

## TABLE OF CONTENTS

LIST OF FIGURES .....	xv
LIST OF TABLES .....	xxiii
ACRONYMS AND ABBREVIATIONS .....	xxxix
SUMMARY .....	xxxiii
<b>1.0 PURPOSE OF ACTION AND NEED FOR POWER.....</b>	<b>1-1</b>
1.1 PURPOSE OF ACTION.....	1-1
1.2 NEED FOR POWER.....	1-1
1.3 INTERVENTIONS.....	1-4
1.4 SCOPING .....	1-5
1.5 RECOMMENDATIONS, TERMS, AND CONDITIONS.....	1-5
1.6 COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT .....	1-6
<b>2.0 PROPOSED ACTION AND ALTERNATIVES .....</b>	<b>2-1</b>
2.1 NO-ACTION ALTERNATIVE.....	2-1
2.1.1 Existing Project Facilities .....	2-1
2.1.1.1 East Side and West Side Developments .....	2-1
2.1.1.2 Keno Development .....	2-5
2.1.1.3 J.C. Boyle Development .....	2-7
2.1.1.4 Copco No. 1 Development.....	2-8
2.1.1.5 Copco No. 2 Development.....	2-11
2.1.1.6 Fall Creek Development .....	2-12
2.1.1.7 Iron Gate Development.....	2-12
2.1.1.8 Project Safety.....	2-14
2.1.2 Existing Project Operations .....	2-14
2.1.3 Existing Environmental Measures .....	2-15
2.2 PACIFICORP'S PROPOSAL .....	2-16
2.2.1 Proposed Project Facilities.....	2-16
2.2.1.1 East Side and West Side Developments .....	2-17
2.2.1.2 Keno Development .....	2-17
2.2.1.3 J.C. Boyle Development .....	2-17
2.2.1.4 Copco No. 2 Development.....	2-18
2.2.1.5 Fall Creek Development .....	2-18
2.2.1.6 Iron Gate Development.....	2-18
2.2.2 Proposed Project Operations.....	2-19
2.2.3 Proposed Environmental Measures .....	2-19
2.2.4 Proposed Project Boundary .....	2-22
2.2.4.1 East Side and West Side Developments .....	2-23
2.2.4.2 Keno Development .....	2-23
2.2.4.3 J.C. Boyle Development .....	2-23
2.2.4.4 Copco No. 1 Development.....	2-24
2.2.4.5 Copco No. 2 Development.....	2-25
2.2.4.6 Fall Creek Development .....	2-25
2.2.4.7 Iron Gate Development.....	2-26
2.3 MODIFICATIONS TO THE PROPOSED ACTION .....	2-26
2.3.1 Mandatory Conditions .....	2-26
2.3.1.1 Water Quality Certification .....	2-26

2.3.1.2	Section 18 Fishway Prescriptions .....	2-27
2.3.1.3	Alternative Section 18 Fishway Prescriptions Pursuant to the Energy Policy Act of 2005.....	2-30
2.3.1.4	Section 4(e) Federal Land Management Conditions .....	2-32
2.3.1.5	Alternative Section 4(e) Conditions from Others .....	2-45
2.3.1.6	Administrative Law Judge Decision.....	2-45
2.3.2	Staff Alternative.....	2-46
2.3.3	Staff Alternative with Mandatory Conditions.....	2-53
2.3.4	Retirement of Copco No. 1 and Iron Gate Developments .....	2-54
2.3.4.1	Retirement of Copco No. 1 and Iron Gate Developments .....	2-56
2.3.4.2	Four-Dam Removal Alternative .....	2-59
2.4	ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY .....	2-60
2.4.1	Federal Government Takeover .....	2-60
2.4.2	Nonpower License .....	2-60
2.4.3	Decommissioning of Project with Dams Remaining in Place .....	2-61
3.0	ENVIRONMENTAL CONSEQUENCES .....	3-1
3.1	GENERAL DESCRIPTION OF THE KLAMATH RIVER BASIN .....	3-1
3.2	SCOPE OF THE CUMULATIVE EFFECTS ANALYSIS .....	3-2
3.2.1	Geographic Scope .....	3-3
3.2.2	Temporal Scope .....	3-4
3.3	PROPOSED ACTION AND ACTION ALTERNATIVES .....	3-5
3.3.1	Geology and Soils.....	3-5
3.3.1.1	Affected Environment.....	3-5
3.3.1.1.1	Soils.....	3-5
3.3.1.1.2	Slope Stability/Landslides.....	3-5
3.3.1.1.3	Klamath River Geomorphology .....	3-6
3.3.1.1.4	Fluvial Geomorphic Conditions for Riparian Vegetation .....	3-23
3.3.1.2	Environmental Effects .....	3-27
3.3.1.2.1	Shoreline Erosion.....	3-27
3.3.1.2.2	Project Effects on Sediment Supply.....	3-29
3.3.1.2.3	Project Effects on Sediment Transport .....	3-33
3.3.1.2.4	Effect of Project Operations on Erosion and Sediment Transport at Cultural Sites and Tributary Confluences.....	3-51
3.3.1.2.5	Fluvial Geomorphic Effects on Riparian Vegetation.....	3-52
3.3.1.2.6	Development Decommissioning and Dam Removal .....	3-57
3.3.1.3	Cumulative Effects .....	3-61
3.3.1.4	Unavoidable Adverse Effects .....	3-62
3.3.2	Water Resources .....	3-62
3.3.2.1	Affected Environment.....	3-62
3.3.2.1.1	Water Quantity .....	3-62
3.3.2.1.2	Water Quality .....	3-95
3.3.2.2	Environmental Effects .....	3-131
3.3.2.2.1	Water Quantity.....	3-131
3.3.2.2.2	Water Quality.....	3-141
3.3.2.3	Cumulative Effects .....	3-172
3.3.2.4	Unavoidable Adverse Effects .....	3-173
3.3.3	Aquatic Resources .....	3-174
3.3.3.1	Affected Environment.....	3-174

3.3.3.1.1	Aquatic Habitat Conditions.....	3-174
3.3.3.1.2	Anadromous Fish Species.....	3-208
3.3.3.1.3	Trinity and Iron Gate Hatcheries.....	3-220
3.3.3.1.4	Diseases Affecting Salmon and Steelhead.....	3-226
3.3.3.1.5	Salmon and Steelhead Harvest and Harvest Management...	3-230
3.3.3.1.6	Resident Fish Species.....	3-242
3.3.3.1.7	Aquatic Macroinvertebrates.....	3-243
3.3.3.2	Environmental Effects.....	3-247
3.3.3.2.1	Instream Flows.....	3-247
3.3.3.2.2	Fish Passage.....	3-283
3.3.3.2.3	Disease Management.....	3-304
3.3.3.2.4	Dam Removal or Decommissioning.....	3-312
3.3.3.2.5	Anadromous Fish Restoration.....	3-317
3.3.3.2.6	Iron Gate Hatchery Operations.....	3-333
3.3.3.2.7	Habitat Enhancement.....	3-338
3.3.3.2.8	Monitoring and Adaptive Management.....	3-341
3.3.3.3	Cumulative Effects.....	3-345
3.3.3.3.1	Chinook Salmon.....	3-345
3.3.3.3.2	Steelhead.....	3-347
3.3.3.3.3	Rainbow Trout.....	3-347
3.3.3.3.4	Pacific Lamprey.....	3-347
3.3.3.4	Unavoidable Adverse Effects.....	3-348
3.3.4	Terrestrial Resources.....	3-348
3.3.4.1	Affected Environment.....	3-348
3.3.4.1.1	Botanical Resources.....	3-348
3.3.4.1.2	Wildlife Resources.....	3-361
3.3.4.2	Environmental Effects.....	3-376
3.3.4.2.1	Vegetation Management/Noxious and Invasive Species Control.....	3-376
3.3.4.2.2	Wildlife Resource Management.....	3-386
3.3.4.2.3	Development Decommissioning and Dam Removal.....	3-398
3.3.4.3	Unavoidable Adverse Effects.....	3-399
3.3.5	Threatened and Endangered Species.....	3-399
3.3.5.1	Affected Environment.....	3-399
3.3.5.1.1	Lost River and Shortnose Sucker.....	3-399
3.3.5.1.2	Coho Salmon.....	3-401
3.3.5.1.3	Bull Trout.....	3-404
3.3.5.1.4	Essential Fish Habitat.....	3-405
3.3.5.1.5	Slender Orcutt Grass.....	3-406
3.3.5.1.6	Applegate's Milk-vetch.....	3-406
3.3.5.1.7	Gentner's Fritillaria.....	3-406
3.3.5.1.8	California Red-legged Frog.....	3-407
3.3.5.1.9	Bald Eagle.....	3-407
3.3.5.1.10	Northern Spotted Owl.....	3-410
3.3.5.1.11	Western Snowy Plover.....	3-411
3.3.5.1.12	Canada Lynx.....	3-412
3.3.5.1.13	Gray Wolf.....	3-412
3.3.5.2	Environmental Effects.....	3-412
3.3.5.2.1	General Recommendations.....	3-412
3.3.5.2.2	Coho Salmon.....	3-413
3.3.5.2.3	Lost River and Shortnose Suckers.....	3-417

3.3.5.2.4	Bull Trout.....	3-418
3.3.5.2.5	Applegate’s Milk-vetch.....	3-419
3.3.5.2.6	Gentner’s Fritillaria.....	3-419
3.3.5.2.7	Bald Eagle.....	3-420
3.3.5.2.8	Northern Spotted Owl.....	3-423
3.3.5.3	Cumulative Effects.....	3-424
3.3.5.3.1	Coho Salmon.....	3-424
3.3.5.3.2	Shortnose and Lost River Suckers.....	3-425
3.3.5.4	Unavoidable Adverse Effects.....	3-426
3.3.6	Recreational Resources.....	3-426
3.3.6.1	Affected Environment.....	3-426
3.3.6.1.1	Regional Recreational Setting.....	3-426
3.3.6.1.2	Project Recreational Resources.....	3-431
3.3.6.2	Environmental Effects.....	3-449
3.3.6.2.1	Recreation Resource Management.....	3-450
3.3.6.2.2	River Recreation.....	3-467
3.3.6.2.3	Development Decommissioning and Dam Removal.....	3-489
3.3.6.3	Unavoidable Adverse Effects.....	3-490
3.3.7	Land Use and Aesthetic Resources.....	3-490
3.3.7.1	Affected Environment.....	3-490
3.3.7.1.1	Land Use, Ownership, and Management.....	3-490
3.3.7.1.2	Road Management.....	3-494
3.3.7.1.3	Aesthetic Resources.....	3-496
3.3.7.2	Environmental Effects.....	3-499
3.3.7.2.1	Land Management and Use.....	3-499
3.3.7.2.2	Road Management.....	3-504
3.3.7.2.3	Project Boundary.....	3-506
3.3.7.2.4	Aesthetic Resources.....	3-508
3.3.7.2.5	Development Decommissioning and Dam Removal.....	3-510
3.3.7.3	Unavoidable Adverse Effects.....	3-511
3.3.8	Socioeconomic Resources.....	3-511
3.3.8.1	Affected Environment.....	3-511
3.3.8.1.1	Demographic Characteristics.....	3-513
3.3.8.1.2	Project-related Economic Sectors.....	3-520
3.3.8.2	Environmental Effects.....	3-526
3.3.8.2.1	Project Employment, Payroll, and Taxes.....	3-527
3.3.8.2.2	Recreation.....	3-528
3.3.8.2.3	Commercial Fishing, Recreational Ocean Fishing, and the Tribal Fishery.....	3-532
3.3.8.2.4	Minority and Low Income Populations (Environmental Justice).....	3-534
3.3.8.3	Cumulative Effects.....	3-536
3.3.8.3.1	Fisheries.....	3-536
3.3.8.3.2	Indian Tribes.....	3-536
3.3.8.3.3	Agriculture.....	3-536
3.3.8.4	Unavoidable Adverse Effects.....	3-538
3.3.9	Cultural Resources.....	3-538
3.3.9.1	Affected Environment.....	3-538
3.3.9.1.1	Definition of Cultural Resources, Historic Properties, Effects, and Area of Potential Effects.....	3-538
3.3.9.1.2	Cultural History Overview.....	3-539

	3.3.9.1.3 Prehistoric and Historic Archaeological Resources .....	3-543
	3.3.9.1.4 Historic Buildings and Structures .....	3-544
	3.3.9.1.5 Traditional Cultural Properties.....	3-545
	3.3.9.2 Environmental Effects .....	3-546
	3.3.9.2.1 Effects of Project Operations on Cultural Resources.....	3-546
	3.3.9.2.2 Management of Cultural Resources .....	3-550
	3.3.9.3 Unavoidable Adverse Effects .....	3-557
3.4	NO-ACTION ALTERNATIVE.....	3-557
3.5	IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES....	3-557
3.6	RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY .....	3-557
4.0	DEVELOPMENTAL ANALYSIS .....	4-1
4.1	POWER AND ECONOMIC BENEFITS OF THE NO-ACTION ALTERNATIVE ....	4-3
4.2	POWER AND ECONOMIC BENEFITS OF PACIFICORP’S PROPOSAL .....	4-3
4.3	POWER AND ECONOMIC BENEFITS OF THE STAFF ALTERNATIVE .....	4-4
4.4	POWER AND ECONOMIC BENEFITS OF THE STAFF ALTERNATIVE WITH MANDATORY CONDITIONS.....	4-4
4.5	POWER AND ECONOMIC BENEFITS OF RETIREMENT OF COPCO NO. 1 AND IRON GATE DEVELOPMENTS.....	4-4
4.6	POWER AND ECONOMIC BENEFITS OF RETIREMENT OF J.C. BOYLE, COPCO NO. 1, COPCO NO. 2, AND IRON GATE DEVELOPMENTS.....	4-4
4.7	CONCEPTUAL COSTS OF PROJECT DAM REMOVAL.....	4-5
	4.7.1 Keno Development .....	4-7
	4.7.2 J.C. Boyle Development .....	4-7
	4.7.3 Copco No. 1 Development.....	4-8
	4.7.4 Copco No. 2 Development.....	4-8
	4.7.5 Fall Creek Development .....	4-9
	4.7.6 Iron Gate .....	4-9
4.8	KENO DEVELOPMENT ANALYSIS .....	4-13
4.9	GREENHOUSE GAS EMISSIONS.....	4-22
5.0	STAFF’S CONCLUSIONS .....	5-1
5.1	SUMMARY COMPARISON OF APPLICANT’S PROPOSAL AND STAFF ALTERNATIVE.....	5-1
	5.1.1 Description of Alternatives.....	5-1
	5.1.1.1 PacifiCorp’s Proposal .....	5-1
	5.1.1.2 Staff Alternative.....	5-1
	5.1.1.3 Staff Alternative with Mandatory Conditions.....	5-10
	5.1.1.4 Retirement of Copco No. 1 and Iron Gate Developments with Staff Measures .....	5-11
	5.1.1.5 Retirement of J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Developments with Staff Measures.....	5-13
	5.1.2 Summary of Effects .....	5-15
5.2	DISCUSSION OF KEY ISSUES .....	5-28
	5.2.1 Seasonal High Flows and Sediment Management.....	5-28
	5.2.2 Restoration of Slopes and Channel at the J.C. Boyle Bypassed Reach .....	5-31
	5.2.3 Project Operation Management .....	5-34
	5.2.4 Water Quality Management.....	5-35
	5.2.5 Instream Flows.....	5-37

5.2.6	Anadromous Fish Restoration .....	5-47
5.2.7	Fish Disease Management .....	5-53
5.2.8	Resident Fish Passage .....	5-54
5.2.9	Hatchery Management .....	5-56
5.2.10	Aquatic Habitat Enhancement .....	5-59
5.2.11	Aquatic Resources Monitoring .....	5-60
5.2.12	Vegetation Management .....	5-62
5.2.13	Wildlife Management .....	5-65
5.2.14	Recreational Resource Management.....	5-66
5.2.15	Aesthetic Resource Management.....	5-68
5.2.16	Road Management .....	5-69
5.2.17	Cultural Resources Management .....	5-69
5.2.18	East Side and West Side Development Decommissioning .....	5-70
5.2.19	Keno Development .....	5-71
5.2.20	Project Boundary Changes.....	5-72
5.2.21	Dam Removal .....	5-73
5.3	PREFERRED ALTERNATIVE .....	5-82
5.4	SUMMARY OF SECTION 10(J) RECOMMENDATIONS AND 4(E) CONDITIONS .....	5-82
5.4.1	Fish and Wildlife Agency Recommendations .....	5-82
5.4.2	U.S. Bureau of Land Management and U.S Bureau of Reclamation Section 4(e) Conditions .....	5-104
5.5	CONSISTENCY WITH COMPREHENSIVE AND OTHER RESOURCE PLANS .....	5-110
5.6	RELATIONSHIP OF LICENSE PROCESS TO LAWS AND POLICIES .....	5-114
5.6.1	Section 401 of the Clean Water Act—Water Quality Certification.....	5-114
5.6.2	Coastal Zone Management Act—Consistency Certification .....	5-114
5.6.3	Section 18 of the Federal Power Act—Authority to Prescribe Fishways .....	5-114
5.6.4	Endangered Species Act .....	5-114
5.6.5	Essential Fish Habitat .....	5-116
5.6.6	National Historic Preservation Act .....	5-116
5.6.7	Wild and Scenic Rivers Act.....	5-117
6.0	LITERATURE CITED .....	6-1
7.0	LIST OF PREPARERS.....	7-1
8.0	LIST OF RECIPIENTS .....	8-1
APPENDIX A	COSTS OF PROPOSED, RECOMMENDED, PRESCRIBED, AND SPECIFIED ENVIRONMENTAL MEASURES FOR THE KLAMATH HYDROELECTRIC PROJECT .....	A-1
APPENDIX B	STAFF RESPONSES TO COMMENTS ON THE DRAFT EIS .....	B-1
APPENDIX C	COMMENTS OF INDIVIDUALS ON THE DRAFT EIS .....	C-1
APPENDIX D	ORAL COMMENTS OF INDIVIDUALS ON THE DRAFT EIS FROM PUBLIC MEETINGS.....	D-1

## LIST OF FIGURES

Figure 1-1.	Klamath River Basin showing major rivers, reservoirs, and lakes within the watershed.....	1-2
Figure 2-1.	Schematic of existing PacifiCorp project facilities .....	2-2
Figure 2-2.	General site location of the Klamath Hydroelectric Project, Link River dam to Keno reservoir .....	2-4
Figure 2-3.	General site location of the Klamath Hydroelectric Project, Keno reservoir to downstream of J.C. Boyle powerhouse (the peaking reach). .....	2-6
Figure 2-4.	Schematic showing movement of water through the Klamath Irrigation Project area .....	2-7
Figure 2-5.	General site location of the Klamath Hydroelectric Project, from the J.C. Boyle peaking reach to Copco reservoir .....	2-9
Figure 2-6.	General site location of the Klamath Hydroelectric Project, from Copco reservoir to Iron Gate dam.....	2-10
Figure 2-7.	Locations of project facilities, Fall Creek development.....	2-13
Figure 3-1.	Klamath River profile.....	3-7
Figure 3-2.	Klamath River pebble counts, median (D50) particle size longitudinal distribution.....	3-8
Figure 3-3.	Flows released from J.C. Boyle dam to the bypassed reach under historical conditions and flows specified in the NMFS, Bureau of Land Management, and Oregon Fish & Wildlife seasonal high flow measure.....	3-40
Figure 3-4.	Conceptual diagram of the box model for riparian recruitment .....	3-53
Figure 3-5.	NMFS BiOp Phase III flow regimes for Iron Gate dam based on water year .....	3-56
Figure 3-6.	Upper Klamath Lake historical lake levels.....	3-65
Figure 3-7.	Keno reservoir March and July median inflows and outflows upstream of Keno dam .....	3-71
Figure 3-8.	Keno reservoir daily water surface elevations.....	3-73
Figure 3-9.	J.C. Boyle reservoir daily water surface elevations for January 2, 1990, to December 5, 2004.....	3-75
Figure 3-10.	Klamath River flows (cfs) during July for the J.C. Boyle peaking reach for water years 1990 to 2004.....	3-77
Figure 3-11.	Copco reservoir daily water surface elevations .....	3-79
Figure 3-12.	Iron Gate reservoir daily water surface elevations .....	3-81
Figure 3-13.	Flow below Iron Gate dam for water years 1963 to 2004.....	3-82
Figure 3-14.	Iron Gate flows for April 1 through September 30, 2003.....	3-84
Figure 3-15.	Iron Gate flows for April 1 though September 30, 2004.....	3-84
Figure 3-16.	Iron Gate flows for April 1 though September 30, 2005 .....	3-85

Figure 3-17.	Daily Klamath River flow at Seiad Valley (USGS gage no. 11520500) for water years 1963 to 2004.....	3-89
Figure 3-18.	Daily Klamath River flow at Orleans (USGS gage no. 11523000) for water years 1963 to 2004.....	3-90
Figure 3-19.	Yearly flow exceedance curves for gage no. 11530000 Trinity River at Hoopa, CA, representing pre- and post-TRD flow conditions.....	3-91
Figure 3-20.	Daily inflow from the Trinity River at the confluence with the Klamath River for water years 1963 to 2004.....	3-92
Figure 3-21.	Flow release schedule from Lewiston reservoir based on the 2000 Record of Decision.....	3-94
Figure 3-22.	Daily flow at USGS gage no. 11530500 Klamath River at Klamath, CA for water years 1963 to 2004.....	3-94
Figure 3-23.	Water temperatures measured above and below the J.C. Boyle development during peaking operation (top) and during non-peaking flow (bottom), 2002.....	3-100
Figure 3-24.	Average monthly temperature profiles for Copco (2002-top) and Iron Gate (2001-bottom).....	3-101
Figure 3-25.	Daily average water temperature data from below Iron Gate dam and from a depth of 10 feet in the Iron Gate reservoir.....	3-102
Figure 3-26.	Temperature trends based on hourly data in the Klamath River immediately below Iron Gate dam. ....	3-103
Figure 3-27.	Temperature trends based on hourly data in the Klamath River above the Shasta River confluence.....	3-103
Figure 3-28.	Temperature trends based on hourly data in the Klamath River at Seiad Valley ...	3-104
Figure 3-29.	Temperature trends based on hourly data in the Klamath River at Weitchpec (RM 43.5).....	3-104
Figure 3-30.	Trends in DO concentrations based on hourly data in Keno reservoir at Miller Island.....	3-106
Figure 3-31.	Trends in DO concentrations based on hourly data in the Klamath River above Copco reservoir.....	3-106
Figure 3-32.	Trends in DO concentrations based on hourly data in the Klamath River below Iron Gate dam.....	3-107
Figure 3-33.	Trends in DO concentrations based on hourly data in the Klamath River at Seiad Valley.....	3-107
Figure 3-34.	Comparison of flows and DO concentrations in the Klamath River (peaking reach) below J.C. Boyle powerhouse in August 2002.....	3-109
Figure 3-35.	Average DO concentrations at 1 meter intervals in Copco (top) and Iron Gate (bottom) reservoirs from March through November, 2002.....	3-110
Figure 3-36.	Total phosphorous concentrations measured during 1991 to 1999 in Upper Klamath Lake and its outflow.....	3-112
Figure 3-37.	Upper Klamath Lake mean total phosphorus concentrations (1991 – 1998).....	3-112

Figure 3-38.	Longitudinal gradient in average nitrogen concentrations in the Klamath River from Link River to the estuary in August 2002.....	3-113
Figure 3-39.	Longitudinal profile of mean summer total nitrogen concentrations in the Klamath River mainstem sites for the years 2000-2004 (reservoirs excluded).....	3-114
Figure 3-40.	Longitudinal profile of mean summer total phosphorus concentrations in the Klamath River mainstem sites for the years 2000-2004 (reservoirs excluded).....	3-114
Figure 3-41.	Minimum, mean and maximum total orthophosphate (top) and phosphorous (bottom) concentrations (mg/L) in the Klamath River between Upper Klamath Lake and Keno dam during June, July, August, and September 2001-2004.....	3-116
Figure 3-42.	Minimum, mean, and maximum total phosphorous (top) and orthophosphate (bottom) concentrations (mg/L) in the Klamath River from Keno dam to the confluence with the Shasta River during June, July, August, and September 2001-2004.....	3-117
Figure 3-43.	Minimum, mean, and maximum total nitrate (top) and ammonia (bottom) nitrogen (mg/L) concentrations in the Klamath River between Upper Klamath Lake and Keno dam during June, July, August, and September 2001-2004.....	3-118
Figure 3-44.	Minimum, mean, and maximum total nitrate (top) and ammonia (bottom) nitrogen (mg/L) concentrations in the Klamath River between Keno dam and the confluence with the Shasta River during June, July, August, and September 2001-2004.....	3-119
Figure 3-45.	Box plot showing the distribution by month of combined chlorophyll a values measured in Copco and Iron Gate reservoirs during 2000 to 2003.....	3-123
Figure 3-46.	Maximum, mean, and minimum chlorophyll a concentrations at four stations below Iron Gate dam from data collected in 1996 and 1997.....	3-124
Figure 3-47.	Seasonal trends in chlorophyll a concentrations at four stations below Iron Gate dam from data collected in 1996 and 1997 by NCRWQCB.....	3-124
Figure 3-48.	Average August daily maximum pH values for locations along the mainstem Klamath River below Iron Gate dam for the years 2000-2004 using data collected by FWS, USGS, and the Karuk and Yurok tribes.....	3-127
Figure 3-49.	Variability in pH values in the mainstem Klamath River below Iron Gate dam and at Seiad Valley, 2002 (half hour intervals).....	3-127
Figure 3-50.	Simulated hourly water temperature below Iron Gate dam (RM 190.5) based on 2002 (considered a dry year) for existing conditions compared to hypothetical conditions without the existing Klamath Hydroelectric Project.....	3-143
Figure 3-51.	Simulated hourly DO levels below Iron Gate dam based on the year 2002 (a dry year) for existing conditions compared to hypothetical conditions without the Klamath Hydroelectric Project.....	3-148
Figure 3-52.	Box plots of existing conditions and without project daily minimum, mean, and maximum water temperatures from April to November for the years 2000 through 2004 below Keno dam predicted by PacifiCorp's Klamath River Water Quality Model.....	3-162

Figure 3-53.	Box plots of 2-week summaries of modeled existing conditions and without project daily minimum, mean, and maximum water temperatures from April to November for the years 2000 through 2004 below J.C. Boyle dam, above the springs within the bypassed reach, predicted by PacifiCorp’s Klamath River Water Quality Model.....	3-164
Figure 3-54.	Box plots of 2-week summaries of modeled existing conditions and without project daily minimum, mean, and maximum water temperatures from April to November for the years 2000 through 2004 above J.C. Boyle powerhouse, below the springs within the bypassed reach, predicted by PacifiCorp’s Klamath River Water Quality Model.....	3-165
Figure 3-55.	Box plots of 2-week summaries of modeled existing conditions and without project daily minimum, mean, and maximum water temperatures from April to November for the years 2000 through 2004 below Copco 1 dam, predicted by PacifiCorp’s Klamath River Water Quality Model. ....	3-167
Figure 3-56.	Box plots of two week summaries of modeled existing conditions and without project daily minimum, mean, and maximum water temperatures from April to November for the years 2000 through 2004 below Iron Gate dam, predicted by PacifiCorp’s Klamath River Water Quality Model. ....	3-168
Figure 3-57.	Shasta River estimated spawning escapement of grilse and adult fall Chinook salmon, 1930 to 2002. Note: Grilse (jacks) are precocious adult Chinook salmon males that have spent only one year in the ocean .....	3-199
Figure 3-58.	Shasta River weir counts of coho salmon, 1930 to 2002.....	3-200
Figure 3-59.	Shasta River weir counts of adult steelhead, 1930 to 1996.....	3-201
Figure 3-60.	Salmon River estimated spawning escapement of grilse and adult spring Chinook salmon, 1980 to 2002.....	3-203
Figure 3-61.	Salmon River estimated spawning escapement of steelhead, 1980 to 2002.....	3-204
Figure 3-62.	Trinity River estimated spawning escapement of naturally spawning and hatchery spawned spring Chinook salmon, 1978 to 2002 .....	3-206
Figure 3-63.	Trinity River estimated spawning escapement of grilse and adult coho salmon above Willow Creek, 1977 to 2002.....	3-207
Figure 3-64.	Weekly abundance index for natural and hatchery fall Chinook smolts during screw-trap sampling conducted at Big Bar (RM 49.7) on the Klamath River, 1997-2000.....	3-210
Figure 3-65.	Weekly abundance index for fall Chinook smolts during screw-trap sampling conducted at Willow Creek (RM 21.1) on the Trinity River, 1997-2000 .....	3-211
Figure 3-66.	Weekly abundance index for natural and hatchery coho salmon smolts during screw-trap sampling conducted at Big Bar (RM 49.7) on the Klamath River, 1997-2000.....	3-215
Figure 3-67.	Eulachon commercial landings in the Columbia River and tributaries, 1936 to 2001 .....	3-219
Figure 3-68.	Fall Chinook salmon production at Iron Gate Hatchery, 1965 to 2001.....	3-223
Figure 3-69.	Coho salmon production at Iron Gate Hatchery, 1965 to 2001 .....	3-223
Figure 3-70.	Steelhead production at Iron Gate Hatchery, 1965 to 2001.....	3-224

Figure 3-71.	Adult salmon and steelhead returns to the Iron Gate Hatchery .....	3-225
Figure 3-72.	Estimates of <i>Ceratomyxa shasta</i> infection prevalence (poi) and associated confidence levels within selected populations of <i>Manayunkia speciosa</i> collected from the Klamath River. Sites sorted on the x-axis from Upper Klamath Lake (Rkm 441) going downriver towards the mouth .....	3-228
Figure 3-73.	Percent prevalence and percent mortality of rainbow trout ( <i>Oncorhynchus mykiss</i> ) exposed in Klamath River (June 2004) locations reading from the uppermost site (left) to the lowest (right) .....	3-229
Figure 3-74.	Pacific coast ports and management zones.....	3-232
Figure 3-75.	Klamath River total fall Chinook salmon adult natural spawning escapement and ocean landings by PFMC management zone.....	3-234
Figure 3-76.	Klamath River adult fall Chinook salmon river return and spawning escapements, 1978 to 2006.....	3-236
Figure 3-77.	Natural and hatchery Sacramento River fall Chinook salmon escapement to mouth of Sacramento River.....	3-239
Figure 3-78.	Oregon production index area coho salmon abundance estimates by stratified random survey accounting methods, 1970 to 2006 .....	3-241
Figure 3-79.	Total invertebrate density measured during fall 2002 and spring 2003 in the Klamath River between Link River and the confluence with the Shasta River ....	3-244
Figure 3-80.	Number of species of mayflies, stoneflies and caddisflies (EPT richness) measured during fall 2002 and spring 2003 in the Klamath River between Link River and the confluence with the Shasta River.....	3-245
Figure 3-81.	Flows measured below Keno dam in 1992 (dry year).....	3-250
Figure 3-82.	Flows measured below Keno dam in 1995 (average year).....	3-250
Figure 3-83.	Flows measured below Keno dam in 1998 (above average year) .....	3-251
Figure 3-84.	Median channel temperatures versus river mile for Klamath River, CA/OR, along with the location of surface water inflows (represented by red squares) on July 15, 2001 .....	3-254
Figure 3-85.	Rainbow trout WUA for the J.C. Boyle bypassed reach. Discharge equals release from J.C. Boyle dam.....	3-254
Figure 3-86.	Weighted usable area (WUA) as a function of discharge (cfs) in the J.C. Boyle bypassed reach for Chinook salmon, coho salmon, and steelhead juveniles.....	3-256
Figure 3-87.	Hourly flows in the J.C. Boyle peaking reach for representative dry (1992), average (1995), and wet (1998) years .....	3-259
Figure 3-88.	Rainbow trout WUA versus discharge for the J.C. Boyle peaking reach.....	3-260
Figure 3-89.	Length frequency of sampled trout, from 1979 to 1982 Oregon Fish & Wildlife angler surveys.....	3-262
Figure 3-90.	Length frequency of trout collected by hook-and-line sampling in 2002.....	3-263
Figure 3-91.	Comparison of 2004 angler catch rates among 33 wild trout streams in California.....	3-264
Figure 3-92.	Sucker WUA versus discharge for the J.C. Boyle peaking reach .....	3-265

Figure 3-93.	WUA for rainbow trout and suckers in the Copco No. 2 bypassed reach .....	3-269
Figure 3-94.	WUA versus discharge for rainbow trout in Fall Creek .....	3-273
Figure 3-95.	Seven-day moving average water temperatures from 1995 recorded in Jenny Creek above and below the confluence with Spring Creek .....	3-275
Figure 3-96.	Seven-day moving average water temperatures from 1996 recorded in Jenny Creek above and below the confluence with Spring Creek .....	3-275
Figure 3-97.	Seven-day moving average water temperatures from 1997 recorded in Jenny Creek above and below the confluence with Spring Creek .....	3-276
Figure 3-98.	Average monthly flows below Iron Gate dam for 1997, 2000, 2002, 2004, 2005 and 2006 to date.....	3-280
Figure 3-99.	Daily minimum DO conditions in Keno reservoir. Daily minima calculated from hourly data and averaged over 1-3 sites in Keno reservoir from January 2002 – December 2004. Standard deviations calculated from daily averages .....	3-285
Figure 3-100.	Potential fish passage and gravel transport barrier formed by boulder sidecast material in the J.C. Boyle bypassed reach, about 2.5 miles upstream of the J.C. Boyle powerhouse .....	3-295
Figure 3-101.	Percent of weekly frame-trap catch of Chinook salmon that were dead, percent of remaining live Chinook salmon examined that exhibited outward clinical signs of disease, and weekly average discharge at the Kinsman trap site (RM 146) on the Klamath River near the mouth of the Scott River in 2004 .....	3-308
Figure 3-102.	Mean daily flow (cfs) at Orleans and mean daily river temperature (°C) at the Big Bar screw trap sampling site (RM 49.7), 1997-2000.....	3-311
Figure 3-103.	Trends in wild spawning escapement and wild pre-harvest abundance of Rogue River coho salmon, 1980-2001.....	3-403
Figure 3-104.	Klamath Hydroelectric Project recreation facilities: Link River dam to Keno reservoir .....	3-432
Figure 3-105.	Klamath Hydroelectric Project recreation facilities: Keno reservoir to downstream of J.C. Boyle powerhouse .....	3-433
Figure 3-106.	Klamath Hydroelectric Project recreation facilities: J.C. Boyle peaking reach to Copco reservoir .....	3-434
Figure 3-107.	Klamath Hydroelectric Project recreation facilities: Copco reservoir to Iron Gate dam.....	3-435
Figure 3-108.	Below average water year type, Link River bypassed reach optimal angling .....	3-470
Figure 3-109.	Average water year type, Link River bypassed reach optimal angling .....	3-470
Figure 3-110.	Above average water year type, Link River bypassed reach optimal angling.....	3-471
Figure 3-111.	Below average water year type, J.C. Boyle bypassed reach optimal range of flows for angling.....	3-472
Figure 3-112.	Average water year type, J.C. Boyle bypassed reach, optimal range of flows for angling .....	3-472
Figure 3-113.	Above average water year type, J.C. Boyle bypassed reach optimal range of flows for angling.....	3-473

Figure 3-114.	Below average water year type, J.C. Boyle bypassed reach acceptable range of flows for angling.....	3-473
Figure 3-115.	Average water year type, J.C. Boyle bypassed reach acceptable range of flows for angling .....	3-474
Figure 3-116.	Above average water year type, J.C. Boyle bypassed reach acceptable range of flows for angling.....	3-474
Figure 3-117.	Below average water year type, J.C. Boyle bypassed reach acceptable range of flows for technical kayaking.....	3-475
Figure 3-118.	Average water year type, J.C. Boyle bypassed reach acceptable range of flows for technical kayaking .....	3-475
Figure 3-119.	Above average water year type, J.C. Boyle bypassed reach acceptable range of flows for technical kayaking.....	3-476
Figure 3-120.	Modeled flow and reservoir elevations during August based on the median monthly flow .....	3-478
Figure 3-121.	Below average water year type, J.C. Boyle peaking reach, acceptable range for commercial rafting.....	3-480
Figure 3-122.	Average water year type, J.C. Boyle peaking reach, acceptable range for commercial rafting.....	3-480
Figure 3-123.	Above average water year type, J.C. Boyle peaking reach acceptable range for commercial rafting.....	3-481
Figure 3-124.	Below average water year type, J.C. Boyle peaking reach, acceptable range of flows for angling.....	3-481
Figure 3-125.	Average water year type, J.C. Boyle peaking reach, acceptable range of flows for .....	3-482
Figure 3-126.	Above average water year type, J.C. Boyle peaking reach, acceptable range of flows for angling.....	3-482
Figure 3-127.	Below average water year type, J.C. Boyle peaking reach, optimal range of flows for angling.....	3-483
Figure 3-128.	Average water year type, J.C. Boyle peaking reach, optimal range of flows for angling .....	3-483
Figure 3-129.	Above average water year type, J.C. Boyle peaking reach, optimal range of flows for angling.....	3-484
Figure 3-130.	Below average water year type, Copco No. 2 bypassed reach acceptable range of flows for standard whitewater.....	3-485
Figure 3-131.	Average water year type, Copco No. 2 bypassed reach acceptable range of flows for standard whitewater boating .....	3-486
Figure 3-132.	Above average water year type, Copco No. 2 bypassed reach acceptable range of flows for standard whitewater boating .....	3-486

Figure 3-133.	Below average water year type, Copco No. 2 bypassed reach acceptable range of flows for angling .....	3-487
Figure 3-134.	Average water year type, Copco No. 2 bypassed reach acceptable range of flows for angling .....	3-487
Figure 3-135.	Above average water year type, Copco No. 2 bypassed reach acceptable range of flows for angling .....	3-488
Figure 3-136.	Socioeconomic study region and subregions.....	3-512
Figure 4-1.	Flows entering Keno reservoir via Link River and in the Klamath River downstream of Keno development at USGS gage no. 11509500 and J.C. Boyle development at USGS gage no. 11510700 for water year 1996.....	4-17
Figure 4-2.	Relationship between inflow to Keno reservoir, USGS gages at Keno and below J.C. Boyle powerhouse, and storage at J.C. Boyle and Keno reservoirs—June 1, 1996, until September 12, 1996.....	4-18
Figure 4-3.	Relationship between inflow to Keno reservoir, USGS gages at Keno and below J.C. Boyle powerhouse, and storage at J.C. Boyle and Keno reservoirs—October 18, 1995, until October 28, 1995 .....	4-20
Figure 4-4.	Relationship between net inflow to Keno reservoir, USGS gages at Keno and below J.C. Boyle powerhouse—October 18, 1995, until October 28, 1995 .....	4-21

## LIST OF TABLES

Table 2-1.	River reaches, reservoirs, and major tributaries proceeding downstream within the Klamath River Basin .....	2-3
Table 2-2.	Summary of preliminary fishway prescriptions and timetable for the Klamath Hydroelectric .....	2-29
Table 2-3.	Environmental measures specified by the Bureau of Land Management pursuant to section 4(e) of the Federal Power Act and PacifiCorp's and others' corresponding alternative conditions pursuant to the Energy Policy Act of 2005 ...	2-33
Table 2-4.	Environmental measures specified by Reclamation pursuant to section 4(e) of the Federal Power Act and PacifiCorp's and others' corresponding alternative conditions, pursuant to the Energy Policy Act of 2005 .....	2-44
Table 3-1.	Computation of tributary sediment yields from reservoir delta deposits.....	3-19
Table 3-2.	Measured landslide sediment volumes in the J.C. Boyle bypassed reach .....	3-20
Table 3-3.	Estimated loss in reservoir volume based on comparison of current bathymetry with historic topography for four of the five study sites .....	3-21
Table 3-4.	Tracer gravel sites, deployment, and recovery .....	3-24
Table 3-5.	Flow at threshold of mobility for with- and without-project conditions .....	3-36
Table 3-6.	Frequency when flows exceeded the threshold of mobility .....	3-37
Table 3-7.	Flow summary for historical conditions for releases from J.C. Boyle dam to the bypassed reach and the flows specified by the NMFS, Bureau of Land Management, and Oregon Fish & Wildlife seasonal high flow measure .....	3-40
Table 3-8.	Sediment budget modeling results.....	3-45
Table 3-9.	Estimate of sediment thickness in Iron Gate reservoir, as modeled by DREAM-1 .	3-60
Table 3-10.	Average flows in the Upper Klamath Lake and Keno reservoir area .....	3-63
Table 3-11.	Reclamation's Upper Klamath Lake operational plan per water year type .....	3-64
Table 3-12.	Monthly discharge (cfs) statistics for East Side and West Side powerhouses and Link River downstream of the East Side powerhouse for January 2, 1990, through December 5, 2004 .....	3-66
Table 3-13.	Minimum flow and ramping rates for Link River dam .....	3-66
Table 3-14.	General information on dams and canals within the Klamath Irrigation Project .....	3-67
Table 3-15.	Monthly discharge (cfs) statistics for canals in the Klamath Irrigation Project area for January 2, 1990, through December 5, 2004.....	3-68
Table 3-16.	Water bank summary for 2003 through 2005.....	3-70
Table 3-17.	Reservoir area, inflow, storage, and retention times .....	3-72
Table 3-18.	Monthly discharge (cfs) statistics in the Klamath Project area .....	3-74
Table 3-19.	Average spillage at J.C. Boyle, Copco No. 1, and Iron Gate dams for January 2, 1990, through December 5, 2004 .....	3-76

Table 3-20.	Monthly discharge (cfs) statistics for J.C. Boyle, Copco No. 1, and Iron Gate powerhouses .....	3-78
Table 3-21.	Ramping rate requirements for Iron Gate dam .....	3-82
Table 3-22.	NMFS 2002 BiOp Iron Gate dam releases criteria based on water year .....	3-83
Table 3-23.	Phase III, NMFS 2002 BiOp Iron Gate dam releases criteria based on water year..	3-86
Table 3-24.	Monthly discharge (cfs) statistics for USGS gages along the Lower Klamath River and for the Shasta, Scott, Salmon, and Trinity rivers .....	3-87
Table 3-25.	Applicable water quality criteria and objectives for Klamath Basin in the vicinity of the Klamath Hydroelectric Project.....	3-96
Table 3-26.	Average water temperature data for stream reaches within the Klamath River Basin affected by project operation, 2001–2004 .....	3-99
Table 3-27.	Average DO concentration for stream reaches and the top 9 meters of reservoirs within the Klamath River Basin affected by project operation, 2001–2004 .....	3-105
Table 3-28.	Average DO concentration within Keno reservoir, 2001-2004.....	3-108
Table 3-29.	Average DO concentrations from representative profiles in Keno reservoir during May, July, and October, 2002 .....	3-108
Table 3-30.	Mean total phosphate, orthophosphate, and ammonia (mg/L) in Copco and Iron Gate reservoirs in samples collected between 2001 and 2004.....	3-120
Table 3-31.	Water quality constituents at sites sampled downstream from Iron Gate dam.....	3-121
Table 3-32.	Secchi depth measurements at representative locations along the Klamath River in 2001 to 2003 .....	3-128
Table 3-33.	Mean turbidity (NTUs) in the Klamath River, 2002-2003 .....	3-129
Table 3-34.	Total PCBs found in composite fish tissue samples in Project reservoirs, 2003....	3-130
Table 3-35.	Perceived effect of water quality on recreational visits in the Klamath Hydroelectric Project study area (yes/no) .....	3-131
Table 3-36.	Current gages in the vicinity of the Klamath Hydroelectric Project.....	3-132
Table 3-37.	Fish species known to occur in the Klamath River and reservoirs upstream of Iron Gate dam and that are likely to occur downstream of Iron Gate dam.....	3-175
Table 3-38.	Estimated lifestage periodicity of key fish species occurring in the Klamath River .....	3-178
Table 3-39.	Summary of fishery sampling conducted in the Link River using electrofishing techniques .....	3-182
Table 3-40.	Keno reservoir electrofishing catch during fall 2001, and spring, summer and fall 2002.....	3-183
Table 3-41.	Summary of fishery sampling conducted in the Keno reach using backpack electrofishing techniques .....	3-184
Table 3-42.	Number of fish collected by gear type during 1998 and 1999 in the J.C. Boyle reservoir.....	3-186
Table 3-43.	Fishery sampling conducted in the J.C. Boyle bypassed reach using backpack electrofishing techniques .....	3-187

Table 3-44.	Fishery sampling conducted in the J.C. Boyle peaking reach using backpack and boat electrofishing techniques .....	3-188
Table 3-45.	Number of fish collected by gear type during 1998 and 1999 in Copco reservoir.	3-190
Table 3-46.	Fishery sampling conducted in the Copco No. 2 bypassed reach using backpack electrofishing techniques .....	3-191
Table 3-47.	Number of fish collected by gear type during 1998 and 1999 in the Iron Gate reservoir .....	3-193
Table 3-48.	Annual escapement of fall Chinook salmon by sub-basin and hatchery, 1978 through 2002.....	3-195
Table 3-49.	Distribution of fall Chinook salmon spawning redds observed from 1993 through 2002 from Iron Gate dam to Indian Creek .....	3-196
Table 3-50.	Non-target species (excluding Chinook salmon, coho salmon, and steelhead) collected during screw-trap sampling conducted at Big Bar (RM 49.7) on the Klamath River and at Willow Creek (RM 21.1) on the Trinity River, 1997-2000.	3-197
Table 3-51.	Pools containing juvenile coho salmon, Chinook salmon, and steelhead on the mainstem Klamath River in 2001, as determined in snorkeling surveys.....	3-214
Table 3-52.	Harvest of green sturgeon from California, Oregon, and Washington from 1985 to 2003 .....	3-218
Table 3-53.	Iron Gate Fish Hatchery production .....	3-221
Table 3-54.	PFMC stock management quotas for 2001-2005 for Klamath River fall Chinook salmon .....	3-233
Table 3-55.	Harvest (# fish) of age-3 and age-4 Klamath River fall Chinook salmon .....	3-235
Table 3-56.	Estimates of Yurok and Hoopa Valley Reservation gillnet harvest, 1990-2006 ....	3-236
Table 3-57.	Klamath River angler harvest estimates for Chinook and coho salmon, and steelhead 1983 to 1987 seasons .....	3-240
Table 3-58.	Sampling sites where bivalve species were observed during macroinvertebrate sampling and focused bivalve surveys .....	3-246
Table 3-59.	Estimated water temperatures, wetted perimeter, and modeled rainbow trout WUA in the lower J.C. Boyle bypassed reach based on the volume of water released at J.C. Boyle dam .....	3-253
Table 3-60.	Rainbow trout catch per hour from Oregon Fish & Wildlife angler survey data from 1978 to 1984 for the Keno, J.C. Boyle bypassed, and J.C. Boyle peaking reaches .....	3-257
Table 3-61.	Rainbow trout catch per hour from PacifiCorp hook-and-line sampling conducted in 2002 in the Keno, J.C. Boyle bypassed, and J.C. Boyle peaking reaches .....	3-258
Table 3-62.	Modeled wetted area and rainbow trout WUA modeled for the J.C. Boyle peaking reach.....	3-261
Table 3-63.	Peaking reach fish stranding and entrapment observations, 2002.....	3-266
Table 3-64.	Estimates of wetted perimeter and rainbow trout WUA habitat modeled for the Copco No. 2 bypassed reach .....	3-268

Table 3-65.	Estimates of wetted perimeter and rainbow trout WUA modeled for the Fall Creek bypassed reach .....	3-273
Table 3-66.	Hardy Phase II and agency flow recommendations .....	3-278
Table 3-67.	Estimates of existing and recoverable anadromous fish habitat in tributaries to Upper Klamath Lake .....	3-284
Table 3-68.	Criteria for water temperature and DO concentration used to classify levels of stress for anadromous salmonids. Thresholds between the four levels of stress are averages of daily minima (7d-min), mean (7d-avg), or maxima (7d-max), calculated for the previous 7 days .....	3-286
Table 3-69.	Thermal stress level for juvenile Chinook salmon based on temperature and DO levels predicted by the Klamath River water quality model. Values shown are the percentage of days falling within stress categories for each 2 week period based on simulations from 2000 to 2004.....	3-287
Table 3-70.	Thermal stress level for juvenile steelhead based on temperature and DO levels predicted by the Klamath River water quality model. Values shown are the percentage of days falling within stress categories for each 2 week period based on simulations from 2000 to 2004.....	3-288
Table 3-71.	Thermal stress level for adult anadromous salmonids based on temperature and DO levels predicted by the Klamath River water quality model. Values shown are the percentage of days falling within stress categories for each 2 week period based on simulations from 2000 to 2004.....	3-289
Table 3-72.	Disease management recommendations .....	3-306
Table 3-73.	Comparison of the benefits of four alternative approaches to anadromous fish restoration .....	3-322
Table 3-74.	Cumulative average survival estimates for all-volitional and collection and transport alternatives used in the KlamRAS fish passage model for fall Chinook salmon originating above Upper Klamath Lake .....	3-324
Table 3-75.	Estimated adult anadromous fish abundance under volitional passage and trap and haul alternatives .....	3-324
Table 3-76.	Phase 1 studies under PacifiCorp’s April 25, 2006, alternative prescription .....	3-324
Table 3-77.	Estimated habitat capacity for adult fall Chinook salmon in the Iron Gate to Copco No. 2 dam, Copco No. 1 to J.C. Boyle, and J.C. Boyle to Keno reaches....	3-332
Table 3-78.	Ratio of coded-wire tagged Chinook salmon subyearling and yearling smolt release return rates (percent) to Iron Gate Hatchery and water-year types .....	3-337
Table 3-79.	Cover types and habitats mapped in the vicinity of the Klamath Hydroelectric Project.....	3-349
Table 3-80.	Special status plant species that are known to occur in the vicinity of the Klamath Hydroelectric Project .....	3-358
Table 3-81.	Non-special status amphibian species that are known occur in the vicinity of the Klamath Project .....	3-362
Table 3-82.	Non-special status reptile species that are known to occur in the vicinity of the Klamath Project .....	3-363

Table 3-83.	Special status species that are known or documented to occur in the Klamath Project vicinity.....	3-367
Table 3-84.	Bald eagle territories and nesting status through 2003 in the general vicinity of the Klamath River Hydroelectric Project .....	3-409
Table 3-85.	Regional rivers with angling opportunities .....	3-428
Table 3-86.	Rivers with whitewater boating opportunities in the region.....	3-429
Table 3-87.	Acceptable and optimal flow ranges for various river-based activities for reaches of the Klamath River .....	3-436
Table 3-88.	Recreational facilities at Keno development .....	3-438
Table 3-89.	Recreational facilities at J.C. Boyle reservoir .....	3-439
Table 3-90.	Estimated annual whitewater boating use between J.C. Boyle powerhouse and Copco reservoir (1994—2001).....	3-441
Table 3-91.	Recreational facilities on the Klamath River between J.C. Boyle dam and Copco reservoir.....	3-443
Table 3-92.	Recreational facilities at Copco development .....	3-444
Table 3-93.	Recreational facilities at Fall Creek development.....	3-445
Table 3-94.	Recreational facilities at Iron Gate development.....	3-446
Table 3-95.	Annual estimated use and capacity assessment at recreational facilities at the Iron Gate development .....	3-447
Table 3-96.	PacifiCorp’s proposed recreational improvements at J.C. Boyle development .....	3-452
Table 3-97.	PacifiCorp’s proposed recreational improvements at Copco development.....	3-457
Table 3-98.	PacifiCorp’s proposed recreational improvements at Fall Creek development .....	3-458
Table 3-99.	PacifiCorp’s proposed recreational improvements at Iron Gate development .....	3-460
Table 3-100.	Number of days with flows over 1,500 cfs in the peaking reach under the Bureau of Land Management’s modified 4(e) conditions, as modeled by the Bureau of Land Management flow management scenario. ....	3-477
Table 3-101.	Number of days per month between 1,500 and 3,500 cfs in the peaking reach per month under the Bureau of Land Management’s modified 4(e) conditions, based on the median monthly flows. ....	3-478
Table 3-102.	Land ownership within the proposed project boundary .....	3-492
Table 3-103.	Road mileage and maintenance responsibility within the Klamath River Project study area, existing project boundary, and proposed project boundary.....	3-495
Table 3-104.	Specified and alternative land use conditions.....	3-500
Table 3-105.	Race and ethnic distribution by county and community within the 5-mile corridor, 2000 .....	3-514
Table 3-106.	Population and percent of residents identified as American Indian alone or in combination with one or more other races by reservation within the six-county study area.....	3-515

Table 3-107.	Distribution of employment (percent) in agriculture, forestry, fishing, and hunting by community, 1990 and 2000.....	3-517
Table 3-108.	Distribution of low incomes and substandard housing (percent) by community in the 5-mile corridor, 2000.....	3-518
Table 3-109.	Income and poverty on the Indian reservations in the six-county study area. ....	3-519
Table 3-110.	Annual recreation use and associated expenditures of total and non-local visitors in the upstream subregion, 2002.....	3-521
Table 3-111.	Annual recreation use and associated expenditures of total and non-local visitors in the downstream subregion, 2002.....	3-522
Table 3-112.	Estimates of KMZ coastal community personal income (in thousands of real 2005 dollars) from the recreational ocean salmon fishery by port area.....	3-523
Table 3-113.	Estimates of KMZ coastal community personal income (in thousands of real 2006 dollars) from the troll ocean salmon fishery by port area.....	3-524
Table 3-114.	Losses associated with tribal commercial fishery closures .....	3-526
Table 3-115.	Annual recreation use and associated expenditures of total and non-local visitors engaged in selected recreational activities in the upstream and downstream subregions in 2002 and with 5 and 15 percent growth .....	3-529
Table 3-116.	Annual recreation use and associated expenditures of total and non-local visitors engaged in whitewater boating and river-based angling in the upstream and downstream subregions in 2002 and with 5 percent and 15 percent growth .....	3-532
Table 4-1.	Staff assumptions for economic analysis of the Klamath Hydroelectric Project .....	4-1
Table 4-2.	Net investment value and operation and maintenance cost assumptions for the economic analysis of the Klamath Hydroelectric Project.....	4-2
Table 4-3.	Summary of the annual net benefits in 2006 dollars for the No-action Alternative, PacifiCorp’s Proposal, the Staff Alternative, the Staff Alternative with Mandatory Conditions, Retirement of Copco No. 1 and Iron Gate Developments, and Retirement of J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate developments for the Klamath Hydroelectric Project. ....	4-2
Table 4-4.	Dam removal capital cost comparisons .....	4-6
Table 4-5.	Dam removal recommendations and costs .....	4-10
Table 4-6.	Estimated annual generation (GWh) with and without operation of Keno facilities .....	4-15
Table 4-7.	Data description and sources .....	4-15
Table 4-8.	Klamath Project carbon emissions displacement .....	4-22
Table 4-9.	Oregon and California greenhouse gas reduction goals .....	4-23
Table 5-1.	Summary of effects of PacifiCorp’s Proposal, the Staff Alternative, the Staff Alternative with Mandatory Conditions, Retirement of Copco No. 1 and Iron Gate Developments, and Retirement of J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate developments. ....	5-16

Table 5-2.	Summary of environmental resource effects of mainstem dam removal .....	5-74
Table 5-3.	Analysis of fish and wildlife agency recommendations for the Klamath Hydroelectric Project.....	5-84
Table 5-4.	Bureau of Land Management and Reclamation modified 4(e) conditions for the Klamath Hydroelectric Project .....	5-104
Table 5-5.	Summary of effect determinations for fish, plants, and wildlife .....	5-115