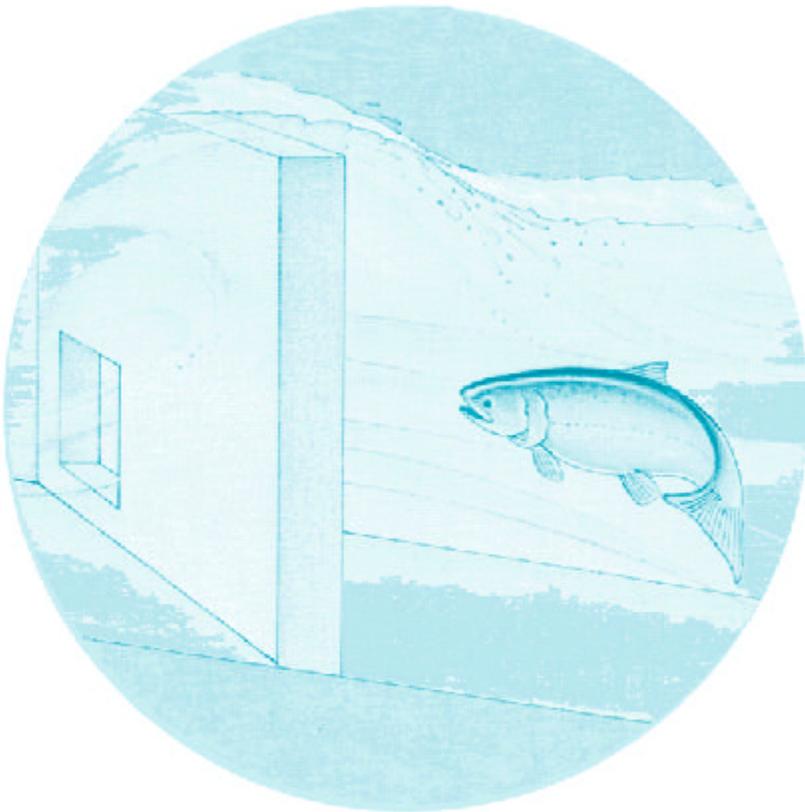


November 1990

**VELOCITY MEASUREMENTS AT SIX FISH SCREENING
FACILITIES IN THE YAKIMA RIVER BASIN, WASHINGTON
SUMMER 1988**

Annual Report 1990



DOE/BP-01830-4



This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views of this report are the author's and do not necessarily represent the views of BPA.

This document should be cited as follows:

*Abernethy, C. Scott, Duane A. Neitzel, E. William Lusty, Pacific Northwest Laboratory, Thomas Clune. Project Manager
U.S. Department of Energy, Bonneville Power Administration, Project No. 1985-62, Contract No.
DE-AC06-76RL01830, 191 electronic pages (BPA Report DOE/BP-01830-4)*

This report and other BPA Fish and Wildlife Publications are available on the Internet at:

<http://www.efw.bpa.gov/cgi-bin/efw/FW/publications.cgi>

For other information on electronic documents or other printed media, contact or write to:

Bonneville Power Administration
Environment, Fish and Wildlife Division
P.O. Box 3621
905 N.E. 11th Avenue
Portland, OR 97208-3621

Please include title, author, and DOE/BP number in the request.

VELOCITY MEASUREMENTS AT SIX FISH SCREENING FACILITIES
IN THE YAKIMA RIVER BASIN, WASHINGTON
SUMMER 1988

ANNUAL REPORT

BY

C. Scott Abernethy
Duane A. Neitzel
E. William Lusty
Pacific Northwest Laboratory

Prepared for

Thomas Clune, Project Manager
U. S. Department of Energy
Bonneville Power Administration
103 South 3rd Street
Yakima, Washington 98901
Project No. 85-62
Contract No. DE-AC06-76RLO 1830

November 1989

PREFACE

The Bonneville Power Administration (BPA), the United States Bureau of Reclamation (USBR), and the Washington State Department of Ecology (WDOE) are funding the construction and evaluation of fish passage facilities and fish protection facilities at irrigation and hydroelectric diversions in the Yakima River Basin, Washington State. This construction implements Section 803 (d) of the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program (NPPC 1987). The program provides offsite enhancement to compensate for fish and wildlife losses caused by hydroelectric development throughout the Columbia River Basin, and addresses natural propagation of salmon to help mitigate the impact of irrigation in the Yakima River Basin.

The Columbia, Richland, Westside Ditch, Sunnyside, Wapato, and Roza Screens are six of the juvenile screening facilities. This report evaluates the flow characteristics of the screening facilities. Studies consisted of velocity measurements taken in front of the rotary drum screens and within the fish bypass systems during peak flows. Measurements of approach velocity and sweep velocity were emphasized in these studies; however, vertical velocity was also measured. Results indicate that velocity patterns within the screening facilities often exceed design specifications, but are generally conducive to effective fish bypass.

ACKNOWLEDGMENTS

The involvement and cooperation of many people during these studies were greatly appreciated. Thomas J. Clune of the Bonneville Power Administration was the Project Manager. Robert Pearce of the National Marine Fisheries Service (NMFS) and Ken Bates of the Washington Department of Fisheries reviewed the plans for measuring velocities. Chuck Keller of the Bureau of Reclamation and his operations and maintenance staffs provided critical support and assistance during site preparation and data collection. Alvin L. Jensen (NMFS) provided the instrumentation used in our studies. The manuscript was reviewed by Susan A. Kreml, Wallace H. Walters, and Dennis D. Dauble.

ABSTRACT

We measured the velocity conditions at six fish screening facilities in the Yakima River Basin: the Columbia, Richland, Westside Ditch, Sunnyside, Wapato, and Roza screens. Approach, sweep, and vertical velocity measurements were taken in front of the rotary drum screens using bidirectional electromagnetic instruments. Velocities were also measured at the entrance of fish bypasses, in front of traveling belt screens in separation chambers, and in the entrance to the fish return.

Approach velocities at the Columbia Screens exceeded design specifications under peak canal flow conditions. Discharge through each of the drum screens was comparable. Stoplog configuration did not adversely affect approach velocity at the face of the drum screens.

Approach velocities at the Richland Screens generally met design specifications; however, low sweep-to-approach velocity ratios occurred at the first drum screen. The canal was not operating at peak canal flow. Velocities under the curvature of the drum screens were similar to velocities in front of the drum screens. Discharge through the drum screens appeared to be equal; however, fish return discharge was greater than described in the design specifications.

Velocities at the Westside Ditch Screens met design criteria, except in front of the most upstream screen. Discharge through the drum screens was not identical. The close proximity of the outer wall to the last drum screen did not adversely affect performance at that screen. Fish return discharge was low because of a stoplogging error; however, adequate fish return discharge is easily achievable.

Approach velocities at the Sunnyside Screens exceeded design specifications during peak canal flow. The intermediate wing wall disrupted the sweep velocity. Sweep velocities in the head end of the intermediate and terminal bypasses indicated that discharges were not identical. Velocities were not uniform in the separation chamber, and approach velocity exceeded design specifications in some areas on the face of traveling screens.

Approach velocity at the Wapato Screens exceeded design specifications in front of the rotary drum screens during peak canal flow. Flow through the three fish bypasses were not equal, with more flow passing through the terminal bypass. Reverse sweep velocities occurred in the upstream end of the fish separation chamber. Unequal discharge through the two traveling belt screens caused excessive approach velocities at the face of one of the screens. Total discharge in the fish return was adequate; however, most of the water entered the fish return from the bottom.

Approach velocity at the Roza Screens during peak canal flow often exceeded design specifications. Additionally, low sweep velocities in the screen forebay resulted in a sweep-to-approach ratio that was less than desirable. Approach velocity exceeded design specifications in front of the traveling belt screens in the separation chamber. Discharge in the fish return was adequate, with water entering equally from the surface and the bottom.

CONTENTS

PREFACE	iii
ACKNOWLEDGMENTS	V
ABSTRACT	vii
INTRODUCTION	1
METHODS	5
EQUIPMENT	6
PROBE POSITIONING	6
DATA COLLECTION AND ANALYSIS	8
DESCRIPTION OF CONDITIONS AT EACH SITE	9
COLUMBIA CANAL	9
RICHLAND CANAL	10
WESTSIDE DITCH	11
SUNNYSIDE CANAL	12
WAPATO CANAL	14
ROZA CANAL	15
RESULTS	19
COLUMBIA SCREENS	19
RICHLAND SCREENS	20
WESTSIDE DITCH SCREENS	20
SUNNYSIDE SCREENS	20
WAPATO SCREENS	23
ROZA SCREENS	31
DISCUSSION	35
SWEEP AND APPROACH VELOCITY IN FRONT OF THE ROTARY DRUM SCREENS	35
SWEEP AND APPROACH VELOCITY IN THE FISH BYPASS SYSTEM	37
SUMMARY	41
COLUMBIA SCREENS	41
RICHLAND SCREENS	41
WESTSIDE DITCH SCREENS	41
SUNNYSIDE SCREENS	42
WAPATO SCREENS	42
ROZA SCREENS	43
RECOMMENDATIONS	45
REFERENCES	47
APPENDIX A - OPERATING CRITERIA	A-1
APPENDIX B - COLUMBIA SCREENS RAW DATA SHEETS	B-1
APPENDIX C - RICHLAND SCREENS RAW DATA SHEETS	C-1
APPENDIX D - WESTSIDE DITCH SCREENS RAW DATA SHEETS	D-1
APPENDIX E - SUNNYSIDE SCREENS RAW DATA SHEETS	E-1
APPENDIX F - WAPATO SCREENS RAW DATA SHEETS	F-1
APPENDIX G - ROZA SCREENS RAW DATA SHEETS	G-1

FIGURES

1	Yakima River Basin Fish Screening Facilities and Other Fish Protection and Passage Facilities.....	2
2	Measurement Depths and Probe Positioning Relative to the Front Face of Rotary Drum Screens in Complete Surveys.....	5
3	Bidirectional Electromagnetic Probes Used in Velocity Measurements.....	6
4	Relationship of Probe Support Assembly to Probes During Velocity Measurements.....	7
5	Probe Location Map for Partial Velocity Measurement Survey at the Columbia Screens, Summer 1988.....	10
6	Probe Location Map for Complete Velocity Measurement Survey at the Richland Screens, Summer 1988.....	11
7	Probe Location Map for Partial Velocity Measurement Survey at the Westside Ditch Screens, Summer 1988.....	12
8	Probe Location Map for Partial Velocity Measurement Survey in Front of the Screens at the Sunnyside Screens, Summer 1988.....	13
9	Probe Location Map for Partial Velocity Measurement Survey in the Separation Chamber at the Sunnyside Screens, Summer 1988.....	13
10	Probe Location Map for Complete Velocity Measurement Survey at the Wapato Screens. Summer 1988,	15
11	Probe Location Map for Partial Velocity Measurement Survey at the Roza Screens. Bay 1. Summer 1988.....	16
12	Probe Location Map for Partial Velocity Measurement Survey in the Separation Chamber at the Rota Screens. Summer 1988.....	17
13	Flow Patterns in the Sunnyside Screens Separation Chamber as Described by Velocity Data and Visual Observations of the Water Surface	25
14	Approach (Impingement) Velocity at the Face of the Traveling Belt Screens in the Sunnyside Screens Separation Chamber.....	26
15	Flow Patterns in the Wapato Screens Separation Chamber as Described by Velocity Data and Visual Observations of the Water Surface.....	29
16	Approach (Impingement) Velocity at the Face of the Traveling Belt Screens in the Wapato Screens Separation Chamber.....	30
17	Flow Patterns in the Roza Screens Separation Chamber as Described by Velocity Data and Visual Observations of the Water Surface.....	33
18	Approach (Impingement) Velocity at the Face of the Traveling Belt Screens in the Roza Screens Separation Chamber.....	34

TABLES

1	Summary of Approach (X) Sweep (Y), and Vertical (Z) Velocity Measurements (fps) at Peak Canal Flow at the Columbia Screens, Summer 1988.....	19
2	Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements at the Richland Screens. Summer 1988.....	21
3	Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements at Peak Canal Flow at the Westside Ditch Screens, Summer 1988.....	22
4	Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements in Front of the Rotary Drum Screens During Peak Canal Flow at the Sunnyside Screens, Summer 1988.....	22
5	Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements in the Intermediate and Terminal Fish Bypasses During Peak Canal Flow at the Sunnyside Screens. Summer 1988.....	24
6	Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements in the Separation Chamber at the Sunnyside Screens, Summer 1988.....	24
7	Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements at the Face of the Traveling Belt Screens and in the Fish Return at the Sunnyside Screens, Summer 1988.....	25
8	Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements in Front of the Drum Screens During Peak Canal Flow at the Wapato Screens, Summer 1988.....	27
9	Summary of Approach (X), and Sweep (Y) Velocity (fps) Measurements in Front of the Rotary Drum Screens During Moderate Canal Flow at the Wapato Screens, Summer 1988.....	28
10	Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity Measurements at the Entrance to the Fish Bypasses at the Wapato Screens. Summer 1988.....	28
11	Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements in the Separation Chamber and Fish Return at the Wapato Screens. Bay 1. Summer 1988.....	29
12	Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity Measurements (fps) at the Face of the Traveling Belt Screens at the Wapato Screens, Summer 1988.....	30
13	Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity Measurements (fps) During Peak Canal Flow in Front of the Drum Screens and in the Fish Bypass in the First Bay at the Roza Screens. Summer 1988.....	32

14	Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity Measurements (fps) in the Separation Chamber and Fish Return at the Roza Screens, Summer 1988.....	33
15	Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity Measurements (fps) at the Face of the Traveling Belt Screens at the Roza Screens, Summer 1988.....	34

INTRODUCTION

The Pacific Northwest Electric Power Planning and Conservation Act (Public Law 96-501) was passed to enable preparation and implementation of a regional Conservation and Electric Power Plan. The Northwest Power Planning Council administers the plan, and is charged with developing a program to protect and enhance fish and wildlife populations and to mitigate adverse effects from development, operation, and management of hydroelectric facilities.

The Yakima River Basin was selected as one site for enhancement of salmon (*Oncorhynchus* spp.) and steelhead (*Salmo gairdneri*) runs. Under the Plan, the Bonneville Power Administration (BPA), the Bureau of Reclamation (USBR), and the Washington State Department of Ecology (WDOE) are funding the construction of fish passage and protection facilities at irrigation and hydroelectric diversions in the Yakima River Basin (Figure 1).

The improvement of fish screening facilities in irrigation canals is a major component in the overall fisheries enhancement program. Hydrologists and biologists from various agencies, including the National Marine Fisheries Service (NMFS), the Washington Department of Fisheries (WDF), and the Yakima Indian Nation (YIN), provided input for the design of the new facilities. The angled rotary drum screen design was chosen as the best alternative for fish screening in irrigation canals.

The BR and NMFS built scale models (1:10) of some of the proposed facilities to evaluate velocity parameters before the actual construction of the facilities began. The Sunnyside Fish Screening Facility, the first of the new fish screening facilities in the Yakima Basin, began operation in 1985.

Pacific Northwest Laboratory (PNL) conducted fisheries evaluations at five of the new fish screening facilities from 1985 through 1988 (Neitzel et al. 1985, 1986, 1987). The scope of the studies included the quantification of injury and mortality, predation, and passage effectiveness for emigrating salmonids; however, it did not include evaluation of hydraulic characteristics within the screening facilities. The hydraulic conditions in front of the drum screens as well as within components of the fish guidance system (fish bypasses, separation chamber, and fish return slot) are critical in providing optimal conditions for safe fish bypass. The screens were designed to provide an approach velocity (perpendicular to the screens) of 0.5 feet per second (fps) or less to minimize impingement of fish, and a sweep velocity (parallel to the screen face) of at least twice the magnitude of the approach velocity to guide fish into the bypass system (Easterbrooks 1984).

Inadequate sweep velocities, excessive approach velocities, or unequal discharges through the drum screens and fish bypass system have been observed at several of the screening facilities during our fisheries evaluations. These flow pattern anomalies can affect the overall efficiency of a facility. The objective of these hydraulic studies was to monitor the actual velocity characteristics at selected facilities during normal operation, as defined by the operating criteria for each facility.

This report describes the measurement studies conducted by PNL staff at the Columbia, Richland, Westside Ditch, Sunnyside, Wapato, and Roza screens in 1988. The report describes the equipment and methods used to measure the

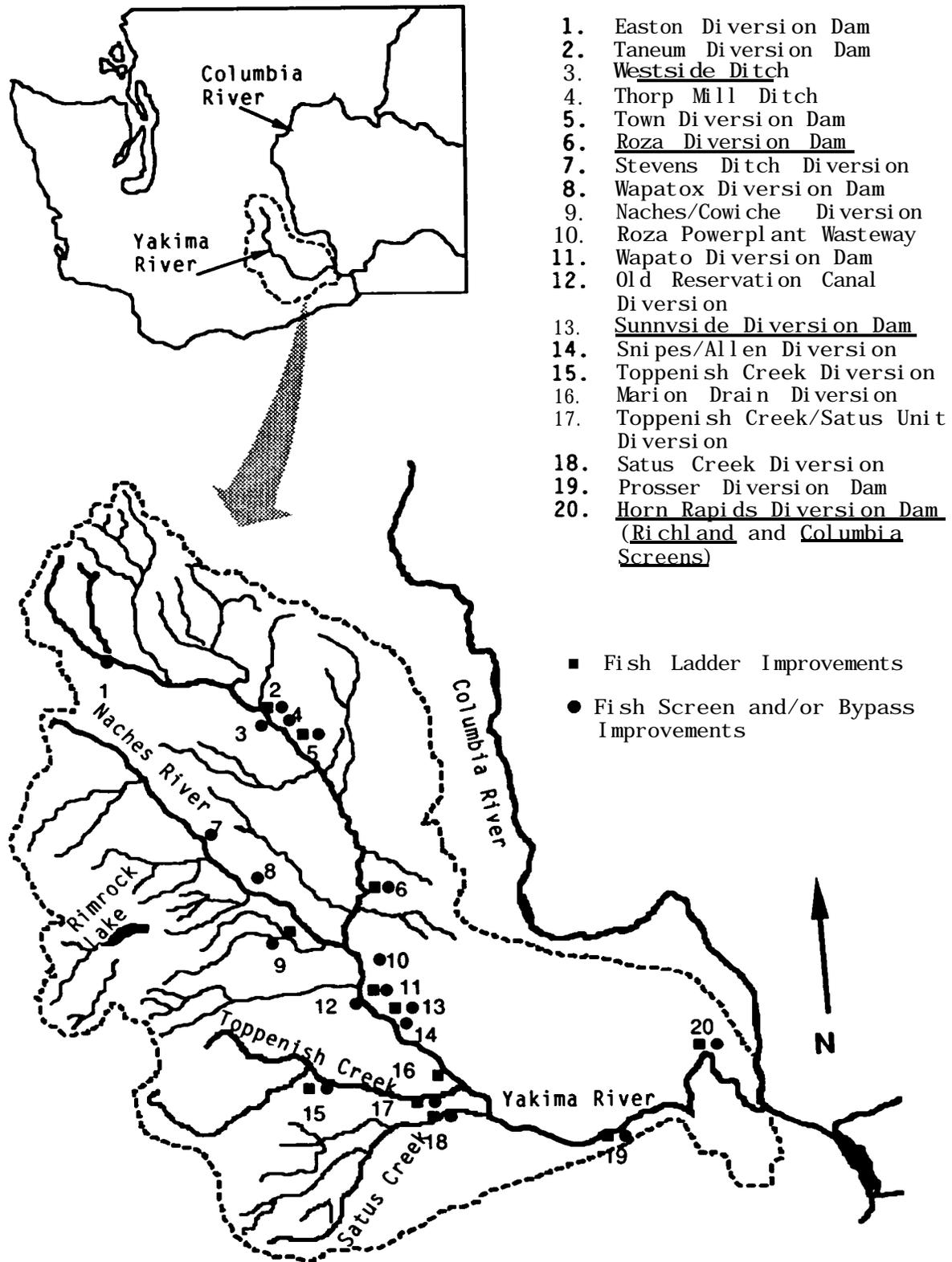


FIGURE 1. Yakima River Basin Fish Screening Facilities and Other Fish Protection and Passage Facilities

hydraulic characteristics and the operating conditions at each facility during data collection, and summarizes the results. The similarities and differences among sites are discussed. The raw data are included in six appendices (one for each site) to provide for independent analysis of the data.

METHODS

Two monitoring protocols were used in our data collection. Partial surveys, in which measurements were taken only at 0.2 and 0.8 of the water depth [Z; hereinafter referred to as "of water depth" or 0.2 (e.g. 1 depth)], were conducted at the Columbia, Westside Ditch, Sunnyside, and Roza screens. Additional measurements were taken to address specific concerns at these four sites. Complete surveys, which included additional measurements at 0.05, 0.5, 0.8, and 0.9 of the water depth (Figure 2), were conducted at the Richland and Wapato screens. Velocity measurements were taken in front of the rotary drum screens, in the separation chamber (if applicable), and in the fish return. Velocity parameters were simultaneously measured in the X (approach), Y (sweep), and Z (vertical) axes.

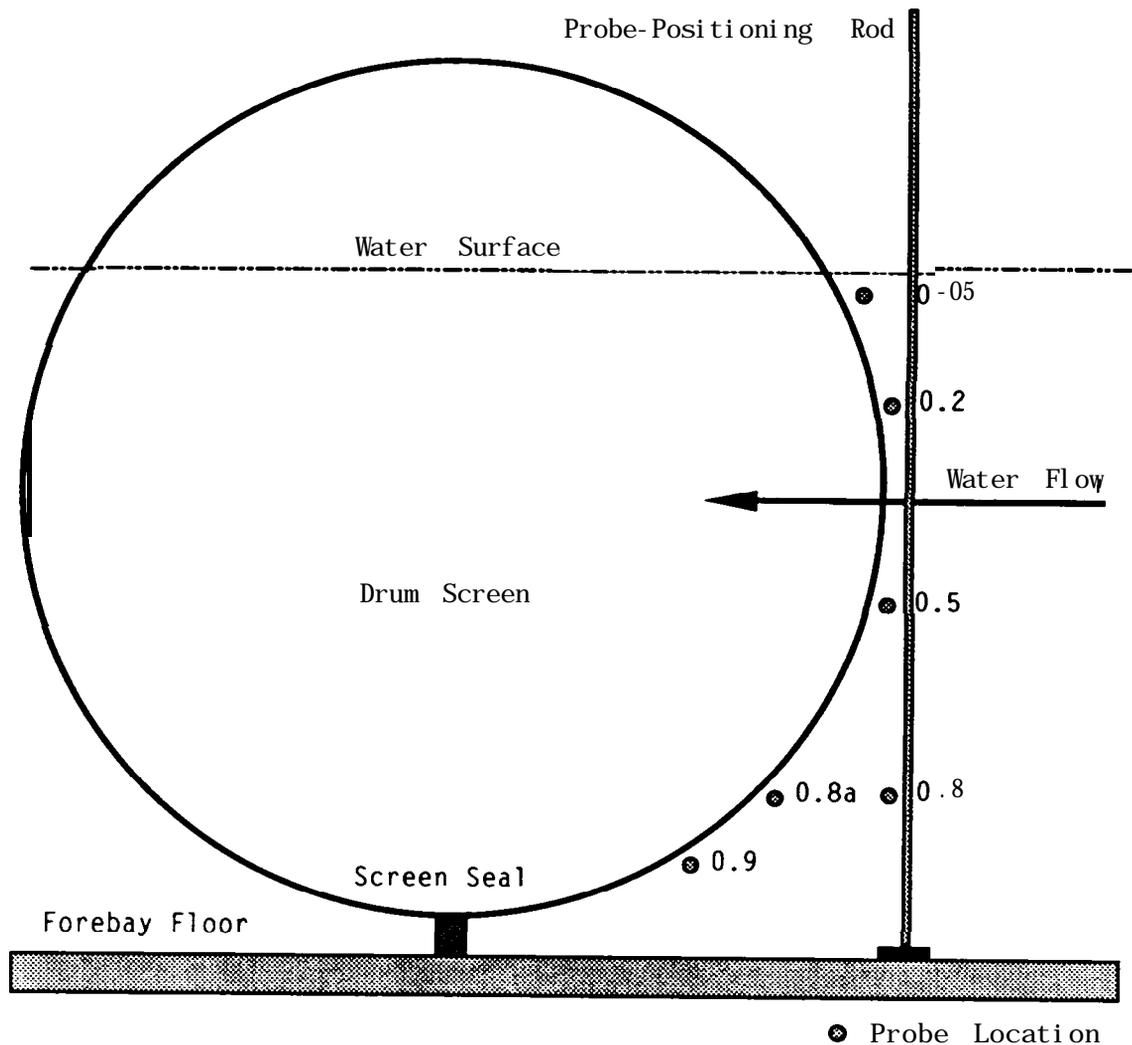


FIGURE 2. Measurement Depths and Probe Positioning Relative to the Front Face of Rotary Drum Screens in Complete Surveys

EQUIPMENT

Four electromagnetic water current meters were used to monitor water velocities. Each meter utilized a bidirectional probe (Figure 3). Probes were mounted in pairs so that one measured the X and Y and the other measured the Y and Z velocity components at a given depth. Measurements were made at two depths simultaneously. Outputs were read visually from the panel gauges.

The meter probes were securely fastened to a horizontal arm that extended from a movable sleeve secured to a vertical pole. The length of the horizontal arm and the position of the sleeve on the vertical pole were adjustable. The probe support assembly was positioned at least 18 in. downstream or outside of the sensors so that the vertical pole and horizontal bracket arm would not disrupt velocity readings at the probes (Figure 4).

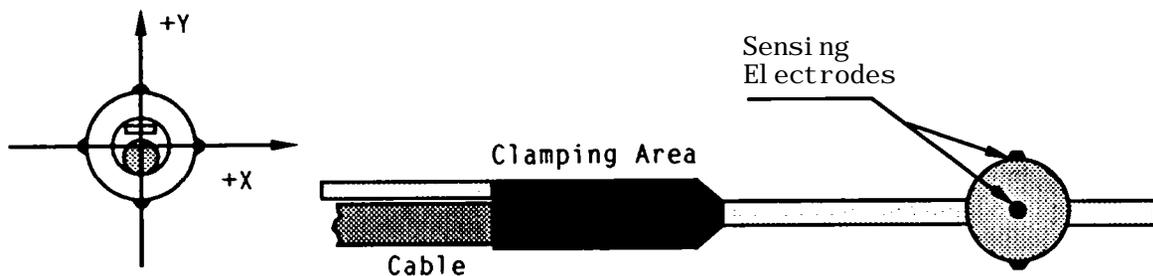


FIGURE 3. Bi directional Electromagnetic Probes Used in Velocity Measurements

PROBE POSTIONING

Drum Screens

The vertical pole was positioned close to the perimeter of the screen: however, none of the components of the probe assembly was in contact with the screen face. The bottom of the pole rested on the forebay floor, and the top end of the pole was clamped to a fixed object such as the gantry frame or a girder. Measurements at 0.2, 0.5, and 0.8 of water depth were taken by mounting the probes on a horizontal arm pointing upstream, and measurements near the screen face at 0.05, 0.8, and 0.9 of water depth were taken by mounting the probes on a horizontal arm pointed inward toward the face of the screen. The length of the horizontal arm required to position the probes close to the screen face was calculated based on screen diameter, water depth, and the position of the vertical pole relative to the perimeter of the screen. The set of probes was generally within 4 to 6 in. of the screen face for the near-screen measurements. The drum screens are constructed at an angle to the canal flow: therefore, all measurements were taken with the probe orientation parallel and perpendicular to the screen face, not to the canal flow. Most of the velocity measurements were taken at the centerline of the screen. Measurements were also taken in the upper and lower quadrant (halfway between the upper or lower edge of the screen and the centerline) in complete surveys.

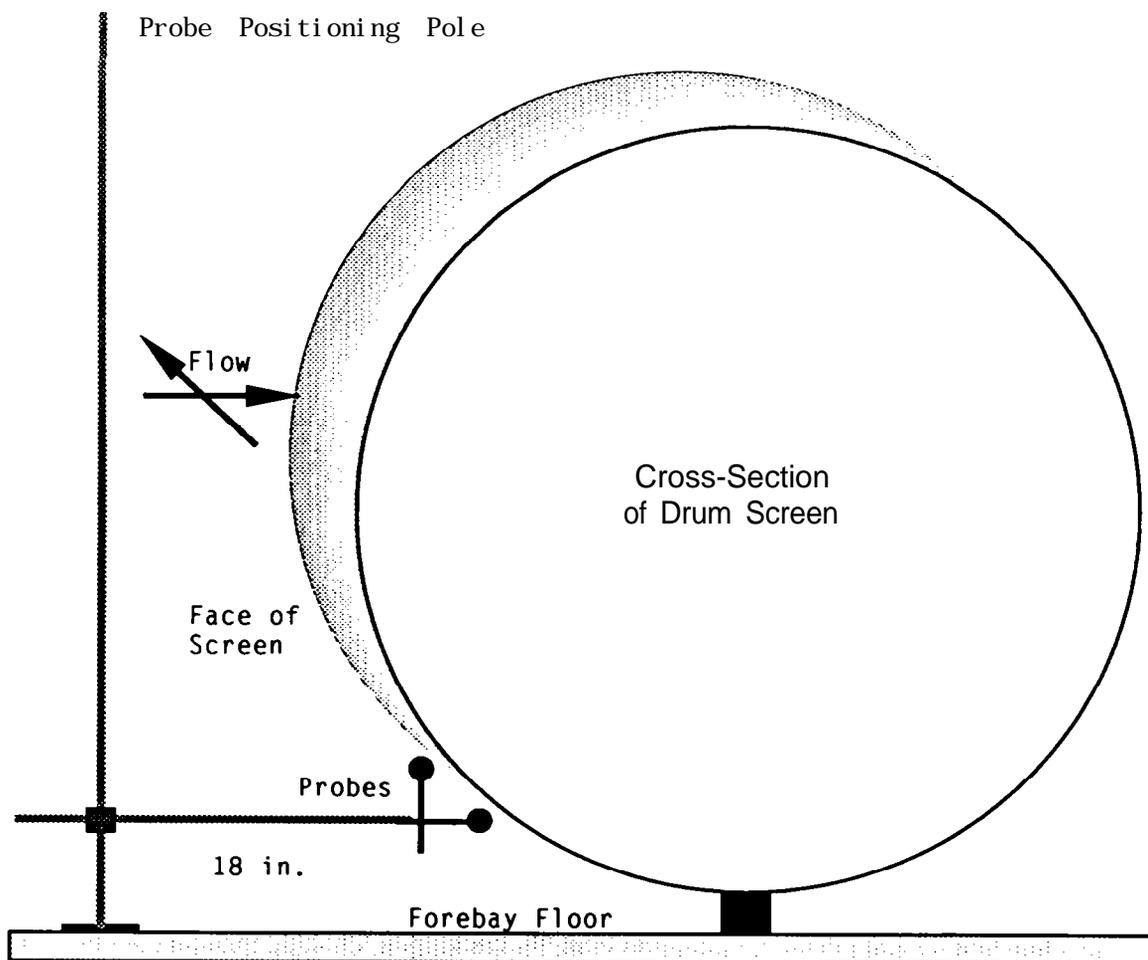


FIGURE 4. Relationship of Probe Support Assembly to Probes During Velocity Measurements

Fish Bypasses

Measurements were taken at 0.2 and 0.8 of water depth at the centerline of the 24-in.-wide fish bypasses. All bypasses had submerged ramps to guide fish and water up from the bottom of the screen structure and over an adjustable weir at the back of the ramp. The probes were positioned about 18 in. upstream of the ramp. This positioning generally placed the probes within the concrete structure of the bypass. Additionally, at the request of the Washington Department of Fisheries (WDF), velocity measurements were taken at 0.1, 0.3, 0.5, 0.7, and 0.9 of water depth at the Sunnyside Screens, instead of the normal 0.2 and 0.8 depth.

Separation Chamber

Measurements were taken at 0.2 and 0.8 of water depth in transects across the width of the separation chamber. Transects were made upstream of the vertical traveling screens and at the centerline of selected traveling screens. The traveling screens were constructed perpendicular to the separation chamber flow, with the outer wall (distal to the traveling screens) angling toward the screens. The probes were positioned parallel

to the traveling screens, pointing upstream. Turbulent areas where bypass flows mix at the head of the separation chamber were not evaluated.

Vertical Traveling Screens

Measurements were taken at 0.2 and 0.8 of water depth at the face of the traveling screens. The probes were positioned parallel to the screen face at 1-ft intervals at the Sunnyside Screens, and at the centerline and in the upper and lower quadrants at the Wapato and Roza screens. The measurements along the screen face and the transects across the separation chamber merged to form a T pattern of velocity measurements.

Fish Return

Velocity in the fish returns of the smaller facilities (Columbia, Richland, and Westside Ditch screens) was measured in the "window" of water passing over the flow-regulating dam boards. Velocity in the larger facilities (Sunnyside, Wapato, and Roza screens) was measured near the upstream end of the fish return slot. The vertical pole was positioned upstream of the submerged approach ramp. A second set of measurements was taken in the middle of the Wapato Screens fish return.

DATA COLLECTION AND ANALYSIS

Ten sets of velocity measurements were recorded in a 3- to 5-min interval. Each set of readings provided a "snapshot" of all velocity measurements. Beginning and ending times were recorded for each series of data. Abnormal operating or canal flow conditions were recorded as "Notes" on the data sheets. Analyses and comparisons were performed using the means of the data.

DESCRIPTION OF CONDITIONS AT EACH SITE

Our data were collected at the time of the year when maximum canal flow was most likely to occur, and under normal operating conditions, as described in the operating criteria for each site. However, because of projected water shortages in 1988, some canals were not operating at maximum capacity. Surface elevation and/or forebay depth were determined from staff gauges at each site. Canal flows were also provided by BR for most sites; however, canal flow at the Richland Canal was not available. Abnormal flow or operating conditions were recorded at each site.

COLUMBIA CANAL

The Columbia Screens are located in the Columbia Canal on the right bank of the Horn Rapids Diversion Dam at river mile (RM) 18.0 on the Yakima River. The facility consists of 10 rotary drum screens (8 ft in diameter, 10 ft in length) and a fish return. The water depth in the screen forebay is about 4.2 ft when the canal is at the maximum flow of 150 cubic feet per second (cfs). Flow through the fish return is maintained at about 25 cfs by placing dam boards in the fish return.

A partial survey was conducted at the Columbia Screens on August 3, 1988, under full canal flow conditions, estimated at 148 cfs by Columbia Canal maintenance personnel. Canal elevation was 4.2 ft on the staff gauge behind the screens. Only 47 in. (49%) of the 96-in.-diameter drum screens was submerged. Water depth in front of the screens was 53 in. We assumed the difference in water depth and submerged screen depth to be the height of the bottom screen seal.

All operating conditions were normal during our measurements with the following exceptions:

- Screen 8 was not turning and was completely plugged with debris.
- Screens 2 and 3 were not turning when we arrived and were reset before our measurement series.
- Porosity boards were in use in all screen bays behind the screens. The upper half of each screen bay was completely closed off, and 2 ft of board were positioned 6 to 10 in. from the bottom in the lower half of each screen bay to prevent silt buildup near the screens.
- The fish return had dam boards in slot A (narrow slot at the front end of the fish return) instead of slot C (wide slot in the middle of the fish return).

Velocity measurements were taken at 0.2 and 0.8 of water depth. Measurements were made at the centerline of most screens; however, measurements were taken in the upper and lower quadrants on selected screens to determine if the porosity board configuration behind the screens affected approach velocities at different points on the face of the screens (Figure 5). Measurements in the fish return were made in the center of the water column at middepth of the water flowing over dam boards in the narrow slot. The series of measurements was completed in 3 h. No changes in canal flow or operating conditions occurred during our measurements.

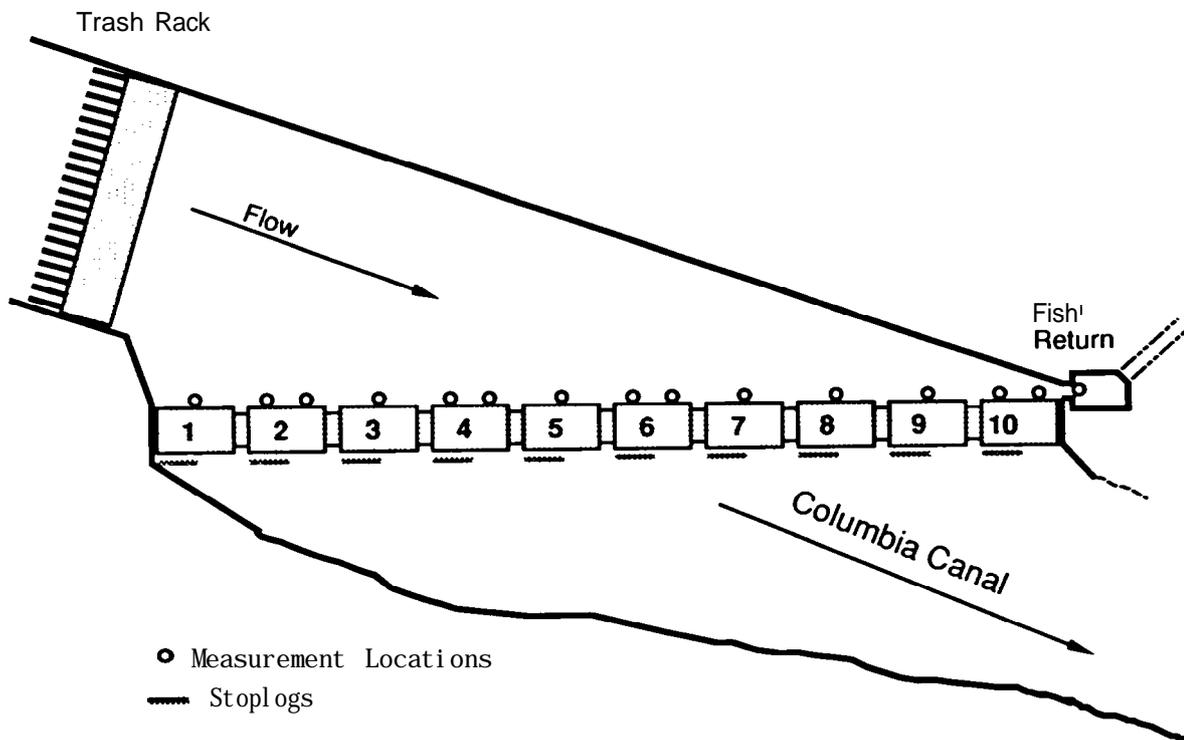


FIGURE 5. Probe Location Map for Partial Velocity Measurement Survey at the Columbia Screens, Summer 1988

RICHLAND CANAL

The Richland Screens are Located in the Richland Canal on the left bank of the Horn Rapids Diversion Dam at RM 18.0 on the Yakima River. The facility consists of four rotary drum screens (6 ft in diameter, 10 ft in length), a wastewater channel, and a fish return. Maximum canal flow is 80 cfs. The canal surface elevation at maximum canal flow is 413.85 ft. This forebay elevation represents the maximum canal level with no spill over the sill of the wastewater channel.

A complete survey was conducted at the Richland Screens on August 4 and 8, 1988. The forebay elevation was 413.8 to 413.85 ft. and canal level was 5.7 ft on the staff gauge behind the screens. Total canal flow was unknown. The water in front of the screens was 69 in. deep. Of the 72-in. drum screen diameter, 55 in. (76%) was submerged. The screens at the Richland Canal are set on top of a 12-in. sill. We used the submerged screen depth (55 in.) as the basis for our measurements so that the probe positioning at 0.8a and 0.9 depths would be relative to the screen and not to the solid sill.

All operating conditions were normal during our measurements with the following exceptions:

Flow through the fish return was excessive. Stoplogs may not have been all the way to the bottom in slot C, allowing water to go under as well as over the stoplogs. Porosity boards were in use behind the screens to reduce silt buildup in the screen bays. Two

12 in. boards were positioned about 10 in. from the bottom in each bay. Siltation was excessive behind the screens; however, silt deposition in the screen forebay was minimal.

Velocity measurements were taken at six locations at five depths (0.05, 0.2, 0.5, 0.8, 0.8a, and 0.9 of water depth) in three transects (centerline and upper and lower quadrants) at each screen (Figure 6). Measurements in the fish return were made in the center of the water column at 0.2 and 0.8 of water depth in Slot A. Survey measurements required a total of 10 h during 2 days. Change in canal elevation during the 2 days of sampling was negligible.

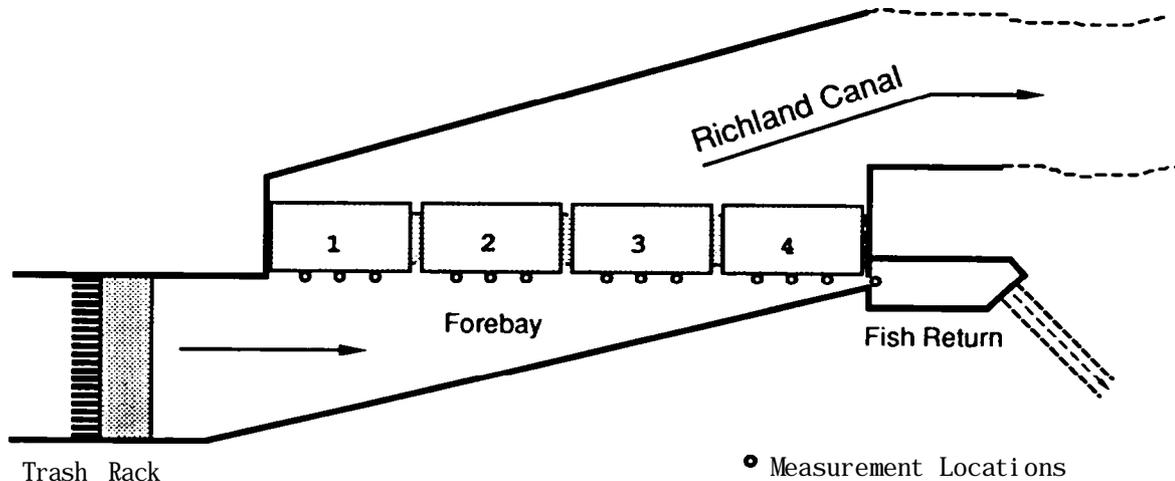


FIGURE 6. Probe Location Map for Complete Velocity Measurement Survey at the Richland Screens, Summer 1988

WFSTSIDF DITCH

The Westside Ditch Screens are located in the Westside Ditch on the right bank of the Yakima River at RM 166.2. The facility consists of four rotary drum screens (6 ft in diameter, 12 ft in length), a wastewater channel, and a fish return. Maximum canal flow is 120 cfs. The maximum forebay level is about 1682.1 ft on the staff gauge in the screen forebay.

A partial survey was conducted at Westside Ditch on August 9 1988. The canal was operating at an excessively high level when we arrived at the site. About 6 in. (8%) of the drum screen diameter was above the surface, and 6 to 8 in. of water was spilling over the wastewater channel sill. About 6 in. of water was spilling over the weir on a wastewater channel at the old head gate structure in the bay behind the screens.

The head gates were closed until the canal level stabilized at 1682.0 ft on the staff gauge. At this level, 14 in. of the drum screens was exposed and 58 in. (81%) was submerged, and no water spilled over the sill of the wastewater channel. About 6 in. of water was flowing through the wastewater channel slot. Water flow ceased in the old wastewater channel behind the screens. The dam board height in the fish return was not changed. Canal flow was 96 cfs.

The water depth of 64 in. in front of the drum screens was used to calculate depths for probe positioning. Velocity measurements were taken at 0.2 and 0.8 of the depth (Figure 7). Measurements in the fish return were made in the center of the water column at middepth of the water

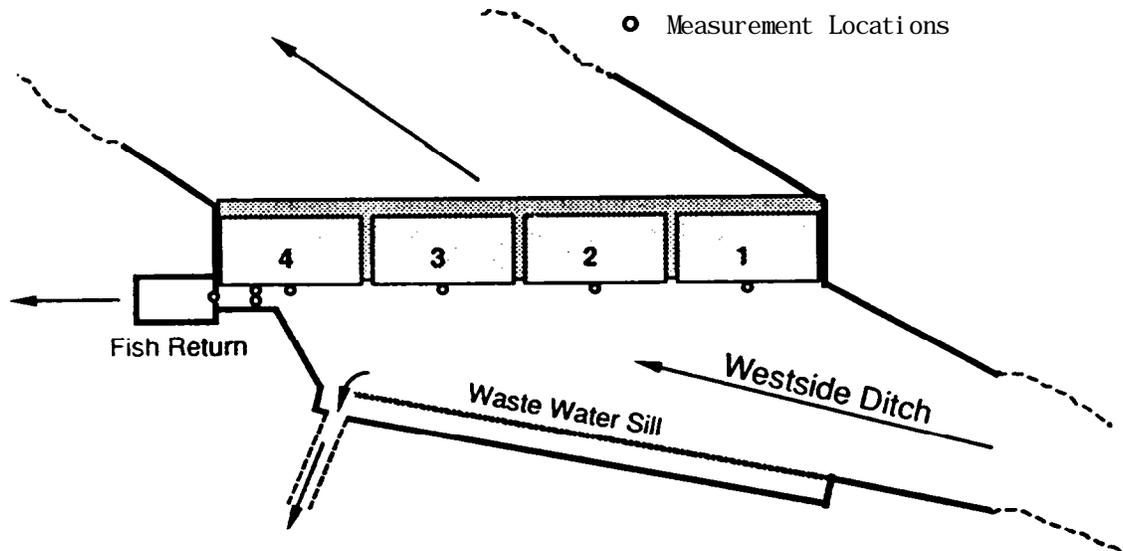


FIGURE 7. Probe Location Map for Partial Velocity Measurement Survey at the Westside Ditch Screens, Summer 1988

flowing over the dam boards in the fish return slot. The fish return flow was 19 in. of head instead of the 24 to 27 in. suggested in the operating criteria.

SUNNYSIDE CANAL

The Sunnyside Screens are located in the Sunnyside Canal on the left bank of the Yakima River at RM 103.8. The facility consists of 17 rotary drum screens (16 ft in diameter, 12 ft in length) and a fish bypass system that includes intermediate and terminal fish bypasses, a separation chamber with two bypass water recovery pumps located behind vertical traveling screens, and primary and secondary fish return pipes. The maximum canal flow is about 1550 cfs. and the maximum forebay elevation is 897.0 ft. Flow through the bypass system is controlled by adjusting weir gates in the fish bypasses and fish returns. Of the 100 cfs of water entering the separation chamber (50 cfs from each fish bypass), 80 cfs are pumped back to the canal when both pumps are operating, leaving 20 cfs to flow through the primary fish return. Porosity boards are used behind screens 8 and 10 through 14 to help balance discharge through the screens. Screens 1 and 2 are completely blocked off.

A partial survey was conducted at the Sunnyside Screens on August 10 and 11, 1988 (Figures 8 and 9). The canal forebay elevation was 897.0 and canal flow was about 1275 cfs. Both pumpback systems were in operation, and the weirs in the intermediate bypass, the terminal bypass, and the fish return were adjusted according to the operating criteria. Water depth in

front of the screens was 168 in.: 150 in. (83%) of the 180-in. drum screen diameter was submerged. We used the submerged screen depth (150 in.) for our calculations so that probe positioning would be relative to the drum screens.

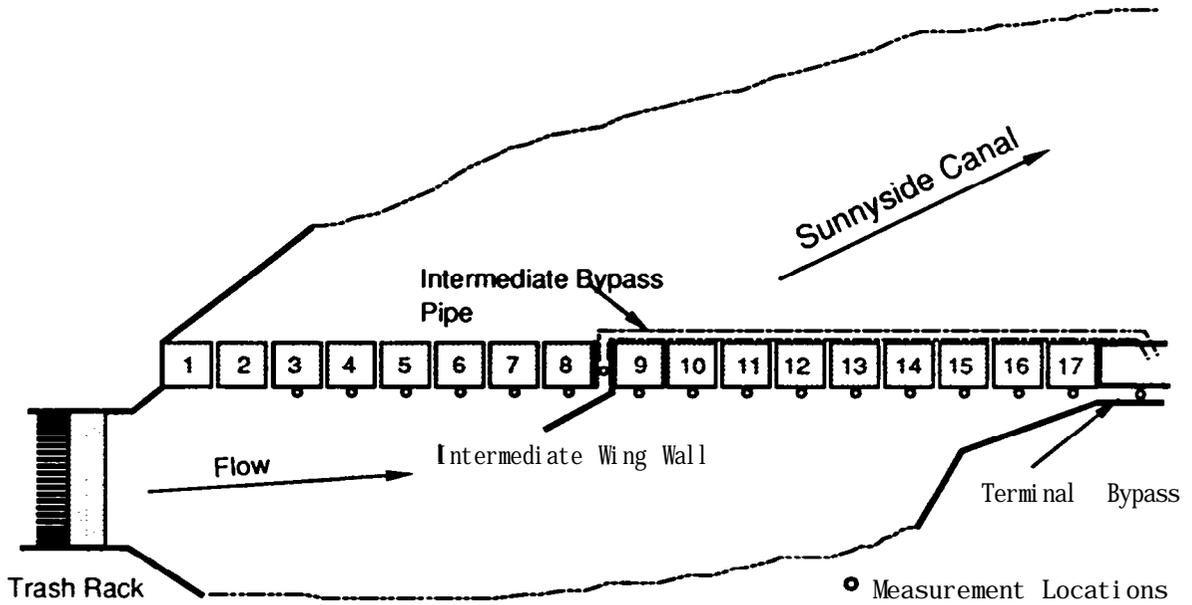


FIGURE 8. Probe Location Map for Partial Velocity Measurement Survey in Front of the Screens at the Sunnyside Screens, Summer 1988

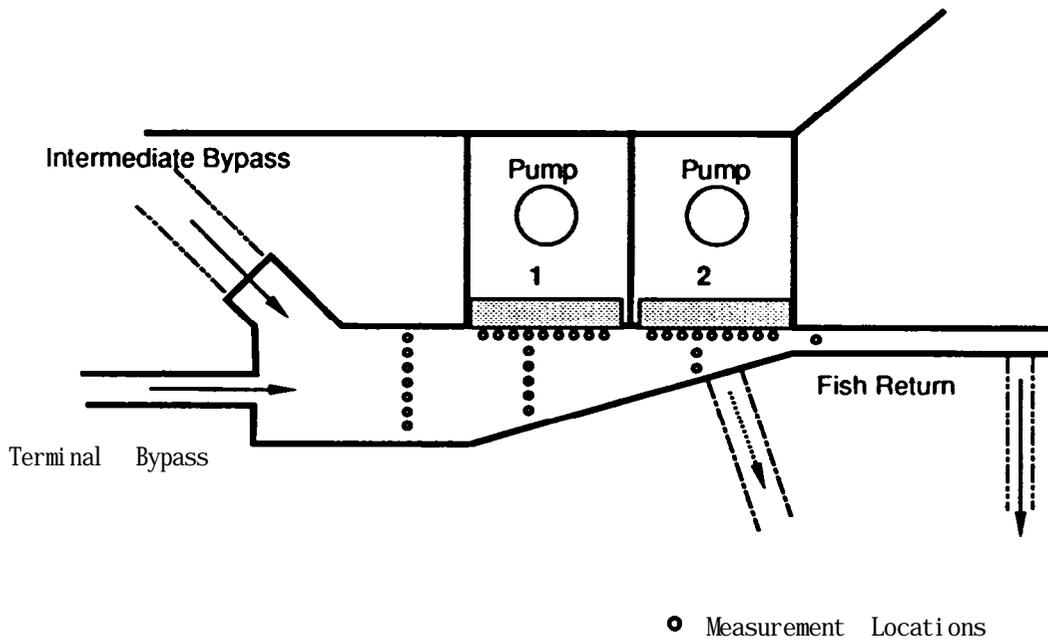


FIGURE 9. Probe Location Map for Partial Velocity Measurement Survey in the Separation Chamber at the Sunnyside Screens, Summer 1988

All operating conditions were normal during our measurements except that screens 1 and 2 were stoplogged and out of service. The operating criteria call for only screen 1 to be stoplogged although screen 2 has not been in operation since 1985.

WAPATO CANAL

The Wapato Screens are located in the Wapato Canal on the right bank of the Yakima River at RM 106.7. The facility consists of 15 rotary drum screens (14 ft in diameter and 24 ft in length) and a fish bypass system that includes three fish bypasses (two intermediate and a terminal), a separation chamber with two bypass water recovery pumps located behind vertical traveling screens, and a fish return. The forebay elevation is about 935 ft at the maximum canal flow of 1800 cfs. Flow through the fish bypass system is controlled by adjusting weir gates in each fish bypass, the fish return, and the recovery pump bays behind the traveling screens. The two recovery pumps are not used during normal operation. Of the 150 cfs of water entering the separation chamber (50 cfs from each fish bypass), about 30 to 35 cfs flows through the fish return and the remainder is wasted over the weirs behind the traveling screens.

A complete survey was conducted at the Wapato Canal on August 16 through 18, 1988. Canal elevation was 934.6 ft. and the canal flow was 1750 cfs. Weir heights in the three fish bypasses and the fish return were set according to the operating criteria. Water depth in front of the screens was 135 in. Of the 168-in. drum screen diameter, 130 in. (77%) was submerged. We used the submerged screen depth as the basis for calculating probe positioning.

All operating conditions were normal with the following exceptions:

- The vertical traveling screens in the separation chamber were not fully functional. The screens were cleaned and lowered into operating position when we took our measurements in the separation chamber; however, the spray pumps were not operating, and only one traveling screen was rotating. When our measurements were completed, the screens were removed.
- Discharge through the two traveling belt screens was not equal. Most of the wastewater was discharged through screen 2 (the screen closer to the fish return slot).
- Rotary drum screens 1 and 9 were not operational. The screens were not stoplogged; however, they appeared to be totally plugged with debris. No measurements were taken in front of these screens.
Three YIN salmon rearing pens were floating in the canal forebay.
All drum screens were stoplogged according to previous modeling data; however, stoplog configurations were not included in the operating criteria.

Velocity measurements were taken at six locations at five depths (0.05, 0.2, 0.5, 0.8, 0.8a, and 0.9 of water depth) in three transects (centerline and upper and lower quadrants) at screens immediately upstream and downstream of each fish bypass (screens 5, 6, 10, 11, and 15). Measurements were taken at 0.2 and 0.8 depths at the centerline of the remaining screens, in the entrance to fish bypasses, in front of the

traveling belt screens in the separation chamber, and in the fish return (Figure 10).

We also conducted velocity measurements on September 8, 1988, after the YIN salmon pens were removed from the canal forebay. The purpose of these measurements was to determine if the floating pens affected velocity measurements in front of the drum screens or in the fish bypasses. However, the surface elevation in the canal had dropped from 934.6 to 933.3 ft. and the canal flow was down to 1150 cfs because of reduced irrigation demands. Additionally, bypass flows described in the operating criteria were not achievable at a canal elevation of 933.3 ft.

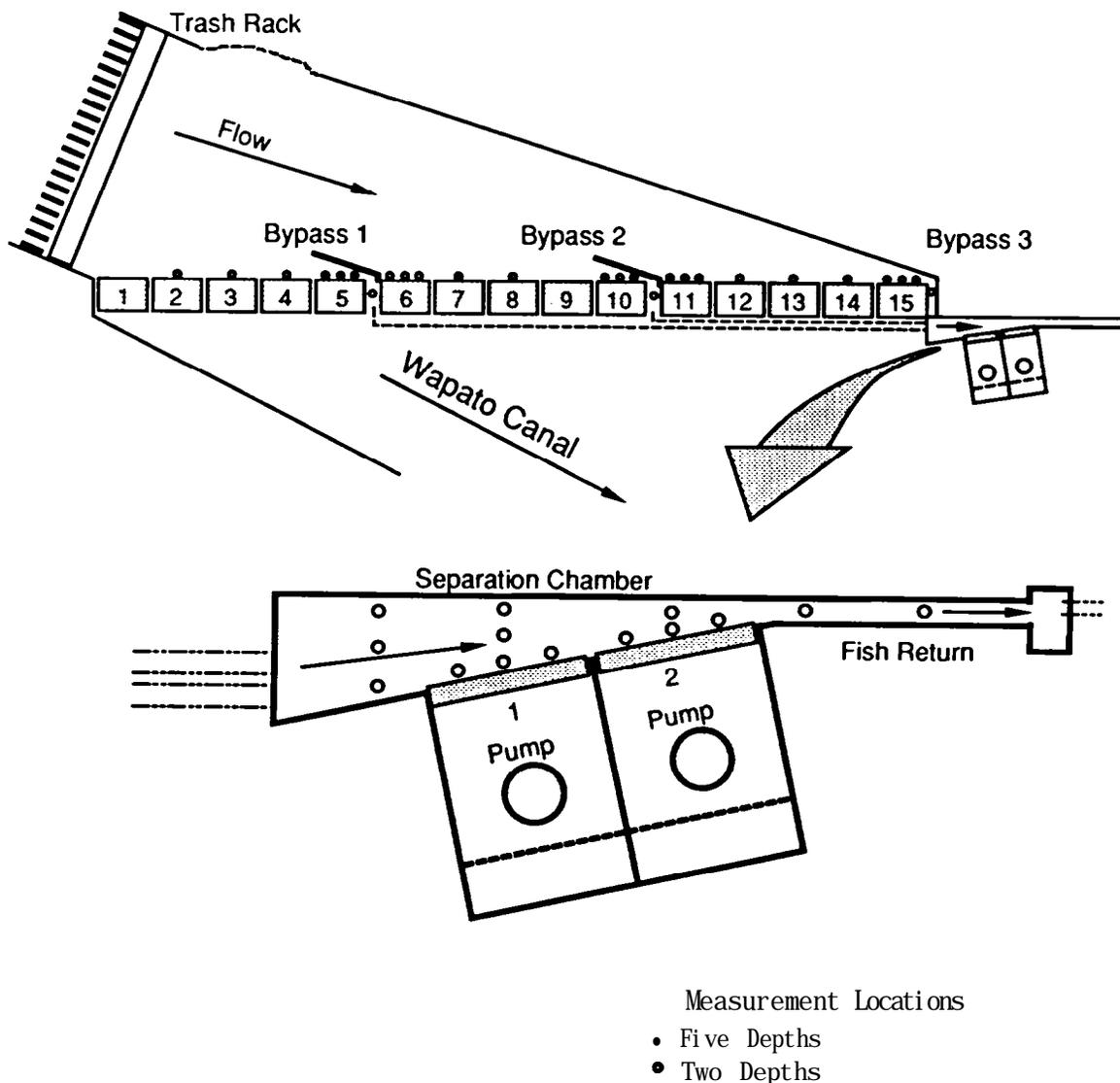


FIGURE 10. Probe Location Map for Complete Velocity Measurement Survey at the Wapato Screens. Summer 1988

ROZA CANAL

The Roza Screens are located in the Roza Canal on the right bank of the Yakima River at RM 127.9. The facility consists of 27 rotary drum screens (17 ft in diameter and 12 ft in length) in five screen bays- (7 screens in the upstream bay and 5 in each of the other four bays), a fish bypass system that includes five fish bypasses, a separation chamber with four bypass water recovery pumps located behind vertical traveling screens, and a fish return. At the maximum canal flow of 2000 cfs. the forebay elevation is about 1220.8 ft. Flow through the fish bypass system is controlled by adjusting weir gates in each of the fish bypasses and the fish return. Of the 250 cfs of fish bypass flow (50 cfs through each fish bypass) during normal operation. 20 cfs flows through the fish return and 230 cfs (57.5 cfs for each of the four pumps) is pumped back to the canal.

A partial survey was conducted at the Roza Screens on August 22 and 23, 1988. Canal elevation was 1220.3 ft behind the screens, and total canal flow was 1950 cfs. Velocity measurements were taken in the first bay. Water depth in front of the screens was 160 in. Of the 204-in. drum screen diameter, 151 in. (74%) was submerged. We used the submerged screen depth (151 in.) as our depth so that probe positioning would be relative to the drum screens. Measurements were taken at 0.2 and 0.8 of water depth at the centerline of screens 1, 2, 4, and 5. No measurements were taken in front of screen 3 because the boom truck used to position our probe assembly would not reach the screen. Measurements were taken at 0.05, 0.2, 0.5, 0.8, 0.8a, and 0.9 depths at the centerline of screens 6 and 7 (Figure 11). Velocity measurements were taken in front of the first and third vertical traveling screens in the separation chamber (Figure 12). All operating conditions were normal.

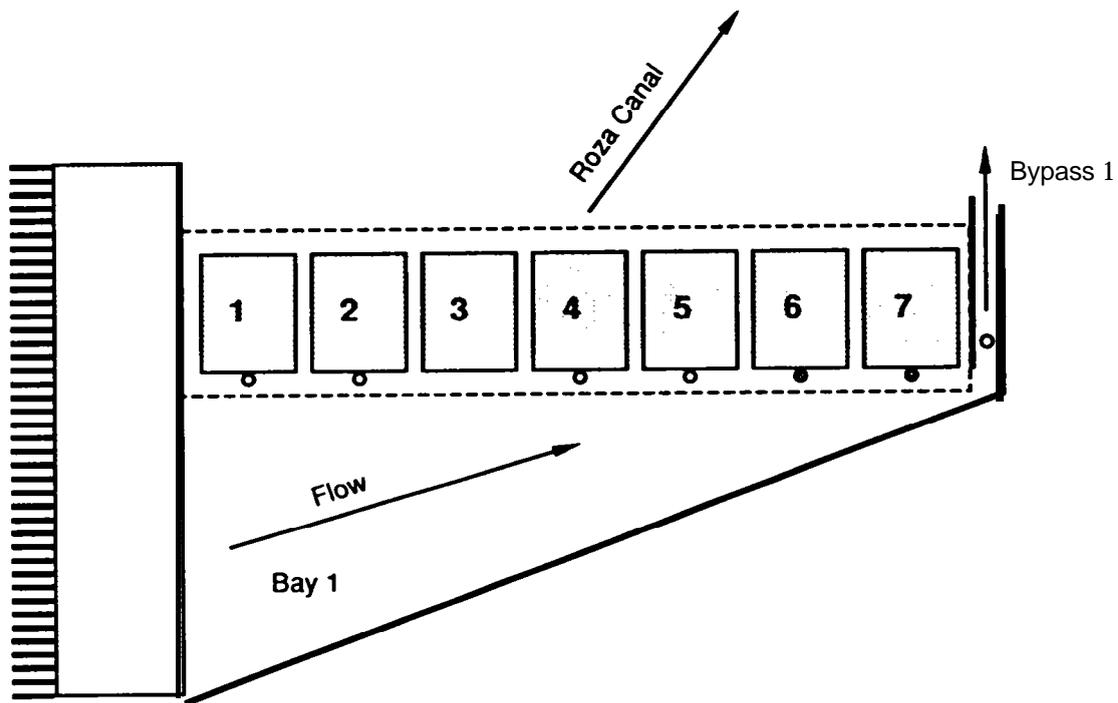


FIGURE 11. Probe Location Map for Partial Velocity Measurement Survey at the Roza Screens, Bay 1. Summer 1988

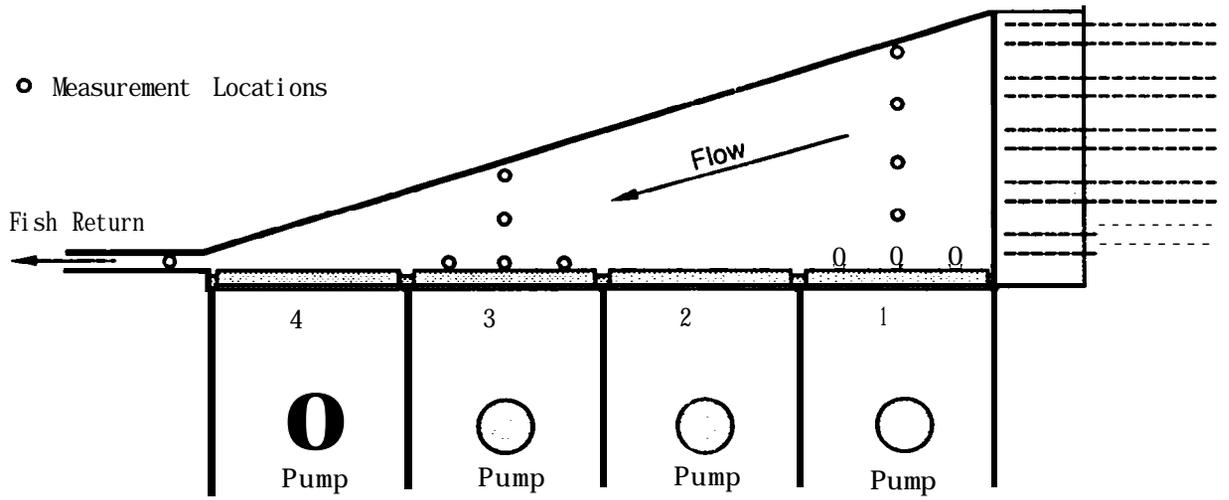


FIGURE 12. Probe Location Map for Partial Velocity Measurement Survey in the Separation Chamber at the Roza Screens, Summer 1988

RESULTS

Current velocities were measured at six screening facilities during 1988. The facilities are Columbia, Richland, Sunnyside, Wapato, Roza, and Westside Ditch. Velocities measured in all the canals were near the design specification and generally conducive to an effective fish bypass. Approach velocities sometimes exceeded 0.5 fps, however, they usually were at least twofold less than sweep velocities. Vertical velocities were usually less than 0.5 fps. Some velocity anomalies related to facility design were observed. For example, negative flow velocities were measured near walls and at some bypass entrances. The velocity characteristics are presented on a site-by-site basis. The raw data for each site are included in Appendices B through G.

COLUMBIA SCREENS

Velocity measurements for the Columbia Screens are summarized in Table 1. Approach velocity exceeded 0.5 fps by more than 10% at all operating

TABLE 1. Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity Measurements (fps) at Peak Canal Flow at the Columbia Screens, Summer 1988

Screen Number	Quadrant	0.2 Depth			0.8 Depth		
		X	Y	Z	X	Y	Z
1 ^a	Center	0.61 ^b	1.15	0.16	0.84 ^b	1.41 ^c	0.06
2	Upper	0.51	1.78	0.26	0.88 ^b	2.10	0.17
2	Lower	0.44	1.60	0.36	0.65 ^b	1.93	0.28
3	Center	0.36	1.56	0.29	0.55 ^b	1.63	0.09
4	Upper	0.49	1.62	0.17	0.63 ^b	1.68	0.06
4	Lower	0.61 ^b	0.98 ^c	0.11	0.67 ^b	1.42	0.00
5	Center	0.57 ^b	1.56	0.13	0.69 ^b	1.54	0.05
6	Upper	0.56 ^b	1.66	0.16	0.71 ^b	1.71	0.08
6	Lower	0.57 ^b	1.49	0.17	0.52	1.33	0.05
7	Center	0.52	1.45	0.13	0.62 ^b	1.24	0.04
8 ^d	Center	0.38	0.93	0.16	0.26	1.17	0.00
9	Center	0.60 ^b	1.28	0.19	0.62 ^b	1.01 ^c	0.06
10	Upper	0.60 ^b	1.38	0.11	0.78 ^b	1.34	0.01
10	Lower	0.58 ^b	1.41	0.11	0.62 ^b	1.29	0.00
Fish Return ^e	Center	0.43	8.0	0.41			

a Screen 1 is at the upstream end of the screening facility: Screen 10 is at the downstream end nearest the fish return.

b Approach velocity exceeds design specification (≥ 0.5 fps) by $>10\%$

c Sweep-to-approach velocity ratio is less than design specification of $\geq 2:1$ by 10% .

d Screen 8 was not operating and was plugged with debris.

e Fish return flow cross-sectional area of 4.17 ft^2 ; velocities were measured in the center of the fish return overflow.

screens. The excess occurred more often at 0.8 depth. Even though approach velocities exceeded 0.5 fps, the sweep-to-approach ratio of 2:1 was maintained at eight of nine operating screens for 0.2 depth and seven of nine operating screens at 0.8 depth. Vertical velocity was less than 0.2 fps at seven of the nine operating screens. Vertical velocities were consistently greater at 0.2 depth than for 0.8 depth. There was no consistent variation in the difference between approach measurements at the upper and lower quadrants of Screens 2, 4, 6, and 10. Flow through the fish return was adequate to prevent diverted fish from swimming into the screen facility from downstream of the fish return slot. The stoplog configuration being used during our measurements was not the same as prescribed by the operating guides.

RICHLAND SCREENS

Velocity measurements for the Richland Screens are summarized in Table 2. Approach velocities did not exceed 0.5 fps by more than 10% at 0.05, 0.5, and 0.8 depth near the screen. Approach velocity exceeded 0.5 fps by more than 10% for three of 12 measurement locations at 0.2 depth, 1 of 12 measurement locations at 0.8 depth near the screen, and 1 of 12 measurement locations at 0.9 depth. Sweep-to-approach velocities exceeded a 2:1 ratio at all depths measured on Screen 1 except for 0.5 depth. For Screen 2, the sweep-to-approach ratio was greater than 2:1 at 0.2 and 0.8 depth. For Screens 3 and 4, the sweep-to-approach ratios were 2:1 or greater at all measurement locations.

Approach velocities were consistently higher in the upstream quadrant of each screen compared to the centerline and lower quadrant measurements, indicating that screen bay walls affected flow patterns. Flow through the fish return resulted in average approach velocities of less than 0.2 fps for the lower quadrant of Screen 4. Approach velocity at 0.9 depth for the lower quadrant of Screen 4 was reversed. Flow through the fish return was adequate to prevent diverted fish from swimming into the screen facility from downstream of the fish return slot.

WESTSIDE DITCH screens

Velocity measurements for the Westside Ditch Screens are summarized in Table 3. Approach velocities were less than 0.5 fps at 0.2 depth and exceeded 0.5 fps by more than 10% at 0.8 depth for Screens 1 and 4. The sweep-to-approach ratios were greater than 2:1 at all measurement locations except at 0.8 depth on Screen 1. One additional velocity measurement location was added in the lower quadrant of Screen 4 because of the location of the fish return slot. Measurements indicated the approach velocities were not affected by the close proximity of the wing wall to Screen 4. The fish return flow was less than required to prevent fish from swimming into the screen facility from downstream of the fish return slot. The stoplog configuration used during the measurements was not the same as prescribed by the operating guides.

SUNNYSIDE SCREENS

Approach velocities in front of the drum screens exceeded 0.5 fps in most instances (Table 4). Sweep velocity was generally high, resulting in sweep-to-approach velocity ratios greater than 2:1. Sweep-to-approach

TABLE 2. Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements at the Richland Screens, Summer 1988

Screen Number	Quadrant	0.05 Depth			0.2 Depth			0.5 Depth			0.8 Depth			0.8a Depth			0.9 Depth		
		X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
1 ^a	Upper	0.27	0.32 ^b	-0.13	0.56 ^c	0.50 ^b	0.40	0.33	1.14	-0.03	0.45	0.40 ^b	-0.03	0.48	0.51 ^b	-0.06	0.81 ^c	1.08 ^b	-0.27
1	Center	0.16	0.51	-0.15	0.55	0.51 ^b	0.33	0.20	1.14	0.14	0.36	0.43 ^b	-0.15	0.37	0.59 ^b	-0.01	0.44	1.15	-0.20
1	Lower	0.11	0.53	-0.13	0.48	0.58 ^b	0.36	0.11	1.09	0.21	0.37	0.58 ^b	0.05	0.30	0.63	0.07	0.16	1.05	-0.13
2	Upper	0.11	0.79	-0.06	0.55	0.96 ^b	0.29	0.19	1.34	0.18	0.45	0.46 ^b	0.46	0.36	0.95	-3.38 ^d	0.61	1.47	-0.24
2	Center	0.06	0.60	0.14	0.58 ^c	0.92 ^b	0.44	0.17	1.08	0.14	0.41	0.71 ^b	0.06	0.26	0.93	0.17	0.41	1.36	-0.17
2	Lower	0.09	0.85	-0.24	0.50	0.74 ^b	0.35	0.17	1.08	0.18	0.30	0.83	-0.05	0.22	0.91	0.04	0.22	1.19	-0.15
3	Upper	0.12	1.18	-0.32	0.51	1.05	0.28	0.26	1.06	-0.05	0.37	0.87	-0.03	0.46	1.12	-7.65 ^d	0.52	1.37	-0.23
3	Center	0.09	1.13	-0.11	0.52	1.02	0.41	0.27	.93	-0.07	0.36	0.89	0.01	0.27	1.08	0.02	0.27	1.33	-0.17
3	Lower	0.07	1.10	-0.24	0.44	1.01	0.29	0.32	1.04	-0.12	0.26	0.94	0.07	0.24	1.01	0.14	0.15	1.26	-0.10
4	Upper	0.43	1.44	-0.07	0.58 ^c	1.37	0.27	0.41	1.33	-0.14	0.57 ^c	1.31	-0.12	0.42	1.53	-0.28	0.49	1.53	-0.27
4	Center	0.36	1.60	-0.13	0.50	1.59	0.25	0.31	1.56	-0.17	0.46	1.45	-0.17	0.30	1.68	-0.14	0.29	1.64	-0.22
4	Lower	0.22	1.79	-0.10	0.33	2.03	0.35	0.12	2.02	-0.10	0.20	1.94	0.09	0.28	1.96	-0.07	-0.05	1.79	-0.18
Return ^e	Center				0.43	6.95	-0.56				0.47	7.15	0.48						

^a Screen 1 is at the upstream end of the screening facility; Screen 4 is at the downstream end nearest the fish return.

^b Sweep-to-approach ratio is less than design specifications by >10%.

^c Approach velocity exceeds design specifications (0.5 fps) by >10%.

^d False readings due to probe contact at the screen face.

^e Fish return flow cross-sectional area of 7.75 ft² in the fish return slot where measurements were taken.

TABLE 3. Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements at Peak Canal Flow at the Westside Ditch Screens, Summer 1988

Screen Number	Quadrant	0.2 Depth			0.8 Depth		
		X	Y	Z	X	Y	Z
1 ^a	Center	0.30	0.74	-0.19	0.66 ^b	0.63 ^c	-0.08
2	Center	0.33	1.08	-0.30	0.37	0.90	0.10
3	Center	0.23	1.27	-0.16	0.51	1.20	0.09
4	Center	0.42	1.39	0.09	0.65	1.23	0.22
4	Lower ^d	0.15	1.39	-0.14	0.09	0.96	0.21
Fish Return ^e	Center	-0.93	3.95	0.47	-	-	-

a Screen 1 is at the upstream end of the facility; Screen 4 is nearest the fish return.

b Approach velocity exceeds the design specification (≤ 0.5 fps) by $>10\%$.

c Sweep-to-approach ratio is less than design specifications by $>10\%$.

d Additional transect was added because of close proximity of outer wall to the lower end of Screen 4.

e Fish return velocities were measured in the center of the fish return overflow. Cross-sectional area was 2.38 ft²; fish return was not stoplogged properly during our measurements.

TABLE 4. Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements in Front of the Rotary Drum Screens During Peak Canal Flow at the Sunnyside Screens, Summer 1988

Screen Number	Quadrant	0.2 Depth			0.8 Depth		
		X	Y	Z	X	Y	Z
3 ^a	Center	0.53	2.19	0.02	0.51	3.84	-0.54
4	Center	0.53	2.27	-0.34	0.86 ^b	3.11	-0.36
5	Center	0.61 ^b	1.47	-0.41	0.46	2.20	-0.21
6	Center	0.53	2.30	-0.17	0.50	2.37	-0.37
7	Center	0.68 ^b	1.90	-0.41	0.39	2.43	0.00
8	Center	0.73 ^b	1.29	-0.36	0.41	1.58	-0.10
9	Center	0.64 ^b	-0.61 ^c	0.06	0.63 ^b	1.42	0.16
10	Center	0.68 ^b	0.85 ^c	-0.21	0.75 ^b	2.06	-0.37
11	Center	0.76 ^b	1.51	-0.11	0.67 ^b	2.52	-0.33
12	Center	0.66 ^b	1.75	-0.26	0.58 ^b	3.40	-0.20
13	Center	0.52	1.75	-0.32	0.41	3.17	-0.28
14	Center	0.68 ^b	1.98	-0.15	0.65 ^b	2.71	-0.05
15	Center	0.65 ^b	1.92	-0.23	0.46	3.26	-0.25
16	Center	0.64 ^b	1.82	-0.21	0.72 ^b	2.22	-0.11
17	Center	0.70 ^b	1.97	-0.20	0.74 ^b	3.10	-0.07

a Screen 3 is the first operational screen at the upstream end of the facility; Screen 8 is upstream and inside of the intermediate wing wall; Screen 17 is nearest the terminal fish bypass.

b Approach velocity exceeds design specification (≤ 0.5 fps) by $>10\%$.

c Sweep-to-approach ratio is less than design criteria by $>10\%$.

velocities were less than 2:1 only where velocities were disrupted by the intermediate bypass wing wall. An eddy in front of Screen 9 (immediately downstream of the wing wall) resulted in a negative sweep velocity at the 3.2 depth.

A low sweep velocity in front of Screen 8 indicated that flow may be restricted by the intermediate wing wall and/or intermediate bypass. Velocity measurements within the intermediate and terminal bypasses (Table 5) indicated that the terminal bypass (oriented parallel to the screens) had a greater sweep velocity than the intermediate bypass (oriented perpendicular to the screens).

Sweep velocity in the separation chamber upstream of and in front of the traveling screens was not uniform (Table 6). Flow patterns within the separation chamber were affected by the bypass design and unbalanced bypass flows (Figure 13; Table 7). The intermediate bypass pipe enters below the surface and is oriented at approximately a 45° angle away from the traveling screens. The terminal bypass discharge, which dominated the flow pattern in the separation chamber, enters at the surface and is oriented parallel to the traveling screens. Discharge from the terminal bypass is directed toward the face of the traveling screens and resulted in a very high sweep velocity immediately in front of the traveling screens, whereas sweep velocity near the wing wall opposite the traveling screens was lower. The flow patterns persisted throughout the length of the separation chamber.

Approach velocities at the face of the traveling belt screens exceeded 0.5 fps by more than 10% (Table 7). Approach velocities at traveling screen 1 were uniform at 0.2 of the depth but not at 0.8 of the depth, where approach velocities were negative at the upstream end but exceeded 1.5 fps at the downstream end of the traveling screen face (Figure 14). Additionally, sweep velocities were consistently lower at the 0.8 depth. Sweep and approach velocities were more consistent in front of traveling screen 2; however, approach velocity was excessive at the 0.2 depth and sweep velocity was greater at the 0.2 depth than at 0.8 depth. Flow in the fish return was adequate, but the sweep velocity was greater at the 0.2 depth than at 0.8 depth, the same pattern as was observed in the separation chamber.

WAPATO SCREENS

Approach velocities slightly exceeded 0.5 fps by more than 10% at over 60% (64 of 105) of the measurement locations during peak canal flow (Table 8). Approach velocities were uniform, except at Screens 6 and 11 where wing walls seemed to affect approach velocity, especially at the 0.8, 0.8a, and 0.9 depths. Measurements in the upper, center, and lower quadrants of these screens showed that the approach velocity returned to normal within one screen length (24 ft).

Sweep velocities were generally twice as great as approach velocities, but steadily declined with depth and proximity to the terminal bypass.

Approach velocities met design specifications at most measurement locations during 65% canal flow (Table 9). Approach velocities tended to be less at the 0.2 depth than during peak canal flow; however, the approach velocity at the 0.8 depth was similar at both canal flows. Sweep-to-approach ratio was greater than 2:1 at most measurement locations. Sweep velocities were

TABLE 5. Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements in the Intermediate and Terminal Fish Bypasses During Peak Canal Flow at the Sunnyside Screens, Summer 1988

Depth	Intermediate Bypass ^a			Terminal Bypass ^b		
	X	Y	Z	X	Y	Z
0.1	0.38	0.99	0.02	0.25	4.28	0.12
0.3	0.17	2.45	-0.03	0.21	3.74	0.71
0.5	0.19	2.10	-0.01	0.18	6.25	1.19
0.7	0.07	3.27	-0.03	0.05	5.75	1.42
0.9	0.21	3.03	-0.04	0.00	5.75	1.42

a Intermediate bypass measured 14.0 ft deep; therefore, cross-sectional area is 28 ft².

b Depth at measurement point was 10.5 ft because of approach ramp on the bottom. Cross-sectional area of terminal bypass is 21 ft².

TABLE 6. Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements in the Separation Chamber at the Sunnyside Screens, Summer 1988

Transect	Position	0.2 Depth			0.8 Depth		
		X	Y	Z	X	Y	Z
Upper ^a	1 ^b	0.73	2.37	-0.61	-0.52	2.60	1.40
	2	0.59	1.26	-0.12	-0.37	3.12	0.85
	3	0.80	1.51	-0.32	-0.54	2.28	0.07
	4	0.88	3.72	-0.65	-0.77	1.88	-0.25
	5	0.55	6.10	-0.59	-0.14	1.72	-0.45
	6	0.69	7.15	-0.62	0.33	4.77	-1.21
	7	0.76	7.60	-0.44	0.37	4.70	-1.16
Screen 1	1	0.98	2.12	-0.61	-0.56	0.10	0.69
	2	0.83	2.06	-0.38	-0.88	0.27	0.13
	3	0.77	2.76	-0.40	-0.72	0.27	-0.02
	4	0.94	4.15	-0.23	-0.44	1.78	-0.70
	5	0.78	3.96	-0.61	-0.16	1.73	-0.65
Screen 2	1	0.85	3.09	-0.44	0.40	0.54	-0.13
	2	0.98	3.82	0.07	0.44	1.43	-0.48

a Upper transect is 3 ft upstream of the upstream edge of traveling screen 1. Screen transects are at the centerline of the designated screen.

b Position is distance (feet) from the wall opposite the traveling screens. Last position of each screen transect merges with the centerline measurement (Position 5) at the traveling screen face in Table 7.

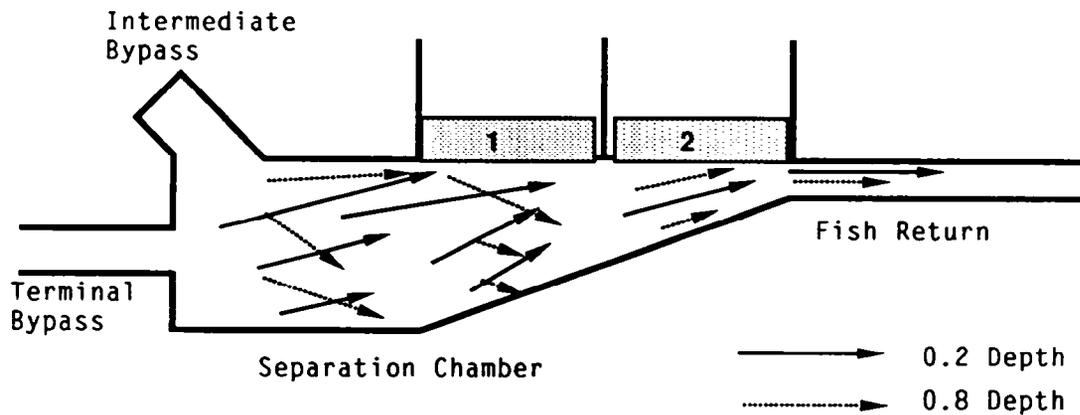


FIGURE 13. Flow Patterns in the Sunnyside Screens Separation Chamber as Described by Velocity Data and Visual Observations of the Water Surface

TABLE 7. Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements at the Face of the Traveling Belt Screens and in the Fish Return at the Sunnyside Screens, Summer 1988

Screen ^a	Position ^b	0.2 Depth			0.8 Depth		
		X	Y	Z	X	Y	Z
1	1	0.29	6.17	-0.13	-0.49	4.37	-1.23
	2	0.43	5.73	-0.31	-0.68	4.16	-0.91
	3	1.05 ^c	6.24	0.05	0.11	1.93	-0.59
	4	0.97 ^c	5.84	0.11	0.17	1.61	-0.72
	5	0.80 ^c	5.93	0.18	0.20	2.14	-0.44
	6	0.79 ^c	5.07	-0.03	-0.16	1.94	-0.59
	7	0.85 ^c	5.27	-0.14	1.23 ^c	2.60	-0.50
	8	0.91 ^c	4.83	-0.09	1.75 ^c	1.68 ^d	-0.63
	9	0.88 ^c	3.88	-0.26	1.25 ^c	1.46 ^d	-0.54
2	1	0.58 ^c	4.41	-0.07	0.20	1.50	-1.08
	2	0.94 ^c	3.72	-0.16	0.26	1.62	-0.87
	3	0.69 ^c	4.07	-0.87	0.07	1.39	-0.77
	4	0.85 ^c	3.61	0.20	0.47	0.90	-0.92
	5	0.90 ^c	4.14	-0.21	0.08	0.77	-0.41
	6	0.71 ^c	4.00	-0.37	0.00	1.25	-0.36
	7	0.69 ^c	4.00	-0.11	0.52	1.24	-0.61
	8	0.68 ^c	4.13	-0.17	0.54	1.67	-0.58
	9	0.75 ^c	3.72	-0.42	0.60 ^c	1.57	-0.57
Fish Return ^e		0.05	4.15	-0.44	0.01	2.28	0.14

- a Screen 1 is the upstream screen; Screen 2 is nearest the fish return.
b Position is shown as feet from the upstream edge of the screen (position 5 is the centerline).
c Approach velocity exceeds design specification (0.5 fps) by >10%.
d Sweep-to-approach Ratio is less than design specifications by >10%.
e Fish return cross-sectional area is 16.67 ft².

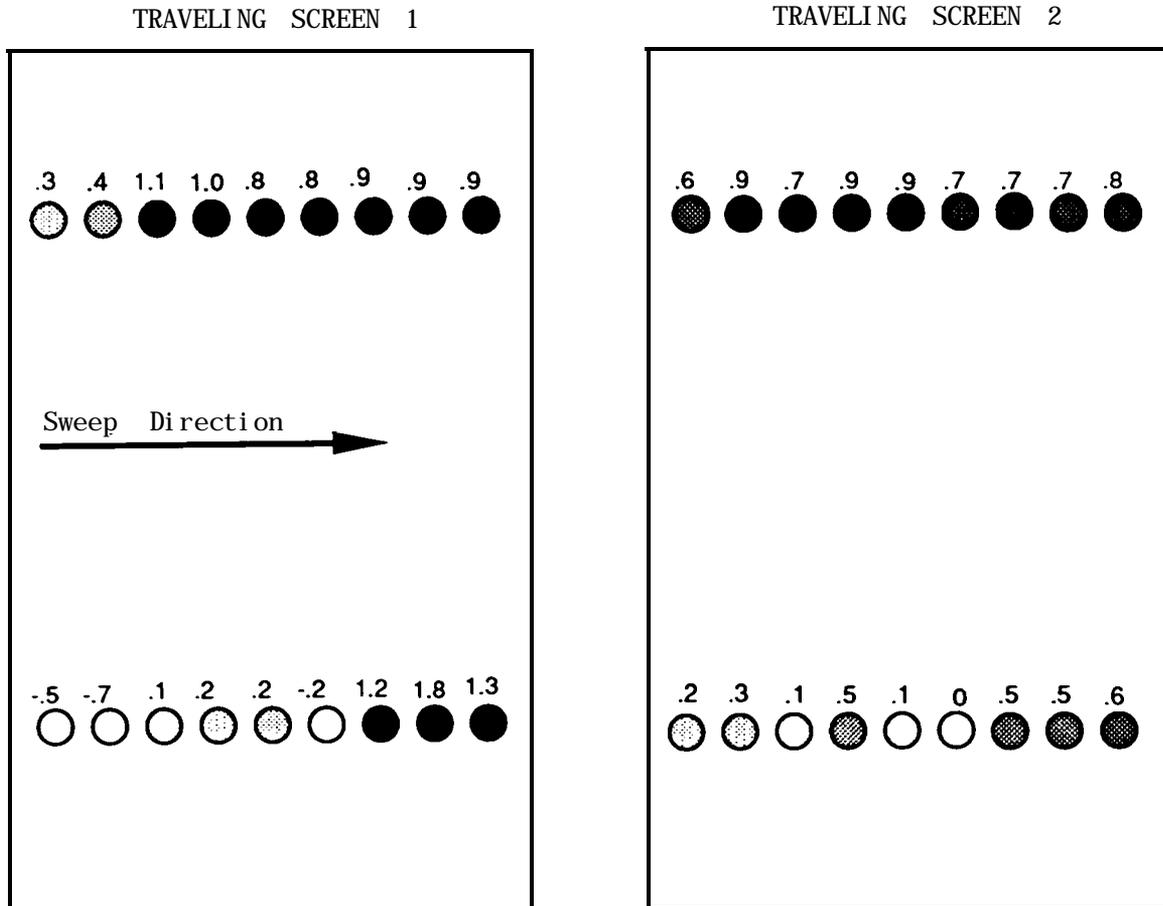


FIGURE 14. Approach (Impingement) Velocity at the Face of the Traveling Belt Screens in the Sunnyside Screens Separation Chamber

lower in the downstream end of the facility. No measurements were taken in the fish bypass system during 65% canal flow.

Discharge through the three bypasses was not balanced (Table 10). Sweep velocities indicated that almost half of the bypass flow may enter the separation chamber via the terminal bypass. Sweep velocities were similar between the two intermediate bypasses (bypass 1 and 2).

Sweep velocities were not uniform in the upstream end of the separation chamber (Table 11). Negative sweep velocity occurred at the 0.2 depth (Figure 15), causing an accumulation of floating debris in the head of the separation chamber. High vertical velocities were also observed in the transect upstream of the traveling belt screens. Sweep velocity was more uniform in front of the traveling screens, however.

Approach velocities taken in front of each of the traveling screens indicated that most of the water discharged through traveling screen 2, and approach velocity exceeded 0.5 fps by more than 10% at the 0.8 depth (Table 12; Figure 16). After we completed our measurement series, we visually inspected the spill gates (gates 5 and 6) behind the two traveling screens and found that most of the spill was over Gate 6, the gate controlling discharge through traveling screen 2. Additionally, abnormal sweep velocities (>6 fps) occurred at the 0.8 depth in front of traveling

TABLE-8. Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements in Front of the Drum Screens During Peak Canal Flow at the Wapato Screens, Summer 1988

Screen Number	Quadrant	0.05 Depth			0.2 Depth			0.5 Depth			0.8 Depth			0.8a Depth			0.9 Depth		
		X ^a	Y	Z	x	Y	z	x	Y	z	-x	Y	z	x	Y	z	x	Y	z
2 ^b	Center				0.56 ^c	1.79	-0.20				0.41	2.69	. ^e						
3	Center				0.56 ^c	1.98	-0.05				0.43	3.43	-. ^e						
4	Center	0.59 ^c	1.93	-0.19	0.59 ^c	4.40	-0.19				0.44	4.40	-. ^e						
5	Upper	0.41	1.69	0.02	0.61 ^c	1.96	0.16	0.62 ^c	2.12	-0.39	0.55	4.44	. ^e	0.75 ^c	2.01	-0.39	0.73 ^c	1.12 ^d	0.12
5	Center	0.37	1.65	0.12	0.63 ^c	1.92	-. ^e	0.40	2.08	0.05	0.48	4.49	-. ^e	0.64 ^c	1.83	0.01	0.90 ^c	1.92	0.02
5	Lower	0.42	1.52	0.04	0.55 ^c	1.91	0.07	0.51	1.76	-0.03	0.47	4.23	-. ^e	0.67 ^c	1.76	-0.03	0.87 ^c	1.52 ^d	0.01
6	Upper	0.54	1.62	0.16	0.59 ^c	1.69	-0.29	0.79 ^c	1.24 ^d	-0.63	1.31 ^c	0.65 ^d	0.06	1.18 ^c	1.08 ^d	-0.46	1.38 ^c	0.744	-0.07
6	Center	0.34	1.76	0.20	0.60 ^c	1.52	-0.32	0.47	1.59	-0.36	0.81 ^c	1.07 ^d	0.25	0.81 ^c	1.60	-0.17	0.95 ^c	1.66 ^d	-0.15
6	Lower	0.37	1.67	0.30	0.60 ^c	1.54	-0.38	0.50	1.56	-0.33	0.46	0.96	-0.05	0.70 ^c	1.68	-0.04	0.77 ^c	1.64	0.01
7	Center				0.68 ^c	1.68	-0.43				0.55	2.51	-0.01						
8	Center				0.59 ^c	1.54	-0.25				0.55	2.15	-0.02						
10	Upper	0.45	1.95	0.38	0.69 ^c	1.84	0.35	0.67 ^c	1.91	-0.22	0.47	2.01	-0.01	0.82 ^c	1.99	-0.07	0.94 ^c	2.03	0.03
10	Center	0.29	1.85	0.22	0.63 ^c	1.74	0.36	0.63 ^c	1.72	-0.27	0.46	1.75	0.01	0.64 ^c	1.98	0.05	0.65 ^c	1.77	0.23
10	Lower	0.38	1.86	0.23	0.60 ^c	1.55	-0.46	0.58 ^c	1.53	-0.15	0.44	2.06	-0.02	0.63 ^c	1.04	0.03	0.59 ^c	1.57	0.13
11	Upper	0.47	1.40	0.08	0.61 ^c	1.49	0.14	0.70 ^c	1.58	-0.30	0.45	1.27	0.04	0.84 ^c	1.19 ^d	0.19	0.91 ^c	0.99 ^d	-0.20
11	Center	0.34	1.24	0.01	0.59 ^c	1.72	0.22	0.50	1.65	0.18	. ^e	2.75	0.07	0.64 ^c	1.07 ^d	0.16	0.62 ^c	1.25	-0.07
11	Lower	0.29	1.39	-0.09	0.53	1.68	-0.12	0.57 ^c	1.74	0.00	0.21	2.56	0.05	0.60 ^c	1.52	-0.13	0.75 ^c	1.11 ^d	-0.14
12	Center				0.54	1.67	-0.39				0.47	1.40	0.03						
13	Center				0.53	1.44	-0.25				0.48	1.35	0.02						
14	Center				0.58 ^c	0.98 ^d	-0.43				0.50	0.78 ^d	0.05						
15	Upper	0.59 ^c	-. ^e	-0.41	0.70 ^c	1.34	0.47	0.69 ^c	1.84	0.46	0.64 ^c	1.00 ^d	0.05	1.21 ^c	0.304	0.31	0.76 ^c	1.02 ^d	0.10
15	Center	0.44	-. ^e	0.44	0.56 ^c	1.19	0.31	0.42	1.29	0.24	0.62 ^c	0.98 ^d	-0.01	1.04 ^c	0.43 ^d	0.11	0.83 ^c	0.89 ^d	0.00
15	Lower	0.66 ^c	-. ^e	-0.40	0.54	1.06	-0.02	0.55	1.15	0.48	0.66 ^c	1.29	-0.05	0.82 ^c	0.56 ^d	0.02	0.84 ^c	0.82 ^d	. ^e

27

^a Agreement between two approach velocity measurements indicates possible instrument malfunction. The highest approach reading is presented in the table.
^b Screen 1 was not operating. Screen 2 is at the upstream end of the screening facility. Screen 5 is upstream of and inside the first intermediate bypass wing wall. Screen 9 was not operating. Screen 10 is upstream and inside of the second intermediate bypass wing wall. Screen 15 is nearest the terminal bypass.
^c Approach velocity exceeds design specification (0.5 fps) by >10%.
^d Sweep-to-approach ratio is less than design specification by >10%.
^e Abnormal readings: data rejected.

TABLE 9. Summary of Approach (X) and Sweep (Y) Velocity (fps) Measurements in Front of the Rotary Drum Screens During Moderate Canal Flow at the Wapato Screens. Summer 1988

Screen	Quadrant	0.2 Depth		0.8 Depth	
		X	Y	X	Y
2 ^a	Center	0.42	1.34	0.60 ^b	1.45
3	Center	0.84 ^b	1.64	1.15 ^b	1.86 ^c
4	Center	0.41	1.61	0.50	1.50
5	Center	0.45	1.61	0.47	1.70
6	Center	0.45	1.27	0.68 ^b	1.13 ^c
7	Center	0.44	1.36	0.58 ^b	1.47
8	Center	0.41	1.41	0.50	1.40
9					
10	Center	0.37	1.55	0.47	1.26
11	Center	0.27	1.22	0.54	1.00
12	Center	0.32	1.38	0.43	1.15
13	Center	0.35	1.16	0.47	1.06
14	Center	0.30	1.19	0.52	1.02
15	Center	0.43	1.03	0.58 ^b	0.92 ^c

a Screens 1 and 9 were not operating. Screen 2 is at the upstream end of the facility.

b Approach velocity exceeds design specifications (0.5 fps) by >10%.

c Sweep-to-approach ratio is less than design specifications by >10%.

TABLE 10. Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements at the Entrance to the Fish Bypasses at the Wapato Screens, Summer 1988

Fish Bypass	0.2 Depth			0.8 Depth		
	X	Y	Z	X	Y	Z
Intermediate Bypass 1 ^a	0.16	1.61	0.14	-0.79	1.68	0.04
Intermediate Bypass 2	0.17	1.74	-0.13	0.77	0.95	0.03
Terminal Bypass 3	0.77	3.59	-0.26	0.27	2.17	-0.34

a Cross-sectional area of each fish bypass at the entrance was 21.67 ft².

TABLE 11. Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity (fps) Measurements in the Separation Chamber and Fish Return at the Wapato Screens, Summer 1988

Transect	Position	0.2 Depth			0.8 Depth		
		X	Y	Z	X	Y	Z
Upper ^a	Outer ^b	0.57	-1.23	1.37	0.01	0.86	- ^c
	Center	0.56	-1.66	1.13	-0.19	1.57	.
	Inner	0.66	1.51	0.67	-0.59	1.51	.
Screen 1	Outer	-0.66	1.48	0.48	-0.35	2.26	-0.25
	Center	-0.45	0.75	-0.57	-0.26	2.30	-0.10
Screen 2	Center	0.22	1.55	-0.21	0.42	6.38	.
Fish Return	1 ^c	0.06	2.02	-0.14	-0.13	6.61	0.01
	2	0.28	2.31	-0.11	0.00	2.33	0.01

- a Upper transect was 9.75 ft downstream of the head end of the separation chamber. Screen transects were at the centerline of the respective screens.
- b Outer position was 2 ft from the outer wall. Center position was midway between the outer wall and the face of the traveling screens. Inner position was 2 ft from the wall adjacent to and upstream of the traveling screens.
- c Position 1 and 2 were 6 and 27 ft. respectively, downstream of the entrance to the fish return. Cross-sectional area of fish return was 16.67 ft².

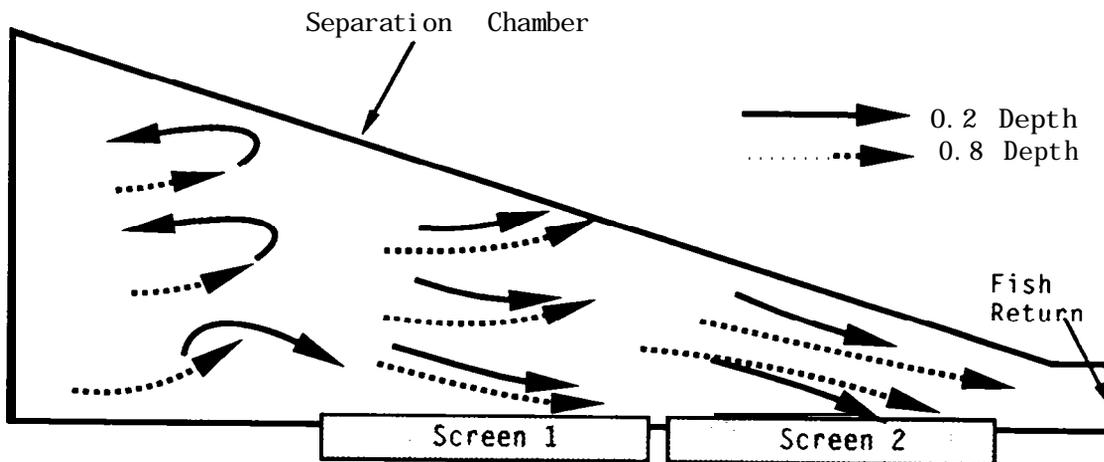


FIGURE 15. Flow Patterns in the Wapato Screens Separation Chamber as Described by Velocity Data and Visual Observations of the Water Surface

TABLE 12. Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity Measurements (fps) at the Face of the Traveling Belt Screens at the Wapato Screens, Summer 1988

Screen ^a	Position ^b	0.3 Depth			0.8 Depth		
		X	Y	Z	X	Y	Z
1	Upper	0.35	2.27	-0.11	0.32	2.04	-0.42
	Center	0.30	2.12	0.79	0.39	2.29	-0.39
	Lower	-0.03	1.86	0.35	0.25	1.25	-0.43
2	Upper	0.71 ^c	1.82	0.26	1.22 ^c	5.83	0.02
	Center	0.60 ^c	1.67	0.23	0.92 ^c	6.27	- ^d
	Lower	0.53	1.31	- ^d	0.64 ^c	6.27	- ^d

- a Screen 1 is the upstream screen. Screen 2 is nearer the fish return.
b Upper position is 2 ft from the upstream edge of the traveling screen: center is at the screen centerline: lower is 2 ft from the lower edge of the screen.
c Approach velocity exceeds design specification by >10%.
d Instrument/probe failure. No data.

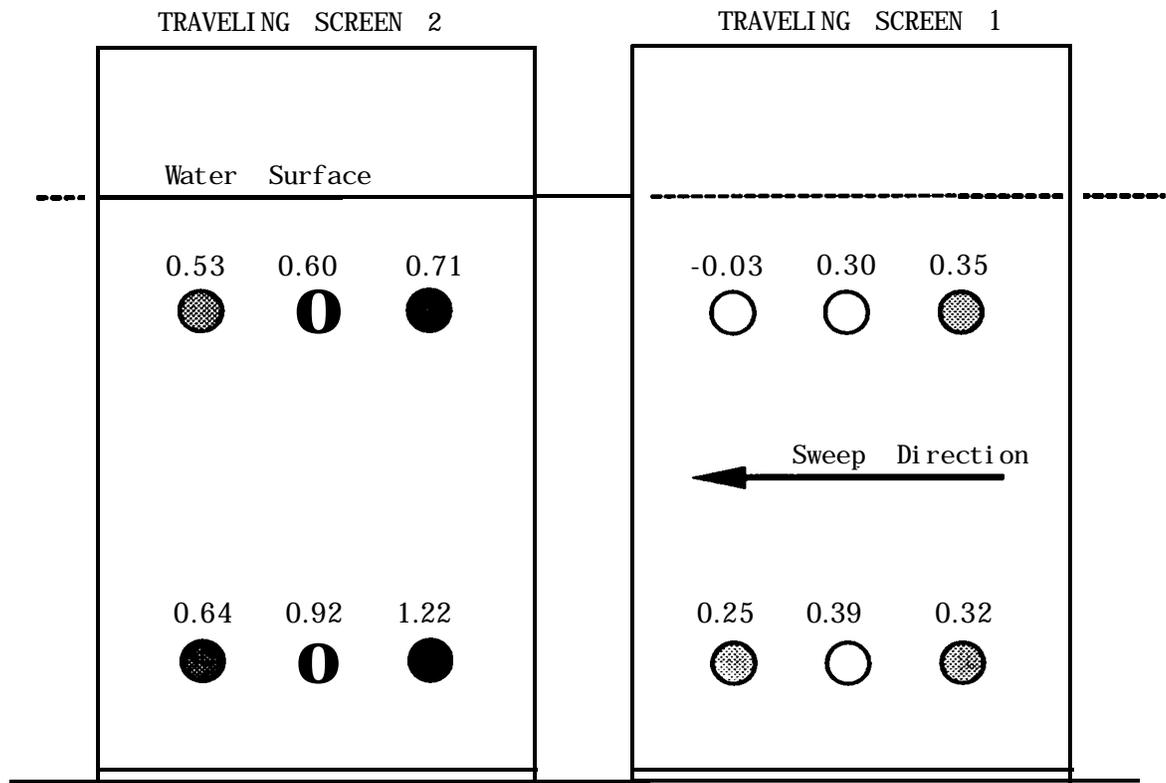


FIGURE 16. Approach (Impingement) Velocity at the Face of the Traveling Belt Screens in the Wapato Screens Separation Chamber

screen 2 that continued into the head end of the fish return (Table 12). A second set of measurements taken about 28 ft from the head end of the fish return showed that sweep velocities were nearly equal at 0.2 and 0.8 depths.

ROZA SCREENS

Approach velocities at the Roza Screens exceeded 0.5 fps by more than 10% at 5 of 6 screens measured in the first bay (Table 13). Sweep velocities varied with measurement locations and depth. Sweep velocities gradually decreased from the upstream to the downstream end of the screen forebay; however, the approach velocity remained relatively constant. The sweep-to-approach ratio was less than 2:1 throughout most of the screen bay, especially at the 0.8, 0.8a, and 0.9 depths.

Bypass flow appeared to be well balanced, drawing water equally from 0.2 and 0.8 depths. Instrument failure occurred during the course of our measurements in front of screens 6 and 7 and in the fish bypass resulting in the loss of some data. Apparent increases in vertical velocity in the lower end of the screen bay may have been caused by instrument failure.

Data collection in the separation chamber was limited to sweep and approach velocity measurements because of time constraints and instrument problems. Sweep velocities were not uniform across the upstream end of the separation chamber (Table 14; Figure 17). Sweep velocity as low as 0.3 fps occurred at the 0.2 depth near the center of the separation chamber, and sweep velocities at the 0.8 depth were about twice that at the 0.2 depth.

Approach velocities through traveling screens 1 and 3 was generally greater than 0.5 fps, and the sweep-to-approach ratio was often less than 2:1 (Table 15). Discharge through the traveling screens appeared to be well balanced, based on average approach velocities for the two measured screens (Figure 18). Flow in the fish return was balanced with equal sweep velocity at the 0.2 and 0.8 depths (Table 14).

TABLE 13. Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity Measurements (fps) During Peak Canal Flow in Front of the Drum Screens and in the Fish Bypass in the First Bay at the Roza Screens, Summer 1988

Screen Number	0.05 Depth			0.2 Depth			0.5 Depth			0.8 Depth			0.8a Depth			0.9 Depth		
	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
1 ^a				0.65 ^b	1.57	-0.29				1.06 ^b	1.60 ^c	-0.59						
2				0.57 ^b	1.26	-0.34				0.67 ^b	1.02 ^c	-0.33						
3																		
4				0.57 ^b	0.94 ^c	-0.22				0.63 ^b	0.93 ^c	-0.28						
5				0.26	1.11	-0.25				0.55 ^b	1.02	-0.32						
6	0.44	1.20	. ^d	0.39	1.14	. ^d	0.34	0.86	0.67	0.59 ^b	0.97 ^c	0.58	0.57 ^b	1.02	. ^d	0.71 ^b	1.26	. ^d
7	0.46	1.12	. ^d	0.33	0.91	0.44	0.41	0.91	0.50	0.52	0.84 ^c	0.46	0.54	0.89 ^c	. ^d	0.58 ^b	0.92 ^c	. ^d
Fish Return ^e				0.22	2.79	. ^d				0.15	2.42							

- ^a Screen 1 is at the upstream end of the screen bay. Screen 3 could not be sampled. Screen 7 is nearest the fish bypass.
- ^b Approach velocity exceeds design specifications (0.5 fps) by >10%.
- ^c Sweep-to-approach ratio is less than design specifications by >10%.
- ^d Instrument malfunction. Data rejected.
- ^e Cross-sectional area of fish bypass was 25 ft².

TABLE 14 Summary of Approach (X), Sweep (Y), and Vertical (Z) velocity Measurements (fps) in the Separation Chamber and Fish Return at the Roza Screens, Summer 1988

Transect	Position	0.2 Depth			0.8 Depth		
		X	Y	Z	X	Y	Z
Screen 1 ^a	1 ^b	0.66	1.05	- ^c	0.31	2.11	- ^c
	2	0.39	0.30	-	0.30	1.66	-
	3	0.44	0.27	-	0.34	3.10	-
	4	0.37	0.61	-	0.24	2.61	-
Screen 3	1	0.43	1.14	-	0.54	1.39	-
	3	0.54	1.39	-	0.50	1.72	-
Return ^d	Center	0.06	3.44	-	0.11	3.51	-

- a Screen 1 and Screen 3 transects were at the centerline of the corresponding traveling screens.
- b Position 1 was 1 ft from outer wall. Position 3 was the centerline of the separation chamber. Positions 2 and 4 in the Screen 1 transect were 4.3 and 11 ft from the outer wall, respectively.
- c Instrument failure; no data collected.
- d Measurements taken 6 ft downstream of entrance to fish return. Cross-sectional area of fish return was 12 ft².

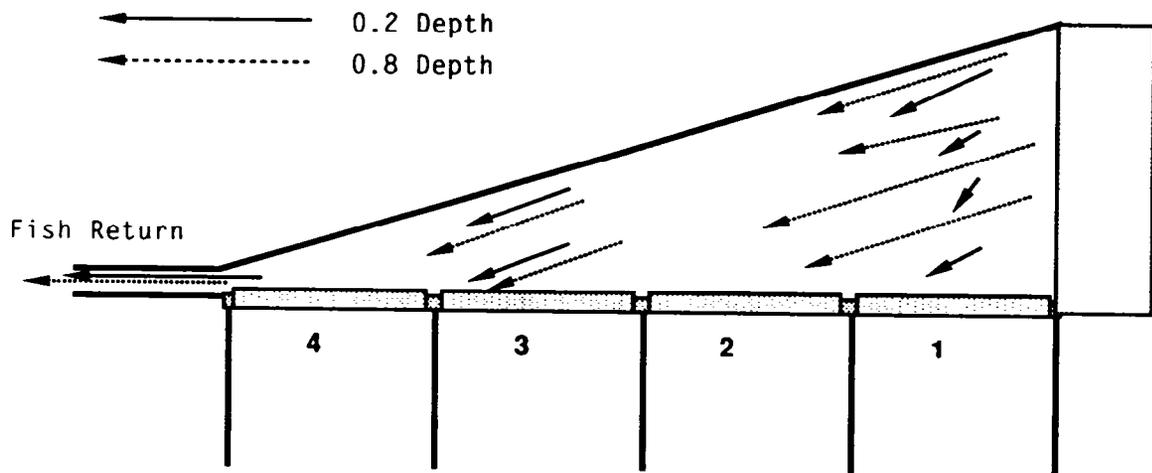


FIGURE 17 Flow Patterns in the Roza Screens Separation Chamber as Described by Velocity Data and Visual Observations of the Water Surface

TABLE 15. Summary of Approach (X), Sweep (Y), and Vertical (Z) Velocity Measurements (fps) at the Face of the Traveling Belt Screens at the Roza Screens, Summer 1988

Screen ^a	Position ^b	0.2 Depth			0.8 Depth		
		X	Y	Z	X	Y	Z
1	Upper	0.62 ^c	1.41	- ^e	0.48	3.56	- ^e
	Center	0.76 ^c	0.96 ^d	-	0.58 ^c	3.42	-
	Lower	0.63 ^c	1.04 ^d	-	0.78 ^c	2.42	-
3	Upper	0.66 ^c	1.27	-	0.30	2.06	-
	Center	0.67 ^c	1.47	-	0.69 ^c	1.96	-
	Lower	0.76 ^c	1.25 ^d	-	0.47	1.87	-

a Screen 1 is the upstream screen: Screen 3 is nearer the fish return.

b Upper position is 3 ft from the upstream edge of the traveling screen: center is at the screen centerline: lower is 3 ft from the lower edge of the screen.

c Approach velocity exceeds design specification (0.5 fps) by >10%.

d Sweep-to-approach ratio is less than design specifications by >10%.

e Instrument failure. No data.

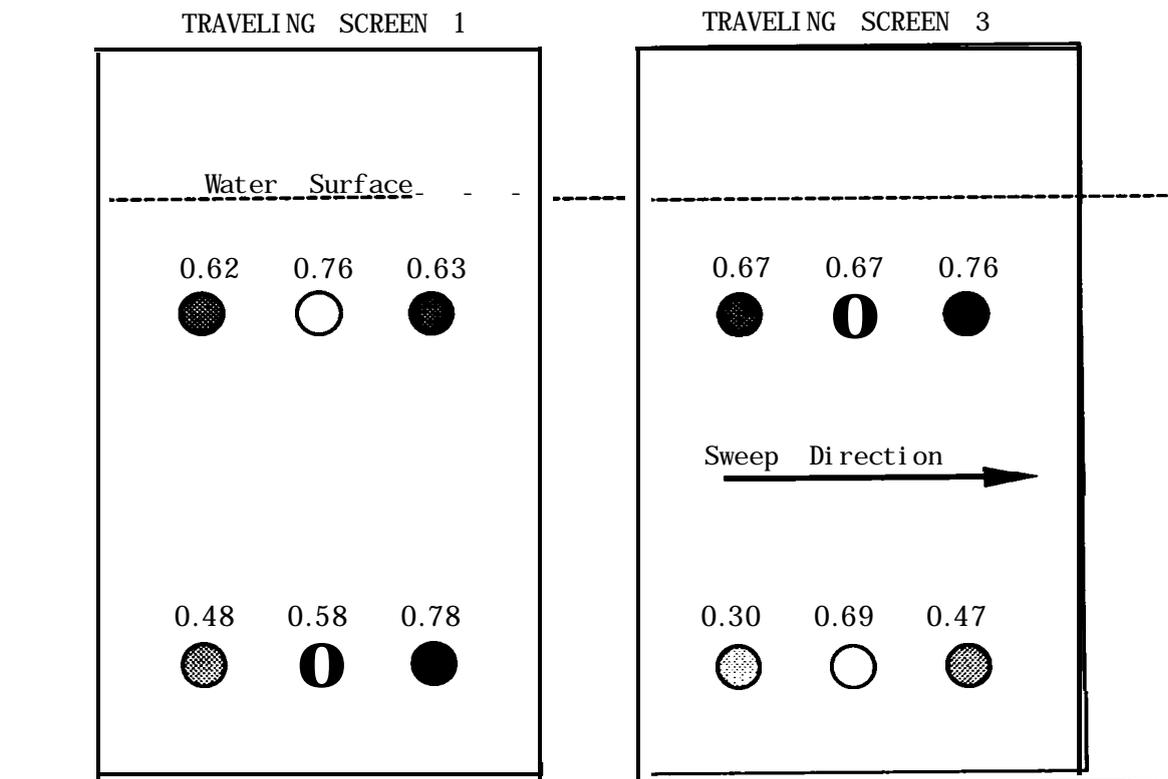


FIGURE 18. Approach (Impingement) velocity at the Face of the Traveling Belt Screens in the Roza Screens Separation Chamber

DISCUSSION

This study was conducted to determine if water velocities and patterns within fish screening facilities met design specifications and were conducive to effective fish bypass. Measurements were taken to determine if: 1) approach (impingement) velocities were 10.5 fps in front of the drum screens and vertical traveling screens; 2) sweep velocities were adequate to guide fish toward the fish return and maintain a sweep-to-approach velocity ratio of 2:1; 3) discharges through components of fish bypass systems were adequate and balanced when set to operating criteria specifications; and 4) site-specific structures and/or operations altered flow patterns that could affect bypass efficiency. Velocity studies were conducted at six screening facilities, ranging from small canals with simple fish return pipes and flows as low as 50 cfs to large canals with flows up to 2000 cfs and complex bypass systems that include guidance walls, fish bypass pipes, vertical traveling screens, and pumpback systems.

SWEEP AND APPROACH VELOCITY IN FRONT OF THE ROTARY DRUM SCREENS

Sweep velocities indicate downstream movement, or movement parallel to the screen face and in the direction of the fish return. Several structural features of the screen forebays appear to affect sweep velocity. Inadequate or unbalanced sweep velocity can affect the sweep-to-approach ratio and provide habitats where either downstream migrant salmonids or their predators could congregate.

Approach velocities indicate lateral movement, or movement that is perpendicular to the screen face (impingement). Structural features that decrease sweep velocity usually cause an increase in approach velocity as well, which can result in a poor sweep-to-approach velocity ratio.

Fisheries evaluations at existing screen sites in the Yakima River Basin have demonstrated that fish are effectively bypassed without significant injuries or delays (Neitzel et al. 1985, 1986, 1987). However, approach velocity measurements offer the best source of data for identifying potential trouble spots at screening facilities and evaluating whether a screening facility meets the specified velocity criteria. Attempts to improve sweep and approach velocity conditions in identified problem areas should be considered in the design of future screen facilities.

Forebay Configuration

In all the screening facilities we evaluated, except the Roza Screens, the new screen sites have been installed in an existing canal channel. Generally, the screen forebays are wider than the canal to accommodate the large number of screens used in the angled screen design. The new screening facilities link up to the existing canal behind the screens, forming a dogleg in the canal with the screens on the inside of the bend. Sweep velocities are consistently lower in front of the screen at the head end of each facility (Screen 1), resulting in a lower sweep-to-approach ratio. At the Roza Screens, five bays of screens with five to seven screens per bay are constructed in a saw-tooth arrangement, with the front of the screens facing upstream. The sweep velocity is higher in front of Screen 1 than subsequent screens, because the screens are located on the outer bend of the dogleg. After the canal flow is "bent" to run parallel to the screen faces, sweep velocity becomes more stable.

Approach velocities are generally slightly higher in front of the screen at the head end of a facility (Screen 1), again as a result of canal flows that have not fully stabilized. However, an abnormally low approach velocity is possible, as in the case of the Sunnyside Screens, where screens 1 and 2 have been stoplogged shut because negative approach velocities were observed in 1985. The combination of low sweep velocity and high approach velocity can result in poor sweep-to-approach ratios. At Westside Ditch and Richland Canal, approach velocity can equal or exceed sweep velocity in front of Screen 1. At Columbia Canal and Roza Canal, the convergence of sweep and approach velocity is slight. No measurements were taken in front of the first screen at Wapato Canal because it was not in operation.

Drum Screens

The standard hydraulic measurements for evaluating velocity in a channel are taken at 0.2 and 0.8 of the water depth. The curved surface of a drum screen dictates how close the sensors can be positioned relative to the screen face. Because screens are not fully submerged during normal operation, the 0.2 depth is just above the centerline of the screen, and consequently the probe can be positioned close to the screen face. However, the 0.8 depth is well below the centerline of the drum screen, and the probe can be as far as 30 in. from the screen face at facilities with large screen diameters, such as the Roza Screens.

Based on comparisons of measurements at each site, sweep and approach velocities at the 0.2 depth are often similar, although not identical, to those at the 0.8 depth. Sweep velocity at the 0.8 depth is higher than at the 0.2 depth at the Sunnyside and Wapato screens and lower at the Westside Screens, and approach velocity at the 0.8 depth is higher than at the 0.2 depth at the Westside and Columbia screens and lower at the Richland Screens.

Additional measurements were taken at 0.05, 0.5, 0.8, and 0.9 depths (probes positioned near the screen face) at the Richland, Wapato, and Roza screens to evaluate if values obtained from the standard hydraulic measurements at 0.2 and 0.8 depths accurately describe conditions near the screen face and to verify velocity conditions under the curvature of the screens. Values at 0.05 and 0.5 depths are similar to and thus represented by the standard measurements; however, data collected near the screen face under the curvature of the screen (0.8a and 0.9 depth measurements) shows that velocity values may differ significantly from values obtained at 0.8 depth.

Sweep and approach velocity values may be affected by the position of the screen in relation to the forebay floor. The screens in the Richland Canal are set on top of a 12-in.-high sill. Sweep velocities are similar at 0.8 and 0.8a depths, but are higher at 0.9 depth. The higher sweep velocity at 0.9 depth may be the result of the open channel below the screens where friction along the screen face and the forebay floor and screen wall foundations does not hinder sweep velocity. Approach velocity under the curvature of the screens is similar to the 0.8 depth value, except at the upper end of Screen 1. However, approach velocity is higher in the upper quadrant of each screen than at the center or lower quadrant, indicating that the concrete walls between screen bays affect approach velocity.

The screens at Wapato Canal are mounted on a 6-in.-high bottom seal, or

nearly flush with the forebay floor. Sweep velocities at 0.8a and 0.9 depths are generally lower than at 0.8 depth. The lower sweep velocity under the curvature of the drum may be the result of friction on the screen face and forebay floor or may be a function of screen bay wall foundations in the narrow channel under the screens. Approach velocity at 0.8 and 0.9 depths is greater than at 0.8 depth and usually exceeds design specifications. However, the additional measurements at 0.8a and 0.9 depths were taken only on screens near wing walls and fish bypasses and not along the entire length of the screening facility.

The screens at Roza Canal are set 2 ft below the level of the forebay floor, which is contoured to the shape of the screen, sloping downward at the perimeter of the screens, then leveling off under the screens. Sweep velocity at 0.8 and 0.8a depths are nearly equal, and values at 0.9 depth are somewhat higher. However, approach velocity under the curvature of the drum screen is greater than at 0.8 depth and exceeds design criteria. Measurements at 0.8a and 0.9 depths were taken only at screens 6 and 7 (near the fish bypass) and not along the entire length of the screening facility.

Fish Bypass Entrances and Wing Walls

Larger screening facilities, such as the Sunnyside and Wapato screens, incorporate intermediate bypasses and wing walls to prevent fish from contacting the entire array of screens during guidance to the fish bypass. Our measurements show that wing walls dramatically disrupt sweep velocity, especially in front of the screen immediately downstream of the wing wall. At the Sunnyside Screens, sweep velocity is reversed or reduced in front of Screen 9, depending on the depth; however, approach velocities are not affected. Additionally, flow appears to be bottlenecked because of the wing wall and intermediate bypass, as demonstrated by reduced sweep velocities in front of Screen 8 (above and inside the wing wall). At the Wapato Screens, sweep and approach velocity are altered below each of the intermediate bypasses, resulting in poor sweep-to-approach ratios and approach velocities that exceed design specifications. However, flows do not appear to bottleneck inside the wing walls at the Wapato Screens as was observed at the Sunnyside Screens.

The angle and/or length of the wing wall may be a factor affecting wing wall performance. The wing walls at Wapato are longer than at the Sunnyside Screens. Disruption of the sweep velocity is only momentary at both sites; sweep velocity returns to normal within one screen length.

SWEEP AND APPROACH VELOCITY IN THE FISH BYPASS SYSTEM

Adequate bypass flows are essential to guide fish into and through the fish bypass system. Balanced flow through various components of the bypass system ensures favorable bypass conditions for fish. In facilities with multiple fish bypasses, more flow is required to achieve adequate sweep velocity through each fish bypass than is necessary to provide effective bypass through the fish return pipe. Excess bypass flow can be utilized for irrigation by the use of pumpback systems that withdraw water through traveling screens in the separation chamber.

Approach and sweep velocity parameters are just as important in front of traveling belt screens as in front of rotary drum screens. An approach velocity of >0.5 fps at the face of the traveling screens can result in

impingement. Sweep velocities are important for maintaining an adequate sweep-to-approach ratio for guiding fish to the fish return pipe. Areas within the separation chamber with low sweep velocities can provide habitat for predators.

Fish Bypasses

Based on sweep velocity measurements taken at the upstream end of fish bypasses, discharge through intermediate bypasses is less than discharge through the terminal bypass at the Sunnyside and Wapato screens, although flow control gates were set to the operating criteria specifications at both sites during our studies. The unbalanced discharge may be the result of greater resistance in intermediate bypass pipes than was observed in models used in facility design. Unbalanced bypass discharges may affect flow patterns and fish passage efficiency in the separation chamber. An adjustment to the flow control gate settings listed in the operating criteria may correct the problem. However, no apparent problem exists with respect to passage through bypass pipes. No injuries or other adverse effects were observed to be caused by passage through intermediate or terminal bypasses during fisheries evaluations at the Sunnyside and Wapato screens (Neitzel et al. 1985, 1987).

Separation Chamber

Measurements across the width of the separation chamber indicate that sweep velocity is not uniform and may be dependent on the location and orientation of, and volume of discharge through, components of the fish bypass system. Extreme variations in sweep velocity occur (from -1.6 to >7.0 fps). This suggests that areas exist within the separation chamber where fish, either predators or prey, could reside. Sweep velocity also varies in relation to depth. Sweep velocity is consistently lower at 0.8 of water depth in the Sunnyside Screens separation chamber, and at 0.2 of water depth in the Wapato and Roza screens separation chambers. The sweep velocity patterns observed in the separation chamber are related to the depth and orientation of the fish bypasses, and can persist through the entire length of the separation chamber.

The highest sweep velocities in the separation chamber are generally near the face of the traveling screens, resulting in a high sweep-to-approach ratio. Fish that followed the dominant flow pattern during transit through the separation chamber would likely be directed near the face of the traveling screens. A uniform sweep velocity throughout the separation chamber would result in fewer fish passing directly in front of the traveling screens, and areas where potential predators could reside would be diminished.

The variation in approach velocity at the face of traveling screens suggests that water is not drawn equally through all portions of the screen, especially in front of traveling screens at the Sunnyside Screens. Turbulent flow conditions in the upstream end of the separation chamber may adversely affect approach velocity in front of the traveling screens. Unequal velocities also occur at the face of the traveling screens at the Wapato Screens, where wastewater passes over flow control gates and the pumps are not operated. The flow patterns in the separation chamber at the Roza Screens are less turbulent, and approach velocity at the face of the traveling screens is more uniform.

Fish Return

Sweep velocity in the fish return is dependent on sweep velocity parameters in the separation chamber just upstream of the entrance to the fish return. In order for the fish return to draw water equally from all depths, sweep velocities in the separation chamber must also be equal from the surface to the bottom.

SUMMARY

Velocity measurements were conducted at six fish screening facilities in the Yakima Basin: the Columbia, Richland, Westside Ditch, Sunnyside, Wapato, and Roza screens. Our objective was to determine if velocity parameters in front of the rotary drum screens and within components of the fish bypass system were consistent with design specifications necessary to promote effective fish bypass. The objective was addressed by evaluating if: 1) the approach (impingement) velocity was ≤ 0.5 fps at the face of rotary drum screens and traveling belt screens; 2) the sweep velocity in front of the screens was sufficient to provide a 2:1 sweep-to-approach velocity ratio; 3) fish bypass flows were balanced and sufficient to direct fish toward the fish return pipe; and 4) operating criteria were successful in providing effective fish passage conditions.

COLUMBIA SCREENS

Velocity measurements taken during full canal flow conditions indicated that the approach velocity slightly exceeds design specifications. Sweep-to-approach velocity ratio in front of the drum screens is adequate. Approach velocity in front of each drum screen is uniform, and stoplog configuration behind the drum screens (upper half of screen bay closed off) do not significantly alter approach velocity at the face of the drum screens. Fish return flows were adequate at peak canal flow.

RICHLAND SCREENS

The canal flow at the Richland Screens could not be determined, but appeared to be much less than the full canal flow. The approach velocity at the face of the drum screens was generally within design specifications; however, approach velocities would undoubtedly be higher at peak canal flow. Approach velocities were higher under the curvature of the drum screens at the upper end of each screen. Comparable approach velocity in front of each screen indicated canal discharge was equally distributed among the four screens. Sweep-to-approach velocity was acceptable throughout most of the facility. Excessive fish return discharge may have resulted in higher sweep velocities than could be expected when fish return discharge is set in accordance to the operating criteria. Mounting drum screens on top of a 12-in. sill may improve sweep-to-approach velocity ratios under the curvature of the drum screen.

WESTSLIDE DITCH SCREENS

Velocity measurements taken during full canal flow conditions indicated that the approach velocity and sweep-to-approach velocity ratio in front of the drum screens met design specifications. Approach velocity in front of the four screens is not uniform, indicating that stoplogging behind the screens may be necessary to balance discharge through the screens. The close proximity of the guidance wall did not affect approach velocity at the last drum screen. The low fish return flow was the result of improper stoplogging during velocity measurement preparation; however, adequate fish return flows appear to be achievable.

SUNNYSIDE SCREENS

Velocity measurements taken under nearly full canal flow conditions indicated that approach velocity slightly exceeded the design specifications. Sweep-to-approach velocity was acceptable except where disrupted by the intermediate wing wall. Approach velocity in front of each drum screen indicated that the present stoplog configuration distributes discharge evenly among the 15 operational screens. Total bypass flow was adequate; however, the flow was not equally distributed between the two fish bypasses, with less discharge through the intermediate bypass.

Sweep velocity in the separation chamber was dominated by the terminal fish bypass discharge that enters at the surface of the separation chamber. High sweep velocity occurred at the surface and near the traveling screens, and low sweep velocity occurred near the bottom and along the outer wall of the separation chamber. Approach velocity was not uniform on the face of the traveling screens with areas of each screen exceeding design specifications. Fish return flow was adequate, although more water enters the fish return from the surface than from the bottom of the separation chamber.

WAPATO SCREENS

Velocity measurements taken under full canal flow conditions indicated that approach velocity equaled or slightly exceeded the design specifications. Excessive approach velocity occurred under the curvature of the drum screens. The sweep-to-approach velocity ratio was adequate in front of most screens, but was poor at the downstream end of the facility (in front of screens 14 and 15) and under the curvature of screens immediately downstream of wing walls (screens 6 and 11). The low ratio was a result of both high approach and low sweep velocities.

At 65% of peak canal flow, approach velocities still slightly exceeded design specifications at the 0.8 depth; however, approach velocity at the 0.2 depth was proportionally lower than during peak canal flow. Sweep velocity was also proportionally lower at both depths. Stoplog configuration behind the drum screens may affect flow patterns during lower canal flow because of the accompanying lower canal surface elevation. The effect of floating net pens on velocity patterns within the screen forebay could not be determined because of the substantial difference in canal flow during our two sampling sessions.

Flow through the fish bypasses was adequate but not balanced. The sweep velocity in bypass 3 (terminal bypass) was higher than in the two intermediate bypasses. Sweep velocity in the separation chamber was not uniform. A negative sweep velocity (eddy) in the upstream end of the separation chamber provides a habitat where potential predators or downstream migrant salmonids could reside. Sweep velocity was lower at the surface than at the bottom of the separation chamber, and velocities near the bottom increased in the downstream end of the separation chamber.

Discharge through the traveling screens was not balanced. The pumps behind the traveling screens are not operated under normal conditions, and balanced discharge is achieved by visually adjusting overflow gates. Approach velocity was low in front of traveling screen 1 and high in front of traveling screen 2, although a high sweep velocity provided an adequate

sweep-to-approach ratio in front of the screens. Fish return flow was adequate, although most of the water entered the fish return near the bottom.

ROZA SCREENS

Velocity measurements taken under full canal flow conditions in the first screen bay indicated that approach velocity in front of the drum screens slightly exceeded the design specifications, and was highest in front of Screen 1. Sweep velocity throughout the forebay was low and contributed to a low sweep-to-approach ratio in front of all screens. Sweep velocity in the fish bypass indicated an adequate flow, with water drawn equally from the surface and the bottom.

Sweep velocity in the separation chamber was greater near the bottom than at the surface; however, the flow was much more uniform than we had observed in separation chambers at the other sites. Approach velocity at the face of the traveling screens was uniform, but slightly exceeded design specifications. Additionally, the sweep-to-approach ratio was lower than design specifications near the surface. Fish return flow was adequate, and water was drawn equally from the surface and the bottom.

RECOMMENDATIONS

Although fisheries evaluations conducted by PNL at four of the six sites have not identified any major design problems resulting in mortality, injury, or delay to migrating fish, these hydraulic studies indicate that velocity conditions could be improved at some of the sites through modification of operating criteria or adjustment of the existing facilities. Furthermore, these studies suggest that additional flow modeling might be required to address and resolve common velocity condition problems to provide information for the design of similar facilities in the future.

The shape and configuration of the forebay structure can result in poor velocity conditions in front of the first (upstream) screen. Canal flow should be stable and parallel to the screen structure before reaching the first screen. Sweep and approach velocity anomalies at the head end of the screen structure could be reduced if flow were more parallel and the straight-sided wall immediately upstream of the first screen were contoured similar to the walls between the screen bays. However, it would be very expensive to retrofit existing screen facilities to control flow parameters this precisely, and the potential benefit to fish is small. Reduced discharge through one screen may not be a significant problem at larger facilities; however, at smaller facilities with few screens, a reduced discharge through the first screen could result in a significant increase in discharge through other screens, affecting approach velocities and performance of other screens.

Stoplogging behind individual screens appears to be an effective method of balancing discharge among screens and reducing silt buildup in the screen bays. However, optimum stoplog configurations may be different during periods of reduced canal flow when canal surface elevations are lower. Our studies indicate that stoplogging might be necessary to balance discharge through the screens at Westside Ditch and to reduce the discharge through the first screen in the first bay at the Roza Screens. Although only one of the five bays was evaluated at Roza Screens, stoplogging may be necessary elsewhere at the facility. When stoplogs are used, a 12-in. gap is usually left at the bottom to prevent silt buildup. Increased approach velocity under the curvature of the drum screens may be the product of a high volume of water passing through the lower portions of the drum screen. Reducing the stoplog gap to the minimum required to prevent siltation might reduce the approach velocity under the curvature of the drum screens, especially during periods when canal surface elevations are low.

The most dominant structural feature affecting velocity conditions in front of the screens is the intermediate wing wall. The purpose of a wing wall, from a fisheries standpoint, is to prevent migrating fish from coming into contact with all the drum screens at a large screening facility by directing fish into an intermediate bypass. No signs of mortality, descaling, or other injury attributable to screen contact have been observed in previous fisheries evaluations. However, hydraulic studies show that wing walls can dramatically affect sweep and approach velocity in front of the drum screens, especially on the screen just downstream of the wing wall. Additionally, our data show that discharge through intermediate bypasses is less than discharge through the terminal bypass. Flow gate adjustments and modification of operating criteria are required. Hydraulic forces, such as resistance in bypass pipes or head level in the separation chamber, may make discharge balance difficult to achieve. If wing walls and intermediate bypasses do not significantly improve fish passage, fish

bypass systems could be simplified, reducing the construction and operating costs of screening facilities designed in the future.

Our studies indicate that the least desirable velocity conditions at a fish screening facility occur in the separation chamber. High approach (impingement) velocity can occur at the face of the traveling screens, and nonuniform sweep velocity can provide habitat for predators. Flow adjustment to achieve balanced discharge through intermediate and terminal bypasses may improve sweep and approach velocity parameters in the separation chamber; however, dominant flow patterns may also be altered. Velocity measurements should be repeated in separation chambers at the Sunnyside and Wapato screens if bypass discharges are significantly changed, to determine how bypass discharges affect conditions in the separation chamber. Additionally, discharge should be balanced through the two traveling screens at the Wapato Screens. Gauges should be installed on flow gates 5 and 6 (behind the traveling screens) to aid operations personnel in maintaining a balanced discharge between the two traveling belt screens.

Our measurements in the first bay at the Roza Screens indicate that stoplogging may be required at the first screen in that bay; however, the other four bays were not evaluated. If stoplogging is under consideration at the Roza Screens, measurements should be taken in the other bays to determine where stoplogs are needed. Additionally, all five fish bypasses should be measured to check for balanced discharges.

Velocity measurements made during complete surveys indicate that many of the measurements taken were not necessary. Vertical velocity measurements had little utility except during measurements in the separation chamber. Measurements in front of the drum screens at 0.05 and 0.5 depths did not provide any unique information, and should be dropped in future velocity monitoring studies. Velocity measurements under the curvature of the drum screen are often different from velocity measurements obtained using the standard 0.8 depth measurement that is not near the drum screen face, and provide a more accurate estimate of impingement velocity at the screen face. In most instances, velocity measurements at the 0.9 water depth were comparable to measurements at the 0.8a water location. Therefore, the 0.9 depth measurement could also be abandoned in future monitoring programs. However, velocity measurements at the 0.8a location provide valuable information and should be considered as a replacement for or supplement to the standard 0.8 depth readings at rotary drum screening facilities.

REFERENCES

- Easterbrooks, J. A. 1984. Juvenile Fish Screen Design Criteria: A Review of the Objectives and Scientific Data Base. State of Washington Department of Fisheries, Habitat Management Division, Yakima, Washington.
- Neitzel, D. A., C. S. Abernethy, E. W. Lusty, and L. A. Prohammer. 1985. A Fisheries Evaluation of the Sunnyside Canal Fish Screening Facilities, Spring 1985. Prepared by the Pacific Northwest Laboratory, Richland, Washington, for the Division of Fish and Wildlife, Bonneville Power Administration, Portland, Oregon.
- Neitzel, D. A., C. S. Abernethy, and E. W. Lusty. 1986. A Fisheries Evaluation of the Richland and Toppenish/Satus Canal Fish Screening Facilities, Spring 1986. Prepared by the Pacific Northwest Laboratory, Richland, Washington, for the Division of Fish and Wildlife, Bonneville Power Administration, Portland, Oregon.
- Neitzel, D. A., C. S. Abernethy, E. W. Lusty, and S. J. Wampler. 1987. A Fisheries Evaluation of the Richland and Wapato Canal Fish Screening Facilities, Spring 1987. Prepared by the Pacific Northwest Laboratory, Richland, Washington for the Division of Fish and Wildlife, Bonneville Power Administration, Portland, Oregon.
- NPPC (Northwest Power Planning Council). 1987. Fish and Wildlife Program (as amended). Northwest Power Planning Council, Portland Oregon.

APPENDIX A

OPERATING CRITERIA FOR THE FISH SCREENING FACILITIES AT RICHLAND, SUNNYSIDE, AND WAPATO SCREENS

Appendix A contains the operating criteria for three of the six fish screening facilities included in this report. The criteria were developed by hydrologists from the National Marine Fisheries Service. The intent of the criteria is to provide the information necessary so that maintenance personnel can set and adjust fish bypass flows to achieve optimum fish bypass conditions at each screening facility.

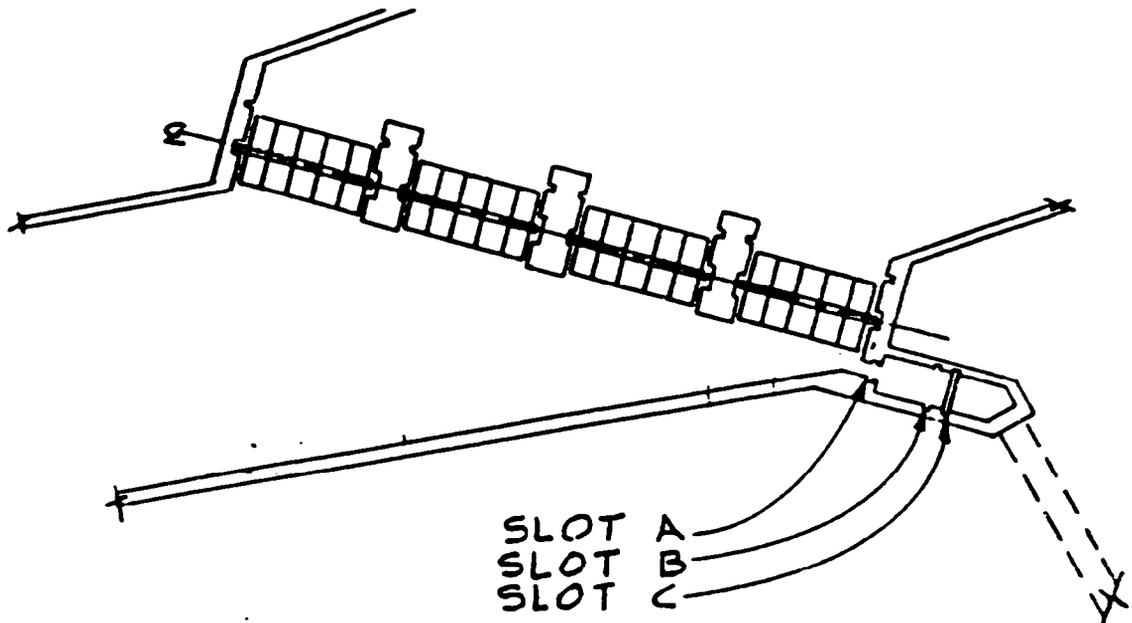
The operating criteria for the Richland Screens are on page A-2. The criteria describe alternate methods to adjust the canal surface elevation to achieve proper bypass flows. A diagram of the Richland Screens is included.

The operating criteria for the Sunnyside Screens are on pages A.3-A.12. Text describing different operating modes are on pages A.3-A.6. A diagram of the Sunnyside Screens is on page A.7. Detailed graphs for setting each of the five weirs at the Sunnyside are on pages A.8-A.12.

The operating criteria for the Wapato Screens are on pages A.13-A.16. Text describing the operating criteria appears on pages A.13-A.14, and a diagram of the Wapato Screens is on page A-15. A graph summarizing weir crest height adjustment based on canal surface elevation is on page A.16.

Final operating criteria were not available for the Columbia, Westside Ditch, and Roza Screens when the velocity measurements were taken. The Bureau of Reclamation provided preliminary stoplog settings for the fish returns at the Columbia and Westside Ditch screens, and the normal canal surface elevation for the Roza Screens.

OPERATING CRITERIA
Richland Screens
(NMFS-S/28/87)



Set check structure (downstream of screen structure) to provide canal water surface of E1.413.75. The canal water surface should not exceed E1.413.85, nor should it be lower than E1.413.4.

Slot (A) is to be empty, slot (B) is to be empty. Place stoplogs in slot (C), with top stoplog 1.5' below water surface elevation.

Design Bypass $Q=25$ cfs

- Notes:
1. The 12" wide, full depth slot is not to be used at the bypass entrance.
 2. If the canal water surface falls below E1.413.4, either add stoplogs to the downstream water surface control structure (old screen structure), or increase the head gate opening, or both. Under no circumstances should the bypass entrance flows be reduced to increase canal flows. This should not be necessary, especially if the canal is properly maintained.
 3. Minimize flow through the overflow facilities, upstream of the new and old screen locations, except for temporary flushing of debris.

Operating Criteria for Sunnyside Canal Fish Screens
Bypass System, Trashrack and Screen Structure
Stoplogs and Pump Bay Baffles

I. Fish Screen Bypass System:

Operation of the fish bypass system requires the adjustment of four bypass overflow weir gates located at points in the bypass system. These weir gates control the quantity of bypass flows and the water surface elevations within the system for good fish passage. The layout of the facility is shown on attached Figure 1.

The operation of the fish bypass requires that 50 cubic feet per second (cfs) enter the pumpback structure through both the intermediate fish bypass pipe and the terminal bypass (100 cfs total). The fish water return pumps, when both are operating, remove 80 cfs from the structure and return it to the Sunnyside Canal downstream of the screen facility. The remaining 20 cfs is returned to the river via the primary fish return pipe at the extreme southeast end of the pumpback structure. The bypass system should be operated in the pumpback mode (both pumps operating) whenever river flows past Sunnyside Dam are less than 500 cfs to avoid attracting upstream migrating adult fish into the river outlets of the primary and auxiliary fish return pipes.

In lieu of two pump operation, the required cfs bypass flow is provided by proper adjustment of the weir gates. In the case where the pumps are not operating, approximately 50 cfs should exit the structure by each of the primary and auxiliary fish return pipes, returning the total 100 cfs to the river. In the case where only one pump is operating, 40 cfs is pumped back to the canal with approximately 30 cfs being returned to the river by the fish return pipe and auxiliary fish return pipe each making a total of 60 cfs to the river.

To provide these specified bypass flows, the overflow weir gates should be adjusted as follows. The weir gates and gages are numbered and located as shown on the attached Figure 1.

For Two - Pump Operation:

1. Fish return weir gate No. 3 set at el. 841.0 (full open) with yoke at 5.5 ft. below deck.
2. Intermediate bypass control weir gate No. 1 at el. 892.0 (full open), with yoke at 6.0 ft. below deck.
3. Terminal bypass weir gate No. 2 set at el. 892.0 (full open), with yoke 4.5 ft. below deck.

For No Pumps Operating or One Pump Operation:

1. Open all four gates full open

Fish return weir gate No. 3 set at el. 891.0 with yoke 5.5 ft. below deck.

Intermediate bypass control weir gate No. 1 set at el. 892.0, with yoke at 6.0 ft. below deck.

Terminal bypass control weir gate No. 2 set at el. 892.0 with yoke at 4.5 ft. below deck.

Aux fish return weir gate No. 4 set at el. 892.25 with yoke at 4.25 ft. below deck.

Care must be taken to avoid operation of either pump ~~until~~ ^{when canal water surface is at least 20 ft above weir gate No. 3} the flow through the bypass system is sufficient to assure ~~at least 20 ft of water surface above weir gate No. 3~~ discharged over weir gate No. 3 through the fish return pipe back to the river. To maintain this minimum return flow at all times requires the weir gate No. 3 be lowered completely and the water surface in the pumpback structure at gage No. 4 be at elevation 893.1 or higher. The pump low-water shutoff switches for both pumps must be set at elevations above 893.1.

Attached figures 2 through 5 provide information on weir gate flows for various gage water surface elevations and weir gate settings, and Figure 6 provides pump discharges for various gage No. 4 water surface elevations. These figures are the basis for the weir gate operations specified above. They can be used to more precisely define flow quantities through the bypass system.

Generally, the weir gate settings specified above will provide the desired bypass system flows during periods when the canal water surface is near the maximum elevation of 896.5. During periods when the canal water surface is

significantly lower (below 896.0) the bypass flows will fall somewhat short of design values, but biological evaluation of the facility has indicated they will be adequate.

The fabricated metal adjustable-width slot assemblies initially provided for the bypass slots are not to be used.

II. Trashrack Stoplogs:

Wood and steel stoplogs have been provided immediately downstream of the trashracks to alter the naturally unbalanced flow in the canal to obtain a relatively uniform distribution of flow across the full width of the drum screen forebay. This uniform flow is fundamental to obtaining acceptable fish guidance conditions in front of the drum screens. The initial placement of logs was determined by hydraulic model studies and has an eight-foot height of logs in the right (south) bay and a seven-foot height of logs in the center bay. The left (north) bay has no logs placed in it. The placement of the logs should not be changed.

III. Screen Structure Stoplogs:

The screen structure stoplogs are located in pier slots immediately downstream of the drum screens. They are wood and steel, to be placed in such a configuration as to prevent floatation. Their purpose is to baffle flow to provide for a uniform velocity distribution through the screen drums.

The stoplog placement has been adjusted based on field observations and velocity measurements to obtain the best flow distribution possible. This placement noted below should be maintained in the future.

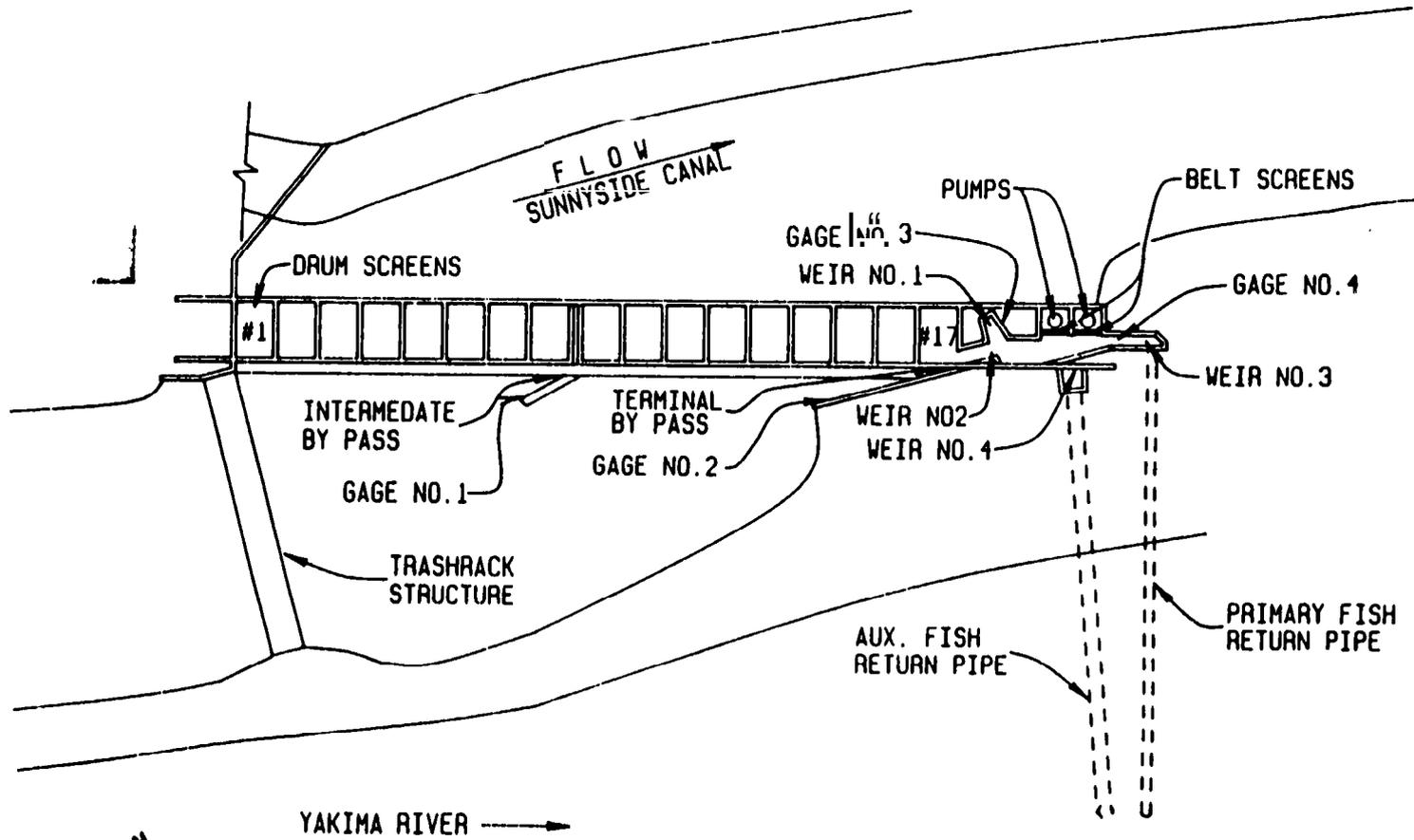
Note that "on blocks" means that two concrete blocks are placed beneath the bottom-most log to create a 8-inch \pm gap between the concrete slab and the bottom log.

<u>Screen bay No.</u>	<u>Steel logs/timber logs/Blocks</u>
1 (upstream-most bay)	Totally closed w/logs
2	None
3	None
4	None
5	None
6	None
7	None
8	2 steel/3 timber/on blocks
9	None

10	3 steel/S timber/on blocks
11	1 steel/2 timber/on blocks
12	1 steel/2 timber/on blocks
13	2 steel/3 timber/on blocks
14	2 steel/3 timber/on blocks
15	None
16	None
17 (downstream-most bay)	None

IV. Pump Bay Baffles:

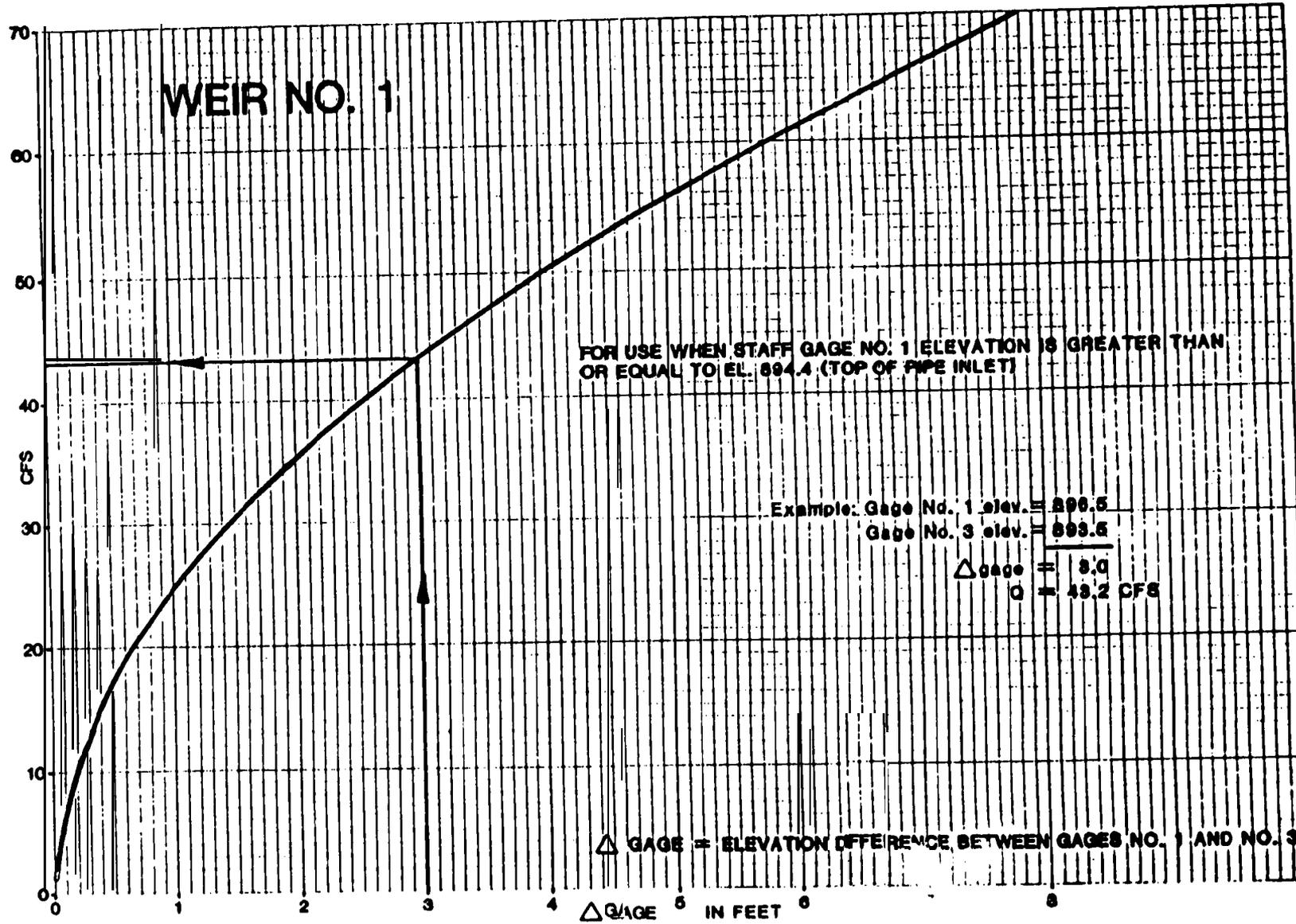
Directly behind the belt screens in the pumpback structure are structural steel frames with adjustable horizontal baffles. The baffles regulate the distribution of velocity top to bottom to meet current screening criteria. No future adjustment of the baffles is anticipated. Extra baffles have been provided and are stored on the site. The two frames are different and vary in width by 1/2-inch to meet "as-build" concrete dimensions.

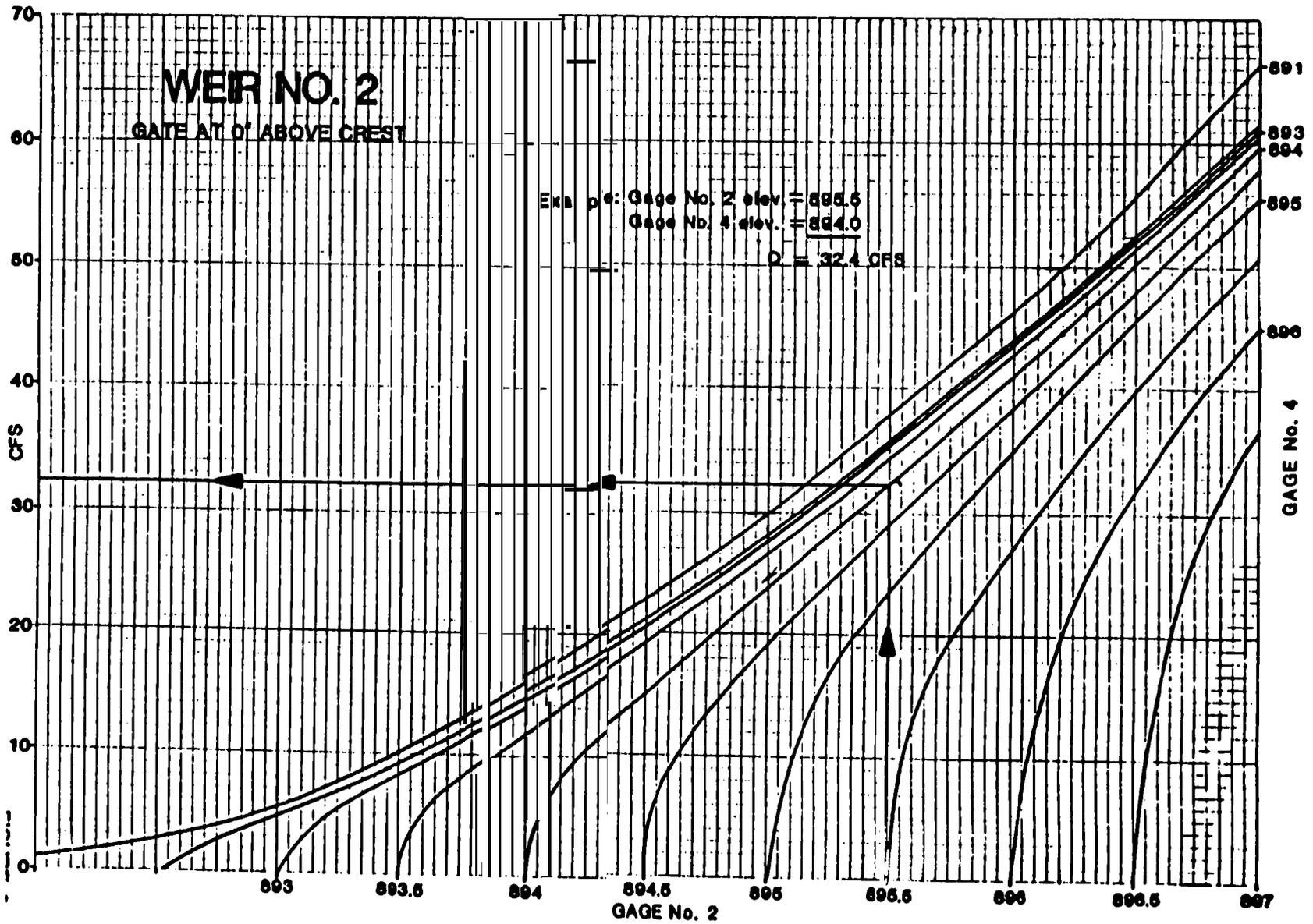


A

FIGURE 1

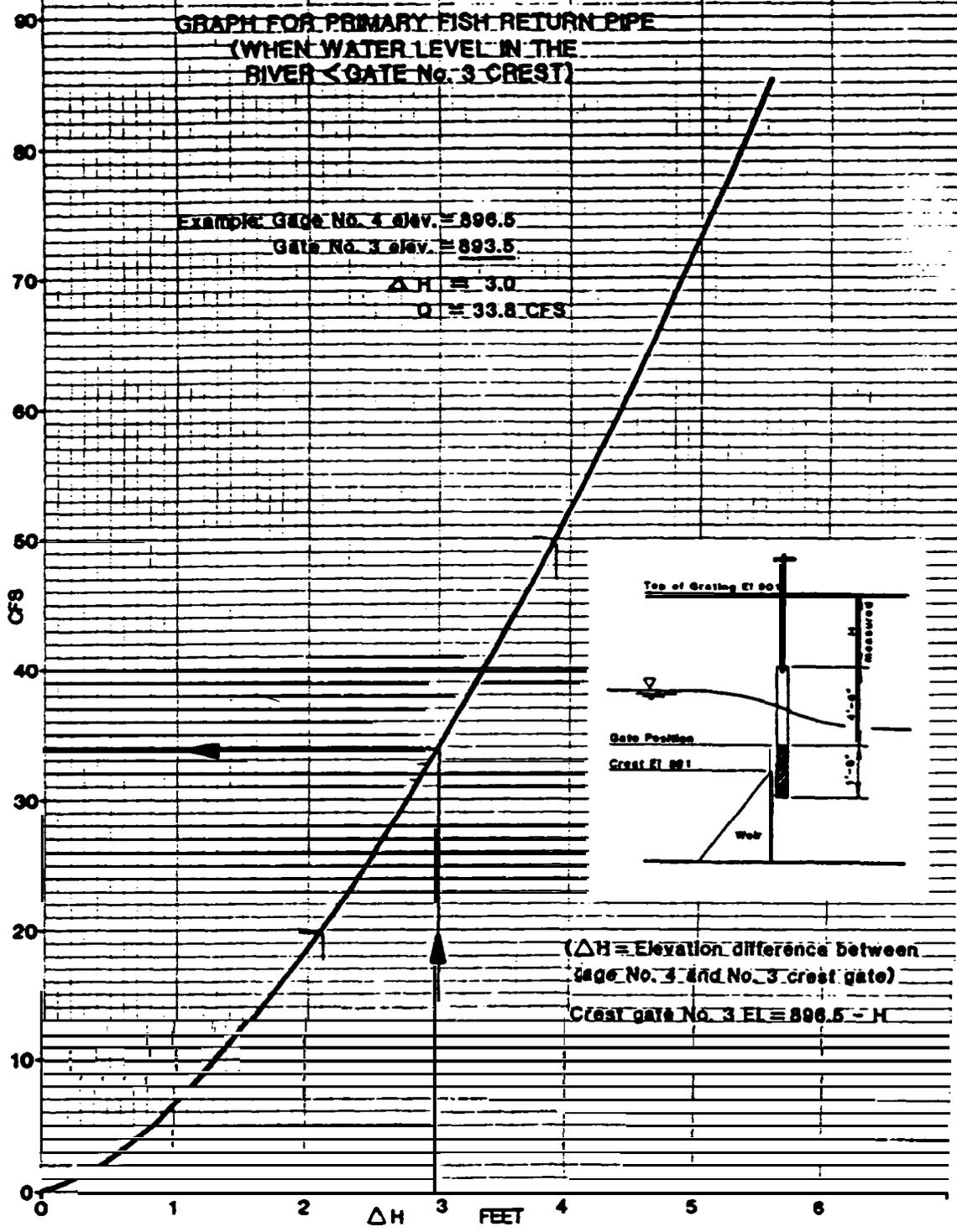
NATIONAL MARINE FISHERIES SERVICE	
SUNNYSIDE CANAL FISH SCE FACILITY GEN. ARR	
DESIGNED BY: RP	DATE: 2-13-87
DRAWN BY: GAH	SCALE: NONE





WEIR NO. 3

GRAPH FOR PRIMARY FISH RETURN PIPE
(WHEN WATER LEVEL IN THE RIVER < GATE No. 3 CREST)



Example: Gate No. 4 elev. = 896.5
Gate No. 3 elev. = 893.5
 $\Delta H = 3.0$
 $Q = 33.8 \text{ CFS}$

(ΔH = Elevation difference between
gate No. 4 and No. 3 crest gate)
Crest gate No. 3 El = 896.5 - H

WEIR NO. 4

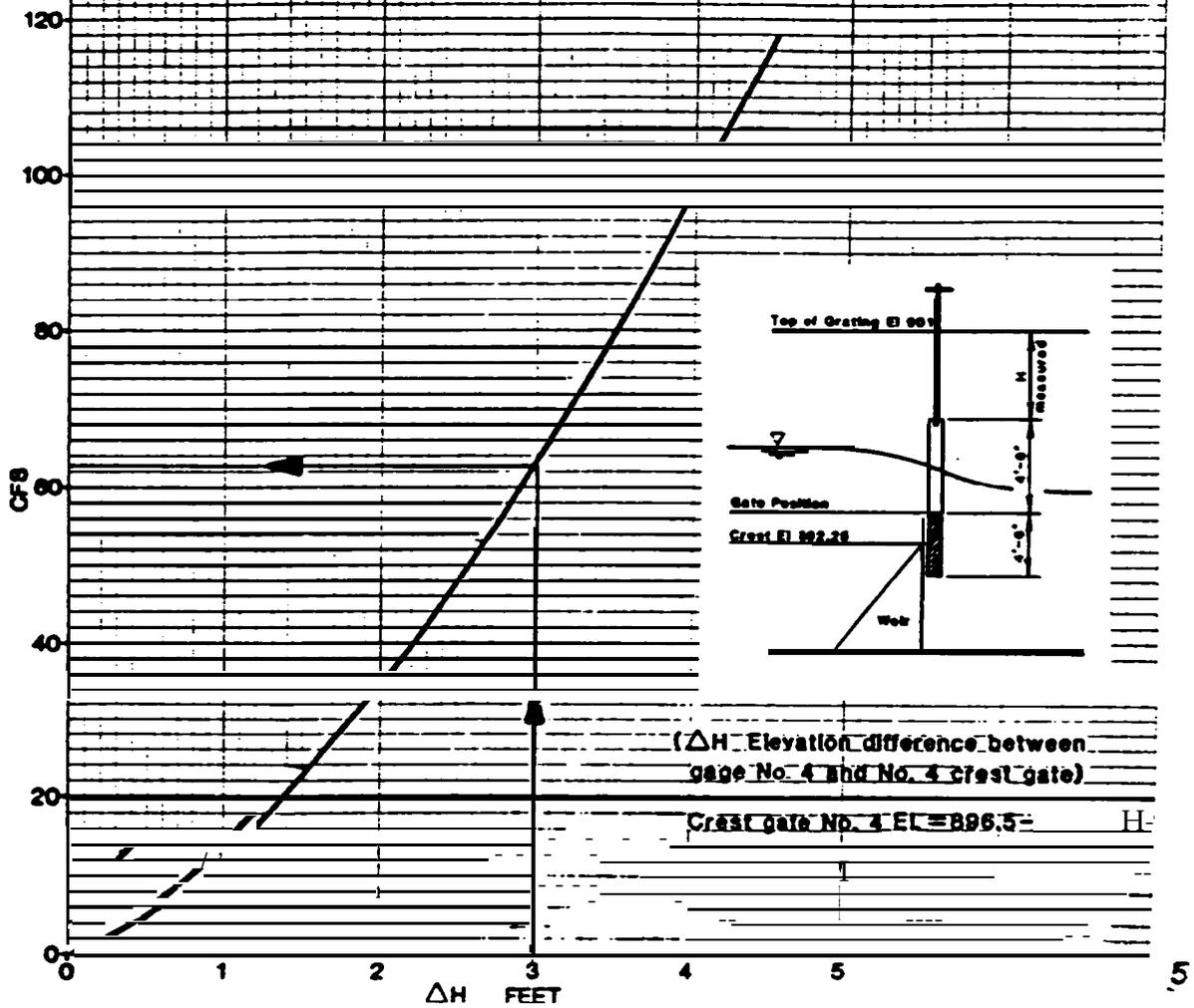
GRAPH FOR SECONDARY FISH RETURN PIPE
(WHEN WATER LEVEL IN THE
RIVER < GATE No. 4 CREST)

Example: Gate No. 4 gage = 896.5

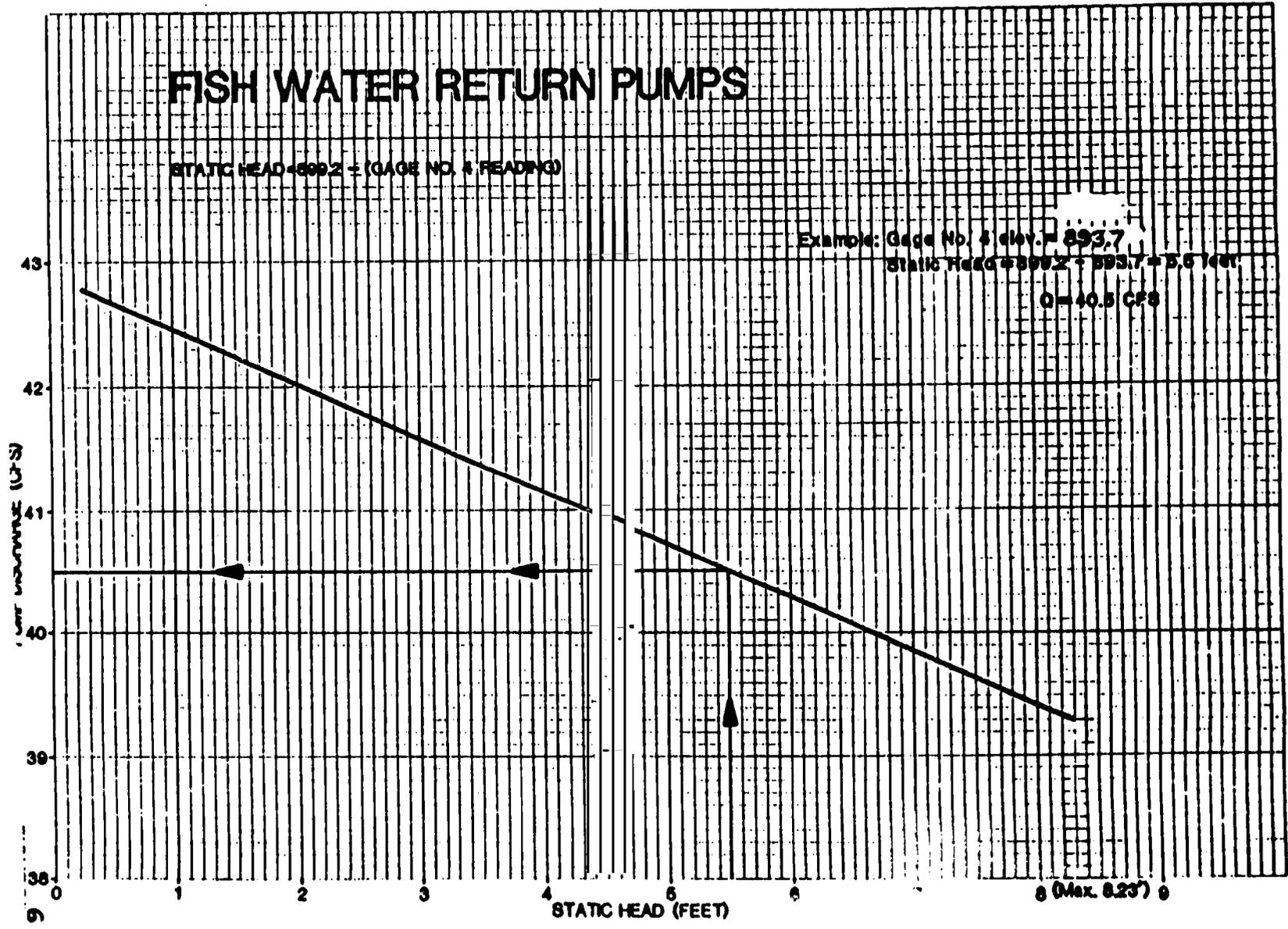
Gate No. 4 gage = 893.5

$\Delta H = 3.0$

$Q = 61.2 \text{ CFS}$



FISH WATER RETURN PUMPS



A.12

Operating Criteria
Wapato Canal Fish Screens Bypass System

Operation of the bypass system requires the adjustment of four 2-foot wide bypass overflow weir gates (these are temporarily stoplogs at the present time) located in the fish bypass channels and two 5-foot wide excess water overflow weir gates located behind the pumps in the pumpback structure. These weir gates (or temporary stoplogs) control the quantity of bypass flows and the water surface elevations within the system for good fish passage.

Weir gates (or stoplogs) should be adjusted as follows. Weir gate locations are shown on the attached sketch.

Normal Operation (no pumpback):

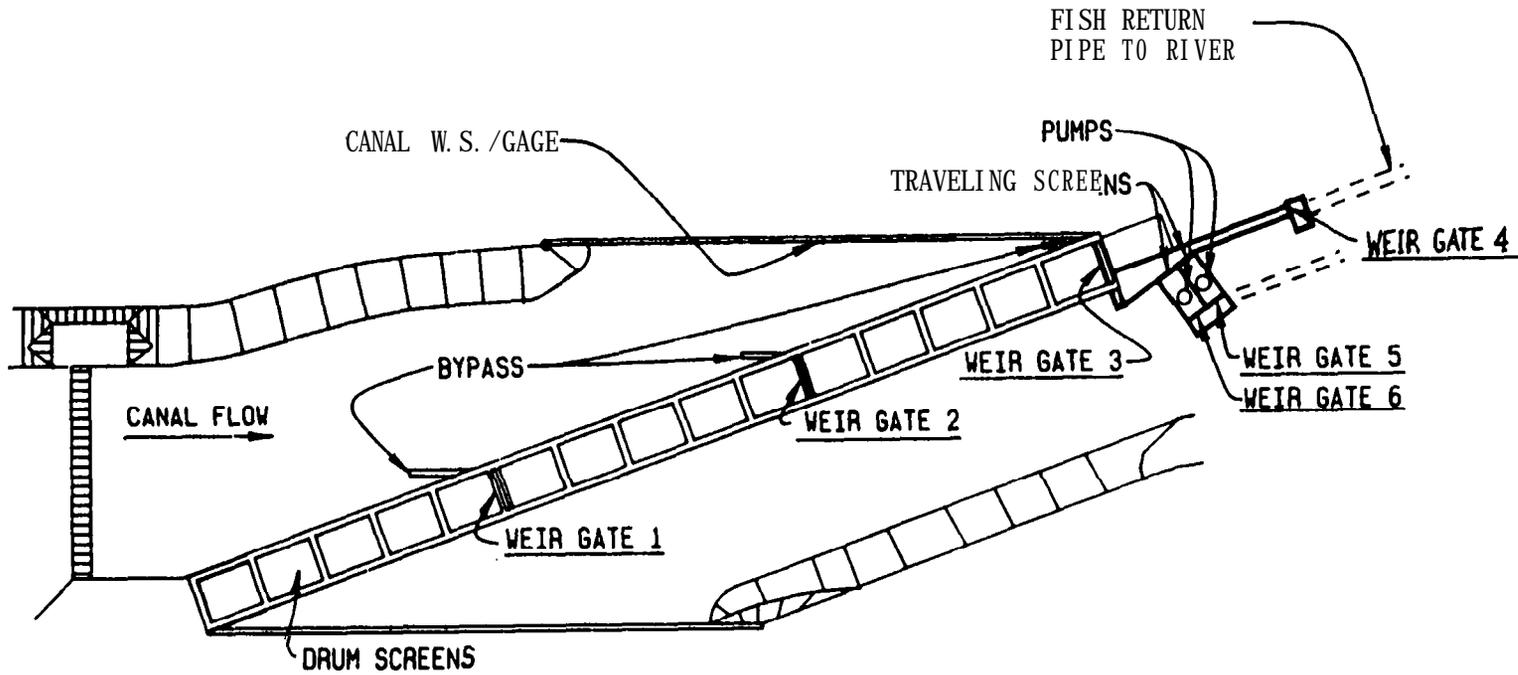
1. Adjust crest of weir gates #1, #2, and #3 (or top of temporary stoplogs) to appropriate elevation depending on canal w.s. (water surface) elevation from attached graph. Example: canal w.s. in front of drum screens is at elevation 934.0; set crest of weir gates (stoplogs) to elevation 930.7
2. Adjust crest of weir gate #4 (or top of temporary stoplogs) To appropriate elevation depending on canal w.s. elevation as shown on attached graph. Example: canal w.s. elevation 934.0; set crest of #4 weir gate (or top of stoplog) at elevation 928.0.
3. Adjust weir gates #5 & #6 "equally" until w.s. elevation in front of traveling screens is 3.5' lower than canal w.s. elevation in front of drum screens. Example: canal w.s. elevation 934.0: adjust weir gates #5 & #6 equally until w.s. elevation is front of traveling screens is 930.5. .

Operation with Pumpback:

1. Set weir gates #1, #2, #3 & #4 same as for Normal Operation (No Pumpback).
2. With either one or both pumps in operation adjust both weir gates #5 & #6 to maintain the traveling screen w.s. 3.5' lower than canal w.s. elevation. Divide flow through both traveling screens equally.
3. If the difference between the canal w.s. and the traveling screen w.s. is greater than 3.5', even with

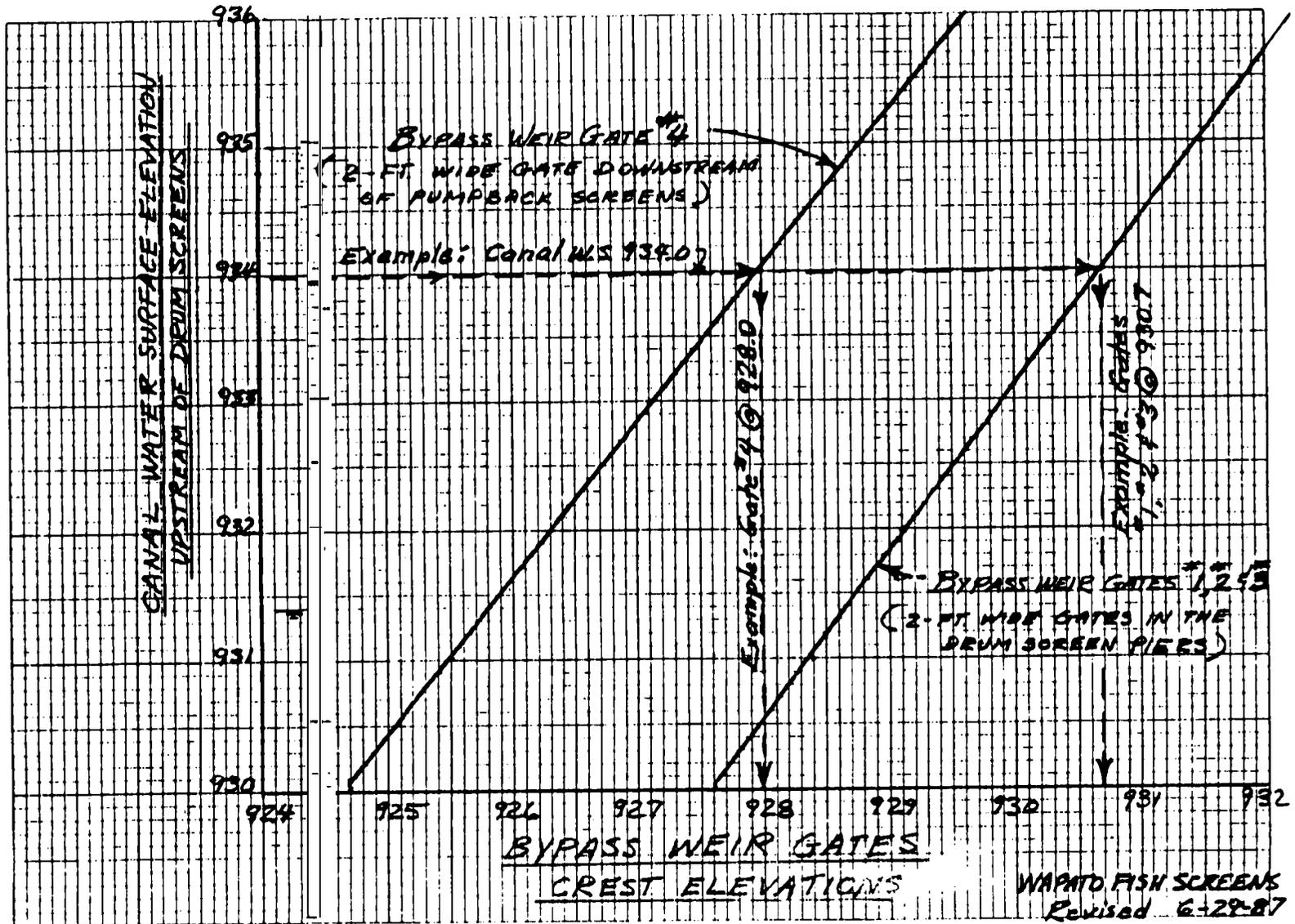
both weir gates #5 & #6 closed, then lower gates #1, #2 & #3 equally to obtain 3.5' difference. Note: This is very important since for certain conditions the pumps may have enough capacity to pull the water level in the pumpback structure down too low, drying up the bypass flow over weir gate No. 4 and resulting in major fish damage.

A.15



WAPATO CANAL FISH SCREEN FACILITY PLAN

NATIONAL MARINE FISHERIES SERVICE	
WAPATO CANAL FISH SCREEN FACILITY	
DESIGNED BY R.P.	DATE: 2 - 30 - 87
DRAWN BY: G.A.H.	SCALE:
CAD FILE: WAPCAFSF	



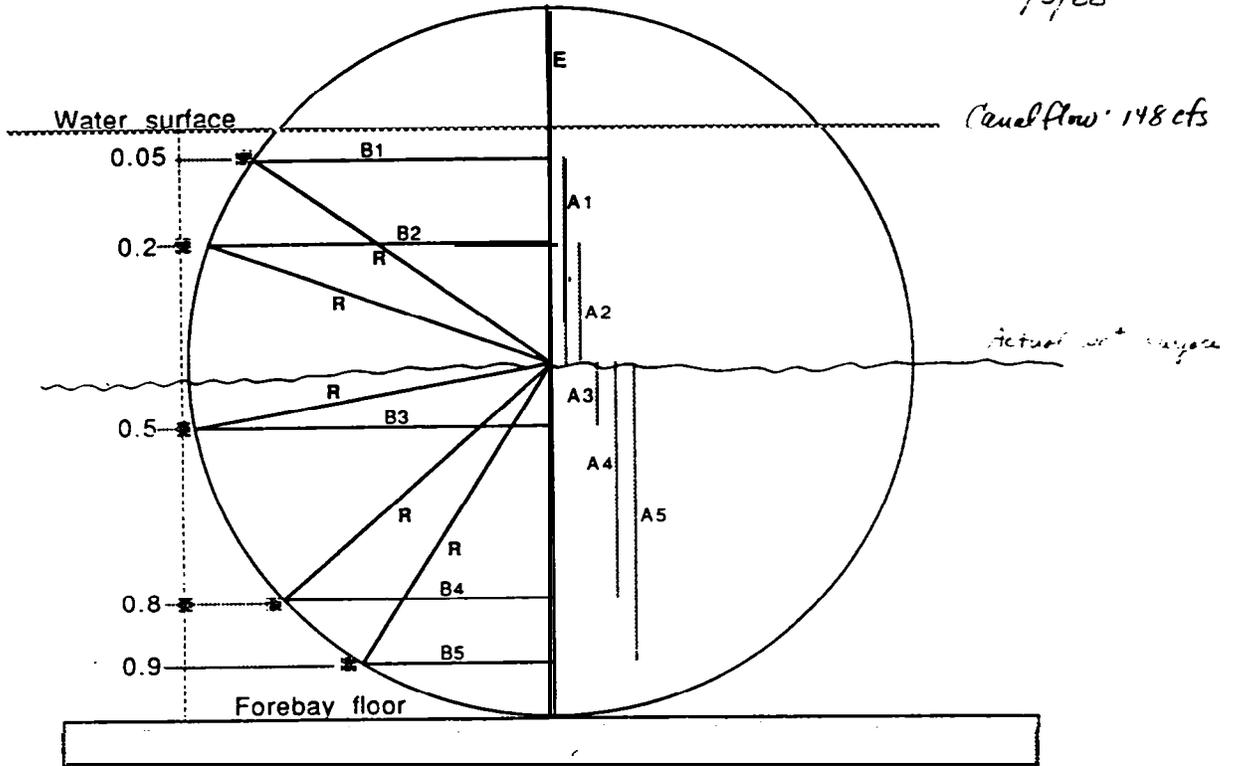
APPENDIX B

COLUMBIA SCREENS RAW DATA SHEETS

Appendix B contains the raw data sheets for flow measurements conducted at the Columbia Screens on August 3, 1988. Page 8.2 shows the calculations made to position probes at the proper measurement depths, and the distance between the probe and the screen face at the measured depths. Raw data for measurements in front of the drum screens are found on pages 8.3 through B-12. Flow measurements for the fish return are on page 8.13.

WORKSHEET FOR DEPTH DETERMINATIONS

Columbia Canal
2/3/88



Drum Diameter (D): 76 SIDE A SIDE B

Radius (R): 48

Exposed to air (E): 48.5

Submerged (Z): 42+6=54

0.05 Z:	A1= (E+0.05Z)-R	<u> </u>	B1= (R ² -A1A2) ^{0.5}	<u> </u>
0.20 Z: <u>10.8'</u>	A2= (E+0.2Z)-R	<u>10.8</u>	B2= (R ² -A2A2) ^{0.5}	<u> </u>
0.50 Z:	A3= (E+0.5Z)-R	<u> </u>	B3= (R ² -A3A2) ^{0.5}	<u> </u>
0.80 Z: <u>43.2'</u>	A4= (E+0.8Z)-R	<u>43.2'</u>	B4= (R ² -A4A2) ^{0.5}	<u>20.73'</u>
0.90 Z:	A5= (E+0.9Z)-R	<u> </u>	B5= (R ² -A5A2) ^{0.5}	<u> </u>

Distance From Vertical To Screen Face

0.05 Z:	R-B1=	<u> </u>
0.20 Z:	R-B2=	<u>1.23'</u>
0.50 Z:	R-B3=	<u> </u>
0.90 Z:	R-B4=	<u>27.08'</u>
0.90 Z:	R-B5=	<u> </u>

Yakima River Fish Screening Facility Flow Measurements

Site Columbia

Forebay Elevation 4.22

Date 8/3/88

Screen # 1

Screen Diameter (in) 96"

Canal Flow 148 cfs

Personnel CSA/EWI

Exposed (in) 49"

Submerged (in) 47"46" = 53" (2)

personal communication,
Gary Robinson, C.I.U.

Time Start	<u>0838 H</u>	<u>0852 H</u>				
Time End	<u>0838 H</u>	<u>0838 H</u>				

Location	U (C) L				U (C) L				U C L				U C L				U C L			U C L		
	0.2				0.8				0.2				0.8				0.2			0.8		
Depth	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	S	A	V	S	A	V
1	1.2	.6	.2	-.3	1.4	.8	.1	-.9														
2	1.2	.6	.1	-.5	1.4	.6	0	-.8														
3	1.0	.6	.2	-.4	1.0	.5	.1	-.7														
4	1.1	.6	.1	-.4	1.4	.8	0	-.0														
5	1.3	.7	.2	-.6	1.7	.5	.2	-.8														
6	1.0	.6	.1	-.4	1.2	.6	.1	-.0														
7	1.2	.6	.2	-.4	1.0	.5	0	-.7														
8	1.1	.6	.2	-.4	1.8	.6	.1	-.9														
9	1.0	.6	.1	-.3	1.6	.7	.1	-.9														
10	1.4	.6	.2	-.4	1.6	.8	-.1	-.7														

Average	1.15	0.61	0.16	0.41	1.41	0.64	0.06	0.94														
Minimum	1.0	0.6	0.1	0.3	1.0	0.5	-0.1	0.7														
Maximum	1.4	0.7	0.2	0.6	1.8	0.8	0.2	1.0														

Notes: 0.2 depth @ 0.5" below structure +S & -A = 818 } +A +V = 823 }
 0.8 depth @ 10.5" above bottom } 5 } -A = 810 } +A +V = 815 }
 scale = 0-5 } scale = 0-2 }

Depth	Unit	X	Y
0.2	818	+S	-A
0.2	823	+A	+V
0.8	810	+S	-A
0.8	811	+A	+V

these probes and orientations were used for all screen measurements at Columbia Canal (CA)

Yakima River Fish Screening Facility Flow Measurements

Site Columbia

Forebay Elevation 4.22

Date 08/2/88

Screen # 2

Screen Diameter (in) 96

Canal Flow 148 cfs

Per Panel CSA # 141K

Exposed (in) 49

Submerged (in) 47"

Time Start	0851 H	0851 H	0859 H	0859 H		
Time End	0853 H	0856 H	0903 H	0903 H		

Location	(U) C L				(U) C L				U C (L)				U C (L)				U C L			U C L		
	0.2				0.8				0.2				0.8				0.2			0.8		
Depth	+S	+A	+V	-A	S	A	V	S	A	V												
1	1.8	1.5	1.3	-1.3	2.4	1.6	1.1	-1.1	1.6	1.5	1.3	-1.4	1.5	1.4	1.3	-1.6						
2	2.0	1.4	1.3	-1.5	2.2	1.4	1.2	-1.8	1.4	1.5	1.4	-1.4	2.0	1.4	1.3	-1.5						
3	1.7	1.5	1.2	-1.4	2.0	1.6	1.1	-1.9	1.9	1.5	1.3	-1.3	1.8	1.4	1.3	-1.6						
4	1.6	1.5	1.3	-1.2	1.8	1.5	1.2	-1.8	1.4	1.5	1.3	-1.3	2.2	1.5	1.2	-1.8						
5	2.0	1.6	1.2	-1.4	2.2	1.5	1.1	-1.9	1.8	1.3	1.4	-1.2	1.6	1.4	1.3	-1.6						
6	1.9	1.5	1.3	-1.5	2.1	1.7	1.2	-1.0	1.6	1.4	1.3	-1.2	1.9	1.3	1.4	-1.3						
7	1.8	1.5	1.3	-1.3	1.8	1.4	1.2	-1.9	1.6	1.5	1.3	-1.2	2.3	1.8	1.3	-1.8						
8	1.6	1.6	1.2	-1.5	2.0	1.4	1.2	-1.8	1.4	1.4	1.4	-1.5	1.9	1.4	1.1	-1.6						
9	1.8	1.5	1.3	-1.4	2.3	1.7	1.2	-1.0	1.6	1.4	1.4	-1.4	2.1	1.5	1.3	-1.6						
10	1.6	1.5	1.2	-1.7	2.2	1.6	1.2	-1.6	1.5	1.4	1.5	-1.3	2.0	1.4	1.3	-1.7						

Average	1.78	0.51	0.26	0.44	2.10	0.54	0.17	0.82	1.60	0.44	0.36	0.32	1.93	0.45	0.29	0.65						
Minimum	1.6	0.4	0.2	0.2	1.8	0.4	0.1	0.6	1.4	0.3	0.3	0.2	1.5	0.3	0.1	0.5						
Maximum	2.0	0.6	0.3	0.7	2.4	0.7	0.2	1.1	1.9	0.5	0.5	0.5	2.3	0.8	0.4	0.8						

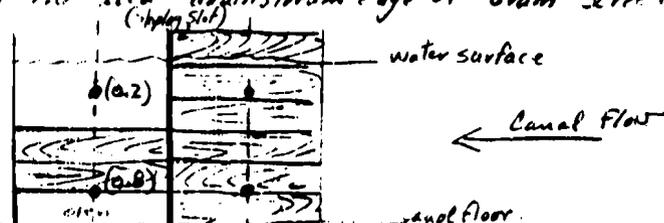
Notes: "U" Readings are half-way between centerline and upstream edge of drum screen (30" from end)

"L" Readings are half-way between centerline and downstream edge of drum screen (30" from end)

Stoplog configuration behind screens

Upper half completely stoplogged. Lower half has two stoplogs 6-10" from bottom.

Water goes both over and under stoplogs on lower half. This arrangement results in "L" Readings



Yakima River Fish Screening Facility Flow Measurements

Site Columbia

Forebay Elevation 4.22

Date 8/3/88

Screen # 3

Screen Diameter (in) 96

Canal Flow 148 cfs

Personnel CSA, EWL

Exposed (in) 49

Submerged (in) 47

Time Start	<u>0912 H</u>	<u>0912 H</u>				
Time End	<u>0916 H</u>	<u>0916 H</u>				

Location	U <u>C</u> L				U <u>C</u> L				U C L			U C L			U C L			U C L		
	0.2				0.8				0.2			0.8			0.2			0.8		
Depth	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	S	A	V	S	A	V	S	A	V
1	1.5	.3	.4	-.1	1.4	.5	.3	-.5												
2	1.7	.3	.2	-.2	1.5	.4	.1	-.5												
3	1.2	.4	.2	-.2	1.4	.5	.1	-.6												
4	1.6	.3	.2	-.3	1.8	.4	-.1	-.6												
5	1.6	.4	.3	-.2	1.7	.5	.1	-.5												
6	1.5	.4	.2	-.2	1.4	.4	0	-.5												
7	1.6	.4	.3	-.2	2.0	.6	.2	-.7												
8	1.6	.3	.4	-.2	1.4	.3	0	-.4												
9	1.5	.4	.4	-.3	2.0	.4	.2	-.6												
10	1.8	.4	.3	-.3	1.7	.3	0	-.6												

Average	<u>1.57</u>	<u>0.36</u>	<u>0.29</u>	<u>0.22</u>	<u>1.63</u>	<u>0.43</u>	<u>0.09</u>	<u>0.55</u>												
Minimum	<u>1.1</u>	<u>0.3</u>	<u>0.2</u>	<u>0.1</u>	<u>1.4</u>	<u>0.3</u>	<u>-0.1</u>	<u>0.5</u>												
Maximum	<u>1.8</u>	<u>0.4</u>	<u>0.4</u>	<u>0.3</u>	<u>2.0</u>	<u>0.6</u>	<u>0.3</u>	<u>0.7</u>												

Notes:

Yakima River Fish Screening Facility F² Measurements

Site Columbia

Screen 2 A

Screen Diameter (in) 96
Exposed (in) 49
Submerged (in) 47

Forebay Elevation 4.22
Canal Flow 148 cfs

Date 8/3/88
Personnel CSA & FWL

Time Start	<u>0925 H</u>	<u>0925 H</u>	<u>0934 H</u>	<u>0934 H</u>		
Time End	<u>0929</u>	<u>0929 H</u>	<u>0939 H</u>	<u>0939 H</u>		

Location	<u>(U)</u> C L				<u>(U)</u> C L				U C <u>(L)</u>				U C <u>(L)</u>				U C L				U C L			
	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	S	A	V		S	A	V	
Depth	0.2				0.8				* 0.2				0.8				0.2				0.8			
Vector	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	S	A	V		S	A	V	
1	1.8	1.5	1.2	-1.3	1.6	1.5	0	-1.8	1.2	1.6	0.1	-1.3	1.5	1.3	0.1	-1.7								
2	1.6	1.5	1.1	-1.3	1.7	1.5	1.1	-1.6	1.4	1.6	0.1	-1.4	1.5	1.5	-1.1	-1.6								
3	1.6	1.5	1.2	-1.4	1.7	1.3	0	-1.6	1.3	1.6	0.1	-1.2	1.3	1.5	0.1	-1.6								
4	1.8	1.4	1.3	-1.4	1.6	1.3	1.1	-1.6	1.2	1.6	0.1	-1.4	1.4	1.4	0	-1.6								
5	1.8	1.5	1.2	-1.4	1.6	1.5	1.1	-1.7	1.2	1.6	0.1	-1.2	1.4	1.3	0	-1.6								
6	1.5	1.5	1.2	-1.4	1.5	1.6	0.1	-1.6	0.9	1.4	1.1	-1.3	1.3	1.5	0	-1.7								
7	1.7	1.5	1.1	-1.4	1.7	1.5	-1.1	-1.4	1.2	1.7	1.2	-1.2	1.5	1.5	1.1	-1.8								
8	1.4	1.5	1.0	-1.3	1.8	1.4	1.1	-1.6	1.7	1.6	1.1	-1.2	1.4	1.5	-1.1	-1.7								
9	1.4	1.5	1.2	-1.4	2.0	1.3	0.1	-1.6	1.1	1.6	1.1	-1.3	1.5	1.4	-1.1	-1.7								
10	1.6	1.5	1.2	-1.3	1.6	1.4	1.1	-1.8	1.0	1.6	1.1	-1.3	1.4	1.3	0	-1.7								

Average	1.62	0.49	0.17	0.36	1.68	0.43	0.06	0.63	0.98	0.61	0.11	0.28	1.42	0.42	0.0	0.67								
Minimum	1.4	0.4	0.0	0.3	1.5	0.3	-0.1	0.4	0.2	0.6	0.1	0.2	1.3	0.3	-0.1	0.6								
Maximum	1.8	0.5	0.3	0.4	2.0	0.6	0.1	0.8	1.4	0.7	0.2	0.4	1.5	0.5	0.1	0.8								

Notes: * Meter fluctuated wildly for about 1/2 minutes during the sample - maybe = weed stuck on probe?
No weeds observed on lower reaches of bed.

Yakima River Fish Screening Facility Flow Measurements

Site Columbia

Screen # 5

Screen Diameter (In) 96
 Exposed (In) 49
 Submerged (In) 47

Forebay Elevation 4.22
 Canal Flow 148 cfs

Date 8/3/8
 Personnel CSA FEWL

Time Start	<u>0945H</u>	<u>0945H</u>				
Time End	<u>0949H</u>	<u>0949H</u>				

Location	U <u>(C)</u> L				U <u>(C)</u> L				U C L			U C L			U C L			U C L		
	0.2				0.8				0.2			0.8			0.2			0.8		
Depth	+S	+A	+V	-A	+S	+A	+V	-A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.7	.6	.1	-.5	1.5	.3	0	-.7												
2	1.4	.5	.1	-.5	1.6	.4	-.1	-.7												
3	1.5	.6	.2	-.4	1.6	.4	.2	-.8												
4	1.7	.6	.2	-.4	1.6	.4	.2	-.7												
5	1.5	.6	.2	-.5	1.6	.5	.1	-.6												
6	1.6	.6	.1	-.5	1.7	.4	.1	-.8												
7	1.6	.5	.1	-.4	1.3	.5	.1	-.6												
8	1.6	.6	.1	-.4	1.3	.3	0	-.6												
9	1.6	.6	.1	-.4	1.7	.4	0	-.8												
10	1.5	.5	.1	-.5	1.5	.3	-.1	-.6												

Average	<u>1.56</u>	<u>0.57</u>	<u>0.13</u>	<u>0.45</u>	<u>1.54</u>	<u>0.39</u>	<u>0.05</u>	<u>0.64</u>												
Minimum	<u>1.4</u>	<u>0.5</u>	<u>0.1</u>	<u>0.4</u>	<u>1.3</u>	<u>0.3</u>	<u>0.1</u>	<u>0.6</u>												
Maximum	<u>1.7</u>	<u>0.6</u>	<u>0.2</u>	<u>0.5</u>	<u>1.7</u>	<u>0.5</u>	<u>0.2</u>	<u>0.8</u>												

Notes:

Yakima River Fish Screening Facility F² Measurements

Site Columbia

Screen # 6

Screen Diameter (in) 96
Exposed (in) 49
Submerged (in) 47

Forebay Elevation 4.22
Canal Flow 148 cfs

Date 8/3/88
Personnel CSAF KWL

Time Start	<u>0955 H</u>	<u>0955 H</u>	<u>1002 H</u>	<u>1002 H</u>		
Time End	<u>0959 H</u>	<u>0959 H</u>	<u>1007 H</u>	<u>1007 H</u>		

Location	<u>(U) C L</u>				<u>(U) C L</u>				<u>U C (L)</u>				<u>U C (L)</u>				<u>U C L</u>				<u>U C L</u>			
	0.2				0.8				0.2				0.8				0.2				0.8			
Depth	0.2				0.8				0.2				0.8				0.2				0.8			
Vector	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	S	A	V		S	A	V	
1	1.6	.5	.2	-.5	1.7	.3	.1	-.7	1.3	.6	.1	-.5	1.5	.8	.1	-.4								
2	1.8	.6	.2	-.5	1.7	.4	.1	-.8	1.6	.6	.2	-.4	1.5	.3	.1	-.6								
3	1.6	.6	.2	-.4	1.8	.4	.1	-.8	1.4	.5	.2	-.4	1.6	.3	.1	-.4								
4	1.8	.6	.1	-.5	1.8	.5	.1	-.8	1.2	.6	.2	-.5	1.5	.3	.1	-.6								
5	1.4	.5	.2	-.5	1.8	.3	.1	-.6	1.6	.5	.2	-.4	1.1	.3	.1	-.6								
6	1.4	.6	.2	-.4	1.6	.4	.1	-.6	1.8	.6	.2	-.7	1.2	.3	0	-.6								
7	1.6	.5	.2	-.3	2.0	.4	.2	-.8	1.4	.5	.1	-.5	1.2	.3	0	-.5								
8	1.8	.6	.1	-.5	1.7	.5	.1	-.7	1.7	.6	.2	-.5	1.2	.4	.1	-.5								
9	1.8	.5	.1	-.5	1.5	.5	0	-.6	1.5	.6	.2	-.5	1.2	.3	.1	-.4								
10	1.8	.6	.1	-.5	1.4	.4	-.1	-.7	1.4	.6	.1	-.4	1.3	.4	0	-.6								

Average	<u>1.66</u>	<u>0.56</u>	<u>0.16</u>	<u>0.46</u>	<u>1.71</u>	<u>0.41</u>	<u>0.08</u>	<u>0.70</u>	<u>1.49</u>	<u>0.57</u>	<u>0.17</u>	<u>0.48</u>	<u>1.33</u>	<u>0.32</u>	<u>0.05</u>	<u>0.52</u>							
Minimum	<u>1.4</u>	<u>0.5</u>	<u>0.1</u>	<u>0.3</u>	<u>1.4</u>	<u>0.3</u>	<u>0.0</u>	<u>0.6</u>	<u>1.2</u>	<u>0.5</u>	<u>0.1</u>	<u>0.4</u>	<u>1.2</u>	<u>0.3</u>	<u>0.1</u>	<u>0.4</u>							
Maximum	<u>1.8</u>	<u>0.6</u>	<u>0.2</u>	<u>0.5</u>	<u>2.0</u>	<u>0.5</u>	<u>0.2</u>	<u>0.8</u>	<u>1.8</u>	<u>0.6</u>	<u>0.2</u>	<u>0.7</u>	<u>1.6</u>	<u>0.4</u>	<u>0.1</u>	<u>0.6</u>							

Notes:

Yakima River Fish Screening Facility Flow Measurements

Site Columbia

Screen # 7

Screen Diameter (in) 96
 Exposed (in) 48
 Submerged (in) 47

Forebay Elevation 4.22
 Canal Flow 145 cfs

Date 8/3/88
 Personnel CSAF FALL

Time Start	<u>1014H</u>	<u>1014H</u>				
Time End	<u>1018H</u>	<u>1018H</u>				

Location	U (C) L				U (C) L				U C L				U C L				U C L				U C L			
	Depth 0.2				0.8				0.2				0.8				0.2				0.8			
Vector	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	S	A	V		S	A	V		S	A	V	
1	1.5	.5	.1	-.5	1.2	.4	0	-.6																
2	1.4	.5	.1	-.4	1.0	.3	.1	-.8																
3	1.3	.5	.1	-.5	1.0	.3	.1	-.5																
4	1.7	.5	.1	-.4	1.2	.5	.1	-.6																
5	1.2	.5	.2	-.5	1.5	.3	.1	-.7																
6	1.8	.6	.2	-.4	.9	.4	.1	-.6																
7	1.2	.5	.1	-.4	1.3	.4	0	-.7																
8	1.4	.6	.1	-.4	1.4	.4	0	-.6																
9	1.6	.5	.2	-.4	1.5	.4	-.1	-.5																
10	1.4	.5	.1	-.3	1.4	.4	0	-.6																

Average	<u>1.45</u>	<u>0.52</u>	<u>0.13</u>	<u>0.42</u>	<u>1.24</u>	<u>0.38</u>	<u>0.04</u>	<u>0.62</u>																
Minimum	<u>1.2</u>	<u>0.5</u>	<u>0.1</u>	<u>0.3</u>	<u>0.9</u>	<u>0.3</u>	<u>-0.1</u>	<u>0.5</u>																
Maximum	<u>1.8</u>	<u>0.6</u>	<u>0.2</u>	<u>0.5</u>	<u>1.5</u>	<u>0.5</u>	<u>0.1</u>	<u>0.8</u>																

Notes:

B.9

Yakima River Fish Screening Facility Flow Measurements

Site Columbia

Forebay Elevation 4.22

Date 8/3/88

Screen # 8

Screen Diameter (in) 76

Canal Flow 148 cfs

Personnel CSA & FWL

Exposed (in) 49

Submerged (in) 47

Time Start	1030 H	1030 H																				
Time End	1035 H	1035 H																				
Location	S C L	S C L	EWS				EWS				U C L			U C L								
Depth	0.2				0.8				0.2				0.8				0.2			0.8		
Vector	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	S	A	V	S	A	V
1	1.0	.4	.1	-.1	1.1	.2	0	-.3														
2	1.0	.4	.1	-.2	1.2	.1	0	-.3														
3	1.0	.4	.2	-.1	1.2	0	.1	-.2														
4	1.1	.4	.3	0	1.6	.2	-.1	-.4														
5	.9	.4	.2	-.2	1.3	.1	0	-.3														
6	1.0	.4	.1	-0	.9	.1	-.1	-.4														
7	.9	.4	.2	-.1	1.2	.1	.1	-.2														
8	.7	.3	.2	0	1.2	.1	0	-.2														
9	.8	.3	.1	0	1.0	.1	0	-.1														
10	.9	.4	.1	0	1.0	.2	0	-.2														
Average	0.93	0.38	0.16	0.08	1.17	0.12	0.0	0.26														
Minimum	0.7	0.3	0.1	0.0	0.9	0	-0.1	0.1														
Maximum	1.0	0.4	0.3	0.2	1.6	0.2	0.1	0.4														

Notes: NOTE: Drum NOT Running - Plugged top - Bottom?

Probe close to and somewhat surrounded by weeds at 0.2 & depth, (+S and -A probe).

Yakima River Fish Screening Facility Flow Measurements

Site Columbia

Screen # 9

Screen Diameter (in) 96

Exposed (in) 49

Submerged (in) 47

Forebay Elevation 4.22

Canal Flow 148 cfs

Date 8/3/88
Personnel CSA & FWL

Time Start	<u>1040H</u>	<u>1040H</u>				
Time End	<u>1044H</u>	<u>1044H</u>				

Location	U (C) L				U (C) L				U C L			U C L			U C L			U C L		
	0.2				0.8				0.2			0.8			0.2			0.8		
Depth	+S	+A	+V	-A	+S	+A	+V	-A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.4	.6	.2	-.5	.7	.3	.1	-.6												
2	1.3	.6	.2	-.5	1.3	.3	.1	-.7												
3	1.2	.6	.2	-.6	1.2	.4	.1	-.6												
4	1.2	.6	.2	-.5	.9	.4	0	-.5												
5	1.4	.6	.1	-.5	1.0	.4	0	-.7												
6	1.3	.6	.2	-.5	.8	.4	.1	-.6												
7	1.2	.6	.2	-.5	1.0	.4	0	-.7												
8	1.3	.6	.2	-.5	1.0	.3	.1	-.6												
9	1.1	.6	.2	-.5	1.1	.4	.1	-.6												
10	1.4	.6	.2	-.5	1.1	.4	0	-.6												

Average	1.28	0.6	0.19	0.51	1.01	0.37	0.06	0.62												
Minimum	1.1	0.6	0.1	0.5	0.7	0.3	0.0	0.5												
Maximum	1.4	0.6	0.2	0.6	1.3	0.4	0.1	0.7												

Notes:

Maint staff turn off Drum ~ 1/2 way through test!

8.11

Yakima River Fish Screening Facility Flow Measurements

Site Columbia

Screen # 10

Screen Diameter (in) 96
Exposed (in) 49
Submerged (in) 47

Forebay Elevation 4.22
Canal Flow 148 cfs

Date 8-3-88
Personnel CSA & FWL

Time Start	<u>1052H</u>	<u>1052H</u>	<u>1101H</u>	<u>1101H</u>		
Time End	<u>1057H</u>	<u>1057H</u>	<u>1105H</u>	<u>1105H</u>		

Location	<u>(U)</u> C L				<u>(U)</u> C L				U C <u>(L)</u>				U C <u>(L)</u>				U C L			U C L		
	0.2				0.8				0.2				0.8				0.2			0.8		
Depth	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	S	A	V	S	A	V
1	1.2	0.6	0.1	-0.5	1.3	0.6	0	-0.7	1.6	0.6	0.1	-0.4	1.3	0.5	-0.1	-0.7						
2	1.4	0.6	0.1	-0.5	1.2	0.6	0	-0.8	1.6	0.5	0.1	-0.4	1.1	0.4	0	-0.6						
3	1.4	0.6	0.1	-0.5	1.3	0.5	0.1	-0.9	1.5	0.6	0.2	-0.4	1.4	0.4	0.1	-0.6						
4	1.2	0.6	0.2	-0.5	1.6	0.6	0.1	-0.7	1.5	0.5	0.1	-0.4	1.3	0.5	0	-0.5						
5	1.6	0.6	0.1	-0.6	1.2	0.5	-0.1	-0.8	1.4	0.6	0.1	-0.5	1.3	0.5	0.1	-0.7						
6	1.4	0.6	0.1	-0.5	1.2	0.4	0.1	-0.8	1.3	0.6	0.1	-0.4	1.4	0.4	0	-0.5						
7	1.3	0.6	0.1	-0.4	1.5	0.5	-0.1	-0.7	1.5	0.6	0.1	-0.4	1.3	0.5	-0.1	-0.7						
8	1.4	0.6	0.1	-0.5	1.5	0.5	0	-0.8	1.3	0.6	0.1	-0.4	1.3	0.5	0.1	-0.5						
9	1.5	0.6	0.1	-0.5	1.4	0.5	0	-0.9	1.2	0.6	0.1	-0.5	1.2	0.5	0	-0.7						
10	1.4	0.6	0.1	-0.5	1.2	0.6	0	-0.7	1.2	0.6	0.1	-0.4	1.3	0.5	-0.1	-0.7						

Average	<u>1.38</u>	<u>0.60</u>	<u>0.11</u>	<u>0.50</u>	<u>1.34</u>	<u>0.53</u>	<u>0.01</u>	<u>0.78</u>	<u>1.41</u>	<u>0.56</u>	<u>0.11</u>	<u>0.42</u>	<u>1.29</u>	<u>0.47</u>	<u>0.00</u>	<u>0.62</u>						
Minimum	<u>1.2</u>	<u>0.6</u>	<u>0.1</u>	<u>0.4</u>	<u>1.2</u>	<u>0.4</u>	<u>-0.1</u>	<u>0.7</u>	<u>1.2</u>	<u>0.5</u>	<u>0.1</u>	<u>0.4</u>	<u>1.1</u>	<u>0.4</u>	<u>-0.1</u>	<u>0.5</u>						
Maximum	<u>1.6</u>	<u>0.6</u>	<u>0.2</u>	<u>0.6</u>	<u>1.6</u>	<u>0.6</u>	<u>0.1</u>	<u>0.9</u>	<u>1.6</u>	<u>0.6</u>	<u>0.2</u>	<u>0.5</u>	<u>1.4</u>	<u>0.5</u>	<u>0.1</u>	<u>0.7</u>						

Notes:

Yakima River Fish Screening Facility Flow Measurements

Site Columbia

Forebay Elevation 4.22
Canal Flow 148 cfs

Date 8-3-88
Personnel CSA & PAW

Slot # Retu on slot
Screen Diameter (in)
Exposed (in)
Submerged (in)

Time Start	<u>1129H</u>				
Time End	<u>1134H</u>				

Location	U (C) L				U C L			U C L			U C L			U C L			U C L		
Depth	0.2				0.8			0.2			0.8			0.2			0.8		
Vector	+S	+A	+V	-A	S	A	V	S	A	V	S	A	V	S	A	V	S	A	V
1	8.0	.3	.4	-.025															
2	8.0	.4	.3	-.05															
3	8.0	.5	.5	-.05															
4	8.0	.5	.4	-.025															
5	8.0	.4	.5	-.025															
6	8.0	.4	.4	0															
7	8.0	.5	.4	-.05															
8	8.0	.4	.3	-.05															
9	8.0	.4	.5	-.05															
10	8.0	.5	.4	-.025															

Average	8.0	0.43	0.41	0.35															
Minimum	8.0	.3	.3	0															
Maximum	8.0	.5	.5	0.5															

Notes:

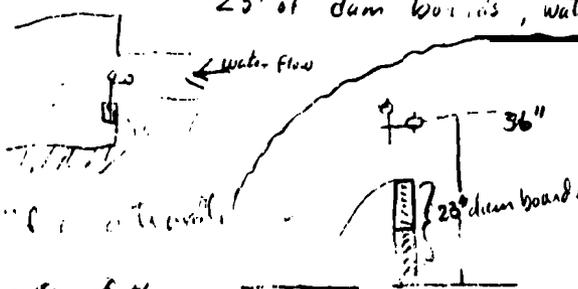
NOTE: -A x 10 =

+S & -A scale = 0-10 fps
+A & +V scale = 0-2 fps

Vertical mounting bracket was positioned b...

Measurement taken in center of fish slot at center of the water column (P.A.D.)

SLOT = 24" wide.
23" of dam boards, water ~ 48" deep in slot



Probes mounted in center of "fish slot" (36" from dam board) in center of X section of 48" wide slot

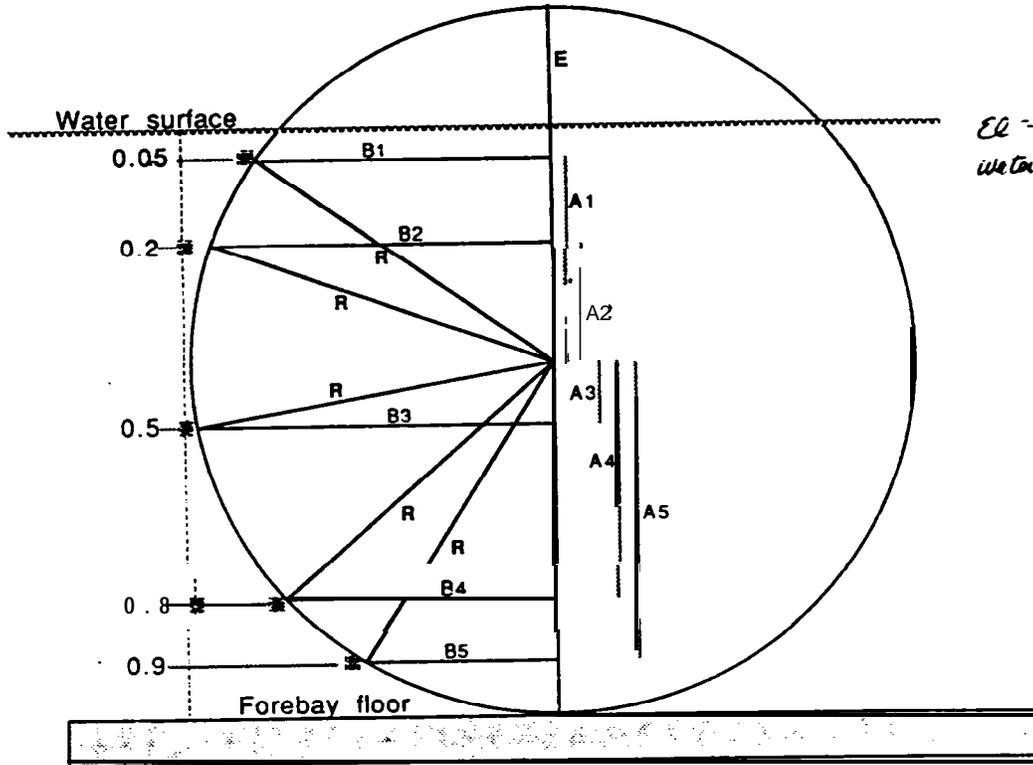
APPENDIX C

RICHLAND SCREENS RAW DATA SHEETS

Appendix C contains the raw data sheets for flow measurements conducted at the Richland Screens on August 4 and 8, 1988. Page C.2 shows the calculations made to position probes at the proper measurement depths, and the distance between the probe and the screen face at the measured depths. A horizontal probe support the length of the distance between the probe and the screen face was used for measurements near the face of the drum screen. Raw data for measurements in front of the drum screens are found on pages C.3 through C.14. Flow measurements for the fish return are on page C.15.

WORKSHEET FOR DEPTH DETERMINATIONS

Rickland Canal
8/4/68



$E_0 = 413.8'$
water depth = 69"

55" drum
13.5" sill
68.5" sep.

Drum Diameter (D): 72"
Radius (R): 36"
Exposed to air (E): 17"
Submerged (Z): 55"

SIDE A

SIDE B

0.05 Z: <u>2.75"</u>	$A1 = (E+0.05Z)-R$	<u>16.25</u>	$B1 = (R^2 - A1^2)^{0.5}$	<u>32.12</u>
0.20 Z: <u>11.0"</u>	$A2 = (E+0.2Z)-R$	<u>8.0</u>	$B2 = (R^2 - A2^2)^{0.5}$	<u>35.17</u>
0.50 Z: <u>27.5"</u>	$A3 = (E+0.5Z)-R$	<u>8.5</u>	$B3 = (R^2 - A3^2)^{0.5}$	<u>34.91</u>
0.80 Z: <u>44.0"</u>	$A4 = (E+0.8Z)-R$	<u>25.0</u>	$B4 = (R^2 - A4^2)^{0.5}$	<u>25.90</u>
0.90 Z: <u>49.5"</u>	$A5 = (E+0.9Z)-R$	<u>30.5</u>	$B5 = (R^2 - A5^2)^{0.5}$	<u>2</u>

Distance From Vertical To Screen Face

0.05 Z: R-B1=	<u>3.88</u>
0.20 Z: R-B2=	<u>0.90"</u>
0.50 Z: R-B3=	<u>1.02"</u>
0.80 Z: R-B4=	<u>10.1"</u>
0.90 Z: R-B5=	<u>16.88"</u>

Yakima River Fish Screening Facility Flow Measurements

Site Richland

Forebay Elevation $\frac{44}{413.8} - \frac{9/8}{413.85}$
 Canal Flow ?

Date 8/4/88
 Personnel CSA & FLW

Screen # 1

Screen Diameter (in) 72
 Exposed (in) 17
 Submerged (in) 55

Time Start	<u>0818H</u>	<u>0818H</u>	<u>1252H</u>	<u>1031H</u>	<u>1252H</u>	<u>1353H</u>
Time End	<u>0822H</u>	<u>0822H</u>	<u>1257H</u>	<u>1034H</u>	<u>1257H</u>	<u>1356H</u>

Location	U (C) L				U (C) L				U (C) L				U (C) L				U (C) L							
	0.2				0.8				.05				0.5				0.8a				0.9			
Depth	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	+V	-A
1	.5	.5	.6	.3	.4	.3	0	-.3	.7	.1	0	-.1	.6	.5	.1	-.2	.7	.3	.1	-.4	.1	-.5	.2	-.2
2	.5	.6	.2	-.3	.4	.3	-.1	0	.4	.2	.1	0	.3	.1	-.2	-.2	.6	.3	0	-.3	.1	-.5	.2	-.1
3	.6	.6	.4	-.2	.5	.3	-.1	-.1	.5	.2	0	0	.1	.2	-.2	-.2	.6	.3	0	-.4	.9	-.5	.2	-.9
4	.4	.6	.3	-.3	.5	.5	0	-.3	.5	.2	0	0	.3	.2	-.2	-.1	.2	.2	-.1	-.4	.1	-.4	.2	-.3
5	.5	.7	.4	-.4	.5	.4	0	-.2	.4	.1	.1	-.1	.1	.1	-.2	-.2	.6	.3	-.1	-.5	.6	-.5	.2	-.1
6	.5	.5	.2	-.2	.4	.3	0	-.2	.5	.1	.1	0	.9	.2	-.1	-.3	.5	.3	0	-.4	.9	-.4	.2	-.3
7	.4	.5	.2	-.2	.5	.4	0	-.4	.4	.2	.3	0	.1	.1	-.2	-.2	.5	.3	-.1	-.3	.1	-.4	.1	-.1
8	.6	.5	.4	-.4	.4	.4	0	-.3	.7	.2	.3	-.1	.2	.3	0	-.2	.5	.3	.1	-.4	.9	-.4	.2	-.1
9	.6	.5	.4	-.2	.4	.4	.1	-.2	.6	.1	.2	.1	.2	.2	-.1	-.2	.7	.2	0	-.3	.1	-.4	.2	-.3
10	.5	.5	.4	-.3	.3	.3	.1	-.3	.6	.2	.4	0	.2	.1	-.1	-.1	.5	.2	0	-.3	.1	-.4	.2	-.3

Average	.51	.55	.23	.28	.43	.26	0	.22	.51	.16	-.15	0.02	.14	.20	.14	0.19	.29	.27	-.01	0.37	.10	.44	-.20	1.15
Minimum	.4	.5	.2	.2	.3	.3	-.1	0	.3	.1	-.4	0	.9	.1	0	.1	.5	.2	-.1	.3	.9	.4	-.3	.9
Maximum	.6	.7	.4	.4	.5	.4	.1	.4	.7	.2	0	.1	.3	.5	.2	.3	.7	.3	.1	.5	.2	.5	-.1	.3

Notes:

C.4

Yakima River Fish Screening Facility Flow Measurements

Site Richland

Forebay Elevation 413.8 - 413.85
 Canal Flow ?

Date 8/4/88
 Personnel CSA & F 201

Screen # 1

Screen Diameter (in) 72
 Exposed (in) 17
 Submerged (in) 55

Time Start	<u>0825H</u>	<u>0825H</u>	<u>1300H</u>	<u>1036H</u>	<u>1300H</u>	<u>1348H</u>
Time End	<u>0829H</u>	<u>0829H</u>	<u>1304H</u>	<u>1039H</u>	<u>1304H</u>	<u>1351H</u>

Location	<u>(L)</u>				<u>(D)</u>				<u>(L)</u>				<u>(L)</u>				<u>(L)</u>				<u>(D)</u>																										
	Depth 0.2								0.8								.05								0.5								0.8a								0.9						
Vector	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-S																			
1	.7	.4	.3	-.3	.5	.4	-.1	-.2	.4	.1	.1	-.1	.9	.2	-.1	-.1	.6	.2	0	-.3	1.0	-.2	.1	-0.9																							
2	.6	.5	.4	-.1	.6	.5	0	-.3	.6	.1	.1	.1	1.2	0	-.3	-.1	.8	.2	-.2	-.3	.9	-.1	.2	-1.1																							
3	.7	.5	.4	-.2	.7	.3	.1	-.2	.4	.1	.2	0	1.1	0	-.2	-.2	.7	.3	-.1	-.4	1.0	-.2	.1	-.9																							
4	.6	.5	.3	-.2	.5	.3	-.1	-.1	.6	.2	.3	.1	1.2	.1	-.2	0	.6	.1	-.1	-.2	1.0	-.1	.2	-1.1																							
5	.6	.5	.4	-.2	.6	.3	0	-.2	.5	.1	.1	0	.9	.2	-.1	-.1	.7	.2	0	-.3	.9	-.1	.1	-1.2																							
6	.6	.4	.4	-.2	.7	.4	0	-.4	.6	.1	.2	.1	1.0	0	-.2	-.1	.6	.3	0	-.3	1.0	-.2	.1	-.9																							
7	.6	.5	.4	-.3	.5	.4	0	-.2	.4	.1	.3	0	1.1	.1	-.2	-.2	.6	.2	0	-.2	1.1	-.2	.2	-1.0																							
8	.5	.4	.3	-.2	.6	.5	.1	-.4	.6	.1	0	0	1.1	0	-.3	-.1	.5	.2	-.1	-.3	1.0	-.2	.1	-1.2																							
9	.3	.6	.4	-.2	.5	.2	.1	0	.7	.1	0	-.1	1.2	0	-.2	-.1	.5	.2	-.1	-.4	1.0	-.2	.1	-1.1																							
10	.6	.5	.3	-.3	.6	.4	.1	-.3	.5	.1	0	0	1.2	.2	-.3	-.1	.7	.1	-.1	-.3	1.0	-.1	.1	-1.1																							

Average	<u>0.58</u>	<u>0.48</u>	<u>.36</u>	<u>0.22</u>	<u>0.58</u>	<u>0.37</u>	<u>.25</u>	<u>.23</u>	<u>0.53</u>	<u>0.11</u>	<u>-.13</u>	<u>0.01</u>	<u>1.09</u>	<u>0.08</u>	<u>.21</u>	<u>0.11</u>	<u>0.63</u>	<u>.20</u>	<u>.07</u>	<u>0.30</u>	<u>0.99</u>	<u>0.16</u>	<u>-.13</u>	<u>1.05</u>
Minimum	<u>.3</u>	<u>.4</u>	<u>.3</u>	<u>.1</u>	<u>.5</u>	<u>.2</u>	<u>-.1</u>	<u>0</u>	<u>.4</u>	<u>.1</u>	<u>-.3</u>	<u>-.1</u>	<u>.9</u>	<u>0</u>	<u>.1</u>	<u>0</u>	<u>.5</u>	<u>.1</u>	<u>0</u>	<u>.2</u>	<u>.9</u>	<u>.1</u>	<u>-.2</u>	<u>.9</u>
Maximum	<u>.7</u>	<u>.6</u>	<u>.4</u>	<u>.3</u>	<u>.7</u>	<u>.5</u>	<u>.1</u>	<u>.4</u>	<u>.7</u>	<u>.2</u>	<u>0</u>	<u>.1</u>	<u>1.2</u>	<u>.2</u>	<u>.3</u>	<u>.2</u>	<u>.8</u>	<u>.3</u>	<u>.2</u>	<u>.4</u>	<u>1.1</u>	<u>.2</u>	<u>-.1</u>	<u>1.2</u>

Notes:

C.5

Yakima River Fish Screening Facility Flow Measurements

Site Richland

Forebay Elevation $\frac{8/4}{9133.8} - \frac{8/8}{85}$
 Canal Flow 7

Date 8/4/88
 Personnel CASEY WIK

Screen # 2

Screen Diameter (in) 72
 Exposed (in) 17
 Submerged (in) 55

Time Start	<u>0835H</u>	<u>0835H</u>	<u>1314H</u>	<u>1042H</u>	<u>1314H</u>	<u>1342H</u>
Time End	<u>0840H</u>	<u>0840H</u>	<u>1320H</u>	<u>1045H</u>	<u>1320H</u>	<u>1345H</u>

Location	<u>(U)</u> C L				<u>(U)</u> C L				<u>(U)</u> C L				<u>(U)</u> C L				<u>(U)</u> C L							
	0.2				0.8				.05				0.5				0.8a				0.9			
Depth	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A
1	1.3	.5	.2	0	-.2	.7	-.1	-.5	1.1	.1	.5	0	1.2	.2	-.3	-.3	.9	.4	2.0	0	1.3	-.6	.2	-1.4
2	1.0	.6	0	0	.4	.4	-.3	-.1	1.0	.1	.2	0	1.2	0	-.1	0	.9	.4	4.2	-.4	1.2	-.6	.2	-1.5
3	1.1	.5	-.4	-.4	.5	.6	-.2	-.3	1.2	.2	.8	0	2.0	.2	-.2	0	1.0	.3	1.8	-.4	1.4	-.6	.3	-1.6
4	1.0	.7	.7	-.2	.4	.3	-.7	-.2	.4	.1	-.5	-.1	1.5	.4	4.2	-.4	.7	.4	.4	0	1.3	-.7	.3	-1.5
5	.4	.7	.9	-.3	1.0	.4	-.3	-.2	.8	.1	.7	-.1	1.0	0	-.3	-.1	1.2	.4	1.0	-.8	1.2	-.6	.2	-1.5
6	.7	.3	.6	-.5	.6	.5	-.4	-.5	1.0	.2	.5	0	1.1	.2	-.1	-.2	1.2	.3	3.2	-.4	1.2	-.6	.2	-1.3
7	.9	.4	-.1	-.1	.4	.4	-.2	-.5	.8	.1	-.2	-.1	1.6	.1	-.3	-.2	.6	.3	1.8	-.3	1.1	-.6	.3	-1.5
8	.7	.7	.9	-.3	.5	.3	-.5	0	.5	0	-.3	-.1	1.4	.2	4.2	-.3	1.2	.4	4.2	-.6	1.2	-.7	.2	-1.5
9	1.2	.6	.1	0	.6	.4	-.2	-.5	.5	.2	-.1	0	.7	0	-.5	-.1	.7	.3	8.0	0	1.0	-.6	.2	-1.3
10	1.3	.5	-.2	0	.4	.5	-.7	-.5	1.6	0	-.4	-.1	1.7	.5	-.4	-.3	1.1	.2	4.2	-.7	.9	-.5	.3	-1.6
Average	0.96	0.55	.29	.17	0.46	0.45	0.46	0.33	0.94	0.11	-.06	0.05	1.34	0.16	.18	0.14	0.95	0.35	3.30	0.36	1.18	0.61	-.24	1.47
Minimum	.4	.3	-.4	0	.2	.3	.2	0	0	0	-.8	0	.7	0	-.2	0	.6	.3	0.0	0	.9	.5	-.3	1.3
Maximum	1.3	.7	.9	.5	1.0	.7	1.1	.5	1.2	.2	.5	.1	2.0	.5	.5	.4	1.2	.4	1.0	.8	1.4	.7	-.2	1.6

Notes:

.8a -V & -A scale = 0-5 fps

C.6

Yakima River Fish Screening Facility Flow Measurements

Site Richland

Forebay Elevation ^{8/4} 412.8 - ^{8/8} 413.85
 Canal Flow ?

Date 8/4/88
 Personnel OSA & FWL

Screen # 2

Screen Diameter (in) 72
 Exposed (in) 17
 Submerged (in) 55

Time Start	<u>0844H</u>	<u>0844H</u>	<u>1324H</u>	<u>1047H</u>	<u>1324H</u>	<u>1337H</u>
Time End	<u>0849H</u>	<u>0947H</u>	<u>1330H</u>	<u>1050H</u>	<u>1330H</u>	<u>1340H</u>

Location Depth	U (C) L				U (C) L				U (C) L				U (C) L				U (C) L				U (C) L			
	0.2				0.8				.05				0.5				0.8a				0.9			
Vector	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A
1	1.3	.7	.3	.1	1.8	.5	-.4	-.1	.7	.1	.3	0	1.1	-.1	.2	-.3	1.0	.2	-.1	-.5	1.0	-.4	.2	-.4
2	.8	.7	.8	-.5	.6	.6	0	-.4	.5	0	-.2	-.1	1.5	.2	-.2	-.1	1.2	.3	-.2	-.2	1.2	-.4	.2	-.3
3	.2	.5	.5	-.3	.6	.4	.1	-.4	.7	.1	-.2	-.1	1.4	.4	0	-.2	.8	.2	-.5	-.6	.9	-.4	.2	-.3
4	1.2	.6	.8	-.3	.8	.6	-.1	-.6	.5	0	-.4	0	.2	.1	-.1	-.2	1.3	.3	-.4	-.1	1.2	-.3	.2	-.6
5	1.0	.5	.1	0	1.0	.4	-.3	.1	.5	.1	-.6	0	.9	.1	-.1	-.1	1.0	.2	.4	-.6	1.5	-.5	.2	-.3
6	.9	.7	.8	-.5	.6	.4	-.3	-.4	.4	-.1	-.7	-.1	1.1	.2	-.3	-.2	.6	.3	-.3	0	1.2	-.4	.1	-.3
7	1.0	.6	.2	0	.7	.2	0	0	.3	0	-.4	-.1	1.2	.2	-.2	-.1	.9	.1	.4	-.5	1.4	-.5	.2	-.3
8	1.2	.4	.2	.1	.7	.5	.2	-.3	.8	.1	.4	.1	1.6	.3	-.2	-.6	1.1	.2	-.4	-.2	1.3	-.5	.1	-.4
9	.8	.7	.6	-.6	.7	.2	.1	-.2	1.3	.3	.8	.1	.8	-.2	-.2	-.4	.5	.2	-.2	.2	1.0	-.3	.2	-.5
10	.8	.4	.1	.2	.6	.3	.1	-.1	1.3	0	-.4	0	1.0	.3	-.3	0	.9	.2	-.4	-.1	1.2	-.4	.1	-.2

Average	0.92	0.58	0.44	0.22	0.71	0.41	0.06	0.24	0.60	0.16	0.14	0.00	1.08	0.17	0.14	0.17	0.93	0.22	0.17	0.26	1.19	0.41	-.17	1.36
Minimum	.2	.4	.1	-.2	.6	.2	-.4	-.1	.3	-.1	-.8	-.1	.2	-.2	-.2	0	.5	.1	-.4	-.2	.9	.3	-.2	1.2
Maximum	1.3	.7	.8	.6	1.0	.6	.3	.6	1.3	.3	.7	.1	1.6	.4	.3	.4	1.3	.3	.5	.6	1.5	.5	-.1	1.6

Notes: 0.8 scale all 0-2 fms

C.7

Yakima River Fish Screening Facility Flow Measurements

Site Richland

Forebay Elevation ^{8/4} 413.8 - ^{8/5} 413.85
 Canal Flow 7

Date 8/4/88
 Personnel C.S.R. & E.W.K.

Screen # 2

Screen Diameter (in) 72
 Exposed (in) 17
 Submerged (in) 55

Time Start	<u>0852 H</u>	<u>0852</u>	<u>1833 H</u>	<u>1052 H</u>	<u>1333 H</u>	<u>1931 H</u>
Time End	<u>0856 H</u>	<u>076</u>	<u>1837 H</u>	<u>1055 H</u>	<u>1332 H</u>	<u>1934 H</u>

~~8-8-88~~ 8/9/88 ~~8/8/88~~

C.8

Location	U C (L)				U C (L)				U C (L)				U C (L)				U C (L)				U C (L)							
	0.2				0.8				.05				0.5				0.8a				0.9							
Depth	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A
1	.9	.7	.7	-.1	.8	.3	.2	0	1.1	.2	.7	0	1.1	.1	-.2	-.1	.6	0	.2	-.2	1.1	-.2	.2	-.3				
2	.6	.6	.7	-.5	.9	.2	-.1	-.2	1.0	.1	.3	.1	1.2	.2	-.1	-.2	.7	0	.2	-.2	1.1	-.2	.2	-.1				
3	.9	.4	.7	-.6	.7	.4	-.2	-.4	.6	0	.2	.1	.7	0	-.3	-.2	.8	.1	-.1	0	.8	-.1	.1	-.1				
4	.7	.4	.4	-.5	.9	.3	.2	.4	.8	.1	.1	0	1.3	.2	+.2	-.3	.9	.1	-.3	.1	1.1	-.2	.1	-.3				
5	.4	.5	.6	-.4	.8	.4	-.4	0	.6	0	0	.1	.7	-.2	-.2	-.2	1.2	.2	-.1	-.2	1.2	-.3	.2	-.4				
6	.7	.4	-.1	.2	.9	.2	0	.5	.6	0	.1	.1	1.0	0	-.2	-.1	.6	0	.2	-.3	.9	-.2	.2	-.2				
7	.5	.5	0	.1	.7	.4	0	-.1	1.2	.2	.9	0	1.5	.3	0	-.2	1.2	.2	-.3	-.2	1.0	-.3	.1	-.9				
8	.4	.4	.2	-.3	.9	.4	0	.1	1.1	.2	.4	0	.9	-.1	-.2	-.3	.7	.1	.2	-.6	1.0	-.2	.1	-.1				
9	1.5	.6	0	0	.9	.3	0	0	.7	0	-.4	.1	1.0	.1	-.2	-.2	1.2	.2	-.2	-.3	.9	-.2	.2	-.4				
10	.5	.5	.3	-.4	.9	.1	.2	-.4	.8	.1	.2	.1	1.4	0	-.6	+.1	1.1	.1	-.2	-.3	1.0	-.3	.1	-.1				

Average	0.71	0.50	0.35	0.25	0.93	0.30	-0.05	0.03	0.65	0.04	-.24	-0.16	1.04	0.06	0.18	0.17	0.91	0.10	0.04	0.22	1.01	0.22	-.15	1.19
Minimum	.4	.4	-.1	-.2	.7	.1	-.4	-.5	.6	0	-.8	-.1	.7	-.2	-.2	-.1	.6	0	-.2	0	.8	.1	-.2	.9
Maximum	1.5	.7	.7	.6	.9	.4	.2	.4	1.2	.2	.4	0	1.5	.3	.6	.3	1.2	.2	.3	.6	1.1	.3	-.1	1.4

Notes:

Yakima River Fish Screening Facility Flow Measurements

Site Richland

Forebay Elevation 413.8^{8/4} - 413.85^{8/8}
 Canal Flow ?

Date 8/11/88
 Personnel CAS & JWL

Screen # 3

Screen Diameter (in) 72
 Exposed (in) 17
 Submerged (in) 55

Time Start	<u>0900 H</u>	<u>0900 H</u>	<u>1340 H</u>	<u>8-8-88 1058 H</u>	<u>8/4/88 1340 H</u>	<u>8/8/88 1326 H</u>
Time End	<u>0904 H</u>	<u>0904 H</u>	<u>1345 H</u>	<u>1101 H</u>	<u>1345 H</u>	<u>1329 H</u>

Location	(U) C L	(U) C L	(U) C L	(U) C L	(U) C L	(U) C L
Depth	0.2	0.8	.05	0.5	0.8a *	0.9
Vector	+S +A +V -A	+S +A +V -A	+S +A +V -A	+S +A +V -A	+S +A +V -A	+S +A +V -A
1	1.1 .4 .2 -.4	1.7 .6 -.1 -.3	1.1 .1 0 0	1.0 .2 0 -.2	1.1 .2 6.0 -.4	1.3 -.6 .2 -1.5
2	1.0 .5 .2 -.2	1.8 .3 .2 -.4	1.1 .2 .1 0	1.1 .3 .1 -.2	1.0 .3 7.5 -.5	1.5 -.5 .2 -1.3
3	.9 .6 .2 -.1	1.9 .3 .3 -.4	1.1 .1 .5 0	1.0 .2 0 -.2	1.1 .3 7.5 -.3	1.2 -.4 .2 -1.4
4	.8 .4 0 -.2	1.9 .4 .1 -.3	1.3 .1 .4 0	1.1 .2 -.2 -.2	1.2 .2 7.0 -.4	1.4 -.5 .2 -1.2
5	1.6 .5 .7 -.2	1.8 .4 -.1 -.2	1.2 .2 .3 0	1.3 .2 .3 -.2	1.1 .3 8.0 -.7	1.3 -.5 .3 1.3
6	1.1 .5 .6 -.2	1.8 .4 0 -.2	1.2 .1 .5 0	1.1 .2 -.1 -.2	1.1 .3 8.5 -.5	1.2 -.6 .2 -1.3
7	1.2 .6 .1 -.3	1.1 .3 .3 0	1.3 .1 .6 0	1.1 .4 0 -.2	1.0 .2 8.5 -.5	1.4 -.5 .2 -1.3
8	.8 .5 .1 -.3	1.8 .3 -.2 -.2	1.3 .1 0 0	1.2 .2 .1 -.1	1.2 .4 6.5 -.2	1.5 -.6 .3 -1.3
9	1.0 .5 .4 .2	1.0 .3 .3 -.2	1.2 .1 .4 0	1.2 .3 .1 -.2	1.3 .3 8.5 -.4	1.6 -.5 .2 -1.6
10	1.0 .6 .3 -.2	1.9 .4 .1 -.2	1.0 .1 .4 0	1.0 .4 .2 -.1	1.1 .2 8.5 -.7	1.1 -.5 .3 -1.5

Average	1.05	0.51	0.28	0.19	0.87	0.14	-0.03	0.24	1.19	0.12	-0.32	0	1.06	0.26	-0.09	0.18	1.17	0.27	7.45	0.46	1.35	0.52	-0.23	1.37
Minimum	.8	.4	0	-.2	.7	.3	-1.1	0	1.0	.1	-.6	0	.8	.2	-.3	.1	1.0	.2	-8.5	.2	1.1	.4	-.3	1.2
Maximum	1.6	.6	.7	.4	1.1	.6	.3	.4	1.3	.2	0	0	1.2	.4	.2	.2	1.3	.4	6.0	.7	1.6	.6	-.2	1.6

Notes: * These readings seem very strange - unexplainable at this point. (1.22)
 May be due to probe touching screen! (CJA) 8/30/88

C.9

Yakima River Fish Screening Facility Flow Measurements

Site Richland

Forebay Elevation ⁴⁴ 413.8 - ⁴⁸ 413.85
 Canal Flow 7

Date 8/4/88
 Personnel CAS & ENL

Screen # 3
 Screen Diameter (in) 3 2
 Exposed (in) 17
 Submerged (in) 55

8-8-88 → 8/4/88 → 8/8/88

Time Start	0908 H	0908 H	1349 H	1102 H	1349 H	1321 H
Time End	0912 H	0912 H	1353 H	1105 H	1353 H	1324 H

Location	U (C) L				U (C) L				U (C) L				U (C) L				U (C) L				U (C) L			
	0.2				0.8				.05				0.5				0.8a				0.9			
Depth	U	A	V	-A	U	A	V	-A	U	A	-V	-A	U	A	-V	-A	U	A	-V	-A	U	A	-V	-A
1	1.0	.5	.4	-.3	.9	.3	.1	-.3	1.2	.1	0	.1	1.0	.3	.1	-.1	1.2	.2	-.1	-.3	1.1	-.3	.2	-.2
2	1.0	.5	.6	-.2	.9	.3	-.1	-.1	1.3	.1	.1	.1	1.0	.3	.1	-.2	1.1	.1	-.2	-.4	1.5	-.4	.2	-.3
3	1.0	.6	0	-.2	.9	.4	.1	-.2	1.0	.1	0	0	1.0	.2	.1	-.2	.9	.2	0	-.4	1.3	.3	.2	-.2
4	1.1	.6	.6	-.2	.9	.3	.4	-.2	.9	.1	.2	.1	.9	.3	-.1	-.1	1.1	.1	.2	-.2	1.5	-.3	.2	-.4
5	.8	.3	.2	-.3	.9	.3	.1	-.4	1.3	.1	.4	0	.9	.3	-.1	-.2	1.2	.1	-.1	-.1	1.4	-.3	.2	-.2
6	1.0	.6	.4	-.4	.9	.4	-.1	-.2	1.3	.1	.2	.1	.9	.3	.1	-.2	1.1	.1	.2	0	1.4	-.2	.1	-.3
7	1.0	.6	.4	-.2	.9	.3	0	0	1.2	0	.1	.2	1.0	.2	.3	-.2	.8	.2	-.2	-.4	1.1	-.2	.1	-.1
8	1.4	.6	.8	-.2	.8	.4	-.2	-.3	1.0	.1	.2	.1	.9	.3	.1	-.2	1.0	.2	0	-.4	1.4	-.2	.2	-.2
9	1.1	.4	.1	-.2	1.0	.5	-.1	0	1.2	.1	-.3	.1	.9	.3	0	-.2	1.2	.1	-.1	-.2	1.4	-.3	.2	-.1
10	.8	.5	.6	-.2	.8	.4	-.1	-.3	.9	.1	.2	.1	.8	.2	.1	-.1	1.2	.2	.1	-.3	1.2	-.2	.1	-.3

Average	1.02	0.52	0.41	0.25	0.89	0.36	0.01	0.20	1.13	0.04	-.11	-.04	0.93	0.27	-.07	0.18	1.08	.15	0.02	0.27	1.39	0.27	-.17	1.20
Minimum	.8	.3	0	-.2	.8	.3	-.2	0	.9	0	-.4	-.2	.8	.2	-.3	.1	.8	.1	-.2	0	1.2	.2	-.2	1.1
Maximum	1.4	.6	.8	0	1.0	.5	.4	.3	1.3	.1	.3	0	1.0	.3	.1	.3	1.2	.2	.2	.4	1.5	.4	-.1	1.5

Notes:

C.10

Yuma River Fish Screen Facility Flow Measurements

Site Richland

Forebay Elevation ⁴⁴ 413.8 - ⁸⁰ 413.85
 Canal Flow ?

Date 8/4/88
 Personnel CSA & F&L

Screen # 3
 Screen Diameter (in) 72
 Exposed (in) 17
 Submerged (in) 55

Time Start	<u>0916 H</u>	<u>0916 H</u>	<u>1357 H</u>	<u>8-8-88</u> <u>1107 H</u>	<u>8/4/88</u> <u>1357 H</u>	<u>8/8/88</u> <u>1316 H</u>
Time End	<u>0921 H</u>	<u>0921 H</u>	<u>1401 H</u>	<u>1110 H</u>	<u>1401 H</u>	<u>1319 H</u>

Location	U C (L)				U C (L)				U C (L)				U C (L)				U C (L)				U C (L)			
	0.2				0.8				.05				0.5				0.8a				0.9			
Depth	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A
1	1.0	.5	.6	-.1	1.0	.2	0	-.2	1.1	.1	.4	0	.9	.3	0	-.1	1.3	.1	0	-.2	1.3	-.1	.1	-.4
2	1.1	.5	.2	-.3	.9	.2	.2	-.1	1.0	.1	.2	.1	1.2	.3	.1	-.2	1.1	.1	-.1	-.4	1.1	0	.1	-.2
3	.9	.4	.4	-.2	1.0	.3	.2	-.3	1.2	0	.4	.1	1.1	.4	.2	-.1	.9	.1	-.1	-.2	1.2	-.2	.1	-.6
4	1.2	.4	.2	0	1.0	.2	0	-.1	.9	.1	-.2	.1	1.0	.3	.2	-.2	.9	.1	-.3	-.2	1.3	-.2	.1	-.1
5	1.1	.5	.2	0	1.1	.2	-.1	-.2	1.0	.1	.5	.1	1.2	.2	.1	-.1	1.1	.1	0	-.3	1.5	-.1	.1	-.2
6	1.2	.4	.4	-.2	.9	.2	.2	-.3	1.2	0	.2	0	.7	.1	.1	-.1	.9	.1	-.2	-.3	1.3	-.2	.1	-.2
7	1.0	.5	.2	-.2	1.0	.3	.2	+.2	1.2	0	0	.1	1.1	.3	.2	0	.9	0	-.2	0	1.2	-.2	.1	-.1
8	1.2	.3	.3	0	.8	.3	.2	0	1.1	.1	.4	.1	1.0	.3	0	-.2	1.3	.1	-.1	-.2	1.2	-.2	.2	-.3
9	.6	.5	.2	-.4	.9	.4	-.1	-.1	1.2	.1	.1	0	1.3	.3	.2	-.2	1.0	.1	-.3	-.2	1.2	-.2	0	-.4
10	.8	.4	.5	-.1	.8	.3	-.1	-.3	1.1	.1	.4	.1	.7	.4	.1	-.1	1.0	.1	-.1	-.4	1.3	-.1	.1	-.3

Average	1.01	0.44	0.29	0.15	0.94	0.26	0.07	0.14	1.10	0.17	-.24	-.07	1.04	0.32	-.12	.13	1.01	0.09	0.14	0.24	1.26	0.15	-.1	.22
Minimum	.6	.3	.1	0	.8	.2	-.1	-.2	.9	0	-.5	-.1	.7	.2	-.2	0	.9	0	0	0	1.1	0	-.2	1.0
Maximum	1.2	.5	.6	.4	1.1	.4	.2	.3	1.2	.1	.2	0	1.3	.4	0	.2	1.3	.1	.3	.4	1.5	.2	0	1.4

Notes:

C.11

Yakima River Fish Screening Facility Flow Measurements

Site Richland

Forebay Elevation ^{8/4} 413.8 - ^{8/8} 413.85
 Canal Flow ?

Date 8/4/88
 Personnel CSA & EML

Screen # 4

Screen Diameter (in) 72
 Exposed (in) 17
 Submerged (in) 55

Time Start	<u>0926 H</u>	<u>0926 H</u>	<u>1200 H</u>	<u>1113 H</u>	<u>1230 H</u>	<u>1307 H</u>
Time End	<u>0930 H</u>	<u>0230 H</u>	<u>1203 H</u>	<u>1116 H</u>	<u>1233 H</u>	<u>1310 H</u>

Location	<u>(U)</u> C L				<u>(U)</u> C L				<u>(U)</u> C L				<u>(U)</u> C L				<u>(U)</u> C L							
	0.2				0.8				.05				0.5				0.8a				0.9			
Depth	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	-A	-V	-S	+S	-A	-V	-S
1	1.3	.6	.1	-.3	1.3	.5	-.2	-.5	1.3	.4	0	-.1	1.2	.4	.1	-.2	1.5	-.3	.2	-.4	1.3	-.6	.2	-.1.5
2	1.3	.6	.4	-.2	1.3	.5	-.1	-.4	1.5	.4	.1	-.1	1.5	.3	.1	-.2	1.6	-.5	.3	-.1.6	1.5	-.5	.2	-.1.6
3	1.2	.6	.4	0	1.3	.5	-.1	-.3	1.4	.4	0	-.1	1.3	.3	.1	-.2	1.5	-.4	.3	-.1.5	1.5	-.5	.3	-.1.6
4	1.5	.5	.2	-.4	1.4	.6	-.1	-.4	1.5	.5	.1	-.1	1.4	.4	.1	-.2	1.6	-.5	.3	-.1.6	1.4	-.5	.3	-.1.5
5	1.6	.6	0	-.3	1.3	.6	-.1	-.3	1.5	.5	.1	-.2	1.3	.5	.2	-.2	1.4	-.4	.3	-.1.6	1.4	-.5	.3	-.1.6
6	1.4	.7	.4	-.3	1.3	.6	-.2	-.5	1.5	.4	0	-.1	1.2	.4	.1	-.3	1.5	-.4	.3	-.1.4	1.4	-.5	.2	-.1.5
7	1.4	.5	.2	-.2	1.2	.6	-.2	-.3	1.4	.4	.1	-.1	1.3	.4	.2	-.2	1.5	-.4	.3	-.1.6	1.5	-.5	.3	-.1.5
8	1.3	.6	.4	-.3	1.4	.5	.1	-.3	1.4	.4	.1	-.1	1.4	.5	.2	-.2	1.6	-.5	.3	-.1.5	1.5	-.4	.4	-.1.6
9	1.3	.5	.1	-.2	1.3	.6	-.1	-.3	1.5	.5	.2	-.1	1.4	.4	.2	-.2	1.6	-.4	.3	-.1.5	1.3	-.4	.3	-.1.5
10	1.4	.6	.5	-.2	1.3	.7	-.2	-.4	1.4	.4	0	-.1	1.3	.5	.1	-.3	1.5	-.4	.2	-.1.6	1.5	-.5	.2	-.1.4

Average	1.37	0.59	.27	0.24	1.31	0.57	-.12	.37	1.44	0.43	-.07	.11	1.33	0.41	-.14	.22	1.53	.18	-.28	1.53	1.43	.49	-.27	1.52
Minimum	1.2	.5	0	0	1.2	.5	-.2	.3	1.2	.4	-.2	.1	1.2	.3	-.2	.2	1.4	.3	-.3	1.4	1.3	.4	-.4	1.4
Maximum	1.6	.7	.5	.4	1.4	.7	.1	.5	1.5	.5	0	.2	1.5	.5	-.1	.3	1.6	.5	-.2	1.6	1.5	.6	-.2	1.6

Notes:

X Y
 823 -V +S
 818 +A -S

C.12

Yakima River Fish Screening Facility Flow Measurements

site Richland

Screen # 4

Screen Diameter (in) 72
Exposed (in) 17
Submerged (in) 55

Forcible Elevation ^{9/4} 913.8 - ^{9/6} 913.85
Canal Flow 7

Date 8/4/88
Personnel 2 AS & 4

Time Start	<u>0934 H</u>	<u>0934 H</u>	<u>1154 H</u>	<u>1118 HRS</u>	<u>1236 H.</u>	<u>1302 H</u>
Time End	<u>0939 H</u>	<u>0939 H</u>	<u>1157 H</u>	<u>1121 H</u>	<u>1239 H</u>	<u>1305 H</u>

Location	U (C) L				U (C) L				U (C) L				U (C) L				U (C) L				U (C) L							
	0.2				0.8				.05				0.5				0.8a				0.9							
Depth	U	C	L		U	C	L		U	C	L		U	C	L		U	C	L		U	C	L		U	C	L	
Vector	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	-A	-V	-S	+S	-A	-V	-S	+S	-A	-V	-S
1	1.5	.6	.3	-1	1.5	.5	.3	-.4	1.5	.4	.2	0	1.6	.1	.1	0	1.6	-.3	.2	-1.8	1.7	-.3	.2	-1.6				
2	1.7	.5	.2	-.3	1.5	.4	0	-.2	1.6	.4	.1	0	1.5	.4	.3	-.1	1.6	-.3	0	-1.6	1.6	-.3	.2	-1.7				
3	1.5	.5	.2	-.3	1.5	.4	-.2	-.3	1.6	.3	.1	-.1	1.6	.5	.3	-.1	1.7	-.3	.1	-1.5	1.8	-.3	.3	-1.2				
4	1.5	.5	.4	-.1	1.4	.4	-.1	-.3	1.5	.3	.1	0	1.6	.3	.2	-.1	1.6	-.4	.2	-1.7	1.5	-.3	.2	-1.6				
5	1.5	.5	.4	-.3	1.4	.5	-.1	-.3	1.8	.4	.2	-.1	1.5	.2	0	0	1.7	-.3	.2	-1.8	1.6	-.4	.2	-1.6				
6	1.7	.5	.1	-.3	1.5	.4	-.2	-.3	1.6	.3	.2	0	1.7	.3	.1	-.1	1.6	-.3	.2	-1.7	1.6	-.3	.2	-1.7				
7	1.4	.4	.3	-.3	1.4	.6	-.2	-.8	1.5	.4	.1	0	1.7	.4	.3	-.2	1.6	-.2	.1	-1.7	1.5	-.2	.3	-1.6				
8	1.7	.6	.4	-.1	1.6	.5	-.3	-.6	1.7	.4	.2	-.1	1.6	.4	.3	-.1	1.6	-.3	.2	-1.7	1.6	-.2	.2	-1.5				
9	1.6	.4	.2	-.4	1.4	.5	-.2	-.5	1.6	.3	.1	0	1.5	.2	0	-.1	1.5	-.2	.1	-1.6	1.4	-.3	.2	-1.2				
10	1.5	.5	0	-.2	1.3	.4	-.1	-.2	1.6	.4	0	0	1.6	.3	.1	0	1.6	-.4	.1	-1.7	1.5	-.3	.2	-1.2				

Average	1.59	0.50	.25	.24	1.45	0.44	-.17	.039	1.67	0.36	-.13	.03	1.56	0.31	-.17	0.08	1.61	0.30	-.14	1.69	1.58	0.29	-.22	1.64
Minimum	1.4	.4	0	0	1.3	.4	-.3	.2	1.5	.3	-.2	0	1.4	.2	-.3	0	1.5	.2	-.2	1.5	1.4	.2	-.3	1.6
Maximum	1.7	.6	.4	.4	1.6	.5	0	.2	1.8	.4	0	.1	1.7	.4	0	.2	1.7	.4	0	1.8	1.8	.4	-.2	1.7

Notes:

Yakima River Fish Screening Facility Flow Measurements

Site Richland

Forebay Elevation $\frac{8/8}{413.8} - \frac{8/8}{413.85}$
 Canal Flow ?

Date 8/4/88
 Personnel CSA & EWB

Screen # A

Screen Diameter (in) 72
 Exposed (in) 17
 Submerged (in) 55

Time Start	<u>0944H</u>	<u>0944H</u>	<u>1142H</u>	<u>1124H</u>	<u>1242H</u>	<u>1255H</u>
Time End	<u>0949H</u>	<u>0949H</u>	<u>1145H</u>	<u>1128H</u>	<u>1245H</u>	<u>1258H</u>

Location	U C (L)				U C (L)				U C (L)				U C (L)				U C (L)				U C (L)			
	0.2				0.8				.05				0.5				0.8a				0.9			
Depth																								
Vector	+S	+A	+V	-A	+S	+A	+V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	-A	-V	-S	+S	-A	-V	-S
1	2.0	.3	.4	.2	1.8	.2	.1	0	1.8	.2	.1	.1	2.0	.2	.3	.3	2.1	.1	.2	-2.2	1.8	.1	.2	2.0
2	1.8	.4	.6	.2	1.9	.2	.2	-.1	1.7	.2	.1	.1	2.1	.5	-.1	.3	1.9	.3	.2	-2.2	1.7	0	.2	1.8
3	2.4	.3	.3	0	2.0	.2	-.2	.1	1.7	.2	.1	.2	2.0	-.1	.4	.2	2.1	.3	0	-2.2	1.9	.1	.1	1.8
4	1.7	.4	.5	+.2	2.1	.2	0	-.2	1.9	.3	.3	.1	2.0	0	.3	.1	1.8	.3	.1	-2.1	1.8	.1	.2	1.9
5	2.2	.4	.2	0	2.0	.1	.1	-.2	1.9	.3	.1	.1	2.0	0	.3	.3	1.9	.3	.1	-2.1	1.9	0	.2	1.9
6	1.9	.4	.5	.2	1.9	.3	.1	0	1.7	.2	0	.2	2.0	.5	.2	.4	2.0	.4	0	-2.1	1.8	.1	.2	1.8
7	2.2	.2	.1	0	1.9	.2	.1	0	1.8	.2	.1	.2	1.9	-.1	.4	.2	1.8	.2	.1	-2.3	1.8	0	.2	1.8
8	1.8	.4	.3	.2	1.9	.2	.3	-.1	1.6	.2	0	.2	2.1	-.5	.1	.3	1.9	.3	0	-2.0	1.8	0	.1	1.8
9	2.2	.3	.4	.1	1.9	.2	.1	-.1	2.0	.2	.1	.2	2.0	.3	.1	.3	2.0	.2	0	-2.1	1.7	0	.2	1.9
10	2.1	.2	.2	0	2.0	.2	.1	-.2	1.8	.2	.1	.1	2.1	.4	.1	.4	2.1	.4	0	-2.2	1.7	.1	.2	1.9

Average	2.03	0.33	.35	.11	1.94	0.20	.09	.08	1.79	0.22	-.1	-.15	2.02	0.12	-.21	-.28	1.96	0.28	-.07	2.15	1.79	0.05	-.18	1.87
Minimum	1.7	.2	.1	0	1.8	.1	-.2	-.1	1.6	.2	-.3	-.2	1.9	-.5	-.4	-.4	1.8	.1	-.2	2.0	1.7	-.1	-.2	1.8
Maximum	2.4	.4	.6	.2	2.1	.3	.2	.2	2.0	.3	0	-.1	2.1	.5	.1	-.1	2.1	.4	0	2.3	1.9	0	-.1	2.0

Notes: +S & -A scale = 0-5 fps

X Y
 0.05 818 +A +S
 0.05 823 -A -V

 0.8a 810 +A +S
 0.8a 811 -A -V

C.14

Yakima River Fish Screening Facility Flow Measurements

Site Richland

Forebay Elevation 413.8 8/4/88

Date 8/4/88

Screen # Fish Return Lot

Screen Diameter (in)

Canal Flow ?

Personnel CSA & JWB

Exposed (in)

Submerged (in) 62" deep

Time Start	<u>1131H</u>	<u>1131H</u>				
Time End	<u>1140H</u>	<u>1140H</u>				

Location	U (C) L				U (C) L				U C L			U C L			U C L			U C L		
	0.2				0.8				.05			0.5			0.8a			0.9		
Depth									S	A	V	S	A	V	S	A	V	S	A	V
Vector	+S	+A	-V	-A	-S	+A	-V	-A												
1	7.0	.5	.7	-.4	7.5	.25	.4	-.5												
	7.0	.5	.6	-.5	7.0	.5	-.4	-.6												
	7.0	.5	.4	-.3	7.0	.25	-.5	-.5												
A	7.0	.5	.6	-.3	7.0	.5	-.8	-.7												
	6.5	.25	.6	-.5	7.0	.25	-.4	-.4												
6	7.0	.25	.5	-.4	7.5	.5	-.3	-.5												
7	7.0	.25	.6	-.4	7.0	.25	-.6	-.5												
8	7.0	.25	.6	-.5	7.0	.5	-.4	-.3												
9	7.0	.25	.5	-.5	7.0	.5	-.5	-.3												
10	7.0	.25	.6	-.5	7.5	.6	-.5	-.4												
Average	6.95	0.35	-0.5	0.43	7.15	0.40	0.48	0.47												
Minimum	6.5	0.25	-0.7	0.3	7.0	.25	0.3	0.3												
Maximum	7.0	0.5	-0.4	0.5	7.5	.50	0.8	0.7												

Notes: 0.2 818 (X) (Y) 0-2 fps
 0.2 823 +A +V (Note: +A is toward screens)
 0.6 1101 -A -V 0-2 fps
 0.8 1141 -S +A scale = 0-10 fps

0.2 depth = 12.5"
 0.8 depth = 49.5"

Note: +A Denotes movement towards screens
 +V Denotes upward movement, -V is downward.

C.15

APPENDIX D

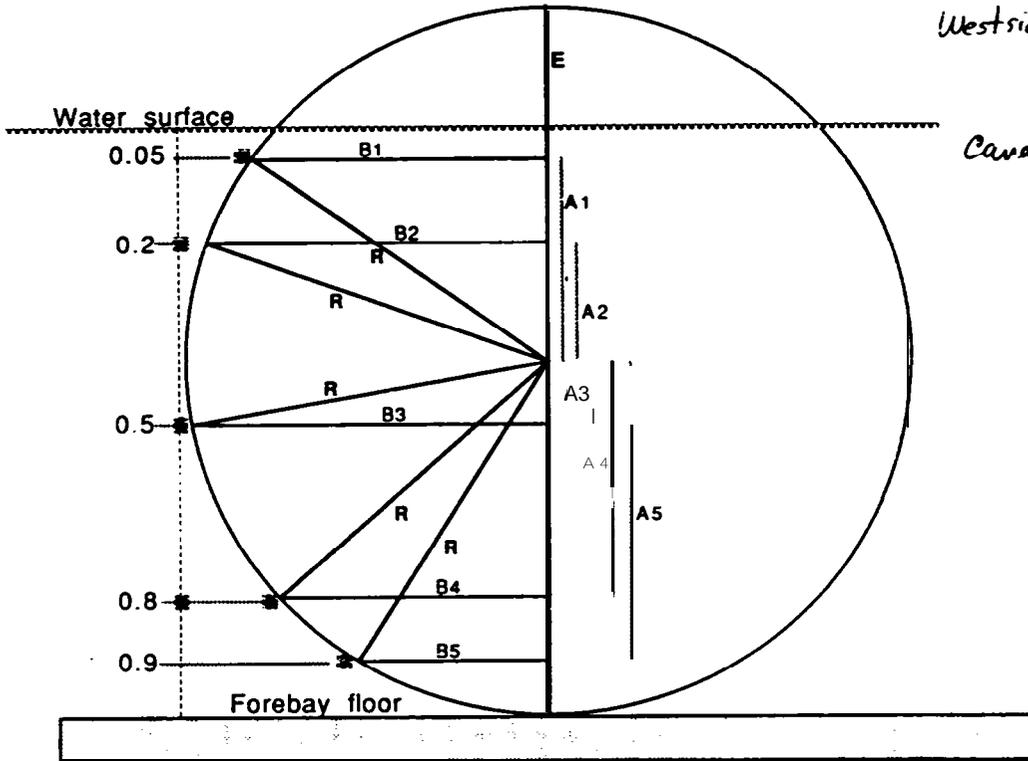
WESTSIDE DITCH SCREENS RAW DATA SHEETS

Appendix D contains the raw data sheets for flow measurements conducted at the Westside Ditch Screens on August 8, 1988. Page D.2 shows the calculations made to position probes at the proper measurement depths, and the distance between the probe and the screen face at the measured depths. Raw data for measurements in front of the drum screens are found on pages D.3 through D-6. Flow measurements for the fish return are on page 0.7.

WORKSHEET FOR DEPTH DETERMINATIONS

Westside Ditch
8/9/88

Canal flow: 96 cfs



Drum Diameter (D): 72" SIDE A SIDE B

Radius (R): 36"

Exposed to air (E) : 14"

Submerged (Z): 58" + 5/11" = 64"

0.05 Z:	<u>12.8"</u>	A1= (E+0.05Z)-R	<u>9.2</u>	B1= (R ² -A1 ²) ^{0.5}	<u>34.80</u>
0.20 z:	<u>12.8"</u>	A2= (E+0.2Z)-R	<u>29.2</u>	B2= (R ² -A2 ²) ^{0.5}	<u>21.06</u>
0.50 z:	<u>51.2"</u>	A3= (E+0.5Z)-R	<u>29.2</u>	B3= (R ² -A3 ²) ^{0.5}	<u>21.06</u>
0.80 Z:	<u>51.2"</u>	A4= (E+0.8Z)-R	<u>29.2</u>	B4= (R ² -A4 ²) ^{0.5}	<u>21.06</u>
0.90 z:	<u>51.2"</u>	A5= (E+0.9Z)-R	<u>29.2</u>	B5= (R ² -A5 ²) ^{0.5}	<u>21.06</u>

Distance From Vertical To Screen Face

0.05 Z: R-B1= 1.20"

0.20 Z: R-B2= 14.94"

0.50 Z: R-B3= 14.94"

0.80 Z: R-B4= 14.94"

0.90 Z: R-B5= 14.94"

Yakima River Fish Screening Facility Flow Measurements

Site Westside

Screen # 1

Screen Diameter (in) 72"

Exposed (in) 14"

Submerged (in) 58" + sill 64"

Forebay Elevation 3.2 (0.2' under 3' line)

Canal Flow 92 cfs

Date 8/19/88

Personnel CSA/EWL

Other gauge readings: $\left\{ \begin{array}{l} 1.7 \text{ (0.3' below 2' line) in small canal} \\ 3.3 \text{ (0.3' below 3' line) at valve to user canal.} \\ 6.5 \text{ (0.5' below 6' line) in West canal} \end{array} \right.$

Time Start	<u>1234 Hrs.</u>	<u>1234 Hrs</u>				
Time End	<u>1238 Hrs.</u>	<u>1234 Hrs</u>				

Location	U C L				U C L				U C L				U C L				U C L							
	0.2				0.8				0.2				0.8				0.2				0.8			
Depth																								
Vector	+S	+A	-V	-A	+S	+A	-V	-A	S	A	V		S	A	V		S	A	V		S	A	V	
1	.8	.1	.3	-.2	.7	.7	.1	-.6																
2	.7	.2	-.1	-.2	.7	.6	.1	-.6																
3	.8	.3	.4	-.2	.7	.7	.1	-.6																
4	.8	.3	.3	-.2	.4	.7	.2	-.6																
5	.8	.3	0	-.2	.6	.8	0	-.7																
6	.8	.3	0	-.2	.7	.7	.1	-.7																
7	.7	.3	.4	-.1	.6	.6	-.1	-.8																
8	.8	.4	.3	-.1	.7	.5	.1	-.7																
9	.6	.2	.1	-.2	.5	.5	.1	-.7																
10	.6	.3	.2	-.2	.7	.6	.1	-.6																

Average	<u>0.74</u>	<u>0.30</u>	<u>0.14</u>	<u>0.18</u>	<u>0.63</u>	<u>0.14</u>	<u>0.08</u>	<u>0.66</u>																
Minimum	<u>0.6</u>	<u>0.2</u>	<u>-.4</u>	<u>0.1</u>	<u>0.4</u>	<u>0.5</u>	<u>0.2</u>	<u>0.6</u>																
Maximum	<u>0.8</u>	<u>0.4</u>	<u>+.1</u>	<u>0.2</u>	<u>0.7</u>	<u>0.8</u>	<u>0.1</u>	<u>0.8</u>																

Notes: $\begin{matrix} X & Y \\ 0.2 & 818 & +S & +A \\ 0.2 & 823 & -V & -A \\ 0.8 & 810 & +S & +A \\ 0.8 & 811 & -V & -A \end{matrix}$

scale 0-2 fps
 $0.2 z : (.2)(64) = 12.8''$ below surface
 $0.8 z : (.8)(64) = 51.2''$ below surface

Water level ~ 5" below o+r flow channel i.p. About 8"-10" wide in waste water gate in channel

D.3

Yakima River Fish Screening Facility Flow Measurements

Site Up-st side

Screen Diameter (in) 72

Forebay Elevation 3.2'

Date 8-9-00

Screen # 2

Exposed (in) 14

Canal Flow 96 cfs

Personnel CSA & FW

Submerged (in) 58

Time Start	12:44 Hrs	12:44 Hrs				
Time End	12:49 Hrs	12:49 Hrs				

Location	U (C) L				U (C) L				U C L			U C L			U C L			U C L		
	0.2				0.8				0.2			0.8			0.2			0.8		
Depth	+S	+A	-V	-A	+S	+A	-V	-A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.3	.4	.3	-1.2	1.0	.3	0	-1.3												
2	1.1	.3	.2	-1.2	1.0	.1	-1.2	-1.3												
3	.9	.3	0	-1.1	1.0	.4	-1.2	-1.3												
4	1.1	.4	.5	-1.2	1.7	.3	-1.1	-1.3												
5	.8	.3	.2	-1.1	1.0	.6	-1.1	-1.5												
6	1.0	.2	.1	-1.2	.8	.3	0	-1.2												
7	1.3	.4	.7	-1.1	.8	.5	0	-1.8												
8	1.0	.3	.2	-1.1	.9	.3	-1.1	-1.3												
9	1.2	.4	.6	-1.2	.8	.2	-1.2	-1.4												
10	1.1	.3	.2	-1.2	.8	.3	-1.1	-1.3												

Average	1.08	0.33	-0.30	0.16	0.90	0.31	0.10	0.37												
Minimum	0.8	0.2	-0.7	0.1	0.7	0.1	0	0.8												
Maximum	1.3	0.4	0	0.2	1.0	0.6	0.2	0.8												

Notes:

0.4

Yakima River Fish Screening Facility Flow Measurements

Site Westside

Forebay Elevation 3.2'

Date 8-9-88

Screen # 3

Screen Diameter (in) 72

Canal Flow 96 cfs

Personnel CSRF/EWL

Exposed (in) 14

Submerged (in) 58

Time Start	<u>12:56 Hrs.</u>	<u>12:56 Hrs.</u>				
Time End	<u>1:01 Hrs.</u>	<u>1:01 Hrs.</u>				

Location	U (C) L				U (C) L				U C L				U C L				U C L				U C L			
	0.2				0.8				0.2				0.8				0.2				0.8			
Depth																								
Vector	+S	+A	-V	-A	+S	+A	-V	-A	S	A	V		S	A	V		S	A	V		S	A	V	
1	1.2	.3	0	-.1	1.1	.3	0	-.5																
2	1.3	.3	.2	-.1	1.1	.5	-.3	-.5																
3	1.2	.2	.1	-.2	1.2	.3	-.1	-.6																
4	1.5	.2	.2	-.1	1.3	.3	-.1	-.5																
5	1.3	.3	.4	-.4	1.2	.3	-.1	-.5																
6	1.3	.3	.1	-.2	1.2	.3	-.1	-.5																
7	1.1	.1	.3	-.1	1.3	.4	-.1	-.6																
8	1.2	.2	.3	-.1	1.2	.3	-.1	-.4																
9	1.3	.2	0	-.1	1.1	.4	0	-.4																
10	1.2	.2	0	-.2	1.3	.4	0	-.6																

Average	<u>1.27</u>	<u>0.23</u>	<u>0.16</u>	<u>0.16</u>	<u>1.20</u>	<u>0.35</u>	<u>0.04</u>	<u>0.51</u>																
Minimum	<u>1.1</u>	<u>0.1</u>	<u>0.4</u>	<u>0.1</u>	<u>1.1</u>	<u>0.3</u>	<u>0</u>	<u>0.4</u>																
Maximum	<u>1.5</u>	<u>0.3</u>	<u>0</u>	<u>0.4</u>	<u>1.3</u>	<u>0.5</u>	<u>0.3</u>	<u>0.6</u>																

Notes:

0.5

Yakima River Fish Screening Facility Flow Measurements

Site Westside

Forebay Elevation 3.2'

Date 8-9-88

Screen # fish return slot

Screen Diameter (in) -
 Exposed (in) -
 Submerged (in) 18"

Canal Flow 96 cfs

Personnel CJA/EWL

~19" Difference between top boof di and forebay surface level can

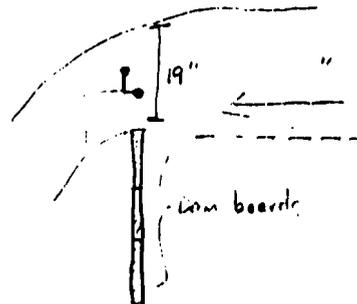
Time Start	<u>1413 Hrs</u>				
Time End	<u>1417 Hrs</u>				

Location	U <u>(C)</u> L				U C L			U C L			U C L			U C L			U C L		
Depth	0.2				0.8			0.2			0.8			0.2			0.8		
Vector	S	A	-V	-A	S	A	V	S	A	V	S	A	V	S	A	V	S	A	V
1	3.5	1.5	-1.4	1.1															
2	4.0	-2.0	-1.5	1.0															
3	3.5	-1.5	-1.5	.7															
4	4.0	-1.5	-1.4	.9															
5	4.0	-1.0	-1.5	1.0															
6	4.0	-2.0	-1.3	.9															
7	4.5	-1.5	-1.3	1.0															
8	4.0	0	-1.5	1.0															
9	4.0	1.5	-1.9	.8															
10	4.0	-1.5	-1.4	.9															

Average	<u>3.95</u>	<u>-0.6</u>	<u>1.24</u>	<u>0.93</u>															
Minimum	<u>3.5</u>	<u>-2.0</u>	<u>0.3</u>	<u>-1.7</u>															
Maximum	<u>4.0</u>	<u>1.5</u>	<u>0.9</u>	<u>1.1</u>															

Notes: +S & +A 0-10 fps scale
 -V & -A -0-2 fps
 time const '5 sec.

Flow measurements taken in center of 'window' at mid-depth
 Fish slot = 18" wide.



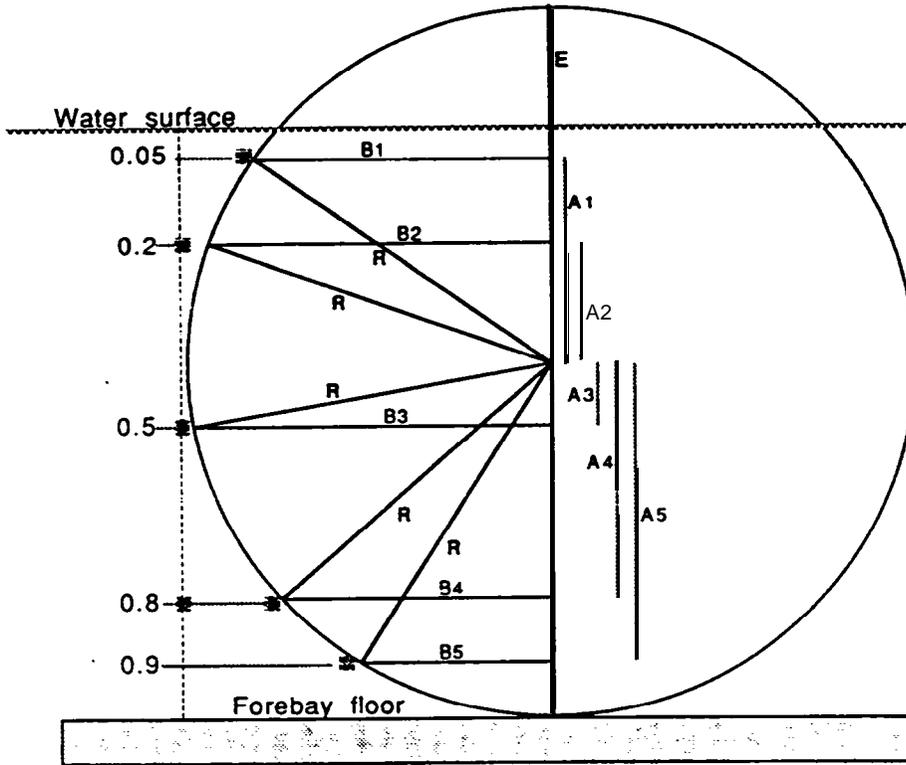
APPENDIX E

SUNNYSIDE SCREENS RAW DATA SHEETS

Appendix E contains the raw data sheets for flow measurements conducted at the Sunnyside Screens on August 10 and 11, 1988. Page E.2 shows the calculations made to position probes at the proper measurement depths, and the distance between the probe and the screen face at the measured depths. Raw data for measurements in front of the drum screens are found on pages E.3 through E.17. Flow measurements in the entrance to the intermediate and terminal fish bypasses are on pages E.18 and E.19. Flow measurements in three transects across the separation chamber are on pages E-20 through E.25. Flow measurements at the face of the two traveling belt screens in the separation chamber are on pages E-26 through E.31. Flow measurements in the entrance to the fish return are on page E.32.

WORKSHEET FOR DEPTH DETERMINATIONS

Sunnyside
8/10/88



Cond flow: 1275 cfs

Note: Drums must be on a silt, water depth was 68" instead of 53" 140

Drum Diameter (D):	<u>180"</u>		SIDE A		SIDE B
Radius (R):	<u>90"</u>				
Exposed to air (E):	<u>30"</u>				
Submerged (Z):	<u>150"</u>				
0.05 z:		$A1 = (E+0.0SZ)-R$		$B1 = (R^2-A1^2)^{0.5}$	
0.20 z:	<u>30.0"</u>	$A2 = (E+0.2Z)-R$	<u>30.0</u>	$B2 = (R^2-A2^2)^{0.5}$	<u>51.5"</u>
0.50 z:		$A3 = (E+0.5Z)-R$		$B3 = (R^2-A3^2)^{0.5}$	
0.80 Z:	<u>120.0"</u>	$A4 = (E+0.8Z)-R$	<u>62.0</u>	$B4 = (R^2-A4^2)^{0.5}$	<u>57.28"</u>
0.90 z:		$A5 = (E+0.9Z)-R$		$B5 = (R^2-A5^2)^{0.5}$	

Distance From Vertical To Screen Face

0.05 Z:	R-B1=	<u> </u>
0.29 Z:	R-B2=	<u>51.5"</u>
0.50 Z:	R-B3=	<u> </u>
0.80 Z:	R-B4=	<u>22.72"</u>
0.90 Z:	R-B5=	<u> </u>

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Forebay Elevation 897.0

Date 8/10/88

Screen # 17

Screen Diameter (in) 180"

Canal Flow 1275 cfs

Personnel RS/EWL

Exposed (in) 30"

Submerged (in) 150" Water depth = 168" in front of screens

Time Start	<u>1005 Hrs.</u>	<u>1005 Hrs.</u>				
Time End	<u>1010 Hrs.</u>	<u>1010 Hrs.</u>				

Location	U <u>(C)</u> L				U <u>(C)</u> L				U C L			U C L			U C L			U C L		
	(618)	0.2	(413)		(612)	0.8	(411)		0.2			0.8			0.2			0.8		
Vector	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.8	-1.3	.2	.7	3.0	-1.7	.1	.3												
2	1.9	-1.5	.2	.8	3.2	-1.9	-.1	.3												
3	2.1	-1.3	0	.7	3.0	-1.6	.1	.3												
4	2.0	-1.6	.2	.8	3.0	-1.7	.2	.4												
5	1.8	-1.4	.1	.7	3.3	-1.7	.1	.4												
6	1.9	-1.4	.4	.6	3.1	-1.8	0	.3												
7	1.8	-1.5	.2	.7	3.4	-1.8	.2	.4												
8	2.1	-1.4	.2	.6	3.6	-1.6	0	.1												
9	2.4	-1.4	.2	.7	3.6	-1.8	0	.3												
10	1.9	-1.3	.1	.7	3.8	-1.8	.1	.2												

Average	<u>1.9</u>	<u>1.97</u>	<u>0.41</u>	<u>0.2</u>	<u>3.10</u>	<u>0.74</u>	<u>0.07</u>	<u>0.31</u>												
Minimum	<u>1.8</u>	<u>0.3</u>	<u>0.1</u>	<u>0.1</u>	<u>2.6</u>	<u>0.6</u>	<u>0.2</u>	<u>0.1</u>												
Maximum	<u>2.4</u>	<u>0.6</u>	<u>0</u>	<u>0.4</u>	<u>3.6</u>	<u>0.9</u>	<u>0.1</u>	<u>0.4</u>												

Notes: 10:02 2' 30" = 30" Below surface
 10:03 1' 12" = 120" Below surface

A Y
 0.22 818 +S -A - 0.5 fps
 0.22 823 -V +A
 0.82 810 +S -A - 0.5 fps
 0.82 811 -V +A

STAFF Gauge in Fish Return at 299.0'

Intermediate & Terminal bypass weirs not to specifications & 2 pump operation by BR person at 0900

0.82 Sweep sometimes went as low as 0 and as high as 1.4
 0.8 - V-mud/A swept fast - some sometimes (at 1.2 fps)

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Screen # 14

Screen Diameter (in) 180"
Exposed (in) 30"
Submerged (in) 150"

Forebay Elevation 897.0
Canal Flow 1275 cfs

Date 8-10-88
Personnel CASSEWB

Time Start	<u>1019 Hrs.</u>	<u>1019 Hrs.</u>				
Time End	<u>1024 Hrs.</u>	<u>1024 Hrs.</u>				

Location	U (0) L				U (0) L				U C L			U C L			U C L			U C L		
	(815) 0.2 (823)				(810) 0.8 (811)				0.2			0.8			0.2			0.8		
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.8	-1.5	.2	.7	2.0	-1.5	.2	.3												
2	1.8	-1.5	.1	.6	2.0	-1.8	.4	.5												
3	1.4	-1.4	.1	.7	2.6	-1.3	-1.5	.4												
4	1.7	-1.2	.2	.6	2.2	-1.6	.2	.2												
5	1.9	-1.4	0	.7	2.5	-1.5	-1.2	.3												
6	1.9	-1.5	.1	.6	2.2	-1.8	.1	.5												
7	1.8	-1.4	.4	.6	2.5	-1.7	.3	.1												
8	2.4	-1.2	.4	.6	1.2	-1.2	.2	.1												
9	1.8	-1.7	.4	.7	1.4	-1.0	.1	0												
10	1.7	-1.4	.2	.6	2.6	-1.8	.3	0												
Average	1.82	0.51	-0.21	0.64	2.22	0.72	-0.11	0.24												
Minimum	1.4	0.2	-0.4	0.6	1.2	0.3	-0.4	0												
Maximum	2.4	1.2	0	0.7	3.0	1.2	0.5	0.5												

Notes: +S - A = scale 0 - 5 f/s

All gauges swung in wide ranges most accuracy

Value 11 example is 0.82

Yakima River Fish Screening Efficiency Flow Measurements

Site Sunnyside

Screen # 15

Screen Diameter (in) 180
 Exposed (in) 30
 Submerged (in) 150

Forebay Elevation 577.0
 Canal Flow 1275 cfs

Date 8/10/88
 Personnel CAS/FA/L

Time Start	<u>1033 Hrs.</u>	<u>1033 Hrs.</u>				
Time End	<u>1036 Hrs.</u>	<u>1033 Hrs.</u>				

Location	U (C) L				U (C) L				U C L			U C L			U C L			U C L		
Depth	<u>1.8' 0.2' (1823)</u>				<u>1.8' 0.8' (81)</u>				0.2			0.8			0.2			0.8		
Vector	+S	-A	-V	+A	-S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.7	-4	.2	.5	3.4	2.0	.3	.5												
2	2.0	-6	.2	.7	3.5	-6	0	.4												
3	2.0	-4	.2	.7	3.2	-6	.2	.5												
4	1.8	-4	.4	.2	3.3	-3	.2	.5												
5	1.8	-3	.4	.7	3.0	-8	.4	.6												
6	2.1	-3	.2	.7	4.2	-6	.1	.5												
7	2.1	-5	.4	.6	2.6	-8	.5	.6												
8	2.0	-6	.3	.2	3.4	-6	.2	0												
9	1.9	.5	-.2	.6	2.8	-8	0	.5												
10	1.8	-4	.2	.6	3.2	-8	.6	.5												

Average	<u>1.92</u>	<u>0.44</u>	<u>-0.23</u>	<u>0.65</u>	<u>3.26</u>	<u>0.43</u>	<u>-0.15</u>	<u>0.46</u>												
Minimum	<u>1.7</u>	<u>0.3</u>	<u>-0.4</u>	<u>0.5</u>	<u>2.6</u>	<u>-2.0</u>	<u>0.6</u>	<u>0</u>												
Maximum	<u>2.1</u>	<u>0.6</u>	<u>0.2</u>	<u>0.7</u>	<u>4.2</u>	<u>0.8</u>	<u>0</u>	<u>0.6</u>												

Notes:

E.5

Yakima River Fish Screening Facility Flow Measurements

Silo Sunnyside

Screen # 14

Screen Diameter (in) 80
Exposed (in) 33
Submerged (in) 150

Forebay Elevation 897.0
Canal Flow 1275 cfs

Date 8-10-88
Personnel CSA/EWL

Time Start	<u>1046 Hrs.</u>	<u>1047 Hrs.</u>				
Time End	<u>1051 Hrs.</u>	<u>1051 Hrs.</u>				

Location	U (C) L				U (C) L				U C L			U C L			U C L			U C L		
	(816) 0.2 (823)				(816) 0.8 (811)				0.2			0.8			0.2			0.8		
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.8	-0.4	0	0.6	2.8	-0.7	0.1	0.3												
2	1.8	-0.4	0.2	0.6	2.6	-0.7	-0.2	0.3												
3	1.8	-0.2	0.1	0.6	2.8	-0.6	0	0.2												
4	2.0	-0.4	0.2	0.8	3.2	-0.8	0	0.2												
5	2.0	-0.6	0.3	0.7	3.0	-0.4	0.3	0.5												
6	2.0	-0.6	0.2	0.7	2.4	-0.7	-0.2	0.3												
7	2.5	-0.4	0	0.8	2.6	-0.4	0.4	0.4												
8	2.0	-0.4	0.1	0.7	2.4	-1.0	0.1	0.5												
9	1.8	-0.4	0.2	0.7	2.5	-0.6	-0.1	0.4												
10	2.0	-0.5	0.2	0.6	2.8	-0.6	0.1	0.2												

Average	1.98	0.43	-0.15	0.68	2.71	0.65	-0.05	0.33												
Minimum	1.0	0.2	-0.3	0.6	2.4	0.4	-0.3	0.2												
Maximum	2.5	0.6	0	0.8	3.0	1.0	0.2	0.5												

Notes:

Yakima River Fish Screening Facility - Tor M easurements

Site Sunnyside

Screen # 13

Screen Diameter (in) 180
Exposed (in) 30
Submerged (in) 150

Forebay Elevation 893.0
Canal Flow 1275 cfs

Date 8-10-88
Personnel CAS/EWL

Time Start	<u>1057 Hrs.</u>	<u>1057 Hrs.</u>				
Time End	<u>1101 Hrs.</u>	<u>1101 Hrs.</u>				

Location	U (C) L				U (C) L				U C L			U C L			U C L			U C L		
	0.2		(823)		0.8		(811)		0.2			0.8			0.2			0.8		
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.7	-2	.4	.5	3.4	.6	1.5	.6												
2	2.0	-1.3	.1	.4	3.2	.2	.2	.8												
3	2.1	-1.3	.5	.7	3.2	.6	.3	.2												
4	1.4	-2	.2	.4	3.0	-2	.3	.2												
5	2.0	-2	.3	.5	3.2	-4	.1	1.2												
6	1.6	-1	.4	.5	2.9	-3	.6	-.3												
7	1.6	-2	.2	.6	3.1	-.5	.1	.2												
8	1.2	-2	.1	.6	3.3	-.5	.6	.6												
9	1.6	-3	.3	.5	3.2	-.4	0	.4												
10	2.0	-.4	.4	.5	3.2	-.5	.1	.2												

Average	1.75	0.24	-0.32	0.52	3.17	0.26	-0.28	0.41												
Minimum	1.2	0.1	-.1	0.4	2.9	-0.6	-0.6	-0.3												
Maximum	2.4	0.4	-.5	0.7	3.4	0.6	0	1.2												

Notes:

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Forebay Elevation 877.0
Canal Flow 1275 cfs

Date 1-11-08
Personnel 2

Screen # 12

Screen Diameter (in) 180
Exposed (in) 30
Submerged (in) 150

Time Start	<u>1108 Hrs.</u>	<u>1108 Hrs.</u>				
Time End	<u>1113 Hrs.</u>	<u>1113 Hrs.</u>				

Location	U \odot L				U \odot L				U C L			U C L			U C L			U C L		
	(818) 0.2 (823)				(810) 0.8 (811)				0.2			0.8			0.2			0.8		
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.7	-0.4	0.3	0.6	2.4	-0.2	0	0.3												
2	2.2	-0.3	0.6	0.6	3.0	-0.4	0	0.6												
3	2.1	-0.4	0.1	0.7	3.4	-0.7	0.3	0.4												
4	1.3	-0.3	0.1	0.6	3.8	-0.5	0.2	0.1												
5	1.7	-0.5	0.4	0.5	4.0	-0.6	0.4	0.2												
6	1.1	-0.8	0.4	0.7	3.4	-0.5	0.2	0.1												
7	2.0	-0.6	0.3	0.8	3.7	-0.6	0.3	0.2												
8	2.1	-0.6	0.2	0.6	3.3	-0.7	0.2	0.5												
9	1.9	-0.6	0.1	0.9	4.0	-0.8	0.1	0.4												
10	1.4	-0.5	0.1	0.6	3.0	-0.8	0.3	0.4												

Average	1.75	0.50	-0.26	0.66	3.40	0.58	-0.20	0.32												
Minimum	1.1	0.3	-0.6	0.5	2.4	0.2	-0.4	0.1												
Maximum	2.2	0.8	-0.1	0.8	4.0	0.8	0.2	0.6												

Notes:

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Forebay Elevation 897.0

Date 8-10-88

Screen # 11

Screen Diameter (in) 180

Canal Flow 1275 cfs

Personnel CSA/FAH

Exposed (in) 30

Submerged (in) 150

Time Start	<u>1114 Hrs.</u>	<u>11:22 AM</u>				
Time End	<u>1124 Hrs.</u>	<u>11:24 AM</u>				

Location	U (0.2) L (0.2)				U (0.8) L (0.8)				U C L			U C L			U C L			U C L		
	U	A	V	L	U	A	V	L	S	A	V	S	A	V	S	A	V	S	A	V
Depth	<u>(818) 0.2 (823)</u>				<u>(810) 0.8 (811)</u>				<u>0.2</u>			<u>0.8</u>			<u>0.2</u>			<u>0.8</u>		
Vector	U	A	V	L	U	A	V	L	S	A	V	S	A	V	S	A	V	S	A	V
1	<u>1.1</u>	<u>-1.6</u>	<u>.1</u>	<u>1.8</u>	<u>2.6</u>	<u>-2.7</u>	<u>.3</u>	<u>-2</u>												
2	<u>2.0</u>	<u>-1.4</u>	<u>-3</u>	<u>1.2</u>	<u>4.0</u>	<u>-1.8</u>	<u>1.5</u>	<u>.4</u>												
3	<u>1.0</u>	<u>-3</u>	<u>.2</u>	<u>.6</u>	<u>3.0</u>	<u>-2.5</u>	<u>.1</u>	<u>.2</u>												
4	<u>2.0</u>	<u>-1.7</u>	<u>.2</u>	<u>.8</u>	<u>2.2</u>	<u>-1.6</u>	<u>1.5</u>	<u>1.3</u>												
5	<u>1.1</u>	<u>-1.4</u>	<u>.3</u>	<u>.5</u>	<u>2.1</u>	<u>-1.5</u>	<u>.4</u>	<u>.4</u>												
6	<u>1.8</u>	<u>-1.5</u>	<u>.1</u>	<u>.8</u>	<u>2.3</u>	<u>-1.9</u>	<u>0</u>	<u>.2</u>												
7	<u>1.2</u>	<u>-1.4</u>	<u>.1</u>	<u>1.5</u>	<u>1.9</u>	<u>-1.4</u>	<u>.3</u>	<u>1.6</u>												
8	<u>.8</u>	<u>-1.8</u>	<u>.4</u>	<u>.7</u>	<u>1.8</u>	<u>-1.6</u>	<u>1.1</u>	<u>.4</u>												
9	<u>1.9</u>	<u>-1.5</u>	<u>1.5</u>	<u>.8</u>	<u>2.9</u>	<u>-1.0</u>	<u>1.6</u>	<u>1.4</u>												
10	<u>2.2</u>	<u>-1.0</u>	<u>-1.5</u>	<u>1.9</u>	<u>3.5</u>	<u>-1.7</u>	<u>.2</u>	<u>1.5</u>												
Average	<u>1.51</u>	<u>0.56</u>	<u>0.11</u>	<u>0.76</u>	<u>2.52</u>	<u>0.64</u>	<u>-0.33</u>	<u>0.38</u>												
Minimum	<u>0.8</u>	<u>0.3</u>	<u>0.5</u>	<u>0.5</u>	<u>1.8</u>	<u>0.4</u>	<u>-0.6</u>	<u>0.2</u>												
Maximum	<u>2.2</u>	<u>1.0</u>	<u>0.5</u>	<u>1.2</u>	<u>4.0</u>	<u>1.0</u>	<u>0</u>	<u>0.8</u>												

Notes:

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Forebay Elevation 897.0

Date 8-10-88

Screen # 10

Screen Diameter (in) 180

Canal Flow 1275 cfs

Personnel CSA/EWL

Exposed (in) 30

Submerged (in) 150

Time Start	<u>11:27 Hrs.</u>	<u>11:29 Hrs.</u>				
Time End	<u>11:34 Hrs.</u>	<u>11:34 Hrs.</u>				

Location	U (C) L				U (C) L				U C L				U C L				U C L				U C L			
	(815) 0.2 (823)				(810) 0.8 (811)				0.2				0.8				0.2				0.8			
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V		S	A	V		S	A	V		S	A	V	
1	1.6	-1.4	.5	.8	1.7	-1.3	.4	.5																
2	1.0	-1.3	-1.0	.5	2.1	-1.6	1.5	.6																
3	1.7	-1.3	-1.4	1.0	1.4	0	.2	0																
4	.5	-1.2	.5	.3	2.2	-1.1	.2	.5																
5	1.3	-1.5	-1.0	.7	1.8	-1.1	.1	.3																
6	1.0	-1.0	-1.6	.9	2.0	-1.8	.4	.7																
7	1.2	-1.3	.3	.6	1.8	-1.9	.8	.5																
8	.9	-1.2	.3	.6	2.1	-1.4	.2	.3																
9	1.3	0	.8	.7	3.1	-1.1	.6	.8																
10	1.0	-1.7	-1.5	.7	2.4	-1.4	.3	1.1																

Average	0.85	0.39	-0.21	0.68	2.06	0.75	0.37	0.53																
Minimum	0.3	0	-0.8	0.3	1.4	0	-0.8	0																
Maximum	1.3	1.0	1.0	1.0	3.1	1.1	-0.1	1.1																

Notes:

E.10

Yakima River Fish Screen Facility Flow Measurements

Site Sunnyside

Screen # 9

Screen Diameter (in) 180

Exposed (in) 30

Submerged (in) 150

Forebay Elevation 897.0

Canal Flow 1275 cfs

Date 8-10-94

Personnel CSA/EJK

Time Start	<u>1140 Hrs.</u>	<u>1140 Hrs.</u>				
Time End	<u>1145 Hrs.</u>	<u>1145 Hrs.</u>				

Location	U (C) L				U (C) L				U C L			U C L			U C L			U C L		
	(818) 0.2 (923)				(810) 0.8 (911)				0.2			0.8			0.2			0.8		
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	-1.4	-0.5	0	0.8	1.6	0	0.3	0.1												
2	0	-0.2	-0.1	0.4	1.3	0	-0.6	1.6												
3	-0.4	-0.5	-0.5	0.7	1.4	-0.8	-0.1	1.0												
4	-0.8	-0.3	0.5	0.5	2.0	0	-0.5	-0.3												
5	-0.8	-0.7	-0.3	1.1	1.5	-0.6	0	0.9												
6	-0.6	-0.3	0.1	0.5	1.4	-0.5	-0.2	-0.1												
7	-0.5	-0.5	0.3	0.4	1.5	-0.4	-0.3	0.3												
8	-0.1	-0.5	-0.8	0.7	1.1	-0.6	-0.3	0.6												
9	-0.8	-0.3	-0.4	0.7	1.8	-0.6	0	0.8												
10	-0.7	-0.6	0.6	1.6	1.6	-0.8	0.1	1.4												

Average	-0.61	0.44	10.06	0.64	1.42	0.43	0.16	0.63												
Minimum	-1.1	0.2	-0.6	0.4	0.6	0	-0.3	-0.3												
Maximum	0	0.7	0.8	1.1	2.0	0.8	0.6	1.4												

Notes: +A Reading at 0.92 was taken using 5-sec constant - Needle swing too excessive to read with 1-second constant. CSA.

E.11

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Screen Diameter (in) 180
 Exposed (in) 30
 Submerged (in) 150

Forebay Elevation 897.0
 Canal Flow 1275 cfs

Date 8-10-88
 Personnel CSA/LEWL

Screen # 8

Time Start	1152 Hrs.	1152 Hrs.				
Time End	1156 Hrs.	1156 Hrs.				

Location	U C L				U C L				U C L				U C L				U C L							
	U		L		U		L		U		L		U		L		U		L					
Depth	(8'8") 0.2		(8'23")		(8'0") 0.8		(8'11")		0.2				0.8				0.2				0.8			
Vector	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V					S	A	V						
1	.8	-.6	.8	.7	1.8	-.9	.5	.2																
2	1.4	-.7	.4	.7	1.4	-.6	.1	.3																
3	1.3	-.6	.2	.6	1.5	-.4	0	.1																
4	2.0	-.2	.6	.6	2.1	-.2	.1	.1																
5	1.0	-.4	.4	.7	1.4	-.6	-.1	.3																
6	1.7	-.4	.2	.8	1.0	-.3	-.1	.1																
7	.9	-.6	.4	1.0	1.6	-.2	-.1	.1																
8	.8	-.4	.3	.6	1.4	-.3	.1	.1																
9	1.5	-.3	.1	1.0	2.0	-.6	.6	.4																
10	1.5	-.4	.2	.6	1.6	0	-.1	.3																

Average	1.29	0.46	0.26	0.73	1.58	0.41	-0.10	0.20														
Minimum	0.8	0.3	-0.8	0.6	1.0	0	-0.6	0.1														
Maximum	2.0	0.7	-0.1	1.0	2.1	0.9	0.1	0.4														

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Screen # 7

Screen Diameter (in) 160
 Exposed (in) 30
 Submerged (in) 130

Forebay Elevation 107.0
 Canal Flow 1275 cfs

Date 8-10-88
 Personnel CSA/FWL

Time Start	<u>1202 Hrs.</u>	<u>1202 Hrs.</u>				
Time End	<u>1207 Hrs.</u>	<u>1207 Hrs.</u>				

Location	U <u>(C)</u> L				U <u>(C)</u> L				U C L			U C L			U C L			U C L		
	0.2		0.2		0.8		0.8		0.2			0.8			0.2			0.8		
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.7	-1.8	-1.4	0.6	3.0	-1.4	0	-0.2												
2	2.9	-1.4	1.8	0.6	1.8	-1.3	0	1.2												
3	1.7	-1.8	0	1.2	2.9	-1.8	1.2	0.5												
4	1.5	-1.4	1.3	0.8	2.1	-1.6	1.1	0												
5	2.6	-1.5	1.4	0.6	2.2	-1.1	1.3	0.6												
6	2.2	-1.2	1.7	0.6	2.5	0	-1.2	0.5												
7	1.8	-1.4	1.5	0.8	2.8	-1.7	0	1.2												
8	1.6	-1.3	1.5	0.7	2.0	-1.3	-1.2	0												
9	1.7	-1.4	1.5	0.7	2.3	-1.6	-1.1	0.4												
10	1.3	-1.2	1.8	0.7	2.4	-1.1	-1.1	1.2												

Average	<u>1.40</u>	<u>0.44</u>	<u>-0.41</u>	<u>0.68</u>	<u>2.43</u>	<u>0.39</u>	<u>0.00</u>	<u>0.24</u>												
Minimum	<u>1.3</u>	<u>0.2</u>	<u>-0.8</u>	<u>0.6</u>	<u>1.8</u>	<u>0</u>	<u>-0.3</u>	<u>-0.2</u>												
Maximum	<u>2.9</u>	<u>0.8</u>	<u>0.4</u>	<u>0.8</u>	<u>3.0</u>	<u>0.8</u>	<u>0.2</u>	<u>0.6</u>												

Notes:

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Forebay Elevation 299.0
Canal Flow 12.75 cfs

Date 8-10-56
Personnel CSA, F. S. L. K.

Screen # 6

Screen Diameter (in) 180
Exposed (in) 30
Submerged (in) 150

Time Start	<u>12:12 Hrs.</u>	<u>12:12 Hrs.</u>				
Time End	<u>12:18 Hrs.</u>	<u>12:18 Hrs.</u>				

Location	U (C) L				U (C) L				U C L			U C L			U C L					
	(718) 0.2 (823)				(810) 0.8 (915)				0.2			0.8			0.2			0.8		
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.8	-3	.8	.2	1.4	.2	.3	.5												
2	2.1	-.4	.2	.7	1.8	-.5	.2	.5												
3	2.0	-.7	-.3	.9	2.4	-.4	.3	.2												
4	2.1	-.5	.4	.6	2.0	-.8	.2	.1												
5	2.3	-.4	.3	.5	2.4	-.6	.6	.6												
6	4.0	3.1	-.8	.5	4.2	2.1	-.1	.1												
7	2.8	-.5	.5	.5	2.4	-.7	.6	.5												
8	3.2	.2	.1	.5	2.4	.6	.1	.2												
9	1.5	-.5	-.3	.5	2.1	-.8	.8	0												
10	2.2	-.4	.8	.4	2.6	1.0	.7	1.3												

Average	2.30	10.04	-0.17	0.53	2.39	0.01	0.33	0.60												
Minimum	1.5	-3.1	0.8	0.2	1.4	-2.1	-0.8	0												
Maximum	2.8	0.7	0.3	0.9	4.2	0.8	0.1	1.3												

Notes: All instruments had wind fluctuations - About 1/2 g wind speed, wind taken with 5-sec. time constant. No indications of current to make a looking at water surface, but apparently there is. (20)

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Forebay Elevation 899.0
Canal Flow 1275 cfs

Date 8-10-88
Personnel CSAFEWL

Screen # 5

Screen Diameter (in) 180
Exposed (in) 30
Submerged (in) 150

Time Start	<u>1225 Hrs.</u>	<u>1225 Hrs.</u>				
Time End	<u>1230 Hrs</u>	<u>1230 Hrs.</u>				

Location	U (C) L				U (C) L				U C L				U C L				U C L				U C L			
	(818) 0.2 (823)				(810) 0.8 (811)				0.2				0.8				0.2				0.8			
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V		S	A	V		S	A	V		S	A	V	
1	1.4	-0.5	.2	.6	2.8	-0.4	.7	.6																
2	1.4	-0.2	.4	.8	3.0	-0.4	-0.3	.2																
3	1.1	-0.3	.6	.8	1.8	-0.4	.1	.4																
4	1.6	-0.3	.4	.5	1.8	-0.3	.2	1.6																
5	1.1	-0.3	.6	.6	3.2	-0.6	.2	0																
6	1.0	-0.4	-0.3	.7	1.1	-0.3	-0.2	-0.4																
7	1.3	-0.2	.2	.5	1.8	-0.2	.7	.9																
8	1.8	-0.7	.3	.4	2.3	-0.6	.1	.7																
9	1.9	-0.1	.6	.5	1.4	-0.4	.1	-0.2																
10	2.1	-0.5	.5	.7	2.8	-0.6	.5	.8																

Average	1.44	0.35	-0.41	0.61	3.20	0.42	0.21	0.46																
Minimum	1.0	0.1	-0.6	0.4	1.1	0.2	-0.7	0.4																
Maximum	2.1	0.1	0.3	0.8	3.2	0.6	0.3	1.6																

Notes:

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Screen # 4

Screen Diameter (in) 180
 Exposed (in) 30
 Submerged (in) 150

For-bay Elevation 892.0
 Canal Flow 1275 cfs

Date 8/10/58
 Personnel ASA/...

Time Start	<u>1236 Hrs.</u>	<u>1236 Hrs.</u>				
Time End	<u>1241 Hrs.</u>	<u>1241 Hrs.</u>				

Location	U (C) L				U (C) L				U C L			U C L			U C L			U C L		
	(110) 0.2 (823)				(811) 0.8 (211)				0.2			0.8			0.2			0.8		
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.9	-1.4	1.2	1.5	3.0	-1.6	1.4	1.2												
2	2.8	-1.3	1.5	1.6	3.0	-1.5	1.3	1.3												
3	2.2	-1.2	1.3	1.6	3.0	-1.5	1.6	1.2												
4	1.9	-1.2	1.2	1.5	2.9	-1.7	1.4	1.3												
5	1.9	-1.4	1.5	1.6	3.3	-1.8	1.4	1.3												
6	2.0	-1.2	1.5	1.6	2.9	-1.7	1.4	-1.4												
7	-1.2	1.6	1.6	1.4	2.9	-1.8	1.4	1.6												
8	1.4	1.3	1.2	1.3	2.9	-1.5	1.3	1.4												
9	4.8	-1.6	1.2	1.5	3.7	-2.9	1.2	2.0												
10	5.0	-3.6	-1.8	1.7	3.5	-1.6	1.2	1.3												

Average	<u>2.27</u>	<u>0.50</u>	<u>-0.41</u>	<u>0.53</u>	<u>3.11</u>	<u>0.86</u>	<u>-0.36</u>	<u>0.42</u>												
Minimum	<u>-0.2</u>	<u>-0.6</u>	<u>-1.2</u>	<u>0.3</u>	<u>1.9</u>	<u>0.5</u>	<u>-0.2</u>	<u>-0.4</u>												
Maximum	<u>5.0</u>	<u>3.6</u>	<u>0.8</u>	<u>0.7</u>	<u>2.7</u>	<u>2.9</u>	<u>-0.6</u>	<u>2.0</u>												

Notes: Time cond. = 5 sec.

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Screen Diameter (in) 180

Forebay Elevation 777.0

Date 8-10-98

Screen # 3

Exposed (in) 30

Canal Flow 1275 cfs

Personnel CSA/EGIL

Submerged (in) 150

Time Start	<u>1253 Hrs.</u>	<u>1259 Hrs.</u>				
Time End	<u>1267 Hrs.</u>	<u>1257 Hrs.</u>				

Location	U (C) L				U (C) L				U C L			U C L			U C L			U C L		
	0.2				0.8				0.2			0.8			0.2			0.8		
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.8	-0.2	-0.1	0.5	3.8	-1.8	0.2	0.3												
2	2.5	-0.2	0.1	0.5	4.1	-1.8	0.7	0.5												
3	2.6	-0.3	0.1	0.5	4.1	-1.8	0.5	0.3												
4	2.3	-0.2	-0.1	0.6	4.0	-1.0	0.7	0.3												
5	1.6	-0.2	-0.3	0.6	3.9	-0.7	0.5	0.4												
6	3.2	-0.1	0.1	0.4	2.7	-0.5	0.4	0.2												
7	2.7	-0.4	-0.1	0.5	4.3	-0.9	0.6	0.1												
8	2.7	-0.4	0	0.6	3.5	0.7	0.5	0.3												
9	1.2	-0.2	-0.2	0.6	3.9	0.8	0.5	0.5												
10	1.3	-0.3	0.3	0.6	4.0	1.0	0.8	0.4												

Average	<u>2.19</u>	<u>0.25</u>	<u>-0.02</u>	<u>0.53</u>	<u>3.84</u>	<u>0.51</u>	<u>-0.54</u>	<u>0.33</u>												
Minimum	<u>1.2</u>	<u>0.1</u>	<u>-0.3</u>	<u>0.4</u>	<u>2.7</u>	<u>-0.8</u>	<u>-0.8</u>	<u>0.1</u>												
Maximum	<u>2.7</u>	<u>0.4</u>	<u>0.3</u>	<u>0.6</u>	<u>4.1</u>	<u>1.0</u>	<u>-0.4</u>	<u>0.5</u>												

Notes: All .5 sec.

E.17

Yakima River Fish Screening Facility Flow Measurements

Site Swimsyde

Screen Diameter (in) 5

Forebay Elevation 847.0

Date 8/10/88

Screen # Intermediate Bypass

Exposed (in) 0
Submerged (in) 16.8" deep

Canal Flow 1275 cfs

Personnel CM/PLK

Time Start	<u>1417 Hrs.</u>	<u>1407 Hrs.</u>	<u>1353 Hrs.</u>	<u>1407 Hrs.</u>	<u>1353 Hrs.</u>	
Time End	<u>1420 Hrs.</u>	<u>1411 Hrs.</u>	<u>1359 Hrs.</u>	<u>1411 Hrs.</u>	<u>1359 Hrs.</u>	

Location	U (C) L				U (C) L				U (C) L				U (C) L				U C L						
Depth	(816) 0.2 0.1 (823)				(816) 0.8 0.3 (823)				(816) 0.6 0.5 (811)				(816) 0.5 0.7 (811)				(816) 0.8 0.9 (811)				0.9		
Vector	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V
1	1.1	-1.4	-1.1	.3	2.5	.4	0	.1	1.6	.8	-1.2	.5	2.2	.3	0	-1	3.1	.2	0	-1.8			
2	1.0	.3	.1	.4	2.7	.2	.2	.1	1.9	-1.2	-1	.2	2.6	-1.1	.1	-1.4	3.2	.3	-1.2	-1			
3	.9	-1.2	.1	.5	2.8	.3	0	.2	2.2	.1	-1.2	0	3.2	.2	-1	.3	3.1	.6	-1	-1.7			
4	1.1	-1.2	-1.1	.3	2.2	0	.1	.1	2.3	-1.6	.1	.1	3.3	.1	.2	-1	2.4	-1.4	.3	.4			
5	1.0	-1.2	-1.2	.4	2.2	-1.3	.1	.1	2.1	.4	-1	.2	1.0	.2	-1	.5	3.2	.5	0	-1.4			
6	.9	-1.4	.2	.3	2.9	-1	.2	0	2.1	.4	.4	0	3.5	.3	-1	.5	2.5	-1.5	.5	1.1			
7	.8	0	-1.2	.6	2.3	.3	-1	.3	2.0	.2	-1.2	.5	3.4	0	.1	.4	3.4	.6	.3	.5			
8	1.0	.1	.2	.4	2.4	.5	-1	.4	2.5	-1.5	.2	.1	2.6	-1.2	.1	-1.3	2.6	-1.4	.2	.3			
9	1.0	-1	0	.3	2.3	.2	0	.1	2.0	.1	0	.2	3.6	-1.4	.1	-1.3	2.7	.4	-1.4	-1.6			
10	1.1	0	-1.2	.3	2.2	0	-1	.3	2.3	-1.4	.2	-1	4.3	0	0	.2	4.1	0	.4	.2			

Average	0.99	0.19	10.02	0.38	2.45	-0.15	-2.03	0.17	2.10	-0.07	-0.01	0.19	3.27	-0.05	-0.03	0.07	3.03	-0.13	-0.04	0.21			
Minimum	0.8	0	0.2	0.3	2.2	-0.5	-0.2	0	1.6	-0.8	-0.4	0	2.2	-0.3	-0.2	-0.4	2.4	-0.6	-0.4	-0.8			
Maximum	1.1	0.4	0.2	0.6	2.9	1.3	0.1	0.4	2.5	0.6	0.2	0.5	4.3	0.4	0.1	0.5	4.1	0.4	0.4	1.1			

Notes: 0.1 = 16.8" below surface
 0.3 = 50.4"
 0.5 = 84.0"
 0.7 = 117.6"
 0.9 = 151.2"

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Forebay Elevation 897.0

Date 8/10/88

Screen # Terminal Bypass

Screen Diameter (in)

Canal Flow 1275 cfs

Personnel CAE/EMC

Exposed (in)

Submerged (in) 126"

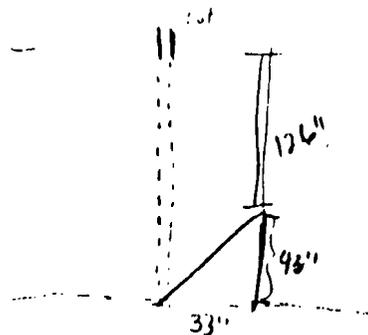
126" - partially up on ramp in bypass

Time Start	1532 Hrs.	1546 Hrs.	1558 Hrs.	1546 Hrs.	1532 Hrs.	
Time End	1538 Hrs.	1551 Hrs.	1601 Hrs.	1551 Hrs.	1538 Hrs.	

Location	U	C	L	U	C	L	U	C	L	U	C	L	U	C	L					
Depth	(818) 0.2-0.1(823)			(818) 0.8-0.3(823)			(810) 0.5-0.5(811)			(810) 0.5-0.7(811)			(810) 0.8-0.9(811)			0.9				
Vector	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	
1	4.5	.2	0	.3	4.0	1.0	-1.2	0	5.5	0	-1.2	0	6.0	1.1	-1.9	0	6.0	0	-1.6	0
2	4.5	.2	0	.1	3.5	.4	-1.8	.6	6.5	-2	-1.2	0	6.5	0	-1.5	0	5.5	-1.5	-1.4	0
3	4.0	0	0	.2	3.8	-2	-1.6	.7	6.5	0	-1.1	0	6.5	0	-1.4	0	5.5	-1.0	-1.3	0
4	4.5	.2	0	.3	4.0	0	-1.8	.2	6.0	-2	-1.2	.4	4.5	0	-1.5	.1	6.0	.8	-1.5	0
5	4.5	.5	0	.3	4.0	.2	-1.8	.1	6.5	0	-1.2	.1	6.0	0	-1.4	-.3	6.5	0	-1.4	0
6	4.2	.2	0	.3	4.0	.1	-1.9	.5	6.0	0	-1.1	.6	6.0	0	-1.5	-.1	6.0	.5	-1.5	0
7	3.9	.5	-1	.2	3.6	-1.8	-1.6	.3	5.5	-2	-1.3	-.4	6.5	0	-1.4	.2	6.0	.5	-1.4	0
8	3.9	.5	0	.2	3.4	-2	-1.2	0	6.5	0	-1.2	.1	6.0	0	-1.4	.2	5.5	0	-1.4	0
9	4.4	.8	-1.8	.2	3.6	.9	-1.1	.1	3.0	0	-1.1	.2	5.5	0	-1.5	.1	5.0	-1.5	-1.3	0
10	4.4	.3	-1.3	.4	3.5	-1.0	-1.4	-.2	6.5	0	-1.3	.3	6.0	0	-1.5	.3	5.5	.2	-1.4	-1

Average	4.38	0.94	0.12	0.25	3.74	0.04	0.71	0.21	6.25	0.06	1.19	0.18	6.15	0.11	1.00	0.05	5.25	0.0	1.42	-0.01
Minimum	3.9	-0.8	0	0.1	2.4	-1.0	0.2	-0.2	5.5	0	1.1	-0.4	5.5	0	0.9	-0.3	5.0	-0.8	1.3	-1
Maximum	4.5	0	0.6	0.4	4.0	1.0	1.1	0.7	7.0	0.2	1.3	0.8	6.5	-1.1	1.5	0.3	6.5	1.0	1.6	0

Notes:



- 0.1 = 126" from Surface
- 0.3 = 37.9" " "
- 0.5 = 63.0" " "
- 0.7 = 88.2" " "
- 0.9 = 113.4" " "

+S -A - scale = 0-10 fps 19Z only

Note +A is toward the wall closest to screen

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Forebay Elevation 897.0
Canal Flow 1275 cfs

Date 8/11/88
Personnel CR/EWL

Screen # Sup. chamber

Screen Diameter (in) _____
Exposed (in) _____
Submerged (in) 120" water depth. (100")

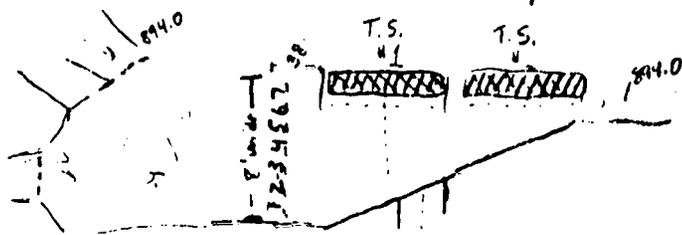
Time Start	<u>0955 Hrs.</u>	<u>0955 Hrs.</u>	<u>1008 Hrs.</u>	<u>1002 Hrs.</u>	<u>1015 Hrs.</u>	<u>1015 Hrs.</u>
Time End	<u>1000 Hrs.</u>	<u>1000 Hrs.</u>	<u>1008 Hrs.</u>	<u>1008 Hrs.</u>	<u>1020 Hrs.</u>	<u>1020 Hrs.</u>

Location	①				②				③				④				⑤							
	U	C	L		U	C	L		U	C	L		U	C	L		U	C	L					
Depth	(818) 0.2 (823)				(810) 0.8 (811)				(816) 0.2 (821)				(810) 0.8 (811)				(816) 0.2 (823)				(810) 0.8 (811)			
Vector	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A
1	2.4	-1.2	.6	.9	3.1	.2	-1.6	-1.5	1.2	.2	.1	.4	2.0	.8	-1.7	-1.7	1.9	-1.4	.4	.5	2.6	.2	.2	0
2	1.9	0	.7	1.0	3.2	.6	-1.3	-1.8	1.1	.3	.7	.6	3.5	.3	0	-1	1.2	-1.1	-1	.7	1.8	.5	-1.4	0
3	1.8	-1.2	.8	.9	3.4	.4	-1.2	-1.6	1.9	.8	.2	.8	2.7	.2	-1.9	-1.4	.7	-1.5	.3	.5	2.6	.8	-1.3	0
4	2.8	0	.8	.6	0	.2	-1.2	-1.4	.9	-1.4	.3	.3	3.4	.5	-1.9	-1.0	2.6	-1.0	.5	1.3	3.4	1.2	-1.2	0
5	2.6	0	.7	.9	1.5	-1	-1.9	-1.3	1.3	-1.6	-1.9	.8	3.4	.6	-1.0	-1.9	1.4	-1.6	0	.9	3.0	.2	-1.2	0
6	2.9	.1	.4	.4	2.9	.3	-1.6	-1.4	1.2	-1.9	.1	1.1	3.2	.4	-1.1	-1.2	1.4	-1.5	.1	.9	-1.4	.6	-1.3	0
7	2.8	-1.1	-1.3	.3	3.0	.4	-1.6	-1.6	1.5	-1.6	.2	.5	3.0	-1.2	-1.2	.1	1.9	-1.0	.3	.8	3.0	.2	-1.6	0
8	2.1	-1.6	.8	1.0	3.2	.5	-1.9	-1.8	1.2	-1.0	-1.3	.6	2.6	.4	-1.7	-1.6	2.6	-1.5	.6	.4	2.6	1.1	.3	0
9	1.9	-1.3	.9	.5	2.9	.4	-1.5	-1.3	1.4	-1.7	.3	.7	3.2	1.3	-1.5	3.2	1.1	-1.3	.5	.4	3.1	.3	.4	0
10	2.5	.5	.7	.8	2.8	.4	-1.2	-1.5	.9	-1.4	.5	.1	4.2	.8	-1.5	-3.1	.3	-1.6	.6	.6	2.1	.3	.4	0

Average	2.37	.18	-1.61	0.73	2.60	-.33	1.40	0.52	1.26	.33	-1.12	0.59	3.12	-0.51	.85	2.37	1.51	0.80	-1.32	0.70	2.28	0.54	0.07	X
Minimum	1.8	-.5	-1.9	.3	0	-.6	.6	1.4	.9	-.3	-1.7	.1	2.0	-1.3	0	-3.1	.3	.4	-1.6	.4	-1.4	-1.2	-1.4	X
Maximum	2.8	1.1	.3	1.0	3.4	.1	1.9	-.3	1.9	1.0	.9	1.1	4.2	.2	1.5	3.2	2.6	1.3	.1	1.3	3.4	.2	.6	X

* Probe malfunction?

Notes: transect will be made ~ 1 meter upstream of traveling screen (100")



0.2Z = 24"	0.2	818	+S	-A
0.8Z = 96"	0.2	823	-V	+A
	0.8	810	+S	-A
	0.8	811	-V	+A

Note: +S is toward travel by screen
+V is upward

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Forebay Elevation 897.0

Date 8-11-88

Screen Diameter (in)

Canal Flow 1275 cfs

Personnel CSA/EWK

Screen # Separation Chamber

Exposed (in)

Submerged (in) 120"

Time Start	<u>1025 Hrs.</u>	<u>1025 Hrs.</u>	<u>1033 Hrs.</u>	<u>1033 Hrs.</u>	<u>1053 Hrs.</u>	<u>1053 Hrs.</u>
Time End	<u>1030 Hrs.</u>	<u>1030 Hrs.</u>	<u>1040 Hrs.</u>	<u>1040 Hrs.</u>	<u>1057 Hrs.</u>	<u>1057 Hrs.</u>

Location	<u>(#4)</u>				<u>(#5)</u>				<u>(#6)</u>															
	U	C	L		U	C	L		U	C	L		U	C	L									
Depth	<u>(8.0) 0.2 (8.2)</u>				<u>(8.0) 0.8 (8.1) *</u>				<u>(8.0) 0.2 (8.2)</u>				<u>(8.0) 0.8 (8.1)</u>				<u>0.2</u>				<u>0.8</u>			
Vector	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A
1	3.5	-1.0	.8	1.2	-3.4	.8	.5	0	5.5	0	.8	.7	3.1	0	.7	-.8	7.0	-.5	.8	1.2	2.6	.9	1.3	-.2
2	3.6	-.7	.5	1.0	1.4	.7	.4	0	5.5	.5	.4	.6	3.4	.6	.2	-.1	7.5	1.0	.9	.7	5.5	.6	1.3	-.3
3	3.1	-.1	.6	1.4	3.2	.2	.3	0	7.0	-.5	.6	.4	7.0	.3	.2	-.3	6.5	.8	1.0	.5	4.5	0	1.6	-.2
4	3.9	.4	.9	.9	4.0	1.0	-.1	0	6.5	0	.7	.7	-.4	-.4	.8	-.4	7.5	0	.2	-.1	4.2	.5	1.4	.4
5	3.5	-.2	.4	1.0	3.1	.6	.2	0	6.0	.5	1.0	.6	.6	-.2	.7	-.5	7.0	-.5	.8	.7	6.0	.8	1.7	-1.8
6	3.0	.4	.8	.6	1.8	1.2	.6	0	6.0	-.5	1.1	-.2	1.2	.4	.8	-.3	7.0	0	.9	.1	5.5	.5	1.7	-.7
7	7.8	0	.8	1.2	2.2	1.0	.3	0	7.0	.5	.1	.8	7.4	.3	-.1	2.4	7.0	-.5	.2	.5	4.2	0	1.0	-.6
8	3.6	-1.0	.5	1.1	-1.6	.6	.7	0	5.5	0	.4	.1	1.4	.6	-.6	-.3	7.0	0	.4	1.1	4.5	.5	.9	.4
9	3.9	-.2	1.1	1.2	3.3	.2	.3	0	6.0	0	.5	.8	.9	-.2	1.0	-.4	7.5	1.5	.6	1.1	6.5	.8	1.2	.3
10	4.3	-.5	.1	.2	3.8	1.4	-.7	0	6.0	.5	.3	1.0	1.4	.8	.8	-.7	7.5	.5	.4	1.1	4.2	.5	1.0	-.6

Average	3.72	0.26	-.65	0.88	1.88	2.71	-.25	X	6.10	-.1	-.59	0.55	1.72	-.22	-.45	-.214	7.15	-.23	-.62	0.69	4.77	-.051	-.721	0.33
Minimum	3.1	-.4	-.5	.2	3.4	-.14	-.6	X	5.5	-.5	-.1	-.2	-.4	-.8	-.10	-.1	6.5	-.65	-.9	-.1	2.6	-.9	-.7	-1.8
Maximum	4.8	1.0	-1.1	.2	4.0	.2	.7	X	7.0	.5	-.1	1.0	3.4	.4	.6	2.4	7.5	.5	-.2	1.2	6.5	0	-.6	.4

Notes: * Probe malfunction? probe taped to prevent readings (8.2)

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Forebay Elevation 897.0
Canal Flow 1275 cfs

Date 8-11-88
Personnel CSA/Fulk

Screen # Separation Chamber Screen Diameter (in)
Exposed (in)
Submerged (in) 120"

Time Start	<u>1101 Hrs.</u>	<u>1101 Hrs.</u>				
Time End	<u>1106 Hrs.</u>	<u>1106 Hrs.</u>				

Location	U C L				U C L				U C L			U C L			U C L					
	(8/8) 0.2 (8/23)				(8/10) 0.8 (8/11)				0.2			0.8			0.2			0.8		
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	0.5	.5	.3	1.2	6.5	.5	1.2	0												
2	7.0	-5	.9	.7	4.0	0	1.8	-3												
3	7.5	.5	1.6	.6	4.4	0	1.0	-3												
4	7.5	1.0	.6	.7	3.5	.8	.8	.1												
5	8.0	0	-1.4	.7	5.5	.7	1.1	-1.5												
6	7.0	-1.8	.9	1.2	4.6	.4	1.8	-4												
7	7.5	.3	.5	1.2	5.0	.5	.7	-1.6												
8	7.5	.4	.1	.5	5.5	.6	1.1	-1.5												
9	8.0	0	.3	1.4	4.0	0	1.4	-1.5												
10	7.5	-1.5	.6	.4	4.0	.3	.7	-1.5												

Average	<u>7.60</u>	<u>-1.2</u>	<u>-1.44</u>	<u>0.76</u>	<u>4.70</u>	<u>-0.38</u>	<u>-1.16</u>	<u>-0.37</u>												
Minimum	<u>7.0</u>	<u>-1.0</u>	<u>-1.9</u>	<u>.2</u>	<u>3.5</u>	<u>-1.8</u>	<u>1.8</u>	<u>-1.6</u>												
Maximum	<u>8.5</u>	<u>.5</u>	<u>.4</u>	<u>1.4</u>	<u>6.5</u>	<u>0</u>	<u>.7</u>	<u>0</u>												

Notes:

Yakima River Fish Screening Facility Flow Measurements

Silo Sunny side

Screen # T.S. 1

Screen Diameter (in) _____
 Exposed (in) _____
 Submerged (in) 120"

Forebay Elevation 897.0
 Canal Flow 1275 cfs

Date 8/11/88
 Personnel CSA/EWL

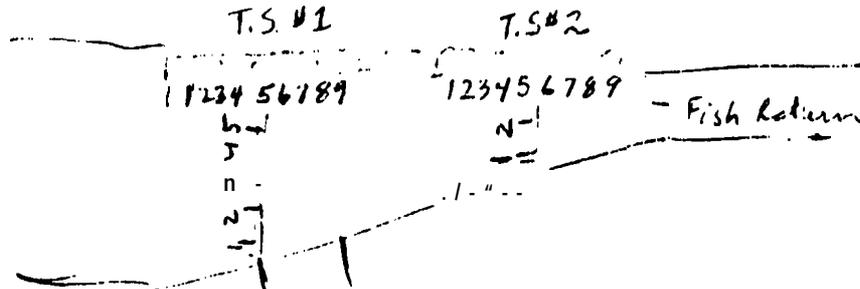
894.0 Separation Chamber.

Time Start	<u>1210 Hrs.</u>	<u>1210 Hrs.</u>	<u>1220 Hrs.</u>	<u>1220 Hrs.</u>	<u>1339 Hrs.</u>	<u>1339 Hrs.</u>
Time End	<u>1215 Hrs.</u>	<u>1215 Hrs.</u>	<u>1229 Hrs.</u>	<u>1229 Hrs.</u>	<u>1344 Hrs.</u>	<u>1344 Hrs.</u>

Location	*2*				*2*				*2*				*2*				*2*							
	U	C	L		U	C	L		U	C	L		U	C	L		U	C	L					
Depth	(816) 0.2 (823)				(810) 0.8 (811)				(816) 0.2 (823)				(810) 0.8 (811)				(816) 0.2 (823)				(810) 0.8 (811)			
Vector	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A
1	5.5	.2	.7	.6	3.8	.5	1.3	-.7	7.3	.8	.2	.2	4.1	1.0	1.2	-.4	6.7	0	-.2	1.3	-.6	-.2	.4	1.0
2	5.0	.4	.3	.2	4.0	.8	1.3	.4	7.1	1.1	.5	-.5	3.6	1.2	.8	-.8	7.3	-.4	.1	1.0	1.8	-.2	1.5	.4
3	6.3	.8	.2	.8	3.1	.6	1.3	-.4	4.9	1.9	.6	-.5	4.1	1.9	.8	1.2	6.9	-.6	.5	1.3	1.8	.4	.2	.6
4	6.0	.5	.2	.4	4.5	.6	1.4	-.2	5.4	1.1	.7	-.7	3.0	1.6	1.3	-.2	6.2	-.5	.3	.6	2.2	.3	-.2	-.4
5	6.0	.3	0	.5	5.9	.8	1.8	-.9	5.7	-.1	0	1.1	4.3	0	.7	-.3	6.6	.1	-.2	1.2	2.7	.6	1.2	-.4
6	6.5	.8	-.5	.4	4.8	.6	1.3	-.4	6.5	-.8	.2	.7	3.6	.2	.8	-.4	5.9	0	-.1	1.3	2.5	.2	.4	.1
7	7.5	.5	-.3	-.1	3.5	.4	.4	-.4	5.7	.7	.4	1.3	4.0	1.3	.4	-.2	4.5	-.2	-.2	1.1	1.4	.2	.3	.1
8	7.0	1.2	.1	-.2	5.6	.9	1.8	-.6	6.4	0	.2	1.2	4.8	.9	1.1	-.6	5.5	-.3	.1	1.0	2.5	-.2	.9	0
9	5.6	.7	.1	0	3.7	1.0	.9	-.8	1.3	.6	.1	.7	4.7	.4	.8	-.6	5.6	-.2	.1	1.2	2.4	0	.8	.1
10	6.3	.6	.7	.3	4.6	.7	.8	-.9	7.0	-.6	.2	.8	5.4	.7	1.2	-.1	7.2	-.6	.1	.5	2.6	.2	.4	-.4

Average	6.17	-0.64	-.13	0.29	4.37	-0.64	-1.23	0.49	5.93	-0.27	-.31	0.43	4.16	-.82	-.91	-.68	6.24	.27	1.05	1.05	1.93	-.13	-.59	.11
Minimum	5.0	-.2	-.7	-.2	3.1	-.1	-.8	-.9	1.3	-.1	-.7	-.7	3.0	-.6	-.3	-.2	4.5	-.1	-.5	.6	-.6	-.6	-.5	-.4
Maximum	7.5	-.2	.3	.8	5.9	-.5	-.4	.4	7.3	1.1	0	1.3	5.4	0	-.4	-.4	7.3	.6	.2	1.3	2.7	.2	.2	1.0

Notes:



Note: Re-arranged our probe rod - n's
 Replaced aluminum shaft with steel shaft,
 and put on foot plate instead of pointer
 foot to stabilize our apparatus (A)

Yakima River Est. Screening Facility Flow Measurements

Site unnside
Screen # T.S #1

Screen Diameter (in) -
Exposed (in) -
Submerged (in) 120"

Forebay Elevation 877.0
Canal Flow 1275 cfs

Date 8/11/88
Personnel CAA/EWL

Time Start	1350 Hrs.	1350 Hrs.	1413 Hrs.	1413 Hrs.	1422 Hrs.	1422 Hrs.
Time End	1355 Hrs.	1355 Hrs.	1418 Hrs.	1418 Hrs.	1427 Hrs.	1427 Hrs.

Location	U C L				U C L				U C L				U C L				U C L							
	(F10) 0.2 (F23)				(F10) 0.8 (F11) *				(F10) 0.2 (F23)				(F10) 0.8 (F11)				(F10) 0.2 (F23)				(F10) 0.8 (F11)			
Depth	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A
1	5.2	0	-1.2	1.4	1.5	-4	.6	0	6.3	-4	-3	.9	2.5	-2	-2	.2	4.4	-3	0	.6	2.6	-6	.9	-1.8
2	4.2	0	-3	.7	3.4	-4	.6	0	6.1	-3	-3	.8	3.4	-4	.3	-7	5.4	-3	0	.8	1.8	-2	-3	-9
3	6.3	-4	.1	1.4	1.3	-3	.9	0	6.0	0	.2	1.2	.6	-2	.6	.3	5.7	0	.1	.5	.9	-1	-2	.6
4	5.6	-2	.3	1.1	1.9	-7	1.6	0	5.5	.3	-8	.7	2.2	-5	.3	-1.1	5.2	-4	-1	.8	3.0	-2	.9	0
5	6.4	.2	-2	1.0	1.4	.4	.8	0	5.4	-4	.2	.8	.6	.4	.8	.5	6.0	-3	.3	.8	.7	-6	1.1	-5
6	5.8	0	-2	.8	2.3	.3	1.4	0	5.3	-2	.1	.6	1.5	-5	1.1	-2	4.2	-6	0	.7	1.5	1.3	.7	0
7	6.2	-4	-6	1.0	0.5	.4	.5	0	5.4	.3	.2	.7	2.3	-3	.5	.3	5.7	0	.2	.9	3.2	0	1.3	0
8	6.0	-5	.3	.9	.2	-2	.1	0	6.6	-7	-3	.4	.7	0	.5	-2	4.6	-4	0	.8	2.3	-5	.9	-1
9	6.1	.3	-2	.8	1.8	.3	1.2	0	6.4	-5	-2	.8	4.0	0	-4	-1	5.2	-2	.1	1.0	2.7	-4	-1	-1
10	6.6	-3	-1	.6	1.8	-5	.5	0	6.3	-6	-6	1.1	3.6	-3	.9	1.1	4.3	-4	-3	1.0	1.7	-3	.7	-1

Average	5.84	.13	.11	0.97	1.61	.17	-.72	X	5.93	.25	.18	0.80	2.14	0.20	-.44	0.07	5.07	.29	-.03	.79	1.94	-.16	-.59	-1.19
Minimum	4.2	-3	-3	.6	0.2	-.4	-1.4	X	5.3	-3	-2	.4	.6	-.4	-1.1	-1.1	4.2	0	-.3	.5	.7	-1.3	-1.3	-.9
Maximum	6.6	.5	.6	1.4	3.4	.7	-.1	X	6.6	.7	.8	1.2	3.6	.5	.4	1.1	6.0	.6	.3	1.0	3.2	.6	.3	.6

Notes: * Probe malfunction?

Yakima River Fish Screening Facility F- Measurements

Site Sunnyside

Screen # T.S #2

Screen Diameter (in) -
 Exposed (in) -
 Submerged (in) 720"

Forebay Elevation 299.0
 Canal Flow 1275 cfs

Date 8/11/88
 Personnel CM/EWL

Time Start	<u>1433 Hrs.</u>	<u>1433 Hrs.</u>	<u>1441 Hrs.</u>	<u>1441 Hrs.</u>	<u>1459 Hrs.</u>	<u>1459 Hrs.</u>
Time End	<u>1438 Hrs.</u>	<u>1438 Hrs.</u>	<u>1446 Hrs.</u>	<u>1446 Hrs.</u>	<u>1504 Hrs.</u>	<u>1504 Hrs.</u>

Location	U C L				U C L				U C L				U C L				U C L			
	(8'6") 0.2 (8'23)		(8'11) 0.8 (8'11)		(8'6") 0.2 (8'23)		(8'0") 0.8 (8'11)		(8'6") 0.2 (8'23)		(8'0") 0.8 (8'11)		(8'6") 0.2 (8'23)		(8'0") 0.8 (8'11)					
Depth	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A
1	5.3	-1.4	-1.2	.9	2.2	-1.7	.9	.2	3.6	.4	.1	1.1	2.0	-1.2	1.5	.1	3.7	.1	1.2	.9
2	5.2	-1.3	1.7	1.1	4.2	-1.3	.8	.4	5.2	-1.6	.2	.7	.2	-1.4	1.5	-1.3	3.8	-1.1	.5	1.1
3	6.2	-1.8	.3	.7	2.4	-1.7	.5	-1.6	5.0	.2	-1.1	.9	1.2	-1.4	1.6	1.3	4.7	0	.3	.8
4	5.4	-1.5	.2	.9	1.2	-1.2	.8	-1	5.3	-1.4	.3	1.0	3.2	-2.0	1.2	1.0	4.0	0	-1.2	.8
5	4.6	-1.1	-1.2	.7	2.9	-1.0	1.4	-1.7	5.4	.3	.3	1.4	2.5	-2.6	.1	-1.4	2.9	-1.3	.7	.8
6	4.6	-1.3	0	1.3	2.5	-1.2	.5	-1	4.0	-1.2	-1.1	.9	3.9	-1.6	1.0	0	3.5	0	.1	.7
7	4.3	-1.4	-1.4	0.9	2.0	-1.4	0	-1.3	5.1	.1	.4	1.6	.8	-1.5	.3	-1.6	3.6	-1.5	.7	1.0
8	5.7	-1.2	.7	.8	3.4	-1.4	-1.2	0	5.8	0	1.2	1.8	-1.8	-1.6	1.0	1.1	2.9	-1.2	.3	.7
9	5.6	-1.2	0	1.6	3.1	-1.5	1.6	0	4.4	-1.1	-1.5	.8	2.6	-2.0	1.1	-1.5	4.1	.2	-1.3	1.2
10	5.8	.2	.3	1.6	2.1	-1.9	.7	-1.2	4.9	-1.3	.1	.9	1.2	-2.2	0	-1.3	4.6	0	.3	.8

Average	5.27	1.34	-1.14	.85	2.60	1.23	-1.50	-1.14	4.83	.06	-1.09	0.91	1.68	1.75	-1.63	0.04	3.88	.08	-1.26	.88
Minimum	4.3	.1	-1.7	.6	1.2	.7	-1.9	-1.7	3.6	-1.4	-1.4	.6	-1.8	1.2	-1.1	-1.6	2.9	-1.2	-1.7	.7
Maximum	6.2	.8	.4	1.3	4.2	1.5	.2	.4	5.8	.6	.5	1.1	3.9	2.6	0	1.3	4.7	.5	.3	1.2

Notes:

E.25

Yakima River Fish Screening Facility Flow Measurements

Site Summit

Forebay Elevation 897.0
Canal Flow 1275 cfs

Date 8/11/88
Personnel CA/EWL

Screen # T.S.#2

Screen Diameter (in) -
Exposed (in) -
Submerged (in) 120"

Time Start	1519 Hrs.	1519 Hrs.	1528 Hrs.	1528 Hrs.	1537 Hrs.	1537 Hrs.																		
Time End	1524 Hrs.	1524 Hrs.	1533 Hrs.	1533 Hrs.	1542 Hrs.	1542 Hrs.																		
Location	④				④				④															
Depth	(8/5) 0.2 (8/3)				(8/5) 0.8 (8/1)				(8/5) 0.2 (8/3)				(8/5) 0.8 (8/1)											
Vector	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A								
1	4.9	.7	.1	.4	4.6	1.0	1.4	-.4	4.0	-.6	.4	.8	4.6	-.4	1.6	.5	3.4	-.2	.1	.8				
2	4.5	0	-.4	.5	3.8	1.0	.4	.1	3.5	-.6	-.2	.8	1.4	-.6	.2	.6	4.5	-.5	.2	1.0	1.0	-.1	-.2	-.4
3	3.9	-.6	.1	.7	.9	-.3	.7	.2	5.7	-.6	1.0	.8	1.2	.3	.4	-.4	4.6	0	-.2	-.8	1.0	.2	.7	-.4
4	4.4	-.4	0	.7	1.7	-.7	1.0	.1	4.2	-.4	.6	1.0	1.8	0	.8	-.1	3.5	-.3	0	.9	1.4	1.4	2.5	.4
5	4.2	-.6	-.1	.3	.4	-.8	1.4	-.2	4.3	-.5	.4	1.0	1.3	0	.3	-.2	3.6	-.4	.8	1.0	1.9	.2	1.4	.3
6	5.7	0	-.1	.9	1.6	1.7	1.2	.2	3.4	-.9	0	.8	1.0	.1	.7	.1	3.5	.4	-.5	1.1	-.2	-.4	1.8	-.7
7	3.5	-.5	.1	.5	.6	-.8	1.6	.1	2.1	.6	.4	1.0	.7	-.1	.8	-.2	3.7	0	.3	.9	1.3	-.2	.8	.1
8	4.0	-.5	.6	.5	.8	-.2	.9	.1	4.0	-.3	-.1	1.0	1.5	.1	1.2	-.1	4.0	-.5	-.3	.7	1.0	-.3	-.6	-.3
9	4.9	0	0	.7	1.2	-.3	1.0	.2	3.8	-.2	.8	1.1	0.7	.1	.7	1.9	4.7	.1	.2	.8	2.6	.4	.6	1.5
10	4.1	-.3	.4	1.6	1.4	-.6	1.2	.2	2.2	0	-.7	1.1	2.0	-.8	2.0	.5	5.2	-.4	.4	.5	2.5	-.6	-.3	-.8
Average	4.41	.22	.07	.58	1.50	.20	1.08	.06	3.72	.35	-.16	.94	1.62	.23	-.87	.26	4.07	.18	-.10	.69	1.39	-.07	-.77	.07
Minimum	3.5	-.7	-.6	.3	.4	-.7	-.6	-.4	2.1	-.6	-.10	.8	.7	-.3	-2.0	-.4	3.5	-.4	-.8	-.8	-.2	-1.4	-2.5	-.7
Maximum	5.7	.6	.4	.9	1.6	1.8	-.4	.2	5.7	.9	1.7	1.1	4.6	1.4	-.2	1.9	4.7	.5	.5	1.1	2.6	.6	.6	1.5

Notes:

Yakima River Fish Screening Facility Flow Measurements

Site surveys 6

Forebay Elevation 897.0
Canal Flow 1275 cfs

Date 3/11/88
Personnel CGG/ELW

Screen # TS 02

Screen Diameter (in) _____
Exposed (in) _____
Submerged (in) 120"

Time Start	<u>1549 Hrs.</u>	<u>1549 Hrs.</u>	<u>1603 Hrs.</u>	<u>1603 Hrs.</u>	<u>1610 Hrs.</u>	<u>1610 Hrs.</u>
Time End	<u>1554 Hrs.</u>	<u>1554 Hrs.</u>	<u>1608 Hrs.</u>	<u>1608 Hrs.</u>	<u>1615 Hrs.</u>	<u>1615 Hrs.</u>

Location	<u>0.2</u>				<u>0.8</u>				<u>0.5</u>				<u>0.5</u>				<u>0.5</u>							
	U	C	L		U	C	L		U	C	L		U	C	L		U	C	L					
Depth	<u>(910) 0.2 (823)</u>				<u>(810) 0.8 (811)</u>				<u>(718) 0.2 (823)</u>				<u>(820) 0.8 (811)</u>				<u>(810) 0.2 (823)</u>				<u>(810) 0.8 (811)</u>			
Vector	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A
1	4.5	-4	-1	1.7	1.2	.1	1.4	-2	4.3	-6	-4	.7	1.3	-4	1.4	-1	2.9	-2	.3	.9	1.8	-4	.1	.2
2	3.1	.3	-5	.8	2.7	-1.0	1.3	1.8	4.5	-4	.3	1.1	-4	1.5	1.9	-1.5	3.5	0	0	.5	.9	-2	-1	-2
3	3.3	0	-3	1.2	-1.0	.6	2.0	1.2	4.6	0	.1	.8	-2	.3	.2	-1	3.7	-2	0	.6	-4	1.5	-4	-4
4	2.9	-2	-2	1.4	.5	.9	.6	.6	4.1	-7	.3	.9	.9	-2	-3	.1	4.3	-4	.6	.8	1.9	-3	.9	-3
5	3.2	-4	.1	.6	1.0	-4	.4	0	4.4	.1	.2	.9	1.2	-4	.2	.7	3.5	-5	.6	.9	1.8	-2	-4	-4
6	3.3	-3	-1	.8	2.1	-2	.4	1.2	3.7	-4	.4	.9	1.1	-2	.9	-1.5	4.1	-5	.5	.6	1.3	1.9	.4	-6
7	4.1	.2	-2	1.0	.7	-4	.7	1.0	4.2	-3	1.1	.9	1.3	-4	-4	-1	4.9	-3	1.5	.8	1.8	.5	.4	1.2
8	3.6	0	-3	.4	-1.8	1.2	1.1	-3	3.9	-3	1.2	.9	.6	0	-1	.1	4.1	0	.4	.7	1.3	-4	.1	-1
9	3.4	-4	-4	.7	1.0	-4	.6	1.5	4.0	-4	.3	.8	.9	-5	.2	-2	4.8	.2	1.5	.8	1.5	-3	.9	-1
10	4.7	-2	0	.9	1.6	-3	.7	.9	3.7	-4	.6	1.1	1.0	-5	.1	.2	4.2	-8	.3	.5	3.6	-1.1	1.7	.6

Average	3.61	.14	.20	.85	1.90	1.09	-.92	.47	4.14	.26	-.21	.90	1.77	.08	-.41	-.06	4.00	.27	-.97	.71	1.25	.00	-.36	-.11
Minimum	3.1	-.3	0	.6	-1.0	-.9	-2.0	-.3	3.7	-.1	-.6	.7	-4	-1.5	-1.9	-.5	3.5	-2	-.6	.5	-.4	-1.9	-1.7	-.6
Maximum	4.7	0	1.5	1.4	2.7	1.0	-.4	1.9	4.6	.7	.4	1.1	1.3	.5	.4	.7	4.9	.8	0	.9	3.6	1.1	.4	.6

Notes:

E.27

Yakima River Fish Screening Facility Flow Measurements

Site Swan, inside

Forebay Elevation 897.0

Date 8/11/88

Screen # T.S. #2

Screen Diameter (in) -
 Exposed (in) -
 Submerged (in) 120"

Canal Flow 1275 cfs

Personnel CGA/CWL

Time Start	1618 Hrs.	1618 Hrs.	1626 Hrs.	1626 Hrs.	1635 Hrs.	1635 Hrs.
Time End	1623 Hrs.	1623 Hrs.	1631 Hrs.	1631 Hrs.	1640 Hrs.	1640 Hrs.

Location	67				68				69															
	U	C	L		U	C	L		U	C	L		U	C	L									
Depth	(815) 0.2 (823)				(810) 0.8 (811)				(815) 0.2 (823)				(810) 0.8 (811)											
Vector	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A								
1	3.6	.2	-.1	.5	2.4	-.5	1.1	0	4.3	-.2	-.1	.8	1.3	-.7	.1	0	4.2	.2	.5	.7	1.3	-.4	1.1	0
2	4.1	-.2	.4	.7	1.1	-.3	.5	-.2	4.2	.2	.3	.7	2.8	-.1	0	0	4.0	.2	.7	1.4	1.8	-.2	.8	0
3	3.5	0	.3	1.1	.8	-.6	1.1	.2	4.2	.2	-.3	-.5	1.4	-.2	-.1	0	4.1	.2	.3	.9	1.1	-.7	.1	0
4	4.4	.1	.2	.6	1.1	-.5	-.1	-.3	4.6	-.2	.6	.8	2.8	-.2	.6	0	3.2	.7	.6	.5	3.4	-.9	1.2	0
5	4.1	-.2	.2	.9	1.3	-.2	.5	.1	4.3	-.4	.3	1.0	1.9	-.5	.9	0	3.7	-.2	.3	.8	1.2	-.5	.1	0
6	4.4	-.4	.3	1.0	2.1	-.8	.5	-.9	3.9	.2	.3	.9	.8	-.3	1.0	0	4.1	0	.4	.7	1.4	-.7	.4	0
7	3.6	.3	.1	.5	1.4	-.5	.8	0	4.0	-.2	.2	1.1	2.0	-.8	1.8	0	3.7	-.2	.4	.6	.6	-.2	.9	0
8	4.6	-.3	0	.6	.6	-.2	.2	-.8	3.6	0	0	.6	2.1	-.6	.3	0	4.0	-.3	.5	.7	1.8	-.3	.1	0
9	3.8	0	.1	.6	1.0	-.3	.7	-.3	4.1	-.1	.2	.7	.4	-.2	-.1	0	3.6	-.2	.3	.5	1.6	-.1	.2	0
10	3.9	-.1	-.4	.4	.6	-.3	.8	-.2	4.1	0	.2	.7	1.2	-.8	1.3	0	2.6	-.4	.2	.7	1.5	-.4	.8	0

Average	4.10	.06	-.11	.69	1.24	.52	-.61	-.24	4.13	.05	-.17	.68	1.67	.54	-.58	0	3.72	0	-.42	.75	1.57	.60	-.57	0
Minimum	3.5	-.3	-.4	.4	.6	.2	-.1	-.9	3.6	-.2	-.6	-.5	.4	.1	-.18		3.2	-.7	-.7	.5	.6	.1	-.1	?
Maximum	4.6	.4	.4	1.1	2.4	1.3	.1	.2	4.6	.4	.3	1.1	2.8	1.2	.1		4.2	.4	-.2	1.4	3.4	1.2	-.1	?

Notes: * probe malfunction?

E. 28

Yakima River Fish Screening Facility Flow Measurements

Site Sunnyside

Forebay Elevation 897.0

Date 8/11/88

Screen # T5#2-X5

Screen Diameter (in) _____
Exposed (in) _____
Submerged (in) 120"

Canal Flow 1275 cfs

Personnel CR/EWL

Time Start	1738 Hrs.	1738 Hrs.	1726 Hrs.	1726 Hrs.																												
Time End	1743 Hrs.	1743 Hrs.	1732 Hrs.	1732 Hrs.																												
Location	<u>(#1)</u>				<u>(#2)</u>																											
Depth	(816) 0.2 (823)				(810) 0.8 (811)				(816) 0.2 (823)				(810) 0.8 (811)				U C L				U C L											
Vector	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A
1	2.9	-3	.6	.9	1.4	-2	.3	0	3.4	-5	-.3	1.0	1.2	-3	1.8	.3																
2	3.4	-4	.5	.8	1.0	-4	-4	-.1	3.8	-4	0	.7	1.8	-3	1.5	-.1																
3	3.5	-3	.4	.7	1.2	-.1	-.5	.4	4.2	-.6	-.3	1.2	1.7	-.8	.3	-.3																
4	2.4	-2	.7	.9	.8	0	-.2	.2	3.3	-.4	.8	1.3	1.5	0	1.0	.3																
5	3.0	-4	.5	.8	.7	-.6	-.2	.1	5.0	-.2	-.1	1.2	2.4	0	.1	.1																
6	3.4	-3	.4	1.0	1.0	-.3	.3	.2	3.4	-.4	-.2	1.1	1.1	-.2	.9	1.2																
7	3.3	-5	.2	.9	1.2	-.4	-.2	.3	3.3	-.4	-.3	.9	1.4	-.5	.4	.3																
8	2.8	-.6	.9	.6	.7	.2	.5	.3	4.2	-.0	.1	.8	1.9	-.2	.8	.6																
9	3.1	-.3	.3	1.1	2.2	2.1	1.5	1.6	4.5	.4	0	.8	1.4	-.9	-.8	1.2																
10	3.1	-.6	-.1	.8	.6	1.4	.2	1.1	3.1	-.4	.1	.8	1.9	-.3	.8	1.8																
Average	3.09	.39	-.44	.85	0.54	.17	-.13	.40	3.82	.39	.07	.98	1.43	.35	-.48	.44																
Minimum	2.4	.2	-.9	.6	-.2	-.2	-.1	-.1	3.1	-.4	-.3	.7	.5	0	-1.0	-.3																
Maximum	3.5	.6	.1	1.1	1.4	.6	.5	1.6	5.0	1.0	.3	1.3	2.4	.9	.8	1.8																

Notes: Cross-section in line with T.S. #2 set #4.

#1 is 1' from outer wall

#2 is about midchannel between wall and T.S. #2

Yakima River Fish Screening Facility Flow Measurements

Site Swan side

Forebay Elevation 897.0
Canal Flow 1675 cfs

at Dam 8/11/88
Per Donnell COA/EWL

Screen # Fish Return

Screen Diameter (in) _____
Exposed (in) _____
Submerged (in) 100" ~~108"~~

894.0 Fish return

Time Start	<u>1705 Hrs.</u>	<u>1705 Hrs.</u>				
Time End	<u>1709 Hrs.</u>	<u>1709 Hrs.</u>				

Location	U C L				U C L				U C L			U C L			U C L			U C L		
Depth	<u>(816) 0.2 (823)</u>				<u>(810) 0.8 (811)</u>				0.2			0.8			0.2			0.8		
Vector	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	<u>3.9</u>	<u>.5</u>	<u>.4</u>	<u>.3</u>	<u>2.2</u>	<u>0</u>	<u>.1</u>	<u>.1</u>												
2	<u>3.8</u>	<u>.6</u>	<u>.5</u>	<u>.1</u>	<u>2.5</u>	<u>-.1</u>	<u>.8</u>	<u>.1</u>												
3	<u>4.4</u>	<u>.7</u>	<u>.4</u>	<u>0</u>	<u>2.4</u>	<u>.1</u>	<u>-.5</u>	<u>-.2</u>												
4	<u>4.1</u>	<u>.8</u>	<u>.6</u>	<u>-.2</u>	<u>2.2</u>	<u>0</u>	<u>-.3</u>	<u>-.1</u>												
5	<u>4.3</u>	<u>.6</u>	<u>.6</u>	<u>0</u>	<u>2.0</u>	<u>0</u>	<u>-.2</u>	<u>-.1</u>												
6	<u>4.2</u>	<u>.5</u>	<u>.3</u>	<u>.1</u>	<u>2.6</u>	<u>.1</u>	<u>-.6</u>	<u>-.2</u>												
7	<u>4.0</u>	<u>.6</u>	<u>.4</u>	<u>-.1</u>	<u>2.6</u>	<u>0</u>	<u>-.4</u>	<u>-.2</u>												
8	<u>4.2</u>	<u>.5</u>	<u>.3</u>	<u>.2</u>	<u>2.2</u>	<u>-.2</u>	<u>.4</u>	<u>-.1</u>												
9	<u>4.3</u>	<u>.6</u>	<u>.4</u>	<u>0</u>	<u>2.1</u>	<u>0</u>	<u>-.2</u>	<u>-.1</u>												
10	<u>4.3</u>	<u>.5</u>	<u>.5</u>	<u>.1</u>	<u>2.0</u>	<u>0</u>	<u>-.5</u>	<u>-.3</u>												

Average	<u>4.25</u>	<u>-.59</u>	<u>-.44</u>	<u>.05</u>	<u>2.28</u>	<u>.01</u>	<u>.14</u>	<u>-.11</u>												
Minimum	<u>3.8</u>	<u>-.5</u>	<u>-.6</u>	<u>-.2</u>	<u>2.0</u>	<u>-.1</u>	<u>-.8</u>	<u>.3</u>												
Maximum	<u>4.4</u>	<u>-.8</u>	<u>-.3</u>	<u>.3</u>	<u>2.6</u>	<u>.2</u>	<u>.6</u>	<u>.1</u>												

Notes:

Yakima River Fish Screening Facility F^a Measurements

Site Sunnyside

Forebay Elevation 897.0

Date 8/11/88

Screen # T.S.1-XS

Screen Diameter (in) _____

Canal Flow 12.75 cfs

Personnel CA/EWL

Exposed (in) _____

Submerged (in) 120"

Time Start	<u>1757 Hrs.</u>	<u>1757 Hrs.</u>	<u>1803 Hrs.</u>	<u>1803 Hrs.</u>	<u>1810 Hrs.</u>	<u>1810 Hrs.</u>
Time End	<u>1801 Hrs.</u>	<u>1801 Hrs.</u>	<u>1808 Hrs.</u>	<u>1808 Hrs.</u>	<u>1815 Hrs.</u>	<u>1815 Hrs.</u>

Location	U C L				U C L				U C L				U C L				U C L							
	(815) 0.2 (822)		(810) 0.8 (811)		(818) 0.2 (823)		(805) 0.8 (811)		(810) 0.2 (822)		(805) 0.8 (811)		(810) 0.2 (822)		(805) 0.8 (811)									
Depth	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A				
1	2.1	-1.6	1.2	1.6	1.6	1.7	-1.0	-1.6	2.2	-1.4	1.1	1.7	1.4	1.8	-1.6	-1.5	2.6	-1.2	1.8	1.0	1.7	1.4	0	-1.0
2	2.1	-1.8	1.6	1.9	1.6	1.0	-1.6	-1.2	2.0	-1.2	1.3	1.8	0	1.2	-1.3	-1.4	3.1	-1.6	1.3	1.1	-1.2	1.2	0	-1.3
3	1.9	-1.2	0	1.8	-1.4	1.6	-1.5	-1.5	2.3	-1.3	1.9	1.3	1.4	1.1	-1.5	-1.1	2.5	-1.1	1.7	1.2	-1.9	1.7	-1.3	-1.9
4	2.8	-1.2	1.6	1.3	0	1.2	-1.5	-1.5	2.4	-1.5	1.5	1.6	1.8	1.5	1.4	-1.9	2.4	1.2	1.2	1.5	1.5	1.4	1.4	-1.8
5	1.8	-1.4	1.6	1.3	1.3	1.2	-1.1	-1.4	2.1	-1.1	1.3	1.2	1.2	1.6	1.4	-1.3	2.6	-1.6	1.3	1.7	1.3	1.6	-1.4	-1.8
6	2.2	-1.8	1.5	1.5	-1.1	1.4	-1.8	-1.7	2.7	0	1.1	1.9	1.4	1.6	-1.6	-1.2	2.8	-1.2	1.1	1.1	1.2	1.2	1.1	-1.7
7	2.9	0	1.2	1.8	1.7	1.4	-1.0	-1.6	2.5	-1.3	0	1.4	1.2	1.6	-1.1	-1.1	3.3	1.1	1.7	1.9	0	1.2	-1.1	-1.0
8	1.8	-1.4	1.2	1.5	-1.2	1.6	-1.5	-1.6	1.6	-1.4	-1.2	1.2	-1.4	1.0	-1.4	-1.2	3.4	-1.4	1.3	1.1	1.9	1.6	0	1.2
9	2.0	0	1.1	1.3	-1.2	1.9	-1.2	-1.8	1.6	-1.4	1.6	1.9	1.3	1.5	1.3	-1.8	2.6	0	1.2	1.2	1.2	1.1	1.4	-1.6
10	1.6	-1.1	1.3	1.8	0	1.3	-1.7	-1.7	1.2	-1.2	1.2	1.3	1.4	1.9	1.1	-1.2	2.3	-1.2	1.4	1.0	1.0	1.1	1.1	-1.3

Average	2.12	1.45	-1.61	1.98	1.10	1.83	1.69	-1.56	2.06	1.28	-1.38	1.83	1.27	1.88	1.13	1.17	2.76	1.20	-1.40	1.77	1.27	-1.95	-1.02	-1.72
Minimum	1.6	0	-1.2	1.3	-1.4	-1.3	1.1	-1.2	1.2	0	-1.1	1.3	-1.4	-1.5	-1.4	1.3	2.3	-1.2	-1.8	1.1	-1.9	-1.6	-1.4	-1.6
Maximum	2.9	1.8	0	1.8	1.7	-1.2	1.2	-1.8	2.7	1.5	1.2	1.3	1.8	-1.2	1.6	-1.8	3.4	1.6	-1.1	1.2	1.0	-1.1	1.4	1.2

Notes: #1 near west far wall (canal) along transect at T.S.#2, Set #1, etc.
 #5 nearest T.S.#2

Yakima River Fish Screening Facility Flow Measurements

Site Sunny side

Forebay Elevation 897.0

Date 8/11/88

Screen # TS#2-XS

Screen Diameter (in) -

Canal Flow 1275 cfs

Personnel CA/ELW

Exposed (in) -

Submerged (in) 120"

Time Start	1818 Hrs.	1818 Hrs.	1825 Hrs.	1825 Hrs.																				
Time End	1823 Hrs.	1823 Hrs.	1830 Hrs.	1830 Hrs.																				
Location	<u>0.2</u>				<u>0.8</u>				<u>0.2</u>				<u>0.8</u>											
Depth	(818) 0.2 (823)				(818) 0.8 (811)				(818) 0.2 (823)				(818) 0.8 (811)											
Vector	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V		S	A	V	
1	4.4	-1.6	.7	.8	3.0	1.0	.9	-1.4	4.0	-1.1	.4	.8	.8	.9	.6	.8								
2	3.2	-1.6	.3	1.2	2.8	1.1	.9	-1.6	3.3	0	.6	.7	1.7	1.1	.7	1.2								
3	3.7	-1.7	.6	1.3	1.3	.1	.2	-1.7	3.9	-1.2	.6	.7	1.6	1.3	.7	.5								
4	4.2	.2	0	.9	2.1	1.0	.9	-1.3	3.6	.2	.8	.7	1.6	1.3	.6	-1.6								
5	4.0	-1.3	-1	1.0	1.9	1.8	1.1	-1.4	3.6	.2	.5	.6	5.0	1.3	.5	-1.4								
6	3.6	-1.5	.2	1.1	2.2	1.8	.7	-1.4	4.7	-1.9	.7	.9	1.2	.8	.6	-1.6								
7	4.1	0	-1	1.0	1.8	1.4	.8	-1.6	3.7	.3	.6	.9	1.4	1.0	.9	-1.7								
8	4.4	-1.2	.1	.6	1.9	.8	.4	-1.3	3.5	.2	.6	.5	1.5	1.1	.3	-1.8								
9	5.3	-1.6	.2	.9	1.0	.7	.4	-1.5	4.5	-1.4	1.0	1.2	1.9	0.8	.8	-1.6								
10	4.6	-1.5	.6	.6	1.8	.6	.7	-1.2	4.8	-1.2	.3	.8	1.6	.3	.8	-1.4								
Average	4.15	.38	-1.23	.94	1.78	-.83	-.70	-.14	3.96	.12	-.61	.78	1.73	-1.02	-.65	-1.6								
Minimum	3.2	-.2	-.6	.6	.8	-1.4	-.9	-.7	3.3	-.3	-1.0	.5	.6	-1.4	-.9	-.8								
Maximum	5.3	.7	.1	1.3	2.8	-.1	-.2	-.2	4.8	.9	-.3	1.2	5.0	-.3	-.5	1.2								

Notes:

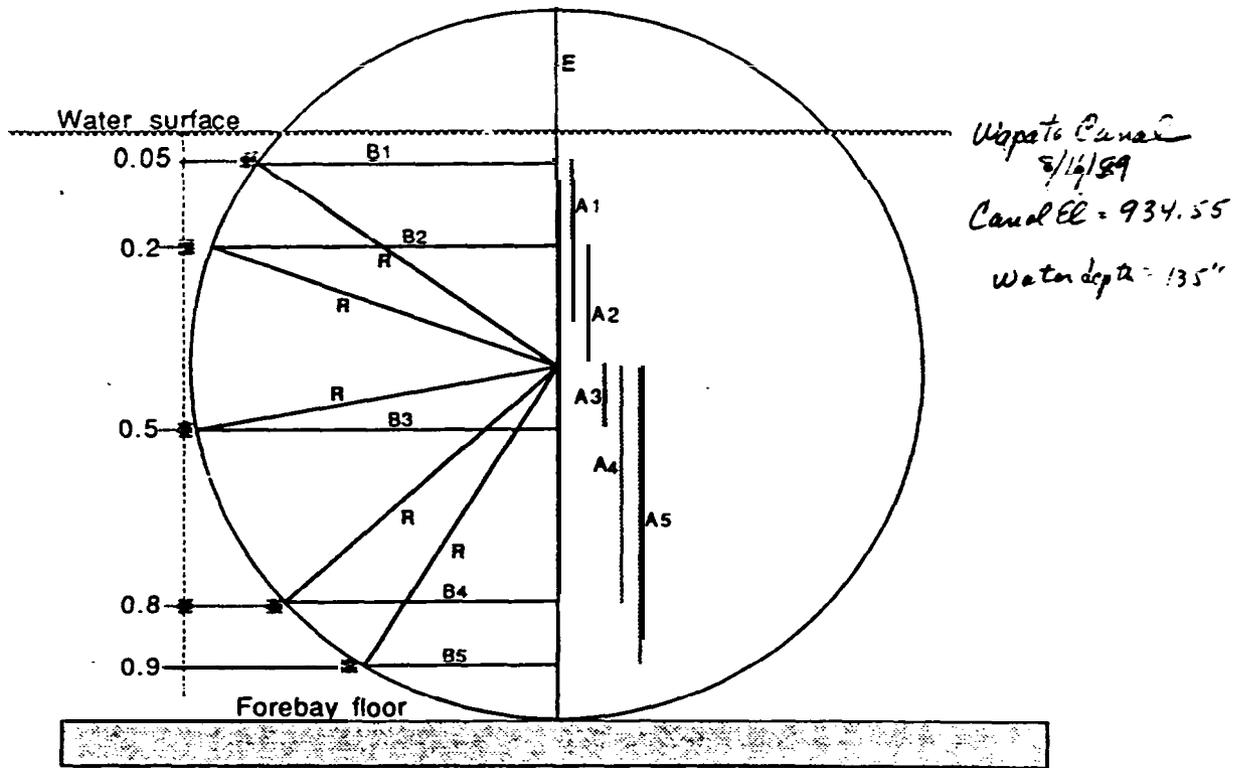
APPENDIX F

WAPATO SCREENS RAW DATA SHEETS

Appendix F contains the raw data sheets for two sets of flow measurements conducted at the Wapato Screens. A complete survey was conducted on August 16 through 18, 1988. Three Yakima Indian Nation net pens were located in the screen forebay during the measurement series. Page F.2 shows the calculations made to position probes at the proper measurement depths, and the distance between the probe and the screen face at the measured depths. A horizontal probe support the length of the distance between the probe and the screen face was used for measurements near the face of the drum screen. Raw data for measurements in front of the drum screens are found on pages F.3 through F.25. Flow measurements in the entrance to the two intermediate and the terminal fish bypasses on on pages F.26 through F.28. Flow measurements in three transects across the separation chamber are on pages F.29 through F.31. Flow measurements at the face of the two traveling belt screens in the separation chamber are on pages F.32 through F.33. Flow measurements for the fish return are on page F.34.

A partial survey was conducted at the Wapato Screens on September 8 1988 after the three Yakima Indian Nation net pens had been removed from the screen forebay. Measurements were only taken in front of the screens. Page F.35 shows the calculations made to position probes at the proper measurement depths. and the distance between the probe and the screen face at the measured depths. Raw data for measurements in front of the drum screens are found on pages F.36 through F.40.

WORKSHEET FOR DEPTH DETERMINATIONS



Upstate Canal
8/16/89
Canal EL = 934.55
Water depth = 135"

Drum Diameter (D): 168 SIDE A SIDE B
 Radius (R): 84
 Exposed to air (E) : 38.3"
 Submerged (Z): 130"

0.05 Z: <u>6.5"</u>	A1 = (E+0.05Z)-R	<u>39.5</u>	B1= (R^2-A1^2)^0.5	<u>74.13</u>
0.20 Z: <u>26.0"</u>	A2= (E+0.2Z)-R	<u>20.0</u>	B2= (R^2-A^2)^0.5	<u>81.58</u>
0.50 Z: <u>65.0"</u>	A3= (E+0.5Z)-R	<u>17.8</u>	B3= (R^2-A3^2)^0.5	<u>81.92</u>
0.80 Z: <u>104.0"</u>	A4= (E+0.8Z)-R	<u>58.0</u>	B4= (R^2-A4^2)^0.5	<u>60.76</u>
0.90 Z: <u>117.0"</u>	A5= (E+0.9Z)-R	<u>71.0</u>	B5= (R^2-A5^2)^0.5	<u>44.89</u>

Distance From Vertical To Screen Face

0.05 Z:	R-B1=	<u>9.87"</u>
0.20 Z:	R-B2=	<u>2.42"</u>
0.50 Z:	R-B3=	<u>2.18"</u>
0.80 Z:	R-B4=	<u>23.24"</u>
0.90 Z:	R-B5=	<u>39.11"</u>

Yakima River Fish Screening Facility Flow Measurements

Site WAPATO

Screen # Bypass #3

Screen Diameter (in) -
 Exposed (in) -
 Submerged (in) 130"

Forebay Elevation 934.55
894.55
 Canal Flow 1850 cfs

Date 8/16/88
 Personnel CM/F.M.

Time Start	<u>0852 Hrs.</u>	<u>0852 Hrs.</u>				
Time End	<u>0858 Hrs.</u>	<u>0858 Hrs.</u>				

Location	U (C) L				U (C) L				U C L			U C L			U C L			U C L		
	(816) 0.2 (823)				(810) 0.8 (811)*				0.2			0.8			0.2			0.8		
Depth	+S	+A	-V	-A	+S	+A	-V	-A	S	A	V	S	A	V	S	A	V	S	A	V
1	3.5	.6	0.9	.5	2.5	-.4	.6	-.3												
2	4.1	-.2	-.4	.7	2.7	-.5	-.1	.1												
3	3.9	.8	.2	.5	2.5	0	1.0	.4												
4	3.6	.4	.7	.4	2.3	-.4	0	0												
5	3.8	1.1	.4	-.3	2.2	.5	.7	-.1												
6	3.6	0	.6	.7	2.2	-.6	-.1	.2												
7	3.5	.2	.5	.7	2.4	-.7	-.1	.3												
8	3.2	2.2	-.2	-.6	1.6	1.3	.6	.5												
9	3.6	2.1	.4	.3	1.4	2.2	.8	.7												
10	3.1	2.2	-.3	-.2	1.9	.9	0	1.1												

Average	3.54	.77	-.26	-.27	2.17	.27	-.84	-.29												
Minimum	2.1	-.2	-.9	-.7	1.4	-.5	-1.0	-1.1												
Maximum	4.1	2.2	.4	.6	2.7	2.2	.1	.3												

Notes: $\frac{X}{Y}$ * scale - 0.5 fps.
 0.2 818 +S +A
 0.2 823 -V -A
 0.8 810 +S +A
 0.8 811 -V -A

* Probe malfunction:

Yakima River Fish Screening Facility Flow Measurements

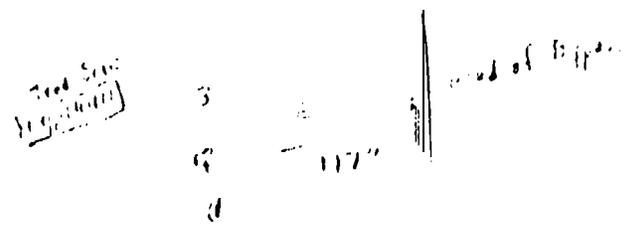
Site Wapato Screen Diameter (in) Weirbay Elevation 934.55 Date 8/16/82
 Screen # Separation chamber Exposed (in) Canal Flow 1250 cfs Personnel DA/FWL
 Submerged (in) 171" 0.2 = 34.2" 0.8 = 136.8"

Time Start	1047 Hrs.	1047 Hrs.	1054 Hrs.	1054 Hrs.	1101 Hrs.	1101 Hrs.
Time End	1052 Hrs.	1052 Hrs.	1059 Hrs.	1059 Hrs.	1105 Hrs.	1105 Hrs.

Location	U C L				U C L				U C L				U C L				U C L							
	(816) 0.2		(823)		(810) 0.8		*(811)		(816) 0.2		(823)		(816) 0.2		(823)		(810) 0.8		*(811)*					
Depth	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A				
1	-1.3	.3	-1.3	.1	.7	.2	0	.1	-1.7	.6	-1.3	-1.6	1.0	-.1	0	-.1	-1.8	.8	-1.7	-.5	2.4	-.5	0	0
2	-1.6	.8	-1.2	-.4	1.0	.1	0	-.4	-1.7	.5	-.8	-.5	1.7	-.2	0	0	-1.1	.8	-.4	-.2	2.4	-.6	-.1	0
3	-.8	.3	-1.5	0	.7	-.1	0	0	-1.8	-.0	-1.0	-.7	1.6	.2	0	0	-1.4	.2	-.5	-.2	2.0	-.6	.1	-.1
4	-1.2	.6	-.1	-.1	1.1	0	0	.2	-2.0	.1	-.7	-.1	1.5	-.6	0	-.1	-1.4	.8	-.7	-.9	1.9	-.5	0	0
5	-1.4	.8	-1.2	-.3	.2	0	0	-.2	-1.7	.7	-.9	-.6	1.9	-.4	0	0	-1.3	.4	-1.1	-.4	2.1	-.8	0	0
6	-1.1	.6	-1.5	-.6	1.3	0	0	0	-1.2	.9	-1.7	-.8	1.3	-.3	0	-.1	-1.7	.6	-.6	-.2	1.6	-.5	0	0
7	-1.4	.6	-1.6	-1.1	1.0	.1	0	-.4	-1.5	.6	-1.1	-.7	1.6	0	0	0	-1.5	.5	-.9	-.4	2.0	-.4	0	0
8	-1.1	.8	-1.2	-.1	1.2	.2	0	0	-1.8	-.1	-1.1	-.3	1.8	-.1	0	0	-1.4	.9	-.3	-.7	2.1	-.6	0	-.1
9	-1.0	.2	-1.5	-.5	1.0	0	0	.8	-1.9	.6	-.9	-.3	1.5	-.2	0	-.1	-1.6	.6	-.7	-.7	2.2	-.9	0	-.1
10	-1.4	.7	-1.1	-.4	.4	-.4	0	.2	-1.3	.7	-1.8	-.9	1.8	-.2	.1	0	-1.7	1.0	-.8	-.8	1.4	-.5	0	0

Average	1.23	.57	1.37	.44	.86	.01	0	-.03	-1.66	.56	1.13	.55	1.57	-.19	-.01	.04	1.51	.66	+.69	.50	2.01	-.59	0	.03
Minimum	1.6	.3	1.1	0	.2	-.4	0	-.8	-2.0	-1.0	.7	.3	1.0	-.6	-.1	0	1.3	.2	.3	.2	1.4	-.9	.1	0
Maximum	-.8	.8	1.7	1.1	1.3	.2	0	.4	-1.3	.7	1.8	.9	1.9	.2	0	.1	1.8	1.0	1.1	.9	2.4	-.4	-.1	.1

Notes:



* probe via function?

F. 4

Yakima RD or Fish Screening Facility Flow Measurements

Site Upstate

Screen # TS #1

Screen Diameter (in) —
 Exposed (in) —
 Submerged (in) 1.11"

Forebay Elevation 934.55'
~~945.5~~
 Canal Flow 1850 cfs

Date 8/16/88
 Personnel CAG/EWL

Time Start	<u>1114 Hrs.</u>	<u>1114 Hrs.</u>	<u>1123 Hrs.</u>	<u>1129 Hrs.</u>	<u>1156 Hrs.</u>	<u>1156 Hrs.</u>
Time End	<u>1119 Hrs.</u>	<u>1119 Hrs.</u>	<u>1128 Hrs.</u>	<u>1128 Hrs.</u>	<u>1200 Hrs.</u>	<u>1200 Hrs.</u>

Location	(U) C L				(U) C L				U (C) L				U (C) L				U C (L)				U C L			
	Depth	(810)	0.2	(823) *	(810)	0.8	(811) *	(810)	0.2	(823) *	(810)	0.8	(811) *	(810)	0.2	(823)	(810)	0.8	(811) *					
Vector	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A				
1	2.7	.5	-.6	.1	1.9	.4	.4	.4	1.9	.1	-.8	.2	2.8	.2	.4	1.9	1.6	-.2	-.3	.4	1.5	.2	.5	0
2	2.4	.3	-.8	0	2.2	.3	.5	.2	2.2	.5	-.9	.2	2.9	.5	.8	-.3	2.1	.2	-.4	.3	1.1	.6	1.3	0
3	2.3	.4	-.6	.2	2.3	.6	.7	.7	2.0	.2	-.5	.3	2.5	.4	.2	.2	1.8	0	-.5	.4	1.3	.2	.3	0
4	2.4	.2	-1.0	.1	2.2	0	.2	.3	2.2	0	-.8	-.2	2.0	-.4	.4	0	1.7	-.1	-.2	.5	1.4	.2	.3	0
5	1.9	.2	-.8	.3	1.8	.2	.5	0	2.4	.3	-1.1	.2	1.8	.2	.3	0	1.6	-.1	-.4	.4	1.0	.3	.5	0
6	2.1	.3	-1.1	.2	2.0	.7	.1	.9	2.7	.2	-1.1	.2	2.6	.3	0	0	1.6	-.3	-.2	.4	1.6	.3	.4	0
7	2.5	.4	-.7	0	2.6	.3	.1	-1	1.8	.6	-.6	.3	2.0	.3	.2	0	2.3	.4	-.6	.4	.9	.4	.7	0
8	2.2	.3	-.9	.2	2.2	.4	.5	.4	1.5	.5	-.5	.2	1.3	.4	1.1	0	1.9	0	-.5	.5	1.4	.1	.1	0
9	2.0	.4	-.7	0	1.9	.3	.5	.4	2.2	.3	-.8	.3	2.5	.4	.4	0	1.7	-.2	-.1	.6	1.2	.4	.3	0
10	2.2	.5	-.8	0	1.3	0	.7	1.0	2.3	.3	-.8	.3	2.5	.8	.1	0	2.3	0	-.3	.5	1.1	-.2	-.1	0

Average	2.27	.35	.82	-.11	2.04	.32	-.42	-.42	2.12	.30	1.79	-.24	2.29	.39	-.39	-.18	1.86	-.03	.35	-.44	1.25	.25	-.43	0
Minimum	1.9	.2	.6	-.3	1.3	0	-.7	-.9	1.5	0	.5	-.3	1.3	.2	-1.1	-1.4	1.6	-.3	.1	-.6	.9	-.2	-1.3	0
Maximum	2.7	.5	1.1	0	2.6	.7	-.1	.1	2.7	.6	1.1	-.2	2.9	.8	0	.3	2.3	.4	.6	-.3	1.5	.6	.1	0

Notes: #1 is 2' from upstream edge of traveling screen.

U₂ is CL

U₃ is 2' from ^{downstream} edge of traveling screen

* Probe malfunction?

F.5

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Forebay Elevation 934.03'
 Canal Flow 844.55
1850 cfs

Date 8/16/87
 Personnel CR/F.R.K.

Screen # TS# LXS

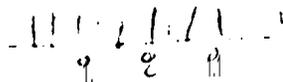
Screen Diameter (in) —
 Exposed (in) —
 Submerged (in) 171"

Time Start	<u>1136 Hrs.</u>	<u>1136 Hrs.</u>	<u>1144 Hrs.</u>	<u>1144 Hrs.</u>		
Time End	<u>1141 Hrs.</u>	<u>1141 Hrs.</u>	<u>1148 Hrs.</u>	<u>1148 Hrs.</u>		

Location	U C L				U C L				U C L				U C L				U C L							
	(815) 0.2 (823)				(810) 0.8 (811)*				(816) 0.2 (823)				(815) 0.8 (811)*				0.2				0.8			
Depth	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	S	A	V		S	A	V	
1	1.7	-0.6	-0.7	0.6	2.2	-0.4	0.1	0	1.0	-1.0	0.6	0.8	3.6	-0.1	0.2	-0.1								
2	1.7	-0.6	-0.7	1.2	2.2	-0.6	0.4	0	1.7	-0.3	0.1	0.4	2.2	-0.4	0	-0.1								
3	1.3	-0.7	-0.3	0.7	1.6	-0.2	0.4	0	0.6	-0.5	0.5	0.8	1.9	-0.3	0.1	-0.1								
4	1.5	-0.6	-0.7	0.9	2.5	-0.2	0.1	0	0.8	-0.3	0.7	0.5	2.0	-0.3	0	0								
5	1.6	-0.3	-0.5	1.1	2.4	-0.5	0.2	0	0.7	-0.6	0.8	0.6	2.0	-0.2	0	-0.1								
6	1.3	-0.5	-0.3	0.4	2.1	-0.2	0.2	0	0.4	-0.4	0.7	0.4	2.6	-0.3	0.1	0								
7	1.4	-0.4	-0.2	0.6	2.4	-0.5	0.2	0	0.9	-0.3	0.5	0.7	2.1	-0.1	0.3	0.3								
8	1.7	0	-0.2	-0.7	2.9	-0.4	0.4	0	0.8	0	0.4	0.4	2.1	-0.3	0	0.1								
9	1.5	-0.8	-0.6	0.9	1.8	-0.1	0.4	0	0.8	-0.7	0.9	0.8	2.4	-0.4	0.3	-0.2								
10	1.1	-0.6	-0.6	0.9	2.5	-0.4	0.1	0	0.8	-0.4	0.5	0.7	2.1	-0.2	0	-0.1								

Average	1.48	-0.51	+0.48	-0.66	2.26	-0.35	-0.25	0	0.75	-0.45	-0.57	-0.61	2.30	-0.26	-0.1	0.03								
Minimum	1.1	-0.8	0.2	-1.1	1.6	-0.6	-0.4	0	0.4	-1.0	-0.9	-0.9	1.9	-0.4	-0.3	-0.3								
Maximum	1.7	0	0.7	0.7	2.9	-0.1	-0.1	0	1.0	0	-0.1	-0.4	3.6	-0.1	0	0.1								

Notes:



(1) > 2' from ou let ussif
 (2) = 1/2" separation c ha in uss.

* probe malfunction?

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Screen # IS#2

Screen Diameter (in)
Exposed (in)
Submerged (in) 171"

Forebay Elevation 934.55
Canal Flow 844.55
1850 cfs

Date 8/16/88
Personnel Chi / E. J. L.

Time Start	1219 Hrs.	1219 Hrs.	1231 Hrs.	1231 Hrs.	1246 Hrs.	1246 Hrs.
Time End	1225 Hrs.	1225 Hrs.	1236 Hrs.	1236 Hrs.	1251 Hrs.	1251 Hrs.

Location	(U) C L				(U) C L				U (C) L				U C L				U C L							
Depth	(816) 0.2 (823) *				(810) 0.8 * (811) *				(816) 0.2 (823) *				(810) 0.8 * (811) *				(816) 0.2 * (823) *				(810) 0.8 * (811) *			
Vector	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A
1	1.2	.6	-.3	-.1	3.0	1.2	0	0	1.8	.6	-.2	-.1	5.9	.9	0	0	1.4	.5	0	0	6.6	.7	0	0
2	2.3	.7	-.2	-.2	6.4	1.2	0	0	1.9	.6	-.1	-.1	6.6	.8	0	0	1.6	.5	0	0	6.3	.6	0	0
3	1.1	.7	-.3	-.2	2.7	1.3	0	0	1.5	.5	-.3	-.1	6.6	.9	0	0	1.6	.6	-.1	-.1	6.5	.9	0	0
4	2.1	.8	-.2	-.2	6.5	1.2	.1	0	1.2	.6	-.2	-.1	5.9	1.1	0	0	1.2	.6	0	-.1	5.8	.6	0	0
5	2.0	.7	-.4	-.1	6.7	1.2	0	0	1.6	.6	-.1	-.1	6.3	.9	0	0	1.6	.4	-.1	-.1	6.2	.7	0	0
6	1.5	.6	-.3	-.1	6.4	1.3	-.1	0	1.6	.5	-.3	-.1	6.5	1.0	0	0	.8	.5	0	-.1	6.4	.5	0	0
7	2.1	.7	-.1	-.1	6.4	1.2	0	0	1.9	.7	-.2	-.1	6.0	.9	0	0	1.6	.4	0	0	6.2	.5	0	0
8	2.0	.8	-.2	-.1	6.7	1.3	-.1	0	1.6	.6	-.4	-.2	6.5	1.0	0	0	.9	.7	.1	-.2	6.3	.6	-.1	0
9	1.9	.8	-.3	-.2	6.8	1.1	-.1	0	1.6	.6	-.3	-.1	6.3	.9	0	0	1.4	.6	.1	-.1	6.1	.6	0	0
10	2.0	.7	-.3	-.2	6.5	1.2	0	0	2.0	.7	-.2	-.2	6.1	.8	0	0	1.8	.6	0	-.1	6.3	.7	0	0

Average	1.82	.71	.26	.15	5.93	1.22	.02	0	1.67	.60	.23	.12	6.27	.92	0	0	1.31	.53	0	.08	6.27	.64	.01	0
Minimum	1.1	.6	.2	.1	3.0	1.1	-.1	0	1.2	.5	.1	.1	5.9	.9	0	0	.6	.4	0	0	5.8	.5	0	0
Maximum	2.3	.8	.4	.2	6.8	1.3	.1	0	2.0	.7	.4	.2	6.5	1.1	0	0	1.8	.7	0	.2	6.6	.9	.1	0

Notes:

'U' is 2' from Upstream
'C' is CL
'L' is 2' from Downstream

* probe mal function?

F.7

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Forebay Elevation 934.55
Canal Flow 1850 cfs

Date 8/16/88
Personnel Car/EWL

Screen # T5#2XS

Screen Diameter (in) —
Exposed (in) —
Submerged (in) 171

Time Start	1238 Hrs.	1238 Hrs.				
Time End	1242 Hrs.	1242 Hrs.				

Location	U (C) L				U (C) L				U C L				U C L				U C L				U C L			
	0.2		(823)		0.8		x(8)		0.2				0.8				0.2				0.8			
Depth	+S	+A	-V	-A	+S	+A	-V	-A	S	A	V		S	A	V		S	A	V		S	A	V	
1	1.7	-0.2	.2	.2	5.7	.2	-1	0																
2	1.6	0	.2	.1	6.4	.3	.1	0																
3	1.4	.7	.2	.1	6.6	.4	0	0																
4	1.6	.2	.3	.2	6.7	.4	0	0																
5	1.8	.1	.1	.2	6.1	.5	0	0																
6	1.7	.4	.2	.1	6.4	.4	0	0																
7	1.6	0	.3	.1	6.3	.3	0	0																
8	1.2	.5	.3	.1	6.7	.4	0	0																
9	1.3	.2	.1	.1	6.8	.9	-1	0																
10	1.6	.3	.2	.1	6.5	.4	0	0																
Average	1.55	.22	-.21	-.13	6.38	.42	.01	0																
Minimum	1.2	-.2	-.3	-.2	5.7	.2	-1	0																
Maximum	1.8	.7	-.1	-.1	6.8	.9	.1	0																

Notes: Centerline is using ~12" from W of P.S. *

F.8

Yakima River Fish Screening Facility Flow Measurements

Site U6 Site Wapato

Forebay Elevation 934.55
 Canal Flow 1850 cfs

Date 8-16-08
 Personnel CSA/2WK

Screen # Fish Return

Diameter (in) ---
 Exposed (in) ---
 Submerged (in) 100"

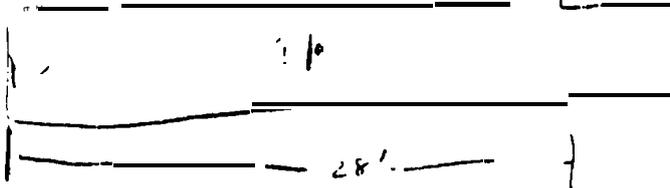
Time Start	<u>1318 Hrs.</u>	<u>1318 Hrs.</u>	<u>1329 Hrs.</u>	<u>1329 Hrs.</u>		
Time End	<u>1322 Hrs.</u>	<u>1322 Hrs.</u>	<u>1332 Hrs.</u>	<u>1333 Hrs.</u>		

Location	#1				#2				#3				#4				#5							
	U	C	L		U	C	L		U	C	L		U	C	L		U	C	L					
Depth	<u>(210) 0.2 (823)</u>				<u>(910) 0.8 (811)</u>				<u>(816) 0.2 (823)</u>				<u>(810) 0.8 (811)</u>				<u>0.2</u>				<u>0.8</u>			
Vector	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	+S	+A	-V	-A	S	A	V		S	A	V	
1	1.8	0	.2	.1	6.5	-.2	.1	0	1.3	.2	.2	.1	2.2	0	0	0								
2	1.9	0	-.1	.1	6.7	0	0	0	2.1	-.4	.1	.1	2.4	0	.1	0								
3	1.9	-.2	.1	.1	6.2	-.3	-.1	0	2.4	.4	.1	.1	2.2	0	0	0								
4	2.3	.1	.1	.1	6.2	.2	0	0	2.5	.9	.1	.1	2.4	0	0	0								
5	1.9	.2	.2	.1	6.6	-.4	0	0	2.3	.3	.1	.1	2.3	0	-.1	0								
6	1.6	.1	.2	.1	6.2	-.2	0	0	2.5	.2	.1	.1	2.2	0	0	0								
7	2.0	0	.1	.1	6.3	-.3	-.1	0	2.3	.3	.1	.1	2.7	0	0	0								
8	2.0	.1	.2	0	7.2	0	0	0	2.1	.1	.1	.1	2.3	0	-.1	0								
9	2.4	.1	.2	.1	8.0	.2	0	0	2.4	.2	.1	.1	2.3	0	.1	0								
10	2.4	.2	.2	.1	6.2	-.3	0	0	2.2	.1	.1	.2	2.3	0	-.1	0								
Average	2.02	.06	-.14	.09	6.61	-.13	.01	0	2.31	.28	-.11	-.11	2.33	0	.01	0								
Minimum	1.6	-.2	-.2	-.1	6.2	-.4	-.1	0	2.1	-.4	-.2	-.2	2.2	0	-.1	0								
Maximum	2.4	.2	.1	0	8.0	.2	.1	0	2.5	.9	-.1	-.1	2.7	0	.1	0								

Notes:

#1 Set = 6' from head of fish return
 #2 Set = 27' from head of fish return

Timing Screen #2
 111



Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Screen Diameter (in) 168''
 Exposed (in) 38''
 Submerged (in) 130''

Forebay Elevation 934.55
 Canal Flow 1850 cfs

Date 8-16-88
 Personnel CSA/EWL

Screen # 15

Time Start	<u>0836 Hrs.</u>	<u>0836 Hrs.</u>	<u>8-18-88</u> <u>1224 Hrs.</u>	<u>8-17-88</u> <u>1328 Hrs.</u>	<u>8-18-88</u> <u>0829 Hrs.</u>	<u>8-17-88</u> <u>1417 Hrs.</u>
Time End	<u>0841 Hrs.</u>	<u>0841 Hrs.</u>	<u>1228 Hrs.</u>	<u>1331 Hrs.</u>	<u>0833 Hrs.</u>	<u>1420 Hrs.</u>

Location	U C (L)				U C (L)				U C (L)				U C (L)				U C (L)				U C (L)			
Depth	(818) 0.2 (823)				(810) 0.8 (811)				(818) .05 (823)				(818) 0.5 (823)				(823) 0.8a (818)				(823) 0.9 (816)			
Vector	+S	+A	-V	-A	+S	+A	-V	-A	-S	+A	+V	-A	+S	+A	-V	-A	+S	-A	+V	+A	+S	-A	+V	+A
1	1.1	.5	.2	-.1	1.3	.6	0	0	.6	.4	-.4	-.6	1.1	.5	-.6	-.4	.6	-.4	.1	.8	.9	-.7	.1	.9
2	1.2	.6	.1	-.1	1.4	.6	.1	.1	.7	.4	-.2	-.7	1.3	.8	-.7	-.5	.5	-.5	0	.9	.9	-.7	-.1	.9
3	1.0	.6	-.1	-.1	1.2	.8	.1	-.1	.8	.4	-.3	-.6	.8	.2	-.5	-.4	.6	-.5	0	.9	.9	-.8	-.1	.8
4	1.0	.6	-.3	0	1.2	.7	.1	-.1	.7	.4	-.4	-.7	1.1	.6	-.3	-.3	.5	-.5	.1	.8	.7	-.6	0	.8
5	1.0	.5	0	-.1	1.3	.7	0	.1	.9	.5	-.4	-.6	1.0	.7	-.6	0	.5	-.5	0	.8	.8	-.7	0	.9
6	1.1	.5	.2	-.1	1.5	.7	0	0	.7	.5	-.4	-.7	1.2	.6	-.5	-.3	.6	-.5	0	.8	.7	-.7	.1	.9
7	1.0	.5	.1	-.1	1.2	.7	0	.1	.7	.4	-.5	-.7	1.2	.5	-.3	-.4	.6	-.6	0	.8	.8	-.7	0	.8
8	1.1	.6	-.3	-.1	1.2	.6	0	0	.8	.5	-.5	-.7	1.3	.5	-.6	-.2	.6	-.6	0	.8	.8	-.6	0	.7
9	1.0	.5	-.1	-.1	1.4	.6	.1	-.1	.8	.4	-.5	-.6	1.2	.5	-.3	-.6	.6	-.5	0	.8	.8	-.6	0	.8
10	1.1	.5	.4	-.1	1.2	.6	.1	0	.6	.4	-.4	-.7	1.3	.6	-.4	-.5	.5	-.5	0	.8	.9	-.7	0	.9

Average	1.06	.54	-.02	.09	1.29	.66	-.05	0	.73	.43	-.40	-.66	1.15	.55	.48	.36	.56	.51	.02	.82	.82	.68	0	.84
Minimum	1.0	.5	-.4	0	1.2	.6	-.1	-.1	.6	.4	-.5	.6	.8	.2	.3	0	.5	.4	0	.8	.7	.6	-.1	.7
Maximum	1.2	.6	.3	.1	1.5	.8	0	.1	.9	.5	-.2	.7	1.3	.8	.7	.6	.6	.6	.1	.9	.9	.8	.1	.9

Notes:

Net pens in the water on all 8/16/88 measurements

* probe malfunction?

*
 0.9 Probes (All Screens)
 818 +V +A
 823 -A +S

Yakima River Fish Screening Facility Flow Measurements

Site 1101.10 Forebay Elevation 934.55 Date 8-16-98
 Screen # 15 Screen Diameter (in) 16.4 Canal Flow 1850 cfs Personne! CSA/EWK
 Exposed (in) 38
 Submerged (in) 130

Time Start	1449 Hrs.	1449 Hrs.	1234 Hrs.	1318 Hrs.	0842 Hrs.	1428 Hrs.
Time End	1454 Hrs.	1454 Hrs.	1237 Hrs.	1321 Hrs.	0845 Hrs.	1431 Hrs.

Location	(U) C L				(U) C L				(U) C L				(U) C L				(U) C L				(U) C L			
	+S	+A	-V	-A	+S	+A	-V	-A	-S	+A	+V	-A	+S	+A	-V	-A	+S	-A	+V	+A	+S	-A	+V	+A
Depth	816	0.2	823		810	0.8			818	0.05	823		818	0.5	823		823	0.8a	818		823	0.9	818	
1	1.0	.6	-.5	-.2	.8	.7	-.2	-.2	.5	.5	-.6	-.6	1.9	.6	-.8	-.4	.4	-.6	.4	1.2	1.1	-.6	.2	.7
2	1.5	.7	-.5	-.2	1.7	.3	-.1	.5	.5	.5	-.4	-.6	1.9	.6	-.5	-.4	.2	-.6	.3	1.4	1.0	-.6	.1	.7
3	1.5	.8	-.3	-.2	1.3	.8	-.1	-.2	.5	.5	-.4	-.6	1.7	.6	-.4	-.3	.5	-.6	.2	1.1	.9	-.6	.1	.7
4	1.2	.7	-.5	-.2	1.2	.7	-.1	-.2	.4	.4	-.4	-.6	1.9	.8	-.4	-.3	.3	-.6	.3	1.2	.9	-.6	.0	.7
5	1.4	.6	-.4	-.3	.6	.6	0	.1	.4	.5	-.5	-.6	1.7	.7	-.8	-.3	.4	-.6	.2	1.3	1.0	-.5	.1	.7
6	1.1	.8	-.6	-.3	1.6	.8	0	-.5	.7	.4	-.2	-.5	1.9	.8	-.6	-.4	.4	-.6	.3	1.1	1.1	-.6	.1	.7
7	1.2	.7	-.4	-.2	1.1	.6	0	-.5	.5	.4	-.3	-.6	1.8	.7	0	-.4	.2	-.5	.4	1.2	1.0	-.6	.1	.9
8	1.6	.4	-.3	-.2	.6	.6	0	-.1	.4	.4	-.4	-.5	1.9	.7	-.3	-.2	.2	-.6	.3	1.2	1.0	-.7	.1	.8
9	1.6	.7	-.5	-.3	1.0	.7	0	0	.5	.4	-.4	-.6	1.8	.7	-.5	-.4	.1	-.5	.4	1.2	1.1	-.7	.1	.8
10	1.3	.8	-.4	.2	1.3	.6	0	-.4	.6	.5	-.5	-.7	1.9	.6	-.3	-.3	.3	-.6	.3	1.2	1.1	-.7	.1	.8

Average	1.34	.70	.47	.24	1.00	.64	.05	.05	.50	.45	.41	.59	1.84	.69	.46	.34	.30	.58	.31	1.21	1.02	.62	.01	.76
Minimum	1.1	.6	.3	.2	-.6	.3	0	-.5	-.7	.1	-.6	.5	1.7	.6	0	.2	.1	.5	.2	1.1	.9	.5	.0	.7
Maximum	1.6	.8	.6	.3	1.7	.8	.2	.5	.4	.5	-.2	.7	1.9	.8	.8	.4	.5	.6	.4	1.4	1.1	.7	.2	.9

Notes:

Force up to bottom
 8/16/98 due to 8:15.0
 (was 8:15.0 on 8/11/98)

(U)

* probe malfunction?

Screen # 14 - 1248 - 1244 Hrs.

1.2	.4	.3	-.2	
1.1	.4	.3	-.2	
1.3	.4	.3	-.2	
1.2	.4	.3	-.3	
1.3	.4	.2	-.2	
1.1	.5	.3	-.2	
1.2	.5	.2	-.2	
1.2	.4	.2	-.3	
1.1	.4	.3	-.4	
Ave	1.18	.41	.27	.25

* For some unknown reason, Suscep velocity readings reversed in front of screen w/5 at the 0.0 depth. The measurements appeared to be normal. No changes were made in probe orientation. To verify the peculiarity, we measured screen # 14 (see data to left) and the normal measurements again. We suspect some kind of electrical interference may be present.

Yakima River Fish Screen Facility Flow Measurements

Site U/2 p. 26
 Screen # 14

Screen diameter (in) 168"
 Exposed (in) 38"
 Submerged (in) 130"

Forebay Elevation 934.55
 Canal Flow 1850 cfs

Date 6-88
 Personnel CSR/KWL

Time Start	1459 Hrs.	1459 Hrs.				
Time End	1504 Hrs.	1504 Hrs.				

Location	U (0) L				U (0) L				U C L			U C L			U C L			U C L		
	(818) 0.2		(823)		(810) 0.8		(811)*		.05			0.5			0.8a			0.9		
Depth	+S	+A	-V	-A	+S	+A	-V	-A	S	A	V	S	A	V	S	A	V	S	A	V
1	.8	.6	.5	-.1	1.2	.6	.1	-.1												
2	1.1	.6	.3	-.2	.8	.4	0	-.1												
3	1.0	.6	.5	-.1	1.2	.4	0	.3												
4	1.1	.7	.5	-.2	1.0	.4	-.3	-.1												
5	.9	.6	.5	-.2	1.3	.6	0	-.1												
6	.9	.6	.4	-.1	0	.4	-.2	-.2												
7	1.0	.6	.5	-.2	1.0	.6	-.1	-.1												
8	.9	.5	.5	-.2	.8	.5	0	-.4												
9	1.0	.6	.5	-.1	1.3	.5	0	.7												
10	1.1	.4	.1	-.2	.8	.6	0	.9												

Average	.98	.58	-.43	.16	.78	.50	.05	.08												
Minimum	.8	.4	-.5	.1	-.8	.4	-.1	-.9												
Maximum	1.1	.7	-.1	.2	1.3	.6	.3	.4												

Notes: * probe malfunction?

2:13

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Screen # 13

Screen Diameter (in) 16

Exposed (in) 38

Submerged (in) 120

Forebay Elevation 934.50

Canal Flow 1450 cfs

Date 8-16-98

Personnel CSA/ewh

Time Start	1509 Hrs.	1509 Hrs.				
Time End	1515 Hrs.	1515 Hrs.				

Location	U C L				U C L				U C L				U C L				U C L							
Depth	(818) 0.2 (823)*				(910) 0.8 (811)*				.05				0.5				0.8a				0.9			
Vector	+S	+A	-V	-A	+S	+A	-V	-A	S	A	V		S	A	V		S	A	V		S	A	V	
1	1.4	.6	.3	-.1	1.2	.3	-.1	-.3																
2	1.5	.5	.3	-.1	1.5	.7	0	.3																
3	1.3	.6	.2	-.1	1.5	.4	0	-.1																
4	1.6	.6	.3	-.1	1.4	.5	0	.1																
5	1.4	.5	.2	-.1	1.3	.5	-.2	-.6																
6	1.4	.5	.3	-.1	1.2	.4	0	-.1																
7	1.7	.5	.2	-.1	1.3	.5	0	.1																
8	1.4	.5	.2	0	1.3	.4	0	0																
9	1.6	.5	.2	-.1	1.3	.6	.1	-.3																
10	1.1	.5	.3	-.1	1.5	.5	0	.1																

Average	1.44	.53	-.25	.09	1.35	.48	.02	-.08																
Minimum	1.1	.5	-.3	0	1.2	.3	-.1	-.3																
Maximum	1.7	.6	-.2	.1	1.5	.7	.2	.6																

Notes: * probe malfunction?

F.14

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Screen # 12

Screen Diameter (in) 168
 Exposed (in) 36
 Submerged (in) 130

Forebay Elevation 934.55
 Canal Flow 1850 cfs

Date 8-16-98
 Personnel CSA/EWL

Time Start	1536 Hrs.	1536 Hrs.				
Time End	1540 Hrs.	1540 Hrs.				

Location	U (C) L				U (C) L				U C L				U C L				U C L				U C L			
	0.2		(823)		0.8		*811*		0.2				0.8				0.2				0.8			
Depth	+S	+A	-V	-A	+S	+A	-V	-A	S	A	V		S	A	V		S	A	V		S	A	V	
1	1.8	.5	.4	-.2	1.6	.5	0	.2																
2	1.7	.5	.3	-.1	1.4	.5	-.1	-.1																
3	1.8	.6	.4	-.2	1.3	.5	-.1	-.1																
4	1.7	.5	.4	-.2	1.4	.4	0	.1																
5	1.6	.5	.3	-.2	1.4	.6	.1	-.4																
6	1.6	.6	.5	-.2	1.4	.5	0	.1																
7	1.6	.6	.3	-.2	1.4	.5	-.2	-.1																
8	1.6	.5	.3	-.2	2.0	.4	0	0																
9	1.6	.5	.5	-.2	1.5	.4	0	.2																
10	1.7	.6	.5	-.2	1.4	.4	0	-.2																

Average	1.67	.54	-.39	.19	1.48	.47	.03	.03																
Minimum	1.6	.5	-.3	.1	1.3	.4	-.1	-.2																
Maximum	1.8	.6	-.5	.2	2.0	.6	.2	.4																

Notes: * probe mis function? *

F.15

Yakima River Fish Screening Facility Flow Measurements

Site Wapato Screen Diameter (in) 168 Forebay Elevation 934.55 Date 8-16-88
 Screen # 11 Exposed (in) 38 Canal Flow 1850 cfs Personnel CSA/KWL
 Submerged (in) 130

Time Start	1546 Hrs.	1546 Hrs.	8-18-88 1204 Hrs.	8-17-88 1309 Hrs.	8-18 0853 Hrs.	8-17 1438 Hrs.
Time End	1551 Hrs.	1551 Hrs.	1207 Hrs.	1312 Hrs.	0857 Hrs.	1441 Hrs.

Location	U C (L)				U C (L)				U C (L)				U C (L)				U C (L)				U C (L)			
Depth	(818) 0.2 (823) *				(810) 0.8 * (811)				(816) .05 (823)				(816) 0.5 (823)				(823) 0.8a (818)				(823) 0.9 (818)			
Vector	+S	+A	-V	-A	+S	+A	-V	-A	-S	+A	+V	-A	+S	+A	-V	-A	+S	-A	+V	+A	+S	-A	+V	+A
1	1.6	.4	1.6	-1.0	1.7	.4	0	.4	-1.2	.3	-.1	-.2	1.6	.5	-.2	-.1	1.5	-.5	-.2	.5	1.3	-.8	-.2	.7
2	1.5	.6	-.4	.2	2.1	-.5	0	-.1	-1.3	.3	.1	-.2	1.5	.6	0	-.2	1.4	-.7	-.1	.8	1.0	-.8	-.1	.5
3	1.6	.5	-.3	.2	2.4	.4	-.1	.5	-1.5	.3	.3	-.1	1.7	.5	-.1	-.3	1.6	-.7	-.2	.4	1.0	-.7	-.1	.8
4	1.6	.6	0	.2	2.4	.6	-.1	-.2	-1.4	.4	.2	-.1	1.6	.7	.2	-.3	1.6	-.6	-.2	.6	1.1	-.7	-.1	.5
5	1.9	.5	0	-.2	2.7	.6	-.1	-.2	-1.6	.3	0	-.2	1.8	.7	.1	-.2	1.4	-.5	-.1	.5	1.1	-.8	-.1	.6
6	1.7	.4	-.2	.2	2.7	.3	-.1	-.3	-1.2	.3	.1	-.1	1.9	.6	.1	-.4	1.5	-.6	-.1	.7	1.1	-.7	-.1	.7
7	1.9	.7	-.3	.1	3.0	.3	-.1	-.2	-1.5	.2	.2	0	1.8	.6	.2	-.4	1.6	-.5	-.2	.7	1.1	-.8	-.2	.6
8	1.8	.5	.2	-.2	2.7	-.1	0	.4	-1.5	.2	0	-.1	2.0	.4	-.2	-.3	1.5	-.7	-.2	.3	1.0	-.7	-.1	.7
9	1.5	.5	.3	-.2	3.0	.3	0	-.2	-1.4	.3	.1	-.1	1.6	.6	0	-.2	1.5	-.5	-.1	.6	1.2	-.8	-.2	.6
10	1.7	.6	.3	-.2	2.9	-.2	0	-.1	-1.3	.3	0	0	1.9	.5	.1	-.2	1.6	-.7	.1	.5	1.2	-.7	-.2	.7

Average	1.68	.53	-.12	.09	2.56	.21	.05	0	1.39	.29	-.09	.11	1.74	.57	0	.26	1.52	.60	-.13	.56	1.11	.75	.14	.64
Minimum	1.5	.4	.4	-.2	1.7	-.2	0	-.5	1.2	.2	-.3	0	1.5	.4	-.2	.1	1.4	.5	-.1	.3	1.0	.7	-.1	.5
Maximum	1.9	.7	-.16	1.0	3.0	.6	.1	.3	1.6	.4	.1	.2	2.0	.7	.2	.4	1.6	.7	.2	.7	1.3	.8	-.2	.8

Notes:

F.16

Yakima River Fish Screening Facility Flow Measurements

Site Ulapato

Screen # 11

Screen Diameter (in) 168
Exposed (in) 38
Submerged (in) 130

Forebay Elevation 934.55
894.55
Canal Flow -1950 cfs

Date 8-16-88
Personnel CSA/FWK

Time Start	1604 Hrs.	1604 Hrs.	1153 Hrs.	1258 Hrs.	0907 Hrs. *	1458 Hrs. *
Time End	1608 Hrs.	1608 Hrs.	1156 Hrs.	1302 Hrs.	0910 Hrs.	1501 Hrs.

Location	(U) C L				(U) C L				(U) C L				(U) C L				(U) C L							
	(815) 0.2		(823) *		(818) 0.8		(811) *		(818) .05		(823)		(818) 0.5		(823)		(823) 0.8a		(818)		(823) 0.9		(818)	
Depth	+S	+A	-V	-A	+S	+A	-V	-A	-S	+A	+V	-A	+S	+A	-V	-A	+S	-A	+V	+A	+S	-A	+V	+A
1	1.6	.7	-.7	.3	1.5	.9	-.1	.5	-1.3	.5	0	-.1	1.6	.8	.4	-.3	1.2	-.8	-.3	.8	1.0	-.9	-.2	1.0
2	1.2	.6	-.7	-.4	1.9	.2	0	-.2	-1.3	.4	.1	-.1	1.5	.7	.3	-.4	1.2	-.7	-.2	.9	.9	-.9	-.2	.8
3	1.3	.5	.2	-.3	1.3	.5	-.1	.6	-1.2	.5	-.1	-.3	2.1	.8	.6	-.5	1.0	-.5	-.1	.7	1.0	-.9	-.2	1.0
4	1.5	.5	.4	-.2	1.4	.1	-.1	1.3	-1.3	.5	0	-.5	1.5	.6	.2	-.1	1.3	-.8	-.2	.9	1.1	-.1	-.2	.9
5	1.3	.6	.1	-.1	1.5	.2	0	-.2	-1.4	.5	.1	-.4	1.5	.6	.2	-.1	1.3	-.8	-.3	.9	1.0	-.9	-.2	.9
6	1.4	.8	0	-.2	1.3	.4	-.1	.4	-1.5	.4	.1	-.3	1.8	.7	.3	-.5	1.8	-.8	-.3	.9	.9	-.9	-.2	.8
7	1.8	.7	.1	-.1	1.3	.4	.1	-.4	-1.4	.5	.2	-.2	1.3	.5	.5	-.5	1.2	-.8	-.2	1.0	.9	-.9	-.2	.9
8	1.7	.7	.1	-.2	1.2	0	0	-.7	-1.7	.4	.1	-.3	1.4	.8	-.1	-.2	1.1	-.7	-.1	.8	1.0	-.8	-.2	.8
9	1.6	.5	0	-.1	.3	.8	0	-.6	-1.3	.5	.2	-.3	1.6	.8	.3	-.3	1.2	-.7	-.2	.8	1.1	-.1	-.2	.9
10	1.5	.5	.1	-.1	1.0	1.4	-.1	.1	-1.6	.5	.1	-.3	1.4	.7	.3	-.2	1.1	-.6	-.2	.7	1.0	-.8	-.2	.9

Average	1.49	.61	.14	.14	1.27	.45	.04	-.08	1.40	.47	.08	.28	1.58	.70	-.30	.31	1.19	.72	.19	.84	0.99	.91	-.20	.89
Minimum	1.2	.5	-.4	-.3	.3	-.2	-.1	-.13	1.2	.4	-.1	.1	1.3	.5	-.6	.1	1.0	.5	.1	.7	.9	.8	-.2	.8
Maximum	1.8	.8	1.7	.4	1.9	1.4	.1	.7	1.7	.5	.2	.5	2.1	.8	.1	.5	1.3	.8	.3	1.0	1.1	1.1	-.2	1.0

Notes: *0.9 - Could not swing probe in at 6' from top - c lists. * probe malfunction?

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Forebay Elevation 934.55
~~944.55~~
 Canal Flow ~1850 cfs

Date 8-17-88
 Personnel CSA/KWL

Screen # 10

Screen Diameter (in) 168
 Exposed (in) 38
 Submerged (in) 130

8-18-88

8-18-88

Time Start	<u>0751 Hrs.</u>	<u>0751 Hrs.</u>	<u>1146 Hrs.</u>	<u>1251 Hrs.</u>	<u>0914 Hrs.</u>	<u>1506 Hrs.</u>
Time End	<u>0756 Hrs.</u>	<u>0756 Hrs.</u>	<u>1149 Hrs.</u>	<u>1254 Hrs.</u>	<u>0917 Hrs.</u>	<u>1509 Hrs.</u>

Location	U C (L)				U C (L)				U C (L)				U C (L)				U C (L)				U C (L)			
	g11	0.2	(g13)		(g11)	0.8	*g11*		(g12)	.05	(g13)		(g12)	0.5	(g13)		(g13)	0.8a	(g18)		(g22)	0.9	(g18)	
Depth	+S	+A	-V	-A	+S	+A	-V	-A	-S	+A	+V	-A	+S	+A	-V	-A	+S	-A	+V	+A	+S	-A	+V	+A
1	1.5	.6	1.0	-1.2	1.6	.5	0	-1	-1.7	.3	.0	-2	1.5	.5	.3	-3	1.8	-.6	.1	1.1	1.7	-.7	.1	.5
2	1.3	.4	-1.4	-.3	1.8	.4	0	0	-1.6	.4	.1	-3	1.2	.8	.3	-2	1.6	-.5	0	.6	1.7	-.6	.1	.5
3	1.6	.7	.5	-1.2	1.8	.4	.1	-1	-2.0	.4	.2	-3	1.3	.5	.4	-2	1.9	-.5	-.1	.6	1.5	-.5	.1	.6
4	1.5	.5	.4	-1.3	1.8	.4	-.1	-1	-1.5	.4	-.1	-2	1.4	.5	0	-1	1.8	-.5	0	.4	1.5	-.6	.2	.7
5	1.5	.5	.3	-1.3	1.8	.4	0	-1	-2.2	.5	.6	-3	1.7	.5	.2	-.4	1.9	-.5	0	.7	1.6	-.6	.1	.6
6	1.6	.7	.5	-1.2	2.1	.4	0	-1	-1.8	.3	.4	-3	1.4	.5	-.6	-.5	1.9	-.6	0	.7	1.5	-.6	.1	.6
7	1.6	.6	.5	-1.2	1.5	.4	0	-1	-1.7	.4	.2	-.4	1.8	.7	-.1	-.4	2.0	-.6	.1	.6	1.5	-.7	.1	.6
8	1.7	.6	.7	-.3	1.6	.5	0	-1	-2.1	.4	.1	-.4	1.6	.6	.3	-.7	2.0	-.6	.1	.5	1.5	-.5	.2	.5
9	1.7	.7	.5	-1.2	1.8	.6	.1	.1	-2.2	.3	.4	-.1	1.5	.7	.3	-2	1.8	-.5	.1	.6	1.5	-.5	.1	.5
10	1.5	.7	.6	-1.2	4.8	.4	.1	0	-1.8	.4	.4	-.4	1.4	.5	.4	-.5	1.7	-.5	0	.5	1.7	-.6	.2	.6

Average	1.55	.60	-.46	.25	2.20	.44	-.02	.06	1.76	.38	.23	.29	1.53	.58	-.15	.35	1.84	.54	.03	.63	1.57	.59	.13	.57
Minimum	1.3	.4	-.7	.2	1.6	.4	-.1	-.1	1.5	.3	-.1	.1	1.3	.5	-.4	.1	1.6	.5	-.1	.4	1.5	.5	.1	.5
Maximum	1.7	.7	1.0	.3	11.8	.6	.1	.1	2.2	.5	.6	.4	1.7	.8	.6	.7	2.0	.6	.1	1.1	1.7	.7	.2	.7

* *

Notes: probe malfunction?

F.18

Yakima River Fst Screening Facility Flow Measurements

Site Wapato

Screen # 10

Screen Diameter (in) 168
Exposed (in) 38
Submerged (in) 130

Forebay Elevation 934.55
Canal Flow 1850 cfs

Date 8-17-88
Personnel CSA/FWL

Time Start	0759 Hrs.	0759 Hrs.	1141 Hrs.	1246 Hrs.	0919 Hrs.	1512 Hrs.
Time End	0803 Hrs.	09:21 Hrs.	1144 Hrs.	1249 Hrs.	0923 Hrs.	1516 Hrs.

Location	U (C) L				U (C) L				U (C) L				U (C) L				U (C) L							
Depth	(916) 0.2 (923)				(810) 0.8 * (811) *				(216) .05 (811)				(916) 0.5 (823)				(217) 0.8a (816)				(923) 0.9 (916)			
Vector	+S	+A	-V	-A	+S	+A	-V	-A	-S	+A	+V	-A	+S	+A	-V	-A	+S	-A	+V	+A	+S	-A	+V	+A
1	1.7	.6	.3	-2	1.9	.4	0	0	-2.0	.3	.2	-2	1.5	.6	-.1	.4	2.0	-.8	-.1	.6	1.8	-.6	.2	.8
2	1.7	.7	.2	-3	1.8	.4	0	-.1	-1.8	.3	.5	-3	1.8	.7	.2	.3	2.0	-.7	.1	.5	1.8	-.7	.1	.6
3	1.8	.6	.4	-2	1.8	.4	0	0	-1.9	.3	.2	-5	1.6	.4	.2	.2	2.1	-.6	.1	.5	1.8	-.5	.3	.7
4	1.9	.6	.3	-2	1.9	.5	0	-.1	-2.0	.4	-.1	-2	1.9	.7	.3	.3	2.0	-.6	0	.6	1.8	-.6	.2	.6
5	1.7	.7	.4	-3	1.7	.6	0	0	-1.9	.3	.1	-.1	1.8	.8	.1	.3	1.9	-.6	.1	.4	1.9	-.7	.4	.8
6	1.6	.4	.9	-2	1.7	.4	-.1	.4	-1.8	.3	.4	-3	1.8	.6	.1	.3	1.9	-.6	.1	.6	1.8	-.5	.2	.6
7	2.1	.7	.7	-2	1.5	.5	-.1	.2	-2.1	.3	.4	-2	1.7	.8	.4	.2	1.8	-.6	0	.7	1.5	-.5	.2	.7
8	1.5	.4	.3	-2	1.6	.4	-.1	.3	-1.8	.2	.3	-3	1.6	.5	-.1	.2	1.9	-.6	0	.5	1.7	-.5	.3	.6
9	1.6	.7	.4	-2	1.7	.5	.1	-.1	-1.8	.3	.1	-.5	1.7	.5	.3	.3	2.0	-.6	.1	.5	1.7	-.5	.3	.5
10	1.8	.9	-.3	-2	1.9	.5	.1	-.1	-1.4	.2	.1	-3	1.8	.7	.3	.2	2.2	-.7	.1	.6	1.9	-.7	.1	.6

Average	1.74	.63	.36	.22	1.75	.46	.01	-.05	1.85	.29	.22	.29	1.72	.63	-.27	.27	1.98	.64	.05	.55	1.77	.58	.23	.65
Minimum	1.5	.4	-.3	.2	1.5	.4	-.1	-.3	1.4	.2	-.1	.1	1.5	.4	-.1	.2	1.8	.6	-.1	.4	1.5	.5	.1	.5
Maximum	2.1	.7	.9	.3	1.9	.6	.1	.1	2.1	.4	.5	.5	1.8	.8	.1	.4	2.1	.8	.1	.7	1.9	.7	.3	.8

Notes: * probe malfunction?

F.19

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Screen # 10

Screen Diameter (in) 1/28

Exposed (in) 38

Submerged (in) 130

Forebay Elevation 934.55
Canal Flow 844.55

Canal Flow 1850 cfs

Date 8-17-88

Personnel CSA/EWL

Time Start	0806 Hrs.	0806 Hrs.	8-18-88 1136 Hrs.	1241 Hrs.	8-18-88 0925 Hrs.	1519 Hrs.
Time End	0811 Hrs.	0811 Hrs.	1139 Hrs.	1244 Hrs.	0928 Hrs.	1522 Hrs.

Location	(U) C L	(U) C L	(U) C L	(U) C L	(U) C L	(U) C L
Depth	(.16) 0.2 (.23) *	(.16) 0.8 * (.1) *	(.16) .05 (.23)	(.16) 0.5 (.23)	(.22) 0.8a (.1)	(.22) 0.9 (.12)
Vector	+S +A -V -A	+S +A -V -A	-S +A +V -A	+S +A -V -A	+S -A +V +A	+S -A +V +A
1	2.0 .7 -.7 .2	1.7 .3 0 -.1	-1.9 .4 .4 -.6	1.9 .6 .1 -.2	2.1 -.8 -.1 .8	1.9 -.8 0 .6
2	1.8 .6 .6 .2	1.9 .5 0 -.1	-2.0 .5 .5 -.5	1.9 .6 .4 -.4	2.1 -.8 -.1 .6	2.0 -.8 .1 .5
3	1.9 .7 .5 .1	2.1 .4 -.1 -.1	-1.8 .4 .7 -.3	2.2 .9 .3 -.5	2.0 -.0 0 .6	2.1 -.9 0 .7
4	1.4 .4 1.1 .2	1.8 .6 -.1 -.1	-2.1 .5 .3 -.4	1.9 .4 .1 -.3	1.9 -.7 0 .8	2.1 -.9 0 .6
5	1.8 .7 .5 -1.4	2.0 .4 0 -.1	-2.0 .4 .2 -.4	1.8 .7 .1 -.3	1.9 -.8 -.2 .6	2.0 -.8 .1 .7
6	1.6 .8 1.1 .2	4.0 .8 .1 -.1	-1.7 .4 .7 -.6	1.9 .7 .2 -.3	1.8 -.8 0 .7	1.9 -.8 0 .6
7	2.1 .7 -2.1 .2	1.7 .6 .1 0	-1.7 .4 .2 -.4	2.0 .8 .3 -.5	1.9 -.9 0 .7	2.0 -.8 .1 .6
8	1.8 .7 -2.2 .2	1.3 .2 .1 -.4	-2.2 .5 .2 -.5	1.7 .5 .2 -.4	2.1 -.8 0 .6	2.1 -.9 0 .6
9	1.9 .8 -1.6 .2	1.8 .5 0 0	-2.2 .5 .2 -.4	1.8 .7 .3 -.3	2.1 -.8 -.2 .8	2.1 -.9 -.1 .8
10	2.1 .8 .3 .2	1.8 .4 0 -.1	-1.9 .5 .4 -.4	2.0 .8 .2 -.3	2.0 -.8 -.1 .7	2.1 -.8 .1 .5

Average	1.84 .69 .35 -.03	2.01 .47 -.01 .11	1.95 .45 .38 .45	1.91 .67 -.22 .35	1.99 .82 -.07 .69	2.03 .84 .03 .62
Minimum	1.4 .6 -2.2 -.2	1.3 .2 -.1 0	1.7 .4 .2 .4	1.7 .4 -.4 .3	1.8 .7 -.2 .6	1.9 .8 -.1 .5
Maximum	2.1 .8 1.1 1.4	4.0 .8 .1 .4	2.2 .5 .7 .6	2.2 .9 -.1 .5	2.1 1.0 0 .8	2.1 .9 .1 .8

Notes: * probe malfunction?

IF.20

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Screen # Bypass #2

Screen Diameter (in) -
 Exposed (in) -
 Submerged (in) 130

Forebay Elevation 934.53'
 Canal Flow 1850 cfs

Date 8-16-88
 Personnel CSA/FAH

Time Start	<u>1626 Hrs.</u>	<u>1626 Hrs.</u>				
Time End	<u>1630 Hrs.</u>	<u>1630 Hrs.</u>				

Location	U (C) L				U (C) L				U C L			U C L			U C L			U C L		
	0.2		(0.3)		0.8		(0.9)		0.2			0.8			0.2			0.8		
Depth	+S	+A	-V	-A	+S	+A	-V	-A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.7	.7	.2	.1	1.1	-.9	0	-.1												
2	1.7	.1	0	.6	.8	-.8	0	0												
3	1.6	.2	.3	.1	.8	-.7	0	.1												
4	1.8	.1	.3	.1	.7	-.6	0	-.4												
5	1.6	.3	.1	.2	.7	-.9	-.1	.4												
6	1.8	0	0	.5	1.2	-.9	0	-.1												
7	1.9	-.3	0	.5	1.2	-.7	-.1	0												
8	1.7	.2	0	.4	1.0	-.7	0	-.1												
9	1.8	.1	.3	.2	.9	-.9	-.1	-.1												
10	1.8	.3	.1	.2	1.1	-.6	0	-.1												
Average	1.74	.17	-.13	-.29	.95	.77	.03	.04												
Minimum	1.6	-.3	-.3	-.6	.7	.6	0	-.4												
Maximum	1.8	.7	0	-.1	1.2	.9	.1	.4												

Notes: * probe malfunction?

Yakima River Fish Screening Facility Flow Measurements

Site Uapato

Screen # 8

Screen Diameter (in) 168

Exposed (in) 38

Submerged (in) 132

Forebay Elevation 534.55
844.55

Canal Flow 1850 cfs

Date 8-17-88

Personnel CSA/EWK

Time Start	<u>0817 Hrs.</u>	<u>0817 Hrs.</u>				
Time End	<u>0821 Hrs.</u>	<u>0821 Hrs.</u>				

Location	U (C) L				U (C) L				U C L				U C L				U C L				U C L			
	(4.1) 0.2		(6.2)		(6.1) 0.8		* (F) *		0.2				0.8				0.2				0.8			
Depth	+S	+A	-V	-A	+S	+A	-V	-A	S	A	V		S	A	V		S	A	V		S	A	V	
1	1.5	.5	.2	-.2	1.6	.5	.2	-.5																
2	1.6	.5	.4	-.1	1.8	.5	0	-/																
3	1.4	.6	.3	-/	1.7	.6	-/	-/																
4	1.5	.6	.2	-.1	1.5	.5	-/	/																
5	1.4	.5	.2	-.2	5.9	.8	.1	-.3																
6	1.6	.6	.3	-.2	1.7	.5	.1	-/																
7	1.5	.6	.3	-.1	1.8	.5	0	0																
8	1.6	.7	.2	-.2	1.9	.5	0	-/																
9	1.6	.6	0	-.2	1.8	.5	0	0																
10	1.7	.7	.4	-.1	1.8	.6	0	-.1																

Average	1.54	.59	-.25	.16	2.15	.55	-.02	-.12																
Minimum	1.4	.5	-.4	.1	1.5	.5	-.2	-.1																
Maximum	1.7	.7	0	.2	5.9	.6	.1	.5																

Notes: * probe mal function?

F.22

Yakima Diver Fish Screening Facility Flow Measurements

Site Wapato

Screen # 7

Screen Diameter (in) 168

Exposed (in) 38

Submerged (in) 130

Forebay Elevation 934.55
844.55

Canal Flow 1850 cfs

Date 8-17-88

Personnel CSA/EWK

Time Start	<u>0930 Hrs.</u>	<u>0830 Hrs.</u>				
Time End	<u>0935 Hrs.</u>	<u>0835 Hrs.</u>				

Location	U (C) L				U (C) L				U C L			U C L			U C L			U C L		
	(ft)		(ft)		(ft)		*		0.2			0.8			0.2			0.8		
Depth	+S	+A	-V	-A	+S	+A	-V	-A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.9	1.7	1.1	-3	1.9	.6	-.2	-.2												
2	2.4	1.2	.8	-.2	1.6	.6	0	-.3												
3	2.2	.5	-1.1	-.2	1.6	.6	-.2	.1												
4	1.2	.4	-1.6	-.2	6.7	.5	.2	.1												
5	1.3	1.7	2.0	-.2	1.6	.6	-.2	-.1												
6	1.7	.3	.4	-.2	1.9	.7	.4	-.2												
7	1.5	.5	1.8	-.2	1.5	.6	.3	-.3												
8	1.4	.8	1.6	-.3	4.5	.3	-.4	.2												
9	1.4	.9	-2.1	-.3	1.9	.4	.1	-.3												
10	.8	.8	1.4	-.3	1.9	.6	.1	-.1												
Average	1.68	.68	-.43	.24	2.51	.55	-.01	.11												
Minimum	.8	.4	-2.0	.2	1.6	.3	-.4	-.1												
Maximum	2.4	1.2	1.6	.3	6.7	.6	.4	.3												

Notes: * probe malfunction?

Yakima River Fish Screening Facility Flow Measurements

Site Mapato

Forebay Elevation 894.55

Date 8-17-88

Screen # 6

Screen Diameter (in) 166

Canal Flow 1850 cfs

Personnel CSA/EWK

Exposed (in) 33

Submerged (in) 130

8-18-88

8-18-88

Time Start	<u>0941 Hrs.</u>	<u>0947 Hrs.</u>	<u>1126 Hrs.</u>	<u>1230 Hrs.</u>	<u>0934 Hrs.</u>	<u>1531 Hrs.</u>
Time End	<u>0846 Hrs.</u>	<u>0845 Hrs.</u>	<u>1131 Hrs.</u>	<u>1233 Hrs.</u>	<u>0937 Hrs.</u>	<u>1534 Hrs.</u>

Location	U C (U)				U C (U)				U C (U)				U C (U)				U C (U)							
Depth	<u>(8X) 0.2 (123)</u>				<u>(810) 0.8 (15)*</u>				<u>.05</u>				<u>0.5</u>				<u>0.8a</u>				<u>0.9</u>			
Vector	+S	+A	-V	-A	+S	+A	-V	-A	-S	+A	+V	-A	+S	+A	-V	-A	+S	-A	+V	+A	+S	-A	+V	+A
1	1.7	.6	.6	-.2	1.5	.5	0	0	-1.9	.4	.3	-.2	1.5	.4	.4	-.2	1.7	-.6	0	.5	1.9	-.9	.1	.8
2	2.0	.9	.4	-.2	1.8	0	.3	-.6	-1.6	.4	.2	-.2	1.8	.7	.3	-.5	1.7	-.7	-.1	.7	1.6	-.7	0	.7
3	1.3	.5	.5	-.2	2.0	.7	-.2	.1	-1.6	.3	.3	-.2	1.7	.5	.2	-.2	1.7	-.7	-.1	.9	1.7	-.8	0	.7
4	1.5	.6	.3	-.2	1.0	.6	0	-.1	-1.8	.4	.2	-.1	1.5	.4	.5	-.3	1.8	-.7	0	.8	1.5	-.8	.1	.7
5	1.4	.5	.4	-.2	1.2	.6	0	-.1	-1.6	.4	.4	-.3	1.3	.5	.3	-.2	1.6	-.5	-.1	.7	1.4	-.8	0	.6
6	1.6	.7	.3	.3	1.3	.5	0	-.1	-1.7	.3	.4	-.3	1.5	.5	.4	-.2	1.6	-.7	0	.7	1.4	-.6	0	.7
7	1.5	.6	.4	-.2	1.3	.5	0	-.1	-1.7	.3	.3	-.2	1.6	.5	.4	-.3	1.7	-.7	-.1	.8	1.8	-.8	0	.6
8	1.4	.5	.2	-.3	1.2	.4	-.1	0	-1.6	.4	.4	-.3	2.0	.5	.3	-.1	1.7	-.6	0	.7	1.9	-.8	0	.6
9	1.6	.6	.3	-.2	1.4	.5	0	-.1	-1.7	.4	.1	-.2	1.3	.4	.3	-.2	1.6	-.5	0	.5	1.5	-.8	0	.6
10	1.4	.5	.4	-.2	3.1	.3	.2	0	-1.5	.4	.4	-.3	1.4	.6	.2	-.4	1.7	-.6	0	.7	1.7	-.7	-.1	.4

Average	1.54	.60	-.38	.22	.96	.46	-.05	.10	1.67	.37	.30	.23	1.56	.50	-.33	.26	1.68	.63	-.04	.70	1.64	.77	.01	.64
Minimum	1.3	.5	-.6	.2	-3.1	0	-.6	-.1	1.5	.3	.1	.1	1.3	.4	-.2	.1	1.6	.5	-.1	.5	1.4	.6	-.1	.4
Maximum	2.0	.9	-.3	.3	2.0	.7	.2	.6	1.9	.4	.4	.3	2.0	.7	-.5	.5	1.8	.7	0	.9	1.9	.9	.1	.8

Notes: * probe no function?

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Forebay Elevation 934.55
~~894.55~~
 Canal Flow 1850 cfs

Date 8-17-88
 Personnel 3596/2014

Screen # 6
 Screen Diameter (in) 168
 Exposed (in) 38
 Submerged (in) 130

Time Start	0845 Hrs.	0846 Hrs.	1123 Hrs.	1224 Hrs.	0940 Hrs.	1537 Hrs.
Time End	0958 Hrs.	0852 Hrs.	1126 Hrs.	1227 Hrs.	0944 Hrs.	1510 Hrs.

Location	U (C) L				U (C) L				U (C) L				U (C) L				U (C) L							
	(818) 0.2		(823) *		(810) 0.8		(811) *		(816) 0.05		(823)		(816) 0.5		(823) *		(823) 0.8a		(815)		(823) 0.9		(816)	
Depth	+S	+A	-V	-A	+S	+A	-V	-A	-S	+A	+V	-A	+S	+A	-V	-A	+S	-A	+V	+A	+S	-A	+V	+A
1	1.6	.6	.3	-.2	-3.1	.5	.2	-.1	-1.7	.3	.3	-.2	1.7	.5	.4	.1	1.7	-.7	-.2	.9	1.6	-1.0	-.2	.9
2	1.5	.6	.2	-.2	1.6	.8	-.4	.6	-1.9	.3	.3	-.1	1.6	.5	.3	.3	1.5	-.6	-.1	.8	1.8	-1.0	-.2	.9
3	1.6	.7	.3	-.2	1.9	.9	-.3	.2	-1.8	.4	.2	0	1.5	.4	.4	0	1.5	-.6	-.2	.7	1.7	-1.0	-.1	.9
4	1.7	.6	.2	-.2	1.5	.8	-.3	.2	-1.5	.3	.3	0	1.5	.4	.3	.1	1.8	-.7	-.2	.7	1.6	-.9	-.1	.9
5	1.7	.6	.4	-.2	1.5	.8	-.3	.2	-1.8	.4	.4	-.2	1.5	.4	.2	.1	1.6	-.7	-.3	.9	1.6	-.9	-.2	.9
6	1.4	.6	.4	-.2	1.9	.8	-.4	.2	-1.7	.3	.2	-.1	1.5	.5	.5	0	1.6	-.7	-.2	1.0	1.7	-.7	-.2	1.0
7	1.4	.4	.2	-.2	1.7	.9	-.3	.3	-1.7	.3	.1	-.1	1.9	.6	.4	.1	1.5	-.6	-.1	.7	1.7	-1.0	-.3	1.0
8	1.5	.7	.5	-.2	2.4	.8	-.5	.5	-1.8	.4	.4	-.3	1.6	.5	.4	.1	1.5	-.6	-.1	.8	1.7	-1.0	-.1	.9
9	1.4	.5	.3	-.2	3.2	1.0	-.4	.6	-1.9	.4	.4	-.2	1.6	.5	.1	.1	1.7	-.8	-.2	.9	1.6	-.9	-.1	1.0
10	1.4	.7	.4	-.2	-2.1	.8	.2	0	-1.8	.3	.2	-.1	1.5	.4	.6	.1	1.6	-.6	-.1	.7	1.6	-.9	0	1.0

Average	1.52	.60	-.32	.20	1.07	.81	.25	.27	1.76	.34	.28	.13	1.59	.47	-.36	-.10	1.60	.66	-.17	.81	1.66	.95	-.15	.94
Minimum	1.4	.4	-.5	.2	-3.1	.5	-.2	-.1	1.5	.3	.1	0	1.5	.4	-.6	-.3	1.5	.6	-.3	.3	1.6	.9	-.3	.9
Maximum	1.7	.7	-.2	.2	3.2	1.0	.5	.6	1.9	.4	.4	.3	1.7	.6	-.1	0	1.8	.8	-.1	1.0	1.8	1.0	0	1.0

Notes: * probe malfunction?

F.25

Yakima River Fish Screening Facility Flow Measurements

Site Wapato Forebay Elevation 934.55 Date 8-17-88
 Screen # 6 Screen Diameter (in) 168 Canal Flow 1850 cfs Personnel CSA/EWL
 Exposed (in) 38
 Submerged (in) 30 130

Time Start	0857 Hrs.	0857 Hrs.	1117 Hrs.	1218 Hrs.	0946 Hrs.	1544 Hrs.
Time End	0902 Hrs.	0902 Hrs.	1120 Hrs.	1221 Hrs.	0949 Hrs.	1547 Hrs.

Location	(U) C L	(U) C L	(U) C L	(U) C L	(U) C L	(U) C L
Depth	(818) 0.2 (823)	(810) 0.8 (811) *	(816) .05 (823)	(818) 0.5 (823)	(822) 0.8a (818)	(823) 0.9 (818)
Vector	+S +A -V -A	+S +A -V -A	-S +A +V -A	+S +A -V -A	+S -A +V +A	+S -A +V +A
1	1.9 .7 .5 -.3	1.0 1.3 0 -.1	-1.7 .6 .1 -.4	1.2 .8 1.0 -.6	1.1 -1.1 -.4 1.3	.7 -1.4 .1 1.3
2	1.5 .6 .2 -.2	1.0 1.2 0 -.1	-1.6 .5 .1 -.4	1.2 .8 .6 -.5	1.1 -1.0 -.4 1.3	.9 -1.5 -.1 1.4
3	1.4 .5 .3 -.2	.9 1.2 -.2 .2	-1.6 .6 .3 -.3	1.3 .8 .7 -.5	.9 -1.1 -.4 1.2	.8 -1.5 0 1.6
4	1.4 .5 .2 -.2	-4.2 1.2 .1 -.1	-1.5 .5 .1 -.3	1.1 .8 .6 -.5	1.1 -1.2 -.5 1.5	.7 -1.3 -.1 1.3
5	1.9 .6 .4 -.1	1.2 1.4 0 -.1	-1.8 .5 .2 -.3	1.1 .7 .5 -.4	1.2 -1.3 -.6 1.3	.7 -1.2 0 1.3
6	2.1 .6 .4 -.2	1.3 1.3 0 -.1	-1.5 .5 .1 -.3	1.4 .8 .7 -.5	1.0 -1.3 -.5 1.4	.7 -1.4 -.1 1.3
7	1.5 .7 .3 -.2	1.1 1.3 0 0	-1.6 .7 .2 -.4	1.1 .9 .8 -.6	1.1 -1.2 -.4 1.4	.6 -1.3 0 1.4
8	1.7 .5 .2 -.3	.9 1.4 0 -.1	-1.5 .5 .2 -.4	1.4 .8 .4 -.5	1.1 -1.1 -.5 1.5	.7 -1.4 -.2 1.5
9	1.8 .6 .1 -.2	2.4 1.5 -.5 .2	-1.7 .5 .1 -.4	1.1 .7 .5 -.5	1.0 -1.3 -.5 1.4	.8 -1.5 0 1.5
10	1.7 .6 .5 -.2	.9 1.3 0 -.1	-1.7 .5 .2 -.3	1.2 .8 .5 -.4	1.2 -1.2 -.4 1.4	.8 -1.3 -.1 1.4

Average	1.69 .59 -.29 .21	0.65 1.31 .06 .03	1.62 .54 .16 .35	1.24 .79 -.63 .50	1.08 1.18 -.46 1.37	.74 1.38 -.07 1.40
Minimum	1.4 .5 -.5 .1	-4.2 1.2 -.1 -.2	1.5 .5 .1 .3	1.1 .7 -1.0 .4	.9 1.0 -.6 1.3	.6 1.2 -.2 1.3
Maximum	2.1 .7 -.1 .3	2.4 1.5 .5 .1	1.8 .7 .3 .4	1.4 .9 -.4 .6	1.2 1.3 -.4 1.5	.9 1.5 0 1.6

Notes: probe malfunction?

Yakin a River Fish Screening Facility Flow Measurements

Site Wapato

Screen Diameter (in) 148
Exposed (in) 30
Submerged (in) 130

Forebay Elevation 934.55
899.55
Canal Flow 1450 cfs

Date 8-17-88
Personnel CSA/EWA

Screen # 5

B-18-88

B-18-88

Time Start	1001 Hrs.	1001 Hrs.	1110 Hrs.	1209 Hrs.	0955 Hrs.	1552 Hrs.
Time End	1005 Hrs.	1005 Hrs.	1113 Hrs.	1212 Hrs.	0958 Hrs.	1555 Hrs.

Location	U C (L)				U C (L)				U C (L)				U C (L)				U C (L)							
Depth	(816) 0.2		(823)		(810) 0.8		(811)		(916) .05		(823)		(818) 0.5		(823) 0.8a		(818)		(823) 0.9		(816)			
Vector	+S	+A	-V	-A	+S	+A	-V	-A	-S	+A	+V	-A	+S	+A	-V	-A	+S	-A	+V	+A	+S	A	+V	+A
1	2.1	.6	-.1	-.2	4.8	.4	X	X	-1.5	.4	.1	-.3	1.9	.8	-.3	-.2	1.7	-.6	0	.8	1.5	-.9	0	.8
2	1.5	.5	-.1	-.2	4.3	.5	X		-1.5	.4	0	-.3	1.7	.5	-.3	-.2	1.8	-.7	-.1	.6	1.5	-.9	0	.5
3	1.8	.5	-.1	-.2	4.4	.4	X		-1.5	.4	.1	-.3	1.9	.6	-.3	-.2	1.8	-.5	-.1	.7	1.4	-.8	0	.8
4	1.7	.6	-.1	-.2	4.4	.4			-1.4	.4	0	-.3	1.7	.4	-.1	-.2	1.7	-.6	-.2	.7	1.7	-.9	0	.7
5	1.9	.4	0	-.2	4.1	.5			-1.5	.4	0	-.2	1.8	.5	-.4	-.2	1.7	-.6	0	.7	1.6	-.9	0	1.1
6	2.0	.5	.1	-.3	4.1	.6			-1.7	.5	0	-.3	1.9	.4	-.1	-.2	1.7	-.7	0	.6	1.5	-.9	-.1	.8
7	2.1	.5	0	-.3	4.2	.5			-1.5	.4	-.1	-.3	1.7	.5	-.3	-.1	1.8	-.6	0	.5	1.6	-.9	-.1	.8
8	2.0	.6	-.2	-.3	3.6	.4			-1.6	.5	-.1	-.3	1.9	.5	-.3	-.2	1.8	-.6	0	.6	1.5	-.9	.3	.9
9	1.9	.7	-.1	-.2	4.4	.5			-1.5	.4	.2	-.2	1.8	.5	-.2	-.2	1.8	-.6	.1	.8	1.4	-.8	0	.6
10	1.9	.6	-.1	-.3	4.0	.5			-1.5	.4	.2	-.2	2.0	.4	-.3	-.2	1.8	-.6	0	.7	1.5	-.8	0	.9

Average	1.9	.53	.07	.24	4.23	.47	X	X	1.52	.42	.04	.27	1.83	.51	.26	.19	1.76	.61	-.03	.67	1.52	.87	.01	.79
Minimum	1.5	.4	-.1	.2	3.6	.4	X	X	1.4	.4	-.1	.2	1.7	.4	.1	.1	1.7	.5	-.2	.5	1.4	.8	-.1	.5
Maximum	2.1	.7	.2	.3	4.8	.6	X	X	1.6	.5	.2	.3	2.0	.8	.4	.2	1.8	.7	.1	.8	1.7	.9	.3	1.1

Notes: X will not cal.

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Forebay Elevation 934.55
~~844.55~~
 Canal Flow 1850 cfs

Date 8-17-88
 Personnel CSA/EWK

Screen # 5

Screen Diameter (in) 168
 Exposed (in) 38
 Submerged (in) 130

Time Start	<u>1014 Hrs.</u>	<u>1014 Hrs.</u>	<u>1049 Hrs.</u>	<u>1202 Hrs.</u>	<u>1000 Hrs.</u>	<u>1557 Hrs.</u>
Time End	<u>1018 Hrs.</u>	<u>1018 Hrs.</u>	<u>1052 Hrs.</u>	<u>1207 Hrs.</u>	<u>Hrs.</u>	<u>1600 Hrs.</u>

Location	U (C) L				U (C) L				U (C) L				U (C) L				U (C) L							
	Depth	(815) 0.2	** (823)		(810) 0.8	(811)			(818) .05	(823)			(818) 0.5	(823)			(822) 0.8a	(815)			(823) 0.9	(812)		
Vector	+S	+A	-V	-A	+S	+A	-V	-A	-S	+A	+V	-A	+S	+A	-V	-A	+S	-A	+V	+A	+S	-A	+V	+A
1	1.9	.5	0	-.2	4.6	.4	*	*	-1.5	.4	.1	-.2	5.2	.3	.1	-.4	1.8	-.7	0	.7	2.0	-.8	0	.7
2	1.9	.8	-.1	-.2	4.9	.5			-1.6	.3	.1	-.2	2.1	.8	-.1	-.1	1.9	-.5	0	.5	2.0	-.9	.1	.8
3	1.8	.8	-.1	-.2	4.5	.5			-1.6	.4	.2	-.3	2.1	.7	-.2	-.1	1.8	-.7	.1	.9	2.0	-.9	.1	.7
4	1.9	.4	-.1	-.2	4.4	.5			-1.7	.3	.2	-.3	2.1	-.3	0	-.6	1.9	-.7	0	.6	1.9	-.9	0	.7
5	1.9	.6	0	-.1	4.5	.5			-1.6	.4	.1	-.3	2.0	.4	.2	.2	1.9	-.7	0	.7	1.9	-.9	.1	.8
6	1.9	.6	0	-.2	4.6	.4			-1.6	.3	0	-.1	2.2	.4	.2	-.3	1.7	-.6	0	.6	1.9	-.8	0	.7
7	1.9	.6	0	-.1	4.1	.6			-1.8	.4	.1	-.3	2.0	.5	-.1	-.2	1.9	-.6	0	.7	1.8	-.9	0	.7
8	1.9	.7	-.1	-.2	4.4	.5			-1.7	.4	0	-.3	2.2	.4	-.2	-.3	1.8	-.6	0	.6	1.8	-.9	-.1	.8
9	2.0	.7	0	-.1	4.4	.4			-1.7	.4	.2	-.2	1.9	.5	-.2	-.2	1.8	-.6	0	.5	1.9	-.6	0	.8
10	2.1	.6	.1	-.2	4.5	.5			-1.7	.4	.2	-.3	2.0	.3	-.2	-.2	1.8	-.6	0	.6	2.0	-.6	0	.8

Average	1.92	.63	.03	.17	4.49	.48	X	X	1.65	.39	.12	.25	2.08	.40	.05	.22	1.83	.63	.01	.64	1.92	.90	.02	.75
Minimum	1.8	.4	-.1	.1	4.1	.4	X	X	1.5	.3	.1	.1	1.9	-.3	-.2	-.2	1.7	.5	0	.5	1.8	.8	-.1	.7
Maximum	2.1	.8	.1	.2	4.9	.6	X	X	1.8	.4	.2	.3	2.2	.8	.2	.6	1.9	.7	.1	.9	2.0	1.0	.1	.8

Notes: * out of service

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Screen # 5

Screen Diameter (in) 161
Exposed (in) 38
Submerged (in) 150

Forebay Elevation 934.55
Canal Flow 1850 cfs

Date 8-17-88
Personnel CSA/EWL

Time Start	1023 Hrs.	1023 Hrs.	1044 Hrs.	1157 Hrs.	1012 Hrs.	1602 Hrs.
Time End	1027 Hrs.	1027 Hrs.	1048 Hrs.	1201 Hrs.	1015 Hrs.	1605 Hrs.

Location	(U) C L				(U) C L				(U) C L				(U) C L				(U) C L							
	818		823		810		811		815		823		823		818a		818		823		818			
Depth	+S	+A	-V	-A	+S	+A	V		-S	+A	+V	-A	+S	+A	-V	-A	+S	-A	+V	+A	+S	-A	+V	+A
1	1.8	.8	-2	-.3	5.1	.4	*		-1.6	.4	.1	-.2	2.4	.9	.4	-.2	2.0	-.7	.1	.6	1.1	-.8	.1	.8
2	2.0	.6	-2	-.2	4.6	.5			-1.7	.4	.1	-.2	2.1	.6	.4	-.4	2.0	-.8	.1	.6	1.1	-.7	.1	.8
3	2.1	.7	-1	-.4	4.2	.5			-1.6	.4	-.1	-.2	2.0	.6	.8	-.7	2.0	-.7	.1	.6	1.0	-.7	.1	.7
4	1.9	.5	-1	-.4	4.9	.5			-1.7	.4	-.1	-.2	2.1	.7	.4	-.3	2.0	-.8	0	.6	1.1	-.8	.1	.8
5	1.9	.4	-2	-.3	4.2	.6			-1.7	.4	-.2	-.3	2.0	.5	.1	-.1	2.1	-.7	.1	.6	1.1	-.7	.1	.7
6	2.0	.8	-1	-.3	3.7	.7			-1.7	.4	.1	-.2	2.1	.5	.5	-.3	2.0	-.8	.1	.7	1.1	-.7	.2	.8
7	2.1	.7	-1	-.3	3.9	.7			-1.6	.4	.1	-.3	2.1	.6	.4	-.5	2.1	-.9	.1	.7	1.2	-.8	.2	.7
8	1.9	.3	0	-.3	4.0	.4			-1.7	.5	.1	-.3	2.3	.7	.2	-.3	2.0	-.7	.1	.6	1.2	-.6	.1	.6
9	2.0	.5	-2	-.3	4.9	.6			-1.8	.4	0	-.2	2.1	.5	.4	-.5	1.9	-.7	.1	.6	1.1	-.7	.1	.7
10	1.9	.8	-.4	-.3	5.0	.6			-1.8	.4	.1	-.3	2.0	.6	.3	-.4	2.0	-.7	.1	.6	1.2	-.7	.1	.7

Average	1.96	.61	.16	.31	4.44	.55	X	X	1.69	.41	.02	.24	2.12	.62	-.39	.37	2.01	.75	.09	.62	1.12	.72	.12	.73
Minimum	1.8	.3	0	.2	3.7	.4	X	X	1.6	.4	-.2	.2	2.0	.5	-.8	.1	1.9	.7	0	.6	1.0	.6	.1	.6
Maximum	2.1	.8	.4	.4	5.1	.7	X	X	1.8	.5	.1	.3	2.4	.9	-.1	.7	2.1	.9	.1	.7	1.2	.8	.2	.8

Notes: * out of service.
probe malfunction.

818 -S +A
823 -A +V

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Screen # Bypass #1

Screen Diameter (in)
 Exposed (in)
 Submerged (in) 130"

Forebay Elevation 934.53
944.50
 Canal Flow 1850 cfs

Date 8-17-88
 Personnel CSA/EWK

Time Start	<u>0933 Hrs.</u>	<u>0939 Hrs.</u>				
Time End	<u>0939 Hrs.</u>	<u>0939 Hrs.</u>				

Location	U (0) L				U (0) L				U C L				U C L				U C L				U C L			
	0.2 (823)				0.8 (811)				0.2				0.8				0.2				0.8			
Depth	+S	+A	-V	-A	+S	+A	-V	-A	S	A	V		S	A	V		S	A	V		S	A	V	
1	1.7	.2	-.1	0	1.0	-.7	-.1	0																
2	1.6	-.5	-.2	.4	1.3	-.1	0	.2																
3	1.4	.1	.4	1.1	1.1	-.4	-.1	.5																
4	1.8	.4	.2	-.9	1.7	-.2	-.2	.1																
5	1.7	.3	-.1	.7	1.5	-.4	0	-.2																
6	1.7	-.2	-.0	0	1.4	-.5	.3	.4																
7	1.4	1.0	-.4	-.3	1.9	-.2	0	.1																
8	1.6	-.6	-.1	.6	1.2	-.2	0	-.4																
9	1.4	.2	.4	-.2	1.3	-.3	-.2	.3																
10	1.8	.7	-.5	.6	1.4	-.9	-.1	0																

Average	1.61	.16	.14	-.20	1.68	-.79	.04	-.09																
Minimum	1.4	-.6	-.4	-.1	1.0	-.2	-.3	-.5																
Maximum	1.8	1.0	1.0	.9	1.7	-.2	.2	.2																

Notes:

F.30

Yakimativ efish Screening Facility Flow Measurements

Site Site Wapato

Forebay Elevation 934.55
 Canal Flow 1850 cfs

Date 8-17-88
 Personnel CSA/EWL

Screen # 4

Screen # 160
28
130

Time Start	Time Start	10:32 Hrs.				
Time End	4	10:55 Hrs.				

Location	U (815) C (820) L *				U (810) C (811) L				U C L			U C L			U C L			U C L		
	S	A	V	A	S	A	V		S	A	V	S	A	V	S	A	V	S	A	V
Depth	0.2				0.8				0.2			0.8			0.2			0.8		
Vector	S	A	V	A	S	A	V		S	A	V	S	A	V	S	A	V	S	A	V
1	1.9	.6	.3	-.1	4.4	.5	*													
2	2.1	.5	.1	-.1	4.7	.5														
3	1.9	.7	0	0	4.2	.4														
4	1.9	.6	-.1	-.1	4.2	.3														
5	1.8	.4	.2	0	4.3	.4														
6	1.8	.7	.2	-.1	4.3	.5														
7	1.9	.6	.1	-.1	4.9	.4														
8	2.0	.6	.3	-.1	4.6	.5														
9	2.0	.6	.4	0	4.3	.5														
10	2.0	.6	.4	-.1	4.1	.4														
Average	1.93	.59	-.19	.07																
Minimum	1.8	.4	-.4	0																
Maximum	2.1	.7	.1	.1																

Notes: * probe malfunction?
 ** Out of service

F.31

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Screen # 3

Screen Diameter (in) 1.25

Exposed (in) 36

Submerged (in) 130

Forebay Elevation 534.55
844.55

Canal Flow 1850 cfs

Date 8-17-88

Personnel CSA/FAH

Time Start	row Hrs.	1041 Hrs.				
Time End	row Hrs.	1045 Hrs.				

Location	U (0) L				U (C) L			U C L			U C L			U C L			U C L		
Depth	(610) 0.2 (825)				(810) 0.8 (811)			0.2			0.8			0.2			0.8		
Vector	+S	+A	-V	-A	+S	+A	V	S	A	V	S	A	V	S	A	V	S	A	V
1	2.2	.7	.2	-.1	4.3	.5	*												
2	2.3	.8	.5	-.4	3.9	.6													
3	2.5	1.0	.2	-.1	4.5	.5													
4	1.8	.4	-.1	0	4.4	.4													
5	2.1	.5	.2	-.1	3.1	.4													
6	1.4	.3	-3.4	.1	3.5	.4													
7	1.5	.5	1.3	-.2	2.4	.3													
8	1.8	.4	-.1	-.1	2.3	.4													
9	1.9	.5	.1	0	2.7	.4													
10	3.3	.4	1.6	-.3	2.8	.4													

Average	1.98	.55	-.05	-.1	3.43	.43													
Minimum	1.4	.3	-1.3	-.1	2.4	.4													
Maximum	2.5	1.0	3.4	.4	4.5	.6													

Notes: * probe malfunction?
** out of service

F.32

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Screen # 2

Screen Diameter (in) 168
Exposed (in) 38
Submerged (in) 130

Forebay Elevation 934.55
Canal Flow 1850 cfs

Date 8-17-89
Personnel CSA/EWL

Time Start	<u>1050 Hrs.</u>	<u>1053 Hrs.</u>				
Time End	<u>1054 Hrs.</u>	<u>1054 Hrs.</u>				

Location	U (C) L				U (C) L				U C L				U C L				U C L				U C L								
Depth	<u>(.48)</u>		<u>0.2</u>		<u>(.81)</u>		<u>0.8</u>		<u>(.11)</u>		0.2				0.8				0.2				0.8						
Vector	+S	+A	-V	-A	+S	+A	V			S	A	V			S	A	V			S	A	V			S	A	V		
1	1.8	.6	.1	0	2.7	.4	*																						
2	1.8	.5	.2	0	2.8	.3																							
3	1.7	.4	.2	-.2	2.9	.3																							
4	1.6	.4	.1	0	2.5	.4																							
5	1.7	.7	.4	-.1	2.3	.4																							
6	1.9	.6	.1	-.2	2.8	.5																							
7	1.8	.7	.3	-.1	2.9	.4																							
8	1.9	.7	.2	-.1	2.8	.4																							
9	1.9	.5	.3	-.1	2.6	.4																							
10	1.8	.5	.1	0	2.6	.6																							

Average	<u>1.79</u>	<u>.56</u>	<u>-.20</u>	<u>.08</u>	<u>2.69</u>	<u>.41</u>																						
Minimum	<u>1.6</u>	<u>.4</u>	<u>-.1</u>	<u>0</u>	<u>2.3</u>	<u>.3</u>																						
Maximum	<u>1.9</u>	<u>.7</u>	<u>-.1</u>	<u>.2</u>	<u>2.9</u>	<u>.6</u>																						

Notes: * probe mal function?
or out of service

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Screen # 11

Screen Diameter (in) 168
Exposed (in) 38
Submerged (in) 130

Forebay Elevation 934.55
Canal Flow 894.55
1850 cfs

Date 8-16-88
Personnel CBA/FWL

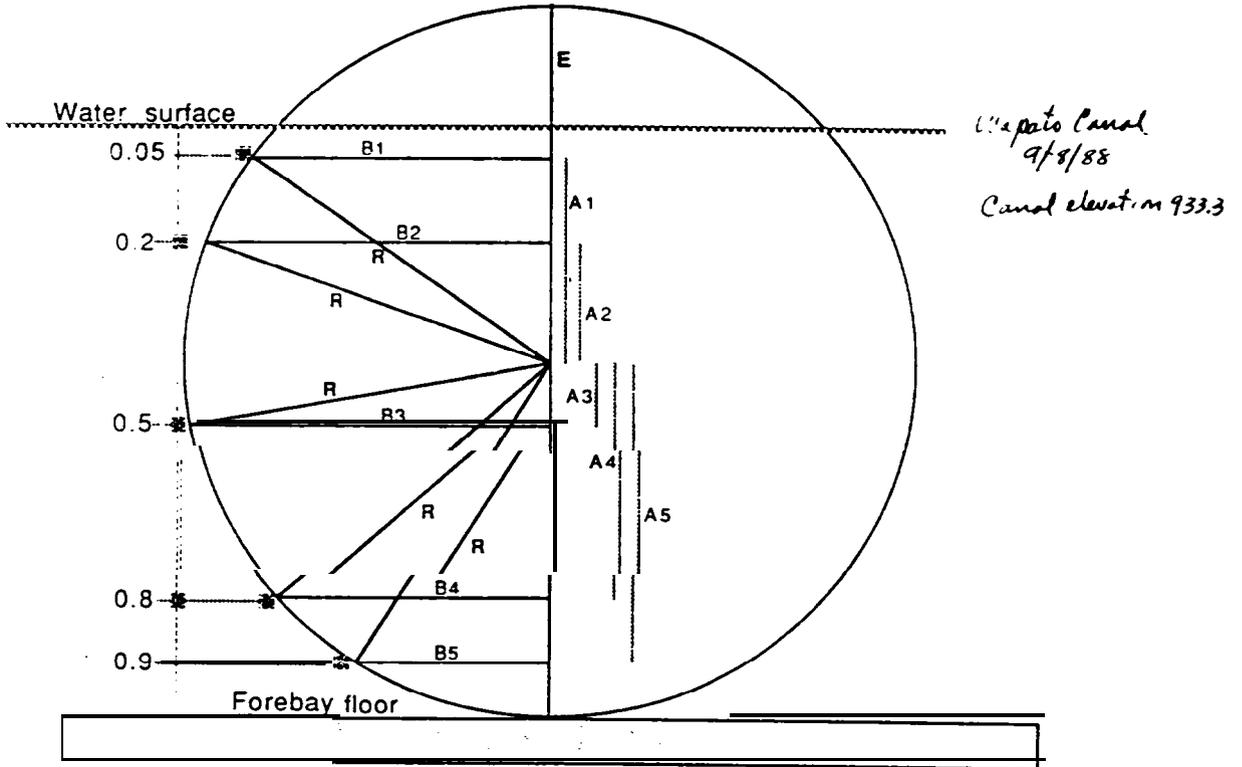
Time Start	1555 Hrs.	1555 Hrs.	1158 Hrs.	1304 Hrs.	0900 Hrs.	1448 Hrs.
Time End	1600 Hrs.	1600 Hrs.	1201 Hrs.	1307 Hrs.	0903 Hrs.	1451 Hrs.

Location	U (816) 0.2 (823) *				U (810) * 0.8 * (811)				U (816) .05 (823)				U (816) 0.5 (823)				U (823) 0.8a (816)				U (823) 0.9 (816)			
	+S	+A	-V	-A	+S	+A	-V	-A	-S	+A	+V	-A	+S	+A	-V	-A	+S	-A	+V	+A	+S	-A	+V	+A
1	1.7	.6	-.1	.1	2.9	.3	0	-.2	-1.2	.3	0	-.2	1.7	.5	-.2	0	1.0	-.6	-.2	.5	1.2	-.6	-.1	.5
2	1.9	.5	-.3	.2	2.2	.1	-.2	.2	-1.0	.3	0	-.2	1.9	.5	-.1	-.2	1.0	-.6	-.2	.6	1.2	-.6	-.1	.6
3	1.8	.6	-.5	.2	2.8	-.4	-.1	-.4	-1.3	.4	-.1	-.3	1.6	.5	-.1	-.3	1.1	-.6	-.2	.7	1.3	-.6	-.1	.6
4	1.7	.6	-.1	.1	3.0	-.6	-.2	-.2	-1.1	.3	0	-.2	1.7	.4	-.1	-.2	1.1	-.6	-.1	.5	1.2	-.4	0	.5
5	1.8	.5	-.3	.1	3.2	-.8	.2	-.4	-1.2	.4	0	-.1	1.6	.5	-.1	0	1.4	-.7	-.4	1.0	1.1	-.7	-.1	.6
6	1.6	.6	-.1	.1	3.1	-.6	-.2	-.2	-1.2	.3	-.1	-.1	1.7	.7	-.1	-.2	1.2	-.7	-.1	.7	1.2	-.7	-.1	.7
7	1.9	.6	-.2	.1	2.8	-.5	0	.5	-1.5	.4	0	-.2	1.3	.4	-.1	.1	1.1	-.7	-.2	.6	1.2	-.6	-.1	.6
8	1.8	.6	-.1	.1	2.6	-.4	-.1	-.2	-1.2	.3	.1	-.1	1.7	.6	0	-.3	.8	-.7	-.1	.6	1.4	-.8	-.1	.7
9	1.5	.7	-.3	.2	3.0	-.6	-.1	-.1	-1.4	.4	.2	-.2	1.7	.5	-.1	-.3	1.2	-.7	-.1	.6	1.3	-.7	0	.7
10	1.5	.6	-.2	0	2.9	-.8	0	-.1	-1.3	.3	0	-.2	1.6	.4	-.2	-.2	.8	-.5	0	.6	1.1	-.5	0	.5

Average	1.72	.59	.22	-.12	2.75	-.93	.07	.11	1.24	.34	.01	.18	1.65	.50	.18	.16	1.07	.64	.16	.64	1.25	.62	-.07	.60
Minimum	1.5	.5	.1	-.2	2.2	-.8	-.2	-.5	1.0	.3	-.1	.1	1.3	.4	-.1	.1	.8	.5	0	.5	1.1	.4	-.1	.5
Maximum	1.9	.7	.3	0	3.2	.3	.2	.4	1.5	.4	.2	.3	1.9	.7	1.0	.3	1.4	.7	.4	1.0	1.3	.8	0	.7

Notes: * probe malfunction?

WORKSHEET FOR DEPTH DETERMINATIONS



Drum Diameter (D):	<u>168"</u>	SIDE A	SIDE B
Radius (R):	<u>84</u>		
Exposed to air (E):	<u>54"</u>		
Submerged (Z):	<u>114. + 6" sill = 120"</u>		
0.05 z:	_____	A1 = (E+0.05Z)-R	B1 = (R ² -A1 ²) ^{0.5}
0.20 z:	<u>24"</u>	A2 = (E+0.2Z)-R	<u>6</u> B2 = (R ² -A2 ²) ^{0.5} <u>32.4</u>
0.50 z:	_____	A3 = (E+0.5Z)-R	B3 = (R ² -A3 ²) ^{0.5}
0.80 z:	<u>96"</u>	A4 = (E+0.8Z)-R	<u>66.2</u> B4 = (R ² -A4 ²) ^{0.5} <u>52.0</u>
0.90 z:	_____	A5 = (E+0.9Z)-R	B5 = (R ² -A5 ²) ^{0.5}

Distance From Vertical To Screen Face

0.05 Z:	R-B1 = _____
0.20 Z:	R-B2 = <u>• .1-</u>
0.50 Z:	R-B3 = _____
0.80 Z:	R-B4 = <u>32.0.</u>
0.90 Z:	R-B5 = _____

Yakima River Fish Screening Facility F² Measurements

Site Wapato

Screen # 2

Screen Diameter (in) 168
Exposed (in) 54
Submerged (in) 114

Forebay Elevation 933.3
Canal Flow 1296 cfs

Date 9-8-86
Personnel CSA/EWB

Time Start	<u>1106 Hrs.</u>	<u>1115 Hrs.</u>				
Time End	<u>1107 Hrs.</u>	<u>1118 Hrs.</u>				

Location	U (C) L			U (C) L			U C L			U C L			U C L			U C L		
	U	C	L	U	C	L	U	C	L	U	C	L	U	C	L	U	C	L
Depth	0.2			0.8			0.2			0.8			0.2			0.8		
Vector	±S	±A	V	±S	±A	V	S	A	V	S	A	V	S	A	V	S	A	V
1	1.4	.4		1.4	.6													
2	1.4	.5		1.5	.6													
3	1.2	.3		1.5	.6													
4	1.4	.5		1.7	.7													
5	1.3	.4		1.2	.5													
6	1.5	.4		1.6	.7													
7	1.1	.4		1.4	.6													
8	1.2	.4		1.4	.6													
9	1.4	.5		1.4	.5													
10	1.5	.4		1.4	.6													

Average	1.34	.42		.45	.60
Minimum	1.1	.3		.2	.7
Maximum	1.5	.5		.6	.7

Notes: Net pens removed, canal flow much lower than during previous data set collected 8/16-8/19/86
Cea

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Screen # 5-4-3

Screen Diameter (in) 168
Exposed (in) 54
Submerged (in) 114

Forebay Elevation 933.3
Canal Flow 1296 cfs

Date 9-8-88
Personnel CSA/EWL

Time Start	1045 Hrs.	1134 Hrs.	1051 Hrs.	1128 Hrs.	1058 Hrs.	1122 Hrs.												
Time End	1048 Hrs.	1137 Hrs.	1054 Hrs.	1131 Hrs.	1102 Hrs.	1125 Hrs.												
	(5)		(4)		(3)													
Location	U (C) L			U (C) L			U (C) L			U (C) L			U (C) L					
Depth	0.2			0.8			0.2			0.8			0.2			0.8		
Vector	+S	+A	V	+S	+A	V	+S	+A	V	+S	+A	V	+S	+A	V	+S	+A	V
1	1.6	.4		1.6	.5		1.6	.4		1.5	.6		1.5	.4		2.2	3.0	
2	1.6	.5		1.6	.5		1.7	.5		1.3	.4		1.7	.5		1.9	.9	
3	1.5	.4		1.5	.5		1.6	.4		1.6	.4		1.6	.4		1.6	.6	
4	1.6	.5		1.6	.5		1.6	.4		1.8	.6		1.8	2.8?		2.6	1.4	
5	1.5	.4		1.7	.5		1.7	.5		1.4	.5		1.8	.8		3.2	2.6	
6	1.8	.5		1.9	.5		1.7	.3		1.3	.5		1.6	.5		2.2	1.8	
7	1.7	.4		1.8	.4		1.5	.4		1.5	.6		1.7	.4		1.0	0	
8	1.6	.5		1.8	.4		1.6	.4		1.4	.5		1.6	.4		1.7	.5	
9	1.6	.5		1.9	.4		1.5	.4		1.7	.5		2.3	1.6?		1.7	.7	
10	1.6	.4		1.6	.5		1.6	.4		1.5	.4		.8	.6		.5	0	
													X X			X X		
Average	1.61	.45		1.70	.47		1.61	.41		1.50	.50		1.64	.84		1.86	1.15	
Minimum	1.5	.4		1.5	.4		1.5	.3		1.3	.4		.8	.4		.5	0	
Maximum	1.8	.5		1.9	.5		1.9	.5		1.8	.6		2.3	2.8		3.2	3.0	

Notes:

* Note: Readings very erratic - wild
fluctuation from -2 hrs - 15 mins
on Sump - similar in appearance

Yakima River Fish Screening Facility Flow Measurements

Site Uapato

Screen Diameter (in) 188

Forebay Elevation 1733.3

Date 7-9-89

Screen # 8-7-6

Exposed (in) 54

Canal Flow 1296 cfs

Personnel CSA/EWA

Submerged (in) 114

Time Start	<u>1029 Hrs.</u>	<u>1155 Hrs.</u>	<u>1131 Hrs.</u>	<u>1149 Hrs.</u>	<u>1037 Hrs.</u>	<u>1149 Hrs.</u>
Time End	<u>1028 Hrs.</u>	<u>1158 Hrs.</u>	<u>1224 Hrs.</u>	<u>1152 Hrs.</u>	<u>1040 Hrs.</u>	<u>1146 Hrs.</u>

Location	U (0) L			U (C) L														
	0.2			0.8			0.2			0.8			0.2			0.8		
Depth	+S	+A	V															
1	1.5	.4		1.5	.5		1.4	.4		1.7	.6		1.3	.5		1.2	.7	
2	1.6	.4		1.4	.5		1.3	.4		1.5	.6		1.4	.5		1.1	.7	
3	1.4	.4		1.5	.5		1.3	.5		1.3	.5		1.2	.5		1.0	.6	
4	1.4	.5		1.4	.6		1.3	.4		1.5	.6		1.3	.4		1.2	.8	
5	1.4	.4		1.3	.5		1.1	.4		1.5	.6		1.1	.3		1.1	.7	
6	1.4	.4		1.5	.5		1.4	.4		1.5	.6		1.4	.5		1.0	.6	
7	1.4	.4		1.2	.4		1.5	.5		1.4	.5		1.4	.5		1.0	.6	
8	1.4	.4		1.5	.5		1.4	.4		1.4	.6		1.1	.3		1.3	.7	
9	1.3	.4		1.4	.5		1.4	.5		1.4	.6		1.2	.5		1.3	.7	
10	1.3	.4		1.3	.5		1.3	.5		1.5	.6		1.3	.5		1.1	.7	

Average	1.41	.41		1.40	.50		1.36	.44		1.47	.58		1.27	.45		1.13	.68	
Minimum	1.3	.4		1.2	.4		1.1	.4		1.3	.5		1.1	.3		1.0	.6	
Maximum	1.6	.5		1.5	.6		1.6	.5		1.7	.6		1.4	.5		1.3	.8	

Notes:

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Screen # 12-11-10

Screen Diameter (in) 168"
 Exposed (in) 54"
 Submerged (in) 114"

Forebay Elevation 933.3
 Canal Flow 1296 cfs

Date 9-8-88
 Personnel CSA/EWK

Time Start	<u>1005 Hrs.</u>	<u>1214 Hrs.</u>	<u>1011 Hrs.</u>	<u>1208 Hrs.</u>	<u>1017 Hrs.</u>	<u>1202 Hrs.</u>
Time End	<u>1008 Hrs.</u>	<u>1217 Hrs.</u>	<u>1014 Hrs.</u>	<u>1211 Hrs.</u>	<u>1020 Hrs.</u>	<u>1205 Hrs.</u>

Location	U (C) L																	
	U	(C)	L															
Depth	0.2			0.8			0.2			0.8			0.2			0.8		
Vector	+S	+A	V															
1	1.3	.3		1.1	.3		1.2	.3		1.9	.5		1.8	.5		1.3	.5	
2	1.4	.3		1.2	.4		1.3	.3		1.1	.6		1.6	.4		1.3	.4	
3	1.3	.3		1.2	.4		1.3	.3		1.1	.5		1.6	.3		1.5	.5	
4	1.4	.4		1.3	.5		1.4	.4		1.2	.5		1.6	.3		1.3	.5	
5	1.5	.3		1.1	.4		1.2	.3		1.0	.5		1.4	.4		1.2	.5	
6	1.4	.3		1.0	.5		1.3	.3		.9	.5		1.5	.3		1.2	.4	
7	1.5	.3		1.0	.4		1.4	.2		.9	.5		1.6	.4		1.3	.5	
8	1.5	.3		1.2	.5		1.1	.3		1.0	.6		1.5	.4		1.2	.5	
9	1.2	.3		1.2	.4		.7	-.1		.9	.6		1.5	.4		1.3	.4	
10	1.3	.4		1.2	.5		1.3	.4		1.0	.6		1.4	.3		1.0	.5	

Average	1.38	.37		1.15	.43		1.22	.27		1.00	.54		1.55	.37		1.26	.47	
Minimum	1.2	.3		1.0	.3		.7	-.1		.9	.5		1.4	.3		1.0	.4	
Maximum	1.5	.4		1.3	.5		1.4	.4		1.2	.6		1.8	.5		1.5	.5	

Notes:

Yakima River Fish Screening Facility Flow Measurements

Site Wapato

Forebay Elevation 933.3

Date 9/8/88

Screen # 15-14-13

Screen Diameter (in) 168"

Canal Flow 1296 cfs

Personnel 629/602

Exposed (in) 54"

Submerged (in) 114" 16" sill = 120" d pipe

Time Start	<u>0944 Hrs.</u>	<u>1232 Hrs.</u>	<u>0951 Hrs.</u>	<u>1226 Hrs.</u>	<u>0957 Hrs.</u>	<u>1220 Hrs.</u>
Time End	<u>0947 Hrs.</u>	<u>1235 Hrs.</u>	<u>0954 Hrs.</u>	<u>1229 Hrs.</u>	<u>1000 Hrs.</u>	<u>1223 Hrs.</u>

Location	U C L			U C L			U C L			U C L			U C L			U C L		
	+S	+A	V	+S	+A	V	+S	+A	V	+S	+A	V	+S	+A	V	+S	+A	V
Depth	0.2			0.8			0.2			0.8			0.2			0.8		
1	1.1	1.5		1.0	.7		1.4	.3		1.1	.6		1.2	.3		1.0	.6	
2	1.1	1.4		1.0	.6		1.1	.4		1.1	.5		1.1	.4		.9	.5	
3	1.3	.6		1.1	.6		1.2	.3		.9	.6		1.0	.3		1.0	.4	
4	1.2	.4		.8	.6		1.3	.2		.9	.5		1.1	.4		.8	.4	
5	.5	.2		.8	.5		1.1	.3		.9	.5		1.1	.3		1.0	.5	
6	.9	.3		.9	.5		1.1	.3		1.0	.5		1.3	.4		1.1	.5	
7	.8	.5		.9	.6		1.2	.3		1.1	.6		1.2	.3		1.1	.4	
8	1.0	.4		1.0	.7		1.2	.3		1.1	.5		1.2	.4		1.0	.5	
9	1.2	.5		.9	.6		1.1	.3		1.2	.4		1.2	.4		1.2	.4	
10	1.2	.5		.8	.4		1.2	.3		.9	.5		1.2	.3		1.5	.5	

Average	1.03	.43		0.92	.58		1.17	.13		1.02	.52		1.16	.35		1.16	.47	
Minimum	.5	.2		.8	.4		1.1	.2		.9	.4		1.0	.3		.8	.4	
Maximum	1.3	.6		1.1	.7		1.4	.4		1.2	.6		1.3	.4		1.5	.6	

Notes: #818 $\frac{X}{+A}$ $\frac{Y}{+S}$

Note: Dale Wilson (BR) said canal flow has been dropped 800 cfs since our last measurement (300 yesterday); a last week, final level down 1.75' (16" our measurement). Separation between level is 24" less than forebay level instead of 42". Level on west side of canal is about robbing from fish.

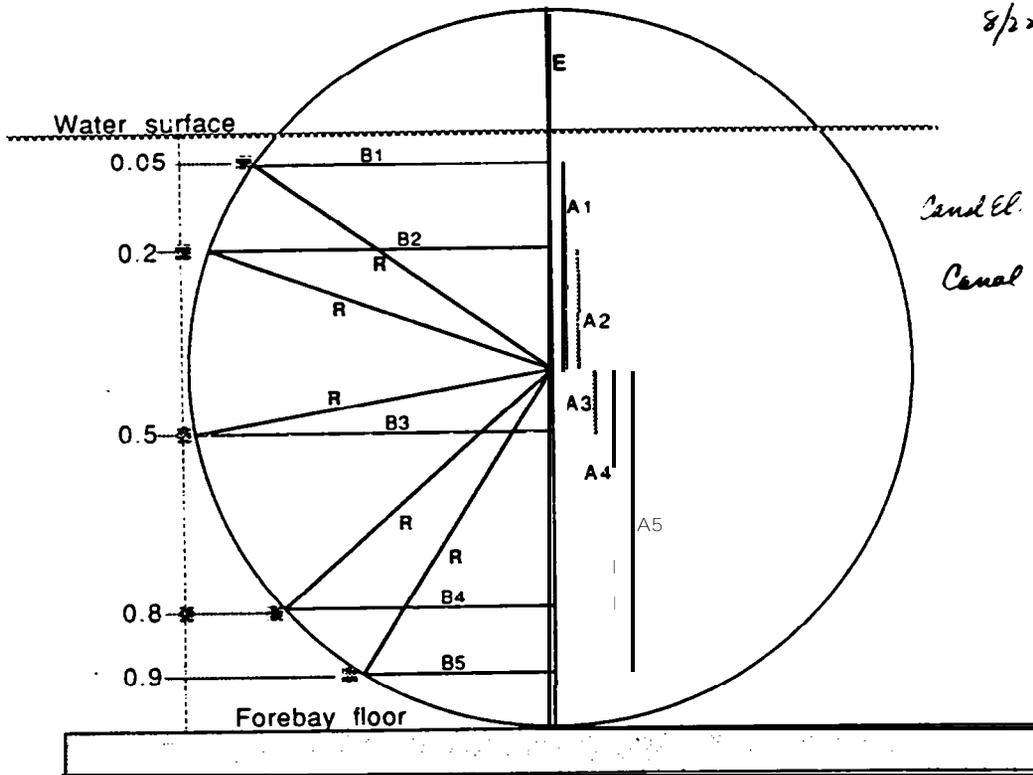
APPENDIX G

ROZA SCREENS RAW DATA SHEETS

Appendix G contains the raw data sheets for flow measurements conducted at the Roza Screens on August 22 and 23, 1988. Page 6.2 shows the calculations made to position probes at the proper measurement depths, and the distance between the probe and the screen face at the measured depths. A horizontal probe support the length of the distance between the probe and the screen face was used for measurements near the face of the drum screen on 2 screens. Raw data for measurements in front of the drum screens are found on pages 6.3 through G.8. Flow measurements in the entrance to the Bay 1 fish bypass are on page G.9. Flow measurements in two transects across the separation chamber are on pages G.10 through 6.12. Flow measurements at the face of the two traveling belt screens in the separation chamber are on pages 6.13 and 6.14. Flow measurements in the entrance to the fish return are on page G.15.

WORKSHEET FOR DEPTH DETERMINATIONS

Rozal Canal
8/22/88



Canal El. 1220.3

Canal Flow: 1957 cfs.

Drum Diameter (D): 204"
 Radius (R): 102"
 Exposed to air (E): 53"
 Submerged (Z): 151"

SIDE A

SIDE B

0.05 z: <u>7.6"</u>	A1= (E+0.05Z)-R	<u>41.4</u>	B1= (R ² -A1 ²) ^{0.5}	<u>93.2</u>
0.20 z: <u>30.2"</u>	A2= (E+0.2Z)-R	<u>18.8</u>	B2= (R ² -A2 ²) ^{0.5}	<u>100.2</u>
0.50 z: <u>75.5"</u>	A3= (E+0.5Z)-R	<u>26.5</u>	B3= (R ² -A3 ²) ^{0.5}	<u>98.5</u>
0.80 z: <u>120.8"</u>	A4= (E+0.8Z)-R	<u>71.8</u>	B4= (R ² -A4 ²) ^{0.5}	<u>72.4</u>
0.90 z: <u>135.9"</u>	A5= (E+0.9Z)-R	<u>86.9</u>	B5= (R ² -A5 ²) ^{0.5}	<u>53.4</u>

Distance From Vertical To Screen Face

0.05 Z: R-B1=	<u>8.8'</u>
0.20 Z: R-B2=	<u>1.7'</u>
0.50 Z: R-B3=	<u>3.5"</u>
0.80 Z: R-B4=	<u>29.6.</u>
0.90 Z: R-B5=	<u>48.6'</u>

Yakima River Fish Screening Facility Flow Measurements

Site ROZA

Forebay Elevation 1220.3

Date 8/22/88

Screen # 1
Top Bay

Screen Diameter (in) 204"

Canal Flow 957 cfs

Exposed (in) 53"

Personnel CDL/ELW

Submerged (in) 151"

Time Start	<u>1039 Hrs.</u>	<u>1048 Hrs.</u>				
Time End	<u>1042 Hrs.</u>	<u>1051 Hrs.</u>				

Location	U C L				U C L				U C L				U C L				U C L							
	(818) 0.2 (823)				(818) 0.8 (823)				0.2				0.8				0.2				0.8			
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V		S	A	V		S	A	V		S	A	V	
1	1.5	-0.3	.4	.7	1.8	-0.8	.6	1.2																
2	1.7	-0.3	.3	.6	1.9	-0.9	.7	1.2																
3	1.8	-0.3	.2	.2	1.5	-1.0	.6	1.1																
4	1.5	-0.2	.3	.6	1.9	-0.9	.7	1.2																
5	1.9	-0.4	.3	.7	1.6	-1.0	.5	.9																
6	1.7	-0.2	.1	.7	1.3	-0.8	.6	1.2																
7	1.4	-0.3	.4	.6	1.6	-1.1	.6	1.0																
8	1.2	-0.2	.3	.6	1.4	-1.1	.5	.9																
9	1.6	-0.3	.2	.2	1.5	-1.2	.6	.9																
10	1.8	-0.3	.1	.6	1.5	-0.9	.5	1.1																

Average	1.57	0.28	-0.29	0.65	1.60	0.97	-0.59	1.06																
Minimum	1.2	.2	-.4	.6	1.4	.8	-.7	.8																
Maximum	1.9	.4	-.1	.7	1.9	1.2	-.5	1.2																

Notes: X Y
818 +S -A
823 -V +A

Yakima River Fish Screening Facility Flow Measurements

Site Roca

Forebay Elevation 1220.3

Date 8-21-88

Screen # 2

Screen Diameter (in) 204

Canal Flow 1957 cfs

Personnel CSA/FWK

Exposed (in) 53"

Submerged (in) 151"

Time Start	<u>1106 Hrs.</u>	<u>1058 Hrs.</u>				
Time End	<u>1109 Hrs.</u>	<u>1101 Hrs.</u>				

Location	U C L				U C L				U C L			U C L			U C L					
	<u>(818)0.2 (823)</u>				<u>(818)0.8 (823)</u>				0.2			0.8			0.2			0.8		
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	1.0	-.3	.2	.6	.9	-.4	.1	.9												
2	1.2	-.2	.1	.6	1.3	-.5	.2	.7												
3	1.4	-.5	.4	.6	1.1	-.3	.4	.6												
4	1.6	-.7	.1	.6	1.7	-.3	.4	.6												
5	1.1	-.3	.2	.6	1.8	-.2	.2	.7												
6	1.5	-.4	.5	.5	1.1	-.6	.5	.8												
7	1.7	-.3	.5	.5	1.2	-.4	.4	.9												
8	1.4	-.2	.6	.7	1.0	-.5	.2	.5												
9	.9	-.2	.6	.6	1.1	-.3	.4	.5												
10	.8	-.3	.2	.4	1.0	-.3	.4	.5												

Average	1.26	0.27	-.34	0.57	1.02	0.38	-.33	0.67												
Minimum	.8	.2	-.6	.1	.7	.2	-.5	.5												
Maximum	1.7	.5	-.1	.6	1.3	.6	-.2	.9												

Notes:

Yakima River Fish Screening Facility Flow Measurements

Site Ko-2

Screen # A

Screen Diameter (in) 204"
 Exposed (in) 53"
 Submerged (in) 151"

Forebay Elevation 1220.3
 Canal Flow 1957 cfs

Date 8-22-88
 Personnel CSA/EWK

Time Start	<u>1124 Hrs.</u>	<u>1130 Hrs.</u>				
Time End	<u>1127 Hrs.</u>	<u>1135 Hrs.</u>				

Location	U C L				U C L				U C L				U C L				U C L				U C L			
Depth	(g18) 0.2 (g23)				(g18) 0.8 (g23)				.05				0.5				0.8a				0.9			
Vector	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V		S	A	V		S	A	V		S	A	V	
1	.9	-.4	.4	.4	1.0	-.5	0	.6																
2	1.0	-.2	.1	.5	.8	-.4	-.4	.7																
3	.7	-.4	.2	.6	.7	-.6	.3	.6																
4	.7	-.3	.1	.5	.7	-.6	.3	.7																
5	.9	-.4	.2	.5	1.2	-.3	.3	.6																
6	1.0	-.5	.3	.7	.7	-.5	.3	.7																
7	.7	-.5	.2	.6	1.0	-.5	.3	.7																
8	1.2	-.3	.2	.5	.9	-.5	.3	.7																
9	1.1	-.3	.3	.7	.8	-.3	.3	.5																
10	.8	-.5	.2	.7	.9	-.6	.3	.5																

Average	<u>0.94</u>	<u>.38</u>	<u>-.22</u>	<u>0.57</u>	<u>0.93</u>	<u>-.26</u>	<u>-.28</u>	<u>0.63</u>																
Minimum	<u>.7</u>	<u>.2</u>	<u>-.4</u>	<u>.4</u>	<u>.8</u>	<u>-.6</u>	<u>-.4</u>	<u>.5</u>																
Maximum	<u>1.2</u>	<u>.5</u>	<u>-.1</u>	<u>.7</u>	<u>1.2</u>	<u>.6</u>	<u>0</u>	<u>.7</u>																

Notes:

Yakima River Fish Screening Facility Flow Measurements

Site Roza

Forebay Elevation 1223
Canal Flow 1957 cfs

Date 8-22-99
Personnel JSA/ELK

Screen # 5

Screen Diameter (in) 704"
Exposed (in) 53"
Submerged (in) 151"

Time Start	<u>1153 hrs</u>	<u>1145 hrs</u>				
Time End	<u>1156 hrs</u>	<u>1148 hrs</u>				

Location	U C L				U C L				U C L				U C L				U C L						
	(818)0.2 (823)				(818)0.8 (823)				0.2				0.8				0.2				0.8		
Depth	tS	A	V	tA	tS	A	V	tA	S	A	V	S	A	V	S	A	V	S	A	V			
1	1.9	-0.3	.3	.2	1.0	-0.7	.2	.6															
2	1.1	-0.2	.3	.2	1.2	-0.5	.2	.5															
3	1.9	-0.3	.3	.3	1.7	-0.8	.4	.5															
4	1.1	-0.2	.4	.2	1.0	-0.6	.5	.5															
5	1.9	-0.3	.3	.1	.9	-0.5	.2	.5															
6	1.1	-0.4	.2	.3	.9	-0.6	.4	.3															
7	1.7	-0.2	.3	.1	1.0	-0.4	.4	.5															
8	1.3	-0.2	.1	.4	1.2	-0.6	.2	.4															
9	1.3	-0.2	.2	-.2	.7	-0.5	.3	.6															
10	1.5	-0.3	.1	-.1	1.1	-0.3	.4	.4															

Average	1.11	0.26	-0.25	0.12	1.02	0.55	-0.32	0.48												
Minimum	.8	.2	-.4	-.2	.9	.3	-.5	.3												
Maximum	1.5	.4	0	.4	1.2	.8	-.2	.6												

Notes:

9.6

Yakima River Dist Screening Facility Flow Measurements

Site Rozz

Forebay Elevation 1220.3

Date 8-22-88

Screen # 6

Screen Diameter (in) 204"

Canal Flow 1457 cfs

Personnel CS9/EWL

Exposed (in) 53"

Submerged (in) 151"

Time Start	1409 Hrs.	1350 Hrs.	1546 Hrs.	1400 Hrs.	1509 Hrs.	1523 Hrs.
Time End	1412 Hrs.	1354 Hrs.	1551 Hrs.	1404 Hrs.	1513 Hrs.	1526 Hrs.

Location	U C L				U C L				U C L				U C L				U C L							
	(SIS) 0.2 (823)				(SIS) 0.8 (823)				(SIS) 0.2 0.05 (823)				(SIS) 0.8 0.5 (823)				(SIS) 0.2 0.8 A (823)				(SIS) 0.8 0.9 (823)			
Vector	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A	+S	-A	-V	+A
1	1.0	-0.3	-1.4	0.3	0.9	-1.5	-1.5	0.4	1.3	-1.6	*	0.4	0.8	-1.3	-1.7	0.3	1.2	-1.6	-1.6	0.6	1.2	-1.7	-1.0	0.6
2	1.1	-1.5	-1.3	0.3	0.7	-0.7	-0.7	0.5	1.0	-1.5	*	0.3	0.8	-1.2	-1.6	0.4	1.0	-1.6	0.9	0.5	2.6	-1.7	2.2	0.3
3	1.2	-1.4	-1.5	0.3	1.0	-1.5	-1.6	0.5	1.0	-1.3	*	0.4	1.0	-1.2	-1.6	0.4	1.0	-1.6	*	0.6	1.1	-1.8	0.2	0.6
4	1.1	-1.4	-1.4	0.3	1.1	-1.6	-1.6	0.4	1.1	-1.6	*	0.4	1.2	-1.3	-1.2	0.4	1.0	-1.6	*	0.6	1.1	-1.7	-1.4	0.6
5	1.4	-1.5	-1.6	0.4	1.1	-1.6	-1.5	0.4	1.3	-1.4	*	0.4	0.9	-1.2	-1.8	0.3	0.9	-1.6	*	0.6	1.1	-1.7	-1.6	0.6
6	1.2	-1.4	-1.5	0.3	1.0	-1.6	-1.8	0.3	1.4	-1.4	*	0.4	0.9	-1.2	-1.7	0.3	1.0	-1.5	*	0.5	1.0	-1.7	1.6	0.5
7	1.0	-1.4	-1.6	0.3	1.0	-1.4	-1.4	0.5	1.3	-1.5	*	0.4	0.9	-1.2	-1.6	0.3	1.1	-1.5	*	0.5	1.2	-1.7	1.2	0.6
8	1.0	-1.3	-1.5	0.4	0.9	-1.6	-1.5	0.4	1.1	-1.5	*	0.4	0.9	-1.2	-1.6	0.4	1.0	-1.5	*	0.5	1.2	-1.7	1.4	0.7
9	1.2	-1.4	-1.4	0.3	1.1	-1.7	-1.6	0.5	1.2	-1.3	*	0.3	0.8	-1.2	-1.5	0.3	0.9	-1.6	*	0.5	1.1	-1.7	2.3	0.5
10	1.1	-1.3	-1.3	0.3	0.9	-1.7	-1.6	0.5	1.0	-1.3	*	0.4	0.7	0	-1.6	0.3	1.1	-1.6	*	0.5	1.0	-1.7	1.8	0.6

Average	1.14	0.39	1.45	0.32	0.97	0.59	0.58	0.44	1.20	0.44	X	0.38	0.86	0.21	1.67	0.34	1.02	0.57	X	0.54	1.26	0.71	-1.71	0.58
Minimum	1.0	0.3	1.3	0.3	0.7	0.4	0.4	0.3	1.0	0.3	X	0.3	0.4	0	0.6	0.3	0.9	0.5	X	0.5	1.0	0.7	-2.2	0.3
Maximum	1.4	0.5	1.6	0.4	1.1	0.7	0.8	0.5	1.1	0.6	X	0.4	1.2	0.3	0.8	0.4	1.2	0.6	X	0.6	2.6	0.8	1.0	0.7

Notes:

* = Readings went from +1.0 to -2.0
 Probe problems occurred after the 1409-1412 hr. readings at 0.2 depth. "Vertical" parameter became unreliable - All vertical readings thereafter were either unvendable or suspect. (CSA)
 * probe malfunction?

Yakima River Fish Screening Facility Flow Measurements

Site Poza

Screen Diameter (in) 204"
Exposed (in) 53"
Submerged (in) 151"

Forebay Elevation 122.3
Canal Flow 1957 cfs

Date 8-22-98
Personnel CSA/SLK

Screen # 7

Time Start	1313 Hrs.	1331 Hrs.	1600 Hrs.	1322 Hrs.	1612 Hrs.	1622 Hrs.
Time End	1316 Hrs.	1334 Hrs.	1603 Hrs.	1326 Hrs.	1615 Hrs.	1625 Hrs.

Location	U C L				U C L				U C L				U C L				U C L				U C L							
Depth	(818) 0.2 (823)				(818) 0.8 (823)				(818) .05 (823) *				(818) 0.5 (823)				(818) 0.8a * (823)				(818) 0.9 (823)							
Vector	IS	-A	-V	IA	IS	-A	-V	IA	IS	-A	-V	IA	IS	-A	-V	IA	IS	-A	-V	IA	IS	-A	-V	IA	IS	-A	-V	IA
1	.6	-.3	-.4	.4	1.0	-.4	-.5	.3	1.3	-.4	*	.2	1.2	-.4	-.7	.3	.9	-.5	*	.3	1.0	-.7	*	.4	1.0	-.7	*	.4
2	.7	-.3	-.8	.1	1.0	-.4	-.4	.4	.9	-.4	*	.2	1.1	-.4	-.8	.4	1.0	-.5	*	.4	.8	-.7	*	.5	1.0	-.6	*	.4
3	.9	-.4	-.3	.5	.8	-.5	-.4	.3	1.2	-.4	*	.3	1.0	-.5	-.6	.4	.8	-.6	*	.4	1.0	-.6	*	.4	.8	-.6	*	.4
4	1.1	-.3	-.3	.3	.9	-.6	-.5	.6	1.1	-.5	*	.2	.3	-.4	-.4	.3	1.0	-.5	*	.3	.8	-.6	*	.4	.8	-.6	*	.4
5	.7	-.4	-.4	.3	.9	-.5	-.6	.5	1.1	-.4	*	.2	.7	-.4	-.5	.4	.9	-.4	*	.4	.8	-.6	*	.4	.9	-.5	*	.5
6	.7	-.1	-.5	.3	.8	-.5	-.5	.4	1.2	-.5	*	.1	.8	-.4	.2	.2	.7	-.7	*	.2	.9	-.5	*	.5	.9	-.5	*	.5
7	.9	-.4	-.4	.4	.8	-.5	-.5	.4	1.1	-.5	*	.4	.9	-.4	-.2	.4	.8	-.5	*	.3	1.2	-.5	*	.5	.9	-.5	*	.5
8	1.0	-.4	-.5	.3	.7	-.5	-.4	.4	1.1	-.5	*	1.1	1.0	-.4	-.7	.5	.9	-.6	*	.3	.9	-.5	*	.5	.9	-.5	*	.5
9	1.0	-.3	-.4	.4	.8	-.6	-.4	.4	.9	-.6	*	1.1	.8	-.3	-.6	.3	.9	-.5	*	.7	.9	-.6	*	.6	.9	-.6	*	.6
10	1.3	-.4	-.4	.3	.7	-.6	-.4	.4	.2	-.4	*	1.3	.8	-.5	-.8	.3	1.0	-.6	*	.4	.9	-.5	*	.5	.9	-.5	*	.5

Average	0.91	0.33	.44	0.33	0.84	0.52	.46	0.41	1.12	0.46	*/	-.27	0.91	0.41	.50	0.35	0.89	0.54	*	0.37	0.92	0.58	*	0.47
Minimum	.6	.1	.3	.1	.7	.4	.4	.3	.9	.4	*/	-.1.3	.7	.3	.2	.2	.7	.4	*/	.2	.8	.5	*/	.4
Maximum	1.3	.4	.8	.5	1.0	.6	.5	.6	1.3	.6	*/	.3	1.2	.5	.8	.5	1.0	.7	*/	.7	1.2	.7	*/	.6

Notes: * - unreadable
* - probe malfunctions?

Yakima River Fish Screening Facility Flow Measurements

Screen # By-pass-Bay #1 Screen Diameter (in) _____
 Exposed (in) _____
 Submerged (in) ~150' deep

Forebay Elevation 1220.3
 Canal Flow 1957 cfs

Date 8-22-88
 Personnel PSA/EWL

Time Start	1430 Hrs.	1430 Hrs.				
Time End	1425 Hrs.	1433 Hrs.				

Location	U C L				U C L				U C L			U C L			U C L					
	(815) 0.2 (823)				(818) 0.8 (823)				0.2			0.8			0.2			0.8		
Depth	+S	-A	-V	+A	+S	-A	-V	+A	S	A	V	S	A	V	S	A	V	S	A	V
1	2.5	-1.5	-0.8	.4	2.7	1.4	.8	-1.0												
2	2.8	-1.3	-2.6	.2	2.4	0	.2	-.9												
3	2.9	-1.2	-2.3	.2	2.6	.4	1.1	-.9												
4	2.6	-1.3	-2.6	.2	2.5	-1.2	.6	-.5												
5	2.8	-1.3	-2.6	-.1	2.7	.8	-.8	-.6												
6	2.8	-1.2	-2.8	.1	1.8	-1.6	-.2	-.3												
7	2.9	0	-2.7	.1	2.0	-.9	0	-.3												
8	2.5	-1.3	-3.2	-.1	2.3	-1.4	-1.9	-.4												
9	2.8	-1.2	-3.1	.0	2.5	.1	-.9	-.4												
10	3.0	-1.2	-3.0	-.1	2.7	.9	-1.8	-.4												

Average	2.79	.22	2.57	.13	2.42	.15	-.29	-.57												
Minimum	2.5	0	.8	-.1	1.8	-1.4	-.1	-1.0												
Maximum	3.0	1.3	3.2	.4	2.7	1.6	1.9	-.3												

Notes: Probe malfunction?

*

Yakima River Fish Screening Facility Flow Measurements

Site RozA

Forebay Elevation 1220.3

Date 8/25/88

Screen # TS#1

Screen Diameter (in) -

Canal Flow 1957 cfs

Personnel CBK/ENC

Exposed (in) -

Submerged (in) 144" deep

Time Start	<u>1119 Hrs.</u>	<u>1019 Hrs.</u>	<u>1125 Hrs.</u>	<u>1028 Hrs.</u>	<u>1131 Hrs.</u>	<u>1035 Hrs.</u>
Time End	<u>1122 Hrs.</u>	<u>1022 Hrs.</u>	<u>1128 Hrs.</u>	<u>1031 Hrs.</u>	<u>1134 Hrs.</u>	<u>1038 Hrs.</u>

Location	(U) C L			(U) C L			U (C) L			U (C) L			U C (L)			U C (L)		
	+S	+A	V	+S	+A	V	+S	+A	V	+S	+A	V	+S	+A	V	+S	+A	V
Depth	<u>(8/8)0.2</u>			<u>(8/8)0.8</u>			<u>(8/8)0.2</u>			<u>(8/8)0.8</u>			<u>(8/8)0.2</u>			<u>(8/8)0.8</u>		
1	2.1	.6		3.1	.5		1.4	.4		3.9	.2		1.0	.7		3.2	.8	
2	1.1	.6		4.0	.5		1.0	.8		3.3	.5		.8	.7		3.1	.9	
3	1.7	.5		2.7	.2		1.4	.7		2.6	1.0		.4	.6		2.9	.8	
4	1.0	.5		3.8	.6		.3	.4		3.1	.4		1.6	.5		2.4	.7	
5	2.0	.7		4.2	.5		.7	.7		3.7	.9		.5	.7		3.6	.7	
6	.8	.7		3.3	.6		1.0	.8		3.5	.7		1.2	.6		3.4	.7	
7	1.8	.5		4.0	.4		.8	.9		3.5	.5		.4	.7		2.8	.6	
8	1.3	.7		3.9	.4		1.4	.8		2.9	.3		1.7	.5		2.5	.9	
9	1.4	.6		3.3	.3		.3	.6		3.5	.6		1.5	.6		3.2	.8	
10	.9	.8		3.4	.8		1.3	1.0		3.2	.7		1.3	.7		3.4	.9	

ver. Average	<u>2</u>	<u>3.56</u>	<u>.48</u>	<u>0.96</u>	<u>.76</u>	<u>3.42</u>	<u>.58</u>	<u>1.04</u>	<u>.63</u>	<u>2.42</u>	<u>.78</u>
inim. Minimum		<u>2.7</u>	<u>.3</u>	<u>.3</u>	<u>.4</u>	<u>2.9</u>	<u>.3</u>	<u>.4</u>	<u>.5</u>	<u>2.5</u>	<u>.6</u>
max. Maximum		<u>4.0</u>	<u>.8</u>	<u>1.4</u>	<u>1.0</u>	<u>3.9</u>	<u>1.0</u>	<u>1.7</u>	<u>.7</u>	<u>3.6</u>	<u>.9</u>

N side 18 $\frac{y}{+A}$ $\frac{y}{+S}$ Traveling $\frac{y}{+A}$ 12' wide 11 no. 2 fin ps riser pipe

let us provide...
 by...
 not to...
 ...

6.10

Yakima River Fish Screening Facility Flow Measurements

Site Rozz

Forebay Elevation 1220.3

Date 8/25/88

Screen # TS# 3

Screen Diameter (in) -

Canal Flow 1757 cfs

Personnel CLL/EWL

Exposed (in) -
Submerged (in) 144" deep

Time Start	<u>1141 Hrs.</u>	<u>1048 Hrs.</u>	<u>1147 Hrs.</u>	<u>1055 Hrs.</u>	<u>1152 Hrs.</u>	<u>1102 Hrs.</u>
Time End	<u>1144 Hrs.</u>	<u>1051 Hrs.</u>	<u>1150 Hrs.</u>	<u>1058 Hrs.</u>	<u>1155 Hrs.</u>	<u>1105 Hrs.</u>

Location	(U) C L	(U) C L	U (C) L	U (C) L	U C (L)	U C (L)
Depth	(5/8) 0.2	(5/8) 0.8	(5/8) 0.2	(5/8) 0.8	(5/8) 0.2	(5/8) 0.8
Vector	+S +A V					
1	1.7 .6	2.4 .5	1.7 1.0	1.4 .6	1.2 .7	1.3 .4
2	1.1 .7	2.2 .3	1.6 .5	1.7 .7	1.1 .8	1.5 .7
3	1.2 .6	2.6 .4	1.2 .8	1.9 .7	1.3 .8	2.4 .5
4	1.1 .6	2.5 .4	1.4 .7	2.0 .8	.9 .7	2.5 .4
5	1.7 .7	2.1 .4	1.2 .7	1.4 .6	1.3 .7	2.2 .5
6	1.1 .6	1.9 .3	1.3 .6	2.2 .7	1.0 .6	2.3 .5
7	.7 .8	1.8 .2	1.2 .7	2.0 .8	1.8 1.0	2.2 .4
8	1.2 .8	1.6 .2	2.1 .5	1.8 .6	1.2 .8	1.2 .3
9	2.0 .6	1.9 .2	1.4 .5	2.7 .6	1.1 .6	1.9 .6
10	.9 .6	1.7 .2	2.0 .5	2.1 .8	1.6 .9	1.2 .4

Average	<u>1.27 .66</u>	<u>2.06 .30</u>	<u>1.47 .67</u>	<u>1.96 .69</u>	<u>1.25 .76</u>	<u>1.87 .47</u>
Minimum	<u>.7 .6</u>	<u>1.7 .2</u>	<u>1.2 .5</u>	<u>1.4 .6</u>	<u>.9 .6</u>	<u>1.2 .4</u>
Maximum	<u>2.0 .8</u>	<u>2.6 .5</u>	<u>2.1 1.0</u>	<u>2.2 .8</u>	<u>1.8 1.0</u>	<u>2.5 .7</u>

Notes: Probe 818 used for all measurements (CLL)

G.11

Yakima River Fish Screening Facility Flow Measurements

Site TPO2A

Forebay Elevation 1220.3

Date 2/23/88

Screen # 75" X-5

Screen Diameter (in) 75

Canal Flow 1457 cfs

Personnel CRJ/EWL

Exposed (in) 75
Submerged (in) 144" deep

Time Start	1220 Hrs	1241 Hrs	1226 Hrs	1236 Hrs		
Time End	1223 Hrs	1244 Hrs	1229 Hrs	1239 Hrs		

Location	U C L			U C L			U (C) L			U (C) L			U C L			U C L		
	+S	+A	V	+S	+A	V	+S	+A	V	+S	+A	V	S	A	V	S	A	V
Depth	(818) 0.2			(818) 0.8			(818) 0.2			(818) 0.8			0.2			0.8		
Vector	+S	+A	V	+S	+A	V	+S	+A	V	+S	+A	V	S	A	V	S	A	V
1	.9	.5		1.9	.6		1.4	.6		1.8	.2							
2	1.1	.3		2.1	.5		1.3	.4		2.8	1.1							
3	1.6	.4		1.6	.4		1.4	.6		1.8	.9							
4	1.3	.2		1.3	.5		1.4	.5		1.8	.6							
5	1.3	.3		1.8	.4		1.2	.4		1.3	.4							
6	1.5	.7		-.6	.1		1.4	.7		1.7	.2							
7	1.1	.4		1.1	.5		1.9	.8		1.7	.4							
8	1.1	.5		1.7	.4		1.5	.3		1.6	.6							
9	.4	0		3.6	.5		1.2	.5		1.6	.2							
10	1.2	.5		1.3	.6		1.4	.6		1.1	.4							

Average	1.11	.43		1.58	.45		1.39	.51		1.72	.50							
Minimum	.4	0		-.6	.1		1.2	.3		1.3	.2							
Maximum	1.6	.7		3.6	.6		1.9	.8		2.8	1.1							

Notes: #1 set is 1' from outer wall
#2 set is 3 1/2' @
centerline reading of set 3 is 1.5

Yakima River Fish Screening Facility Flow Measurements

Site ROBA

Screen # T5#2 X-S

Screen Diameter (in)

Exposed (in)

Submerged (in) 144" deep

Forebay Elevation 1220.3

Canal Flow 1957 cfs

Date 8/23/88

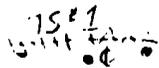
Personnel S.R., E.W.L.

Time Start	1350 Hrs.	1317 Hrs.	1356 Hrs.	1324 Hrs.	1402 Hrs.	1331 Hrs.
Time End	1353 Hrs.	1320 Hrs.	1357 Hrs.	1327 Hrs.	1405 Hrs.	1334 Hrs.

Location	U C L			U C L			U C L			U C L			U C L			U C L								
	Depth	+S	+A	V	Depth	+S	+A	V	Depth	+S	+A	V	Depth	+S	+A	V	Depth	+S	+A	V				
	(8/8) 0.2				(8/8) 0.8				(8/8) 0.2				(8/8) 0.8				(8/8) 0.2				(8/8) 0.8			
1	1.9	1.1			2.1	.4			0	.7			1.6	.2			.6	.1			3.6	.6		
2	.8	.3			1.9	.5			.2	-.4			1.8	.4			-.5	1.0			4.4	.8		
3	.3	.6			2.3	.3			.6	0			1.1	.2			.3	.2			3.9	.4		
4	.9	.6			2.0	.4			0	1.0			1.3	.1			.4	1.1			2.8	.2		
5	1.6	.2			1.7	.3			.2	.1			2.2	.5			.2	.4			2.6	-.1		
6	1.1	.7			3.2	.5			.8	.9			2.1	.4			.5	.8			2.2	.2		
7	.9	.8			2.2	.6			1.1	.8			1.8	.2			0	.3			2.4	.7		
8	.8	.6			1.5	0			.2	.2			2.4	.1			.3	-.4			3.3	-.4		
9	1.3	1.0			2.5	-.2			-.5	0			1.5	.4			.3	.4			4.2	.4		
10	.9	.7			1.7	.3			.4	.6			0.8	.5			.6	.5			1.6	.6		

Average	1.05	.66		2.11	.31		.30	.39		1.66	.30		.27	.44		3.10	.34	
Minimum	.3	.2		1.7	-.2		-.5	-.4		.8	.1		-.5	-.4		1.6	-.4	
Maximum	1.9	1.1		3.2	.6		1.1	1.0		2.4	.5		.6	1.1		4.4	.8	

Notes:



1 15' van outie wall

2 4' " " "

3 1'9" " "

4 11'0" (4' van - screen)

Photo 816 used for all measurements (sta.)

Yacoma River Fish Screening Facility Flow Measurements

Site FOEA

Forebay Elevation 1220.3

Date 8/23/88

Screen # 741 0.5

Screen Diameter (in) -

Canal Flow 1957 CFS

Personnel COA/EUL

Exposed (in) -

Submerged (in) 144" deep

Time Start	<u>1407 Hrs.</u>	<u>1338 Hrs.</u>				
Time End	<u>1410 Hrs.</u>	<u>1341 Hrs.</u>				

Location	U C L			U C L			U C L			U C L			U C L					
Depth	<u>(818) 0.2</u>			<u>(818) 0.8</u>			<u>0.2</u>			<u>0.8</u>			<u>0.2</u>			<u>0.8</u>		
Vector	+S	+A	V	+S	+A	V	S	A	V	S	A	V	S	A	V	S	A	V
1	<u>.9</u>	<u>.4</u>		<u>2.3</u>	<u>.2</u>													
2	<u>-.2</u>	<u>.9</u>		<u>3.1</u>	<u>.5</u>													
3	<u>2.1</u>	<u>-.2</u>		<u>2.1</u>	<u>.5</u>													
4	<u>0</u>	<u>.6</u>		<u>2.3</u>	<u>.2</u>													
5	<u>-.5</u>	<u>.2</u>		<u>2.8</u>	<u>-.2</u>													
6	<u>.3</u>	<u>.6</u>		<u>2.4</u>	<u>1.2</u>													
7	<u>.3</u>	<u>.2</u>		<u>1.7</u>	<u>-.1</u>													
8	<u>1.1</u>	<u>.2</u>		<u>3.5</u>	<u>-1.4</u>													
9	<u>1.5</u>	<u>-.3</u>		<u>2.4</u>	<u>.9</u>													
10	<u>1.6</u>	<u>1.1</u>		<u>3.5</u>	<u>.6</u>													

Average	<u>.61</u>	<u>.37</u>		<u>2.61</u>	<u>.24</u>												
Minimum	<u>-.5</u>	<u>-.3</u>		<u>1.7</u>	<u>-1.1</u>												
Maximum	<u>1.1</u>	<u>1.1</u>		<u>3.5</u>	<u>1.2</u>												

Notes: Make 818 used for all measurements. (810)

Yakima River Fish Screening Facility Flow Measurements

Site F.024

Forebay Elevation 1220.3

Date 8/23/88

Screen # 1, 6, 10 turn

Screen Diameter (in) _____

Canal Flow 1957 cfs

Personnel C. J. Lewis

Exposed (in) _____

Submerged (in) 72"

12" deep, 24" wide

Time Start	<u>1445 Hrs</u>	<u>1453 Hrs</u>				
Time End	<u>1448 Hrs</u>	<u>1456 Hrs</u>				

Location	U (C) L			U (C) L			U C L			U C L			U C L			U C L		
	U	C	L	U	C	L	U	C	L	U	C	L	U	C	L	U	C	L
Depth	<u>(8.8) 0.2</u>			<u>(5.8) 0.8</u>			0.2			0.8			0.2			0.8		
Vector	+S	+A	V	+S	+A	V	S	A	V	S	A	V	S	A	V	S	A	V
1	<u>3.5</u>	<u>0</u>		<u>3.6</u>	<u>.1</u>													
2	<u>3.4</u>	<u>0.1</u>		<u>3.5</u>	<u>.1</u>													
3	<u>3.5</u>	<u>0.2</u>		<u>3.4</u>	<u>0</u>													
4	<u>3.5</u>	<u>0</u>		<u>3.4</u>	<u>0</u>													
5	<u>3.5</u>	<u>0</u>		<u>3.5</u>	<u>.1</u>													
6	<u>3.3</u>	<u>0.1</u>		<u>3.6</u>	<u>.2</u>													
7	<u>3.4</u>	<u>0</u>		<u>3.6</u>	<u>.2</u>													
8	<u>3.4</u>	<u>.1</u>		<u>3.5</u>	<u>.1</u>													
9	<u>3.5</u>	<u>0</u>		<u>3.5</u>	<u>.1</u>													
10	<u>3.4</u>	<u>.1</u>		<u>3.5</u>	<u>.2</u>													

Average	<u>3.44</u>	<u>.06</u>		<u>3.51</u>	<u>.11</u>													
Minimum	<u>3.3</u>	<u>0</u>		<u>3.4</u>	<u>0</u>													
Maximum	<u>3.5</u>	<u>.2</u>		<u>3.6</u>	<u>.2</u>													

Notes:

0.2 = 14.4" below surface

0.8 = 57.6" below surface

Measurements are 72" from head of fish return