PRELIMINARY RESULTS AND RECOMMENDATIONS FROM THE NORTHWEST CASCADES TYPE 4/5 STREAM STUDY

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Introduction

The following report presents selected study results that are relevant to regulatory water typing of non-fish-bearing streams in northwestern Washington. It was developed to make this information available prior to finalization of permanent Forest Practices Rules, expected to occur in winter 2000/'01. More specifically, results describe the distribution of perennial and seasonally flowing reaches, the key attribute distinguishing Type 4 waters, which require partial buffering during timber harvest, from Type 5 waters, which do not. A subsequent report that covers this and other issues related to the implementation of new rules governing protection along non-fish-bearing streams will be written and made available in early 2001.

Among the primary objectives of this study was evaluating the applicability of the Emergency Rule default criteria for defining the upper extent of Type 4 waters in the northwest Cascades. For all areas west of the Cascades (exclusive of the coastal spruce zone), the present Emergency Rules (March 20, 1999 version) define the Type 4/5 break as the most upstream point of perennial flow. Except in cases where a distinct "perennial initiation point" is apparent, perennial flow is assumed to occur where the contributing basin size exceeds 52-acres (see WAC 222-16-010 – "perennial initiation point" definition). Concerns regarding the widespread applicability of the 52-acre threshold arose primarily because the data supporting that threshold were collected within southwestern Washington only (Mike Liquori, geomorphologist, International Paper Company, personal communication). The need for local validation of the default acreages was recognized in the Forests and Fish Report, which indicates that basin size thresholds are "subject to review through adaptive management" (Appendix B. II- B.1 (e) (iii)).

Study Approach

The following section provides a brief overview of field methods used; more complete documentation is provided in the Appendix of this report. Field investigation occurred during summer low-flow conditions in August and September 2000. Efforts were focused on locating and describing the most upstream point of perennial flow along a sample of small streams in the Skagit River basin and vicinity. Each such flow initiation point, when located in the field, is termed a "low flow initiation point" (or LFIP). Forty-three LFIPs were field located during summer 2000 field efforts, most in proximity to small stream sites randomly-chosen for a previous windthrow study (i.e. Grizzel and Wolff, 1998).

Key Findings

The basin drainage areas associated with the 43 low flow initiation points (LFIPs) were highly variable, ranging from one to 136 acres (Appendix B). However, all but three drainage areas (93%) were less than 52 acres (Figure 1) and the median value among all sites was 17 acres.

Although substantial differences in drainage areas were not apparent between most of the geologic types involved, the drainage areas above LFIPs in areas of deep glacial-lacustrine sediments was considerably less than for other geologies. Analyzing the LFIPs from the two broad geologic categories (glacial-lacustrine sediments vs. other geologies) separately led to the following conclusions:

- Among the eight LFIPs located in glacial-lacustrine sediments, the median basin area was approximately 3 acres.
- Among the 35 LFIPs in all other geologic materials (various types of bedrock – phyllite, greenschist, granitics, volcanics and sedimentary - and glacial till), the median basin area was 21 acres.

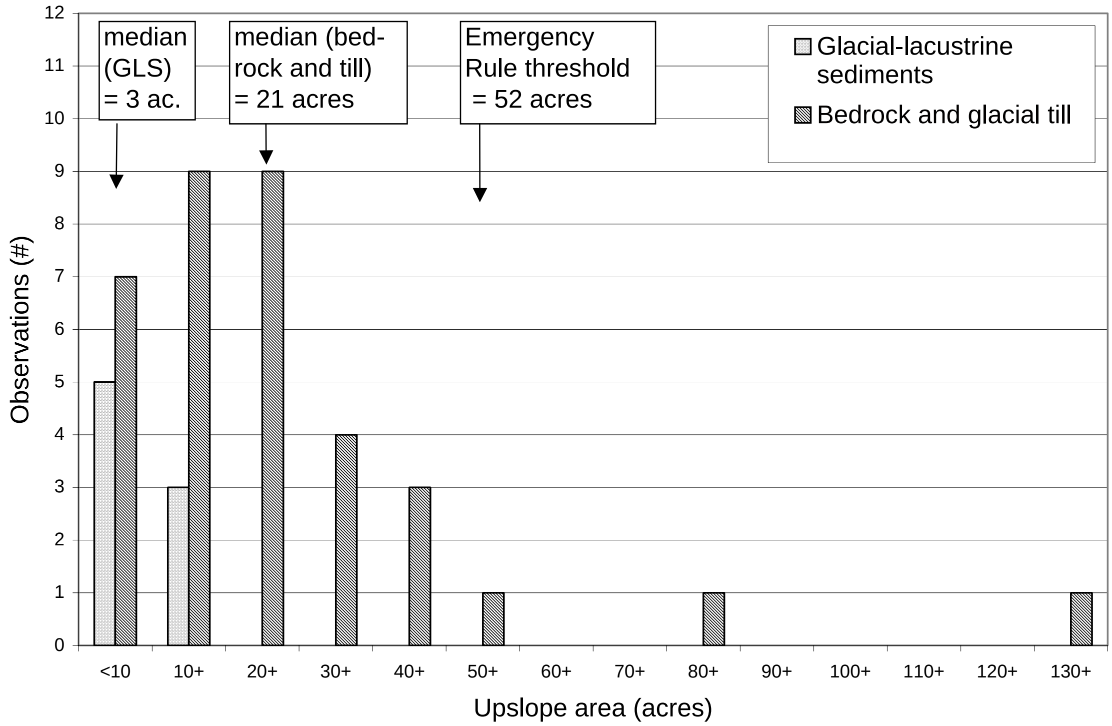

Figure 2. Frequency distribution of drainage areas of 43 low flow initiation points located in the Skagit basin and vicinity during summer 2000.

Recommendations

Although not definitive, these findings suggest that the 52-acre default value is considerably larger than that necessary to support perennial flow in the Skagit basin. Thus, application of the 52-acre threshold in this region will result in the false typing of stream lengths between drainage areas of 21 and 52 acres as Type 5 waters that require no riparian protection during harvest. In actuality, the intervening stream lengths are likely to support perennial flow, and as such should be designated as Type 4s that would require patch buffering.

The physical reasons why these basin areas differ from the southwest Washington sites that support the Emergency Rule default are not clear, but may well include differences in soils, precipitation regimes, vegetation and perhaps field methodologies used. Until such differences are better understood, we recommend adopting the 21-acre median value as the default acreage for differentiating Type 4 and 5 waters in the Skagit basin and perhaps throughout the northwest Cascades. A threshold value of three-acres could then be applied specifically to streams within glacial-lacustrine sediment deposits.

Reference

Grizzel, J. D. and N. Wolff. 1998. Occurrence of windthrow in forest buffer strips and its effect on small streams in northwest Washington. Northwest Science, 72 (3): 214-223.

Appendix A - Additional description of data collection methods

Seasonal Considerations

All stream observations were made during low flow conditions during August and September, the two months in which annual low flows most commonly occur in small streams in this area (based on USGS streamflow data). Data collection was suspended for 2-3 days following each significant (i.e. >~0.1") rainfall event within this period. The summer of 2000 was generally regarded as "typical" (i.e. neither particularly wet nor dry) relative to the average local summer rainfall regime, though published monthly rainfall data from Bellingham suggest that July, August and September were each slightly dryer than average (Figure A). If indeed the 2000 low flow season was slightly drier than average, then surface flow would not have persisted as far upstream as in a truly average year, resulting in an overestimation to some degree of the drainage areas required to maintain surface flow in an average year.

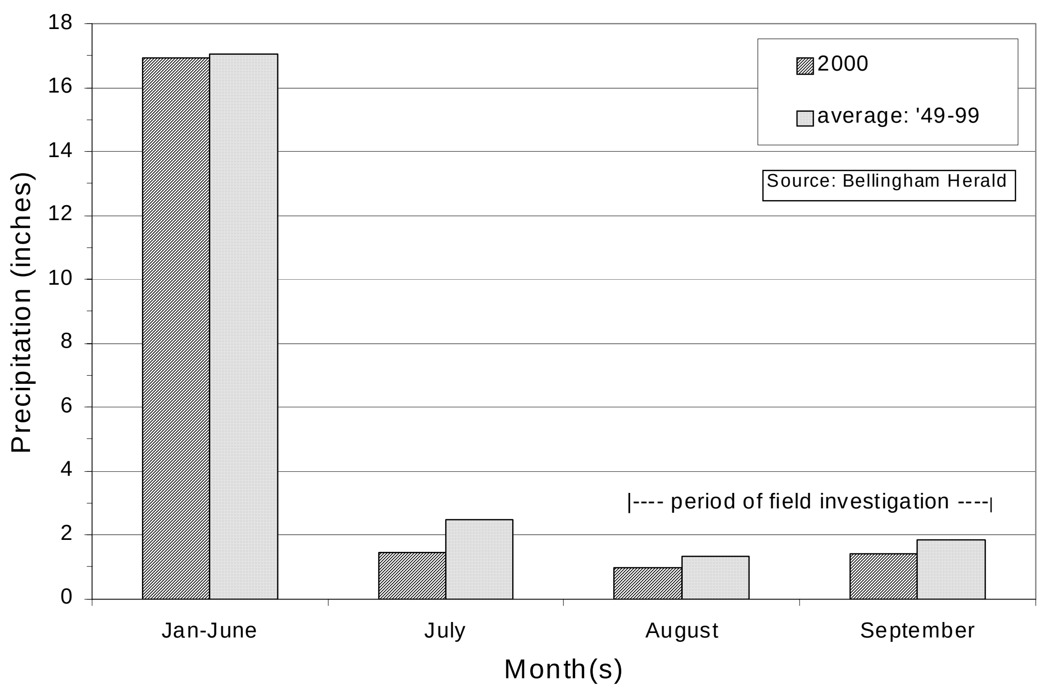

Figure A. Bellingham precipitation prior to and during the field investigation of perennial flow in the northwestern Cascades. Note that precipitation during August and September 2000 (cross-hatched bars) was slightly less than the long-term monthly averages (dotted bars).

Regulatory Criteria for Distinguishing Type 4 from Type 5 Waters

The goal of this field effort was to locate the break-off point between Type 4 and Type 5 waters on the basis of observed perennial flow for as many streams as possible. In this effort, we commonly encountered "spatially intermittent" reaches that complicated this process substantially. First, it required clarification of the regulatory definition of which field conditions would indicate a Type 4/5 break. Secondly, the potential misinterpretation of spatially intermittent reaches complicated finding the correct break points in the field. Before discussing these issues further, it may be useful to describe the two configurations of spatially intermittent reaches that were observed:

1. **Depositional intermittent reach:** This is a seasonally dry reach situated downstream of a reach with continuous perennial flow (Figure B). Such dry reaches are typically observed in areas with thick deposits of coarse sediment, such as alluvial fans, where substantial flows can infiltrate into the streambed and flow for substantial distances through interstitial spaces.

2. **Transitional intermittent reach:** This is a reach with patchy surface flow in an area that is transitional between a continuously dry reach upstream and a perennially flowing reach downstream (Figure B). Transitional reaches typically have water in pools, but flow entirely subsurface through intervening riffles or accumulations of sediment and/or debris. The length of such transitional reaches is variable but is typically several hundred feet or less.

Based on discussions with the Department of Natural Resources and several other individuals directly involved in the Forest and Fish negotiations, it was clear that depositional intermittent reaches should be viewed as perennial (i.e. Type 4), so long as reach-scale perennial flow was occurring upstream. Because it was unclear whether "transitional" intermittent reaches should be considered perennial, we interpreted such reaches as seasonal (i.e. Type 5) for the purpose of this study. This interpretation avoids the need to find the very upper-most wetted point in a channel, which could potentially be substantially upstream of the highest reach-scale surface flow. To summarize, we located the upstream limit of reach-scale perennial flow, and interpreted this as the physical situation intended to define the Type 4/5 break (Figure B). Such points were termed "low flow initiation points" (or LFIPs).

We choose not refer to these as "perennial initiation points", because they are seldom easily recognized points within the channel network where surface flow emanates throughout much of the year. Instead, most LFIPs were observed at indistinct points in the network and presumably move up and downstream in response to varying soil moisture inputs.

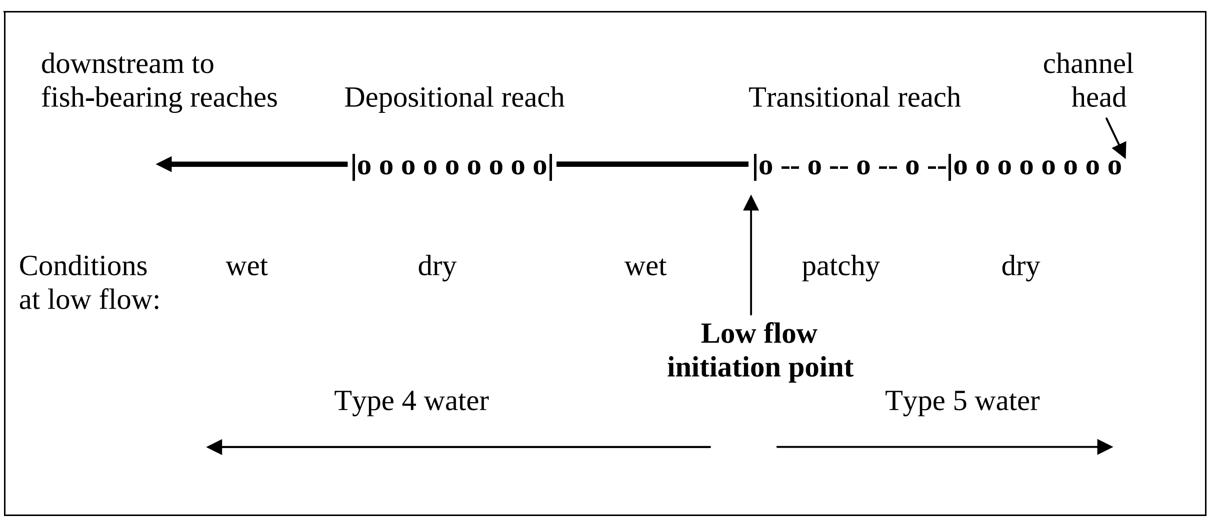

Figure B. Generalized sketch of a non-fish-bearing stream with depositional and transitional types of spatially intermittent reaches. The median drainage area upstream of low flow initiation points was 21 acres for most geologic types involved, aside from glacial-lacustrine sediments.

Site Selection

The spatial coverage of the field investigation was oriented around the 40 study sites used for a previous windthrow assessment (Grizzel and Wolff 1998). These sites had been randomly selected from 100+ logging permits from the mid-90's, all of which involved buffering along Type 4 streams (using water typing definitions at that time). Because the windthrow sites were chosen from across the range of state and private lands in the Northwest Region, they were assumed to represent reasonable coverage of the range of environmental conditions present on lands subject to Forest Practices Rules in this part of Washington. The field investigation for this study involved revisiting all accessible windthrow sites and many other small streams crossing roads in close proximity.

Among 35 of the 38 windthrow sites accessed, the LFIP was not evident in the vicinity, as the entire reach was either flowing or dry. Instead, the majority of LFIPs (32) were found on other streams close to the windthrow sites. Most effort toward locating additional LFIPs was focused near windthrow sites within the Skagit or Samish basins, with the exception of a handful in closely adjacent areas (i.e. upper South Fork Nooksack basin and Lake Cavanaugh areas, see Appendix B).

After all accessible windthrow sites had been revisited, an additional eight LFIPs were found during a focused investigation of the area underlain by glacial-lacustrine sediments near the town of Concrete (Appendix B – sites CA-CH). The additional glacial-lacustrine LFIPs were selected to determine whether low flow properties differ significantly from bedrock and/or till areas, as past informal field observations had indicated. As discussed in the above report, such differences were confirmed and the glacial-lacustrine LFIPs were analyzed as a separate data pool from those found near windthrow sites.

Locating Low Flow Initiation Points

Most LFIPs were located a short distance up or downstream from a road crossing where minimal or patchy streamflow was observed. Such conditions suggested that the upstream drainage area was barely adequate to support continuous surface flow. Because of our desire to maximize the number of LFIP observations within the available field season, walking extended distances along individual streams was avoided, if a LFIP could not be found. From such crossings, we went a couple of hundred feet up- and/or downstream to try to locate find the LFIP. Although road crossings provided easy access to many small stream crossings, an effort was made to go far enough up or downstream to avoid potential road-created influences, such as localized aggradation. Also, in cases where a dry channel was judged to be particularly large or aggraded with coarse sediment, road crossings located further upstream were visited to see look for any perennial reaches located upstream. The location of each LFIP was marked on 1998 orthophotos and various channel characteristics (e.g. width, gradient, bed material) were recorded as well. None of this site data has yet been analyzed, but may be for the subsequent full report.

Determining Drainage Areas

Drainage areas for each LFIP were delineated using 1. stereo aerial photos (1995/6, ~1:12,000 scale), 2. ortho-photos (1998 – digital: 3x3' pixels) and/or 3. topo maps (1:24,000 scale), ranked in decreasing order of preference (Appendix B). Aerial photos were used, depending on available coverage and land exposure when photographed (clearcut conditions allow the best resolution). Basin acreages were determined using a planimeter. We also calculated drainage areas using Arc-View GIS software and Digital Elevation Models, but found results to be unreliable for delineating the relatively small drainage areas associated with LFIPs. The comparison of methods available for basin delineation will be discussed further in the subsequent report.

Appendix B. Location and attributes of low flow initiation points observed in northwest Washington, summer 2000.

Site	Basin	WAU	Location1		Water	Basin area		Geology
number			Sec.	T/R	type2	acres	from:	
3A	Skagit	E. Shannon	30	36-9	5	34.3	photo	BR-volcanic
18A	Skagit	Jordan/Boulder	20	35-11	NS	2.3	photo	BR-granitic
18B	Skagit	Jordan/Boulder	20	35-11	NS	2.4	photo	BR-granitic
23A	Skagit	Jordan/Boulder	22	35-11	NS	12.2	photo	BR-granitic
23B	Skagit	Jordan/Boulder	22	35-11	9	30.2	photo	BR-granitic
28A	Skagit	Nookachamps	16	34-5	NS	12.3	photo	Glacial till
28B	Skagit	Nookachamps	16	34-5	NS	10.8	photo	Glacial till
28C	Skagit	Nookachamps	16	34-5	4	27.2	photo	Glacial till
32A	Samish	Samish	8	36-5	NS	11.9	photo	BR-phyllite
32B	Samish	Samish	8	36-5	NS	23.4	photo	BR-phyllite
36A	SF Nook.	Howard	3	36-5	9	5.0	ortho	BR-phyllite
36B	SF Nook.	Howard	10	36-5	5	7.2	ortho	BR-phyllite
40A	Skagit	Hilt	4	34-10	NS	3.8	photo	BR-greenschist
W40	Skagit	Hilt	4	34-10	9	42.9	photo	BR-greenschist
41A	Skagit	Hansen	6	35-6	5	30.4	photo	BR-phyllite
41B	Skagit	Hansen	31	36-6	NS	12.1	photo	BR-phyllite
W47	Skagit	Hansen	2	36-6	5	59.8	photo	BR-phyllite
63A	SF Nook.	Hutchinson	7	37-6	NS	26.6	topo	BR-phyllite
67A	NF Stilly	Deer Creek	18	33-7	4	88.4	photo	Glacial till
67B	NF Stilly	Deer Creek	7	33-7	9	33.0	photo	BR-sedimentary
67C	NF Stilly	Deer Creek	8	33-7	NS	20.3	photo	Glacial till
71A	NF Stilly	Pilchuck	9	33-6	NS	136.0	photo	Glacial till
75A	Skagit	Day Creek	31	34-7	4	42.9	ortho	BR-volcanic
77A	NF Stilly	Pilchuck	1	33-6	NS	21.1	photo	BR-metamorphic
77B	NF Stilly	Pilchuck	1	33-6	NS	12.5	photo	BR-metamorphic
77C	NF Stilly	Pilchuck	1	33-6	NS	7.3	photo	BR-metamorphic
W83	SF Nook.	Howard	19	36-7	5	29.8	photo	BR-phyllite
83A	SF Nook.	Howard	19	36-7	NS	12.4	photo	BR-phyllite
88A	Skagit	Rinker	1	32-9	NS	26.6	photo	BR-phyllite
90A	Skagit	Loretta	25	35-6	4	28.5	topo	BR-greenschist
90B	Skagit	Loretta	24	35-6	NS	7.1	ortho	BR-greenschist
99A	SF Nook.	Hutchinson	10	37-5	5	47.0	photo	BR-phyllite
105A	Skagit	Corkindale	17	35-9	NS	16.5	photo	BR-phyllite
105B	Skagit	Corkindale	17	35-9	NS	25.2	photo	BR-phyllite
105C	Skagit	Corkindale	17	35-9	5	17.5	photo	BR-volcanic
CA	Skagit	W. Shannon	10	35-8	9	2.0	photo	Glacial-lacustrine
CB	Skagit	W. Shannon	3	35-8	NS	3.6	photo	Glacial-lacustrine
CC	Skagit	W. Shannon	10	35-8	NS	1.2	photo	Glacial-lacustrine
CD	Skagit	W. Shannon	10	35-8	NS	1.8	photo	Glacial-lacustrine
CE	Skagit	Finney	22	35-8	5	16.8	photo	Glacial-lacustrine
CF	Skagit	Finney	19	35-8	NS	11.0	photo	Glacial-lacustrine
CG	Skagit	Finney	30	35-8	NS	2.8	photo	Glacial-lacustrine
CH	Skagit	Finney	30	35-8	5	13.4	photo	Glacial-lacustrine

1 - Townships are North, Ranges are East of Willamette Meridian. More detailed location information available from author.

2 - Water type shown on map (pre-Emergency Rule); "NS" indicates stream is not shown.