STREAM INVENTORY REPORT

North Fork Redwood Creek

WATERSHED OVERVIEW

North Fork Redwood Creek is a tributary to Redwood Creek (Figure 1). Elevations range from 400 feet at the mouth of the creek to 1200 feet in the headwater areas. North Fork Redwood Creek's legal description at the confluence with Redwood Creek is T19N R16W S12. Its location is 39°30'16"N. latitude and 123°36'29"W. longitude according to the USGS Sherwood PK 7.5 minute quadrangle.

HABITAT INVENTORY RESULTS

The habitat inventory of November 11, 1997, was conducted by Dave Wright, James Gragg and Andrew Hepokowski. The total length of surveyed stream in North Fork Redwood Creek was 5372 feet (1.01 miles, 1.64 km) (Table 1). There were no side channels in this creek.

No flow measurements were taken for the purpose habitat typing surveys. Flow measurements are available though, through the 1997 GP electro-fishing survey.

North Fork Redwood Creek consists of four reaches: a G3 (Reach 1), an E3 (Reach 2), a B4 (Reach 3), and an E4 (Reach 4).

Table 1 summarizes the Level II riffle, flatwater and pool habitat types. By percent occurrence, riffles comprised 18%, flatwater 27% and pools 50% of the habitat types (Graph 1). By percent total length, riffles comprised 14%, flatwater 31% and pools 43% (Graph 2).

Seventeen Level IV habitat types were identified and are summarized in Table 2. The most frequently occurring habitat types were step runs, 17%, trench pools, 14%, and low gradient riffles, 14% (Graph 3). The most prevalent habitat types by percent total length were step runs at 21%, trench pools at 16%, and dry units at 12% (Table 2).

Table 3 summarizes main channel, scour and backwater pools which are Level III pool habitat types. Scour pools were most often encountered at 64% occurrence and comprised 50% of the total length of pools.

Table 4 is a summary of maximum pool depths by Level IV pool habitat types. In second order streams, pools with depths of two (0.61m) or greater are considered optimal for fish habitat. In North Fork Redwood Creek, 34 of the 70 pools (49%) had a depth of two feet or greater (Graph 4).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the pool tail-outs measured, 0% had a value of 1, 7% had a value of 2, 43% had a value of 3 and 51% had a value of 4 (Graph 5).

Of the Level II habitat types, pools had the highest mean shelter rating at 32 (Table 1). Of the Level III pool habitat types, scour pools had the highest mean shelter rating at 35 (Table 3).

Of the 70 pools, 31% were formed by large woody debris (LWD): 16% by logs and 15% 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 20% had small cobble as the dominant substrate (Graph 6).

Mean percent closed canopy was 86%: 71% coniferous trees and 15% deciduous trees. Mean percent open canopy was 14% (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 84% while mean percent left bank vegetated was 71%. Grass was the dominant bank vegetation type in 38% of the units fully measured. The dominant substrate composing the structure of the stream banks was Silt and Clay, found in 71% 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 in need of enhancement so appropriate conditions for North Fork Redwood Creek can be obtained over time.

Level II habitat types by percent occurrence and length

Flatwater habitat types comprised a moderate percentage of the units by both percent occurrence and length at 27% and 31% respectively (Table 1 and Graph 1). These unit types usually do not provide optimal spawning or rearing habitat for salmonids. Riffle habitat units also comprised a moderate percentage of the stream by both percent occurrence and length at 18% and 14% respectively. Pools, however, comprised a higher percentage by both percent occurrence and length at 50% and 43% 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 salmon. 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. North Fork Redwood Creek, a second order stream, is comprised mainly of shallow pools with 49% of the pools having a maximum depth of two 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 32. Of the Level III habitat types, scour pools had the highest shelter rating at 35. These values are low 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 North Fork Redwood Creek was 31%. 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 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 total amount of LWD in North Fork Redwood 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 North Fork Redwood Creek was 86%. This is relatively high since a canopy cover of 80% or higher is considered optimum (Flosi and Reynolds, 1994).

Coniferous trees occupied a larger portion of the canopy than did deciduous trees. Coniferous trees comprised 71% of the canopy. The significance of this is that wood from alders and most other deciduous species deteriorates more rapidly than wood from coniferous species (Sedell, *et al*. 1988). Therefore, more LWD would be available in the future for fish cover and LWD formed pools in this creek and others dominated by coniferous species.

Embeddedness

High embeddedness values (silt levels), such as those found in North Fork Redwood 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 North Fork Redwood Creek, 100% 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 North Fork Redwood Creek, 40% of the low gradient riffles had gravel and 20% had small cobble as the dominant substrate. Collectively 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. While this creek had sufficient substrate for spawning in the riffles surveyed, the overall percentage of riffles in the surveyed portions of the creek was low at only 18% (Table 1). Subsequently, there may be a lack of sufficient spawning habitat. Another point to consider is 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, North Fork Redwood Creek appears to have a relatively high percentage of LWD formed pools and sufficient canopy. However, this stream also appears to have low shelter values, a relatively low percentage of primary pools, and high embeddedness values. In addition, while there was sufficient substrate for spawning, habitat for spawning appeared to be limited.

Georgia-Pacific recognizes that there are areas of North Fork Redwood 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.

<u>RECOMMENDATIONS</u>

1) North Fork Redwood Creek should be managed as an anadromous, natural production watershed.

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

3) Shelter values throughout North Fork Redwood Creek could be increased by addition of large logs and root wads, boulder clusters, log and boulder wiers and log and boulder deflectors. These need to be placed carefully to prevent washing out in high flows. The Stream Habitat Restoration Manual, by Flosi and Reynolds, 1994, provides detailed descriptions for restoration efforts.

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

5) 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.

6) North Fork Redwood Creek suffers from stream bank destabilization in many areas due to the collapse of the old Railroad grade which parallels most of the stream channel. This bank failure, and its associated LDA, is most apparent in the channel segment that begins at approximately 500 ft (from the main confluence) and continues for 4- 500 ft.

7) This is a high gradient area (4-5%) characterized by log debris accumulations which force the stream to flow subsurface, at least in low flow conditions. While this area cannot be considered a complete barrier to fish passage, it certainly is restrictive. Large upstream areas of low gradient, high quality salmonid habitat were observed to be underutilized by juvenile salmonids.

8) Attempts at bank stabilization made in this area by rehabilitation crews, as evidenced by the crib structure in the uppermost region, have been largely ineffective. However, due to the relatively easy accessibility of the area, the brevity of the area in need of repair, and the large amount of area that would resultingly be opened up, this reach would be a prime candidate for rehabilitative effort.

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.

Position (ft):	Comments:
52	Begin survey at confluence with Redwood Creek.
190	Old railroad trestle crosses creek.
597	LDA measures 72' long x 10' high x 30' wide. Approx. 3-4% gradient with boulders and logs. Possible barrier.
836	LDA. Bank failures both sides measure 25’ high x 70’ wide. Definite restriction to fish passage, also no natal habitat as water flows subsurface. CCC crib rehab. structure appears ineffective as bank is still failing.
858	Stream channel returns to lower gradient.
935	Begin E3 channel type.
1022	Six steelhead observed.

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2447	Right bank gulch.
2755	Switch to B4 channel type.
2838	Confluence with gulch on left.
3093	Three steelhead observed. Marshy area.
3646	Log jam measures 6’ high x 15’ wide x 30’ long; possible barrier.
3744	Confluence with the East Branch of North Fork Redwood Creek.
3956	Switch to E4 channel type.
5372	End survey due to diminished habitat.

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