

APPENDICES to Technical Report 2012-8

**Adult Pacific Lamprey Passage: Data Synthesis and Fishway Improvement
Prioritization Tools**

**Prepared by: Matthew L. Keefer, Tami C. Clabough, Michael A. Jepson, Eric L. Johnson,
Charles T. Boggs & Christopher C. Caudill**

**Department of Fish and Wildlife Sciences
College of Natural Resources, University of Idaho**

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Appendix A. Monitoring arrays

Table A1. Radiotelemetry monitoring sites at **Bonneville Dam** in 1997-2002 and 2007-2010. The tailrace was also monitored.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
Bradford Island										
PH1 S entrance	X	X	X	X	X	X	X	X	X	X
PH1 Collection chan	X	X	X	X	X	X	-	-	-	-
PH1 SG entrances	X	X	X	X	X	X	-	-	-	-
PH1 N entrance	X	X	X	X	X	X	X	X	X	X
PH1 transition pool	X	X	X	X	X	X	X	X	X	X
PH1 junction pool	X	X	X	X	X	X	X	X	X	X
PH1 count station	-	-	-	X	X	X	X	X	X	X
PH1 makeup water	X	X	X	X	X	X	X	X	X	X
PH1 serpentine weir	-	-	-	X	X	X	X	X	X	X
PH1 ladder exit	X	X	X	X	X	X	X	X	X	X
PH1 LPS	-	-	-	-	-	-	X	X	X	X
B-Br entrance	X	X	X	X	X	X	X	X	X	X
B-Br transition pool	X	X	X	X	X	X	X	X	X	X
Washington-shore										
CI entrance	X	X	X	X	X	X	X	X	X	X
CI transition pool	X	X	X	X	X	X	X	X	X	X
CI makeup water	X	X	X	-	-	-	X	X	X	X
CI LPS	-	-	-	-	-	-	X	X	X	X
PH2 S entrance (ds)	X	X	X	X	X	X	X	X	X	X
PH2 S entrance (us)	X	X	X	X	X	X	X	X	X	X
PH2 Collection chan	X	X	X	-	-	-	-	-	-	-
PH2 OG entrances	X	X	X	-	-	-	-	-	-	-
PH2 N entrance (ds)	X	X	X	X	X	X	X	X	X	X
PH2 N entrance (us)	X	X	X	X	X	X	X	X	X	X
PH2 transition pool	X	X	X	X	X	X	X	X	X	X
PH2 ladder	X	X	X	X	X	X	X	X	X	X
PH2 UMT junction	X	X	X	X	X	X	X	X	X	X
PH2 count station	-	-	-	X	X	X	X	X	X	X
PH2 makeup water	-	-	-	X	X	X	X	X	X	X
PH2 serpentine weir	-	-	-	X	X	X	X	X	X	X
PH2 ladder exit	X	X	X	X	X	X	X	X	X	X
PH2 LPS	-	-	-	-	-	-	X	X	X	X

Appendix A. Monitoring arrays

Table A2. Radiotelemetry monitoring sites at **The Dalles Dam** in 1997-2002 and 2007-2010. The tailrace was also monitored.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
South spillway entrances	X	X	-	X	X	X	X	X	X	X
Powerhouse entrances	X	X	-	X	X	X	X	X	X	X
East ladder										
East ladder entrance	X	X	-	X	X	X	X	X	X	X
East ladder transition pool	X	X	-	X	X	X	X	X	X	X
East ladder exit	X	X	X	X	X	X	X	X	X	X
North ladder										
North ladder entrance	X	X	-	X	X	X	X	X	X	X
North ladder transition pool	X	X	-	X	X	X	X	X	X	X
North ladder exit	X	X	X	X	X	X	X	X	X	X
North spillway area ¹	-	-	-	-	-	-	X	-	-	X
South spillway area ¹	-	-	-	-	-	-	-	-	-	X

¹ aerial antennas

Table A3. Radiotelemetry monitoring sites at **John Day Dam** in 1997-2002 and 2007-2010. The tailrace was also monitored.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
North shore										
North entrance	X	X	-	X	X	X	-	-	-	-
North transition pool	X	X	-	X	X	X	-	-	-	-
North count window pool	X	-	-	-	-	-	-	-	-	-
North ladder exit	X	X	X	X	X	X	X	X	X	X
South shore										
North powerhouse entrance	X	X	-	X	X	X	-	-	-	-
South entrance	X	X	-	X	X	X	-	-	X	-
South transition pool	X	X	-	X	X	X	-	-	-	-
South count window pool	X	-	-	-	-	-	-	-	-	-
South ladder exit	X	X	X	X	X	X	X	X	X	X
Juvenile facility	-	X	-	X	X	X	-	-	-	-

Appendix A. Monitoring arrays

Table A4. Radiotelemetry monitoring sites at **McNary Dam** in 1997-2002 and 2005-2010. The tailrace was also monitored.

	1997	1998	1999	2000	2001	2002	2005	2006	2007	2008	2009	2010
North powerhouse entrance	X	X	X	X	X	X	X	X	X	X	X	X
Powerhouse orifice gates	X	X	X	-	-	-	-	-	-	-	-	-
North shore												
North entrance	X	X	X	X	X	X	X	X	X	X	X	X
North transition pool	X	X	X	X	X	X	X	X	X	X	X	X
North ladder exit	X	X	X	X	X	X	X	X	X	X	X	X
South shore												
South entrance	X	X	X	X	X	X	X	X	X	X	X	X
South transition pool	X	X	X	X	X	X	X	X	X	X	X	X
South ladder exit	X	X	X	X	X	X	X	X	X	X	X	X
Juvenile bypass	X	X	X	X	X	X	-	-	-	-	-	-
Navigation lock	X	X	X	X	X	X	-	-	-	-	-	-

Table A5. Radiotelemetry monitoring sites at **Ice Harbor** in 1997-2002 and 2005-2010. The tailrace was also monitored.

	1997	1998	1999	2000	2001	2002	2005	2006	2007	2008	2009	2010
North powerhouse entrance	X	X	-	X	X	X	X	X	X	X	X	X
Powerhouse orifice gates	X	X	-	-	-	-	-	-	-	-	-	-
North shore												
North entrance	X	X	X	X	X	X	X	X	X	X	X	X
North transition pool	X	X	-	X	X	X	X	X	X	X	X	X
North ladder exit	X	X	X	X	X	X	X	X	X	X	X	X
South shore												
South entrance	X	X	-	X	X	X	X	X	X	X	X	X
South transition pool	-	-	X	X	X	X	X	X	X	X	X	X
South ladder exit	X	X	X	X	X	X	X	X	X	X	X	X

In 2010, yagis were outside fishway openings. The receivers inside the openings were removed on 30 June to be used downstream. No lamprey were detected on the inside receivers while they were deployed.

Appendix A. Monitoring arrays

Table A6. Radiotelemetry monitoring sites at **Lower Monumental** in 1997-2002 and 2005-2010. The tailrace was also monitored.

	1997	1998	1999	2000	2001	2002	2005	2006	2007	2008	2009	2010
South powerhouse entrance	X	-	-	X	X	X	-	-	-	X	-	-
Powerhouse orifice gates	-	-	-	-	-	-	-	-	-	-	-	-
North shore												
North entrance	X	X	-	X	X	X	-	-	-	X	-	-
North transition pool	-	-	X	X	X	X	-	-	-	X	-	-
North ladder exit	X	X	X	X	X	X	X	X	X	X	X	X
South shore												
South entrance	X	-	-	X	X	X	-	-	-	X	-	-
South transition pool	-	-	X	X	X	X	-	-	-	X	-	-
South ladder exit	X	X	X	X	X	X	X	X	X	X	X	X

Table A7. Radiotelemetry monitoring sites at **Little Goose** in 1997-2002 and 2005-2010. The tailrace was also monitored.

	1997	1998	1999	2000	2001	2002	2005	2006	2007	2008	2009	2010
North shore entrance	X	-	-	X	X	X	-	-	-	X	-	-
North powerhouse entrance	X	-	-	X	X	X	-	-	-	X	-	-
Powerhouse orifice gates	-	-	-	-	-	-	-	-	-	-	-	-
South shore												
South entrance	X	-	-	X	X	X	-	-	-	X	-	-
South transition pool	X	-	X	X	X	X	-	-	-	X	-	-
South ladder exit	X	X	X	X	X	X	X	X	X	X	X	X

Table A8. Radiotelemetry monitoring sites at **Lower Granite Dam** in 1997-2002 and 2005-2010. The tailrace was also monitored.

	1997	1998	1999	2000	2001	2002	2005	2006	2007	2008	2009	2010
North shore entrance	-	-	-	X	X	X	-	-	-	X	-	-
North powerhouse entrance	X	X	-	X	X	X	-	-	-	X	-	-
Powerhouse orifice gates	-	-	-	-	-	-	-	-	-	-	-	-
South shore												
South entrance	-	-	-	X	X	X	-	-	-	X	-	-
South transition pool	-	-	X	X	X	X	-	-	-	X	-	-
Count window pool	-	-	-	-	-	-	-	-	-	X	-	-
South ladder exit	X	X	X	X	X	X	X	X	X	X	X	X

Appendix A. Monitoring arrays

Table A9. Radiotelemetry monitoring sites at **Priest Rapids Dam** in 1997-2002 and 2005-2010. The tailrace was also monitored.

	1997	1998	1999	2000	2001	2002	2005	2006	2007	2008	2009	2010
West powerhouse entrance	X	-	-	-	-	-	-	-	-	-	-	-
Powerhouse orifice gates	X	-	-	-	-	-	-	-	-	-	-	-
West shore												
West entrance	-	-	-	-	-	-	-	-	-	-	-	-
West transition pool	-	-	-	-	-	-	-	-	-	-	-	-
West ladder exit	X	X	-	X	X	X	X	X	X	X	X	X
East shore												
East entrance	X	-	-	-	-	-	-	-	-	-	-	-
East transition pool	X	-	-	-	-	-	-	-	-	-	-	-
East ladder exit	X	X	-	X	X	X	X	X	X	X	X	X
Juvenile bypass	-	-	-	-	-	-	-	-	-	-	-	-
Navigation lock	-	-	-	-	-	-	-	-	-	-	-	-

Appendix A. Monitoring arrays

Table A10. Half Duplex (HD) PIT tag monitoring sites at Columbia River Dams in 2005-2012. See Appendix J for maps.

	2005	2006	2007	2008	2009	2010	2011	2012
Bonneville Dam								
WA shore entrance	-	-	X	X	X	X	X	X ¹
WA ladder inside	X	X	X	X	X	X	X	X
WA shore rest box	-	-	-	-	-	-	X	X
WA shore LPS	-	-	X	X	X	X	X	X
WA shore exit	X	X	X	X	X	X	X	X
Cascades Is. entrance	-	-	X	X	X	X	X	X
Cascades Is. flow control	-	X	X	X	X	X	X	X
Cascades Is. LPS	-	-	-	-	-	X	X	X
Bradford Island LPS	X	X	X	X	X	X	X	X
Bradford Island exit	X	X	X	X	X	X	X	X
The Dalles Dam								
East ladder inside	-	-	X	X	X	X	X ¹	X
East ladder exit	-	X	X	X	X	X	X	X
North ladder exit	-	X	X	X	X	X	X	X
John Day Dam								
North ladder entrance	-	-	-	-	-	-	-	X
North ladder exit	-	X	X	X	X	X	X	X
South ladder exit	-	X	X	X	X	X	X	X
McNary Dam								
North ladder entrance	X	X	-	-	-	-	-	-
North ladder inside	-	X	X	X	X	X	X	X
North ladder exit	X	X	X	X	X	X	X	X
South juvenile channel	-	-	X	X	X	X	X	X
South ladder entrance	X	X	-	-	-	-	-	-
South ladder inside	X	X	X	X	X	X	X	X
South ladder exit	X	X	X	X	X	X	X	X
Priest Rapids Dam								
East ladder exit	-	-	-	X	X	X	X	X
West ladder exit	-	-	-	X	X	X	X	X

¹Installed but not operational

Appendix A. Monitoring arrays

Table A11. Half Duplex (HD) PIT tag monitoring sites at **Snake River Dams** in 2005-2012. See Appendix J for maps.

	2005	2006	2007	2008	2009	2010	2011	2012
Ice Harbor Dam								
South ladder entrance	X	X	X	X	X	X	X	X
South ladder inside	X	X	X	X	X	X	X	X
South ladder exit	-	X	X	X	X	X	X	X
North ladder entrance	X	X	-	-	-	-	-	-
North ladder inside	X	X	X	X	X	X	X	X
North ladder exit	-	-	X	X	X	X	X	X
Lower Monumental Dam								
North ladder inside	-	-	-	-	-	-	X	X
North ladder exit	-	-	-	-	-	-	X	X
South ladder inside	-	-	-	-	-	-	X	X
South ladder exit	-	-	-	-	-	-	X	X
Lower Granite Dam								
South ladder inside	-	-	-	-	-	-	X	X
South ladder exit	-	-	-	-	-	-	X	X

Appendix B. Fishway approach, entry, and exit distributions

Table B1. Distributions of **first** fishway approach locations for radio-tagged Pacific lamprey at **Bonneville Dam** in 1997-2002 and 2007-2010. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
First approached (<i>n</i>)	129	182	183	260	277	193	271	443	470	276
PH1 S (<i>n</i>)	3	12	18	30	23	9	33	90	90	62
PH1 SG (<i>n</i>)	48	50	36	48	26	34	-	-	-	-
PH1 N (<i>n</i>)	12	11	18	21	18	1	14	18	14	24
PH1 Unknown (<i>n</i>)	2	4	2	6	4	3	2	24	6	2
SP S (<i>n</i>)	10	11	12	56	27	19	35	42	54	42
SP N (<i>n</i>)	10	15	8	25	15	12	18	20	35	25
PH2 S down (<i>n</i>)	12	12	18	11	32	20	23	2	17	6
PH2 S up (<i>n</i>)	6	16	6	24	54	35	41	74	72	39
PH2 OG (<i>n</i>)	8	24	25	-	-	-	-	-	-	-
PH2 N down (<i>n</i>)	10	10	9	17	25	33	34	53	39	37
PH2 N up (<i>n</i>)	4	15	29	21	48	25	69	99	126	28
PH2 Unknown (<i>n</i>)	4	2	2	1	5	2	2	21	17	11
PH1 S (%)	2	7	10	12	8	5	12	20	19	22
PH1 SG (%)	37	27	20	18	9	18	-	-	-	-
PH1 N (%)	9	6	10	8	6	<1	5	4	3	9
PH1 Unknown (%)	2	2	1	2	1	2	1	5	1	1
SP S (%)	8	6	7	22	10	10	13	9	11	15
SP N (%)	8	8	4	10	5	6	7	5	7	9
PH2 S down (%)	9	7	10	4	12	10	8	<1	4	2
PH2 S up (%)	5	9	3	9	19	18	15	17	15	14
PH2 OG (%)	6	13	14	-	-	-	-	-	-	-
PH2 N down (%)	8	5	5	7	9	17	13	12	8	13
PH2 N up (%)	3	8	16	8	17	13	25	22	27	10
PH2 Unknown (%)	3	1	1	<1	2	1	1	5	4	4

¹ includes approaches at the PH2 ice and trash outfall near PH2 S downstream fishway opening; not coded as approaches in subsequent years

Appendix B. Fishway approach, entry, and exit distributions

Table B2. Distributions of **total** fishway approach locations for radio-tagged Pacific lamprey at **Bonneville Dam** in 1997-2002 and 2007-2010. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
Total approached (<i>n</i>)	2811	3323	3398	1349	3210	2120	2666	2838	2790	2267
PH1 S (<i>n</i>)	21	94	86	137	253	63	105	333	182	421
PH1 SG (<i>n</i>)	320	371	282	263	203	239	-	-	-	-
PH1 N (<i>n</i>)	192	109	131	83	102	85	37	45	35	129
PH1 Unknown (<i>n</i>)	4	9	9	9	25	31	9	53	17	7
SP S (<i>n</i>)	126	79	99	141	130	184	117	164	211	189
SP N (<i>n</i>)	85	65	49	59	99	102	56	95	226	155
PH2 S down (<i>n</i>)	217	240	158	123	611	303	1019	26	213	148
PH2 S up (<i>n</i>)	328	496	364	181	1008	456	425	598	556	468
PH2 OG (<i>n</i>)	1113	1309	1520	-	-	-	-	-	-	-
PH2 N down (<i>n</i>)	200	162	225	144	322	275	380	513	442	393
PH2 N up (<i>n</i>)	130	384	458	200	403	302	488	889	724	253
PH2 Unknown (<i>n</i>)	¹ 75	5	17	9	54	80	30	122	184	104
PH1 S (%)	<1	3	3	10	8	3	4	12	7	19
PH1 SG (%)	11	11	8	19	6	11	-	-	-	-
PH1 N (%)	7	3	4	6	3	4	1	2	1	6
PH1 Unknown (%)	<1	<1	<1	1	1	1	<1	2	1	<1
SP S (%)	4	2	3	10	4	9	4	6	8	8
SP N (%)	3	2	1	4	3	5	2	3	8	7
PH2 S down (%)	8	7	5	9	19	14	38	1	8	7
PH2 S up (%)	12	15	11	13	31	22	16	21	20	21
PH2 OG (%)	40	39	45	-	-	-	-	-	-	-
PH2 N down (%)	7	5	7	11	10	13	14	18	16	17
PH2 N up (%)	5	12	13	15	13	14	18	31	26	7
PH2 Unknown (%)	3	<1	<1	1	4	4	1	4	7	5

¹ includes approaches at the PH2 ice and trash outfall near PH2 S downstream fishway opening; not coded as approaches in subsequent years

Appendix B. Fishway approach, entry, and exit distributions

Table B3. Distributions of **first** fishway entry locations for radio-tagged Pacific lamprey at **Bonneville Dam** in 1997-2002 and 2007-2010. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
First entered (<i>n</i>)	102	154	162	213	240	169	201	317	384	237
PH1 S (<i>n</i>)	3	17	15	29	17	3	20	46	40	39
PH1 SG (<i>n</i>)	2	17	8	10	9	11	-	-	-	-
PH1 N (<i>n</i>)	9	13	24	22	14	9	12	14	13	24
PH1 Unknown (<i>n</i>)	28	18	9	22	17	17	10	43	20	4
SP S (<i>n</i>)	14	11	9	34	17	20	32	38	48	31
SP N (<i>n</i>)	9	5	5	18	19	11	11	20	35	34
PH2 S down (<i>n</i>)	5	11	18	11	42	16	23	5	13	4
PH2 S up (<i>n</i>)	14	30	25	30	35	40	51	57	61	39
PH2 OG (<i>n</i>)	3	6	5	-	-	-	-	-	-	-
PH2 N down (<i>n</i>)	3	4	8	6	11	9	6	15	24	5
PH2 N up (<i>n</i>)	5	16	26	20	17	11	22	10	26	15
PH2 Unknown (<i>n</i>)	7	6	10	11	42	22	14	69	104	42
PH1 S (%)	3	11	9	14	7	2	10	15	10	16
PH1 SG (%)	2	11	5	5	4	7	-	-	-	-
PH1 N (%)	9	8	15	10	6	5	6	4	3	10
PH1 Unknown (%)	27	12	6	10	7	10	5	14	5	2
SP S (%)	14	7	6	16	7	12	16	12	16	13
SP N (%)	9	3	3	8	8	7	5	6	9	14
PH2 S down (%)	5	7	11	5	18	9	11	2	3	2
PH2 S up (%)	14	19	14	14	15	24	25	18	16	16
PH2 OG (%)	3	4	3	-	-	-	-	-	-	-
PH2 N down (%)	3	3	4	3	5	5	3	5	6	2
PH2 N up (%)	5	10	14	9	7	7	11	3	7	6
PH2 Unknown (%)	7	4	6	5	18	13	8	22	27	18

Appendix B. Fishway approach, entry, and exit distributions

Table B4. Distributions of **total** fishway entry locations for radio-tagged Pacific lamprey at **Bonneville Dam** in 1997-2002 and 2007-2010. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
Total entered (<i>n</i>)	329	454	502	369	742	527	379	589	816	598
PH1 S (<i>n</i>)	7	37	28	43	26	11	21	72	46	71
PH1 SG (<i>n</i>)	5	27	14	16	28	20	-	-	-	-
PH1 N (<i>n</i>)	13	21	43	34	35	23	15	20	15	45
PH1 Unknown (<i>n</i>)	42	32	14	28	46	32	11	54	24	9
SP S (<i>n</i>)	52	27	28	53	36	70	48	62	90	72
SP N (<i>n</i>)	20	24	19	30	30	40	20	29	73	79
PH2 S down (<i>n</i>)	26	46	51	26	119	52	60	8	41	10
PH2 S up (<i>n</i>)	55	115	111	57	217	130	114	136	179	130
PH2 OG (<i>n</i>)	30	39	52	-	-	-	-	-	-	-
PH2 N down (<i>n</i>)	37	23	35	15	32	37	13	40	55	26
PH2 N up (<i>n</i>)	27	42	75	40	42	32	42	37	49	47
PH2 Unknown (<i>n</i>)	15	21	32	27	131	80	35	131	244	109
PH1 S (%)	2	8	6	12	4	2	6	12	6	12
PH1 SG (%)	2	6	3	4	4	4	-	-	-	-
PH1 N (%)	4	5	9	9	5	4	4	3	2	8
PH1 Unknown (%)	13	5	3	8	6	6	3	9	3	2
SP S (%)	16	7	6	14	5	13	13	11	11	12
SP N (%)	6	5	4	8	4	8	5	5	9	13
PH2 S down (%)	8	10	10	7	16	10	16	1	5	2
PH2 S up (%)	17	25	22	15	29	25	30	23	22	22
PH2 OG (%)	9	9	10	-	-	-	-	-	-	-
PH2 N down (%)	11	5	7	4	4	7	3	7	7	4
PH2 N up (%)	8	9	15	11	6	6	11	1	6	8
PH2 Unknown (%)	5	5	6	7	18	15	9	11	30	18

Appendix B. Fishway approach, entry, and exit distributions

Table B5. Distributions of **first** fishway exit locations (from fishways to the tailrace) for radio-tagged Pacific lamprey at **Bonneville Dam** in 1997-2002 and 2007-2010. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
First exited (<i>n</i>)	81	121	126	127	173	132	151	226	268	175
PH1 S (<i>n</i>)	3	12	9	11	5	4	3	27	9	18
PH1 SG (<i>n</i>)	3	7	5	5	11	7	-	-	-	-
PH1 N (<i>n</i>)	8	6	8	3	5	3	2	12	2	13
PH1 Unknown (<i>n</i>)	11	9	8	15	7	13	10	16	11	7
SP S (<i>n</i>)	15	21	12	24	9	16	21	29	41	28
SP N (<i>n</i>)	8	3	6	11	13	7	7	14	33	23
PH2 S down (<i>n</i>)	6	26	15	18	30	23	34	3	47	19
PH2 S up (<i>n</i>)	11	14	18	18	57	28	36	46	31	23
PH2 OG (<i>n</i>)	5	5	5	-	-	-	-	-	-	-
PH2 N down (<i>n</i>)	4	6	8	7	15	6	12	17	31	11
PH2 N up (<i>n</i>)	-	4	8	3	6	7	7	5	3	3
PH2 Unknown (<i>n</i>)	7	8	24	12	15	18	19	57	60	30
PH1 S (%)	4	10	7	9	3	3	2	12	3	10
PH1 SG (%)	4	6	4	4	6	5	-	-	-	-
PH1 N (%)	10	5	6	2	3	2	1	5	1	7
PH1 Unknown (%)	14	7	6	12	4	10	7	7	4	4
SP S (%)	19	17	10	19	5	12	14	13	15	16
SP N (%)	10	2	5	9	8	5	5	6	12	13
PH2 S down (%)	7	21	12	14	17	17	23	1	18	11
PH2 S up (%)	14	12	14	14	33	21	24	20	12	13
PH2 OG (%)	6	4	4	-	-	-	-	-	-	-
PH2 N down (%)	5	5	6	6	9	5	8	8	12	6
PH2 N up (%)	-	3	6	2	3	5	5	2	1	2
PH2 Unknown (%)	9	7	19	9	9	14	13	25	22	17

Appendix B. Fishway approach, entry, and exit distributions

Table B6. Distributions of **total** fishway exit locations (from fishways to the tailrace) for radio-tagged Pacific lamprey at **Bonneville Dam** in 1997-2002 and 2007-2010. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
Total exited (<i>n</i>)	279	383	421	228	603	420	298	442	618	472
PH1 S (<i>n</i>)	3	21	14	13	8	16	4	42	10	37
PH1 SG (<i>n</i>)	4	19	11	10	30	10	-	-	-	-
PH1 N (<i>n</i>)	13	8	12	5	18	9	2	15	4	26
PH1 Unknown (<i>n</i>)	18	15	16	20	31	25	10	28	18	12
SP S (<i>n</i>)	55	38	33	36	25	57	33	45	68	62
SP N (<i>n</i>)	18	22	19	18	26	25	15	26	66	62
PH2 S down (<i>n</i>)	42	87	63	37	131	89	81	10	111	60
PH2 S up (<i>n</i>)	47	77	76	34	235	81	81	88	95	71
PH2 OG (<i>n</i>)	23	22	25	-	-	-	-	-	-	-
PH2 N down (<i>n</i>)	22	23	30	20	37	41	27	44	66	39
PH2 N up (<i>n</i>)	1	15	27	9	10	16	10	6	15	12
PH2 Unknown (<i>n</i>)	33	36	95	26	52	51	35	138	165	91
PH1 S (%)	1	5	3	6	1	4	1	10	2	8
PH1 SG (%)	1	5	3	4	5	2	-	-	-	-
PH1 N (%)	5	2	3	2	3	2	1	3	1	6
PH1 Unknown (%)	6	4	4	9	5	6	3	6	3	3
SP S (%)	20	10	8	16	4	14	11	10	11	13
SP N (%)	6	6	5	8	4	6	5	6	11	13
PH2 S down (%)	15	23	15	16	22	21	27	2	18	13
PH2 S up (%)	17	20	18	15	39	19	27	10	15	15
PH2 OG (%)	8	6	6	-	-	-	-	-	-	-
PH2 N down (%)	8	6	7	9	6	10	9	10	11	8
PH2 N up (%)	<1	4	6	4	2	4	3	1	2	3
PH2 Unknown (%)	12	9	23	11	9	12	12	31	27	19

Appendix B. Fishway approach, entry, and exit distributions

Table B7. Distributions of **first and total** fishway approach locations for radio-tagged Pacific lamprey at **The Dalles Dam** in 1997-2002 and 2007-2010. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	¹ 2008	2009	2010
First approached (<i>n</i>)	64	38	-	85	92	56	31	90	103	93
East (<i>n</i>)	20	13	-	19	22	17	9	30	20	31
West Powerhouse (<i>n</i>)	15	12	-	21	22	16	1	19	20	12
Spillway (<i>n</i>)	10	4	-	6	14	4	2	14	4	6
East unknown (<i>n</i>)	1	-	-	1	5	9	3	-	7	4
North (<i>n</i>)	18	9	-	38	29	10	16	27	52	40
East (%)	31	34	-	22	24	30	29	33	19	33
West Powerhouse (%)	23	32	-	25	24	29	3	21	19	13
Spillway (%)	16	11	-	7	15	7	6	16	4	6
East unknown (%)	2	-	-	1	5	16	10	-	7	4
North (%)	28	24	-	45	32	18	52	30	50	43
Total approached (<i>n</i>)	272	102	-	154	369	200	243	330	197	229
East (<i>n</i>)	98	25	-	38	113	76	21	157	40	71
West Powerhouse (<i>n</i>)	66	38	-	46	106	51	3	58	35	28
Spillway (<i>n</i>)	23	15	-	14	51	16	3	55	10	18
East unknown (<i>n</i>)	7	-	-	2	7	20	5	1	15	28
North (<i>n</i>)	78	24	-	54	92	37	211	59	97	84
East (%)	36	25	-	25	31	38	9	48	20	31
West Powerhouse (%)	24	37	-	30	29	26	1	18	18	12
Spillway (%)	8	15	-	9	14	8	1	17	5	8
East unknown (%)	3	-	-	1	2	10	2	<1	8	12
North (%)	29	24	-	35	25	19	87	9	49	37

¹ aerial antennas at fishway openings rather than underwater

Appendix B. Fishway approach, entry, and exit distributions

Table B8. Distributions of **first and total** fishway entry locations for radio-tagged Pacific lamprey at **The Dalles Dam** in 1997-2002 and 2007-2010. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
First entered (<i>n</i>)	48	33	-	82	88	61	29	77	95	84
East (<i>n</i>)	13	13	-	19	16	8	10	35	23	28
West Powerhouse (<i>n</i>)	10	6	-	17	21	10	-	11	8	-
Spillway (<i>n</i>)	7	5	-	6	9	3	2	10	4	-
East unknown (<i>n</i>)	16	2	-	1	13	14	4	-	12	16
North (<i>n</i>)	2	7	-	39	29	26	13	21	48	40
East (%)	27	39	-	23	18	13	34	45	24	33
West Powerhouse (%)	21	18	-	21	24	16	-	14	8	-
Spillway (%)	15	15	-	7	10	5	7	13	4	-
East unknown (%)	33	6	-	1	15	23	14	-	13	19
North (%)	4	21	-	48	33	43	45	27	51	48
Total entered (<i>n</i>)	169	62	-	111	203	130	38	124	139	147
East (<i>n</i>)	73	21	-	27	41	29	14	54	31	49
West Powerhouse (<i>n</i>)	36	17	-	24	44	22	-	18	9	1
Spillway (<i>n</i>)	14	8	-	9	24	5	3	22	6	2
East unknown (<i>n</i>)	33	3	-	3	24	24	5	1	17	30
North (<i>n</i>)	13	13	-	48	70	50	16	29	76	65
East (%)	43	34	-	24	20	22	37	44	22	33
West Powerhouse (%)	21	27	-	22	22	17	-	15	6	1
Spillway (%)	8	13	-	8	12	4	8	18	4	1
East unknown (%)	20	5	-	3	12	18	13	1	12	14
North (%)	8	21	-	43	34	38	42	23	55	44

¹ aerial antennas at fishway openings rather than underwater

Appendix B. Fishway approach, entry, and exit distributions

Table B9. Distributions of **first and total** fishway exit locations for radio-tagged Pacific lamprey at **The Dalles Dam** in 1997-2002 and 2007-2010. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
First exited (<i>n</i>)	41	20	-	27	48	38	12	36	46	36
East (<i>n</i>)	8	3	-	4	9	2	3	8	6	10
West Powerhouse (<i>n</i>)	7	3	-	3	6	6	-	5	1	-
Spillway (<i>n</i>)	8	5	-	5	8	3	1	9	2	1
East unknown (<i>n</i>)	15	1	-	4	7	9	1	3	6	10
North (<i>n</i>)	3	8	-	11	18	18	7	11	31	15
East (%)	20	15	-	15	19	5	25	22	13	28
West Powerhouse (%)	17	15	-	11	13	16	-	14	2	-
Spillway (%)	20	25	-	19	17	8	8	25	4	3
East unknown (%)	37	5	-	15	15	24	8	8	13	28
North (%)	7	40	-	41	38	47	58	31	67	42
Total exited (<i>n</i>)	137	34	-	37	127	82	14	61	68	74
East (<i>n</i>)	64	5	-	6	20	8	3	14	9	15
West Powerhouse (<i>n</i>)	25	7	-	7	16	12	-	8	1	-
Spillway (<i>n</i>)	15	6	-	6	22	8	2	19	2	4
East unknown (<i>n</i>)	23	5	-	5	21	23	2	5	7	9
North (<i>n</i>)	10	11	-	13	48	31	7	15	49	30
East (%)	47	15	-	16	16	10	21	23	13	20
West Powerhouse (%)	18	21	-	19	13	15	-	13	1	-
Spillway (%)	11	18	-	16	17	10	14	31	3	5
East unknown (%)	17	15	-	14	17	28	14	8	10	12
North (%)	7	32	-	35	38	38	50	25	72	41

¹ aerial antennas at fishway openings rather than underwater

Appendix B. Fishway approach, entry, and exit distributions

Table B10. Distributions of **first and total** fishway approach locations for radio-tagged Pacific lamprey at **John Day Dam** in 1997-2002 and 2007-2010. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	¹ 2009	2010
First approached (<i>n</i>)	1	10	-	70	47	34	-	-	42	-
South (<i>n</i>)	1	7	-	42	31	19	-	-	39	-
North Powerhouse (<i>n</i>)	-	1	-	10	6	4	-	-	-	-
South unknown (<i>n</i>)	-	-	-	8	8	6	-	-	3	-
North (<i>n</i>)	-	2	-	10	2	5	-	-	-	-
South (%)	100	70	-	60	66	56	-	-	-	-
North Powerhouse (%)	-	10	-	14	13	12	-	-	-	-
South unknown (%)	-	-	-	11	17	18	-	-	-	-
North (%)	-	20	-	14	4	15	-	-	-	-
Total approached (<i>n</i>)	24	30	-	218	302	193	-	-	122	-
South (<i>n</i>)	8	17	-	107	163	80	-	-	115	-
North Powerhouse (<i>n</i>)	10	8	-	56	78	34	-	-	-	-
South unknown (<i>n</i>)	-	-	-	17	27	26	-	-	7	-
North (<i>n</i>)	6	5	-	38	34	53	-	-	-	-
South (%)	33	57	-	49	54	41	-	-	-	-
North Powerhouse (%)	42	27	-	26	26	18	-	-	-	-
South unknown (%)	-	-	-	8	9	13	-	-	-	-
North (%)	25	17	-	17	11	27	-	-	-	-

¹ only south entrance monitored

Appendix B. Fishway approach, entry, and exit distributions

Table B11. Distributions of **first and total** fishway entry locations for radio-tagged Pacific lamprey at **John Day Dam** in 1997-2002 and 2007-2010. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	¹ 2009	2010
First entered (<i>n</i>)	1	7	-	60	46	34	-	-	39	-
South (<i>n</i>)	-	5	-	20	20	9	-	-	29	-
North Powerhouse (<i>n</i>)	-	-	-	6	5	4	-	-	-	-
South unknown (<i>n</i>)	1	1	-	20	18	12	-	-	10	-
North (<i>n</i>)	-	1	-	14	3	9	-	-	-	-
South (%)	-	71	-	33	43	26	-	-	-	-
North Powerhouse (%)	-	-	-	10	11	12	-	-	-	-
South unknown (%)	100	14	-	33	39	35	-	-	-	-
North (%)	-	14	-	23	7	26	-	-	-	-
Total entered (<i>n</i>)	15	12	-	93	196	97	-	-	85	-
South (<i>n</i>)	5	7	-	28	92	29	-	-	77	-
North Powerhouse (<i>n</i>)	4	-	-	14	23	11	-	-	-	-
South unknown (<i>n</i>)	2	2	-	31	55	26	-	-	18	-
North (<i>n</i>)	4	3	-	20	26	31	-	-	-	-
South (%)	33	58	-	30	47	30	-	-	-	-
North Powerhouse (%)	27	-	-	15	12	11	-	-	-	-
South unknown (%)	14	17	-	33	28	27	-	-	-	-
North (%)	27	25	-	22	13	32	-	-	-	-

¹ only south entrance monitored

Appendix B. Fishway approach, entry, and exit distributions

Table B12. Distributions of **first and total** fishway exit locations for radio-tagged Pacific lamprey at **John Day Dam** in 1997-2002 and 2007-2010. Fish were tagged at **Bonneville Dam**.

	1997	1998	1999	2000	2001	2002	2007	2008	¹ 2009	2010
First exited (<i>n</i>)	1	5	-	41	38	28	-	-	31	-
South (<i>n</i>)	1	2	-	18	27	5	-	-	8	-
North Powerhouse (<i>n</i>)	-	-	-	3	4	2	-	-	-	-
South unknown (<i>n</i>)	-	2	-	13	5	14	-	-	23	-
North (<i>n</i>)	-	1	-	7	2	7	-	-	-	-
South (%)	100	40	-	44	71	18	-	-	-	-
North Powerhouse (%)	-	-	-	7	11	7	-	-	-	-
South unknown (%)	-	40	-	32	13	50	-	-	-	-
North (%)	-	20	-	17	5	25	-	-	-	-
Total exited (<i>n</i>)	24	9	-	59	163	71	-	-	61	-
South (<i>n</i>)	8	2	-	25	68	11	-	-	13	-
North Powerhouse (<i>n</i>)	10	1	-	6	26	7	-	-	-	-
South unknown (<i>n</i>)	-	3	-	19	45	34	-	-	48	-
North (<i>n</i>)	6	3	-	9	24	19	-	-	-	-
South (%)	33	22	-	42	42	15	-	-	-	-
North Powerhouse (%)	42	11	-	10	16	10	-	-	-	-
South unknown (%)	-	33	-	32	28	48	-	-	-	-
North (%)	25	33	-	15	15	27	-	-	-	-

¹ only south entrance monitored

Appendix B. Fishway approach, entry, and exit distributions

Table B13. Distributions of **first and total** fishway approach locations for radio-tagged Pacific lamprey at **McNary Dam** in 1997-2002 and 2007-2010. Fish were tagged at **Bonneville Dam**.

	1997	1998	1999	2000	2001	2002	2007	¹ 2008	2009	2010
First approached (<i>n</i>)	-	-	-	13	9	2	-	8	10	11
South (<i>n</i>)	-	-	-	7	2	1	-	4	4	4
North Powerhouse (<i>n</i>)	-	-	-	4	7	-	-	-	4	3
South unknown (<i>n</i>)	-	-	-	2	-	-	-	3	2	4
North (<i>n</i>)	-	-	-	-	-	1	-	1	-	-
South (%)	-	-	-	54	22	50	-	50	40	36
North Powerhouse (%)	-	-	-	31	78	-	-	-	40	27
South unknown (%)	-	-	-	15	-	-	-	38	20	36
North (%)	-	-	-	-	-	50	-	13	-	-
Total approached (<i>n</i>)	-	-	-	29	30	3	-	15	16	18
South (<i>n</i>)	-	-	-	11	8	1	-	7	8	4
North Powerhouse (<i>n</i>)	-	-	-	11	20	1	-	1	4	7
South unknown (<i>n</i>)	-	-	-	4	-	-	-	4	3	6
North (<i>n</i>)	-	-	-	3	2	1	-	3	1	1
South (%)	-	-	-	38	27	33	-	47	50	22
North Powerhouse (%)	-	-	-	38	67	33	-	7	25	39
South unknown (%)	-	-	-	14	-	-	-	27	19	33
North (%)	-	-	-	10	7	33	-	20	13	6

¹ aerial antennas used near fishway openings

Appendix B. Fishway approach, entry, and exit distributions

Table B14. Distributions of **first and total** fishway entry locations for radio-tagged Pacific lamprey at **McNary Dam** in 1997-2002 and 2007-2010. Fish were tagged at **Bonneville Dam**.

	1997	1998	1999	2000	2001	2002	2007	¹ 2008	2009	2010
First entered (<i>n</i>)	-	-	-	12	9	2	-	7	10	7
South (<i>n</i>)	-	-	-	3	2	1	-	3	6	2
North Powerhouse (<i>n</i>)	-	-	-	3	6	-	-	-	1	-
South unknown (<i>n</i>)	-	-	-	4	-	-	-	4	3	5
North (<i>n</i>)	-	-	-	2	1	1	-	-	-	-
South (%)	-	-	-	25	22	50	-	43	60	29
North Powerhouse (%)	-	-	-	25	67	-	-	-	10	-
South unknown (%)	-	-	-	33	-	-	-	57	30	71
North (%)	-	-	-	17	11	50	-	-	-	-
Total entered (<i>n</i>)	-	-	-	17	18	2	-	7	10	8
South (<i>n</i>)	-	-	-	3	6	1	-	3	6	2
North Powerhouse (<i>n</i>)	-	-	-	5	11	-	-	-	1	-
South unknown (<i>n</i>)	-	-	-	7	-	-	-	4	3	5
North (<i>n</i>)	-	-	-	2	1	1	-	-	-	1
South (%)	-	-	-	18	33	50	-	43	60	25
North Powerhouse (%)	-	-	-	29	61	-	-	-	10	-
South unknown (%)	-	-	-	41	-	-	-	57	30	63
North (%)	-	-	-	12	6	50	-	-	-	13

¹ aerial antennas used near fishway openings

Appendix B. Fishway approach, entry, and exit distributions

Table B15. Distributions of **first and total** fishway exit locations for radio-tagged Pacific lamprey at **McNary Dam** in 1997-2002 and 2007-2010. Fish were tagged at **Bonneville Dam**.

	1997	1998	1999	2000	2001	2002	2007	¹ 2008	2009	2010
First exited (<i>n</i>)	-	-	-	3	5	-	-	-	2	3
South (<i>n</i>)	-	-	-	-	-	-	-	-	-	1
North Powerhouse (<i>n</i>)	-	-	-	3	2	-	-	-	1	-
South unknown (<i>n</i>)	-	-	-	-	2	-	-	-	1	2
North (<i>n</i>)	-	-	-	-	1	-	-	-	-	-
South (%)	-	-	-	-	-	-	-	-	-	33
North Powerhouse (%)	-	-	-	100	40	-	-	-	50	-
South unknown (%)	-	-	-	-	40	-	-	-	50	67
North (%)	-	-	-	-	20	-	-	-	-	-
Total exited (<i>n</i>)	-	-	-	6	11	-	-	-	2	3
South (<i>n</i>)	-	-	-	-	1	-	-	-	-	1
North Powerhouse (<i>n</i>)	-	-	-	5	7	-	-	-	1	-
South unknown (<i>n</i>)	-	-	-	1	2	-	-	-	1	2
North (<i>n</i>)	-	-	-	-	1	-	-	-	-	-
South (%)	-	-	-	-	9	-	-	-	-	33
North Powerhouse (%)	-	-	-	83	64	-	-	-	50	-
South unknown (%)	-	-	-	17	18	-	-	-	50	67
North (%)	-	-	-	-	9	-	-	-	-	-

¹ aerial antennas used near fishway openings

Appendix B. Fishway approach, entry, and exit distributions

Table B16. Distributions of **first and total** fishway approach locations for radio-tagged Pacific lamprey at **McNary Dam** in 1997-2002 and 2007-2010. Fish were tagged at [McNary Dam](#).

	2005	2006	2007	2008	2009	2010
First approached (<i>n</i>)	22	15	14	26	68	13
South (<i>n</i>)	9	8	8	16	18	9
North Powerhouse (<i>n</i>)	3	2	1	4	24	-
South unknown (<i>n</i>)	1	3	2	1	11	3
North (<i>n</i>)	9	2	3	5	15	1
South (%)	41	53	57	62	26	69
North Powerhouse (%)	14	13	7	15	35	-
South unknown (%)	5	20	14	4	16	23
North (%)	41	13	21	19	22	8
Total approached (<i>n</i>)	47	25	33	59	139	29
South (<i>n</i>)	26	11	11	32	36	17
North Powerhouse (<i>n</i>)	7	5	8	14	44	4
South unknown (<i>n</i>)	1	5	2	10	26	7
North (<i>n</i>)	13	4	12	3	33	1
South (%)	55	44	33	54	26	59
North Powerhouse (%)	15	20	24	24	32	14
South unknown (%)	2	20	6	17	19	24
North (%)	28	16	36	5	24	3

[†] aerial antennas used near fishway openings

Appendix B. Fishway approach, entry, and exit distributions

Table B17. Distributions of **first and total** fishway entry locations for radio-tagged Pacific lamprey at **McNary Dam** in 1997-2002 and 2007-2010. Fish were tagged at **McNary Dam**.

	2005	2006	2007	2008	2009	2010
First entered (<i>n</i>)	18	15	10	19	53	13
South (<i>n</i>)	11	8	6	12	19	8
North Powerhouse (<i>n</i>)	1	1	1	-	1	-
South unknown (<i>n</i>)	1	4	2	2	20	4
North (<i>n</i>)	5	1	1	5	13	1
South (%)	61	53	60	63	36	62
North Powerhouse (%)	6	7	10	-	2	-
South unknown (%)	6	27	20	11	38	31
North (%)	28	7	10	26	25	8
Total entered (<i>n</i>)	22	19	14	22	66	22
South (<i>n</i>)	15	11	8	12	22	13
North Powerhouse (<i>n</i>)	1	1	1	1	3	-
South unknown (<i>n</i>)	1	5	2	3	26	8
North (<i>n</i>)	5	2	3	6	15	1
South (%)	68	58	57	55	33	59
North Powerhouse (%)	5	5	7	5	5	-
South unknown (%)	5	26	14	14	39	36
North (%)	23	11	21	27	23	5

[†] aerial antennas used near fishway openings

Appendix B. Fishway approach, entry, and exit distributions

Table B18. Distributions of **first and total** fishway exit locations for radio-tagged Pacific lamprey at **McNary Dam** in 1997-2002 and 2007-2010. Fish were tagged at **McNary Dam**.

	2005	2006	2007	2008	2009	2010
First exited (<i>n</i>)	4	4	5	7	13	7
South (<i>n</i>)	3	2	2	4	5	5
North Powerhouse (<i>n</i>)	-	1	1	1	-	1
South unknown (<i>n</i>)	-	-	1	-	3	1
North (<i>n</i>)	1	1	1	2	5	-
South (%)	75	50	40	57	38	71
North Powerhouse (%)	-	25	20	14	-	14
South unknown (%)	-	-	20	-	23	14
North (%)	25	25	20	29	38	-
Total exited (<i>n</i>)	4	6	7	8	16	13
South (<i>n</i>)	3	3	3	4	5	8
North Powerhouse (<i>n</i>)	-	1	1	2	1	1
South unknown (<i>n</i>)	-	1	1	-	4	4
North (<i>n</i>)	1	1	2	2	6	-
South (%)	75	50	43	50	31	62
North Powerhouse (%)	-	17	14	25	6	8
South unknown (%)	-	17	14	-	25	31
North (%)	25	17	29	25	38	-

[†] aerial antennas used near fishway openings

Appendix B. Fishway approach, entry, and exit distributions

Table B19. Distributions of **first and total** fishway approach locations for radio-tagged Pacific lamprey at **Ice Harbor Dam** in 2005-2010. Fish were tagged at **McNary Dam** and released below McNary Dam or below Ice Harbor Dam.

	2005	2006	2007	2008 ¹	2009	2010	2005-IH	2006-IH
First approached (<i>n</i>)	-	1	-	4	3	3	9	12
South (<i>n</i>)	-	1	-	3	2	-	6	8
North Powerhouse (<i>n</i>)	-	-	-	-	-	-	-	-
South unknown (<i>n</i>)	-	-	-	-	-	2	1	2
North (<i>n</i>)	-	-	-	1	1	1	2	2
South (%)	-	100	-	75	67	-	67	67
North Powerhouse (%)	-	-	-	-	-	-	-	-
South unknown (%)	-	-	-	-	-	67	11	17
North (%)	-	-	-	25	33	33	22	17
Total approached (<i>n</i>)	-	10	-	26	11	3	40	77
South (<i>n</i>)	-	7	-	12	7	-	24	59
North Powerhouse (<i>n</i>)	-	-	-	8	-	-	3	-
South unknown (<i>n</i>)	-	2	-	-	-	2	5	2
North (<i>n</i>)	-	1	-	6	5	1	8	16
South (%)	-	70	-	46	64	-	60	77
North Powerhouse (%)	-	-	-	31	-	-	8	-
South unknown (%)	-	20	-	-	-	67	13	3
North (%)	-	10	-	23	45	33	20	21

¹ aerial antennas used near fishway openings

Appendix B. Fishway approach, entry, and exit distributions

Table B20. Distributions of **first and total** fishway entry locations for radio-tagged Pacific lamprey at **Ice Harbor Dam** in 2005-2010. Fish were tagged at **McNary Dam** and released below McNary Dam or below Ice Harbor Dam.

	2005	2006	2007	2008 ¹	2009	2010	2005-IH	2006-IH
First entered (<i>n</i>)	-	1	-	3	3	3	8	11
South (<i>n</i>)	-	-	-	2	2	-	5	6
North Powerhouse (<i>n</i>)	-	-	-	-	-	-	-	-
South unknown (<i>n</i>)	-	-	-	-	1	2	2	3
North (<i>n</i>)	-	1	-	1	-	1	1	2
South (%)	-	-	-	67	67	-	63	55
North Powerhouse (%)	-	-	-	-	-	-	-	-
South unknown (%)	-	-	-	-	33	67	25	27
North (%)	-	100	-	33	-	33	13	18
Total entered (<i>n</i>)	-	3	-	7	3	3	15	21
South (<i>n</i>)	-	-	-	5	2	-	9	12
North Powerhouse (<i>n</i>)	-	1	-	-	-	-	-	-
South unknown (<i>n</i>)	-	1	-	1	1	2	5	3
North (<i>n</i>)	-	1	-	1	-	1	1	6
South (%)	-	-	-	71	67	-	60	57
North Powerhouse (%)	-	33	-	-	-	-	-	-
South unknown (%)	-	33	-	14	33	67	33	14
North (%)	-	33	-	14	-	33	7	28

¹ aerial antennas used near fishway openings

Appendix B. Fishway approach, entry, and exit distributions

Table B21. Distributions of **first and total** fishway exit locations for radio-tagged Pacific lamprey at **Ice Harbor Dam** in 2005-2010. Fish were tagged at **McNary Dam** and released below McNary Dam or below Ice Harbor Dam.

	2005	2006	2007	2008	2009	2010	2005-IH	2006-IH
First exited (<i>n</i>)	-	1	-	3	1	-	4	6
South (<i>n</i>)	-	-	-	2	-	-	1	2
North Powerhouse (<i>n</i>)	-	-	-	-	-	-	-	-
South unknown (<i>n</i>)	-	1	-	-	1	-	3	4
North (<i>n</i>)	-	-	-	1	-	-	-	-
South (%)	-	-	-	67	-	-	25	33
North Powerhouse (%)	-	-	-	-	-	-	-	-
South unknown (%)	-	100	-	-	100	-	75	67
North (%)	-	-	-	33	-	-	-	-
Total exited (<i>n</i>)	-	1	-	4	1	-	8	9
South (<i>n</i>)	-	-	-	3	-	-	1	3
North Powerhouse (<i>n</i>)	-	-	-	-	-	-	-	-
South unknown (<i>n</i>)	-	1	-	-	1	-	7	6
North (<i>n</i>)	-	-	-	1	-	-	-	-
South (%)	-	-	-	75	-	-	13	33
North Powerhouse (%)	-	-	-	-	-	-	-	-
South unknown (%)	-	100	-	-	100	-	87	67
North (%)	-	-	-	25	-	-	-	-

Appendix C. Dam-wide passage efficiency metrics

Table C1. Dam-wide passage efficiency metrics for unique radio-tagged Pacific lamprey at **Bonneville Dam** in 1997-2002 and 2007-2010. Approached = approached fishway opening; Entered = entered fishway; Passed = passed dam. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
Released (<i>n</i>)	147	205	199	299	298	201	398	595	596	312
Approached (<i>n</i>)	129	182	183	260	277	193	271	443	470	276
Entered (<i>n</i>)	102	154	162	213	240	169	201	317	384	237
Passed (<i>n</i>)	49	73	82	123	129	92	83	¹ 156	² 198	³ 128
Approached:Released	0.88	0.89	0.92	0.87	0.93	0.96	0.68	0.74	0.79	0.88
Entered:Released	0.69	0.75	0.81	0.71	0.81	0.84	0.51	0.53	0.64	0.76
Passed:Released	0.33	0.36	0.41	0.41	0.43	0.46	0.21	0.26	0.33	0.41
Entered:Approached	0.79	0.85	0.89	0.82	0.87	0.88	0.74	0.72	0.82	0.86
Passed:Approached	0.38	0.40	0.45	0.47	0.47	0.48	0.31	0.35	0.42	0.46
Passed:Entered	0.48	0.47	0.51	0.58	0.54	0.54	0.41	0.49	0.52	0.54

¹ *n* = 146; ² *n* = 177; ³ *n* = 126 when trap recaptures were treated as NOT PASSING the dam

Table C2. Dam-wide passage efficiency metrics for unique radio-tagged Pacific lamprey at **The Dalles Dam** in 1997-2002 and 2007-2010. At Dam = recorded in tailrace or at a fishway; Approached = approached fishway opening; Entered = entered fishway; Passed = passed dam. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
At Dam (<i>n</i>)	66	43	49	91	94	73	38	95	112	104
Approached (<i>n</i>)	64	38	-	84	92	70	31	90	103	93
Entered (<i>n</i>)	48	33	-	82	77	61	29	77	95	84
Passed (<i>n</i>)	35	24	24	67	68	46	21	63	68	70
Approached:At Dam	0.97	0.88	-	0.93	0.98	0.96	0.82	0.95	0.92	0.89
Entered:At Dam	0.73	0.77	-	0.90	0.82	0.84	0.76	0.81	0.85	0.81
Passed:At Dam	0.53	0.56	0.49	0.74	0.72	0.63	0.55	0.66	0.61	0.67
Entered:Approached	0.75	0.87	-	0.96	0.84	0.87	0.94	0.86	0.92	0.90
Passed:Approached	0.55	0.63	-	0.79	0.74	0.66	0.68	0.70	0.66	0.75
Passed:Entered	0.73	0.73	-	0.82	0.88	0.75	0.72	0.82	0.72	0.83

Appendix C. Dam-wide passage efficiency metrics

Table C3. Dam-wide passage efficiency metrics for unique radio-tagged Pacific lamprey at **John Day Dam** in 1997-2002 and 2007-2010. At Dam = recorded in tailrace or at a fishway; Approached = approached fishway opening; Entered = entered fishway; Passed = passed dam. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
At Dam (<i>n</i>)	1	10	13	74	51	34	11	42	44	39
Approached (<i>n</i>)	1	10	-	70	47	34	-	-	42	-
Entered (<i>n</i>)	1	7	-	60	46	34	-	-	39	-
Passed (<i>n</i>)	0	3	3	28	25	17	9	27	22	34
Approached:At Dam	1.00	1.00	-	0.95	0.92	0.92	-	-	0.95	-
Entered:At Dam	1.00	0.70	-	0.81	0.90	0.90	-	-	0.89	-
Passed:At Dam	0.00	0.30	0.23	0.38	0.49	0.49	0.82	0.64	0.50	0.87
Entered:Approached	1.00	0.70	-	0.86	0.98	0.98	-	-	0.93	-
Passed:Approached	0.00	0.30	-	0.40	0.53	0.53	-	-	0.52	-
Passed:Entered	0.00	0.43	-	0.47	0.54	0.54	-	-	0.56	-

Radiotelemetry: McNary

Table C4. Dam-wide passage efficiency metrics for unique radio-tagged Pacific lamprey at **McNary Dam** in 1997-2002 and 2007-2010. At Dam = recorded in tailrace or at a fishway; Approached = approached fishway opening; Entered = entered fishway; Passed = passed dam. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
At Dam (<i>n</i>)	-	-	-	13	9	5	-	8	10	11
Approached (<i>n</i>)	-	-	-	13	9	2	-	8	10	11
Entered (<i>n</i>)	-	-	-	12	9	2	-	7	10	7
Passed (<i>n</i>)	-	-	-	11	6	2	-	7	8	6
Approached:At Dam	-	-	-	1.00	1.00	0.40	-	1.00	1.00	1.00
Entered:At Dam	-	-	-	0.92	1.00	0.40	-	0.88	1.00	0.64
Passed:At Dam	-	-	-	0.85	0.67	0.40	-	0.88	0.80	0.55
Entered:Approached	-	-	-	0.92	1.00	1.00	-	0.88	1.00	0.64
Passed:Approached	-	-	-	0.82	0.67	1.00	-	0.88	0.80	0.55
Passed:Entered	-	-	-	0.92	0.67	1.00	-	1.00	0.80	0.86

Appendix C. Dam-wide passage efficiency metrics

Table C5. Dam-wide passage efficiency metrics for unique radio-tagged Pacific lamprey at **McNary Dam** in 2005-2010. Approached = approached fishway opening; Entered = entered fishway; Passed = passed dam. Fish were tagged at McNary Dam.

	2005	2006	2007	2008	2009	2010
Released (<i>n</i>)	40	40	60	34	84	18
Approached (<i>n</i>)	22	15	14	26	68	13
Entered (<i>n</i>)	18	15	10	19	53	13
Passed (<i>n</i>)	13	12	7	14	47	9
Approached:Released	0.55	0.38	0.23	0.76	0.81	0.72
Entered:Released	0.45	0.38	0.17	0.56	0.63	0.72
Passed:Released	0.33	0.30	0.12	0.41	0.56	0.50
Entered:Approached	0.82	1.00	0.71	0.73	0.78	1.00
Passed:Approached	0.59	0.80	0.50	0.54	0.69	0.69
Passed:Entered	0.72	0.80	0.70	0.74	0.89	0.69

Table C6. Dam-wide passage efficiency metrics for unique radio-tagged Pacific lamprey at **Ice Harbor Dam** in 2005-2010. At Dam = recorded in tailrace or at a fishway; Approached = approached fishway opening; Entered = entered fishway; Passed = passed dam. Fish were tagged at McNary Dam and released below McNary Dam or Ice Harbor (IH) Dam.

	Released below McNary Dam						Released: Ice Harbor	
	2005	2006	2007	2008	2009	2010	2005-IH	2006-IH
¹ Released or At Dam (<i>n</i>)	-	2	-	4	3	3	20	20
Approached (<i>n</i>)	-	2	-	4	3	3	9	12
Entered (<i>n</i>)	-	1	-	3	3	3	8	11
Passed (<i>n</i>)	-	1	-	2	2	3	3	9
Approached:At Dam	-	1.00	-	1.00	1.00	1.00	0.45	0.60
Entered:At Dam	-	0.50	-	0.75	1.00	1.00	0.40	0.55
Passed:At Dam	-	0.50	-	0.50	0.67	1.00	0.15	0.45
Entered:Approached	-	0.50	-	0.75	1.00	1.00	0.89	0.92
Passed:Approached	-	0.50	-	0.50	0.67	1.00	0.33	0.75
Passed:Entered	-	1.00	-	0.67	0.67	1.00	0.38	0.82

¹ 'Released' is for Ice Harbor releases and 'At dam' is for McNary releases

Appendix D. Site-specific fishway entrance efficiency

Table D1. Fishway entrance efficiency metrics for radio-tagged Pacific lamprey at **Bonneville Dam Powerhouse 1 fishway openings** in 1997-2002 and 2007-2010. Total approaches = total number of fishway approach events; Total entries = total number of fishway entry events; Unique approaches = number of unique fish that approached opening; Unique entries = number of unique fish that entered opening. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
PH1 S										
Total approaches (<i>n</i>)	21	94	86	137	254	63	105	333	183	422
Total entries (<i>n</i>)	10	45	28	50	30	12	22	73	53	71
Total efficiency	0.48	0.48	0.33	0.36	0.12	0.19	0.21	0.22	0.29	0.17
Unique approaches (<i>n</i>)	16	50	53	82	55	32	44	125	100	96
Unique entries (<i>n</i>)	8	31	23	43	27	8	22	57	49	49
Unique efficiency	0.50	0.62	0.43	0.52	0.49	0.25	0.50	0.46	0.49	0.51
PH1 SG										
Total approaches (<i>n</i>)	320	371	282	263	203	239	-	-	-	-
Total entries (<i>n</i>)	22	40	15	25	38	20	-	-	-	-
Total efficiency	0.07	0.11	0.05	0.10	0.19	0.08	-	-	-	-
Unique approaches (<i>n</i>)	74	86	78	100	63	58	-	-	-	-
Unique entries (<i>n</i>)	18	36	14	23	27	19	-	-	-	-
Unique efficiency	0.24	0.42	0.18	0.23	0.43	0.33	-	-	-	-
PH1 N										
Total approaches (<i>n</i>)	193	109	131	84	102	85	37	45	35	130
Total entries (<i>n</i>)	28	26	47	39	41	23	16	20	15	46
Total efficiency	0.15	0.24	0.36	0.46	0.40	0.27	0.43	0.44	0.43	0.35
Unique approaches (<i>n</i>)	52	50	59	63	56	41	24	35	31	67
Unique entries (<i>n</i>)	25	22	37	38	28	22	15	20	14	34
Unique efficiency	0.48	0.44	0.63	0.60	0.50	0.54	0.63	0.57	0.45	0.51
PH1 unknown										
Total approaches (<i>n</i>)	7	10	9	10	26	31	9	54	17	7
Total entries (<i>n</i>)	6	7	9	8	26	31	9	54	17	7
Total efficiency	0.86	0.70	1.00	0.80	1.00	1.00	1.00	1.00	1.00	1.00
Unique approaches (<i>n</i>)	7	9	8	10	9	26	9	48	17	7
Unique entries (<i>n</i>)	6	6	8	8	9	26	9	48	17	7
Unique efficiency	0.86	0.67	1.00	0.80	1.00	1.00	1.00	1.00	1.00	1.00

Appendix D. Site-specific fishway entrance efficiency

Table D2. Fishway entrance efficiency metrics for radio-tagged Pacific lamprey at **Bonneville Dam spillway** and **Washington-shore fishway openings** in 1997-2002 and 2007-2010. Total approaches = total number of fishway approach events; Total entries = total number of fishway entry events; Unique approaches = number of unique fish that approached opening; Unique entries = number of unique fish that entered opening. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
SP S										
Total approaches (<i>n</i>)	133	79	99	143	130	183	119	166	211	188
Total entries (<i>n</i>)	53	27	28	57	39	65	48	63	90	71
Total efficiency	0.40	0.34	0.28	0.40	0.30	0.36	0.40	0.38	0.43	0.38
Unique approaches (<i>n</i>)	49	55	57	88	68	84	80	108	125	107
Unique entries (<i>n</i>)	23	21	26	49	30	44	39	51	68	57
Unique efficiency	0.47	0.38	0.46	0.56	0.44	0.52	0.49	0.47	0.54	0.53
SP N										
Total approaches (<i>n</i>)	85	65	49	62	100	103	56	96	226	156
Total entries (<i>n</i>)	20	24	19	30	30	41	20	28	73	78
Total efficiency	0.24	0.37	0.39	0.48	0.30	0.40	0.36	0.29	0.32	0.50
Unique approaches (<i>n</i>)	38	42	34	45	52	53	37	65	85	90
Unique entries (<i>n</i>)	14	17	18	27	27	32	18	28	51	54
Unique efficiency	0.37	0.40	0.53	0.60	0.52	0.60	0.49	0.43	0.60	0.60
PH2 S down										
Total approaches (<i>n</i>)	220	240	158	123	611	303	1019	26	213	148
Total entries (<i>n</i>)	29	52	53	29	139	52	60	8	45	11
Total efficiency	0.13	0.22	0.34	0.24	0.23	0.17	0.06	0.31	0.21	0.07
Unique approaches (<i>n</i>)	58	72	72	58	136	103	117	8	112	53
Unique entries (<i>n</i>)	17	32	40	24	77	41	40	16	39	10
Unique efficiency	0.29	0.44	0.56	0.41	0.57	0.40	0.34	0.50	0.35	0.19
PH2 S up										
Total approaches (<i>n</i>)	344	496	364	181	1009	302	425	598	556	468
Total entries (<i>n</i>)	58	117	115	62	232	129	114	136	45	131
Total efficiency	0.17	0.24	0.32	0.34	0.23	0.43	0.27	0.23	0.08	0.28
Unique approaches (<i>n</i>)	59	82	90	76	149	109	133	200	213	113
Unique entries (<i>n</i>)	27	53	49	43	82	68	65	81	39	63
Unique efficiency	0.46	0.65	0.54	0.57	0.55	0.62	0.58	0.41	0.18	0.56

Appendix D. Site-specific fishway entrance efficiency

Table D3. Fishway entrance efficiency metrics for radio-tagged Pacific lamprey at **Bonneville Dam Washington-shore fishway openings** in 1997-2002 and 2007-2010. Total approaches = total number of fishway approach events; Total entries = total number of fishway entry events; Unique approaches = number of unique fish that approached opening; Unique entries = number of unique fish that entered opening. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
PH2 OG										
Total approaches (<i>n</i>)	1116	1309	1520	-	-	-	-	-	-	-
Total entries (<i>n</i>)	50	44	58	-	-	-	-	-	-	-
Total efficiency	0.04	0.03	0.04	-	-	-	-	-	-	-
Unique approaches (<i>n</i>)	67	88	106	-	-	-	-	-	-	-
Unique entries (<i>n</i>)	24	27	38	-	-	-	-	-	-	-
Unique efficiency	0.36	0.31	0.36	-	-	-	-	-	-	-
PH2 N down										
Total approaches (<i>n</i>)	203	162	226	144	322	275	380	514	442	393
Total entries (<i>n</i>)	30	25	37	18	38	37	16	39	61	27
Total efficiency	0.15	0.15	0.16	0.13	0.12	0.13	0.04	0.08	0.14	0.07
Unique approaches (<i>n</i>)	61	65	84	73	108	99	136	203	198	103
Unique entries (<i>n</i>)	16	22	33	16	29	29	15	34	54	23
Unique efficiency	0.26	0.34	0.39	0.22	0.27	0.29	0.11	0.17	0.27	0.22
PH2 N up										
Total approaches (<i>n</i>)	131	384	457	200	404	302	488	889	724	254
Total entries (<i>n</i>)	17	43	74	43	75	32	42	40	94	51
Total efficiency	0.13	0.11	0.16	0.22	0.19	0.11	0.09	0.04	0.13	0.20
Unique approaches (<i>n</i>)	48	82	107	83	152	109	155	242	251	98
Unique entries (<i>n</i>)	15	31	54	37	66	26	38	33	84	39
Unique efficiency	0.31	0.38	0.50	0.45	0.43	0.24	0.25	0.14	0.33	0.40
PH2 unknown										
Total approaches (<i>n</i>)	5	3	17	10	54	80	32	127	185	104
Total entries (<i>n</i>)	5	2	17	7	54	80	32	127	185	104
Total efficiency	1.00	0.67	1.00	0.70	1.00	1.00	1.00	1.00	1.00	1.00
Unique approaches (<i>n</i>)	5	2	16	7	43	55	28	95	120	74
Unique entries (<i>n</i>)	5	1	16	6	43	55	28	95	120	74
Unique efficiency	1.00	0.50	1.00	0.86	1.00	1.00	1.00	1.00	1.00	1.00

Appendix D. Site-specific fishway entrance efficiency

Table D4. Fishway entrance efficiency metrics for radio-tagged Pacific lamprey at **The Dalles Dam fishway openings** in 1997-2002 and 2007-2010. Total approaches = total number of fishway approach events; Total entries = total number of fishway entry events; Unique approaches = number of unique fish that approached opening; Unique entries = number of unique fish that entered opening. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
East										
Total approaches (<i>n</i>)	78	25	-	40	113	86	22	157	42	71
Total entries (<i>n</i>)	23	13	-	29	51	38	15	52	34	51
Total efficiency	0.29	0.52	-	0.73	0.45	0.44	0.68	0.33	0.81	0.72
Unique approaches (<i>n</i>)	25	17	-	36	46	34	17	58	31	41
Unique entries (<i>n</i>)	12	11	-	29	35	24	15	44	28	35
Unique efficiency	0.48	0.65	-	0.81	0.76	0.71	0.88	0.76	0.90	0.85
West powerhouse										
Total approaches (<i>n</i>)	66	38	-	46	106	52	3	58	35	28
Total entries (<i>n</i>)	43	18	-	24	45	22	0	18	9	2
Total efficiency	0.65	0.47	-	0.52	0.42	0.42	0.00	0.31	0.26	0.07
Unique approaches (<i>n</i>)	27	19	-	31	36	27	2	33	28	25
Unique entries (<i>n</i>)	19	9	-	21	26	17	0	14	8	2
Unique efficiency	0.70	0.47	-	0.68	0.72	0.63	0.00	0.42	0.29	0.08
Spillway										
Total approaches (<i>n</i>)	23	15	-	14	51	19	3	55	10	18
Total entries (<i>n</i>)	20	7	-	9	27	5	3	22	7	2
Total efficiency	0.87	0.47	-	0.64	0.53	0.26	1.00	0.40	0.70	0.11
Unique approaches (<i>n</i>)	13	12	-	14	32	9	2	28	10	13
Unique entries (<i>n</i>)	12	6	-	9	21	5	2	16	7	2
Unique efficiency	0.92	0.50	-	0.64	0.66	0.56	1.00	0.57	0.70	0.15
North										
Total approaches (<i>n</i>)	99	24	-	56	93	53	211	59	97	84
Total entries (<i>n</i>)	76	22	-	49	71	47	16	29	76	64
Total efficiency	0.77	0.92	-	0.88	0.76	0.89	0.08	0.49	0.78	0.76
Unique approaches (<i>n</i>)	27	16	-	47	44	30	16	32	56	47
Unique entries (<i>n</i>)	18	15	-	45	34	30	13	23	50	43
Unique efficiency	0.67	0.94	-	0.96	0.77	1.00	0.81	0.72	0.89	0.91

Appendix D. Site-specific fishway entrance efficiency

Unknown east										
Total approaches (<i>n</i>)	6	2	1	9	18	4	1	13	28	
Total entries (<i>n</i>)	6	2	1	9	18	4	1	13	28	
<i>Total efficiency</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	
Unique approaches (<i>n</i>)	6	2	1	9	17	3	1	13	24	
Unique entries (<i>n</i>)	6	2	1	9	17	3	1	13	24	
<i>Unique efficiency</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	<i>1.00</i>	

Appendix D. Site-specific fishway entrance efficiency

Table D5. Fishway entrance efficiency metrics for radio-tagged Pacific lamprey at **John Day Dam fishway openings** in 1997-2002 and 2007-2010. Total approaches = total number of fishway approach events; Total entries = total number of fishway entry events; Unique approaches = number of unique fish that approached opening; Unique entries = number of unique fish that entered opening. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
South										
Total approaches (<i>n</i>)	7	17	-	107	163	80	-	-	-	-
Total entries (<i>n</i>)	5	10	-	27	92	29	-	-	-	-
Total efficiency	0.71	0.59	-	0.25	0.56	0.36	-	-	-	-
Unique approaches (<i>n</i>)	1	9	-	51	42	28	-	-	-	-
Unique entries (<i>n</i>)	1	5	-	23	38	17	-	-	-	-
Unique efficiency	1.00	0.56	-	0.45	0.90	0.61	-	-	-	-
South powerhouse										
Total approaches (<i>n</i>)	10	8	-	58	78	34	-	-	-	-
Total entries (<i>n</i>)	4	0	-	14	23	11	-	-	-	-
Total efficiency	0.40	0.00	-	0.24	0.29	0.32	-	-	-	-
Unique approaches (<i>n</i>)	1	4	-	29	26	14	-	-	-	-
Unique entries (<i>n</i>)	1	0	-	10	16	7	-	-	-	-
Unique efficiency	1.00	0.00	-	0.34	0.62	0.50	-	-	-	-
North										
Total approaches (<i>n</i>)	6	6	-	38	35	57	-	-	-	-
Total entries (<i>n</i>)	4	3	-	20	29	34	-	-	-	-
Total efficiency	0.67	0.50	-	0.53	0.83	0.60	-	-	-	-
Unique approaches (<i>n</i>)	1	4	-	27	11	18	-	-	-	-
Unique entries (<i>n</i>)	1	3	-	18	8	17	-	-	-	-
Unique efficiency	1.00	0.75	-	0.67	0.73	0.94	-	-	-	-
South unknown										
Total approaches (<i>n</i>)	1	-	-	30	49	21	-	-	-	-
Total entries (<i>n</i>)	0	-	-	29	49	20	-	-	-	-
Total efficiency	0.00	-	-	0.97	1.00	0.95	-	-	-	-
Unique approaches (<i>n</i>)	1	-	-	27	28	14	-	-	-	-
Unique entries (<i>n</i>)	0	-	-	26	28	13	-	-	-	-
Unique efficiency	0.00	-	-	0.96	1.00	0.93	-	-	-	-

Appendix D. Site-specific fishway entrance efficiency

Table D6. Fishway entrance efficiency metrics for radio-tagged Pacific lamprey at **McNary Dam fishway openings** in 1997-2002 and 2007-2010. Total approaches = total number of fishway approach events; Total entries = total number of fishway entry events; Unique approaches = number of unique fish that approached opening; Unique entries = number of unique fish that entered opening. Fish were tagged at Bonneville Dam. (Note: 2008 setup used aerial rather than underwater antennas at fishway openings)

	1997	1998	1999	2000	2001	2002	2007	¹ 2008	2009	2010
South										
Total approaches (<i>n</i>)	-	-	-	11	8	1	1	7	8	4
Total entries (<i>n</i>)	-	-	-	3	6	1	0	3	6	2
Total efficiency	-	-	-	0.27	0.75	1.00	0.00	0.43	0.75	0.50
Unique approaches (<i>n</i>)	-	-	-	9	5	1	1	4	7	4
Unique entries (<i>n</i>)	-	-	-	3	5	1	0	3	6	2
Unique efficiency	-	-	-	0.33	1.00	1.00	0.00	0.75	0.86	0.50
North powerhouse										
Total approaches (<i>n</i>)	-	-	-	11	20	1	-	1	4	7
Total entries (<i>n</i>)	-	-	-	5	12	0	-	0	1	0
Total efficiency	-	-	-	0.45	0.60	0.00	-	0.00	0.25	0.00
Unique approaches (<i>n</i>)	-	-	-	5	8	1	-	1	4	6
Unique entries (<i>n</i>)	-	-	-	3	7	0	-	0	1	0
Unique efficiency	-	-	-	0.60	0.88	0.00	-	0.00	0.25	0.00
North										
Total approaches (<i>n</i>)	-	-	-	3	2	1	-	3	1	1
Total entries (<i>n</i>)	-	-	-	2	1	1	-	0	0	1
Total efficiency	-	-	-	0.67	0.50	1.00	-	0.00	0.00	1.00
Unique approaches (<i>n</i>)	-	-	-	3	2	1	-	1	1	1
Unique entries (<i>n</i>)	-	-	-	2	1	1	-	0	0	1
Unique efficiency	-	-	-	0.67	0.50	1.00	-	0.00	0.00	1.00
Unknown south										
Total approaches (<i>n</i>)	-	-	-	7	-	-	-	1	3	5
Total entries (<i>n</i>)	-	-	-	5	-	-	-	1	3	5
Total efficiency	-	-	-	0.71	-	-	-	1.00	1.00	1.00
Unique approaches (<i>n</i>)	-	-	-	5	-	-	-	1	3	5
Unique entries (<i>n</i>)	-	-	-	5	-	-	-	1	3	5
Unique efficiency	-	-	-	1.00	-	-	-	1.00	1.00	1.00

Appendix D. Site-specific fishway entrance efficiency

Table D7. Fishway entrance efficiency metrics for radio-tagged Pacific lamprey at **McNary Dam fishway openings** in 2005-2010. Total approaches = total number of fishway approach events; Total entries = total number of fishway entry events; Unique approaches = number of unique fish that approached opening; Unique entries = number of unique fish that entered opening. Fish were tagged at McNary Dam. (Note: 2008 setup used aerial rather than underwater antennas at fishway openings)

	2005	2006	2007	¹ 2008	2009	2010
South						
Total approaches (<i>n</i>)	26	11	11	32	36	17
Total entries (<i>n</i>)	15	0	8	12	22	13
Total efficiency	0.58	0.00	0.73	0.38	0.58	0.76
Unique approaches (<i>n</i>)	13	9	9	18	27	9
Unique entries (<i>n</i>)	11	0	7	12	20	8
Unique efficiency	0.85	0.00	0.78	0.67	0.74	0.89
North powerhouse						
Total approaches (<i>n</i>)	7	5	8	14	44	4
Total entries (<i>n</i>)	1	1	1	1	3	0
Total efficiency	0.14	0.20	0.13	0.07	0.07	0.00
Unique approaches (<i>n</i>)	5	4	3	10	34	2
Unique entries (<i>n</i>)	1	1	1	1	2	0
Unique efficiency	0.20	0.25	0.33	0.10	0.06	0.00
North						
Total approaches (<i>n</i>)	13	4	12	10	33	1
Total entries (<i>n</i>)	5	0	3	6	15	1
Total efficiency	0.38	0.00	0.25	0.60	0.45	1.00
Unique approaches (<i>n</i>)	11	3	4	9	22	1
Unique entries (<i>n</i>)	5	0	2	6	14	1
Unique efficiency	0.45	0.00	0.50	0.67	0.64	1.00
Unknown south						
Total approaches (<i>n</i>)	1	-	2	3	26	5
Total entries (<i>n</i>)	1	-	2	3	26	5
Total efficiency	1.00	-	1.00	1.00	1.00	1.00
Unique approaches (<i>n</i>)	1	-	2	3	25	4
Unique entries (<i>n</i>)	1	-	2	3	25	4
Unique efficiency	1.00	-	1.00	1.00	1.00	1.00

Appendix D. Site-specific fishway entrance efficiency

Table D8. Fishway entrance efficiency metrics for radio-tagged Pacific lamprey at **Ice Harbor Dam fishway openings** in 2005-2010. Total approaches = total number of fishway approach events; Total entries = total number of fishway entry events; Unique approaches = number of unique fish that approached opening; Unique entries = number of unique fish that entered opening. Fish were tagged at McNary Dam and released below McNary Dam or Ice Harbor (IH) Dam.

	2005	2006	2007	2008	2009	2010	2005-IH	2006-IH
South								
Total approaches (<i>n</i>)	-	8	2	12	7	-	24	56
Total entries (<i>n</i>)	-	0	1	5	2	-	9	10
Total efficiency	-	0.00	0.50	0.42	0.29	-	0.38	0.18
Unique approaches (<i>n</i>)	-	2	1	4	3	-	7	10
Unique entries (<i>n</i>)	-	0	1	2	2	-	5	6
Unique efficiency	-	0.00	1.00	0.50	0.67	-	0.71	0.60
North powerhouse								
Total approaches (<i>n</i>)	-	-	-	5	-	-	3	-
Total entries (<i>n</i>)	-	-	-	0	-	-	0	-
Total efficiency	-	-	-	0.00	-	-	0.00	-
Unique approaches (<i>n</i>)	-	-	-	3	-	-	2	-
Unique entries (<i>n</i>)	-	-	-	0	-	-	0	-
Unique efficiency	-	-	-	0.00	-	-	0.00	-
North								
Total approaches (<i>n</i>)	-	1	1	6	4	-	8	15
Total entries (<i>n</i>)	-	0	0	1	0	-	1	6
Total efficiency	-	0.00	0.00	0.17	0.00	-	0.13	0.40
Unique approaches (<i>n</i>)	-	1	1	3	2	-	4	7
Unique entries (<i>n</i>)	-	0	0	1	0	-	1	4
Unique efficiency	-	0.00	0.00	0.33	0.000	-	0.25	0.57
Unknown south								
Total approaches (<i>n</i>)	-	2	-	-	1	-	5	4
Total entries (<i>n</i>)	-	2	-	-	1	-	5	4
Total efficiency	-	1.00	-	-	1.00	-	1.00	1.00
Unique approaches (<i>n</i>)	-	1	-	-	1	-	4	4
Unique entries (<i>n</i>)	-	1	-	-	1	-	4	4
Unique efficiency	-	1.00	-	-	1.00	-	1.00	1.00

Appendix E. Route-specific fishway passage efficiency

Table E1. Route-specific fishway passage efficiency metrics for radio-tagged Pacific lamprey at **Bonneville Dam Powerhouse 1** in 1997-2002 and 2007-2010. Total entries = total number of fishway entry events; Unique entries = number of unique fish that entered opening; Passed dam = number of entries that resulted in successful dam passage. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
PH1 S										
Total entries (<i>n</i>)	7	37	28	42	26	11	21	72	46	71
Passed dam (<i>n</i>)	1	10	8	20	11	4	14	26	26	20
Total efficiency	0.14	0.27	0.29	0.48	0.42	0.36	0.67	0.36	0.57	0.28
Unique entries (<i>n</i>)	6	27	23	37	24	8	21	56	42	49
Passed dam (<i>n</i>)	1	10	8	20	11	4	14	26	26	20
Unique efficiency	0.17	0.37	0.35	0.54	0.46	0.50	0.67	0.46	0.62	0.41
PH1 SG										
Total entries (<i>n</i>)	5	27	19	15	28	20	-	-	-	-
Passed dam (<i>n</i>)	0	9	6	9	9	5	-	-	-	-
Total efficiency	0.00	0.33	0.32	0.60	0.32	0.25	-	-	-	-
Unique entries (<i>n</i>)	4	24	18	14	18	19	-	-	-	-
Passed dam (<i>n</i>)	0	9	6	9	9	5	-	-	-	-
Unique efficiency	0.00	0.38	0.33	0.64	0.50	0.26	-	-	-	-
PH1 N										
Total entries (<i>n</i>)	13	21	43	34	35	23	15	20	15	45
Passed dam (<i>n</i>)	7	10	19	22	17	11	10	9	8	15
Total efficiency	0.54	0.48	0.44	0.65	0.49	0.48	0.67	0.45	0.53	0.33
Unique entries (<i>n</i>)	13	18	33	32	24	22	14	20	14	34
Passed dam (<i>n</i>)	7	10	19	22	17	11	10	9	8	15
Unique efficiency	0.54	0.56	0.58	0.69	0.71	0.50	0.71	0.45	0.57	0.44
PH1 unknown										
Total entries (<i>n</i>)	42	32	9	28	25	25	8	54	24	8
Passed dam (<i>n</i>)	14	8	5	13	7	5	2	25	14	4
Total efficiency	0.33	0.25	0.56	0.46	0.28	0.20	0.25	0.46	0.58	0.50
Unique entries (<i>n</i>)	35	27	8	26	23	21	8	48	24	8
Passed dam (<i>n</i>)	14	8	5	13	7	5	2	25	14	4
Unique efficiency	0.40	0.30	0.63	0.50	0.30	0.24	0.25	0.52	0.58	0.50

Appendix E. Route-specific fishway passage efficiency

Table E2. Route-specific fishway passage efficiency metrics for radio-tagged Pacific lamprey at **Bonneville Dam spillway** and **Washington-shore** in 1997-2002 and 2007-2010. Total entries = total number of fishway entry events; Unique entries = number of unique fish that entered opening; Passed dam = number of entries that resulted in successful dam passage. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
SP S										
Total entries (<i>n</i>)	52	27	28	56	39	67	48	62	90	72
Passed dam (<i>n</i>)	1	4	3	17	17	11	19	19	27	19
Total efficiency	0.02	0.15	0.11	0.30	0.44	0.16	0.40	0.31	0.30	0.26
Unique entries (<i>n</i>)	23	21	26	48	30	44	39	50	68	58
Passed dam (<i>n</i>)	1	4	3	17	17	11	19	19	27	19
Unique efficiency	0.04	0.19	0.12	0.35	0.57	0.25	0.49	0.38	0.40	0.33
SP N										
Total entries (<i>n</i>)	21	23	19	29	29	33	20	29	73	79
Passed dam (<i>n</i>)	5	5	5	7	8	14	7	14	20	26
Total efficiency	0.24	0.22	0.26	0.24	0.28	0.42	0.35	0.48	0.27	0.33
Unique entries (<i>n</i>)	14	17	18	26	27	29	18	29	51	55
Passed dam (<i>n</i>)	5	5	5	7	8	14	7	14	20	26
Unique efficiency	0.36	0.29	0.28	0.27	0.30	0.48	0.39	0.48	0.39	0.47
PH2 S down										
Total entries (<i>n</i>)	26	46	51	26	118	52	60	8	41	10
Passed dam (<i>n</i>)	0	0	1	3	4	1	3	2	2	0
Total efficiency	0.00	0.00	0.02	0.12	0.03	0.02	0.05	0.25	0.05	0.00
Unique entries (<i>n</i>)	15	29	38	23	71	41	40	8	36	9
Passed dam (<i>n</i>)	0	0	1	3	4	1	3	2	2	0
Unique efficiency	0.00	0.00	0.03	0.13	0.06	0.02	0.08	0.25	0.06	0.00
PH2 S up										
Total entries (<i>n</i>)	54	115	111	57	216	130	114	136	179	130
Passed dam (<i>n</i>)	0	2	2	3	5	4	4	3	3	2
Total efficiency	0.00	0.02	0.02	0.05	0.02	0.03	0.04	0.02	0.02	0.02
Unique entries (<i>n</i>)	26	52	47	39	71	68	65	81	107	62
Passed dam (<i>n</i>)	0	2	2	3	5	4	4	3	3	2
Unique efficiency	0.00	0.04	0.04	0.08	0.07	0.06	0.06	0.04	0.03	0.03

Appendix E. Route-specific fishway passage efficiency

Table E3. Route-specific fishway passage efficiency metrics for radio-tagged Pacific lamprey at **Bonneville Dam Washington-shore** in 1997-2002 and 2007-2010. Total entries = total number of fishway entry events; Unique entries = number of unique fish that entered opening; Passed dam = number of entries that resulted in successful dam passage. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
PH2 OG										
Total entries (<i>n</i>)	31	38	66	-	-	-	-	-	-	-
Passed dam (<i>n</i>)	6	1	6	-	-	-	-	-	-	-
Total efficiency	0.19	0.03	0.09	-	-	-	-	-	-	-
Unique entries (<i>n</i>)	17	26	42	-	-	-	-	-	-	-
Passed dam (<i>n</i>)	6	1	6	-	-	-	-	-	-	-
Unique efficiency	0.35	0.04	0.13	-	-	-	-	-	-	-
PH2 N down										
Total entries (<i>n</i>)	27	23	35	15	32	37	13	40	55	26
Passed dam (<i>n</i>)	4	9	8	6	6	7	3	15	9	4
Total efficiency	0.15	0.39	0.23	0.40	0.19	0.19	0.23	0.38	0.16	0.15
Unique entries (<i>n</i>)	13	21	31	13	24	29	12	35	48	22
Passed dam (<i>n</i>)	4	9	8	6	6	7	3	15	9	4
Unique efficiency	0.31	0.43	0.26	0.46	0.25	0.24	0.25	0.43	0.19	0.18
PH2 N up										
Total entries (<i>n</i>)	13	42	75	40	41	32	42	37	48	47
Passed dam (<i>n</i>)	5	11	17	17	21	11	13	14	24	9
Total efficiency	0.38	0.26	0.23	0.43	0.51	0.34	0.31	0.38	0.50	0.19
Unique entries (<i>n</i>)	11	31	56	35	37	26	38	30	42	38
Passed dam (<i>n</i>)	5	11	17	17	21	11	13	14	24	9
Unique efficiency	0.45	0.35	0.30	0.49	0.57	0.42	0.34	0.47	0.57	0.24
PH2 unknown										
Total entries (<i>n</i>)	35	21	17	19	119	73	34	130	244	110
Passed dam (<i>n</i>)	5	2	1	4	21	19	7	23	66	30
Total efficiency	0.14	0.10	0.06	0.21	0.18	0.26	0.21	0.18	0.27	0.27
Unique entries (<i>n</i>)	21	18	15	17	83	52	30	99	161	77
Passed dam (<i>n</i>)	5	2	1	4	21	19	7	23	66	30
Unique efficiency	0.24	0.11	0.07	0.24	0.25	0.37	0.23	0.23	0.41	0.39

Appendix E. Route-specific fishway passage efficiency

Table E4. Route-specific fishway passage efficiency metrics for radio-tagged Pacific lamprey at **The Dalles Dam** in 1997-2002 and 2007-2010. Total entries = total number of fishway entry events; Unique entries = number of unique fish that entered opening; Passed dam = number of entries that resulted in successful dam passage. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
East										
Total entries (<i>n</i>)	13	11	-	27	41	29	14	54	31	49
Passed dam (<i>n</i>)	5	5	-	21	21	13	10	36	18	23
Total efficiency	0.38	0.45	-	0.78	0.51	0.45	0.71	0.67	0.58	0.47
Unique entries (<i>n</i>)	7	9	-	27	32	20	14	46	25	34
Passed dam (<i>n</i>)	5	5	-	21	21	13	10	36	18	22
Unique efficiency	0.71	0.56	-	0.78	0.66	0.65	0.71	0.78	0.72	0.65
West powerhouse										
Total entries (<i>n</i>)	36	17	-	24	46	22	-	18	9	1
Passed dam (<i>n</i>)	4	3	-	11	11	8	-	8	5	1
Total efficiency	0.11	0.18	-	0.46	0.24	0.36	-	0.44	0.56	1.00
Unique entries (<i>n</i>)	14	9	-	21	26	18	-	14	8	1
Passed dam (<i>n</i>)	4	3	-	11	11	8	-	8	5	1
Unique efficiency	0.29	0.33	-	0.52	0.42	0.44	-	0.57	0.63	1.00
Spillway										
Total entries (<i>n</i>)	14	8	-	9	27	5	6	22	8	2
Passed dam (<i>n</i>)	3	3	-	5	9	2	2	4	6	0
Total efficiency	0.21	0.38	-	0.56	0.33	0.40	0.33	0.18	0.75	0.00
Unique entries (<i>n</i>)	9	7	-	9	21	5	4	16	8	2
Passed dam (<i>n</i>)	3	3	-	5	9	2	2	4	6	0
Unique efficiency	0.33	0.43	-	0.56	0.43	0.40	0.50	0.25	0.75	0.00
North										
Total entries (<i>n</i>)	77	21	-	47	70	50	15	29	75	65
Passed dam (<i>n</i>)	11	14	-	33	22	18	8	14	26	35
Total efficiency	0.14	0.67	-	0.70	0.31	0.6	0.53	0.48	0.35	0.54
Unique entries (<i>n</i>)	18	15	-	43	34	32	12	23	49	44
Passed dam (<i>n</i>)	11	12	-	33	22	18	8	13	25	34
Unique efficiency	0.61	0.80	-	0.77	0.65	0.56	0.67	0.57	0.51	0.77

Appendix E. Route-specific fishway passage efficiency

Unknown east										
Total entries (<i>n</i>)	29	5	-	2	17	21	2	1	15	30
Passed dam (<i>n</i>)	6	1	-	1	7	5	2	1	14	14
Total efficiency	0.21	0.20	-	0.50	0.41	0.24	1.00	1.00	0.93	0.47
Unique entries (<i>n</i>)	23	5	-	2	15	20	2	1	15	24
Passed dam (<i>n</i>)	6	1	-	1	7	5	2	1	14	14
Unique efficiency	0.26	0.20	-	0.50	0.47	0.25	1.00	1.00	0.93	0.58

Appendix E. Route-specific fishway passage efficiency

Table E5. Route-specific fishway passage efficiency metrics for radio-tagged Pacific lamprey at **John Day Dam** in 1997-2002 and 2007-2010. Total entries = total number of fishway entry events; Unique entries = number of unique fish that entered opening; Passed dam = number of entries that resulted in successful dam passage. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
South										
Total entries (<i>n</i>)	5	-	-	28	92	-	-	-	82	-
Passed dam (<i>n</i>)	0	-	-	8	14	-	-	-	21	-
Total efficiency	0.00	-	-	0.29	0.15	-	-	-	0.26	-
Unique entries (<i>n</i>)	1	-	-	24	38	-	-	-	36	-
Passed dam (<i>n</i>)	0	-	-	8	13	-	-	-	17	-
Unique efficiency	0.00	-	-	0.33	0.34	-	-	-	0.47	-
North powerhouse										
Total entries (<i>n</i>)	6	7	-	14	23	-	-	-	-	-
Passed dam (<i>n</i>)	0	2	-	4	4	-	-	-	-	-
Total efficiency	0.00	0.29	-	0.29	0.17	-	-	-	-	-
Unique entries (<i>n</i>)	1	5	-	10	16	-	-	-	-	-
Passed dam (<i>n</i>)	0	2	-	4	4	-	-	-	-	-
Unique efficiency	0.00	0.40	-	0.40	0.25	-	-	-	-	-
North										
Total entries (<i>n</i>)	4	3	-	20	28	-	-	-	-	-
Passed dam (<i>n</i>)	0	0	-	8	3	-	-	-	-	-
Total efficiency	0.00	0.00	-	0.40	0.11	-	-	-	-	-
Unique entries (<i>n</i>)	1	3	-	18	8	-	-	-	-	-
Passed dam (<i>n</i>)	0	0	-	7	3	-	-	-	-	-
Unique efficiency	0.00	0.00	-	0.39	0.38	-	-	-	-	-
Unknown east										
Total entries (<i>n</i>)	-	2	-	31	52	-	-	-	-	-
Passed dam (<i>n</i>)	-	1	-	9	7	-	-	-	-	-
Total efficiency	-	0.50	-	0.29	0.13	-	-	-	-	-
Unique entries (<i>n</i>)	-	2	-	26	29	-	-	-	-	-
Passed dam (<i>n</i>)	-	1	-	9	6	-	-	-	-	-
Unique efficiency	-	0.50	-	0.35	0.21	-	-	-	-	-

Appendix E. Route-specific fishway passage efficiency

Table E6. Route-specific fishway passage efficiency metrics for radio-tagged Pacific lamprey at **McNary Dam** in 1997-2002 and 2007-2010. Total entries = total number of fishway entry events; Unique entries = number of unique fish that entered opening; Passed dam = number of entries that resulted in successful dam passage. Fish were tagged at **Bonneville Dam**.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
South										
Total entries (<i>n</i>)	-	-	-	3	6	1	-	3	6	2
Passed dam (<i>n</i>)	-	-	-	3	4	1	-	3	6	1
Total efficiency	-	-	-	1.00	0.67	1.00	-	1.00	1.00	0.50
Unique entries (<i>n</i>)	-	-	-	3	5	1	-	3	6	2
Passed dam (<i>n</i>)	-	-	-	3	4	1	-	3	6	1
Unique efficiency	-	-	-	1.00	0.80	1.00	-	1.00	1.00	0.50
North powerhouse										
Total entries (<i>n</i>)	-	-	-	5	11	-	-	-	1	-
Passed dam (<i>n</i>)	-	-	-	1	2	-	-	-	0	-
Total efficiency	-	-	-	0.20	0.18	-	-	-	0.00	-
Unique entries (<i>n</i>)	-	-	-	3	6	-	-	-	1	-
Passed dam (<i>n</i>)	-	-	-	1	2	-	-	-	0	-
Unique efficiency	-	-	-	0.33	0.33	-	-	-	0.00	-
North										
Total entries (<i>n</i>)	-	-	-	2	1	1	-	-	-	1
Passed dam (<i>n</i>)	-	-	-	1	0	1	-	-	-	1
Total efficiency	-	-	-	0.50	0.00	1.00	-	-	-	1.00
Unique entries (<i>n</i>)	-	-	-	2	1	1	-	-	-	1
Passed dam (<i>n</i>)	-	-	-	1	0	1	-	-	-	1
Unique efficiency	-	-	-	0.50	0.00	1.00	-	-	-	1.00
Unknown south										
Total entries (<i>n</i>)	-	-	-	7	-	-	-	4	3	5
Passed dam (<i>n</i>)	-	-	-	6	-	-	-	4	2	3
Total efficiency	-	-	-	0.86	-	-	-	0.00	0.67	0.60
Unique entries (<i>n</i>)	-	-	-	6	-	-	-	4	3	5
Passed dam (<i>n</i>)	-	-	-	6	-	-	-	4	2	3
Unique efficiency	-	-	-	1.00	-	-	-	1.00	0.67	0.60

Appendix E. Route-specific fishway passage efficiency

Table E7. Route-specific fishway passage efficiency metrics for radio-tagged Pacific lamprey at **McNary Dam** in 2005-2010. Total entries = total number of fishway entry events; Unique entries = number of unique fish that entered opening; Passed dam = number of entries that resulted in successful dam passage. Fish were tagged at **McNary Dam**.

	2005	2006	2007	2008	2009	2010
South						
Total entries (<i>n</i>)	15	11	8	12	22	13
Passed dam (<i>n</i>)	10	9	5	7	18	4
<i>Total efficiency</i>	<i>0.67</i>	<i>0.82</i>	<i>0.63</i>	<i>0.58</i>	<i>0.82</i>	<i>0.31</i>
Unique entries (<i>n</i>)	11	9	7	12	20	8
Passed dam (<i>n</i>)	8	9	5	7	17	4
<i>Unique efficiency</i>	<i>0.76</i>	<i>1.00</i>	<i>0.71</i>	<i>0.58</i>	<i>0.85</i>	<i>0.50</i>
North powerhouse						
Total entries (<i>n</i>)	1	1	1	1	3	-
Passed dam (<i>n</i>)	0	0	0	0	1	-
<i>Total efficiency</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.33</i>	
Unique entries (<i>n</i>)	1	1	1	1	2	-
Passed dam (<i>n</i>)	0	0	0	0	1	-
<i>Unique efficiency</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.50</i>	
North						
Total entries (<i>n</i>)	5	2	3	6	15	1
Passed dam (<i>n</i>)	4	0	1	4	9	1
<i>Total efficiency</i>	<i>0.80</i>	<i>0.00</i>	<i>0.33</i>	<i>0.67</i>	<i>0.60</i>	<i>1.00</i>
Unique entries (<i>n</i>)	5	2	2	6	14	1
Passed dam (<i>n</i>)	4	0	1	4	9	1
<i>Unique efficiency</i>	<i>0.80</i>	<i>0.00</i>	<i>0.50</i>	<i>0.67</i>	<i>0.64</i>	<i>1.00</i>
Unknown south						
Total entries (<i>n</i>)	1	4	2	3	26	8
Passed dam (<i>n</i>)	1	2	1	3	22	4
<i>Total efficiency</i>	<i>1.00</i>	<i>0.50</i>	<i>0.50</i>	<i>1.00</i>	<i>0.85</i>	<i>0.50</i>
Unique entries (<i>n</i>)	1	4	2	3	25	7
Passed dam (<i>n</i>)	1	2	1	3	21	4
<i>Unique efficiency</i>	<i>1.00</i>	<i>0.50</i>	<i>0.50</i>	<i>1.00</i>	<i>0.84</i>	<i>0.57</i>

Appendix E. Route-specific fishway passage efficiency

Table E8. Route-specific fishway passage efficiency metrics for radio-tagged Pacific lamprey at **Ice Harbor Dam** in 2005-2010. Total entries = total number of fishway entry events; Unique entries = number of unique fish that entered opening; Passed dam = number of entries that resulted in successful dam passage. Fish were tagged at McNary Dam and released below McNary Dam or Ice Harbor (IH) Dam.

	2005	2006	2007	2008	2009	2010	2005-IH	2006-IH
South								
Total entries (<i>n</i>)	-	-	1	5	2	-	9	10
Passed dam (<i>n</i>)	-	-	1	3	1	-	2	5
Total efficiency	-	-	1.00	0.60	0.50	-	0.22	0.50
Unique entries (<i>n</i>)	-	-	1	2	2	-	5	6
Passed dam (<i>n</i>)	-	-	1	2	1	-	2	5
Unique efficiency	-	-	1.00	1.00	0.50	-	0.40	0.83
North								
Total entries (<i>n</i>)	-	1	-	1	1	-	1	6
Passed dam (<i>n</i>)	-	1	-	0	1	-	0	5
Total efficiency	-	1.00	-	0.00	1.00	-	0.00	0.86
Unique entries (<i>n</i>)	-	1	-	1	1	-	1	5
Passed dam (<i>n</i>)	-	1	-	0	1	-	0	5
Unique efficiency	-	1.00	-	0.00	1.00	-	0.00	1.00
Unknown south								
Total entries (<i>n</i>)	-	2	-	1	1	-	5	4
Passed dam (<i>n</i>)	-	1	-	0	1	-	1	0
Total efficiency	-	0.50	-	0.00	1.00	-	0.20	0.00
Unique entries (<i>n</i>)	-	1	-	1	1	-	4	4
Passed dam (<i>n</i>)	-	1	-	0	1	-	1	0
Unique efficiency	-	1.00	-	0.00	1.00	-	0.25	0.00

Appendix F. Fishway segment passage efficiency

Table F1. Estimated fishway segment efficiency metrics (*n*) for radio-tagged Pacific lamprey at **Bonneville Dam** in 1997-2002 and 2007-2010. Efficiency (number of unique lamprey that passed a segment/number of unique lamprey detected in the segment). Denominators change along routes because lamprey entered and exited fishways at multiple sites. Dashes (-) indicate site not monitored or insufficiently monitored.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
Bradford Island A										
South entry channel	0.57 (21)	0.75 (32)	0.78 (23)	0.92 (38)	0.96 (26)	0.67 (9)	0.91 (22)	0.75 (56)	0.86 (42)	0.82 (49)
Mid collection chan	0.81 (21)	0.82 (50)	0.65 (31)	0.78 (60)	0.82 (50)	0.59 (32)	-	-	-	-
North entry channel	0.90 (40)	0.93 (67)	0.89 (57)	0.98 (86)	0.94 (62)	0.88 (43)	0.88 (40)	0.83 (98)	0.93 (72)	0.97 (70)
Transition pool	0.72 (36)	0.90 (62)	0.96 (51)	0.86 (84)	0.91 (58)	0.92 (38)	1.00 (35)	0.90 (81)	0.99 (67)	0.82 (68)
Junction pool	0.89 (28)	0.77 (61)	0.85 (53)	0.99 (90)	0.99 (72)	0.98 (53)	0.93 (54)	0.96 (100)	0.99 (101)	0.95 (80)
Upper ladder ¹	0.92 (25)	0.87 (47)	0.91 (45)	0.91 (89)	0.86 (71)	0.69 (52)	0.90 (50)	0.82 (96)	0.75 (100)	0.76 (76)
Bradford Island B										
Entry channel	0.35 (23)	0.52 (21)	0.38 (26)	0.52 (48)	0.70 (30)	0.57 (44)	0.69 (39)	0.66 (50)	0.60 (68)	0.83 (58)
Transition pool	0.25 (8)	0.45 (11)	0.40 (10)	0.80 (25)	0.90 (21)	0.76 (25)	0.78 (27)	0.82 (33)	0.88 (41)	0.54 (48)
Cascades Island										
Entry channel	0.86 (14)	0.59 (17)	0.72 (18)	0.65 (26)	0.81 (27)	0.79 (29)	0.94 (18)	0.97 (29)	0.73 (51)	0.78 (55)
Transition pool	0.50 (12)	0.60 (10)	0.38 (13)	0.71 (17)	0.73 (22)	0.74 (23)	0.76 (17)	0.86 (28)	0.95 (37)	0.77 (43)
CI exit channel	-	-	-	-	-	-	1.00 (13)	0.96 (24)	0.94 (35)	0.94 (33)
Washington-shore										
S. entry chan down	1.00 (15)	0.90 (30)	0.95 (38)	1.00 (23)	0.77 (75)	0.95 (41)	0.98 (41)	0.80 (10)	0.97 (36)	0.73 (11)
S. entry chan corner	0.53 (30)	0.70 (60)	0.60 (65)	-	-	-	-	-	-	-
Mid collection chan	0.29 (34)	0.25 (53)	0.34 (61)	-	-	-	-	-	-	-
N. entry chan down	0.80 (15)	0.73 (22)	0.76 (33)	0.89 (18)	0.66 (29)	0.83 (30)	0.93 (14)	0.95 (37)	0.82 (51)	0.91 (22)
N. entry chan up	1.00 (12)	1.00 (16)	1.00 (25)	1.00 (16)	1.00 (19)	0.60 (25)	0.64 (14)	0.74 (35)	0.57 (44)	0.81 (21)
Transition pool	0.75 (32)	0.63 (51)	0.60 (80)	0.75 (63)	0.78 (92)	0.67 (79)	0.70 (66)	0.76 (109)	0.75 (191)	0.70 (100)
Lower ladder	0.96 (24)	0.91 (32)	0.90 (48)	0.93 (44)	0.97 (72)	0.94 (53)	0.80 (46)	0.94 (83)	0.92 (144)	0.83 (70)
UMT junction	0.86 (29)	0.86 (35)	0.83 (48)	0.98 (52)	1.00 (86)	1.00 (66)	1.00 (50)	1.00 (98)	1.00 (164)	0.99 (88)
Upper ladder ¹	-	-	-	0.78 (51)	0.76 (86)	0.85 (66)	0.74 (50)	0.72 (98)	0.76 (164)	0.80 (87)

¹ upper ladder = count window + serpentine weir + auxiliary water supply channel

Appendix F. Fishway segment passage efficiency

Table F2. Estimated fishway segment efficiency metrics (*n*) for radio-tagged Pacific lamprey at **The Dalles Dam** in 1997-2002 and 2007-2010. Efficiency (number of unique lamprey that passed a segment/number of unique lamprey detected in the segment). Denominators change along routes because lamprey entered and exited fishways at multiple sites. Dashes (-) indicate site insufficiently monitored.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
East fishway										
1. East collection chan	1.00 (7)	0.78 (9)	-	0.89 (27)	0.94 (32)	0.95 (20)	0.93 (14)	1.00 (46)	0.96 (25)	0.97 (34)
2. Junction pool	0.96 (28)	0.85 (20)	-	1.00 (45)	0.94 (66)	0.88 (41)	1.00 (18)	0.98 (58)	0.98 (54)	0.98 (48)
3. Transition pool	0.67 (27)	0.71 (17)	-	0.84 (45)	0.81 (62)	0.78 (36)	0.78 (18)	0.86 (57)	0.83 (53)	0.79 (47)
4. Upper ladder	1.00 (18)	1.00 (12)	-	1.00 (38)	0.96 (50)	1.00 (28)	1.00 (14)	1.00 (49)	0.98 (44)	1.00 (37)
5. Spillway collect ch	0.33 (12)	0.86 (7)	-	0.67 (9)	0.71 (21)	0.40 (5)	0.75 (4)	0.50 (16)	1.00 (8)	1.00 (2)
6. West collect chan	0.31 (16)	0.78 (9)	-	0.76 (21)	0.88 (26)	0.63 (19)	-	0.79 (14)	0.88 (8)	1.00 (1)
North fishway										
7. Entry channel	0.78 (18)	1.00 (15)	-	0.95 (43)	0.82 (34)	0.94 (32)	1.00 (12)	1.00 (23)	1.00 (49)	1.00 (44)
8. Transition pool	0.79 (14)	0.80 (15)	-	0.80 (41)	0.79 (28)	0.60 (30)	0.67 (12)	0.57 (23)	0.51 (49)	0.77 (44)
9. Upper ladder	1.00 (11)	1.00 (12)	-	1.00 (33)	1.00 (22)	1.00 (18)	1.00 (8)	1.00 (13)	1.00 (25)	1.00 (34)

Table F3. Estimated fishway segment efficiency metrics (*n*) for radio-tagged Pacific lamprey at **John Day Dam** in 1997-2002 and 2007-2010. Efficiency (number of unique lamprey that passed a segment/number of unique lamprey detected in the segment). Denominators change along routes because lamprey entered and exited fishways at multiple sites. Dashes (-) indicate site insufficiently monitored.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
South fishway										
1. N. PH entry channel	1.00 (1)	1.00 (5)	-	0.80 (10)	0.88 (16)	-	-	-	-	-
2. S. collection chan	1.00 (1)	1.00 (5)	-	0.96 (46)	0.98 (43)	-	-	-	1.00 (34)	-
3. S. PH entry channel	0.00 (1)	-	-	0.79 (24)	1.00 (33)	-	-	-	0.94 (33)	-
4. Transition pool	0.00 (1)	0.67 (6)	-	0.48 (44)	0.55 (42)	-	-	-	0.50 (34)	-
5. Count station	-	0.75 (4)	-	-	-	-	-	-	-	-
6. Upper ladder	-	1.00 (3)	-	1.00 (21)	0.96 (23)	-	-	-	1.00 (17)	-
North fishway										
7. Collection chan	1.00 (1)	1.00 (3)	-	1.00 (18)	0.75 (8)	-	-	-	-	-
8. Transition pool	0.00 (1)	0.67 (3)	-	0.39 (18)	0.50 (6)	-	-	-	-	-
9. Count station	-	0.00 (2)	-	-	-	-	-	-	-	-
10. Upper ladder	-	-	-	1.00 (7)	1.00 (3)	-	-	-	-	-

Appendix F. Fishway segment passage efficiency

Table F4. Estimated fishway segment efficiency metrics (*n*) for radio-tagged Pacific lamprey at **McNary Dam** in 1997-2002 and 2007-2010. Efficiency (number of unique lamprey that passed a segment/number of unique lamprey detected in the segment). Denominators change along routes because lamprey entered and exited fishways at multiple sites. Dashes (-) indicate site insufficiently monitored. Fish tagged at [Bonneville Dam](#).

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
South fishway										
1. N. PH entry channel	-	-	-	0.25 (4)	0.67 (6)	-	-	-	1.00 (1)	0.00 (1)
2. S. coll channel	-	-	-	1.00 (10)	1.00 (7)	1.00 (1)	-	1.00 (7)	0.90 (10)	0.67 (6)
3. S PH entry channel	-	-	-	1.00 (3)	1.00 (5)	1.00 (1)	-	1.00 (3)	1.00 (6)	1.00 (2)
4. Transition pool	-	-	-	1.00 (10)	0.86 (7)	1.00 (1)	-	1.00 (7)	0.90 (10)	0.67 (6)
5. Upper ladder	-	-	-	1.00 (10)	0.96 (6)	1.00 (1)	-	1.00 (7)	0.89 (9)	1.00 (4)
North fishway										
6. Entry channel	-	-	-	1.00 (2)	0.00 (1)	1.00 (1)	-	-	-	1.00 (1)
7. Transition pool	-	-	-	0.50 (2)	-	1.00 (1)	-	-	-	1.00 (1)
8. Upper ladder	-	-	-	0.50 (2)	-	1.00 (1)	-	-	-	1.00 (1)

Table F5. Estimated fishway segment efficiency metrics (*n*) for radio-tagged Pacific lamprey at **McNary Dam** in 2005-2010. Efficiency (number of unique lamprey that passed a segment/number of unique lamprey detected in the segment). Denominators change along routes because lamprey entered and exited fishways at multiple sites. Dashes (-) indicate site insufficiently monitored. Fish tagged at [McNary Dam](#).

	2005	2006	2007	2008	2009	2010
South fishway						
1. N. PH entry channel	1.00 (1)	0.00 (1)	0.00 (1)	1.00 (1)	0.67 (3)	0.00 (2)
2. S. coll channel	1.00 (11)	1.00 (11)	1.00 (8)	1.00 (13)	1.00 (43)	1.00 (10)
3. S PH entry channel	0.82 (11)	1.00 (9)	0.86 (7)	0.75 (12)	1.00 (20)	0.88 (8)
4. Transition pool	0.91 (11)	1.00 (11)	0.88 (8)	0.77 (13)	0.93 (43)	0.80 (10)
5. Upper ladder	0.90 (10)	1.00 (11)	0.86 (7)	0.77 (10)	0.98 (40)	1.00 (8)
North fishway						
6. Entry channel	0.80 (5)	1.00 (2)	0.00 (2)	0.67 (6)	0.64 (14)	1.00 (1)
7. Transition pool	1.00 (4)	-	0.50 (2)	1.00 (4)	1.00 (9)	1.00 (1)
8. Upper ladder	1.00 (4)	-	1.00 (1)	1.00 (4)	1.00 (9)	1.00 (1)

Appendix G. Fishway turnaround locations

Table G1. Total turn-around events (*n*) and estimated percentage (%) of turn-arounds inside fishways by radio-tagged Pacific lamprey at **Bonneville Dam** in 1997-2002 and 2007-2010. Turn-around = fishway passage attempt that included fishway entry but did not result in dam passage; individual lamprey could make multiple attempts. Site numbers refer to locations in Figures 1 & 2.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
Total events (<i>n</i>)	278	381	420	240	582	410	293	438	616	469
Bradford Island A	16	22	16	25	13	15	6	21	7	19
1. South collection	4	5	2	3	1	2	1	7	2	5
2. Mid collection	2	7	5	8	3	5	-	-	-	-
3. North collection	3	2	5	2	6	2	2	7	1	4
4. Transition pool	5	2	1	6	1	2	<1	2	<1	5
5. Junction pool	1	4	2	1	<1	<1	1	1	<1	1
6. Upper ladder ¹	1	2	1	5	2	4	2	4	4	4
Bradford Island B	18	6	5	15	3	12	9	8	9	10
7. Collection	15	4	4	13	3	9	6	6	8	3
8. Transition pool	3	2	1	2	<1	3	3	2	1	7
Cascades Island	6	5	3	8	2	4	3	1	1	4
9. Collection	3	3	1	5	1	2	1	<1	<1	<1
10. Transition pool	3	2	2	3	1	2	2	1	1	4
11. CI exit channel	-	-	-	-	-	-	0	<1	<1	<1
Washington-shore	59	69	75	55	83	70	82	69	77	60
12. S. collection down	2	2	1	0	9	1	2	<1	<1	1
13. S. collection corner	18	27	22	33	58	46	59	45	46	33
14. Mid collection	27	25	28	-	-	-	-	-	-	-
15. N. collection down	6	2	3	2	3	4	<1	1	2	1
16. N. collection up	-	-	-	-	-	3	2	3	4	1
17. Transition pool	5	11	16	13	9	11	10	11	16	15
18. Lower ladder	<1	1	3	1	<1	2	4	2	2	5
19. UMT junction	1	1	2	1	0	0	0	0	0	<1
20. Upper ladder ¹	-	-	-	5	4	3	5	7	7	4

¹ upper ladder = count window + serpentine weir + auxiliary water supply channel

Appendix G. Fishway turnaround locations

Table G2. Total turn-around events (*n*) and estimated percentage (%) of turn-around inside fishways recorded for radio-tagged Pacific lamprey at **The Dalles Dam** in 1997-2002 and 2007-2010. Turn-around = fishway passage attempt that included fishway entry but did not result in dam passage; individual lamprey could make multiple attempts.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
Total events (<i>n</i>)	140	36	-	38	131	81	15	61	69	74
East fishway	54	81		63	63	61	54	76	28	59
1. East collection chan	4	8	-	8	5	5	7	10	4	5
2. Junction pool	1	11	-	0	11	19	0	10	3	8
3. Transition pool	13	25	-	29	24	17	27	23	19	46
4. Upper ladder	0	0	-	0	2	0	0	0	1	0
5. Spillway collect ch	10	6	-	8	9	4	20	23	0	0
6. West collect chan	26	31	-	18	12	16	0	10	1	0
North fishway	47	20		37	37	40	47	25	71	41
7. Entry channel	37	6	-	11	23	10	0	0	0	0
8. Transition pool	10	14	-	26	14	30	47	25	71	41
9. Upper ladder	0	0	-	0	0	0	0	0	0	0

Appendix H. Reservoir passage efficiency estimates

Table H1. Reservoir conversion estimates for radio-tagged Pacific lamprey in 1997-2002 and 2007-2010. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
Top BON (<i>n</i>)	49	73	82	123	129	92	83	156	198	128
At TDD (<i>n</i>)	29	43	49	86	94	73	38	95	112	104
Top TDD (<i>n</i>)	-	24	24	67	68	46	21	63	68	70
At JDD (<i>n</i>)	-	10	13	41	51	34	11	42	44	39
Top JDD (<i>n</i>)	-	3	3	28	24	17	9	27	22	34
At MCN (<i>n</i>)	-	-	-	13	9	5	-	8	10	11
At TDD:Top BON	0.59	0.59	0.60	0.70	0.73	0.79	0.46	0.61	0.57	0.81
At JDD:Top TDD	-	0.42	0.54	0.61	0.75	0.74	0.52	0.67	0.67	0.56
At MCN:Top JDD	-	-	-	0.46	0.36	0.29	-	0.30	0.45	0.32

Appendix I. Reach escapement estimates

Table II. Reach-specific escapement estimates for radio-tagged Pacific lamprey in 1997-2002 and 2007-2010. Fish were tagged at Bonneville Dam.

	1997	1998	1999	2000	2001	2002	2007	2008	2009	2010
Released (<i>n</i>)	147	205	199	299	298	201	398	595	596	312
Top BON (<i>n</i>)	49	73	82	123	129	92	83	¹ 156	² 198	³ 128
Top TDD (<i>n</i>)	16	24	25	70	68	46	21	63	68	70
Top JDD (<i>n</i>)	3	3	3	23	27	17	9	27	22	34
Top MCN (<i>n</i>)	-	-	-	10	6	2	-	7	8	6
Top ICH (<i>n</i>)	-	-	-	-	-	-	-	-	1	2
Top PRD (<i>n</i>)	-	-	-	-	3	1	-	2	3	3
Top BON:Released	0.33	0.36	0.41	0.41	0.43	0.46	0.21	0.26	0.33	0.41
Top TDD:Released	0.11	0.12	0.13	0.23	0.23	0.23	0.05	0.11	0.11	0.22
Top JDD:Released	0.02	0.01	0.02	0.08	0.09	0.08	0.02	0.05	0.04	0.11
Top MCN:Released	-	-	-	0.03	0.02	0.01	-	0.01	0.01	0.02
Top ICH:Released	-	-	-	-	-	-	-	-	<0.01	<0.01
Top PRD:Released	-	-	-	-	0.01	<0.01	-	<0.01	<0.01	0.01
Top TDD:Top BON	0.33	0.33	0.30	0.57	0.53	0.50	0.25	0.40	0.34	0.55
Top JDD:Top TDD	0.19	0.13	0.12	0.33	0.40	0.37	0.43	0.43	0.32	0.49
Top MCN:Top JDD	-	-	-	0.43	0.22	0.12	-	0.26	0.36	0.18
Top ICH:Top MCN	-	-	-	-	-	-	-	-	0.13	0.33
Top PRD:Top MCN	-	-	-	-	0.50	0.50	-	0.29	0.38	0.50

¹ *n* = 146; ² *n* = 177; ³ *n* = 126 when trap recaptures were treated as NOT PASSING the dam

Appendix I. Reach escapement estimates

Table I2. Reach-specific escapement estimates for HD-PIT tagged Pacific lamprey in 2005-2011. Fish were tagged at Bonneville Dam.

	2005	2006	2007	2008	2009	2010	2011
Released (<i>n</i>)	841	2000	757	608	368	13	800
Top BON (<i>n</i>)	446	822	393	318	172	² 8	³ 460
Top TDD (<i>n</i>)	-	558	246	166	90	3	238
Top JDD (<i>n</i>)	-	382	129	109	50	2	190
Top MCN (<i>n</i>)	40	80	35	28	8	-	64
Top ICH (<i>n</i>)	2	6	5	5	-	-	15
Top PRD (<i>n</i>)	-	-	-	3	4	-	35
Top BON:Released	0.53	0.41	0.52	0.52	0.47	0.62	0.58
Top TDD:Released	-	0.28	0.32	0.27	0.24	0.23	0.30
Top JDD:Released	-	0.19	0.17	0.18	0.14	0.15	0.24
Top MCN:Released	0.05	0.04	0.05	0.05	0.02	-	0.08
Top ICH:Released	<0.01	<0.01	0.01	0.01	-	-	0.02
Top PRD:Released	-	-	-	<0.01	0.01	-	0.04
Top TDD:Top BON	-	0.68	0.63	0.52	0.52	0.38	0.52
Top JDD:Top TDD	-	0.68	0.52	0.66	0.56	0.67	0.80
Top MCN:Top JDD	-	0.21	0.27	0.26	0.16	-	0.34
Top ICH:Top MCN	0.05	0.08	0.14	0.18	-	-	0.23
Top PRD:Top MCN	-	-	-	0.11	0.50	-	0.55

¹ lamprey were released into the ladder in 2005

² *n* = 7; ³ *n* = 449 when trap recaptures were treated as NOT PASSING the dam

Appendix J. Maps of HD PIT antenna locations

Figure J1. Locations of HD PIT antennas in the Washington-shore fishway at Bonneville Dam. See Table A10 for year-to-year history.

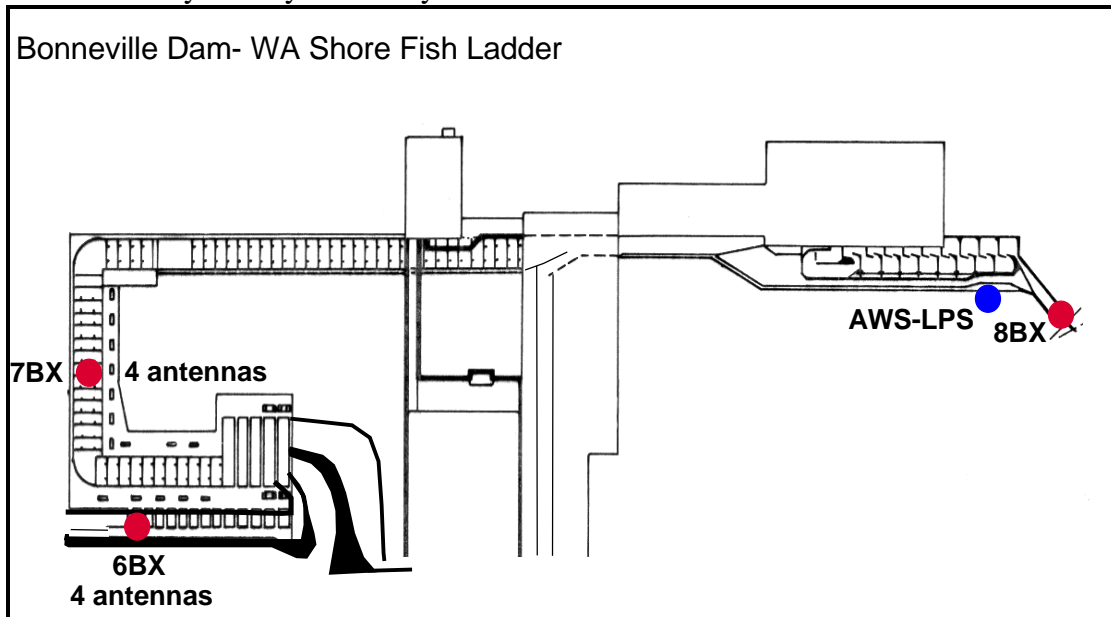
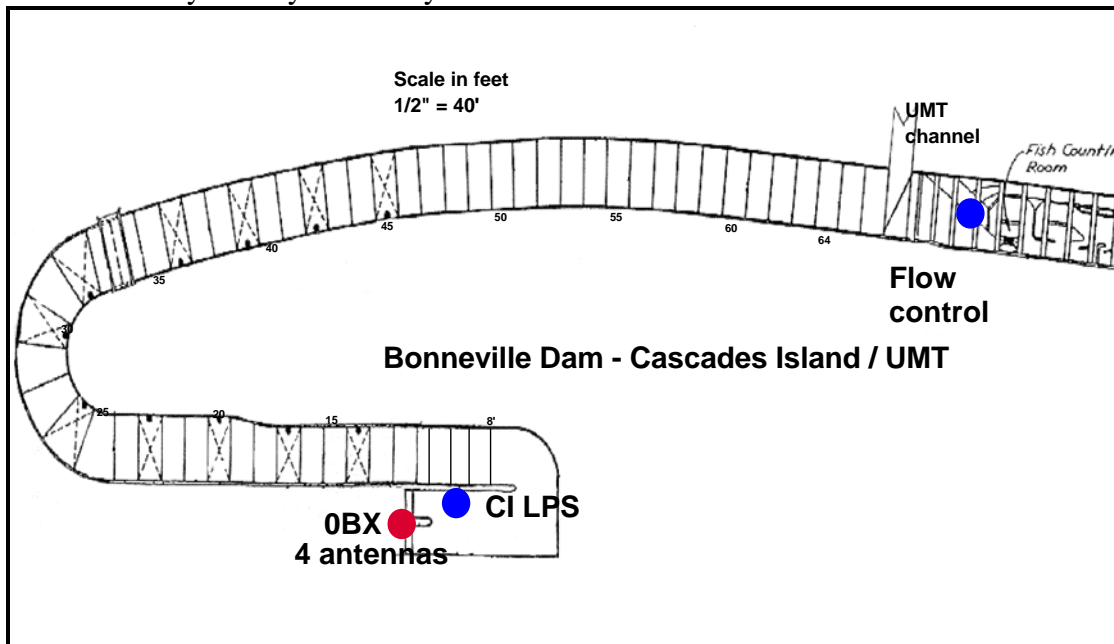
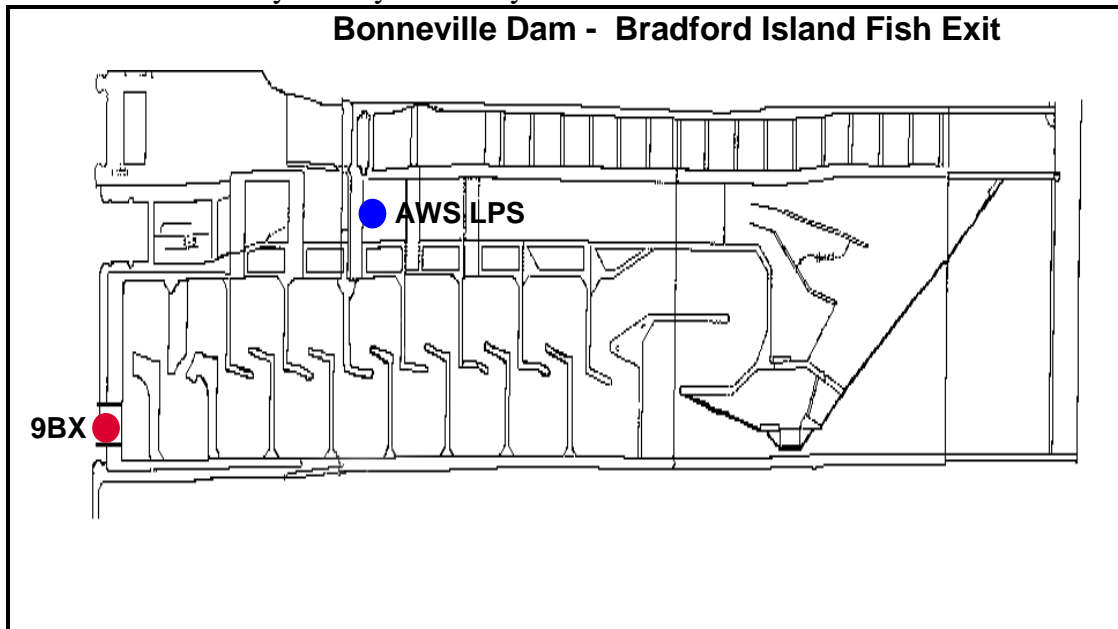


Figure J2. Locations of HD PIT antennas in the Cascades Island fishway at Bonneville Dam. See Table A10 for year-to-year history.



Appendix J. Maps of HD PIT antenna locations

Figure J3. Locations of HD PIT antennas in the top of the Bradford Island fishway at Bonneville Dam. See Table A10 for year-to-year history.



Appendix J. Maps of HD PIT antenna locations

Figure J4. Locations of HD PIT antennas in the south fishway at The Dalles Dam. See Table A10 for year-to-year history.

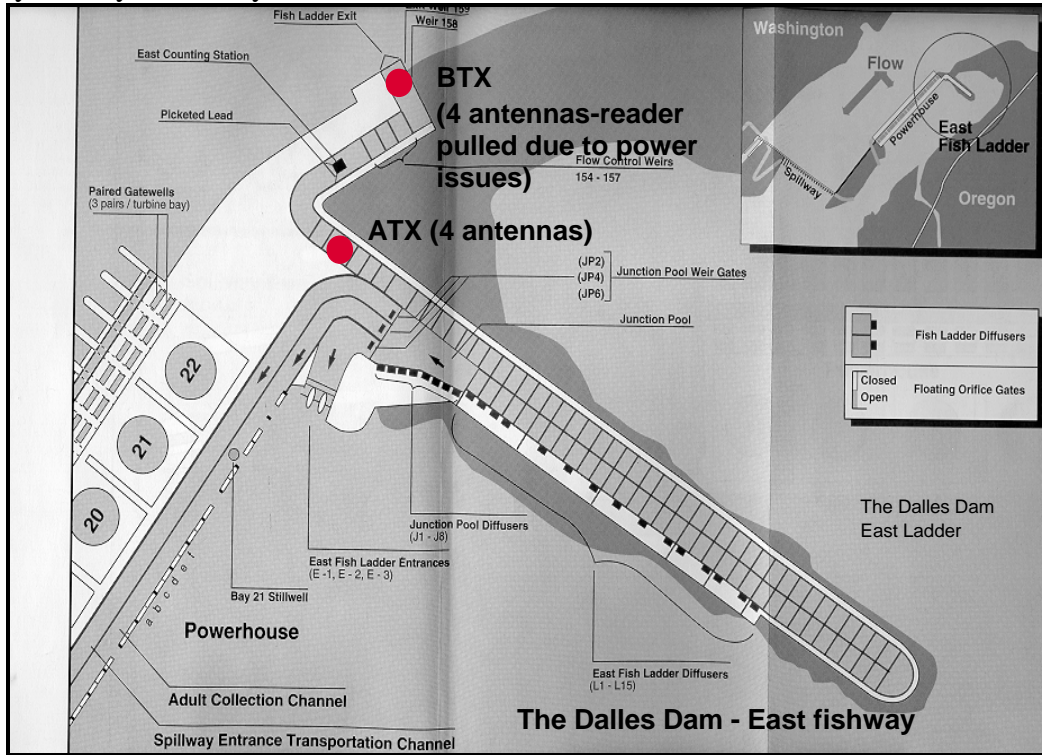
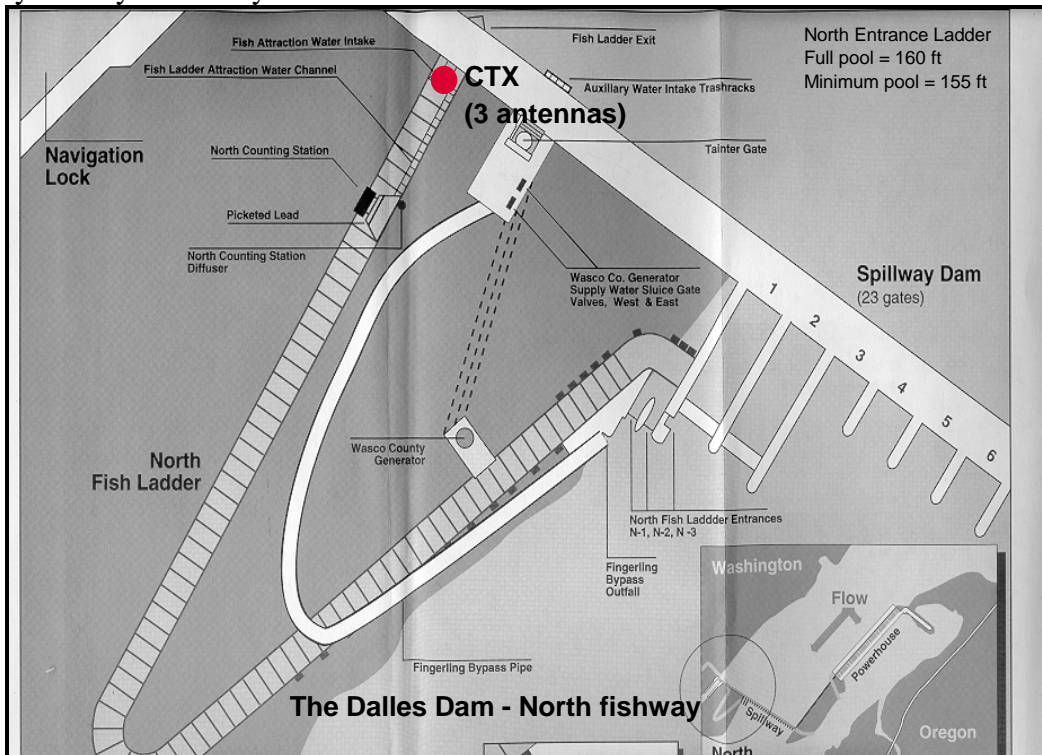


Figure J5. Locations of HD PIT antennas in the north fishway at The Dalles Dam. See Table A10 for year-to-year history.



Appendix J. Maps of HD PIT antenna locations

Figure J6. Locations of HD PIT antennas in the south fishway at John Day Dam. See Table A10 for year-to-year history.

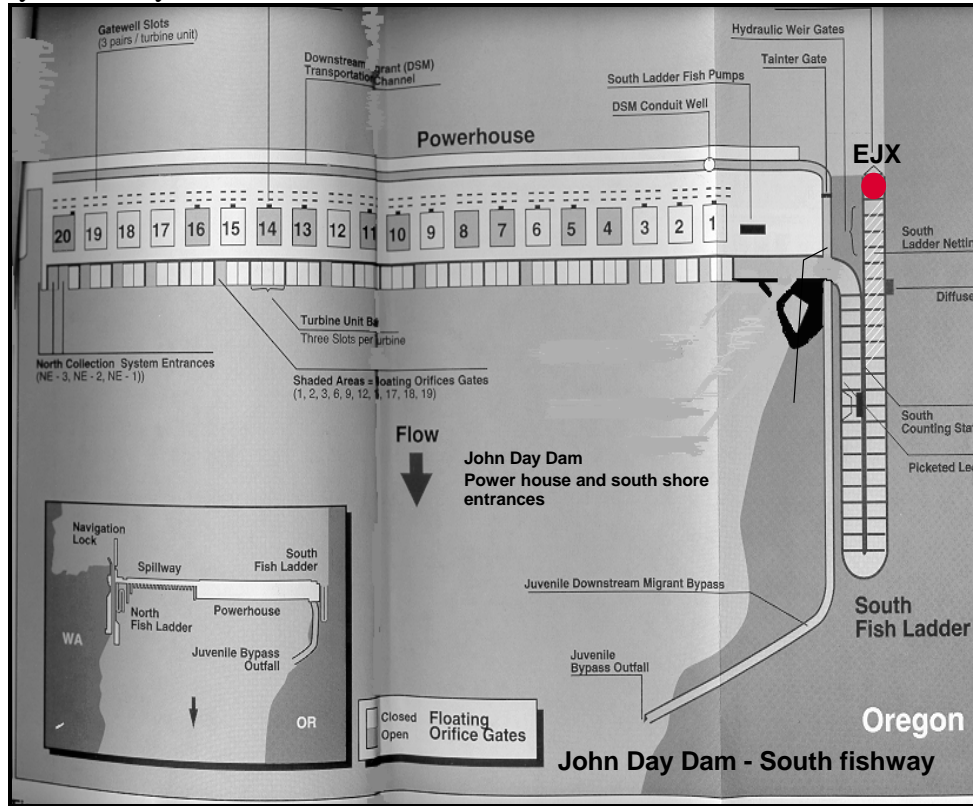
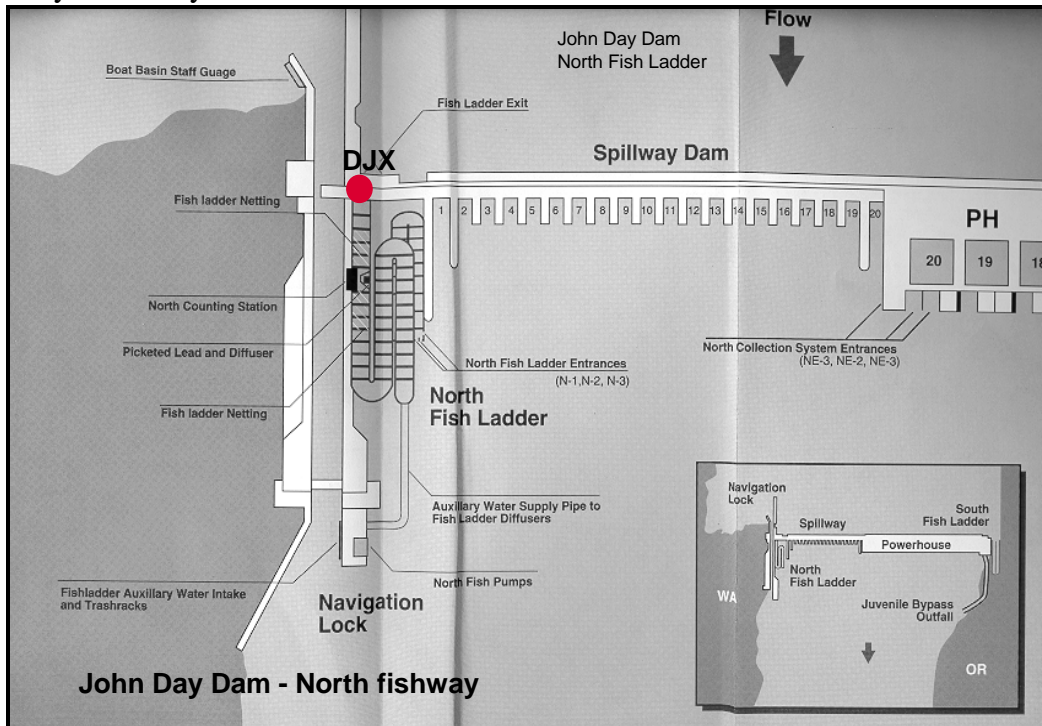
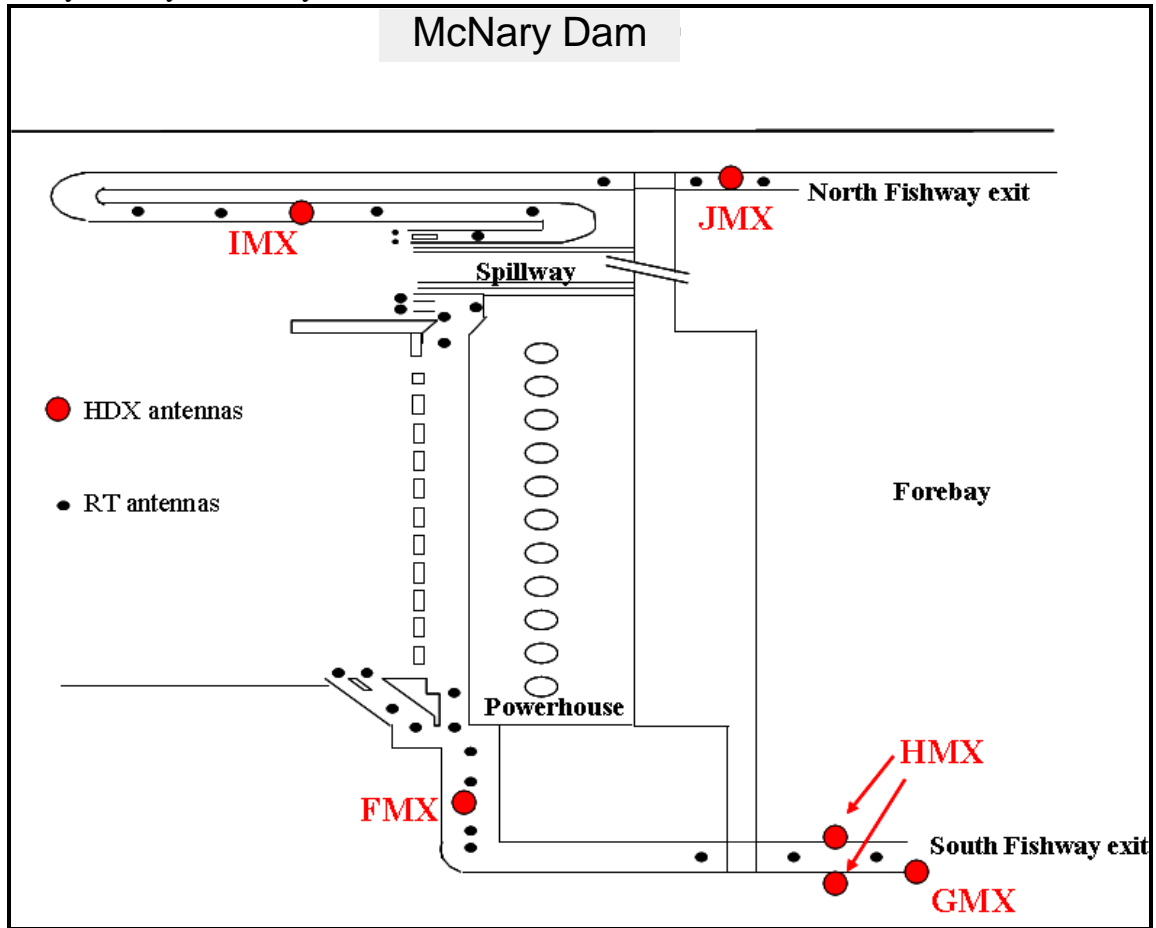


Figure J7. Locations of HD PIT antennas in the north fishway at John Day Dam. See Table A10 for year-to-year history.



Appendix J. Maps of HD PIT antenna locations

Figure J8. Locations of HD PIT antennas in the McNary fishways at Bonneville Dam. See Table A10 for year-to-year history.



Appendix J. Maps of HD PIT antenna locations

Figure J9. Locations of HD PIT antennas in the south fishway at Ice Harbor Dam. See Table A11 for year-to-year history.

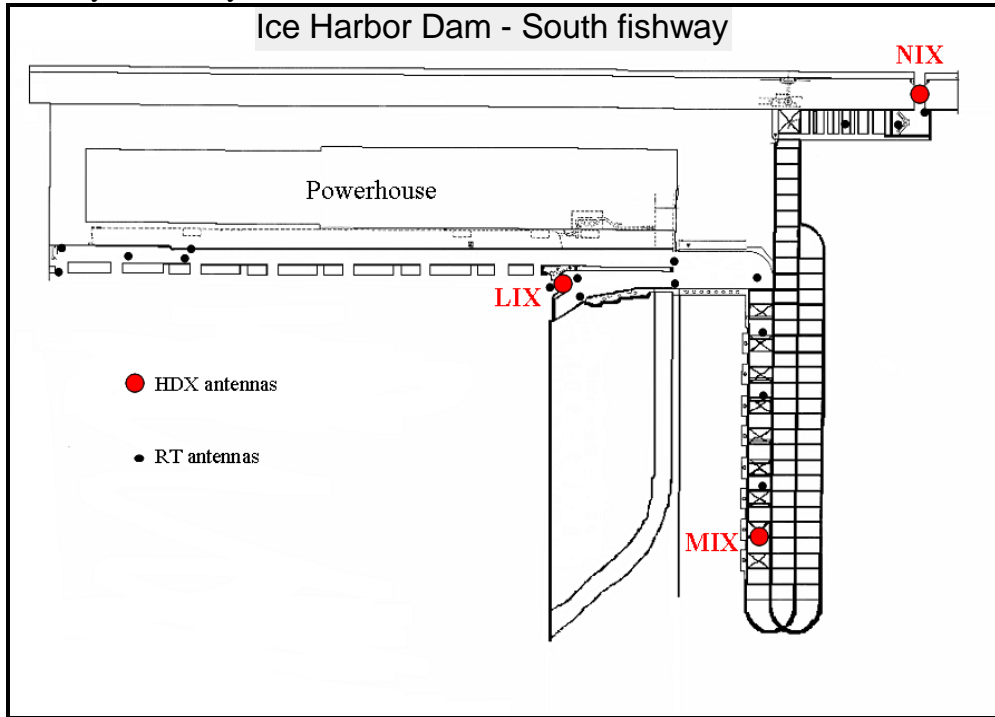
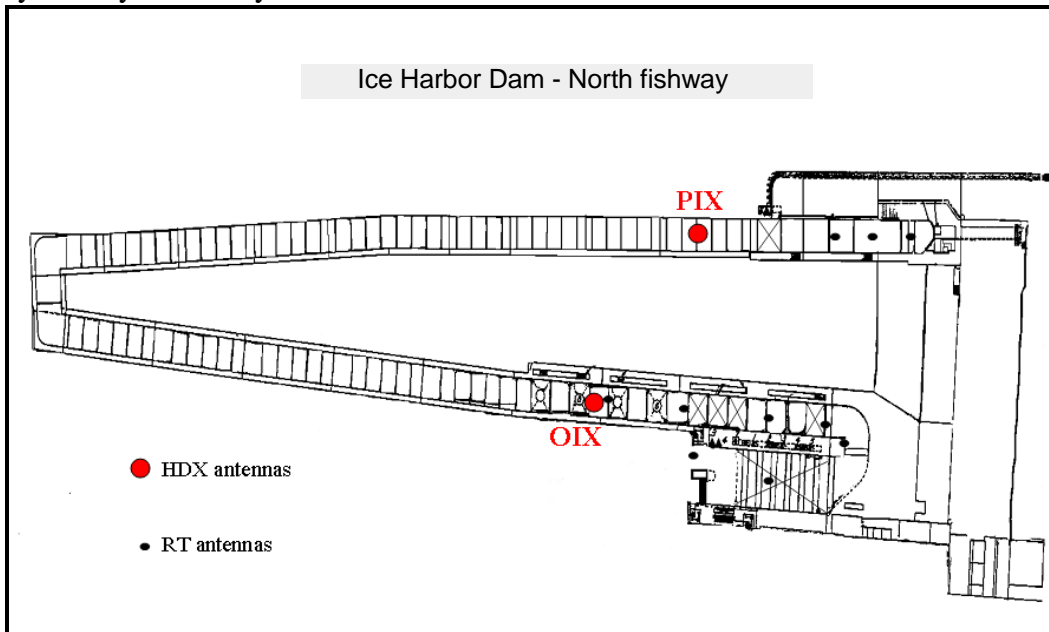


Figure J10. Locations of HD PIT antennas in the north fishway at Ice Harbor Dam. See Table A11 for year-to-year history.



Appendix J. Maps of HD PIT antenna locations

Figure J11. Locations of HD PIT antennas in the south fishway at Lower Monumental Dam. See Table A11 for year-to-year history.

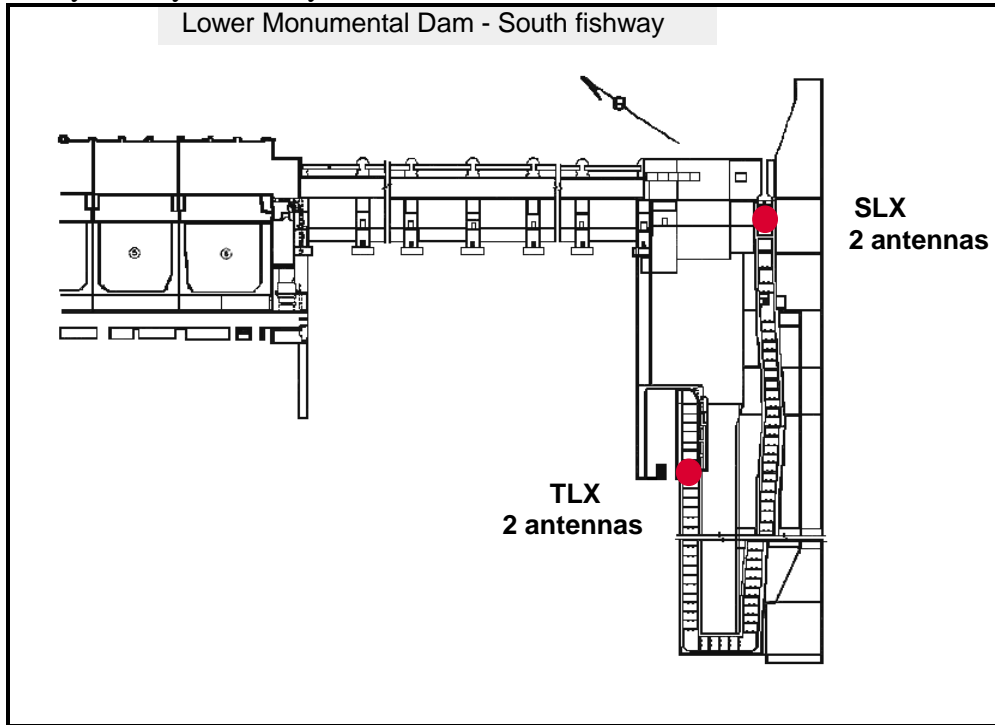
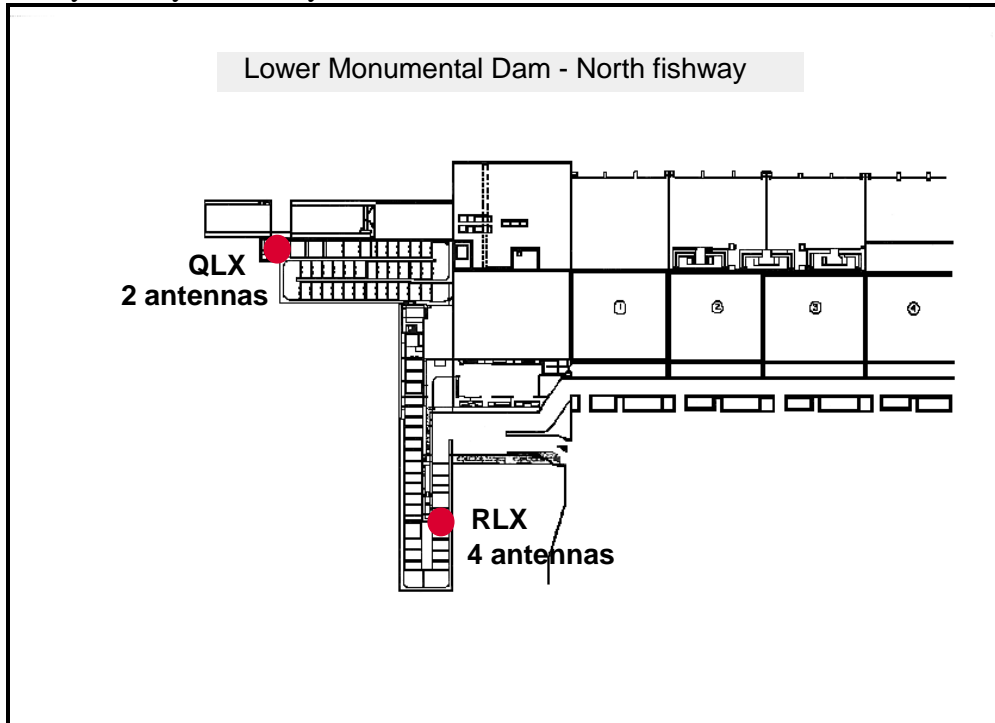


Figure J12. Locations of HD PIT antennas in the north fishway at Lower Monumental Dam. See Table A11 for year-to-year history.



Appendix J. Maps of HD PIT antenna locations

Figure J13. Locations of HD PIT antennas in the fishway at Lower Granite Dam. See Table A11 for year-to-year history.

