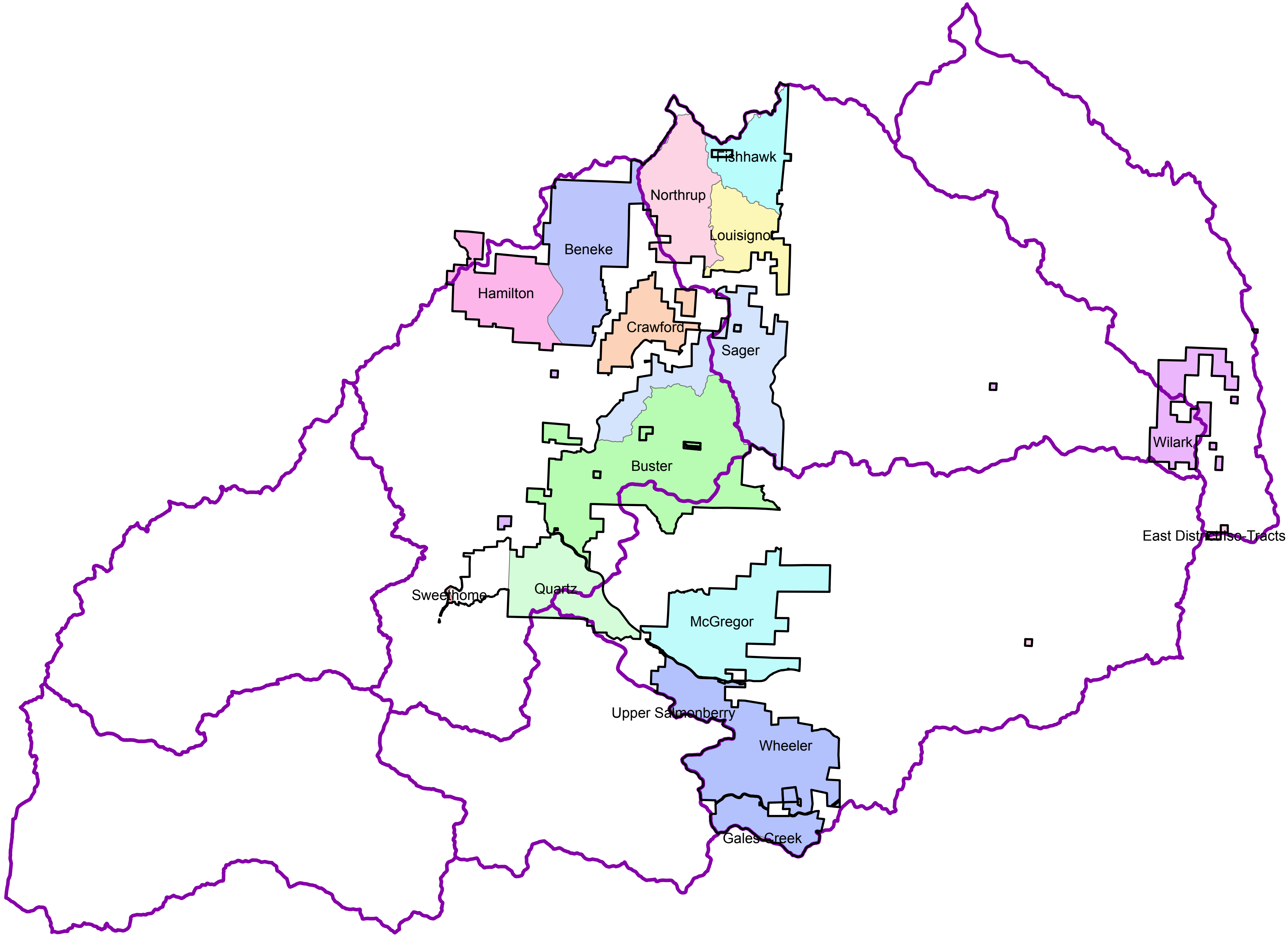


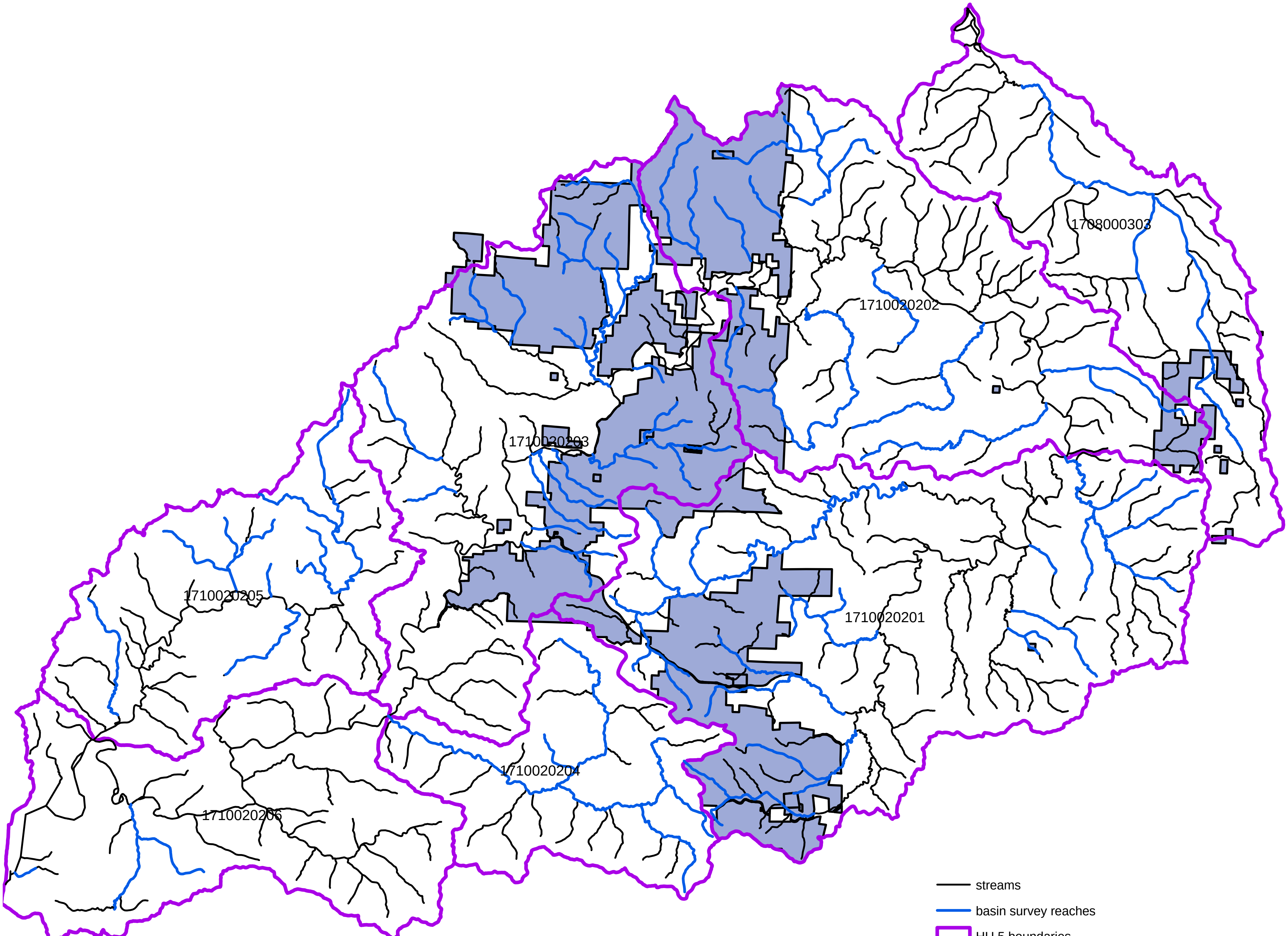
Figure 9. Fish habitat quality in the mid-Nehalem study area, by percent of survey reaches (n=87). Estimates of quality are based on HLFM and Habrate models.



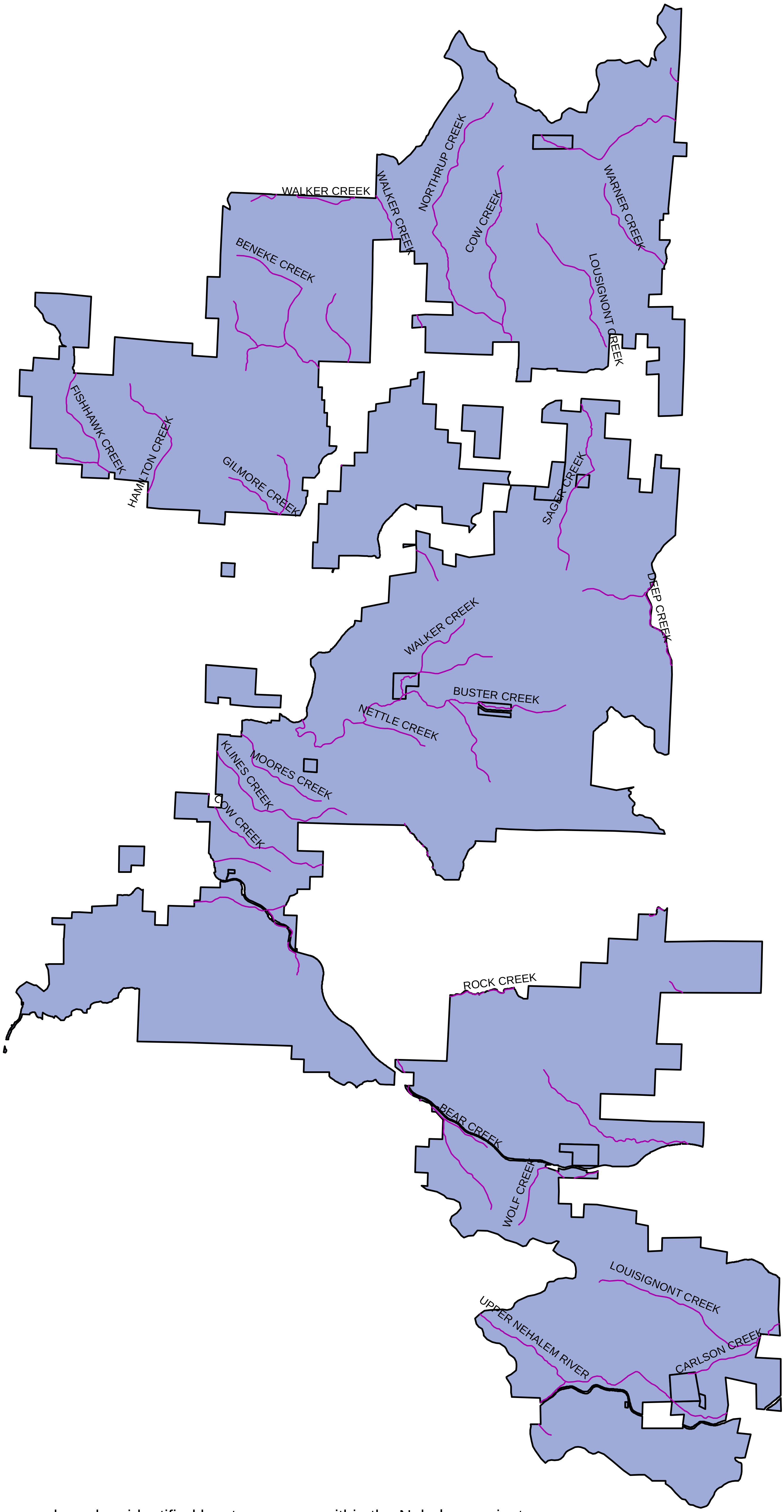
Map 1. Nehalem and Clatskanie project area in the state of Oregon.



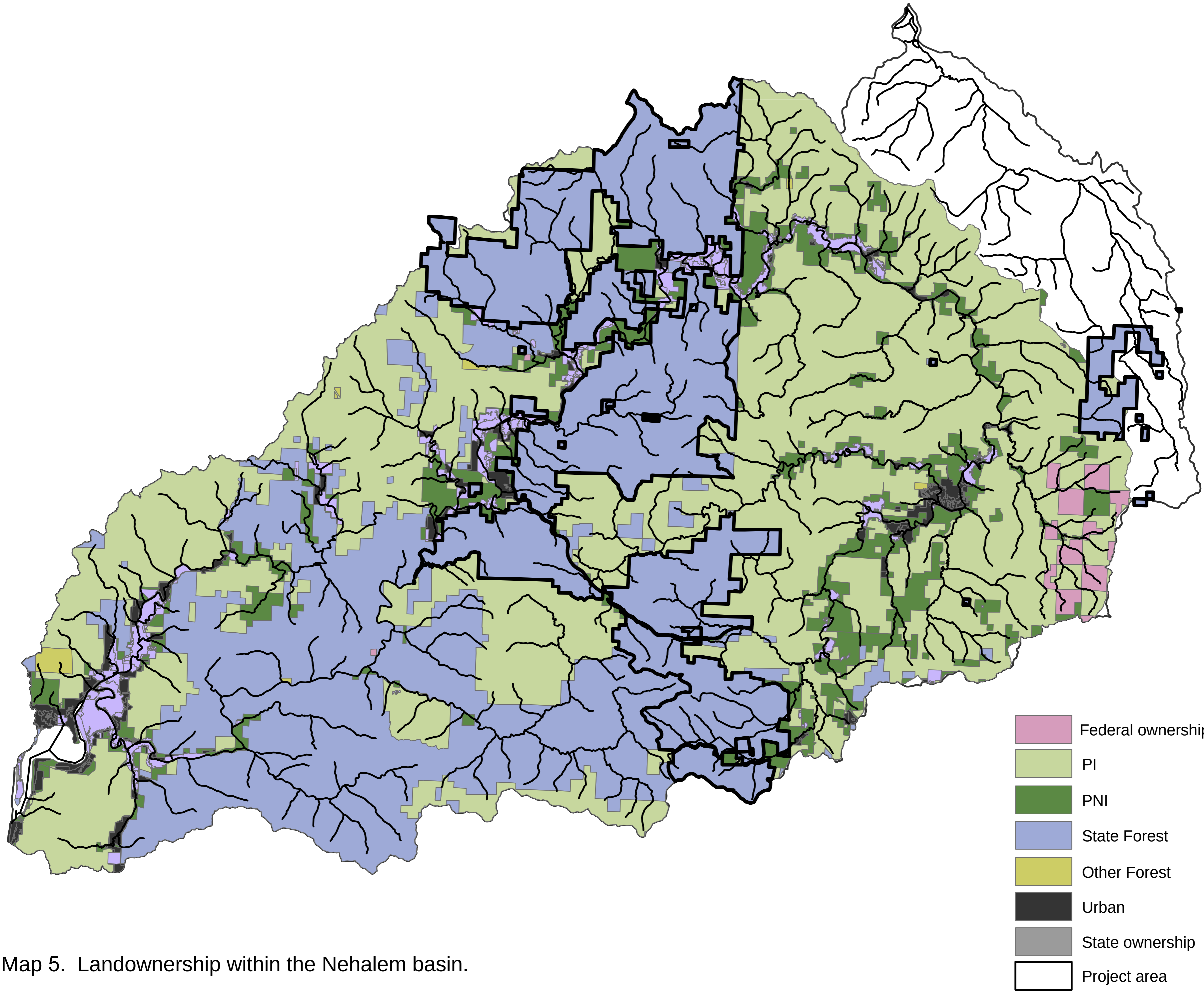
Map 2. Nehalem and Clatskanie study area with Oregon Department of Forestry management basins displayed as colored polygons and CLAMS 5th field HU outlined in purple.



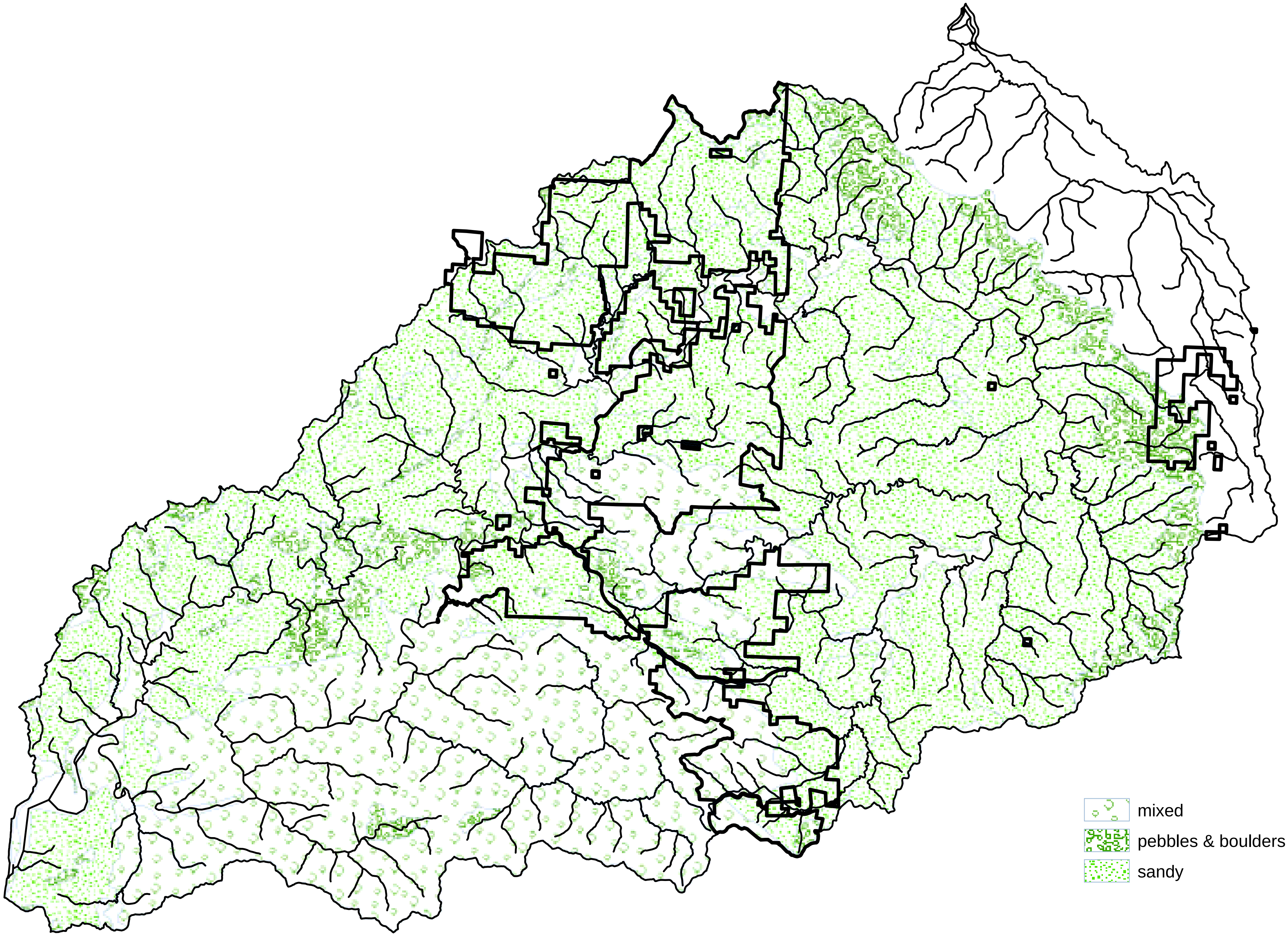
Map 3. Nehalem and Clatskanie study area with fifth field HUC designations.



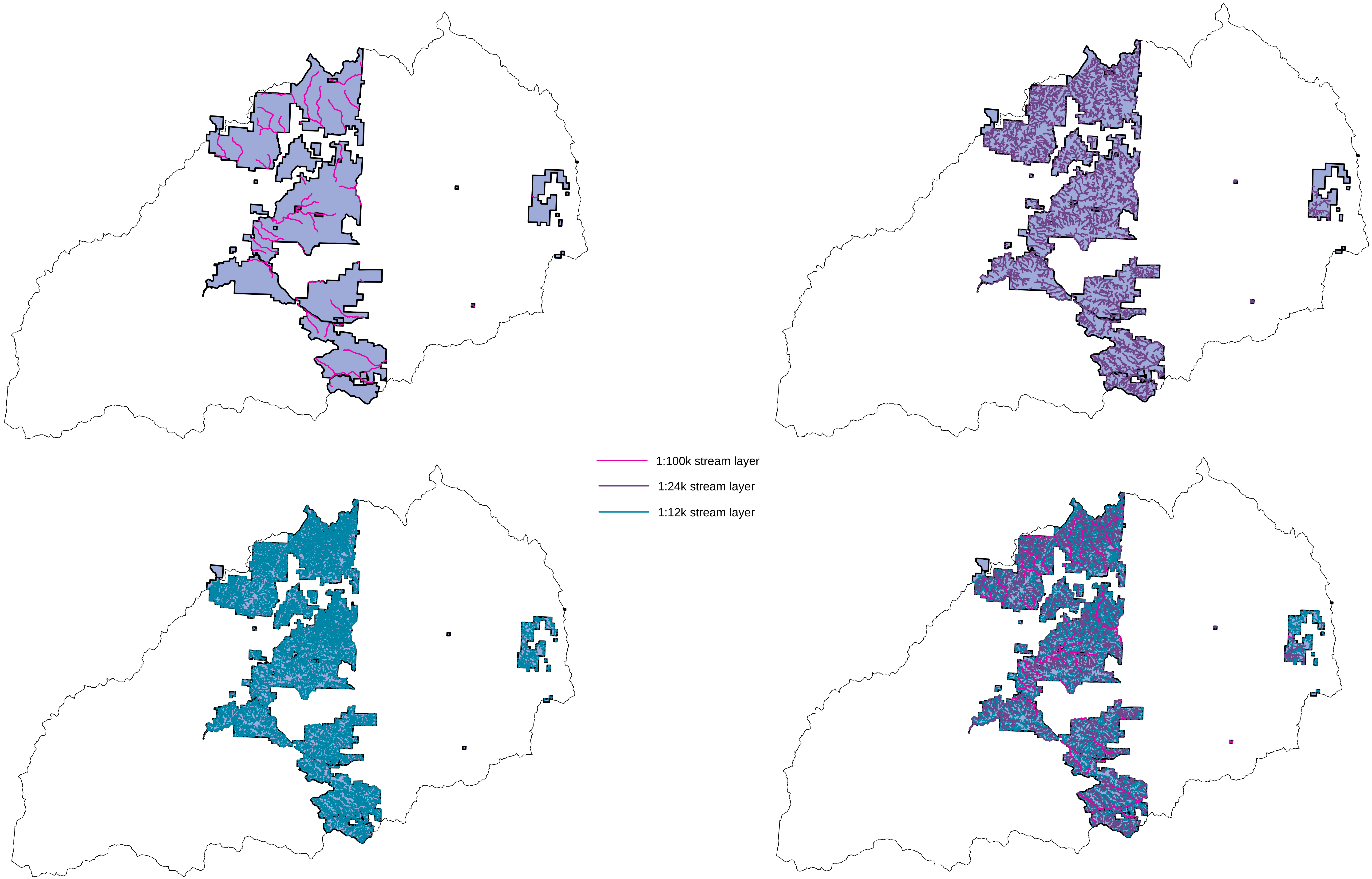
Map 4. Surveyed reaches identified by streamname within the Nehalem project area.



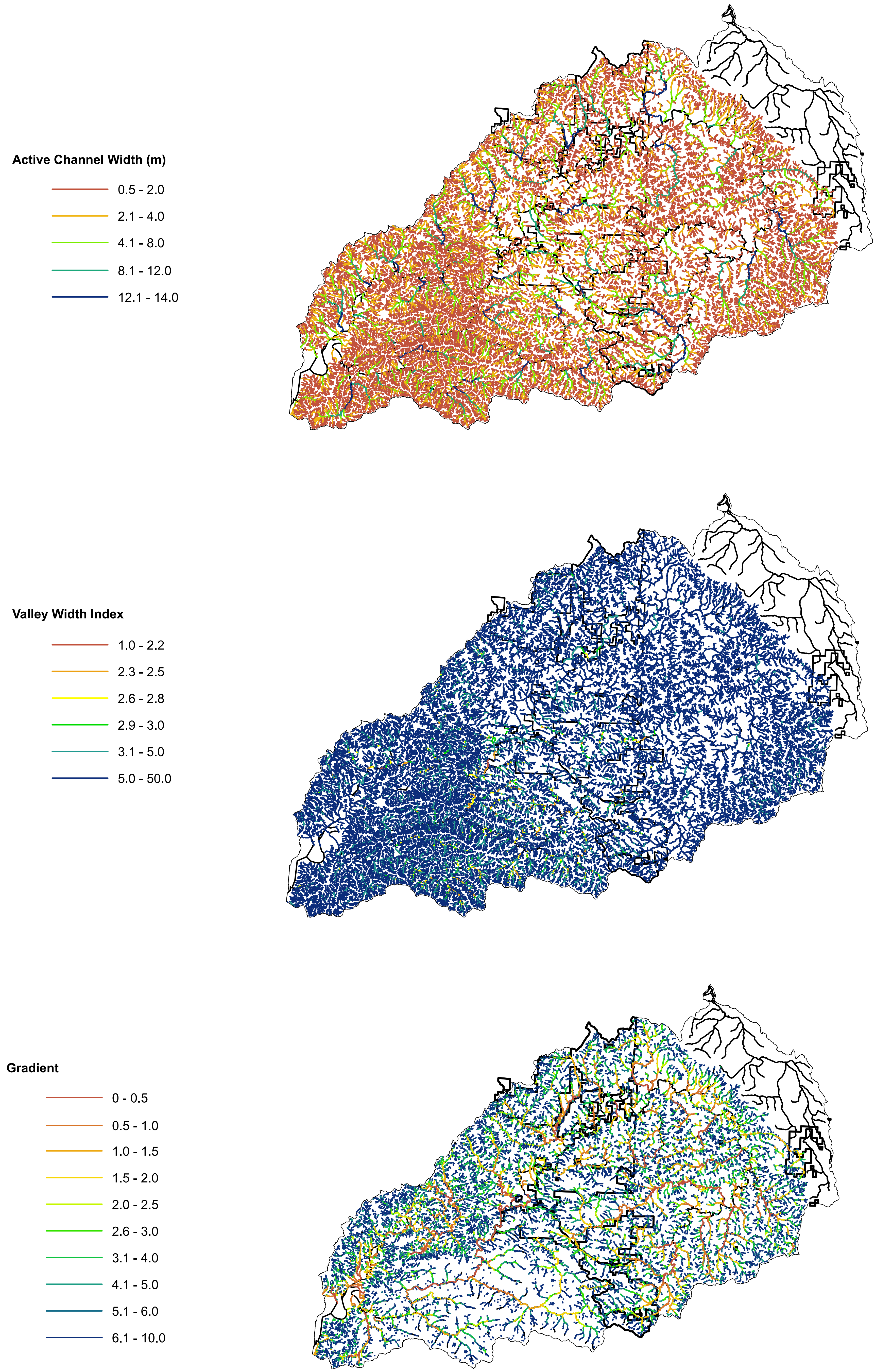
Map 5. Landownership within the Nehalem basin.



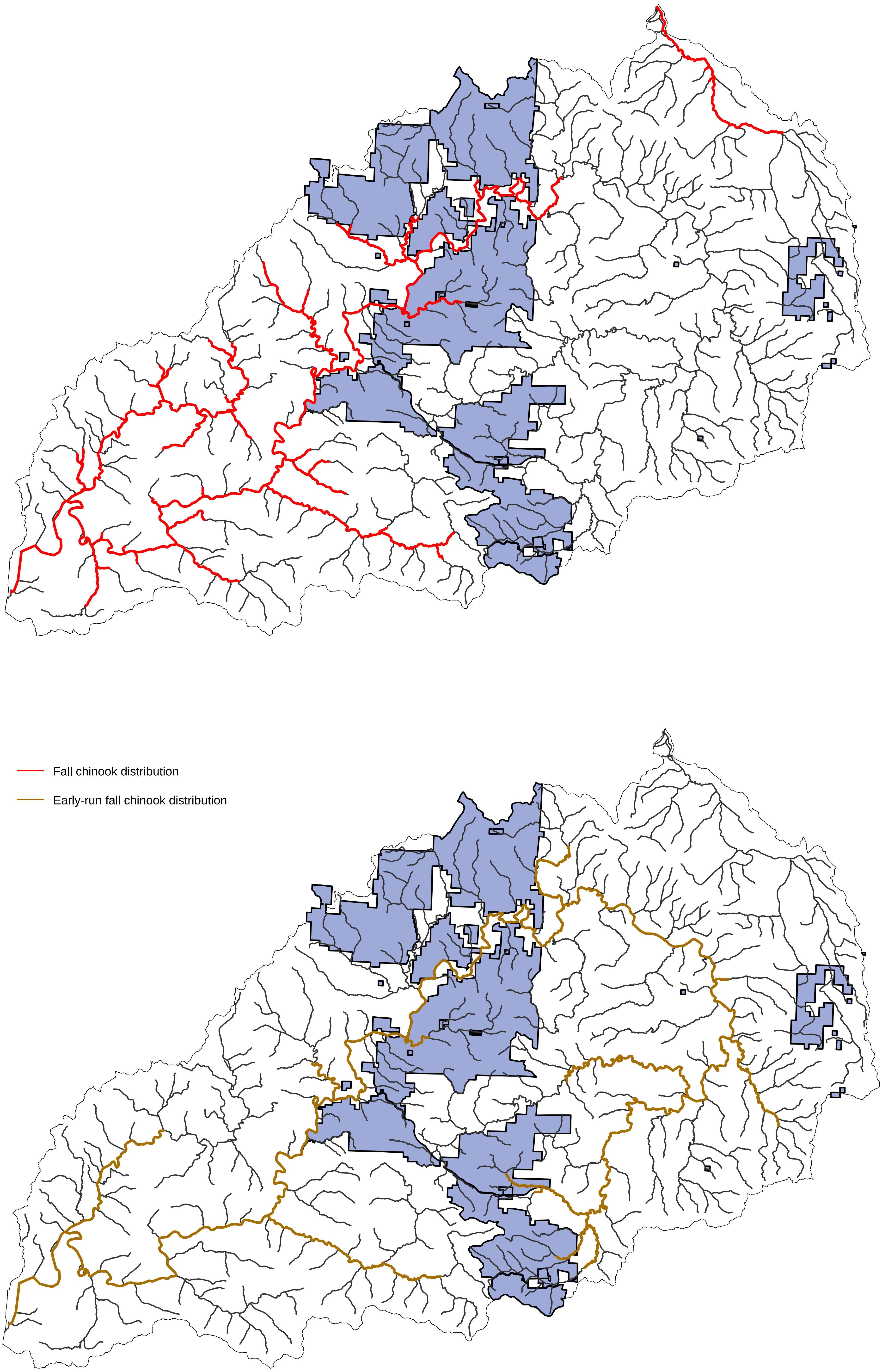
Map 6. Channel geology within the Nehalem basin and project area.



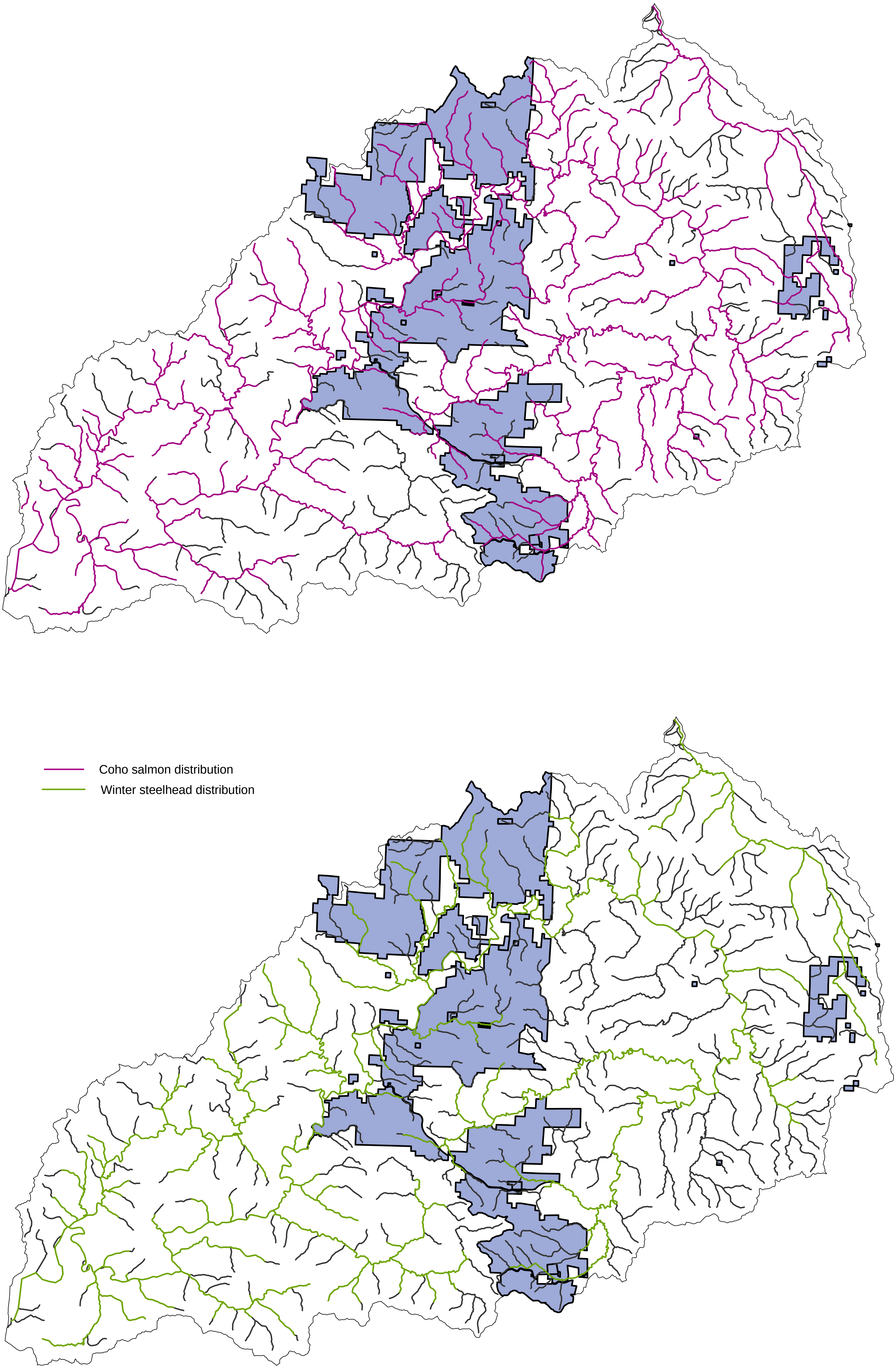
Map 7. Stream layers - 1:100k (ODFW), 1:24k (CLAMS), 1:12k (ODF) - within the Nehalem and Clatskanie project area.



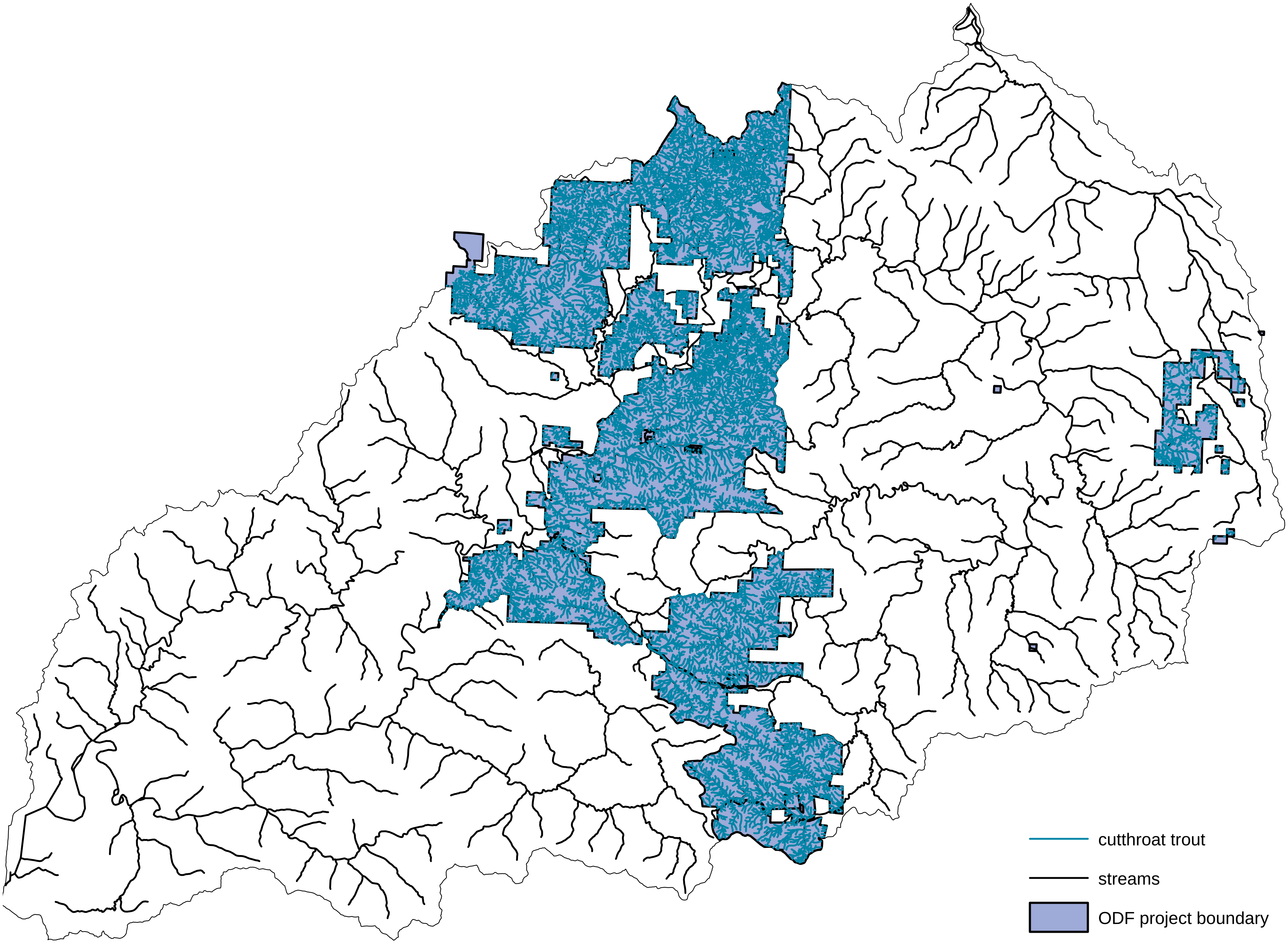
Map 8. Active channel width (m), valley width index, and gradient (%) within the Nehalem project area (source: CLAMS).



Map 9. Fall and early-run fall chinook salmon distribution within the Nehalem and Clatskanie project area.



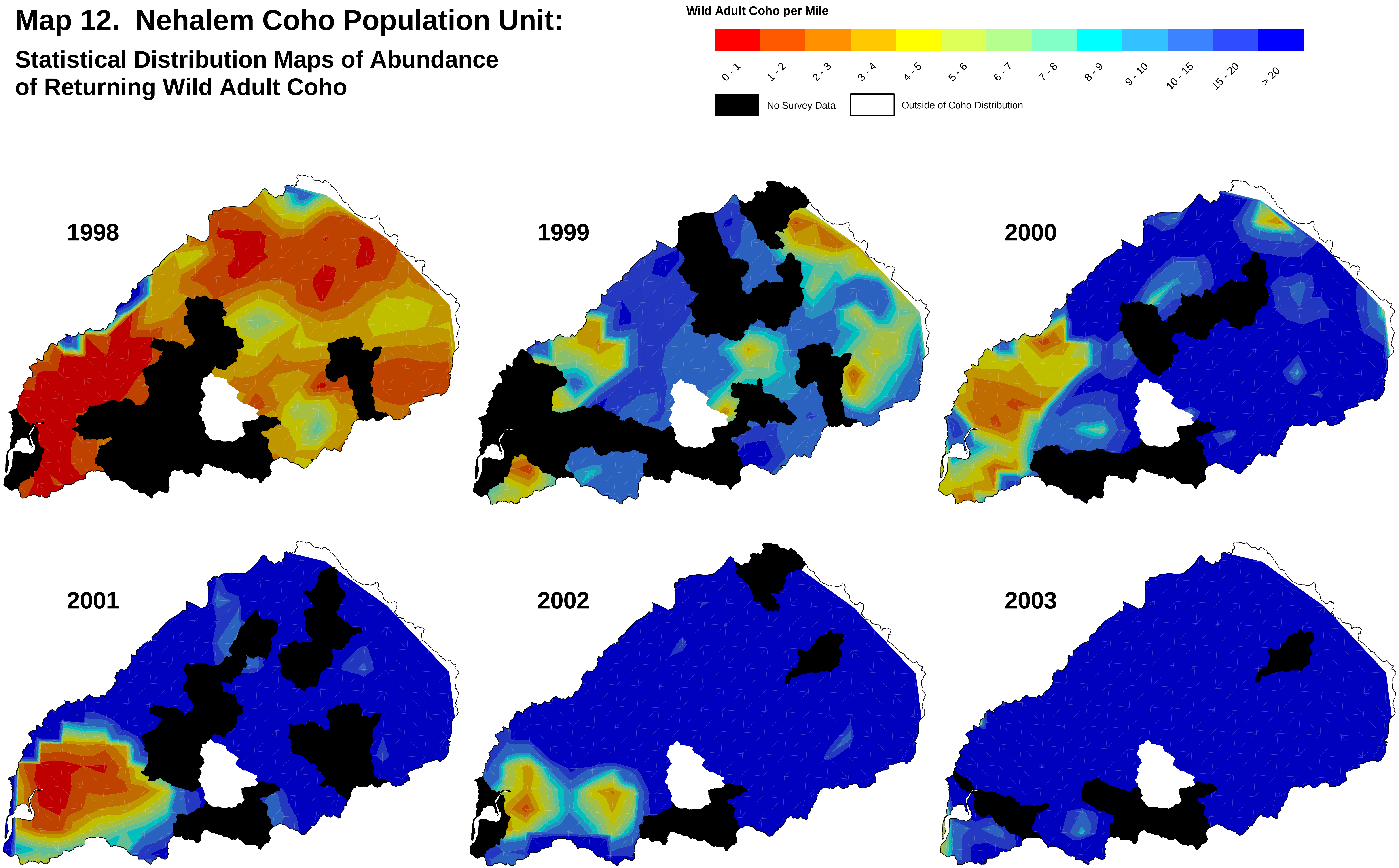
Map 10. Coho salmon and winter steelhead distributions within the Nehalem project area.



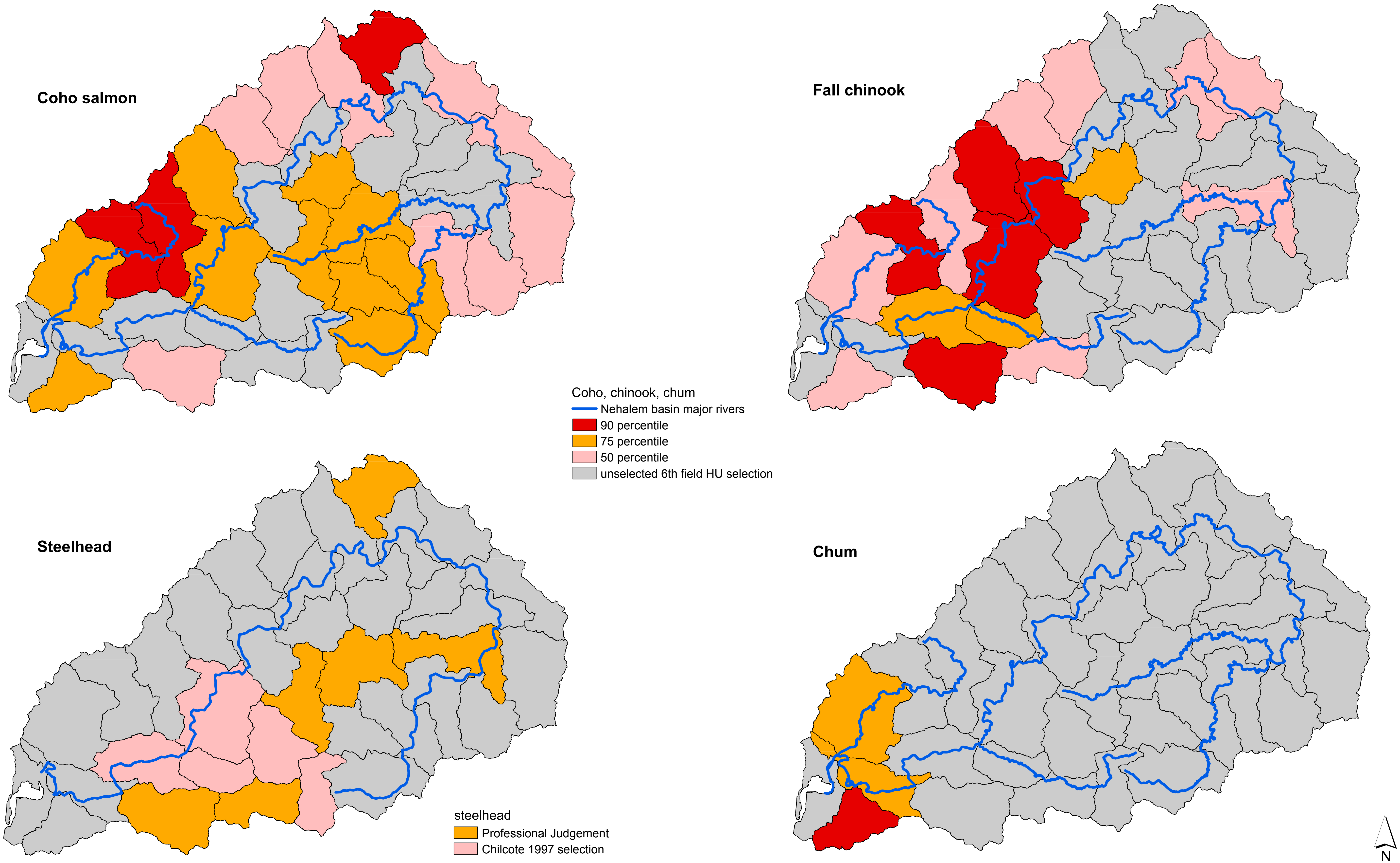
Map 11. Cutthroat distribution within the Nehalem project area.

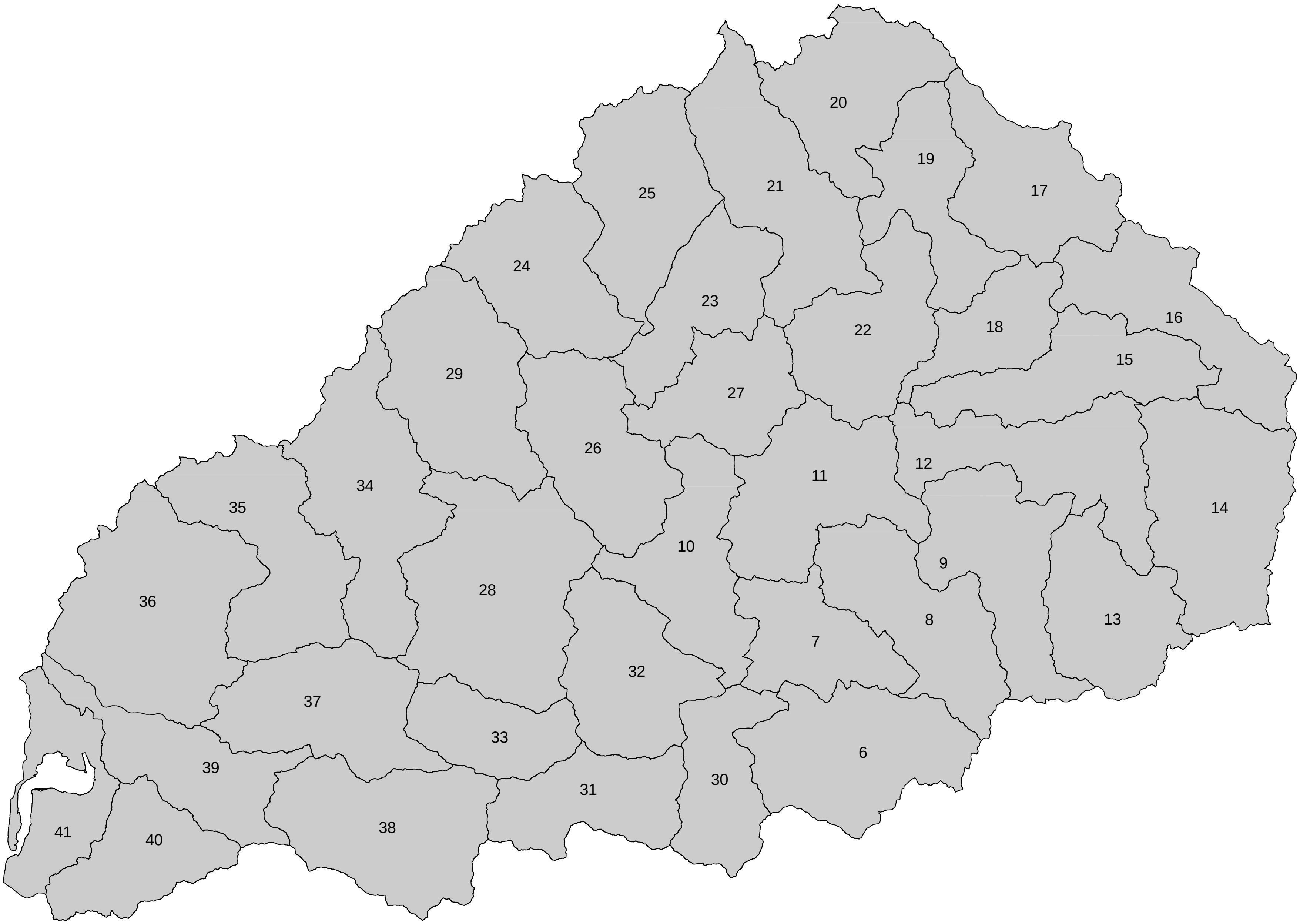
Map 12. Nehalem Coho Population Unit:

Statistical Distribution Maps of Abundance of Returning Wild Adult Coho

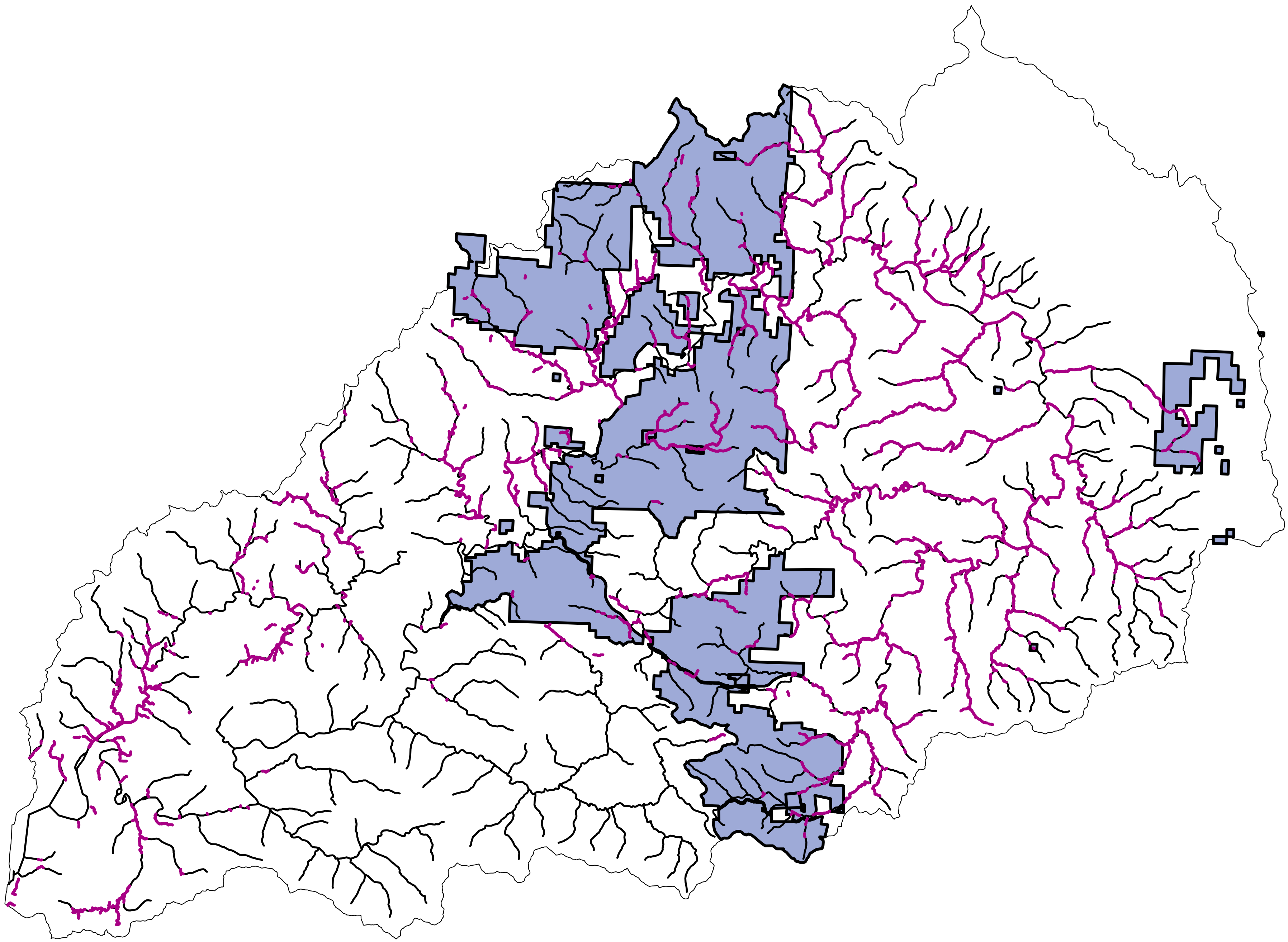


Map 13. Species abundance and diversity within the Nehalem and Clatskanie basins per ODFW Coastal Salmonid Inventory Project data 1989 - 2000.
Colored 6th field HUs indicate that at least half the years surveyed met the minimum indicated percentile for peak counts.

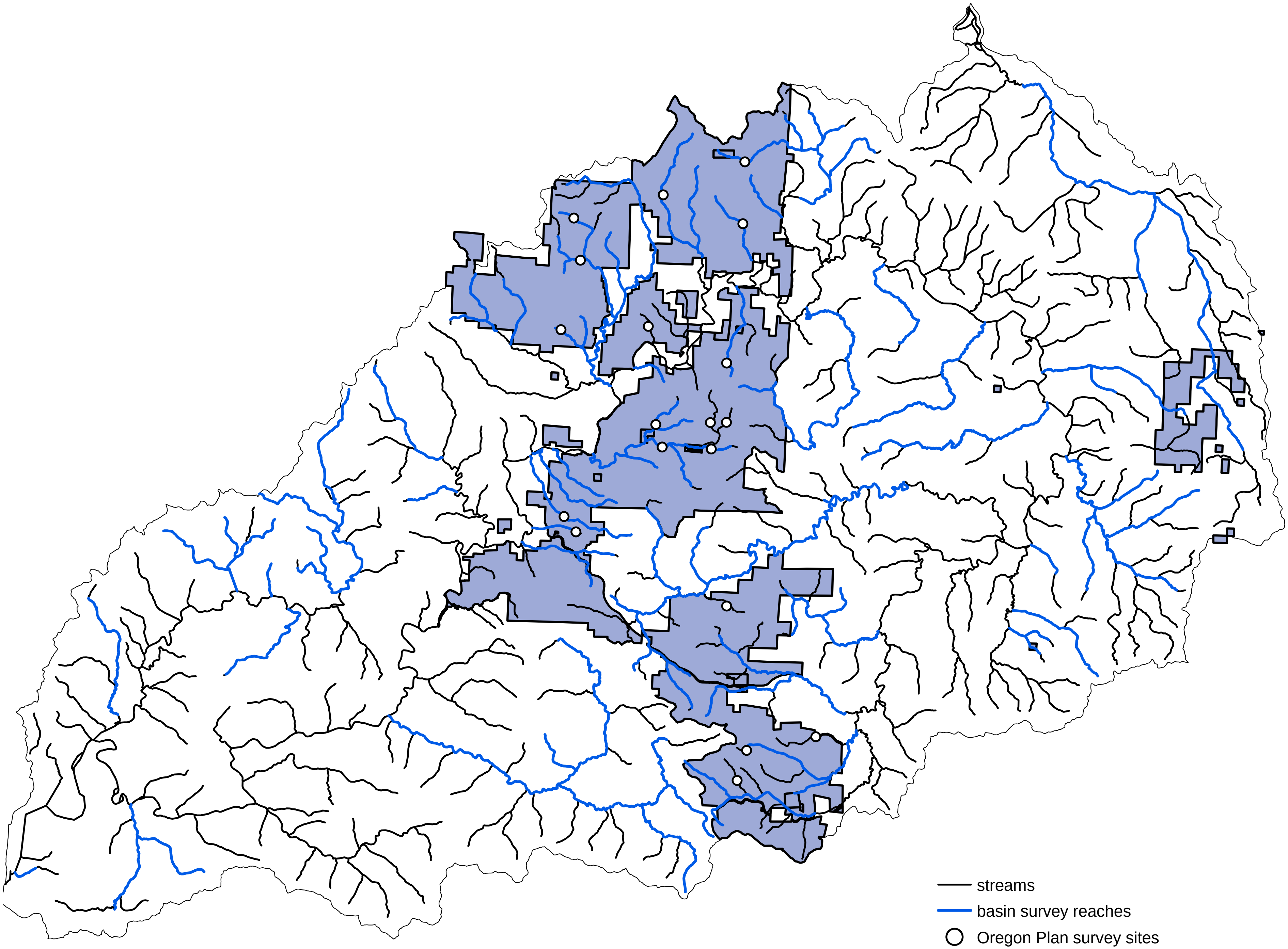




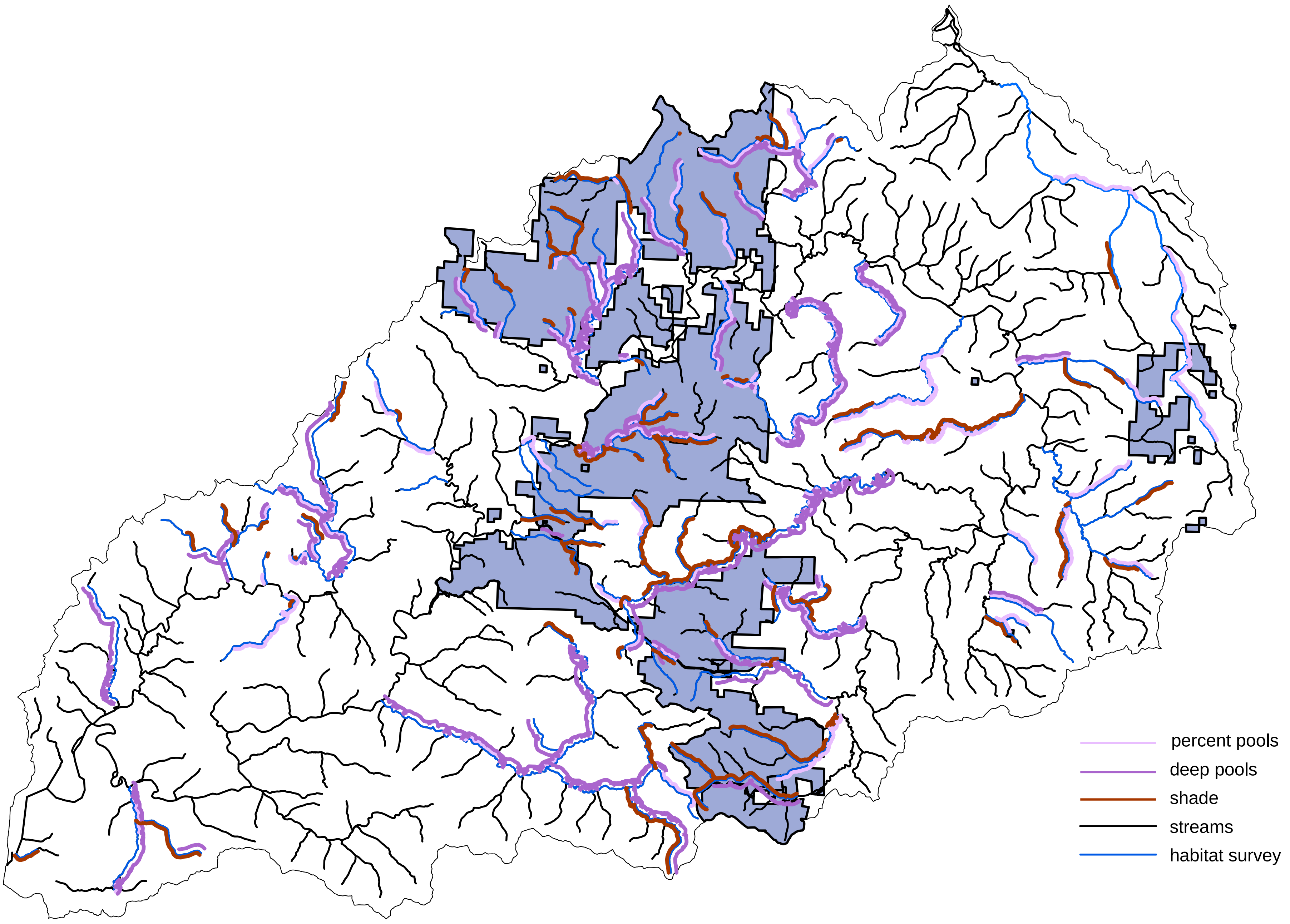
Map 14. Sixth field HUs identified by reference number within the Nehalem basin. Numbers agree with those listed in the Salmon Habitat and Diversity Watershed table.

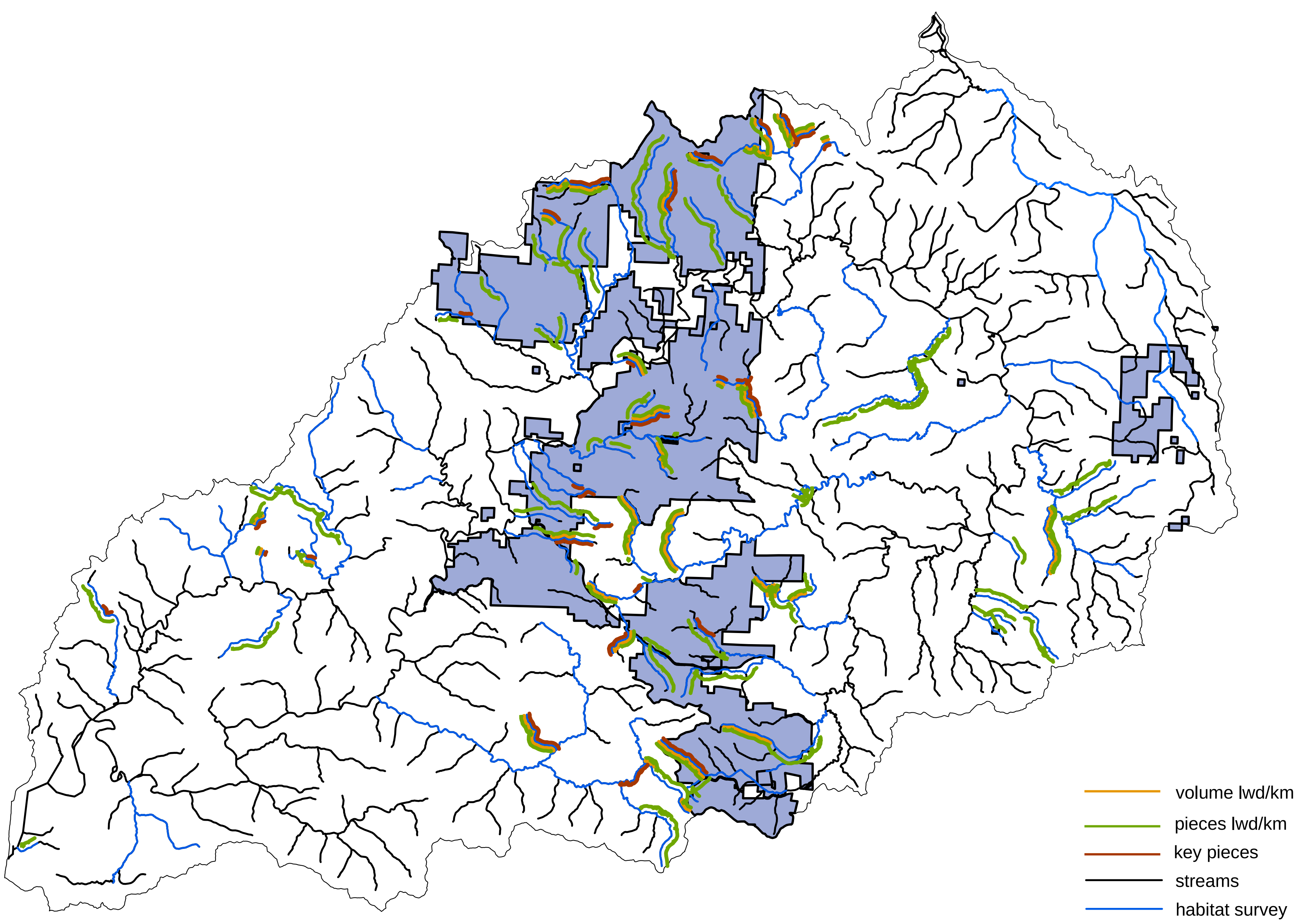


Map 15. Intrinsic potential for coho salmon (>0.8 = high) within the Nehalem study area (source: CLAMS).

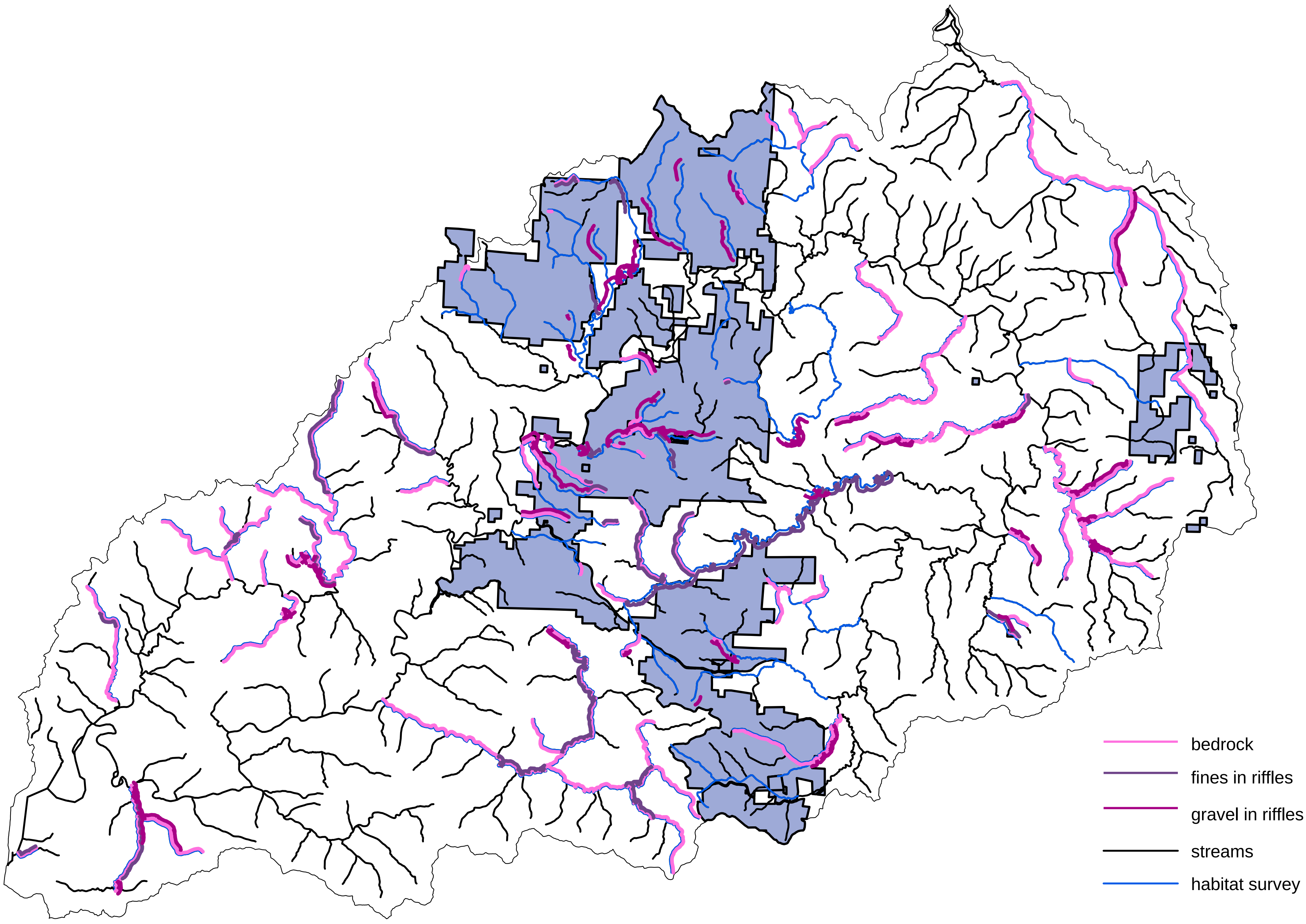


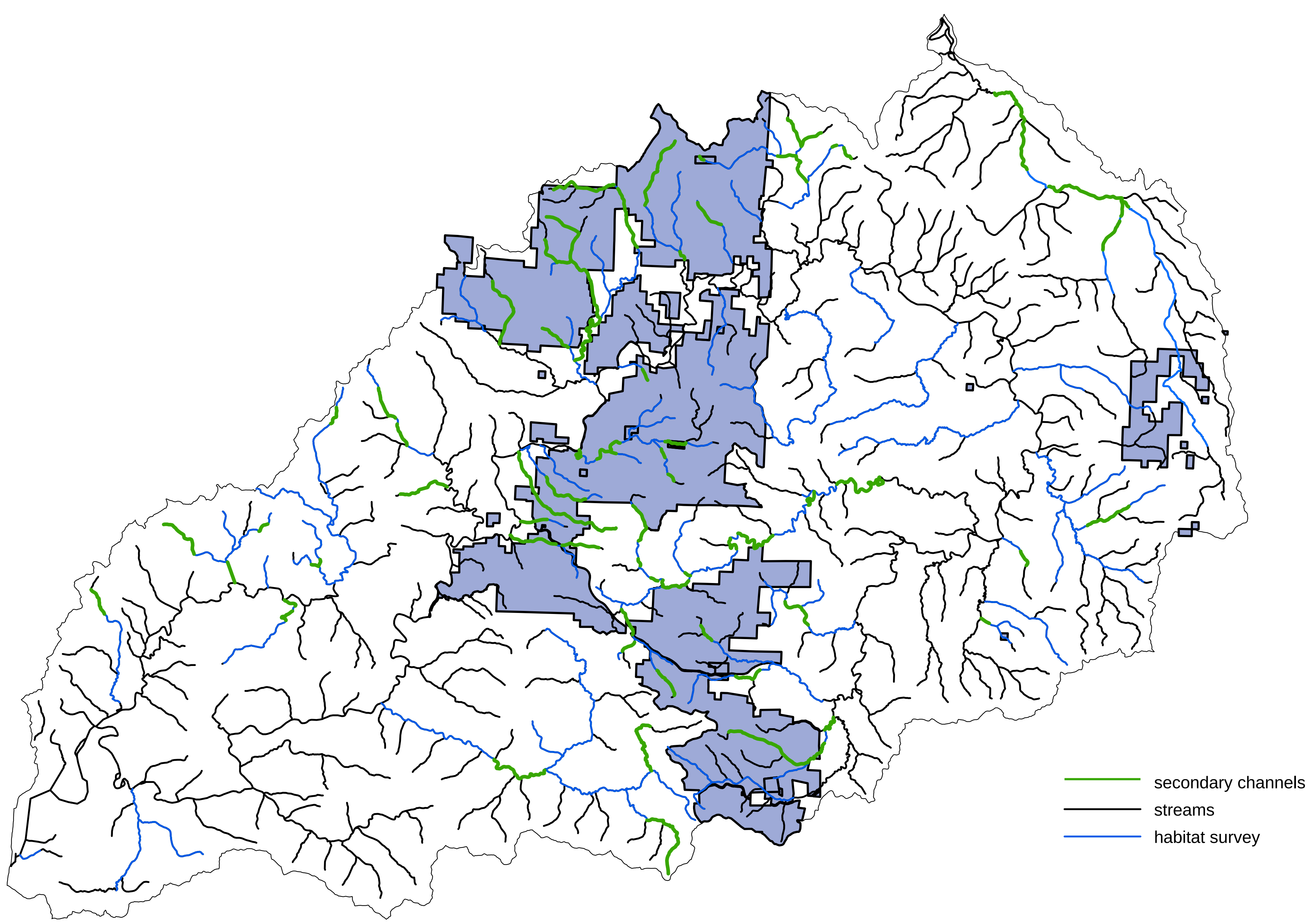
Map 16. Habitat survey sites within the Nehalem and Clatskanie study area.



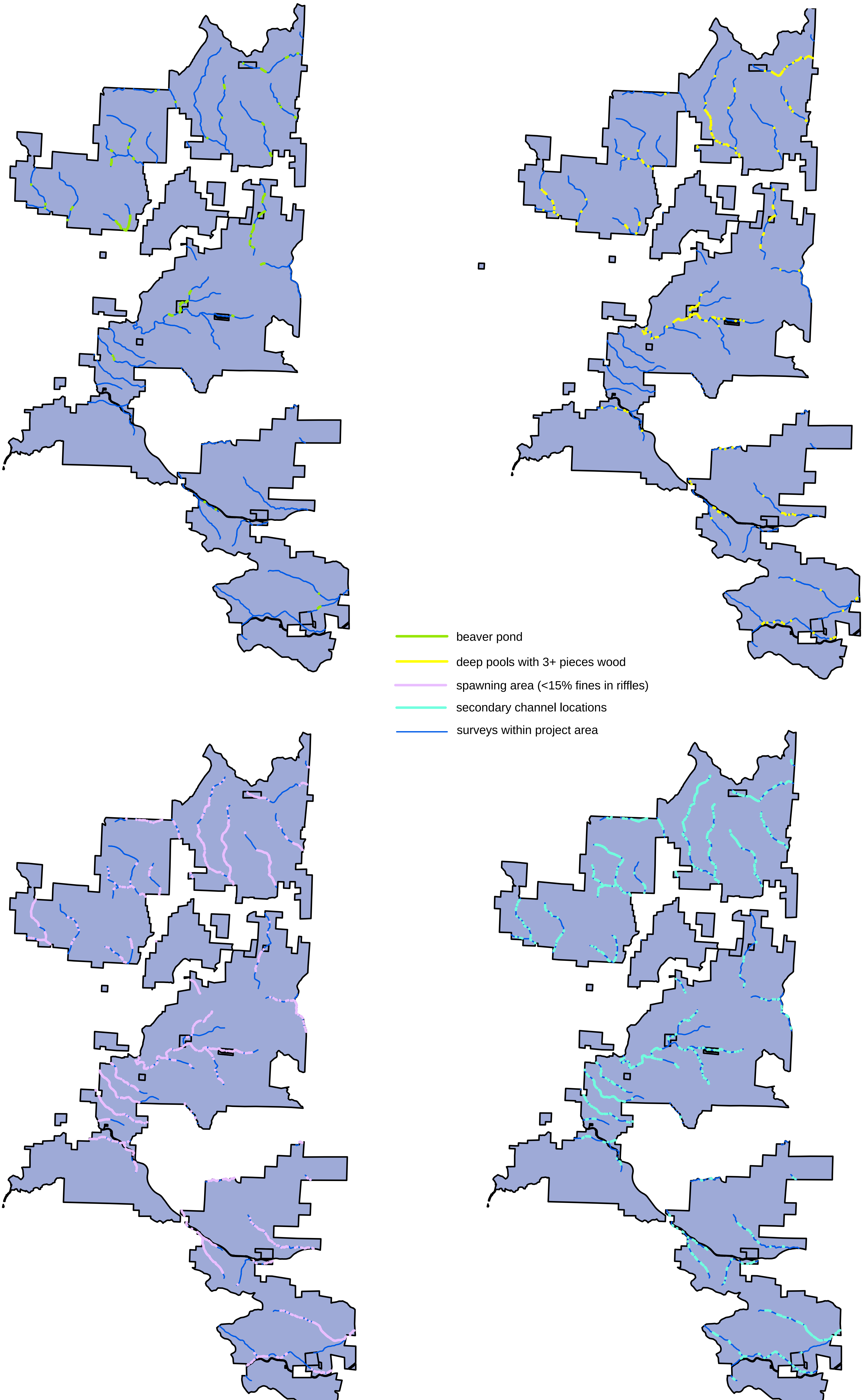


Map 17. Key habitat characteristics - percent shade and pools, number of deep pools, wood pieces, wood volume, and key pieces - which meet or exceed high benchmark levels in the Nehalem study area.

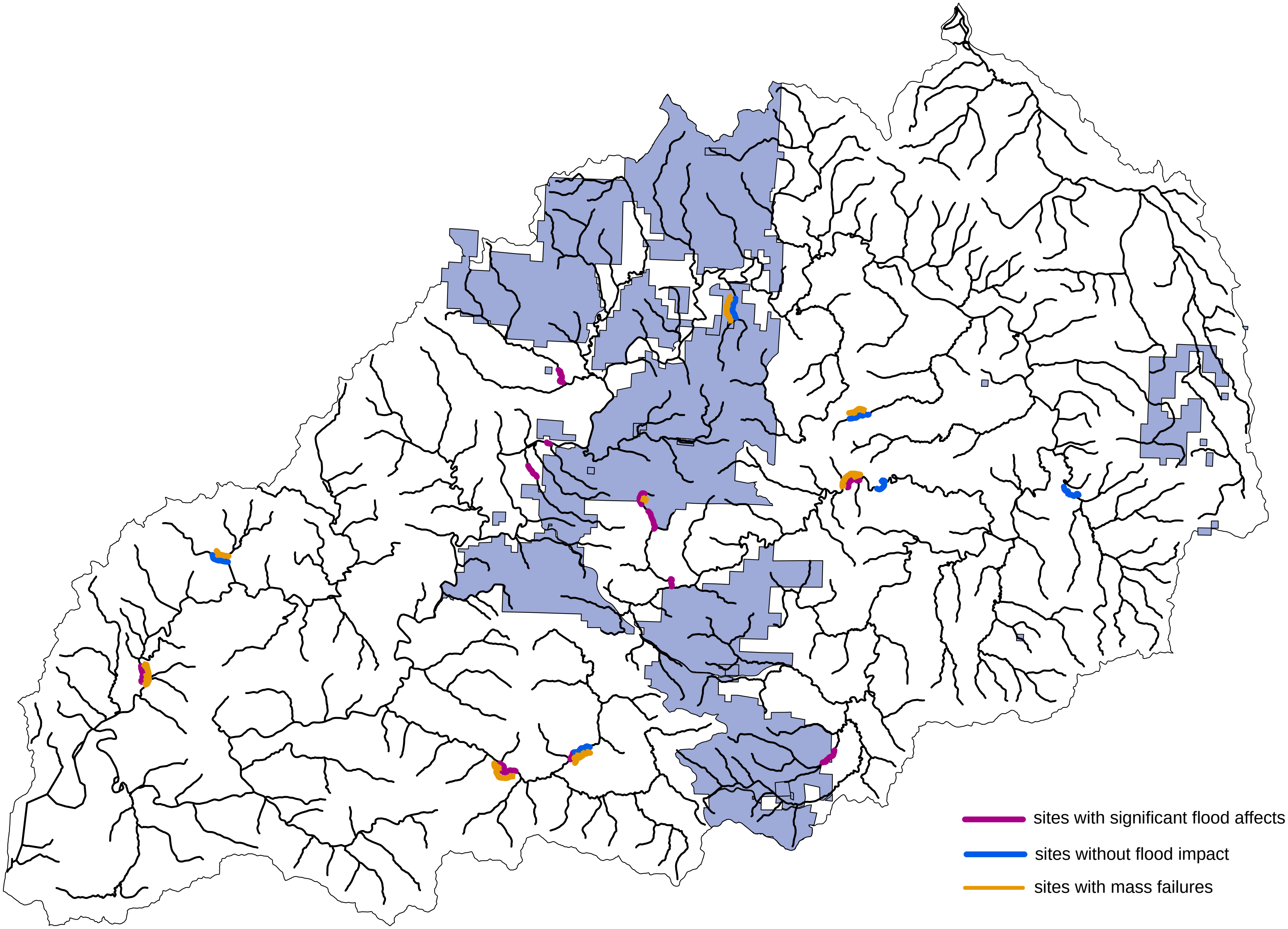




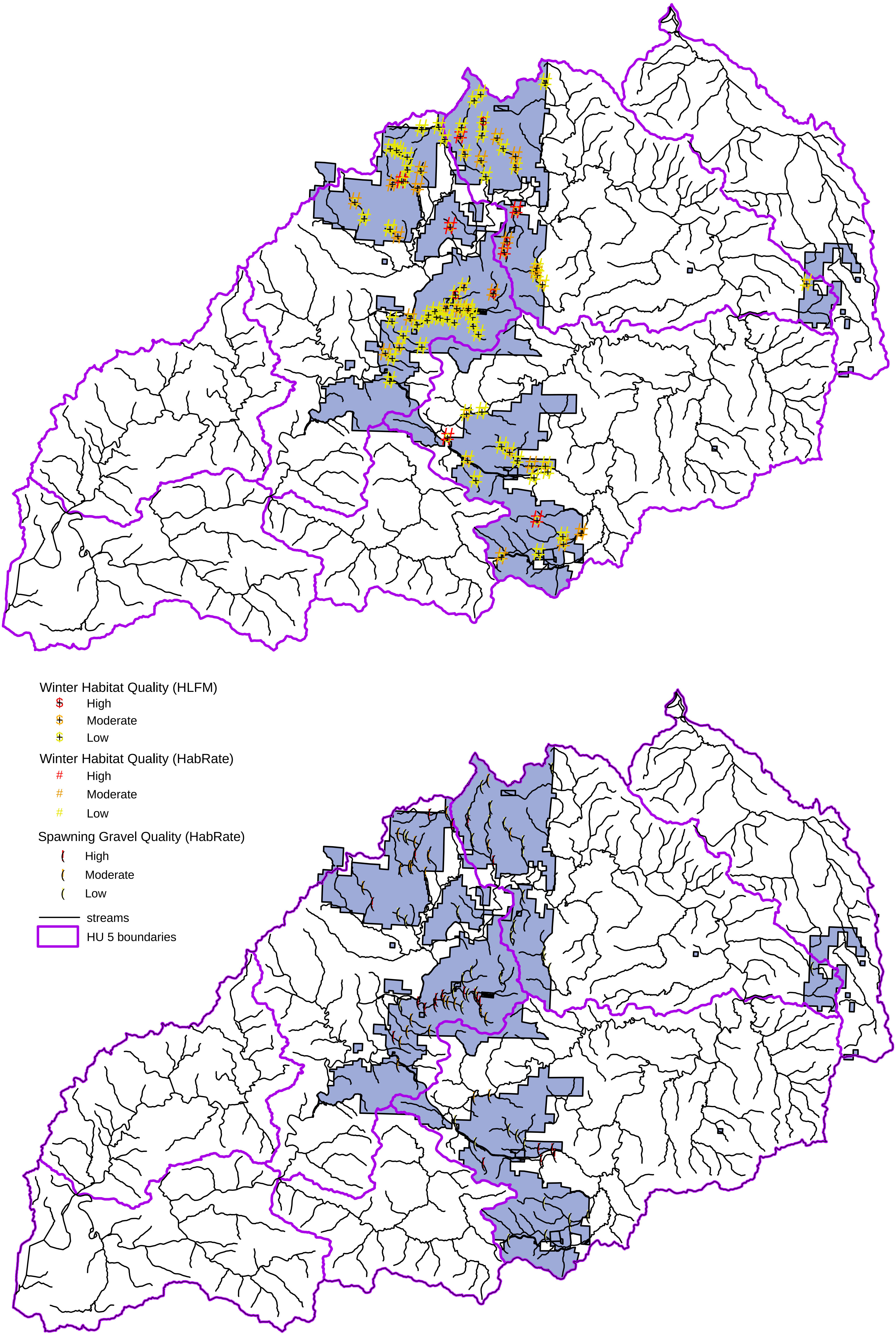
Map 18. Key habitat characteristics - percent fine sediment and gravel substrate in riffle units, percent bedrock, and percent secondary channel area - which meet or exceed high benchmark levels in the Nehalem study area.



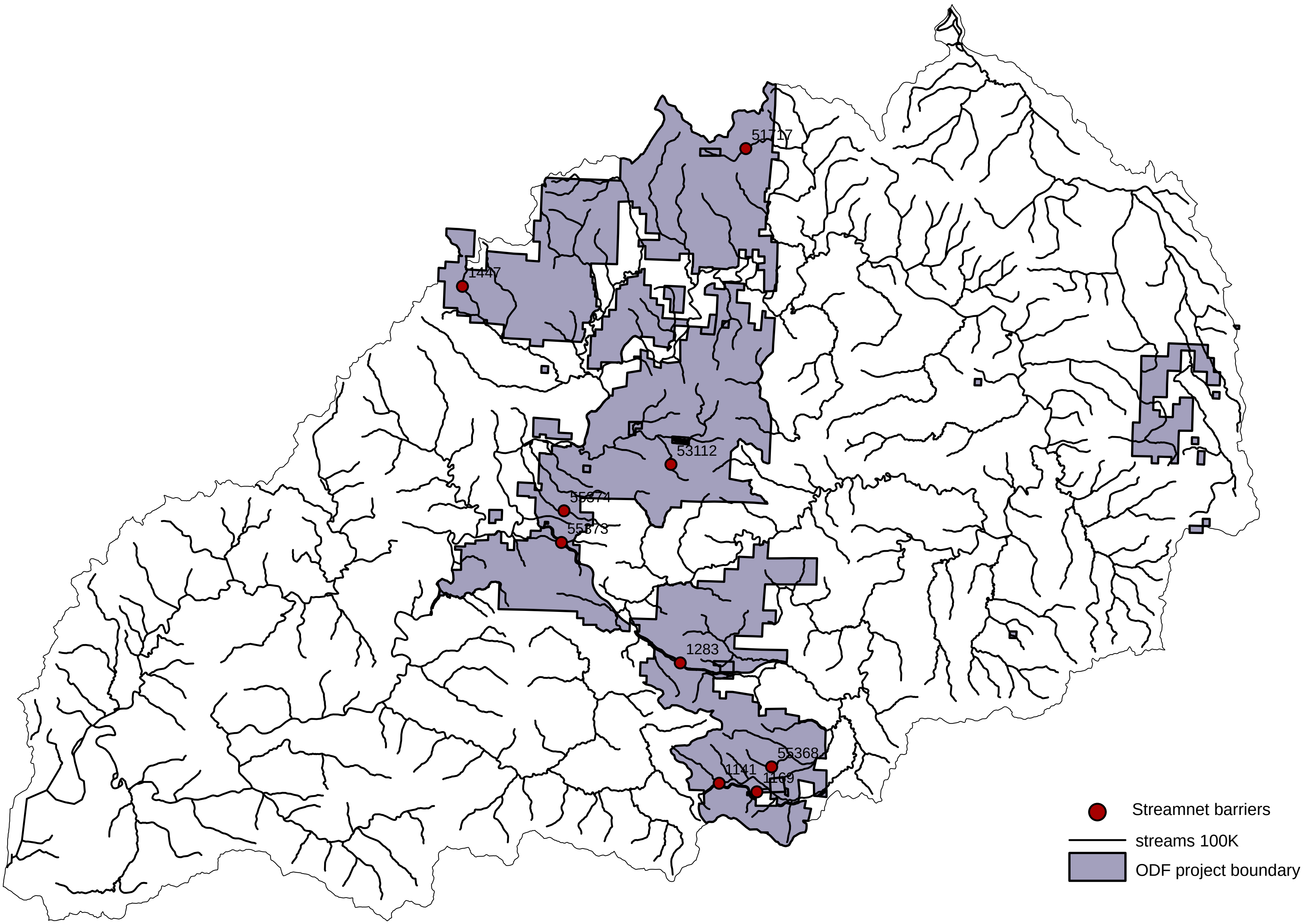
Map 19. Important habitat characteristics on the unit level scale within the Nehalem project area.



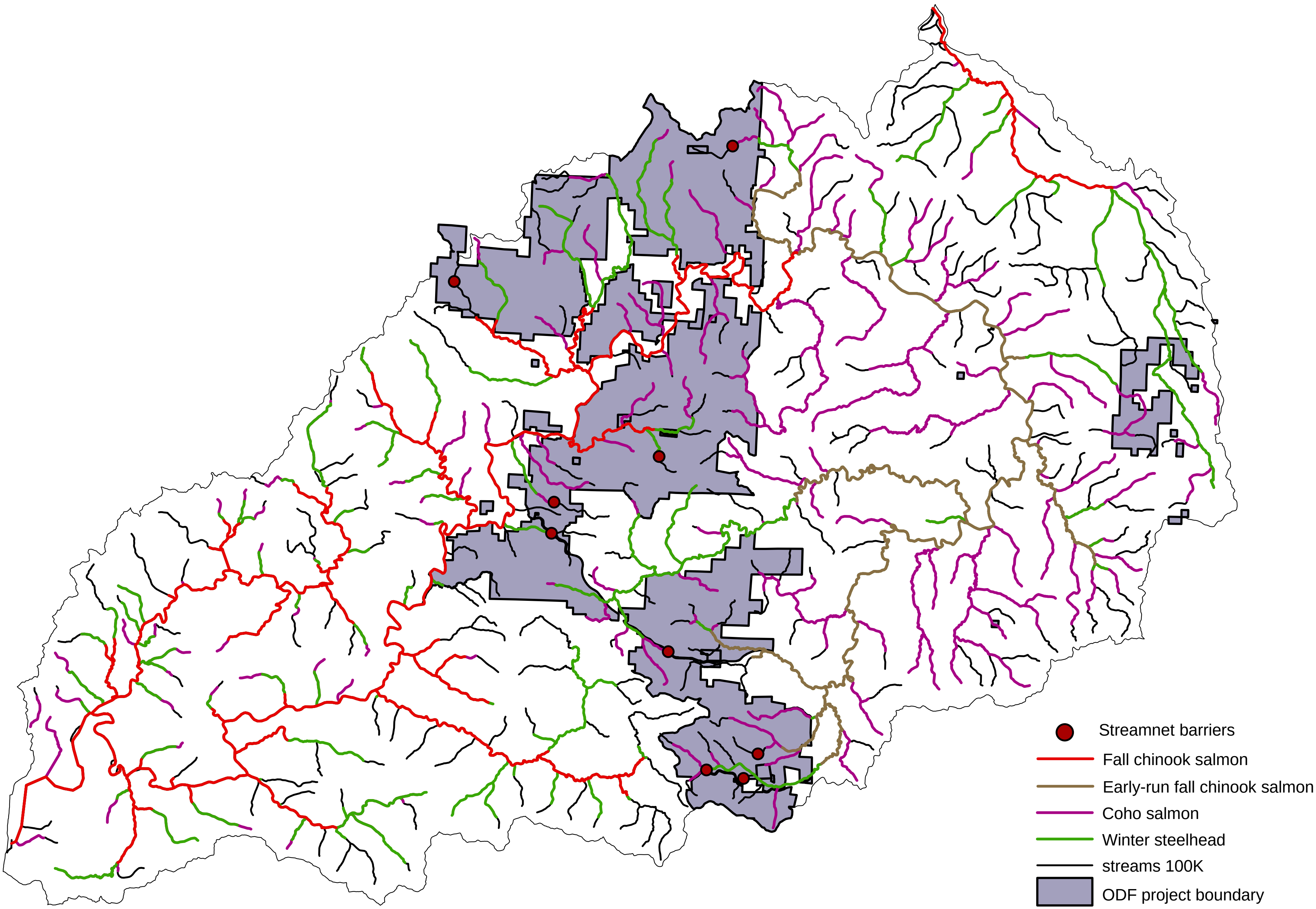
Map 20. 1996 flood affects within the Nehalem basin. Sites were randomly chosen from previous basin surveys.



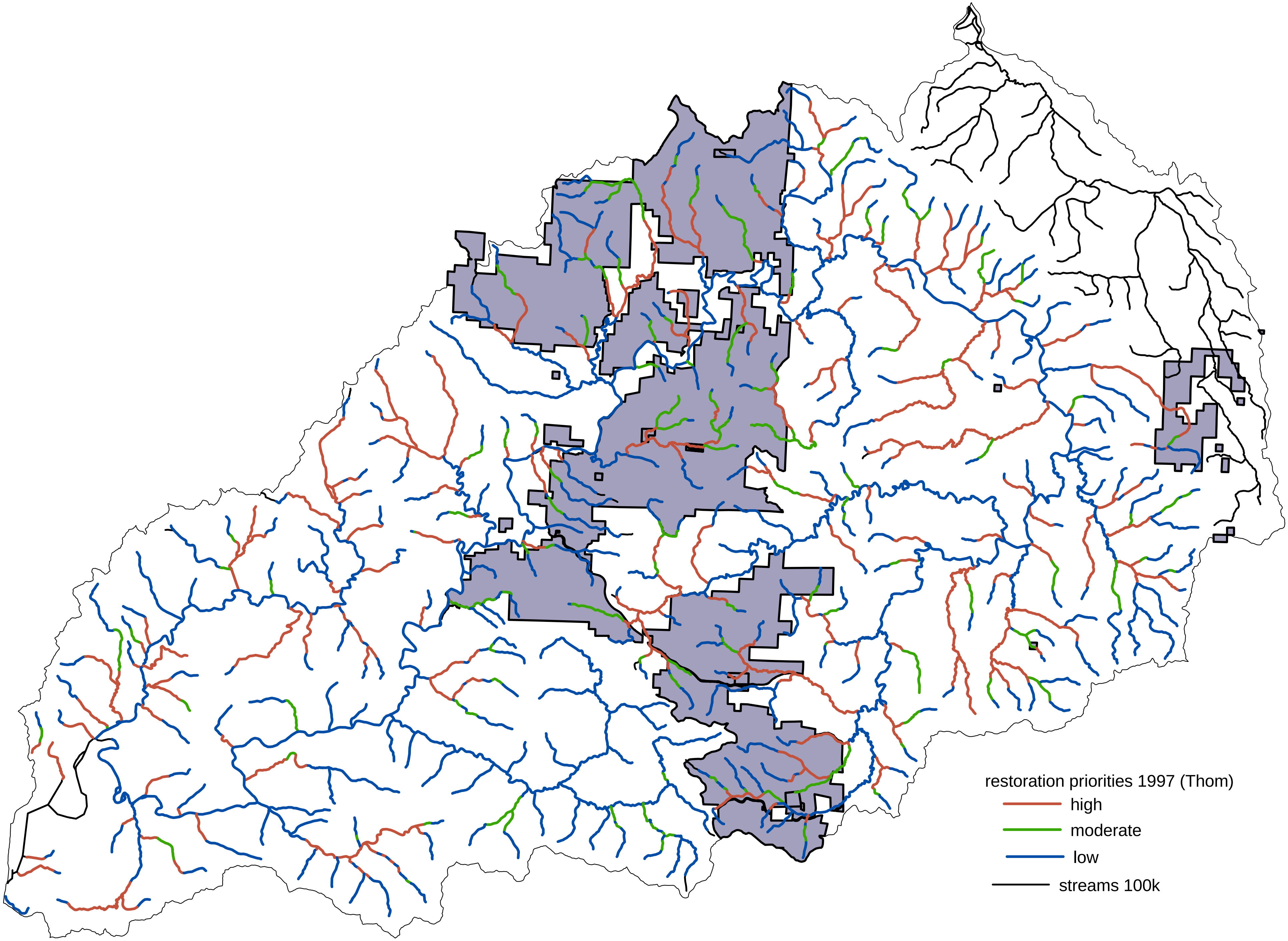
Map 21. Quality of winter habitat and spawning gravel within Coho salmon distribution in the Nehalem project area.



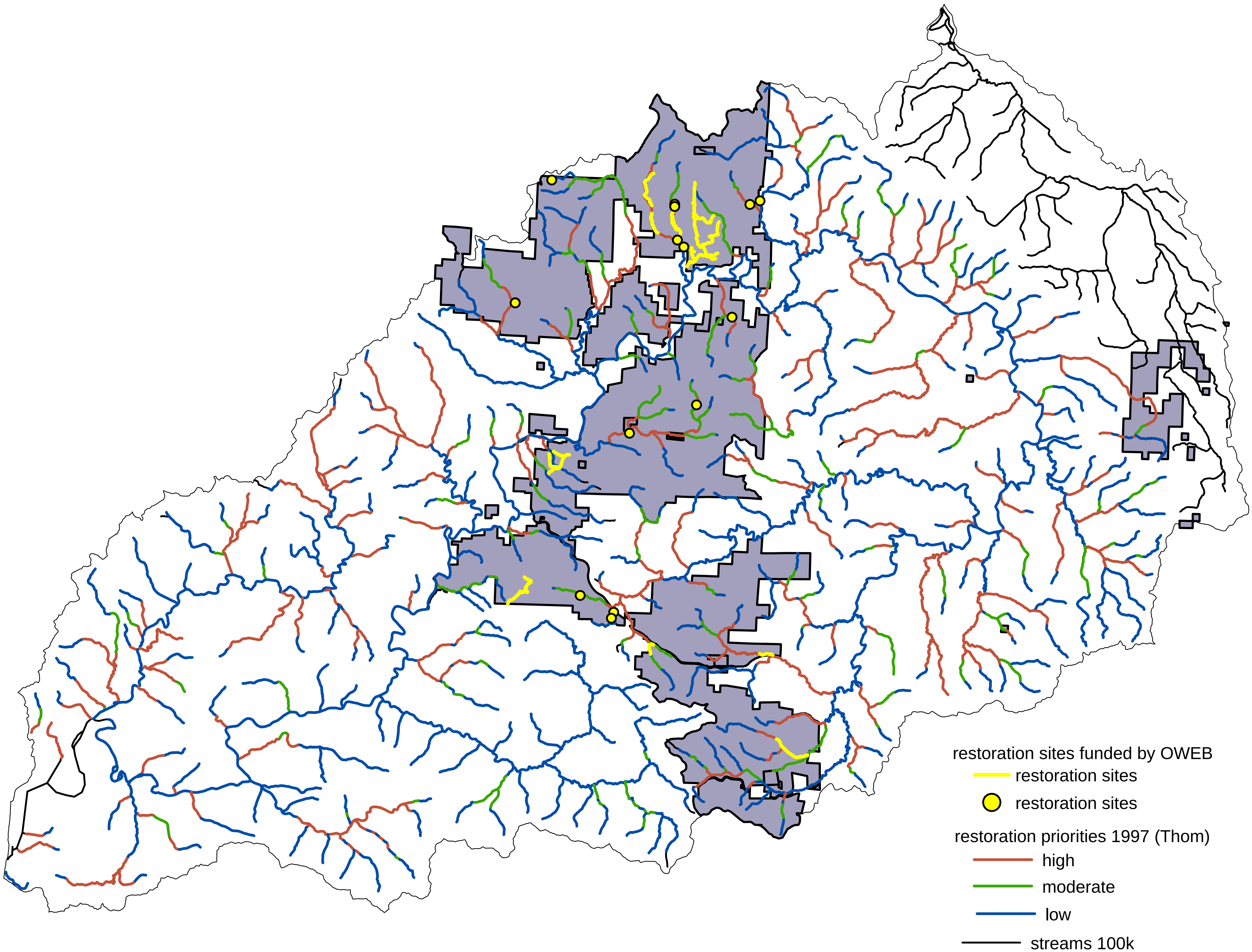
Map 22 . Potential barriers as identified by Streamnet within the Nehalem project area.



Map 23. The distribution of Coho salmon, fall and early-run fall Chinook salmon, and winter steelhead and potential barriers (Streamnet) within the Nehalem project area.



Map 24. Potential sites for restoration based on priority level within the Nehalem project area (Thom and Moore, 1997) .



Map 25. Potential sites for restoration based on priority level (Thom and Moore, 1997) paired with restoration treatments funded by OWEB since 1997 within the Nehalem project area.