STREAM INVENTORY REPORT

Wages Creek

WATERSHED OVERVIEW

Wages Creek is a tributary to the Pacific Ocean (Figure 1). Elevations range from 0 feet at the mouth of the creek to 2,400 feet in the headwater areas. Wages Creek's legal description at the confluence with the Pacific Ocean is T21N R17W S29. Its location is 39°37'27"N. latitude and 123°45'50"W. longitude according to the USGS Westport 7.5 minute quadrangle. Wages Creek drains a watershed of approximately 8,589 acres.

HABITAT INVENTORY RESULTS

The habitat inventory of August 30, 1996 through September 9, 1996, was conducted by Diana Hines and Dave Wright. The total length of surveyed stream in Wages Creek was 38,948 feet (7.4 miles, 11.8 KM) (Table 1). Side channels comprised 537 feet of this total.

Flow measured at the mouth of Wages Creek on October 4, 1996 was 3.21 cubic feet per second (cfs).

Wages Creek consists of three reaches: F4 for the first 26,629 feet, a B3 for the next 7,949 feet and a B2 for the remaining 3,833 feet.

Table 1 summarizes the Level II riffle, flatwater and pool habitat types. By percent occurrence, riffles comprised 26%, flatwater 40% and pools 33% of the habitat types (Graph 1). By percent total length, riffles comprised 28%, flatwater 52% and pools 19% (Graph 2).

Twenty Level IV habitat types were identified and are summarized in Table 2. The most frequently occurring habitat types were low gradient riffles, 25%, runs, 15% and step runs, 14% (Graph 3). The most prevalent habitat types by percent total length were low gradient riffles at 28%, step runs at 22%, and runs at 18% (Table 2).

Table 3 summarizes main, scour and backwater pools which are Level III pool habitat types. Scour pools were most often encountered at 63% occurrence and comprised 63% of the total length of pools.

Table 4 is a summary of maximum pool depths by Level IV pool habitat types. In third order streams, pools with depths of three feet (0.91 m) or greater are considered optimal for fish habitat. In Wages Creek, 39 of the 158 pools (25%) had a depth of three feet or greater (Graph 4).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the pool tail-outs measured, 1% had a value of 1, 12% had a value of 2, 52% had a value of 3 and 35% had a value of 4 (Graph 5).

Of the Level II habitat types, pools had the highest mean shelter rating at 91 (Table 1). Of the Level III pool habitat types, scour pools had the highest mean shelter rating at 133 (Table 3).

Of the 158 pools, 41% were formed by large woody debris (LWD): 20% by logs and 21% by root wads (calculated from Table 4).

Table 6 summarizes dominant substrate by Level IV habitat types. Of the low gradient riffles fully measured, 40% had gravel and 27% had small cobble as the dominant substrate (Graph 6).

Mean percent closed canopy was 82%: 13% coniferous trees and 69% deciduous trees. Mean percent open canopy was 18% (Graph 7, calculated from Table 7).

Table 7 summarizes the mean percent substrate/vegetation types found along the banks of the stream. Mean percent right bank vegetated was 94% while mean percent left bank vegetated was 87%. Deciduous trees were the dominant bank vegetation type in 78% of the units fully measured. The dominant substrate composing the structure of the stream banks was cobble/gravel, found in 52% of the units fully measured.

DISCUSSION

The information gathered in the process of habitat typing will provide Georgia-Pacific with baseline data on the current condition of this creek and the available habitat for salmonids. These data can be used to identify components of the habitat which are in need of enhancement so appropriate conditions for Wages Creek can be obtained over time.

Level II habitat types by percent occurrence and length

Flatwater habitat types comprised a high percentage of the units by both percent occurrence and length at 40% and 52% respectively (Table 1 and Graph 1). These unit types usually do not provide optimal spawning or rearing habitat for salmonids. Riffle habitat units comprised a moderate percentage of the stream by both percent occurrence and length at 26% and 28% respectively. Pools also comprised a much moderate percentage by both percent occurrence and length at 33% and 19% respectively. Riffles usually provide good spawning habitat while pools provide important rearing habitat. In addition, Mundie (1969) reported that invertebrate food production is maximized in riffles while pools provide an optimum feeding environment for coho. In fact, the most productive streams are those consisting of a pool to riffle ratio of approximately one to one (Ruggles 1966).

Pool Depth

According to Flosi and Reynolds (1994), a stream with at least 50% of its total habitat comprised of primary pools is generally desirable. Primary pools are at least two feet deep in first and second order streams and at least three feet deep in third order streams. The information from

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Graph 4 on maximum depth in pools was used to determine percent of primary pools. Wages Creek, a third order stream, is comprised mainly of shallow pools with 25% of the pools having a maximum depth of three feet or greater.

Instream Shelter

Instream shelter ratings are derived from two measurements: instream shelter complexity and instream shelter percent cover. The first is a value rating which provides a relative measure of the quality and composition of the shelter, and the second is a measure of the area of a habitat unit covered by shelter. The various types of instream shelter include LWD, small woody debris, boulders, root wads, terrestrial vegetation, aquatic vegetation, bedrock ledges and undercut banks. Of the Level II habitat types, pools had the highest shelter rating at 91. Of the Level III habitat types, scour pools had the highest shelter rating at 133. These values are high as shelter values of 80 or higher are considered optimal for good rearing habitat (Flosi and Reynolds 1994).

Large Woody Debris

The presence of large woody debris in streams is a significant component of fish habitat. Woody debris creates areas of low flow, providing a refuge for fish during periods of high flow (Robison and Beschta, 1990). Woody debris also provides cover for fish, lowering the risk of predation. The percent of pools formed by LWD in Wages Creek was 41%. Whether these numbers are high or low, relative to the needs of salmonids is difficult to ascertain since the optimum amount of woody debris in streams has not been specified (Robison and Beschta 1990). However, based on data from Georgia-Pacific's 1995 Aquatic Vertebrate Study, the only coho salmon found in the Ten Mile River Basin were in stream reaches where approximately 50% of pools were formed by large woody debris. Those reaches that did not support coho had a significantly lower percentage of pools formed by large woody debris (Ambrose et al, 1996). This suggests that a low percentage of LWD formed pools could adversely affect juvenile coho populations (C.S. Shirvel 1990).

The above LWD analysis pertains only to pools formed by logs or root wads as described in Flosi and Reynolds (1994)**:** lateral scour pool-log enhanced, lateral scour pool-rootwad enhanced, backwater pool-log formed and backwater pool-rootwad formed. Other pools containing LWD as a component were not included in the calculation. For example, plunge pools may be formed by boulders, bedrock or LWD, but are not described as such by habitat unit types. Therefore, the LWD formed pool calculation is limited to four pool types and does not quantify the amount of LWD in Wages Creek.

Canopy

There are two important benefits of canopy cover in coastal streams. Canopy keeps stream temperatures cool as well as providing nutrients in the form of leaf litter and organic material (Bilby 1988). This leaf litter, organic material, and their associated nutrients are utilized as a food source by benthic macroinvertebrates (aquatic insects). The macroinvertebrates, in turn, are major food sources for most fish species in forested areas (Gregory et al., 1987). Mean percent canopy cover for the Wages Creek was 82%. This is relatively high since a canopy cover of 80% or higher is considered optimum (Flosi and Reynolds, 1994).

Deciduous trees occupied a larger portion of the canopy than did coniferous trees. Coniferous trees comprised only 13% of the canopy. The significance of this is that wood from alder and most other deciduous species deteriorates more rapidly than wood from coniferous species (Sedell, *et al*. 1988). Therefore, less LWD would be available in the future for fish cover and LWD formed pools in this creek and others dominated by deciduous species.

Embeddedness

High embeddedness values (silt levels), such as those found in Wages Creek, have been associated with many negative impacts to salmonids. These negative impacts can be observed in important environmental components of salmonid habitat, such as pool habitats, dissolved oxygen levels and water temperatures.

The impact high silt levels have on pool habitat is that they fill in and eventually eliminate pools. As already mentioned, pools provide important habitat for rearing salmonids.

High silt levels also impact oxygen levels in the water. They do so by reducing water circulation within the substrate, thus lowering the oxygen levels needed by salmonid eggs (Sandercock, 1991). This can hinder the survival of the eggs deposited in redds, as well as the survival of juvenile salmonids.

Water temperature is impacted by high silt levels in several ways. Hagans et al (1986) reported the following impacts to water temperatures: 1) the loss of a reflective bottom; 2) darker sediment (as opposed to clean gravels) storing heat from direct solar radiation which is then transferred to the water column; and 3) a reduction in the flow of water through the substrate interstitial spaces thereby exposing more of the water column to direct solar radiation.

Another means by which water temperatures are increased is through the widening of stream channels: over time, high silt levels increase the substrate surface level of the creek, resulting in a wider, shallower stream channel (Flosi and Reynolds, 1994). In shallow streams more surface area is exposed to the sun relative to the volume of water, leading to an increase in solar heating which in turn leads to higher water temperatures.

Substrates embedded with silt in varying degrees were given corresponding values as follows: 0-25%= value 1, 26 - 50% = value 2, 51 - 75% = value 3 and 76 - 100% = value 4. According to Flosi and Reynolds (1994), creeks with embeddedness values of two or higher are considered to have poor quality fish habitat. In Wages Creek, 99% of the pool tail-outs measured had embeddedness values of two or more.

It is important to consider, however, that the above embeddedness values were obtained in the summer during low flow conditions. In winter and spring, flows are usually higher due to the rainy season and the lowered evapotranspiration of the trees. This higher flow can carry away some of the previously deposited silt to sites further downstream. Therefore, embeddedness values may fluctuate throughout the year along different sections of the stream.

Substrate

In Wages Creek, 40% of the low gradient riffles had gravel and 27% had small cobble as the dominant substrate. The relatively high concentration of gravel and small cobble in riffles indicates that there is a sufficient amount of substrate available as potential spawning habitat in this creek. However, it is important to consider that regardless of the amount of substrate or spawning habitat available, this habitat may not be suitable for salmonids if it is highly embedded.

Overall, Wages Creek appears to have a relatively high percentage LWD formed pools, high shelter values, sufficient canopy as well as sufficient substrate. However, this stream also appears to have high embeddedness values and a low percentage of primary pools.

Georgia-Pacific recognizes that there are areas of Wages Creek in need of enhancement, and where feasible will attempt to restore those areas over time as part of its long term management plan. The company will also attempt to facilitate a healthy environment for salmonids in this creek through sound management practices.

RECOMMENDATIONS

1) Wages Creek should be managed as an anadromous, natural production watershed.

2) Where feasible, design and engineer pool enhancement structures to increase the depth of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

3) Log debris accumulations retaining large quantities of fine sediment should be modified if necessary, over time, to avoid excessive sediment loading in downstream reaches.

4) Sources of stream bank erosion should be mapped and prioritized according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediment entering the stream. In addition, sediment sources related to road systems need to be identified, mapped and treated according to their potential for sediment yield to the watershed.

COMMENTS AND LANDMARKS

The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach.

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Position (ft):	Comments:
432	Approximately 20 steelhead observed.
690	Ten salmonids observed.
799	25+ salmonids observed.
1392	Highway 1 crosses the channel.
3220	Bridge spans the channel.
5359	Road crossing. Rider Gulch confluence.
5832	Road crossing.
6647	Approximately 40 salmonids, 40-50mm long, observed.
6918	Tributary.
7157	Approximately 60 salmonids, 40-50mm long, observed.
9137	Approximately 30 salmonids, 50-60mm long, observed.
11471	25 salmonids, 50-60mm long, observed.
12584	Gulch entering on left bank.
13617	Approximately 60 salmonids, 60mm long, observed.
13765	Left bank gulch.
14004	Hobo temperature logger in pool.
17220	Roach Gulch confluence.
17388	Clean gravel.
19980	Roberts Gulch confluence.
21450	Left bank gulch.
24768	Three large resident trout, 10-12 inches long, observed.
24870	Approximately 10 steelhead, 70mm long, observed.

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25188	Left bank failure measures approximately 80' long x 40' high.
25405	Left bank failure measures 90' high x 50' long.
25475	Left bank failure measures 15' high.
25532	Left bank failure measures 8' high.
26629	Confluence with North Fork Wages Creek.
26646	Change channel type to B3.
27196	Log jam measures 8' high x 40' long x 30' wide.
27277	Old bridge crossing.
27341	Bank failure; old road cut measures 30' high x 80' long.
27397	Log jam covers entire unit. Excellent cover, however few fish observed.
27880	Confluence with Brink Gulch.
29391	Good pool, nice cover (lwd) but few fish observed.
30349	Confluence with Van Sicken Gulch.
30508	No fish observed.
30858	Small gulch on left bank.
31596	Right bank failure measures 70' long x 50' high.
31945	Log jam measures 25' high x 50' long x 75' wide, possible fish barrier.
32219	Little Gulch enters right bank.
32379	Gulch on left bank.
32949	Gulch on right bank.
33927	Small gulch on left bank.
34384	Left bank gulch.
34542	Channel type changes to B2.

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35670	Confluence with South Fork Wages Creek.
38239	Water diminishing rapidly.
38411	End of survey. No water, too much gradient.

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