Benthic Infauna and Sediment Characteristics in the Columbia River near Westport, Oregon, August 1989

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INTRODUCTION

In August 1989, the U.S. Army Corps of Engineers (COE), Portland District, and the National Marine Fisheries Service (NMFS), in a cooperative investigation, sampled the Columbia River benthos in the vicinity of the route followed by the Cathlamet Ferry. The Cathlamet Ferry is a small ferry that runs between a dock on Puget Island, Washington, which is located at River Mile (RM) 43.2 on the Columbia River, and Westport, Oregon. The objectives of the study were to determine the species compositions and densities of benthic invertebrates in areas that may be dredged. This report summarizes the results of this investigation.

METHODS

On 31 August 1989, benthic invertebrate and sediment samples were collected at five stations in the vicinity of the route followed by the Cathlamet Ferry (Figure 1; Appendix Table 1). Five benthic invertebrate samples and one sediment sample were collected at each station using a 0.1 m^2 Van Veen grab sampler (Word 1976). When practical, each benthic invertebrate sample was sieved through a 0.5-mm screen and the residue preserved in a buffered formaldehyde solution (≥4%) containing rose bengal, an organic stain. If it appeared that most of the sample would not wash through the sieve, then the entire sample was preserved and sieved at a later time. Each benthic invertebrate sample was sorted and the invertebrates were identified to the lowest practical taxonomic level and counted. Sediment samples were analyzed by the COE (North Pacific Division Materials Laboratory, Troutdale, Oregon) for sediment grain size and percent organic carbon (total volatile solids).

Data were analyzed by station. Information calculated for each station included the number of taxa; total number, frequency of occurrence, and mean number/m^2 and standard deviation (SD) for each taxon; mean number of invertebrates/sample and SD;

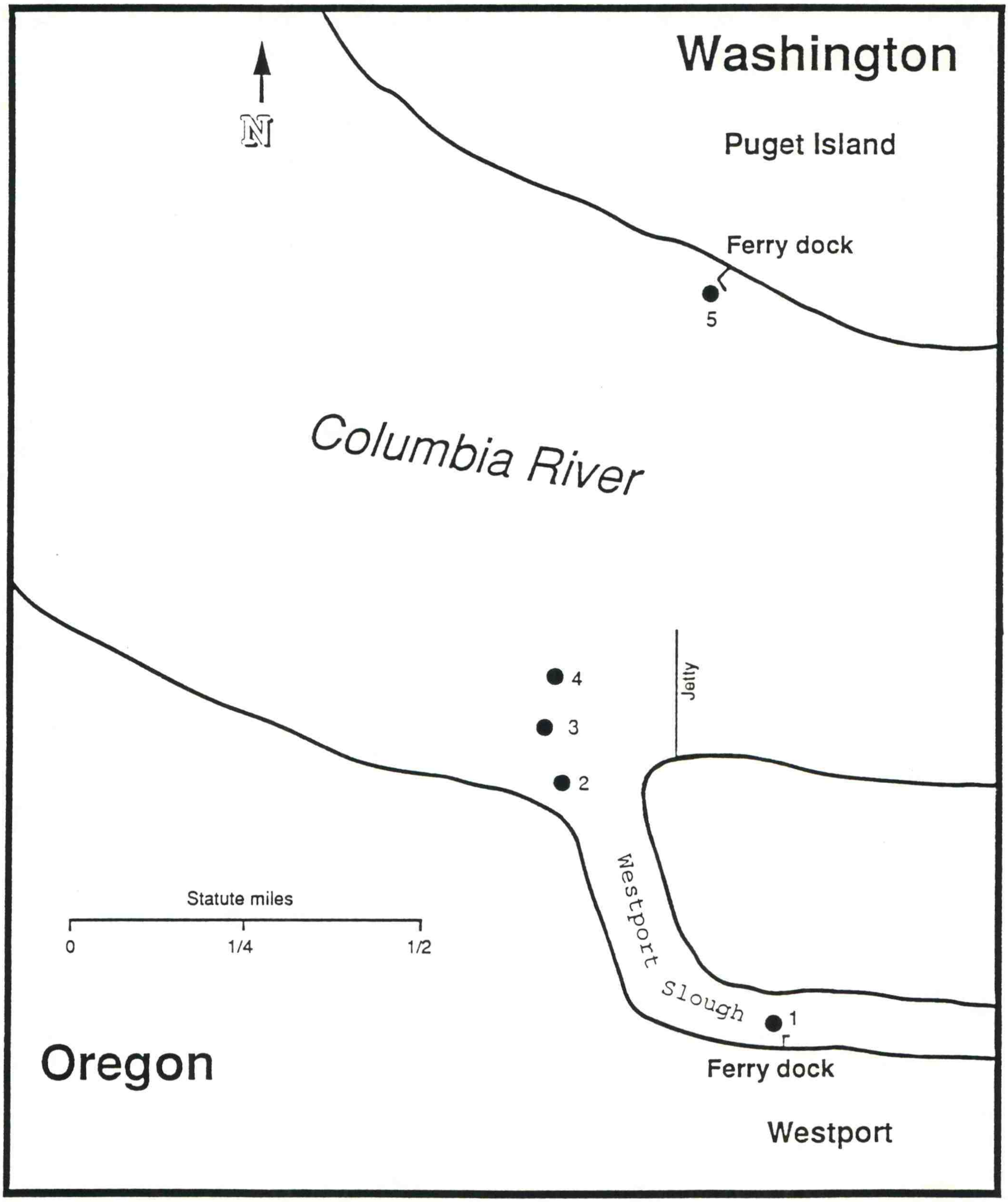

Figure 1.--Locations of the five benthic sampling stations between Westport, Oregon, and Puget Island, Washington.

and total number of invertebrates/m^2 and SD. Also, four community structure indices were calculated for each station--Shannon-Wiener Diversity Index (H') (Krebs 1978), Simpson Diversity Value (SDV) (Simpson 1949), Species Richness (SR) (Margalef 1958), and Evenness (J') (Pielou 1966):

$$H' = -\sum_{i=1}^{s} Pi \log_2 Pi$$

$$SDV = 1 - \sum_{i=1}^{s} Pi^2$$

$$SR = (s-1)/\ln (n)$$

$$J' = H'/\log_2 s.$$

where $Pi = Xa/n$ (Xa is the number of individuals of a particular species in a sample and n is the total number of individuals in a sample) and s = number of species.

RESULTS AND DISCUSSION

Densities of benthic organisms at the five sampling stations ranged from 1,529 (Station 1) to 2,871 organisms/m^2 (Station 3) (Tables 1-5). Essentially all organisms collected were benthic invertebrates, with the exception of six lampreys (Lampetra spp.) collected at Stations 3 and 4. The tube-dwelling amphipod Corophium salmonis was by far the dominant benthic invertebrate collected at all five stations--C. salmonis densities ranged from 1,264 (Station 1) to 2,461/m^2 (Station 3) with a mean of 1,818/m^2. Corophium salmonis is an important food for fishes in the Columbia River estuary (McCabe et al. 1983; Bottom et al. 1984). Densities of C. salmonis at the Westport sampling stations were lower than densities reported by Emmett et al. (1986) at four sampling stations in Cathlamet Bay of the Columbia River estuary, where C. salmonis

Table 1.--Summary of benthic invertebrate collections at Station 1 near Westport, Oregon, 31 August 1989.

Taxon	Total number	Frequency of occurrence (%)	Mean number /m^2	Standard deviation /m^2
Neanthes limnicola	1	20	2.1	4.7
Oligochaeta	103	100	216.3	141.0
Corbicula manilensis	9	60	18.9	18.8
Neomysis mercedis	2	40	4.2	5.8
Corophium spp.	3	20	6.3	14.0
Corophium salmonis	602	100	1,264.2	804.9
Heleidae larvae	6	60	12.6	17.2
Odonata	1	20	2.1	4.7
Arachnida	1	20	2.1	4.7

Number of taxa: 9

Mean number/sample: 145.6 Standard deviation (SD): 69.8

Mean number/m^2: 1,528.8 SD/m^2: 732.4

H' = 0.86 SDV = 0.30 SR = 1.21 J' = 0.27

Table 2.--Summary of benthic invertebrate collections at Station 2 near Westport, Oregon, 31 August 1989.

Taxon	Total number	Frequency of occurrence (%)	Mean number /m^2	Standard deviation /m^2
Neanthes limnicola	31	100	65.1	22.8
Oligochaeta	145	100	304.5	243.4
Corbicula manilensis	12	100	25.2	9.4
Ostracoda	15	80	31.5	42.0
Corophium salmonis	1,149	100	2,412.9	715.0
Chironomidae larvae	7	80	14.7	12.0
Ephemeroptera	2	40	4.2	5.8

Number of taxa: 7

Mean number/sample: 272.2 Standard deviation (SD): 55.0

Mean number/m^2: 2,858.1 SD/m^2: 577.6

H' = 0.86 SDV = 0.28 SR = 0.83 J' = 0.31

Table 3.--Summary of benthic invertebrate (and Lampetra spp.) collections at Station 3 near Westport, Oregon, 31 August 1989.

Taxon	Total number	Frequency of occurrence (%)	Mean number /m^2	Standard deviation /m^2
Neanthes limnicola	1	20	2.1	4.7
Oligochaeta	178	100	373.8	326.4
Corbicula manilensis	5	80	10.5	7.4
Neomysis mercedis	2	40	4.2	5.8
Corophium salmonis	1,172	100	2,461.2	847.0
Chironomidae larvae	2	40	4.2	5.8
Chironomidae pupae	2	20	4.2	9.4
Lampetra spp.	5	40	10.5	18.2

Number of taxa: 8

Mean number/sample: 273.4 Standard deviation (SD): 54.1

Mean number/m^2: 2,870.7 SD/m^2: 568.2

H' = 0.68 SDV = 0.25 SR = 0.97 J' = 0.23

Table 4.--Summary of benthic invertebrate (and Lampetra spp.) collections at Station 4 near Westport, Oregon, 31 August 1989.

Taxon	Total number	Frequency of occurrence (%)	Mean number /m^2	Standard deviation /m^2
Nematomorpha	1	20	2.1	4.7
Neanthes limnicola	1	20	2.1	4.7
Oligochaeta	137	100	287.7	188.5
Corbicula manilensis	45	100	94.5	104.7
Neomysis mercedis	1	20	2.1	4.7
Corophium salmonis	609	100	1,278.9	309.8
Heleidae larvae	1	20	2.1	4.7
Unidentified insect	1	20	2.1	4.7
Lampetra spp.	1	20	2.1	4.7

Number of taxa: 9

Mean number/sample: 159.4 Standard deviation (SD): 49.0

Mean number/m^2: 1,673.7 SD/m^2: 514.4

H' = 1.04 SDV = 0.38 SR = 1.20 J' = 0.33

Table 5.--Summary of benthic invertebrate collections at Station 5 near Westport, Oregon, 31 August 1989.

Taxon	Total number	Frequency of occurrence (%)	Mean number /m^2	Standard deviation /m^2
Oligochaeta	8	60	16.8	17.6
Corbicula manilensis	23	100	48.3	26.4
Corophium spp.	14	40	29.4	46.0
Corophium salmonis	796	100	1,671.6	578.0
Diptera adult	2	40	4.2	5.8
Chironomidae larvae	4	60	8.4	8.8
Heleidae larvae	24	80	50.4	40.9

Number of taxa: 7

Mean number/sample: 174.2 Standard deviation (SD): 61.1

Mean number/m^2: 1,829.1 SD/m^2: 641.5

H' = 0.61 SDV = 0.16 SR = 0.89 J' = 0.22

densities ranged from 7,470 to 35,890/m^2 (mean = 20,478/m^2) on 29 August 1984. Densities of C. salmonis at six stations near Woody Island in the Columbia River estuary (RM 28) ranged from 529 to 5,424/m^2 (mean = 2,544/m^2) on 12 September 1988 (McCabe et al. 1989). In channel areas of the Columbia River near Kalama, Washington (RMs 75 and 79, 13 September 1988), C. salmonis densities at 10 stations were much lower (mean = 107/m^2, range = 11 to 433/m^2) (McCabe et al. 1989) than densities at the Westport sampling stations.

The substrate at four of the sampling sites consisted primarily of sand; however, at Station 2, silt/clay was the most important material (Appendix Table 2). Organic content at all stations was less than 3.5%.

Results from this one survey do not adequately describe the benthic invertebrate community in shallow water between Westport, Oregon, and Puget Island, Washington. To adequately describe the benthic invertebrate community in this area, it would be necessary to sample seasonally (four seasons) for at least 2 years.

This report does not constitute NMFS's formal comment under the Fish and Wildlife Coordination Act or the National Environmental Policy Act.

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APPENDIX

Data Tables

Appendix Table 1.--Depths, sampling times, and geographic locations of the five benthic sampling stations between Westport, Oregon, and Puget Island, Washington. All sampling was done on 31 August 1989.

Station	Time (h)	Depth (m)	Geographic location (lat. and long.)
1	1000	2.7	46° 08' 13"N. 123° 22' 37"W.
2	1040	5.8	46° 08' 40"N. 123° 23' 04"W.
3	1232	1.8	46° 08' 46"N. 123° 23' 05"W.
4	1301	1.2	46° 08' 50"N. 123° 23' 03"W.
5	1330	2.7	46° 09' 13"N. 123° 22' 41"W.

Appendix Table 2.--Results of physical analyses of sediment samples (by station) collected near Westport, Oregon, 31 August 1989.

System : Columbia River — Date : 31 Aug 1989
Project: Westport, OR — Depth : 2.7 m
Station: 1 — Method: 0.1 m2 Van Veen

Size mm	U.S.Sieve Pan	#	Phi	Percent finer	Percent retained	Percent by size classification
64 mm	2-1/2 in		-6	100.0	0.0	0.0 % Rubble
32 mm	1-1/4 in		-5	100.0	0.0	0.0 % Coarse gravel
16 mm	5/8 in		-4	98.8	1.2	
8 mm	5/16 in		-3	97.2	1.6	2.8 % Medium gravel
4 mm	No.	5	-2	94.4	2.8	
2 mm		10	-1	91.1	3.3	6.1 % Fine gravel
1 mm		18	0	89.8	1.3	
0.5 mm		35	1	82.8	7.0	8.3 % Coarse sand
0.25 mm		60	2	44.0	38.8	38.8 % Medium sand
0.125 mm		120	3	21.5	22.5	
0.0625 mm		230	4	13.2	8.3	30.8 % Fine sand
<.0625 mm	<230				13.2	13.2 % Silt/clay

Gravel = 8.9 %
Sand = 77.9 %
Fines = 13.2 %

3.3 % Organics

System : Columbia River — Date : 31 Aug 1989
Project: Westport, OR — Depth : 5.8 m
Station: 2 — Method: 0.1 m2 Van Veen

Size mm	U.S.Sieve Pan	#	Phi	Percent finer	Percent retained	Percent by size classification
64 mm	2-1/2 in		-6	100.0	0.0	0.0 % Rubble
32 mm	1-1/4 in		-5	100.0	0.0	0.0 % Coarse gravel
16 mm	5/8 in		-4	100.0	0.0	
8 mm	5/16 in		-3	100.0	0.0	0.0 % Medium gravel
4 mm	No.	5	-2	100.0	0.0	
2 mm		10	-1	100.0	0.0	0.0 % Fine gravel
1 mm		18	0	100.0	0.0	
0.5 mm		35	1	100.0	0.0	0.0 % Coarse sand
0.25 mm		60	2	99.8	0.2	0.2 % Medium sand
0.125 mm		120	3	97.1	2.7	
0.0625 mm		230	4	61.9	35.2	37.9 % Fine sand
<.0625 mm	<230				61.9	61.9 % Silt/clay

Gravel = 0.0 %
Sand = 38.1 %
Fines = 61.9 %

2.6 % Organics

System : Columbia River — Date : 31 Aug 1989
Project: Westport, OR — Depth : 1.8 m
Station: 3 — Method: 0.1 m2 Van Veen

Size mm	U.S.Sieve Pan	#	Phi	Percent finer	Percent retained	Percent by size classification
64 mm	2-1/2 in		-6	100.0	0.0	0.0 % Rubble
32 mm	1-1/4 in		-5	100.0	0.0	0.0 % Coarse gravel
16 mm	5/8 in		-4	100.0	0.0	
8 mm	5/16 in		-3	100.0	0.0	0.0 % Medium gravel
4 mm	No.	5	-2	100.0	0.0	
2 mm		10	-1	100.0	0.0	0.0 % Fine gravel
1 mm		18	0	100.0	0.0	
0.5 mm		35	1	99.9	0.1	0.1 % Coarse sand
0.25 mm		60	2	99.4	0.5	0.5 % Medium sand
0.125 mm		120	3	88.2	11.2	
0.0625 mm		230	4	13.8	74.4	85.6 % Fine sand
<.0625 mm	<230				13.8	13.8 % Silt/clay

Gravel = 0.0 %
Sand = 86.2 %
Fines = 13.8 %

1.1 % Organics

System : Columbia River — Date : 31 Aug 1989
Project: Westport, OR — Depth : 1.2 m
Station: 4 — Method: 0.1 m2 Van Veen

Size mm	U.S.Sieve Pan	#	Phi	Percent finer	Percent retained	Percent by size classification
64 mm	2-1/2 in		-6	100.0	0.0	0.0 % Rubble
32 mm	1-1/4 in		-5	100.0	0.0	0.0 % Coarse gravel
16 mm	5/8 in		-4	100.0	0.0	
8 mm	5/16 in		-3	100.0	0.0	0.0 % Medium gravel
4 mm	No.	5	-2	100.0	0.0	
2 mm		10	-1	100.0	0.0	0.0 % Fine gravel
1 mm		18	0	100.0	0.0	
0.5 mm		35	1	99.8	0.2	0.2 % Coarse sand
0.25 mm		60	2	99.1	0.7	0.7 % Medium sand
0.125 mm		120	3	77.8	21.3	
0.0625 mm		230	4	10.8	67.0	88.3 % Fine sand
<.0625 mm	<230				10.8	10.8 % Silt/clay

Gravel = 0.0 %
Sand = 89.2 %
Fines = 10.8 %

0.6 % Organics

Appendix Table 2.--Continued.

System : Columbia River	Date : 31 Aug 1989
Project: Westport, OR	Depth : 2.7 m
Station: 5	Method: 0.1 m2 Van Veen

Size mm	U.S.Sieve Pan	#	Phi	Percent finer	Percent retained	Percent by size classification
64 mm	2-1/2 in		-6	100.0	0.0	0.0 % Rubble
32 mm	1-1/4 in		-5	100.0	0.0	0.0 % Coarse gravel
16 mm	5/8 in		-4	100.0	0.0	
8 mm	5/16 in		-3	100.0	0.0	0.0 % Medium gravel
4 mm	No.	5	-2	100.0	0.0	
2 mm		10	-1	99.8	0.2	0.2 % Fine gravel
1 mm		18	0	98.6	1.2	
0.5 mm		35	1	86.7	11.9	13.1 % Coarse sand
0.25 mm		60	2	23.9	62.8	62.8 % Medium sand
0.125 mm		120	3	1.5	22.4	
0.0625 mm		230	4	0.3	1.2	23.6 % Fine sand
<.0625 mm	<230				0.3	0.3 % Silt/clay

Gravel =	0.2 %	0.6 % Organics
Sand =	99.5 %	
Fines =	0.3 %	