

Limiting Factors Assessment and Restoration Plan

Big Creek

An Ocean Basin Located Between Waldport and Yachats, OR

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Introduction

This document provides watershed restoration actions proposed to enhance the Coho Salmon population within the Big Creek sub-watershed in Lincoln County, Oregon. Big Creek is a 5th order coastal stream that passes through extensive wetlands before entering the ocean midway between Waldport and Yachats, OR. Big Creek receives the majority of its flow from three mountain valley drainages and minor flow from a coastal lowland drainage.

The goal of the restoration effort is to identify the dominant processes and habitat characteristics that currently limit the production of Coho salmon smolts in the watershed, and to develop a prioritized list of actions (“prescriptions”) for removing the limitations in ways that help normalize landscape and stream channel function.

Central to this goal is the identification of Coho “Core Areas” and “Anchor Sites”, which are sections of the stream channel that support the remnant Coho population. By Core Area we mean a contiguous section of stream channel or channel system where juveniles rear on a consistent (year to year) basis. The term Anchor Site is used to specify a portion of the Core Area which provides all essential habitat features necessary to support the complete Coho freshwater life history.

For a more detailed description of these concepts as well as the restoration, assessment, and prioritization protocols used in developing the plan, please refer to “*Midcoast Limiting Factors Analysis, A Method for Assessing 6th field subbasins for Restoration*”. This document is available at www.midcoastwatershedscouncil.org/GIS or by contacting the Midcoast Watersheds Council.

The following questions exemplify the types of issues addressed in the assessment process:

- How well and in what mode is the current system functioning for Coho production (what part does each of the habitat subdivisions play)
- What temperature problems are apparent?
- Where are temperature refugia located?
- Where are the barriers?
- What are the sediment issues in the system?
- Where are the spawning areas, and how are they integrated with the summer and winter rearing sites?
- What needs to be done to make the Core habitat function for all life phases, and to function at a higher level?
- What work should be done in each area to facilitate a more completely functional whole?
- What is the best upslope work that supports the instream work?
- How are the fish currently using the system?
- What problems are generated by the current habitat configuration (e.g., temperature dependant movements that expose juveniles to predation)

- How and when are the greatest losses generated to the population?
- Within the Core habitat, what are the dominant limiting factors?
- Within the 6th field, what are the dominant limiting factors?
- Within the 4th field, what are the dominant limiting factors?
- Does the presence or absence of adequate winter habitat outside the spatial boundaries of the 6th field suggest or preclude the need for expanding the quantity or quality of winter habitat?

Resources used in developing the plan

The following resources were used in preparing the restoration plan:

- Aquatic habitat inventories: Big Creek was surveyed by the United States Forest Service in 1994.
- Summer snorkel surveys: These “Rapid Bio Assay” fish inventories identify the species, age class, density and distribution of salmonids in pools based on fish counts made in randomly selected pools of a stream reach. Big Creek was surveyed by Bio-Surveys during the summers of 2001, 2002, 2003, and 2005.
- Field assessment: This identifies the location and functionality of the sub-watershed’s Core Area and Anchor Site(s). The field assessment of Elkhorn Creek was conducted on June 6, 2005.
- Oregon Department of Forestry slide assessment mapping: This procedure evaluates failure-prone headwater slopes as potential sources of wood and substrate to the aquatic corridor. The evaluations help identify Critical Recruitment Areas within the sub-watershed.
- Habitat Limiting Factor Model (HLFM): This analytical model, also referred to as the Nickleson Model, evaluates estimates of spawning gravel, egg deposition rates, and abundance of aquatic habitat to identify which seasonal habitat, and thus which Coho life stage, currently limits smolt production within a watershed. The model is described in ODFW Information Report 98-4.

Watershed overview

Big Creek originates at approximately 1,000 feet from a coastal front valley in the central Oregon Coast Range. It flows west and then north to run through complex Spruce wetlands and estuarine marsh habitats before joining the ocean through a highly manipulated transition zone at Hwy 101. On its northerly vector it is joined by two streams flowing out of two other coastal front valleys located immediately north (Dicks Fk) and south (SF Big Cr) of the Big Creek valley. Additional minor flow is contributed from a lowland drainage to the north (Reynolds Cr).

The general appearance of the Big Creek drainage system is palmate in structure. However, this description is somewhat misleading because the three mountain valleys are not composed as a basin of nested valleys, where flows combine into a common mainstem before entering lowland habitats. Rather, three independent flows combine in the lowlands to the west of the mountain valleys, and each could be viewed as a separate 4th order stream corridor. The three streams have been lumped into a single 6th field

hydraulic unit for convenience of classification and management, and that is how they were assessed in this analysis.

Three wetlands exist. One surrounds the estuary, extending from the Highway 101 bridge east into the Reynolds Creek and Big Creek arms. Upstream and separate from this coastal wetlands, Reynolds Creek flows through a shallow lake with an extensive wetland /marsh ecotype (Placer Lake). The third significant wetland is located in lower SF Big Cr; this wetland is partially the result of the constriction linked to the historical construction of a rail line by the Spruce Division and the more contemporary impacts of constricted flow at the Blodget Rd crossing.

Together, the mountain drainage systems, lowland mainstem, estuary and wetlands comprise a diverse and highly complex aquatic system. The challenge of the assessment process was to determine both how the various components function for each Coho life history stage and how the system's physical characteristics limit Coho distribution and rearing success. The process has emphasized that complex ecosystem functions do not lend themselves to simple classification and analysis. It is clear that many implicit but undetected relationships remain unexplored.

Some important physical features to be considered in the assessment process included:

- Very low summer flows in Reynolds Cr limit wetland rearing potential and create elevated temperatures that function as migration barriers.
- A falls located midway in the Big Creek valley prevents upstream access by anadromous fish.
- Transitional reaches (moderate gradient depositional zones characteristic of Coho refugia) are sparsely represented in the three mountain valleys.
- Flows and valley morphologies are not generally conducive to sorting high quality gravels for incubation. Similarly, boulders are abundant in upper valleys but not delivered in quantity to moderate gradient reaches.

The watershed has an extensive history of human use and alternation that continues to the present. In the early 1920's, timber harvest began, aided by the construction of a railroad system that substantially changed the floodplain and course of stream channels. Timber removal and subsequent debris-based fires led to the loss of riparian shade, nutrients, and LWD resources, while producing debris torrents that added deep layers of soft sediments and embedded wood to the floodplain and estuary.

These depositional events were later augmented by the construction of the Highway 101 overpass, which functions as a sediment trap. The human changes were apparently preceded by one or more tsunami events that delivered large loads of ocean sands to the lowland floodplain.

All of these changes tend to stimulate expansion of the wetlands and complex channel development, but at the same time limit tidal exchange, creating zones of poorly flushed channels having the potential for elevated temperatures and anoxic conditions.

Beaver activity diminished greatly between the 1994 and 2005 surveys. The early survey recorded 21 ponds, but only one was encountered in 2005. This represents a serious loss in the system's ability to generate important Coho rearing functions, including pool-based rearing and gravel sorting.

The effects of old growth and second growth timber harvest have produced a patchwork of alder and conifer regrowth in various seral stages, along with some remnant old growth stands. Current ownership is dominated by National Forest lands, and the south Lincoln County Water District operates two water diversions for domestic water supply in the basin. There is very limited impact from rural residential land use and there is no agricultural impact within the entire basin.

Current status of Coho

The status of Coho has been well documented in the Big Cr basin by the Midcoast Watersheds Councils RBA inventories that have been conducted on a basin scale. These inventories have resulted in the estimates of total summer parr abundance documented in the following table.

Year	Coho
2001	4,013
2002	7,125
2003	10,425
2005	4,344

20% visual bias added for Coho

The peak juvenile counts observed in 2003 were the result of exceptional ocean survival for adults returning in 2002. Adult escapement when back calculated from juvenile abundance is estimated in the range of 84 – 95 adult Coho basin wide. The Lincoln SWCD has also collected adult escapement data for the mainstem of Big Cr for the years 1999-2005. Within this time frame the greatest adult abundance was also observed during 2002 with a peak count of 28 Coho and a peak redd count of 37. No AUC estimate was available for Big Cr because these data are lumped into a group of coastal tributaries to achieve greater statistical relevance.

Big Creek Coho have been classified as a dependant population by the Coastal Coho TRT.

Limiting seasonal habitat analysis

A primary goal of this assessment process is to identify which seasonal habitat most restricts smolt production. Restoration work then focuses on improving those aquatic, riparian, and upslope conditions that contribute to the restriction.

A principle, but not the only, tool used to identify the limiting seasonal habitat is the Nickelson Model. The analysis requires estimates of the amount of Coho spawning

gravel in the sub watershed, and the amount of each type of pool, riffle, glide, and rapid habitat present during each season of the year.

The assessment phase of the current study supplies estimates of spawning gravel, while previously conducted habitat inventories provide habitat data. Most of the habitat inventories have been conducted by ODFW, USFS, BLM and occasionally private landowners and watershed councils also commission inventories. The AQHI data utilized for this modeling effort was collected during the summer of 2005 by the Lincoln SWCD.

Model limitations

Several factors can limit the usefulness of this analysis:

- Typically, only summer data are available. Winter and spring inventories are almost never conducted.
- Habitat inventories may be lacking altogether within a sub watershed, or may miss important Coho-bearing reaches.
- Inventory protocols often vary among agencies (e.g., trench pools may be identified in one survey, but not in another).
- Variable surveyor experience and point of view can generate variable data sets (e.g., one surveyor may see a glide where another sees a pool tail out).
- Habitat conditions can change year to year, sometimes dramatically. High water years can change habitat structures. Beaver can move into or out of a drainage, or be removed for management purposes. Slope failures, natural timber recruitment, logging and similar events can introduce large amounts of soil and wood into a channel.
- The model relies on a highly simplified view of the Coho life cycle and the forces that control season to season survival.
- Model results depend heavily on assumptions made about season to season survival rates, and these rates are both evasive and debatable.

We attempt to address these problems in the following ways:

- To estimate winter rearing capacity, we use an empirical polynomial regression equation provided by ODFW that predicts smolt rearing density based on summer inventory data describing channel gradient, % pools, number of beaver ponds, active channel width, and reach length.
- The spring season is ignored in the analysis.
- Where possible, we approximate missing reach habitat data with information collected in nearby reaches, or with habitat sub samples collected during RBA surveys.
- We run the model using two sets of survival rates. One set is provided in ODFW Information Report 98-4, and the other set is based on the unpublished data of James Hall at Oregon State University. The two sets of rates vary in their assumptions about survival, and thus provide outputs that express alternative views of seasonal rearing potentials. More specifically, the ODFW survival rates are higher than those of the OSU study because they assume that only density independent mortalities occur, while the OSU rates are based on population studies where all forms of mortality occurred.

Combining model results with other resources

Clearly, the model's output should be seen as just one guideline in a decision making process that necessarily relies heavily on the professional judgment of the biologists conducting the assessment as other information is reviewed.

As part of this process, summer habitat conditions and distribution (based on habitat inventories) are compared to the summer distribution of juvenile Coho (RBA surveys). This comparison shows how the fish respond to physical habitat variables, and is generally very informative.

Some very important habitat conditions which are not adequately evaluated during physical habitat surveys must also be considered. These include sediment loading and elevated summer temperature. Information on these topics is generally sparse, and usually must be augmented by observations made during the Limiting Factors field assessment. A typical examination of elevated temperature effects would review the few temperature measurements provided by survey crews and possibly some DEQ temperature monitoring records, consider the sources and locations of cold water inputs, and assess the level of shading provided by the riparian canopy.

The assessment process therefore is not a fixed methodology that relies strictly on data tabulation and model outputs. Rather, it is an informed use of diverse and incomplete resources that change from system to system.

Field assessment

Migration barriers

Distribution is terminated in each of the two primary tributaries and the mainstem by definitive anadromous barriers. Dicks Fk is an ephemeral debris torrent jam at RM 2.7, Big Cr is a 26 ft bedrock falls at RM 2.3 and SF Big is a debris torrent jam on a 7 ft bedrock falls at RM 1.6.

In addition, there is a culvert under the Blodgett Rd crossing of SF Big that is undersized and has historically terminated anadromous distribution because of impoundment by Beaver. This culvert was open and the habitat accessible during the 2005 spring inventory conducted by Bio-Surveys.

Water Withdrawal

The South Lincoln County Water District maintains permitted water diversions for domestic use on both the mainstem of Big Cr and Dicks Fk. These water rights are registered with the Oregon Water Resources at 0.3 cfs and 0.4 cfs respectively. In addition, there is a single registered water right on the SF Big for 0.3 cfs (private irrigation) and 3 registered water rights on Reynolds Cr that total 0.51 cfs (0.464 cfs of this total is for reservoir storage only and is not classified as a consumptive use).

Oregon Water Resources has modeled the net flows (after complete utilization of the registered water rights) at the 80% exceedance levels. These values indicate that flows

are generally maintained above the following values for the listed critical summer months:

May – 15.20 cfs
June – 5.98 cfs
July - 4.77 cfs
Aug - 3.18 cfs
Sept - 2.88 cfs
Oct - 4.32 cfs

No minimum criterion has been established as a reserve stream flow. These values are basin wide estimates projected for the mainstem of Big Cr at the mouth near its confluence with the Pacific Ocean.

The 1994 Aquatic habitat inventory conducted by the USFS quantified flows at the mouth of 4.2 cfs on August 12. There have been 6 independent inventories conducted in the Big Cr basin during the period between 1994 and 2005. All of these inventories have been conducted between July and September and none of the inventories have documented sub standard summer flow profiles evidenced by isolated pool habitats, dry channels or intermittent flow. There does not appear to currently be an adverse affect on stream temperatures related to water diversions within the basin (see temperature discussion below).

Temperature issues

Big Cr is not listed as temperature limited in the DEQ's 2002 database of 303 (d) listed streams. The maximum temperature recorded for the Big Cr mainstem during the 1994 USFS Aquatic Habitat Inventory on August 12 was 57 deg. The maximum temperature recorded during the 2005 Aquatic Habitat Inventory conducted by the Lincoln SWCD was 68 deg at the confluence of the Reynolds Cr arm and the mainstem Big Cr. estuary. Temperatures of 59 deg were recorded below this junction at the Hwy 101 bridge and indicate that the large surface area of Placer Lake in the Reynolds arm was experiencing elevated temperatures from a combination of extensive solar radiation and minimal upstream inputs of fresh water flow from Reynolds Cr. proper.

The remainder of the basin however, exhibited stable water temperatures with daily fluctuations within a narrow range between 52.7 and 55.4 deg. Dicks Fk at its confluence with the mainstem of Big Cr was 54.5 deg. There appears to be only limited potential for elevated water temperatures and these exist in the portion of the wetland / marsh complex without access to salmonid incubation habitat (Reynolds Cr arm).

Aquatic habitats overview

Core Area

Describe the Core Area and its location.

The Core area describes the potential summer distribution of Coho within the 6th field. A combination of historical inventories are available that effectively described the Core

area. ODFW has conducted seining inventories in the brackish marsh above the Hwy 101 bridge and observed summer Coho parr rearing down to Hwy 101. Considering the Hwy 101 bridge as the downstream limit of summer distribution, the Core area contains 2.3 miles of rearing habitat available in mainstem Big Cr, 1.6 miles in SF Big Cr, 2.7 miles in Dicks Fk and 0.6 miles in the Reynolds Cr arm to a point just above Placer lake (for all practical purposes there is no spawning gravel accessible upstream of Placer Lake and juvenile salmonids rearing in the Reynolds Cr arm would be the result of migrants incubated in Big Cr or it's other tributaries).

Spawning gravel

Describe the quantity, quality and location of spawning gravel.

Spawning gravel summaries conducted by Bio-Surveys in May of 2005 resulted in a total of 102 sq meters of total gravel distributed in locations that exhibit the proper hydraulics for successful spawning. This inventory also ranked the quality of gravel into 3 categories of Poor, Fair and Good and attributed differential effectiveness ratings to those gravels that reduced the effective abundance of gravel for the Limiting Factors Modeling exercise to 35 sq. meters (see appendix 3). Because this low value would be the obvious driver in determining a limiting season for salmonid production, we also developed an optimistic estimate of gravel abundance that assumes all gravel is of the highest quality and utilized the slightly higher average estimate of gravel abundance generated by the Lincoln SWCD spawning survey crew over 10 independent surveys spanning the winters between 2001 and 2005. This resulted in a best case scenario of 133 sq. meters of fully functional spawning gravel. You will find a discussion of modeling these two scenarios under Restoration Analysis "Defining the production bottleneck".

The quality of spawning gravels within the Big Cr system in general is low. Gravels contain high percentages of sand and fines throughout their distribution with only 3 sq. meters in the upper most reaches of Dicks Fk classified as high quality (clean and well sorted). This is the result of a combination of channel morphology (consistent low gradient) and heavy sediment loading from historical upslope activities. There is extensive evidence of debris torrent activity in the upper mainstem of Dicks Fk (above the bedrock slide) and Big Cr above the falls. Habitats in these locations are scoured to bedrock and are not trapping and retaining mobile substrates and sediments.

The 1995 AQHI conducted by Bio-Surveys, LLC quantified 384 sq meters of spawning gravel in the same portion of the basin inventoried in 2005. This was 3 times the gravel abundance currently observed. We hypothesize that the 94% reduction in the abundance of beaver pond surface area in the last decade (from 21 beaver dams in 1995 to 1 in 2005) has had a direct impact on the abundance of well sorted spawning gravels available for anadromous adults (see channel complexity / addressing the limitations discussion).

Spawning gravels are located near the top end of Coho distribution in all 3 of the primary tributaries of Big Cr. There is approximately 1 mile in Big Cr from the confluence of SF Big to the falls, 1 mile in Dicks Fk from the confluence of Trib B to the bedrock slide and 0.4 miles in SF Big below the confluence of Trib B. These are the zones where stream

gradients increase significantly to provide the hydraulic potential required to sort gravels and reduce the deposition of fines.

Summer juvenile distribution

Describe the summer distribution of Coho juveniles. Include a description of the resources used.

Summer juvenile distribution has been contemporarily well described by the RBA snorkel inventories conducted by the Midcoast Watersheds Council. The greatest abundance and broadest distribution was observed in 2003 as a result of increased ocean survival rates for the 2002 adult brood. The 2003 summer Coho parr distribution can be observed in appendix 6.

For the 2003 inventory mainstem Big Cr maintains even rearing distribution from the confluence of Dicks Fk to the spawning peak observed directly below the falls. This is an indicator that habitats in this zone appear to function well for summer populations and are not being constricted by temperature limitations. None of the available summer habitats were seeded to capacity on even this year of increased adult abundance.

The summer rearing densities in Dicks Fk. were significantly higher than observed in mainstem Big Cr and some habitats were seeded to capacity near high quality spawning locations. In addition, there appeared to be a minor upstream temperature dependant migration from mainstem Big Cr into the lower 500 ft of Dicks Fk. This is an indicator of potential temperature increases in the mainstem. The total distribution of Coho extended 2.5 miles and was terminated by an ephemeral debris torrent jam (5 ft vertical).

The summer distribution of juveniles was not even in SF Big. There was an increase in rearing density in the 4,800 ft of lowland marsh habitat that exists above the Blodget Rd culvert. All spawning and incubation must by default occur in the 4,100 ft above this marsh to the barrier falls just below the confluence of Trib B a 50% contribution of flow. The expanded estimate of juveniles for the SF Big during 2003 was 1,595. This was approximately the production of 7 female adults utilizing an 8.8% egg / parr survival rate. It is interesting to note that there was 7 sq. meters of gravel documented in the SF Big during the May 2005 inventory by Bio-Surveys.

Summer cover

Describe the character and distribution of summer cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Summer cover for juvenile salmonids is often expressed in quantitative inventories as the abundance of wood compared to a desired condition criterion. If 80 pieces / mile (the criteria developed in option 9 of the Northwest Forest Plan) is the goal, then the Big Cr basin in general averages approximately 23 pieces / mile over 7 mainstem and tributary reaches with a range between 6 and 36 pieces / mile. As expected, the lower mainstems of Big and SF Big are the lowest in wood density, with densities increasing as active channel widths decrease upstream.

There is an additional factor that contributes to the summer cover and habitat complexity issue that needs to be reviewed for the Big Cr basin in general. The vast surface areas of wetland / marsh habitat with complex channel matrixes that are undocumented in the AQHI. This additional habitat feature increases the complexity rating of the basin and offers supplemental complex cover to both summer and winter rearing juveniles. These wetland / Marsh surface areas exist in reach 1 of mainstem Big Cr from the Hwy 101 bridge to the USFS forest boundary and in the 4,800 ft above the Blodget Rd culvert on the SF Big.

Winter cover

Describe the character and distribution of winter cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Essentially the discussions above for summer cover, documenting the distribution of wood complexity and the existence of the wetland / marsh surface areas, also brackets the discussion of winter cover. The primary difference is that the abundance and accessibility of the wetland / marsh surface area for juvenile salmonids during winter flow regimes is much greater than is observed during summer. Vast surface areas of this high quality winter habitat exist both in the lower mainstem of Big Cr and the Reynolds Cr arm as far upstream as Placer Lake. There is so much of this additional interactive habitat that the abundance of winter habitat is the least likely limiting habitat for juvenile salmonids in the basin.

The Limiting Factors model runs developed during this assessment do not even consider the additional acreage available in these wetland / marsh habitats because we attempt to utilize the most conservative estimate of abundance for each seasonal habitat to test the hypothesis that it could be the limiting season. Even with the most conservative estimate of winter rearing area, the abundance of winter habitat is clearly not the limiting season.

Channel form and floodplain interaction

Describe the channel form and degree of floodplain interaction..

The mainstem of Big Cr from the head of tide to approximately the confluence of the SF Big exists within a moderately entrenched channel that during mean winter flows and lower is isolated from its floodplain terraces. Flows above the mean winter level exhibit extensive potential for floodplain connectivity. The reach functions well during peak events to provide high quality off channel habitat. There are some significant exceptions to this generalization adjacent to the Alsea Veneer Plant site where historical mechanical manipulation of floodplain terraces has created the potential for floodplain interaction during winter flow events below the level of the winter mean. The section of mainstem Big from the confluence of SF Big to the barrier falls (4,900 ft) exhibits alternating low interactive terraces with excellent potential for the development of off channel winter habitat. This upper segment of the Big Cr mainstem also increases in gradient from 1 to 2 percent which begins to create the morphological environment required for the deposition and sorting of spawning gravels.

The Dicks Fk subbasin exhibits extremely deep channel entrenchment (6-7 ft) from its confluence with Big Cr to approximately the confluence of Trib A from the north (4,300 ft). There is no potential for floodplain connectivity within this lower reach. Above the confluence of Trib A the channel form and gradient shifts to allow floodplain interaction with low inner terraces on opposing banks that are not hillslope confined. This segment of Dicks Fk. contains an identified Coho Anchor Site.

The SF of Big Cr is moderately confined by hillslope and a parallel road bed from its confluence with Big Cr to the Blodget Rd culvert crossing. This lower 1,200 ft exhibits limited potential for the development of floodplain interaction. Above the Road crossing, a broad wetland / marsh created by the existence of the Blodget rd culvert exhibits a complex channel matrix that provides both high quality summer and winter habitat. There is no defined main channel within much of this marsh surface area because of the extensive legacy of beaver impoundment at the site of the culvert that has impounded the wetland surface area from wall to wall and deprived the main channel of hydraulic scour. The channel form above the wetland / marsh increases in gradient and does not exhibit confinement or entrenchment.

Channel complexity potential

Assess the potential for the development of meander, braiding, side channel, alcove, backwater channel forms.

Channel complexity is compromised in the mainstem of Big below the confluence of the South Fk and in Dicks below the confluence of Trib A from the moderate to deep channel entrenchment discussed above. This condition does not lend itself to the development of off channel habitat types (backwaters, alcoves, side channels). There is however excellent sinuosity (1.2) and the evidence of historical channel meander in these entrenched reaches. This feature increases riparian wood contribution and helps maintain significant wood densities within the active channel.

The channel complexity above the confluence of SF Big on the mainstem and above Trib A on Dicks Fk is significant and facilitates the development of interactive back water and off channel eddy habitats. There are only minor surface areas of braided or side channel habitats.

The SF Big maintains an extremely complex channel form within the 4,800 ft of wetland / marsh habitat above the Blodget Rd. culvert crossing. The remainder of the SF Big channel is simple with limited off channel features.

Channel complexity limitations

List and rank the factors currently limiting the development of channel complexity.

Probably the most significant alteration in channel condition observed between the 1994 AQHI and the 2005 AQHI was the reduction in the abundance of beaver pond habitats. This was the one of the primary functional disorders observed within the Big Cr basin that has had a direct impact on the development and maintenance of channel complexity. The 1994 surface area estimate of summer beaver pond habitat was 12,167 sq. meters

observed behind 21 different beaver dam structures. The 2005 inventory documented a 94% reduction in the abundance of this habitat type to 750 sq. meters of beaver pond habitat behind a single beaver dam structure.

Addressing the limitations

Are these limitations addressable through restoration work? Explain for each limitation listed above.

The limitation of channel complexity created by the near absence of full spanning beaver dam complexes has a trickle down effect for multiple ecosystem functions. We can expect a reduction in the retention of nutrient rich sediments and organics, a reduction in the abundance of both summer and winter rearing surface area, a reduction in the abundance of complex channel forms such as braids and side channels and significantly, a reduction in the abundance of well sorted gravels for spawning and incubation. Addressing the reduction in the abundance of stable beaver dam habitats appears to be a potential coast wide issue with recently observed reductions common in many Oregon Coast Range basins.

As we proceed with this analysis you will note that this issue dominates the recovery and restoration discussion.

Anchor Site 1

Location and length

Anchor Site #1 was observed in the mainstem of Big Cr from a point 1,490 ft above the confluence of SF Big to just below the power line crossing. The Anchor was approximately 2,200 ft in length. 89 % of the lineal distance of this anchor is contained on National Forest ownership.

Sinuosity

The sinuosity was relatively high at 1.2 through the morphological reach that brackets the anchor site. 98 % of the pool surface areas within the anchor were classified as lateral scour pools. The outstanding abundance of under cut bank habitat was significant and a function of the high level of sinuosity.

Terrace structure

Alternating low interactive terraces were observed within this anchor primarily opposed by higher confining terraces. This condition created opportunities for the development of channel braids and the development of backwater habitat surface areas during winter flow regimes. Below this identified anchor the active channel was deeply entrenched (5 ft) and above the anchor the channel straightened and did not exhibit the sinuosity, complexity or the interactive low terraces of the anchor.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

The anchor contains the bulk of the higher quality spawning substrate identified for all of the mainstem of Big Cr. The gradient increases here to approximately 2.5 % to provide the hydraulic potential required to sort and clean gravels burdened with silt, sand and fines. The summer densities of Coho parr within this anchor have never (within the scope of the inventoried years 2000 – 2005) approached the levels expected from high quality habitats seeded to capacity. There is no apparent reason that this zone should not maintain higher densities during summer flow regimes if abundant fry were emerging from adjacent gravels. Moderate levels of off channel winter habitat exist within the anchor. The low density of full spanning wood complexes to impound flows and trap and sort mobile substrates definitively limits the current capacity and functionality of this anchor for the provision of high quality spawning gravel and off channel winter rearing area.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?

Although there are varying estimates of the quantity (32 – 110 sq meters) of spawning gravel within the gravel bearing segment of Big Cr, it is apparent that sand and sediment are a significant issue for these gravels from all of the independent inventory efforts. This is the most likely functional limitation for production potential within anchor site #1 and increasingly more of a negative influence on egg / fry survival in a downstream progression from the falls.

Addressing the limitations

List and rank the restoration work at the site that would most effectively increase survival within the site and stabilize the core population at a higher base level.

Because this anchor site exhibits the proper underlying channel morphology (gradient) it is one of only two key areas in the Big Cr basin where addressing the limitation of spawning gravel is appropriate. The only realistic restoration alternative here is to boost the level of instream wood complexity in an attempt to encourage additional scour and sorting. A careful balance of trapping and sorting structures would be the likely prescription. The net benefit of structure placement in this reach to the total abundance of gravel would likely be small, but the benefits from improved gravel quality could be significant.

Anchor Site 2

Location and length

Anchor site # 2 exists in Dicks Fk and begins 3,800 ft above the mouth of Dicks Fk and 400 ft below the confluence of Trib B from the right (south). The anchor then extends 2,7000 ft and ends 1,200 ft above the confluence of Trib C from the left (north).

Sinuosity

The sinuosity within the anchor is excellent at 1.2. Channel meander and active erosion are present and responsible for regularly recruiting stream adjacent trees to the active channel.

Terrace structure

A distinct transition in terrace structure is what is immediately noticeable when approaching this anchor. 100 % of the channel below the start point of the anchor is deeply entrenched (7 ft) and confined by a uniform (elevation) and very broad terrace of depositional soils. There is a legacy here of ancient impoundment or massive debris flow.

Within the anchor opposing hillslopes begin to influence the active channel, confine flows and develop a multiple terrace structure with low interactive terraces becoming part of the equation.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

The 2005 survey conducted by Bio-Surveys identified 32 sq meters of gravel within the confines of the identified anchor. This was 62% of all of the gravel documented for the entire Dicks Fk (52 sq meters) within the current distribution for Coho. 20 sq meters (63%) of the spawning substrate within the anchor was classified as poor and contained a high percentage of embedding sand and sediments. The first spawning gravels in Dicks Fk occur in this anchor. There is a bedrock intrusion a short distance above the top end of the anchor that is classified as a bedrock slide (not a falls) with a 12 ft elevation differential. Anadromous distribution has been observed above this feature, so it is not a definitive barrier, but on low flow winters the slide has occasionally been the upper extent of adult Coho distribution. Coho distribution currently extends on normal flow years to a point 2.5 from the confluence with the mainstem of Big Cr and is terminated by a 5 ft vertical debris torrent jam (see photo).

The summer rearing capacity appears to be significantly higher than current abundance inventories suggest. Habitats within the anchor were rearing only 0.6 Coho / sq. meter during the high abundance year of 2003 (1.7 Coho / sq. meter is seeded to capacity). Rearing densities trailed off below the anchor site indicating probable low levels of fry available to colonize the abundant summer habitats.

The availability of potential winter habitat within the anchor was modest and consisted of low interactive terraces and their associated backwater habitats during mean winter flow regimes. No special winter habitat features were present such as Beaver dams or natural dam pool habitats.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?

Because there are only two significant spawning locations within the entire Big Cr basin (Anchor site #1 and #2), and both of these locations report poor quality gravel as the dominate gravel type. We believe that both the quantity and quality of incubation substrate is the primary limitation for not only the anchor site but for the Big Cr basin as a whole.

These anchor sites are essentially morphological transition reaches from a transport corridor to a depositional plain. Gravel resources that are not trapped and retained move completely through the transition zone and are quickly buried downstream by abundant sediments settling out in the low gradient reach just below the anchor site. Gravels retained within the anchor, require the sorting and flushing provided by woody structure during winter high flows or they also become burdened with sand and sediment. Peak flow events of the 10 and 50 yr frequency class are also very important to the short term condition of stored gravels for effective incubation. For example, it is likely that the large flow events documented on the Oregon Coast during the winter of 2005 / 2006 have substantially improved the quality of the gravels within the anchor site and egg / fry survival rates should improve for at least the 2005 and 2006 adult broods.

Addressing the limitations

List and rank the restoration work at the site that would most effectively increase survival within the site and stabilize the core population at a higher base level.

Because this anchor site exhibits the proper underlying channel morphology (gradient) it is one of only two key areas in the Big Cr basin where addressing the limitation of spawning gravel is appropriate. The only realistic restoration alternative here is to boost the level of instream wood complexity in an attempt to encourage additional scour and sorting. A careful balance of trapping and sorting structures would be the likely prescription. The net benefit of structure placement in this reach to the total abundance of gravel would likely be much greater than estimated for the Big Cr anchor because there is significant historical evidence that gravels exist in the headwater transport reaches from the large accumulations of gravel stored behind beaver dam complexes that was observed in the 1994 Aquatic Habitat Inventory. In addition, as observed for anchor site #1, the additional channel roughness provided by wood complexity could significantly improve the sorting, flushing and final net quality of gravels within the anchor.

Anchor site rankings

Function

Rank the identified anchor sites in terms of current function (1= best).

There does not appear to be any significant difference between the two identified Anchor sites in terms of their current function. Averages of gravel abundance inventories suggest that each anchor exhibits roughly the same amount of spawning gravel and it was classified as the approximately the same quality (poor or fair – no high quality). Riparian functions although slightly different in dominant species composition are also stable and interactive. Sediment transport from headwaters also appears to be very similar. There are similar registered water diversions above each anchor that predetermine functionality. No distinction in current function can be made and current function for both is classified as a 2 if 1 is the best.

Restoration potential

Rank the identified anchor sites in terms of restoration potential.

- 1) Anchor Site # 1 (prioritized only for its ease of access)
- 2) Anchor Site # 2

Secondary Branch Habitats

There are no secondary branch habitats within the distribution of Coho in Big Cr, SF Big or in Dicks Fk that play a significant role in the provision of aquatic habitat for juvenile Coho. Only Dicks Fk has significant flow contribution from Trib A and Trib C but neither of these tributaries provides more than short stretches of supplemental habitat for Cutthroat.

It should be mentioned that Reynolds Cr , a small tributary that enters the estuarine wetland / marsh from the north has not been incorporated in this review because it exhibits no historical distribution of large anadromous salmonids (Steelhead, Coho). Reynolds is also not likely to ever play a significant role for salmonid production because of the almost complete absence of spawning gravel. The minor abundance of gravel that exists would provide spawning and incubation potential for Cutthroat only. You will find a discussion of the other potential rearing habitats that exist in the Reynolds Cr arm under the Lowlands discussion.

Lower mainstem area

Winter habitat potential

The lower mainstem below the confluence of Dicks Fk has been included in this analysis because the arbitrary 6th field designation has included all habitats above the confluence of Big Cr and the Pacific Ocean. Therefore for modeling purposes the physical habitat types and available habitat surface areas for rearing have all been quantified within the Limiting seasonal analysis. This zone is complex and seasonally dynamic. There is tidal interchange here both winter and summer on peak tide cycles and the influence of tide

can extend upstream to the USFS boundary. Salinities are certain to play a role in juvenile distributions seasonally. It is an understatement that this area provides high quality winter habitat surface area. The abundance of this habitat type was intentionally minimized in the modeling process to test the hypothesis that the abundance of this seasonal habitat could be limiting. During winter flow regimes, the abundance of this habitat type is much larger than reported in either the seasonal habitat limitation model or the Aquatic Habitat Inventories. If we assume that during winter flows salmonid juveniles are also capable of migrating up the Reynolds Cr arm of the estuary then there is additional high quality low salinity habitat to boost even higher the available winter habitat surface area.

Summer habitat potential

This same lowland habitat that exists below the confluence of Dicks Fk in the mainstem is probably providing some level of juvenile salmonid production at summer flow regimes. There is limited summer data from this zone because visibility is compromised for snorkeling by vegetative decomposition and the resultant tannins. There is antitidal information that juveniles are typically summer rearing here. For the limiting seasonal habitat model scenarios however, we assumed that the elevated temperatures observed at the mouth of the shallow Reynolds Cr arm (20 deg C) created a barrier to the upstream utilization of those habitats (including Placer Lake) in the Reynolds Cr arm. Again, our goal was to minimize each of the seasonal habitats to test the theory that they could be a seasonal limitation in the worst case scenario for abundance. Essentially, there is no fish distribution or abundance data for the Reynolds Cr wetland / marsh habitats and it is possible that additional summer habitats exist here that are accessible to migratory fry or parr during spring or summer flow regimes. If this is the case, then the determination that spawning gravel is the primary seasonal limitation is exceptionally strengthened.

Lowland habitats

Describe lowland habitats and locations outside the 6th field.

There are no lowlands outside of the scope of this analysis.

Riparian corridor

Dimensions and location

Describe the lineal dimensions and location of deciduous, coniferous, and open canopy.

All of the Big Cr riparian is Alder dominated (92 – 100% by reach). The remainder of the subdominant species are a mix of Spruce and Hemlock. These coniferous components become more significant above the falls and anadromous distribution. There are extensive open canopies in the lowland marsh habitats of reach 1 that extend from the Hwy 101 bridge to approximately the USFS boundary at RM 0.4.

In SF Big the riparian in reach 1 to the top end of the wetland / marsh is Alder dominated with a 5% under story of coniferous Spruce. Above the marsh the riparian is conifer

dominated (73%) and contains both Spruce and Hemlock. The only open canopy exists in the wetland / marsh corridor that is approximately 0.3 miles.

In Dicks Fk the riparian is 70% Alder in reach 1 but also exhibits 30 % of the canopy in a mature old growth Spruce condition. This is a unique lowland ecotype that provides exceptional diversity to approximately 1 mile of riparian and aquatic habitat. The riparian in Reach 2 is 40% Alder and Hemlock in the small tree seral stage. The reach also exhibits approximately 38% of the riparian canopy in a mix of large and mature tree seral stages that include Spruce, Hemlock and Cedar. There are no segments of open canopy within Dicks Fk.

Recruitment potential

What is the recruitment potential and time frame for delivery to the channel?

There are 3 reaches in mainstem Big Cr that are unique in their morphology as well as their potential to contribute riparian wood resources to the active channel. Reach 1 from the confluence with the Pacific Ocean to the Alsea Veneer ownership contained 1 riparian conifer / 100 ft. Reach 2 from the confluence of the SF Big to the barrier falls exhibited 8 riparian conifers / 100 ft. Reach 3 from the falls to the end of all fish distribution (including Cutthroat) exhibited 16 riparian conifers / 100 ft.

Dicks Fk was described by 2 reaches. Reach 1 from the mouth to the confluence of Trib C exhibited 16 riparian conifers / 100 ft. Reach 2 from Trib C to the end of Cutthroat distribution contained 10 riparian conifers / 100 ft.

The SF Big also contained 2 reaches. Reach 1 from the mouth to the top end of the wetland / marsh habitat above the Blodgett Rd crossing exhibited 10 riparian conifers / 100 ft and reach 2 from the wetland to the end of Cutthroat distribution exhibited the highest potential for long term contribution with 26 riparian conifers / 100 ft.

Most conifers are moderate aged at approximately 40 – 50 years. The largest contiguous exceptions are those trees described for reach 1 of Dicks Fk. These are late seral and exhibit the greatest current potential for delivery to the active channel.

Thermal problems

Describe the relationship between riparian condition and thermal problems in the aquatic system. Include locations and causes.

The only documented thermal issues documented within the basin have been for the Reynolds Cr arm. A temperature of 20 deg C was recorded here in 2005 between its confluence with Big Cr and Placer lake. These habitats are primarily impounded surface areas with only minor exchanges in flow during the summer. In addition, large surface areas of the Reynolds Cr lowland habitat receive extensive solar exposure. The influence of these warm impounded surface areas on the lower mainstem below the confluence of the Reynolds Cr arm seem moderate with 15 deg C temperatures recorded on the same day at essentially the same time.

Critical Contributing Areas (CCA)

Description and relation to core site

Identify the CCA's and describe the spatial relationship between each CCA and the Core Area and Anchor Site(s). Identify CCA's that contribute directly to specific Anchor Sites.

There are primarily only moderately steep (60-70%) headwater slopes and tributaries documented within the basin on the CLAMS landslide risk assessment model. The majority of these slopes surround first order upslope canyons on both the north and south slopes of Dick's ridge (see appendix # 5). These are short stream adjacent draws with limited run out potential that exhibit low probabilities of contribution. However these are the few locations (identified as direct contribution priority 1) that could potentially contribute to Big Cr above the falls or Dicks Fk. within the Coho bearing segment of the mainstem. Any upslope deliveries from these sites would therefore have the potential of contributing upslope resources to either Anchor site #1 or #2. None of the lower basin tributaries accessible to salmonids exhibits any significant potential to contribute wood or substrate resources to the Coho bearing portion of the mainstem from debris torrent migration (Trib A, B, and C of Dicks Fk).

Only tributaries F and G of Dicks Fk and the headwater fork of mainstem Dicks Fk appear to contain the slope characteristics required for potential debris flow activity. These stream segments exist far enough above anadromous distribution and in gentle enough mainstem gradient profiles that the run out model suggests that resources delivered from these locations would not be transported to salmonid bearing lower reaches.

Ranking

Rank the CCA's in order of importance to the Core/Anchor Site system. This ranking should consider the contribution of substrate, wood, flow, and temperature maintenance to the Anchor Site system.

- 1) Dicks Fk headwater mainstem
- 2) Dicks Fk Trib G
- 3) Dicks Fk Trib F

Restoration analysis

The purpose of this section is to create a list that ranks the factors currently limiting Coho production. This ranking should be based on the information and conclusions developed in this report, as well as the output from the Nickelson model which estimates seasonal smolt potential using rearing habitat data. The analysis requires an integrated view of the Coho rearing system which up to this point has been assessed as individual components. The process necessarily utilizes professional judgment in weighing the importance of diverse information resources.

Nickelson Model results

The two Limiting Habitat Analysis Worksheets (see Appendix 4) display two independent modeling scenarios that represent worst and best case scenarios for the apparent seasonal limitation which is the abundance of spawning gravel for incubation.

Scenario # 1 attributes a quality rating to the observed gravels and then reduces the abundance of high quality gravel utilized in the model. This worst case scenario clearly indicates that the abundance of gravel is the primary seasonal habitat limitation whether utilizing the Nickelson Model coefficients or the Alsea Watershed Study coefficients. The problem with this model run is that the AWS coefficients of survival produce less smolts (793) than actually observed during the 2003 inventory year (summer RBA abundance 10,425 X 0.28 over winter survival = 2,919 smolts). This model run when tested against known values appears to substantially under estimate the abundance of spawning gravel.

Scenario # 2 utilizes a more liberal estimate of spawning gravel abundance collected by a different inventory crew and classifies all of the observed gravel as good quality and capable of the egg / fry survival rates utilized by each of the independent studies (Nickelson / Alsea Watershed Study). This model run can be referred to as the best case scenario for current gravel abundance. Here there is not agreement between the two methods of applying seasonal survival rates as to the limiting seasonal habitat. The Nickelson survival rates suggest that the abundance of summer habitat is the current seasonal limitation while the Alsea Watershed Study suggests that the abundance of spawning gravel continues to be the primary seasonal limitation (see appendix 4). To test the validity of these results we can return to the supplemental data that we have for life stage abundance. From the 2003 summer RBA snorkel inventory we generated a summer parr estimate of 10,425. If we apply a range of over winter survival rates observed in the coast range between 28 and 32 percent we produce 2,919 – 3,336 smolts. Compare these values to the 3,330 smolt estimate from the Alsea Watershed studies optimistic estimate and we get some corroboration. From another perspective, our review of summer parr densities during the high abundance year of 2003 indicate that very few summer habitats were seeded to capacity and that the potential for summer capacity was far from being realized (suggesting the abundance of summer habitat was not the limiting season as suggested by the Nickelson Model). These two approaches to validation suggest to this review team that gravel is likely the current seasonal limitation and that the Big Cr basin was close to functioning at its current capacity for the 2002 brood year.

Defining the production bottleneck

Does the seasonal bottleneck identified by the Nickelson Model remain the primary limiting habitat when each of the other issues identified in the assessment process are factored in? Explain.

Given that the abundance of spawning gravel appears to be the limiting seasonal habitat for Coho in the basin based on the Limiting Habitat Analysis Worksheet (appendix 4), it is interesting to review the historical data with that analysis in mind. The peak observed summer juvenile abundance that occurred in 2003 after the exceptional marine survival

years of 2001 and 2002 for the parent brood, resulted in an estimate of 10,425 summer parr for the basin. If we utilize an egg / parr survival rate of 8%, 2.5 redds / female and 1 sq. meter of gravel / redd we conclude that 130 sq meters of spawning gravel was utilized to produce the 2003 summer crop of juveniles. This value is very close to the optimistic scenario of gravel abundance discussed for model run #2 above (148 sq. meters).

This suggests that the Big Cr basin was likely at its current carrying capacity for the 2002 adult escapement year, the 2003 juvenile rearing season, and the 2004 smolt migration. Given the current status of the available incubation habitat that limits carrying capacity, the current best case scenario for the Big Cr basin as a whole in terms of smolt production, may be in the range of 3,300 – 5,400. This variation incorporates a range of high end over winter survival rates of 32% – 52% which have been observed in restored habitats with high wood complexity (Green River).

The values above are meant to give some context to the basins current production potential and to test modeling conclusions with historical inventory data sets. They are not designed to be definitive or conclusive. In fact, the RBA surveys utilized to estimate summer parr abundance were not capable of generating an estimate for the habitats below the confluence of Dicks Fk because of tannins and the lack of visibility for the snorkel methodology. Therefore, additional summer rearing was left unquantified which would result in additional smolt production.

Potential for lowlands contribution

If the abundance of winter habitat has been determined as the primary factor limiting Coho production, discuss how lowland habitats existing outside the boundaries of the 6th field might function to provide winter habitat for smolts produced in the 6th field.

Winter habitats are the most abundant and least likely source of a seasonal limitation to carrying capacity for the Big Cr basin. All of the lowland habitats are complex marsh / wetland surface areas and are in close proximity to summer rearing populations of juvenile salmonids. In addition, these habitats are likely to remain low salinity environments through the majority of the winter season because of the increase in freshwater contribution and the large size of the drainage basin.

Ownership issues

To what degree would land use and ownership allow restoration work?

The majority of the upper basin forest habitats and stream corridors are within public ownership on USFS property. There are however, significant critical lowland reaches that are owned by a wide array of small private landowners. Approximately ½ of the Big Cr estuary / wetland / marsh is privately owned. 0.7 miles of mainstem Big Cr is small private ownership and 0.8 miles of SF Big from its confluence with Big is small private ownership. These ownerships describe a very large proportion of the winter rearing habitats on the basin scale. They include only a small fraction of the areas identified as significant for spawning and incubation.

If the restoration strategy addressed seasonal limitations for Coho first (spawning and incubation), then all of the potential work could be accomplished on public ownership without an immediate need for involving small private ownerships. It would be prudent however, to begin considering the long term questions of ecosystem function on the basin scale as a component of this restoration strategy. This would involve addressing other life history stages, other upslope issues and consequently a more significant role from small private landowners and municipalities.

The large issues of concern for maintaining long term function are the municipal water withdrawals from mainstem Big Cr and Dicks Fk., the protection and enhancement of the privately owned portion of the estuary / wetland / marsh surface area, and the recovery and restoration of the riparian and aquatic corridor adjacent to the Alsea Veneer property.

All of these sites require the cooperation and involvement of key small private owners. There appears to currently be an excellent opportunity in the estuary / wetland / marsh habitat for establishing a conservation easement on the Nasef property for protection and enhancement (first property upstream and to the south of the Hwy 101 bridge). There also appears to be a conservation opportunity with the owners of the Alsea Veneer property to negotiate a partial or complete acquisition of properties they have classified as surplus for their operations.

Channel complexity potential

What is the potential to increase channel complexity in the long term through natural recruitment processes, with and without restoration?

The enhancement of channel complexity through natural recruitment directly addresses the primary basin wide limitation of spawning gravel abundance and quality. Improving the current condition through natural process (slope failure and stream adjacent recruitment) is currently a reality because of the ongoing maturation of the riparian coniferous canopy that currently exhibits a trajectory toward increasing aquatic complexity.

This only remains a viable conclusion if the riparian and upslope wood resources are protected for future delivery and not liquidated as forest commodities. This includes all of the 1st and 2nd order headwater corridors that have been identified as slide prone and capable of delivering these resources to the Salmonid bearing segments of the aquatic corridor.

Relying on natural recruitment represents a long term vision of the restoration of channel complexity. Active short term restoration would likely accelerate the process of developing complexity and may also initiate chain reactions in the development of channel complexity from deflection, erosion and meander.

Restoration prescriptions

Potential restoration sites

- 1) Culvert on SF Big Cr Blodget Rd crossing
- 2) Conservation easement for estuary / wetland / marsh property
- 3) Basin wide recovery or enhancement of beaver population
- 4) Develop basin wide minimum flow criteria
- 5) Anchor Site # 1
- 6) Anchor Site # 2
- 7) Acquisition of high quality lowlands / Alesa Veneer Property

Location

- 1) The Blodget Rd culvert exists 0.8 road miles from Hwy 101 and passes the SF Big Cr under the Blodget Rd.
- 2) The Nasef property that borders Hwy 101 on the east and south side of the Big Cr estuary
- 3) Entire Big Cr watershed area that includes Reynolds, Dicks Fk, Big and SF Big
- 4) Minimum flow criteria for the Dicks Fk and Big Cr sub basins
- 5) Anchor Site #1 was observed in the mainstem of Big Cr from a point 1,490 ft above the confluence of SF Big to just below the power line crossing. The Anchor was approximately 2,200 ft in length. 89 % of the lineal distance of this anchor is contained on National Forest ownership.
- 6) Anchor site # 2 exists in Dicks Fk and begins 3,800 ft above the mouth of Dicks Fk and 400 ft below the confluence of Trib B from the right (south). The anchor then extends 2,7000 ft and ends 1,200 ft above the confluence of Trib C from the left (north).
- 7) The Alesa Veneer Property exists 0.3 road miles from Hwy 101 on the Blodget Rd and directly east and south of the Angel Job Corp Center.

Issue

- 1) The culvert at the Blodget Rd crossing is currently inadequate for meeting state stream crossing guidelines. This condition had historically been problematic because it has created an unnatural impoundment above the culvert that has altered the lowland habitats above the crossing from the accelerated deposition of sediments and fines. In addition, when beaver populations were healthy within the Big Cr basin, this site was routinely the site of a full spanning beaver dam complex that threatened the road and terminated anadromous migration (the dam was typically built at the top end of the pipe creating a definitive migration barrier). Although additional wetland habitats provide species diversity and are generally considered high quality rearing habitats for salmonids, the additions to this wetland from unnatural impoundment may also have resulted in decreasing the abundance of spawning gravel in the SF Big (the identified limiting factor for salmonid production). With the recent crash in beaver abundance the long standing dam at this crossing has not been recently rebuilt but the root problem still exists.

- 2) The Nasef property that encompasses the majority of the private ownership of the Big Cr estuarine / wetland / marsh habitat is a precious and rare habitat commodity within the larger scope of all Oregon Coastal wetlands. This zone although not pristine (historical rail line construction, impacts from impoundment caused by Hwy 101 and residential impacts) currently is providing exceptional long term refugia to a vast array of coastal plant species, birds, amphibians, invertebrates and fishes. The future pressure that could be exerted on this zone from alterations in land use is a risk not worth incurring for the continued function of the Big Cr ecosystem. The abundance of this wetland habitat is currently not limiting salmonid production within the basin, however the maintenance of healthy long term function for the Big Cr basin requires the long term protection of this habitat asset.
- 3) Two AQHI (Aquatic Habitat Inventories) were conducted 11 years apart (1994-2005). The abundance of beaver dams and the beaver pond rearing surface area were one of the many attributes quantified in each of those inventories. The dramatic decline in beaver dams between these years (21- 1) suggests that a comparable decline in the resident beaver population has also occurred. Beaver dam complexes provide many very significant complementary functions for salmonids that include the provision of low velocity impounded habitats for both summer and winter rearing, the full spanning dam complexes that trap and retain mobile silts, sands, gravels, organics and nutrients and the ability to lift the active channel in elevation to interact with its floodplain. This last attribute creates complex channel forms by developing braided channels and side channels that in turn provide additional spawning and incubation opportunities on a smaller and more frequent scale than may be observed in the mainstem. We hypothesize that the reduction in full spanning beaver dam complexes within the Big Cr basin has had a net negative impact on gravel abundance for salmonid incubation.
- 4) There are currently two municipal water diversions within the Big Cr basin that are permitted to withdraw a combined total of 0.7 cfs for domestic consumption. These withdrawals appear to leave a minimum of at least 2.88 cfs within the active channel at least 80 % of the time during the critical low flow period modeled for September. The flow volumes reserved for the stream environment are small and are shared between 4 subbasins (Reynolds, Big, SF Big, and Dicks Fk). The impacts of these pinch period low flows on aquatic communities and fish populations are unknown. There are increasing pressures being applied on municipalities to deliver water as communities grow and populations increase. The Big Cr basin is a likely source of future additional water allocation.
- 5) Moderate wood densities within the anchor could be boosted to affect the abundance and quality of spawning substrates within the anchor to address the identified primary limitation for Coho production. This increase in wood complexity and channel roughness would theoretically provide additional gravel retention, sorting and scour.
- 6) Moderate wood densities within the anchor could be boosted to affect the abundance and quality of spawning substrates within the anchor to address the identified primary limitation for Coho production. This increase in wood

complexity and channel roughness would theoretically provide additional gravel retention, sorting and scour.

- 7) Extensive floodplain manipulation has occurred on the site of the abandoned Alesa Vener Mill. There currently exists a legacy of two historical log ponds as well as road bed fill, diking and channel modification. Impacts to the native riparian community are extensive and the restoration potential that exists in restoring both floodplain habitats and the active channel are extensive. Most of the restoration here would generate additional shade, vegetative diversity, off channel habitats for supplemental summer and winter rearing and improvements in water quality. None of these restoration components directly address the current seasonal limitation for Coho production. There are however, powerful arguments for including the acquisition of this property into the basin wide discussion of the long term restoration of ecosystem function.

Goal

- 1) Restore the natural process of resource transport and prevent the future isolation of habitats from salmonid access.
- 2) Protect and restore high quality estuarine marsh habitat for maintaining proper function in the Big Cr basin and for the coast wide system of refugia.
- 3) Restore a cornerstone species that plays a fundamental role in maintaining proper functional relationships within the Big Cr ecosystem.
- 4) Protect future water resources for the proper function of the Big Cr stream, wetland and estuary system.
- 5) Enhance the best of the existing habitat to effect a positive impact on the retention and sorting of spawning substrates.
- 6) Enhance the best of the existing habitat to effect a positive impact on the retention and sorting of spawning substrates.
- 7) Restore high quality lowland habitats that exhibit the impacts of historical manipulation and protect the site from potential new trajectories in land use that might negatively influence the restoration of long term ecosystem function.

Method

- 1) A bottomless arch would be the ideal replacement for the current undersized metal corrugated pipe. This type of installation could be sufficient in size to accommodate wood transport and the two way migration of both aquatic and terrestrial species.
- 2) The implementation of a conservation easement would require partnership development with a non profit NGO
- 3) Live trap and transport beaver into the Big Cr basin to attempt rapid re-colonization.
- 4) A prudent precautionary measure to insure that future over allocation does not become an issue for ecosystem function in the Big Cr basin is to review current ecosystem requirements and establish legal minimum flow criteria for the basin that can be monitored. Replicate snorkel inventories in June and October would help evaluate the pinch period impacts on summer rearing parr to establish if an aquatic resource issue currently exists for salmonids. This would be valuable data

to sequester prior to establishing permitted minimum flow reserves for the streams in question.

- 5) Place large woody debris in multiple log complexes designed to both trap and sort gravels (impoundments and deflectors). Placement at this site could be accomplished by either excavator or helicopter.
- 6) Place large woody debris in multiple log complexes designed to both trap and sort gravels (impoundments and deflectors). Placement at this site could be accomplished by helicopter only.
- 7) Acquisition funds could be sought from either State or Federal sources for the acquisition of these lowland acres.

Potential complications

- 1) No complications anticipated
- 2) Development of appropriate partnerships for acquiring the easement before the current cooperative landownership is altered.
- 3) What ever has devastated the current beaver population continues to be present within the basin and no net change from supplementation is realized.
- 4) The preventative strategy for securing future stream flows is not supported by management agencies.
- 5) No complications anticipated
- 6) Access is extremely difficult and wood placement may not be feasible other than by helicopter
- 7) Development of the funding base for direct acquisition before the property changes hands to another owner with a new land use targeted.

Expected results

- 1) Culvert removal and replacement with a properly sized open bottomed arch would facilitate the restoration of natural resource transport through the system that may boost the availability of spawning gravel resources.
- 2) The development of a perpetual conservation easement on this ownership would secure the long term function of these habitats for the Big Cr ecosystem and contribute to the larger system of coastal refugia. In addition, the easement would eliminate the long term risk of detrimental alterations in land use.
- 3) The restoration of the Big Cr beaver population would restore one of the cornerstone components of proper long term function to the Big Cr ecosystem. The trickle down could positively impact the primary limitation to salmonid abundance, the availability of high quality gravels for incubation.
- 4) The establishment of minimum flow criteria for each Big Cr sub basin would protect the long term proper function of the Big Cr stream network from the future risk of over allocation.
- 5) The increase in wood complexity should result in a positive response in the abundance and quality of spawning gravel.
- 6) The increase in wood complexity should result in a positive response in the abundance and quality of spawning gravel.

- 7) The acquisition of this parcel would protect lowlands from the threat of residential or commercial land use and begin to establish a positive trajectory for the restoration of system function.

Restoration rankings

From the recommendations listed above, list and rank the restoration work that most effectively stabilizes the population at a higher base level and prioritizes the recovery of ecosystem function.

Short term Limitations

- 5 – (Addresses current seasonal limitation for salmonids)
- 6 – (Addresses current seasonal limitation for salmonids)
- 3 – (Addresses current seasonal limitation for salmonids)
- 1 – (Addresses current seasonal limitation for salmonids)
- 2
- 7
- 4

Long term Function

- 2
- 7
- 4
- 3 – (Addresses current seasonal limitation for salmonids)
- 5 – (Addresses current seasonal limitation for salmonids)
- 6 – (Addresses current seasonal limitation for salmonids)
- 1 – (Addresses current seasonal limitation for salmonids)

APPENDICES

Appendix 1. Habitat features and survey status of Big Creek sub-watershed reaches which have Coho bearing potential

Current Reach ID	Stream	Description	River Mile			Survey Resource			Valley Morphology			Aquatic Habitats			
			Beg	End	Len	Type	Year	Surv Rch ID	Grad (%)	Valley Width	Constraint	Pools (%)	Bvr Pnds (#)	Wood (pcs/mi)	
														Total	Key
1	Big Creek	Hwy 101 bridge to head of tide (forest interface)	0.0	0.4	0.4	LSWCD	2005	1	0.1	Very broad	Unconstrained/terrace	70	0	64	0
2	Big Creek	Head of tide to jnct SF Big	0.4	1.5	1.1	LSWCD	2005	2	0.7	Very broad	Terrace	53	1	267	11
3	Big Creek	SF Big to 40 ft falls (end of anadromous distribution)	1.5	2.3	0.8	LSWCD	2005	3	2.6	Broad	Terrace	30	0	307	19
1	Dick's Fork	Mouth to Trib B	0.0	0.8	0.8	LSWCD	2005	1	0.4	Very broad	Terrace	54	0	415	31
2	Dick's Fork	Trib B to Trib C	0.8	1.5	0.7	LSWCD	2005	2	1.0	Broad	Terrace	52	0	308	23
3	Dick's Fork	Trib C to end of survey	1.5	2.2	0.6	LSWCD	2005	3	2.7	Narrow	Terrace/Hillslope	15	0	341	24
1	SF Big	Mouth to end of flooded wetland	0.0	0.7	0.7	LSWCD	2005	1	0.5	Very broad	Unconstrained/terrace		0	90	3
2	SF Big	Begin active channel morphology to end of survey	0.7	1.3	0.6	LSWCD	2005	2	2.6	Very broad	Terrace/Hillslope	23	0	165	13

SF Big Reach 1 is a flooded wetland with no defined channel.
2005 survey was conducted by Lincoln SWCD, data compiled by ODFW

Appendix 2. Big Creek sub-watershed drainages

Drainage	River Mile	Enters from	Slope faces	Relative size	Valley description	Comments
Big Crk	0.0	N/A*	West	Large	Moderate, narrow	Primary contributor to mainstem summer flow
Dick's Fork	0.7	Left	West	Large	Flat, broad,	Second major contribution to summer flow
SF Big Crk	1.3	Right	Northwest	Large	Flat, broad	Minor summer flow
Reynolds Crk	0.1	Left	South	Very small	Flat, broad	Insignificant summer flow

Appendix 3. Big Creek sub-watershed spawning gravel estimates

Stream	Reach	Poor	Fair	Good
Big Cr	1	26	10	0
Dicks Fk	1	0	0	0
Dicks Fk	2	29	20	3
SF Big	1	0	0	0
SF Big	2	7	0	0
Reynolds	1	7	0	0
Total		69	30	3

Appendix 4. Big Creek sub-watershed limiting habitat analysis based on the Nickelson model

The following text and tables are extracted from an Excel workbook that implements the Nickelson model. The analysis was performed two times for the purpose of estimating smolt production and identifying the seasonal limiting habitat under varied scenarios:

- 1) Scenario 1: Amounts and quality of spawning gravel found in the 2005 survey were evaluated.
- 2) Scenario 2: Optimized spawning gravels. The goal of this scenario was to offer an upper range of potential for spawning gravel abundance. This takes an alternate data set and classifies all of the gravel observed as high quality with the capability of achieving the egg / fry survival rate utilized by the two model coefficients. The only alterations in this scenario are the spawning gravel values. Spawning gravel estimates were derived by averaging 10 different spawning gravel estimates between the years of 2001 and 2005 conducted by experienced surveyors from the Lincoln SWCD during spawning surveys for adult salmonids. These surveys were only conducted for Dicks Fk and mainstem Big Cr to the falls. The value for the SF Big was derived from the field comments from the 2005 Aquatic Habitat Inventory conducted by the same Lincoln SWCD crew (Stone / Woods).

The text and the first set of tables (Tables A and B) are descriptive of the analytic process conducted in each scenario, and therefore are presented just once. Below this are the results of each scenario analysis. Tables C through F appear for each scenario, containing output data specific to that scenario.

Table A. Stream summer rearing densities

Table A. Coho rearing density for each summer stream habitat type.

Habitat type	Fish/sq m
Cascades	0.24
Rapids	0.14
Riffles	0.12
Glides	0.77
Trench Pools	1.79
Plunge Pools	1.51
Lateral Scour Pools	1.74
Mid Chan Scour Pools	1.74
Dam Pools	1.84
Alcoves	0.92
Beaver Ponds	1.84
Backwaters	1.18

Data of Tom Nickelson based on ODFW reseach.

Table B. Survival rates to smolt

Table B. Season (life stage) to smolt survival rates.

ODFW Reseach		Alesa study data	
Life stage	Survival rate	Life stage	Survival rate
Egg to smolt	0.3200	Egg to smolt	0.0270
Spring to smolt	0.4600	June to Smolt	0.0644
Summer to smolt	0.7200	Fall to smolt	0.1110
Winter to smolt	0.9000	Winter to smolt	0.2870

Rates used by Tom Nickelson (ODFW)

Rates provided by Jim Hall (OSU Dept of F & W)

SCENARIO 1: Conditions of spawning gravel encountered in 2005 survey.

Table C. Rearing capacities

Table C1. Upland rearing capacities.

Stream ID		Rearing capacity (# eggs or fish)		
Number	Name	Spawning	Summer	Winter
Stream 1	Big Creek	9,583	12,914	6,984
Stream 2	Dick's Fork	16,875	14,199	6,976
Stream 3	SF Big Creek	1,458	1,967	1,468
Stream 4	Reynolds Creek	1,458		
Stream 5				
Stream 6				
Totals		29,375	29,080	15,428

Table C2. Lowland rearing capacities.

Habitat type	Rearing capacity (# fish)	
	Summer	Winter
Stillwater with edge habitat		
Wetland channels	2,936	
Flooded wetlands	5,211	39,025
Total	8,146	39,025

Table D. Potential smolt production based on ODFW survival rates

Table D1. Upland potential smolt production based on ODFW survival rates.

Stream ID		Potential smolt production (# fish)		
Number	Name	Spawning	Summer	Winter
Stream 1	Big Creek	3,067	9,298	6,285
Stream 2	Dick's Fork	5,400	10,223	6,278
Stream 3	SF Big Creek	467	1,416	1,321
Stream 4	Reynolds Creek	467		
Stream 5				
Stream 6				
Total		9,400	20,938	13,885

Table D2. Lowland potential smolt production based on ODFW survival rates.

Habitat type	Rearing capacity (# fish)	
	Summer	Winter
Stillwater with edge habitat		
Wetland channels	2,114	
Flooded wetlands	3,752	35,122
Total	5,865	35,122

Table E. Potential smolt production based on Aalsea study survival rates

Table E1. Upland potential smolt production based on Aalsea study survival rates.

Stream ID		Potential smolt production (# fish)		
Number	Name	Spawning	Summer	Winter
Stream 1	Big Creek	259	1,433	2,004
Stream 2	Dick's Fork	456	1,576	2,002
Stream 3	SF Big Creek	39	218	421
Stream 4	Reynolds Creek	39		
Stream 5				
Stream 6				
Total		793	3,228	4,428

Table E2. Lowland potential smolt production based on Aalsea study survival rates.

Habitat type	Rearing capacity (# fish)	
	Summer	Winter
	326	
	578	11,200
Total	904	11,200

Table F. Overall rearing and smolt production capacities.

Table F. Combined upland and lowland rearing capacity and potential smolt production. Smolt production is estimated using both ODFW and Aalsea watershed survival rates.

Life stage (season)	Rearing capacity (# fish)	Potential smolt production (# fish)	
		ODFW rates	Aalsea rates
Spawning (# eggs)	29,375	9,400	793
Spring (# fish)	no data	no data	no data
Summer (# fish)	37,227	26,803	4,132
Winter (# fish)	54,452	49,007	15,628

SCENARIO 2: Conditions of optimal spawning gravel.

Table C. Rearing capacities

Table C1. Upland rearing capacities.

Stream ID		Rearing capacity (# eggs or fish)		
Number	Name	Spawning	Summer	Winter
Stream 1	Big Creek	55,833	12,914	6,984
Stream 2	Dick's Fork	43,333	14,199	6,976
Stream 3	SF Big Creek	18,333	1,967	1,468
Stream 4	Reynolds Creek	5,833		
Stream 5				
Stream 6				
Totals		123,333	29,080	15,428

Table C2. Lowland rearing capacities.

Habitat type	Rearing capacity (# fish)	
	Summer	Winter
Stillwater with edge habitat		
Wetland channels	2,936	
Flooded wetlands	9,068	36,227
Total	12,004	36,227

Table D. Potential smolt production based on ODFW survival rates

Table D1. Upland potential smolt production based on ODFW survival rates.

Stream ID		Potential smolt production (# fish)		
Number	Name	Spawning	Summer	Winter
Stream 1	Big Creek	17,867	9,298	6,285
Stream 2	Dick's Fork	13,867	10,223	6,278
Stream 3	SF Big Creek	5,867	1,416	1,321
Stream 4	Reynolds Creek	1,867		
Stream 5				
Stream 6				
Total		39,467	20,938	13,885

Table D2. Lowland potential smolt production based on ODFW survival rates.

Habitat type	Rearing capacity (# fish)	
	Summer	Winter
Stillwater with edge habitat		
Wetland channels	2,114	
Flooded wetlands	6,529	32,604
Total	8,643	32,604

Table E. Potential smolt production based on Alsea study survival rates

Table E1. Upland potential smolt production based on Alsea study survival rates.

Stream ID		Potential smolt production (# fish)		
Number	Name	Spawning	Summer	Winter
Stream 1	Big Creek	1,508	1,433	2,004
Stream 2	Dick's Fork	1,170	1,576	2,002
Stream 3	SF Big Creek	495	218	421
Stream 4	Reynolds Creek	158		
Stream 5				
Stream 6				
Total		3,330	3,228	4,428

Table E2. Lowland potential smolt production based on Alsea study survival rates.

Habitat type	Rearing capacity (# fish)	
	Summer	Winter
	326	
	1,007	10,397
Total	1,332	10,397

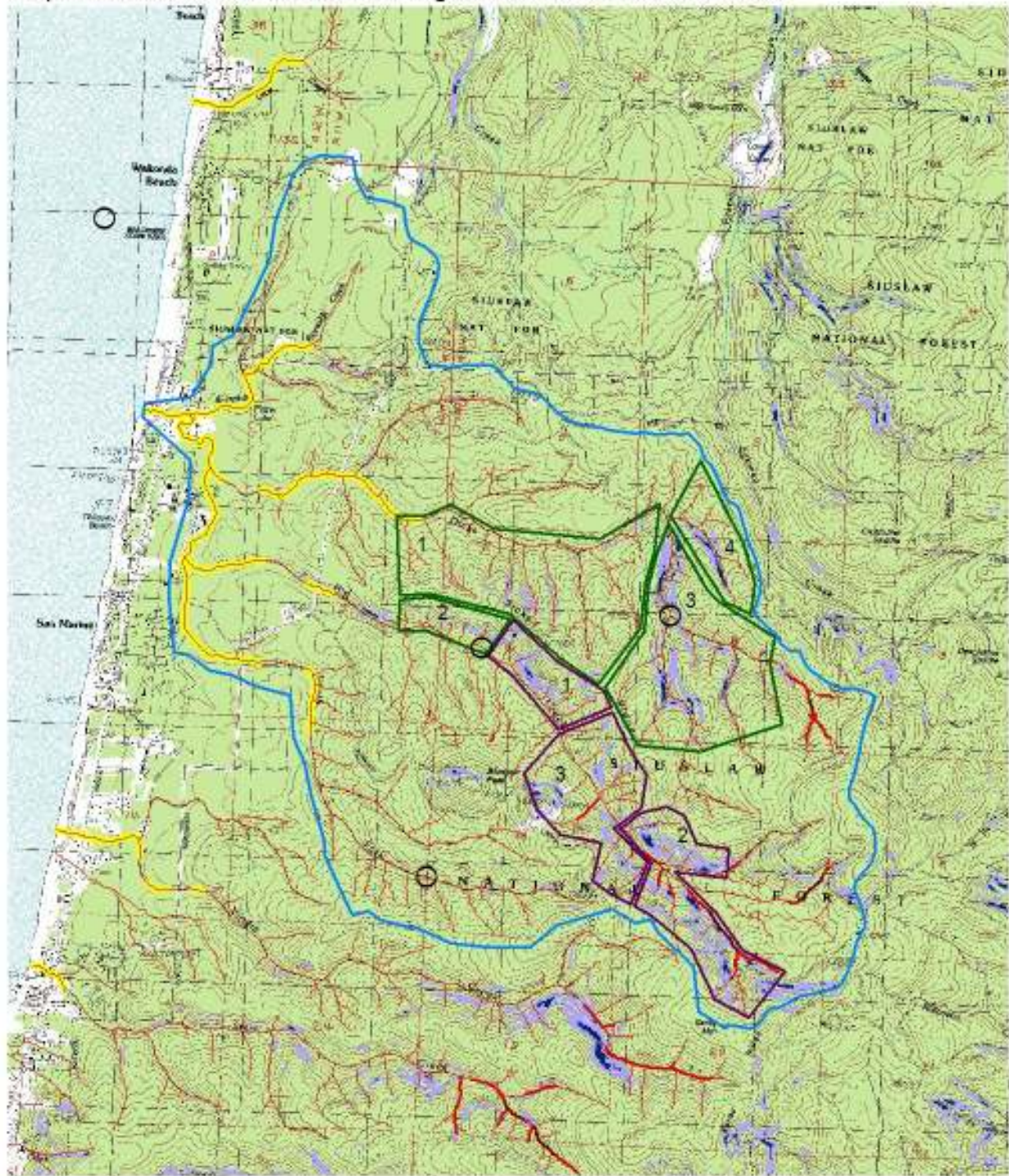
Table F. Overall rearing and smolt production capacities.

Table F. Combined upland and lowland rearing capacity and potential smolt production. Smolt production is estimated using both ODFW and Alsea watershed survival rates.

Life stage (season)	Rearing capacity (# fish)	Potential smolt production (# fish)	
		ODFW rates	Alsea rates
Spawning (# eggs)	123,333	39,467	3,330
Spring (# fish)	no data	no data	no data
Summer (# fish)	41,084	29,581	4,560
Winter (# fish)	51,654	46,489	14,825

Appendix 5. Big Creek sub-watershed ODF slope risk analysis map

Map of Debris Flow Potential for Big Creek 6th Field Watershed



Legend

- Big Creek Watershed
- Coas Intrinsic Potential (CLAMS)
- Good
- End of Coas Use (Bio-Barriers)
- Probability of Debris Flow Initiation (Slope %)
- Moderate (50% - 75%)
- High (75%+)
- Probability of Debris Flow Occurrence (CLAMS)
- low
- moderate
- high
- very high
- Sub-basin with indirect Debris Flow Delivery to Coas
- Sub-basin with Direct Debris Flow Delivery to Coas

0 0.25 0.5 0.75 1 Miles

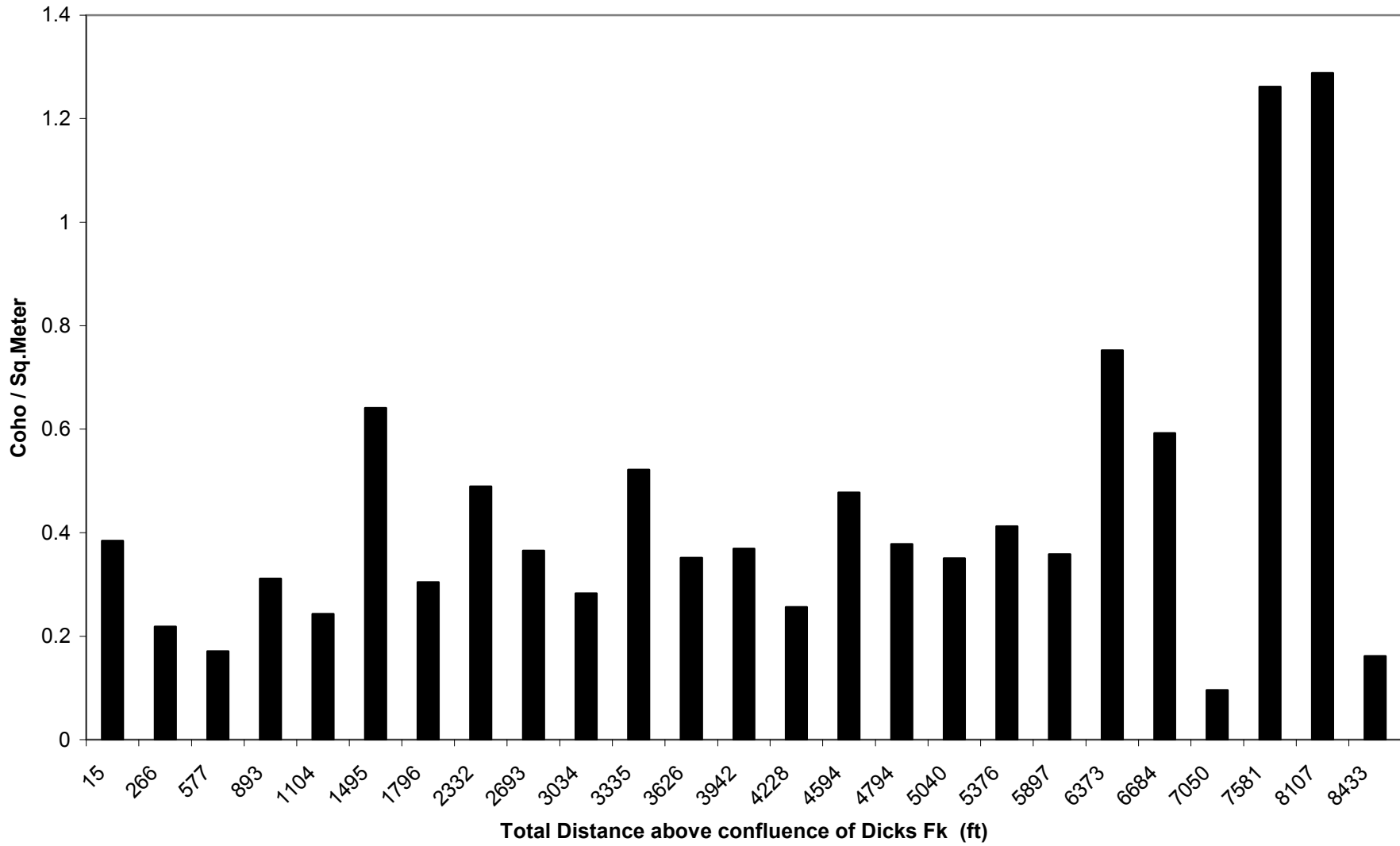
Jason Hinkle, Geotechnical Specialist
Oregon Department of Forestry
12/8/2005

NOTE

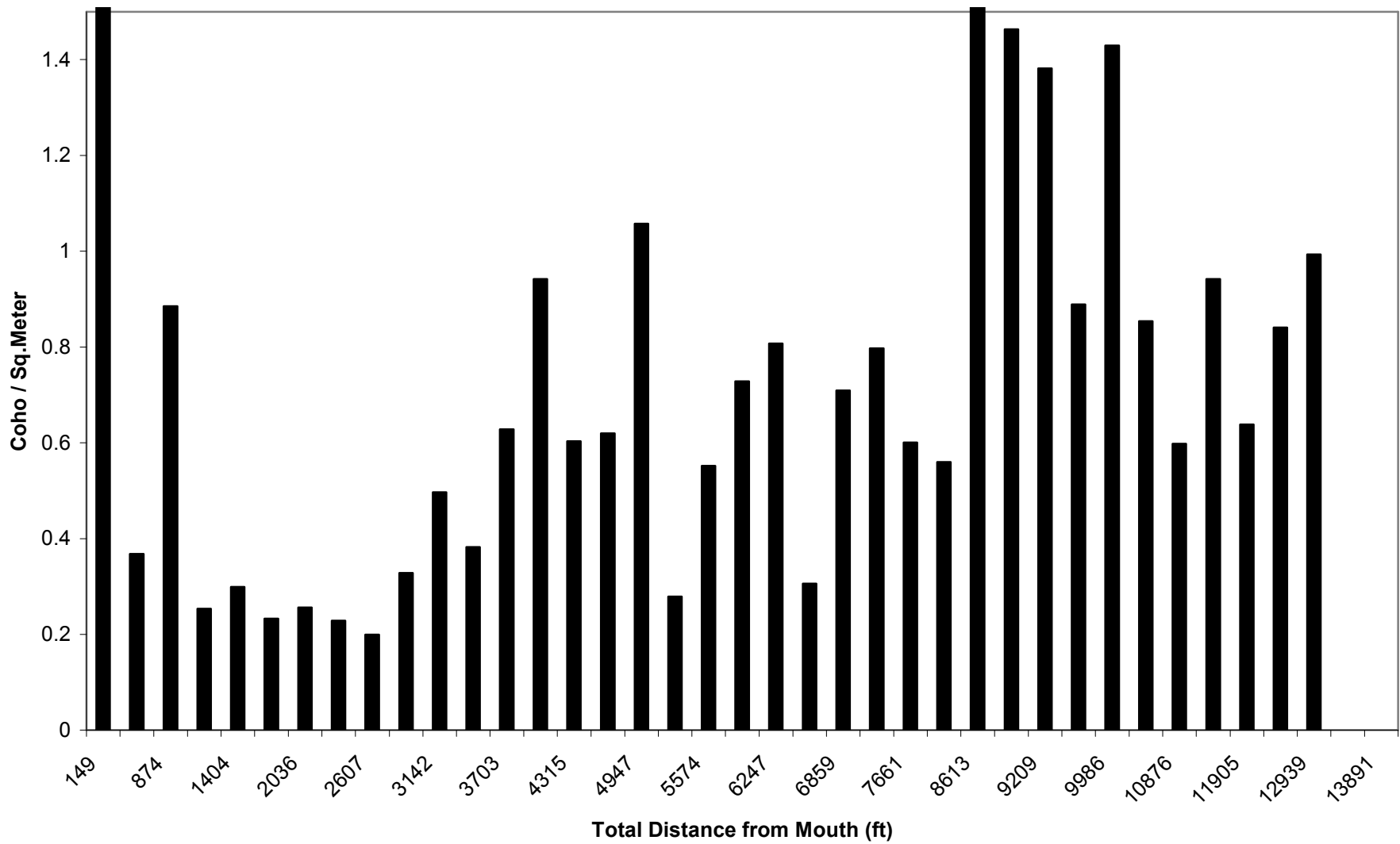
- This map is based on qualitative geotechnical judgement applied to quantitative DEM measurements. DEM data is not always accurate.
- Both sets of sub-basins are ranked, 1 = most significant.
- Data for coho intrinsic potential and probability of debris flow occurrence modified from CLAMS.

Appendix 6. Big Creek sub-watershed summer Coho distribution charts

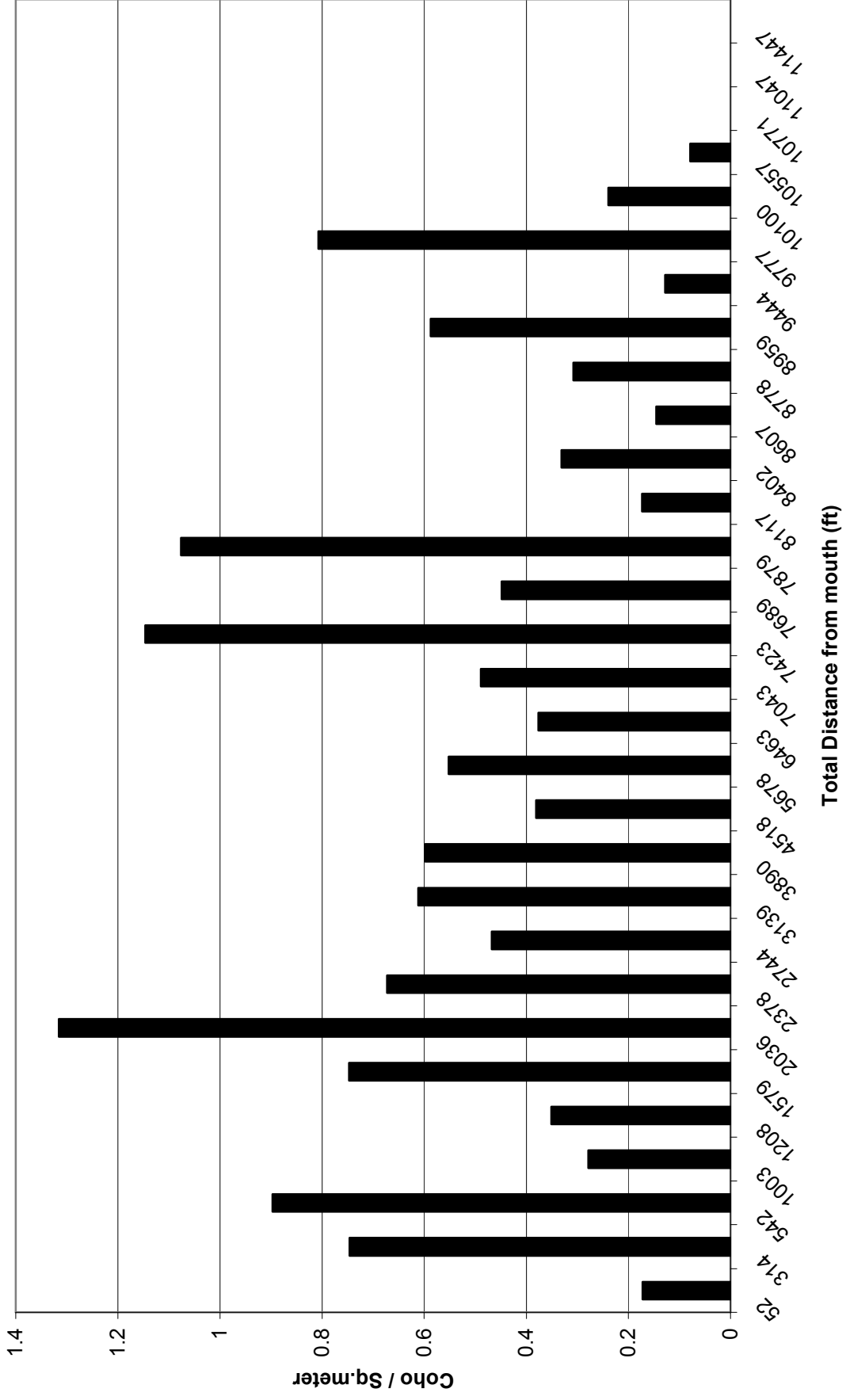
2003 Big Cr Coho Densities



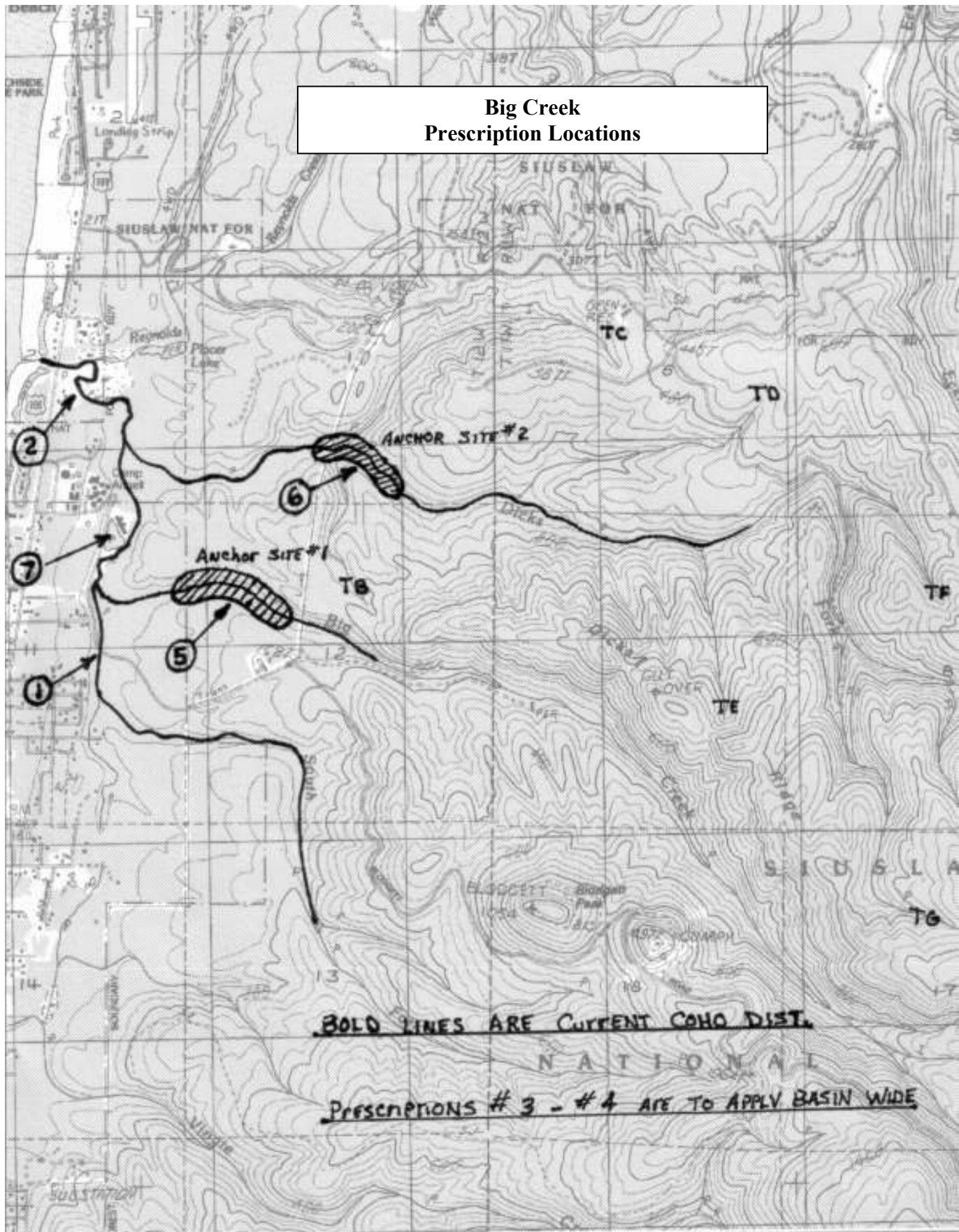
2003 Dicks Fk Coho Densities



SF Big Coho Densities 2003



Appendix 7. Big Creek sub-watershed prescription location map



Appendix 8. Big Creek sub-watershed photos

Photo 1. Dick's Fk: Channel below Anchor Site #2.



Photo 2. Dick's Fk: Legacy wood buried in substrate.



Photo 3. Dick's Fk: Riparian spruce.



Photo 4. Dick's Fk: Channel entrenchment.



Photo 5. Dick's Fk: Anchor Site #2. Note low interactive terrace.



Photo 6. Dick's Fk: Note numerous nurse logs.



Photo 7. Dick's Fk: Note bedrock slide.



Photo 8. Dick's Fk: End of anadromous distribution at debris torrent jam.



Photo 9. Dick's Fk: Debris torrent legacy.



Photo 10. Dick's Fk: Calf elk.



Photo 11. Big Cr: Spawning gravel.



Photo 12. Big Cr: Below Anchor Site #1.



Photo 13. Big Cr: Lower reach. Note entrenchment.



Photo 14. Big Cr: Anchor Site #1. Note interactive low terrace.



Photo 15. Big Cr: Falls defining end of anadromous distribution.



Photo 16. SF Big Cr: Above wetland/marsh.



Photo. 17. SF Big Cr: Note short functional segment.



Photo 18. SF Big Cr: Note cobble dominated and gravel limited.



Photo 19. SF Big Cr: Below debris torrent jam, end of anadromous distribution.



Photo 20. SF Big Cr: Culvert at Blodget Rd crossing.

