

# *Contents*

Executive Summary .....	iii
Acknowledgments .....	xiii
List of Tables.....	xxi
List of Figures .....	xxii

## **CHAPTER 1: INTRODUCTION**

1.1 Laboratory Mission and Policy.....	1-1
1.2 Research and Discoveries .....	1-2
1.3 History .....	1-2
1.4 Facilities and Operations .....	1-4
1.5 Location, Local Population, and Local Economy .....	1-7
1.6 Geology and Hydrology .....	1-8
1.7 Climate.....	1-9
1.8 Natural Resources.....	1-10
1.9 Cultural Resources.....	1-10
References and Bibliography .....	1-14

## **CHAPTER 2: ENVIRONMENTAL MANAGEMENT SYSTEM**

2.1 Integrated Safety Management, ISO 14001, and OHSAS 18001 .....	2-1
2.2 Environmental, Safety, Security, and Health Policy.....	2-2
2.3 Planning .....	2-3
2.3.1 Environmental Aspects.....	2-3
2.3.2 Compliance Obligations.....	2-3
2.3.3 Objectives and Targets .....	2-4
2.3.4 Environmental Management Programs.....	2-4
2.3.4.1 Compliance .....	2-4
2.3.4.2 Groundwater Protection.....	2-4
2.3.4.3 Waste Management.....	2-5
2.3.4.4 Pollution Prevention and Waste Minimization .....	2-7
2.3.4.5 Water Conservation .....	2-7
2.3.4.6 Energy Management and Conservation.....	2-11
2.3.4.7 Natural and Cultural Resource Management Programs .....	2-13
2.3.4.8 Environmental Restoration .....	2-13
2.4 Implementing the Environmental Management System.....	2-16
2.4.1 Structure and Responsibility .....	2-16
2.4.2 Communication and Community Involvement.....	2-16

2.4.2.1	Communication Forums .....	2-16
2.4.2.2	Community Involvement in Cleanup Projects.....	2-18
2.4.3	Monitoring and Measurement.....	2-18
2.4.3.1	Compliance Monitoring.....	2-18
2.4.3.2	Restoration Monitoring.....	2-19
2.4.3.3	Surveillance Monitoring.....	2-19
2.4.4	EMS Assessments .....	2-20
2.5	Environmental Stewardship at BNL.....	2-22
	References and Bibliography .....	2-22

### **CHAPTER 3: COMPLIANCE STATUS**

3.1	Compliance with Requirements.....	3-2
3.2	Environmental Permits .....	3-2
3.2.1	Existing Permits .....	3-2
3.2.2	New or Modified Permits .....	3-8
3.2.2.1	NYS Wetlands and Wild Scenic, Recreational Rivers Act .....	3-8
3.3	NEPA Assessments .....	3-8
3.4	Preservation Legislation .....	3-8
3.5	Clean Air Act .....	3-8
3.5.1	Conventional Air Pollutants .....	3-9
3.5.1.1	Boiler Emissions.....	3-9
3.5.1.2	Ozone-Depleting Substances .....	3-9
3.5.2	Hazardous Air Pollutants.....	3-10
3.5.2.1	Maximum Available Control Technology.....	3-10
3.5.2.2	Asbestos .....	3-10
3.5.2.3	Radioactive Airborne Emissions.....	3-10
3.6	Clean Water Act.....	3-10
3.6.1	Sewage Treatment Plant.....	3-11
3.6.2	Recharge Basins and Stormwater .....	3-17
3.7	Safe Drinking Water Act.....	3-19
3.7.1	Potable Water .....	3-19
3.7.2	Cross-Connection Control.....	3-23
3.7.3	Underground Injection Control .....	3-23
3.8	Preventing and Reporting Spills .....	3-25
3.8.1	Preventing Oil Pollution and Spills.....	3-25
3.8.2	Emergency Reporting Requirements .....	3-25
3.8.3	Spills and Releases.....	3-25
3.8.4	Major Petroleum Facility License.....	3-26
3.8.5	Chemical Bulk Storage .....	3-26
3.8.6	County Storage Requirements.....	3-27

3.9 RCRA Requirements .....	3-27
3.10 Polychlorinated Biphenyls.....	3-28
3.11 Pesticides .....	3-28
3.12 Wetlands and River Permits.....	3-28
3.13 Protection of Wildlife .....	3-28
3.13.1 Endangered Species Act.....	3-28
3.13.2 Migratory Bird Treaty Act.....	3-30
3.13.3 Bald and Golden Eagle Protection Act.....	3-30
3.14 Public Notification of Clearance of Property .....	3-30
3.15 External Audits and Oversight .....	3-31
3.15.1 Regulatory Agency Oversight.....	3-31
3.15.2 DOE Assessments/Inspections .....	3-31
3.15.3 Environmental Multi-Topic Assessment.....	3-31
3.15.4 Nevada National Security Site .....	3-33
3.16 Agreements, Enforcement Actions, and Other Environmental Occurrence Reports ...	3-33
References and Bibliography .....	3-33

#### **CHAPTER 4: AIR QUALITY**

4.1 Radiological Emissions .....	4-1
4.2 Facility Monitoring.....	4-1
4.2.1 High Flux Beam Reactor.....	4-2
4.2.2 Brookhaven Linac Isotope Producer.....	4-2
4.2.3 Target Processing Laboratory.....	4-3
4.2.4 Additional Minor Sources .....	4-3
4.2.5 Nonpoint Radiological Emission Sources.....	4-4
4.3 Ambient Air Monitoring .....	4-4
4.3.1 Gross Alpha and Beta Airborne Activity.....	4-4
4.3.2 Airborne Tritium .....	4-6
4.4 Nonradiological Airborne Emissions.....	4-6
4.5 Greenhouse Gas Emissions .....	4-8
References and Bibliography .....	4-10

#### **CHAPTER 5: WATER QUALITY**

5.1 Surface Water Monitoring Program.....	5-1
5.2 Sanitary System Effluents.....	5-3
5.2.1 Sanitary System Effluent – Radiological Analyses.....	5-5
5.2.2 Sanitary System Effluent – Nonradiological Analyses .....	5-7
5.3 Process-Specific Wastewater .....	5-7
5.4 Recharge Basins.....	5-7

5.4.1 Recharge Basins – Radiological Analyses .....	5-11
5.4.2 Recharge Basins – Nonradiological Analyses.....	5-11
5.4.3 Stormwater Assessment .....	5-14
5.5 Peconic River Surveillance.....	5-15
5.5.1 Peconic River – Radiological Analyses .....	5-15
5.5.2 Peconic River – Nonradiological Analyses.....	5-15
References and Bibliography.....	5-16

## CHAPTER 6: NATURAL AND CULTURAL RESOURCES

6.1 Natural Resource Management Program.....	6-1
6.1.1 Identification and Mapping .....	6-1
6.1.2 Habitat Protection and Enhancement.....	6-3
6.1.2.1 Salamander Protection Efforts.....	6-4
6.1.2.2 Banded Sunfish .....	6-4
6.1.2.3 Migratory Birds .....	6-4
6.1.2.4 Bald Eagle.....	6-5
6.1.2.5 Northern Long-eared Bat.....	6-5
6.1.3 Population Management.....	6-6
6.1.3.1 Wild Turkey .....	6-6
6.1.3.2 White-Tailed Deer.....	6-6
6.1.4 Compliance Assurance and Potential Impact Assessment .....	6-6
6.2 Upton Ecological and Research Reserve .....	6-7
6.3 Monitoring Flora and Fauna .....	6-7
6.3.1 Deer Sampling.....	6-7
6.3.1.1 Cesium-137 in White-Tailed Deer.....	6-8
6.3.2 Other Animals Sampled .....	6-11
6.3.3 Fish Sampling .....	6-11
6.3.3.1 Fish Population Assessment .....	6-13
6.3.4 Vegetation Sampling .....	6-13
6.3.4.1 Grassy Plants and Soil .....	6-13
6.4 Precipitation Monitoring.....	6-13
6.4.1 Mercury Monitoring of Precipitation .....	6-13
6.5 Wildlife Programs .....	6-13
6.6 Cultural Resource Activities .....	6-17
References and Bibliography.....	6-18

## **CHAPTER 7: GROUNDWATER PROTECTION**

7.1 The BNL Groundwater Protection Management Program .....	7-1
7.1.1 Prevention .....	7-1
7.1.2 Monitoring .....	7-2
7.1.3 Restoration .....	7-2
7.1.4 Communication.....	7-2
7.2 Groundwater Protection Performance .....	7-2
7.3 Groundwater Monitoring Programs.....	7-3
7.4 Groundwater Monitoring Results .....	7-3
7.5 Groundwater Treatment Systems.....	7-7
References and Bibliography.....	7-10

## **CHAPTER 8: RADIOLOGICAL DOSE ASSESSMENT**

8.0 Introduction .....	8-2
8.1 Direct Radiation Monitoring .....	8-2
8.1.1 Ambient Radiation Monitoring .....	8-2
8.1.2 Facility Area Monitoring.....	8-6
8.2 Dose Modeling .....	8-9
8.2.1 Dose Modeling Program .....	8-10
8.2.2 Dose Calculation Methods and Pathways.....	8-12
8.2.2.1 Maximally Exposed Off-site and On-site Individual.....	8-12
8.2.2.2 Effective Dose Equivalent .....	8-12
8.2.2.3 Dose Calculation: Fish Ingestion.....	8-12
8.2.2.4 Dose Calculation: Deer Meat Ingestion .....	8-13
8.3 Sources: Diffuse, Fugitive, “Other”.....	8-13
8.3.1 Remediation Work .....	8-13
8.4 Dose from Point Sources .....	8-13
8.4.1 Brookhaven Linac Isotope Producer.....	8-13
8.4.2 Target Processing Laboratory.....	8-14
8.4.3 High Flux Beam Reactor.....	8-14
8.4.4 Brookhaven Medical Research Reactor .....	8-14
8.4.5 Brookhaven Graphite Research Reactor .....	8-14
8.4.6 Waste Management Facility .....	8-14
8.4.7 Unplanned Releases .....	8-14
8.5 Dose from Ingestion .....	8-14
8.6 Dose to Aquatic and Terrestrial Biota.....	8-15
8.7 Cumulative Dose .....	8-15
References and Bibliography.....	8-16

## **CHAPTER 9: QUALITY ASSURANCE**

9.1 Quality Program Elements.....	9-1
9.2 Sample Collection and Handling.....	9-2
9.2.1 Field Sample Handling.....	9-3
9.2.1.1 Custody and Documentation .....	9-3
9.2.1.2 Preservation and Shipment .....	9-3
9.2.2 Field Quality Control Samples.....	9-3
9.2.3 Tracking and Data Management .....	9-4
9.3 Sample Analysis .....	9-5
9.3.1 Qualifications .....	9-5
9.4 Verification and Validation of Analytical Results .....	9-5
9.4.1 Checking Results.....	9-7
9.5 Contract Analytical Laboratory QA/QC.....	9-7
9.6 Performance or Proficiency Evaluations .....	9-7
9.6.1 Summary of Test Results.....	9-9
9.6.1.1 Radiological Assessments .....	9-9
9.6.1.2 Nonradiological Assessments .....	9-9
9.7 Audits.....	9-9
9.8 Conclusion .....	9-10
References and Bibliography .....	9-10
<b>Appendix A:</b> Glossary .....	A-1
Acronyms and Abbreviations.....	A-1
Technical Terms .....	A-5
<b>Appendix B:</b> Understanding Radiation.....	B-1
<b>Appendix C:</b> Units of Measure and Half-Life Periods .....	C-1
<b>Appendix D:</b> Federal, State, and Local Laws and Regulations Pertinent to BNL.....	D-1
<b>Appendix E:</b> BNL Site Sustainability Plan: Status Summary for Fiscal Year 2018 .....	E-1