LAKE AND STREAM SURVEY FORM

Sample Site Identification

Water Name: Snipes Creek
Section Name: Hanks Road

Township: 9
Range: 35
E / W (circle one)
Section: 15
Qtr. Section:

Site Specifics: From Hanks Road downstream 100 meters

Sample Date (mn dy yr): 06 16 09
International Time: 1030
Physiographic Province:
Stream Habitat Unit Type:

Sampler Last Name: Cumming/Mark / Richards / Bill Rice (SVID) + Neil Hall
Agency:

Comments (weather conditions, flooding, pollution, etc.): Air Temp 21.5 After shocking a surge of water increased flow from about 8 to 30 cfs + water temp increased from 16.4 to 17.1 C

NOT FOR DATA ENTRY

County:
Mgmt Unit Code:

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. (°C)	16.4										
pH											
DO_2 (mg/l)											
Total Alkalinity (mg $CaCO_3$/l)											
TDS (mg/l)											
Conductivity (micromhos/cm)											
Water Clarity (m-lake/JTU-stream)											
Nitrate N_2 (mg/l)											
Total PO_4 (mg/l)											
Ortho PO_4 (mg/l)											
Chlorophyll 'A' (mg/l)											

SURFACE → → → BOTTOM

Other Chemical Measurements Taken:

WDW 699-A (8-30-93)

100 M   · 16.4 1010   17.1 after surge - 30   27.5 Air   Bill Rico SUID
8 cfs   Neil Hull SUID

Water Name: Snipes Cr   Date: 061600   Time: 1030   Sampler Name: Cummins/Monk/Richard   Page ___ of ___

BIOLOGICAL DATA

SURVEY TYPE	ELECTRICAL INFORMATION	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
EF	Pass 1	400		476
	Pass 2			
	Pass 3			
	Pass 4			

7H

NET INFORMATION	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED

Pass/Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		CO	110.				-									.		
		SK	36.				-									.		

Section: From Hanks Road down

S15 R8S T-9W

WDW 699-B (6-15-93)

LAKE AND STREAM SURVEY FORM

Sample Site Identification

NOT FOR DATA ENTRY
County ______
Mgmt Unit Code ______

Water Name: Swipes Creek   Section Name: Hanks Road
Township: 9   Range: 35   E / W *(circle one)*   Section: 15   Qtr. Section: ______
Site Specifics: From Hanks Road downstream 100 meters
Sample Date: 06 16 09 (mn dy yr)   International Time: 1030   Physiographic Province: ______   Stream Habitat Unit Type: ______
Sampler Last Name: Cummins/ Mark / Richards / Bill Rice (SVID) + Neil Hall   Agency: ______
Comments (weather conditions, flooding, pollution, etc.): Air Temp 21.5 After shocking a surge of water increased flow from about 8 to 30 cfs + water temp increased from 16.4 to 17.1 C

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. (°C)	16.4										
pH											
DO_2 *(mg/l)*											
Total Alkalinity *(mg $CaCO_3$/l)*											
TDS *(mg/l)*											
Conductivity *(micromhos/cm)*											
Water Clarity *(m-lake/JTU-stream)*											
Nitrate N_2 *(mg/l)*											
Total PO_4 *(mg/l)*											
Ortho PO_4 *(mg/l)*											
Chlorophyll 'A' *(mg/l)*											

SURFACE → → → BOTTOM

Other Chemical Measurements Taken: ______

100 M · 16.4 1010 8 cfs 17.1 after swage - 30 27.5 Air Bill Rice SUID Neil Hull SUID 1

Water Name Snipes C Date 061600 Time 1030 Sampler Name Cummins/Monk/Richard Page ___ of ___

BIOLOGICAL DATA

SURVEY TYPE

EF

ELECTRICAL INFORMATION 7H

	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
Pass 1	400		476
Pass 2			
Pass 3			
Pass 4			

NET INFORMATION

	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED

Pass/ Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		CO	110.				-									.		
		SK	36.				-									.		

Section: from Hanks Road down

S15 R8S T-9N

LAKE AND STREAM SURVEY FORM

Sample Site Identification

Water Name Snipes Creek Section Name Railroad Trestle

Township 9. Range 25. (E)/ W (circle one) Section 27 Qtr. Section

Site Specifics See 5/24/00 Survey form

Sample Date 06 16 00 (mn dy yr) International Time 1130 Physiographic Province Stream Habitat Unit Type

Sampler Last Name Cummins / Monk / Rice / Hull Agency

Comments (weather conditions, flooding, pollution, etc.) Flow much lower than 5/24/00. Significantly fewer coho.

NOT FOR DATA ENTRY

County

Mgmt Unit Code

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. (°C)	17.9										
pH											
DO_2 (mg/l)											
Total Alkalinity (mg $CaCO_3$/l)											
TDS (mg/l)											
Conductivity (micromhos/cm)											
Water Clarity (m-lake/JTU-stream)											
Nitrate N_2 (mg/l)											
Total PO_4 (mg/l)											
Ortho PO_4 (mg/l)											
Chlorophyll 'A' (mg/l)											

SURFACE → → → BOTTOM

Other Chemical Measurements Taken:

WDW 699-A (8-30-93)

17.9°C

Water Name Snipes Creek #1 Date 062600 Time 1130 Sampler Name Cummins/Mark/Bill Page 1 of 1

BIOLOGICAL DATA

SURVEY TYPE	ELECTRICAL INFORMATION 76	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
EF	Pass 1	400		503
	Pass 2			
	Pass 3			
	Pass 4			

NET INFORMATION	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED No Block Net.

Pass/ Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		CO	115.				-									.		
		SMB	152.				-									.		
		CO	94.				-									.		
		CO	104.				-									.		
		CO	107.				-									.		

R25E T9 - S27 Railroad Trestle.

Flow lower than 1st time - fewer fish

WDW 699-B (6-15-93)

LAKE AND STREAM SURVEY FORM

Sample Site Identification

Water Name: Snipes Creek   Section Name: Railroad Trestle

Township: 9.   Range: 25.   E/W (circle one): E   Section: 27   Qtr. Section: ___

Site Specifics: See 5/24/00 Survey form

Sample Date (mn dy yr): 06 16 00   International Time: 1130   Physiographic Province: ___   Stream Habitat Unit Type: ___

Sampler Last Name: Cummins / Monk / Rice / Hull   Agency: ___

Comments (weather conditions, flooding, pollution, etc.): Flow much lower than 5/24/00. Significantly fewer coho.

NOT FOR DATA ENTRY

County: ___

Mgmt Unit Code: ___

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. (°C)	17.9										
pH											
DO_2 (mg/l)											
Total Alkalinity (mg $CaCO_3$/l)											
TDS (mg/l)											
Conductivity (micromhos/cm)											
Water Clarity (m-lake/JTU-stream)											
Nitrate N_2 (mg/l)											
Total PO_4 (mg/l)											
Ortho PO_4 (mg/l)											
Chlorophyll 'A' (mg/l)											

SURFACE → → → BOTTOM

Other Chemical Measurements Taken: ___

17.9°C

Water Name Snipes Creek #1 Date 062600 Time 1130 Sampler Name Cumming/Mark/Bill Page 1 of 1

BIOLOGICAL DATA

SURVEY TYPE	ELECTRICAL INFORMATION	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
EF	Pass 1	400	76	503
	Pass 2			
	Pass 3			
	Pass 4			

NET INFORMATION	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED No Block Net.

Pass/ Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		CO	115.				-									.		
		SMB	152.				-									.		
		CO	94.				-									.		
		CO	104.				-									.		
		CO	107.				-									.		

R25E T9 - S27 Railroad Trestle.

Flow lower than 1st time - fewer fish

WDW 699-B (6-15-93)

LAKE AND STREAM SURVEY FORM

Sample Site Identification

Water Name: Snipe's Creek

Section Name: Benton 59.32 Siphon

Township: 9. Range: 25. (E)/ W *(circle one)* Section: 15 Qtr. Section:

Site Specifics:

Sample Date: 06/16/00 (mn dy yr) International Time: 0930 Physiographic Province: Stream Habitat Unit Type:

Sampler Last Name: Cummins/Monk Agency:

Comments (weather conditions, flooding, pollution, etc.):

NOT FOR DATA ENTRY

County:

Mgmt Unit Code:

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. *(°C)*											
pH											
DO_2 *(mg/l)*											
Total Alkalinity *(mg $CaCO_3$/l)*											
TDS *(mg/l)*											
Conductivity *(micromhos/cm)*											
Water Clarity *(m-lake/JTU-stream)*											
Nitrate N_2 *(mg/l)*											
Total PO_4 *(mg/l)*											
Ortho PO_4 *(mg/l)*											
Chlorophyll 'A' *(mg/l)*											

SURFACE → → → BOTTOM

Other Chemical Measurements Taken:

Length - 68M 15°C

Water Name Snipes Cr Date 061600 Time 0930 Sampler Name Cummins/Monk Page 1 of 1

BIOLOGICAL DATA

SURVEY TYPE: EF

ELECTRICAL INFORMATION

	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
Pass 1	400	66	
Pass 2			
Pass 3			
Pass 4			

NET INFORMATION

	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED

Pass/Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		CO	138.	T														
		CO	127.	/														
		LRS	103.															
		BLS	89.															
		CO	112.															
		BLS	132.															
		SK	.			8	30-											
		BLS	98.															
		CO	110.															
		BLS	96.															

Burton 59.32 siphon down — 68M
Upstream from

Much lower flow than 1st trip to Snipes
Good shocking conditions
S15 R25E T9N

WDW 699-B (6-15-93)

LAKE AND STREAM SURVEY FORM

Sample Site Identification

Water Name Snipes Creek Section Name Benton 59.32 Siphon

Township 9. Range 25. E / W (circle one) Section 15 Qtr. Section

Site Specifics

Sample Date 06 16 00 (mn dy yr) International Time 0930 Physiographic Province Stream Habitat Unit Type

Sampler Last Name Cummins/Monk Agency

Comments (weather conditions, flooding, pollution, etc.)

NOT FOR DATA ENTRY

County

Mgmt Unit Code

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. (°C)											
pH											
DO_2 (mg/l)											
Total Alkalinity (mg $CaCO_3$/l)											
TDS (mg/l)											
Conductivity (micromhos/cm)											
Water Clarity (m-lake/JTU-stream)											
Nitrate N_2 (mg/l)											
Total PO_4 (mg/l)											
Ortho PO_4 (mg/l)											
Chlorophyll 'A' (mg/l)											

SURFACE → → → BOTTOM

Other Chemical Measurements Taken:

Length - 68 M 15°C

Water Name Snipes Cr Date 061600 Time 0930 Sampler Name Cummins/Monk Page 1 of 1

BIOLOGICAL DATA

SURVEY TYPE: EF

ELECTRICAL INFORMATION (Frequency: 66)

	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
Pass 1	400		
Pass 2			
Pass 3			
Pass 4			

NET INFORMATION

	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED

Pass/Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Mark Code	Age	Aging Method	Comment Codes
		CO	138.	T			-											
		CO	127.	/			-											
		LRS	103.				-											
		BLS	89.				-											
		CO	112.				-											
		BLS	132.				-											
		SK	.			8	30-											
		BLS	98.				-											
		CO	110.				-											
		BLS	96.				-											

Bottom 59.32 siphon down — 68 M
upstream from

Much lower flow than 1st trip to Snipes
Good shocking conditions
515 R25E T9N

LAKE AND STREAM SURVEY FORM

Sample Site Identification

Water Name: Snipe's Creek
Section Name: Benton 59.32 Siphon

Township 9. Range 25. (E)/ W *(circle one)* Section 15 Qtr. Section

Site Specifics

Sample Date 06/16/00 (mn dy yr) International Time 0930 Physiographic Province Stream Habitat Unit Type

Sampler Last Name: Cummins/Monk
Agency

Comments (weather conditions, flooding, pollution, etc.)

NOT FOR DATA ENTRY
County
Mgmt Unit Code

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. (°C)											
pH											
DO_2 (mg/l)											
Total Alkalinity (mg $CaCO_3$/l)											
TDS (mg/l)											
Conductivity (micromhos/cm)											
Water Clarity (m-lake/JTU-stream)											
Nitrate N_2 (mg/l)											
Total PO_4 (mg/l)											
Ortho PO_4 (mg/l)											
Chlorophyll 'A' (mg/l)											

SURFACE → → → BOTTOM

Other Chemical Measurements Taken:

Length - 68M 15°C

Water Name Snipes Cr Date 061600 Time 0930 Sampler Name Cummins/Monk Page 1 of 1

BIOLOGICAL DATA

SURVEY TYPE: EF

ELECTRICAL INFORMATION

	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
Pass 1	400	66	
Pass 2			
Pass 3			
Pass 4			

NET INFORMATION

	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED

Pass/Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		CO	138.	T			-											
		CO	127.				-											
		LRS	103.				-											
		BLS	89.				-											
		CO	112.				-											
		BLS	132.				-											
		SK	.			8	30-											
		BLS	98.				-											
		CO	110.				-											
		BLS	96.				-											

Burton 59.32 siphon down — 68M
upstream from

Much lower flow than 1st trip to Snipes
Good shocking conditions
S15 R25E T9N

WDW 699-B (6-15-93)

LAKE AND STREAM SURVEY FORM

Sample Site Identification

Water Name Snipe's Creek — Section Name Benton 59.32 Siphon

Township 9. Range 25. (E)/ W (circle one) — Section 15 — Qtr. Section

Site Specifics

Sample Date 06/16/00 (mn dy yr) — International Time 0930 — Physiographic Province — Stream Habitat Unit Type

Sampler Last Name Cummins/Monk — Agency

Comments (weather conditions, flooding, pollution, etc.)

NOT FOR DATA ENTRY
County
Mgmt Unit Code

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. (°C)											
pH											
DO_2 (mg/l)											
Total Alkalinity (mg $CaCO_3$/l)											
TDS (mg/l)											
Conductivity (micromhos/cm)											
Water Clarity (m-lake/JTU-stream)											
Nitrate N_2 (mg/l)											
Total PO_4 (mg/l)											
Ortho PO_4 (mg/l)											
Chlorophyll 'A' (mg/l)											

SURFACE → → → BOTTOM

Other Chemical Measurements Taken:

Length - 68M 15°C

Water Name Snipes Cr Date 061600 Time 0930 Sampler Name Cummins/Monk Page 1 of 1

BIOLOGICAL DATA

SURVEY TYPE EF

ELECTRICAL INFORMATION

	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
Pass 1	400	66	
Pass 2			
Pass 3			
Pass 4			

NET INFORMATION

	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED

Pass/Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		CO	138.	T			-											
		CO	127.				-											
		LRS	103.				-											
		BLS	89.				-											
		CO	112.				-											
		BLS	132.				-											
		SK	.			8	30-											
		BLS	98.				-											
		CO	110.				-											
		BLS	96.				-											

Benton 59.32 Siphon down - 68M
Upstream from

Much lower flow than 1st trip to Snipes
Good shocking conditions
S15 R25E T9N

WDW 699-B (6-15-93)

LAKE AND STREAM SURVEY FORM

Sample Site Identification

Water Name: Snipes Cr #2 | Section Name: Spring Creek Confluence

Township: 09. | Range: 25. | E / W (circle one) | Section: 27 | Qtr. Section: NW

Site Specifics: 67 meter section down from Confluence with Spring Creek.

Sample Date: 05 24 09 (mn dy yr) | International Time: 1139 | Physiographic Province: | Stream Habitat Unit Type:

Sampler Last Name: Cummins/Monk | Agency:

Comments (weather conditions, flooding, pollution, etc.): Near Confluence with Yakima (300m?) + 67 meters below Spring Creek. High velocity, turbid, undercut banks, tall grass on both sides of creek.

NOT FOR DATA ENTRY

County: Benton

Mgmt Unit Code:

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. (°C)											
pH											
DO_2 (mg/l)											
Total Alkalinity (mg $CaCO_3$/l)											
TDS (mg/l)											
Conductivity (micromhos/cm)											
Water Clarity (m-lake/JTU-stream)											
Nitrate N_2 (mg/l)											
Total PO_4 (mg/l)											
Ortho PO_4 (mg/l)											
Chlorophyll 'A' (mg/l)											

SURFACE → → → BOTTOM

Other Chemical Measurements Taken:

Water Name Snipes Cr. #2 Date 052409 Time 1130 Sampler Name Cummins/ Mork. Page 1 of 1

BIOLOGICAL DATA

SURVEY TYPE

EF

ELECTRICAL INFORMATION

	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
Pass 1	400		304
Pass 2			
Pass 3			
Pass 4			

NET INFORMATION

	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH)
Surface (SU)
Bottom (BO)
Midwater (MI)

Mesh Size = E- Experimental (Variable)
or Mesh Size (Stretch)

FISH SAMPLED

Pass/ Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples			Origin	Sex	Mat.	Tag	Marks			Age	Aging Method	Comment Codes
						# of Fish	Length Range	Batch Weight					M1	M2	Mark Code			
		SMB	210.				-									.		
		CO	80.				-									.		
		LNP	40.				-									.		
		CMO	240.				-									.		
		CP	130.				-									.		
		CO	125.				-									.		
		CO	130.				-									.		
		CO	75.				-									.		
		CO	90.				-									.		
		SD	90.				-									.		
		LND	55.				-									.		
		BCS	135.				-									.		
		LNP	55.				-									.		
		SD	55.				-									.		
		LNP	55.				-									.		
		SD	60.				-									.		
		LND	50.				-									.		
		LND	45.				-									.		
			.				-									.		
			.				-									.		
			.				-									.		
			.				-									.		

LAKE AND STREAM SURVEY FORM

Sample Site Identification

Water Name: Snipes Creek #1 Section Name: Railroad Trestle

Township: 9. Range: 24. E / W *(circle one)* Section: 27 Qtr. Section: NW

Site Specifics: Locked gate off Hess Rd down Chandler Canal. Upstream from railroad trestle

Sample Date: 05 24 90 (mn dy yr) International Time: 1020 Physiographic Province: Stream Habitat Unit Type:

Sampler Last Name: Jim Cummins / Pat Monk Agency:

Comments (weather conditions, flooding, pollution, etc.): Shocked from railroad trestle up 84 meters. Block net washed out. High velocity, turbid water. Cohos abundant. No other species

NOT FOR DATA ENTRY

County: Benton

Mgmt Unit Code:

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. *(°C)*											
pH											
DO_2 *(mg/l)*											
Total Alkalinity *(mg $CaCO_3$/l)*											
TDS *(mg/l)*											
Conductivity *(micromhos/cm)*											
Water Clarity *(m-lake/JTU-stream)*											
Nitrate N_2 *(mg/l)*											
Total PO_4 *(mg/l)*											
Ortho PO_4 *(mg/l)*											
Chlorophyll 'A' *(mg/l)*											

SURFACE → → → BOTTOM

Other Chemical Measurements Taken:

Water Name Snipes Cr #1 Date 052489 Time 1020 Sampler Name Cummins/Mark Page 1 of 2

BIOLOGICAL DATA

SURVEY TYPE	ELECTRICAL INFORMATION	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
EF	Pass 1	400		1617
	Pass 2			
	Pass 3			
	Pass 4			

NET INFORMATION	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED

Pass/Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		CO	80.				-		W							.		
		CO	90.				-		↓							.		
		CO	80.				-									.		
		CO	110.				-									.		
		CO	110.				-									.		
		CO	100.				-									.		
		CO	85.				-									.		
		CO	—.				-									.		
		CO	80.				-									.		
		CO	100.				-									.		
		CO	—.				-									.		
		CO	75.				-									.		
		CO	120.				-									.		
		CO	100.				-									.		
		CO	—.				-									.		
		CO	90.				-									.		
		CO	100.				-									.		
		CO	100.				-									.		
		CO	75.				-									.		
		CO	75.				-									.		
		CO	75.				-									.		
		CO	85.				-		↓							.		

Water Name Swipes #1 Date 052400 Time 1020 Sampler Name Cummins/Monk Page 2 of 2

BIOLOGICAL DATA

SURVEY TYPE	ELECTRICAL INFORMATION	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
EF	Pass 1	400		1617
	Pass 2			
	Pass 3			
	Pass 4			

NET INFORMATION	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED

Pass/ Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		CO	80.				-									.		
		CO	85.				-									.		
		CO	85.				-									.		
		CO	-.				-									.		
			.				-									.		
			.				-									.		
			.				-									.		
			.				-									.		
			.				-									.		
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			.				-									.		
			.				-									.		
			.				-									.		

LAKE AND STREAM SURVEY FORM

Sample Site Identification

Water Name Snipes Creek #1 Section Name Railroad Trestle

Township 9. Range 24. E / W *(circle one)* Section 27 Qtr. Section NW

Site Specifics Locked gate off Hess Rd down Chandler Canal. Upstream from railroad trestle

Sample Date 05 24 90 (mn dy yr) International Time 1020 Physiographic Province Stream Habitat Unit Type

Sampler Last Name Jim Cummins / Pat Monk Agency

Comments (weather conditions, flooding, pollution, etc.) Shocked from railroad trestle up 84 meters. Block net washed out. High velocity, turbid water. Cohos abundant. No other species

NOT FOR DATA ENTRY
County Benton
Mgmt Unit Code

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. *(°C)*											
pH											
DO_2 *(mg/l)*											
Total Alkalinity *(mg $CaCO_3$/l)*											
TDS *(mg/l)*											
Conductivity *(micromhos/cm)*											
Water Clarity *(m-lake/JTU-stream)*											
Nitrate N_2 *(mg/l)*											
Total PO_4 *(mg/l)*											
Ortho PO_4 *(mg/l)*											
Chlorophyll 'A' *(mg/l)*											

SURFACE ⟶ ⟶ ⟶ BOTTOM

Other Chemical Measurements Taken:

Water Name Snipes Cr #1 Date 052489 Time 1020 Sampler Name Cummins/Mark Page 1 of 2

BIOLOGICAL DATA

SURVEY TYPE	ELECTRICAL INFORMATION	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
EF	Pass 1	400		1617
	Pass 2			
	Pass 3			
	Pass 4			

NET INFORMATION	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH)
Surface (SU)
Bottom (BO)
Midwater (MI)

Mesh Size = E- Experimental (Variable)
or Mesh Size (Stretch)

FISH SAMPLED

Pass/ Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		CO	80.				-		W							.		
		CO	90.				-									.		
		CO	80.				-									.		
		CO	110.				-									.		
		CO	110.				-									.		
		CO	100.				-									.		
		CO	85.				-									.		
		CO	[illegible]				-									.		
		CO	80.				-									.		
		CO	100.				-									.		
		CO	[illegible]				-									.		
		CO	75.				-									.		
		CO	120.				-									.		
		CO	100.				-									.		
		CO	[illegible]				-									.		
		CO	90.				-									.		
		CO	100.				-									.		
		CO	100.				-									.		
		CO	75.				-									.		
		CO	75.				-									.		
		CO	75.				-									.		
		CO	85.				-									.		

Water Name Snipes #1 Date 052400 Time 1020 Sampler Name Cummins/Monk Page 2 of 2

BIOLOGICAL DATA

SURVEY TYPE: EF

ELECTRICAL INFORMATION

	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
Pass 1	400		1617
Pass 2			
Pass 3			
Pass 4			

NET INFORMATION

	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED

Pass/ Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		CO	86.				-											
		CO	85.				-											
		CO	85.				-											
		CO	7.				-											

WDW 699-B (6-15-93)

1 Rs at this site

SVID Map #10

LAKE AND STREAM SURVEY FORM

Sample Site Identification

Water Name JD 43.9 Section Name Bethany Rd

Township 19 Range 23 E / W *(circle one)* Section 10 Qtr. Section

Site Specifics From Bethany Rd down 44 meters

Sample Date 08 08 06 (mn dy yr) International Time Physiographic Province Stream Habitat Unit Type

NOT FOR DATA ENTRY

County

Mgmt Unit Code

Sampler Last Name Monk, Cummins, Brady, Jason Agency WDF SVID

Comments (weather conditions, flooding, pollution, etc.) bright & warm. low & clear

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. (°C)											
pH											
DO, *(mg/l)*											
Total Alkalinity *(mg CaCO₃/l)*											
TDS *(mg/l)*											
Conductivity *(micromhos/cm)*											
Water Clarity *(m-lake/JTU-stream)*											
Nitrate N_2 *(mg/l)*											
Total PO_4 *(mg/l)*											
Ortho PO_4 *(mg/l)*											
Chlorophyll 'A' *(mg/l)*											

SURFACE → → → BOTTOM

Other Chemical Measurements Taken:

WDW 699-A (8-30-93)

Bo
LCD
INSTREAM
Water Disch

Name ______ Date ______ Time ______ Sampler Name ______ Page 2 of 2

BIOLOGICAL DATA

SURVEY TYPE: EF

ELECTRICAL INFORMATION

	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
Pass 1			
Pass 2			
Pass 3			
Pass 4			

NET INFORMATION

	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)		108		-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

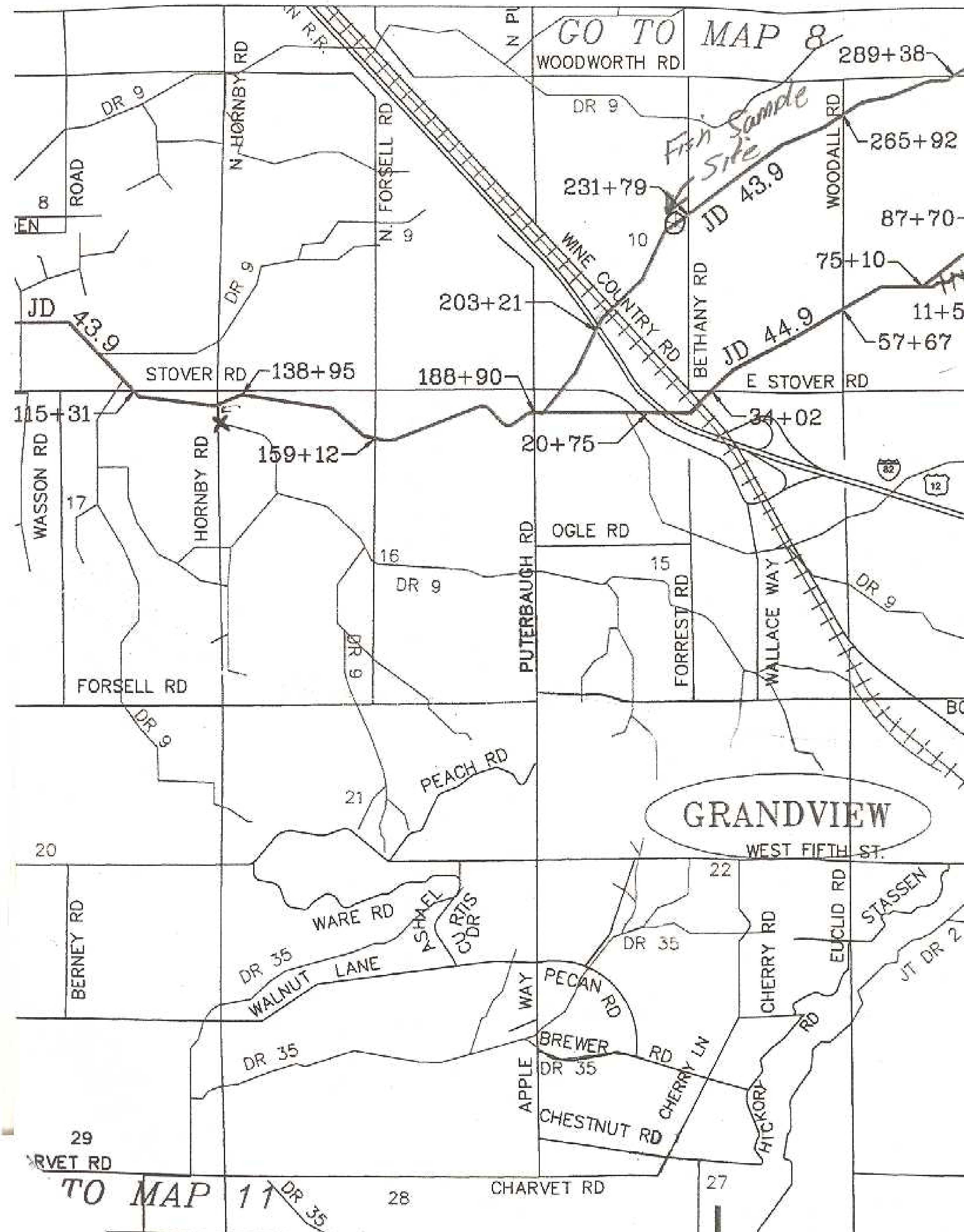
Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED

Pass/Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		BRS	116.				-											
	10	SD				10	-											
	4	SD				4	-											
							-											
		SD				47	-											
		Rb	13.4				-											

electrofish

WDW 699-B (6-15-93)


GO TO MAP 8
WOODWORTH RD
289+38
265+92
Fish Sample Site
231+79
JD 43.9
WOODALL RD
87+70
10
75+10
11+5
57+67
JD 44.9
203+21
WINE COUNTRY RD
BETHANY RD
E STOVER RD
188+90
34+02
20+75
JD 43.9
STOVER RD
138+95
115+31
159+12
DR 9
N HORNBY RD
N FORSELL RD
ROAD
8
WASSON RD
HORNBY RD
17
16
OGLE RD
15
DR 9
PUTERBAUGH RD
FORREST RD
WALLACE WAY
FORSELL RD
PEACH RD
21
GRANDVIEW
WEST FIFTH ST.
20
22
BERNEY RD
WARE RD
ASHAEL
CURTIS DR
DR 35
WALNUT LANE
PECAN RD
WAY
CHERRY RD
EUCLID RD
STASSEN
JT DR 2
BREWER RD
APPLE
CHERRY LN
HICKORY RD
CHESTNUT RD
29
CHARVET RD
TO MAP 11
28
27
CHARVET RD

1 Rs at this site

SVID Map #10

LAKE AND STREAM SURVEY FORM

Sample Site Identification

Water Name JD 43.9 Section Name Bethany Rd

Township 19 Range 2 E / W (circle one) Section 10 Qtr. Section

Site Specifics From Bethany Rd down 44 meters

Sample Date 08 08 06 (mn dy yr) International Time Physiographic Province Stream Habitat Unit Type

NOT FOR DATA ENTRY

County

Mgmt Unit Code

Sampler Last Name Monk, Cummins, Brady, Jason Agency WDF SVID

Comments (weather conditions, flooding, pollution, etc.) bright & warm. low & clear

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. (°C)											
pH											
DO_2 (mg/l)											
Total Alkalinity (mg $CaCO_3$/l)											
TDS (mg/l)											
Conductivity (micromhos/cm)											
Water Clarity (m-lake/JTU-stream)											
Nitrate N_2 (mg/l)											
Total PO_4 (mg/l)											
Ortho PO_4 (mg/l)											
Chlorophyll 'A' (mg/l)											

SURFACE → → → BOTTOM

Other Chemical Measurements Taken:

WDW 699-A (8-30-93)

Name ______ Date ______ Time ______ Sampler Name ______

BIOLOGICAL DATA

SURVEY TYPE

EF

ELECTRICAL INFORMATION

	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
Pass 1			
Pass 2			
Pass 3			
Pass 4			

NET INFORMATION

	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)		108		-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

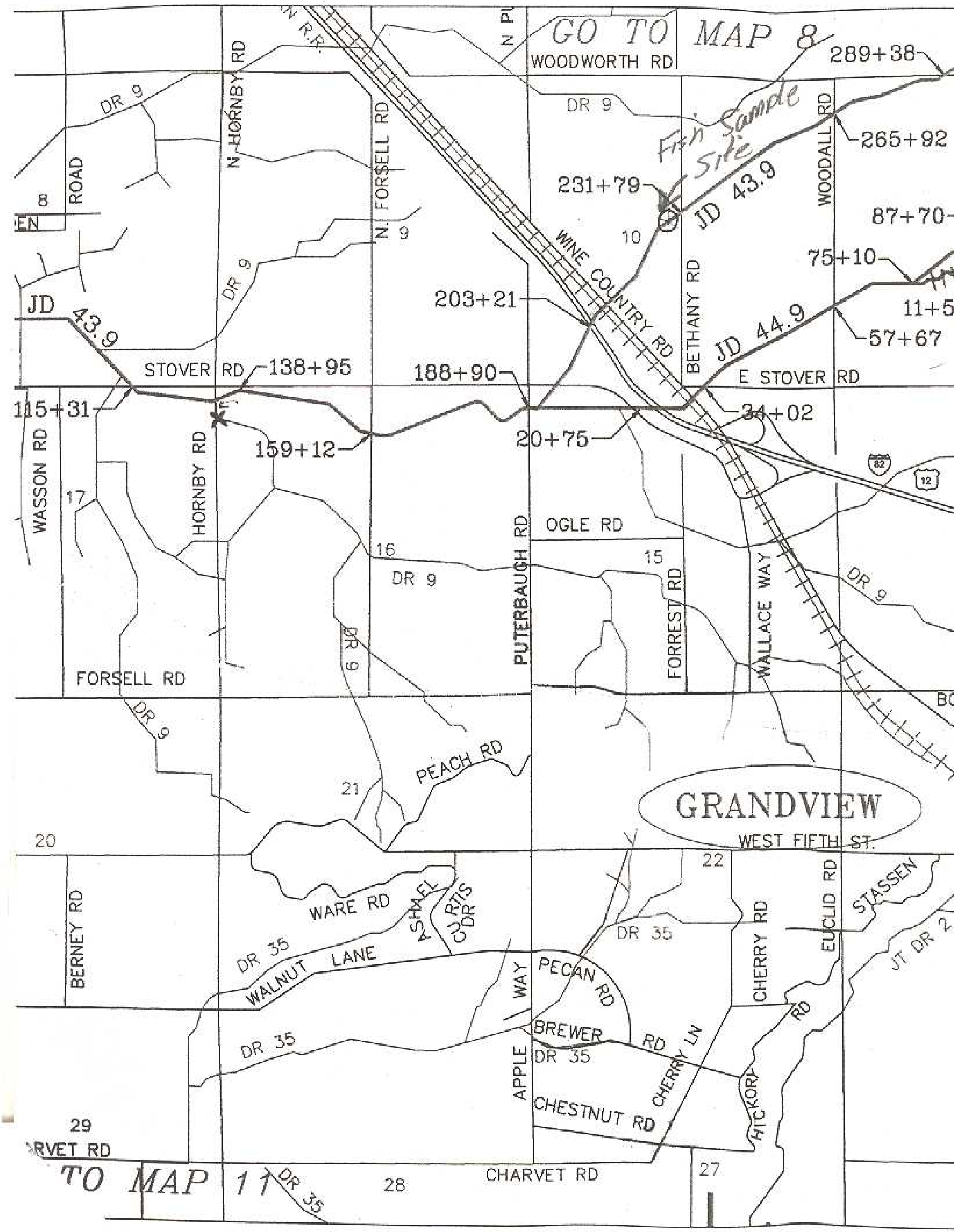
Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

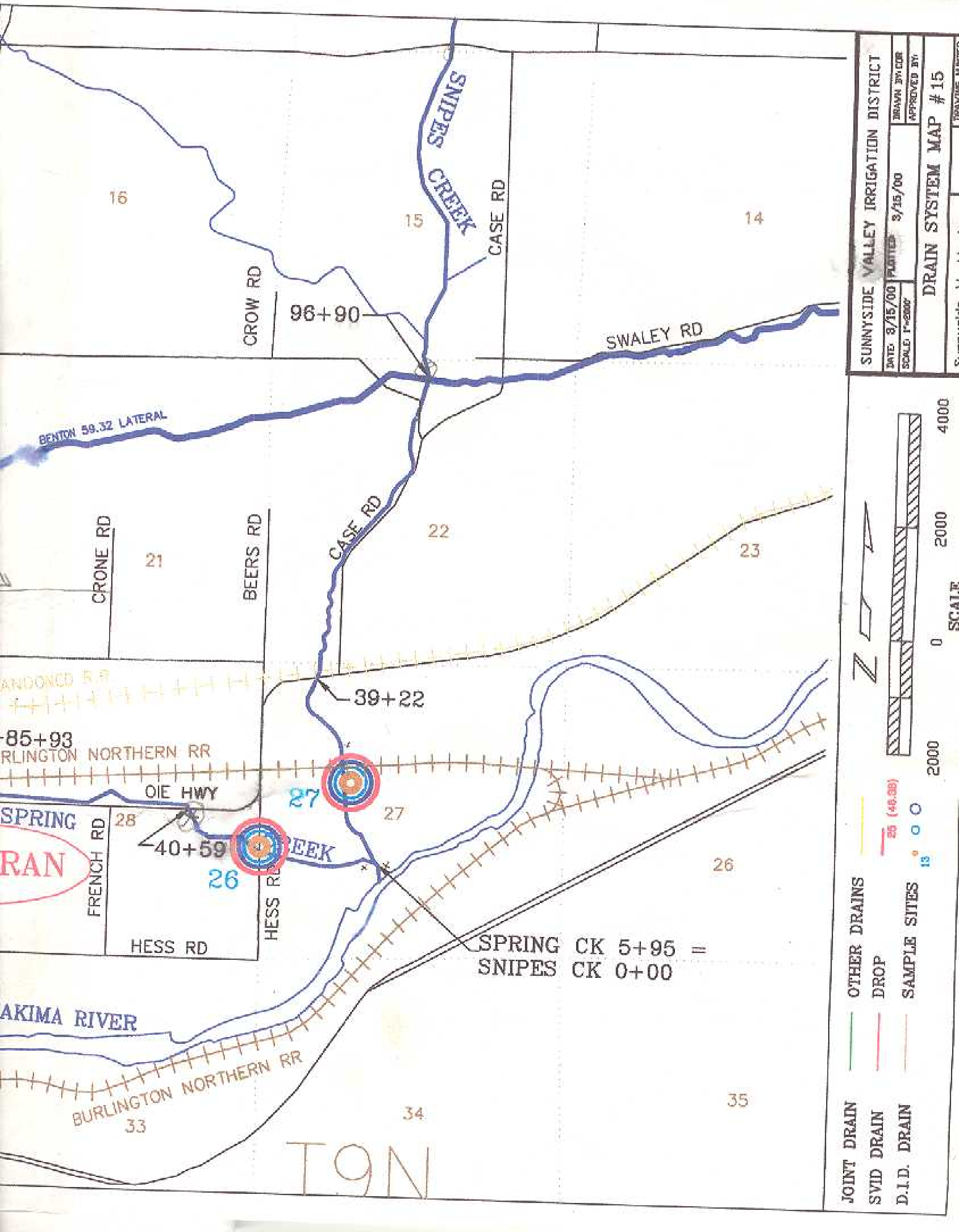
FISH SAMPLED

Pass/Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		BRS	116.				-											
	10	SD.				10	-											
	4	SD				4	-											
							-											
		SD				47	-											
		Rb	13.4				-											

electrofish

WDW 699-B (6-15-93)


GO TO MAP 8
WOODWORTH RD
289+38
DR 9
Fish Sample Site
265+92
WOODALL RD
N HORNBY RD
N FORSELL RD
ROAD
8
231+79
JD 43.9
10
87+70
75+10
WINE COUNTRY RD
BETHANY RD
N 9
DR 9
JD
43.9
203+21
11+5
JD 44.9
57+67
STOVER RD
138+95
188+90
E STOVER RD
115+31
34+02
20+75
159+12
WASSON RD
HORNBY RD
17
PUTERBAUGH RD
OGLE RD
16
15
DR 9
FORREST RD
WALLACE WAY
FORSELL RD
BO
PEACH RD
21
GRANDVIEW
WEST FIFTH ST.
20
22
BERNEY RD
WARE RD
ASHAEL
CURTIS DR
EUCLID RD
STASSEN
CHERRY RD
DR 35
JT DR 2
DR 35
WALNUT LANE
WAY
PECAN RD
RD
DR 35
BREWER RD
APPLE
DR 35
CHERRY LN
HICKORY
CHESTNUT RD
29
RVET RD
TO MAP 11
DR 35
28
CHARVET RD
27



SUNNYSIDE VALLEY IRRIGATION DISTRICT
DRAIN SYSTEM MAP #15
DATE: 3/15/00
PLOTTED 3/15/00
SNIPES CREEK
CASE RD
CROW RD
96+90
SWALEY RD
BENTON 59.32 LATERAL
CRONE RD
BEERS RD
39+22
85+93
BURLINGTON NORTHERN RR
OIE HWY
SPRING
CREEK
RAN
FRENCH RD
HESS RD
40+59
SPRING CK 5+95 =
SNIPES CK 0+00
YAKIMA RIVER
T9N
16
15
14
21
22
23
28
27
26
33
34
35
JOINT DRAIN
SVID DRAIN
D.I.D. DRAIN
OTHER DRAINS
DROP
SAMPLE SITES
SCALE
2000
0
2000
4000

Washington Department of Fish and Wildlife

Region 3 • District 4 • 2620 N. Commercial Ave • Pasco WA 99301
Phone: 509-545-2284 • Fax 509-545-2236 • E-mail: hoffaph@dfw.wa.gov

November 16, 2005

From: Paul A. Hoffarth, District 4 Fish Biologist

Subject: Snipes, Spring, and Corral Creek Redd Surveys

I conducted spawning surveys in Snipes, Spring, Corral, and Amon Creeks on November 16, 2005.
The results are summarized in the table below.

Location	Redds	Live Fish	Carcass	Comments
Snipes/Spring	7	3	1	Live fish and carcass appeared to be coho
Snipes Creek	0	0	0	Surveyed up to train trestle (lower ½ mile)
Spring Creek	23	4	2	Surveyed up to Hess Rd (barrier culvert) live fish were likely 2 coho, 2 fall chinook; carcass appeared to be coho
Corral Creek	0	0	0	Lower 200yds, heavily vegetated
Amon Creek	0	0	0	Un-watered wasteway arm

There are two waterfalls in Spring Creek that I do not recall from prior surveys. At least one or both of them may be man-made. Both are approximately 3 feet in height. Redds were found above both so apparently they are not passage barriers. One of the 23 redds in Spring Creek was unwatered indicating that it was likely formed prior to irrigation shut down.

Spring Creek and Corral Creek had good flow with water temperature of 9ºC in Spring/Snipes and 11ºC in Corral. Snipes Creek had relatively low flow, guessing at 1-3 cfs.

The unwatered arm of Amon Creek that has no natural flow (flow is supplied by irrigation wastewater) is a nightmare. Large amounts of debris - tires, pallets, appliances, trash. My main concern is the off-roading that has and is occurring in the streambed. The channel is completely destroyed in many areas. When the irrigation comes back on in the Spring there will be multiple channels and large amounts of sediment deposited downstream and into the Yakima River.

Spring Creek and Snipes Creek combine into one channel at the confluence with the Yakima River. This lower combined section of these streams is less than 50 meters in length. This section is labeled Snipes/Spring in the table above.

Washington Department of Fish and Wildlife

District 4 • 3030 W. Clearwater Ave Suite 115 • Kennewick, WA 99336
Phone: 509-734-7434 • Fax: 509-734-7102 • E-mail: hoffaph@dfw.wa.gov

October 22, 2001

From: Paul A. Hoffarth, District 4 Fish Biologist

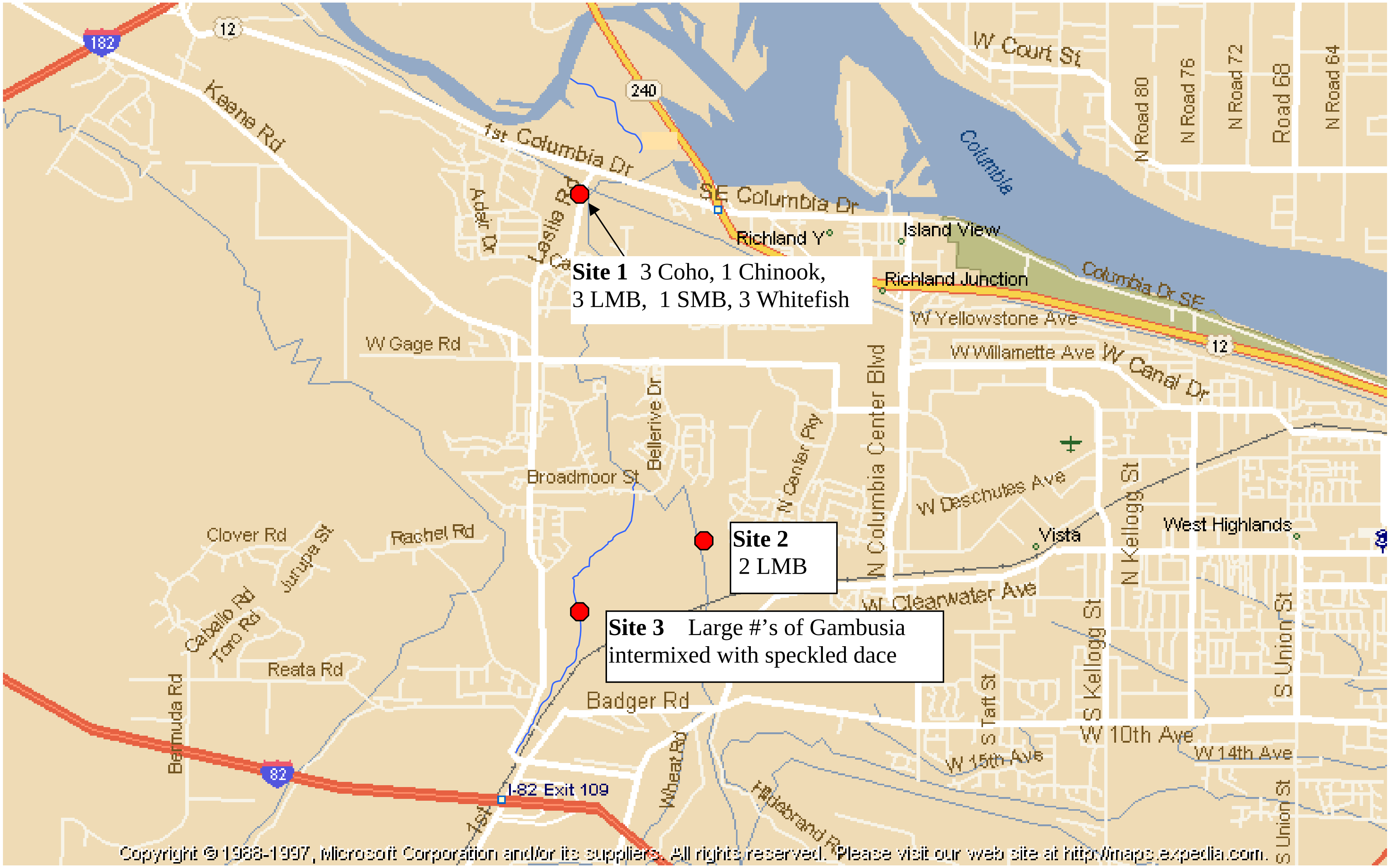
To:

Subject: Amon Creek Coho

Paul LaRiviere documented 2 adult coho in Amon Creek in the golf course.

Amon Creek Survey July 18, 2001

Site 1: Coho were ~70–85mm, Chinook ~ 90mm, LMB ~ 75-100mm, SMB ~180mm, MWF ~ 100-120mm
Site 2: LMB ~ 50mm
Site 3: Gambusia ~ 15-50mm, Dace ~ 30-40mm



From Jim Cummins

Yesterday, March 8, 2001 Pat Monk, Paul Hoffarth, and I electroshocked several sections of Snipes and Spring Creeks. Here are some highlights.

Both Creeks were very low and clear.

We captured and measured about 41, 35-43 cm coho fry in the lower ends of Snipes and Spring Creeks. All the fry were buttoned up, but have recently left the gravel. No coho or fish were found above immediately Hess Road. We found several juvenile SMB and one Rb, 21.5 cm in this area on Spring Creek. In addition we observed but did not capture one brown trout just below Hess Rd on Spring Creek, that was about 25-30 cm.

In Snipes Creek at and above the Benton lateral we sampled 10 coho yearlings, 13.7-16.4 cm, indicating that these fish survived the summer. We also found several juvenile black crappie and a spawned out male rainbow trout (23 cm).

About 175 meters above the Benton lateral is a beaver pond. The dam is about 6-7 feet high. This is the first of several ponds. There may be more than an acre of water ponded here. Beaver are very active. We saw a muskrat, and 35-40 mallard ducks. We did not walk all the way upstream to look at all the ponds. There is one trout or steelhead redd just above the Inland Empire Highway on Snipes.

Pat Monk recently walked Snipes Creek to look for steelhead redds, and my understanding is that this redd, likely a rainbow redd, is the only one he has found. Maybe he or someone else found a redd on Spring Creek.

We will check Sulphur Creek for coho fry survival next week.

We sampled one other area above this point, put only found bridgelip sucker.

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Pat Monk recently walked Snipes Creek to look for steelhead redds, and my understanding is that this redd, likely a rainbow redd, is the only one he has found. Maybe he or someone else found a redd on Spring Creek.

We will check Sulphur Creek for coho fry survival next week.

We sampled one other area above this point, put only found bridgelip sucker.

Water Name: Snipes Creek (above Benton Lateral - Case Road) Date: 030801 Time: 1330 Sampler Name: Cummins/Monk/Hoffarth Page ___ of ___

BIOLOGICAL DATA

SURVEY TYPE: EF

ELECTRICAL INFORMATION

	Volts	Frequency (pulses/sec)	Elapsed Time (h/mm)
Pass 1	250	175	
Pass 2			
Pass 3			
Pass 4			

NET INFORMATION

	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED The time meter was not working.

Pass/Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	# of Fish	Length Range	Batch Weight	Origin	Sex	Mat.	Tag	M1	M2	Mark Code	Age	Aging Method	Comment Codes
		CO	16.0															
		CO	16.2															
		CO	13.7															
		CO	14.5															
		CO	14.1															
		CO	15.9															
		CO	16.4															
		CO	17.0															
		CO	14.6															
		CO	14.1															
		CO																
		RS	13.0		Ripe male - lower caudal worn off.													
		CM	11.5															
		BC	8.5															
		BC	8.5															
		BRS	8.6															
		BRS	7.3															
		BRS	9.4															
		BRS	7.0															
		BRS	7.6															
		BRS	7.5															
		BRS	6.8															

(The CO entries are bracketed together:) all fish that should smolt this spring. Noteworthy that these fish evidently spent the summer in Snipes Creek. Also, no Coho fry found in this season. No Coho redds were found here last fall - but some were found 1+ KM down stream.

Note: - We stopped shocking at the first of lower of a series of large 6-7' high beaver dams. I saw 13 dams but [illegible] indicated that there were more! - several acres of water.

WDW 690-B (6-15-93) S22 T-9N R-25 Shocked 172 meters (?) above Benton Lateral.

Over

Water Name Spring Creek Below Hess Rd Culvert Date 03 08 01 Time 1100 Sampler Name Cummins, Monk, Hallock Page 1 of 1

BIOLOGICAL DATA

SURVEY TYPE: EF

ELECTRICAL INFORMATION

	Volts	Frequency (pulses/sec)	Elapsed Time (hh:mm)
Pass 1	200	25	365
Pass 2			
Pass 3			
Pass 4			

NET INFORMATION

	Mesh Size	Elapsed Time (hh:mm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED Elapsed time may not be correct: timer not working?

Pass/Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Length Range	Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	M2	Mark Code	Age	Aging Method	Comment Codes
		CP	4.3	TL														
		CP	3.8															
		Cb	4.3															
		Clo	4.0															
		Rb	21.5															

Rb 21.5 → we saw this fish before we shocked it, but did not see any redds

Observed but did not capture 1 Bt about 25+30 cm

55 Meters S27 T9N, R25E

Spring Ck above Chandler (Hess Rd.)

No fish

The time meter is not working (114 Meters)

No redds - Steelhead or trout from Yakima R to upstream above Chandler Cannel

S-26, T9N, R25E

WDW 699-B (6-15-93)

LAKE AND STREAM SURVEY FORM

Sample Site Identification

Water Name: Spring Creek
Section Name: Mouth - up 91 M

Township: 09. Range: 25. E / W *(circle one)* Section: 27 Qtr. Section: SW

Site Specifics: Mouth up to pump

Sample Date: 052409 (mn dy yr) International Time: 1219 Physiographic Province: Stream Habitat Unit Type:

Sampler Last Name: Cummins/Monk Agency:

Comments (weather conditions, flooding, pollution, etc.): Turbid, high, but fishable, fast flowing, undercut grass banks - No trees in riparian zone.

NOT FOR DATA ENTRY

County: Benton

Mgmt Unit Code:

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. (°C)											
pH											
DO_2 *(mg/l)*											
Total Alkalinity *(mg $CaCO_3$/l)*											
TDS *(mg/l)*											
Conductivity *(micromhos/cm)*											
Water Clarity *(m-lake/JTU-stream)*											
Nitrate N_2 *(mg/l)*											
Total PO_4 *(mg/l)*											
Ortho PO_4 *(mg/l)*											
Chlorophyll 'A' *(mg/l)*											

SURFACE → → → BOTTOM

Other Chemical Measurements Taken:

WDW 599-A (8-30-93)

Water Name Spring Creek Date 05 24 00 Time 1210 Sampler Name Cummins / Monk Page 1 of 1

BIOLOGICAL DATA

SURVEY TYPE

EF

ELECTRICAL INFORMATION

	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
Pass 1	400		847
Pass 2			
Pass 3			
Pass 4			

NET INFORMATION

	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH)
Surface (SU)
Bottom (BO)
Midwater (MI)

Mesh Size = E- Experimental (Variable)
or Mesh Size (Stretch)

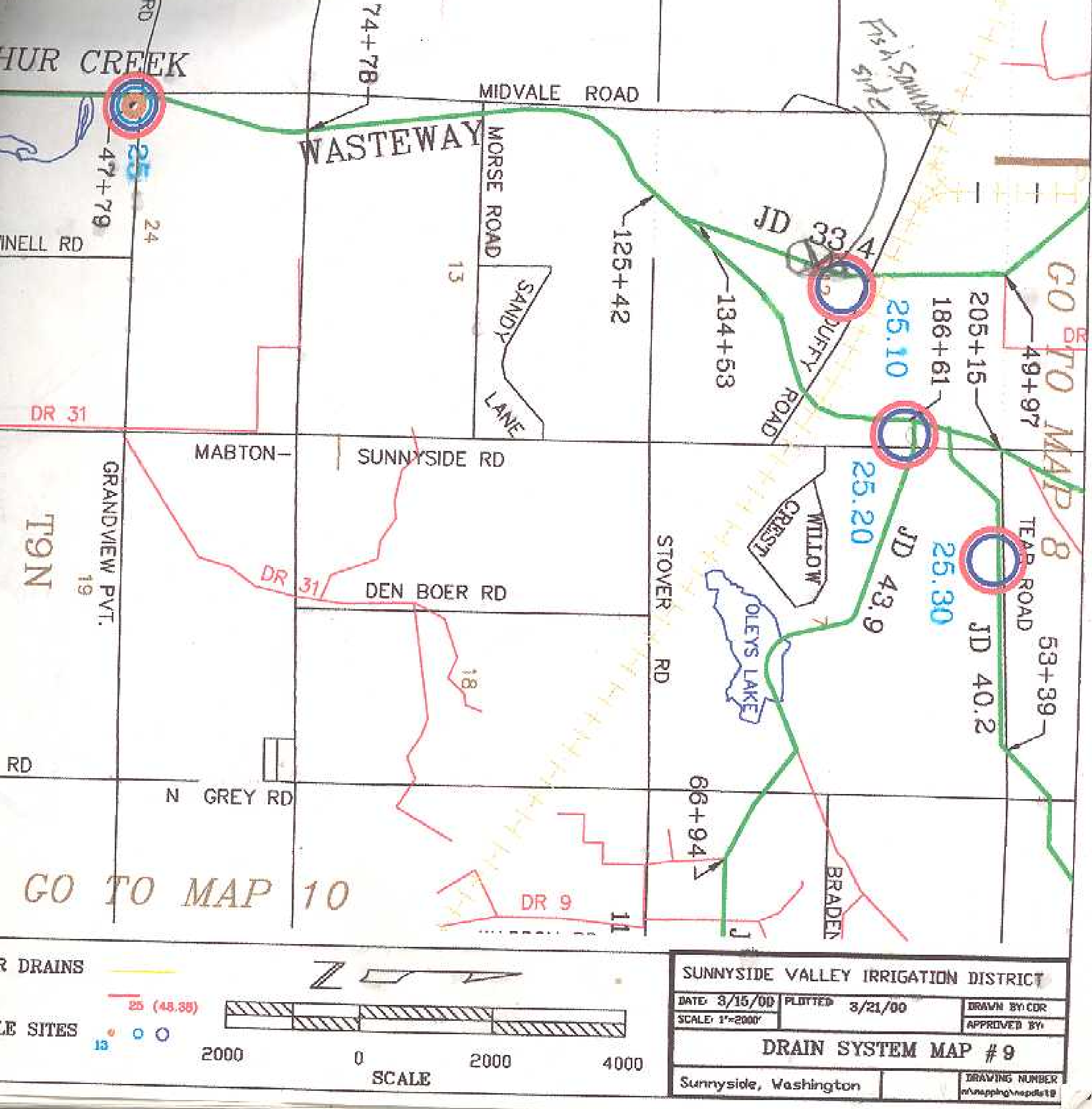
FISH SAMPLED

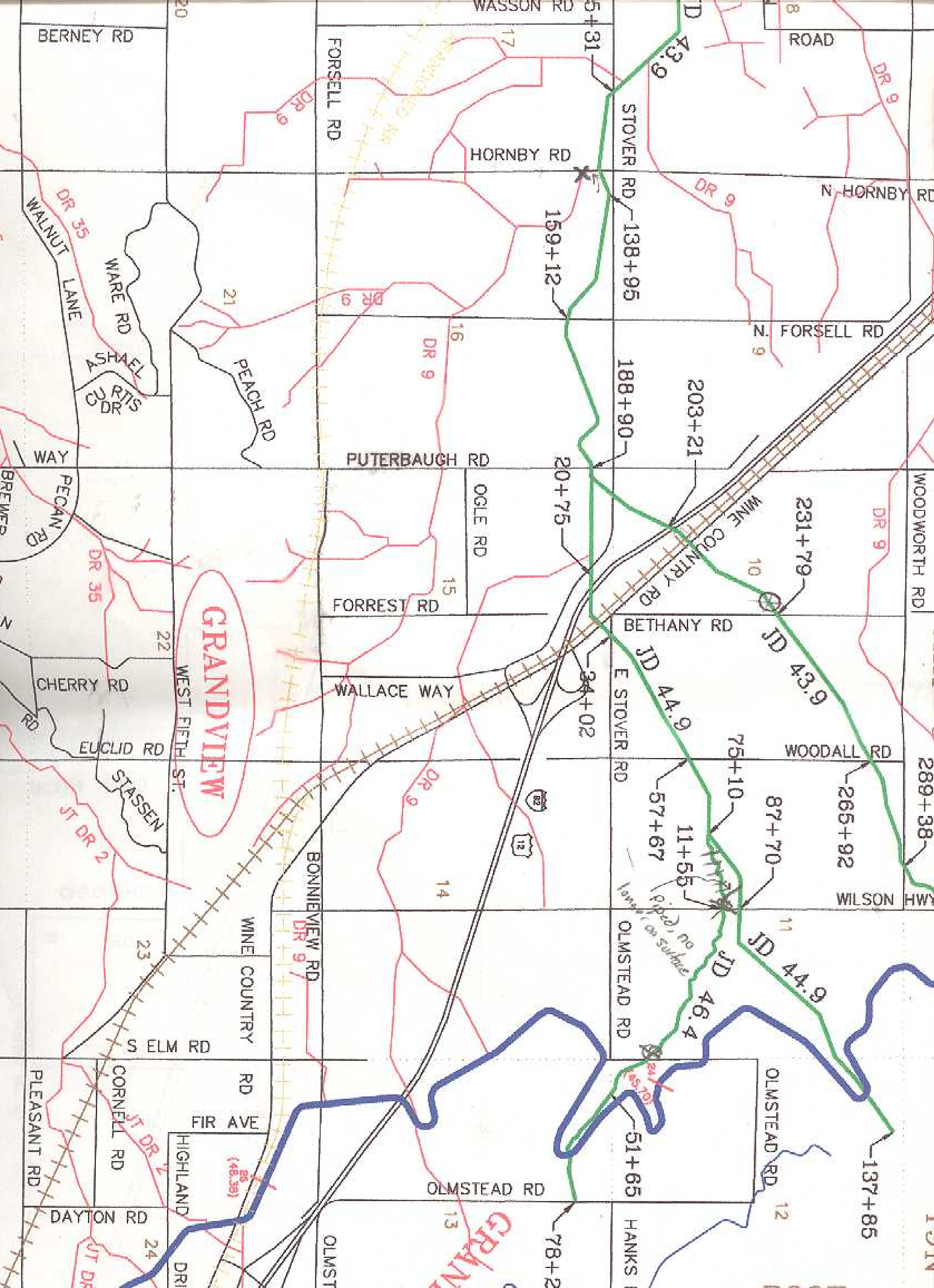
Pass/ Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		BRS	390.				-									.		
		NSF	290.				-									.		
		CO	125.				-									.		
		NSF	220.				-									.		
		SMB	150.				-									.		
		CO	125.				-									.		
		CO	135.				-									.		
		SMB	165.				-									.		
		CO	120.				-									.		
		CO	120.				-									.		
		CO	100.				-									.		
		SO	90.				-									.		
		CO	85.				-									.		
	?	TR	28.				-									.		
		~~TR~~	.				-									.		

WDW 699-B (6-15-93)

2006

Snipes	RR Trestle	5/24	48 Co.
Snipes	Spring Cr. Confluence	5/24	6 Co LND, SD, BRS, SMB, [illegible]
Spring Cr.	Mouth	5/24	7 Co 2 RS/SH, SMB, NSF BRS
Spring Cr	Hess Rd	5/24	No fish
Snipes	Wasteway #8	5/24	Sucker fry?
JD 43.9	Morton Wasteway	6/14	BRS, NSF, PS (Confluence Sifter[illegible]
JD 35.4	Allen Rd	6/14	No fish
DR 9	Hornby Rd	6/14	SP, RS lots
JD 43.9	I82	6/14	1 Rb, RS, SP, Leopard Dace?
JD 40.2	Braden	6/14	BRS, NSF, LRS,
JD 40.2	Wanetta R	6/14	LSD, BLS, SP, PS, CP lots
Snipes	Benton 59.32 Siphon	6/16	4 CO, LRS, BLS, SK,
Snipes	RR Trestle	6/16	4 CO, 1 SMB
Snipes	Hanks Rd	6/16	1 CO 1 SK
JD 52.8	Wamba	6/16	SD moderate


HUR CREEK
WASTEWAY
MIDVALE ROAD
MORSE ROAD
74+78
47+79
25
24
13
INELL RD
125+42
134+53
JD 33.4
DUFFY ROAD
SANDY LANE
25.10
186+61
205+15
49+97
GO TO MAP 8
DR
DR 31
MABTON-SUNNYSIDE RD
GRANDVIEW PVT.
19
T9N
DR 31
DEN BOER RD
18
STOVER RD
CREST
WILLOW
OLEYS LAKE
25.20
JD 43.9
25.30
TEAR ROAD
JD 40.2
53+39
RD
N GREY RD
66+94
BRADEN
GO TO MAP 10
DR 9
11
R DRAINS
25 (48.38)
LE SITES
13
2000
0
2000
4000
SCALE
SUNNYSIDE VALLEY IRRIGATION DISTRICT
DATE: 3/15/00
PLOTTED 3/21/00
DRAWN BY: CDR
SCALE: 1"=2000'
APPROVED BY:
DRAIN SYSTEM MAP # 9
Sunnyside, Washington
DRAWING NUMBER



WASSON RD
BERNEY RD
ROAD
FORSELL RD
STOVER RD
HORNBY RD
N. HORNBY RD
DR 9
DR 35
WALNUT LANE
WARE RD
ASHAEL
CURTIS DR
PEACH RD
N. FORSELL RD
PUTERBAUGH RD
WAY
PECAN RD
BREWER
OGLE RD
WOODWORTH RD
WINE COUNTRY RD
FORREST RD
BETHANY RD
GRANDVIEW
CHERRY RD
WEST FIFTH ST.
WALLACE WAY
EUCLID RD
E STOVER RD
WOODALL RD
STASSEN
JT DR 2
BONNIEVIEW RD
WILSON HWY
OLMSTEAD RD
S ELM RD
PLEASANT RD
CORNELL RD
FIR AVE
HIGHLAND
DAYTON RD
HANKS
JD 43.9
JD 44.9
JD 46.4
5+31
138+95
159+12
188+90
203+21
20+75
231+79
34+02
75+10
57+67
11+55
87+70
265+92
289+38
51+65
78+2
137+85
17
20
21
16
15
22
14
13
12
11
10
9
8
23
24
(45.70)
(48.38)

From: James L. Cummins
To: "patrickm@ellensburg.com"@GWDFW.SMTP
Date: Thu, Mar 15, 2001 4:09 PM
Subject: Sulphur Creek Survey

Today, March 15, 2001 Jim Cummins, Pat Hoffarth, Steve Croci and Gary Toretta electroshocked Sulphur Creek and two drains. Following is a brief summary. Except for JD 40.2 which was 100 M, each section was 200 M long.

JD 33.4 @ Duffy Road. No salmonids. Large numbers of chiselmouth, numerous Northern pike minnow, and a few smallmouth, bridgelip sucker, carp, redside shiner, and speckled dace. High density of fish.

JD 40.2 @ Tear Road. few fish and no salmonids. chiselmouth and bridgelip suckers. Very low fish density.

Sulphur Creek @ Allen Road No salmonids. Number of smallmouth bass, Northern pike minnow, bridgelip suckers, few chiselmouth, mountain suckers and speckled dace. Moderately low fish density.

Sulphur Creek @ Sheller Road. 3 coho 7.4, 16.2 and 4.9 cm. Three or four coho fry were observed but not captured. Two adult steelhead - not shocked, but observed right at Sheller Road. Few Northern pike minnow and speckled dace. Moderately low fish density.

Considering the number of coho that spawned in Sulphur Creek, coho production is very low. On the other hand, a yearling pre-smolt coho either indicates that coho survive the summer, or that fish move into Sulphur Creek and over-winter.

Sulphur Creek gravel is compacted and most is covered with a layer of silt. Also, the two drains have very little gravel and heavy deposits of silt.

Jim Cummins, Fish Biologist
Washington Department of Fish & Wildlife
1701 South 24th Ave.
Yakima, WA 98902
(509) 457-9316
cummijlc@dfw.wa.gov

CC: Eric Anderson; John Easterbrooks

Below Shetler Rd 200 M T-10N, R23E, S30

Water Name: Sulpher Ck Date: 03/15/91 Time: 1255 Sampler Name: Cummins, Hallock, Cross, Tonk Page 1 of 1

BIOLOGICAL DATA

SURVEY TYPE	ELECTRICAL INFORMATION	Volts	Frequency (pulses/sec)	Elapsed Time (hh:mm)	NET INFORMATION	Mesh Size	Elapsed Time (hh:mm)	Set Location	Depth Range (m)
EF	Pass 1	150	75		1)				-
	Pass 2				2)				-
	Pass 3				3)				-
	Pass 4				4)				-

Set Location = Shore (SH), Surface (SU), Bottom (BO), Midwater (MI)

Mesh Size = E- Experimental (Variable) or Mesh Size (Stretch)

FISH SAMPLED

Pass/Net #	Fish Sample #	Species Code	Length (cm)	Type	Wgt. (gm)	Batch Samples: # of Fish	Batch Samples: Length Range	Batch Samples: Batch Weight	Origin	Sex	Mat.	Tag	Marks: M1	Marks: M2	Marks: Mark Code	Age	Aging Method	Comment Codes
		NSF	15.8	TL			-											
		NSF	14.2				-											
		NSF	12.8				-											
		NSF	14.4				-											
		CO	16.2				-											
		CO	7.4				-											
		SD	7.1				-											
		SD	7.2				-											
		SD	6.1				-											
		SD	6.5				-											
		SD	5.7				-											
		SD	5.8				-											
		SD	5.3				-											
		SD	5.9				-											
		SD	4.5				-											
		CO	4.9				-											

Flow may be less than 1 cfs at Shetler road. A drain near the lower end of the sampled section may be adding 1 cfs. Much of the gravel that was cleaned by spawning coho is silted in.

Shocked 200M from Shetler Rd down. Very low flow. Clear.

2 adult Steelhead at Shetler road; 1 on left side, another on right side of channel separated by concrete flume

From: James L. Cummins
To: John Easterbrooks
Date: Wed, Oct 25, 2000 2:47 PM
Subject: Suphur Creek

Today Pat Monk and several RID, SVID employees, and I walked Sulphur Creek from Tear Road to Sheller Road.

Although all fish ID of live fish was not 100% certain, all of the carcasses were coho. Here are results of our survey.

Redds - 58
Carcasses - 27 coho
Live Salmon - 148 + (I didn't get Pat's live salmon count)

I will firm up this data with Pat, and get his live fish count.

In addition, the Yakama Nation captured and transported 56 coho back to the river near Granger. I talked to several tribal employees and they all agreed that the fish were coho. I didn't see the fish that they took. They were done about the time we reached Sheller Road.

I don't believe that there are steelhead or fall chinook in that part of Suphur Creek that we surveyed. If I understood correctly, three radio tagged coho were in Sulphur Creek. One was captured and transported to the Yakima and two remain. Someone else mentioned that there might have been 7 tagged coho in Sulphur Creek, but I think three is the correct number.

Irrigation district employees report that there are fish below where we surveyed, all the way to the Yakima.

CC: Eric Anderson

12/06/83

STATE OF WASHINGTON

THE DEPARTMENT OF WILDLIFE

Drainage ditch off Sulfur Creek near Sunnyside had fuel oil spill; reported fish kill.

Site of spill : Right off Hwy 241 (Van Belle Rd.) approx. 1 mile, drainage ditch which flows into Sulfur Creek ; diesel fuel spill from Van Belle Mint Distillery.

Investigated fish kill on Jan 29, 1988 with Phil Peterson (Dept. of Fisheries) and Kim Sherwood (Dept. of Ecology). Reported fish kill occurred several days prior to the investigation.

No sign of dead fish were present at the spill site. Electroshocked the ditch above and below the spill but no fish were found. Electroshocked at the point where the drainage ditch flows into Sulfur Creek (~~several~~ 2 miles below the fuel spill) near airport and found a healthy population of rainbow trout and speckled dace. Sulfur Ck/Drainage Ditch confluence T10 R23 S29 NW¼

A report was submitted by the Dept. of Ecology.

GAM -936-

From: Richard Visser
To: Dale Bambrick, Eric Anderson, James L. Cummins, ...
Date: 11/5/99 10:21AM
Subject: Sulfur Creek Salmon

On November 3rd 1999, while conducting a fish survey in the Lower Valley I found 25 to 50 salmon below the Sunnyside/Roza spillway in Sulfur Creek. Identifying the species was difficult but some of them appeared to be fall chinook based on their size. There may have also been coho. Rainbow/Steelhead were observed. It appeared that I was not the only person to have spotted these fish because there was a well used trail to an overlook area above the pool that most of the fish were using.

There are little if any gravels that are suitable for spawning in Sulfur Creek (it has been lined with rough cobble sized rock) so I would assume that these fish are more than likely strays. However, this may be a faulty assumption because I did see one female attempting to build a redd. Currently DOT is working on replacing a culvert on a tributary that runs into Sulfur Creek near the site of the fish. They are asking if fish passage is needed. My opinion is that this tributary does not provide quality habitat but could be a death trap for fish that enter it because it is managed for irrigation (I think this may be a man made ditch). It is my view that passage into this tributary should not be provided. DOT has stated that they could mitigate for non-passage by placing spawning gravels into Sulfur Creek. I think that there are low winter flows through this stream but am not sure.

Any insight or opinions on passage or mitigation would be appreciated. DOT is waiting for me to get back to them early next week to discuss these issues.

Thanks

Richard

map # 8

LAKE AND STREAM SURVEY FORM

Sample Site Identification

NOT FOR DATA ENTRY

County ______

Mgmt Unit Code

Water Name Sulphur Creek Section Name ______

Township 19. Range 23. E / W *(circle one)* Section 30 Qtr. Section

Site Specifics From Sheller Rd down.

Sample Date 08/11/00 (mn dy yr) International Time 0810 Physiographic Province Stream Habitat Unit Type

Sampler Last Name Cummins/ Monk / Jason/ Carol Reading Agency WDFW 1SWD

Comments (weather conditions, flooding, pollution, etc.) Confluence of Sulphur + Roza wasteways #5 form Sulphur Ck. water flows low when we started but increase dramaticly This Creek fluctuates constantly. Rocky bottom. Turbid -

Chemistry for Streams and Lakes (multiple depths available for lakes)

	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Method
Depth (m)											
Temp. (°C)	F 62										
pH											
DO_2 *(mg/l)*											
Total Alkalinity *(mg $CaCO_3$/l)*											
TDS *(mg/l)*											
Conductivity *(micromhos/cm)*											
Water Clarity *(m-lake/JTU-stream)*											
Nitrate N_2 *(mg/l)*											
Total PO_4 *(mg/l)*											
Ortho PO_4 *(mg/l)*											
Chlorophyll 'A' *(mg/l)*											

SURFACE → → → BOTTOM

Other Chemical Measurements Taken: ______

Water Name Sulphur Ck Date 08/11/00 Time 0810 am Sampler Name Cummins Mark Page 1 of 1

BIOLOGICAL DATA

SURVEY TYPE	ELECTRICAL INFORMATION	Volts	Frequency (pulses/sec)	Elapsed Time (hhmm)
EF	Pass 1	400		623
	Pass 2			
	Pass 3			
	Pass 4			

Handwritten next to ELECTRICAL INFORMATION: H12

NET INFORMATION	Mesh Size	Elapsed Time (hhmm)	Set Location	Depth Range (m)
1)				-
2)				-
3)				-
4)				-

Set Location = Shore (SH)
Surface (SU)
Bottom (BO)
Midwater (MI)

Mesh Size = E- Experimental (Variable)
or Mesh Size (Stretch)

FISH SAMPLED NS RB SD

Pass/ Net #	Fish Sample #	Species Code	Length (mm)	Type	Wgt. (gm)	Batch Samples # of Fish	Batch Samples Length Range	Batch Samples Batch Weight	Origin	Sex	Mat.	Tag	Marks M1	Marks M2	Mark Code	Age	Aging Method	Comment Codes
		RB	360 mm															
		RB	263															
		NSF	319															
		NSF	300															
		NSF	190															
		NSF	220															
		SD	59															
		SD	60															
		SD	53															
		SD	58															
		NSF	270															
		NSF	226															
		NSF	213															
		NSF	200															
		NSF	196															
		RS	117															
		RS	109															

Yakima River

In 1998, WDFW began a project to improve coded-wire tag sampling of natural and hatchery URB fall chinook populations in the Hanford Reach, Columbia River, and lower Yakima River. As part of this process, WDFW began to survey the lower Yakima River for fall chinook spawning abundance and population age structure. Prior to the work conducted in 1998, no fall chinook population estimates existed for the lower Yakima River portion of the Upper Columbia Up River Bright stock. In 1999, a fall chinook sport fishery was opened on the lower Yakima River and creel sampling was conducted to estimate harvest and refine escapement estimates. WDFW has opened a fishery for fall chinook and coho and estimated fall chinook returns in the lower Yakima River (below Prosser) for all years since the inception of this program.

Lower Yakima River Fall Chinook Escapement

In 2005, WDFW continued the fall chinook carcass and redd surveys initiated in 1998 on the lower Yakima River to estimate escapement. Project staff collected carcasses and counted redds to determine the age and sex distribution of the natural and hatchery supplementation spawning population of fall chinook on the lower 74 kilometers of the Yakima River. The lower Yakima River was broken into four strata. The four sections were floated weekly to identify new redd construction and recover post-spawn carcasses (Figure 42). Staff collected scales from all chinook and snouts from marked (fin clipped) chinook encountered during the surveys and recorded information on fork length, gender, fin clip, and egg retention (females).

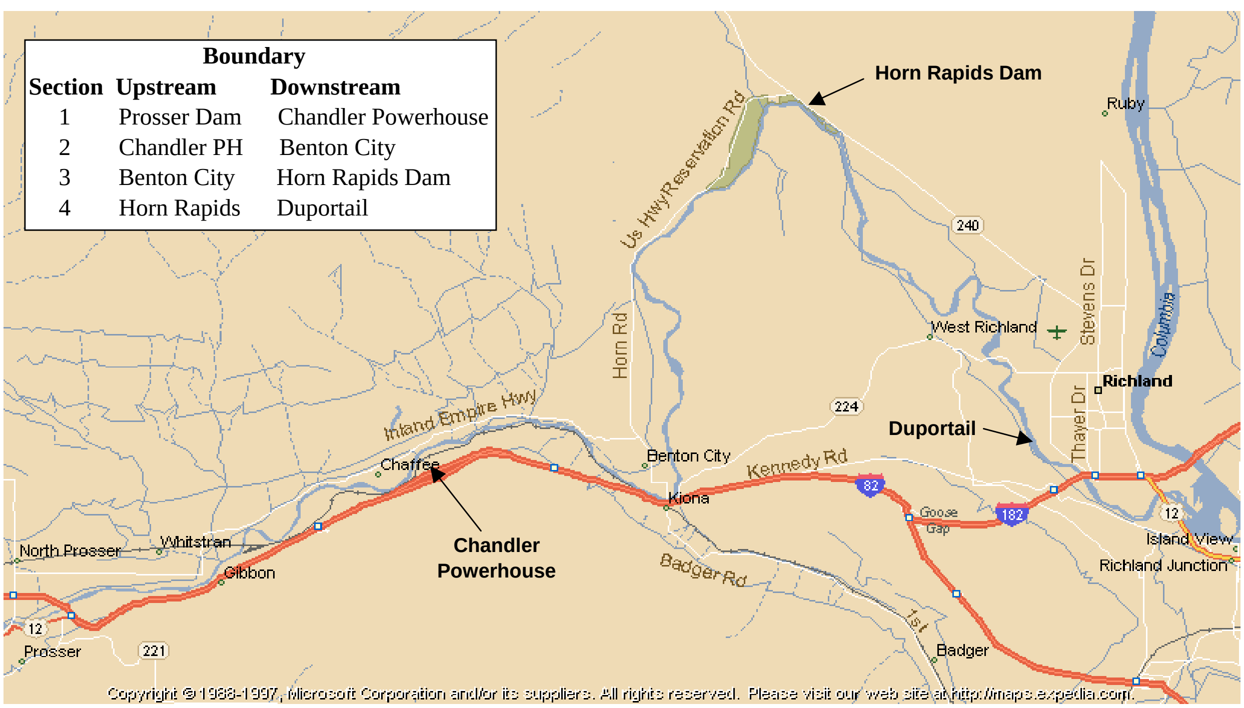


Figure 42. Lower Yakima River showing the four areas carcass and redd counts were conducted.

Spawning surveys consisted of weekly redd counts in four sections of the lower Yakima River extending from Prosser Dam to Duportail Road in Richland. This area was the primary spawning area for fall chinook in the Yakima River prior to 2001, typically accounting for 70% to 80% of the naturally spawning fall chinook production in the river. All visible redds were counted during each survey. Due to periods of high turbidity and the presence of aquatic vegetation redds visibility was greatly reduced in 2005. To estimate the total number of redds it was assumed that redds were distributed uniformly in the spawning areas and a maximum of 50% of all redds could be identified through direct visual observation. An estimated 120 redds were constructed in the lower Yakima River in 2005 (Table 66). Fall chinook escapement estimates were then calculated using the Area Under the Curve program (Ames 1983 WDFW). The estimated escapement of adult fall chinook into the Yakima River below Prosser based on a visible redd ratio of 50% was 491 chinook. In prior years redd visibility was estimated at 70%. The redd visibility factor was decreased to 50% in 2005 primarily due to the difficulty of observing redds through the aquatic vegetation. Redd construction was scattered throughout the survey period. The absence of any peak spawning time period may have been due to the difficulty in observing redds in 2005. Escapement in the lower Yakima River below Prosser is continuing to decline, decreasing by 77% compared to the estimated 2,231 chinook escapement in 2004.

Table 66. Weekly redd, carcass, and chinook counts from spawning surveys in the Yakima River below Prosser, 2005.

	Total	Week 1 Oct30-Nov5	Week 2 Nov 6-12	Week 3 Nov 13-19	Week 4 Nov 20-26	Week 5 Nov27-Dec3	Week 6 Dec 4-12
Section 1	Prosser to Chandler Powerhouse						
Redds (new)	56	12	2	7	12	15	8
Chinook (live)	294	75	122	60	17	19	1
Carcass	194	15	10	33	86	41	9
Section 2	Chandler Powerhouse to Benton City						
Redds (new)	2	0	0	0	1	1	
Chinook (live)	2	0	2	0	0	0	
Carcass	11	0	0	1	8	2	
Section 3	Benton City to Horn Rapids Dam						
Redds (new)	0	0	0	0		0	
Chinook (live)	1	0	1	0		0	
Carcass	0	0	0	0		0	
Section 4	Horn Rapids Dam to Duportail						
Redds (new)	2	0	2	0			
Chinook (live)	5	1	3	1			
Carcass	3	0	2	1			
Total							
Redds	60	12	4	7	13	16	8
Chinook	302	76	128	61	17	19	1
Carcass	208	15	12	35	94	43	9

An estimated 3,094 fall chinook returned to the Yakima River in 2005 (Table 67 & 68). This number is based on sport harvest of 726 chinook, spawning escapement estimate of 498 chinook for the area below Prosser Dam, and passage of 1,870 fall chinook through Prosser Dam. Fall chinook returns to the Yakima River increased from 1999 to 2002 but have rapidly declined during the past three years. The 2005 return decreased 50% from the previous year (6,247) and has declined by 77% from the peak return of 13,672 chinook in 2002. Fall chinook passage through McNary Dam and escapement into the Hanford Reach decreased in 2005 but too a lesser degree indicating the shortfall in the Yakima return is likely the result of poor spawning habitat and juvenile survival conditions in the Yakima River.

Table 67. Estimated fall chinook return, escapement, and harvest in the Yakima River, 1999-2005.

			Escapement					
	Return		Above Prosser		Below Prosser		**Harvest**	
Year	Adult	Jack	Adult	Jack	Adult	Jack[1]	Adult	Jack
2005	3,049	45	1,848	22	491	7	710	16
2004	5,870	283	2,907	97	2,231	140	732	46
2003	10,109	198	4,813	84	3,874	73	1,422	41
2002	11,321	287	6,090	93	4,923	116	2,300	0
2001	5,760	849	3,653	662	1,293	151	942	58
2000	6,554	1,057	1,373	922	4,923	116	255	22
1999	4,056	44	1,876	21	1,794	20	134	0
1998	1,744	107	1,065	84	645	23	34	0

[1] Jack estimate is based on proportion of jack chinook passing Prosser

Table 68. Salmon and steelhead passage at Prosser Dam in the Yakima River, 1999-2005.

Year	**Spring Chinook**		**Fall Chinook**		**Coho**		
	Adult	Jack	Adult	Jack	Adult	Jack	**Steelhead**[1]
2005	6,044	448	1,848	22	2,828	225	1,463[2]
2004	14,368	729	2,907	97	2,325	64	3,451
2003	4,982	1,894	4,813	84	2,192	162	2,665
2002	14,054	717	6,090	93	475	343	2,235
2001	19,761	1,707	3,653	662	4,978	68	4,525
2000	17,420	1,589	1,373	922	4,390	1,826	3,089
1999	1,795	977	1,876	21	3,853	91	1,611
1998	1,877	25	1,065	84	4,624	54	1,070

[1] Steelhead counts from July 1 through June 30.
[2] Steelhead count incomplete, data from July 1 through December 1, 2005

Staff recovered fall chinook carcasses in the lower Yakima during weekly stream surveys from October 31 to December 5. A total of 205 carcasses were sampled, 187 fall chinook and 18 coho. Scales were collected from 187 fall chinook carcasses, of which 95% were readable (177/187). Mean fork length for fall chinook recovered during the stream surveys was 87cm, range 62cm - 114cm (Figure 43). No jacks were recovered during stream surveys but were present in the fishery. Mean fork length by age was 73cm for age 3, 84cm for age 4, and 95cm at age 5. Based on scale analysis, the lower Yakima River age composition was 1.4% age 2, 20.0% age 3, 66.3% age 4, and 12.2% age 5 (Figure 44 & Table 69). The natural spawning population in 2005 was 53.9% female. The female composition of the sport fishery was 45.8%. There is typically a bias towards females and a negative bias in jacks in carcass recovery. Age composition of chinook jacks was low in both surveys. This may be an indication of poor survival from the 2003 BY and will likely lead to poor returns for Age 3 fall chinook in the Yakima River in 2006.

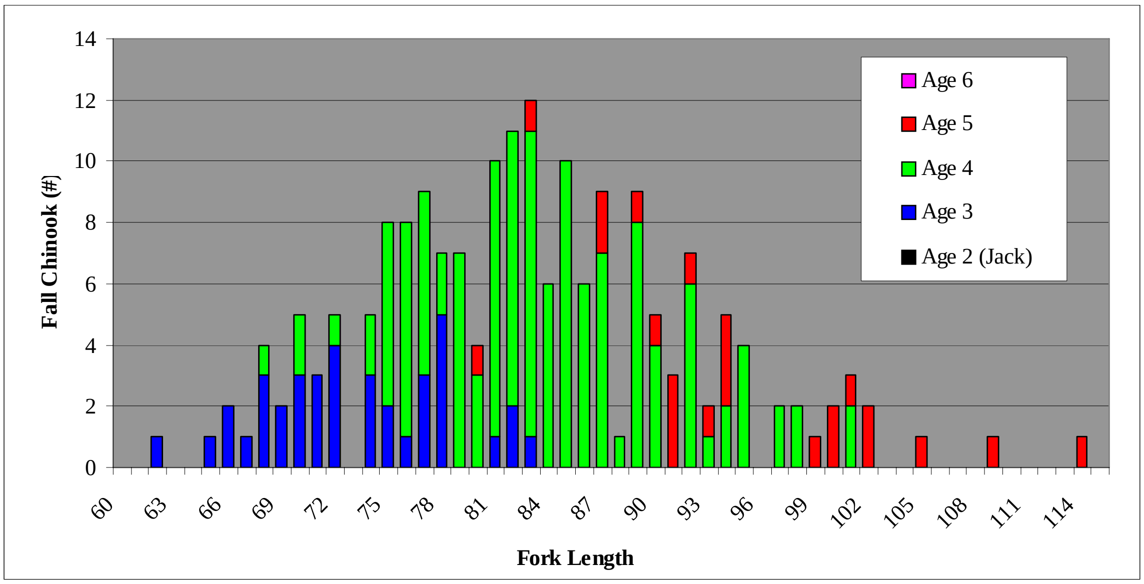


Figure 43. Length frequency distribution by fork length and age for fall chinook recovered in the Yakima River stream surveys, 2005.

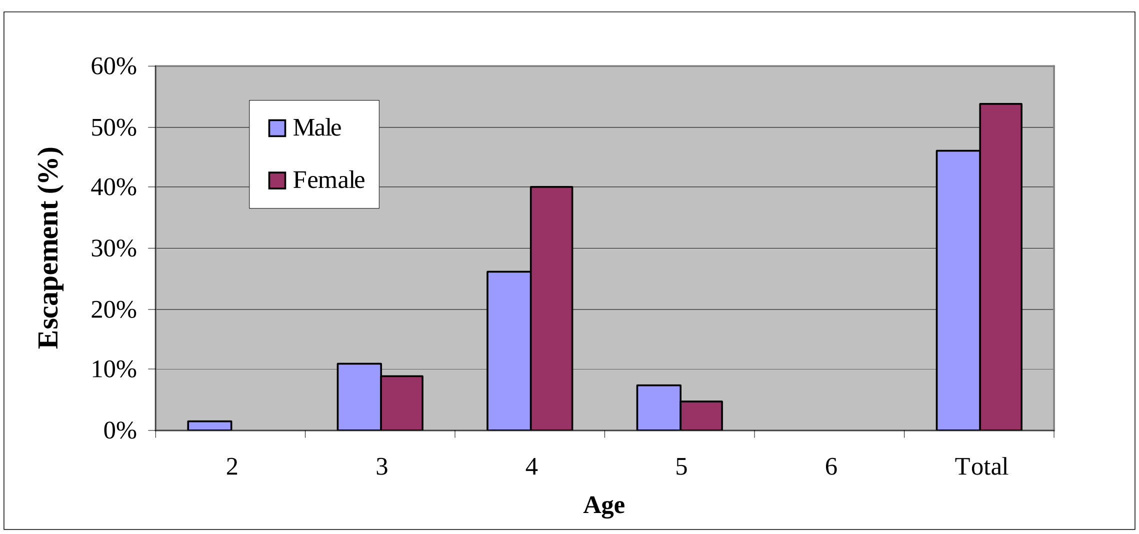


Figure 44. Age and gender composition of naturally spawning fall chinook in the lower Yakima River, 2005.

Table 69. Age and sex composition of the fall chinook escapement in the lower Yakima River, Stream Survey, 2005.

	Age 2		Age 3		Age 4		Age 5		Age 6		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Male	7	1.4	55	11.0	131	26.3	37	7.4	0	0.0	230	46.1
Female	0	0.0	45	9.0	200	40.1	24	4.8	0	0.0	269	53.9
Total	7	1.4	100	20.0	331	66.3	61	12.2	0	0.0	499	100.0

Snouts were collected from all marked (clipped) salmon during stream surveys in 2005 and sent to the WDFW CWT lab in Olympia for decoding of coded wire tags. Snouts were collected from 20 adipose clipped chinook in 2005. No vent clipped chinook were observed during the stream surveys. Of these, 10 had readable tags, 6 did not contain a tag, and 4 tags were unreadable. The majority of the tagged fish recaptured in the Yakima River were from fall chinook released at Prosser in 2002 (Table 70). CWT data indicates approximately 0.5% of the spawning escapement in the Yakima River was composed of hatchery strays from juvenile fall chinook releases in the Umatilla River (Figure 45).

Table 70. 2005 WDFW coded wire tag recoveries from lower Yakima River fall chinook carcasses.

Code	**Tags** (#)	**Brood Year**	**Run**	**Age**	**Stock**	**Release Location**	**CWT Release**		**Exp factor**	**Total**	**% of Escape**
							Date	#			
501030102	8	2001	Fall	4	Little White Salmon	Yakima @ Prosser	4/3/02	199,332	8.5	**68**	36.4%
93504	1	2001	Fall	4	WA Brights	Umatilla River	5/23/02	158,572	1.0	**1**	0.5%
51382	1				Unknown						
Total	**10**		**187 chinook sampled for CWT in Escapement**							**69**	36.9%

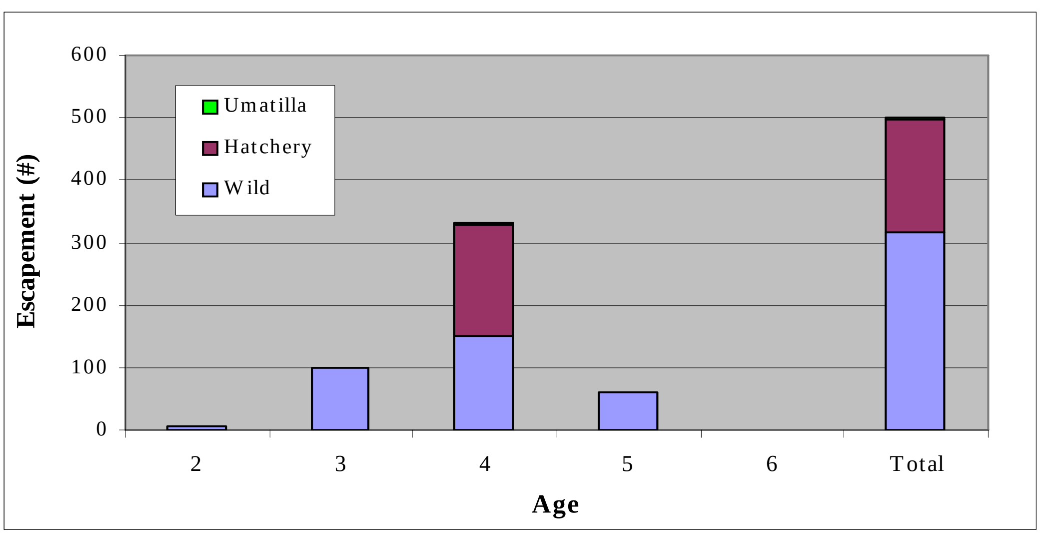


Figure 45. Hatchery, wild, and stray composition of the fall chinook escapement in the lower Yakima River, 2005.

Age distribution of fall chinook returns to the Yakima River are typically comprised primarily of Age 4 chinook (~50%), followed by Age 5, Age 3, and Age 2 (jacks) (Table 71). This pattern varies from year to year depending on survival of each brood year component of the return. The mean escapement to the lower Yakima River from 1998 to present has been 2,376 chinook with a peak spawning escapement of 5,039 chinook in 2000 and a minimum of 499 chinook this year.

Table 71. Age composition, number and percent, of the Yakima Fall chinook escapement, 1998 - 2005.

Return Year	Age 2	Age 3	Age 4	Age 5	Age 6	Total
2005	7	100	331	61	0	499
2004	140	445	497	1,282	7	2,371
2003	73	246	2,786	842	0	3,947
2002	194	327	1,346	1,258	0	3,125
2001	129	944	169	52	0	1,294
2000	113	1,118	3,720	88	0	5,039
1999	23	461	1,354	231	0	2,069
1998	23	353	190	101	0	667
Mean	**88**	**499**	**1,299**	**489**	**1**	**2,376**
Return Year	**Age 2**	**Age 3**	**Age 4**	**Age 5**	**Age 6**	
2005	1.4%	20.0%	66.3%	12.2%	0.0%	
2004	5.9%	18.8%	20.9%	54.1%	0.3%	
2003	1.8%	6.2%	70.6%	21.3%	0.0%	
2002	2.3%	22.9%	73.1%	1.7%	0.0%	
2001	10.0%	73.0%	13.1%	4.0%	0.0%	
2000	2.2%	22.2%	73.8%	1.7%	0.0%	
1999	1.1%	22.3%	65.4%	11.2%	0.0%	
1998	3.4%	52.9%	28.5%	15.1%	0.0%	
Mean	**4.0%**	**28.2%**	**47.7%**	**20.0%**	**0.0%**	

Age 4 chinook typically dominate the age composition of fall chinook adult returns of URB in the Yakima River and Hanford Reach. Age 5 chinook returning in 2005 originated from the 2000 brood. The juveniles from the 2000 brood year incubated and out-migrated during the drought of 2001 and this has likely led to the poor returns from this brood year for all ages (Table 72).

The 2005 escapement continues a downward trend in fall chinook returns to the Yakima River in recent years. The Yakima River continues to lose preferred spawning habitat in the areas below Prosser Dam. For example, there were more than 300 redds between Benton City and Horn Rapids Dam in 2000. In 2002, only 80 redds were found in this section, 4 redds in 2003, and no redds were observed in 2004 or 2005 (Table 73). The reduction in fall chinook spawning below Prosser and increased migration of fall chinook above Prosser is most likely due to the proliferation of aquatic vegetation into the primary spawning areas. All the primary spawning areas in the lower Yakima River below Prosser from the mouth to Prosser Dam have been covered with aquatic vegetation since 2004. Redd construction has shifted upstream and an increasing percentage of the chinook have passed above Prosser Dam. Prior to 2001 roughly 70% of the fall chinook spawned below Prosser Dam. From 2001 to 2004, 50% of the estimated return has passed above the Prosser facility and in 2005, 79% of the estimated escapement migrated above the Prosser Diversion.

Table 72. Annual Yakima River URB fall chinook escapement by brood year, 1992 - 2003.

Brood Year	Age 2	Age 3	Age 4	Age 5	Age 6	Total
2003	7					
2002	140	100				
2001	73	445	331			
2000	194	246	497	61		998
1999	129	327	2,786	1,282	0	4,524
1998	113	944	1,346	842	7	3,252
1997	23	1,118	169	1,258	0	2,568
1996	23	461	3,720	52	0	4,256
1995		353	1,354	88	0	1,795
1994			190	231	0	
1993				101	0	
Mean	**88**	**499**	**1,299**	**489**	**1**	**3,650**

Table 73. Fall chinook redd counts in the lower Yakima River, 2000-2005.

Area	Redds					
	2005	2004	2003	2002	2001	2000
Horn Rapids to Mouth	2	24	112	150	71	29
Benton City to Horn Rapids	0	0	4	106	21	311
Chandler to Benton City	2	48	286	188	101	150
Prosser to Chandler	56	377	392	587	95	199
Total	60	449	794	1,031	288	689

A total of 18 coho were sampled during the 2005 stream survey. The majority of the coho recovered were collected in Spring and Snipes Creeks (13). Mean fork length was 66 cm (range 49cm - 73cm) (Figure 46). Carcasses sampled were 62.5% female and nine of the ten females had spawned successfully. All coho were three-year-old fish from the 2002 Brood Year and all having spent two years in fresh water before migrating.

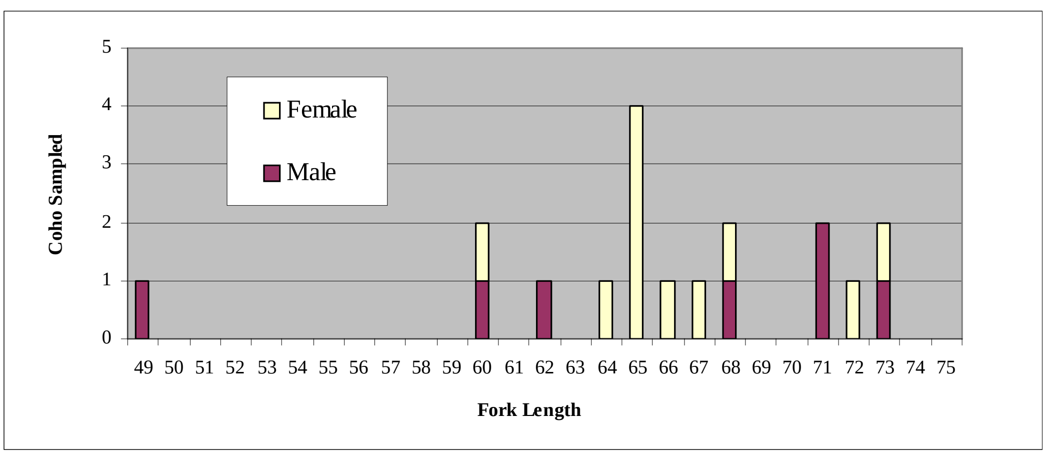


Figure 46. Length frequency distribution of coho sampled during the Yakima River stream survey, 2005.

Snipes, Spring, and Corral Creek Redd Surveys

Spawning surveys were conducted on November 16 in Snipes, Spring, Corral, and Amon Creeks. There were 30 redds, 7 live adult salmon, and 3 salmon carcasses observed in Spring Creek between the Yakima River and Hess Road during the survey (Table 74). The Hess Road overpass is considered to be a barrier to salmon passage. The majority of the redds were found upstream of the Snipes/Spring Creek junction. Adult salmon carcasses were found in Snipes Creek during the weekly Yakima River stream surveys but no redds were observed during the November 16 survey upstream of the Spring/Snipes Creek confluence.

Table 74. Summary of redd surveys of Snipes, Spring, Corral, and Amon Creeks, November 16, 2005.

Location	Redds	Live Fish	Carcass	Comments
Snipes/Spring	7	3	1	Live fish and carcass appeared to be coho
Snipes Creek	0	0	0	Surveyed up to train trestle (lower ½ mile)
Spring Creek	23	4	2	Surveyed up to Hess Rd (barrier culvert) live fish were likely 2 coho, 2 fall chinook; carcass appeared to be coho
Corral Creek	0	0	0	Lower 200yds, heavily vegetated
Amon Creek	0	0	0	Un-watered wasteway arm

There are two low elevation waterfalls in Spring Creek that were not recorded during prior surveys. At least one or both may have been constructed in recent years. Both falls are approximately three feet in height. Redds were observed above both falls. One of the 23 redds in Spring Creek was unwatered at the time of the survey indicating that it was likely formed prior to the conclusion of irrigation as Spring Creek receives wastewater from the Sunnyside Valley Irrigation District. Spring Creek and Corral Creek had moderate flows (~3-5cfs) with water temperatures of 9ºC in Spring/Snipes and 11ºC in Corral. Snipes Creek had relatively low flow, estimated at 1-3 cfs.

During the lower Yakima River stream surveys in 2005, 29 of the 205 carcasses were recovered from Spring and Snipes Creeks. Only 60 redds were observed in the Yakima River below Prosser in 2005 whereas 30 redds were observed in Spring and Snipes Creeks. Production from Spring/Snipes Creeks accounted for a third of the natural salmon production in the lower Yakima River in 2005.

Only a small section located in the lowermost 200 yards of Corral Creek was surveyed in 2005. No redds were observed but the heavy overgrowth of Russian Olive made surveying difficult.

The east fork of Amon Creek rarely has any natural flow. This arm does receive irrigation wastewater from Kennewick Irrigation District. The east fork was unwatered (post irrigation season) during the November 12 survey. No redds or fish were observed during the survey. This branch of Amon has had frequent use from off road vehicles during and after the irrigation season. Large amounts of debris including tires, pallets, appliances, and trash were observed in the stream channel during the survey. A large portion of the stream channel along this fork is no longer in tact due to off road vehicles use. The vehicles have created multiple roadways of loose silt/sand substrate in what was the stream bed. Irrigation wastewater will be flowing back into this arm in March/April of 2006 resulting in the displacement of sediment and debris downstream and may potentially block downstream culverts in addition to increasing sediment loads in Amon Creek and the Yakima River.

Yakima River Fall Salmon Fishery

The first sport chinook salmon fishery in the lower Yakima River since 1966 opened on September 1, 1998. Biologists anticipated a return of 3,700 fall chinook and an estimated harvest of 410 chinook. Selective gear rules were in effect, bait was prohibited. The fishery was open from the mouth to Chandler powerhouse and only fall chinook could be harvested. The season ran through October 31, 1998. The fishery was opened by emergency regulation in 1999 from Sept. 25 through Oct. 31 in the lower Yakima River from the Highway 240 bridge upstream to 400 feet below Prosser Dam and from Nov. 15 through Dec. 31 the Yakima River from the I-82 bridge at Union Gap upstream to 400 feet below Roza Dam was opened. All coho and chinook with adipose or ventral fin clips could be retained. Unlike 1998, selective gear rules were not adopted as imposing selective gear rules conflicted with tackle commonly used for the popular channel catfish and smallmouth bass fisheries. The 2000 season was opened by emergency regulation with the same timelines and locations as the 1999 fishery. In 2001, the sport salmon season was opened again by emergency regulation on the lower Yakima River from September 16 through October 31 from the Highway 240 bridge upstream to Prosser Dam. Anglers were allowed to keep hatchery and natural-origin chinook and coho. In 2002, the Yakima fall sport fishery was approved by the Fish and Wildlife Commission and incorporated into the Washington Fishing Rules Pamphlet. Fall chinook typically begin spawning during the later part of October in the Yakima River. Anglers often target on spawning chinook though these fish are of poor table quality. Catch and release of these chinook would likely reduce spawning success in addition to direct hooking mortality. A modification to the regulation was submitted to and approved by the Washington Fish and Wildlife Commission in 2004 to protect fall chinook during spawning and thus improve spawning success. The Yakima River fall chinook and coho fishery would be closed on October 22, nine days earlier than the previous regulation, but would be opened two weeks earlier on September 1 to provide similar angling opportunities. An additional area of the Yakima River was opened from the Hwy 223 Bridge at Granger to Sunnyside (Parker) Dam. Anglers are allowed to keep hatchery and natural-origin chinook and coho.

A creel survey is conducted annually in conjunction with the opening of the salmon fishery to estimate harvest and impacts to ESA listed Mid-Columbia steelhead. The Yakima River was divided into three sections. The first section, extended from the mouth (Highway 240 Bridge) to Horn Rapids (Wanawish) Dam. The second section extended from Horn Rapids Dam upstream to Prosser Diversion Dam and the third section included the area from Granger (Highway 223 bridge) to Parker Dam. Angler and boat index counts were conducted twice per day in all three sections. Anglers were interviewed to obtain information on number of hours fished, harvest, and fish released. Harvested fish were sampled to collect fork lengths, scales (aging), and snouts from coded wire tagged fish. Scale samples were sent to the WDFW scale lab for age analysis.

Each fish was examined for external marks (fin clips) indicating the presence of coded wire tags. Snouts were collected from all clipped chinook and sent to the WDFW Coded Wire Tag lab for extraction and decoding.

Estimated harvest in 2005 was 733 fish, 710 adult fall chinook, 16 jack chinook, and 7 adult coho. These harvest estimates were generated from combining weekly estimates (Table 75). The number of adult chinook harvested based on monthly expansions was 740 chinook ±153 at the 95% level of confidence. An estimated 117 ESA listed Mid-Columbia steelhead were caught and released during this fishery (13.8% of the catch). Hooking mortality based on a 5% mortality rate was 6 steelhead.

Table 75. Weekly summary of harvest, impacts to ESA Listed steelhead, sampling, and effort during the Yakima fall fishery, 2005.

Week	**Harvest**				**Steelhead** Catch & Released	**Sampled**		**Total Effort** (pole hrs)
	Chinook		Coho					
	Adult	Jacks	Adult	Jacks		Anglers	Hours	
Sept 1 - 4	0	0	0	0	0	10	26	198
Sept 5 - 11	0	0	0	0	0	37	106	484
Sept 12 - 18	18	0	0	0	0	72	167	1,124
Sept 19 - 25	23	11	0	0	11	140	362	1,733
Sept 26 - Oct 2	42	0	7	0	7	172	394	2,570
Oct 3 - 9	280	5	0	0	72	382	812	3,393
Oct 10 - 16	238	0	0	0	27	300	614	3,680
Oct 17 - 22	109	0	0	0	0	134	298	2,013
Season	**710**	**16**	**7**	**0**	**117**	**1,247**	**2,778**	**15,195**

WDFW staff interviewed 1,247 anglers during the fall chinook fishery in 2005, 18.3% of the estimated angler effort (Table 76). Estimated effort for the 2005 Yakima River sport salmon fishing season was 15,195 pole hours, well below that of the previous three years. Similar to 2004, there was very little angler activity in the Yakima River from Granger to Sunnyside (Table 77). This area was newly opened in 2004. With the exception of 2002, WDFW has consistently sampled above 15% of the total effort during this fishery. Flows averaged 1,149cfs during this fishery (range 644cfs to 2440cfs).

Harvest of fall chinook in the Yakima River was similar to the 2004 fishery but well below the harvest in 2002 and 2003 (Table 78). The reduced harvest was likely a product of a reduction in the number of fall chinook returning to the Yakima River, reduced effort, and an earlier closure of the fishery in 2004 and 2005.

Table 76. Summary of effort, fish sampled, and anglers interviewed during the Yakima fall fishery, 1998 – 2004.

Year	**Effort** (pole hours)			**Anglers** Interview	**Fish Sampled**			
	Total	Sampled	%		Chinook (Adult)	Chinook (Jacks)	Coho	Steelhead (released)
2005	15,195	2,778	18.3	1,247	132	4	1	19
2004	23,878	3,725	15.6	1,837	113	7	8	22
2003	32,225	5,045	15.7	2,341	225	9	0	4
2002	22,796	1,697	7.4	711	145	0	4	1
2001	13,193	2,159	16.4	861	149	12	7	3
2000	12,556	1,933	15.4	712	41	3	11	3

Table 77. Distribution of harvest by location and between bank and boat anglers in the three areas sampled during the 2005 fall Yakima River salmon fishery.

Lower (Mouth to Horn Rapids)						
	Adult	Jack	Coho	Jack	StHead	Effort (pole hrs)
Bank	285	5	0	0	57	4,543
Boat	50	0	0	0	1	1,100
Middle (Benton City to Prosser)						
Bank	372	11	7	0	60	8,746
Boat	1	0	0	0	0	209
Upper (Granger to Parker)						
Bank	0	0	0	0	0	471
Boat	0	0	0	0	0	124

Table 78. Summary of salmon sport harvest and wild steelhead release, Yakima River, 1999-2005.

Year	**Spring Chinook**		**Fall Chinook**		**Coho**		**Steelhead**
	Adult	Jack	Adult	Jack	Adult	Jack	(Released)
2005			710	16	7	0	117
2004			732	46	42	10	146
2003	No Fishery		1,422	41	0	0	27
2002[1]	487	5	2,350	0	40	0	13
2001	1,918	105	942	58	54	0	18
2000	92	8	255	22	54	15	19
1999	No Fishery		134	0	54	0	na
1998	No Fishery		34	0	0	0	na

[1]2002 spring chinook fishery was open for retention of hatchery chinook only

Scale samples were collected from 111 fall chinook and 1 coho in 2005. Mean fork length for fall chinook harvested in the Yakima fishery was 83cm , range 48cm - 114cm (Figure 47). The majority of the harvest was three and four year old chinook. Breakdown by age for the 2005 sport harvest was 2% age 2, 26% age 3, 59% age 4, 11% age 5, and 2% age 6 (Table 79 & Figure 48). Chinook age distribution was more typical in 2005 though Age 5 chinook returns were lower than normal. The fish from the 2000 brood year out-migrated during drought conditions in the spring of 2001. This has likely led to the low contributions to the harvest for this brood year (Table 80). Age composition of fall chinook sampled in the sport fishery was similar to the carcass survey. The male to female ratio was lower in the sport harvest as is typical. The percentage of females in the sport harvest was 45.8% compared to 53.9% in the carcass recovery. There is a positive bias towards females and a negative bias in jacks associated with carcass recovery. The proliferation of aquatic vegetation in the river in 2005 likely reduced carcass recovery efficiency.

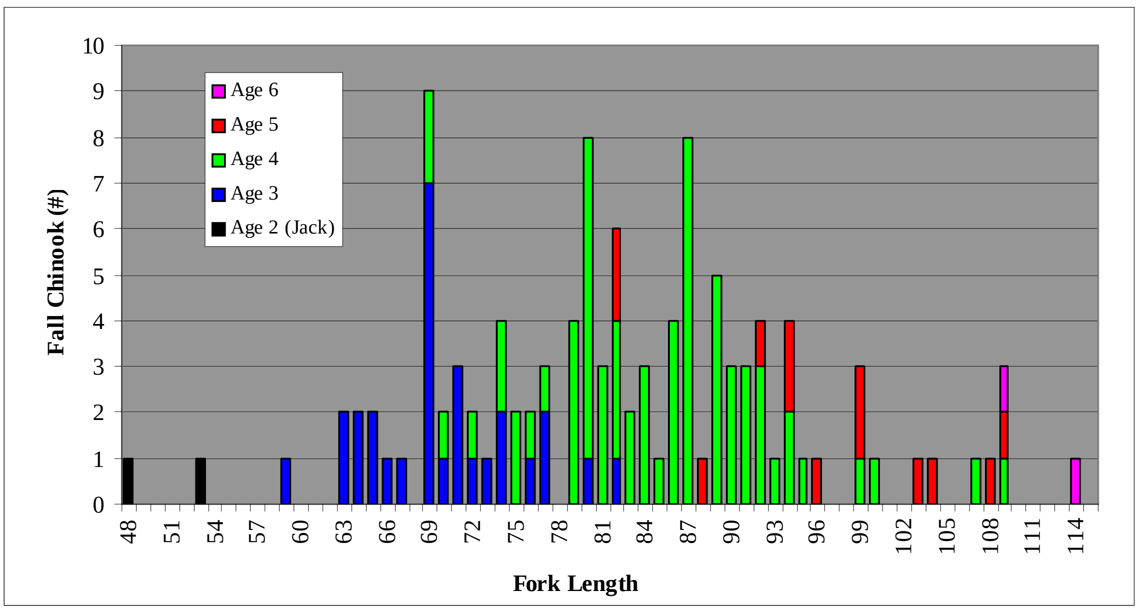


Figure 47. Length frequency distribution by fork length and age for fall chinook sampled in the Yakima River sport fishery, 2005.

Table 79. Age and gender composition of fall chinook in the sport fishery in the lower Yakima River, 2005.

	Age 2		Age 3		Age 4		Age 5		Age 6		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Male	16	2.2	96	13.2	230	31.7	38	5.3	13	1.8	393	54.2
Female	0	0.0	90	12.3	198	27.3	45	6.2	0	0.0	333	45.8
Total	16	2.2	185	25.6	429	59.0	83	11.5	13	1.8	726	100.0

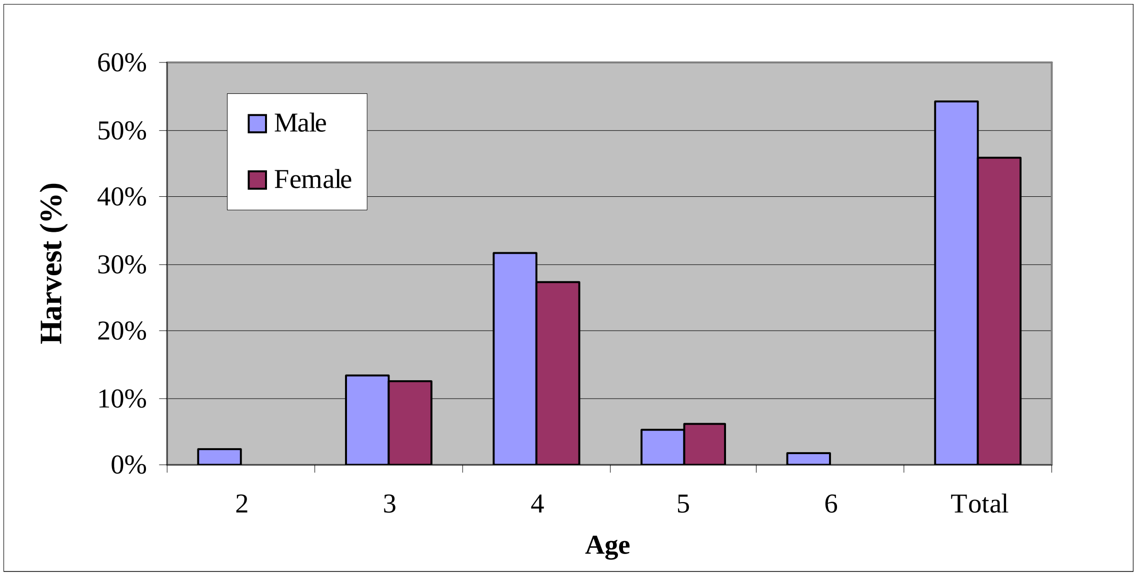


Figure 48. Age and gender composition of fall chinook in the sport fishery in the lower Yakima River, 2005.

Table 80. Age composition (%) of the Yakima Fall chinook harvest, 2000 - 2005.

Brood Year	Age 2	Age 3	Age 4	Age 5	Age 6
2005	2.2	25.6	59.0	11.5	1.8
2004	3.8	35.8	22.6	36.8	0.9
2003	1.8	8.8	65.8	23.7	0.0
2002	0.7	25.5	70.9	2.8	0.0
2001	7.6	74.1	15.2	2.5	0.6
2000[1]	9.3	4.7	48.8	37.2	0.0

[1] Shaded areas are returns for the 2000 Brood Year

Snouts were collected from 5 adipose clipped fall chinook during the sport fishery. Of these, two tags were readable. The three readable tags were released by the Yakama Nation at Prosser in 2002 and 2003 (Table 81).

Table 81. List of coded-wire tags recovered from fall chinook sport harvest by tag code on the Yakima River 2005.

Tag Code	Tags (#)	BRD Year	Run	Stock	Release Site	CWT Release		Exp Factor	Harvest	
						Date	#		#	Age
501030102	2	2000	Fall	L.White Salmon	Yakima @ Prosser	4/3/02	195,975	8.5	**17**	5
501040306	1	2002	Fall	Columbia URB	Yakima @ Prosser	3/28/03	200,120	6.6	**7**	3

DRAFT FOR REVIEW

Results of Fish Surveys in the Roza-Sunnyside Board of Joint Control Irrigation Drain Network

January, 2000

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Executive Summary

Results

Snipes Creek: Adult coho salmon and fall chinook salmon were found spawning in lower Snipes Creek. Juvenile coho salmon were the most abundant fish species rearing in Snipes Creek during May and June of 2000. Limited habitat data suggested conditions were suitable for salmonids.

Spring Creek: Coho and chinook salmon were observed spawning in Spring Creek. A culvert at Hess road may function as a fish-passage barrier for most anadromous fish, excluding them from all but the lowest reach of Spring Creek. Juvenile coho salmon and rainbow/steelhead trout, along with other native and introduced species, were found in lower Spring Creek. Juvenile brown trout were found in upper Spring Creek. Habitat conditions were variable, requiring more assessment.

Sulphur Creek Wasteway: 300-500 adult coho salmon entered Sulphur Creek Wasteway during the fall of 2000. About 110 fish were removed from the wasteway. Salmonids were not common in samples of juvenile and resident fishes; however, the mainstem of Sulphur Creek Wasteway was not surveyed extensively during the summer due to high flow conditions. Habitat conditions were variable in this large watershed.

Granger Drain: Salmonids were found rearing in Granger Drain only at the confluence with the Yakima River. A series of seven road culverts in the City of Granger, just upstream of the mouth of the drain, may deny anadromous fish access to Granger Drain. Only native minnows and suckers were found upstream from Granger.

Introduction

The Roza and Sunnyside divisions of the Yakima Project provide irrigation water to a combined total of 176,570 acres of agricultural and municipal land in the Yakima River basin. Most of the acreage lies north and east of the Yakima River in the lower Yakima valley (Figure 1). Much of the Roza district serves higher-elevation lands adjacent to the Sunnyside division. Combined, the two divisions divert up to 891,576 acre-feet of water from the Yakima River annually, amounting to about 5 feet of water diverted for every acre of land. The Roza-Sunnyside Board of Joint Control (RSBOJC) was formed in 1997 to improve the management of irrigation facilities used jointly by the two divisions.

Since the late 1800's through the 1950's, a network of canals, pumping plants, and laterals were developed to distribute irrigation water to agricultural lands within the RSBOJC boundaries. Along with the water distribution system, a network of drains and wasteways had to be developed to convey irrigation return flows back to the Yakima River. Return flows are estimated to be about 50% of surface diversions (Lentz 1974), so some of these waterways carry significant amounts of flow, particularly during the irrigation season. Major drains within the RSBOJC include Granger Drain, Sulphur Creek Wasteway and it's numerous tributaries, and Spring Creek and Snipes Creek wasteways. These as well as other smaller drains, return water RSBOJC lands directly to the Yakima River.

Fish from the Yakima River are able to access some areas within the RSBOJC drainage networks. The current extent of anadromous and resident fish distribution, and the seasonality of fish use of drains, is unknown. During the summer and fall of 2000, exploratory surveys of fish species presence, distribution, abundance, and habitat conditions were initiated in the RSBOJC drainage network. Survey participants included RSBOJC staff, Washington Dept. of Fish and Wildlife (WDFW), and Patrick A. Monk, consulting fish biologist. This report describes progress of the studies.

Methods

Study Area

The study area include the four major RSBOJC drainage networks: Granger Drain, which enters the Yakima at river-mile (RM) 83.0 with a drainage area of 17,600 acres (WDOE 2000), Sulphur Creek Wasteway (RM 61.0) which has a drainage area of about 100,000 acres (SYCD 1995), and Spring and Snipes creeks, which drains about 30,000 acres and enter the Yakima River jointly at RM 41.8. Additionally, a small isolated drain near Prosser, Washington, subdrain 52.8 (RM 47.0) and Corral Canyon Creek (RM 33.8), a Roza Irrigation District facility, were also surveyed on a limited basis.

For the purposes of analysis and discussion, the data collected in lower Spring Creek was combined with the data collected in Snipes Creek. Both of these waterways flow together on the floodplain of the Yakima River. However, a culvert on Spring Creek, about 0.6 kilometer upstream from the confluence of Spring Creek with Snipes Creek, creates a fish-passage barrier for most anadromous fish. Fish can move freely between lower Spring and Snipes creeks (and the Yakima River), but due to the culvert fish access is restricted from lower to upper Spring Creek. Fish that were observed in lower Spring Creek during both spawning and electrofishing surveys were included in the Snipes Creek data, not just because of the free access, but also because habitats appeared essentially homogeneous. We did not find any passage barriers on Snipes Creek, which was surveyed from the mouth up to the Roza Canal.

We chose sites at different locations to sample a broad geographic area during the summer season. Sample sites within each water body were selected for a variety of reasons, including flow conditions on the day of the survey, prior knowledge of fish use, access, connectivity with the Yakima River, and drain channel conditions. Subsurface drains, or drains that flowed long distances underground through pipes (> 1,000 feet), were excluded from surveys. We were only able to survey wadeable streams using our

Snipes Creek

Snipes Creek, including the lower portion of Spring Creek, was surveyed on May 24 and June 16, 2000. We sampled the lower, middle, and upper reaches, up to the Roza Canal. Overall 549 meters of Snipes Creek were sampled.

Snipes Creek was notable for the high abundance of coho salmon. Coho were found in all reaches of the creek surveyed, but were most abundant towards confluence with the Yakima River. In contrast to the other drains, speckled dace were found in low abundance in Snipes Creek (Table 2). Table 5 shows that nearly three-quarters of the coho captured were at, or near, smoltification (Sandercock 1991), which generally occurs when individuals grow to a fork-length of 100 mm (TL = 90).

Juvenile coho salmon could have migrated up Snipes Creek from the Yakima River, or they could be progeny of adult salmon that spawned in the creek. Adult coho salmon have been observed spawning in lower Snipes Creek since at least 1989 (Cuffney et al. 1998). It is likely these juveniles originated from redds deposited by naturally spawning fish in Snipes Creek.

As was suggested by the abundance of salmonids in Snipes Creek, this waterway in particular appeared to have good habitat conditions for salmonids, with gravel/cobble/boulder substrates, tree growth along the banks, and beaver dams found at a number of locations.

Results of Spawning Surveys

In 1999 salmon were observed congregating in the Sulphur Creek Wasteway near the terminus at Sheller Road. In response, exploratory spawning surveys were initiated during the fall of 1999. Included in the 1999 surveys were Sulphur Creek, Spring Creek, Snipes Creek, and Corral Creek wastways. The spawning surveys were expanded in the fall of 2000, as large numbers of salmon were again observed returning to the wasteways (see http://www.yakima-herald.com/cgi-bin/liveique.acgi$rec=16144?home, also http://www.truckbeds.com/salmon/taking.htm).

Sulphur Creek was incompletely surveyed in early November 1999. Eight coho redds were found within 300 meters of the upper end of the wasteway, but no attempts were made to survey other areas in the wasteway in 1999. In 2000, Sulphur Creek Wasteway was surveyed more extensively, from the Tear Road bridge upstream to the end of the wasteway, a distance of about 4.8 km (3 miles). Spawning surveys were conducted on October 25 and November 21. The final results are reported in Table 6. During the October 25 survey, 58 redds (many with fish on them), 27 carcasses, and over 150 live fish were observed. In contrast, on the final surveys four live fish were observed, indicating that the spawning activity was nearly concluded. Thus spawning occurred over about a 5-6 week period, just prior to the end of the irrigation season (October 20), lasting until late November. Although exact fish counts have not been made, by combining data sources, it is estimated 300-500 salmon (mostly coho) were observed in Sulphur Creek Wasteway.

Spawning surveys were also conducted in Snipes Creek (including lower Spring Creek) in 1999 and 2000. Partial surveys conducted in October 1999 revealed 35 salmon redds in Snipes Creek. During 2000, systematic surveys were conducted on the 1st and 30th of November. Surveys were conducted from the mouth up to the Benton Canal lateral, a distance of about 3.5 km. Redd, carcass, and fish data are summarized in Table 6. Spawn timing was similar to Sulphur Creek.

In Spring Creek, surveys were conducted from Hess Road up to Old Inland Empire Highway (500 meters). No redds were found upstream of Hess Road culvert. Lower Spring Creek proper, below Hess Road, contained about 5 redds/100 meters of channel length surveyed (29 redds over a distance of about 600 meters). The lack of salmon

Table 6. Summary of spawning survey data collected for selected drainages.[1]

Site	Reach	Redds	Carcasses	Live Fish
Sulphur Ck 11/21/00				
	Tear-Allan Rd	34	25	2
	Allan-Sheller Rd	57	139	2
	totals	*91*	*164*	*4*
Snipes Ck 11/30/00				
	Mouth-Railroad	52	5	4
	Railroad-Benton Canal	17	4	1
	totals	*69*	*9*	*5*

[1] Snipes Ck includes lower Spring Ck. Carcasses and live fish were predominantly coho salmon, although 1 fall chinook carcass was found in Snipes Creek. Earlier surveys identified 4 fall chinook carcasses in Sulphur Creek.

redds in habitat directly upstream of the culvert is an indication the culvert is a passage barrier for adult salmon.

Spawning surveys were also conducted in the lower section of Corral Creek in 1999 and 2000. In 1999, four redds were observed in the Creek at the confluence with the Yakima River. In 2000, one redd was observed at the same location, along with one live coho salmon. Riparian vegetation growth along the creek banks consists of very dense stands of Russian olive trees, making spawning surveys difficult and ineffective.

Spawning salmon were not observed congregating in Granger Drain in late October or early November (Richard Visser, WDFW, pers. comm.). Another trip to Granger Drain on November 17, 2000 did not reveal any salmon in the drain; however, this drain was not surveyed in a comprehensive fashion. Passage barriers and unsuitable habitat apparently make Granger Drain an unlikely place to find spawning salmon.

Discussion

The RSBOJC drainage network was developed for a variety of purposes. Wasteways and spillways were designed to carry water in the event of a canal break or to absorb flutuations in demand for irrigation water. Drains were cut to maintain the productivity of the soils. None of these facilties were developed for the expressed purpose of providing fish and wildlife habitat, but animals are present and using the habitat that is available.

Geology and climate (modified by topography) are the factors most strongly influencing habitat conditions. The climate and topography are fairly uniform throughout the RSBOJC network. Figure 5 shows the geology of the lower Yakima River Basin (Molenaar 1985), which varies in the lower Yakima Basin. Sedimentary deposits and

Anadromous Salmonid Habitat in Three Watersheds of the Columbia Basin Project

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MISSION STATEMENTS

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1. ABSTRACT

We investigated three watersheds on the Columbia Basin Irrigation Project (RB4C Wasteway, Crab Creek, WB-10 Wasteway) that are tributaries to the Columbia River. Physical water temperatures were monitored in five stream segments throughout these three watersheds. We reconnoitered six stream segments in these three watersheds for habitat use by Fall chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*Oncorhynchus mykiss*). Fall chinook redds were common in only two tributaries: Lower RB4C Wasteway and Red Rock Coulee. Steelhead spawning was not observed in any tributary but individual steelhead were observed on three occasions in Red Rock Coulee. When found, we mapped redds of spawning anadromous salmonids. At redd locations, we made measurements of velocity, depth, substrate, and hyporheic flow.

Habitat was evaluated using the Physical Habitat Simulation (PHABSIM) component of the Instream Flow Incremental Methodology (IFIM) and Geographical Information Systems. We integrated our observations of available habitat, habitat selected by Fall chinook, and computational and geographical techniques to estimate absolute habitat and quality of habitat available in five stream segments. The modeling suggested that for all life stages except Fall chinook spawning, Crab Creek ranked first in habitat quantity and RBC Wasteway ranked last. This was probably because Crab Creek was the longest stream segment modeled and RBC was the shortest. In terms of quality, RBC had the lowest quality habitat among stream segments. Upper RB4C Wasteway had the best quality habitat for chinook spawning and Lower RB4C Wasteway had the best chinook juvenile habitat.

This study suggests that current anadromous salmonid use in these three watersheds is limited to Fall chinook salmon. Steelhead individuals were observed but no spawning was documented. Fall chinook rearing was observed in Lower RB4C Wasteway and Red Rock Coulee. Habitat modeling suggests that available chinook rearing habitat may be limited in these three watersheds. Use of available habitat by juveniles is uncertain.

2. INTRODUCTION

This research had two goals: 1) determine where anadromous salmonids were using habitat in three Columbia Basin Irrigation Project (CBIP) watersheds (Figure 1): RB4C Wasteway (also known as Sand Hollow Creek) (Figures 2, 3, and 4), Crab Creek (Figures 5, 6, 7, and 8), WB-10 Wasteway (Figure 9) and 2) in two watersheds, estimate the potential of anadromous salmonid habitat in five stream segments: Lower RB4C Wasteway (from confluence with Columbia River upstream to WA Hwy. 26 crossing), Upper RB4C Wasteway (from WA Hwy. 26 crossing upstream to S SW Road (N 46°55'49.25"W119°54'59.87")), Crab Creek, Red Rock Coulee (Figure 8), and Royal Branch Canal (RBC) Wasteway (Figure 5).

To evaluate habitat use by anadromous salmonids, we investigated adult spawning and juvenile rearing activity. Adult spawning activity was investigated by reconnaissance, intensive observation, and measurements of microhabitat parameters near redds. Reconnaissance for spawning activity of all stream segments took place between November, 1996 and March, 1998. Intensive observations of spawning and redd building showed that Lower RB4C Wasteway and Red Rock Coulee were the two stream segments that had the most Fall chinook salmon spawning activity. Thus, it was expected and we found that Fall Chinook rearing activity was concentrated in these same two stream segments. Furthermore, we made measurements of microhabitat parameters near redds and at several Fall chinook juvenile rearing locations in Lower RB4C Wasteway and Red Rock Coulee. Steelhead were observed in only Red Rock Coulee. However, no steelhead spawning or rearing activity was observed in any stream segments investigated in this study. Anadromous salmonid habitat potential was quantified using the Physical Habitat Simulation (PHABSIM) component of the Instream Flow

Incremental Methodology (IFIM) and Geographical Information Systems (GIS). These two habitat evaluation models provided estimates of the absolute habitat amount available for anadromous salmonid spawning and rearing.

3. METHODS

Spawning habitat was evaluated through five methods. First, streams were reconnoitered for use by spawning adult salmon or steelhead; spawning and redd locations were mapped. Second, after fry emergence, column velocity, bottom velocity, depth, substrate, and hyporheic flow were measured on the redds. Third, recording temperature probes were placed in five study reaches of three watersheds. Fourth, spawning habitat was modeled using PHABSIM. Fifth, in two study reaches (Upper RB4C Wasteway and Lower RB4C Wasteway), GIS was used to evaluate habitat.

3.1. *RECONNAISSANCE*

Reconnaissance for spawning activity and redds was done by traversing and mapping. Stream segments were traversed by foot or kayak and spawning activity recorded by drawing a map of 1) the exact redd location after spawning activity or 2) when repeated redd building at a single microsite by the female was observed. Stream segments were traversed during and after the spawning season and when irrigation was not operational on the CBIP.

Figure 1. Locations of the three Columbia Basin Irrigation Project watersheds evaluated during this study: overview of the RB4C Wasteway, Crab Creek, and WB-10 Wasteway study locations.

Figure 2. RB4C Wasteway Study Area is referred to upon USGS topographic maps as Sand Hollow Creek. It is indicated on this figure by the heavy blue line.

Figure 3. Lower RB4C Wasteway: Geo-referenced aerial photography with GPSed control points.

Figure 4. Upper RB4C Wasteway: Geo-referenced aerial photography with GPSed control points.

Figure 5. Crab Creek Watershed. Crab Creek Study Area, Section 1 and RBC Wasteway are labeled with GPS points used for habitat typing.

Figure 6. Crab Creek Watershed. Crab Creek Study Area, Section 2 is labeled with GPS points used for habitat typing.

Figure 7. Crab Creek Watershed Crab Creek Study Area, Section 3 is labeled with GPS points used for habitat typing.

Figure 8. Red Rock Coulee Study Area in the Crab Creek watershed. Studied stream reaches are indicated in black.

Figure 9. WB-10 Wasteway in the Wahluke Basin watershed. Studied stream reaches are indicated in black.

3.2. *MICROHABITAT PARAMETERS*

Microhabitat parameters were measured at redd locations during March (Appendix 7.1) following spawning at a discharge similar (± 0.34 m^3/s (12 cfs) in RB4C and Red Rock Coulee) to when spawning was observed. Redds were distinct and still readily observable. Column velocity (0.2 and 0.8 of the total depth) and bottom velocity (3 cm from bottom) were measured (± 0.05 cm/s (0.0016 ft/s) with a ten second average (Marsh McBirney Flo-Mate 2000 velocity meter) at six locations systematically distributed inside the perimeter of the egg mound. Depth (± 0.005 m (0.016 ft) was taken at these same six locations. At each of the six locations, six substrate particles were measured (± 0.5 mm (0.020 in)); a total of 36 particles were measured in each redd. These particles were selected by the observer in proportion to that in which they were observed in the redd.

Substrates were visually estimated during reconnaissance. The dominant substrate and sub-dominant substrates were each estimated in mean diameter (mm). Then, the relative of proportion of each substrate was estimated visually. The substrate code was then recorded according to the procedure in 3.5.1 "Field Procedures."

3.3. *HYPORHEIC FLOW*

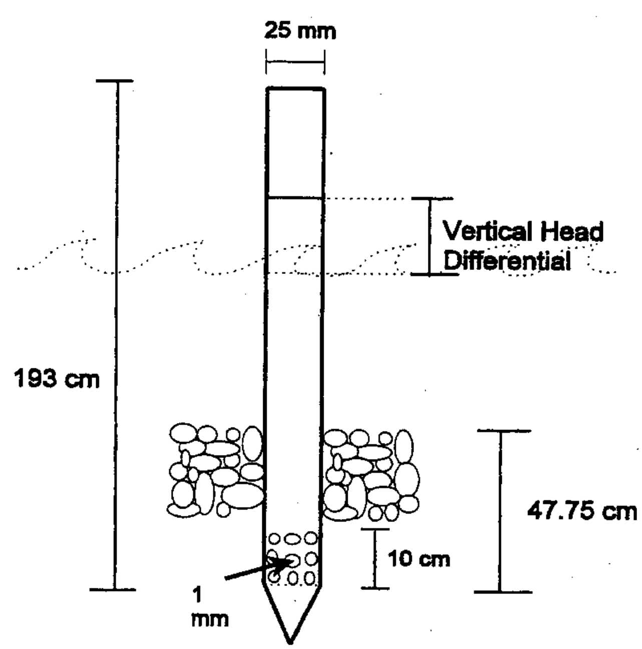
Hyporheic flow in redds was monitored using 92 piezometers in RB4C Wasteway and Red Rock Coulee in 1998. In each of these stream segments, 40 piezometers were placed systematically throughout the spawning reach and hyporheic flow direction and magnitude were measured. In 1998, in all redds observed in each stream segment (six in each), a piezometer was placed at the anterior edge of the egg mound.

Piezometers (Figure 10) were constructed of schedule 40 galvanized steel pipe 1.93 m (76 in.) in length with an inner diameter of 2.54 cm (1.0 in.). A band of holes, 10 cm (3.9 in.) in length, was drilled in the pipe; each hole was 1 mm in diameter. A wire mesh screen, 1 mm (.254 in.) mesh, was inserted into the pipe and spanned the hole band. The screen was tacked into place with silicone glue.

3.4. *TEMPERATURE*

Temperature was recorded by Stow-away thermal probes every hour through two years in Crab Creek, RBC Wasteway (Crab Creek drainage), and WB-10 Wasteway. Temperature was recorded every hour through one year in RB4C Wasteway and Red Rock Coulee (Crab Creek drainage). One thermal probe was lost in 1999 in Red Rock Coulee and one thermal probe was lost in 2000 in RB4C.

Figure 10. Cross-sectional view of piezometer.



3.5. *PHYSICAL HABITAT SIMULATION*

Habitat was quantified in five stream segments located within the CBIP. These stream segments were Lower RB4C Wasteway, Upper RB4C Wasteway, Red Rock Coulee, RBC Wasteway, and Crab Creek. The objectives were to 1) relate the influence of discharge on habitat availability in the five study reaches; and 2) estimate the amount of spawning and rearing habitat available at specific discharges for each of the five study reaches.

The PHABSIM portion of IFIM was the method selected for assessing the quantity of fish habitat as a consequence of stream discharge in these wasteways. The IFIM provides a problem-solving framework for fluvial water resource issues (Bovee et al. 1998). PHABSIM is the habitat-modeling component of this framework. PHABSIM involves a variety of simulation tools that characterize the physical habitat structure of a stream and evaluate the flow dependent characteristics of physical habitat as it relates to the biological needs of selected target species and life stages (Milhous et al. 1989). The target species/life stages for this study were juvenile and spawning chinook salmon and steelhead. The end products of the habitat modeling were habitat versus discharge functions for each target species and life stage.

3.5.1. FIELD PROCEDURES

Stream reaches were initially mapped by measuring the length of each habitat type. Habitat mapping occurred at low discharges for each study stream. Field survey data were collected according to Trihey and Wegner (1981). Transects were established in the field using differential leveling techniques. Transects were referenced to an arbitrary, fixed benchmark and identified in the field using survey hubs and flagging. Transect placement attempted to capture the habitat variability of the stream (Table 1). The number of transects varied in each study reach (Table 2). Transect placement did not cover all habitat types identified during habitat mapping. This means that a portion of each modeled stream reach was not modeled because there were no hydraulic data collected for that habitat type (Table 1). The distance between transects was measured to the nearest foot along the stream channel.

We conducted the surveys at a range of discharges to include discharges that occurred during salmon spawning. Depths, mean velocities, and substrates were measured at various points along each transect. Depths were measured using a top setting wading rod. Streambed elevations and water depths were measured to the nearest 3 cm (0.1 ft). Mean column water velocity was measured to the nearest 3 cm (0.1 ft/sec) using a Marsh McBirney Flo-Mate 2000 velocity meter attached to the wading rod. Substrate for PHABSIM was visually assessed using a modified Wentworth coding system (Trihey and Wegner 1981) (Table 3) and converted to a three-digit code to allow coding of non-adjacent substrate classes. The first number was the smallest substrate, the second number was the largest substrate, and the percent of the larger substrate was the third number. For example, a code of 56.2 referred to a cell with 80 % gravel (code 5) and 20 % cobble (code 6).

A temporary staff gage was installed at each stream so that fluctuations in water surface elevations (WSL) could be monitored during data collection. Water surface elevations were also measured to the nearest 0.3 cm (0.01 ft) at each transect. Data were collected at either one, two or three different discharges, depending on stream segment and the range of available spawning flows, for calibration purposes (Table 4).

Table 1. Summary of habitat mapping results.

Stream Reach	Length Habitat Mapped (m (ft))	Length represented by transects (m (ft))	Percent (%) Reach Simulated
Lower RB4C Wasteway	2,524 (8,282)	2,103 (6,900)	83.3
Upper RB4C Wasteway	3,817 (12,523)	3,236 (10,616)	84.8
Red Rock Coulee	4,065 (13,338)	3,187 (10,456)	78.4
RBC	107 (352)	82 (270)	76.7
Crab Creek	34,831 (114,276)	32,184 (105,590)	92.4

Table 2. Cumulative distance (m (ft)) between transects placed on CBIP streams from the most downstream transect to the upper most transect.

Stream	Transect									
	1	2	3	4	5	6	7	8	9	10
Lower RB4C Wasteway	0	5.5 (18)	8.5 (28)	28.0 (92)	64.9 (213)	104.9 (344)	128.9 (423)	144.5 (474)	190.2 (624)	246.0 (807)
Red Rock Coulee	0	106.7 (350)	139.0 (456)	264.9 (869)	336.5 (1104)	471.8 (1548)	477.6 (1567)	515.4 (1691)	629.1 (2064)	
Upper RB4C Wasteway	0	22.6 (74)	46.9 (154)	78.0 (256)	112.8 (370)	137.2 (450)				
Crab Creek	0	32.0 (105)	41.8 (137)	86.3 (283)	102.7 (337)					
RBC	0	15.8 (52)	27.4 (90)	38.1 (125)	54.3 (178)					

Table 3. Substrate coding used in this study.

Substrate Description	Code Assigned
plant	1
mud	2
silt (< 0.062 mm)	3
sand (0.062-2 mm)	4
gravel (2-64 mm)	5
cobble (64-250 mm)	6
boulder (250-4000 mm)	7
bedrock (solid rock)	8

Table 4. Discharges measured during field surveys at CBIP streams.

Stream	Discharge (cms (cfs))	Survey Dates
Lower RB4C Wasteway	0.76 (27)	Dec 03, 1998
	3.20 (113)	Oct 20, 1998
	5.13 (181)	Aug 17, 1998
Upper RB4C Wasteway	0.68 (24)	Dec 01, 1998
	3.31 (117)	Aug 19, 1998
Red Rock Coulee	2.18 (77)	Aug 18, 1998
	2.46 (87)	Oct 22, 1998
Crab Creek	5.15 (182)	Dec 02, 1998
	5.66 (200)	Aug 18, 1998
RBC	0.25 (9)	Dec 03, 1998

3.5.2. HYDRAULIC MODELING

Two computer programs in PHABSIM, Manning's Equation (MANSQ) and Water Surface Profile (WSP), were used to simulate WSLs in the five study streams. The MANSQ program was used for Lower RB4C Wasteway, Upper RB4C Wasteway, Red Rock Coulee, and Crab Creek. RBC was modeled using the WSP model. This model is more appropriate for simulating elevations in habitat with backwater effects, such as pools and runs. Each transect was weighted according to the proportion of habitat type that each transect represented in each stream reach as determined from the habitat mappings (Tables 5-9). Calibration of the data consisted of manipulating parameters within each program (i.e., beta values in MANSQ and Manning's n values in WSP) until simulated WSLs were within 0.3 m (0.1 ft) of measured WSLs. After the data decks were calibrated, a hydraulic simulation using the IFG4 program was run on each file to simulate depths and velocities. Each simulation covered a range of flows from 0.4 to 2.5 times the measured flow. It should be noted that the predictive capability of these data sets was limited by the number of calibration flows measured. The most accurate simulated WSLs were for those flows closest to the calibration flows within each data set. Velocity adjustment factor (VAF) was one output parameter from the IFG4 program that was useful in examining the relative accuracy of the velocity simulations.

We modeled each stream based on a 305-meter (1,000-foot) reach in three steps: First, we determined the habitat type a transect represented. Second, we determined the proportion of stream comprised by each habitat type (Tables 5-9). Third, we applied these proportions to determine the length of each habitat type in the modeled 305-meter (1,000-foot) reach. Additional details on model calibrations and transect weighting are presented by Smith (2000).

Table 5. Summary of transect habitat proportions for Lower RB4C Wasteway.

Habitat Type[1]	Length[2] m (ft)	% Total Length[3]	% Total Length * 305 m (1000 ft)	Transect Represented
LG Run	217.5 (713.7)	0.103	31.5 (103.47)	1,2,4
LGRun/Eddy	38.5 (126.3)	0.018	5.5 (18.30)	3
HG Run	176.1 (577.6)	0.084	25.6 (83.71)	5,9
LG Rif	122.8 (402.8)	0.058	17.7 (58.37)	6
HG Rif	122.6 (402.1)	0.058	17.7 (58.28)	7,8
Cas	1,426.4 (4,679.9)	0.678	206.8 (677.92)	10
Sum	2,103 (6,900.4)	0.999	305 (1000)	

1: LG Run = low gradient run; LG Run/Eddy = low gradient run and eddy; HG Run = high gradient run; LG Rif = low gradient riffle; HG Rif = high gradient riffle; Cas = cascade
2: Lengths determined from habitat typing
3: Percent represented by habitat type (Length/Total length)

Table 6. **Summary of transect habitat proportions for Upper RB4C Wasteway.**

Habitat Type[1]	Length[2] m (ft)	% Total Length[3]	% Total Length * 305 m (1000 ft)	Transect Represented
Cascades	251.5 (825)	0.079	24.1 (79)	1
LG Rif	2,065.8 (6,777.8)	0.637	194.3 (637.23)	2,4
HG Run	786.5 (2,580.4)	0.243	74.1 (242.60)	3
LG Run/Eddy	131.9 (432.6)	0.041	12.5 (40.67)	5,6
Sum	3,236 (10,616)	1.00	305 (1000)	

1: LG Rif = low gradient riffle
HG Run = high gradient run
LG Run/eddy = low gradient run and eddy
2: Lengths determined from habitat typing
3: Percent represented by habitat type (Length/Total length)

Table 7. **Summary of transect habitat proportions for Red Rock Coulee.**

Habitat Type[1]	Length[2] m (ft)	% Total Length[3]	% Total Length * 305 m (1000 ft)	Transect Represented
LG Run	921.7 (3,024)	0.289	88.1 (289)	1,3
Pool/LG Run	514.5 (1,688)	0.161	49.1 (161)	2
LG Riff	774.8 (2,542)	0.243	74.1 (243)	4,5,6,7
HG Riff/Eddy	132.9 (436)	0.042	12.8 (42)	8
HG Riff	843.1 (2,766)	0.265	80.8 (265)	9
Sum	3,187 (10,456)	1.00	305 (1000)	

1: LG Run = low gradient run HG Rif/Eddy = high gradient riffle and eddy
LG Rif = low gradient riffle HG Rif = high gradient riffle
2: Lengths determined from habitat typing
3: Percent represented by habitat type (Length/Total length)

Table 8. **Summary of transect habitat proportions for Crab Creek.**

Habitat Type[1]	Length[2] m (ft)	% Total Length[3]	% Total Length * 305 m (1000 ft)	Transect Represented
LG Run	28,262 (92,723)	0.8781	267.8 (878.1)	1,4,5
LG Run/Eddy	3,709 (12,169)	0.1152	35.1 (115.2)	2
HG Run/Eddy	213 (699)	0.0066	2.0 (6.6)	3
Sum	32,184 (105,590)	0.999	305 (1000)	

1: LG Run = low gradient run LG Run/Eddy = high gradient riffle and eddy
HG Run/Eddy = high gradient run and eddy
2: Lengths determined from habitat typing
3: Percent represented by habitat type (Length/Total length)

Table 9. Summary of transect habitat proportions for RBC.

Habitat Type[1]	Length[2] m (ft)	% Total Length[3]	% Total Length * 305 m (1000 ft)	Transect Represented
LG Run/Eddy	10.3 (33.9)	0.125	38.1 (126)	1
LG Run	50.9 (167.1)	0.619	188.8 (620)	4
LG Run/Ucut	4.4 (14.3)	0.053	16.2 (53)	2,3
HG Run	16.7 (54.8)	0.201	61.3 (201)	5
	82 (270)	0.999	305 (1000)	

1: LG Run/Eddy = high gradient run and eddy LG Run/Ucut bank = low gradient run/undercut bank
LG Run = low gradient run HG Run = high gradient run
2: Lengths determined from habitat typing Ucut = Undercut Banks
3: Percent represented by habitat type (Length/Total length)

3.5.3. HABITAT SUITABILITY CRITERIA

Habitat Suitability Criteria (HSC) are used by PHABSIM to relate observed fish use of depth, velocity and substrate to predicted channel hydraulic values of depth, velocity and substrate. The observed values of depth, velocity and substrate where fish occur theoretically reflect the microhabitat conditions that a given life stage will freely select.

Habitat suitability criteria were developed for spawning chinook salmon in the study streams using site-specific observations (see Section 3.2). Visual observations were conducted in Lower RB4C Wasteway and Red Rock Coulee when salmon were spawning. Field observations included measurements of depth, mean column velocity, and substrate where individual salmon redds were located. Each sampling point was treated as one observation. The data for these observations are presented in Appendix 7.2. A total of 23 observations was made of salmon redds in the study streams.

All field data were entered into a microcomputer for development of HSC. Procedures described by Bovee (1986), Cheslak and Garcia (1988), and Slauson (1988) were used to derive habitat utilization curves (i.e., HSCs). Frequency distributions were developed for each habitat variable by plotting various intervals of each parameter versus the frequency of observations. Parameter bin sizes were determined from the following equation taken from Sturges (1926, as cited in Cheslak and Garcia 1988):

$C = R/(1+3.322 * \log_{10}N)$, where

C = interval size

R = measured range of the variable

N = number of observations

For example, 23 spawning salmon observations were made at velocities ranging from 20 cm/sec (0.65 ft/sec) to 90 cm/sec (2.96) ft/sec (Appendix 7.2). Thus, R = 2.31, N = 23, and C = 0.42.

Each frequency distribution was smoothed by using nonparametric tolerance limits (90% confidence limits) as described by Bovee (1986) and Slauson (1988). Weighting factors were assigned to various ranges of each variable. A weighting factor of 1.0 was applied to the range of the variable that encompassed 50% of the observations. A weighting factor of 0.5 was assigned to the range encompassing 75% of the observations, 0.2 to the range encompassing 90%, and 0.1 to the 95% range. The HSCs were normalized with a value of 1.0 considered optimum, and a value of 0.0 considered unusable. Thus, suitability indexes ranged from 0.0 - 1.0; 0 was the least utilized value and 1.0 the most utilized value. For our study, calculated bin sizes for the HSC development were 0.1 m (0.33 ft.) for depth, 12.8 cm/sec (0.42 ft/sec) for velocity, and 0.24 for substrate. Final HSCs for spawning chinook are presented in Appendix 7.2.

Criteria values for spawning chinook salmon were assigned to each variable (depth, velocity, and substrate) and submitted to the U.S. Fish and Wildlife Service (FWS) for review.

The FWS felt that the utilization criteria were appropriate to use in the habitat simulations (Jeff Thomas, FWS, Yakima WA., personal communication). The remainder of the HSC's used in the study were supplied by the Washington State Department of Fish and Wildlife (Caldwell et al. 1999) (Appendix 7.2). These included curves for spawning and juvenile chinook salmon and steelhead. The depth and velocity supplied in the HSC were left unchanged. The substrate values were recoded to match the three-digit substrate coding used in this study.

3.5.4. HABITAT SIMULATION

Habitat was simulated using the model HABTAT (Milhous et al. 1989). Habitat predictions were made using the HSC discussed in the previous section. The output from the HABTAT simulation was habitat area, expressed as Weighted Usable Area (WUA) (m^2/305 m (ft^2/1000 ft of stream)). Weighted Usable Area was calculated by multiplying the depth, velocity, and substrate HSC values for a life stage at predicted hydraulic conditions, and cell surface area. Weighted Usable Area for spawning and juvenile rearing was predicted for a range of discharges at the five study sites. Total habitat (m^2(ft^2)) was calculated by multiplying WUA times the total reach length (m (ft)). For spawning fish, total habitat was estimated at one discharge representative of discharges at which spawning occurred. Total habitat for juveniles was estimated at two discharges, one representative of the irrigation off-season and one representative of the irrigation season.

3.6. *GEOGRAPHIC INFORMATION SYSTEM*

The GIS portion of this study was conducted for Lower and Upper RB4C study reaches only by acquiring aerial photography and classifying it by fish habitat parameters. The method used was divided into a five step process: 1) locating control points, 2) collecting aerial photography, 3) geo-referencing the aerial photography using the control points, 4)classifying the photography by fish habitat parameters, and 5) calculating the area for unique combinations of fish habitat parameters. Each of these steps is described in more detail below.

Step one consisted of locating control points, which would later be used to geo-reference the aerial photography. It was decided that individual white panels, approximately 1.8 m (six ft) in diameter, should be staked into the ground. The study area was divided into two main areas: Lower RB4C Wasteway and Upper RB4C Wasteway. Twenty-five control points were located in Lower RB4C Wasteway and 55 in Upper RB4C Wasteway. There were approximately 90-120 m (300-400 ft) between each control point. This was sufficient to locate from 5-10 control points within each aerial photo (average of 6.8). The locations of each control point were located close to the main channel, but outside the meanders. The locational information was gathered using a Global Positioning System (GPS). The GPS system used was the Federal PLGR+96 GPS unit, created by Rockwell. Through Department of Interior studies, these units have been found to have approximately a four meter spatial resolution, when the averaging option is used.

Step two involved collecting the aerial photography. The photography was flown with black/white film on March 11, 1999. The flight date occurred before the beginning of the irrigation season to acquire low flow levels (0.3-0.6 cms (10-20 cfs)) not influenced by irrigation run-off. The photography was acquired at approximately a 1:2000 scale. Aerial photos with control points are shown in Figures 3 and 4 for Lower and Upper RB4C Wasteway, respectively. The photos were cropped and blown-up twice to produce 1:500 scale images. These were scanned at a resolution of 600 dpi.

Step three used the control points from step one to geo-reference the images created in step two. The Environmental Systems Research Institute's (ESRI) software 'ArcView Image Analyst' was used to perform the geo-referencing. The projection chosen to geo-reference the images to was State Plane using the Washington North Zone and the North American Datum 1983 (NAD83). The State Plane projection was used, since it conformed to the current database and produces good area calculations. The Root Mean Squared (RMS) error for each image ranged from 1.61 to 15.7 m (5.3 to 51.5 ft) with an average of 7.9 m (25.9 ft).

Step four required a fishery biologist to classify the geo-referenced images from step three into three fish habitat parameters (in-stream habitat types(riffle, run, pool etc.), velocity, and depth.) The ESRI software 'ArcView' was used to "on-screen digitize" the three habitat parameters from the images.

Step five produced the final area calculations for input into the equations. All three habitat parameters were combined using the Union routine in ESRI's 'ArcInfo' software. The combined habitat parameters were then converted into an ArcView shapefile and the areas calculated for the different combinations of habitat parameters.

4. RESULTS

4.1. *RECONNAISSANCE AND MAPPING OF REDDS*

We visited the six study stream segments during two winters. Water chemistry for each study segment was adequate for spawning at certain times of the year. Water temperatures were compared to the upper lethal limit (24°C (75 °F)) for steelhead (Bell 1991) (Figures 11-15). The temperature at which 50% mortalities (LC-50) occur in juvenile chinook salmon is 25 °C (77 °F), when acclimated to 15 °C (59 °F) (Armour 1991). We observed redds in four study segments: Lower RB4C Wasteway, Crab Creek mainstem, Red Rock Coulee, and RBC Wasteway. Appendix 7.3 summarizes observations of anadromous salmonid presence in study segments where no associated water chemistry was measured. Appendix 7.4 summarizes data where water chemistry and presence and activity of anadromous salmonids was recorded. Appendix 7.5 summarizes measurements of Fall chinook juvenile habitat in Red Rock Coulee. Stream segments that we visited but no anadromous salmonid redds were observed included Upper RB4C Wasteway (above the Hwy. 26 culvert), Crab Creek mainstem, tributaries, and laterals upstream of the weir located at Razor Ranch, RBC Wasteway upstream of Lower Crab Creek Road crossing, and WB-10 Wasteway.

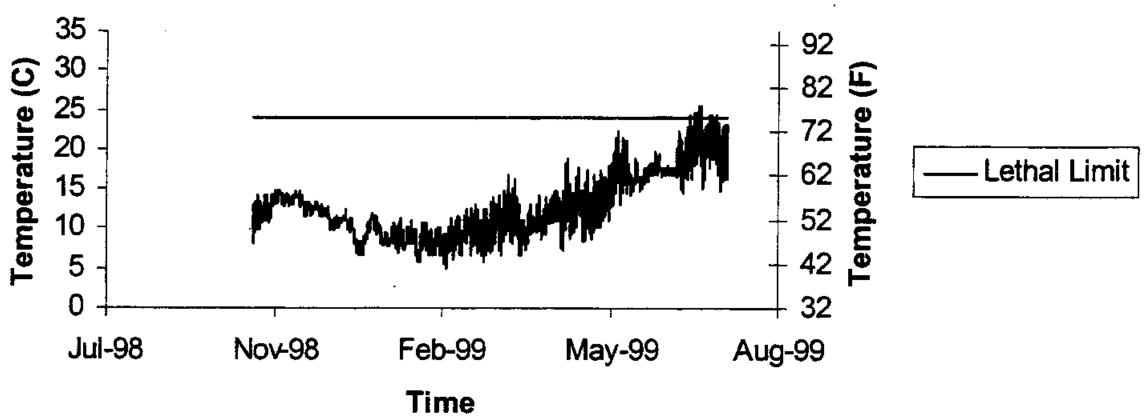
4.1.1. LOWER RB4C WASTEWAY

In Lower RB4C Wasteway, temperatures for spawning and rearing were adequate for both Fall chinook and steelhead (Figure 11). Furthermore from October 1998 through June

1999, temperatures appeared adequate for Fall chinook salmon and steelhead to spawn, rear, and outmigrate successfully.

The known discharge record appears in Appendix 7.6. In the two years on record, October 1, 1993 through September 30, 1995, irrigation was initiated in March of each year.

Figure 11. Temperatures in 1998-1999 in Lower RB4C Wasteway (also known as Sand Hollow Creek), Grant County, WA. Upper lethal temperature limit for steelhead is 24°C (75 °F) (Bell 1991).



On March 17, 1998, we observed Fall chinook parr holding in two low velocity areas in Lower RB4C Wasteway (Appendix 7.4). The influence of high discharge during irrigation season on juvenile salmonid habitat in Lower RB4C is discussed in Section 4.3.1. We noted significant increases in average channel velocity with increased discharge. However, no mapping of low velocity areas occurred at different discharges; it is possible that low velocity areas were created at other locations.

In Lower RB4C Wasteway, the mean velocity in the Fall chinook redds (Appendix 7.1) adjacent to the substrate was 23 cm/s (0.75 f/s) (Standard Deviation = 10.9 cm/s (0.36 f/s)). Mean particle size in the redds was 40.1 mm (1.6 in) while the standard deviation about this mean was 40.47 mm (1.6 in). Mean water depth over the redds was 0.2 m (0.65 ft.) and the standard deviation about this mean was 0.07 m (0.23 ft). These measurements were made with a temporary staff gage reading of 0.2 m (0.65 ft) and the spawning occurred with a staff gage reading of 0.25 m (0.8 ft). This small difference in stage may have had an unknown influence on velocity measurements. The substrate measurements should accurately represent the substrates at the time of spawning. The depth measurements under-represent the actual depths at time of spawning by 0.05 m (0.15 ft). One important note regarding RB4C Wasteway is that a large sediment load is present at certain times of the year. One effect of sediment on salmon egg incubation is to reduce the permeability of the gravel (Cooper 1965) thus increasing mortality of salmon eggs in gravel beds. The influence of sediment on incubating eggs would probably be smaller for Fall chinook salmon than steelhead if they both spawned in Lower RB4C Wasteway. This is because discharge during the Fall chinook incubation period was smaller, and thus stream capacity to deliver sediment was reduced, compared to the March- June period when steelhead would use the wasteway.

In Lower RB4C Wasteway, from WA Highway 26 to the Columbia River, the range of redds observed was usually 6 to 12. However, data (Table 10) from WA Department of Natural Resources suggest the number of spawners may be as high as 47 in some years. Chinook salmon parr were observed in Lower RB4C Wasteway on March 17, 1998. Seventeen parr were collected at one location and 35 were observed at a second location near a redd.

Table 10. **Redd and carcass counts of Fall chinook salmon in Columbia Basin Project stream segments. These data were collected by Duane Unland (WA Dept. of Natural Resources).**

Stream Segment	Date of Survey	No. of Spawning Fish	No. of Carcasses	No. of Redds
Lower RB4C Wasteway	11/14/95	12	7	11
Lower RB4C Wasteway	11/10/96	26	3	9
Lower RB4C Wasteway	10/25/97	47	9	12
Red Rock Coulee	11/14/95	6	0	3
Red Rock Coulee	11/10/96	8	0	4
Red Rock Coulee	10/25/97	9	1	6

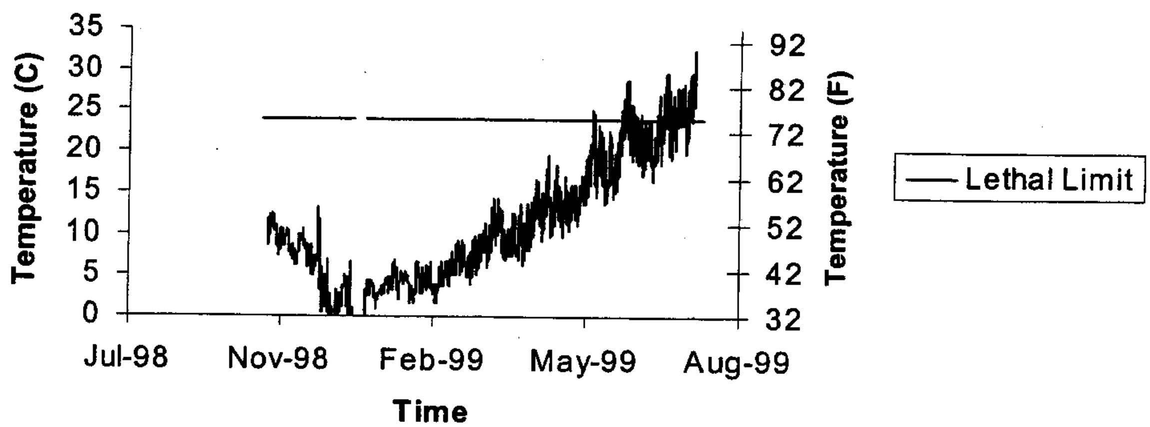
4.1.2. UPPER RB4C WASTEWAY

Temperature (Figure 11) and discharge (Appendix 7.6) were similar between Lower and Upper RB4C Wasteway. No anadromous salmonids were ever observed in Upper RB4C Wasteway.

4.1.3. CRAB CREEK BELOW RAZOR RANCH WEIR

The third stream segment we evaluated was Lower Crab Creek; this creek was larger (mean width in study area = 10.3 m (34 ft.)) (Discharge record in Appendix 7.7) than RB4C Wasteway and flowed into the Columbia River in the Priest Rapids Reservoir pool. Temperatures appeared adequate for Fall chinook spawning and rearing (Figure 12 and Appendix 7.8).

Figure 12. Temperatures in 1998-99 in Crab Creek at Lower Crab Creek Road crossing, Grant County, WA. Recorded temperatures below zero obviously suggest the temperature probe was dewatered and recording ambient air temperature on December 18, 1998. Upper lethal temperature limit for steelhead is 24°C (75 °F) (Bell 1991).

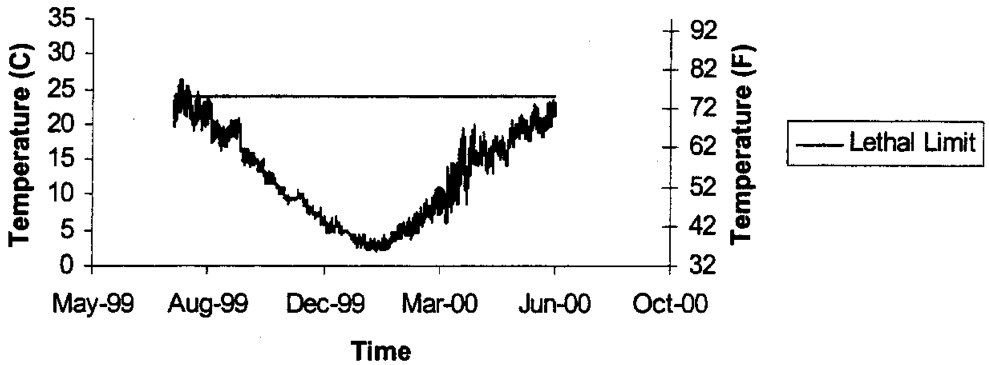


Duane Unland (Washington Department of Natural Resources (DNR), personal communication) observed four chinook salmon ascending a short rapid approximately 7.7 km (4.6 mi.) from Hwy. 243 and Priest Rapids Reservoir. The principal limitation to spawning in Crab Creek may be substrate. We observed very little area with substrates considered appropriate for spawning. While lack of substrates may be a problem in Crab Creek, appropriate substrates appeared abundant in Red Rock Coulee, a tributary of Crab Creek.

4.1.4. RED ROCK COULEE

The fourth stream segment we evaluated was Red Rock Coulee; this stream was similar in size to RB4C Wasteway (Mean width = 5 m (16 ft.)). Temperature records demonstrated that temperatures were appropriate for spawning and rearing by Fall chinook and steelhead in 1999-2000 (Figure 13). Substrates appeared appropriate for spawning (Appendix 7.1). We observed

Figure 13. Temperatures in 1999-2000 in Red Rock Coulee, 1.0 km downstream of Red Rock Reservoir, Grant County, WA. Upper lethal temperature limit for steelhead is 24°C (75 °F) (Bell 1991).



six redds produced in the autumn of 1997 and 1998. Data from state authorities (Table 10) shows this is within the range of variation they have observed. We have received numerous anecdotal reports of fishermen taking steelhead from Red Rock Coulee. Two area biologists, Chris Carlson (Grant County Public Utility District, Chief Fish Biologist, personal communication) and Jeff Korth (WA Fish and Game, Ephrata, personal communication), reported steelhead in Red Rock Coulee about 20 years ago. Duane Unland (WA DNR, Biologist, personal communication), observed steelhead in Red Rock Coulee on January 30, 1995. On March 19, 1998, Mark Bowen, Craig Conley (USBR, Ephrata Field Office) and Hugh MacEachen (S. Columbia Irrigation District) observed one steelhead in Red Rock Coulee moving through riffle areas. Also in 1998, one steelhead was observed on two separate occasions by the FWS in cooperation with this study. No steelhead redds were ever identified in Red Rock Coulee. Effective August 18, 1997, steelhead in Crab Creek or any of its tributaries were listed as endangered (National Marine Fisheries Service (NMFS), 1997). Steelhead in Red Rock

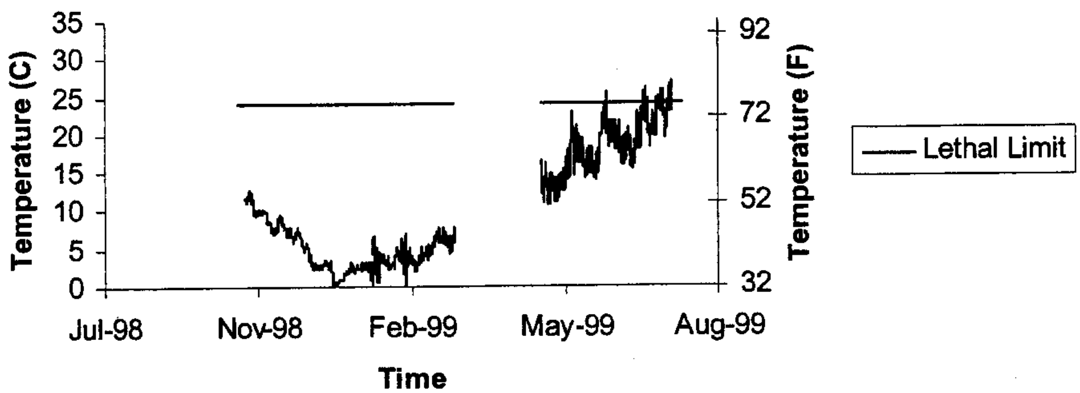
Coulee are part of an Evolutionarily Coulee. Effective August 18, 1997, steelhead in Crab Creek or any of its tributaries were listed as endangered (National Marine Fisheries Service (NMFS), 1997). Steelhead in Red Rock Coulee are part of an Evolutionarily Significant Unit (ESU) in the Upper Columbia River. Larry Brown (WA Fish and Wildlife, Wenatchee, personal communication) reported that steelhead using Red Rock Coulee are likely to be wild or Wells Hatchery Stock. This latter stock was the only hatchery stock listed as a population essential for recovery under the final rule (NMFS 1997). Red Rock Coulee and another Crab Creek tributary, RBC Wasteway, were similar in many respects.

4.1.5. RBC WASTEWAY

The fifth stream segment we evaluated was RBC Wasteway; this wasteway was similar in size to Red Rock Coulee. In addition, temperatures (Figure 14) appeared appropriate for Fall chinook spawning and rearing. However, steelhead incubation and rearing may be limited in duration due to high temperatures in late spring. Substrates appeared appropriate for spawning by anadromous salmonids.

This wasteway has four popular recreational lentic habitats. RBC wasteway originates in a spring 15.0 km (9.3 mi.) ESE of Royal City. The wasteway then flows into Merry Lake, then Lenice Lake, and then Nunnelly Lake. All three of these lakes are renowned fishing locations for rainbow trout. The wasteway exits Nunnelly Lake and flows less than one km (0.6 mi.) before passing over a high gradient riffle (vertical drop 5 m (16 ft.) in a 5-m (16 ft.) horizontal distance). This drop might form an impediment to chinook salmon spawners, but probably not for steelhead. RBC Wasteway then flows into "No Wake Lake." This lake is a popular recreational skiing lake that is privately owned and has resident smallmouth bass (*Micropterus dolomieu*). Owners include Mrs. Fanny Burkett who lives on the NW shore of the

Figure 14. Temperatures in 1998-99 in RBC Wasteway 0.3 km upstream of the confluence with Crab Creek. Missing temperatures were during periods when the temperature probe was dewatered and recording ambient air temperature in March and April. Upper lethal temperature limit for steelhead is 24°C (75 °F) (Bell 1991).



lake and Doug Sladey (Seattle, WA). We observed no impediments to anadromous salmonid spawning migrants. However, No Wake Lake could provide a significant predation gauntlet for salmonid parr migrating downstream. On September 20, 1996, we observed one rainbow trout (41 cm TL (16 in.)) in RBC Wasteway. We believe this fish was a stream-resident because of its size and the time of year of the observation.

4.1.6. WB-10 WASTEWAY

The final stream segment we evaluated was WB-10 Wasteway. Temperature data (Figures 15a and 15b) suggested the lower portion of WB-10 might support Fall chinook rearing habitat. Most of the channel in which WB-10 flowed was concrete lined. However, we observed some areas in which substrates appeared appropriate for spawning. It appeared, because the gradient is currently so great, that some channel alteration would be required before this section could be used for anadromous salmonid spawning or rearing. No evidence of anadromous salmonid habitat use was ever observed in WB-10.

Figure 15a. Temperatures in 1998-99 in WB-10 Wasteway 0.2 km upstream of the confluence with the Columbia River, Franklin County, WA. Upper lethal temperature limit for steelhead is 24°C (75 °F) (Bell 1991).

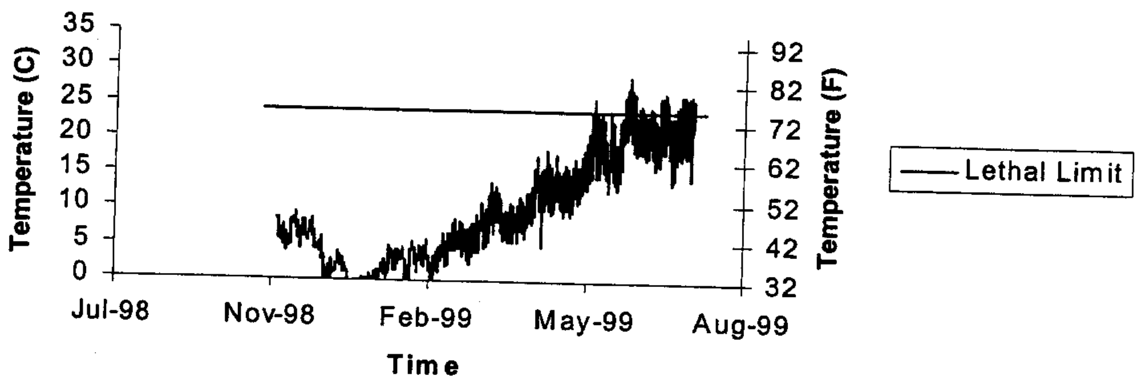
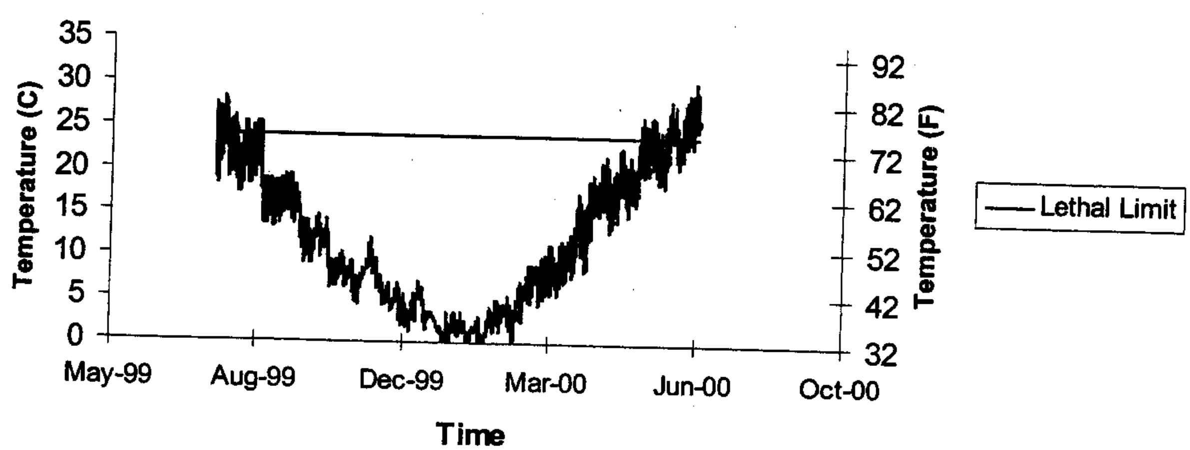


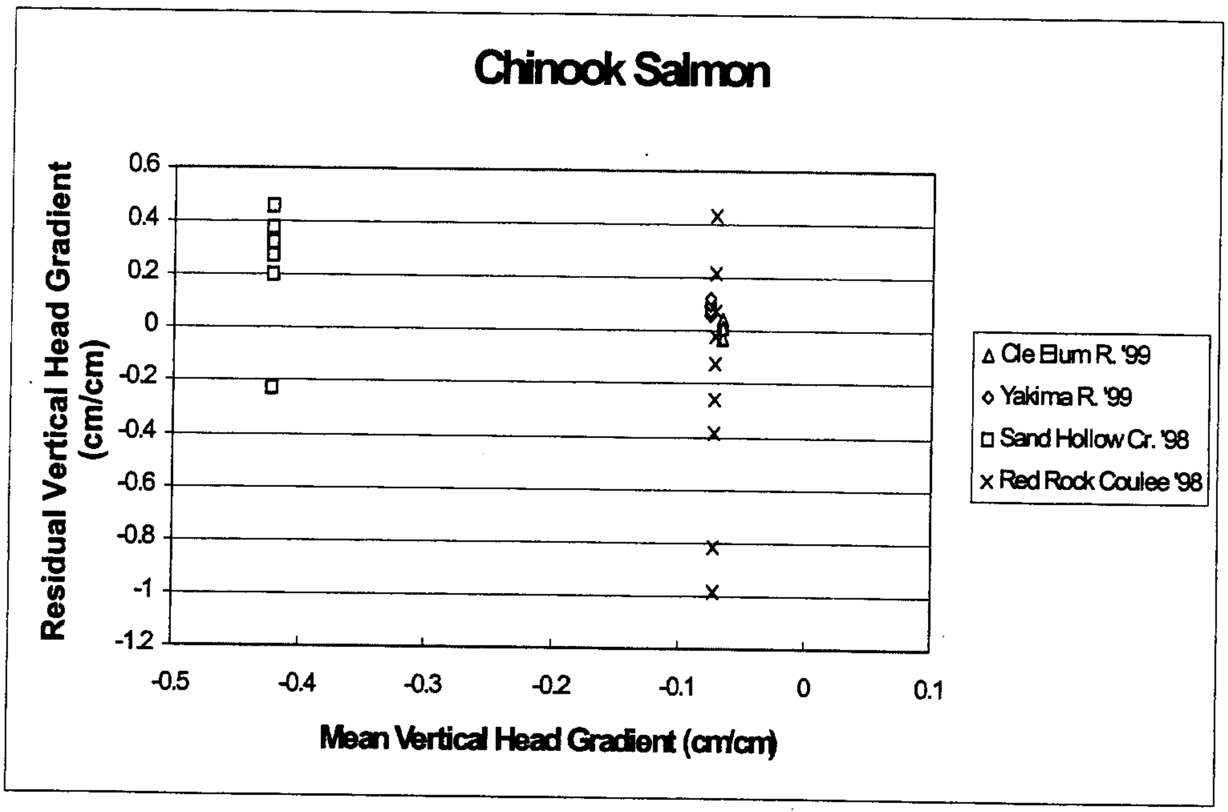
Figure 15b. Temperatures in 1999-2000 in WB-10 Wasteway 0.2 km upstream of the confluence with the Columbia River, Franklin County, WA. Upper lethal temperature limit for steelhead is 24°C (75 °F) (Bell 1991).



4.2. *HYPORHEIC FLOW IN REDDS*

In Lower RB4C Wasteway (Sand Hollow Creek), we found Fall chinook tended to select redd sites with upwelling hyporheic flow relative to that available in the rest of the spawning reach (Figure 16). Such was not the case in Red Rock Coulee. Many females selected sites with large vertical head gradient (VHG), but many of these sites exhibited downwelling hyporheic flow.

Figure 16. Residual of vertical head gradient in two wasteways of the Columbia Basin Project and two streams of the Yakima River basin.



4.3. *PHYSICAL HABITAT SIMULATION*

Final WUA versus discharge functions are summarized in Tables 11-15 for each study reach. The following sections describe these results in more detail.

Table 11. Weighted usable area as a function of discharge for Lower RB4C Wasteway.

Q		Chinook Spawning (CBIP)		Chinook Spawning (Regional)		Chinook Juveniles (Regional)		Steelhead Spawning (Regional)		Steelhead Juveniles (Regional)	
cms	cfs	$m^2/305$ m	$ft^2/1000$ ft	$m^2/305$ m	$ft^2/1000$ ft	$m^2/305$ m	$ft^2/1000$ ft	$m^2/305$ m	$ft^2/1000$ ft	$m^2/305$ m	$ft^2/1000$ ft
0.4	15	93	998	61	659	200	2148	75	806	112	1202
0.6	20	125	1343	111	1195	227	2448	137	1476	139	1495
0.8	30	183	1971	209	2248	216	2328	225	2427	180	1938
1.1	40	227	2445	288	3097	175	1880	292	3146	197	2120
1.4	50	250	2695	335	3606	159	1714	296	3190	197	2121
1.7	60	269	2894	334	3597	160	1720	315	3392	189	2038
2.0	70	278	2991	341	3672	155	1671	337	3626	185	1993
2.3	80	282	3037	348	3745	138	1483	358	3849	184	1977
2.5	90	291	3130	346	3728	134	1443	349	3758	183	1972
2.8	100	302	3254	339	3654	109	1176	344	3703	176	1891
3.4	120	309	3325	322	3463	59	636	369	3973	161	1733
4.0	140	310	3335	328	3528	40	434	367	3947	150	1613
4.2	150	309	3322	331	3565	38	411	339	3647	140	1505

Table 12. Weighted usable area as a function of discharge for Upper RB4C Wasteway.

Q		Chinook Spawning (CBIP)		Chinook Spawning (Regional)		Chinook Juveniles (Regional)		Steelhead Spawning (Regional)		Steelhead Juveniles (Regional)	
cms	cfs	$m^2/305$ m	$ft^2/1000$ ft	$m^2/305$ m	$ft^2/1000$ ft	$m^2/305$ m	$ft^2/1000$ ft	$m^2/305$ m	$ft^2/1000$ ft	$m^2/305$ m	$ft^2/1000$ ft
0.3	10	245	2633	69	747	68	730	84	908	37	393
0.6	20	368	3965	227	2439	75	806	237	2550	59	639
0.8	30	388	4174	324	3484	67	721	332	3575	66	712
1.1	40	312	3354	384	4138	61	652	357	3841	68	731
1.4	50	251	2702	379	4081	58	624	333	3581	67	720
1.7	60	193	2073	322	3461	58	627	278	2996	63	674
2.0	70	162	1739	280	3011	58	624	236	2539	62	672
2.3	80	141	1516	254	2732	56	600	207	2228	62	668
2.5	90	117	1254	217	2340	53	566	170	1833	63	679
2.8	100	101	1092	198	2127	48	521	156	1685	63	682
3.4	120	79	848	158	1699	42	454	117	1255	63	677
4.0	140	61	655	146	1574	41	444	102	1097	63	677
4.2	150	51	552	140	1504	41	443	100	1078	61	657

Table 13. Weighted usable area as a function of discharge for Red Rock Coulee.

Q		Chinook Spawning (CBIP)		Chinook Spawning (Regional)		Chinook Juveniles (Regional)		Steelhead Spawning (Regional)		Steelhead Juveniles (Regional)	
cms	cfs	m²/305 m	ft²/1000 ft	m²/305 m	ft²/1000 ft	m²/305 m	ft²/1000 ft	m²/305 m	ft²/1000 ft	m²/305 m	ft²/1000 ft
0.4	15	334	3590	114	1232	30	325	98	1051	29	314
0.6	20	422	4539	196	2115	40	434	177	1905	37	404
0.8	30	501	5387	338	3640	50	534	361	3883	52	562
1.1	40	504	5428	458	4925	56	598	477	5133	64	686
1.4	50	500	5385	554	5967	63	677	550	5919	73	788
1.7	60	448	4819	606	6526	67	719	591	6367	79	856
2.0	70	381	4101	636	6844	63	682	620	6672	87	939
2.3	80	312	3363	643	6924	66	707	617	6642	94	1015
2.5	90	257	2767	639	6877	68	734	567	6100	98	1052
2.8	100	214	2306	632	6804	72	770	526	5665	101	1088
3.4	120	131	1414	575	6186	90	968	437	4705	119	1283
4.0	140	80	857	487	5243	98	1052	351	3776	117	1261
4.2	150	63	679	443	4767	100	1078	317	3411	117	1255

Table 14. Weighted usable area as a function of discharge for Crab Creek.

Q		Chinook Spawning (CBIP)		Chinook Spawning (Regional)		Chinook Juveniles (Regional)		Steelhead Spawning (Regional)		Steelhead Juveniles (Regional)	
cms	cfs	m²/305 m	ft²/1000 ft	m²/305 m	ft²/1000 ft	m²/305 m	ft²/1000 ft	m²/305 m	ft²/1000 ft	m²/305 m	ft²/1000 ft
2.0	70	123	1322	118	1272	178	1917	94	1010	139	1496
2.3	80	111	1198	128	1383	180	1936	101	1083	149	1607
2.5	90	93	997	138	1490	178	1914	107	1147	157	1685
2.8	100	74	798	147	1583	176	1899	96	1029	163	1757
3.4	120	55	593	145	1565	175	1883	96	1038	176	1894
4.0	140	45	484	140	1512	163	1756	99	1066	184	1985
4.5	160	36	385	135	1450	147	1583	101	1092	198	2129
5.1	180	27	295	128	1375	135	1454	101	1082	206	2217
5.7	200	18	189	124	1332	124	1338	96	1028	208	2243
6.2	220	7	79	123	1328	116	1249	97	1046	207	2226
7.1	250	0	0	122	1318	111	1195	98	1059	199	2139
8.5	300	0	0	121	1302	101	1082	100	1078	177	1909
9.9	350	0	0	121	1298	93	997	101	1087	158	1703
11.3	400	0	0	90	965	88	950	101	1090	153	1648
12.7	450	0	0	0	0	77	833	50	535	92	993
14.2	500	0	0	0	0	73	786	50	539	88	949

Table 15. Weighted usable area as a function of discharge for RBC.

Q		Chinook Spawning (CBIP)		Chinook Spawning (Regional)		Chinook Juveniles (Regional)		Steelhead Spawning (Regional)		Steelhead Juveniles (Regional)	
cms	cfs	m^2/305 m	ft^2/1000 ft	m^2/305 m	ft^2/1000 ft	m^2/305 m	ft^2/1000 ft	m^2/305 m	ft^2/1000 ft	m^2/305 m	ft^2/1000 ft
0.1	3	4	39	1	10	29	312	26	282	9	96
0.1	5	6	65	4	47	48	513	30	319	14	154
0.2	7	13	139	9	92	58	623	30	318	22	232
0.3	9	14	153	14	150	64	685	34	366	37	403
0.3	11	13	141	23	250	65	704	34	370	47	504
0.4	13	12	134	38	405	67	718	36	383	56	600
0.4	15	10	111	54	583	68	731	38	408	60	643
0.5	17	8	81	69	742	68	731	39	417	63	674
0.5	19	6	67	80	858	68	729	41	442	64	687
0.6	21	5	57	87	938	67	726	44	468	64	692

4.3.1. LOWER RB4C WASTEWAY

Weighted Usable Area varied considerably depending on life stage, discharge and HSC used (Table 11). Weighted Usable Area was predicted from a low of 0.4 cms (15 cfs) to a high of 4.2 cms (150 cfs). Based on the CBIP HSC for spawning chinook salmon, WUA was maximized at 4.0 cms (140 cfs). Using the Washington State regional curves, predicted chinook spawning was maximized at 2.3 cms (80 cfs), and chinook rearing was maximized at 0.6 cms (20 cfs). Steelhead spawning was maximized at 3.4 cms (120 cfs), and steelhead rearing was maximized at 1.4 cms (50 cfs). Chinook spawning (CBIP and Washington State) and steelhead spawning habitat/discharge relationships were similar to one another.

Total spawning habitat was estimated at 0.7 cms (23 cfs). This discharge was chosen as representative of discharges occurring during spawning. Total habitat predicted based on three HSCs (CBIP chinook, regional chinook, and regional steelhead) was somewhat similar (Table 16). Habitat estimated using the CBIP chinook criteria was 979 m^2 (10,564 ft^2) compared to 935

m^2 (10,426 ft^2) for the regional chinook criteria. Estimated steelhead habitat was 1,096 m^2 (12,151 ft^2).

Total rearing habitat was estimated at 0.7 cms (23 cfs) (irrigation off-season) and 2.3 cms (80 cfs) (irrigation season). Habitat generally decreased at higher discharges for juvenile chinook, but increased with discharge for juvenile steelhead (Table 17). This may reflect the observed preference for faster water velocity by juvenile steelhead when compared to juvenile chinook (Bjornn and Reiser 1991).

Table 16. Total spawning habitat (m^2 (ft^2)) for each study reach at typical spawning discharges. Total habitat calculated from Weighted Usable Area (WUA) multiplied by reach length modeled.

Reach	Discharge		Length		Chinook (CBIP)		Chinook (Regional)		Steelhead (Regional)	
	cms	cfs	m	ft	m^2	ft^2	m^2	ft^2	m^2	ft^2
Lower RB4C	0.7	23	2,103	6,900	979	10,564	935	10,426	1,096	12,151
Upper RB4C	0.7	23	3,236	10,616	3,957	42,761	2,663	29,226	2,769	30,341
Red Rock Coulee	2.5	87	3,187	10,456	2,800	30,803	6,687	72,052	6,029	65,486
Crab Creek	7.3	256	32,184	105,590	0	0	12,863	138,956	9,845	112,031
RBC	0.3	9	82	270	4	41	4	41	9	99

Table 17. **Total rearing habitat (m^2 (ft^2)) for each study reach at typical rearing discharges. Total habitat calculated from Weighted Usable Area (WUA) multiplied by reach length modeled.**

Reach	Discharge		Length		Chinook (Regional)		Steelhead (Regional)	
	cms	cfs	m	ft	m^2	ft^2	m^2	ft^2
Lower RB4C	0.7	23	2,103	6,900	1,544	16,643	1,027	11,233
	2.3	80			952	10,233	1,269	13,641
Upper RB4C	0.7	23	3,236	10,616	775	8,291	647	7,017
	2.3	80			594	6,370	658	7,091
Red Rock Coulee	2.5	87	3,187	10,456	706	7,591	1,016	10,885
	3.4	120			940	10,121	1,243	13,415
Crab Creek	6.0	213	32,184	105,590	12,557	135,155	21,885	235,677
	9.2	325			10,236	109,814	17,675	190,696
RBC	0.3	9	82	270	17	185	10	109
	0.31	11			17	190	13	136

4.3.2. UPPER RB4C WASTEWAY

Upper RB4C Wasteway had less hydraulic data collected than Lower RB4C Wasteway (Table 4). Weighted Usable Area appeared to be higher for spawning than rearing life stages at any given discharge (Table 12). Weighted Usable Area was predicted from a low of 0.3 cms (10 cfs) to a high of 4.2 cms (150 cfs). Based on the CBIP HSC for spawning chinook salmon, WUA was maximized at 0.8 cms (30 cfs). Using the Washington State regional HSCs, predicted chinook spawning was maximized at 1.1 cms (40 cfs), and chinook rearing was maximized at 0.6 cms (20 cfs). Steelhead spawning and rearing were maximized at 1.1 cms (40 cfs). As in Lower RB4C Wasteway, WUA for juvenile chinook and steelhead generally declined at high discharges (> 1.1 cms (40 cfs)). The slope of Upper RB4C Wasteway was steep (1.8 % slope) and there were few low velocity refugia at these higher discharges.

The same spawning discharge of 0.7 cms (23 cfs) used for habitat predictions in Lower RB4C Wasteway was used for Upper RB4C Wasteway. Total habitat predicted based on three HSCs (CBIP chinook, regional chinook, and regional steelhead) was more variable and abundant than at Lower RB4C Wasteway (Table 16). Habitat estimated using the CBIP chinook criteria was 3,957 m^2 (42,761 ft^2) versus 2,663 m^2 (29,226 ft^2) for the regional chinook criteria. Estimated steelhead habitat was 2,769 m^2 (30,341 ft^2).

Total rearing habitat was estimated at 0.7 cms (23 cfs) (irrigation off-season) and 2.3 cms (80 cfs) (irrigation season). Habitat decreased with increasing discharge for juvenile chinook, and slightly increased for juvenile steelhead (Table 17). This was similar to Lower RB4C Wasteway.

4.3.3. RED ROCK COULEE

Red Rock Coulee had less hydraulic data collected than Lower RB4C Wasteway (Table 4). Weighted Usable Area varied considerably depending on life stage, discharge and HSC used (Table 13). Weighted Usable Area was predicted from a low of 0.4 cms (15 cfs) to a high of 4.2 cms (150 cfs). Based on the CBIP HSC for spawning chinook salmon, WUA was maximized at 1.1 cms (40 cfs). Using the Washington State regional curves, chinook spawning was maximized at 2.3 cms (80 cfs), and chinook rearing was maximized at 4.2 cms (150 cfs). Steelhead spawning was maximized at 2.0 cms (70 cfs), and steelhead rearing was maximized at 3.4 cms (120 cfs).

Unlike Lower RB4C Wasteway or Upper RB4C Wasteway, juvenile rearing WUA increased with discharge. The Red Rock Coulee site had a lower gradient (0.45 % slope) and had more low velocity refugia in the form of mid channel islands, deep runs, and bank protrusions. As discharge increased, many of these areas provided the predicted increase in WUA. Predictions of spawning with Washington State HSC for chinook and steelhead were similar; however, the CBIP prediction for spawning chinook was noticeably different. The CBIP chinook spawning WUA peaked more rapidly and declined to a lower value than when using either of the Washington State spawning HSCs.

A spawning discharge of 2.5 cms (87 cfs) was used for Red Rock Coulee. Total habitat predicted based on three preference curves (CBIP chinook, regional chinook, and regional steelhead) was similar for the regional chinook and steelhead criteria (6,687 m^2 (72,052 ft^2) versus 6,029 m^2 (65,486 ft^2) respectively), but considerably lower for the CBIP chinook criteria (2,800 m^2 (30,803 ft^2)) (Table 16).

Total rearing habitat was estimated at 2.5 cms (87 cfs) (irrigation off-season) and 3.4 cms (120 cfs) (irrigation season). This was the only reach where estimates of juvenile rearing habitat increased with discharge for juvenile chinook and steelhead (Table 17).

4.3.4. CRAB CREEK

Crab Creek had a smaller amount of hydraulic data collected than the hydraulic simulation on Lower RB4C Wasteway (Table 4). Weighted Usable Area varied considerably depending on life stage, discharge and HSC used (Table 14). Weighted Usable Area was predicted from a low of 2.0 cms (70 cfs) to a high of 14.2 cms (500 cfs). Based on the CBIP HSC for spawning chinook salmon, WUA was maximized at 2.0 cms (70 cfs). Washington State regional curves predicted that chinook spawning was maximized at 2.8 cms (100 cfs), and chinook rearing was maximized at 2.3 cms (80 cfs). Steelhead spawning was maximized at 2.5 cms (90 cfs), and steelhead rearing was maximized at 5.7 cms (200 cfs).

A spawning discharge of 7.3 cms (256 cfs) was used for Crab Creek. Total spawning habitat was similar for the regional chinook and steelhead criteria (12,863 m^2 (138,956 ft^2) versus 9,845 m^2 (112,031 ft^2) respectively), but not existent for the CBIP criteria (Table 16). The high values derived from the regional chinook and steelhead criteria reflect that the stream reach was the longest analyzed in this study.

Total rearing habitat was estimated at 6.0 cms (213 cfs) (irrigation off-season) and 9.2 cms (325 cfs) (irrigation season). Habitat estimates decreased for juvenile chinook and steelhead as discharge increased (Table 17). As with the spawning habitat estimates, the large amount of habitat predicted was related to the long length of stream that was mapped.

Both the Washington State chinook spawning and steelhead spawning WUA predictions dropped precipitously at high discharges. Similar to Red Rock Coulee, as simulated discharges increased, the WSL surpassed the head stake elevation and very low velocities were predicted. This may account for the low WUA predictions at higher discharge. Weighted Usable Area for juvenile chinook peaked at lower discharge than steelhead (Table 14).

4.3.5. RBC WASTEWAY

RBC had the smallest amount of hydraulic data collected (Table 4). It was also the smallest stream for which we conducted IFIM habitat modeling.. Weighted Usable Area varied considerably depending on life stage, discharge and HSC used (Table 15). Weighted Usable Area was predicted from a low of 0.1 cms (3 cfs) to a high of 0.6 cms (21 cfs). Based on the CBIP HSC for spawning chinook salmon, WUA was maximized at 0.3 cms (9 cfs). In general, there was little change of WUA at all discharges for the CBIP HSC. The Washington State regional curves predicted that chinook spawning, steelhead spawning, and steelhead rearing were maximized at 0.6 cms (21 cfs). Both the chinook spawning and steelhead rearing WUA steeply increased with discharge. Steelhead spawning and chinook juvenile WUA increased with discharge more slowly.

A spawning discharge of 0.3 cms (9 cfs) was used for RBC. Total habitat was essentially the same for the CBIP chinook and regional chinook criteria (4 m^2 (41 ft^2)) (Table 16). Habitat estimated for spawning steelhead was higher with a total of 9 m^2 (99 ft^2) (Table 16). Spawning habitat was not common in RBC.

Total rearing habitat was estimated at 0.3 cms (9 cfs) (irrigation off-season) and 0.31 cms (11cfs) (irrigation season). Habitat estimates increased slightly with discharge for juvenile chinook and steelhead (Table 17).

4.4. *GEOGRAPHIC INFORMATION SYSTEM*

The GIS used two hypotheses for combining layers. The null model for Fall chinook spawning (Table 18) made habitat type (riffle, run, pool, etc.), velocity, and depth of equal importance, 0.33. The alternative hypothesis made habitat type the most important (0.5), velocity next most important (0.33), and depth the least important (0.17).

Table 18. Total habitat (m^2 (ft^2)) using GIS for each study reach typical of discharge at which chinook spawning occurs.

Reach	Discharge		Length		Chinook Spawning Habitat	
	cms	cfs	m	ft	m^2	ft^2
Lower RB4C Wasteway - Null Hypothesis	0.7	23	2,103	6,900	1,281.2	13,790.7
Alternative Hypothesis	0.7	23	2,103	6,900	655.9	7,059.9
Upper RB4C Wasteway- Null Hypothesis	0.7	23	3,236	10,616	4,134.2	44,500.6
Alternative Hypothesis	0.7	23	3,236	10,616	4,060.7	43,709.4

The null model for Fall chinook rearing (Table 19) made habitat type (riffle, run, pool, etc.), velocity, and depth of equal importance (0.33). The alternative hypothesis made velocity the most important (0.5), habitat type next most important (0.45), and depth the least important (0.05).

Table 19. Total habitat (m^2 (ft^2)) using GIS for each study reach typical of discharge at which chinook rearing occurs.

Reach	Discharge		Length		Chinook Spawning Habitat	
	cms	cfs	m	ft	m^2	ft^2
Lower RB4C Wasteway - Null Hypothesis	0.7	23	2,103	6,900	1,172.4	12,619.6
Alternative Hypothesis	0.7	23	2,103	6,900	2,216.97	23,863.3
Upper RB4C Wasteway- Null Hypothesis	0.7	23	3,236	10,616	520.5	5,602.7
Alternative Hypothesis	0.7	23	3,236	10,616	3,556.5	38,281.4

5. DISCUSSION

5.1. *PHYSICAL HABITAT SIMULATION*

This study quantified the relationship between discharge and habitat availability in the irrigation return flows of the CBIP in eastern Washington State. Habitat was quantified for fall chinook salmon and steelhead spawning and rearing. The amount of habitat at discharges representative of each reach during the spawning and rearing seasons was also calculated.

Habitat quantification was complicated by the absence of site specific HSC for fall chinook juveniles and steelhead spawning and juveniles. Habitat suitability criteria used for these species and life stages were the Washington State regional HSC data. Because of the small size of the study site streams, these regional HSC criteria are difficult to interpret, and are of questionable value. In all cases, the HSC developed from spawning observations in study streams should be considered the most reliable. In general, the WUA predicted by the regional curves for fall chinook and steelhead spawning were in excess of the WUA predictions based on the CBIP HSC.

5.1.1. DISCHARGE - HABITAT RELATIONSHIPS

The first objective was to describe the relationship between discharge and habitat availability in five reaches of irrigation return flows. Tables 11 through 15 display this relationship for each reach. The optimum discharge for spawning based on the CBIP HSC for Fall chinook salmon varied with the stream reach. For Lower RB4C Wasteway, the optimum discharge was 4 cms (140 cfs). Typical autumn discharge after the irrigation season is usually 0.8 to 1.1 cms (30 to 40 cfs), so optimum-spawning conditions will not be met in Lower RB4C Wasteway. For Upper RB4C Wasteway, the optimum discharge was 0.8 cms (30 cfs). This discharge corresponds to the typical autumn discharge found in RB4C Wasteway. Access to Upper RB4C Wasteway by salmon is blocked by a culvert under Washington State Highway 26. Should Upper RB4C Wasteway be made accessible, the WUA available for spawning at 0.8 cms (30 cfs) in RB4C Wasteway will increase from 183 m^2/ 305 m (1,971 ft^2/ 1,000 ft) to 571 m^2/ 305 m (6,145 ft^2/ 1,000 ft) (Tables 11 and 12), an increase of approximately 211%.

The optimum discharge in Red Rock Coulee based on CBIP HSC for Fall chinook spawning was 1.1 cms (40 cfs). This is not an unusual autumn discharge in Red Rock Coulee, and optimum spawning conditions are likely realized here. The optimum discharge for Crab Creek occurred at 2 cms (70 cfs). Typical fall discharges are variable at Crab Creek, but usually range from approximately 6 to 10 cms (210 to 361 cfs) between October 31 and November 7 (Appendix 7.5). At

RBC, optimum spawning conditions were at 0.3 cms (9 cfs). This is a typical discharge for RBC and as a result optimum spawning conditions are met here.

The optimum discharge for steelhead spawning varied depending on the stream reach. In Lower RB4C Wasteway, the optimum discharge was 3.4 cms (120 cfs); for Upper RB4C Wasteway it was 1.1 cms (40 cfs). Red Rock Coulee had an optimum steelhead spawning discharge of 2 cms (70 cfs). In Crab Creek the optimum discharge was 2.5 cms (90 cfs), and in RBC it was 0.6 cms (21 cfs). Steelhead spawning occurs between January and April. This time period spans the change between the irrigation off-season and the irrigation season. If spawning occurs during the irrigation off-season, spawning conditions will be near optimum in Upper RB4C Wasteway. Spawning condition will not be optimum in Lower RB4C Wasteway, Red Rock Coulee, Crab Creek and RBC. Steelhead spawning in these reaches requires discharge more typical of the irrigation season. However, if spawning occurs during the irrigation season there are other potential limitations to the habitat. The increase in discharge and resumption of agricultural activities will increase the transport of fine sediment (Williamson et al. 1998). This may limit the ability of steelhead to spawn successfully in the study reaches.

Although there were insufficient data to develop site-specific HSC criteria for juvenile Fall chinook or steelhead, there is a need to assess the amount of juvenile rearing habitat. For salmonids, such as Fall chinook, that rear in lotic habitat, populations are not usually limited by spawning habitat but by rearing habitat (Mason 1976; Reeves et al. 1991, Brannon et al. 1999). The number of positions in a stream that a juvenile can inhabit is limited partly by physical habitat. Examination of the WUA prediction (Table 11 through 15) shows that the juvenile WUA for all discharges was much lower than that of spawning with the exception of Crab Creek and RBC. Juvenile habitat increased with discharge at RBC. Weighted Usable Area predictions were most accurate between discharges of

0.25-0.31 cms (9-11 cfs) at RBC, and the hydraulic simulation was reasonable for the discharges of interest based on the VAF distribution. Thus, the increase in habitat with discharge at RBC may be real, but further investigation is recommended.

This study was partially limited by the HSC criteria used. Data for steelhead adults and juveniles or Fall chinook juveniles were difficult to collect because the presence of steelhead was unusual and observation of Fall chinook juveniles was obstructed by turbid water typical of the irrigation season. As a result, we partially depended on HSCs developed for other systems.

Despite the limitations associated with the juvenile HSC, there was a pertinent trend that coincided with field observations. The amount of juvenile habitat appeared to be restricted in the study streams due to the apparent low occurrence of low-velocity refugia. High velocities associated with increased discharge during the irrigation season were a potential limitation for juvenile salmonid habitat in the study reaches. But even during the irrigation off-season, rearing habitat may have been limited. In fact, relative to predicted spawning habitat, the amount of rearing habitat was relatively constant across a range of discharges and study streams. Assuming that the HSC criteria for juveniles were applicable, the amount of rearing habitat was restricted in the study streams.

5.1.2. HABITAT AVAILABILITY AT SPECIFIC DISCHARGES

The second objective was to quantify the amount of habitat available in each study reach at a representative discharge. This information allowed comparisons of the amount of habitat among reaches and determinations of habitat availability in each reach.

There are two types of information that can be extracted from estimates of habitat availability. The first is an estimate of total availability. This number is the product of the WUA estimated at a particular discharge and the length of stream modeled hydraulically. A longer reach of stream produces a larger estimate of habitat (Tables 16 and 17).

Stream reach comparisons revealed that Upper RB4C Wasteway had a large amount of inaccessible habitat. This habitat, should it become accessible, has potential to be productive. Comparisons to Lower RB4C Wasteway may allow some insight into the potential of Upper RB4C Wasteway to support spawning Fall chinook salmon.

Observations made as part of this study showed that approximately 15 to 30 adults spawn annually in Lower RB4C Wasteway. Estimates made by Grant Count Public Utility District (PUD) biologists showed as many as 300 fish spawning in Lower RB4C Wasteway (Grand County PUD unpublished data). Fall chinook access to Upper RB4C Wasteway could result in larger numbers of spawning fish using Upper RB4C Wasteway based on use of Lower RB4C Wasteway by Fall chinook, and habitat availability.

Habitat availability in Crab Creek and Red Rock Coulee as estimated from the regional chinook and steelhead-spawning HSCs was higher than estimates based on the CBIP HSCs. This was due to differences between regional and CBIP HSCs. Although the velocity HSCs for spawning chinook salmon were similar, there were obvious differences between the two sets of HSCs for depth and substrate (Appendix 7.2). Examination of the depth parameter shows that the regional curve covered a broader range of depths and peaked in deeper water (1.2-3.4 ft) than the CBIP curve (0.7-1.3 ft). Differences between the substrate HSCs were even more dramatic with CBIP curve showing spawning chinook used substrate codes between about 45 (sand/gravel) and 57 (gravel/boulder). In contrast, the regional substrate HSC showed that salmon used a wider variety of substrates for spawning; from code 35 (silt/gravel) to 67 (cobble/boulder). The broad range of depth and substrate use for regional HSCs resulted in more available spawning habitat when compared with the tighter bounded CBIP HSCs (Tables 13 and 14). The regional estimates appeared to overestimate available habitat based on field observations of spawning salmon. For example, the amount of spawning habitat available in Red Rock Coulee using CBIP HSCs was approximately 1,821 m^2 (20,239 ft^2) higher than Lower RB4C Wasteway (Table 16). Fall chinook observations in Red Rock Coulee made as part of this study showed that 15-30 fish used Red Rock Coulee for spawning; similar to Lower RB4C Wasteway. The regional estimates predicted almost 3 times the habitat than the CBIP estimate in Red Rock Coulee (Table 16). While salmon numbers are influenced by a host of variables other than physical habitat, the similar numbers found in Red Rock Coulee and RB4C Wasteway support the argument that the spawning habitat estimates using regional HSCs may have over- estimated available habitat.

If the spawning habitat estimates in Red Rock Coulee were high using the regional HSCs, then they may have also been high in Crab Creek. No chinook spawning habitat was estimated in Crab Creek based on the CBIP criteria at 7.3 cms (256 cfs) (Table 16). However, the regional criteria estimated over 9,000 m^2 (100,000 ft^2) of steelhead and chinook spawning habitat. It should be noted that discharge in Crab Creek during chinook spawning season (October 31 - November 7) can range from 6 to 10 cms (210 to 361 cfs) (Appendix 7.7). In this discharge range, some spawning habitat appeared present. Based on CBIP HSCs, habitat increases at flows less than or equal to 6.2 cms (220 cfs) (Table 14). Thus, estimates of zero habitat using CBIP HSCs at one spawning flow were not entirely accurate since a few fish spawn in Crab Creek; although spawning habitat was not abundant.

Differences in the amount of habitat simulated among stream segments was reflected in differences in several hydraulic parameters (Figure 17). For example, Crab Creek was the largest and longest stream studied among all streams. The channel was wider and deeper than the other streams and typically had more flow during spawning and rearing periods than the other streams. Velocities were slower in Crab Creek than the other streams and substrates in Crab Creek were smaller; dominated by sand and gravel. These physical parameters separated Crab Creek from the other streams. Obviously, Crab Creek had different hydraulics than the other streams, resulting in different WUA versus discharge results.

The second type of information that was calculated from habitat estimates was normalization of habitat to unit length of stream (Tables 20 and 21). This number allowed comparisons of habitat quality among streams. Upper RB4C Wasteway appeared to have the highest quality of habitat available for Fall chinook spawning based on the CBIP criteria (Table 20). Red Rock Coulee was second and Lower RB4C Wasteway was third. Little or no habitat quality were predicted in Crab Creek and RBC. However using regional curves, Crab Creek showed some potential for chinook and steelhead spawning.

Lower RB4C Wasteway had the highest quality chinook rearing habitat (Table 21) and the highest number of chinook juveniles were observed there (Appendix 7.4). Crab Creek had the second highest habitat quality for chinook rearing. Red Rock Coulee, Upper RB4C Wasteway, and RBC Waterway were all lower in quality and similar to each other with Red Rock Coulee perhaps the best of these three.

Crab Creek had the highest quality steelhead rearing habitat. Since Red Rock Coulee had the highest quality steelhead spawning habitat, it is possible that steelhead might spawn in Red Rock Coulee and rear in Crab Creek, emigrating out before temperatures become too warm in June or July (Appendix 7.8).

Figure 17. Comparisons of mean hydraulic parameters among study streams.

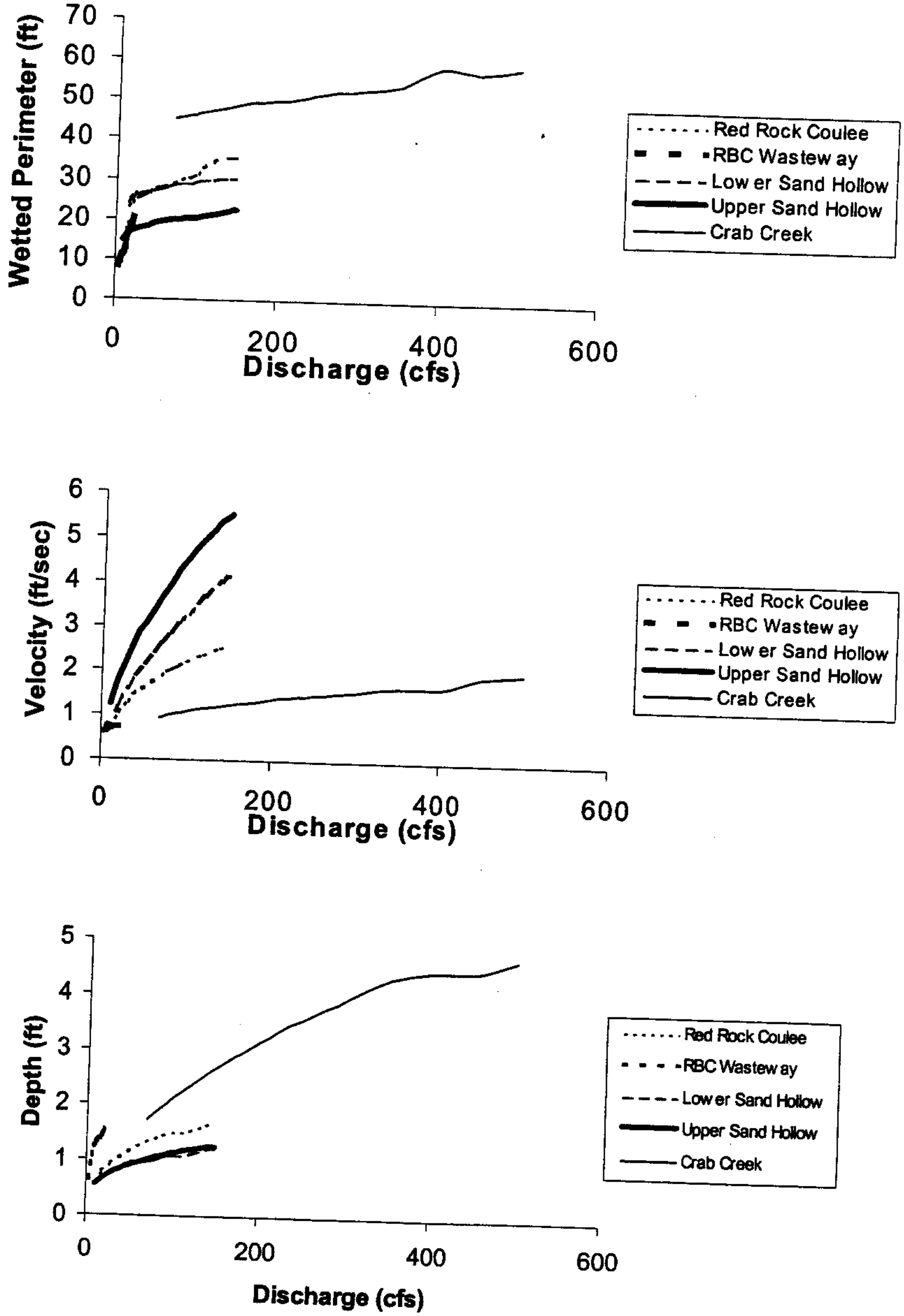


Table 20. **Habitat availability (m^2/m (ft^2/ft) of stream) for spawning chinook and steelhead using PHABSIM.[1]**

Reach	Discharge		Chinook (CBIP)		Chinook (Regional)		Steelhead (Regional)	
	cms	cfs	m^2/m	ft^2/ft	m^2/m	ft^2/ft	m^2/m	ft^2/ft
Lower RB4C Wasteway	0.7	23	0.5	1.5	0.4	1.5	0.5	1.8
Upper RB4C Wasteway	0.7	23	1.2	4.0	0.8	2.8	0.9	2.9
Red Rock Coulee	2.5	87	0.9	2.9	2.1	6.9	1.9	6.3
Crab Creek	7.3	256	0.0	0.0	0.4	1.3	0.3	1.1
RBC	0.3	9	0.1	0.2	0.1	0.2	0.1	0.4

1 Habitat interpolated from WUA versus discharge curves divided by 305 m (1000 ft).

Table 21. **Habitat availability (m^2/m (ft^2/ft) of stream) for juvenile chinook and steelhead using PHABSIM.[1]**

Reach	Discharge		Chinook (Regional)		Steelhead (Regional)	
	cms	cfs	m^2/m	ft^2/ft	m^2/m	ft^2/ft
Lower RB4C Wasteway	0.7	23	0.7	2.4	0.4	1.6
	2.3	80	0.5	1.5	0.6	2.0
Upper RB4C Wasteway	0.7	23	0.2	0.8	0.2	0.7
	2.3	80	0.2	0.6	0.2	0.7
Red Rock Coulee	2.5	87	0.2	0.7	0.3	1.0
	3.4	120	0.3	1.0	0.4	1.3
Crab Creek	6.0	213	0.4	1.3	0.7	2.2
	9.2	325	0.3	1.0	0.5	1.8
RBC	0.25	9	0.2	0.7	0.1	0.4
	0.31	11	0.2	0.7	0.2	0.5

1 Habitat interpolated from WUA versus discharge curves divided by 305 m (1000 ft).

5.2. *GEOGRAPHIC INFORMATION SYSTEM*

The final GIS results met expectations and were similar to the PHABSIM results. Using GPS units with an assumed positional error of at least 4 m (13 ft) to geo-reference uncorrected aerial photography resulted in an average RMS error of 7.9 m (25.9 ft). The on-screen digitizing process (step four) took the overlaps that occurred from the geo-referencing error (step three) into account, thereby minimizing its' effects on the overall area calculations (step five).

Several improvements to the process could have been made if equipment availability and budgetary concerns were not an issue. In step one, a higher quality GPS unit would allow the collection of positional locations at a higher accuracy. At the time of the study, the Federal PLGR+96 GPS units were the best units readily available. A denser network of control points would have helped the geo-referencing process by producing a tighter control. Step two could have been improved by having the photography flown at a better scale resolution. This would result in a better image quality, resulting in even more accurate habitat classifying (step 4). However, considering the network of control points and ground truth observations that agreed with digitized habitat maps, we had more confidence in the GIS models than the PHABSIM, to predict habitat quantity. Quality of habitat using GIS was determined by normalization of habitat to unit length of stream (Table 22). The results were comparable to PHABSIM results where Upper RB4C Wasteway had the best quality habitat for chinook spawning and Lower RB4C Wasteway had the best chinook juvenile habitat (Tables 20, 21 and 22).

Table 22. Habitat availability (m^2/m (ft^2/ft) of stream) for chinook salmon using GIS.

Reach	Discharge		Chinook Spawning Habitat		Chinook Rearing Habitat	
	cms	cfs	m^2/m	ft^2/ft	m^2/m	ft^2/ft
Lower RB4C Wasteway (Null Model)	0.7	23	0.96	3.16	0.88	2.89
Upper RB4C Wasteway (Null Model)	0.7	23	1.05	3.46	0.13	0.43
Lower RB4C Wasteway (Hypothetical Model)	0.7	23	0.49	1.62	5.46	1.66
Upper RB4C Wasteway (Hypothetical Model)	0.7	23	1.03	3.39	2.97	0.91

We ranked stream segments (Table 23 and 24) by quantity and quality, in the following descending order of confidence: GIS output, PHABSIM using the local CBIP curves, and PHABSIM using the regional curves (Tables 23 and 24). Except for chinook spawning, Crab Creek had the highest ranking for quantity of habitat among stream segments for all life stages and RBC had the lowest ranking (Table 23); a result of Crab Creek being the longest stream reach modeled and RBC the shortest. The one exception to Crab Creek's superior ranking was quantity of chinook spawning habitat. We had enough site-specific observations to develop CBIP HSCs for only this life stage. These CBIP HSCs showed chinook spawning at a shallower depth than regional HSCs indicated (Appendix Figure 7.2-1). Also, CBIP HSC for substrate was restricted to a much narrower range of gravel and cobble than regional substrate HSCs (Appendix Figure 7.2-1). Thus, more chinook spawning habitat is found in Upper RB4C because it tends to be shallower with more suitable substrates than Crab Creek. In terms of quality, the only consistent ranking for all life stages was that RBC had the lowest quality habitat among stream segments (Table 24). Upper RB4C Wasteway had the best quality habitat for chinook spawning and Lower RB4C Wasteway had the best chinook juvenile habitat (Table 24).

Table 23. Habitat quantity rankings of study streams for various life stages.

	Chinook Spawning	Chinook Juveniles	Steelhead Spawning	Steelhead Juveniles
Upper RB4C Wasteway	1	4	3	4
Lower RB4C Wasteway	3	2	4	2
Red Rock Coulee	2	3	2	3
Crab Creek	5	1	1	1
RBC	4	5	5	5

Table 24. Habitat quality rankings of study streams for various life stages.

	Chinook Spawning	Chinook Juveniles	Steelhead Spawning	Steelhead Juveniles
Upper RB4C Wasteway	1	4	2	4
Lower RB4C Wasteway	3	1	3	2
Red Rock Coulee	2	3	1	3
Crab Creek	4	2	4	1
RBC	5	5	5	5

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APPENDICES

Appendix 7.1. Habitat measurements in fall chinook salmon redds in two stream segments of the Columbia Basin Project, WA (Grant and Adams Counties).

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub[1]	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
RB4C Wasteway,	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
Redd S9601																				
Position 1	NA	NA	0.27	0.89	0.18	0.59	0.23	0.75	110	4.33	50	1.97	56	2.20	26	1.02	15	0.59	NA	NA
Position 2	NA	NA	0.23	0.75	0.18	0.59	0.17	0.56	87	3.43	2	0.08	20	0.79	37	1.46	95	3.74	NA	NA
Position 3	NA	NA	0.23	0.75	0.18	0.59	0.18	0.59	12	0.47	24	0.94	60	2.36	180	7.09	110	4.33	NA	NA
Position 4	NA	NA	0.21	0.69	0.20	0.66	0.15	0.49	12	0.47	18	0.71	37	1.46	1	0.04	165	6.50	NA	NA
Position 5	NA	NA	0.21	0.69	0.20	0.66	0.15	0.49	29	1.14	55	2.17	18	0.71	12	0.47	78	3.07	NA	NA
Position 6	NA	NA	0.18	0.59	0.14	0.46	0.18	0.59	68	2.68	6	0.24	14	0.55	29	1.14	74	2.91	NA	NA

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
RB4C Wasteway,	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
Redd S9602																				
Position 1	NA	NA	0.03	0.10	0.03	0.10	0.24	0.79	8	0.31	0.05	0.00	140	5.51	25	0.98	70	2.76	NA	NA
Position 2	NA	NA	0.15	0.49	0.18	0.59	0.20	0.66	85	3.35	7	0.28	10	0.39	8	0.31	61	2.40	NA	NA
Position 3	NA	NA	0.25	0.82	0.18	0.59	0.20	0.66	0.05	0.00	3	0.12	30	1.18	180	7.09	1	0.04	NA	NA
Position 4	NA	NA	0.15	0.49	0.15	0.49	0.15	0.49	9	0.35	27	1.06	10	0.39	0.05	0.00	155	6.10	NA	NA
Position 5	NA	NA	0.29	0.95	0.17	0.56	0.23	0.75	1	0.04	8	0.31	20	0.79	14	0.55	155	6.10	NA	NA
Position 6	NA	NA	0.23	0.75	0.20	0.66	0.26	0.85	60	2.36	18	0.71	5	0.20	85	3.35	87	3.43	NA	NA

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
RB4C Wasteway,	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
Redd S9604																				
Position 1	NA	NA	0.40	1.31	0.37	1.21	0.21	0.69	18	0.71	4	0.16	70	2.76	37	1.46	60	2.36	NA	NA
Position 2	NA	NA	0.09	0.30	0.09	0.30	0.29	0.95	42	1.65	1	0.04	11	0.43	40	1.57	60	2.36	NA	NA
Position 3	NA	NA	0.31	1.02	0.14	0.46	0.23	0.75	19	0.75	8	0.31	10	0.39	45	1.77	240	9.45	NA	NA
Position 4	NA	NA	0.12	0.39	0.12	0.39	0.27	0.89	12	0.47	20	0.79	70	2.76	1	0.04	35	1.38	NA	NA
Position 5	NA	NA	0.31	1.02	0.24	0.79	0.21	0.69	11	0.43	46	1.81	65	2.56	3	0.12	50	1.97	NA	NA
Position 6	NA	NA	0.21	0.69	0.18	0.59	0.20	0.66	65	2.56	13	0.51	11	0.43	57	2.24	56	2.20	NA	NA

1 = Sub: Substrate

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
RB4C Wasteway,	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
Redd S9605																				
Position 1	NA	NA	0.24	0.79	0.23	0.75	0.23	0.75	1	0.04	45	1.77	44	1.73	95	3.74	70	2.76	NA	NA
Position 2	NA	NA	0.18	0.59	0.24	0.79	0.24	0.79	43	1.69	75	2.95	70	2.76	60	2.36	73	2.87	NA	NA
Position 3	NA	NA	0.26	0.85	0.08	0.26	0.34	1.12	20	0.79	34	1.34	76	2.99	0.05	0.00	80	3.15	NA	NA
Position 4	NA	NA	0.18	0.59	0.17	0.56	0.31	1.02	22	0.87	1	0.04	85	3.35	40	1.57	60	2.36	NA	NA
Position 5	NA	NA	0.21	0.69	0.17	0.56	0.34	1.12	10	0.39	1	0.04	40	1.57	10	0.39	45	1.77	NA	NA
Position 6	NA	NA	0.11	0.36	0.11	0.36	0.34	1.12	30	1.18	1	0.04	13	0.51	38	1.50	60	2.36	NA	NA

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
RB4C Wasteway,	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
Redd S9601																				
Position 1	0.44	1.44	0.43	1.41	0.43	1.41	0.12	0.39	40	1.57	1	0.04	32	1.26	15	0.59	40	1.57	NA	NA
Position 2	0.41	1.35	0.37	1.21	0.37	1.21	0.12	0.39	18	0.71	20	0.79	10	0.39	7	0.28	40	1.57	NA	NA
Position 3	0.49	1.61	0.40	1.31	0.40	1.31	0.12	0.39	40	1.57	45	1.77	40	1.57	25	0.98	18	0.71	NA	NA
Position 4	0.32	1.05	NA	NA	0.27	0.89	0.09	0.30	36	1.42	23	0.91	23	0.91	31	1.22	1	0.04	NA	NA
Position 5	0.55	1.80	NA	NA	0.34	1.12	0.12	0.39	20	0.79	11	0.43	30	1.18	37	1.46	56	2.20	NA	NA
Position 6	0.34	1.12	NA	NA	0.20	0.66	0.11	0.36	6	0.24	26	1.02	8	0.31	30	1.18	85	3.35	NA	NA

RB4C Wasteway,	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
Redd S9701 Length .76 m -	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
Width .76 m																				
Position 1	0.14	0.45	0.13	0.44	0.06	0.20	0.24	0.80	96	3.78	62	2.44	35	1.38	30	1.18	1	0.04	100	3.94
Position 2	0.17	0.57	0.17	0.57	0.07	0.24	0.21	0.70	7	0.28	9	0.35	56	2.20	18	0.71	9	0.35	2	0.08
Position 3	0.20	0.67	0.21	0.68	0.17	0.56	0.15	0.50	63	2.48	45	1.77	33	1.30	66	2.60	27	1.06	34	1.34
Position 4	0.27	0.90	0.13	0.42	0.04	0.13	0.24	0.80	16	0.63	18	0.71	27	1.06	16	0.63	13	0.51	33	1.30
Position 5	0.30	0.97	0.30	0.97	0.24	0.80	0.15	0.50	100	3.94	35	1.38	26	1.02	20	0.79	9	0.35	1	0.04
Position 6	0.33	1.07	0.36	1.17	0.30	0.97	0.15	0.50	50	1.97	73	2.87	59	2.32	40	1.57	1	0.04	30	1.18

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
RB4C Wasteway	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
Redd S9702																				
Position 1	0.23	0.74	0.17	0.55	0.13	0.43	0.18	0.60	45	1.77	40	1.57	43	1.69	34	1.34	18	0.71	26	1.02
Position 2	0.38	1.24	0.42	1.39	0.34	1.13	0.14	0.45	72	2.83	12	0.47	66	2.60	15	0.59	22	0.87	67	2.64
Position 3	0.23	0.75	0.77	2.53	0.62	2.04	0.14	0.45	26	1.02	17	0.67	18	0.71	17	0.67	9	0.35	20	0.79
Position 4	0.55	1.81	0.41	1.33	0.09	0.29	0.18	0.60	54	2.13	12	0.47	14	0.55	45	1.77	35	1.38	11	0.43
Position 5	0.66	2.15	0.56	1.83	0.39	1.29	0.17	0.55	107	4.21	7	0.28	5	0.20	23	0.91	42	1.65	35	1.38
Position 6	0.34	1.11	0.25	0.81	0.13	0.44	0.14	0.45	28	1.10	36	1.42	25	0.98	65	2.56	20	0.79	30	1.18

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
RB4C Wasteway	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
Redd S9703																				
Position 1	0.95	3.11	0.22	0.73	0.15	0.50	0.15	0.50	28	1.10	49	1.93	8	0.31	20	0.79	36	1.42	30	1.18
Position 2	0.27	0.88	0.20	0.66	0.17	0.55	0.12	0.40	47	1.85	32	1.26	16	0.63	40	1.57	28	1.10	42	1.65
Position 3	0.29	0.96	0.26	0.85	0.20	0.66	0.12	0.40	31	1.22	20	0.79	22	0.87	36	1.42	12	0.47	36	1.42
Position 4	0.32	1.05	0.63	2.07	0.54	1.76	0.15	0.50	50	1.97	16	0.63	15	0.59	35	1.38	50	1.97	12	0.47
Position 5	0.33	1.09	0.97	3.18	0.69	2.28	0.12	0.40	32	1.26	50	1.97	50	1.97	12	0.47	13	0.51	47	1.85
Position 6	0.32	1.06	0.27	0.90	0.19	0.63	0.12	0.40	74	2.91	13	0.51	18	0.71	40	1.57	21	0.83	5	0.20

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
RB4C Wasteway	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
Redd S9704																				
Position 1	0.10	0.34	0.06	0.20	0.05	0.18	0.46	1.50	75	2.95	50	1.97	48	1.89	60	2.36	25	0.98	16	0.63
Position 2	0.13	0.42	0.11	0.37	0.08	0.26	0.46	1.50	102	4.02	65	2.56	42	1.65	43	1.69	20	0.79	78	3.07
Position 3	0.12	0.40	0.14	0.46	0.15	0.48	0.37	1.20	91	3.58	63	2.48	56	2.20	52	2.05	30	1.18	62	2.44
Position 4	0.11	0.37	0.03	0.11	0.02	0.08	0.40	1.30	60	2.36	38	1.50	40	1.57	80	3.15	26	1.02	30	1.18
Position 5	0.39	1.27	0.30	0.57	0.10	0.32	0.40	1.30	48	1.89	57	2.24	60	2.36	33	1.30	71	2.80	22	0.87
Position 6	0.34	1.11	0.29	0.95	0.14	0.45	0.34	1.10	40	1.57	33	1.30	80	3.15	83	3.27	27	1.06	104	4.09

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
RB4C Wasteway	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
Redd S9706																				
Position 1	0.71	2.33	0.38	1.24	0.22	0.73	0.24	0.80	50	1.97	16	0.63	26	1.02	12	0.47	26	1.02	18	0.71
Position 2	0.71	2.32	0.53	1.73	0.36	1.18	0.21	0.70	14	0.55	13	0.51	24	0.94	73	2.87	29	1.14	12	0.47
Position 3	0.78	2.55	0.71	2.32	0.56	1.84	0.21	0.70	50	1.97	9	0.35	26	1.02	15	0.59	5	0.20	30	1.18
Position 4	0.59	1.94	0.47	1.55	0.19	0.63	0.18	0.60	58	2.28	72	2.83	39	1.54	13	0.51	9	0.35	11	0.43
Position 5	0.68	2.22	0.60	1.98	0.50	1.64	0.15	0.50	46	1.81	60	2.36	55	2.17	33	1.30	6	0.24	17	0.67
Position 6	0.73	2.40	0.60	1.98	0.41	1.35	0.18	0.60	29	1.14	58	2.28	36	1.42	15	0.59	13	0.51	11	0.43

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
RB4C Wasteway	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
- Redd S9707																				
Position 1	0.62	2.02	0.52	1.71	0.30	0.97	0.12	0.40	55	2.17	20	0.79	34	1.34	21	0.83	30	1.18	6	0.24
Position 2	0.59	1.94	0.58	1.90	0.41	1.33	0.12	0.40	23	0.91	15	0.59	18	0.71	25	0.98	38	1.50	23	0.91
Position 3	0.62	2.05	0.62	2.02	0.48	1.59	0.12	0.40	101	3.98	79	3.11	22	0.87	26	1.02	5	0.20	2	0.08
Position 4	0.58	1.90	0.55	1.81	0.40	1.31	0.12	0.40	40	1.57	29	1.14	30	1.18	54	2.13	18	0.71	26	1.02
Position 5	0.58	1.91	0.36	1.18	0.25	0.83	0.12	0.40	48	1.89	58	2.28	75	2.95	16	0.63	35	1.38	29	1.14
Position 6	0.61	2.01	0.47	1.53	0.33	1.09	0.14	0.45	20	0.79	18	0.71	31	1.22	40	1.57	43	1.69	33	1.30

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
RB4C Wasteway	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
- Redd S9708																				
Position 1	0.47	1.54	0.46	1.51	0.30	0.97	0.12	0.40	48	1.89	36	1.42	40	1.57	32	1.26	39	1.54	13	0.51
Position 2	0.48	1.58	0.50	1.65	0.45	1.49	0.09	0.30	103	4.06	45	1.77	1	0.04	3	0.12	60	2.36	10	0.39
Position 3	0.48	1.56	0.51	1.66	0.34	1.10	0.12	0.40	30	1.18	70	2.76	22	0.87	28	1.10	7	0.28	27	1.06
Position 4	0.09	0.28	0.11	0.35	0.04	0.14	0.15	0.50	22	0.87	16	0.63	5	0.20	13	0.51	41	1.61	7	0.28
Position 5	0.28	0.91	0.28	0.91	0.20	0.66	0.14	0.45	57	2.24	22	0.87	20	0.79	1	0.04	12	0.47	85	3.35
Position 6	0.36	1.17	0.38	1.25	0.31	1.02	0.12	0.40	30	1.18	30	1.18	30	1.18	61	2.40	26	1.02	2	0.08

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
Red Rock Coulee	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
- R9701																				
Embeddedness -NA																				
Position 1	0.59	1.94	0.30	0.98	0.00	0.01	0.43	1.40	20	0.79	9	0.35	60	2.36	69	2.72	35	1.38	27	1.06
Position 2	0.66	2.17	0.32	1.06	0.16	0.53	0.40	1.30	25	0.98	43	1.69	24	0.94	21	0.83	18	0.71	8	0.31
Position 3	0.45	1.48	0.36	1.17	0.24	0.78	0.34	1.10	41	1.61	21	0.83	7	0.28	60	2.36	10	0.39	19	0.75
Position 4	0.56	1.84	0.49	1.62	0.44	1.43	0.24	0.80	14	0.55	21	0.83	50	1.97	13	0.51	63	2.48	48	1.89
Position 5	0.46	1.51	0.49	1.60	0.31	1.02	0.24	0.80	48	1.89	85	3.35	24	0.94	14	0.55	26	1.02	43	1.69
Position 6	0.57	1.87	0.55	1.82	0.41	1.33	0.18	0.60	18	0.71	39	1.54	17	0.67	49	1.93	70	2.76	15	0.59

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
Red Rock Coulee	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
- R9702																				
90% Embeddedness																				
Position 1	0.80	2.64	0.74	2.44	0.54	1.78	0.52	1.70	24	0.94	32	1.26	10	0.39	10	0.39	15	0.59	14	0.55
Position 2	0.82	2.69	0.74	2.42	0.33	1.08	0.52	1.70	7	0.28	17	0.67	9	0.35	5	0.20	8	0.31	<1.	<0.04
Position 3	0.79	2.59	0.62	2.04	0.07	0.24	0.58	1.90	15	0.59	35	1.38	4	0.16	9	0.35	11	0.43	84	3.31
Position 4	0.77	2.52	0.68	2.22	0.61	2.00	0.49	1.60	27	1.06	13	0.51	4	0.16	45	1.77	43	1.69	41	1.61
Position 5	0.77	2.52	0.74	2.43	0.54	1.76	0.46	1.50	20	0.79	53	2.09	21	0.83	21	0.83	58	2.28	25	0.98
Position 6	0.76	2.48	0.56	1.84	0.04	0.12	0.52	1.70	20	0.79	39	1.54	36	1.42	26	1.02	20	0.79	7	0.28

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
Red Rock Coulee	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
- R9703																				
70% Embeddedness																				
Position 1	0.42	1.37	0.43	1.41	0.41	1.34	0.12	0.40	51	2.01	18	0.71	15	0.59	27	1.06	34	1.34	15	0.59
Position 2	0.46	1.50	0.53	1.74	0.51	1.68	0.09	0.30	32	1.26	20	0.79	14	0.55	35	1.38	13	0.51	17	0.67
Position 3	0.57	1.88	0.56	1.84	0.43	1.40	0.09	0.30	42	1.65	25	0.98	21	0.83	42	1.65	10	0.39	16	0.63
Position 4	0.47	1.54	0.50	1.64	0.49	1.60	0.09	0.30	13	0.51	8	0.31	12	0.47	35	1.38	49	1.93	10	0.39
Position 5	NA	NA	0.63	2.07	0.59	1.95	0.08	0.25	50	1.97	40	1.57	17	0.67	18	0.71	14	0.55	8	0.31
Position 6	0.62	2.04	0.63	2.06	0.55	1.79	0.09	0.30	30	1.18	39	1.54	22	0.87	14	0.55	11	0.43	39	1.54

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
Red Rock Coulee	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
- R9704																				
70% Embeddedness																				
Position 1	0.88	2.90	0.68	2.23	0.58	1.90	0.12	0.40	15	0.59	30	1.18	21	0.83	60	2.36	45	1.77	15	0.59
Position 2	0.76	2.49	0.56	1.83	0.34	1.12	0.12	0.40	48	1.89	38	1.50	16	0.63	11	0.43	20	0.79	6	0.24
Position 3	0.52	1.71	0.34	1.11	0.18	0.60	0.12	0.40	38	1.50	41	1.61	16	0.63	4	0.16	8	0.31	1	0.04
Position 4	0.88	2.88	0.91	2.99	0.59	1.95	0.15	0.50	13	0.51	22	0.87	14	0.55	16	0.63	16	0.63	32	1.26
Position 5	1.02	3.35	0.78	2.56	0.68	2.22	0.15	0.50	16	0.63	18	0.71	27	1.06	28	1.10	57	2.24	37	1.46
Position 6	1.03	3.39	0.66	2.16	0.52	1.69	0.15	0.50	36	1.42	17	0.67	10	0.39	23	0.91	10	0.39	7	0.28

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
Red Rock Coulee	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
- R9705																				
30% Embeddedness																				
Position 1	0.79	2.60	0.75	2.47	0.63	2.06	0.09	0.30	34	1.34	39	1.54	30	1.18	70	2.76	48	1.89	7	0.28
Position 2	0.76	2.49	0.72	2.37	0.57	1.88	0.12	0.40	33	1.30	15	0.59	14	0.55	35	1.38	27	1.06	21	0.83
Position 3	NA	NA	0.65	2.13	0.51	1.66	0.08	0.25	32	1.26	9	0.35	32	1.26	38	1.50	13	0.51	20	0.79
Position 4	0.84	2.75	0.74	2.42	0.51	1.67	0.12	0.40	47	1.85	48	1.89	32	1.26	37	1.46	12	0.47	53	2.09
Position 5	0.87	2.84	0.70	2.29	0.58	1.90	0.11	0.35	53	2.09	28	1.10	11	0.43	18	0.71	78	3.07	24	0.94
Position 6	0.86	2.82	0.66	2.18	0.55	1.80	0.09	0.30	20	0.79	10	0.39	17	0.67	10	0.39	11	0.43	38	1.50

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
Red Rock Coulee	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
- R9706																				
80% Embeddedness																				
Position 1	0.71	2.33	0.68	2.22	0.61	2.00	0.12	0.40	25	0.98	22	0.87	9	0.35	13	0.51	8	0.31	13	0.51
Position 2	0.78	2.57	0.71	2.34	0.55	1.80	0.11	0.35	38	1.50	40	1.57	11	0.43	6	0.24	29	1.14	39	1.54
Position 3	0.82	2.69	0.69	2.26	0.52	1.71	0.11	0.35	24	0.94	5	0.20	27	1.06	20	0.79	34	1.34	45	1.77
Position 4	0.59	1.94	0.62	2.05	0.50	1.63	0.11	0.35	8	0.31	7	0.28	25	0.98	6	0.24	36	1.42	13	0.51
Position 5	0.73	2.39	0.76	2.50	0.67	2.20	0.09	0.30	26	1.02	15	0.59	13	0.51	16	0.63	13	0.51	15	0.59
Position 6	0.80	2.64	0.69	2.26	0.56	1.83	0.11	0.35	29	1.14	30	1.18	13	0.51	15	0.59	21	0.83	54	2.13

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
Red Rock Coulee	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
- R9707																				
70% Embeddedness																				
Position 1	0.82	2.69	0.66	2.16	0.59	1.93	0.12	0.40	36	1.42	23	0.91	35	1.38	30	1.18	10	0.39	44	1.73
Position 2	1.06	3.47	0.74	2.42	0.59	1.93	0.12	0.40	87	3.43	34	1.34	34	1.34	50	1.97	7	0.28	32	1.26
Position 3	0.94	3.10	0.67	2.19	0.41	1.33	0.12	0.40	34	1.34	5	0.20	43	1.69	13	0.51	52	2.05	40	1.57
Position 4	1.05	3.43	0.83	2.72	0.56	1.84	0.18	0.60	62	2.44	22	0.87	28	1.10	30	1.18	21	0.83	7	0.28
Position 5	1.04	3.42	0.83	2.71	0.68	2.22	0.12	0.40	12	0.47	59	2.32	58	2.28	24	0.94	44	1.73	48	1.89
Position 6	1.16	3.81	1.03	3.39	0.75	2.45	0.12	0.40	86	3.39	40	1.57	64	2.52	56	2.20	25	0.98	22	0.87

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
Red Rock Coulee	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
- R9708																				
75% Embeddedness																				
Position 1	0.69	2.28	0.73	2.41	0.63	2.06	0.24	0.80	27	1.06	10	0.39	10	0.39	16	0.63	6	0.24	29	1.14
Position 2	0.74	2.44	0.81	2.67	0.65	2.12	0.21	0.70	11	0.43	7	0.28	20	0.79	12	0.47	13	0.51	7	0.28
Position 3	0.89	2.92	0.85	2.80	0.68	2.22	0.18	0.60	7	0.28	24	0.94	10	0.39	19	0.75	35	1.38	5	0.20
Position 4	0.67	2.21	0.67	2.19	0.62	2.04	0.17	0.55	7	0.28	37	1.46	7	0.28	10	0.39	54	2.13	16	0.63
Position 5	0.74	2.43	0.75	2.46	0.56	1.84	0.09	0.30	32	1.26	10	0.39	16	0.63	22	0.87	25	0.98	15	0.59
Position 6	0.79	2.59	0.79	2.60	0.63	2.07	0.11	0.35	15	0.59	25	0.98	17	0.67	25	0.98	39	1.54	16	0.63

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
Red Rock Coulee	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
- R9709																				
10% Embeddedness																				
Position 1	0.37	1.20	0.33	1.08	0.30	0.99	0.24	0.80	34	1.34	52	2.05	20	0.79	31	1.22	48	1.89	43	1.69
Position 2	0.44	1.45	0.45	1.48	0.41	1.36	0.15	0.50	45	1.77	51	2.01	30	1.18	16	0.63	55	2.17	35	1.38
Position 3	0.52	1.69	0.52	1.72	0.41	1.36	0.12	0.40	63	2.48	25	0.98	75	2.95	16	0.63	30	1.18	21	0.83
Position 4	0.41	1.35	0.34	1.13	0.33	1.07	0.23	0.75	21	0.83	13	0.51	18	0.71	20	0.79	17	0.67	23	0.91
Position 5	0.46	1.51	0.44	1.43	0.43	1.42	0.14	0.45	76	2.99	33	1.30	31	1.22	40	1.57	30	1.18	17	0.67
Position 6	0.44	1.43	0.45	1.48	0.41	1.35	0.15	0.50	52	2.05	49	1.93	26	1.02	72	2.83	63	2.48	20	0.79

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
Red Rock Coulee	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
- R9710																				
60% Embeddedness																				
Position 1	NA	NA	NA	NA	NA	NA	0.12	0.40	35	1.38	17	0.67	15	0.59	37	1.46	32	1.26	48	1.89
Position 2	NA	NA	NA	NA	NA	NA	0.09	0.30	52	2.05	48	1.89	30	1.18	54	2.13	46	1.81	40	1.57
Position 3	NA	NA	NA	NA	NA	NA	0.09	0.30	16	0.63	27	1.06	25	0.98	14	0.55	16	0.63	16	0.63
Position 4	NA	NA	NA	NA	NA	NA	0.06	0.20	17	0.67	45	1.77	76	2.99	62	2.44	24	0.94	15	0.59
Position 5	NA	NA	NA	NA	NA	NA	0.05	0.15	71	2.80	47	1.85	25	0.98	40	1.57	7	0.28	27	1.06
Position 6	NA	NA	NA	NA	NA	NA	0.06	0.20	72	2.83	45	1.77	43	1.69	31	1.22	32	1.26	25	0.98

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
Red Rock Coulee	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
- R9711																				
50% Embeddedness																				
Position 1	0.73	2.40	0.67	2.20	0.53	1.74	0.21	0.70	47	1.85	15	0.59	40	1.57	40	1.57	30	1.18	32	1.26
Position 2	0.73	2.40	0.76	2.50	0.74	2.42	0.15	0.50	51	2.01	40	1.57	8	0.31	54	2.13	17	0.67	43	1.69
Position 3	0.76	2.50	0.61	2.00	0.45	1.48	0.15	0.50	45	1.77	28	1.10	66	2.60	34	1.34	11	0.43	35	1.38
Position 4	0.58	1.90	0.46	1.50	0.31	1.02	0.18	0.60	34	1.34	57	2.24	24	0.94	25	0.98	26	1.02	23	0.91
Position 5	0.61	2.00	0.58	1.90	0.48	1.59	0.15	0.50	35	1.38	26	1.02	50	1.97	17	0.67	50	1.97	22	0.87
Position 6	0.67	2.20	0.61	2.00	0.59	1.93	0.12	0.40	53	2.09	30	1.18	12	0.47	11	0.43	15	0.59	3	0.12

Location	Velocity	Velocity	Velocity	Velocity	Velocity	Velocity	Depth	Depth	Sub 1	Sub 1	Sub 2	Sub 2	Sub 3	Sub 3	Sub 4	Sub 4	Sub 5	Sub 5	Sub 6	Sub 6
Red Rock Coulee	@ .2 m/s	@ .2 ft/s	@ .8 m/s	@ .8 ft/s	@ Bottom m/s	@ Bottom ft/s	m	ft	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
- R9712																				
80% Embeddedness																				
Position 1	0.52	1.71	0.56	1.85	0.48	1.58	0.24	0.80	67	2.64	41	1.61	32	1.26	74	2.91	20	0.79	34	1.34
Position 2	0.63	2.06	0.58	1.89	0.50	1.63	0.21	0.70	43	1.69	73	2.87	40	1.57	40	1.57	29	1.14	21	0.83
Position 3	0.72	2.37	0.73	2.40	0.60	1.96	0.21	0.70	53	2.09	26	1.02	37	1.46	80	3.15	34	1.34	46	1.81
Position 4	0.60	1.98	0.63	2.07	0.54	1.78	0.21	0.70	37	1.46	23	0.91	16	0.63	23	0.91	42	1.65	15	0.59
Position 5	0.73	2.38	0.80	2.64	0.85	2.78	0.15	0.50	21	0.83	14	0.55	34	1.34	36	1.42	18	0.71	9	0.35
Position 6	0.83	2.72	0.85	2.79	0.55	1.79	0.12	0.40	21	0.83	26	1.02	61	2.40	36	1.42	6	0.24	67	2.64

Appendix 7.2. Habitat suitability criteria (HSC) for spawning and rearing chinook salmon and steelhead.

Table 7.2-1. Raw data used to develop CBIP habitat utilization criteria for spawning chinook salmon in study streams.

Observation	Depth		Mean Column Velocity		Substrate Code
	m	ft	cm/sec	ft/sec	
1	0.12	0.38	19.81	0.65	55.0
2	0.17	0.55	22.56	0.74	55.0
3	0.17	0.57	23.47	0.77	55.0
4	0.18	0.58	28.35	0.93	55.0
5	0.19	0.61	30.78	1.01	55.0
6	0.21	0.70	32.00	1.05	55.0
7	0.22	0.72	36.58	1.20	55.0
8	0.23	0.77	42.37	1.39	55.0
9	0.24	0.78	42.98	1.41	55.0
10	0.24	0.79	48.46	1.59	55.0
11	0.24	0.79	55.78	1.83	55.0
12	0.25	0.81	56.69	1.86	55.0
13	0.25	0.83	57.00	1.87	56.1
14	0.28	0.91	62.48	2.05	56.1
15	0.28	0.93	64.62	2.12	56.1
16	0.30	0.98	68.28	2.24	56.1
17	0.30	0.99	71.63	2.35	56.1
18	0.31	1.01	73.15	2.40	56.2
19	0.31	1.01	75.29	2.47	56.3
20	0.34	1.11	76.20	2.50	56.3
21	0.45	1.46	78.03	2.56	56.3
22	0.45	1.48	89.61	2.94	56.3
23	0.67	2.20	90.22	2.96	56.3

Table 7.2-2. Final habitat utilization criteria for spawning chinook salmon in study streams.

Depth m	Depth ft	Frequency n	Suitability Index
0.00	0.00	0	0.0
0.10	0.33	0	0.0
0.20	0.66	5	1.0
0.30	0.99	12	1.0
0.40	1.32	3	1.0
0.50	1.65	2	0.5
0.60	1.98	0	0.2
0.70	2.31	1	0.2
0.80	2.64	0	0.0

Mean Column Velocity cm/sec	Mean Column Velocity ft/sec	Frequency n	Suitability Index
0.00	0.00	0	0.0
12.80	0.42	0	0.0
25.60	0.84	3	0.5
38.40	1.26	4	1.0
51.21	1.68	3	1.0
64.01	2.10	4	1.0
76.81	2.52	6	1.0
89.61	2.94	2	0.5
102.41	3.36	1	0.2
115.21	3.78	0	0.0

Substrate (Code)	Frequency (n)	Suitability Index
44.8	0	0.0
55.0	12	1.0
56.2	6	1.0
56.4	5	1.0
56.6	0	0.0

Figure 7.2-1. Comparisons of CBIP and Regional (Washington) Habitat Suitability Criteria (HSC) for spawning chinook salmon.

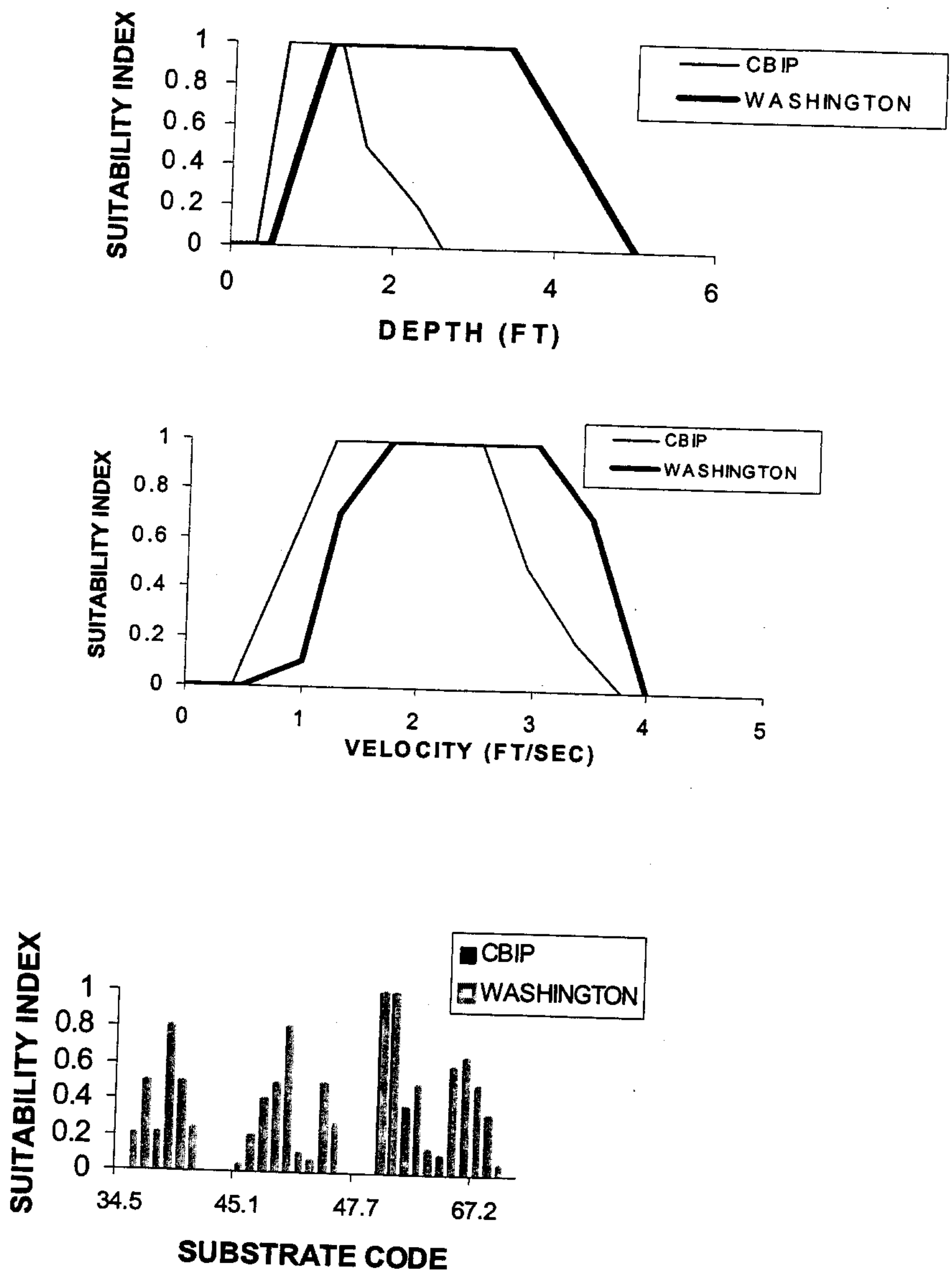
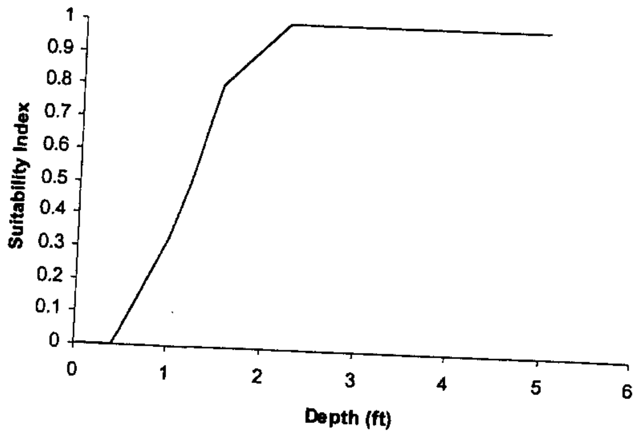
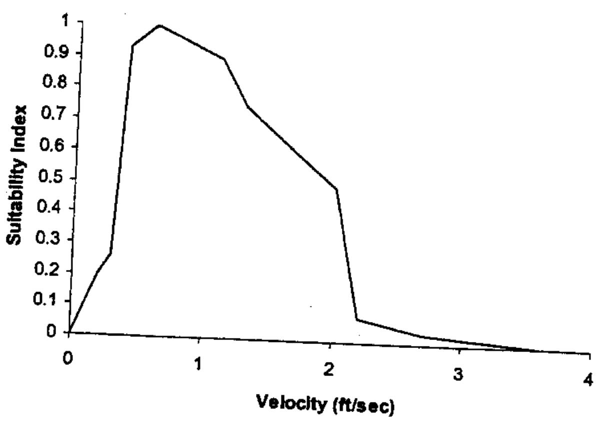


Figure 7.2-2. Washington state habitat suitability criteria for chinook salmon juveniles.





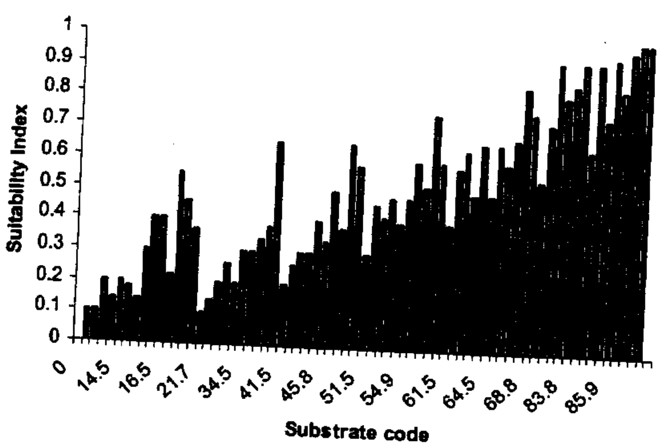


Figure 7.2-3. Washington state habitat suitability criteria for spawning steelhead.

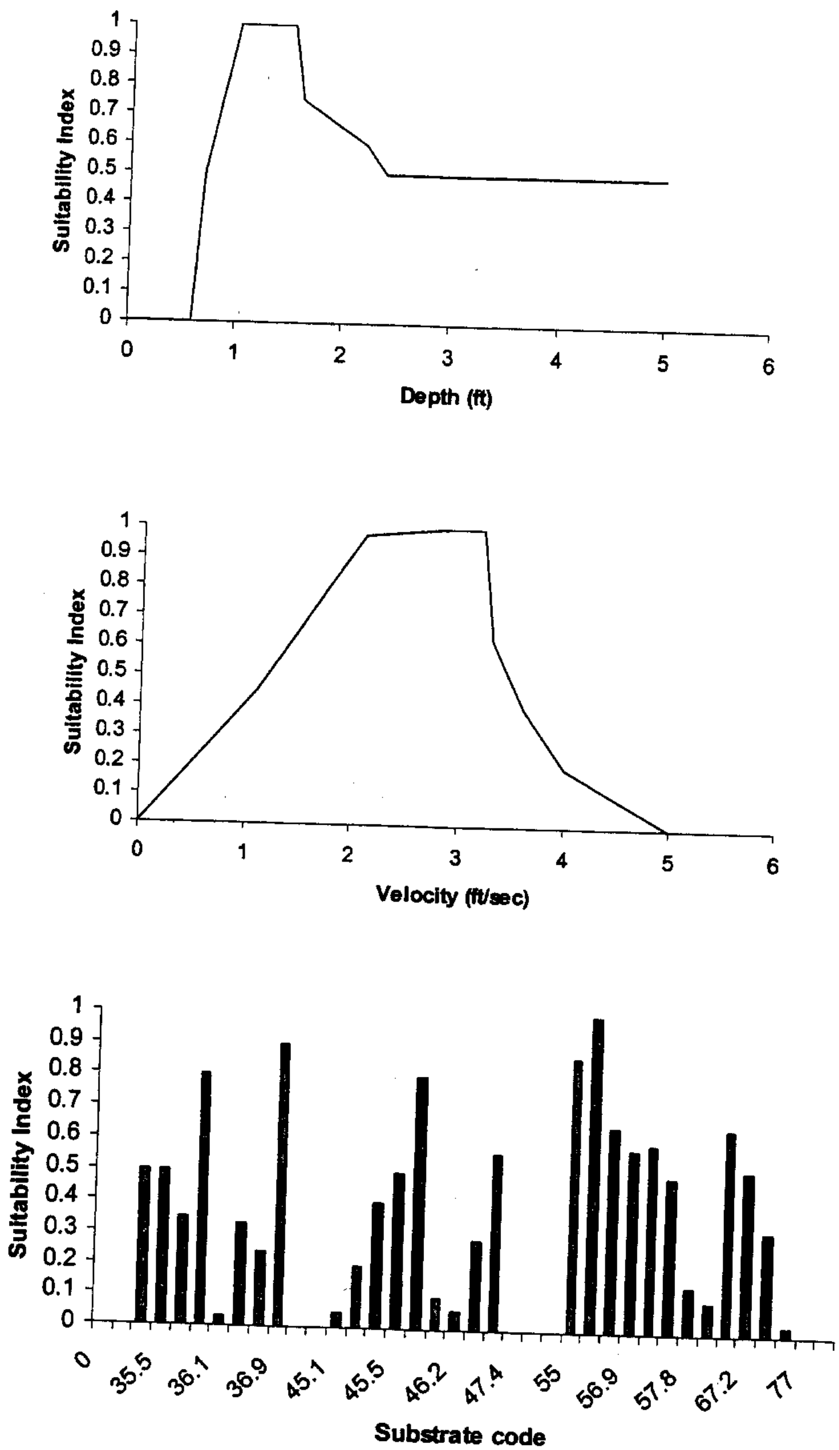
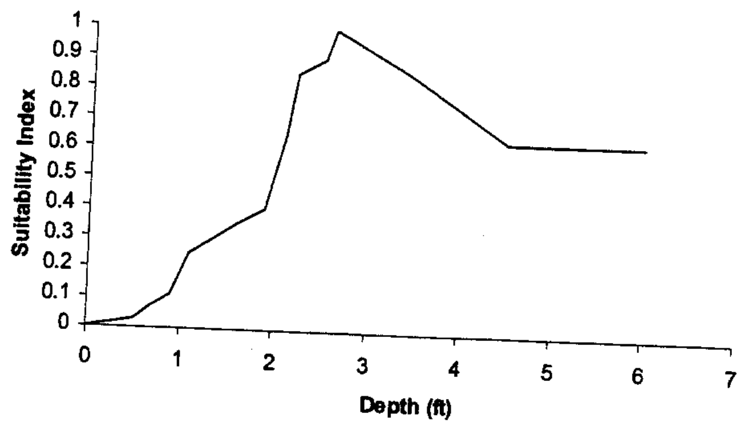
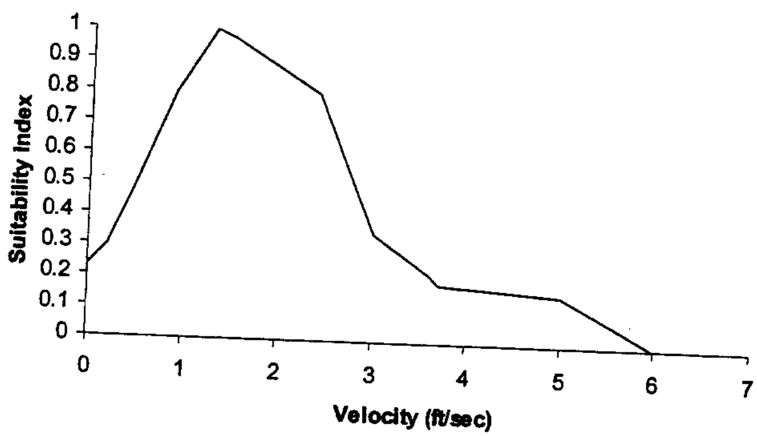
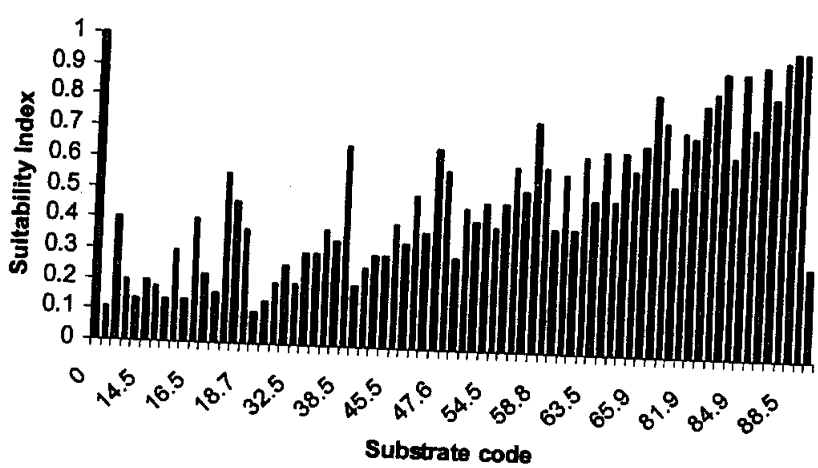


Figure 7.2-4. Washington state habitat suitability criteria for steelhead juveniles.







Appendix 7.3. Observations of anadromous salmonid presence and activity in tributaries of the Columbia River on the Columbia Basin Project, WA (Grant and Adams Counties). These are observations for which no associated water chemistry was taken. Other observations of anadromous salmonids can be found in the next appendix.

Date	Time	Location	Latitude, Longitude	Anadromous Salmonid Species	Life Stage	Activity	Number of Individuals	Comments
				Ot, Om, or None$_1$	AD or Juv$_2$	Spawn, Redd Build, Redd Guard, or Hold$_3$		
RB4C WASTEWAY								
29-Oct-96	0850	Lower RB4C @ Confl. w/ Columbia R.	N 46° 55' 46.6", W 119° 57' 27.1"	None				One carp observed
30-Oct-96	1515	Lower RB4C, Redd S9606, 0.3 km to Confl. w/ Columbia R.	N 46° 55' 45.4", W 119° 57' 13.7"	Ot	AD	Redd Building	1	
04-Nov-97	1600	Lower RB4C, 0.6-1.3 km Upstream of Confluence w/ Columbia R.		Ot	AD	Spawn	7	
05-Nov-97	1130	Lower RB4C @Redd S9705, 0.3 km to Confl. w/ Columbia R.	N 46° 55' 45.36", W 109° 57' 12.96"	Ot	AD	Redd Building	1	
04-Nov-98	1200	Lower RB4C @S9803, 0.3 km to Confl. w/ Columbia R.	N 46°55' 45.31", W 119° 57' 11.52"	Ot	AD	Redd	1	No living adults observed. Redd identified postmortem.
05-Nov-98	1255	Lower RB4C, 0.1-0.5 km to Confl. w/ Columbia R.		Ot	AD	Hold	3	
19-Nov-98	1440	Lower RB4C @S9806, 0.4 km to Confl. w/ Columbia R.	N 46°55' 45.07", W 119° 57' 11.01"	Ot	AD	Redd Guarding	1	
19-Nov-98	1510	Lower RB4C @S9807, 0.4 km to Confl. w/ Columbia R.	N 46°55' 45.22", W 119° 57' 09.28"	Ot	AD	Redd Guarding	1	
19-Nov-98	1540	Lower RB4C @S9808, 0.4 km to Confl. w/ Columbia R.	N 46°55' 45.41", W 119° 57' 13.28"	Ot	AD	Redd	1	No living adults observed. Redd identified postmortem.

Date	Time	Location	Latitude, Longitude	Anadromous Salmonid Species	Life Stage	Activity	Number of Individuals	Comments
RED ROCK COULEE								
20-Sep-96	1010	Ab. Red Rock Lake	N 46° 51' 51.6", W 119° 30' 45.7"	None				Falls ab. Red Rock Lake block access to this point
20-Sep-96	1450	Intermittent Tributary - "Wilson Spring"	N 46° 99' 57", W 119° 48' 57"	None				Insufficient water present for anadromous salmonid spawning
22-Sep-96	1244	Intermittent Tributary	N 46° 51' 08", W 119° 40' 11"	None				Insufficient water present for anadromous salmonid spawning
29-Oct-96	1600	Immediately below RR trestle	N 46° 52' 33.6", W 119° 35' 17.7"	None				
06-Nov-97	1625	@ 0-2.5 km downstream of Red Rock Lk.	Upstream End: N 46° 50' 30.8", W 119° 35' 45.1"	Ot	AD	Spawn	14	
06-Nov-97	1015	@Redd R9704	N 46° 52' 17.11", W 119° 36' 00.531"	Ot	AD	Spawn	14	Three redds
07-Nov-97	1100	@Redd R9704, 1.0 km downstream of Red Rock Lk.		Ot	AD	Redd Guarding	1	
18-Mar-98	1400	2.0 km downstream of Red Rock Lk.		Om	AD	Hold	1	Many areas in RRC have apropriate substrates for steelhead spawning.
19-Mar-98	1200	2.0 km downstream of Red Rock Lk.	N 46° 52' 16.93", W 119° 36' 00.74"	Om	AD	Hold	1	It is likely that this is the same *O. mykiss* indivdual sighted 3/18/98.
15-Apr-98	1130	2.0 km downstream of Red Rock Lk.	N 46° 52' 16.93", W 119° 36' 00.74"	Om	AD	Hold	1	
02-Nov-98	1000	@Redd R9801, 1.0-1.5 km downstream of Red Rock Lk.		Ot	AD	Hold	9	
03-Nov-98	0830	@Redd R9801, 2.0 km downstream of Red Rock Lk.		Ot	AD	Spawn	7	
04-Nov-98	0630	1.5-2.0 km downstream of Red Rock Lk.		Ot	AD	Spawn	7	

Date	Time	Location	Latitude, Longitude	Anadromous Salmonid Species	Life Stage	Activity	Number of Individuals	Comments
04-Nov-98	0630	0.2-0.5 km downstream of Red Rock Lk.		Ot	AD	Hold	1	
05-Nov-98	1530	0.2-0.5 km downstream of Red Rock Lk.		Ot	AD	Hold	11	
09-Nov-98	1200	@R9803, 1.5 km downstream of Red Rock Lk.	N 46°52' 05.29", W 119°36' 08.96"	Ot	AD	Spawn	2	
23-Nov-98	1425	@R9807, 1.5 km downstream of Red Rock Lk.	N 46°52' 16.98", W 119°36' 00.86"	Ot	AD	Redd	1	No living adults observed. Redd identified postmortem.
23-Nov-98	1510	@R9808, 1.6 km downstream of Red Rock Lk.	N 46°52' 16.57", W 119°36' 01.42"	Ot	AD	Redd	1	No living adults observed. Redd identified postmortem.
23-Nov-98	1545	@R9809, 1.7 km downstream of Red Rock Lk.		Ot	AD	Redd	1	No living adults observed. Redd identified postmortem.
23-Nov-98	1550	@R9810, 2.0 km downstream of Red Rock Lk.	N 46°52' 05.12", W 119°36' 08.98"	Ot	AD	Redd	1	No living adults observed. Redd identified postmortem.
RBC WASTEWAY								
29-Oct-96	0900	@ Lower Crab Creek Rd.	N 46°49' 55.3", W 119°54' 28.3"	Om	AD	Hold	1	The *O. mykiss* observed (44 cm TL), thought to be stream resident form.
29-Oct-96	0931	Immediately below Nunnally Lake	N 46°50' 19.4", W 119°54' 21.8"	Om	AD	Hold	1	*O. mykiss* observed (41 cm TL), thought to be stream resident form.
29-Oct-96	1230	@ Source Spring	N 46°50' 50.5", W 119°48' 35.1"	None				Substrate primarily gravel (2.5 - 12.5 cm diameter)
29-Oct-96	1230	Ab. Merry Lake	N 46°50' 28.4", W 119°49' 05.9"	None				
CRAB CREEK								
21-Sep-96	1500	Crab Creek @ Sand Dunes Recreation Area	N 46°49' 39", W 119°52' 32"	None				Sand substrate

Date	Time	Location	Latitude, Longitude	Anadromous Salmonid Species	Life Stage	Activity	Number of Individuals	Comments
22-Sep-96	1244	Intermittent Trib. Of Crab Cr.	N 46°51' 08", W 119°40' 11"	None				Insufficient water on this date for salmonids to spawn
29-Oct-96	1030	Crab Creek @ Falls	N 46°49' 54.3", W 119° 50' 33.7"	None				Duane Unland (WA-DNR) observed 4 Ot adults ascending here in 1995
29-Oct-96	1100	Crab Creek @ Lower Crab Cr. Br.	N 46°49' 53", W 119° 48' 59.8"	None				

1 = Anadromous Salmonid Species: Ot = *Oncorhynchus tshawytscha* (chinook salmon), Om = *Oncorhynchus mykiss* (steelhead), or None.
2 = Life Stage: AD = Adult or Juv = Juvenile.
3 = Activity: Spawn = Spawning, Redd Build = Redd Building, Redd Guard = Redd Guarding or Hold = Holding

Appendix 7.4. Water chemistry, physical parameters and activity of anadromous salmonids in selected tributaries of the Columbia River on the Columbia Basin Project, WA (Grant and Adams Counties). All of these sites were checked for anadromous salmonid presence and thaat activity is recorded. Other observations of anadromous salmonid activity can be found in the preceding appendix.

Date	Time	Location	Latitude, Longitude	Anadromous Salmonid Species and Life Stage	Activity and Number	Q	Compaction	Substrate 1_3	Substrate 2	Temp	pH	DO	Conduc-tivity	ORP
				Ot or Om_1 AD or Juv_2		cms	0=N 1=Yes			°C		mg/L	µS/cm	µV
RB4C Wasteway														
30-Oct-96	0900	Upper RB4C, @ Jct. w/ S SW Rd.	N 46° 55' 49.36", W 119° 54' 59.87"	None						13.5				
30-Oct-96	0900	Upper RB4C, Spring near Jct. w/ S SW Rd.	N 46° 56' 07.9", W 119° 53' 58.7"	None						18				
30-Oct-96	0930	Lower RB4C @ SH 26	N 46° 55' 49.3", W 119° 56' 22.1"	None						14.5				
30-Oct-96	1038	Lower RB4C, 0.4 km down from SH 26 Br., Redd S9601	N 46° 55' 52.6", W 119° 56' 49.3"	Ot-AD	Spawn(2)			See Table 6		12.0				
30-Oct-96	1130	Lower RB4C, 0.8 km down from SH 26 Br., Redd S9602	N 46° 55' 47.8", W 119° 57' 06.3"	Ot-AD	Redd Building(1)			See Table 6		12.0				
30-Oct-96	1245	Lower RB4C, Redd S9603	N 46° 55' 47.4", W 119° 56' 59.8"	Ot-AD	Spawn(2)			See Table 6		12.0				
30-Oct-96	1330	Lower RB4C, Redd S9604	N 46° 55' 44.9", W 119° 57' 06.7"	Ot-AD	Spawn(2)			See Table 6		12.0				
30-Oct-96	1430	Lower RB4C, Redd S9605	N 46° 55' 44.8", W 119° 57' 12.4"	Ot-AD	Redd Building(1)			See Table 6		12.4				
13-Mar-97	1400	Lower RB4C, 0.4km bel. hwy 26 Br.		None						11.5				
22-Jul-97	1100	Lower RB4C, @ Confluence w/ Columbia R.		None						19				
25-Jul-97	1100	Lower RB4C, @ Gauge	N 46° 55' 48", W 119° 57' 00.7"	None						18.1	8.1	9.4	376	

Date	Time	Location	Latitude, Longitude	Anadromous Salmonid Species and Life Stage	Activity and Number	Q	Compaction	Substrate 1₃	Substrate 2	Temp	pH	DO	Conduc-tivity	ORP
03-Nov-97	1600	0.6-1.3 km Upstream of Confluence w/ Columbia R.		Ot-AD	Spawn(9)					14.0				
03-Nov-97	1600	Lower RB4C @ Redd S9701	N 46° 55' 45.35", W 119° 57' 11.44"	Ot-AD	Spawn(2)					11.0	9.5	11	705	0.065
04-Nov-97	1500	Lower RB4C @Redd S9702, O.7 km to Hwy. 26 Br.		Ot-AD	Spawn(2)					14.0				
05-Nov-97	0915	Lower RB4C@Redd S9703, 0.25 km to Confl. w/ Columbia R.	N 46° 55' 44.74", W 109° 57' 15.38"	Ot-AD	Spawn(2)					12.4	9.5	10.4	704	0.082
05-Nov-97	0947	Lower RB4C @Redd S9708	N 46° 55' 45.18", W 119° 57' 4.56"	Ot-AD	Spawn(2)					13.0	9.6	9.8	698	0.080
05-Nov-97	1500	Lower RB4C, 0.6-1.3 km Upstr. of Confl. w/ Columbia R.		Ot-AD	Spawn(11)					14.0				
05-Nov-97	1520	Upper RB4C, @ Jct. w/ S SW Rd.		None						14.0				
05-Nov-97	1520	Upper RB4C, Spring near Jct. w/ S SW Rd.	N 46° 55' 49.36", W 119° 54' 59.87"	None						15.5				
06-Nov-97	1000	Lower RB4C @S9703, 0.4 km to Confl. w/ Columbia R.		Ot-AD	Redd Building(1)					11.3	9.4	9.0	497	0.110
07-Nov-97	1100	Lower RB4C, 0.6-1.3 km Upstr. of Confl. w/ Columbia R.		Ot-AD	Spawn(9)					14.0				
19-Mar-98	1430	Lower RB4C, Near Redd S9606	N 46° 55' 45.4", W 119° 57' 13.7"	Ot-Juv	Hold(17)					12.8				
17-Mar-98	1045	Lower RB4C@Redd S9703, 0.25 km to Confl. w/ Columbia R.	N 46° 55' 44.74", W 109° 57' 15.38"	None						10.5				
17-Mar-98	1350	Lower RB4C, Near Redd S9705, 0.3 km to Confl. w/ Columbia R.	N 46° 55' 45.36", W 119° 57' 12.96"	Ot-Juv	Hold(30)			45.8		13.3	9.3		622	0.088
17-Mar-98	1600	Lower RB4C, 0.4 km to Confl. w/ Columbia R.	N 46° 55' 45.78", W 119° 57' 7.72"	Ot-Juv	Hold(17)			34.5		13.4				

Date	Time	Location	Latitude, Longitude	Anadromous Salmonid Species and Life Stage	Activity and Number	Q	Compaction	Substrate 1_3	Substrate 2	Temp	pH	DO	Conduc-tivity	ORP
22-Jan-98		Lower RB4C, 0.4 km to Confl. w/ Columbia R.								8.4	7.9	12.5	650	0.122
02-Apr-98		Lower RB4C, 0.4 km to Confl. w/ Columbia R.								12.2				
17-Aug-98	1300	Upper RB4C, 2.4 km to Confl. w Columbia R.	N 46° 55' 48.75" W 119° 56' 21.54"	None						22.0				
19-Aug-98	1130	Upper RB4C, 2.4 km to Confl. w Columbia R.	N 46° 55' 48.75", W 119° 56' 21.54"	None						20.0				
20-Aug-98	1000	Upper RB4C, @ Jct. w/ S SW Rd.	N 46° 55' 49.36", W 119° 54' 59.87"	None						19.0				
20-Aug-98	1030	Upper RB4C, Spring N. of Jct. w/ S SW Rd.	N 46° 55' 08.36", W 119° 53' 57.46"	None						19.0				
20-Aug-98	1115	Upper RB4C, Weir @ Inters. of R SW and 11 SW	N 46° 55' 42.02", W 119° 53' 40.91"	None						20.0				
20-Aug-98	1130	Upper RB4C, Weir @ Q SW	N 46° 55' 25.82", W 119° 51' 20.00"	None						20.0				
20-Aug-98	1205	Upper RB4C, Weir @ M SW	N 46° 55' 16.08", W 119° 46' 15.98"	None						20.0				
20-Aug-98	1215	Upper RB4C, Culvert @ 11 SW Betw. L SW and M SW	N 46° 55' 42.55", W 119° 45' 20.73"	None						20.0				
20-Aug-98	1250	Upper RB4C, Culverts @ K SW	N 46° 55' 29.69", W 119° 43' 39.51"	None						16.0				
04-Nov-98	1200	Lower RB4C @S9801, 0.3 km to Confl. w/ Columbia R.	N 46°55' 45.31", W 119° 57' 11.52"	Ot-AD	Redd Building(1)					11.3	9.1	8.5	651	
06-Nov-98	1215	Lower RB4C @S9802, 0.3 km to Confl. w/ Columbia R.	N 46°55' 49.10", W 119° 56' 56.45"	Ot-AD	Redd Building(1)					10.5	9.2	8.9	652	
10-Nov-98	1200	Lower RB4C @S9805, 0.3 km to Confl. w/ Columbia R.	N 46°55' 45.51", W 119° 57' 12.41"	Ot-AD	Redd Building(1)					6.9	9.4	6.3	665	

Date	Time	Location	Latitude, Longitude	Anadromous Salmonid Species and Life Stage	Activity and Number	Q	Compaction	Substrate 1₃	Substrate 2	Temp	pH	DO	Conduc-tivity	ORP
10-Nov-98	1200	Lower RB4C @S9804, 0.3 km to Confl. w/ Columbia R.	N 46°55' 45.31", W 119°57' 11.52"	Ot-AD	Redd(1)					12.0	9.3	5.0	626	
RED ROCK COULEE														
20-Sep-96	1010	Ab. Red Rock Lake	N 46°51' 51.6", W 119°30' 45.7"	None		0.72	0	56.5		14.7	8.8	10.7	431	0.106
20-Sep-96	1149	@ E SW Rd.	N 46°51' 17.5", W 119°35' 52.5"	None			1	65.5	46.5	17.1	8.8	10.7	460	0.074
21-July-97	1100	Ab. Red Rock Lk., 9km ESE of Royal City	N 46°51' 40.7", W 119°31' 01.7"	None						20.6	7.8	9.5	416	
29-Oct-96	1700	@ E SW Rd.	N 46°51' 17.5", W 119°35' 52.5"	None						16.0				
05-Nov-97	1625	1.0 km downstream of Red Rock Lk.		Ot-AD	Redd Building(1)					11.8	9.5	9.9	519	0.119
06-Nov-97	0900	@Redd R9712	N 46°52' 29.45", W 119°35' 49.38"	Ot-AD	Redd Guarding(1)					13.0				
06-Nov-97	1000	@Redd R9703	N 46°52' 30.25", W 119°35' 46.61"	Ot-AD	Redd Guarding(1)					11.3	9.4	9.0	497	0.110
06-Nov-97	1030	@Redd R9710	N 46°52' 22.41", W 119°35' 56.69"	Ot-AD	Redd Building(1)					13.0				
06-Nov-97	1140	@Redd R9711	N 46°52' 19.02", W 119°35' 58.68"	Ot-AD	Redd Building(1)					13.0				
06-Nov-97	1213	@Redd R9707	N 46°52' 18.34", W 119°35' 58.95"	Ot-AD	Spawn(2)					13.0				
07-Nov-97	0900	@Redd R9708, 1.1 km downstream of Red Rock Lk.		Ot-AD	Spawn(6)					12.0				
07-Nov-97	0913	@Redd R9713, 1.1 km downstream of Red Rock Lk.		Ot-AD	Redd Guarding(1)					12.0				

Date	Time	Location	Latitude, Longitude	Anadromous Salmonid Species and Life Stage	Activity and Number	Q	Compaction	Substrate 1_3	Substrate 2	Temp	pH	DO	Conduc-tivity	ORP
07-Nov-97	1000	@Redd R9709, 1.3 km downstream of Red Rock Lk.		Ot-AD	Redd Guarding(1)					12.0				
22-Jan-98		@ Br. 1km below Red Rock Lake								3.1	7.9	16.6	605	0.083
18-Mar-98	1400	1.5 km downstream of Red Rock Lk.								8.5	9.0	11.5		
19-Mar-98	0830	1.5 km downstream of Red Rock Lk.	N 46o52"19.15", W 119o35"58.63"							9.7	9.1	10.3	599	0.088
19-Mar-98	1015	1.5 km downstream of Red Rock Lk.	N 46o52"19.15', W 119o35"58.63'							10.6	8.8		603	0.083
19-Mar-98	1300	1.5 km downstream of Red Rock Lk.	N 46° 52' 19.15", W 119° 36' 58.63"	Ot-Juv	Hold(4)			33.0	11.0	12.8				
19-Mar-98	1330	1.5 km downstream of Red Rock Lk.	N 46° 52" 18.58', W 119° 35" 59.7'	Ot-Juv	Hold(1)					12.9				
19-Mar-98	1500	Near Redd R9704, 1.0 km downstream of Red Rock Lk.								16.2				
02-Apr-98		1.5 km downstream of Red Rock Lk.		None						11.7				
18-Aug-98	1040	1.0 km downstream of Red Rock Lk.		None		1.5				21.0				
20-Aug-98	1500	Upper Red Rock Coulee @ 11 SW	N 46° 55' 41.35", W 119° 40' 53.79"	None						17.0				
06-Nov-98	1100	@R9802, 0.1 km Upstream of Upper E SW Br.		Ot-AD	Spawn(2)					9.1	8.7	7.0	430	
09-Nov-98	1200	@R9803, 0.2 km Downstream of Upper E SW Br.	N 46°52' 05.09", W 119° 36' 09.22"	Ot-AD	Spawn(2)					9.2	9.1	9.7	463	
09-Nov-98	1220	@R9804, 2.0 km Downstream of Red Rock Lk.	N 46°52' 18.63", W 119° 35' 58.79"	Ot-AD	Spawn(2)					9.2	9.1	9.7	463	

Date	Time	Location	Latitude, Longitude	Anadromous Salmonid Species and Life Stage	Activity and Number	Q	Compaction	Substrate 1_3	Substrate 2	Temp	pH	DO	Conduc-tivity	ORP
10-Nov-98	1500	@R9806, 0.2 km Upstream of Upper E SW Br.	N 46°52' 30.29", W 119°35' 46.52"	Ot-AD	Spawn(2)					8.5	9.0	9.0	462	
RBC WASTEWAY														
20-Sep-96	1545	@ Lower Crab Cr Rd.	N 46°49' 55", W 119°54' 29"	Om-AD, Stream Resident	Hold(1)	0.04	0	45.6	45.4	17.5	9.1	10.3	364	0.123
10-Oct-96	1500	Ab. Merry Lk.		None		0.15		13	14					
21-Jul-97	1240	15 km WSW of Royal City	N 46°52' 21", W 119°48' 44.7"	None						18.0				
22-Jul-97	1000	Just above No Wake Lake, @ Lower Crab Cr. Rd.	N 46°49' 53.7", W 119°54' 30.1"	None						22.8	8.8	9.1	453	
04-Nov-97	1656	Lower RBC, 0.4 km from Confl. w/ Crab Cr.		None						9.6	9.4	10.7	432	0.093
22-Jan-98		Just above No Wake Lake, @ Lower Crab Cr. Rd.								2.8	8.0	15.5	528	0.068
19-Aug-98	2235	Just above No Wake Lake, @ Lower Crab Cr. Rd.	N 46°49' 55.73", W 119°54' 29.72"	None		0.7				21.0				
CRAB CREEK														
19-Sep-96	1610	Mainstem @ Corfu Rd.	N 46°49'21", W 119°27'14"	None		4.20		12		19.3	8.5	9.8	488	0.103
19-Sep-96	1610	Lateral @ Corfu Rd.		None						19.1	8.7	12.9	713	0.125
19-Sep-96	1610	Side Ch. @ Corfu Rd.		None						19.2	8.4	9.9	495	0.142
20-Sep-96	1654	Mainstem @ Hwy. 26 (E. Br.)	N 46°49' 47.9", W 119°23'27"	None		2.38	0	37.9	45.5	16.9	8.9	10	455	0.142
20-Sep-96	1720	Crab Creek @ Hwy. 26 (W. Br.)	Near N 46°49' 7.9", W 119°21' 56.5"	None				43.6	43.6	16.7	8.8	9.7	461	0.189

Date	Time	Location	Latitude, Longitude	Anadromous Salmonid Species and Life Stage	Activity and Number	Q	Compaction	Substrate 1[3]	Substrate 2	Temp	pH	DO	Conduc-tivity	ORP
20-Sep-96	1720	Crab Creek @ Crab Creek Rd.		None			1	21	16	12.7	8.2	10.8	739	0.128
20-Sep-96	1720	Crab Creek @ Hwy. 26 (E. Br.)		None			0	11	14					
21-Sep96	0830	Mainstem Near Hwy. 26	N 46°49' 07.9", W 119°21' 56.5"	None				44	44	13.8	8.6	10.4	398	0.044
21-Sep-96	0927	Crab Creek - South Channel@ Crab Cr Rd.	N 46°48' 35", W 119°22' 26"	None		1.06	60%	35.8	35.6	12.7	8.2	10.8	739	0.128
21-Sep-96	1336	Crab Creek, 5km W. of Corfu Rd.	N 46°50' 22", W 119°32' 07"	None		1.93		34.5		15.3	8.4	11.0	538	0.151
21-Jul-97	1000	Crab Creek, @ Falls, 7.7 km above Hwy 243	N 46°49' 54.5", W 119° 50' 37.3"	None						23.5	7.7	8.3	540	
21-Jul-97	1000	Crab Creek, @ Falls, 7.7 km ab. Hwy 243	N 46°49' 54.5", W 119° 50' 37.3"	None										
22-Jan-98		Crab Creek @ Lower Crab Creek Br.								2.7	7.8		643	0.075
18-Aug-98	1636	@ USGS Gauging Station near Smyrna, WA		None		4.0				24.0				
WB-10 Wasteway														
07-Nov-97	1400	Wasteway, WB-10		None						9.5	9.4	10.8	743	0.104

1 = Anadromous Salmonid Species: Ot = *Oncorhynchus tshawytscha* (chinook salmon), Om = *Oncorhynchus mykiss* (steelhead), or None. No entry in this column = no attempt was made to ascertain the presence or activities of anadromous salmonids.

2 = Life Stage: AD = Adult or Juv = Juvenile.

3 = Substrate coding: First digit is the dominant substrate. Second digit is the sub-dominant substrate. Third digit is the proportion of the whole comprised by the dominant substrate. Further discussion of the coding system can be found in section 3.5.1. (page 8). The substate codes for size can be found in Table 3.

Appendix 7.5. Measurements in Fall chinook juvenile habitat in Red Rock Coulee of the Columbia Basin Project, WA (Grant County).

Location	Vel[1] @ .2 m/s	Vel @ .2 f/s	Vel @ .8 m/s	Vel @ .8 f/s	Vel @ Bottom[2] m/s	Vel @ Bottom f/s	Depth m	Depth ft	Sub1 mm	Sub 1 in	Sub 2 mm	Sub 2 in	Sub 3 mm	Sub 3 in	Sub 4 mm	Sub 4 in	Sub 5 mm	Sub 5 in	Sub 6 mm	Sub 6 in	FV[3] m/s	FV f/s	Fish Size[4] mm	Fish Size in
Juvhab[5] R01	0.1	0.33	0.17	0.561	0.17	0.561	0.35	1.155	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.17	0.56	44	1.73
Juvhab R02	0.07	0.231	0.05	0.165	0.01	0.033	0.8	2.64	<1	<0.04	Veg	Veg	1	0.04	1	0.04	1	0.04	1	0.04	0.14	0.46	46	1.81
Juvhab R03	0.05	0.165	0.03	0.099	0.01	0.033	0.7	2.31	<1	<0.04	<1	<0.04	3	0.12	1	0.04	<1	<0.04	<1	<0.04	0.04	0.13	41	1.61

1 = Vel: Velocity at 0.2 and 0.8 of the total depth of the water column.
2 = Bottom: Velocity probe approximately 1 cm from substrate.
3 = FV: Focal velocity is the velocity at the anterior end of a fish.
4 = Size: Total Length.
5 = Juvhab: Juvenile habitat measured at the exact location of a fish or school of fish.

Appendix 7.6. Average daily discharge (Q) in RB4C Wasteway (Sand Hollow Creek), WA from October 1, 1993 through September 30, 1995.

Year	Month	Day	Q(cms)	Q(cfs)
1993	10	1	2.09568	74
1993	10	2	2.124	75
1993	10	3	2.23728	79
1993	10	4	2.124	75
1993	10	5	1.92576	68
1993	10	6	1.89744	67
1993	10	7	1.8408	65
1993	10	8	2.09568	74
1993	10	9	2.03904	72
1993	10	10	2.18064	77
1993	10	11	2.06736	73
1993	10	12	1.86912	66
1993	10	13	1.72752	61
1993	10	14	1.8408	65
1993	10	15	1.89744	67
1993	10	16	1.81248	64
1993	10	17	1.8408	65
1993	10	18	1.86912	66
1993	10	19	1.92576	68
1993	10	20	2.01072	71
1993	10	21	1.92576	68
1993	10	22	1.78416	63
1993	10	23	1.67088	59
1993	10	24	1.61424	57
1993	10	25	1.72752	61
1993	10	26	1.44432	51
1993	10	27	1.44432	51
1993	10	28	0.82128	61
1993	10	29	0.8496	55
1993	10	30	1.50096	53
1993	10	31	1.5576	55
1993	11	1	1.6992	60
1993	11	2	0.8496	30
1993	11	3	0.67968	24
1993	11	4	0.708	25
1993	11	5	1.04784	26
1993	11	6	0.82128	29
1993	11	7	1.10448	25
1993	11	8	0.62304	22
1993	11	9	0.5664	20
1993	11	10	0.5664	20
1993	11	11	0.5664	20
1993	11	12	0.53808	19
1993	11	13	0.50976	18

Year	Month	Day	Q(cms)	Q(cfs)
1993	11	14	0.48144	17
1993	11	15	0.53808	19
1993	11	16	0.48144	17
1993	11	17	0.50976	18
1993	11	18	0.45312	16
1993	11	19	0.45312	16
1993	11	20	0.48144	17
1993	11	21	0.53808	19
1993	11	22	0.45312	16
1993	11	23	0.4248	15
1993	11	24	0.4248	15
1993	11	25	0.4248	15
1993	11	26	1.64256	15
1993	11	27	0.45312	16
1993	11	28	0.45312	16
1993	11	29	0.48144	17
1993	11	30	0.45312	16
1993	12	1	0.48144	17
1993	12	2	0.45312	16
1993	12	3	0.48144	17
1993	12	4	0.48144	17
1993	12	5	1.89744	15
1993	12	6	0.45312	16
1993	12	7	0.45312	16
1993	12	8	0.48144	17
1993	12	9	0.45312	16
1993	12	10	0.48144	17
1993	12	11	0.50976	18
1993	12	12	0.4248	15
1993	12	13	0.45312	16
1993	12	14	0.45312	16
1993	12	15	0.4248	15
1993	12	16	0.4248	15
1993	12	17	0.39648	14
1993	12	18	0.4248	15
1993	12	19	0.4248	15
1993	12	20	0.4248	15
1993	12	21	0.39648	14
1993	12	22	0.39648	14
1993	12	23	0.39648	14
1993	12	24	0.39648	14
1993	12	25	0.4248	15
1993	12	26	0.4248	15
1993	12	27	0.39648	14
1993	12	28	0.36816	13
1993	12	29	0.36816	13
1993	12	30	0.39648	14

Year	Month	Day	Q(cms)	Q(cfs)
1993	12	31	2.63376	15
1994	1	1	0.4248	15
1994	1	2	0.39648	14
1994	1	3	0.39648	14
1994	1	4	0.45312	16
1994	1	5	0.4248	15
1994	1	6	0.39648	14
1994	1	7	0.4248	15
1994	1	8	0.4248	15
1994	1	9	0.4248	15
1994	1	10	0.39648	14
1994	1	11	0.39648	14
1994	1	12	0.39648	14
1994	1	13	0.39648	14
1994	1	14	0.39648	14
1994	1	15	0.39648	14
1994	1	16	0.39648	14
1994	1	17	0.39648	14
1994	1	18	0.39648	14
1994	1	19	0.39648	14
1994	1	20	0.36816	13
1994	1	21	0.36816	13
1994	1	22	0.36816	13
1994	1	23	0.36816	13
1994	1	24	0.36816	13
1994	1	25	0.36816	13
1994	1	26	0.36816	13
1994	1	27	0.33984	12
1994	1	28	0.33984	12
1994	1	29	0.33984	12
1994	1	30	0.33984	12
1994	1	31	0.33984	12
1994	2	1	0.33984	12
1994	2	2	0.33984	12
1994	2	3	0.36816	13
1994	2	4	0.33984	12
1994	2	5	0.33984	12
1994	2	6	0.33984	12
1994	2	7	0.33984	12
1994	2	8	0.31152	11
1994	2	9	0.31152	11
1994	2	10	0.31152	11
1994	2	11	0.2832	10
1994	2	12	0.31152	11
1994	2	13	0.31152	11
1994	2	14	0.2832	10
1994	2	15	0.31152	11

Year	Month	Day	Q(cms)	Q(cfs)
1994	2	16	0.36816	13
1994	2	17	0.4248	15
1994	2	18	0.36816	13
1994	2	19	0.33984	12
1994	2	20	0.33984	12
1994	2	21	0.31152	11
1994	2	22	0.31152	11
1994	2	23	0.33984	12
1994	2	24	0.31152	11
1994	2	25	0.31152	11
1994	2	26	0.31152	11
1994	2	27	0.271872	9.6
1994	2	28	0.274704	9.700001
1994	2	28	0.2832	10
1994	3	1	0.31152	11
1994	3	2	0.2832	10
1994	3	3	0.260544	9.200001
1994	3	4	0.246384	8.700001
1994	3	5	0.24072	8.5
1994	3	6	0.249215	8.799999
1994	3	7	0.257712	9.1
1994	3	8	0.263375	9.299999
1994	3	9	0.271872	9.6
1994	3	10	0.235055	8.299999
1994	3	11	0.186912	6.600001
1994	3	12	0.144432	5.1
1994	3	13	0.235055	8.299999
1994	3	14	0.144432	5.1
1994	3	15	0.266208	9.4
1994	3	16	0.246384	8.700001
1994	3	17	0.223727	7.899999
1994	3	18	0.203904	7.2
1994	3	19	0.144432	5.1
1994	3	20	0.181247	6.399999
1994	3	21	0.116112	4.1
1994	3	22	0.11328	4
1994	3	23	0.104784	3.7
1994	3	24	0.5664	20
1994	3	25	0.93456	33
1994	3	26	1.44432	51
1994	3	27	1.78416	63
1994	3	28	1.86912	66
1994	3	29	2.03904	72
1994	3	30	1.8408	65
1994	4	1	1.75584	62
1994	4	2	1.64256	58
1994	4	3	1.78416	63

Year	Month	Day	Q(cms)	Q(cfs)
1994	4	4	2.15232	76
1994	4	5	2.20896	78
1994	4	6	2.03904	72
1994	4	7	1.92576	68
1994	4	8	2.09568	74
1994	4	9	2.15232	76
1994	4	10	1.61424	57
1994	4	11	1.89744	67
1994	4	12	2.2656	80
1994	4	13	2.35056	83
1994	4	14	2.4072	85
1994	4	15	2.2656	80
1994	4	16	2.20896	78
1994	4	17	2.2656	80
1994	4	18	2.20896	78
1994	4	19	2.15232	76
1994	4	20	2.20896	78
1994	4	21	2.15232	76
1994	4	22	2.15232	76
1994	4	23	2.20896	78
1994	4	24	2.15232	76
1994	4	25	2.15232	76
1994	4	26	2.09568	74
1994	4	27	1.9824	70
1994	4	28	1.92576	68
1994	4	29	1.86912	66
1994	4	30	1.81248	64
1994	5	1	2.09568	74
1994	5	2	2.37888	84
1994	5	3	2.2656	80
1994	5	4	2.20896	78
1994	5	5	2.15232	76
1994	5	6	2.2656	80
1994	5	7	2.37888	84
1994	5	8	2.2656	80
1994	5	9	2.20896	78
1994	5	10	2.20896	78
1994	5	11	2.2656	80
1994	5	12	2.23728	79
1994	5	13	2.2656	80
1994	5	14	2.32224	82
1994	5	15	2.43552	86
1994	5	16	2.5488	90
1994	5	17	2.2656	80
1994	5	18	1.9824	70
1994	5	19	1.6992	60
1994	5	20	1.64256	58

Year	Month	Day	Q(cms)	Q(cfs)
1994	5	21	1.6992	60
1994	5	22	1.81248	64
1994	5	23	1.86912	66
1994	5	24	1.86912	66
1994	5	25	1.92576	68
1994	5	26	1.95408	69
1994	5	27	2.15232	76
1994	5	28	2.37888	84
1994	5	29	2.49216	88
1994	5	30	2.2656	80
1994	5	31	2.124	75
1994	6	1	2.03904	72
1994	6	2	2.20896	78
1994	6	3	2.23728	79
1994	6	4	2.43552	86
1994	6	5	2.60544	92
1994	6	6	3.03024	107
1994	6	7	3.08688	109
1994	6	8	2.57712	91
1994	6	9	2.52048	89
1994	6	10	2.5488	90
1994	6	11	2.5488	90
1994	6	12	2.35056	83
1994	6	13	2.57712	91
1994	6	14	2.6904	95
1994	6	15	2.52048	89
1994	6	16	2.2656	80
1994	6	17	2.86032	101
1994	6	18	2.80368	99
1994	6	19	2.4072	85
1994	6	20	2.15232	76
1994	6	21	1.9824	70
1994	6	22	1.95408	69
1994	6	23	1.92576	68
1994	6	24	2.03904	72
1994	6	25	2.32224	82
1994	6	26	2.66208	94
1994	6	27	3.00192	106
1994	6	28	2.94528	104
1994	6	29	2.88864	102
1994	6	30	2.86032	101
1994	7	1	2.88864	102
1994	7	2	2.66208	94
1994	7	3	2.74704	97
1994	7	4	2.832	100
1994	7	5	3.31344	117
1994	7	6	2.88864	102

Year	Month	Day	Q(cms)	Q(cfs)
1994	7	7	2.74704	97
1994	7	8	2.60544	92
1994	7	9	2.37888	84
1994	7	10	2.46384	87
1994	7	11	2.57712	91
1994	7	12	2.52048	89
1994	7	13	2.49216	88
1994	7	14	2.57712	91
1994	7	15	2.4072	85
1994	7	16	2.832	100
1994	7	17	2.5488	90
1994	7	18	2.49216	88
1994	7	19	2.4072	85
1994	7	20	2.57712	91
1994	7	21	2.43552	86
1994	7	22	2.32224	82
1994	7	23	2.35056	83
1994	7	24	2.52048	89
1994	7	25	2.57712	91
1994	7	26	2.52048	89
1994	7	27	2.43552	86
1994	7	28	2.35056	83
1994	7	29	2.4072	85
1994	7	30	2.57712	91
1994	7	31	2.71872	96
1994	8	1	3.00192	106
1994	8	2	2.88864	102
1994	8	3	2.77536	98
1994	8	4	2.57712	91
1994	8	5	2.77536	98
1994	8	6	2.71872	96
1994	8	7	2.88864	102
1994	8	8	5.35248	189
1994	8	9	2.77536	98
1994	8	10	2.71872	96
1994	8	11	2.5488	90
1994	8	12	2.49216	88
1994	8	13	2.49216	88
1994	8	14	2.5488	90
1994	8	15	2.66208	94
1994	8	16	2.66208	94
1994	8	17	2.66208	94
1994	8	18	2.5488	90
1994	8	19	2.5488	90
1994	8	20	2.60544	92
1994	8	21	2.66208	94
1994	8	22	2.66208	94

Year	Month	Day	Q(cms)	Q(cfs)
1994	8	23	2.5488	90
1994	8	24	2.49216	88
1994	8	25	2.49216	88
1994	8	26	2.60544	92
1994	8	27	2.66208	94
1994	8	28	2.71872	96
1994	8	29	2.66208	94
1994	8	30	2.60544	92
1994	8	31	2.49216	88
1994	9	1	2.43552	86
1994	9	2	2.37888	84
1994	9	3	2.43552	86
1994	9	4	2.5488	90
1994	9	5	2.49216	88
1994	9	6	2.49216	88
1994	9	7	2.5488	90
1994	9	8	2.60544	92
1994	9	9	2.66208	94
1994	9	10	2.77536	98
1994	9	11	2.71872	96
1994	9	12	2.66208	94
1994	9	13	2.66208	94
1994	9	14	2.71872	96
1994	9	15	2.832	100
1994	9	16	2.832	100
1994	9	17	2.94528	104
1994	9	18	2.88864	102
1994	9	19	2.63376	93
1994	9	20	2.15232	76
1994	9	21	2.2656	80
1994	9	22	2.46384	87
1994	9	23	2.63376	93
1994	9	24	2.9736	105
1994	9	25	3.00192	106
1994	9	26	3.17184	112
1994	9	27	2.6904	95
1994	9	28	2.37888	84
1994	9	29	2.4072	85
1994	9	30	2.37888	84
1994	10	1	2.2656	80
1994	10	2	2.35056	83
1994	10	3	2.46384	87
1994	10	4	2.52048	89
1994	10	5	2.52048	89
1994	10	6	2.43552	86
1994	10	7	2.5488	90
1994	10	8	2.60544	92

Year	Month	Day	Q(cms)	Q(cfs)
1994	10	9	2.60544	92
1994	10	10	2.5488	90
1994	10	11	2.37888	84
1994	10	12	2.43552	86
1994	10	13	2.49216	88
1994	10	14	2.46384	87
1994	10	15	2.37888	84
1994	10	16	2.29392	81
1994	10	17	2.52048	89
1994	10	18	2.60544	92
1994	10	19	2.23728	79
1994	10	20	2.15232	76
1994	10	21	2.03904	72
1994	10	22	2.03904	72
1994	10	23	2.03904	72
1994	10	24	1.78416	63
1994	10	25	1.35936	48
1994	10	26	1.01952	36
1994	10	27	0.90624	32
1994	10	28	0.82128	29
1994	10	29	0.76464	27
1994	10	30	0.708	25
1994	10	31	0.73632	26
1994	11	1	0.73632	26
1994	11	2	0.62304	22
1994	11	3	0.62304	22
1994	11	4	0.65136	23
1994	11	5	0.59472	21
1994	11	6	0.59472	21
1994	11	7	0.5664	20
1994	11	8	0.5664	20
1994	11	9	0.62304	22
1994	11	10	0.5664	20
1994	11	11	0.5664	20
1994	11	12	0.53808	19
1994	11	13	0.48144	17
1994	11	14	0.48144	17
1994	11	15	0.53808	19
1994	11	16	0.5664	20
1994	11	17	0.48144	17
1994	11	18	0.45312	16
1994	11	19	0.50976	18
1994	11	20	0.50976	18
1994	11	21	0.45312	16
1994	11	22	0.45312	16
1994	11	23	0.50976	18
1994	11	24	0.48144	17

Year	Month	Day	Q(cms)	Q(cfs)
1994	11	25	0.53808	19
1994	11	26	0.48144	17
1994	11	27	0.48144	17
1994	11	28	0.4248	15
1994	11	28	0.48144	17
1994	11	30	0.48144	17
1994	12	1	0.45312	16
1994	12	2	0.4248	15
1994	12	3	0.4248	15
1994	12	4	0.39648	14
1994	12	5	0.4248	15
1994	12	6	0.4248	15
1994	12	7	0.39648	14
1994	12	8	0.39648	14
1994	12	9	0.36816	13
1994	12	10	0.39648	14
1994	12	11	0.4248	15
1994	12	12	0.39648	14
1994	12	13	0.39648	14
1994	12	14	0.39648	14
1994	12	15	0.39648	14
1994	12	16	0.4248	15
1994	12	17	0.45312	16
1994	12	18	0.48144	17
1994	12	19	0.48144	17
1994	12	20	0.50976	18
1994	12	21	0.45312	16
1994	12	22	0.50976	18
1994	12	23	0.62304	22
1994	12	24	0.62304	22
1994	12	25	0.59472	21
1994	12	26	0.65136	23
1994	12	27	0.708	25
1994	12	28	0.76464	27
1994	12	29	0.87792	31
1994	12	30	0.87792	31
1994	12	31	0.87792	31
1995	1	1	0.87792	31
1995	1	2	0.87792	31
1995	1	3	0.87792	31
1995	1	4	0.87792	31
1995	1	5	0.90624	32
1995	1	6	0.8496	30
1995	1	7	0.8496	30
1995	1	8	0.8496	30
1995	1	9	0.96288	34
1995	1	10	1.67088	59

Year	Month	Day	Q(cms)	Q(cfs)
1995	1	11	1.44432	51
1995	1	12	1.07616	38
1995	1	13	0.9912	35
1995	1	14	0.90624	32
1995	1	15	0.76464	27
1995	1	16	0.65136	23
1995	1	17	0.53808	19
1995	1	18	0.48144	17
1995	1	19	0.4248	15
1995	1	20	0.45312	16
1995	1	21	0.45312	16
1995	1	22	0.45312	16
1995	1	23	0.45312	16
1995	1	24	0.45312	16
1995	1	25	0.45312	16
1995	1	26	0.4248	15
1995	1	27	0.39648	14
1995	1	28	0.4248	15
1995	1	29	0.45312	16
1995	1	30	0.48144	17
1995	1	31	0.50976	18
1995	2	1	0.48144	17
1995	2	2	0.45312	16
1995	2	3	0.45312	16
1995	2	4	0.48144	17
1995	2	5	0.48144	17
1995	2	6	0.48144	17
1995	2	7	0.48144	17
1995	2	8	0.45312	16
1995	2	9	0.45312	16
1995	2	10	0.45312	16
1995	2	11	0.48144	17
1995	2	12	0.4248	15
1995	2	13	0.45312	16
1995	2	14	0.45312	16
1995	2	15	0.45312	16
1995	2	16	0.4248	15
1995	2	17	0.4248	15
1995	2	18	0.36816	13
1995	2	19	0.36816	13
1995	2	20	0.33984	12
1995	2	21	0.31152	11
1995	2	22	0.31152	11
1995	2	23	0.31152	11
1995	2	24	0.2832	10
1995	2	25	0.26904	9.5
1995	2	26	0.25488	9

Year	Month	Day	Q(cms)	Q(cfs)
1995	2	27	0.25488	9
1995	2	28	0.271872	9.6
1995	3	1	0.2832	10
1995	3	2	0.266208	9.4
1995	3	3	0.249215	8.799999
1995	3	4	0.220896	7.8
1995	3	5	0.249215	8.799999
1995	3	6	0.277535	9.799999
1995	3	7	0.206736	7.3
1995	3	8	0.206736	7.3
1995	3	9	0.36816	13
1995	3	10	0.33984	12
1995	3	11	0.220896	7.8
1995	3	12	0.133104	4.7
1995	3	13	0.260544	9.200001
1995	3	14	0.2832	10
1995	3	15	0.274704	9.700001
1995	3	16	0.266208	9.4
1995	3	17	0.203904	7.2
1995	3	18	0.33984	12
1995	3	19	0.31152	11
1995	3	20	0.36816	13
1995	3	21	0.36816	13
1995	3	22	0.33984	12
1995	3	23	0.138768	4.9
1995	3	24	0.201072	7.100001
1995	3	25	0.101952	3.6
1995	3	26	0.101952	3.6
1995	3	27	0.101952	3.6
1995	3	28	0.118944	4.2
1995	3	29	0.67968	24
1995	3	30	1.2744	45
1995	3	31	1.5576	55
1995	4	1	1.9824	70
1995	4	2	1.92576	68
1995	4	3	1.9824	70
1995	4	4	1.81248	64
1995	4	5	1.89744	67
1995	4	6	1.72752	61
1995	4	7	1.9824	70
1995	4	8	1.61424	57
1995	4	9	1.67088	59
1995	4	10	1.89744	67
1995	4	11	1.92576	68
1995	4	12	2.124	75
1995	4	13	2.46384	87
1995	4	14	2.23728	79

Year	Month	Day	Q(cms)	Q(cfs)
1995	4	15	2.09568	74
1995	4	16	2.09568	74
1995	4	17	2.20896	78
1995	4	18	2.2656	80
1995	4	19	2.124	75
1995	4	20	2.18064	77
1995	4	21	2.124	75
1995	4	22	2.15232	76
1995	4	23	1.92576	68
1995	4	24	1.81248	64
1995	4	25	1.72752	61
1995	4	26	1.86912	66
1995	4	27	2.23728	79
1995	4	28	2.49216	88
1995	4	29	2.35056	83
1995	4	30	2.06736	73
1995	5	1	2.06736	73
1995	5	2	1.89744	67
1995	5	3	1.8408	65
1995	5	4	1.81248	64
1995	5	5	1.92576	68
1995	5	6	2.03904	72
1995	5	7	2.15232	76
1995	5	8	2.06736	73
1995	5	9	1.9824	70
1995	5	10	2.15232	76
1995	5	11	2.5488	90
1995	5	12	2.43552	86
1995	5	13	2.23728	79
1995	5	14	2.06736	73
1995	5	15	1.95408	69
1995	5	16	1.81248	64
1995	5	17	1.92576	68
1995	5	18	2.15232	76
1995	5	19	2.09568	74
1995	5	20	2.32224	82
1995	5	21	2.29392	81
1995	5	22	2.29392	81
1995	5	23	2.29392	81
1995	5	24	2.20896	78
1995	5	25	2.35056	83
1995	5	26	2.57712	91
1995	5	27	2.63376	93
1995	5	28	2.49216	88
1995	5	29	2.43552	86
1995	5	30	2.20896	78
1995	5	31	2.37888	84

Year	Month	Day	Q(cms)	Q(cfs)
1995	6	1	2.57712	91
1995	6	2	2.71872	96
1995	6	3	2.66208	94
1995	6	4	2.57712	91
1995	6	5	2.60544	92
1995	6	6	3.17184	112
1995	6	7	3.28512	116
1995	6	8	2.80368	99
1995	6	9	2.63376	93
1995	6	10	2.5488	90
1995	6	11	2.60544	92
1995	6	12	2.63376	93
1995	6	13	2.57712	91
1995	6	14	2.832	100
1995	6	15	4.30464	152
1995	6	16	3.05856	108
1995	6	17	2.57712	91
1995	6	18	2.5488	90
1995	6	19	3.3984	120
1995	6	20	3.54	125
1995	6	21	2.74704	97
1995	6	22	2.43552	86
1995	6	23	2.49216	88
1995	6	24	2.71872	96
1995	6	25	2.63376	93
1995	6	26	2.63376	93
1995	6	27	2.37888	84
1995	6	28	2.29392	81
1995	6	29	2.32224	82
1995	6	30	2.5488	90
1995	7	1	2.88864	102
1995	7	2	3.08688	109
1995	7	3	3.03024	107
1995	7	4	2.77536	98
1995	7	5	2.5488	90
1995	7	6	2.5488	90
1995	7	7	2.43552	86
1995	7	8	2.80368	99
1995	7	9	3.62496	128
1995	7	10	3.79488	134
1995	7	11	3.65328	129
1995	7	12	3.31344	117
1995	7	13	2.80368	99
1995	7	14	2.66208	94
1995	7	15	2.71872	96
1995	7	16	2.91696	103
1995	7	17	3.03024	107

Year	Month	Day	Q(cms)	Q(cfs)
1995	7	18	3.05856	108
1995	7	19	2.74704	97
1995	7	20	2.86032	101
1995	7	21	2.74704	97
1995	7	22	2.52048	89
1995	7	23	2.37888	84
1995	7	24	2.6904	95
1995	7	25	3.03024	107
1995	7	26	2.9736	105
1995	7	27	3.00192	106
1995	7	28	3.00192	106
1995	7	29	2.74704	97
1995	7	30	2.832	100
1995	7	31	3.17184	112
1995	8	1	3.3984	120
1995	8	2	3.34176	118
1995	8	3	3.05856	108
1995	8	4	2.91696	103
1995	8	5	2.88864	102
1995	8	6	3.34176	118
1995	8	7	3.70992	131
1995	8	8	3.56832	126
1995	8	9	3.03024	107
1995	8	10	3.08688	109
1995	8	11	3.17184	112
1995	8	12	3.20016	113
1995	8	13	3.3984	120
1995	8	14	3.17184	112
1995	8	15	2.832	100
1995	8	16	2.832	100
1995	8	17	2.832	100
1995	8	18	2.9736	105
1995	8	19	3.1152	110
1995	8	20	2.9736	105
1995	8	21	2.832	100
1995	8	22	3.1152	110
1995	8	23	3.1152	110
1995	8	24	3.1152	110
1995	8	25	3.17184	112
1995	8	26	3.1152	110
1995	8	27	2.94528	104
1995	8	28	2.6904	95
1995	8	29	2.43552	86
1995	8	30	2.29392	81
1995	8	31	2.43552	86
1995	9	1	2.29392	81
1995	9	2	2.77536	98

Year	Month	Day	Q(cms)	Q(cfs)
1995	9	3	3.03024	107
1995	9	4	3.1152	110
1995	9	5	3.03024	107
1995	9	6	3.00192	106
1995	9	7	3.37008	119
1995	9	8	3.22848	114
1995	9	9	3.14352	111
1995	9	10	2.9736	105
1995	9	11	2.57712	91
1995	9	12	2.43552	86
1995	9	13	2.2656	80
1995	9	14	2.5488	90
1995	9	15	2.71872	96
1995	9	16	2.5488	90
1995	9	17	2.37888	84
1995	9	18	2.32224	82
1995	9	19	2.2656	80
1995	9	20	2.15232	76
1995	9	21	2.23728	79
1995	9	22	2.49216	88
1995	9	23	2.6904	95
1995	9	24	2.74704	97
1995	9	25	2.66208	94
1995	9	26	2.20896	78
1995	9	27	2.15232	76
1995	9	28	2.23728	79
1995	9	29	2.6904	95
1995	9	30	2.86032	101

Appendix 7.7. Discharge record 1992-98 for Crab Creek, Grant County, WA.

Year	Month	Day	Q(cms)	Q(cfs)
1992	10	5	8.8	311
1992	10	6	8.9	315
1992	10	7	8.9	316
1992	10	8	8.9	313
1992	10	9	8.9	313
1992	10	10	8.9	314
1992	10	11	8.9	313
1992	10	12	8.8	310
1992	10	13	8.7	308
1992	10	14	8.7	307
1992	10	15	8.6	305
1992	10	16	8.6	305
1992	10	17	8.9	313
1992	10	18	9.1	321
1992	10	19	9.3	329
1992	10	20	9.5	335
1992	10	21	9.6	339
1992	10	22	9.6	339
1992	10	23	9.6	340
1992	10	24	9.6	339
1992	10	25	9.6	338
1992	10	26	9.7	342
1992	10	27	9.7	344
1992	10	28	9.8	346
1992	10	29	9.5	337
1992	10	30	9.2	326
1992	10	31	8.9	314
1992	11	1	8.8	309
1992	11	2	8.5	301
1992	11	3	8.1	287
1992	11	4	7.9	280
1992	11	5	8.0	282
1992	11	6	7.8	276
1992	11	7	7.6	268
1992	11	8	7.6	268
1992	11	9	7.4	262
1992	11	10	7.2	253
1992	11	11	7.1	249
1992	11	12	7.1	249
1992	11	13	6.9	244
1992	11	14	6.7	238
1992	11	15	6.8	239
1992	11	16	6.8	240
1992	11	17	6.6	232
1992	11	18	6.4	226
1992	11	19	6.4	225
1992	11	20	6.5	228
1992	11	21	6.5	230
1992	11	22	7.3	257
1992	11	23	7.2	253
1992	11	24	6.6	234

Year	Month	Day	Q(cms)	Q(cfs)
1995	10	4	10.4	366
1995	10	5	10.6	376
1995	10	6	10.6	387
1995	10	7	10.6	392
1995	10	8	10.6	391
1995	10	9	10.6	384
1995	10	10	10.6	380
1995	10	11	10.6	391
1995	10	12	10.6	387
1995	10	13	10.6	384
1995	10	14	10.6	386
1995	10	15	10.6	386
1995	10	16	10.6	389
1995	10	17	10.6	394
1995	10	18	10.6	393
1995	10	19	10.6	393
1995	10	20	10.6	391
1995	10	21	10.6	382
1995	10	22	10.6	375
1995	10	23	10.6	371
1995	10	24	10.6	355
1995	10	25	10.6	351
1995	10	26	10.6	346
1995	10	27	10.6	342
1995	10	28	10.6	345
1995	10	29	10.6	295
1995	10	30	10.6	278
1995	10	31	10.6	261
1995	11	1	10.6	245
1995	11	2	10.6	235
1995	11	3	10.6	226
1995	11	4	10.6	215
1995	11	5	10.6	212
1995	11	6	10.6	210
1995	11	7	10.6	218
1995	11	8	10.6	223
1995	11	9	10.6	217
1995	11	10	10.6	207
1995	11	11	10.6	207
1995	11	12	10.6	217
1995	11	13	10.6	215
1995	11	14	10.6	217
1995	11	15	10.6	225
1995	11	16	10.6	236
1995	11	17	10.6	236
1995	11	18	10.6	234
1995	11	19	10.6	230
1995	11	20	10.6	225
1995	11	21	10.6	222
1995	11	22	10.6	220
1995	11	23	10.6	214

Year	Month	Day	Q(cms)	Q(cfs)	Year	Month	Day	Q(cms)	Q(cfs)
1992	11	25	6.3	224	1995	11	24	10.6	219
1992	11	26	6.1	216	1995	11	25	10.6	222
1992	11	27	6.1	215	1995	11	26	10.6	215
1992	11	28	6.3	221	1995	11	27	10.6	212
1992	11	29	6.2	220	1995	11	28	10.6	223
1992	11	30	6.1	216	1995	11	29	10.6	214
1992	12	1	6.1	215	1995	11	30	10.6	209
1992	12	2	6.0	212	1995	12	1	10.6	202
1992	12	3	5.7	203	1995	12	2	10.6	199
1992	12	4	5.4	191	1995	12	3	10.6	197
1992	12	5	5.1	179	1995	12	4	10.6	204
1992	12	6	5.1	180	1995	12	5	10.6	201
1992	12	7	5.2	184	1995	12	6	10.6	197
1992	12	8	5.3	188	1995	12	7	10.6	196
1992	12	9	5.7	200	1995	12	8	10.6	184
1992	12	10	5.9	208	1995	12	9	10.6	181
1992	12	11	6.4	226	1995	12	10	10.6	171
1992	12	12	6.3	221	1995	12	11	10.6	175
1992	12	13	6.1	215	1995	12	12	10.6	241
1992	12	14	6.0	211	1995	12	13	10.6	314
1992	12	15	6.0	211	1995	12	14	10.6	314
1992	12	16	5.9	210	1995	12	15	10.6	286
1992	12	17	6.0	213	1995	12	16	10.6	258
1992	12	18	6.1	217	1995	12	17	10.6	237
1992	12	19	5.8	205	1995	12	18	10.6	228
1992	12	20	6.0	212	1995	12	19	10.6	223
1992	12	21	6.1	217	1995	12	20	10.6	222
1992	12	22	6.1	217	1995	12	21	10.6	215
1992	12	23	6.9	245	1995	12	22	10.6	212
1992	12	24	7.4	262	1995	12	23	10.6	209
1992	12	25	7.4	260	1995	12	24	10.6	206
1992	12	26	6.9	243	1995	12	25	10.6	202
1992	12	27	6.6	234	1995	12	26	10.6	200
1992	12	28	6.5	230	1995	12	27	10.6	200
1992	12	29	6.4	227	1995	12	28	10.6	200
1992	12	30	6.3	222	1995	12	29	10.6	203
1992	12	31	5.7	202	1995	12	30	10.6	209
1993	1	1	4.2	150	1995	12	31	10.6	224
1993	1	2	4.0	140	1996	1	1	10.6	228
1993	1	3	4.2	150	1996	1	2	10.6	225
1993	1	4	4.5	160	1996	1	3	10.6	224
1993	1	5	4.8	170	1996	1	4	10.6	223
1993	1	6	4.8	170	1996	1	5	10.6	215
1993	1	7	4.8	170	1996	1	6	10.6	210
1993	1	8	4.5	160	1996	1	7	10.6	212
1993	1	9	4.2	150	1996	1	8	10.6	219
1993	1	10	4.0	140	1996	1	9	10.6	221
1993	1	11	4.0	140	1996	1	10	10.6	220
1993	1	12	4.0	140	1996	1	11	10.6	215
1993	1	13	4.2	150	1996	1	12	10.6	208
1993	1	14	4.2	150	1996	1	13	10.6	203
1993	1	15	4.5	160	1996	1	14	10.6	199
1993	1	16	4.5	160	1996	1	15	10.6	192
1993	1	17	4.5	160	1996	1	16	10.6	198

Year	Month	Day	Q(cms)	Q(cfs)
1993	1	18	4.5	160
1993	1	19	4.5	160
1993	1	20	4.8	170
1993	1	21	5.1	179
1993	1	22	5.7	200
1993	1	23	7.2	253
1993	1	24	6.3	224
1993	1	25	6.1	217
1993	1	26	7.2	254
1993	1	27	8.3	292
1993	1	28	8.1	286
1993	1	29	7.7	273
1993	1	30	7.4	261
1993	1	31	7.2	254
1993	2	1	7.1	249
1993	2	2	7.0	246
1993	2	3	6.8	241
1993	2	4	6.7	235
1993	2	5	6.6	232
1993	2	6	6.6	233
1993	2	7	6.5	230
1993	2	8	6.5	228
1993	2	9	6.5	229
1993	2	10	6.5	229
1993	2	11	6.4	226
1993	2	12	6.4	226
1993	2	13	6.3	223
1993	2	14	6.2	220
1993	2	15	6.1	214
1993	2	16	5.6	198
1993	2	17	5.4	191
1993	2	18	5.7	203
1993	2	19	5.8	204
1993	2	20	6.1	214
1993	2	21	6.0	213
1993	2	22	5.9	209
1993	2	23	5.8	206
1993	2	24	5.8	205
1993	2	25	5.6	198
1993	2	26	5.5	194
1993	2	27	5.3	188
1993	2	28	5.3	188
1993	3	1	5.3	186
1993	3	5	5.7	200
1993	3	6	5.9	209
1993	3	7	6.3	224
1993	3	8	6.9	242
1993	3	9	6.7	238
1993	3	10	6.4	226
1993	3	11	6.0	212
1993	3	12	5.7	203
1993	3	13	5.6	199
1993	3	14	5.6	198
1993	3	15	5.5	193

Year	Month	Day	Q(cms)	Q(cfs)
1996	1	17	10.6	200
1996	1	18	10.6	199
1996	1	19	10.6	205
1996	1	20	10.6	212
1996	1	21	10.6	201
1996	1	22	10.6	210
1996	1	23	10.6	213
1996	1	24	10.6	222
1996	1	25	10.6	224
1996	1	26	10.6	219
1996	1	27	10.6	212
1996	1	28	10.6	206
1996	1	29	10.6	199
1996	1	30	10.6	150
1996	1	31	10.6	171
1996	2	1	10.6	197
1996	2	2	10.6	216
1996	2	3	10.6	218
1996	2	4	10.6	219
1996	2	5	10.6	221
1996	2	6	10.6	223
1996	2	7	10.6	226
1996	2	8	10.6	224
1996	2	9	10.6	223
1996	2	10	10.6	227
1996	2	11	10.6	229
1996	2	12	10.6	232
1996	2	13	10.6	234
1996	2	14	10.6	236
1996	2	15	10.6	235
1996	2	16	10.6	236
1996	2	17	10.6	251
1996	2	18	10.6	256
1996	2	19	10.6	259
1996	2	20	10.6	259
1996	2	21	10.6	250
1996	2	22	10.6	233
1996	2	23	10.6	184
1996	2	24	10.6	178
1996	2	25	10.6	222
1996	2	26	10.6	222
1996	2	27	10.6	216
1996	2	28	10.6	204
1996	2	29	10.6	199
1996	3	1	10.6	201
1996	3	2	10.6	197
1996	3	3	10.6	199
1996	3	4	10.6	209
1996	3	5	10.6	224
1996	3	6	10.6	225
1996	3	7	10.6	217
1996	3	8	10.6	212
1996	3	9	10.6	209
1996	3	10	10.6	209

Year	Month	Day	Q(cms)	Q(cfs)
1993	3	16	5.5	194
1993	3	17	5.7	200
1993	3	18	5.6	196
1993	3	19	5.4	189
1993	3	20	5.3	187
1993	3	21	5.4	189
1993	3	22	5.7	202
1993	3	23	6.2	219
1993	3	24	6.2	218
1993	3	25	5.9	207
1993	3	26	5.6	197
1993	3	27	5.1	181
1993	3	28	5.0	175
1993	3	29	4.4	156
1993	3	30	4.2	148
1993	3	31	4.4	157
1993	4	1	4.5	159
1993	4	2	4.3	153
1993	4	3	4.4	156
1993	4	4	4.7	165
1993	4	5	4.8	169
1993	4	6	5.2	182
1993	4	7	5.7	200
1993	4	8	6.3	222
1993	4	9	6.8	241
1993	4	10	7.2	253
1993	4	11	7.4	261
1993	4	12	7.5	264
1993	4	13	7.4	262
1993	4	14	7.5	264
1993	4	15	7.4	263
1993	4	16	7.4	261
1993	4	17	7.3	259
1993	4	18	7.3	258
1993	4	19	7.6	270
1993	4	20	7.6	269
1993	4	21	7.4	263
1993	4	22	7.2	255
1993	4	23	7.2	254
1993	4	24	7.3	257
1993	4	25	7.5	264
1993	4	26	7.8	277
1993	4	27	7.9	280
1993	4	28	7.8	275
1993	4	29	7.7	272
1993	4	30	7.8	274
1993	5	1	7.6	269
1993	5	2	7.1	251
1993	5	3	6.8	239
1993	5	4	6.8	241
1993	5	5	6.9	245
1993	5	6	6.8	240
1993	5	7	6.7	237
1993	5	8	6.6	233

Year	Month	Day	Q(cms)	Q(cfs)
1996	3	11	10.6	207
1996	3	12	10.6	201
1996	3	13	10.6	193
1996	3	14	10.6	187
1996	3	15	10.6	171
1996	3	16	10.6	177
1996	3	17	10.6	186
1996	3	18	10.6	197
1996	3	19	10.6	231
1996	3	20	10.6	192
1996	3	21	10.6	184
1996	3	22	10.6	176
1996	3	23	10.6	179
1996	3	24	10.6	166
1996	3	25	10.6	150
1996	3	26	10.6	150
1996	3	27	10.6	167
1996	3	28	10.6	172
1996	3	29	10.6	164
1996	3	30	10.6	159
1996	3	31	10.6	161
1996	4	1	10.6	201
1996	4	2	10.6	232
1996	4	3	10.6	250
1996	4	4	10.6	257
1996	4	5	10.6	259
1996	4	6	10.6	254
1996	4	7	10.6	253
1996	4	8	10.6	259
1996	4	9	10.6	264
1996	4	10	10.6	249
1996	4	11	10.6	239
1996	4	12	10.6	241
1996	4	13	10.6	237
1996	4	14	10.6	229
1996	4	15	10.6	233
1996	4	16	10.6	230
1996	4	17	10.6	244
1996	4	18	10.6	230
1996	4	19	10.6	221
1996	4	20	10.6	204
1996	4	21	10.6	228
1996	4	22	10.6	251
1996	4	23	10.6	260
1996	4	24	10.6	253
1996	4	25	10.6	259
1996	4	26	10.6	250
1996	4	27	10.6	257
1996	4	28	10.6	252
1996	4	29	10.6	246
1996	4	30	10.6	250
1996	5	1	10.6	249
1996	5	2	10.6	248
1996	5	3	10.6	244

Year	Month	Day	Q(cms)	Q(cfs)	Year	Month	Day	Q(cms)	Q(cfs)
1993	5	9	6.6	234	1996	5	4	10.6	233
1993	5	10	6.6	233	1996	5	5	10.6	232
1993	5	11	6.7	236	1996	5	6	10.6	238
1993	5	12	6.3	223	1996	5	7	10.6	245
1993	5	13	5.0	176	1996	5	8	10.6	242
1993	5	14	4.7	165	1996	5	9	10.6	244
1993	5	15	4.9	172	1996	5	10	10.6	254
1993	5	16	5.2	184	1996	5	11	10.6	257
1993	5	17	5.1	180	1996	5	12	10.6	258
1993	5	18	5.2	185	1996	5	13	10.6	270
1993	5	19	5.2	185	1996	5	14	10.6	276
1993	5	20	5.8	206	1996	5	15	10.6	279
1993	5	21	6.3	221	1996	5	16	10.6	275
1993	5	22	6.7	235	1996	5	17	10.6	278
1993	5	23	7.0	248	1996	5	18	10.6	280
1993	5	24	7.2	253	1996	5	19	10.6	281
1993	5	25	7.3	258	1996	5	20	10.6	281
1993	5	26	7.3	259	1996	5	21	10.6	279
1993	5	27	7.3	258	1996	5	22	10.6	274
1993	5	28	7.1	251	1996	5	23	10.6	279
1993	5	29	7.0	246	1996	5	24	10.6	290
1993	5	30	7.1	249	1996	5	25	10.6	286
1993	5	31	7.2	256	1996	5	26	10.6	289
1993	6	1	7.6	270	1996	5	27	10.6	290
1993	6	2	8.1	286	1996	5	28	10.6	286
1993	6	3	8.4	295	1996	5	29	10.6	284
1993	6	4	8.3	293	1996	5	30	10.6	288
1993	6	5	8.3	293	1996	5	31	10.6	291
1993	6	6	8.4	298	1996	6	1	10.6	276
1993	6	7	8.4	295	1996	6	2	10.6	264
1993	6	8	8.6	302	1996	6	3	10.6	253
1993	6	9	8.3	294	1996	6	4	10.6	236
1993	6	10	8.0	282	1996	6	5	10.6	235
1993	6	11	7.3	259	1996	6	6	10.6	223
1993	6	12	7.4	260	1996	6	7	10.6	212
1993	6	13	7.8	274	1996	6	8	10.6	201
1993	6	14	7.9	279	1996	6	9	10.6	190
1993	6	15	7.5	266	1996	6	10	10.6	210
1993	6	16	7.2	255	1996	6	11	10.6	226
1993	6	17	7.2	255	1996	6	12	10.6	221
1993	6	18	7.3	259	1996	6	13	10.6	207
1993	6	19	7.4	262	1996	6	14	10.6	186
1993	6	20	6.8	239	1996	6	15	10.6	193
1993	6	21	6.4	225	1996	6	16	10.6	213
1993	6	22	7.2	255	1996	6	17	10.6	222
1993	6	23	7.9	278	1996	6	18	10.6	245
1993	6	24	7.5	265	1996	6	19	10.6	254
1993	6	25	7.5	266	1996	6	20	10.6	242
1993	6	26	7.6	269	1996	6	21	10.6	250
1993	6	27	7.7	272	1996	6	22	10.6	257
1993	6	28	7.8	277	1996	6	23	10.6	267
1993	6	29	8.0	282	1996	6	24	10.6	271
1993	6	30	8.1	286	1996	6	25	10.6	264
1993	7	1	7.8	275	1996	6	26	10.6	275

Year	Month	Day	Q(cms)	Q(cfs)
1993	7	2	7.5	266
1993	7	3	7.7	271
1993	7	4	7.9	280
1993	7	5	8.2	290
1993	7	6	7.9	280
1993	7	7	7.6	270
1993	7	8	7.4	260
1993	7	9	7.1	250
1993	7	10	6.8	240
1993	7	11	7.4	260
1993	7	12	7.8	275
1993	7	13	7.9	280
1993	7	14	8.1	285
1993	7	15	8.2	290
1993	7	16	7.9	280
1993	7	17	7.8	275
1993	7	18	7.4	260
1993	7	19	6.8	240
1993	7	20	6.5	230
1993	7	21	6.5	230
1993	7	22	6.5	230
1993	7	23	6.5	230
1993	7	24	6.8	240
1993	7	25	6.9	245
1993	7	26	7.1	250
1993	7	27	6.9	245
1993	7	28	6.5	230
1993	7	29	6.2	220
1993	7	30	5.9	210
1993	7	31	5.9	210
1993	8	1	5.9	210
1993	8	2	5.9	210
1993	8	3	5.9	210
1993	8	4	5.9	210
1993	8	5	5.9	210
1993	8	6	5.9	210
1993	8	7	6.2	220
1993	8	8	6.2	220
1993	8	9	6.5	230
1993	8	10	6.5	230
1993	8	11	6.5	230
1993	8	12	6.5	230
1993	8	13	6.7	235
1993	8	14	6.8	240
1993	8	15	6.9	245
1993	8	16	7.1	250
1993	8	17	7.5	265
1993	8	18	7.6	270
1993	8	19	7.5	265
1993	8	20	7.4	260
1993	8	21	7.6	270
1993	8	22	8.4	295
1993	8	23	7.9	280
1993	8	24	8.2	290

Year	Month	Day	Q(cms)	Q(cfs)
1996	6	27	10.6	274
1996	6	28	10.6	274
1996	6	29	10.6	270
1996	6	30	10.6	257
1996	7	1	10.6	246
1996	7	2	10.6	250
1996	7	3	10.6	250
1996	7	4	10.6	248
1996	7	5	10.6	253
1996	7	6	10.6	246
1996	7	7	10.6	249
1996	7	8	10.6	281
1996	7	9	10.6	279
1996	7	10	10.6	285
1996	7	11	10.6	283
1996	7	12	10.6	269
1996	7	13	10.6	250
1996	7	14	10.6	245
1996	7	15	10.6	240
1996	7	16	10.6	236
1996	7	17	10.6	230
1996	7	18	10.6	233
1996	7	19	10.6	261
1996	7	20	10.6	270
1996	7	21	10.6	271
1996	7	22	10.6	279
1996	7	23	10.6	284
1996	7	24	10.6	282
1996	7	25	10.6	261
1996	7	26	10.6	251
1996	7	27	10.6	246
1996	7	28	10.6	243
1996	7	29	10.6	251
1996	7	30	10.6	243
1996	7	31	10.6	239
1996	8	1	10.6	254
1996	8	2	10.6	265
1996	8	3	10.6	272
1996	8	4	10.6	279
1996	8	5	10.6	291
1996	8	6	10.6	301
1996	8	7	10.6	297
1996	8	8	10.6	292
1996	8	9	10.6	292
1996	8	10	10.6	288
1996	8	11	10.6	291
1996	8	12	10.6	299
1996	8	13	10.6	298
1996	8	14	10.6	297
1996	8	15	10.6	298
1996	8	16	10.6	294
1996	8	17	10.6	290
1996	8	18	10.6	296
1996	8	19	10.6	300

Year	Month	Day	Q(cms)	Q(cfs)
1993	8	25	8.5	300
1993	8	26	8.8	310
1993	8	27	9.1	320
1993	8	28	9.1	321
1993	8	29	9.1	322
1993	8	30	9.3	328
1993	8	31	9.4	332
1993	9	1	9.3	330
1993	9	2	9.5	335
1993	9	3	9.5	337
1993	9	4	9.6	339
1993	9	5	9.5	336
1993	9	6	9.5	336
1993	9	7	9.4	333
1993	9	8	9.2	324
1993	9	9	9.2	324
1993	9	10	9.3	327
1993	9	11	8.8	311
1993	9	12	8.8	311
1993	9	13	8.7	306
1993	9	14	8.8	310
1993	9	15	9.1	322
1993	9	16	9.4	333
1993	9	17	9.6	340
1993	9	18	9.7	343
1993	9	19	9.7	342
1993	9	20	9.7	341
1993	9	21	9.7	344
1993	9	22	9.9	350
1993	9	23	10.0	354
1993	9	24	10.2	360
1993	9	25	10.3	363
1993	9	26	10.5	369
1993	9	27	10.6	376
1993	9	28	10.8	380
1993	9	29	10.6	375
1993	9	30	10.5	369
1993	10	1	10.4	368
1993	10	2	10.2	359
1993	10	3	9.7	342
1993	10	4	9.7	341
1993	10	5	9.9	348
1993	10	6	9.8	347
1993	10	7	9.7	342
1993	10	8	9.6	338
1993	10	9	9.6	339
1993	10	10	9.7	343
1993	10	11	9.8	347
1993	10	12	10.0	352
1993	10	13	10.1	357
1993	10	14	10.1	356
1993	10	15	9.7	343
1993	10	16	9.6	338
1993	10	17	9.5	337

Year	Month	Day	Q(cms)	Q(cfs)
1996	8	20	10.6	298
1996	8	21	10.6	292
1996	8	22	10.6	289
1996	8	23	10.6	293
1996	8	24	10.6	292
1996	8	25	10.6	287
1996	8	26	10.6	288
1996	8	27	10.6	304
1996	8	28	10.6	313
1996	8	29	10.6	317
1996	8	30	10.6	318
1996	8	31	10.6	318
1996	9	1	10.6	327
1996	9	2	10.6	334
1996	9	3	10.6	345
1996	9	4	10.6	357
1996	9	5	10.6	364
1996	9	6	10.6	361
1996	9	7	10.6	358
1996	9	8	10.6	360
1996	9	9	10.6	361
1996	9	10	10.6	358
1996	9	11	10.6	358
1996	9	12	10.6	363
1996	9	13	10.6	361
1996	9	14	10.6	358
1996	9	15	10.6	364
1996	9	16	10.6	367
1996	9	17	10.6	370
1996	9	18	10.6	367
1996	9	19	10.6	356
1996	9	20	10.6	360
1996	9	21	10.6	364
1996	9	22	10.6	365
1996	9	23	10.6	366
1996	9	24	10.6	365
1996	9	25	10.6	364
1996	9	26	10.6	355
1996	9	27	10.6	344
1996	9	28	10.6	346
1996	9	29	10.6	344
1996	9	30	9.7	343
1996	10	1	9.6	340
1996	10	2	9.4	332
1996	10	3	9.2	324
1996	10	4	9.1	322
1996	10	5	9.3	327
1996	10	6	9.5	334
1996	10	7	9.7	341
1996	10	8	9.8	347
1996	10	9	10.0	352
1996	10	10	10.0	352
1996	10	11	9.7	344
1996	10	12	9.3	330

Year	Month	Day	Q(cms)	Q(cfs)	Year	Month	Day	Q(cms)	Q(cfs)
1993	10	18	9.7	343	1996	10	13	9.2	326
1993	10	19	9.8	345	1996	10	14	9.2	325
1993	10	20	9.9	349	1996	10	15	9.4	331
1993	10	21	10.1	355	1996	10	16	9.6	340
1993	10	22	10.2	359	1996	10	17	9.8	345
1993	10	23	10.2	360	1996	10	18	9.7	344
1993	10	24	10.2	359	1996	10	19	9.9	350
1993	10	25	10.1	358	1996	10	20	10.1	358
1993	10	26	10.2	359	1996	10	21	10.2	360
1993	10	27	10.2	359	1996	10	22	10.1	356
1993	10	28	10.2	359	1996	10	23	10.1	355
1993	10	29	10.2	359	1996	10	24	10.5	369
1993	10	30	10.2	360	1996	10	25	10.8	381
1993	10	31	10.1	357	1996	10	26	10.6	373
1993	11	1	10.0	353	1996	10	27	9.4	331
1993	11	2	10.0	354	1996	10	28	8.3	292
1993	11	3	10.2	361	1996	10	29	8.4	296
1993	11	4	10.1	358	1996	10	30	8.2	289
1993	11	5	9.1	322	1996	10	31	7.5	264
1993	11	6	7.9	280	1996	11	1	7.0	246
1993	11	7	7.3	259	1996	11	2	6.5	231
1993	11	8	7.1	251	1996	11	3	6.2	220
1993	11	9	6.9	244	1996	11	4	6.3	221
1993	11	10	6.8	241	1996	11	5	6.3	221
1993	11	11	6.8	241	1996	11	6	6.3	221
1993	11	12	6.8	240	1996	11	7	6.2	219
1993	11	13	6.6	234	1996	11	8	5.5	194
1993	11	14	6.5	228	1996	11	9	5.9	210
1993	11	15	6.4	227	1996	11	10	6.1	214
1993	11	16	6.3	223	1996	11	11	6.1	216
1993	11	17	6.3	221	1996	11	12	6.0	213
1993	11	18	6.2	220	1996	11	13	6.0	213
1993	11	19	6.2	220	1996	11	14	6.0	211
1993	11	20	6.1	214	1996	11	15	5.9	210
1993	11	21	6.1	214	1996	11	16	6.0	213
1993	11	22	6.1	215	1996	11	17	5.9	210
1993	11	23	6.0	212	1996	11	18	6.0	211
1993	11	24	4.8	170	1996	11	19	6.4	225
1993	11	25	5.0	175	1996	11	20	7.1	249
1993	11	26	5.1	180	1996	11	21	7.1	250
1993	11	27	5.5	195	1996	11	22	6.9	243
1993	11	28	5.8	204	1996	11	23	6.7	235
1993	11	29	6.1	214	1996	11	24	6.2	220
1993	11	30	6.1	216	1996	11	25	6.6	234
1993	12	1	6.2	220	1996	11	26	6.6	233
1993	12	2	6.5	230	1996	11	27	6.6	234
1993	12	3	6.8	239	1996	11	28	6.9	242
1993	12	4	6.8	240	1996	11	29	7.0	247
1993	12	5	6.6	234	1996	11	30	6.9	242
1993	12	6	6.4	226	1996	12	1	6.7	237
1993	12	7	6.4	225	1996	12	2	6.7	236
1993	12	8	6.5	230	1996	12	3	7.0	247
1993	12	9	7.1	250	1996	12	4	6.7	236
1993	12	10	7.5	264	1996	12	5	6.5	230

Year	Month	Day	Q(cms)	Q(cfs)
1993	12	11	7.0	247
1993	12	12	6.6	234
1993	12	13	6.5	228
1993	12	14	6.5	231
1993	12	15	6.4	225
1993	12	16	6.2	219
1993	12	17	6.1	214
1993	12	18	5.9	210
1993	12	19	5.8	206
1993	12	20	5.7	203
1993	12	21	5.7	200
1993	12	22	5.6	199
1993	12	23	5.7	200
1993	12	24	5.6	199
1993	12	25	5.6	199
1993	12	26	5.6	198
1993	12	27	5.6	199
1993	12	28	5.6	198
1993	12	29	5.6	196
1993	12	30	5.6	197
1993	12	31	5.7	201
1994	1	1	6.1	217
1994	1	2	6.6	233
1994	1	3	6.5	230
1994	1	4	6.7	236
1994	1	5	6.7	236
1994	1	6	6.4	227
1994	1	7	6.3	222
1994	1	8	6.3	222
1994	1	9	6.3	223
1994	1	10	6.3	221
1994	1	11	6.1	216
1994	1	12	6.2	219
1994	1	13	6.2	220
1994	1	14	6.2	219
1994	1	15	6.0	211
1994	1	16	6.1	214
1994	1	17	6.0	211
1994	1	18	5.9	207
1994	1	19	5.9	208
1994	1	20	5.9	208
1994	1	21	5.7	202
1994	1	22	5.9	207
1994	1	23	5.9	210
1994	1	24	5.8	205
1994	1	25	5.7	200
1994	1	26	5.6	199
1994	1	27	5.6	196
1994	1	28	5.5	194
1994	1	29	5.4	191
1994	1	30	5.4	190
1994	1	31	5.3	187
1994	2	1	5.2	185
1994	2	2	5.3	188

Year	Month	Day	Q(cms)	Q(cfs)
1996	12	6	6.3	221
1996	12	7	6.2	220
1996	12	8	6.3	221
1996	12	9	6.5	229
1996	12	10	7.1	250
1996	12	11	7.7	271
1996	12	12	7.6	268
1996	12	13	7.5	265
1996	12	14	7.6	267
1996	12	15	7.2	256
1996	12	16	7.0	246
1996	12	17	6.7	236
1996	12	18	6.4	225
1996	12	19	6.1	214
1996	12	20	6.1	215
1996	12	21	6.1	216
1996	12	22	6.3	221
1996	12	23	6.3	222
1996	12	24	6.3	222
1996	12	25	5.7	200
1996	12	26	4.5	160
1996	12	27	4.0	140
1996	12	28	2.3	80
1996	12	29	2.5	90
1996	12	30	4.2	150
1996	12	31	6.9	242
1997	1	1	8.9	316
1997	1	2	11.5	407
1997	1	3	12.7	447
1997	1	4	14.2	500
1997	1	5	13.9	490
1997	1	6	11.8	418
1997	1	7	10.0	352
1997	1	8	9.5	337
1997	1	9	10.0	353
1997	1	10	10.0	353
1997	1	11	9.3	329
1997	1	12	8.6	304
1997	1	13	8.0	282
1997	1	14	6.9	245
1997	1	15	6.6	232
1997	1	16	6.6	233
1997	1	17	6.9	245
1997	1	18	7.3	257
1997	1	19	8.0	282
1997	1	20	8.0	281
1997	1	21	8.1	286
1997	1	22	8.0	281
1997	1	23	7.9	280
1997	1	24	7.9	280
1997	1	25	7.7	272
1997	1	26	7.3	259
1997	1	27	6.2	219
1997	1	28	5.6	199

Year	Month	Day	Q(cms)	Q(cfs)
1994	2	3	5.8	205
1994	2	4	5.5	194
1994	2	5	5.4	189
1994	2	6	5.2	185
1994	2	7	5.2	185
1994	2	8	4.6	163
1994	2	9	5.1	181
1994	2	10	5.2	183
1994	2	11	5.1	179
1994	2	12	5.1	180
1994	2	13	5.1	179
1994	2	14	5.2	182
1994	2	15	5.1	180
1994	2	16	5.2	184
1994	2	17	5.1	181
1994	2	18	5.4	192
1994	2	19	5.3	186
1994	2	20	5.1	181
1994	2	21	5.0	176
1994	2	22	4.8	171
1994	2	23	4.8	168
1994	2	24	4.7	167
1994	2	25	4.7	167
1994	2	26	4.8	171
1994	2	27	4.9	174
1994	2	28	4.9	172
1994	3	1	5.0	175
1994	3	2	4.6	164
1994	3	3	4.5	158
1994	3	4	4.4	157
1994	3	5	4.5	160
1994	3	6	4.7	167
1994	3	7	4.8	171
1994	3	8	4.8	171
1994	3	9	4.8	170
1994	3	10	4.7	166
1994	3	11	4.6	161
1994	3	12	4.4	155
1994	3	13	4.2	148
1994	3	14	4.1	145
1994	3	15	4.2	147
1994	3	16	4.2	147
1994	3	17	3.9	139
1994	3	18	3.7	132
1994	3	19	3.5	125
1994	3	20	3.3	116
1994	3	21	3.2	112
1994	3	22	3.4	121
1994	3	23	3.9	138
1994	3	24	3.6	128
1994	3	25	3.2	114
1994	3	26	2.9	101
1994	3	27	3.3	115
1994	3	28	5.3	187

Year	Month	Day	Q(cms)	Q(cfs)
1997	1	29	6.5	228
1997	1	30	7.2	253
1997	1	31	8.1	285
1997	2	1	10.4	367
1997	2	2	11.7	412
1997	2	3	11.8	416
1997	2	4	10.4	368
1997	2	5	9.2	326
1997	2	6	8.6	303
1997	2	7	8.1	287
1997	2	8	7.8	276
1997	2	9	7.6	267
1997	2	10	7.4	263
1997	2	11	7.4	261
1997	2	12	7.6	270
1997	2	13	8.5	299
1997	2	14	8.7	308
1997	2	15	8.8	311
1997	2	16	9.0	317
1997	2	17	9.3	329
1997	2	18	9.5	336
1997	2	19	9.7	341
1997	2	20	9.9	348
1997	2	21	9.9	349
1997	2	22	9.8	346
1997	2	23	9.5	337
1997	2	24	9.3	327
1997	2	25	9.1	320
1997	2	26	9.1	321
1997	2	27	9.1	321
1997	2	28	9.0	317
1997	3	1	8.8	312
1997	3	2	9.1	321
1997	3	3	8.8	312
1997	3	4	8.4	297
1997	3	5	8.2	288
1997	3	6	8.2	289
1997	3	7	7.8	274
1997	3	8	7.6	270
1997	3	9	7.4	262
1997	3	10	7.3	258
1997	3	11	7.5	266
1997	3	12	7.4	261
1997	3	13	7.4	261
1997	3	14	7.3	257
1997	3	15	7.2	253
1997	3	16	7.5	265
1997	3	17	7.7	273
1997	3	18	7.7	271
1997	3	19	7.7	273
1997	3	20	7.6	270
1997	3	21	7.5	266
1997	3	22	7.2	255
1997	3	23	6.8	239

Year	Month	Day	Q(cms)	Q(cfs)
1994	3	29	6.7	238
1994	3	30	6.8	241
1994	3	31	6.7	238
1994	4	1	6.7	237
1994	4	2	6.5	229
1994	4	3	6.3	221
1994	4	4	6.2	220
1994	4	5	6.3	222
1994	4	6	6.9	243
1994	4	7	6.8	239
1994	4	8	6.8	239
1994	4	9	7.1	251
1994	4	10	7.3	257
1994	4	11	7.4	260
1994	4	12	7.2	254
1994	4	13	7.8	275
1994	4	14	8.4	296
1994	4	15	8.7	306
1994	4	16	8.3	294
1994	4	17	8.6	302
1994	4	18	8.3	294
1994	4	19	8.2	289
1994	4	20	8.4	295
1994	4	21	8.2	291
1994	4	22	8.1	285
1994	4	23	7.8	274
1994	4	24	7.8	277
1994	4	25	8.0	282
1994	4	26	8.2	291
1994	4	27	8.3	294
1994	4	28	8.2	290
1994	4	29	8.0	282
1994	4	30	7.6	270
1994	5	1	7.5	266
1994	5	2	7.5	265
1994	5	3	7.5	264
1994	5	4	7.3	257
1994	5	5	7.1	252
1994	5	6	7.1	249
1994	5	7	7.2	253
1994	5	8	7.2	256
1994	5	9	6.9	243
1994	5	10	6.6	233
1994	5	11	5.9	208
1994	5	12	5.6	197
1994	5	13	5.8	206
1994	5	14	6.1	214
1994	5	15	6.4	226
1994	5	16	7.5	265
1994	5	17	8.2	289
1994	5	18	8.2	290
1994	5	19	8.4	295
1994	5	20	8.6	305
1994	5	21	8.8	311

Year	Month	Day	Q(cms)	Q(cfs)
1997	3	24	6.6	233
1997	3	25	6.4	227
1997	3	26	6.5	228
1997	3	27	6.4	227
1997	3	28	6.2	219
1997	3	29	6.2	220
1997	3	30	6.1	216
1997	3	31	6.1	215
1997	4	1	6.0	213
1997	4	2	6.1	214
1997	4	3	6.0	213
1997	4	4	6.5	229
1997	4	5	7.2	256
1997	4	6	8.2	290
1997	4	7	8.5	300
1997	4	8	8.9	313
1997	4	9	9.2	325
1997	4	10	9.4	331
1997	4	11	9.3	327
1997	4	12	9.2	324
1997	4	13	9.1	321
1997	4	14	9.2	326
1997	4	15	9.1	321
1997	4	16	8.9	314
1997	4	17	8.7	307
1997	4	18	8.5	300
1997	4	19	8.3	292
1997	4	20	8.4	296
1997	4	21	8.8	312
1997	4	22	9.0	317
1997	4	23	9.2	325
1997	4	24	9.7	341
1997	4	25	9.8	346
1997	4	26	9.8	346
1997	4	27	9.4	332
1997	4	28	9.5	335
1997	4	29	9.4	331
1997	4	30	9.2	325
1997	5	1	8.7	308
1997	5	2	8.8	309
1997	5	3	8.7	308
1997	5	4	8.4	297
1997	5	5	8.4	296
1997	5	6	8.3	294
1997	5	7	8.2	288
1997	5	8	7.9	279
1997	5	9	7.4	261
1997	5	10	8.3	292
1997	5	11	8.0	282
1997	5	12	7.8	274
1997	5	13	7.7	273
1997	5	14	7.6	269
1997	5	15	7.4	263
1997	5	16	7.6	267

Year	Month	Day	Q(cms)	Q(cfs)
1994	5	22	8.6	304
1994	5	23	8.4	298
1994	5	24	8.2	288
1994	5	25	7.9	280
1994	5	26	7.6	269
1994	5	27	7.6	268
1994	5	28	7.2	253
1994	5	29	7.3	257
1994	5	30	7.7	271
1994	5	31	7.7	272
1994	6	1	7.6	269
1994	6	2	7.6	269
1994	6	3	7.6	267
1994	6	4	7.6	269
1994	6	5	7.8	276
1994	6	6	7.8	277
1994	6	7	8.2	290
1994	6	8	8.5	299
1994	6	9	8.0	282
1994	6	10	7.4	260
1994	6	11	7.2	256
1994	6	12	7.1	251
1994	6	13	7.3	258
1994	6	14	7.3	258
1994	6	15	7.4	263
1994	6	16	7.3	258
1994	6	17	7.2	255
1994	6	18	7.1	252
1994	6	19	7.3	259
1994	6	20	7.5	264
1994	6	21	7.7	272
1994	6	22	7.7	273
1994	6	23	7.1	250
1994	6	24	6.9	245
1994	6	25	7.1	249
1994	6	26	6.7	238
1994	6	27	6.9	244
1994	6	28	6.9	245
1994	6	29	6.9	242
1994	6	30	7.0	246
1994	7	1	7.1	249
1994	7	2	6.9	242
1994	7	3	7.1	251
1994	7	4	7.3	257
1994	7	5	7.6	268
1994	7	6	8.1	285
1994	7	7	8.3	293
1994	7	8	7.8	277
1994	7	9	7.2	254
1994	7	10	7.2	255
1994	7	11	7.4	260
1994	7	12	7.2	254
1994	7	13	6.8	239
1994	7	14	7.1	249

Year	Month	Day	Q(cms)	Q(cfs)
1997	5	17	7.5	266
1997	5	18	7.7	273
1997	5	19	7.9	279
1997	5	20	7.8	275
1997	5	21	7.8	276
1997	5	22	8.2	290
1997	5	23	8.4	295
1997	5	24	8.5	300
1997	5	25	9.0	319
1997	5	26	9.4	331
1997	5	27	9.6	340
1997	5	28	10.0	354
1997	5	29	9.9	348
1997	5	30	9.7	344
1997	5	31	9.9	348
1997	6	1	9.9	351
1997	6	2	10.4	367
1997	6	3	10.8	382
1997	6	4	11.0	389
1997	6	5	11.0	388
1997	6	6	10.6	373
1997	6	7	9.9	350
1997	6	8	9.4	332
1997	6	9	9.0	318
1997	6	10	8.6	304
1997	6	11	8.0	282
1997	6	12	7.8	276
1997	6	13	8.1	286
1997	6	14	8.5	299
1997	6	15	8.2	290
1997	6	16	7.9	279
1997	6	17	7.4	261
1997	6	18	6.9	244
1997	6	19	7.3	259
1997	6	20	7.7	273
1997	6	21	7.9	278
1997	6	22	7.9	278
1997	6	23	7.8	276
1997	6	24	8.0	281
1997	6	25	7.7	272
1997	6	26	7.5	264
1997	6	27	7.5	264
1997	6	28	7.5	264
1997	6	29	7.6	268
1997	6	30	7.8	276
1997	7	1	8.0	283
1997	7	2	8.4	298
1997	7	3	8.6	304
1997	7	4	8.5	301
1997	7	5	8.3	293
1997	7	6	8.2	290
1997	7	7	8.2	289
1997	7	8	8.2	291
1997	7	9	8.0	282

Year	Month	Day	Q(cms)	Q(cfs)
1994	7	15	6.9	244
1994	7	16	7.0	248
1994	7	17	7.0	247
1994	7	18	7.1	251
1994	7	19	7.2	255
1994	7	20	7.1	252
1994	7	21	7.2	253
1994	7	22	7.1	249
1994	7	23	6.9	242
1994	7	24	6.9	242
1994	7	25	6.9	245
1994	7	26	7.2	254
1994	7	27	7.2	254
1994	7	28	7.1	249
1994	7	29	6.4	225
1994	7	30	5.8	206
1994	7	31	6.2	218
1994	8	1	6.6	234
1994	8	2	6.9	242
1994	8	3	7.1	252
1994	8	4	7.5	265
1994	8	5	7.3	259
1994	8	6	7.2	256
1994	8	7	7.2	256
1994	8	8	7.5	266
1994	8	9	8.2	290
1994	8	10	8.6	302
1994	8	11	8.6	305
1994	8	12	8.6	304
1994	8	13	8.5	300
1994	8	14	8.3	294
1994	8	15	8.1	287
1994	8	16	8.0	284
1994	8	17	7.9	278
1994	8	18	7.9	279
1994	8	19	7.9	278
1994	8	20	8.3	294
1994	8	21	8.5	301
1994	8	22	8.6	302
1994	8	23	8.6	303
1994	8	24	8.6	304
1994	8	25	8.7	306
1994	8	26	8.6	303
1994	8	27	8.6	303
1994	8	28	8.6	302
1994	8	29	8.5	301
1994	8	30	8.6	304
1994	8	31	8.7	306
1994	9	1	8.8	310
1994	9	2	8.9	313
1994	9	3	8.9	314
1994	9	4	8.9	316
1994	9	5	9.1	321
1994	9	6	9.3	327

Year	Month	Day	Q(cms)	Q(cfs)
1997	7	10	8.1	287
1997	7	11	8.2	291
1997	7	12	8.2	289
1997	7	13	8.3	292
1997	7	14	8.3	292
1997	7	15	8.0	283
1997	7	16	7.7	272
1997	7	17	7.8	276
1997	7	18	7.8	277
1997	7	19	7.8	274
1997	7	20	7.7	271
1997	7	21	7.7	271
1997	7	22	7.7	273
1997	7	23	7.8	277
1997	7	24	7.6	270
1997	7	25	7.6	267
1997	7	26	7.6	267
1997	7	27	7.6	269
1997	7	28	7.8	274
1997	7	29	8.0	281
1997	7	30	8.3	293
1997	7	31	9.0	318
1997	8	1	9.3	329
1997	8	2	9.1	322
1997	8	3	9.1	321
1997	8	4	9.1	320
1997	8	5	8.9	314
1997	8	6	8.6	303
1997	8	7	8.0	283
1997	8	8	8.1	285
1997	8	9	8.3	294
1997	8	10	8.4	297
1997	8	11	8.6	303
1997	8	12	8.8	311
1997	8	13	8.7	306
1997	8	14	8.2	290
1997	8	15	7.8	277
1997	8	16	7.7	273
1997	8	17	7.4	263
1997	8	18	7.8	276
1997	8	19	8.1	287
1997	8	20	8.3	293
1997	8	21	8.4	295
1997	8	22	8.4	296
1997	8	23	8.4	296
1997	8	24	8.5	299
1997	8	25	8.7	307
1997	8	26	8.8	311
1997	8	27	8.9	315
1997	8	28	9.1	320
1997	8	29	9.3	329
1997	8	30	9.5	335
1997	8	31	9.9	350
1997	9	1	10.0	352

Year	Month	Day	Q(cms)	Q(cfs)
1994	9	7	9.3	329
1994	9	8	9.1	320
1994	9	9	8.8	310
1994	9	10	9.0	319
1994	9	11	9.1	320
1994	9	12	9.1	322
1994	9	13	9.3	327
1994	9	14	9.3	330
1994	9	15	9.6	338
1994	9	16	9.8	345
1994	9	17	9.9	350
1994	9	18	9.9	349
1994	9	19	9.7	344
1994	9	20	9.5	336
1994	9	21	9.1	322
1994	9	22	9.0	317
1994	9	23	9.0	318
1994	9	24	9.1	320
1994	9	25	9.2	325
1994	9	26	9.3	328
1994	9	27	9.3	330
1994	9	28	9.3	330
1994	9	29	9.2	325
1994	9	30	8.9	313
1994	10	1	8.7	308
1994	10	2	8.6	305
1994	10	3	8.4	297
1994	10	4	8.4	297
1994	10	5	8.4	295
1994	10	6	8.4	295
1994	10	7	8.3	294
1994	10	8	8.1	286
1994	10	9	8.4	296
1994	10	10	8.8	310
1994	10	11	9.0	318
1994	10	12	8.9	314
1994	10	13	8.7	308
1994	10	14	8.9	314
1994	10	15	9.3	327
1994	10	16	9.4	332
1994	10	17	9.4	331
1994	10	18	9.5	336
1994	10	19	9.7	342
1994	10	20	9.8	345
1994	10	21	9.8	347
1994	10	22	9.9	351
1994	10	23	10.1	357
1994	10	24	10.5	371
1994	10	25	10.8	382
1994	10	26	11.0	388
1994	10	27	10.6	373
1994	10	28	9.6	340
1994	10	29	8.8	312
1994	10	30	8.1	285

Year	Month	Day	Q(cms)	Q(cfs)
1997	9	2	10.0	352
1997	9	3	9.9	349
1997	9	4	10.0	352
1997	9	5	10.2	361
1997	9	6	10.5	371
1997	9	7	10.8	381
1997	9	8	10.8	382
1997	9	9	10.7	379
1997	9	10	10.6	374
1997	9	11	10.3	362
1997	9	12	9.9	350
1997	9	13	9.7	344
1997	9	14	9.9	350
1997	9	15	10.3	364
1997	9	16	10.5	372
1997	9	17	10.7	377
1997	9	18	10.7	377
1997	9	19	10.9	384
1997	9	20	11.0	388
1997	9	21	11.0	388
1997	9	22	10.9	384
1997	9	23	10.7	379
1997	9	24	10.6	373
1997	9	25	10.3	363
1997	9	26	9.8	345
1997	9	27	9.7	341
1997	9	28	9.6	339
1997	9	29	9.6	340
1997	9	30	9.7	344
1997	10	1	9.8	347
1997	10	2	9.7	342
1997	10	3	9.6	339
1997	10	4	9.0	318
1997	10	5	9.1	321
1997	10	6	9.6	338
1997	10	7	9.7	344
1997	10	8	9.9	349
1997	10	9	10.2	360
1997	10	10	10.4	367
1997	10	11	10.4	368
1997	10	12	10.2	359
1997	10	13	9.7	344
1997	10	14	9.6	338
1997	10	15	9.6	338
1997	10	16	9.5	337
1997	10	17	9.6	340
1997	10	18	9.6	340
1997	10	19	9.5	334
1997	10	20	9.3	327
1997	10	21	9.2	326
1997	10	22	9.5	336
1997	10	23	9.7	342
1997	10	24	9.9	348
1997	10	25	9.2	325

Year	Month	Day	Q(cms)	Q(cfs)
1994	10	31	8.0	284
1994	11	1	8.0	284
1994	11	2	7.6	268
1994	11	3	7.3	258
1994	11	4	7.2	255
1994	11	5	7.3	259
1994	11	6	7.2	253
1994	11	7	6.9	245
1994	11	8	6.7	238
1994	11	9	7.0	246
1994	11	10	7.3	259
1994	11	11	7.1	252
1994	11	12	7.0	246
1994	11	13	6.8	240
1994	11	14	6.7	236
1994	11	15	6.7	238
1994	11	16	7.0	247
1994	11	17	6.9	242
1994	11	18	6.6	234
1994	11	19	6.5	230
1994	11	20	6.4	226
1994	11	21	6.3	221
1994	11	22	6.1	217
1994	11	23	6.2	218
1994	11	24	6.2	219
1994	11	25	6.3	221
1994	11	26	6.2	218
1994	11	27	6.2	219
1994	11	28	6.1	217
1994	11	29	6.2	218
1994	11	30	6.2	218
1994	12	1	6.1	215
1994	12	2	5.9	207
1994	12	3	5.8	204
1994	12	4	5.4	190
1994	12	5	5.2	184
1994	12	6	5.8	204
1994	12	7	5.9	209
1994	12	8	5.7	201
1994	12	9	5.7	202
1994	12	10	5.7	201
1994	12	11	5.8	204
1994	12	12	5.9	210
1994	12	13	6.0	211
1994	12	14	6.0	212
1994	12	15	6.0	211
1994	12	16	6.1	215
1994	12	17	7.0	247
1994	12	18	7.2	253
1994	12	19	6.8	240
1994	12	20	6.5	230
1994	12	21	6.4	227
1994	12	22	6.3	223
1994	12	23	6.1	215

Year	Month	Day	Q(cms)	Q(cfs)
1997	10	26	8.3	294
1997	10	27	7.9	280
1997	10	28	7.9	278
1997	10	29	7.7	272
1997	10	30	7.8	276
1997	10	31	8.1	287
1997	11	1	7.8	275
1997	11	2	7.5	265
1997	11	3	7.3	258
1997	11	4	7.3	257
1997	11	5	7.2	256
1997	11	6	7.2	255
1997	11	7	7.2	254
1997	11	8	7.3	257
1997	11	9	7.2	254
1997	11	10	7.1	251
1997	11	11	7.0	248
1997	11	12	7.0	247
1997	11	13	6.9	245
1997	11	14	6.9	242
1997	11	15	7.0	247
1997	11	16	6.8	240
1997	11	17	6.7	236
1997	11	18	6.6	232
1997	11	19	6.8	241
1997	11	20	7.1	249
1997	11	21	6.8	241
1997	11	22	6.6	232
1997	11	23	6.5	230
1997	11	24	6.7	237
1997	11	25	6.7	235
1997	11	26	6.4	226
1997	11	27	6.3	221
1997	11	28	6.1	217
1997	11	29	6.1	214
1997	11	30	6.0	213
1997	12	1	6.0	213
1997	12	2	5.9	208
1997	12	3	5.7	202
1997	12	4	5.6	199
1997	12	5	5.6	199
1997	12	6	5.7	200
1997	12	7	5.7	203
1997	12	8	6.0	212
1997	12	9	6.1	214
1997	12	10	5.7	203
1997	12	11	5.6	199
1997	12	12	5.9	207
1997	12	13	6.2	218
1997	12	14	6.5	229
1997	12	15	6.5	230
1997	12	16	6.9	243
1997	12	17	7.1	250
1997	12	18	7.5	264

Year	Month	Day	Q(cms)	Q(cfs)
1994	12	24	5.9	209
1994	12	25	5.9	207
1994	12	26	5.9	209
1994	12	27	7.1	250
1994	12	28	7.0	247
1994	12	29	6.5	229
1994	12	30	6.2	218
1994	12	31	5.9	209
1995	1	1	5.6	196
1995	1	2	5.2	185
1995	1	3	4.8	168
1995	1	4	5.0	178
1995	1	5	5.3	186
1995	1	6	5.5	193
1995	1	7	5.6	198
1995	1	8	5.6	196
1995	1	9	5.9	209
1995	1	10	7.4	260
1995	1	11	8.6	304
1995	1	12	8.2	290
1995	1	13	7.7	273
1995	1	14	8.0	282
1995	1	15	8.0	283
1995	1	16	7.5	266
1995	1	17	7.2	255
1995	1	18	7.0	247
1995	1	19	6.9	242
1995	1	20	6.7	236
1995	1	21	6.8	239
1995	1	22	6.6	233
1995	1	23	6.4	227
1995	1	24	6.4	226
1995	1	25	6.4	226
1995	1	26	6.5	228
1995	1	27	6.4	226
1995	1	28	6.4	226
1995	1	29	6.6	234
1995	1	30	6.8	239
1995	1	31	7.2	253
1995	2	1	7.2	254
1995	2	2	6.8	241
1995	2	3	6.5	229
1995	2	4	6.3	223
1995	2	5	6.3	223
1995	2	6	6.2	218
1995	2	7	6.1	215
1995	2	8	6.1	217
1995	2	9	6.0	212
1995	2	10	5.9	209
1995	2	11	6.1	214
1995	2	12	6.1	217
1995	2	13	5.0	175
1995	2	14	4.6	163
1995	2	15	5.6	197

Year	Month	Day	Q(cms)	Q(cfs)
1997	12	19	7.6	267
1997	12	20	7.5	266
1997	12	21	7.5	264
1997	12	22	7.4	261
1997	12	23	7.3	259
1997	12	24	7.3	258
1997	12	25	7.1	250
1997	12	26	6.9	244
1997	12	27	6.9	242
1997	12	28	7.0	247
1997	12	29	7.0	246
1997	12	30	7.0	247
1997	12	31	6.9	242
1998	1	1	6.8	240
1998	1	2	6.9	243
1998	1	3	6.8	241
1998	1	4	6.9	244
1998	1	5	6.9	244
1998	1	6	6.7	238
1998	1	7	6.7	237
1998	1	8	6.9	242
1998	1	9	7.3	258
1998	1	10	7.5	265
1998	1	11	6.9	245
1998	1	12	5.9	210
1998	1	13	5.1	180
1998	1	14	5.7	200
1998	1	15	6.7	235
1998	1	16	7.1	250
1998	1	17	8.1	287
1998	1	18	9.0	319
1998	1	19	9.1	322
1998	1	20	8.9	313
1998	1	21	8.4	298
1998	1	22	8.4	296
1998	1	23	8.5	301
1998	1	24	8.8	310
1998	1	25	8.6	305
1998	1	26	8.4	297
1998	1	27	8.3	293
1998	1	28	8.3	292
1998	1	29	8.2	288
1998	1	30	8.1	286
1998	1	31	8.0	281
1998	2	1	7.9	280
1998	2	2	8.1	287
1998	2	3	8.4	295
1998	2	4	8.7	306
1998	2	5	8.6	304
1998	2	6	8.3	294
1998	2	7	8.2	290
1998	2	8	8.2	291
1998	2	9	8.1	286
1998	2	10	7.9	278

Year	Month	Day	Q(cms)	Q(cfs)
1995	2	16	5.9	209
1995	2	17	5.8	205
1995	2	18	6.0	212
1995	2	19	6.0	212
1995	2	20	5.8	206
1995	2	21	5.7	200
1995	2	22	5.5	194
1995	2	23	5.4	190
1995	2	24	5.4	192
1995	2	25	5.4	190
1995	2	26	5.1	180
1995	2	27	4.8	171
1995	2	28	4.8	169
1995	3	1	4.7	166
1995	3	2	4.8	168
1995	3	3	5.0	178
1995	3	4	5.0	176
1995	3	5	4.8	170
1995	3	6	4.8	168
1995	3	7	4.7	166
1995	3	8	4.5	160
1995	3	9	5.1	181
1995	3	10	6.0	212
1995	3	11	6.2	218
1995	3	12	5.7	202
1995	3	13	5.4	189
1995	3	14	5.4	191
1995	3	15	5.7	202
1995	3	16	5.6	199
1995	3	17	5.6	196
1995	3	18	5.5	195
1995	3	19	5.3	187
1995	3	20	5.3	188
1995	3	21	5.3	187
1995	3	22	5.2	182
1995	3	23	5.7	203
1995	3	24	5.7	203
1995	3	25	5.6	197
1995	3	26	5.4	191
1995	3	27	5.4	189
1995	3	28	5.2	184
1995	3	29	4.8	170
1995	3	30	4.8	168
1995	3	31	5.0	178
1995	4	1	5.6	198
1995	4	2	6.6	232
1995	4	3	7.2	254
1995	4	4	7.4	261
1995	4	5	7.6	269
1995	4	6	7.6	270
1995	4	7	7.5	265
1995	4	8	7.3	259
1995	4	9	7.2	254
1995	4	10	7.3	258

Year	Month	Day	Q(cms)	Q(cfs)
1998	2	11	7.8	277
1998	2	12	8.1	285
1998	2	13	8.3	294
1998	2	14	8.3	294
1998	2	15	8.1	285
1998	2	16	8.0	283
1998	2	17	8.3	292
1998	2	18	8.0	281
1998	2	19	7.3	259
1998	2	20	6.2	218
1998	2	21	5.9	207
1998	2	22	5.7	200
1998	2	23	5.5	193
1998	2	24	5.3	187
1998	2	25	5.2	183
1998	2	26	5.2	183
1998	2	27	5.2	183
1998	2	28	5.1	180
1998	3	1	4.8	169
1998	3	2	4.9	173
1998	3	3	5.3	186
1998	3	4	5.2	184
1998	3	5	5.4	191
1998	3	6	5.1	181
1998	3	7	5.1	180
1998	3	8	4.9	172
1998	3	9	4.8	170
1998	3	10	4.8	170
1998	3	11	4.8	170
1998	3	12	4.9	172
1998	3	13	4.9	174
1998	3	14	4.9	173
1998	3	15	4.8	170
1998	3	16	4.6	162
1998	3	17	4.6	161
1998	3	18	4.5	158
1998	3	19	4.2	147
1998	3	20	4.2	148
1998	3	21	4.0	143
1998	3	22	4.0	143
1998	3	23	4.2	150
1998	3	24	4.8	169
1998	3	25	4.9	172
1998	3	26	5.2	183
1998	3	27	5.9	208
1998	3	28	6.5	231
1998	3	29	6.9	242
1998	3	30	6.9	245
1998	3	31	7.3	259
1998	4	1	7.6	268
1998	4	2	7.6	270
1998	4	3	7.7	273
1998	4	4	7.9	278
1998	4	5	8.0	284

Year	Month	Day	Q(cms)	Q(cfs)
1995	4	11	7.3	257
1995	4	12	7.5	266
1995	4	13	7.8	274
1995	4	14	7.4	261
1995	4	15	7.3	259
1995	4	16	7.5	264
1995	4	17	7.6	270
1995	4	18	7.7	273
1995	4	19	7.8	274
1995	4	20	7.4	261
1995	4	21	7.7	271
1995	4	22	8.1	287
1995	4	23	7.8	274
1995	4	24	7.4	263
1995	4	25	7.4	262
1995	4	26	7.3	259
1995	4	27	7.1	252
1995	4	28	7.7	273
1995	4	29	8.5	300
1995	4	30	8.6	302
1995	5	1	8.6	304
1995	5	2	8.6	303
1995	5	3	8.8	309
1995	5	4	8.9	313
1995	5	5	8.6	305
1995	5	6	8.4	297
1995	5	7	8.5	299
1995	5	8	8.4	296
1995	5	9	8.3	294
1995	5	10	8.2	288
1995	5	11	7.9	280
1995	5	12	8.1	287
1995	5	13	8.1	286
1995	5	14	7.8	276
1995	5	15	7.5	265
1995	5	16	7.0	248
1995	5	17	6.8	240
1995	5	18	7.0	246
1995	5	19	6.8	239
1995	5	20	6.7	235
1995	5	21	6.7	238
1995	5	22	6.5	231
1995	5	23	6.5	230
1995	5	24	5.9	209
1995	5	25	5.7	203
1995	5	26	6.1	215
1995	5	27	5.8	206
1995	5	28	5.8	205
1995	5	29	5.9	210
1995	5	30	5.7	201
1995	5	31	5.4	191
1995	6	1	5.5	193
1995	6	2	5.4	189
1995	6	3	5.5	193

Year	Month	Day	Q(cms)	Q(cfs)
1998	4	6	8.1	286
1998	4	7	7.9	280
1998	4	8	7.9	280
1998	4	9	7.8	276
1998	4	10	7.8	277
1998	4	11	7.7	273
1998	4	12	7.8	277
1998	4	13	7.6	268
1998	4	14	7.3	259
1998	4	15	7.5	266
1998	4	16	7.5	265
1998	4	17	7.4	260
1998	4	18	6.7	236
1998	4	19	6.8	240
1998	4	20	7.4	260
1998	4	21	7.6	269
1998	4	22	7.6	267
1998	4	23	7.0	248
1998	4	24	7.3	258
1998	4	25	7.1	252
1998	4	26	7.2	256
1998	4	27	7.2	254
1998	4	28	7.1	250
1998	4	29	7.1	249
1998	4	30	6.7	237
1998	5	1	6.0	211
1998	5	2	5.6	198
1998	5	3	5.4	190
1998	5	4	5.4	191
1998	5	5	5.2	183
1998	5	6	5.2	183
1998	5	7	5.9	208
1998	5	8	5.2	183
1998	5	9	5.3	187
1998	5	10	5.8	205
1998	5	11	6.5	229
1998	5	12	7.0	246
1998	5	13	7.0	246
1998	5	14	7.1	250
1998	5	15	7.4	260
1998	5	16	8.0	284
1998	5	17	8.4	296
1998	5	18	9.0	317
1998	5	19	9.4	332
1998	5	20	9.0	319
1998	5	21	9.3	327
1998	5	22	9.4	331
1998	5	23	9.5	335
1998	5	24	9.8	346
1998	5	25	10.1	357
1998	5	26	10.3	365
1998	5	27	10.5	371
1998	5	28	10.5	369
1998	5	29	10.2	359

Year	Month	Day	Q(cms)	Q(cfs)
1995	6	4	5.6	197
1995	6	5	5.9	210
1995	6	6	6.5	229
1995	6	7	7.1	252
1995	6	8	8.1	285
1995	6	9	8.2	290
1995	6	10	8.1	285
1995	6	11	8.2	288
1995	6	12	7.8	274
1995	6	13	7.7	273
1995	6	14	7.9	280
1995	6	15	7.9	280
1995	6	16	8.0	281
1995	6	17	7.2	256
1995	6	18	7.2	253
1995	6	19	7.3	259
1995	6	20	8.2	291
1995	6	21	8.9	313
1995	6	22	9.1	321
1995	6	23	8.8	309
1995	6	24	8.4	295
1995	6	25	8.1	287
1995	6	26	8.0	282
1995	6	27	7.8	275
1995	6	28	7.5	265
1995	6	29	7.6	267
1995	6	30	7.4	262
1995	7	1	7.1	252
1995	7	2	6.7	235
1995	7	3	6.5	229
1995	7	4	6.5	231
1995	7	5	7.0	247
1995	7	6	6.7	237
1995	7	7	6.3	223
1995	7	8	6.4	227
1995	7	9	6.8	239
1995	7	10	7.4	260
1995	7	11	7.9	279
1995	7	12	8.3	292
1995	7	13	7.9	280
1995	7	14	7.6	268
1995	7	15	7.4	262
1995	7	16	7.5	265
1995	7	17	7.6	267
1995	7	18	7.6	269
1995	7	19	7.2	256
1995	7	20	6.9	243
1995	7	21	6.5	230
1995	7	22	6.6	232
1995	7	23	6.4	227
1995	7	24	6.4	226
1995	7	25	6.7	236
1995	7	26	6.7	237
1995	7	27	7.1	250

Year	Month	Day	Q(cms)	Q(cfs)
1998	5	30	10.1	356
1998	6	1	9.7	341
1998	6	2	8.7	306
1998	6	3	8.1	287
1998	6	4	8.1	285
1998	6	5	7.9	279
1998	6	6	7.8	277
1998	6	7	7.6	267
1998	6	8	7.6	268
1998	6	9	7.3	259
1998	6	10	7.2	256
1998	6	11	7.3	259
1998	6	12	7.2	255
1998	6	13	6.9	242
1998	6	14	6.6	232
1998	6	15	6.5	231
1998	6	16	7.2	254
1998	6	17	6.9	244
1998	6	18	6.4	225
1998	6	19	6.3	224
1998	6	20	6.5	230
1998	6	21	5.9	209
1998	6	22	5.9	210
1998	6	23	6.4	225
1998	6	24	6.2	220
1998	6	25	6.1	217
1998	6	26	6.4	226
1998	6	27	6.8	240
1998	6	28	7.1	249
1998	6	29	7.2	255
1998	6	30	6.8	239
1998	7	1	6.7	237
1998	7	2	6.5	228
1998	7	3	5.8	204
1998	7	4	5.7	200
1998	7	5	5.7	200
1998	7	6	6.3	223
1998	7	7	6.4	225
1998	7	8	6.0	212
1998	7	9	6.1	217
1998	7	10	6.7	236
1998	7	11	6.4	226
1998	7	12	6.5	230
1998	7	13	6.4	226
1998	7	14	6.5	231
1998	7	15	6.5	231
1998	7	16	6.5	229
1998	7	17	6.1	217
1998	7	18	6.3	221
1998	7	19	5.7	202
1998	7	20	5.8	206
1998	7	21	6.0	212
1998	7	22	6.0	211
1998	7	23	5.7	201

Year	Month	Day	Q(cms)	Q(cfs)
1995	7	28	7.4	262
1995	7	29	7.4	261
1995	7	30	7.4	260
1995	7	31	7.7	273
1995	8	1	7.6	268
1995	8	2	7.6	268
1995	8	3	7.2	255
1995	8	4	7.0	246
1995	8	5	7.2	256
1995	8	6	7.4	260
1995	8	7	7.7	271
1995	8	8	8.0	284
1995	8	9	8.1	287
1995	8	10	8.0	281
1995	8	11	8.0	284
1995	8	12	8.2	291
1995	8	13	8.5	299
1995	8	14	8.6	303
1995	8	15	8.6	304
1995	8	16	8.7	308
1995	8	17	8.9	314
1995	8	18	9.0	318
1995	8	19	9.0	319
1995	8	20	9.3	328
1995	8	21	9.4	332
1995	8	22	9.5	335
1995	8	23	9.3	330
1995	8	24	9.2	325
1995	8	25	8.9	316
1995	8	26	8.4	298
1995	8	27	8.2	291
1995	8	28	8.3	294
1995	8	29	8.4	296
1995	8	30	8.5	301
1995	8	31	8.8	309
1995	9	1	9.1	320
1995	9	2	9.2	324
1995	9	3	9.3	327
1995	9	4	9.1	321
1995	9	5	8.7	308
1995	9	6	8.5	299
1995	9	7	8.9	316
1995	9	8	9.6	338
1995	9	9	10.3	363
1995	9	10	10.8	381
1995	9	11	11.0	389
1995	9	12	11.0	387
1995	9	13	10.8	380
1995	9	14	10.5	369
1995	9	15	10.0	354
1995	9	16	10.1	355
1995	9	17	10.0	353
1995	9	18	10.0	354
1995	9	19	10.0	352

Year	Month	Day	Q(cms)	Q(cfs)
1998	7	24	5.5	194
1998	7	25	5.7	200
1998	7	26	5.7	200
1998	7	27	5.7	203
1998	7	28	5.4	191
1998	7	29	5.3	188
1998	7	30	5.4	191
1998	7	31	5.4	190
1998	8	1	6.3	222
1998	8	2	6.2	218
1998	8	3	6.8	240
1998	8	4	7.1	249
1998	8	5	6.9	242
1998	8	6	6.7	235
1998	8	7	6.6	233
1998	8	8	6.5	229
1998	8	9	7.2	253
1998	8	10	6.8	239
1998	8	11	6.9	244
1998	8	12	7.4	263
1998	8	13	6.5	229
1998	8	14	6.8	239
1998	8	15	7.0	246
1998	8	16	7.2	254
1998	8	17	7.3	257
1998	8	18	7.6	270
1998	8	19	7.2	256
1998	8	20	6.6	234
1998	8	21	6.6	233
1998	8	22	7.2	255
1998	8	23	8.0	281
1998	8	24	8.3	292
1998	8	25	8.3	292
1998	8	26	8.6	304
1998	8	27	8.9	314
1998	8	28	9.1	322
1998	8	29	8.9	315
1998	8	30	8.6	305
1998	9	1	8.0	283
1998	9	2	7.4	261
1998	9	3	7.6	268
1998	9	4	7.8	277
1998	9	5	7.9	280
1998	9	6	8.2	288
1998	9	7	8.6	303
1998	9	8	8.9	313
1998	9	9	8.8	312
1998	9	10	9.0	317
1998	9	11	9.1	322
1998	9	12	8.9	314
1998	9	13	9.5	335
1998	9	14	9.6	338
1998	9	15	9.6	340
1998	9	16	9.6	340

Year	Month	Day	Q(cms)	Q(cfs)
1995	9	20	9.7	342
1995	9	21	9.6	339
1995	9	22	9.5	336
1995	9	23	9.4	332
1995	9	24	9.4	333
1995	9	25	9.5	336
1995	9	26	9.6	339
1995	9	27	9.5	335
1995	9	28	9.8	345
1995	9	29	10.0	353
1995	9	30	10.1	357
1995	10	1	10.0	353
1995	10	2	10.1	355
1995	10	3	10.1	358

Year	Month	Day	Q(cms)	Q(cfs)
1998	9	17	9.4	332
1998	9	18	9.1	323
1998	9	19	8.9	316
1998	9	20	8.6	305
1998	9	21	9.1	322
1998	9	22	9.5	335
1998	9	23	9.6	340
1998	9	24	9.7	342
1998	9	25	9.5	336
1998	9	26	9.4	332
1998	9	27	9.4	333
1998	9	28	9.7	341
1998	9	29	9.8	345
1998	9	30	9.6	340

Appendix 7.8. Temperature record for Crab Creek, Grant County, WA.

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1994	11	8	7.1	44.8	5.8	42.4	6.4	43.5
1994	11	9	7.7	45.9	6.7	44.1	7.1	44.8
1994	11	10	8.9	48.0	7.7	45.9	8.2	46.8
1994	11	11	8.1	46.6	6.9	44.4	7.4	45.3
1994	11	12	7.7	45.9	6.6	43.9	7.3	45.1
1994	11	13	6.7	44.1	5.2	41.4	6.2	43.2
1994	11	14	7.0	44.6	5.8	42.4	6.5	43.7
1994	11	15	7.1	44.8	6.3	43.3	6.7	44.1
1994	11	16	6.3	43.3	5.3	41.5	5.8	42.4
1994	11	17	5.3	41.5	4.6	40.3	5.0	41.0
1994	11	18	4.8	40.6	3.5	38.3	4.3	39.7
1994	11	19	5.5	41.9	4.6	40.3	5.0	41.0
1994	11	20	5.4	41.7	4.2	39.6	4.8	40.6
1994	11	21	4.2	39.6	2.7	36.9	3.6	38.5
1994	11	22	4.0	39.2	2.6	36.7	3.4	38.1
1994	11	23	5.2	41.4	3.7	38.7	4.4	39.9
1994	11	24	5.2	41.4	4.6	40.3	5.0	41.0
1994	11	25	5.5	41.9	4.9	40.8	5.2	41.4
1994	11	26	5.1	41.2	4.1	39.4	4.6	40.3
1994	11	27	5.4	41.7	4.1	39.4	4.7	40.5
1994	11	28	4.9	40.8	3.7	38.7	4.3	39.7
1994	11	29	6.4	43.5	4.9	40.8	5.6	42.1
1994	11	30	8.6	47.5	6.4	43.5	7.7	45.9
1994	12	1	8.1	46.6	5.9	42.6	6.8	44.2
1994	12	2	5.9	42.6	4.9	40.8	5.2	41.4
1994	12	3	4.9	40.8	2.7	36.9	4.0	39.2
1994	12	4	2.7	36.9	0.4	32.7	1.3	34.3
1994	12	5	2.3	36.1	1.4	34.5	1.8	35.2
1994	12	6	2.3	36.1	1.5	34.7	2.0	35.6
1994	12	7	2.5	36.5	1.4	34.5	2.0	35.6
1994	12	8	2.8	37.0	1.5	34.7	2.2	36.0
1994	12	9	2.8	37.0	1.7	35.1	2.4	36.3
1994	12	10	3.5	38.3	2.5	36.5	2.9	37.2
1994	12	11	3.9	39.0	3.0	37.4	3.5	38.3
1994	12	12	4.2	39.6	3.5	38.3	3.8	38.8
1994	12	13	4.7	40.5	3.9	39.0	4.3	39.7
1994	12	14	4.4	39.9	3.9	39.0	4.2	39.6
1994	12	15	3.9	39.0	3.1	37.6	3.6	38.5
1994	12	16	4.2	39.6	2.7	36.9	3.5	38.3
1994	12	17	4.7	40.5	4.2	39.6	4.4	39.9
1994	12	18	5.8	42.4	4.7	40.5	5.1	41.2
1994	12	19	6.4	43.5	5.0	41.0	5.5	41.9
1994	12	20	7.8	46.0	6.4	43.5	7.2	45.0
1994	12	21	7.5	45.5	6.0	42.8	6.7	44.1
1994	12	22	6.0	42.8	4.4	39.9	5.0	41.0
1994	12	23	4.7	40.5	4.1	39.4	4.4	39.9
1994	12	24	4.4	39.9	3.6	38.5	4.1	39.4
1994	12	25	4.1	39.4	3.8	38.8	4.0	39.2
1994	12	26	5.2	41.4	3.9	39.0	4.4	39.9
1994	12	27	6.0	42.8	5.2	41.4	5.6	42.1

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1994	12	28	6.0	42.8	4.4	39.9	5.3	41.5
1994	12	29	4.4	39.9	2.7	36.9	3.3	37.9
1994	12	30	2.8	37.0	1.4	34.5	2.1	35.8
1994	12	31	1.9	35.4	0.6	33.1	1.4	34.5
1995	1	1	1.4	34.5	0.1	32.2	0.9	33.6
1995	1	2	1.2	34.2	0.1	32.2	0.6	33.1
1995	1	3	1.1	34.0	0.1	32.2	0.5	32.9
1995	1	4	0.7	33.3	0.1	32.2	0.4	32.7
1995	1	5	1.5	34.7	0.1	32.2	0.7	33.3
1995	1	6	1.5	34.7	0.7	33.3	1.2	34.2
1995	1	7	1.8	35.2	1.2	34.2	1.5	34.7
1995	1	8	2.5	36.5	1.4	34.5	2.0	35.6
1995	1	9	3.0	37.4	2.3	36.1	2.7	36.9
1995	1	10	3.0	37.4	2.5	36.5	2.8	37.0
1995	1	11	3.3	37.9	2.3	36.1	2.8	37.0
1995	1	12	4.1	39.4	3.3	37.9	3.7	38.7
1995	1	13	4.1	39.4	3.8	38.8	4.0	39.2
1995	1	14	4.4	39.9	3.9	39.0	4.1	39.4
1995	1	15	4.1	39.4	3.3	37.9	3.6	38.5
1995	1	16	4.1	39.4	3.5	38.3	3.8	38.8
1995	1	17	4.4	39.9	3.9	39.0	4.1	39.4
1995	1	18	4.4	39.9	3.9	39.0	4.2	39.6
1995	1	19	4.4	39.9	3.5	38.3	3.9	39.0
1995	1	20	4.5	40.1	3.3	37.9	3.9	39.0
1995	1	21	3.9	39.0	2.5	36.5	3.4	38.1
1995	1	22	3.5	38.3	2.0	35.6	2.9	37.2
1995	1	23	3.5	38.3	2.0	35.6	2.8	37.0
1995	1	24	3.9	39.0	2.8	37.0	3.4	38.1
1995	1	25	4.1	39.4	3.0	37.4	3.6	38.5
1995	1	26	4.9	40.8	4.1	39.4	4.5	40.1
1995	1	27	5.5	41.9	4.7	40.5	5.1	41.2
1995	1	28	5.3	41.5	4.9	40.8	5.0	41.0
1995	1	29	5.5	41.9	4.7	40.5	5.1	41.2
1995	1	30	6.1	43.0	5.0	41.0	5.5	41.9
1995	1	31	8.1	46.6	5.8	42.4	6.8	44.2
1995	2	1	8.1	46.6	6.7	44.1	7.4	45.3
1995	2	2	6.9	44.4	5.5	41.9	6.4	43.5
1995	2	3	7.0	44.6	6.0	42.8	6.5	43.7
1995	2	4	7.4	45.3	5.8	42.4	6.6	43.9
1995	2	5	7.4	45.3	5.8	42.4	6.7	44.1
1995	2	6	7.4	45.3	6.3	43.3	6.9	44.4
1995	2	7	6.7	44.1	6.3	43.3	6.5	43.7
1995	2	8	7.7	45.9	5.3	41.5	6.5	43.7
1995	2	9	6.7	44.1	5.0	41.0	6.1	43.0
1995	2	10	6.0	42.8	4.5	40.1	5.6	42.1
1995	2	11	6.1	43.0	5.2	41.4	5.7	42.3
1995	2	12	5.2	41.4	0.6	33.1	2.9	37.2
1995	2	13	1.5	34.7	0.1	32.2	0.7	33.3
1995	2	14	2.7	36.9	0.1	32.2	1.4	34.5
1995	2	15	4.4	39.9	1.1	34.0	2.7	36.9
1995	2	16	5.1	41.2	1.7	35.1	3.5	38.3
1995	2	17	7.5	45.5	5.1	41.2	6.3	43.3

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1995	2	18	7.9	46.2	5.6	42.1	6.5	43.7
1995	2	19	9.8	49.6	7.9	46.2	9.2	48.6
1995	2	20	10.3	50.5	8.7	47.7	9.5	49.1
1995	2	21	11.2	52.2	8.9	48.0	10.0	50.0
1995	2	22	10.0	50.0	7.7	45.9	9.0	48.2
1995	2	23	9.5	49.1	6.7	44.1	8.3	46.9
1995	2	24	10.1	50.2	6.9	44.4	8.7	47.7
1995	2	25	12.5	54.5	9.2	48.6	10.4	50.7
1995	2	26	10.0	50.0	7.4	45.3	8.9	48.0
1995	2	27	8.2	46.8	5.8	42.4	7.1	44.8
1995	2	28	7.0	44.6	4.2	39.6	5.8	42.4
1995	3	1	6.9	44.4	4.2	39.6	5.6	42.1
1995	3	2	6.7	44.1	3.3	37.9	5.1	41.2
1995	3	3	6.9	44.4	4.5	40.1	5.7	42.3
1995	3	4	7.2	45.0	4.4	39.9	5.8	42.4
1995	3	5	8.0	46.4	5.0	41.0	6.4	43.5
1995	3	6	8.0	46.4	4.4	39.9	6.3	43.3
1995	3	7	8.4	47.1	5.0	41.0	6.8	44.2
1995	3	8	8.0	46.4	6.7	44.1	7.4	45.3
1995	3	9	8.1	46.6	7.0	44.6	7.6	45.7
1995	3	10	8.7	47.7	7.7	45.9	8.2	46.8
1995	3	11	11.2	52.2	8.0	46.4	9.5	49.1
1995	3	12	11.1	52.0	8.3	46.9	10.0	50.0
1995	3	13	11.7	53.1	9.1	48.4	10.4	50.7
1995	3	14	11.0	51.8	10.0	50.0	10.4	50.7
1995	3	15	12.0	53.6	8.9	48.0	10.3	50.5
1995	3	16	12.2	54.0	8.3	46.9	10.3	50.5
1995	3	17	11.4	52.5	8.9	48.0	10.4	50.7
1995	3	18	12.8	55.0	10.4	50.7	11.5	52.7
1995	3	19	12.8	55.0	9.4	48.9	11.3	52.3
1995	3	20	11.8	53.2	9.2	48.6	10.8	51.4
1995	3	21	10.0	50.0	7.7	45.9	8.9	48.0
1995	3	22	9.4	48.9	7.8	46.0	8.7	47.7
1995	3	23	11.1	52.0	7.8	46.0	9.4	48.9
1995	3	24	10.1	50.2	7.7	45.9	8.9	48.0
1995	3	25	11.1	52.0	6.7	44.1	8.9	48.0
1995	3	26	12.2	54.0	8.0	46.4	10.1	50.2
1995	3	27	13.1	55.6	8.7	47.7	11.0	51.8
1995	3	28	13.5	56.3	9.5	49.1	11.6	52.9
1995	3	29	14.2	57.6	9.8	49.6	11.9	53.4
1995	3	30	14.5	58.1	10.3	50.5	12.4	54.3
1995	3	31	14.3	57.7	10.8	51.4	12.7	54.9
1995	4	1	13.9	57.0	10.6	51.1	12.4	54.3
1995	4	2	13.7	56.7	9.8	49.6	11.9	53.4
1995	4	3	14.9	58.8	11.1	52.0	13.2	55.8
1995	4	4	14.9	58.8	12.5	54.5	13.6	56.5
1995	4	5	12.8	55.0	10.8	51.4	11.9	53.4
1995	4	6	14.2	57.6	10.6	51.1	12.5	54.5
1995	4	7	15.1	59.2	12.6	54.7	13.8	56.8
1995	4	8	13.5	56.3	10.9	51.6	12.3	54.1
1995	4	9	13.1	55.6	9.4	48.9	11.3	52.3
1995	4	10	11.5	52.7	9.5	49.1	10.9	51.6

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1995	4	11	14.2	57.6	10.3	50.5	12.2	54.0
1995	4	12	13.1	55.6	9.8	49.6	11.3	52.3
1995	4	13	12.6	54.7	9.1	48.4	10.7	51.3
1995	4	14	11.7	53.1	8.7	47.7	10.3	50.5
1995	4	15	13.1	55.6	8.4	47.1	10.8	51.4
1995	4	16	14.0	57.2	10.3	50.5	12.4	54.3
1995	4	17	13.2	55.8	11.1	52.0	12.2	54.0
1995	4	18	12.6	54.7	10.0	50.0	11.4	52.5
1995	4	19	13.5	56.3	9.1	48.4	11.4	52.5
1995	4	20	13.7	56.7	11.4	52.5	12.5	54.5
1995	4	21	15.3	59.5	10.6	51.1	13.0	55.4
1995	4	22	16.4	61.5	12.2	54.0	14.4	57.9
1995	4	23	17.5	63.5	13.4	56.1	15.7	60.3
1995	4	24	18.1	64.6	14.3	57.7	16.5	61.7
1995	4	25	18.3	64.9	14.5	58.1	16.5	61.7
1995	6	27	23.9	75.0	19.9	67.8	22.1	71.8
1995	6	28	24.0	75.2	19.9	67.8	22.2	72.0
1995	6	29	24.4	75.9	20.5	68.9	22.6	72.7
1995	6	30	25.8	78.4	21.0	69.8	23.5	74.3
1995	7	1	25.8	78.4	21.9	71.4	23.9	75.0
1995	7	2	24.1	75.4	20.1	68.2	21.6	70.9
1995	7	3	22.0	71.6	17.6	63.7	19.8	67.6
1995	7	4	22.0	71.6	18.4	65.1	20.2	68.4
1995	7	5	22.7	72.9	18.6	65.5	20.7	69.3
1995	7	6	22.1	71.8	20.2	68.4	21.3	70.3
1995	7	7	23.9	75.0	19.3	66.7	21.4	70.5
1995	7	8	26.6	79.9	21.9	71.4	24.1	75.4
1995	7	9	25.7	78.3	23.0	73.4	24.2	75.6
1995	7	10	23.2	73.8	20.4	68.7	21.9	71.4
1995	7	11	23.2	73.8	19.7	67.5	21.4	70.5
1995	7	12	23.4	74.1	19.7	67.5	21.5	70.7
1995	7	13	22.7	72.9	18.8	65.8	20.8	69.4
1995	7	14	24.0	75.2	19.3	66.7	21.5	70.7
1995	7	15	24.9	76.8	20.4	68.7	22.6	72.7
1995	7	16	26.3	79.3	22.0	71.6	24.2	75.6
1995	7	17	26.6	79.9	22.7	72.9	24.9	76.8
1995	7	18	27.3	81.1	23.2	73.8	25.4	77.7
1995	7	19	27.9	82.2	24.0	75.2	26.1	79.0
1995	7	20	26.8	80.2	23.7	74.7	25.3	77.5
1995	7	21	24.9	76.8	20.9	69.6	22.9	73.2
1995	7	22	25.4	77.7	19.6	67.3	22.2	72.0
1995	7	23	24.7	76.5	20.1	68.2	22.3	72.1
1995	7	24	23.7	74.7	19.3	66.7	21.6	70.9
1995	7	25	25.8	78.4	20.2	68.4	22.8	73.0
1995	7	26	24.6	76.3	21.4	70.5	23.1	73.6
1995	7	27	24.2	75.6	19.6	67.3	21.9	71.4
1995	7	28	25.1	77.2	21.0	69.8	23.0	73.4
1995	7	29	22.4	72.3	18.1	64.6	20.0	68.0
1995	7	30	22.7	72.9	17.5	63.5	20.0	68.0
1995	7	31	24.0	75.2	19.6	67.3	21.9	71.4
1995	8	16	19.4	66.9	17.2	63.0	18.5	65.3
1995	8	17	19.1	66.4	16.5	61.7	17.7	63.9

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1995	8	18	19.4	66.9	15.4	59.7	17.3	63.1
1995	8	19	21.2	70.2	17.3	63.1	19.3	66.7
1995	8	20	22.4	72.3	18.8	65.8	20.6	69.1
1995	8	21	22.5	72.5	19.4	66.9	21.1	70.0
1995	8	22	22.4	72.3	18.9	66.0	20.7	69.3
1995	8	23	21.5	70.7	19.4	66.9	20.4	68.7
1995	8	24	20.5	68.9	17.3	63.1	19.1	66.4
1995	8	25	20.9	69.6	17.6	63.7	19.3	66.7
1995	8	26	20.7	69.3	17.8	64.0	19.4	66.9
1995	8	27	21.2	70.2	17.8	64.0	19.5	67.1
1995	8	28	21.4	70.5	18.3	64.9	20.0	68.0
1995	8	29	20.7	69.3	18.3	64.9	19.5	67.1
1995	8	30	21.2	70.2	17.6	63.7	19.3	66.7
1995	8	31	21.7	71.1	18.3	64.9	20.1	68.2
1995	9	1	22.2	72.0	18.8	65.8	20.5	68.9
1995	9	2	22.5	72.5	19.2	66.6	21.0	69.8
1995	9	3	22.5	72.5	19.7	67.5	21.2	70.2
1995	9	4	23.4	74.1	20.5	68.9	21.8	71.2
1995	9	5	21.2	70.2	18.8	65.8	20.1	68.2
1995	9	6	19.7	67.5	18.0	64.4	19.0	66.2
1995	9	7	19.1	66.4	17.6	63.7	18.4	65.1
1995	9	8	20.9	69.6	18.1	64.6	19.4	66.9
1995	9	9	21.5	70.7	18.8	65.8	20.2	68.4
1995	9	10	21.9	71.4	19.2	66.6	20.6	69.1
1995	9	11	22.2	72.0	19.7	67.5	20.9	69.6
1995	9	12	21.9	71.4	19.6	67.3	20.7	69.3
1995	9	13	21.9	71.4	19.4	66.9	20.7	69.3
1995	9	14	21.9	71.4	19.2	66.6	20.7	69.3
1995	9	15	21.7	71.1	19.2	66.6	20.6	69.1
1995	9	16	21.9	71.4	19.4	66.9	20.7	69.3
1995	9	17	21.9	71.4	19.7	67.5	20.7	69.3
1995	9	18	20.6	69.1	18.2	64.8	19.5	67.1
1995	9	19	20.1	68.2	18.0	64.4	19.2	66.6
1995	9	20	19.6	67.3	17.5	63.5	18.5	65.3
1995	9	21	18.0	64.4	15.6	60.1	16.9	62.4
1995	9	22	16.9	62.4	14.7	58.5	16.0	60.8
1995	9	23	17.2	63.0	14.4	57.9	15.9	60.6
1995	9	24	17.5	63.5	15.0	59.0	16.4	61.5
1995	9	25	17.9	64.2	16.1	61.0	16.9	62.4
1995	9	26	17.7	63.9	15.5	59.9	16.7	62.1
1995	9	27	17.9	64.2	16.7	62.1	17.2	63.0
1995	9	28	17.1	62.8	15.3	59.5	16.2	61.2
1995	9	29	16.4	61.5	14.2	57.6	15.3	59.5
1995	9	30	17.4	63.3	15.6	60.1	16.3	61.3
1995	10	1	15.8	60.4	13.8	56.8	15.0	59.0
1995	10	2	15.6	60.1	14.5	58.1	15.1	59.2
1995	10	3	15.5	59.9	14.1	57.4	15.0	59.0
1995	10	4	14.5	58.1	12.5	54.5	13.6	56.5
1995	10	5	14.1	57.4	12.5	54.5	13.4	56.1
1995	10	6	14.8	58.6	13.1	55.6	14.0	57.2
1995	10	7	15.0	59.0	13.1	55.6	14.1	57.4
1995	10	8	14.4	57.9	13.0	55.4	13.6	56.5

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1995	10	9	14.2	57.6	12.4	54.3	13.3	55.9
1995	10	10	14.2	57.6	13.3	55.9	13.8	56.8
1995	10	11	14.2	57.6	13.0	55.4	13.9	57.0
1995	10	12	13.0	55.4	11.7	53.1	12.5	54.5
1995	10	13	12.8	55.0	11.0	51.8	12.0	53.6
1995	10	14	13.1	55.6	11.4	52.5	12.4	54.3
1995	10	15	13.6	56.5	11.7	53.1	12.8	55.0
1995	10	16	14.4	57.9	13.1	55.6	13.7	56.7
1995	10	17	13.9	57.0	12.8	55.0	13.4	56.1
1995	10	18	12.8	55.0	11.0	51.8	11.8	53.2
1995	10	19	11.7	53.1	10.2	50.4	11.0	51.8
1995	10	20	11.4	52.5	10.3	50.5	10.8	51.4
1995	10	21	10.7	51.3	9.6	49.3	10.2	50.4
1995	10	22	10.2	50.4	8.6	47.5	9.5	49.1
1995	10	23	10.3	50.5	9.3	48.7	9.8	49.6
1995	10	24	10.5	50.9	8.8	47.8	9.7	49.5
1995	10	25	10.5	50.9	10.2	50.4	10.4	50.7
1995	10	26	10.8	51.4	9.6	49.3	10.2	50.4
1995	10	27	10.2	50.4	8.8	47.8	9.6	49.3
1995	10	28	9.6	49.3	8.2	46.8	8.7	47.7
1995	10	29	8.4	47.1	6.8	44.2	7.7	45.9
1995	10	30	7.8	46.0	6.1	43.0	6.9	44.4
1995	10	31	6.7	44.1	5.0	41.0	5.9	42.6
1995	11	1	6.2	43.2	4.5	40.1	5.5	41.9
1995	11	2	5.6	42.1	3.7	38.7	4.9	40.8
1995	11	3	5.4	41.7	3.7	38.7	4.8	40.6
1995	11	4	5.1	41.2	4.3	39.7	4.8	40.6
1995	11	5	6.8	44.2	4.5	40.1	5.6	42.1
1995	11	6	6.8	44.2	5.6	42.1	6.3	43.3
1995	11	7	7.0	44.6	6.5	43.7	6.8	44.2
1995	11	8	10.9	51.6	6.8	44.2	9.1	48.4
1995	11	9	9.5	49.1	6.4	43.5	7.7	45.9
1995	11	10	6.4	43.5	4.6	40.3	5.4	41.7
1995	11	11	5.6	42.1	4.2	39.6	5.0	41.0
1995	11	12	7.2	45.0	5.6	42.1	6.4	43.5
1995	11	13	8.1	46.6	7.2	45.0	7.7	45.9
1995	11	14	9.8	49.6	8.0	46.4	8.9	48.0
1995	11	15	9.8	49.6	9.2	48.6	9.6	49.3
1995	11	16	9.4	48.9	9.2	48.6	9.3	48.7
1995	11	17	9.4	48.9	9.1	48.4	9.2	48.6
1995	11	18	9.2	48.6	8.3	46.9	8.8	47.8
1995	11	19	8.4	47.1	6.9	44.4	7.5	45.5
1995	11	20	7.2	45.0	6.0	42.8	6.7	44.1
1995	11	21	6.6	43.9	5.8	42.4	6.2	43.2
1995	11	22	6.6	43.9	5.6	42.1	6.1	43.0
1995	11	23	5.9	42.6	5.1	41.2	5.4	41.7
1995	11	24	8.0	46.4	5.9	42.6	6.8	44.2
1995	11	25	8.2	46.8	7.6	45.7	8.0	46.4
1995	11	26	7.7	45.9	6.8	44.2	7.2	45.0
1995	11	27	6.8	44.2	5.9	42.6	6.2	43.2
1995	11	28	7.3	45.1	5.9	42.6	6.3	43.3
1995	11	29	10.2	50.4	7.3	45.1	9.0	48.2

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1995	11	30	10.0	50.0	8.5	47.3	9.0	48.2
1995	12	1	8.6	47.5	7.3	45.1	8.1	46.6
1995	12	2	7.3	45.1	5.4	41.7	6.3	43.3
1995	12	3	5.4	41.7	4.5	40.1	4.9	40.8
1995	12	4	5.1	41.2	3.7	38.7	4.3	39.7
1995	12	5	3.8	38.8	2.7	36.9	3.3	37.9
1995	12	6	2.7	36.9	1.2	34.2	2.1	35.8
1995	12	7	2.7	36.9	1.4	34.5	2.1	35.8
1995	12	8	1.9	35.4	0.3	32.5	0.8	33.4
1995	12	9	1.1	34.0	0.4	32.7	0.8	33.4
1995	12	10	1.6	34.9	0.6	33.1	1.1	34.0
1995	12	11	2.2	36.0	0.6	33.1	1.3	34.3
1995	12	12	3.1	37.6	2.0	35.6	2.3	36.1
1995	12	13	3.9	39.0	3.1	37.6	3.5	38.3
1995	12	14	4.7	40.5	3.6	38.5	4.1	39.4
1995	12	15	4.4	39.9	3.3	37.9	3.9	39.0
1995	12	16	4.2	39.6	3.9	39.0	4.1	39.4
1995	12	17	4.3	39.7	3.9	39.0	4.1	39.4
1995	12	18	4.5	40.1	3.9	39.0	4.2	39.6
1995	12	19	5.0	41.0	4.3	39.7	4.7	40.5
1995	12	20	5.4	41.7	4.7	40.5	5.0	41.0
1995	12	21	5.4	41.7	4.5	40.1	5.0	41.0
1995	12	22	4.5	40.1	2.9	37.2	3.6	38.5
1995	12	23	3.7	38.7	2.9	37.2	3.3	37.9
1995	12	24	3.4	38.1	2.9	37.2	3.1	37.6
1995	12	25	2.9	37.2	2.1	35.8	2.7	36.9
1995	12	26	3.1	37.6	2.8	37.0	3.0	37.4
1995	12	27	3.1	37.6	2.8	37.0	3.0	37.4
1995	12	28	3.4	38.1	2.6	36.7	3.0	37.4
1995	12	29	3.6	38.5	2.5	36.5	3.1	37.6
1995	12	30	3.8	38.8	3.3	37.9	3.6	38.5
1995	12	31	3.8	38.8	2.9	37.2	3.4	38.1
1996	1	1	4.1	39.4	3.5	38.3	3.9	39.0
1996	1	2	4.4	39.9	3.8	38.8	4.1	39.4
1996	1	3	4.8	40.6	3.5	38.3	4.0	39.2
1996	1	4	4.3	39.7	3.5	38.3	3.9	39.0
1996	1	5	3.8	38.8	2.9	37.2	3.5	38.3
1996	1	6	3.3	37.9	2.4	36.3	2.9	37.2
1996	1	7	4.0	39.2	3.2	37.8	3.6	38.5
1996	1	8	3.8	38.8	3.2	37.8	3.5	38.3
1996	1	9	3.8	38.8	3.3	37.9	3.6	38.5
1996	1	10	3.8	38.8	2.9	37.2	3.4	38.1
1996	1	11	4.4	39.9	3.0	37.4	3.7	38.7
1996	1	12	4.1	39.4	2.8	37.0	3.5	38.3
1996	1	13	3.5	38.3	3.0	37.4	3.3	37.9
1996	1	14	4.9	40.8	3.1	37.6	3.7	38.7
1996	1	15	7.2	45.0	4.9	40.8	6.3	43.3
1996	1	16	6.7	44.1	4.5	40.1	5.7	42.3
1996	1	17	4.5	40.1	3.1	37.6	3.8	38.8
1996	1	18	3.1	37.6	1.1	34.0	2.4	36.3
1996	1	19	2.5	36.5	0.7	33.3	1.6	34.9
1996	1	20	1.7	35.1	0.6	33.1	0.9	33.6

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1996	1	21	2.2	36.0	0.3	32.5	1.1	34.0
1996	1	22	1.9	35.4	0.1	32.2	1.0	33.8
1996	1	23	2.1	35.8	0.6	33.1	1.4	34.5
1996	1	24	2.6	36.7	0.5	32.9	1.6	34.9
1996	1	25	2.4	36.3	1.2	34.2	1.9	35.4
1996	1	26	1.8	35.2	1.0	33.8	1.4	34.5
1996	1	27	1.3	34.3	0.4	32.7	0.8	33.4
1996	1	28	1.8	35.2	0.2	32.4	0.9	33.6
1996	1	29	1.2	34.2	0.0	32.0	0.3	32.5
1996	1	30	0.2	32.4	0.0	32.0	0.1	32.2
1996	1	31	0.2	32.4	0.0	32.0	0.1	32.2
1996	2	11	2.4	36.3	0.4	32.7	1.5	34.7
1996	2	12	2.9	37.2	0.5	32.9	1.8	35.2
1996	2	14	5.0	41.0	2.4	36.3	3.8	38.8
1996	2	15	5.4	41.7	2.9	37.2	4.3	39.7
1996	2	16	5.9	42.6	3.4	38.1	4.7	40.5
1996	2	17	6.4	43.5	5.0	41.0	5.7	42.3
1996	2	18	8.4	47.1	5.9	42.6	7.1	44.8
1996	2	19	8.4	47.1	7.3	45.1	7.8	46.0
1996	2	20	7.4	45.3	6.0	42.8	6.8	44.2
1996	2	21	7.4	45.3	5.9	42.6	6.7	44.1
1996	2	22	6.1	43.0	4.4	39.9	5.4	41.7
1996	2	23	6.4	43.5	4.4	39.9	5.4	41.7
1996	2	24	5.6	42.1	4.4	39.9	4.7	40.5
1996	2	25	6.3	43.3	3.6	38.5	4.9	40.8
1996	2	26	5.3	41.5	3.0	37.4	4.3	39.7
1996	2	27	4.4	39.9	2.2	36.0	3.4	38.1
1996	2	28	3.4	38.1	0.7	33.3	2.2	36.0
1996	2	29	4.5	40.1	1.1	34.0	2.9	37.2
1996	3	1	5.8	42.4	2.0	35.6	4.1	39.4
1996	3	2	6.9	44.4	3.1	37.6	5.2	41.4
1996	3	3	7.5	45.5	5.5	41.9	6.5	43.7
1996	3	4	7.0	44.6	4.9	40.8	6.3	43.3
1996	3	5	5.8	42.4	4.1	39.4	5.0	41.0
1996	3	6	6.6	43.9	4.7	40.5	5.6	42.1
1996	3	7	6.7	44.1	5.8	42.4	6.3	43.3
1996	3	8	7.7	45.9	6.3	43.3	6.9	44.4
1996	3	9	8.9	48.0	7.2	45.0	8.1	46.6
1996	3	10	9.8	49.6	8.3	46.9	9.0	48.2
1996	3	11	11.4	52.5	8.7	47.7	9.9	49.8
1996	3	12	12.1	53.8	8.4	47.1	10.3	50.5
1996	3	13	12.0	53.6	8.1	46.6	10.2	50.4
1996	3	14	12.6	54.7	8.1	46.6	10.5	50.9
1996	3	15	11.2	52.2	8.9	48.0	10.1	50.2
1996	3	16	10.1	50.2	7.4	45.3	8.6	47.5
1996	3	17	11.5	52.7	6.7	44.1	9.1	48.4
1996	3	18	12.3	54.1	8.0	46.4	10.4	50.7
1996	3	19	12.6	54.7	9.4	48.9	10.9	51.6
1996	3	20	12.5	54.5	8.9	48.0	10.7	51.3
1996	3	21	11.2	52.2	8.6	47.5	10.2	50.4
1996	3	22	11.4	52.5	8.7	47.7	10.1	50.2
1996	3	23	12.0	53.6	8.1	46.6	10.2	50.4

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1996	3	24	10.6	51.1	6.7	44.1	8.8	47.8
1996	3	25	9.2	48.6	4.4	39.9	6.9	44.4
1996	3	26	9.0	48.2	6.3	43.3	7.7	45.9
1996	3	27	10.1	50.2	7.0	44.6	8.6	47.5
1996	3	28	11.1	52.0	6.4	43.5	8.7	47.7
1996	3	29	10.0	50.0	6.9	44.4	8.7	47.7
1996	3	30	11.1	52.0	6.6	43.9	9.0	48.2
1996	3	31	10.0	50.0	8.2	46.8	9.0	48.2
1996	4	1	11.4	52.5	7.6	45.7	9.2	48.6
1996	4	2	11.0	51.8	8.5	47.3	9.7	49.5
1996	4	3	12.4	54.3	7.7	45.9	10.1	50.2
1996	4	4	13.1	55.6	9.4	48.9	11.4	52.5
1996	4	5	14.5	58.1	10.3	50.5	12.5	54.5
1996	4	6	16.9	62.4	12.7	54.9	14.7	58.5
1996	4	7	18.5	65.3	14.4	57.9	16.5	61.7
1996	4	8	19.1	66.4	15.5	59.9	17.5	63.5
1996	4	9	18.3	64.9	15.9	60.6	17.4	63.3
1996	4	10	16.6	61.9	13.4	56.1	15.0	59.0
1996	4	11	14.4	57.9	11.9	53.4	13.2	55.8
1996	4	12	13.0	55.4	10.5	50.9	11.8	53.2
1996	4	13	14.5	58.1	9.7	49.5	12.2	54.0
1996	4	14	15.9	60.6	11.7	53.1	14.0	57.2
1996	4	15	16.4	61.5	13.6	56.5	15.0	59.0
1996	4	16	16.6	61.9	13.8	56.8	14.9	58.8
1996	4	17	15.0	59.0	11.6	52.9	13.5	56.3
1996	4	18	14.1	57.4	11.3	52.3	12.9	55.2
1996	4	19	12.8	55.0	10.5	50.9	11.9	53.4
1996	4	20	13.8	56.8	9.7	49.5	11.8	53.2
1996	4	21	15.0	59.0	11.3	52.3	13.3	55.9
1996	4	22	14.2	57.6	12.5	54.5	13.4	56.1
1996	4	23	13.8	56.8	12.4	54.3	13.1	55.6
1996	4	24	14.7	58.5	10.8	51.4	12.8	55.0
1996	4	25	13.3	55.9	10.8	51.4	11.7	53.1
1996	4	26	13.1	55.6	9.3	48.7	11.4	52.5
1996	4	27	14.5	58.1	9.6	49.3	12.2	54.0
1996	4	28	15.2	59.4	11.2	52.2	13.6	56.5
1996	4	29	16.3	61.3	13.3	55.9	14.8	58.6
1996	4	30	15.2	59.4	12.3	54.1	13.9	57.0
1996	5	1	14.1	57.4	10.7	51.3	12.5	54.5
1996	5	2	13.7	56.7	9.8	49.6	11.9	53.4
1996	5	3	13.3	55.9	9.8	49.6	11.8	53.2
1996	5	4	16.0	60.8	10.6	51.1	13.3	55.9
1996	5	5	17.0	62.6	12.1	53.8	14.5	58.1
1996	5	6	17.3	63.1	12.9	55.2	15.0	59.0
1996	5	7	15.2	59.4	11.9	53.4	13.7	56.7
1996	5	8	14.0	57.2	10.4	50.7	12.2	54.0
1996	5	9	15.7	60.3	10.6	51.1	13.2	55.8
1996	5	10	15.8	60.4	12.3	54.1	14.3	57.7
1996	5	11	15.5	59.9	14.0	57.2	14.8	58.6
1996	5	12	15.7	60.3	13.7	56.7	14.7	58.5
1996	5	13	17.9	64.2	15.1	59.2	16.5	61.7
1996	5	14	18.2	64.8	15.2	59.4	16.7	62.1

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1996	5	15	19.0	66.2	16.0	60.8	17.3	63.1
1996	5	16	19.0	66.2	14.9	58.8	17.2	63.0
1996	5	17	18.6	65.5	15.2	59.4	17.1	62.8
1996	5	18	17.0	62.6	13.3	55.9	15.0	59.0
1996	5	19	16.6	61.9	14.3	57.7	15.6	60.1
1996	5	20	17.4	63.3	12.9	55.2	15.2	59.4
1996	5	21	16.8	62.2	14.3	57.7	15.1	59.2
1996	5	22	16.0	60.8	13.2	55.8	14.5	58.1
1996	5	23	16.5	61.7	12.1	53.8	14.4	57.9
1996	5	24	20.0	68.0	14.7	58.5	17.3	63.1
1996	5	25	21.3	70.3	16.8	62.2	19.2	66.6
1996	5	26	21.2	70.2	17.6	63.7	19.2	66.6
1996	5	27	18.7	65.7	15.4	59.7	17.2	63.0
1996	5	28	16.5	61.7	13.3	55.9	15.2	59.4
1996	5	29	17.1	62.8	14.1	57.4	15.6	60.1
1996	5	30	17.9	64.2	13.7	56.7	15.8	60.4
1996	5	31	19.5	67.1	14.0	57.2	16.8	62.2
1996	6	1	20.7	69.3	16.5	61.7	18.7	65.7
1996	6	2	23.2	73.8	18.4	65.1	20.9	69.6
1996	6	3	23.3	73.9	20.2	68.4	21.9	71.4
1996	6	4	21.5	70.7	17.9	64.2	19.5	67.1
1996	6	5	21.6	70.9	15.2	59.4	18.5	65.3
1996	6	6	23.8	74.8	18.0	64.4	21.0	69.8
1996	6	7	25.3	77.5	20.0	68.0	22.5	72.5
1996	6	8	22.9	73.2	17.5	63.5	20.2	68.4
1996	6	9	21.1	70.0	16.1	61.0	18.7	65.7
1996	6	10	21.8	71.2	15.8	60.4	18.7	65.7
1996	6	11	22.3	72.1	16.1	61.0	19.3	66.7
1996	6	12	23.8	74.8	18.3	64.9	21.1	70.0
1996	6	13	23.9	75.0	19.3	66.7	21.5	70.7
1996	6	14	23.9	75.0	17.9	64.2	20.7	69.3
1996	6	15	22.4	72.3	18.8	65.8	20.5	68.9
1996	6	16	20.3	68.5	17.1	62.8	18.7	65.7
1996	6	17	18.2	64.8	14.2	57.6	16.3	61.3
1996	6	18	18.2	64.8	12.8	55.0	15.5	59.9
1996	6	19	20.8	69.4	14.8	58.6	17.8	64.0
1996	6	20	22.8	73.0	17.2	63.0	20.2	68.4
1996	6	21	21.6	70.9	19.1	66.4	20.0	68.0
1996	6	22	22.1	71.8	17.1	62.8	19.5	67.1
1996	6	23	20.1	68.2	17.4	63.3	19.0	66.2
1996	6	24	20.8	69.4	17.4	63.3	19.2	66.6
1996	6	25	22.6	72.7	17.9	64.2	20.2	68.4
1996	6	26	22.9	73.2	18.7	65.7	20.9	69.6
1996	6	27	21.8	71.2	19.0	66.2	20.7	69.3
1996	6	28	20.6	69.1	16.7	62.1	18.7	65.7
1996	6	29	21.9	71.4	16.4	61.5	19.1	66.4
1996	6	30	23.9	75.0	18.8	65.8	21.4	70.5
1996	7	1	25.3	77.5	20.4	68.7	22.8	73.0
1996	7	2	26.2	79.2	21.9	71.4	24.2	75.6
1996	7	3	25.8	78.4	21.8	71.2	23.8	74.8
1996	7	4	22.9	73.2	18.8	65.8	20.7	69.3
1996	7	5	21.8	71.2	15.9	60.6	19.0	66.2

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1996	7	6	23.8	74.8	18.3	64.9	21.1	70.0
1996	7	7	25.0	77.0	19.8	67.6	22.5	72.5
1996	7	8	25.8	78.4	21.1	70.0	23.6	74.5
1996	7	9	24.8	76.6	20.1	68.2	22.5	72.5
1996	7	10	23.3	73.9	17.7	63.9	20.4	68.7
1996	7	11	25.5	77.9	20.6	69.1	23.0	73.4
1996	7	12	26.4	79.5	21.4	70.5	24.0	75.2
1996	7	13	27.9	82.2	22.5	72.5	25.2	77.4
1996	7	14	28.1	82.6	23.4	74.1	25.8	78.4
1996	7	15	27.3	81.1	23.2	73.8	25.1	77.2
1996	7	16	24.0	75.2	19.7	67.5	22.0	71.6
1996	7	17	21.5	70.7	18.9	66.0	20.2	68.4
1996	7	18	21.2	70.2	17.3	63.1	19.3	66.7
1996	7	19	20.9	69.6	17.6	63.7	19.4	66.9
1996	7	20	22.9	73.2	18.1	64.6	20.4	68.7
1996	7	21	24.2	75.6	19.2	66.6	21.7	71.1
1996	7	22	25.8	78.4	20.7	69.3	23.3	73.9
1996	7	23	26.5	79.7	21.9	71.4	24.3	75.7
1996	7	24	26.8	80.2	22.7	72.9	24.9	76.8
1996	7	25	27.5	81.5	22.9	73.2	25.2	77.4
1996	7	26	27.9	82.2	23.0	73.4	25.6	78.1
1996	7	27	28.1	82.6	23.2	73.8	25.8	78.4
1996	7	28	27.2	81.0	23.4	74.1	25.3	77.5
1996	7	29	26.1	79.0	22.5	72.5	24.2	75.6
1996	7	30	26.8	80.2	22.4	72.3	24.4	75.9
1996	7	31	26.1	79.0	20.4	68.7	23.2	73.8
1996	8	1	25.3	77.5	21.0	69.8	23.0	73.4
1996	8	2	22.0	71.6	18.1	64.6	19.9	67.8
1996	8	3	20.7	69.3	16.5	61.7	18.7	65.7
1996	8	4	20.9	69.6	16.8	62.2	19.0	66.2
1996	8	5	20.2	68.4	16.7	62.1	18.6	65.5
1996	8	6	22.2	72.0	17.3	63.1	19.7	67.5
1996	8	7	23.6	74.5	19.0	66.2	21.4	70.5
1996	8	8	25.0	77.0	20.3	68.5	22.8	73.0
1996	8	9	25.8	78.4	21.4	70.5	23.7	74.7
1996	8	10	25.8	78.4	21.6	70.9	24.0	75.2
1996	8	11	25.0	77.0	21.4	70.5	23.4	74.1
1996	8	12	23.1	73.6	19.0	66.2	21.2	70.2
1996	8	13	23.9	75.0	19.8	67.6	22.1	71.8
1996	8	14	25.0	77.0	21.1	70.0	23.0	73.4
1996	8	15	24.3	75.7	20.4	68.7	22.3	72.1
1996	8	16	23.4	74.1	19.8	67.6	21.5	70.7
1996	8	17	21.8	71.2	18.0	64.4	20.0	68.0
1996	8	18	21.3	70.3	17.1	62.8	19.2	66.6
1996	8	19	22.1	71.8	18.2	64.8	20.2	68.4
1996	8	20	21.1	70.0	18.5	65.3	19.6	67.3
1996	8	21	21.1	70.0	16.7	62.1	19.0	66.2
1996	8	22	22.2	72.0	18.1	64.6	20.3	68.5
1996	8	23	22.8	73.0	18.6	65.5	20.9	69.6
1996	8	24	23.3	73.9	19.4	66.9	21.5	70.7
1996	8	25	23.5	74.3	20.0	68.0	21.9	71.4
1996	8	26	22.5	72.5	20.0	68.0	21.1	70.0

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1996	8	27	20.7	69.3	19.0	66.2	20.0	68.0
1996	8	28	22.2	72.0	18.9	66.0	20.5	68.9
1996	8	29	23.3	73.9	20.0	68.0	21.7	71.1
1996	8	30	22.7	72.9	20.3	68.5	21.6	70.9
1996	8	31	20.7	69.3	18.1	64.6	19.5	67.1
1996	9	1	20.5	68.9	17.3	63.1	18.9	66.0
1996	9	2	19.9	67.8	17.6	63.7	19.0	66.2
1996	9	3	20.0	68.0	17.8	64.0	18.7	65.7
1996	9	4	18.2	64.8	16.5	61.7	17.4	63.3
1996	9	5	17.1	62.8	15.2	59.4	16.2	61.2
1996	9	6	17.4	63.3	15.1	59.2	16.4	61.5
1996	9	7	19.7	67.5	16.6	61.9	18.0	64.4
1996	9	8	20.5	68.9	17.9	64.2	19.1	66.4
1996	9	9	20.5	68.9	17.8	64.0	19.2	66.6
1996	9	10	20.5	68.9	17.6	63.7	19.1	66.4
1996	9	11	20.7	69.3	17.8	64.0	19.4	66.9
1996	9	12	21.0	69.8	19.0	66.2	20.0	68.0
1996	9	13	20.3	68.5	18.2	64.8	19.3	66.7
1996	9	14	19.2	66.6	17.6	63.7	18.3	64.9
1996	9	15	18.4	65.1	17.0	62.6	17.8	64.0
1996	9	16	17.8	64.0	15.4	59.7	16.5	61.7
1996	9	17	17.6	63.7	14.9	58.8	16.3	61.3
1996	9	18	16.6	61.9	15.1	59.2	15.8	60.4
1996	9	19	17.4	63.3	15.3	59.5	16.2	61.2
1996	9	20	16.4	61.5	14.7	58.5	15.6	60.1
1996	9	21	15.3	59.5	13.3	55.9	14.2	57.6
1996	9	22	15.2	59.4	12.4	54.3	13.8	56.8
1996	9	23	14.7	58.5	12.7	54.9	13.9	57.0
1996	9	24	14.4	57.9	12.5	54.5	13.5	56.3
1996	9	25	14.8	58.6	12.2	54.0	13.7	56.7
1996	9	26	15.9	60.6	13.3	55.9	14.6	58.3
1996	9	27	16.9	62.4	14.1	57.4	15.6	60.1
1996	9	28	17.7	63.9	15.0	59.0	16.4	61.5
1996	9	29	17.9	64.2	15.5	59.9	16.8	62.2
1996	9	30	18.0	64.4	15.8	60.4	16.8	62.2
1996	10	1	16.1	61.0	14.2	57.6	15.2	59.4
1996	10	2	15.0	59.0	13.1	55.6	14.1	57.4
1996	10	3	15.8	60.4	13.3	55.9	14.5	58.1
1996	10	4	15.3	59.5	14.0	57.2	14.5	58.1
1996	10	5	15.6	60.1	13.9	57.0	14.7	58.5
1996	10	6	15.4	59.7	13.3	55.9	14.5	58.1
1996	10	7	15.9	60.6	13.7	56.7	14.9	58.8
1996	10	8	16.2	61.2	14.2	57.6	15.3	59.5
1996	10	9	16.2	61.2	14.0	57.2	15.3	59.5
1996	10	10	16.7	62.1	14.8	58.6	15.7	60.3
1996	10	11	16.1	61.0	14.6	58.3	15.5	59.9
1996	10	12	15.3	59.5	13.9	57.0	14.8	58.6
1996	10	13	15.0	59.0	13.4	56.1	14.1	57.4
1996	10	14	13.4	56.1	12.0	53.6	12.7	54.9
1996	10	15	12.2	54.0	10.6	51.1	11.5	52.7
1996	10	16	11.1	52.0	9.2	48.6	10.2	50.4
1996	10	17	10.1	50.2	8.6	47.5	8.9	48.0

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1996	10	18	10.0	50.0	8.4	47.1	9.1	48.4
1996	10	19	10.0	50.0	8.8	47.8	9.4	48.9
1996	10	20	9.1	48.4	7.5	45.5	8.4	47.1
1996	10	21	8.3	46.9	7.4	45.3	7.8	46.0
1996	10	22	8.3	46.9	7.8	46.0	8.1	46.6
1996	10	23	8.1	46.6	7.2	45.0	7.5	45.5
1996	10	24	9.5	49.1	7.4	45.3	8.5	47.3
1996	10	25	10.1	50.2	8.6	47.5	9.4	48.9
1996	10	26	9.5	49.1	8.0	46.4	8.9	48.0
1996	10	27	9.5	49.1	7.8	46.0	8.8	47.8
1996	10	28	9.5	49.1	8.8	47.8	9.0	48.2
1996	10	29	9.7	49.5	8.9	48.0	9.3	48.7
1996	10	30	9.8	49.6	8.8	47.8	9.3	48.7
1996	10	31	9.1	48.4	7.1	44.8	8.1	46.6
1996	11	1	8.4	47.1	6.4	43.5	7.6	45.7
1996	11	2	8.4	47.1	6.4	43.5	7.6	45.7
1996	11	3	8.4	47.1	6.9	44.4	7.8	46.0
1996	11	4	8.9	48.0	7.2	45.0	8.1	46.6
1996	11	5	8.0	46.4	6.4	43.5	7.4	45.3
1996	11	6	9.1	48.4	7.2	45.0	8.1	46.6
1996	11	7	8.1	46.6	6.6	43.9	7.5	45.5
1996	11	8	9.4	48.9	7.4	45.3	8.4	47.1
1996	11	9	9.4	48.9	7.7	45.9	8.7	47.7
1996	11	10	8.8	47.8	7.2	45.0	8.1	46.6
1996	11	11	9.7	49.5	8.0	46.4	8.8	47.8
1996	11	12	9.2	48.6	8.0	46.4	8.5	47.3
1996	11	13	9.7	49.5	8.3	46.9	9.0	48.2
1996	11	14	9.2	48.6	8.1	46.6	8.7	47.7
1996	11	15	8.6	47.5	7.7	45.9	8.2	46.8
1996	11	16	8.4	47.1	7.5	45.5	8.0	46.4
1996	11	17	8.0	46.4	7.2	45.0	7.7	45.9
1996	11	18	7.7	45.9	6.7	44.1	7.1	44.8
1996	11	19	6.7	44.1	2.7	36.9	3.6	38.5
1996	11	20	3.3	37.9	2.0	35.6	2.7	36.9
1996	11	21	3.9	39.0	2.8	37.0	3.3	37.9
1996	11	22	4.6	40.3	3.3	37.9	3.8	38.8
1996	11	23	3.5	38.3	1.4	34.5	2.3	36.1
1996	11	24	3.8	38.8	1.4	34.5	2.5	36.5
1996	11	25	3.8	38.8	2.0	35.6	3.1	37.6
1996	11	26	4.2	39.6	3.3	37.9	3.9	39.0
1996	11	27	4.6	40.3	3.6	38.5	4.1	39.4
1996	11	28	4.4	39.9	2.8	37.0	3.8	38.8
1996	11	29	4.1	39.4	2.7	36.9	3.2	37.8
1996	11	30	3.9	39.0	2.7	36.9	3.4	38.1
1996	12	1	3.8	38.8	3.0	37.4	3.4	38.1
1996	12	2	3.6	38.5	2.7	36.9	3.2	37.8
1996	12	3	3.3	37.9	2.4	36.3	2.9	37.2
1996	12	4	2.5	36.5	1.4	34.5	1.8	35.2
1996	12	5	2.8	37.0	0.9	33.6	1.8	35.2
1996	12	6	2.8	37.0	1.6	34.9	2.3	36.1
1996	12	7	2.4	36.3	1.6	34.9	1.9	35.4
1996	12	8	4.1	39.4	1.9	35.4	3.2	37.8

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1996	12	9	4.2	39.6	3.6	38.5	4.0	39.2
1996	12	10	4.2	39.6	3.6	38.5	4.0	39.2
1996	12	11	3.6	38.5	2.5	36.5	3.0	37.4
1996	12	12	4.1	39.4	2.8	37.0	3.5	38.3
1996	12	13	4.4	39.9	3.6	38.5	4.0	39.2
1996	12	14	3.8	38.8	2.4	36.3	3.1	37.6
1996	12	15	3.6	38.5	2.7	36.9	3.2	37.8
1996	12	16	3.8	38.8	2.7	36.9	3.4	38.1
1996	12	17	2.7	36.9	0.9	33.6	1.6	34.9
1996	12	18	1.6	34.9	0.4	32.7	1.1	34.0
1996	12	19	1.9	35.4	0.9	33.6	1.4	34.5
1996	12	20	1.7	35.1	1.2	34.2	1.6	34.9
1996	12	21	2.4	36.3	1.4	34.5	1.9	35.4
1996	12	22	3.2	37.8	2.2	36.0	2.6	36.7
1996	12	23	2.8	37.0	1.7	35.1	2.2	36.0
1996	12	24	2.2	36.0	0.8	33.4	1.4	34.5
1996	12	25	1.2	34.2	-0.4	31.3	0.6	33.1
1996	12	26	1.2	34.2	-0.4	31.3	0.0	32.0
1996	12	27	0.8	33.4	-0.4	31.3	0.3	32.5
1996	12	28	0.3	32.5	-0.4	31.3	-0.3	31.5
1996	12	29	-0.4	31.3	-0.4	31.3	-0.4	31.3
1996	12	30	-0.4	31.3	-0.4	31.3	-0.4	31.3
1996	12	31	3.2	37.8	-0.4	31.3	1.8	35.2
1997	1	1	3.2	37.8	2.4	36.3	2.8	37.0
1997	1	2	2.5	36.5	1.4	34.5	1.9	35.4
1997	1	3	1.7	35.1	0.4	32.7	1.0	33.8
1997	1	4	1.1	34.0	0.3	32.5	0.7	33.3
1997	1	5	1.1	34.0	0.3	32.5	0.6	33.1
1997	1	6	2.0	35.6	0.8	33.4	1.3	34.3
1997	1	7	4.2	39.6	2.0	35.6	2.9	37.2
1997	1	8	5.0	41.0	4.1	39.4	4.5	40.1
1997	1	9	4.7	40.5	4.1	39.4	4.4	39.9
1997	1	10	4.4	39.9	3.8	38.8	4.2	39.6
1997	1	11	4.2	39.6	3.2	37.8	3.7	38.7
1997	1	12	3.2	37.8	0.9	33.6	1.5	34.7
1997	1	13	1.1	34.0	0.0	32.0	0.6	33.1
1997	1	14	1.6	34.9	0.0	32.0	0.8	33.4
1997	1	15	1.6	34.9	0.0	32.0	0.8	33.4
1997	1	17	2.5	36.5	0.6	33.1	1.6	34.9
1997	1	18	3.3	37.9	2.4	36.3	2.8	37.0
1997	1	19	3.3	37.9	2.4	36.3	2.9	37.2
1997	1	20	3.5	38.3	2.8	37.0	3.1	37.6
1997	1	21	3.3	37.9	2.4	36.3	2.8	37.0
1997	1	22	3.9	39.0	2.7	36.9	3.3	37.9
1997	1	23	3.3	37.9	1.7	35.1	2.6	36.7
1997	1	24	3.0	37.4	1.7	35.1	2.4	36.3
1997	1	25	2.5	36.5	1.7	35.1	1.9	35.4
1997	1	26	1.7	35.1	0.6	33.1	1.3	34.3
1997	1	27	1.6	34.9	-0.4	31.3	0.6	33.1
1997	1	28	2.8	37.0	0.8	33.4	1.7	35.1
1997	1	29	2.7	36.9	0.9	33.6	1.9	35.4
1997	1	30	3.2	37.8	1.7	35.1	2.4	36.3

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1997	1	31	3.8	38.8	2.8	37.0	3.3	37.9
1997	2	1	2.8	37.0	1.4	34.5	2.0	35.6
1997	2	2	2.2	36.0	0.8	33.4	1.5	34.7
1997	2	3	2.5	36.5	1.4	34.5	2.0	35.6
1997	2	4	3.0	37.4	1.2	34.2	2.2	36.0
1997	2	5	3.0	37.4	1.2	34.2	2.3	36.1
1997	2	6	3.0	37.4	2.2	36.0	2.5	36.5
1997	2	7	2.2	36.0	2.0	35.6	2.1	35.8
1997	2	8	2.8	37.0	2.0	35.6	2.5	36.5
1997	2	9	3.5	38.3	2.4	36.3	2.9	37.2
1997	2	10	4.1	39.4	2.7	36.9	3.4	38.1
1997	4	15	13.6	56.5	10.1	50.2	11.9	53.4
1997	4	16	13.9	57.0	12.0	53.6	12.9	55.2
1997	4	17	13.7	56.7	10.8	51.4	12.3	54.1
1997	4	18	12.5	54.5	10.6	51.1	11.4	52.5
1997	4	19	13.1	55.6	10.8	51.4	11.9	53.4
1997	4	20	14.3	57.7	11.2	52.2	12.8	55.0
1997	4	21	13.3	55.9	10.1	50.2	11.9	53.4
1997	4	22	14.0	57.2	10.6	51.1	12.6	54.7
1997	4	23	14.6	58.3	12.2	54.0	13.5	56.3
1997	4	24	14.0	57.2	11.1	52.0	12.6	54.7
1997	4	25	14.8	58.6	11.5	52.7	13.3	55.9
1997	4	26	16.5	61.7	13.1	55.6	15.0	59.0
1997	4	27	15.7	60.3	12.5	54.5	13.6	56.5
1997	4	28	13.6	56.5	10.9	51.6	12.3	54.1
1997	4	29	14.5	58.1	11.4	52.5	12.9	55.2
1997	4	30	13.9	57.0	10.8	51.4	12.3	54.1
1997	5	2	14.6	58.3	10.8	51.4	13.0	55.4
1997	5	3	14.5	58.1	11.9	53.4	13.0	55.4
1997	5	4	15.4	59.7	10.5	50.9	13.1	55.6
1997	5	5	16.4	61.5	13.3	55.9	14.9	58.8
1997	5	6	16.9	62.4	13.3	55.9	14.9	58.8
1997	5	7	16.4	61.5	11.2	52.2	14.1	57.4
1997	5	8	18.5	65.3	13.3	55.9	16.0	60.8
1997	5	9	19.8	67.6	14.6	58.3	17.3	63.1
1997	5	10	19.9	67.8	16.1	61.0	18.2	64.8
1997	5	11	20.6	69.1	15.8	60.4	18.4	65.1
1997	5	12	21.1	70.0	16.4	61.5	18.9	66.0
1997	5	13	21.9	71.4	17.7	63.9	19.8	67.6
1997	5	14	22.4	72.3	18.1	64.6	20.3	68.5
1997	5	15	22.7	72.9	18.5	65.3	20.6	69.1
1997	5	16	22.6	72.7	18.5	65.3	20.5	68.9
1997	5	17	20.6	69.1	16.7	62.1	18.8	65.8
1997	5	18	20.4	68.7	16.2	61.2	18.6	65.5
1997	5	19	20.4	68.7	16.4	61.5	18.4	65.1
1997	5	20	17.7	63.9	14.0	57.2	16.1	61.0
1997	5	21	18.1	64.6	14.0	57.2	16.3	61.3
1997	5	22	19.3	66.7	15.1	59.2	17.4	63.3
1997	5	23	18.0	64.4	15.9	60.6	16.9	62.4
1997	5	24	19.0	66.2	15.0	59.0	16.9	62.4
1997	5	25	17.6	63.7	15.0	59.0	15.9	60.6
1997	5	26	17.0	62.6	14.3	57.7	15.7	60.3

Year	Month	Day	Temp. °C Max	Temp. °F Max	Temp.°C Min	Temp. °F Min	Temp. °C Mean	Temp. °F Mean
1997	5	27	18.1	64.6	15.1	59.2	16.7	62.1
1997	5	28	19.0	66.2	17.0	62.6	17.9	64.2
1997	5	29	21.1	70.0	17.7	63.9	19.5	67.1
1997	5	30	20.6	69.1	18.6	65.5	19.7	67.5
1997	5	31	19.6	67.3	17.9	64.2	18.9	66.0
1997	6	1	18.6	65.5	16.5	61.7	17.5	63.5
1997	6	2	19.9	67.8	15.4	59.7	17.7	63.9
1997	6	3	19.3	66.7	17.7	63.9	18.4	65.1
1997	6	4	18.6	65.5	16.9	62.4	17.8	64.0
1997	6	5	19.9	67.8	15.8	60.4	17.7	63.9
1997	6	6	21.1	70.0	17.0	62.6	19.0	66.2
1997	6	7	20.9	69.6	17.5	63.5	19.2	66.6
1997	6	8	20.7	69.3	16.1	61.0	18.5	65.3
1997	6	9	22.4	72.3	17.7	63.9	20.1	68.2
1997	6	10	22.1	71.8	18.8	65.8	20.7	69.3
1997	6	11	21.2	70.2	18.0	64.4	19.7	67.5
1997	6	23	18.5	65.3	11.1	52.0	14.5	58.1
1997	6	26	21.1	70.0	11.9	53.4	16.0	60.8
1997	6	27	22.2	72.0	11.9	53.4	16.7	62.1
1997	6	28	23.7	74.7	10.5	50.9	17.3	63.1
1997	6	29	21.1	70.0	12.9	55.2	16.1	61.0
1997	6	30	20.9	69.6	10.8	51.4	16.1	61.0
1997	7	1	19.8	67.6	12.6	54.7	15.9	60.6
1997	7	2	21.4	70.5	10.1	50.2	16.8	62.2
1997	7	3	22.9	73.2	10.6	51.1	17.5	63.5
1997	7	4	24.3	75.7	10.5	50.9	18.0	64.4
1997	7	5	34.2	93.6	13.1	55.6	21.0	69.8
1997	7	6	29.6	85.3	15.6	60.1	20.0	68.0
1997	7	7	30.5	86.9	13.9	57.0	20.5	68.9