

# TABLE OF CONTENTS

Chapter	Title	Page
	<b>Acronyms and Abbreviations</b> .....	vii
<b>1</b>	<b>PURPOSE AND NEED</b> .....	1-1
1.1	North Pacific Acoustic Laboratory (NPAL) Project Objectives.....	1-4
1.1.1	Acoustic Thermometry.....	1-4
1.1.2	Long-Range Acoustic Propagation.....	1-6
1.1.3	Marine Mammal Monitoring (M3) Studies.....	1-7
1.2	Background on Acoustic Thermometry.....	1-8
1.2.1	ATOC: Thermometry Results.....	1-10
1.2.2	ATOC: Marine Mammal Research Program Results.....	1-12
1.3	Environmental Impact Analysis.....	1-13
1.3.1	National Environmental Policy Act.....	1-14
1.3.1.1	The EIS Process.....	1-15
1.3.1.2	The EIS Scope.....	1-15
1.3.2	Marine Mammal Protection Act.....	1-16
1.3.3	Endangered Species Act.....	1-17
1.3.4	The Magnuson-Stevens Fisheries Conservation and Management Act.....	1-17
1.3.5	Hawaii Environmental Review Law.....	1-17
1.3.6	Use of Hawaii Conservation District Lands.....	1-18
1.3.7	Coastal Zone Management, Federal Consistency Review.....	1-19
1.4	Scoping Summary.....	1-19
<b>2</b>	<b>DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES</b> .....	2-1
2.1	Alternatives Considered and Rationale.....	2-1
2.1.1	Proposed Action – Continued Operation of the Kauai Source (Preferred Alternative) .....	2-1
2.1.1.1	Kauai Source Specifications.....	2-2
2.1.1.2	Transmission Characteristics.....	2-7
2.1.2	No Action Alternative.....	2-14
2.1.3	Additionally Restrict Source Transmission Times and Modify Source Operational Characteristics of the Kauai Sources.....	2-14
2.1.3.1	Restrict Source Transmission Times.....	2-16
2.1.3.2	Modify Source Operational Characteristics.....	2-17
2.1.4	Alternate Project Site.....	2-18
2.1.5	Moored Autonomous Source.....	2-24
2.1.6	Alternate Sensors.....	2-28
2.1.7	Modeling.....	2-30
2.2	Alternative Eliminated from Detailed Study.....	2-31
2.2.1	Additionally Restrict Source Transmission Times and Modify Source Operational Characteristics.....	2-31
2.2.2	Moored Autonomous Source.....	2-31
2.2.3	Alternate Sensors.....	2-32

2.2.4 Modeling.....	2-32
2.3 Summary of Relative Response of Alternatives to Objectives.....	2-32
<b>3 AFFECTED ENVIRONMENT.....</b>	<b>3-1</b>
3.1 Physical Environment.....	3-1
3.1.1 Site Description.....	3-1
3.1.2 Meteorology.....	3-1
3.1.3 Physical Oceanography.....	3-2
3.1.4 Water Column Characteristics.....	3-2
3.1.4.1 Temperature-Salinity Properties.....	3-2
3.1.4.2 Dissolved Oxygen.....	3-4
3.1.4.3 Existing Noise Setting.....	3-4
3.1.5 Regional Geography and Geology.....	3-6
3.1.5.1 Regional Subsea Geography.....	3-6
3.1.5.2 Seismic Activity.....	3-6
3.1.5.3 Bottom Conditions.....	3-6
3.2 Biological Environment.....	3-7
3.2.1 Species Screening.....	3-7
3.2.1.1 Invertebrates.....	3-8
3.2.1.2 Vertebrates.....	3-8
3.2.2 Marine Mammals.....	3-10
3.2.2.1 Mysticetes.....	3-10
3.2.2.2 Odontocetes.....	3-20
3.2.2.3 Pinnipeds.....	3-24
3.2.3 Sea Turtles.....	3-25
3.2.4 Fish.....	3-28
3.2.4.1 Demersal Species.....	3-28
3.2.4.2 Pelagic Species.....	3-29
3.2.5 Seabirds.....	3-31
3.2.6 Threatened, Endangered, and Special Status Species.....	3-32
3.2.7 Marine Sanctuaries and Special Biological Resource Areas.....	3-33
3.2.8 Biological Environment Along the Cable Route.....	3-35
3.3 Economic Environment.....	3-36
3.3.1 Commercial, Recreational, and Potential Fisheries.....	3-36
3.3.2 Mariculture/Aquaculture.....	3-37
3.3.3 Shipping.....	3-37
3.3.4 Military Usage.....	3-38
3.3.5 Mineral or Energy Development.....	3-38
3.3.6 Cultural and Historic Resources.....	3-38
3.4 Social Environment.....	3-39
3.4.1 Recreational Activities and Tourism.....	3-39
3.4.2 Research and Education.....	3-40
3.4.3 Water Contact Sports.....	3-41
<b>4 ENVIRONMENTAL CONSEQUENCES.....</b>	<b>4-1</b>
4.1 Potential Effects on the Physical Environment.....	4-1

4.1.1	Potential Direct or Indirect Effects on the Physical Environment.....	4-1
4.1.1.1	Construction and Removal of Facilities.....	4-1
4.1.1.2	Underwater Sound.....	4-2
4.1.1.3	Other Potential Physical Effects.....	4-3
4.1.2	Potential Cumulative Effects on the Physical Environment.....	4-3
4.1.2.1	Construction and Removal of Facilities.....	4-3
4.1.2.2	Underwater Sound.....	4-3
4.2	Potential Effects on the Biological Environment.....	4-5
4.2.1	Potential Direct or Indirect Effects on the Biological Environment.....	4-5
4.2.1.1	Construction and Removal of Facilities.....	4-5
4.2.1.2	Underwater Sound.....	4-6
4.2.1.2.1	Marine Mammals.....	4-9
4.2.1.2.2	Sea Turtles.....	4-34
4.2.1.2.3	Fish.....	4-38
4.2.2	Potential Cumulative Effects on the Biological Environment.....	4-49
4.2.2.1	Potential Cumulative Effects of Construction/Removal.....	4-49
4.2.2.2	Potential Cumulative Effects of Underwater Sound.....	4-49
4.2.2.2.1	Potential Cumulative Effects of Underwater Sound on Marine Mammals.....	4-49
4.2.2.2.2	Potential Cumulative Effects of Underwater Sound on Sea Turtles.....	4-56
4.2.2.2.3	Potential Cumulative Effects of Underwater Sound on Fish.....	4-57
4.2.3	Threatened, Endangered, and Special Status Species.....	4-57
4.2.4	Marine Sanctuaries and Special Biological Resource Areas.....	4-58
4.2.5	Essential Fish Habitat.....	4-59
4.3	Potential Effects on the Economic Environment.....	4-62
4.3.1	Potential Direct and Indirect Effects on the Economic Environment.....	4-63
4.3.2	Potential Cumulative Effects on the Economic Environment.....	4-63
4.4	Potential Effects on the Social Environment.....	4-64
4.4.1	Potential Direct and Indirect Effects on the Human Environment.....	4-64
4.4.2	Potential Cumulative Effects on the Human Environment.....	4-65
4.5	Other Potential Impacts.....	4-65
4.5.1	Potential Increases in Vessel and Aircraft Traffic.....	4-65
4.5.2	Potential Direct Construction and Maintenance Impacts.....	4-66
4.5.3	Cultural and Historic Resources.....	4-66
4.5.4	Potential Visual Impacts.....	4-67
4.5.5	Employment, Population, and Public Services.....	4-67
4.5.6	Potential Air Pollution.....	4-67
4.5.7	Potential Hazardous Materials and Waste.....	4-67
4.5.8	Relationship Between Local Short-term Uses of the Human Environment and the Maintenance and Enhancement of Long-term Productivity.....	4-68
4.5.9	Irreversible and Irretrievable Commitments of Resources That Would Be Involved in the Proposed Action Should It Be Implemented.....	4-68
4.5.10	Natural or Depletable Resource Requirements and Conservation Potential...	4-69
4.5.11	Unavoidable Adverse Effects; Unresolved Issues.....	4-69
4.5.12	Growth-inducing Impacts of the Proposed Action.....	4-70

4.6 Conclusion.....	4-70
<b>5 MITIGATION AND MONITORING.....</b>	<b>5-1</b>
5.1 Measures to Mitigate the Sound Source.....	5-1
5.2 Monitoring to Prevent Long-term Effects to Marine Animals.....	5-2
<b>6 RELATIONSHIP OF THE PROPOSED ACTION TO FEDERAL, STATE AND LOCAL PLANS, POLICIES AND CONTROLS.....</b>	<b>6-1</b>
6.1 Federal Programs.....	6-1
6.1.1 NEPA.....	6-1
6.1.2 Marine Mammal Protection Act.....	6-1
6.1.3 Endangered Species Act.....	6-2
6.1.4 Rivers and Harbors Act § 10.....	6-3
6.1.5 Magnuson-Stevens Fisheries Conservation and Management Act.....	6-3
6.1.6 Coastal Zone Management Act, Federal Consistency Review.....	6-4
6.1.7 Environmental Justice.....	6-4
6.1.8 Protection of Children.....	6-5
6.2 Review By the State of Hawaii.....	6-5
6.2.1 Conservation District Use Authorization: DLNR.....	6-6
6.2.2 Coastal Zone Management Program: Federal Consistency Review.....	6-8
6.2.3 Historic Resources Preservation.....	6-17
6.2.4 Division of Aquatic Resources, DLNR.....	6-18
6.2.5 Division of Land Management, DLNR.....	6-19
6.2.6 Hawaii Department of Transportation.....	6-19
6.2.7 Water Quality and Noise Regulation: Department of Health.....	6-19
6.2.8 County of Kauai: Special Management Area Requirements under the Shoreline Protection Act; County General Plan and Development Plans.....	6-21
6.3 Humpback Whale Recovery Plan.....	6-21
6.4 Hawaiian Islands Humpback Whale National Marine Sanctuary.....	6-22
<b>GLOSSARY.....</b>	<b>7-1</b>
<b>LITERATURE CITED.....</b>	<b>8-1</b>
<b>DISTRIBUTION LIST.....</b>	<b>9-1</b>
<b>LIST OF PREPARERS.....</b>	<b>10-1</b>
<b>APPENDICES</b>	
Appendix A – Fundamentals of Underwater Sound.....	A-1
Appendix B – Correspondence.....	B-1
Appendix C – Public Library Distribution List.....	C-1

## LIST OF FIGURES

Number	Title	Page
1-1	Location of the ATOC Sound Sources and Receivers.....	1-9
2.1-1	Line Drawing of Sound Source.....	2-3
2.1-2	Approximate Cable Route and Sound Source Site.....	2-4
2.1-3	PMRF Shallow Water Training Range Cables and ATOC Cables.....	2-6
2.1-4	Received Levels in Immediate Vicinity of Kauai Sound Source For Spherical Spreading.....	2-9
2.1-5	Parabolic Equation Sound Propagation Plot Towards Kauai (Due South).....	2-11
2.1-6	Parabolic Equation Sound Propagation Plot Away From Kauai (Due North).....	2-12
2.1-7	Measured Received Levels from Kauai Sound Source.....	2-13
2.1-8	Ambient Noise Spectra (From Wenz, 1962).....	2-15
2.1-9	Kauai Site Shadow Plot for Bathymetric Features 1000 m (3281 ft) Below the Sound Channel Axis.....	2-21
2.1-10	Midway Island Alternate Site Shadow Plot for Bathymetric Features 1000 m (3281 ft) Below the Sound Channel Axis.....	2-22
2.1-11	Johnston Atoll Alternate Site Shadow Plot for Bathymetric Features 1000 m (3281 ft) Below the Sound Channel Axis.....	2-23
2.1-12	Adak Island Alternate Site Shadow Plot for Bathymetric Features 1000 m (3281 ft) Below the Sound Channel Axis.....	2-25
2.1-13	Conceptual Moored Autonomous Source.....	2-26
3.1-1	General Current Flow Among Hawaiian Islands.....	3-3
3.2-1	1993-1998 Sightings of Humpback Whales (Mobley et al., 1999b).....	3-14
4.2-1	Single Ping Equivalent Probability Function.....	4-19
4.2-2	Risk Analysis Flowchart.....	4-23
4.2-3	Proposed Kauai Site.....	4-25
4.2-4	Initial Humpback Whale Positions.....	4-26
4.2-5	Behavioral Audiograms for Several Fish Species.....	4-40
4.2-6	Relationship Between Best Hearing Frequency and Hearing Threshold.....	4-42
4.2-7	Sound Pressure Thresholds for Three Shark Species.....	4-44

## LIST OF TABLES

Number	Title	Page
2.1-1	Relative Sound Intensity vs. Distance $R$ From Kauai Source For Spherical Spreading.....	2-8
2.1-2	Distances from Kauai Sound Source and a Humpback Whale That Give the Same Received Level.....	2-10
2.1-3	Moored Autonomous Source Advantages and Disadvantages.....	2-29
2.3-1	Relative Response of the Alternatives to Project Objectives.....	2-33
3.2-1	Marine Mammals Sighted During 1993-1998 Hawaii Statewide Aerial Surveys (Mobley et al., 1999b).....	3-11
3.2-2	Threatened, Endangered, and Special Status Species.....	3-34
4.2-1	AIM Input Parameters for Animal Movement.....	4-13
4.2-2	AIM Input Parameters for Diving Behavior.....	4-13
4.2-3	AIM Input for Distribution, Abundance, and Density.....	4-14
4.2-4	PE Input Parameters.....	4-23
4.2-5	Percentages of Marine Mammal Populations Potentially Affected by the Preferred Alternative.....	4-28
4.2-6	Percentages of Marine Mammal Populations Potentially Affected by the Midway Alternative.....	4-29
4.2-7	Management Unit Species Complexes for Bottomfish.....	4-60
4.2-8	Species Complexes for Pelagic Management Unit Species.....	4-61
4.2-9	Species Complexes for Crustacean Management Unit Species.....	4-61
4.2-10	Species Complexes for Precious Coral Management Unit Species.....	4-62