

Glen Canyon Dam

Long-Term Experimental and Management Plan
Environmental Impact Statement



FINAL

Volume 3—Appendices O–Q

U.S. Department of the Interior
Bureau of Reclamation,
Upper Colorado Region
National Park Service,
Intermountain Region

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**GLEN CANYON DAM LONG-TERM EXPERIMENTAL AND MANAGEMENT PLAN
FINAL ENVIRONMENTAL IMPACT STATEMENT**

Joint-Lead Agencies

Bureau of Reclamation
National Park Service

Cooperating Agencies

Department of the Interior	Havasupai Tribe
Bureau of Indian Affairs	Hopi Tribe
U.S. Fish and Wildlife Service	Hualapai Tribe
U.S. Department of Energy	Kaibab Band of Paiute Indians
Western Area Power Administration	Navajo Nation
Arizona Game and Fish Department	Pueblo of Zuni
Colorado River Board of California	Salt River Project
Colorado River Commission of Nevada	Utah Associated Municipal Power Systems
Upper Colorado River Commission	

ABSTRACT

The U.S. Department of the Interior (DOI), through the Bureau of Reclamation and National Park Service (NPS), proposes to develop and implement a Long-Term Experimental and Management Plan (LTEMP) for operations of Glen Canyon Dam. The LTEMP would provide a framework for adaptively managing Glen Canyon Dam operations over the next 20 years, consistent with the Grand Canyon Protection Act of 1992 (GCPA) and other provisions of applicable federal law. The LTEMP would determine specific options for dam operations, non-flow actions, and appropriate experimental and management actions that will meet the GCPA's requirements and minimize impacts on resources within the area impacted by dam operations, including those of importance to American Indian Tribes.

The Final Environmental Impact Statement (FEIS) was developed in accordance with the National Environmental Policy Act of 1969, as amended (NEPA), and followed the implementing regulations developed by the President's Council on Environmental Quality in Title 40 *Code of Federal Regulations* (CFR) Parts 1500 to 1508 and DOI regulations implementing NEPA in 43 CFR Part 46. The FEIS analysis draws on the scientific information that has been collected under the Glen Canyon Dam Adaptive Management Program over the last 20 years to identify the potential environmental effects associated with taking no action, as well as a reasonable range of alternatives to no action for implementing the proposed federal action. Seven alternatives were considered and analyzed for the LTEMP EIS—a no action alternative (Alternative A), a hydropower-focused alternative (Alternative B), three condition-dependent alternatives (Alternatives C, D, and E), and two steady flow alternatives (Alternatives F and G). These alternatives incorporated a broad range of operations and experimental actions that together allowed for a full evaluation of possible impacts of the

proposed action. Based on the impact analyses conducted, DOI has chosen Alternative D as both the preferred and the environmentally preferred alternative. Alternative D is expected to result in an improvement in conditions for humpback chub, trout, and the aquatic food base; have the least impact on vegetation, wetlands, and terrestrial wildlife; improve sandbar building potential and conserve sediment; sustain or improve conditions for reservoir and river recreation; improve preservation of cultural resources; respect and enhance Tribal resources and values; and have limited impacts on hydropower resources.

For additional information, visit <http://ltempeis.anl.gov> or contact:

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CONTENTS

ABSTRACT.....	iii
ACRONYMS AND ABBREVIATIONS.....	lxiii
1 INTRODUCTION.....	1-1
1.1 Description of the Proposed Action.....	1-4
1.2 Purpose of and Need for Action.....	1-5
1.3 Lead and Cooperating Agencies and Consulting Tribes.....	1-9
1.3.1 Lead Agencies.....	1-9
1.3.2 Cooperating Agencies and Consulting Tribes.....	1-9
1.4 Objectives and Resource Goals of the LTEMP.....	1-10
1.5 Scope of the EIS.....	1-13
1.5.1 Affected Region and Resources.....	1-13
1.5.2 Impact Topics Selected for Detailed Analysis.....	1-14
1.5.3 Impact Topics Dismissed from Detailed Analysis.....	1-15
1.6 Role of Adaptive Management.....	1-16
1.6.1 History of the Existing Adaptive Management Program.....	1-16
1.6.2 Relationship of Adaptive Management to NEPA and Changes to Operations.....	1-17
1.7 Role of Decision Analysis in the EIS Process.....	1-17
1.8 History, Location, and Setting.....	1-18
1.8.1 History and Purpose of Glen Canyon Dam.....	1-18
1.8.2 Location of Glen Canyon Dam and LTEMP Affected Area.....	1-19
1.8.3 Operation of the Glen Canyon Dam.....	1-20
1.8.4 History, Purpose, and Significance of the National Park System Units.....	1-22
1.8.4.1 Grand Canyon National Park.....	1-22
1.8.4.2 Glen Canyon National Recreation Area.....	1-24
1.8.4.3 Lake Mead National Recreation Area.....	1-24
1.8.5 Tribal Lands.....	1-25
1.8.5.1 Fort Mojave Tribe.....	1-26
1.8.5.2 Havasupai Tribe.....	1-26
1.8.5.3 Hopi Tribe.....	1-27
1.8.5.4 Hualapai Tribe.....	1-27
1.8.5.5 Navajo Nation.....	1-27
1.8.5.6 Pueblo of Zuni.....	1-28
1.8.5.7 Southern Paiute Tribes.....	1-28
1.9 Laws and Regulations Related to Operations of Glen Canyon Dam and Park Management.....	1-29
1.9.1 Environmental Laws and Executive Orders.....	1-29
1.9.2 Cultural/Historical Laws and Executive Orders.....	1-30

CONTENTS (Cont.)

1.9.3	American Indian and Tribal Consultation Laws and Executive Orders.....	1-31
1.9.4	Laws Establishing Criteria Related to Power Marketing.....	1-31
1.9.5	Law of the River	1-31
1.10	Related Actions	1-31
1.10.1	Biological Opinions	1-33
1.10.2	Environmental Impact Statements and Related Documents.....	1-33
1.10.3	Environmental Assessments and Related Documents	1-35
1.10.4	Other Actions, Programs, Plans, and Projects	1-36
2	DESCRIPTION OF ALTERNATIVES	2-1
2.1	Development of Alternatives.....	2-2
2.2	Descriptions of Alternatives Considered in Detail.....	2-4
2.2.1	Alternative A (No Action Alternative).....	2-8
2.2.2	Alternative B.....	2-20
2.2.3	Alternative C.....	2-23
2.2.3.1	Base Operations under Alternative C.....	2-25
2.2.3.2	Implementation Process for Experiments under Alternative C	2-27
2.2.3.3	Sediment-Related Experiments To Be Evaluated under Alternative C	2-37
2.2.3.4	Aquatic Resource-Related Experiments To Be Evaluated under Alternative C	2-38
2.2.4	Alternative D (Preferred Alternative).....	2-41
2.2.4.1	Base Operations under Alternative D.....	2-44
2.2.4.2	Operational Flexibility under Alternative D	2-46
2.2.4.3	Implementation Process for Experiments under Alternative D	2-48
2.2.4.4	Communication and Consultation Process for Alternative D	2-57
2.2.4.5	Sediment-Related Experiments To Be Evaluated under Alternative D	2-58
2.2.4.6	Aquatic Resource-Related Experiments To Be Evaluated under Alternative D.....	2-62
2.2.4.7	Conservation Measures under Alternative D	2-72
2.2.5	Alternative E	2-72
2.2.5.1	Base Operations under Alternative E.....	2-72
2.2.5.2	Experimental Framework for Alternative E.....	2-75
2.2.6	Alternative F	2-80
2.2.7	Alternative G.....	2-81
2.3	Alternatives Considered and Eliminated from Detailed Study	2-84
2.3.1	Modified Low Fluctuating Flows with Extended Protocols.....	2-84

CONTENTS (Cont.)

2.3.2	Naturally Patterned Flow Alternative	2-85
2.3.3	Seasonal Fluctuations with Low Summer Flow Alternative	2-85
2.3.4	Grand Canyon First! Alternative	2-86
2.3.5	Species Community and Habitat-Based Alternative.....	2-86
2.3.6	Stewardship Alternative.....	2-86
2.3.7	Twelve-Year Experiment of Two Steady-Flow Alternatives	2-87
2.3.8	Decommission Glen Canyon Dam Alternative.....	2-87
2.3.9	Fill Lake Mead First Alternative.....	2-88
2.3.10	Full-Powerplant Capacity Operations Alternative.....	2-88
2.3.11	Run-of-the-River Alternative.....	2-88
2.4	Alternative Elements Eliminated from Detailed Study	2-89
2.4.1	New Infrastructure	2-89
2.4.2	Flow and Non-Flow Actions.....	2-90
2.5	Summary Comparison of Alternatives	2-91
3	AFFECTED ENVIRONMENT	3-1
3.1	Project Area.....	3-1
3.1.1	Colorado River Setting	3-1
3.1.2	Geologic Setting.....	3-3
3.1.2.1	Tribal Perspectives on Geologic Setting	3-3
3.1.3	Climatic Setting	3-4
3.1.4	Glen Canyon Dam Releases and Flow.....	3-5
3.1.5	Colorado River Ecosystem Resource Linkages.....	3-6
3.2	Water Resources.....	3-6
3.2.1	Hydrology	3-7
3.2.1.1	Lake Powell Hydrology.....	3-8
3.2.1.2	Hydrology of the Colorado River Downstream of Glen Canyon Dam.....	3-11
3.2.1.3	Lake Mead Hydrology.....	3-13
3.2.1.4	Seeps and Springs.....	3-14
3.2.2	Water Quality.....	3-16
3.2.2.1	Lake Powell Water Quality	3-16
3.2.2.2	Colorado River Water Quality	3-19
3.2.2.3	Lake Mead Water Quality	3-27
3.2.3	Tribal Perspectives on Water Resources.....	3-29
3.2.4	Hydrology and Climate Change.....	3-32
3.2.4.1	Basis for Runoff Estimates.....	3-32
3.2.4.2	Water Variability and Availability.....	3-33
3.2.4.3	Seasonal Timing Shifts.....	3-34
3.2.4.4	Water Quality	3-35
3.3	Sediment Resources	3-35
3.3.1	Background: Geomorphology of the Colorado River.....	3-35

CONTENTS (Cont.)

3.3.1.1	Geomorphic Features of the Colorado River	3-37
3.3.1.2	Glen Canyon Geomorphology.....	3-40
3.3.1.3	Marble and Grand Canyon Geomorphology	3-41
3.3.2	Sediment Characteristics and Transport Mechanisms	3-43
3.3.2.1	Particle Size and Sediment Supply.....	3-45
3.3.2.2	Sediment Transport Capacity	3-46
3.3.2.3	River Stage	3-46
3.3.3	Sediment Sources.....	3-46
3.3.3.1	Gaged Tributaries.....	3-48
3.3.3.2	Ungaged Tributaries.....	3-48
3.3.4	Sediment Transport and Storage.....	3-50
3.3.4.1	Sediment Transport	3-50
3.3.4.2	Sediment Storage.....	3-51
3.3.4.3	High-Flow Experiments	3-51
3.3.4.4	Sediment Supply Limitation.....	3-53
3.3.4.5	Sandbar Deposition and Retention.....	3-53
3.3.5	Lake Deltas	3-56
3.4	Natural Processes	3-57
3.5	Aquatic Ecology.....	3-59
3.5.1	Aquatic Food Base.....	3-59
3.5.1.1	Periphyton and Rooted Aquatic Plants.....	3-61
3.5.1.2	Plankton.....	3-63
3.5.1.3	Macroinvertebrates.....	3-63
3.5.1.4	Nonnative Invasive Species.....	3-66
3.5.1.5	Food Web Dynamics.....	3-69
3.5.2	Native Fish.....	3-70
3.5.2.1	Special Status Fish Species	3-72
3.5.2.2	Other Native Species.....	3-86
3.5.3	Nonnative Fish.....	3-90
3.5.3.1	Coldwater Nonnative Species	3-94
3.5.3.2	Warmwater Nonnative Species	3-100
3.5.3.3	Interactions with Native Species	3-101
3.5.3.4	Nonnative Fish Control Activities and Effects of Flow Conditions	3-104
3.6	Vegetation	3-109
3.6.1	Historic and Remnant Riparian Plant Communities.....	3-110
3.6.2	Existing Riparian Vegetation Downstream from Glen Canyon Dam.....	3-111
3.6.2.1	Tribal Perspectives on Vegetation.....	3-119
3.6.3	Special Status Plant Species.....	3-121
3.7	Wildlife.....	3-124
3.7.1	Invertebrates.....	3-125
3.7.2	Amphibians and Reptiles	3-126
3.7.3	Birds.....	3-127

CONTENTS (Cont.)

3.7.4	Mammals.....	3-129
3.7.5	Special Status Wildlife Species	3-131
3.7.5.1	Invertebrates	3-132
3.7.5.2	Amphibians and Reptiles.....	3-136
3.7.5.3	Birds	3-136
3.7.5.4	Mammals.....	3-142
3.7.6	Tribal Perspectives on Wildlife	3-142
3.8	Cultural Resources	3-144
3.8.1	Area of Potential Effect	3-146
3.8.2	Description of Cultural Resources and Site Types	3-149
3.8.2.1	Archaeological Resources	3-149
3.8.2.2	Historic Resources.....	3-153
3.8.2.3	Cultural Landscapes	3-155
3.8.2.4	Traditional Cultural Properties and Ethnographic Resources.....	3-156
3.9	Tribal Resources.....	3-156
3.9.1	Fort Mojave Indian Tribe.....	3-157
3.9.2	Havasupai.....	3-158
3.9.3	Hopi.....	3-158
3.9.4	Hualapai	3-159
3.9.5	Navajo Nation.....	3-162
3.9.6	Pueblo of Zuni.....	3-164
3.9.7	Southern Paiute Tribes.....	3-167
3.9.8	Indian Trust Assets and Trust Responsibility	3-168
3.10	Recreation, Visitor Use, and Experience.....	3-168
3.10.1	Glen Canyon Reach of the Colorado River in Glen Canyon National Recreation Area.....	3-169
3.10.1.1	Lees Ferry Recreational Fishery.....	3-169
3.10.1.2	Day-Rafting, Boating, and Camping in the Glen Canyon Reach.....	3-174
3.10.2	The Colorado River in Grand Canyon National Park.....	3-178
3.10.2.1	Campsites in Grand Canyon National Park.....	3-179
3.10.2.2	River Flow and Fluctuation.....	3-183
3.10.2.3	Hualapai Tribe Recreation Program.....	3-186
3.10.3	Recreation Use on Lake Mead and Lake Powell.....	3-187
3.10.3.1	Lake Mead National Recreation Area.....	3-187
3.10.3.2	Lake Powell, Glen Canyon National Recreation Area.....	3-187
3.10.4	Park Operations and Management.....	3-187
3.11	Wilderness.....	3-188
3.11.1	Law and Policy	3-189
3.11.2	Defining Wilderness Character.....	3-190
3.12	Visual Resources	3-192
3.12.1	Glen Canyon National Recreation Area	3-193

CONTENTS (Cont.)

3.12.2	Grand Canyon and the Colorado River.....	3-195
3.12.3	Lake Mead National Recreation Area.....	3-198
3.13	Hydropower.....	3-198
3.13.1	Power Operations.....	3-199
3.13.1.1	Hydropower Generation.....	3-199
3.13.1.2	Basin Fund.....	3-200
3.13.1.3	Operational Flexibility.....	3-201
3.13.1.4	Scheduling.....	3-202
3.13.1.5	Load/Generation Following and Regulation.....	3-203
3.13.1.6	Capacity Reserves.....	3-205
3.13.1.7	Disturbances and Emergencies and Outage Assistance.....	3-205
3.13.1.8	Transmission System.....	3-206
3.13.2	Power Marketing.....	3-206
3.13.2.1	Wholesale Rates.....	3-209
3.13.2.2	Retail Rates.....	3-209
3.14	Socioeconomics and Environmental Justice.....	3-209
3.14.1	The Six-County Region of Influence.....	3-210
3.14.1.1	Population.....	3-210
3.14.1.2	Income.....	3-211
3.14.1.3	Employment.....	3-211
3.14.1.4	Unemployment.....	3-213
3.14.1.5	Environmental Justice.....	3-213
3.14.2	The Seven-State Region of Influence.....	3-221
3.14.2.1	Population.....	3-221
3.14.2.2	Income.....	3-222
3.14.2.3	Employment.....	3-224
3.14.2.4	Unemployment.....	3-226
3.14.2.5	Environmental Justice.....	3-226
3.14.3	Non-Use Value.....	3-228
3.15	Air Quality.....	3-229
3.15.1	Local Air Quality.....	3-229
3.15.2	Regional Air Quality.....	3-231
3.15.3	Regional Air Emissions.....	3-234
3.16	Climate Change.....	3-236
4	ENVIRONMENTAL CONSEQUENCES.....	4-1
4.1	Overall Analysis and Assessment Approach.....	4-1
4.2	Water Resources.....	4-9
4.2.1	Analysis Methods.....	4-10
4.2.1.1	Hydrology.....	4-10
4.2.1.2	Water Quality.....	4-13
4.2.2	Summary of Impacts.....	4-14

CONTENTS (Cont.)

4.2.2.1	Hydrology.....	4-14
4.2.2.2	Water Quality	4-37
4.2.3	Alternative-Specific Impacts	4-47
4.2.3.1	Alternative A (No Action Alternative).....	4-48
4.2.3.2	Alternative B	4-49
4.2.3.3	Alternative C	4-53
4.2.3.4	Alternative D (Preferred Alternative).....	4-55
4.2.3.5	Alternative E.....	4-58
4.2.3.6	Alternative F.....	4-60
4.2.3.7	Alternative G	4-62
4.3	Sediment Resources	4-65
4.3.1	Analysis Methods.....	4-66
4.3.2	Summary of Impacts	4-70
4.3.3	Alternative-Specific Impacts	4-72
4.3.3.1	Alternative A (No Action Alternative).....	4-75
4.3.3.2	Alternative B	4-77
4.3.3.3	Alternative C	4-80
4.3.3.4	Alternative D (Preferred Alternative).....	4-81
4.3.3.5	Alternative E.....	4-84
4.3.3.6	Alternative F.....	4-85
4.3.3.7	Alternative G	4-86
4.4	Natural Processes	4-87
4.4.1	Analysis Methods.....	4-88
4.4.2	Summary of Impacts	4-88
4.4.3	Alternative-Specific Impacts	4-97
4.4.3.1	Alternative A (No Action Alternative).....	4-97
4.4.3.2	Alternative B	4-97
4.4.3.3	Alternative C	4-98
4.4.3.4	Alternative D (Preferred Alternative).....	4-99
4.4.3.5	Alternative E.....	4-99
4.4.3.6	Alternative F.....	4-100
4.4.3.7	Alternative G	4-101
4.5	Aquatic Ecology.....	4-102
4.5.1	Analysis Methods.....	4-102
4.5.1.1	Aquatic Food Base	4-102
4.5.1.2	Nonnative Fish	4-103
4.5.1.3	Native Fish	4-106
4.5.1.4	Aquatic Parasites	4-107
4.5.2	Summary of Impacts	4-107
4.5.2.1	Aquatic Food Base	4-107
4.5.2.2	Nonnative Fish	4-119
4.5.2.3	Native Fish	4-127
4.5.2.4	Aquatic Parasites	4-135

CONTENTS (Cont.)

4.5.3	Alternative-Specific Impacts on Aquatic Resources	4-137
4.5.3.1	Alternative A (No Action Alternative).....	4-137
4.5.3.2	Alternative B	4-140
4.5.3.3	Alternative C	4-143
4.5.3.4	Alternative D (Preferred Alternative).....	4-148
4.5.3.5	Alternative E.....	4-154
4.5.3.6	Alternative F.....	4-157
4.5.3.7	Alternative G	4-160
4.6	Vegetation	4-163
4.6.1	Analysis Methods.....	4-164
4.6.2	Summary of Impacts	4-168
4.6.2.1	Impacts on Old High Water Zone Vegetation.....	4-177
4.6.2.2	Impacts on New High Water Zone.....	4-179
4.6.2.3	Wetlands.....	4-185
4.6.2.4	Special Status Plant Species.....	4-187
4.6.3	Alternative-Specific Impacts	4-190
4.6.3.1	Alternative A (No Action Alternative).....	4-191
4.6.3.2	Alternative B	4-192
4.6.3.3	Alternative C	4-194
4.6.3.4	Alternative D (Preferred Alternative).....	4-196
4.6.3.5	Alternative E.....	4-197
4.6.3.6	Alternative F.....	4-199
4.6.3.7	Alternative G	4-201
4.7	Wildlife.....	4-203
4.7.1	Analysis Methods.....	4-203
4.7.2	Summary of Impacts	4-204
4.7.2.1	Terrestrial Invertebrates	4-204
4.7.2.2	Amphibians and Reptiles.....	4-210
4.7.2.3	Birds	4-212
4.7.2.4	Mammals.....	4-214
4.7.2.5	Special Status Species	4-216
4.7.3	Alternative-Specific Impacts on Wildlife	4-227
4.7.3.1	Alternative A (No Action Alternative).....	4-227
4.7.3.2	Alternative B	4-229
4.7.3.3	Alternative C	4-230
4.7.3.4	Alternative D (Preferred Alternative).....	4-231
4.7.3.5	Alternative E.....	4-232
4.7.3.6	Alternative F.....	4-233
4.7.3.7	Alternative G	4-234
4.8	Cultural Resources	4-235
4.8.1	Compliance with Federal Regulations	4-235
4.8.2	Analysis Methods.....	4-235
4.8.3	Summary of Impacts	4-238

CONTENTS (Cont.)

4.8.4	Alternative-Specific Impacts	4-246
4.8.4.1	Alternative A (No Action Alternative).....	4-246
4.8.4.2	Alternative B	4-246
4.8.4.3	Alternative C	4-247
4.8.4.4	Alternative D (Preferred Alternative).....	4-248
4.8.4.5	Alternative E.....	4-248
4.8.4.6	Alternative F.....	4-249
4.8.4.7	Alternative G	4-250
4.9	Tribal Resources.....	4-251
4.9.1	Tribal Resource Goals.....	4-251
4.9.1.1	Increase the Health of the Ecosystem in Glen, Marble, and Grand Canyons	4-252
4.9.1.2	Protect and Preserve Sites of Cultural Importance.....	4-254
4.9.1.3	Preserve and Enhance Respect for Canyon Life	4-256
4.9.1.4	Preserve and Enhance the Sacred Integrity of Glen, Marble, and Grand Canyons.....	4-258
4.9.1.5	Maintain and Enhance Healthy Stewardship Opportunities and Maintain and Enhance Tribal Connections to the Canyons	4-259
4.9.1.6	Economic Opportunity	4-259
4.9.1.7	Maintain Tribal Water Rights and Supply	4-260
4.9.1.8	LTEMP Process.....	4-261
4.9.2	Analysis Methods.....	4-261
4.9.3	Summary of Impacts.....	4-262
4.9.4	Alternative-Specific Impacts	4-268
4.9.4.1	Alternative A (No Action Alternative).....	4-268
4.9.4.2	Alternative B	4-270
4.9.4.3	Alternative C	4-271
4.9.4.4	Alternative D (Preferred Alternative).....	4-273
4.9.4.5	Alternative E.....	4-274
4.9.4.6	Alternative F.....	4-276
4.9.4.7	Alternative G	4-277
4.10	Recreation, Visitor Use, and Experience.....	4-279
4.10.1	Analysis Methods.....	4-279
4.10.2	Summary of Impacts.....	4-281
4.10.2.1	Glen Canyon Fishing.....	4-281
4.10.2.2	Glen Canyon Day Rafting	4-290
4.10.2.3	Glen Canyon Recreational Facilities	4-291
4.10.2.4	Whitewater Boating.....	4-291
4.10.2.5	Reservoir Activities and Facilities	4-292
4.10.2.6	Tribal Recreation Operations	4-293
4.10.2.7	Pearce Ferry.....	4-296
4.10.2.8	Park Operations and Management	4-296

CONTENTS (Cont.)

4.10.3	Alternative-Specific Impacts	4-297
4.10.3.1	Alternative A (No Action Alternative).....	4-297
4.10.3.2	Alternative B	4-298
4.10.3.3	Alternative C	4-300
4.10.3.4	Alternative D (Preferred Alternative).....	4-301
4.10.3.5	Alternative E.....	4-303
4.10.3.6	Alternative F.....	4-304
4.10.3.7	Alternative G	4-306
4.11	Wilderness.....	4-307
4.11.1	Analysis Methods.....	4-307
4.11.2	Summary of Impacts.....	4-308
4.11.3	Alternative-Specific Impacts	4-313
4.11.3.1	Alternative A (No Action Alternative).....	4-314
4.11.3.2	Alternative B	4-314
4.11.3.3	Alternative C	4-315
4.11.3.4	Alternative D (Preferred Alternative).....	4-316
4.11.3.5	Alternative E.....	4-317
4.11.3.6	Alternative F.....	4-317
4.11.3.7	Alternative G	4-318
4.12	Visual Resources	4-319
4.13	Hydropower.....	4-322
4.13.1	Analysis Methods.....	4-322
4.13.1.1	Hydropower Resource and Capacity Expansion Impacts	4-323
4.13.1.2	Wholesale Rate Impacts	4-330
4.13.1.3	Retail Rate Impacts	4-332
4.13.1.4	Hoover Dam Impacts.....	4-333
4.13.2	Summary of Hydropower Impacts.....	4-334
4.13.2.1	Monthly Water Release Impacts	4-334
4.13.2.2	Hydropower Power Generation and Capacity Impacts	4-340
4.13.2.3	Economic Impacts	4-343
4.13.2.4	Change in FES Wholesale Rates.....	4-349
4.13.2.5	Retail Rate and Bills Impacts	4-350
4.13.2.6	Impacts of LTEMP Alternatives on Hoover Dam Power Economics	4-351
4.13.3	Alternative-Specific Impacts	4-353
4.13.3.1	Alternative A (No Action Alternative).....	4-353
4.13.3.2	Alternative B	4-353
4.13.3.3	Alternative C	4-354
4.13.3.4	Alternative D (Preferred Alternative).....	4-355
4.13.3.5	Alternative E.....	4-358
4.13.3.6	Alternative F.....	4-359
4.13.3.7	Alternative G	4-360

CONTENTS (Cont.)

4.14	Socioeconomics and Environmental Justice	4-362
4.14.1	Analysis Methods.....	4-362
4.14.1.1	Recreational Use and Environmental Non-Use Values	4-362
4.14.1.2	Recreational Economic Impacts.....	4-364
4.14.1.3	Electricity Bill Increase and Generation Capacity Expansion Impacts	4-364
4.14.1.4	Environmental Justice	4-365
4.14.2	Summary of Impacts on Socioeconomics and Environmental Justice.....	4-365
4.14.2.1	Recreational Use Values	4-365
4.14.2.2	Environmental Non-Use Values.....	4-378
4.14.2.3	Recreational Economic Impacts.....	4-379
4.14.2.4	Customer Utility Electricity Generation Capacity and Residential Rate Increase Impacts.....	4-382
4.14.2.5	Environmental Justice Impacts.....	4-384
4.14.3	Alternative-Specific Impacts	4-390
4.14.3.1	Alternative A (No Action Alternative).....	4-390
4.14.3.2	Alternative B	4-391
4.14.3.3	Alternative C	4-393
4.14.3.4	Alternative D (Preferred Alternative).....	4-395
4.14.3.5	Alternative E.....	4-396
4.14.3.6	Alternative F.....	4-398
4.14.3.7	Alternative G	4-400
4.15	Air Quality.....	4-402
4.15.1	Analysis Methods.....	4-402
4.15.2	Summary of Impacts	4-403
4.15.3	Alternative-Specific Impacts	4-409
4.15.3.1	Alternative A (No Action Alternative).....	4-409
4.15.3.2	Alternative B	4-409
4.15.3.3	Alternative C	4-410
4.15.3.4	Alternative D (Preferred Alternative).....	4-410
4.15.3.5	Alternative E.....	4-410
4.15.3.6	Alternative F.....	4-411
4.15.3.7	Alternative G	4-411
4.16	Climate Change.....	4-411
4.16.1	Analysis Methods.....	4-412
4.16.1.1	Effects of LTEMP Alternatives on Climate Change.....	4-412
4.16.1.2	Effects of Climate Change on Hydrology and Downstream Resources	4-413
4.16.2	Summary of Impacts	4-414
4.16.2.1	Effects of LTEMP Alternatives on Climate Change.....	4-414
4.16.2.2	Effects of Climate Change on Hydrology and Downstream Resources	4-419

CONTENTS (Cont.)

4.16.3	Alternative-Specific Impacts	4-421
4.16.3.1	Alternative A (No Action Alternative).....	4-421
4.16.3.2	Alternative B	4-424
4.16.3.3	Alternative C	4-424
4.16.3.4	Alternative D (Preferred Alternative).....	4-424
4.16.3.5	Alternative E.....	4-425
4.16.3.6	Alternative F.....	4-425
4.16.3.7	Alternative G	4-426
4.17	Cumulative Impacts.....	4-426
4.17.1	Past, Present, and Reasonably Foreseeable Future Actions Affecting Cumulative Impacts.....	4-426
4.17.1.1	Past and Present (Ongoing) Actions.....	4-427
4.17.1.2	Reasonably Foreseeable Future Actions	4-442
4.17.2	Climate-Related Changes.....	4-445
4.17.3	Cumulative Impacts Summary by Resource.....	4-446
4.17.3.1	Water Resources.....	4-446
4.17.3.2	Sediment Resources	4-457
4.17.3.3	Natural Processes	4-458
4.17.3.4	Aquatic Ecology.....	4-458
4.17.3.5	Vegetation	4-461
4.17.3.6	Wildlife.....	4-463
4.17.3.7	Cultural Resources	4-466
4.17.3.8	Tribal Resources.....	4-467
4.17.3.9	Recreation, Visitor Use, and Experience.....	4-468
4.17.3.10	Wilderness.....	4-469
4.17.3.11	Visual Resources	4-470
4.17.3.12	Hydropower.....	4-471
4.17.3.13	Socioeconomics and Environmental Justice	4-472
4.17.3.14	Air Quality and Climate Change.....	4-472
4.18	Unavoidable Adverse Impacts.....	4-474
4.19	Relationship between Short-Term Use and Long-Term Productivity.....	4-475
4.20	Irreversible and Irretrievable Commitments of Resources.....	4-475
5	CONSULTATION AND COORDINATION	5-1
5.1	Consultation and Coordination with Other Agencies and Programs	5-1
5.1.1	U.S. Department of the Interior	5-1
5.1.2	Cooperating Agencies.....	5-1
5.1.3	American Indian Tribes	5-2
5.1.4	Other Consultations	5-6
5.1.4.1	National Historic Preservation Act.....	5-6
5.1.4.2	State and Local Water and Power Agency Coordination.....	5-7
5.1.4.3	U.S. Fish and Wildlife Service.....	5-7

CONTENTS (Cont.)

5.2	Public Involvement.....	5-8
5.2.1	Public Scoping Process and Comments Received.....	5-8
5.2.2	Public Meetings on Alternatives.....	5-10
5.2.3	Glen Canyon Dam Adaptive Management Working Group.....	5-11
5.2.4	Public Involvement on the LTEMP DEIS.....	5-11
6	REFERENCES	6-1
7	LIST OF PREPARERS.....	7-1
8	GLOSSARY	8-1
	APPENDIX A: Adaptive Management Working Group Desired Future Conditions	A-1
A.1	Desired Future Conditions: Colorado River Ecosystem	A-5
A.1.1	DFC Description.....	A-5
A.1.2	DFC Background and Legislation	A-6
A.1.3	Why the Colorado River Ecosystem DFCs Are Important.....	A-6
A.1.4	Colorado River Ecosystem DFCs.....	A-6
A.1.4.1	Sediment-Related Resources DFCs.....	A-6
A.1.4.2	Water Quality DFCs.....	A-7
A.1.4.3	Colorado River Ecosystem Aquatic Resource DFCs.....	A-7
A.1.4.4	Colorado River Ecosystem Riparian Resource DFCs.....	A-9
A.1.5	Colorado River Ecosystem DFCs Additional Information.....	A-9
A.1.5.1	Colorado River Ecosystem Linkages	A-9
A.1.5.2	Colorado River Ecosystem Metrics.....	A-10
A.2	Power Desired Future Conditions	A-10
A.2.1	Power DFC Description.....	A-10
A.2.2	Power DFC Background and Legislation	A-10
A.2.3	Why the Power DFC Is Important	A-11
A.2.4	Power DFCs.....	A-11
A.2.5	Power DFC Additional Information	A-12
A.2.5.1	Power Linkages	A-12
A.2.5.2	Power Metrics.....	A-12
A.3	Cultural Resources Desired Future Conditions	A-13
A.3.1	Cultural Resources DFC Description.....	A-13
A.3.2	DFC Background and Legislation	A-13
A.3.3	Why the Cultural Resources DFCs Are Important	A-13
A.3.4	NRHP Eligible Historic Properties DFCs.....	A-14
A.3.4.1	Prehistoric Archaeological Sites and Historic Sites.....	A-14
A.3.4.2	Traditional Cultural Properties.....	A-14
A.3.5	NRHP Eligible Historic Properties DFC Additional Information	A-15
A.3.5.1	NRHP Eligible Historic Properties Linkages.....	A-15

CONTENTS (Cont.)

A.3.5.2	NRHP Eligible Historic Properties Metrics	A-16
A.3.6	Resources of Traditional Cultural Significance but Not NRHP Eligible	A-16
A.3.7	Resources of Traditional Cultural Significance DFCs.....	A-16
A.3.8	Resources of Traditional Cultural Significance Linkages	A-17
A.3.9	Resources of Traditional Cultural Significance Metrics.....	A-17
A.4	Recreation Desired Future Conditions	A-17
A.4.1	Recreation DFC Description.....	A-17
A.4.2	DFC Background and Legislation	A-17
A.4.3	Why the Recreation DFC Is Important	A-18
A.4.3.1	Grand Canyon National Park	A-18
A.4.3.2	Glen Canyon National Recreation Area.....	A-18
A.4.4	Recreation DFCs.....	A-18
A.4.4.1	River Recreation in Grand Canyon National Park	A-18
A.4.4.2	River Recreation in Glen Canyon National Recreation Area	A-19
A.4.4.3	Blue Ribbon Trout Fishery in Glen Canyon National Recreation Area.....	A-19
A.4.4.4	River Corridor Stewardship.....	A-19
A.4.5	Recreation DFC Additional Information	A-20
A.4.6	Recreation Linkages.....	A-20
A.4.7	Recreation Metrics	A-20
A.5	Reference.....	A-21
APPENDIX B: Performance Metrics Used to Evaluate Alternatives		B-1
B.1	Aquatic Ecology.....	B-3
B.1.1	Humpback Chub	B-3
B.1.2	Other Native Fish.....	B-5
B.1.3	Trout Fishery.....	B-5
B.1.4	Nonnative Aquatic Species.....	B-6
B.2	Archaeological and Cultural Resources	B-7
B.3	Hydropower and Energy	B-9
B.4	Natural Processes	B-10
B.5	Recreational Experience.....	B-11
B.5.1	Grand Canyon Metrics.....	B-11
B.5.2	Glen Canyon Metrics	B-15
B.6	Riparian Vegetation.....	B-16
B.7	Sediment.....	B-18
B.8	Tribal Resources.....	B-18
B.9	Water Delivery	B-24
B.10	References	B-25

CONTENTS (Cont.)

APPENDIX C: Decision Analysis to Support Development of the Glen Canyon Dam Long-Term Experimental and Management Plan.....	C-1
APPENDIX D: Hydrology Technical Information and Analysis.....	D-1
D.1 Analysis Methods.....	D-3
D.1.1 Background.....	D-3
D.1.2 Initial Conditions	D-4
D.1.3 Reservoir Operations	D-4
D.1.3.1 Upper Basin Reservoirs above Lake Powell	D-4
D.1.3.2 Lake Powell and Lake Mead.....	D-5
D.1.3.3 Lake Mohave and Lake Havasu.....	D-9
D.1.4 Representation of the Different Alternatives in CRSS.....	D-9
D.1.4.1 Experimental Components Modeled in CRSS.....	D-22
D.1.5 Input Hydrology.....	D-23
D.1.6 Input Demands.....	D-26
D.1.7 Other Key Assumptions.....	D-26
D.2 Supplemental Information on Impact Modeling.....	D-27
D.2.1 Low Summer Flows.....	D-27
D.2.2 Modeled Annual Releases Extending beyond the End of the Water Year.....	D-28
D.2.3 Lake Elevation	D-29
D.3 References	D-36
APPENDIX E: Sediment Resources Technical Information and Analysis.....	E-1
E.1 Introduction	E-3
E.1.1 Analysis Period.....	E-3
E.1.2 General Scope	E-3
E.2 Methods.....	E-4
E.2.1 Sand Budget Model.....	E-4
E.2.1.1 Model Description.....	E-4
E.2.1.2 Sand Budget Model Modifications.....	E-5
E.2.1.3 Modified Sand Budget Model Inputs.....	E-6
E.2.2 Sediment Metrics	E-8
E.2.2.1 Sand Load Index.....	E-9
E.2.2.2 Standard Deviation of High Flows.....	E-9
E.2.2.3 Sand Mass Balance Index.....	E-10
E.3 Results.....	E-10
E.3.1 HFEs Determined by Alternative.....	E-10
E.3.2 Metrics	E-11
E.3.2.1 Sand Load Index.....	E-12
E.3.2.2 Standard Deviation of High Flows.....	E-12

CONTENTS (Cont.)

E.3.3	Sand Mass Balance Index	E-12
E.3.4	Alternative Performance under Climate Change Scenarios.....	E-13
E.3.5	Relative Impacts of Dam Operations and Hydrology on Performance	E-13
E.4	Lake Deltas.....	E-15
E.5	Limitations and Known Issues	E-17
E.5.1	Geographic Scope	E-17
E.5.2	Modeling Improvements.....	E-17
E.6	References	E-18
APPENDIX F: Aquatic Resources Technical Information and Analysis.....		F-1
F.1	Introduction	F-3
F.2	Aquatic Food Base Assessment	F-4
F.2.1	Description of the Aquatic Food Base Downstream from Glen Canyon Dam	F-4
F.2.1.1	The Aquatic Food Base Prior to Construction of Glen Canyon Dam.....	F-5
F.2.1.2	The Aquatic Food Base of the Colorado River Downstream from Glen Canyon Dam.....	F-5
F.2.1.3	Influence of New Zealand Mudsail on the Aquatic Food Base	F-13
F.2.2	Impacts of LTEMP Alternatives on the Aquatic Food Base	F-14
F.2.2.1	Flow Effects on the Aquatic Food Base.....	F-15
F.2.2.2	Temperature Effects on the Aquatic Food Base.....	F-23
F.2.3	Conclusion	F-26
F.3	Modeling Effects of LTEMP Alternatives on Rainbow Trout and Humpback Chub.....	F-28
F.3.1	Model Overview	F-28
F.3.1.1	Glen Canyon Trout Submodel.....	F-29
F.3.1.2	Trout Movement Submodel.....	F-36
F.3.1.3	Humpback Chub Population Submodel	F-40
F.3.2	Results for LTEMP Alternatives	F-52
F.3.2.1	Rainbow Trout Performance Measures	F-52
F.3.2.2	Humpback Chub Performance Measures	F-60
F.4	Modeling the Effects of LTEMP Alternatives on Temperature Suitability	F-62
F.4.1	Model Overview	F-64
F.4.2	Humpback Chub Aggregations.....	F-67
F.4.2.1	Historic Temperature Suitability for Humpback Chub	F-69
F.4.2.2	Results for LTEMP Alternatives.....	F-70
F.4.3	Other Native Fish.....	F-71
F.4.3.1	Historic Temperature Suitability for Native Fish.....	F-73
F.4.3.2	Results for LTEMP Alternatives.....	F-73

CONTENTS (Cont.)

F.4.4	Nonnative Fish.....	F-78
F.4.4.1	Historic Temperature Suitability for Nonnative Fish.....	F-79
F.4.4.2	Results for LTEMP Alternatives.....	F-79
F.4.5	Aquatic Parasites.....	F-81
F.4.5.1	Historic Temperature Suitability for Aquatic Parasites	F-84
F.4.5.2	Results for LTEMP Alternatives.....	F-86
F.5	References	F-90
APPENDIX G: Vegetation Technical Information and Analysis.....		G-1
G.1	Analysis Methods.....	G-3
G.1.1	Old High-Water Zone Analysis	G-4
G.1.2	New High-Water Zone.....	G-5
G.1.2.1	Native Cover Metric.....	G-6
G.1.2.2	Native Diversity Metric.....	G-7
G.1.2.3	Native/Nonnative Ratio Metric	G-7
G.1.2.4	Arrowweed Metric	G-8
G.1.2.5	Overall Score.....	G-8
G.1.3	Wetlands	G-9
G.2	Alternative-Specific Impacts.....	G-10
G.2.1	Alternative A (No Action Alternative).....	G-10
G.2.2	Alternative B.....	G-10
G.2.3	Alternative C.....	G-10
G.2.4	Alternative D (Preferred Alternative).....	G-11
G.2.5	Alternative E	G-11
G.2.6	Alternative F	G-12
G.2.7	Alternative G.....	G-12
G.3	Summary	G-12
G.4	References	G-13
APPENDIX H: Cultural Resources Technical Information and Analysis.....		H-1
H.1	Wind Transport of Sediment.....	H-3
H.1.1	Wind Transport of Sediment—Methods	H-4
H.1.2	Wind Transport of Sediment—Results	H-5
H.2	Flow Effects on Cultural Resources in Glen Canyon	H-8
H.2.1	Flow Effects on Cultural Resources in Glen Canyon—Methods.....	H-9
H.2.2	Flow Effects on Cultural Resources in Glen Canyon—Results.....	H-10
H.3	Time Off River.....	H-13
H.3.1	Time Off River—Methods	H-13
H.3.2	Time Off River—Results	H-14
H.4	References.....	H-16

CONTENTS (Cont.)

APPENDIX I: Tribal Resources Technical Information and Analysis	I-1
I.1 Quantifiable Measures Used to Assess Impacts on Tribal Resources.....	I-4
I.1.1 Riparian Diversity.....	I-4
I.1.2 Wetland Abundance.....	I-8
I.1.3 Trout Management Flows.....	I-10
I.1.4 Mechanical Removal of Trout	I-12
I.1.5 Water Levels at Lake Powell	I-14
I.1.6 Access to Resources.....	I-17
I.2 References	I-18
APPENDIX J: Recreation, Visitor Use, and Experience Technical Information and Analysis.....	J-1
J.1 Recreational Experience Metrics.....	J-3
J.1.1 Grand Canyon Metrics.....	J-4
J.1.2 Glen Canyon Metrics	J-4
J.2 Metric Definitions, Analysis Methods, and Results.....	J-5
J.2.1 Camping Area Index.....	J-5
J.2.1.1 Camping Area Index—Methods	J-6
J.2.1.2 Camping Area Index—Results.....	J-7
J.2.2 Navigational Risk Index	J-8
J.2.2.1 Navigational Risk Index—Methods.....	J-9
J.2.2.2 Navigational Risk Index—Results	J-10
J.2.3 Fluctuation Index	J-11
J.2.3.1 Fluctuation Index—Methods.....	J-12
J.2.3.2 Fluctuation Index—Results.....	J-13
J.2.4 Time Off River.....	J-14
J.2.4.1 Time Off River Index—Methods.....	J-14
J.2.4.2 Time Off River Index—Results	J-15
J.2.5 Glen Canyon Rafting Use.....	J-15
J.2.5.1 Glen Canyon Rafting Use Metric—Methods.....	J-17
J.2.5.2 Glen Canyon Rafting Use Metric—Results	J-18
J.2.6 Glen Canyon Inundation Metric	J-18
J.2.6.1 Glen Canyon Inundation Metric—Methods.....	J-19
J.2.6.2 Glen Canyon Inundation Metric—Results	J-21
J.3 Lake Powell and Lake Mead Dock Access.....	J-21
J.4 Summary	J-26
J.5 References	J-26

CONTENTS (Cont.)

APPENDIX K: Hydropower Systems Technical Information and Analysis.....	K-1
K.1 Economic Value of Glen Canyon Dam Powerplant Capacity and Energy Production	K-3
K.1.1 Power Systems Background	K-3
K.1.2 Glen Canyon Dam, Reservoir, and Powerplant Background	K-5
K.1.3 Power Systems Geographic Scope.....	K-8
K.1.3.1 Top Tier: General Western Interconnection Perspective Modeling	K-9
K.1.3.2 Middle Tier: LTF Customer Utility Systems	K-11
K.1.3.3 Bottom Tier: WAPA SLCA/IP Hydropower Resources.....	K-15
K.1.4 Overview of Power Systems Methods.....	K-16
K.1.5 Description of Individual Power System Models	K-20
K.1.5.1 Colorado River Simulation System Model	K-20
K.1.5.2 Representative Trace Tool.....	K-21
K.1.5.3 Hydropower Outage Model.....	K-21
K.1.5.4 Generation and Transmission Maximization-Lite.....	K-21
K.1.5.5 Sand Budget Model	K-29
K.1.5.6 Large SLCA/IP Powerplant Spreadsheets.....	K-29
K.1.5.7 Small SLCA/IP Powerplant Spreadsheet	K-30
K.1.5.8 Loads Shaping Algorithm	K-30
K.1.5.9 AURORA	K-31
K.1.5.10 LMP Calibration Spreadsheet	K-34
K.1.5.11 Firm Capacity Spreadsheet.....	K-35
K.1.6 SLCA/IP Market System, Data Sources, and Model.....	K-38
K.1.6.1 Historical Data Sources	K-38
K.1.6.2 AURORA Model Dispatch Results for 2013	K-42
K.1.6.3 SLCA/IP Market System Projections.....	K-43
K.1.7 Glen Canyon Dam Powerplant Capacity Cost and Benefit Methodology.....	K-59
K.1.7.1 Treatment of Glen Canyon Dam Capital and Fixed O&M Costs.....	K-61
K.1.7.2 WAPA’s SLCA/IP LTF Obligations and Glen Canyon Dam Replacement Capacity	K-61
K.1.7.3 WAPA SLCA/IP Firm Hydropower Capacity	K-62
K.1.7.4 Firm Capacity Curves for LTEMP Power Systems Analyses for the Peak Month of August	K-79
K.1.7.5 AURORA Capacity Expansion Reserve Margin Targets and Capacity Additions	K-82
K.1.7.6 Dispatch Performed by AURORA Model Capacity Expansion Runs.....	K-86
K.1.7.7 Rationale for the Selection of Hydrology Conditions Used for Capacity Expansion Runs.....	K-90

CONTENTS (Cont.)

K.1.8	Glen Canyon Dam Energy Economic Benefits Methodology	K-90
K.1.9	Net Present Value Calculations and Study Period Adjustments.....	K-94
K.1.10	Power Systems Results	K-96
	K.1.10.1 Main Drivers of Differences among Alternatives	K-97
	K.1.10.2 Capacity Expansion Modeling	K-101
	K.1.10.3 Economic Impacts	K-108
	K.1.10.4 Sensitivity of Results to Exceedance Level	K-116
	K.1.10.5 Sensitivity of Results to Discount Rate.....	K-121
	K.1.10.6 Sensitivity of Results to the Base Capacity Expansion Path.....	K-121
	K.1.10.7 Sensitivity of Results to the Assumed Future Hydrological Conditions	K-123
	K.1.10.8 Sensitivity of Results to Changes in Ancillary Services	K-125
	K.1.10.9 Sensitivity of Results to Customer Capacity Expansion Assumptions	K-129
	K.1.10.10 Summary of Economic Ranking	K-131
K.2	WAPA’s SLCA/IP Firm Electric Service Rate Impacts	K-131
	K.2.1 Relationship between the Economic Impacts of LTEMP Alternatives and Impacts on SLCA/IP FES Rates.....	K-133
	K.2.2 Temporal Scope of the Analysis and Input Data	K-133
	K.2.3 SLCA/IP Rate Setting.....	K-134
	K.2.4 Calculation of Net Electrical Energy Expense.....	K-135
	K.2.4.1 SLCA/IP Electrical Production	K-135
	K.2.4.2 Sustainable Hydropower and Available Hydropower Capacity and Energy	K-135
	K.2.5 Calculation of Capacity Expenses and Total Net Costs.....	K-139
	K.2.6 WAPA Replacement Resources	K-143
	K.2.7 Post-2024 Marketing Period	K-144
	K.2.8 Power Repayment Studies to Determine Rate Impacts	K-146
	K.2.8.1 PRS Expenses.....	K-146
	K.2.8.2 PRS Revenue Distribution.....	K-149
	K.2.8.3 The SLCA/IP PRS.....	K-149
	K.2.8.4 Standard PRS Rate-Setting Method Versus the Method Used in This Analysis.....	K-150
	K.2.9 Results.....	K-150
	K.2.9.1 Pinch-Point Year	K-152
	K.2.10 Definitions Used in Section K.2	K-153
K.3	Impacts on Retail Electricity Rates	K-154
	K.3.1 Analysis Approach.....	K-154
	K.3.1.1 Database of Sales, Rates, and SLCA/IP Allocation for Retail Utility Systems.....	K-156
	K.3.1.2 Incorporation of Power Systems Analysis and Capital Recovery Factors.....	K-158

CONTENTS (Cont.)

	K.3.1.3	Inflation Rates, Sales Growth, and Interest Rates from EIA	K-161
	K.3.1.4	Calculation Process for Computing Rate and Bill Impacts	K-162
K.3.2	Results		K-167
	K.3.2.1	Grid Cost Changes Relative to WAPA Wholesale Revenues	K-168
	K.3.2.2	Retail Rate Changes for Individual Systems and SLCA/IP Power Relative to Total Resources	K-169
	K.3.2.3	Using Regression Equations to Approximate Retail Rate Changes for Systems Not Included in the Database	K-171
K.3.3	Summary of Impacts		K-172
	K.3.3.1	Average Rate Impacts under LTEMP Alternatives over the 20-Year LTEMP Period	K-172
	K.3.3.2	Average Year-by-Year Rate Impacts	K-174
	K.3.3.3	Individual System Impacts and Summary Descriptions of LTEMP Alternatives	K-179
K.3.4	Impacts on Small Systems		K-185
K.3.5	Alternative-Specific Impacts		K-187
	K.3.5.1	Alternative A	K-187
	K.3.5.2	Alternative B	K-187
	K.3.5.3	Alternative C	K-188
	K.3.5.4	Alternative D	K-189
	K.3.5.5	Alternative E	K-189
	K.3.5.6	Alternative F	K-190
	K.3.5.7	Alternative G	K-190
K.4	Financial Impacts of LTEMP Alternatives on American Indian Tribes		K-190
	K.4.1	Contractual Requirements for Calculating and Delivering Benefits to Tribes	K-192
	K.4.2	Calculation of Tribal Benefit Baseline under Alternative A (No Action Alternative)	K-193
	K.4.3	Calculation of Change in Tribal Benefit as a Result of LTEMP EIS Alternatives	K-193
	K.4.4	Impacts on Tribes through a Change in the Retail Rate of the Electrical Supplier to Tribal Lands	K-194
	K.4.5	Calculation of Tribal Impacts for Tribes That Are Direct SLCA/IP Recipients	K-195
	K.4.6	Total Impact of LTEMP EIS Alternatives: Benefit Change and Rate Effect	K-196
	K.4.7	Total Impact on Tribes and Tribal Members Versus Retail Rate Changes to Households	K-202
	K.4.8	Conclusions	K-202
K.5	Impacts of LTEMP Alternatives on Lake Mead and the Hoover Dam Powerplant		K-206

CONTENTS (Cont.)

K.5.1	Hoover Analysis Methods, Model, and Supporting Data.....	K-209
K.5.2	Hoover Monthly Energy Production and Water-to-Power Conversion	K-210
K.5.3	Hoover Maximum Operational Capacity and Firm Capacity	K-213
K.5.4	Economic Value of Hoover Powerplant Energy.....	K-213
K.5.5	Sensitivity of Model Results.....	K-214
K.6	References	K-215
Attachment K.1:	Geographic Scope of the Analysis.....	K-219
Attachment K.2:	AURORA Western Interconnection Spot Market Energy Prices Adjustments	K-223
Attachment K.3:	Selection of Representative Trace	K-226
Attachment K.4:	Discounting Procedures	K-244
Attachment K.5:	Forced Outage Scenario Generation for Hydroelectric Power Facilities.....	K-247
Attachment K.6:	Forecast of Monthly Peak Loads and Energy by SLCA/IP Long-Term Firm Customer.....	K-250
Attachment K.7:	Analysis of the Timing of the Peak Load	K-252
Attachment K.8:	Analysis of Capacity Determinations — Comparing Results Using a Range of Exceedence Levels and Two Summer Peak Months.....	K-258
Attachment K.9:	Results of a Survey of Electric Utility Integrated Resource Plans	K-260
Attachment K.10:	Indices Used for Converting Dollars from One Year to Another.....	K-270
Attachment K.11:	Summary IRP of Capacity Additions in the Joint System and Surrounding Utility Systems through the End of CY2034.....	K-275
Attachment K.12:	Annual SLCA/IP Allocations to American Indian Tribes and Benefit Information.....	K-277
APPENDIX L:	Socioeconomic Technical Information and Analysis.....	L-1
L.1	Recreation Economic Analyses.....	L-3
L.1.1	Recreation Use Values.....	L-3
L.1.1.1	Lake_Full Utility Model.....	L-4
L.1.1.2	GCRec_Full Utility Model.....	L-5
L.1.2	Recreation Non-Use Values.....	L-6
L.1.3	Regional Recreation Economic Impacts.....	L-10
L.1.4	Estimates of Recreational Economic Impacts.....	L-12
L.2	Regional Electricity Analyses	L-13
L.2.1	Regional Electricity Price Impacts.....	L-13
L.2.2	Regional Electricity Generating Capacity Expansion Impacts.....	L-15
L.3	Additional Socioeconomic Data.....	L-15
L.3.1	Urban Population in the Six-County Region	L-15
L.3.2	Urban Income in the Six-County Region.....	L-20
L.4	References	L-21

CONTENTS (Cont.)

APPENDIX M: Air Quality and Climate Change Technical Information and Analysis	M-1
M.1 Analysis Methods	M-4
M.1.1 System Power Generation	M-4
M.1.2 Spot Market	M-5
M.1.3 Generation Type	M-6
M.2 Results	M-6
M.2.1 SO ₂ and NO _x	M-6
M.2.2 GHG Emissions	M-8
M.3 References	M-9
APPENDIX N: Government-to-Government and National Historic Preservation Act Consultation	N-1
N.1 Government-to-Government Consultation	N-3
N.2 Consultation with the State Historic Preservation Office	N-31
N.3 Reference	N-31
Attachment N.1	N-33
Attachment N.2	N-75
Attachment N.3	N-137
APPENDIX O: Biological Assessment for the Glen Canyon Dam Long-Term Experimental and Management Plan	O-1
APPENDIX P: High-Flow Experiment Protocol for the Preferred Alternative	P-1
P.1 Decision-Making Process	P-3
P.1.1 Planning	P-4
P.1.2 Modeling	P-5
P.1.3 Decision and Implementation	P-8
P.2 Operation of Glen Canyon Dam under the HFE Protocol	P-9
P.2.1 Potential Operation of Glen Canyon Dam during the Fall HFE Implementation Window	P-10
P.2.2 Potential Operation of Glen Canyon Dam during the Spring HFE Implementation Window	P-10
P.3 High Flow Experiments to be Evaluated under the Preferred Alternative	P-11
P.3.1 Sediment-Triggered Spring HFEs	P-11
P.3.2 Proactive Spring HFEs	P-12
P.3.3 Sediment-Triggered Fall HFEs	P-13
P.3.4 Extended-Duration Fall HFEs	P-13
REFERENCES	P-14
APPENDIX Q: Responses to Public Comments on the Glen Canyon Dam Long-Term Experimental and Management Plan Draft Environmental Impact Statement	Q-1

FIGURES

1-1	Generalized Locations of Glen Canyon Dam, Lake Powell, the Colorado River between Lake Powell and Lake Mead, and Adjacent Lands	1-5
1-2	Glen Canyon Dam.....	1-6
1-3	Map of the Colorado River between Lake Powell and Lake Mead	1-20
1-4	Indian Reservations within or Adjacent to the LTEMP EIS Project Area.....	1-25
2-1	Mean, Minimum, and Maximum Daily Flows under Alternative A in an 8.23-maf Year Based on Values Presented in Table 2-3	2-18
2-2	Simulated Hourly Flows under Alternative A in an 8.23-maf Year	2-18
2-3	Simulated Hourly Flows under Alternative A for a Week in July in an 8.23-maf Year Showing Typically Lower Weekend Flows	2-19
2-4	Mean, Minimum, and Maximum Daily Flows under Alternative B in an 8.23-maf Year Based on Values Presented in Table 2-4	2-21
2-5	Simulated Hourly Flows under Alternative B in an 8.23-maf Year	2-22
2-6	Simulated Hourly Flows under Alternative B for a Week in July in an 8.23-maf Year Showing Typically Lower Weekend Flows	2-22
2-7	Example Mean, Minimum, and Maximum Daily Flows for a Hydropower Improvement Experiment under Alternative B in an 8.23-maf Year	2-24
2-8	Simulated Hourly Flows for a Hydropower Improvement Experiment under Alternative B in an 8.23-maf Year.....	2-24
2-9	Simulated Hourly Flows for a Hydropower Improvement Experiment under Alternative B for a Week in July in an 8.23-maf Year	2-25
2-10	Mean, Minimum, and Maximum Daily Flows under Base Operations of Alternative C in an 8.23-maf Year Based on the Values Presented in Table 2-5....	2-26
2-11	Simulated Hourly Flows under Alternative C in an 8.23-maf Year	2-28
2-12	Simulated Hourly Flows under Alternative C for a Week in July in an 8.23-maf Year Showing Typically Lower Weekend Flows	2-28
2-13	Decision Tree for Sediment-Related Actions under Alternative C.....	2-29

FIGURES (Cont.)

2-14	Decision Tree for Humpback Chub-Related Actions under Alternative C	2-30
2-15	Example Implementation of a Two-Cycle TMF in June and July with Resumption of Normal Fluctuations between Cycles and Afterward	2-40
2-16	Mean, Minimum, and Maximum Daily Flows under Triggered Low Summer Flows of Alternative C in an 8.23-maf Year Based on the Values Presented in Table 2-6	2-42
2-17	Mean, Minimum, and Maximum Daily Flows under Alternative D in an 8.23-maf Year Based on Values Presented in Table 2-8	2-45
2-18	Simulated Hourly Flows under Alternative D in an 8.23-maf Year	2-47
2-19	Simulated Hourly Flows under Alternative D for a Week in July in an 8.23-maf Year Showing Typically Lower Weekend Flows	2-47
2-20	Decision Tree for Implementation of Sediment-Related Experimental Treatments under Alternative D.....	2-55
2-21	Decision Tree for Implementation of Aquatic Resource-Related Experimental Treatments under Alternative D.....	2-56
2-22	Mean, Minimum, and Maximum Daily Flows under Triggered Low Summer Flows of Alternative D in an 8.23-maf Year Based on the Values Presented in Table 2-10	2-69
2-23	Mean, Minimum, and Maximum Daily Flows under Alternative E in an 8.23-maf Year Based on the Values Presented in Table 2-11	2-74
2-24	Simulated Hourly Flows under Alternative E in an 8.23-maf Year.....	2-74
2-25	Simulated Hourly Flows under Alternative E for a Week in July in an 8.23-maf Year Showing Typically Lower Weekend Flows	2-75
2-26	Decision Tree for Sediment-Related Actions under Alternative E	2-76
2-27	Decision Tree for Trout-Related Actions under Alternative E.....	2-77
2-28	Mean, Minimum, and Maximum Daily Flows under Base Operations of Alternative F in an 8.23-maf Year Based on the Values Presented in Table 2-12	2-82

FIGURES (Cont.)

2-29	Mean, Minimum, and Maximum Daily Flows under Alternative G in an 8.23-maf Year Based on Values Presented in Table 2-13	2-83
3.1-1	LTEMP Project Area and Surrounding Lands	3-2
3.2-1	Map of Lake Powell and Associated Major Tributaries	3-8
3.2-2	Pattern of Annual Historic Flows at Lees Ferry	3-12
3.2-3	Map of Lake Mead and Associated Major Tributaries	3-13
3.2-4	Profile of Lake Powell from Glen Canyon Dam to the Inflow of the Colorado River.....	3-16
3.2-5	Water Temperature at Lees Ferry	3-18
3.2-6	Water Temperatures at Four Stations along the Colorado River from Lees Ferry to Diamond Creek, 1995–2014.....	3-21
3.2-7	Mid-June Warming above Release Temperatures Measured at Diamond Creek, 1994–2004, as a Function of Mean Weekly Discharge.....	3-22
3.3-1	Geomorphic Features of the Colorado River	3-36
3.3-2	Schematic Diagram of the Fan-Eddy Complex on the Colorado River.....	3-38
3.3-3	River Cross Section Depicting Sediment Entrapment and Sandbar Building	3-38
3.3-4	Aeolian and Fluvial Sand Deposits along the Colorado River	3-40
3.3-5	Debris Fans and Variation in Water-Surface Elevation and Channel Width for Colorado River Flows below Glen Canyon Dam	3-42
3.3-6	Comparison of Sandbars Used as Campsites, based on Inventories Conducted in 1973, 1983, and 1991.....	3-42
3.3-7	Repeated Photography Illustrating Sediment Losses and Sandbar Changes along the Colorado River	3-44
3.3-8	Annual Sediment Contributions from the Paria and Little Colorado Rivers	3-49
3.3-9	Matched Photographs of RM 172 Illustrating Positive Depositional Response to the 2008 HFE.....	3-52

FIGURES (Cont.)

3.3-10	Conceptual Diagram of the Dependency between Net Sandbar Size, Duration and Frequency of HFEs, and Post-HFE Erosion Rates.....	3-54
3.3-11	Average Campsite Area above the References Stage: before, after, and 6 Months following the 2008 HFE	3-55
3.3-12	Longitudinal Profiles of the Mainstem Colorado Riverbed Upstream of the Hoover Dam in 1935, 1948, 1963, and 2001	3-57
3.5-1	Temperature Ranges for Spawning, Egg Incubation, and Growth by Native and Nonnative Fishes of the Colorado River System below Glen Canyon Dam	3-71
3.5-2	Humpback Chub Aggregation Areas along the Colorado River between Glen Canyon Dam and Lake Mead.....	3-74
3.5-3	Estimated Adult Humpback Chub Abundance from Age-Structured Mark-Recapture Model Incorporating Uncertainty in Assignment of Age	3-75
3.5-4	Estimated Total Adult Abundance of Humpback Chub in the Lower 8 mi of the Little Colorado River and a 2-mi Portion of the Colorado River Just Downriver of the Confluence of the Little Colorado and Colorado Rivers, for September, 2009 through 2012	3-76
3.5-5	Water Temperatures at Lees Ferry and the Little Colorado River Confluence, 1995 to Present.....	3-81
3.5-6	Mean Electrofishing Catch Rates of Rainbow Trout in the Glen Canyon Reach, 1991–2013.....	3-96
3.5-7	Mean Electrofishing Catch Rates of Brown Trout in the Colorado River between Lees Ferry and Lake Mead, 2000–2009	3-99
3.6-1	Riparian Vegetation Zones along the Colorado River below Glen Canyon Dam ...	3-114
3.7-1	Riparian Zones Used by Nesting Birds.....	3-124
3.7-2	Threatened, Endangered, and Sensitive Species Observed along the Colorado River Corridor	3-135
3.8-1	Spencer Steamboat.....	3-148
3.8-2	A Roasting Pit Feature in a Grand Canyon Dune	3-148

FIGURES (Cont.)

3.8-3	An Archaic Period Site on the Colorado River in GCNP	3-151
3.8-4	Glen Canyon Linear Style Petroglyph in GCNRA	3-151
3.8-5	Puebloan Era Architecture along the Colorado River in GCNP	3-152
3.8-6	Lees Ferry and Lonely Dell Ranch Historic District Located in GCNRA	3-155
3.10-1	Glen Canyon Reach Rainbow Trout	3-170
3.10-2	Mean Rainbow Trout Catch Per Unit Effort of Both Boat Anglers and Shore-Line Anglers from Creel Surveys at Lees Ferry	3-171
3.10-3	Fishing User Days by Month in the Glen Canyon Reach for 2006 and 2009.....	3-172
3.10-4	Angler Days in the Glen Canyon Reach from 1965 through 2011	3-173
3.10-5	Designated Campsite Areas in the Glen Canyon Reach	3-175
3.10-6	Shoreline Environment with Steep Erosion Banks at Glen Canyon Reach Ferry Swale Campsite	3-176
3.10-7	Pontoon Raft Operated by Colorado River Discovery.....	3-176
3.10-8	Boating in Grand Canyon, Anticipated Annual Use by Month	3-179
3.10-9	Change in Camp Size over Time in the Lees Ferry to Diamond Creek Reach of GCNP.....	3-181
3.10-10	Total High-Elevation Campsite Area for Each Survey between 1998 and 2006	3-182
3.10-11	High-Elevation Campsite Area in Critical and Noncritical Reaches between 1998 and 2006.....	3-182
3.12-1	Glen Canyon Viewed from the Colorado River	3-194
3.12-2	Horseshoe Bend	3-194
3.12-3	Typical View of the Colorado River and Grand Canyon Afforded Recreationists on a River Trip	3-196
3.12-4	Colorado River and Granaries at Nankoweap.....	3-196

FIGURES (Cont.)

3.12-5	Entrance to Havasu Canyon.....	3-197
3.12-6	Vasey’s Paradise	3-197
3.14-1	Minority Population Groups in the 11-County Area	3-219
3.14-2	Low-Income Population Groups in the 11-County Area.....	3-220
3.15-1	Nonattainment Areas for SO ₂ , 8-Hour O ₃ , PM _{2.5} , PM ₁₀ , and Pb in the 11-State Area	3-233
3.15-2	PSD Class I Areas in the 11-State Affected Area.....	3-235
3.16-1	Historical Supply and Use and Projected Future Colorado River Basin Water Supply and Demand.....	3-238
4-1	Integrated Multiple-Resource Modeling Framework Showing Inputs, Intermediate Calculations, and Output	4-3
4-2	Example Box-and-Whisker Plot for Alternatives and Their Resource Metric Values	4-6
4.2-1	Monthly Releases under Each Alternative in Years with Different Annual Release Volumes.....	4-22
4.2-2	Mean Monthly Volume under the LTEMP Alternatives Showing the Mean, Median, 75th Percentile, 25th Percentile, Minimum, and Maximum Values for 21 Hydrology Scenarios and Three Sediment Scenarios	4-24
4.2-3	Mean Daily Flows by Month under the LTEMP Alternatives Showing the Mean, Median, 75th Percentile, 25th Percentile, Minimum, and Maximum Values for 21 Hydrology Scenarios and Three Sediment Scenarios	4-27
4.2-4	Mean Daily Change in Flows by Month under the LTEMP Alternatives Showing the Mean, Median, 75th Percentile, 25th Percentile, Minimum, and Maximum Values for 21 Hydrology Scenarios and Three Sediment Scenarios.....	4-29
4.2-5	Lake Powell and Lake Mead End of Calendar Year Pool Elevation for 21 Hydrology Traces and Seven Alternatives	4-32
4.2-6	Percentage of Traces below Lake Powell’s Minimum Power Pool and Percentage of Traces with a Lower Basin Shortage for 21 Hydrology Traces and Seven Alternatives	4-33

FIGURES (Cont.)

4.2-7	Percentage of Time in Different Operating Tier than Alternative	4-34
4.2-8	Frequency of Lake Powell Operating Tiers from 2014 to 2026 under Each of the Alternatives for 21 Hydrologic Traces.....	4-35
4.2-9	Frequency of Lake Powell Operating Tiers from 2027 to 2033 under Each of the Alternatives for 21 Hydrologic Traces.....	4-36
4.2-10	Frequency of Occurrence of Modeled Annual Releases Extending Beyond the Water Year per 20-Year Trace for Each of the Alternatives	4-37
4.2-11	Comparison of Mean Water Temperatures for Representative Wetter, Moderate, and Drier Hydrology Traces for Glen Canyon Dam Releases	4-39
4.2-12	Seasonal Glen Canyon Dam Release Temperatures for LTEMP Alternatives.....	4-40
4.2-13	Seasonal Temperature Trends under the Seven LTEMP Alternatives	4-42
4.2-14	Projected Mean Salinity Concentrations under the LTEMP Alternatives at Lees Ferry	4-46
4.3-1	Conceptual Depiction of the Sand Load Index	4-67
4.3-2	Conceptual Depiction of the Sand Mass Balance Model.....	4-68
4.3-3	Variation in Lake Powell Pool Elevation Relative to Full for 21 Hydrology Traces and Seven Alternatives.....	4-75
4.3-4	Variation in Lake Mead Pool Elevation Relative to Full for 21 Hydrology Traces and Seven Alternatives.....	4-76
4.3-5	Number and Type of HFEs Expected to Occur during the 20-Year LTEMP Period under the Seven Alternatives.....	4-77
4.3-6	Sand Load Index Values for the 20-Year LTEMP Period under the Seven Alternatives	4-78
4.3-7	Sand Mass Balance Index Values for the 20-Year LTEMP Period under the Seven Alternatives	4-79
4.4-1	Anticipated Relationships among Dam Releases, Physical Conditions, Habitats, and Ecological Resources in the Colorado River Ecosystem.....	4-89

FIGURES (Cont.)

4.5-1	Modeled Average Population Size of Age-1 and Older Rainbow Trout in the Glen Canyon Reach during the 20-Year LTEMP Period under the LTEMP Alternatives Showing the Mean, Median, 75th Percentile, 25th Percentile, Minimum, and Maximum Values for 21 Hydrology Scenarios	4-121
4.5-2	Modeled Annual Average Number of Rainbow Trout Emigrating into the Marble Canyon Reach from the Glen Canyon Reach during the 20-Year LTEMP Period under the LTEMP Alternatives	4-123
4.5-3	Modeled Mean Annual Number of Rainbow Trout in the Glen Canyon Reach Exceeding 16 in. Total Length during 20-Year Simulation Periods under the LTEMP Alternatives	4-124
4.5-4	Modeled Mean Annual Temperature Suitability for Rainbow and Brown Trout under LTEMP Alternatives at Four Locations Downstream of Glen Canyon Dam	4-125
4.5-5	Modeled Mean Annual Temperature Suitability for Warmwater Nonnative Fish under LTEMP Alternatives at Four Locations Downstream of Glen Canyon Dam	4-127
4.5-6	Mean Annual Mainstem Temperature Suitability for Humpback Chub under LTEMP Alternatives at Reported Aggregation Locations and Combined Temperature Suitability for RM 157 and RM 213 Locations	4-129
4.5-7	Mean Modeled Total Length Attained by December 31 for YOY Humpback Chub Based on Predicted Mainstem Water Temperatures at the Little Colorado River Confluence and at Pumpkin Spring under Each Alternative	4-130
4.5-8	Modeled Minimum Population Size for Humpback Chub during the 20-Year LTEMP Period under LTEMP Alternatives	4-131
4.5-9	Modeled Mean Annual Temperature Suitability for Native Fish under LTEMP Alternatives at Four Locations Downstream of Glen Canyon Dam	4-135
4.5-10	Overall Modeled Mean Annual Temperature Suitability under LTEMP Alternatives for Aquatic Fish Parasites at Four Locations Downstream of Glen Canyon Dam	4-136
4.6-1	Dominant Factors Affecting Riparian Plant Communities below Glen Canyon Dam	4-177

FIGURES (Cont.)

4.6-2	Comparison among Alternatives for Four Riparian Vegetation Metrics as Predicted by a Vegetation Model.....	4-178
4.6-3	Comparison among Alternatives for Combined Riparian Vegetation Metrics as Predicted by a Vegetation Model.....	4-179
4.6-4	Comparison among Alternatives for Wetland Cover as Predicted by a Vegetation Model.....	4-187
4.8-1	Number of Days per Year Flows Would Be >23,200 cfs under LTEMP Alternatives	4-243
4.8-2	Wind Transport of Sediment Index Values for LTEMP Alternatives	4-245
4.10-1	Recreation, Visitor Use, and Experience Metric Results for LTEMP Alternatives	4-288
4.13-1	Flow Diagram of the Power Systems Methodology Used in the LTEMP EIS.....	4-326
4.13-2	Average Daily Glen Canyon Dam Generation under Representative Hydrological Conditions under LTEMP Alternatives	4-341
4.13-3	Total NPV of Hoover Powerplant Energy over a 20-Year Period under LTEMP Alternatives.....	4-352
4.15-1	Annual Power Generation by Alternative over the 20-Year LTEMP Period	4-407
4.16-1	Weights Used To Reflect the Expected Frequency of Hydrologic Conditions under Climate Change.....	4-415
4.16-2	Mean Annual Inflow Showing the Mean, Median, 75th Percentile, 25th Percentile, Minimum, and Maximum Values for 112 Climate-Change Inflow Traces and 21 Historic Inflow Traces	4-416
4.16-3	Differences between Historic and Climate-Change-Weighted Values of Mean Daily Flow and Mean Daily Change in Flow by Month for LTEMP Alternatives	4-420
D-1	Operating Tiers as Specified by the 2007 Interim Guidelines for the Operations of Lake Powell and Lake Mead.....	D-7
D-2	Monthly Releases for Each Alternative in an 8.23-maf Release Year.....	D-21

FIGURES (Cont.)

D-3	Locations of CRSS 29 Natural Flow Nodes	D-24
D-4	Comparison of CRSS Results Generated Using 105 Traces and 21 Traces for Lake Powell Annual Inflow, Lake Powell Water-Year Release Volume, and Lake Powell Monthly Release Volume	D-25
D-5	Comparison of CRSS Results Generated Using 105 Traces and 21 Traces for Lake Powell End-of-December Water Elevations at the 10th, 50th, and 90th Percentiles	D-25
D-6	Occurrences of Low Summer Flows in Applicable Alternatives	D-28
D-7	Frequency of Occurrence of Modeled Annual Releases Extending beyond the End of the Water Year per 20-yr Trace for Each of the Alternatives	D-29
D-8	Median Volume of Modeled Annual Releases Extending beyond the End of the Water-Year Releases by Trace for Each of the Alternatives	D-30
D-9	Lake Powell and Lake Mead End-of-December Pool Elevation for 21 Hydrology Traces under Alternatives A and B.....	D-30
D-10	Lake Powell and Lake Mead End-of-December Pool Elevation for 21 Hydrology Traces under Alternatives A and C.....	D-31
D-11	Lake Powell and Lake Mead End-of-December Pool Elevation for 21 Hydrology Traces under Alternatives A and D	D-31
D-12	Lake Powell and Lake Mead End-of-December Pool Elevation for 21 Hydrology Traces under Alternatives A and E.....	D-32
D-13	Lake Powell and Lake Mead End-of-December Pool Elevation for 21 Hydrology Traces under Alternatives A and F	D-32
D-14	Lake Powell and Lake Mead End-of-December Pool Elevation for 21 Hydrology Traces under Alternatives A and G	D-33
D-15	Percentage of Traces below Lake Powell’s Minimum Power Pool and Percentage of Traces with a Lower Basin Shortage for 21 Hydrology Traces under Alternatives A and B.....	D-33
D-16	Percentage of Traces below Lake Powell’s Minimum Power Pool and Percentage of Traces with a Lower Basin Shortage for 21 Hydrology Traces under Alternatives A and C.....	D-34

FIGURES (Cont.)

D-17	Percentage of Traces below Lake Powell’s Minimum Power and Percentage of Traces with a Lower Basin Shortage for 21 Hydrology Traces under Alternatives A and D	D-34
D-18	Percentage of Traces below Lake Powell’s Minimum Power Pool and Percentage of Traces with a Lower Basin Shortage for 21 Hydrology Traces under Alternatives A and E.....	D-35
D-19	Percentage of Traces below Lake Powell’s Minimum Power Pool and Percentage of Traces with a Lower Basin Shortage for 21 Hydrology Traces under Alternatives A and F	D-35
D-20	Percentage of Traces below Lake Powell’s Minimum Power Pool and Percentage of Traces with a Lower Basin Shortage for 21 Hydrology Traces under Alternatives A and G	D-36
E-1	Comparison of Calendar, Water, and Sediment Years	E-20
E-2	Model Flow Diagram for Analyses Showing Inputs, Intermediate Calculations, and Output.....	E-21
E-3	Conceptual Schematic of the Sand Budget Model.....	E-22
E-4	Historical Paria Sediment Load per Accounting Period and the 20.5-year Load for the Trace That Begins in Each Fall Accounting Period	E-22
E-5	Sediment Traces s1, s2, and s3 for the Paria River Used in the Modeling to Account for Uncertainty in Future Delivery	E-23
E-6	Little Colorado River Sediment Traces for s1, s2, and s3 Used in the Modeling to Account for Uncertainty in Future Delivery	E-23
E-7	Conceptual Representation of the Sand Mass Balance Index.....	E-24
E-8	Average Sediment and Hydrology Triggered HFE Count by Type for Each Long-Term Strategy	E-24
E-9	Average HFE Count for Sediment Traces s1, s2, and s3 for Each Long-Term Strategy	E-25
E-10	Definition of the Statistics Represented by the Box and Whisker Plots Used in This Analysis	E-25

FIGURES (Cont.)

E-11	Sand Load Index Statistics from 63 Simulations for Each Long-Term Strategy.....	E-26
E-12	Standard Deviation of High Flows Statistics from 63 Simulations for Each Long-Term Strategy	E-26
E-13	Correlation between SDHF and SLI	E-27
E-14	Sand Mass Balance Index Statistics from 63 Simulations for Each Long-Term Strategy	E-27
E-15	Correlation between SMBI and SLI	E-28
E-16	Sand Load Index for Long-Term Strategies Using Climate Change Weights.....	E-28
E-17	Comparison of the Sand Load Index between Climate Change and Historical Weights	E-29
E-18	Standard Deviation of High Flows Using Climate Change Weights.....	E-29
E-19	Comparison of the Standard Deviation of High Flows between Climate Change and Historical Weights	E-30
E-20	Sand Mass Balance Index Using Climate Change Weights	E-30
E-21	Comparison of the Sand Mass Balance Index between Climate Change and Historical Weights	E-31
E-22	Comparison of Long-Term Strategies C1 and C2 for Hydrology Trace 1, Sediment Trace 3	E-31
E-23	SMBI for Alternative E Plotted against Alternative C	E-32
E-24	SLI for Alternative E Plotted against Alternative C	E-32
E-25	Load-Following Curtailment Effects on SLI and SMBI.....	E-33
E-26	Low Summer Flows for WY 2014, Hydrology Trace 1, Sediment Trace 1	E-34
E-27	Hydrology Impacts on the Sand Load Index	E-35
E-28	Hydrology Impacts on the Sand Mass Balance Index	E-35
E-29	Conceptual Diagram of Water Surface Elevation Affecting Delta Location.....	E-36

FIGURES (Cont.)

E-30	Historical Cumulative Sand Load Leaving Marble Canyon and Reaching the Gage above Diamond Creek	E-36
E-31	Hydrology Impacts of Lake Powell Pool Elevations by Month across Alternatives	E-37
E-32	Hydrology Impacts of Lake Mead Pool Elevations by Month across Alternatives	E-37
F-1	Fit of Regressions Predicting the Log of Recruitment of Rainbow Trout in the Glen Canyon Reach Estimated by the Korman et al. Stock Synthesis Model as a Function of the Annual Release Volume from Glen Canyon Dam, the Range of Mean Daily Flows during May–August, and the Maximum Flow Each Year....	F-31
F-2	Relationship between Annual Estimates of the Asymptotic Length of Rainbow Trout in Lees Ferry Predicted by the Stock Synthesis Model as a Function of the Estimated Abundance for Fish >150 mm Each Year.....	F-32
F-3	The Relationship between Annual Recruitment of Rainbow Trout in Lees Ferry Estimated by the Korman et al. Stock Synthesis Model and the Number of Trout That Emigrate from Lees Ferry into Marble Canyon the Following Year	F-35
F-4	Fit of the Glen Canyon Rainbow Trout Simulation Model to Predictions of Recruitment, Asymptotic Length, and the Number of Out-migrants Predicted by the Korman et al. Stock Synthesis Model.....	F-37
F-5	Predicted and Observed Annual Catch of Rainbow Trout by Year and River Reach.....	F-41
F-6	Best-Fitting Distributions Describing Monthly Movement of Rainbow Trout in Marble Canyon Assuming Either a Normal or Cauchy Distribution.....	F-43
F-7	Visual Summary of Humpback Chub Population Model Structure.....	F-44
F-8	Modeled Effects of Trout Abundance and Temperature on Humpback Chub Survival and Growth.....	F-48
F-9	Simulated Adult Abundances from Backcasted Model Compared to Patterns Reported in Coggins and Walters	F-51
F-10	Modeled Average Population Size of Age-1 and Older Rainbow Trout in the Glen Canyon Reach during the 20-year LTEMP Period under LTEMP Alternatives and Long-Term Strategies	F-54

FIGURES (Cont.)

F-11	Modeled Mean Annual Number of Rainbow Trout in the Glen Canyon Reach Exceeding 16 in. Total Length during the 20-year LTEMP Period under the LTEMP Alternatives and Long-Term Strategies	F-55
F-12	Relationship between Modeled Mean Rainbow Trout Abundance in the Glen Canyon Reach and the Mean Number of Rainbow Trout Exceeding 16 in. Total Length during the 20-year LTEMP Period under the LTEMP Alternatives and Long-Term Strategies	F-56
F-13	Modeled Mean Annual Angler Catch Rate for Rainbow Trout in the Glen Canyon Reach during the 20-year LTEMP Period under the LTEMP Alternatives and Long-Term Strategies	F-57
F-14	Relationship between Modeled Mean Rainbow Trout Abundance in the Glen Canyon Reach and Mean Angler Catch Rates during the 20-year LTEMP Period under the LTEMP Alternatives and Long-Term Strategies.....	F-58
F-15	Modeled Annual Average Number of Rainbow Trout Emigrating into the Marble Canyon Reach from the Glen Canyon Reach during the 20-year LTEMP Period under the LTEMP Alternatives and Long-Term Strategies	F-59
F-16	Modeled Frequency of Triggered Mechanical Removal for Rainbow Trout in the Little Colorado River Reach during the 20-year LTEMP Period under the LTEMP Alternatives and Long-Term Strategies	F-61
F-17	Modeled Minimum Population Size for Humpback Chub during the 20-year LTEMP Period under the LTEMP Alternatives and Long-Term Strategies	F-62
F-18	Relationship between Modeled Mean Numbers of Rainbow Trout Out-migrants from the Glen Canyon Reach and the Modeled Mean Minimum Abundance of Adult Humpback Chub during the 20-year LTEMP Period under the LTEMP Alternatives and Long-Term Strategies	F-63
F-19	Suitability for Spawning, Egg Incubation, and Growth of Humpback Chub as a Function of Water Temperature	F-68
F-20	Months for Which Annual Temperature Suitability for Specific Life History Aspects of Humpback Chub Were Calculated.....	F-68
F-21	Modeled Historic Water Temperatures in the Colorado River at Humpback Chub Aggregation Locations, Water Years 1990–2012	F-70

FIGURES (Cont.)

F-22	Output from the Temperature Suitability Model for Humpback Chub Aggregation Locations Based on Modeled Water Temperatures for Water Years 1990–2012	F-71
F-23	Mainstem Temperature Suitability for Humpback Chub Aggregation Locations under LTEMP Alternatives and Long-Term Strategies	F-72
F-24	Suitability of Water Temperatures for Spawning, Egg Incubation, and Growth of Native Fish Species	F-74
F-25	Months for Which Temperature Suitability for Specific Life History Aspects Were Considered for Native Fish Species	F-74
F-26	Modeled Historic Water Temperatures in the Colorado River Downstream of Glen Canyon Dam, Water Years 1990–2012	F-75
F-27	Annual Temperature Suitability Scores for Growth, Spawning, and Egg Incubation of Native Fish Species at RM 225 Based on Modeled Water Temperatures for Water Years 1990–2012.....	F-76
F-28	Annual Temperature Suitability Scores for Native Fish by Assessment Location Based on Modeled Water Temperatures for Water Years 1990–2012.....	F-77
F-29	Mean Annual Overall Temperature Suitability for Native Fish by Assessment Location Based on Modeled Water Temperatures for Water Years 1990–2012.....	F-77
F-30	Mean Annual Mainstem Temperature Suitability for Native Fish under LTEMP Alternatives and Long-Term Strategies at RM 61, RM 157, and RM 225, and Overall Mean for RM 61–225.....	F-78
F-31	Suitability of Water Temperatures for Spawning, Egg Incubation, and Growth of Nonnative Fish Species	F-80
F-32	Months during Which Temperature Suitability for Specific Life History Aspects Were Calculated for Nonnative Fish Species.....	F-81
F-33	Annual Temperature Suitability Scores for Spawning, Incubation, and Growth of Nonnative Fish Species at RM 225 Based on Modeled Temperatures for Water Years 1990 to 2012	F-82
F-34	Mean Annual Temperature Suitability Scores for Nonnative Fish Species and for Temperature Groups by River Location Based on Modeled Water Temperatures for Water Years 1990–2012.....	F-83

FIGURES (Cont.)

F-35	Mean Annual Overall Temperature Suitability Scores for Coldwater and Warmwater Nonnative Fish Species Groups Based on Modeled Historic Temperatures for Water Years 1990–2012.....	F-83
F-36	Mean Annual Mainstem Temperature Suitability for Coldwater Nonnative Fish under LTEMP Alternatives and Long-Term Strategies at RM 15, RM 61, RS 157, and RM 225.....	F-84
F-37	Mean Annual Mainstem Temperature Suitability for Warmwater Nonnative Fish under LTEMP Alternatives and Long-Term Strategies at RM 0, RM 61, RM 157, and RM 225	F-85
F-38	Suitability of Various Water Temperatures for Host Activity and Infestation Rates of Parasite Species	F-86
F-39	Annual Temperature Suitability Scores for Parasite Species at RM 225 Based on Modeled Water Temperatures for Water Years 1990–2012.....	F-87
F-40	Mean Annual Temperature Suitability Scores for Parasite Species by River Location Based on Modeled Water Temperatures for Water Years 1990–2012.....	F-87
F-41	Overall Means of Annual Suitability Scores for Parasite Species across All River Locations during the 1990–2012 Water Years	F-88
F-42	Overall Modeled Mean Annual Temperature Suitability under LTEMP Alternatives and Long-Term Strategies for Aquatic Fish Parasites at Four Locations Downstream of Glen Canyon Dam	F-89
G-1	Native Cover Metric for the LTEMP Alternatives and Associated Long-Term Strategies.....	G-46
G-2	Native Cover Metric under Climate Change for the LTEMP Alternatives and Associated Long-Term Strategies.....	G-46
G-3	Native Diversity Metric for the LTEMP Alternatives and Associated Long-Term Strategies	G-47
G-4	Native Diversity Metric under Climate Change for the LTEMP Alternatives and Associated Long-Term Strategies	G-47
G-5	Native/Nonnative Ratio Metric for the LTEMP Alternatives and Associated Long-Term Strategies	G-48

FIGURES (Cont.)

G-6	Native/Nonnative Ratio Metric under Climate Change for the LTEMP Alternatives and Associated Long-Term	G-48
G-7	Arrowweed Metric for the LTEMP Alternatives and Associated Long-Term Strategies; Higher Values Indicate Less	G-49
G-8	Arrowweed Metric under Climate Change for the LTEMP Alternatives and Associated Long-Term Strategies; Higher Values Indicate Less Arrowweed	G-49
G-9	Overall Combined Score for the LTEMP Alternatives and Associated Long-Term Strategies	G-50
G-10	Overall Combined Score under Climate Change for the LTEMP Alternatives and Associated Long-Term Strategies	G-50
G-11	Relative Change in Wetland Cover for the LTEMP Alternatives and Associated Long-Term Strategies	G-51
G-12	Relative Change in Wetland Cover under Climate Change for the LTEMP Alternatives and Associated Long-Term Strategies.....	G-51
H-1	Wind Transport of Sediment Index Values for the LTEMP Alternatives and Associated Long-Term Strategies.....	H-6
H-2	Average Number of HFEs in the 20-Year LTEMP Period.....	H-7
H-3	Daily Maximum Discharge in a Typical 8.23-maf Water Volume Release Year from the Glen Canyon Dam during the Windy Season of March–June	H-8
H-4	Number of Days per Year Flows Would Be >23,200 cfs under LTEMP Alternatives and Long-Term Strategies	H-10
H-5	Average Number of Days of an HFE Event per Year.....	H-11
H-6	Modeled Glen Canyon Dam Discharge for the Same Year	H-12
H-7	Time Off River Index Values for All LTEMP Alternatives and Associated Long-Term Strategies	H-14
H-8	Daily Average Discharge for Representative Long-Term LTEMP Strategies	H-15
I-1	Riparian Diversity for the LTEMP Alternatives and Associated Long-Term Strategies.....	I-6

FIGURES (Cont.)

I-2	Riparian Diversity under Climate Change Assumptions for the LTEMP Alternatives and Associated Long-Term Strategies	I-7
I-3	Wetland Abundance for the LTEMP Alternatives and Associated Long-Term Strategies.....	I-9
I-4	Wetland Abundance under Climate Change Assumptions for the LTEMP Alternatives and Associated Long-Term Strategies.....	I-10
I-5	Frequency of Trout Management Flows for the LTEMP Alternatives and Associated Long-Term Strategies.....	I-12
I-6	Frequency of Trout Management Flows under Climate Change Assumptions for the LTEMP Alternatives and Associated Long-Term Strategies.....	I-13
I-7	Frequency of Mechanical Removal for the LTEMP Alternatives and Associated Long-Term Strategies.....	I-14
I-8	Frequency of Mechanical Removal under Climate Change Assumptions for the LTEMP Alternatives and Associated Long-Term Strategies	I-15
I-9	Lake Powell Water Levels for the LTEMP Alternatives and Associated Long-Term Strategies	I-16
I-10	Lake Powell Water Levels under Climate Change Assumptions for the LTEMP Alternatives and Associated Long-Term Strategies	I-17
J-1	Camping Area Index for LTEMP Long-Term Strategies	J-8
J-2	Sand Load Index for LTEMP Long-Term Strategies	J-9
J-3	Navigational Risk Index Values for the LTEMP Long-Term Strategies.....	J-11
J-4	Fluctuation Index for LTEMP Long-Term Strategies	J-14
J-5	Time Off River Index for LTEMP Long-Term Strategies.....	J-16
J-6	Average Daily Discharge for All Modeled Traces and Years under LTEMP Alternatives	J-16
J-7	Glen Canyon Rafting Metric for All LTEMP Long-Term Strategies.....	J-19

FIGURES (Cont.)

J-8	Average Number of HFEs in the 20-Year LTEMP Period for LTEMP Long-Term Strategies	J-20
J-9	Glen Canyon Inundation Metric for All LTEMP Long-Term Strategies	J-22
J-10	Percentage of Traces Lake Powell Elevation Equal to or below 3,580 ft AMSL for the Summer Season	J-24
J-11	Percentage of Traces Lake Powell Elevation Equal to or below 3,580 ft AMSL for the Fall and Spring Seasons	J-24
J-12	Percentage of Traces Lake Mead Elevation Equal to or below 1,050 ft AMSL for the Summer Season	J-25
J-13	Percentage of Traces Lake Mead Elevation Equal to or below 1,050 ft AMSL for the Fall and Spring Seasons	J-25
K.1-1	Network Topology Used by the AURORA Western Interconnection Model	K-10
K.1-2	Percentage of Total Generation Resources Owned by Individual Customers	K-12
K.1-3	Simplified Network Topology of the SLCA/IP Market System.....	K-13
K.1-4	Percentage of SLCA/IP Federal Hydropower Nameplate Capacity by Facility	K-16
K.1-5	Flow Diagram of the Power Systems Methodology Used in the LTEMP EIS.....	K-18
K.1-6	Illustration of a Typical GTMax-Lite Result for a 24-Hour Period.....	K-24
K.1-7	GTMax-Lite Network Topology for the Large SLCA/IP Hydropower Resources Other Than Glen Canyon Dam.....	K-26
K.1-8	Illustration of Temporal Modeling Method Used in the GTMax-Lite Five Large SLCA/IP Plant Configuration.....	K-28
K.1-9	Example of the Load Scaling Algorithm LDC	K-31
K.1-10	Example of the Load Scaling Algorithm Chronological Hourly Loads	K-32
K.1-11	Projected Annual Average Calibrated AURORA LMPs at the Palo Verde Market Hub	K-36

FIGURES (Cont.)

K.1-12	Historical Palo Verde On- and Off-Peak Electricity Prices Compared to Natural Gas Prices.....	K-36
K.1-13	2014 AEO Projected Delivered Utility Natural Gas Prices	K-37
K.1-14	Comparison of Modeled and Actual Annual Aggregated Generation Levels for Natural Gas, Coal, and Nuclear Powerplants under the No Action Alternative.....	K-43
K.1-15	Total Non-coincidental Peak Loads for the SLCA/IP Market System	K-49
K.1-16	Total Monthly Loads for the SLCA/IP Market System.....	K-49
K.1-17	Projected 2014 AEO Natural Gas Prices at the Henry Hub.....	K-56
K.1-18	2014 AEO Electricity Market Module Regions and the Mapping of States to Regions	K-57
K.1-19	Projected AEO 2014 Coal Prices by Electricity Market Module Region.....	K-59
K.1-20	WAPA SLCA/IP Hydropower Powerplants.....	K-63
K.1-21	SLCA/IP Federal Hydropower Capacity Uses and Variability Factors.....	K-64
K.1-22	Reductions in Operating Range when Providing Ancillary Services	K-66
K.1-23	Illustration of the Trapezoidal Method Used to Compute Capacity at Flaming Gorge Dam.....	K-72
K.1-24	Illustration of Ramping Time Increase as a Function of Increasing Water Volumes at Flaming Gorge Dam	K-73
K.1-25	Capacity Values at Flaming Gorge Dam Calculated over a Wide Range of Daily Water Releases Using the Trapezoidal Method.....	K-74
K.1-26	Average Historical Non-coincidental Annual Peak Loads for the Eight Large Customers and Percentages Relative to the Total.....	K-75
K.1-27	Historical Coincidental Annual and Average Peak Loads for the Eight Large Customers during the CY 2006 through CY 2009 Time Period.....	K-76
K.1-28	Historical Coincidental Annual and Average Peak Loads for Six Large Customers during the CY 2010 through CY 2012 Time Period.....	K-77

FIGURES (Cont.)

K.1-29	SLCA/IP Models Used for Estimating SHP Capacity	K-78
K.1-30	Historical SHP Capacity Obligation and WAPA Estimated Risk Level in July	K-80
K.1-31	Historical SHP Capacity Obligation and WAPA Estimated Risk Level in August	K-80
K.1-32	Comparison of Firm Marketable Capacity Determinations across Alternatives, Exceedance Levels, and Summer Peak Months.....	K-81
K.1-33	Timing of Capacity Additions in AURORA	K-83
K.1-34	Annual Average Hydropower Generation for the Glen Canyon Dam Powerplant and the Aggregate Generation for All Other SLCA/IP Resources	K-88
K.1-35	Average Daily Glen Canyon Dam Powerplant Hydropower Generations by Month Based on the Average of All 21 CRSS/SBM Hydrology Traces	K-89
K.1-36	Average Annual Glen Canyon Dam Powerplant Generation for the Representative CRSS/SBM Hydrology Trace	K-92
K.1-37	Representative Trace Average Daily Glen Canyon Dam Powerplant Generations by Month.....	K-93
K.1-38	Average Daily Generation by Month for Each Alternative	K-97
K.1-39	Palo Verde Average Daily Electricity Market Price Statistics by Month during the 20-Year LTEMP Period	K-98
K.1-40	Typical Hourly Winter/Summer Price Patterns in the Western United States	K-99
K.1-41	Average Number of HFEs by Alternative for All 21 Hydrology Traces of Sediment Trace 2	K-100
K.1-42	Average Amount of Non-Power Water Releases by Alternative for All 21 Hydrology Traces of Sediment Trace 2	K-100
K.1-43	Average Annual Number of Hours the Lake Powell Elevation Is below the Penstock Intake by Alternative for All 21 Hydrology Traces of Sediment Trace 2	K-101
K.1-44	2014 Annual Energy Outlook Projections of Capacity Additions in the Western Interconnection over the LTEMP Period.....	K-104

FIGURES (Cont.)

K.1-45	Cumulative Capacity Additions for Alternative A	K-106
K.1-46	Cost Difference of Alternatives Compared to Alternative A at 50% Exceedance Level and 3.375% Discount Rate	K-119
K.1-47	Cost Difference of Alternatives Compared to Alternative A at 90% Exceedance Level and 3.375% Discount Rate	K-119
K.1-48	Cost Difference of Alternatives Compared to Alternative A at 99% Exceedance Level and 3.375% Discount Rate	K-120
K.1-49	Cost Difference of Alternatives Compared to Alternative A at 90% Exceedance Level and 1.4% Discount Rate	K-122
K.1-50	Cost Difference of Alternatives Compared to Alternative A at 90% Exceedance Level and 3.375% Discount Rate, Assuming All Alternative A New Capacity Additions Are Advanced Combustion Turbines	K-123
K.1-51	Cost Difference of Alternatives Compared to Alternative A at 90% Exceedance Level and 3.375% Discount Rate, Assuming All Alternative A New Capacity Additions Are Advanced Combined Cycle	K-124
K.1-52	Cost Difference of Alternatives Compared to Alternative A at 90% Exceedance Level and 3.375% Discount Rate Assuming Average Hydropower Conditions.....	K-125
K.2-1	Determination of Energy Hourly Expense or Revenue	K-140
K.2-2	Determination of Total Net Expense or Revenue by Year for Each Alternative.....	K-142
K.3-1	Flowchart Diagram of Rate Impact Analysis Process	K-156
K.3-2	Projected Carrying Charge Rates Used in Rate Impact Analysis	K-161
K.3-3	Flowchart Diagram of Allocation Process	K-162
K.3-4	Load Factors of SLCA/IP Power	K-165
K.3-5	Scatter Plot of Preference Ratio and Annual Retail Sales	K-169
K.3-6	Scatter Plots of Percent Retail Rate Change and the Preference Ratio.....	K-171
K.3-7	Retail Rate Distribution under Alternative A.....	K-173

FIGURES (Cont.)

K.3-8	Monthly Residential Bill Distribution under Alternative A	K-173
K.3-9	Average Retail Rate Impacts under LTEMP Alternatives Relative to Alternative A.....	K-175
K.3-10	Average Residential Bill Impacts under LTEMP Alternatives Relative to Alternative A.....	K-175
K.3-11	Average Retail Percent Revenue Increase Relative to Alternative A.....	K-176
K.3-12	Average Monthly Residential Bill Changes Relative to Alternative A	K-177
K.3-13	Retail Rates under Alternative A	K-188
K.4-1	Calculation of Change in Tribal Benefit Resulting from LTEMP EIS Alternatives	K-194
K.4-2	Financial Impacts under Alternative B Relative to Alternative A for Tribal and Non-Tribal Entities	K-203
K.4-3	Financial Impacts under Alternative C Relative to Alternative A for Tribal and Non-Tribal Entities	K-203
K.4-4	Financial Impacts under Alternative D Relative to Alternative A for Tribal and Non-Tribal Entities	K-204
K.4-5	Financial Impacts under Alternative E Relative to Alternative A for Tribal and Non-Tribal Entities	K-204
K.4-6	Financial Impacts under Alternative F Relative to Alternative A for Tribal and Non-Tribal Entities	K-205
K.4-7	Financial Impacts under Alternative G Relative to Alternative A for Tribal and Non-Tribal Entities	K-205
K.5-1	Change in Lake Powell Monthly Water Release Volumes under LTEMP Alternatives	K-207
K.5-2	Average Lake Mead EOM Pool Elevations under LTEMP Alternatives	K-207
K.5-3	Average Monthly Difference in Turbine Water Releases Relative to Alternative A.....	K-212

FIGURES (Cont.)

K.5-4	Average Monthly Hoover Powerplant Generation for All Power Systems under Primary LTEMP EIS Alternatives	K-212
K.5-5	NPV of Hoover Powerplant Benefits Relative to Alternative A Resulting from LTEMP Alternatives	K-214
L-1	Elements of the Lake_Full Utility Model	L-5
L-2	Elements of the GCRec_Full Utility Model	L-6
L-3	Elements of the Regional Recreation Impacts Analysis	L-11
L-4	Elements of the Regional Electricity Price Impacts Analysis.....	L-16
L-5	Elements of the Regional Electricity Generating Capacity Expansion Impacts Analysis.....	L-17
P-1	Average Monthly Sand Load from the Paria River and Little Colorado River Showing the Fall and Spring HFE Accounting Periods and Implementation Windows	P-4

TABLES

1-1	Glen Canyon Dam Release Constraints under Modified Low Fluctuating Flows.....	1-21
1-2	Selected Documents Included in the Law of the River.....	1-32
2-1	Operational Characteristics of LTEMP Alternatives.....	2-9
2-2	Condition-Dependent and Experimental Elements of LTEMP Alternatives.....	2-11
2-3	Flow Parameters under Alternative A in an 8.23-maf Year.....	2-17
2-4	Flow Parameters under Alternative B in an 8.23-maf Year.....	2-21
2-5	Flow Parameters under Alternative C in an 8.23-maf Year.....	2-26
2-6	Implementation Criteria for Experimental Treatments of Alternative C.....	2-31
2-7	Flow Parameters for a Year with Low Summer Flows under Alternative C in an 8.23-maf Year.....	2-42
2-8	Flow Parameters under Alternative D in an 8.23-maf Year.....	2-45
2-9	Implementation Criteria for Experimental Treatments of Alternative D.....	2-50
2-10	Flow Parameters for a Year with Low Summer Flows under Alternative D in an 8.23-maf Year.....	2-68
2-11	Flow Parameters under Alternative E in an 8.23-maf Year.....	2-73
2-12	Flow Parameters under Alternative F in an 8.23-maf Year.....	2-82
2-13	Flow Parameters under Alternative G in an 8.23-maf Year.....	2-83
2-14	Summary of Impacts of LTEMP Alternatives on Resources.....	2-93
3.5-1	Native Fish of the Colorado River through Glen and Grand Canyons.....	3-72
3.5-2	Nonnative Fish Found in the Colorado River through Glen and Grand Canyons ...	3-91
3.5-3	Mean Water Temperature and Turbidity for Selected Sites in the Colorado River Mainstem from 2006 to 2009.....	3-94
3.5-4	Nonnative Warmwater Fish Species Reported from the Little Colorado River Watershed.....	3-102

TABLES (Cont.)

3.6-1	Plant Communities Occurring on Reattachment Bars, Separation Bars, and Channel Margins	3-113
3.6-2	Special Status Plant Species Known to Occur along the Colorado River from Glen Canyon Dam to Lake Mead	3-122
3.7-1	Habitat and Distribution of Threatened, Endangered, and Sensitive Wildlife Species along the Colorado River Corridor between Glen Canyon Dam and Lake Mead	3-133
3.10-1	Colorado River Discovery Commercial Rafting Passengers 2009–2013	3-177
3.10-2	Tolerable Daily Flow Fluctuations Reported by Commercial and Private Trip Leaders	3-184
3.13-1	Energy and Capacity Characteristics of the Eight Largest WAPA Customers, 2013	3-208
3.14-1	Population in the Six-County Region	3-210
3.14-2	Income in the Six-County Region	3-212
3.14-3	Employment in the Six-County Region	3-213
3.14-4	Employment by Sector in 2011	3-214
3.14-5	Unemployment Rates in the Six-County Region	3-215
3.14-6	Minority and Low-Income Populations in the 11-County Area	3-217
3.14-7	Population in the Seven-State Region of Influence	3-222
3.14-8	Income in the Seven-State Region of Influence	3-223
3.14-9	Employment in the Seven-State Region of Influence	3-224
3.14-10	Employment by Sector in 2011 in the Seven-State Region of Influence	3-225
3.14-11	Unemployment in the Seven-State Region of Influence	3-226
3.14-12	State Minority and Low-Income Populations, 2010	3-227
3.15-1	Clean Air Act Prevention of Significant Deterioration Designations	3-230

TABLES (Cont.)

3.15-2	Criteria Pollutant and VOC Emissions in Counties Encompassing Grand Canyon National Park and for the Navajo Generating Station, 2011	3-231
3.15-3	Criteria Pollutant and VOC Emissions for 2011, and GHG Emissions for 2010, over the 11-State Affected Area within the Western Interconnection	3-236
4.1-1	Experimental Elements Included in Long-Term Strategies Associated with Each LTEMP Alternative	4-4
4.2-1	Summary of the Impacts of LTEMP Alternatives on Hydrology and Water Quality.....	4-15
4.2-2	Summary of Seasonal Temperature Data for LTEMP Alternatives from Lees Ferry to Diamond Creek.....	4-50
4.3-1	Summary of Impacts of LTEMP Alternatives on Sediment Resources	4-73
4.4-1	Indicators Used To Examine Natural Processes under Each LTEMP Alternative.....	4-90
4.4-2	Summary of Impacts of LTEMP Alternatives on Natural Processes Associated with Flow, Water Temperature, Water Quality, and Sediment Resources	4-92
4.5-1	Summary of Impacts of LTEMP Alternatives on Aquatic Ecology	4-109
4.5-2	Impact of High-Flow Experiments from Glen Canyon Dam on the Aquatic Food Base.....	4-116
4.6-1	Vegetation States, Plant Associations, and Corresponding Submodels	4-165
4.6-2	Vegetation States and Corresponding Mapped Vegetation Types.....	4-169
4.6-3	Summary of Impacts of LTEMP Alternatives on Vegetation.....	4-170
4.6-4	Transitions between Riparian Community Types and the Flows That Initiate Transitions.....	4-181
4.6-5	Priority Nonnative Species Identified for Control within the Colorado River Corridor.....	4-185
4.6-6	Summary of Impacts of LTEMP Alternatives on Special Status Plant Species	4-188
4.7-1	Summary of Impacts of LTEMP Alternatives on Wildlife.....	4-205

TABLES (Cont.)

4.7-2	Summary of Impacts of LTEMP Alternatives on Special Status Wildlife Species	4-217
4.8-1	Summary of Impacts of LTEMP Alternatives on Cultural Resources in Glen and Grand Canyons.....	4-239
4.9-1	Vegetation Community Diversity and Change in Tamarisk Cover	4-253
4.9-2	Summary of Impacts of LTEMP Alternatives on Tribal Resources.....	4-263
4.10-1	Summary of Impacts of LTEMP Alternatives on Recreation, Visitor Use, and Experience.....	4-282
4.10-2	Amount of Sediment Transported Out of Marble Canyon under the LTEMP Alternatives over the 20-Year LTEMP Period	4-295
4.11-1	Summary of Impacts of LTEMP Alternatives on Wilderness Experience	4-310
4.13-1	Summary of Impacts of LTEMP Alternatives on Hydropower Resources	4-335
4.14-1	Summary of Impacts of LTEMP Alternative on Socioeconomics and Environmental Justice.....	4-366
4.14-2	Mean Annual Net Economic Value of Recreation Associated with LTEMP Alternatives	4-376
4.14-3	Recreational Visitation by Activity in Lake Powell, Upper and Lower Grand Canyon, and Lake Mead, 2012	4-380
4.14-4	Mean Annual Employment Associated with Recreational Expenditures under LTEMP Alternatives.....	4-380
4.14-5	Mean Annual Income Associated with Recreational Expenditures under LTEMP Alternatives.....	4-381
4.14-6	Seven-State Economic Impacts under LTEMP Alternatives of Additional Generating Capacity for the Eight Largest Customer Utilities, 2015–2033	4-383
4.14-7	Average Annual Impacts on Economic Activity from Changes to Residential Electricity Bills of Largest Eight Customer Utilities, 2015–2033, Relative to Alternative A.....	4-384
4.14-8	Financial Impacts on Tribal and Non-Tribal Electricity Customers.....	4-389

TABLES (Cont.)

4.15-1	Summary of Impacts of LTEMP Alternatives on Visibility and Regional Air Quality.....	4-404
4.15-2	Distributions of SO ₂ and NO _x Emissions Averaged over the 20-Year LTEMP Period by Alternative	4-408
4.16-1	Summary of Impacts of LTEMP Alternatives on GHG Emissions.....	4-417
4.16-2	Expected Impact of LTEMP Alternatives on Downstream Resources under Climate Change Compared to Those under Historic Conditions.....	4-422
4.17-1	Impacting Factors Associated with Past, Present, and Reasonably Foreseeable Future Actions and Basin-Wide Trends in the LTEMP Project Area.....	4-428
4.17-2	Summary of Cumulative Impacts and Incremental Contributions under LTEMP Alternatives	4-447
5.1-1	Summary of Cooperating Agency Involvement	5-3
B-1	Tolerable Flow Fluctuations for Recreational River Use	B-13
D-1	Initial Reservoir Conditions	D-5
D-2	Monthly Release Volumes by Water-Year Release for Alternative A.....	D-11
D-3	Monthly Release Volumes by Water-Year Release for Alternative B	D-12
D-4	Monthly Release Volumes by Water-Year Release for Alternative C	D-13
D-5	Monthly Release Volumes by Water-Year Release for Alternative C with Low Summer Flows	D-14
D-6	Monthly Release Volumes by Water-Year Release for Alternative D.....	D-15
D-7	Monthly Release Volumes by Water-Year Release for Alternative D with Low Summer Flows	D-16
D-8	Monthly Release Volumes by Water-Year Release for Alternative E	D-17
D-9	Monthly Release Volumes by Water-Year Release for Alternative E with Low Summer Flows	D-18
D-10	Monthly Release Volumes by Water-Year Release for Alternative F.....	D-19

TABLES (Cont.)

D-11	Monthly Release Volumes by Water-Year Release for Alternative G	D-20
D-12	Minimum Release Constraints Used for Each Alternative	D-21
D-13	Input Demands by State	D-27
E-1	Sources for Historical Tributary Sediment Load Data.....	E-38
E-2	Historical Periods Used for Paria Sediment Traces s1, s2, and s3	E-38
E-3	Historical Periods Used for Little Colorado River Sediment Traces s1, s2, and s3	E-38
E-4	List of HFEs Available for Sediment-Triggered Experiments	E-39
F-1	Average Mean Habitat-Weighted Invertebrate Biomass at Select Sites in the Colorado River, July 2006–June 2009	F-8
F-2	Average Mean Habitat-Weighted Invertebrate Production at Select Sites in the Colorado River, July 2006–June 2009	F-9
F-3	Average Mean Habitat-Weighted Invertebrate Abundance at Select Sites in the Colorado River, July 2006–June 2009	F-10
F-4	Distribution, Ecological Importance, and Favorable Temperature Range for Select Primary Producers	F-11
F-5	Temperature Requirements for Common Zooplankton	F-24
F-6	Distribution, Importance to Higher Trophic Levels, and Temperature Range for Common Benthic Macroinvertebrates Downstream of Glen Canyon Dam.....	F-25
F-7	Temperature Requirements for the Asian Tapeworm, Anchor Worm, and Trout Nematode	F-26
F-8	Summary of Metrics Values from the Rainbow Trout-Humpback Chub Model	F-53
F-9	Description of Input Parameters for the LTEMP Temperature Suitability Model	F-66
F-10	Humpback Chub Aggregation Locations.....	F-67
F-11	Locations Used for Temperature Suitability Modeling of Native Fish, Nonnative Fish, and Parasites	F-73

TABLES (Cont.)

G-1	Vegetation States, Plant Associations, and Corresponding Submodels	G-15
G-2	Hydrologic Events Considered in the Riparian Vegetation Model	G-16
G-3	Riparian Vegetation Model Transition Rules	G-17
G-4	New High-Water Zone and Old High-Water Zone Vegetation Classes Mapped from Lees Ferry to Diamond Creek	G-22
G-5	Vegetation States and Corresponding Mapped Vegetation Types.....	G-24
G-6	Example Results for the Native Cover Metric	G-25
G-7	Example Results for the Arrowweed Metric.....	G-25
G-8	Results for Alternative A	G-26
G-9	Results for Alternative B, Long-Term Strategy B1	G-27
G-10	Results for Alternative B, Long-Term Strategy B2	G-28
G-11	Results for Alternative C, Long-Term Strategy C1	G-29
G-12	Results for Alternative C, Long-Term Strategy C2	G-30
G-13	Results for Alternative C, Long-Term Strategy C3	G-31
G-14	Results for Alternative C, Long-Term Strategy C4	G-32
G-15	Results for Alternative D, Long-Term Strategy D1.....	G-33
G-16	Results for Alternative D, Long-Term Strategy D2.....	G-34
G-17	Results for Alternative D, Long-Term Strategy D3.....	G-35
G-18	Results for Alternative D, Long-Term Strategy D4.....	G-36
G-19	Results for Alternative E, Long-Term Strategy E1.....	G-37
G-20	Results for Alternative E, Long-Term Strategy E2.....	G-38
G-21	Results for Alternative E, Long-Term Strategy E3.....	G-39

TABLES (Cont.)

G-22	Results for Alternative E, Long-Term Strategy E4.....	G-40
G-23	Results for Alternative E, Long-Term Strategy E5.....	G-41
G-24	Results for Alternative E, Long-Term Strategy E6.....	G-42
G-25	Results for Alternative F.....	G-43
G-26	Results for Alternative G.....	G-44
G-27	The Effects of LTEMP Long-Term Strategies on Wetlands.....	G-45
I-1	Federal Regulations and Executive Orders Pertaining to Consultation with Tribes.....	I-3
I-2	Vegetation States.....	I-5
J-1	Reported Mean Tolerable Daily Changes in Flow Levels for Commercial Motor Guides, Commercial Oar Guides, and Private Trip Leaders Who Have Experienced Daily Fluctuations of at Least 15,000 cfs in the Grand Canyon.....	J-12
J-2	Recreation Response to Daily Maximum Flow.....	J-20
J-3	Summary of Recreation, Visitor Use, and Experience Metrics.....	J-26
K.1-1	Cost and Performance Characteristics of Capacity Expansion Candidates.....	K-51
K.1-2	Cumulative Annual Percentage Increase in Natural Gas Prices at the Henry Hub.....	K-55
K.1-3	Cumulative Annual Percent Increase in Regional Coal Prices.....	K-58
K.1-4	Cumulative Annual Percentage Increase in Regional Distillate Fuel Prices.....	K-60
K.1-5	Assumed Ancillary Services Provided by SLCA/IP Hydropower Facilities from 2013 to 2030.....	K-65
K.1-6	Summary of Utility IRPs for Four Large SLCA/IP Customers and Other Large Utilities in Areas Neighboring the SLCA/IP System.....	K-87
K.1-7	SLCA/IP Marketable Capacity at the 90% Exceedance Level.....	K-102
K.1-8	Difference in Cumulative Capacity Additions of Each Alternative Relative to Alternative A.....	K-105

TABLES (Cont.)

K.1-9	Comparison of the Amount and Timing of New Capacity Additions for Alternatives A and F	K-107
K.1-10	Total Economic Impacts by Alternative at the 90% Exceedance Level	K-109
K.1-11	Estimated Cost of LTEMP Experiments.....	K-116
K.1-12	Comparison of Marketable Capacity, Replacement Capacity, and Capacity Additions by Exceedance Level.....	K-117
K.1-13	Firm SLCA/IP Federal Hydropower Capacity at Various Exceedance Levels at Glen Canyon Dam by Alternative and Ancillary Service Scenarios	K-127
K.1-14	Comparison of Capacity and Energy Values at Glen Canyon Dam by Alternative and Ancillary Services Scenarios at the 90% Exceedance Level	K-128
K.1-15	Difference Relative to Alternative A	K-128
K.1-16	Alternative Cost Increase Estimates for Mixed NGCC/CT Technology Capacity Replacement Relative to CT Only Replacement as Estimated Using GTMax-Lite.....	K-130
K.1-17	Summary of Economic Rankings for Baseline and All Sensitivity Scenarios	K-132
K.2-1	SHP Contractual Obligations and Project Use Required Deliveries by Month.....	K-136
K.2-2	SHP Hourly Load Shapes by Month and Type of Day.....	K-137
K.2-3	Total Levelized Capital and Fixed O&M Cost for System Capacity Expansion by Alternative and Year	K-141
K.2-4	Total Levelized Capital and Fixed O&M Cost for System Capacity Expansion by Alternative and Year Expressed as the Difference from Alternative A.....	K-143
K.2-5	Total Net Purchase Power Expenses by Year and Alternative for the Continuous Current Obligations Scenario	K-147
K.2-6	Total Net Purchase Power Expenses by Year and Alternative for the Reduced Obligations to Match Resource Scenario.....	K-148
K.2-7	SLCA/IP Rate Impact by Alternative	K-151
K.3-1	Energy Allocations for Systems Receiving Indirect SLCA/IP Allocations.....	K-157

TABLES (Cont.)

K.3-2	Coverage of Retail Information from EIA Database Relative to SLCA/IP Preference Power Allocation	K-159
K.3-3	Average Annual Grid Cost Relative to SLCA/IP Wholesale Revenues Relative to Alternative A	K-168
K.3-4	Summary Table of Comparative Values.....	K-178
K.3-5	Individual Systems with the Largest Percent Retail Rate Impacts Relative to Alternative A.....	K-180
K.3-6	Individual Systems with the Smallest Percent Retail Rate Impacts Relative to Alternative A.....	K-182
K.3-7	Individual Systems with the Largest Monthly Residential Bill Impacts Relative to Alternative A	K-183
K.3-8	Individual Systems with the Smallest Monthly Residential Bill Impacts Relative to Alternative A	K-184
K.3-9	Size and Preference Ratio for Utility Systems with Large Rate Impacts	K-186
K.3-10	Rate Impacts for Selected Groups in Maximum Impact Year	K-186
K.4-1	Monthly Change in Residential Electric Utility Bill for Tribes by Alternative.....	K-197
K.4-2	Total Dollar Annual Impact on Tribes under LTEMP Alternatives Relative to Alternative A.....	K-199
L-1	Total Regional Economic Impacts of Non-Local Recreation Expenditures, 2013.....	L-13
L-2	Urban Population, Income, and Poverty in the Six-County Region.....	L-18
M-1	Emission Factors by Plant for System Power Generation and Spot Market.....	M-10
M-2	Power Generation Averaged over the 20-Year LTEMP Period by Alternative	M-12
M-3	Summary of Potential Impacts of LTEMP Alternatives on Visibility and Regional Air Quality.....	M-15
M-4	Annual SO ₂ Emissions Averaged over the 20-Year LTEMP Period by Alternative.....	M-16

TABLES (Cont.)

M-5	Annual NO _x Emissions Averaged over the 20-Year LTEMP Period by Alternative.....	M-19
M-6	Summary of Impacts of LTEMP Alternatives on SO ₂ and NO _x Emissions.....	M-22
M-7	Annual Greenhouse Gas Emissions under LTEMP Alternatives	M-23
M-8	Summary of Impacts of LTEMP Alternatives on CO ₂ e Emissions.....	M-26
N-1	Summary of Tribal Participation Status.....	N-5
N-2	Summary of Tribal Correspondence.....	N-6
N-3	Summary of Major Face-to-Face Meetings, Webinars, and Conference Calls Involving Tribes.....	N-25
N-4	Summary of Individual Tribal Consultation Meetings to Date.....	N-27
N-5	Index of Project Tribal Government Consultation and Coordination Correspondence.....	N-29
P-1	List of HFEs Available for Sediment-Triggered Experiments under the Preferred Alternative.....	P-7
Q-1	Comment Issues and Location in the Report	Q-6
Q-2	Commenter Distribution by State	Q-10
Q-3	Commenter, Affiliation, and Location Where Responses Are Found	Q-88

ACRONYMS AND ABBREVIATIONS

ac	acre(s)
ac-ft	acre-foot (feet)
ACHP	Advisory Council on Historic Preservation
AML	abandoned mine land
AMSL	above mean sea level
AMWG	Adaptive Management Work Group
AOP	Annual Operation Plan for Colorado River Reservoirs
APE	Area of Potential Effect
Argonne	Argonne National Laboratory
ASMR	Age-Structured Mark Recapture Model
AZGFD	Arizona Game and Fish Department
AZ-SGCN	Arizona Species of Greatest Conservation Need
BA	Balancing Authority (in Chapter 3 only) Biological Assessment (in all other sections)
BGEPA	Bald and Golden Eagle Protection Act of 1940
BIA	Bureau of Indian Affairs
BO	Biological Opinion
C	Celsius
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAEDYM	Computational Aquatic Ecosystem Dynamics Model
CCC	Civilian Conservation Corps
CEQ	Council on Environmental Quality
CFMP	<i>Comprehensive Fisheries Management Plan</i>
CFR	<i>Code of Federal Regulations</i>
cfs	cubic feet per second
CH ₄	methane
CO	carbon monoxide
CO ₂	carbon dioxide
CO ₂ e	carbon dioxide equivalent
CPUE	catch per unit effort
CRBC	Colorado River Board of California
CRCN	Colorado River Commission of Nevada
CRD	Colorado River Discovery
CREDA	Colorado River Energy Distributors Association
CRMP	Colorado River Management Plan
CRSP	Colorado River Storage Project
CRSPA	Colorado River Storage Project Act of 1956
CRSS	Colorado River Simulation System
CSU	Colorado Springs Utilities

DEIS	Draft Environmental Impact Statement
Deseret	Deseret Generation and Transmission Cooperative
DFC	desired future condition
DO	dissolved oxygen
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DPS	Distinct Population Segment
EA	Environmental Assessment
eGRID	Emissions & Generation Resource Integrated Database
EIA	Energy Information Administration
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ELCOM	Estuary, Lake and Coastal Ocean Model
EMS	emergency medical services
E.O.	Executive Order
EPA	U.S. Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, and Trichoptera
ESA	Endangered Species Act of 1973, as amended
F	Fahrenheit
FCPP	Four Corners Power Plant
FES	Firm Electric Service
FONSI	Finding of No Significant Impact
FR	<i>Federal Register</i>
ft	foot (feet)
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
GCDAMP	Glen Canyon Dam Adaptive Management Program
GCM	general circulation model
GCMRC	Grand Canyon Monitoring and Research Center
GCNP	Grand Canyon National Park
GCNRA	Glen Canyon National Recreation Area
GCPA	Grand Canyon Protection Act of 1992
GHG	greenhouse gas
GMP	General Management Plan
GW	gigawatt(s)
GWh	gigawatt-hour(s)
GWP	global warming potential
H ₂ S	hydrogen sulfide
HBC	humpback chub
HFC	hydrofluorocarbon
HFE	high-flow experiment
hr	hour(s)

HRR	Hualapai River Runners
in.	inch(es)
IPM	Integrated Pest Management
IRP	integrated resource plan
ISM	Indexed Sequential Method
kaf	thousand acre-feet
kWh	kilowatt-hour(s)
lb	pound(s)
LCRMSCP	Lower Colorado River Multi-Species Conservation Program
LMM	Lake Mead Model
LMNRA	Lake Mead National Recreation Area
LROC	Long-Range Operating Criteria
LTEMP	Long-Term Experimental and Management Plan
LTEP	Long Term Experimental Plan
LTF	long-term firm
maf	million acre-feet
MAMB	miscellaneous algae, macrophytes, and bryophytes
MBTA	Migratory Bird Treaty Act
MCL	maximum contaminant level
mi	mile(s)
MLFF	Modified Low Fluctuating Flow
MMt	million metric tons
MOA	Memorandum of Agreement
MT	metric ton(s)
MW	megawatt(s)
MWh	megawatt-hour(s)
N ₂ O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAU	Northern Arizona University
NC	no change
NEPA	National Environmental Policy Act of 1969, as amended
NERC	North American Electric Reliability Corporation
NEV	net economic use value
NGO	nongovernmental organization
NHPA	National Historic Preservation Act
NM	national monument
NO ₂	nitrogen dioxide
NO ₃	nitrate-nitrogen
NOI	Notice of Intent
NO _x	nitrogen oxides
NPS	National Park Service

NPV	net present value
NRHP	<i>National Register of Historic Places</i>
NTUA	Navajo Tribal Unit Authority
O&M	operation and maintenance
O ₃	ozone
OPAC	Office of Planning and Compliance
OSMRE	Office of Surface Mining Reclamation and Enforcement
PA	Programmatic Agreement
Pb	lead
PEPC	Planning, Environment, and Public Comment
PFC	perfluorocarbon
P.L.	Public Law
PM	particulate matter
PM _{2.5}	particulate matter ≤ 2.5 μm in aerodynamic diameter
PM ₁₀	particulate matter ≤ 10 μm in aerodynamic diameter
POM	particulate organic matter
PSAR	preventative search and rescue
PSD	Prevention of Significant Deterioration
RA	resource available
Reclamation	Bureau of Reclamation
RM	river mile
RMP	Resource Management Plan
ROD	Record of Decision
RSG	Reserve Sharing Group
SAAQS	State Ambient Air Quality Standards
SBM	Sand Budget Model
SCP	Salinity Control Project
SD	standard deviation
SDA	Structured Design Analysis
SE	standard error
Secretary, the	Secretary of the Interior
SF ₆	sulfur hexafluoride
SHPO	State Historic Preservation Officer
SLCA/IP	Salt Lake City Area Integrated Projects
SO	Secretarial Order
SO ₂	sulfur dioxide
SPC	Southern Paiute Consortium
SRP	Salt River Project
SRSG	Southwest Reserve Sharing Group
TCD	temperature control device
TCP	traditional cultural property

TDS	total dissolved solids
THPO	Tribal Historic Preservation Officer
TL	total length
TMF	trout management flow
Tri-State	Tri-State Generation and Transmission Association
TWG	Technical Working Group
UAMPS	Utah Associated Municipal Power Systems
UBWR	Utah Board of Water Resources
UCRC	Upper Colorado River Commission
UMPA	Utah Municipal Power Agency
USC	<i>United States Code</i>
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
WACM	Western Area Colorado-Missouri Region
WALC	Western Area Lower Colorado Region
WAUW	Western Area Upper Great Plains West Region
WECC	Western Electricity Coordinating Council
Western	Western Area Power Administration
YOY	young-of-year
yr	year(s)
ZHHPO	Zuni Heritage and Historic Preservation Office

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