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Radiological Survey at the Puget Sound Naval Shipyard and Naval Submarine Base - Bangor

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Radiological Survey at the Puget Sound Naval Shipyard and Naval Submarine Base - Bangor

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and

Clinton Cox

July 1998

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EXECUTIVE SUMMARY

This report presents results of a radiological survey conducted in September 1996 by the National Air and Radiation Environmental Laboratory (NAREL) to assess levels of environmental radioactivity around Puget Sound Naval Shipyard (PSNS) at Bremerton, WA, and the Naval Submarine Base (NSBB) near Bangor, WA. The purpose of the survey was to assess whether the construction, maintenance, overhaul, refueling or operations of nuclear-powered warships have created elevated levels of radioactivity that could expose nearby populations or contaminate the environment.

During this survey 227 samples were collected: 126 at the PSNS study site; 73 at the NSBB site; 21 from background locations; and 7 near the outfall of the Bremerton sewage treatment plant. Samples included drinking water, harbor water, sediment, sediment cores, and biota. All samples were analyzed for gross alpha and beta activities and gamma emitting radionuclides, and some samples were also analyzed for radium-226 and isotopes of uranium, plutonium, and thorium. In addition to sample collection and analysis, radiation surveys were performed using portable survey instruments to detect gamma radiation.

Except for a trace amount of cobalt-60 in one sediment sample at PSNS, no radioactivity attributable to nuclear-powered warship operations was detected. Iodine-131 was detected in six biota samples: four PSNS samples, one background sample at Manchester Park, and one background sample at Kitsap Memorial Park. Iodine-131 was also detected in a water sample at the Bremerton sewer outfall. The source of the iodine-131 is believed to be sewer discharges from nearby medical facilities. All other radioactivity detected in the 227 samples taken during the survey is attributed to naturally occurring radionuclides or fallout from atmospheric nuclear tests and the Chernobyl reactor accident in 1986. External radiation measurements did not detect any increased radiation above natural background levels. Based on this radiological survey, practices regarding nuclear-powered warship operations at PSNS and NSBB have resulted in no increases in radioactivity causing significant population exposure or contamination of the environment.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the many staff who participated in this study and who helped prepare this report. The detailed planning, support, and assistance of Puget Sound Naval Shipyard personnel was much appreciated. The EPA survey team consisted of Ted Fowler, Clinton Cox, J. Michael Smith, Roger Goodman, David Kappelman, and Mary Wisdom from NAREL and Jerry Leitch from EPA Region 10 in Seattle, WA. The assistance and hard physical work performed by Jerry Leitch with outstanding technical competence was much appreciated. Roger Goodman provided expertise in organizing all the equipment for the survey, and Mary Wisdom provided quality assurance oversight. Staff of the NAREL Monitoring and Analytical Services Branch prepared and analyzed the samples collected during the survey. Other NAREL staff contributed to the preparation of the manuscript. Ed Mantiply provided computer technical expertise in the preparation of figures for the sample locations, Bob Trefethen assisted in the shipment of equipment and preparation of the tables of radioanalytical results, and Chuck Petko edited the report. Finally, we thank the EPA staff who served as technical peer reviewers of the manuscript.

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1.0 INTRODUCTION

The National Air and Radiation Environmental Laboratory (NAREL) of the U.S. Environmental Protection Agency (EPA) in cooperation with the U.S. Naval Sea Systems Command (NAVSEA) has previously surveyed facilities serving nuclear-powered warships. These surveys began in 1963 and have been conducted on the Atlantic and Pacific coasts, on the Gulf of Mexico within the Continental United States, and at Pearl Harbor, Hawaii. In 1996, an interagency agreement was signed with NAVSEA for NAREL to perform radiological surveys over the next five years at active facilities serving nuclear-powered warships. These surveys assess whether the construction, maintenance, overhaul, refueling or operations of nuclear-powered warships have created elevated levels of radioactivity that could expose nearby populations or contaminate the environment.

The first environmental study under the interagency agreement was performed September 9-20, 1996, at the Puget Sound Naval Shipyard (PSNS) at Bremerton, WA, and the Naval Submarine Base (NSBB) near Bangor, WA. A pre-survey trip was made August 6 and 7 to develop a sampling and survey work plan with the assistance of knowledgeable site personnel and the EPA Region 10 Radiation Program Manager, who provided information regarding issues of public interest such as the detection of low levels of iodine-131 (see section 1.2). Staff from NAVSEA and PSNS provided NAREL with information on past and present shipyard radiological operations and procedures. All requested information was freely provided verbally and/or in writing. Based on the information received and that derived from previous EPA studies, a work plan (EPA96a) was developed to describe the approach for assessing the radiological condition of the PSNS and NSBB aquatic environments.

1.1 Site History (Ll89, PSNS96, Ca77)

Both sites, PSNS and NSBB, are located on the Kitsap Peninsula in northwestern Washington (see Fig. 1). Hood Canal separates the Kitsap Peninsula from the Olympic Peninsula to the west. Puget Sound borders the northern and eastern shores of the Kitsap Peninsula. The population of the Kitsap Peninsula is concentrated in the urban areas of Bremerton, Poulsbo, Silverdale, and Port Orchard.

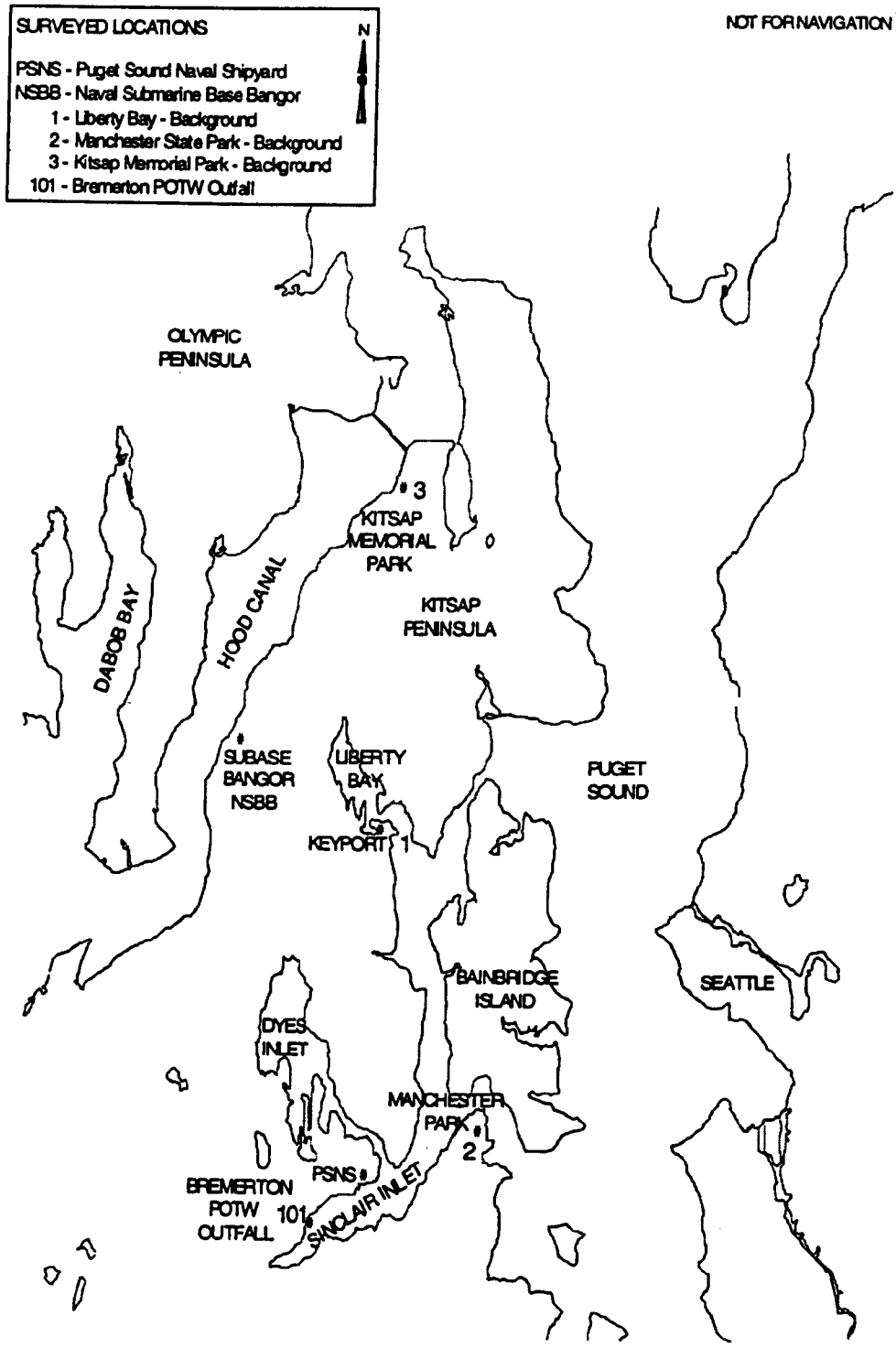

Fig. 1. Puget Sound Area Map

The PSNS is located in Kitsap County in the city of Bremerton, WA, on Sinclair Inlet, an embayment off central Puget Sound. The city of Port Orchard is located to the south across Sinclair Inlet, and the town of Gorst is southwest at the head of the Inlet. Overhaul and repair of nuclear-powered vessels began in 1967. The shores of Sinclair Inlet, Port Orchard, Dyes Inlet, Rich Passage, and Agate Pass are used primarily for commercial, residential, and recreational activities.

Currently, PSNS is a shipyard dedicated to the repair, overhaul, modernization, and disposal of Navy warships. The site consists of more than 300 acres with almost 2 miles of shoreline, six deep-water piers, six dry docks ranging in length from 638 feet to 1,151 feet, and numerous moorings.

The NSBB covers about 7,000 acres, including 5 miles of shoreline, on the east side of Hood Canal on the western shore of Kitsap Peninsula. Hood Canal is a natural channel off Puget Sound that provides direct access to the Pacific Ocean, approximately 100 miles away. The submarine base is located in a sparsely developed portion of Kitsap County. The forested areas along Hood Canal provide excellent areas for recreation, in addition to providing natural habitats for mammals and birds. The town of Silverdale is about 7 miles south-southeast.

Nuclear-powered submarines have visited the Bangor site since the early 1960's while the site was a naval weapons station and not yet a submarine base. Now NSBB is a homeport for Trident and other nuclear-powered submarines dedicated to repairing and testing nuclear-powered submarines and training submarine personnel. Radioactive work at NSBB began in 1982. The Trident Refit Facility's Delta Pier and Controlled Industrial Facility, Building 7201, are located in the base's northern section on Hood Canal.

1.2 Survey History

The PSNS was previously surveyed by EPA in 1974 (Ca77) and 1987 (Ll89). During the 1974 survey, trace amounts of cobalt-60 (0.02-0.09 pCi/g-dry) were found in some silt samples; however, the activity was close to the limit of detection, indicating no appreciable releases (Ca77). A trace amount of cobalt-60 (0.04±0.01 pCi/g-dry) was detected in one sediment sample at PSNS during the 1987 EPA survey (Ll89). The NSBB was also surveyed by EPA in 1987, and trace amounts of silver-110m were found in two mollusk samples. The source of the silver-110m was thought to be fallout from the Chernobyl reactor accident (Ll89). Based on its 1974 and 1987 surveys, EPA concluded that nuclear-powered warship operations did not result in increases in environmental radioactivity causing significant population exposure or contamination of the environment.

In 1994, marine life sampling was performed in Sinclair Inlet by the Washington State Department of Health, EPA, and PSNS (Le94); and no radioactivity levels of concern for public health or the environment were found. Non-naturally occurring radionuclides

identified during the study (Le94) included: (1) cesium-137 at levels comparable to those typically found from global fallout due to nuclear weapons testing and the Chernobyl reactor accident; (2) iodine-131 at low levels near the sewer outfall; and (3) mercury-203, detected by Washington State Department of Health, at very low levels; however, mercury-203 was not detected by PSNS or EPA. In 1995, another study of marine life samples in Sinclair Inlet was performed by the Washington State Department of Health, EPA and PSNS (Le95), and again no radioactivity levels of concern for public health or the environment were found. Non-naturally occurring radionuclides identified during the 1995 study (Le95) included: (1) cesium-137 at levels comparable to those typically found due to nuclear weapons testing and the Chernobyl reactor accident and (2) iodine-131 in very low levels in brown split kelp and black pine seaweed from PSNS and green sea lettuce from near the outfall of the Bremerton sewage treatment plant.

1.3 Contaminants of Concern (Ll89, PSNS96)

The results of previous harbor surveys indicate that cobalt-60 is the predominant radionuclide one would find in environmental media if radioactivity were present as a result of naval nuclear propulsion plant operations. Therefore, environmental sampling during this study emphasized detection of cobalt-60. Other radionuclides of concern in liquid effluents or encountered during maintenance work include tungsten-187, chromium-51, hafnium-181, iron-59, iron-55, nickel-63, niobium-95, zirconium-95, tantalum-182, manganese-54, and cobalt-58. Water samples were also analyzed for tritium since this radionuclide is known to be produced in the coolant of light-water nuclear reactors.

1.4 Study Objectives

The objectives of the study were to determine if radioactive material related to U.S. Navy nuclear-powered warship operations, repair, and maintenance is present at measurable levels in the harbor samples collected, to make comparisons of current study results with past study results, and, as deemed appropriate, to estimate potential doses to the public.

2.0 SAMPLING AND ANALYSIS

The following terms will be used in the discussion of the collection of samples:

Study Site -- the geographical area in and around PSNS or NSBB that was studied.

Background Location -- a selected sampling location where representative levels of naturally occurring or existing radionuclides, not likely to be related to PSNS or NSBB, were measured.

Sampling Location -- a location within or near one of the study sites from which samples were collected.

2.1 Sampling Strategy

This study was intended to determine the concentrations (1) of cobalt-60 and other selected radionuclides that could be present due to the operations performed at PSNS or NSBB and (2) iodine-131 and other selected radionuclides that may be present at or near the study sites but originated from off-site locations. Sampling locations were selected to correspond to the locations where the Navy presently conducts environmental monitoring, locations where the EPA sampled in the 1987 survey, and locations biasedly selected by NAREL to more comprehensively characterize the study sites.

Background sampling locations were selected in order to obtain baseline radionuclide levels that are characteristic of the area, but are believed not to have been affected by operations at the study sites. The data from the study sites were compared directly to the background concentrations when applicable.

2.1.1 Background Locations

The background locations selected were Kitsap Memorial Park, Manchester State Park, and Liberty Bay (see Fig. 1 and Tables 1 - 5). An explanation of symbols used in the tables is on pages 32-34. The background locations were selected during the pre-survey visit (August 6-7, 1996) to the study sites and are located far enough away from the study sites so that operations there would not have impacted those locations. Therefore, representative levels of existing radionuclides in the samples as a result of worldwide fallout can be measured. Samples collected from these background locations are listed as PSNS samples; however, these background locations are used as background locations for both PSNS and NSBB.

2.1.2 Puget Sound Naval Shipyard (PSNS) Study Site

The PSNS study site is located on the north shore of Sinclair Inlet and on the south side of Bremerton, WA. The east and west boundaries of PSNS are clearly marked and identifiable from the Sinclair Inlet. Samples were collected from 46 locations within the study site in 1987 (Ll89). Sampling locations presently used by the Navy, the 1987 EPA sampling locations, and sampling locations added by NAREL were used during this survey. The type of sample collected and the approximate location of each sampling site for the PSNS survey are shown in Figs. 2 - 5. A description of each sampling location and the type of sample collected are presented in Tables 1 - 5. During this study, 126 samples were collected at the PSNS study site. An additional 21 samples were collected from background locations, and 7 samples were collected near the outfall of the Bremerton sewage treatment plant.

2.1.3 Naval Submarine Base, Bangor (NSBB) Study Site

The NSBB study site is located near Bangor, WA. Samples were collected from 27 locations within the study site in 1987 (Ll89). Sampling locations presently used by the Navy, the 1987 EPA sampling locations, and sampling locations added by NAREL were used during this survey. The type of sample collected and the approximate location of each sampling site for the NSBB survey are shown in Figs. 6 - 9. A description of each sampling location and the type of sample collected are presented in Tables 6 - 10. During this study, 73 samples were collected at the NSBB study site.

2.1.4 Instrumentation

At selected locations, primarily public access areas, radiation surveys were performed using portable survey instruments to detect gamma radiation. External radiation measurement locations are shown in Fig. 10 for PSNS and Fig. 11 for NSBB. External gamma radiation was measured with a Ludlum Model 19 Micro-R radiation survey instrument, GENITRON GM survey instrument, and a Reuter-Stokes pressurized ionization chamber. Underwater measurement of gamma radiation was performed at each sediment core sample location using a NaI detector connected to an EG&G ORTEC Nomad Plus-based multichannel analyzer. Instrument serial numbers and calibration dates are available on the field data sheets.

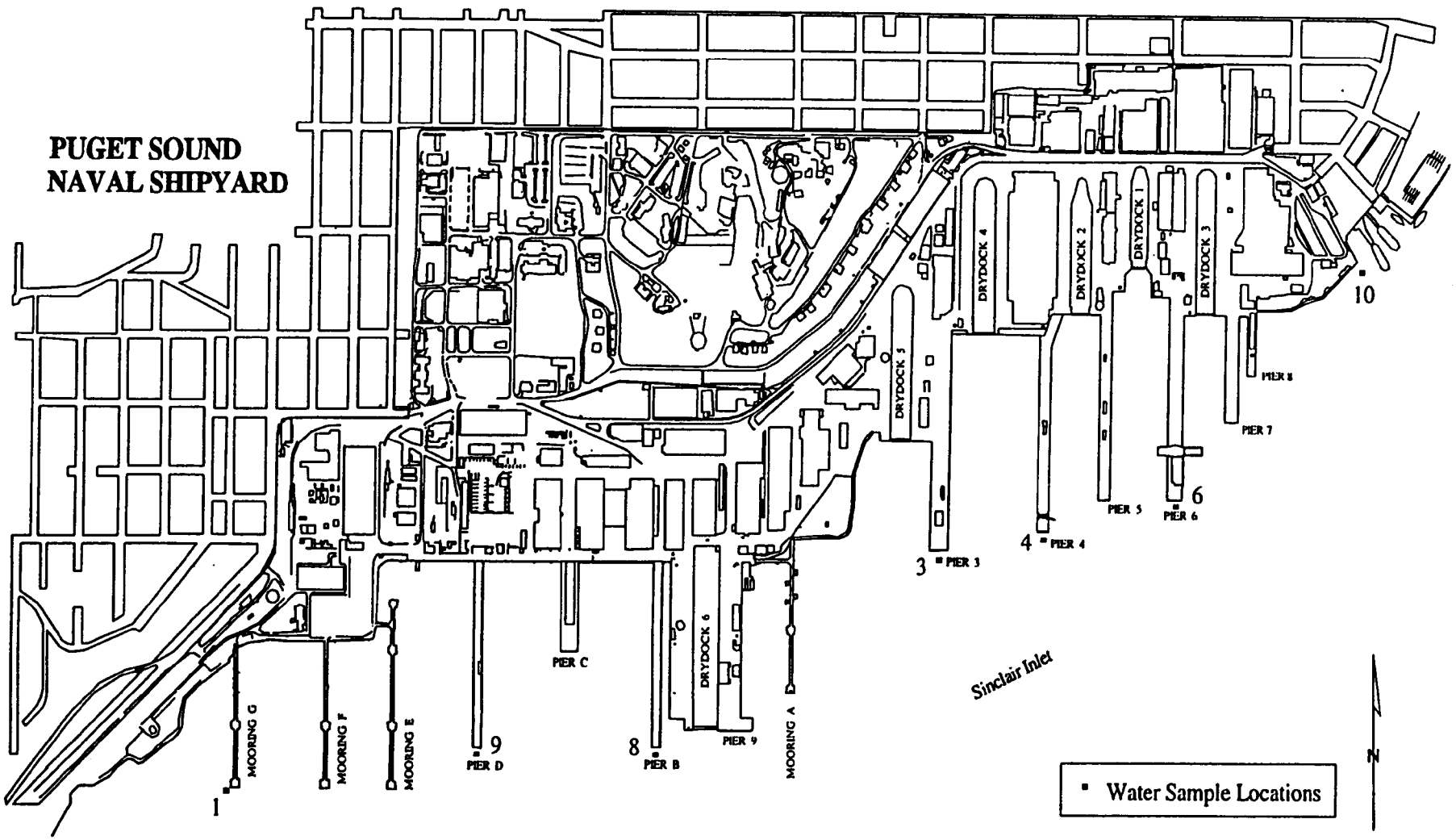

Fig. 2. PSNS Water Sample Locations

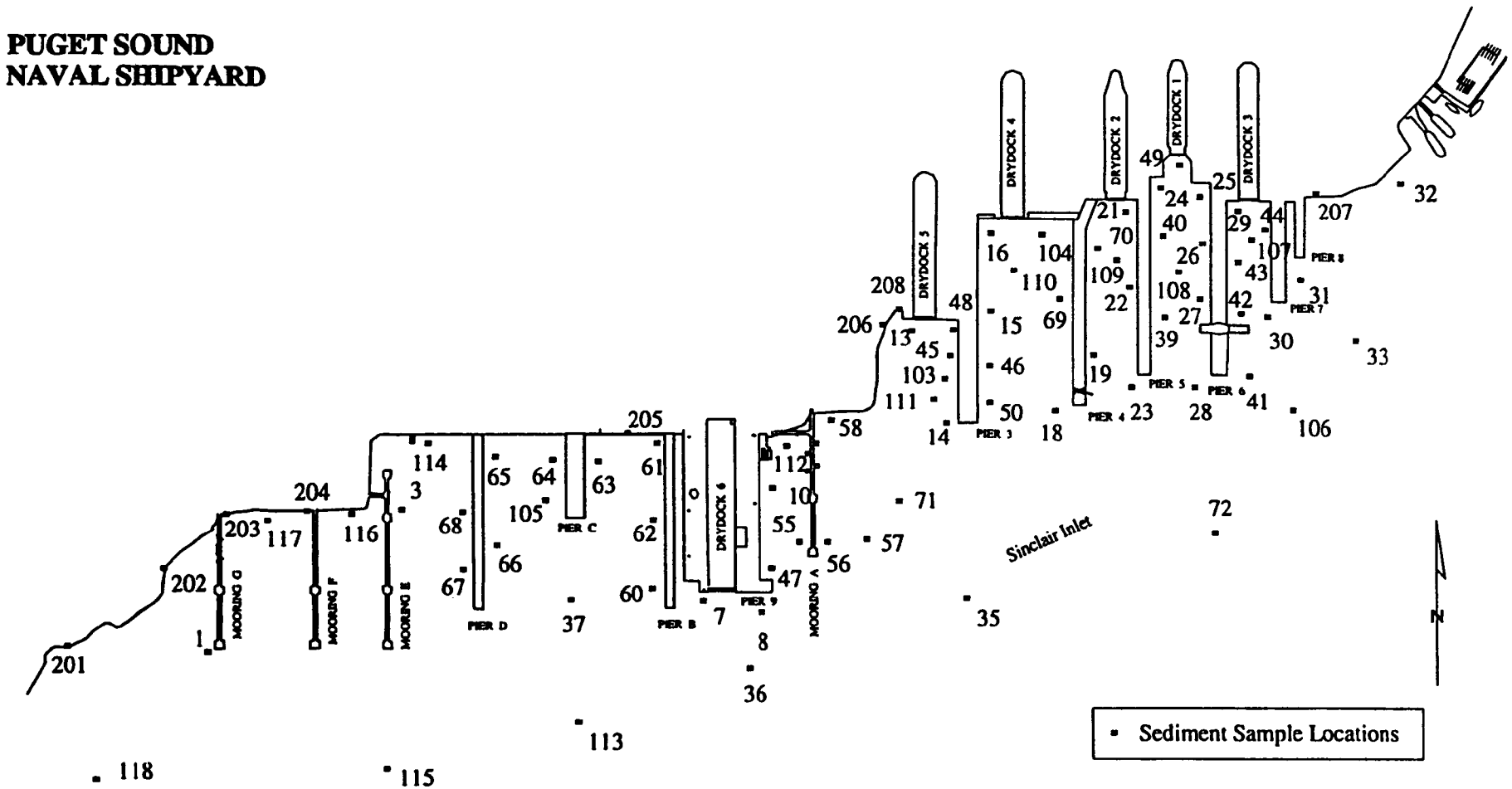

Fig. 3. PSNS Sediment Sample Locations

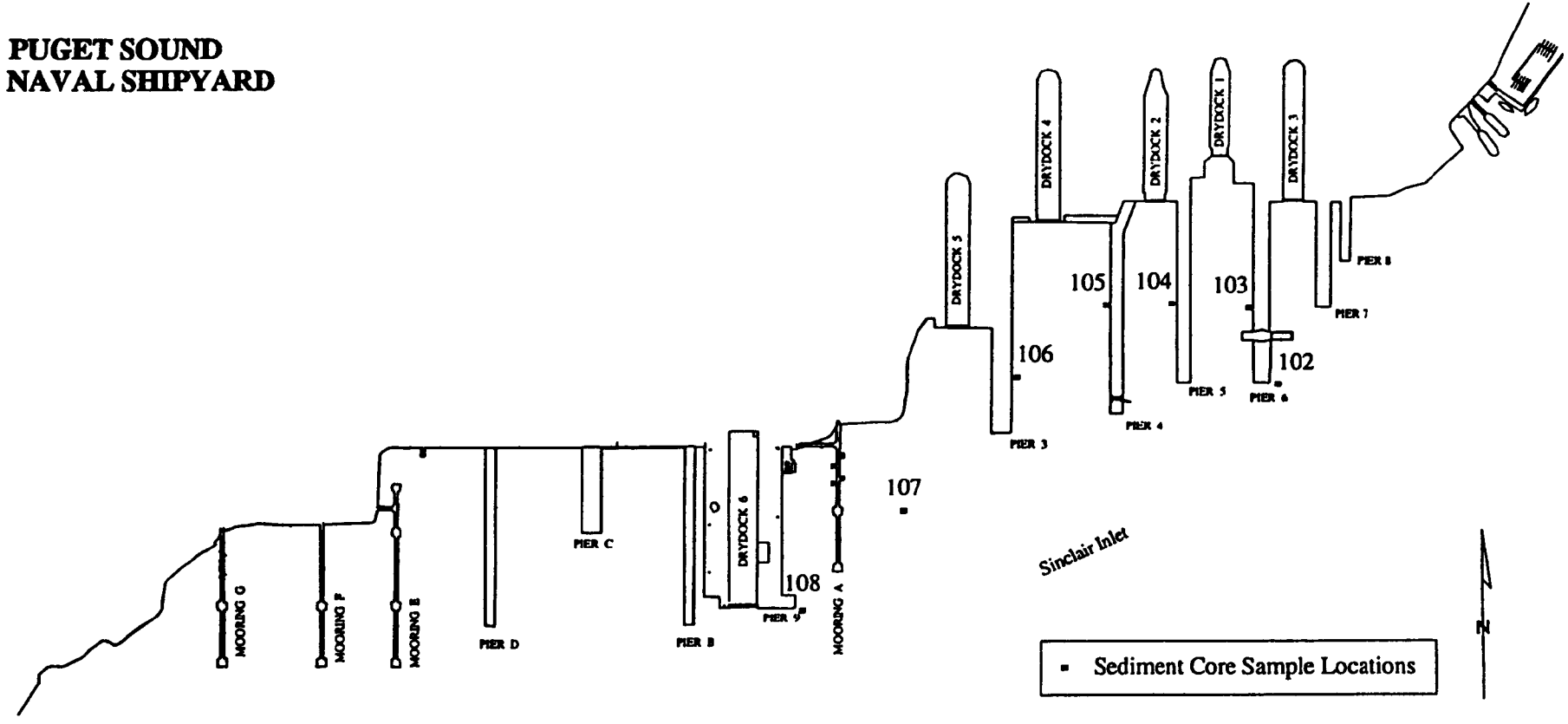

Fig. 4. PSNS Sediment Core Sample Locations

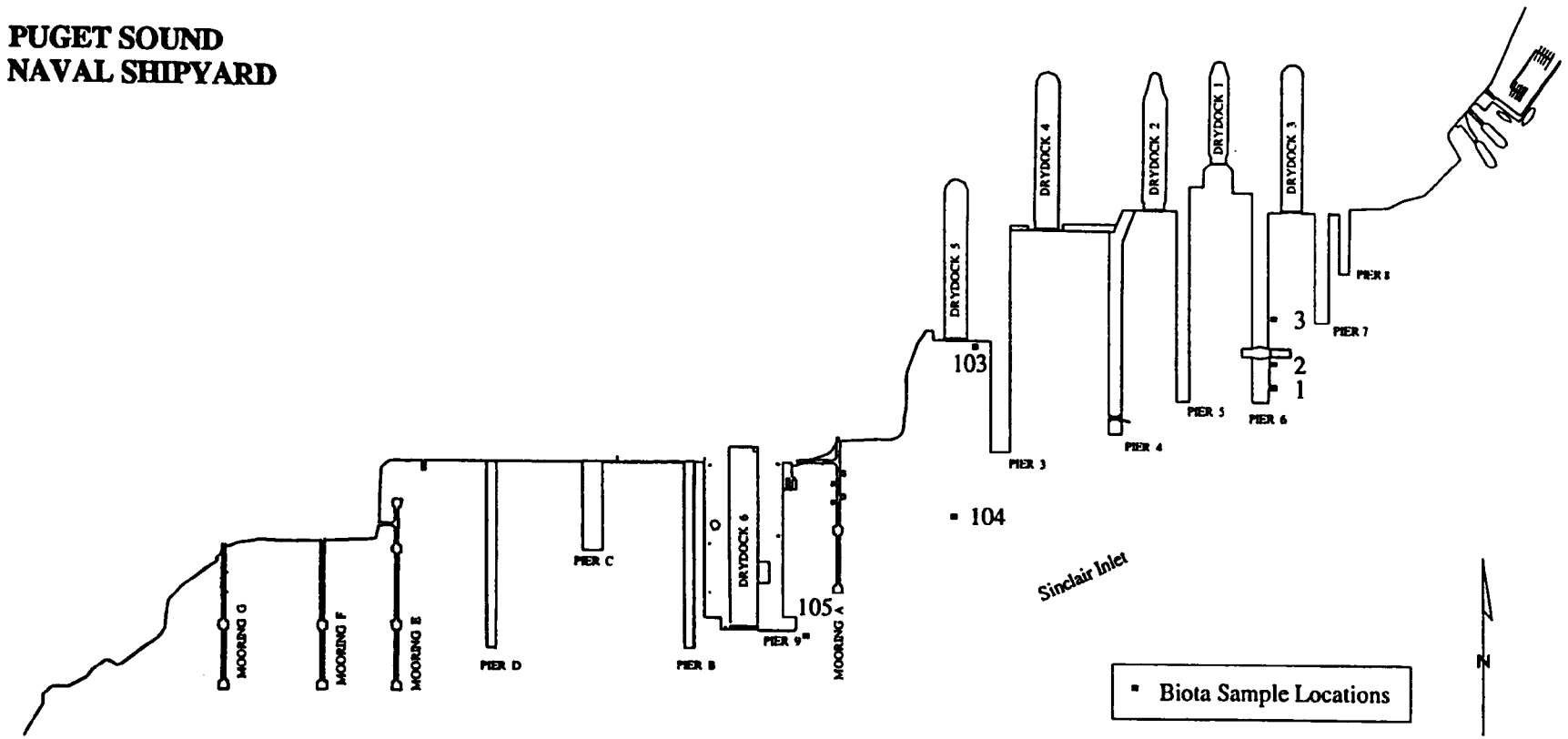

Fig. 5. PSNS Biota Sample Locations

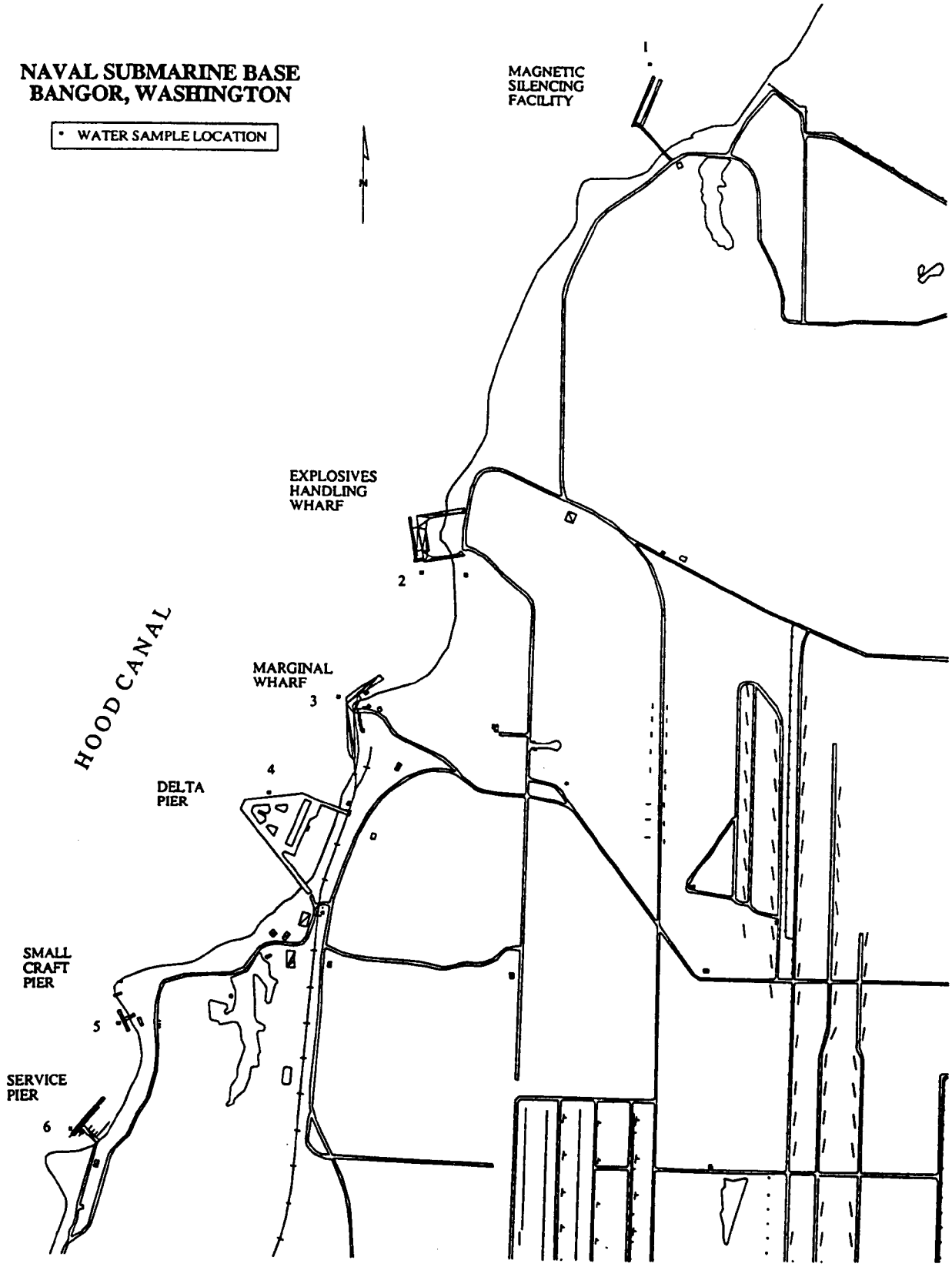

Fig. 6. NSBB Water Sample Locations

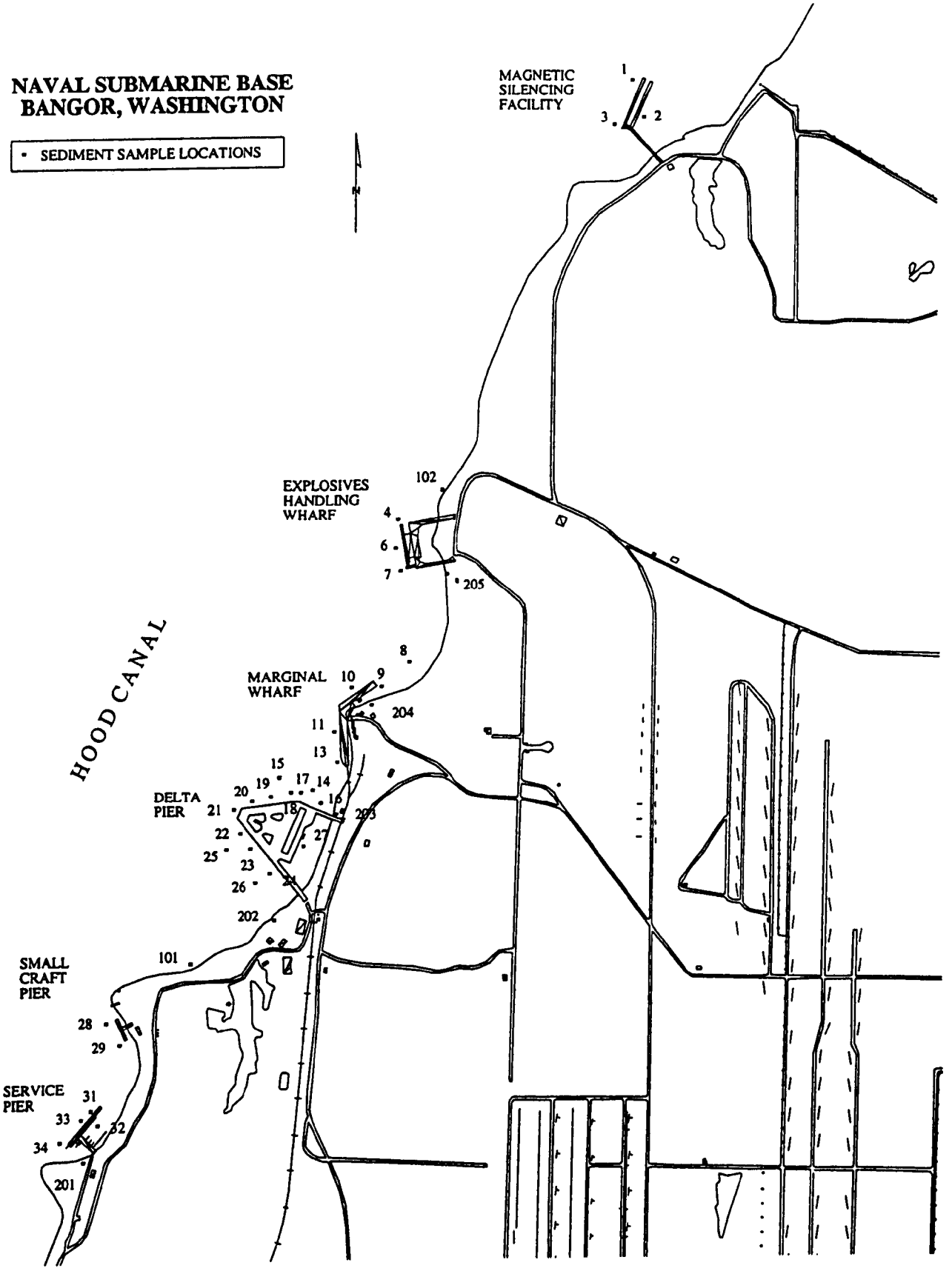

Fig. 7. NSBB Sediment Sample Locations

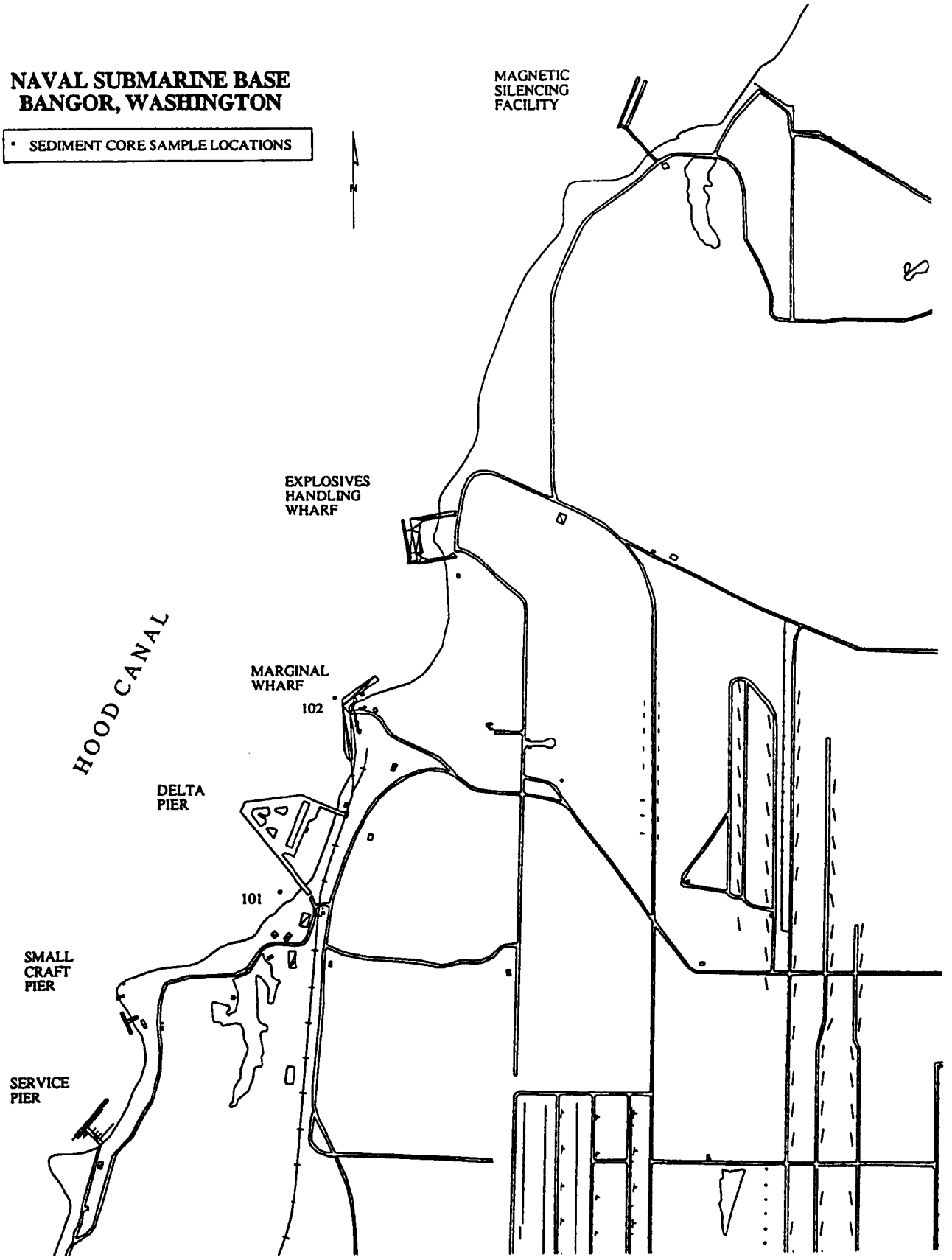

Fig. 8. NSBB Sediment Core Sample Locations

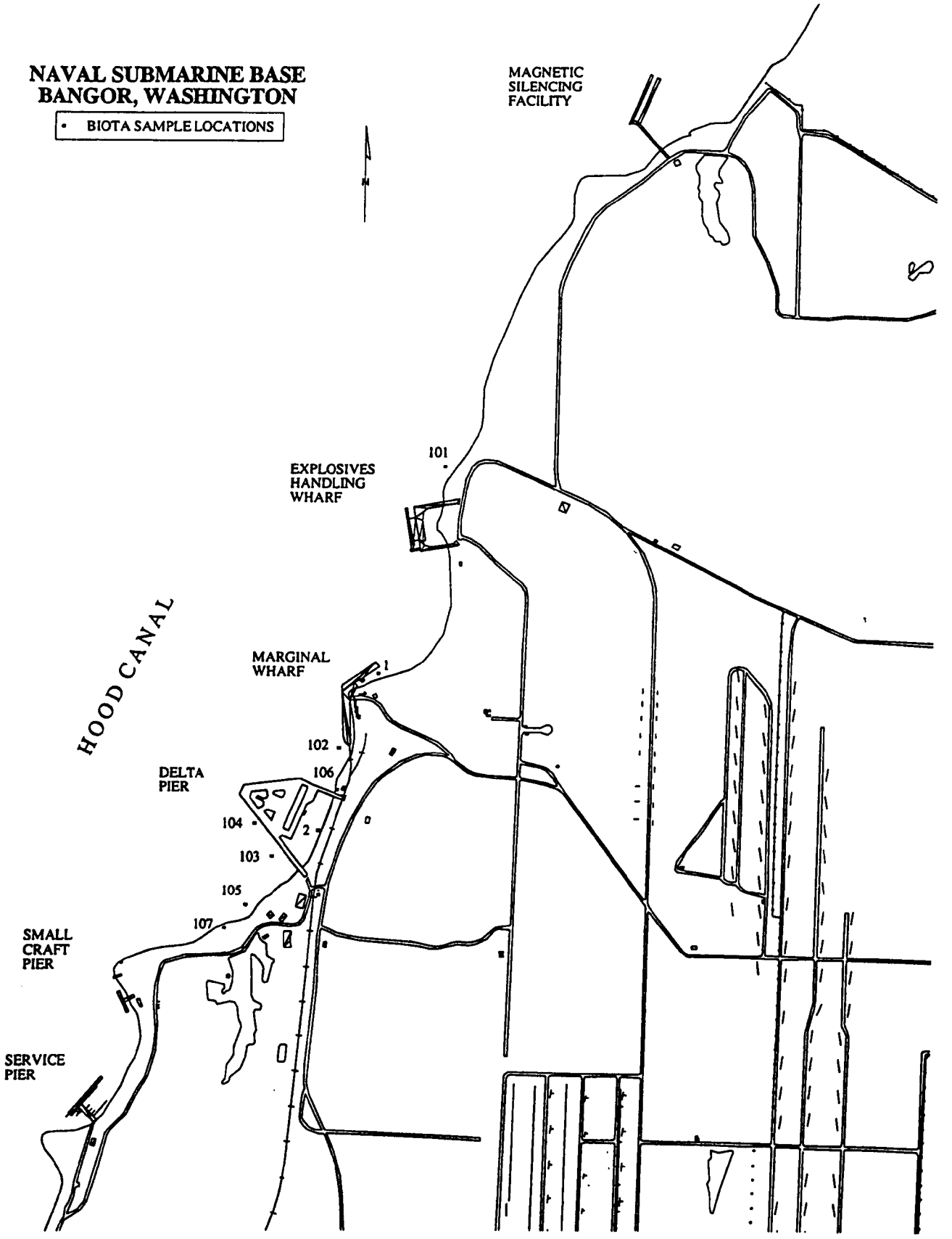

Fig. 9. NSBB Biota Sample Locations

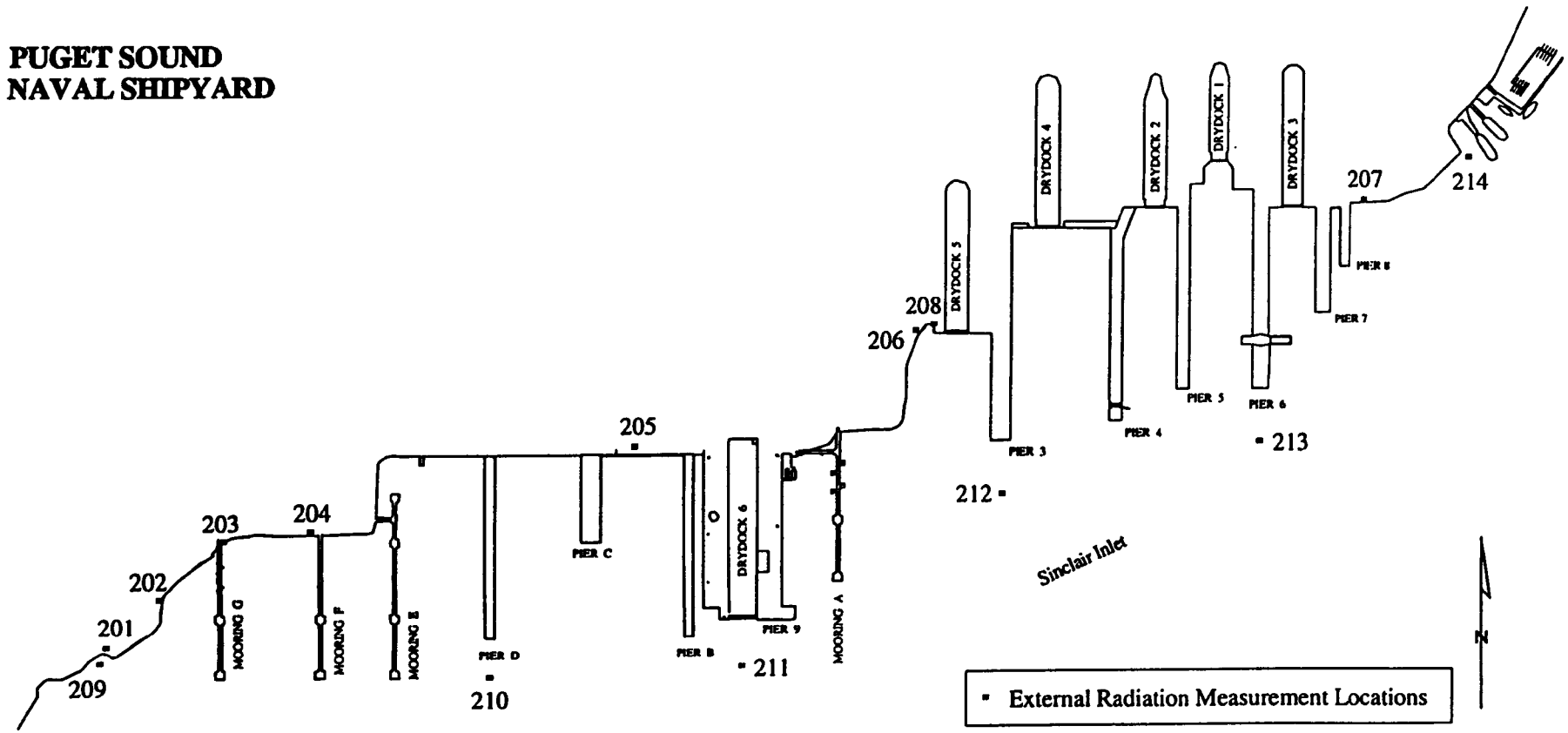

Fig. 10. PSNS External Radiation Measurement Locations

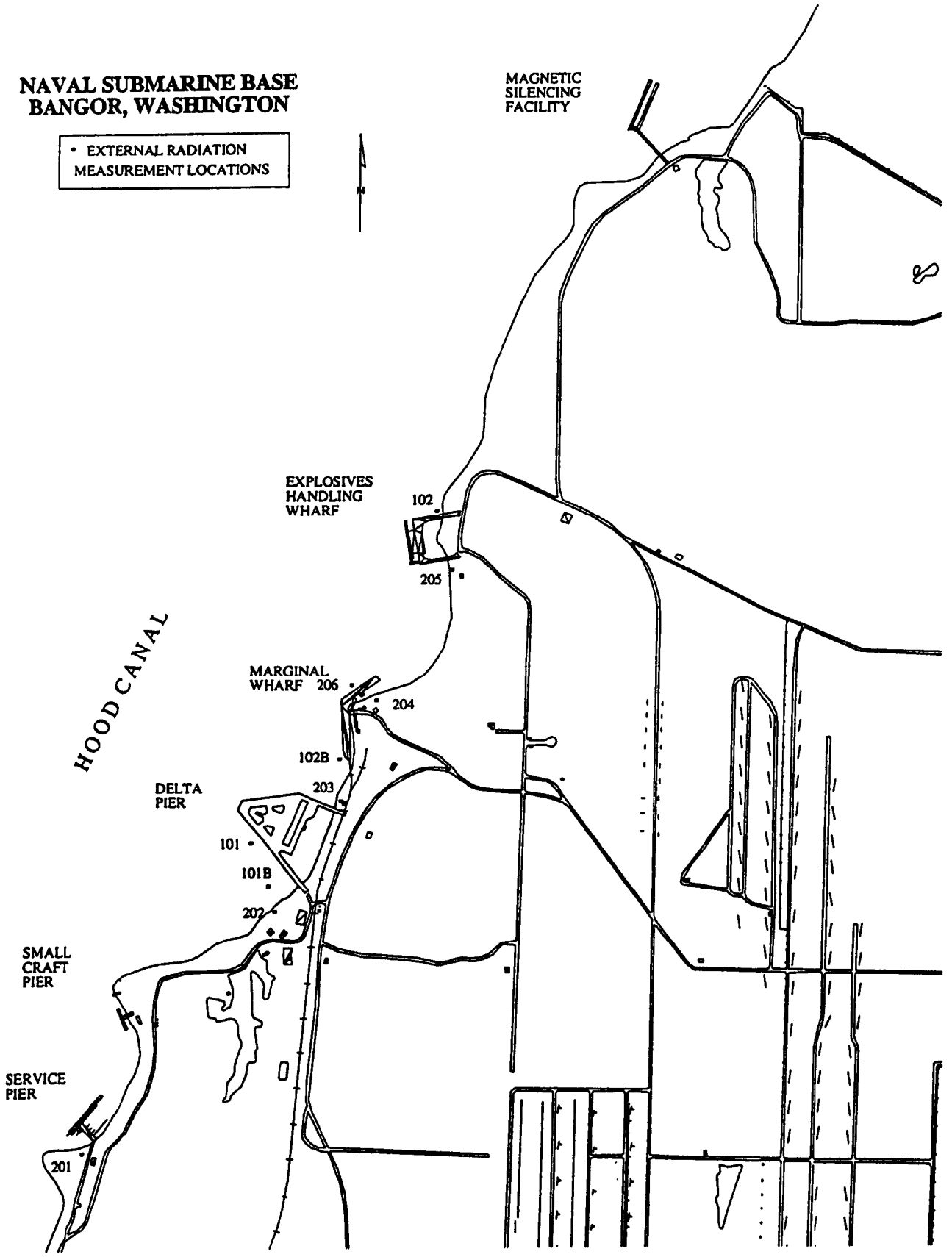

Fig. 11. NSBB External Radiation Measurement Locations

TABLE 1 PSNS Grab Water Samples				
Location	**Location Description**	**Location Latitude**	**Location Longitude**	**Sample ID**
P-001-DW	Sink Faucet, Dive Shop, Bldg 480	N 47° 33.548'	W 122° 38.406'	PUG-001-DW
P-001-DW	Sink Faucet, Dive Shop, Bldg 480	N 47° 33.548'	W 122° 38.406'	PUG-001-DW-D1
P-001-W	SW Corner of Mooring G	N 47° 33.113'	W 122° 39.372'	PUG-001-W
P-003-W	Ctr, S End of Pier 3	N 47° 33.362'	W 122° 38.233'	PUG-003-W
P-004-W	Ctr, S End of Pier 4	N 47° 33.413'	W 122° 38.034'	PUG-004-W
P-004-W	Ctr, S End of Pier 4	N 47° 33.413'	W 122° 38.034'	PUG-004-W-D1
P-006-W	Ctr, S End of Pier 6	N 47° 33.420'	W 122° 37.856'	PUG-006-W
P-008-W	Ctr, S End of Pier B	N 47° 33.175'	W 122° 38.680'	PUG-008-W
P-009-W	Ctr, S End of Pier D	N 47° 33.191'	W 122° 38.962'	PUG-009-W
P-010-W	W of E Shipyard Boundary, Off-Shore 100 ft	N 47° 33.667'	W 122° 37.474'	PUG-010-W
P-101-W	Bremerton POTW Outfall, Depth 3 ft	N 47° 32.850'	W 122° 40.219'	PUG-101-01-W
P-101-W	Bremerton POTW Outfall, Depth 30 ft	N 47° 32.850'	W 122° 40.219'	PUG-101-02-W
P-001-BG-W	Liberty Bay -- N of PSNS on S Side of Entrance of Bay, W of Keyport, WA	N 47° 42.981'	W 122° 37.481'	PUG-001-BG-W
P-002-BG-W	Manchester Park -- Due E of PSNS on W Side of Kitsap Peninsula, Just S of Bainbridge Island on W Side of Rich Passage	N 47° 34.817'	W 122° 32.748'	PUG-002-BG-W
P-003-BG-W	Kitsap Memorial Park -- NNW of Bangor, WA on E Side of Hood Canal	N 47° 49.090'	W 122° 39.321'	PUG-003-BG-W

NOTE: Symbols used in the tables are explained on pages 32 - 34. Water samples were collected at a depth of 3 ft unless otherwise specified.

TABLE 2 PSNS Grab Sediment Samples				
Location	**Location Description**	**Location Latitude**	**Location Longitude**	**Sample ID**
P-001-SD	SW Corner of Mooring G	N 47° 33.113'	W 122° 39.372'	PUG-001-SD
P-003-SD	E Side of Mooring E, 1st Island S of Shore	N 47° 33.241'	W 122° 39.100'	PUG-003-SD
P-007-SD	Dry Dock 6, W End of Caisson	N 47° 33.245'	W 122° 38.629'	PUG-007-SD
P-008-SD	Ctr, S End of Pier 9	N 47° 33.216'	W 122° 38.550'	PUG-008-SD
P-010-SD	SE Corner of Bldg 819	N 47° 33.340'	W 122° 38.540'	PUG-010-SD
P-013-SD	Dry Dock 5, W End of Caisson	N 47° 33.454'	W 122° 38.272'	PUG-013-SD
P-014-SD	SW Corner of Pier 3	N 47° 33.367'	W 122° 38.179'	PUG-014-SD
P-015-SD	E Side of Pier 3, Opposite S End of Dry Dock 5	N 47° 33.531'	W 122° 38.243'	PUG-015-SD
P-016-SD	E Side, N End of Pier 3	N 47° 33.447'	W 122° 38.077'	PUG-016-SD
P-018-SD	SW Corner of Pier 4	N 47° 33.400'	W 122° 38.011'	PUG-018-SD
P-019-SD	E Side of Pier 4, 50 ft S of Bldg 408	N 47° 33.522'	W 122° 37.960'	PUG-019-SD
P-021-SD	W Side of Pier 5, 25 ft S of Sea Wall	N 47° 33.629'	W 122° 37.942'	PUG-021-SD
P-022-SD	W Side of Pier 5 at Electric Substation 5	N 47° 33.485'	W 122° 37.957'	PUG-022-SD
P-023-SD	SW Corner of Pier 5	N 47° 33.476'	W 122° 37.948'	PUG-023-SD
P-024-SD	E Side, N End of Pier 5	N 47° 33.642'	W 122° 37.828'	PUG-024-SD
P-025-SD	S of Bldg 529, 50 ft	N 47° 33.638'	W 122° 37.864'	PUG-025-SD
P-026-SD	W Side of Pier 6, Opposite S End of Electric Substation 6A	N 47° 33.552'	W 122° 37.881'	PUG-026-SD
P-027-SD	W Side of Pier 6, Opposite N End of Hammerhead Crane Base	N 47° 33.542'	W 122° 37.834'	PUG-027-SD
P-028-SD	SW Corner of Pier 6	N 47° 33.438'	W 122° 37.858'	PUG-028-SD
P-029-SD	E Side of Pier 6, Sea Wall-Pier Corner	N 47° 33.733'	W 122° 37.854'	PUG-029-SD
P-030-SD	SW Corner of Pier 7	N 47° 33.455'	W 122° 37.742'	PUG-030-SD
P-031-SD	S End of Pier 8	N 47° 33.476'	W 122° 37.708'	PUG-031-SD
P-032-SD	E of Shipyard Boundary 100 ft, Off-Shore 100 ft	N 47° 33.667'	W 122° 37.474'	PUG-032-SD
P-033-SD	Intersection of the Line from the Extreme E Side of Bldg 460 with the Line from SE Corners of Piers 4 and 6	N 47° 33.460'	W 122° 37.563'	PUG-033-SD
P-035-SD	Intersection of the Line Due S from the W Side of Pier 3 with the Line Due E of the S End of Pier 9	N 47° 33.277'	W 122° 38.220'	PUG-035-SD

TABLE 2–*Continued*

Location	Location Description	Location Latitude	Location Longitude	Sample ID
P-036-SD	Intersection of the Line Due S of the Center of Pier 9 with the Line Across the S Ends of Pier B and the Supply Pier	N 47° 33.???'	W 122° 38.???'	PUG-036-SD
P-037-SD	Intersection of the Line Due S from the W Side of the Supply Pier with the Line Due W of the S End of Pier B	N 47° 33.187'	W 122° 38.853'	PUG-037-SD
P-039-SD	E Side of Pier 5, Opposite Bldg 555	N 47° 33.490'	W 122° 37.878'	PUG-039-SD
P-040-SD	E Side of Pier 5, Opposite Bldg 554	N 47° 33.613'	W 122° 37.850'	PUG-040-SD
P-041-SD	SE Corner of Pier 6	N 47° 33.442'	W 122° 37.730'	PUG-041-SD
P-042-SD	E Side of Pier 6, Opposite N End of Crane Base	N 47° 33.567'	W 122° 37.897'	PUG-042-SD
P-043-SD	E Side of Pier 6, Opposite N End Substation 6C	N 47° 33.514'	W 122° 37.860'	PUG-043-SD
P-044-SD	First Fire Hydrant from N End of Pier 7	N 47° 33.552'	W 122° 37.712'	PUG-044-SD
P-044-SD	First Fire Hydrant from N End of Pier 7	N 47° 33.552'	W 122° 37.712'	PUG-044-SD-D1
P-045-SD	W Side of Pier 3, Opposite N End of Substation 3C	N 47° 33.467'	W 122° 38.268'	PUG-045-SD
P-046-SD	E Side of Pier 3 Between Bldg 580 and Bldg 539	N 47° 33.395'	W 122° 38.195'	PUG-046-SD
P-047-SD	N Side of the S Arm of Pier 9, 10 ft in from the End	N 47° 33.134'	W 122° 38.567'	PUG-047-SD
P-048-SD	Midway Between Dry Dock 5 and Pier 3	N 47° 33.428'	W 122° 38.261'	PUG-048-SD
P-048-SD	Midway Between Dry Dock 5 and Pier 3	N 47° 33.428'	W 122° 38.261'	PUG-048-SD-D1
P-049-SD	Center of the Entrance to Dry Dock 1, 50 ft S of Caisson	N 47° 33.662'	W 122° 37.887'	PUG-049-SD
P-050-SD	E Side of Pier 3, Opposite S End of Bldg 580	N 47° 33.385'	W 122° 38.175'	PUG-050-SD
P-055-SD	W Side of Mooring A by Light 347, 130 ft N of S End	N 47° 33.225'	W 122° 38.471'	PUG-055-SD
P-056-SD	E Side of Mooring A, 20 ft S of Light 335, 100 ft N of S End	N 47° 33.172'	W 122° 38.433'	PUG-056-SD
P-057-SD	Outboard of Ships Moored to the E Side of Mooring A, 100 ft N of S End	N 47° 33.213'	W 122° 38.394'	PUG-057-SD
P-058-SD	Intersection of the Line from SW End of Pier 3 with the Line Through the SE Corner of Pier 3, 50 ft E of Mooring A	N 47° 33.355'	W 122° 38.397'	PUG-058-SD

TABLE 2–*Continued*

Location	Location Description	Location Latitude	Location Longitude	Sample ID
P-060-SD	N 100 ft of the End of Pier B Around Bollard 21 on the W Side	N 47° 33.249'	W 122° 38.735'	PUG-060-SD
P-061-SD	S 50 ft of the N End of Pier B Around Bollard 111 on the W Side	N 47° 33.319'	W 122° 38.796'	PUG-061-SD
P-062-SD	W Side of Pier B, Midline of the Pier, 100 ft from the Pier	N 47° 33.067'	W 122° 38.224'	PUG-062-SD
P-063-SD	E Side of Pier C (Supply Pier), Midline	N 47° 33.316'	W 122° 38.828'	PUG-063-SD
P-064-SD	W Side of Pier C (Supply Pier), Midline	N 47° 33.277'	W 122° 38.902'	PUG-064-SD
P-065-SD	E Side of Pier D, Aligning with the Eighth Lamp Pole from S End of Pier	N 47° 33.347'	W 122° 38.971'	PUG-065-SD
P-066-SD	E Side of Pier D, Aligning with the Fourth Lamp Pole from S End of Pier	N 47° 33.205'	W 122° 39.004'	PUG-066-SD
P-067-SD	W Side of Pier D, Aligning with the Second Lamp Pole from S End of Pier	N 47° 33.281'	W 122° 38.911'	PUG-067-SD
P-068-SD	W Side of Pier D, Aligning with the Sixth Lamp Pole from the S End of Pier	N 47° 33.269'	W 122° 39.085'	PUG-068-SD
P-069-SD	W Side of Pier 4, Midline	N 47° 33.549'	W 122° 38.054'	PUG-069-SD
P-070-SD	E Side of Pier 4, 300 ft S of N End	N 47° 33.555'	W 122° 38.034'	PUG-070-SD
P-071-SD	Mooring A, 500 ft E of Middle Island	N 47° 33.300'	W 122° 38.358'	PUG-071-SD
P-072-SD	Intersection Line from Center End of Pier 6 and Line Due S to End of Mooring A	N 47° 33.239'	W 122° 37.806'	PUG-072-SD
P-101-SD	Bremerton POTW Outfall, Depth 30 ft	N 47° 32.850'	W 122° 40.219'	PUG-101-SD
P-102-SD	SE Corner of Dry Dock 6, EPA 1987 Location	N 47° 33.225'	W 122° 38.579'	PUG-102-SD
P-103-SD	Center of W Side of Pier 3, EPA 1987 Location	N 47° 33.430'	W 122° 38.262'	PUG-103-SD
P-103-SD	Center of W Side of Pier 3, EPA 1987 Location	N 47° 33.430'	W 122° 38.262'	PUG-103-SD-D1
P-104-SD	SW Corner of Bldg 431, EPA 1987 Location	N 47° 33.616'	W 122° 38.008'	PUG-104-SD
P-105-SD	Pier C, 100 ft in from SW Corner on W Side, ARKANSAS Release Location	N 47° 33.266'	W. 122° 38.851'	PUG-105-SD
P-105-SD	Pier C, 100 ft in from SW Corner on W Side, ARKANSAS Release Location	N 47° 33.266'	W 122° 38.851'	PUG-105-SD-D1
P-106-SD	S of Pier 8 on Center Line 1000 ft	N 47° 33.421'	W 122° 37.707'	PUG-106-SD

TABLE 2–*Continued*

Location	Location Description	Location Latitude	Location Longitude	Sample ID
P-107-SD	S of Dry Dock 3 on Center Line 300 ft	N 47° 33.536'	W 122° 37.781'	PUG-107-SD
P-108-SD	S of Dry Dock 1 on Center Line 800 ft	N 47° 33.555'	W 122° 37.816'	PUG-108-SD
P-109-SD	S of Dry Dock 2 on Center Line 400 ft	N 47° 33.530'	W 122° 38.022'	PUG-109-SD
P-110-SD	S of Dry Dock 4 on Center Line 400 ft	N 47° 33.480'	W 122° 38.132'	PUG-110-SD
P-111-SD	S of Dry Dock 5 on Center Line 600 ft	N 47° 33.434'	W 122° 38.302'	PUG-111-SD
P-112-SD	Between Mooring A and Dry Dock 6 at Center of N End	N 47° 33.386'	W 122° 38.486'	PUG-112-SD
P-113-SD	S of Pier C on Center Line 1500 ft	N 47° 33.019'	W 122° 38.875'	PUG-113-SD
P-114-SD	Between Pier D and Mooring E at Center of N End	N 47° 33.297'	W 122° 39.039'	PUG-114-SD
P-115-SD	S of Mooring E 900 ft	N 47° 33.009'	W 122° 39.147'	PUG-115-SD
P-116-SD	Between Mooring E and Mooring F at Center of N End	N 47° 33.250'	W 122° 39.150'	PUG-116-SD
P-117-SD	Between Mooring F and Mooring G at Center of N End	N 47° 33.258'	W 122° 39.319'	PUG-117-SD
P-118-SD	S of W Boundary 1000 ft	N 47° 32.901'	W 122° 39.262'	PUG-118-SD
P-001-BG-SD	Liberty Bay -- N of PSNS on S Side of Entrance of Bay, W of Keyport, WA	N 47° 42.981'	W 122° 37.481'	PUG-001-BG-SD
P-002-BG-SD	Manchester Park -- Due E of PSNS on W Side of Kitsap Peninsula, Just S of Bainbridge Island on W Side of Rich Passage	N 47° 34.817'	W 122° 32.748'	PUG-002-BG-SD
P-003-BG-SD	Kitsap Memorial Park -- NNW of Bangor, WA on E Side of Hood Canal	N 47° 49.090'	W 122° 39.321'	PUG-003-BG-SD

NOTE: Due to lack of sediment, sample PUG-025-SD was not taken.

TABLE 3 PSNS Sediment Core Samples				
Location	**Location Description**	**Location Latitude**	**Location Longitude**	**Sample ID**
P-101-SDC	Bremerton POTW Outfall	N 47° 32.850'	W 122° 40.219'	PUG-101-SDC
P-102-SDC	SE Corner of Pier 6	N 47° 33.442'	W 122° 37.730'	PUG-102-SDC
P-103-SDC	Pier 6, 450 ft in from SW Corner on W Side	N 47° 33.542'	W 122° 37.834'	PUG-103-SDC
P-104-SDC	Pier 5, 500 ft in from SW Corner on W Side	N 47° 33.485'	W 122° 37.957'	PUG-104-SDC
P-105-SDC	Pier 4, 700 ft in from SW Corner on W Side	N 47° 33.549'	W 122° 38.054'	PUG-105-SDC
P-105-SDC	Pier 4, 700 ft in from SW Corner on W Side	N 47° 33.549'	W 122° 37.054'	PUG-105-SDC-D1
P-106-SDC	Pier 3, 350 ft in from SE Corner on E Side	N 47° 33.497'	W 122° 38.086'	PUG-106-SDC
P-107-SDC	On Center Line from E Side of Mooring A, 450 ft out	N 47° 33.318'	W 122° 38.395'	PUG-107-SDC
P-108-SDC	SE Corner of Pier 9	N 47° 32.201'	W 122° 38.468'	PUG-108-SDC
P-001-BG-SDC	Liberty Bay -- N of PSNS on S Side of Entrance of Bay, W of Keyport	N 47° 42.981'	W 122° 37.481'	PUG-001-BG-SDC
P-002-BG-SDC	Manchester Park -- Due E of PSNS on W Side of Kitsap Peninsula, Just S of Bainbridge Island on W Side of Rich Passage	N 47° 34.817'	W 122° 32.748'	PUG-002-BG-SDC
P-003-BG-SDC	Kitsap Memorial Park -- NNW of Bangor on E Side of Hood Canal	N 47° 49.090'	W 122° 39.321'	PUG-003-BG-SDC

NOTE: At each sediment core sample location, measurement of gamma radiation was conducted with a NaI underwater probe.

TABLE 4
PSNS Low-Tide Shoreline Sediment Samples and External Gamma Measurements

Location	Location Description	Location Latitude	Location Longitude	Sample ID
P-201-SDS	W End Boundary	N 47° 33.001'	W 122° 39.624'	PUG-201-SDS
P-202-SDS	W of Mooring G, 1000 ft	N 47° 33.079'	W 122° 39.547'	PUG-202-SDS
P-203-SDS	Under Mooring G	N 47° 33.254'	W 122° 39.410'	PUG-203-SDS
P-204-SDS	W Side of Mooring F	N 47° 33.315'	W 122° 39.209'	PUG-204-SDS
P-205-SDS	Midpoint Between Supply and Pier B	N 47° 33.395'	W 122° 38.656'	PUG-205-SDS
P-206-SDS	W of Dry Dock 5	N 47° 33.479'	W 122° 38.281'	PUG-206-SDS
P-207-SDS	E of Pier 8	N 47° 33.777'	W 122° 37.682'	PUG-207-SDS
P-208-SDS	Dry Dock 5	N 47° 33.510'	W 122° 38.251'	PUG-208-SDS
P-208-SDS	Dry Dock 5	N 47° 33.510'	W 122° 38.251'	PUG-208-SDS-D1
P-209-SDS*	W Boundary at Shoreline from Boat	N 47° 33.030'	W 122° 39.649'	PUG-209-SDS
P-210-SDS*	S From End of Pier D, 300 ft, from Boat	N 47° 33.082'	W 122° 39.036'	PUG-210-SDS
P-211-SDS*	S From End of Dry Dock 6, 300 ft, from Boat	N 47° 33.128'	W 122° 38.537'	PUG-211-SDS
P-212-SDS*	S From End of Pier 3, 300 ft, from Boat	N 47° 33.270'	W 122° 38.035'	PUG-212-SDS
P-213-SDS*	S From End of Pier 6, 300 ft, from Boat	N 47° 33.402'	W 122° 37.685'	PUG-213-SDS
P-214-SDS*	E Boundary at Shoreline, from Boat	N 47° 33.657'	W 122° 37.409'	PUG-214-SDS
P-201-BG-SDS	Liberty Bay -- N of PSNS on W Side of Entrance of Bay, N of Keyport on the marina	N 47° 42.248'	W 122° 37.338'	PUG-201-BG-SDS
P-202-BG-SDS	Manchester Park -- Due E of PSNS on W Side of Kitsap Peninsula, Just S of Bainbridge Island on W Side of Rich Passage	N 47° 34.842'	W 122° 32.849'	PUG-202-BG-SDS
P-203-BG-SDS	Kitsap Memorial Park -- NNW of Bangor on E Side of Hood Canal	N 47° 49.090'	W 122° 39.321'	PUG-203-BG-SDS

NOTE: External gamma (PIC and GM) measurements were performed at low-tide shoreline sample locations and at selected locations off-shore from a boat. Grab low-tide sediment samples were collected at shoreline locations.

* No sediment samples were collected at these locations, external gamma measurements only.

TABLE 5 PSNS Marine Biota Samples				
Location	**Location Description**	**Location Latitude**	**Location Longitude**	**Sample ID**
P-001-B	E Side of Pier 6 in 120 ft from SE Corner	80 ft S of N 47° 33.502'	W 122° 37.829'	PUG-001-BSC
P-001-B	E Side of Pier 6 in 120 ft from SE Corner	80 ft S of N 47° 33.502'	W 122° 37.829'	PUG-001-BB
P-001-B	E Side of Pier 6 in 120 ft from SE Corner	80 ft S of N 47° 33.502'	W 122° 37.829'	PUG-001-BSF
P-001-B	E Side of Pier 6 in 120 ft from SE Corner	80 ft S of N 47° 33.502'	W 122° 37.829'	PUG-001-BC
P-002-B	E Side of Pier 6 in 200 ft from SE Corner	N 47° 33.502'	W 122° 37.829'	PUG-002-BC
P-002-B	E Side of Pier 6 in 200 ft from SE Corner	N 47° 33.502'	W 122° 37.829'	PUG-002-BC-D1
P-002-B	E Side of Pier 6 in 200 ft from SE Corner	N 47° 33.502'	W 122° 37.829'	PUG-002-BSC
P-002-B	E Side of Pier 6 in 200 ft from SE Corner	N 47° 33.502'	W 122° 37.829'	PUG-002-BSC-D1
P-002-B	E Side of Pier 6 in 200 ft from SE Corner	N 47° 33.502'	W 122° 37.829'	PUG-002-BSF
P-002-B	E Side of Pier 6 in 200 ft from SE Corner	N 47° 33.502'	W 122° 37.829'	PUG-002-BSF-D1
P-003-B	E Side of Pier 6 in 500 ft from SE Corner	N 47° 33.516'	W 122° 37.651'	PUG-003-BGSL
P-003-B	E Side of Pier 6 in 500 ft from SE Corner	N 47° 33.516'	W 122° 37.651'	PUG-003-BSF
P-003-B	E Side of Pier 6 in 500 ft from SE Corner	N 47° 33.516'	W 122° 37.651'	PUG-003-BSC
P-003-B	E Side of Pier 6 in 500 ft from SE Corner	N 47° 33.516'	W 122° 37.651'	PUG-003-BC
P-101-B	Bremerton POTW Outfall	N 47° 32.850'	W 122° 40.219'	PUG-101-BSF
P-101-B	Bremerton POTW Outfall	N 47° 32.850'	W 122° 40.219'	PUG-101-BSA
P-101-B	Bremerton POTW Outfall	N 47° 32.850'	W 122° 40.219'	PUG-101-BSC
P-103-B	SE Corner of Dry Dock 5, Previous EPA Location	N 47° 33.510'	W 122° 38.271'	PUG-103-BC
P-103-B	SE Corner of Dry Dock 5, Previous EPA Location	N 47° 33.510'	W 122° 38.271'	PUG-103-BSC
P-103-B	SE Corner of Dry Dock 5, Previous EPA Location	N 47° 33.510'	W 122° 38.271'	PUG-103-BSF

TABLE 5–*Continued*

Location	Location Description	Location Latitude	Location Longitude	Sample ID
P-104-B	SW Corner of Dry Dock 5, 1000 ft out, Previous EPA Location	N 47° 33.273'	W 122° 38.316'	PUG-104-BBK
P-105-B	SE Corner of Pier 9, Previous EPA Location	N 47° 33.201'	W 122° 38.468'	PUG-105-BC
P-105-B	SE Corner of Pier 9, Previous EPA Location	N 47° 33.201'	W 122° 38.468'	PUG-105-BSC
P-105-B	SE Corner of Pier 9, Previous EPA Location	N 47° 33.201'	W 122° 38.468'	PUG-105-BSA
P-105-B	SE Corner of Pier 9, Previous EPA Location	N 47° 33.201'	W 122° 38.468'	PUG-105-BM
P-105-B	SE Corner of Pier 9, E of Dry Dock 6, Previous EPA Location	N 47° 33.201'	W 122° 38.468'	PUG-105-BSF
P-001-BG-B	Liberty Bay -- N of PSNS on S Side of Entrance of Bay, W of Keyport, WA	N 47° 42.981'	W 122° 37.481'	PUG-001-BG-BOSA
P-001-BG-B	Liberty Bay — N of PSNS on S Side of Entrance of Bay, W of Keyport, WA	N 47° 42.981'	W 122° 37.481'	PUG-001-BG-BSF
P-001-BG-B	Liberty Bay — N of PSNS on S Side of Entrance of Bay, W of Keyport, WA	N 47° 42.981'	W 122° 37.481'	PUG-001-BG-BC
P-002-BG-B	Manchester Park -- Due E of PSNS on W Side of Kitsap Peninsula, Just S of Bainbridge Island on W Side of Rich Passage	N 47° 34.817'	W 122° 32.748'	PUG-002-BG-BC
P-002-BG-B	Manchester Park -- Due E of PSNS on W Side of Kitsap Peninsula, Just S of Bainbridge Island on W Side of Rich Passage	N 47° 34.817'	W 122° 32.748'	PUG-002-BG-BSF
P-002-BG-B	Manchester Park -- Due E of PSNS on W Side of Kitsap Peninsula, Just S of Bainbridge Island on W Side of Rich Passage	N 47° 34.817'	W 122° 32.748'	PUG-002-BG-BGSL
P-003-BG-B	Kitsap Memorial Park – NNW of Bangor, WA, on E Side of Hood Canal	N 47° 49.090'	W 122° 39.321'	PUG-003-BG-BBK
P-003-BG-B	Kitsap Memorial Park -- NNW of Bangor, WA on E Side of Hood Canal	N 47° 49.090'	W 122° 39.321'	PUG-003-BG-BGSL
P-003-BG-B	Kitsap Memorial Park -- NNW of Bangor, WA on E Side of Hood Canal	N 47° 49.090'	W 122° 39.321'	PUG-003-BG-BC
P-003-BG-B	Kitsap Memorial Park -- NNW of Bangor, WA on E Side of Hood Canal	N 47° 49.090'	W 122° 39.321'	PUG-003-BG-B???*

NOTE: The type of biota collected depended on availability; several biota samples were usually collected at each site.

* "???" refers to plant biota which could not be identified.

TABLE 6 NSBB Grab Water Samples				
Location	**Location Description**	**Location Latitude**	**Location Longitude**	**Sample ID**
B-001-DW	Faucet on Service Pier	N 47° 43.936'	W 122° 44.446'	BAN-001-DW
B-001-W	N End of W Finger of the Magnetic Silencing Facility	N 47° 46.269'	W 122° 42.450'	BAN-001-W
B-002-W	S End of the Explosives Handling Wharf	N 47° 45.171'	W 122° 43.457'	BAN-002-W
B-002-W	S End of the Explosives Handling Wharf	N 47° 45.171'	W 122° 43.457'	BAN-002-W-D1
B-003-W	Middle of Outboard Side of Marginal Wharf	N 47° 44.987'	W 122° 43.570'	BAN-003-W
B-003-W*	Middle of Outboard Side of Marginal Wharf	N 47° 44.850'	W 122° 43.648'	BAN-003-W-D1
B-004-W	Middle of N Side of Delta Pier	N 47° 44.588'	W 122° 43.915'	BAN-004-W
B-005-W	Middle of Outboard Side of Small Craft Pier	N 47° 44.133'	W 122° 44.347'	BAN-005-W
B-006-W	S End of Service Pier	N 47° 43.818'	W 122° 44.530'	BAN-006-W

* Quasi-duplicate, collected on different date by different survey team group.

TABLE 7 NSBB Grab Sediment Samples				
Location	**Location Description**	**Location Latitude**	**Location Longitude**	**Sample ID**
B-001-SD	100 ft W of the N End of the W Finger of the Magnetic Silencing Facility	N 47° 46.339'	W 122° 42.632'	BAN-001-SD
B-002-SD	100 ft E of the 2nd Concrete Pad, E Finger of the Magnetic Silencing Facility	N 47° 46.270'	W 122° 42.615'	BAN-002-SD
B-003-SD	100 ft W of the 1st Concrete Pad, W Finger of the Magnetic Silencing Facility	N 47° 46.235'	W 122° 42.684'	BAN-003-SD
B-004-SD	100 ft N of the NW Corner of the Explosive Handling Wharf	N 47° 45.256'	W 122° 43.435'	BAN-004-SD
B-006-SD	Middle of W Outboard Side of the Explosive Handling Wharf, 100 ft out	N 47° 45.252'	W 122° 43.449'	BAN-006-SD
B-007-SD	SW Corner, Outboard of the Explosive Handling Wharf	N 47° 45.201'	W 122° 43.371'	BAN-007-SD
B-008-SD	750 ft NE of the Marginal Wharf, in Line with the N Leg of the Marginal Wharf	N 47° 45.005'	W 122° 43.360'	BAN-008-SD
B-009-SD	50 ft NE of the NE Corner of the Marginal Wharf	N 47° 45.046'	W 122° 43.384'	BAN-009-SD
B-010-SD	150 ft W of the 2nd Floodlight from the N End of the Marginal Wharf	N 47° 44.999'	W 122° 43.535'	BAN-010-SD
B-011-SD	Outboard, Midway between the 2nd and 3rd Floodlight from the S End of the Marginal Wharf, 50 ft out	N 47° 44.822'	W 122° 43.594'	BAN-011-SD
B-013-SD	Outboard, Midway between the 1st and 2nd Floodlight from the S End of the Marginal Wharf, 100 ft out	N 47° 44.726'	W 122° 43.633'	BAN-013-SD
B-013-SD	Outboard, Midway between the 1st and 2nd Floodlight from the S End of the Marginal Wharf, 100 ft out	N 47° 44.726'	W 122° 43.633'	BAN-013-SD-D1
B-014-SD	N 350 ft of the Dry Dock Caisson	N 47° 44.724'	W 122° 43.625'	BAN-014-SD
B-015-SD	N 500 ft of the Delta Pier, in Line with the W End of Buildings on Pier	N 47° 44.748'	W 122° 43.772'	BAN-015-SD

TABLE 7–*Continued*

Location	Location Description	Location Latitude	Location Longitude	Sample ID
B-016-SD	N 100 ft of the E End of the Dry Dock Caisson	N 47° 44.654'	W 122° 43.729'	BAN-016-SD
B-017-SD	Near W End of the Dry Dock Caisson, 100 ft out	N 47° 44.678'	W 122° 43.749'	BAN-017-SD
B-017-SD	Near W End of the Dry Dock Caisson, 100 ft out	N 47° 44.678'	W 122° 43.749'	BAN-017-SD-D1
B-018-SD	W 50 ft of E Side of Bldgs, N Side of Delta Pier, 100 ft out	N 47° 44.654'	W 122° 43.862'	BAN-018-SD
B-019-SD	By Radioactive Waste Collection Tank Facility, N Side of Delta Pier, 50 ft out	N 47° 44.626'	W 122° 43.918'	BAN-019-SD
B-020-SD	N Side of Delta Pier in Line with W Bulkhead of Opening in the Pier, 50 ft out	N 47° 44.643'	W 122° 43.869'	BAN-020-SD
B-021-SD	W 50 ft of the NW Corner of the Delta Pier	N 47° 44.612'	W 122° 43.962'	BAN-021-SD
B-022-SD	S Side of Delta Pier in Line with W Bulkhead of Opening in the Pier, 50 ft out	N 47° 44.570'	W 122° 43.976'	BAN-022-SD
B-023-SD	By the Radioactive Waste Collection Tank Facility, S Side of the Delta Pier, 50 ft out	N 47° 44.561'	W 122° 43.863'	BAN-023-SD
B-024-SD	S 50 ft of the Float Near the SE Corner of the Delta Pier	N 47° 44.260'	W 122° 43.728'	BAN-024-SD
B-025-SD	S 500 ft of the Delta Pier in Line with the W Bulkhead of the Opening in the Pier	N 47° 44.550'	W 122° 44.006'	BAN-025-SD
B-026-SD	S 500 ft of the Delta Pier in Line with the E Side of Buildings on the Pier	N 47° 44.546'	W 122° 43.884'	BAN-026-SD
B-027-SD	Middle of the E Side of the Dry Dock, 20 ft out	N 47° 44.558'	W 122° 43.768'	BAN-027-SD
B-028-SD	W 100 ft of the N End of the K/B Docks (Small Craft Pier)	N 47° 44.099'	W 122° 44.389'	BAN-028-SD
B-028-SD	W 100 ft of the N End of the K/B Docks (Small Craft Pier)	N 47° 44.099'	W 122° 44.389'	BAN-028-SD-D1
B-029-SD	W 100 ft of the S End of the K/B Docks (Small Craft Pier)	N 47° 44.068'	W 122° 44.356'	BAN-029-SD

TABLE 7–*Continued*				
Location	**Location Description**	**Location Latitude**	**Location Longitude**	**Sample ID**
B-031-SD	W Side of the Service Pier, 200 ft S of the N End, 50 ft out	N 47° 43.961'	W 122° 44.416'	BAN-031-SD
B-032-SD	E Side of the Service Pier, 250 ft N of the Trestle to the Pier	N 47° 43.899'	W 122° 44.405'	BAN-032-SD
B-033-SD	W Side of the Service Pier, 20 ft N of the Trestle to the Pier, 100 ft out	N 47° 43.885'	W 122° 44.526'	BAN-033-SD
B-034-SD	S End of the Service Pier, Inboard of the Inner Dolphin, 50 ft W of the Boardwalk	N 47° 43.857'	W 122° 44.543'	BAN-034-SD
B-101-SD	SW of Delta Pier 1200 ft, Near the Shore	N 47° 44.288'	W 122° 44.058'	BAN-101-SD
B-102-SD	N of the Explosive Handling Wharf 700 ft, Near the Shore	N 47° 45.454'	W 122° 43.183'	BAN-102-SD

NOTE: Due to lack of sediment, samples BAN-006-SD, BAN-010-SD, and BAN-028-SD-D1 were not taken.

TABLE 8 NSBB Sediment Core Samples				
Location	**Location Description**	**Location Latitude**	**Location Longitude**	**Sample ID**
B-101-SDC	SW End of Delta Pier, 500 ft out, Previous EPA Location	N 47° 44.260'	W 122° 43.728'	BAN-101-SDC
B-102-SDC	Out from N Point of the Marginal Wharf, Previous EPA Location	N 47° 44.987'	W 122° 43.570'	BAN-102-SDC

NOTE: At each sediment core sample location, measurement of gamma radiation was conducted with a NaI underwater probe.

TABLE 9
NSBB Low-Tide Shoreline Sediment Samples and External Gamma Measurements

Location	Location Description	Location Latitude	Location Longitude	Sample ID
B-201-SDS	S of Service Pier	N 47° 43.693'	W 122° 44.455'	BAN-201-SDS
B-202-SDS	S of Delta Pier	N 47° 44.338'	W 122° 43.902'	BAN-202-SDS
B-203-SDS	N of Delta Pier	N 47° 44.707'	W 122° 43.650'	BAN-203-SDS
B-203-SDS	N of Delta Pier	N 47° 44.707'	W 122° 43.650'	BAN-203-SDS-D1
B-204-SDS	N of Marginal Wharf	N 47° 44.950'	W 122° 43.482'	BAN-204-SDS
B-205-SDS	S of Explosive Handling Wharf	N 47° 45.187'	W 122° 43.257'	BAN-205-SDS
B-206-SDS*	Marginal Pier	N 47° 44.880'	W 122° 43.555'	BAN-206-SDS
B-102-SD*	N of the Explosive Handling Wharf 600 ft, near the Shore, from Boat	N 47° 45.454'	W 122° 43.183'	BAN-102-SD-SDS
B-102-B*	S End of Marginal Wharf, from Boat	N 47° 44.654'	W 122° 43.699'	BAN-102-B-SDS
B-101-B*	Near Side of Inlet, S of Delta Pier 1100 ft, from Boat	N 47° 44.288'	W 122° 44.058'	BAN-101-B-SDS
B-101-SDC*	SW End of Delta Pier, from Boat	N 47° 44.260'	W 122° 43.728'	BAN-101-SDC-SDS

NOTE: External gamma (PIC and GM) measurements were performed at low-tide shoreline sample locations and at selected locations off-shore from a boat. Grab low-tide sediment samples were collected at shoreline locations.

* No sediment samples were collected at these locations, external gamma measurements only.

TABLE 10 NSBB Marine Biota Samples				
Location	**Location Description**	**Location Latitude**	**Location Longitude**	**Sample ID**
B-001-B	Between Shore and Marginal Wharf at NE End of Wharf	N 47° 44.884'	W 122° 43.549'	BAN-001-BC
B-001-B	Between Shore and Marginal Wharf at NE End of Wharf	N 47° 44.884'	W 122° 43.549'	BAN-001-BSF
B-001-B	Between Shore and Marginal Wharf at NE End of Wharf	N 47° 44.884'	W 122° 43.549'	BAN-001-BBK
B-002-B	Center Between Shore and Delta Pier	N 47° 44.558'	W 122° 43.768'	BAN-002-BBK
B-002-B	Center Between Shore and Delta Pier	N 47° 44.558'	W 122° 43.768'	BAN-002-BSF
B-101-B	Along Shore, 700 ft NE of Explosive Handling Wharf, Previous EPA Location	N 47° 45.454'	W 122° 43.183'	BAN-101-BC
B-101-B	Along Shore, 700 ft NE of Explosive Handling Wharf, Previous EPA Location	N 47° 45.454'	W 122° 43.183'	BAN-101-BSF
B-101-B	Along Shore, 700 ft NE of Explosive Handling Wharf, Previous EPA Location	N 47° 45.454'	W 122° 43.183'	BAN-101-BGSL
B-101-B	Along Shore, 700 ft NE of Explosive Handling Wharf, Previous EPA Location	N 47° 45.454'	W 122° 43.183'	BAN-101-BSG
B-102-B	S End of Marginal Wharf, New EPA Location	N 47° 44.654'	W 122° 43.699'	BAN-102-BC
B-102-B	S End of Marginal Wharf, New EPA Location	N 47° 44.654'	W 122° 43.699'	BAN-102-BSF
B-102-B	S End of Marginal Wharf, New EPA Location	N 47° 44.654'	W 122° 43.699'	BAN-102-BSG
B-103-B	SW Side of the Delta Pier, 500 ft from the Shore, Previous EPA Location	N 47° 44.260'	W 122° 43.728'	BAN-103-BSF
B-103-B	SW Side of the Delta Pier, 500 ft from the Shore, Previous EPA Location	N 47° 44.260'	W 122° 43.728'	BAN-103-BM
B-103-B	SW Side of the Delta Pier, 500 ft from the Shore, Previous EPA Location	N 47° 44.260'	W 122° 43.728'	BAN-103-BGSL
B-104-B	Near Side of Inlet, S of Delta Pier 1100 ft, Previous EPA Location	N 47° 44.348'	W 122° 44.032'	BAN-104-BSF
B-104-B	Near Side of Inlet, S of Delta Pier 1100 ft, Previous EPA Location	N 47° 44.348'	W 122° 44.032'	BAN-104-BC
B-104-B	Near Side of Inlet, S of Delta Pier 1100 ft, Previous EPA Location	N 47° 44.348'	W 122° 44.032'	BAN-104-BBK
B-104-B	Near Side of Inlet, S of Delta Pier 1100 ft, Previous EPA Location	N 47° 44.348'	W 122° 44.032'	BAN-104-BBKR
B-105-B	Far Side of Inlet, S of Delta Pier 1300 ft, Previous EPA Location	N 47° 44.288'	W 122° 44.058'	BAN-105-BGSL

TABLE 10–*Continued*				
Location	**Location Description**	**Location Latitude**	**Location Longitude**	**Sample ID**
B-105-B	Far Side of Inlet, S of Delta Pier 1300 ft, Previous EPA Location	N 47° 44.288'	W 122° 44.058'	BAN-105-BBSH
B-106-B	NE Corner of Delta Pier on Shoreline	N 47° 44.600'	W 122° 43.666'	BAN-106-BO
B-107-B	S of Delta Pier on the Shore, 0.75 miles	N 47° 44.255'	W 122° 44.016'	BAN-107-BO

NOTE: The type of biota collected depended on availability; several biota samples were collected at most sites.

2.1.5 General Table Notes

2.1.5.1 General

Samples were taken as close to piers as situations permitted when a distance was not specified. Sometimes barges, ships, and other equipment prevented collecting a sample close to the pier, and the alternate location was noted. Geographic positions (latitude and longitude) were determined by commercially available Geographic Positioning System (GPS) units. These units have a typical accuracy of about 30 meters 2 - Distance Root Mean Square (2D RMS); however, position accuracy may be degraded up to 100 meters 2D RMS.

2.1.5.2 Sample Identification

The general scheme for identifying non-background samples is yyy-xxx-xx-yyyy-yx, where x is a number and y is a letter, as shown in the example illustration below.

yyy	xxx	xx	yyyy	yx
↓	↓	↓	↓	↓
Site (PUG)	**Location (101)**	**Number (02)**	**Medium (W)**	**Duplicate Indicator (D1)**

As indicated parenthetically above, in a typical sample identified as PUG-101-02-W-D1, the PUG stands for PSNS; 101 is the sample location; 02 specifies that this is the second water sample collected at this location but at a different depth than the first water sample; W indicates a water sample; and D1 indicates a duplicate (split) water sample collected at this depth. Should a sample be taken at a background location, the code BG is added to the sample identification following the sample location number. For example, if a sample were identified as PUG-003-BG-BGSL, the PUG stands for PSNS; 003 is the sample location; BG indicates a background location; and BGSL shows that it is green sea lettuce biota. (Note.–All samples do not require the use of all 14 alphanumeric characters for identification.)

2.1.5.3 Abbreviations

P	Prefix for sampling location at Puget Sound Naval Shipyard (PSNS).
P-0xx	Format for sites sampled by the Navy at PSNS.
P-1xx	Format for samples collected off shore in water at PSNS for locations selected by EPA.
P-2xx	EPA low-tide shoreline sample location format for PSNS.
B	Prefix for sampling location at Naval Submarine Base, Bangor (NSBB).
B-0xx	Format for sites sampled by the Navy at NSBB.
B-1xx	Format for sites selected by EPA for samples collected off shore in water at NSBB.
B-2xx	EPA low-tide shoreline sample location format for NSBB.
PUG	Prefix for sample identifier for sample collected at PSNS.
BAN	Prefix for sample identifier for sample collected at NSBB.
BG	Suffix for sample location that is a background location. Background locations selected are applicable to both PSNS and NSBB although the prefix for a background sample location is "P".
W	Identifier for a harbor water sample.
DW	Identifier for a drinking water sample.
SD	Identifier for a sediment sample.
SDC	Identifier for a core sediment sample.
SDS	Identifier for a low-tide shoreline sediment sample.
B	Identifier for a biota sample.
Bxxx	Suffix in a sample identifier that designates that the sample is marine biota, e.g., BBSK – Biota, Brown Split Kelp. See biota suffixes below.

BB	Biota, Barnacles
BBA	Biota, Brown Algae
BBK	Biota, Brown Kelp
BBPS	Biota, Black Pine Seaweed
BBS	Biota, Brown Seaweed
BBSH	Biota, Brown Sea Hair
BBSK	Biota, Brown Split Kelp
BC	Biota, Crab
BGA	Biota, Green Algae
BGS	Biota, Green Seaweed
BGSH	Biota, Green Sea Hair
BGSL	Biota, Green Sea Lettuce
BM	Biota, Mussel
BO	Biota, Oyster
BOSA	Biota, Orange Sea Anemone
BS	Biota, Seaweed

BSA	Biota, Sea Anemone
BSC	Biota, Sea Cucumber
BSF	Biota, Starfish
BSG	Biota, Sea Grass
Ctr	Center.
Dx	Suffix in a sample identifier that designates that the sample is a duplicate, e.g., D1.
E	East.
Ge	Germanium.
ID	Identification.
MDC	Minimum Detectable Concentration.
N	North.
NE	Northeast.
NSBB	Naval Submarine Base, Bangor.
NW	Northwest.
POTW	Publicly Owned Treatment Works.
PSNS	Puget Sound Naval Shipyard.
S	South.
SE	Southeast.
SW	Southwest.
W	West.

2.2 Collection of Samples and Analysis

Above-the-low-tide-line sediment (basically the same as soil), sediment (grab and core), water, and biota were collected. By previous agreement between NAREL and the Navy, most samples were split for routine independent comparisons by the Navy. The samples collected from PSNS and NSBB are listed in Tables 1-5 and 6-10, respectively. For approximately 5 percent of each sample type, a field duplicate sample was collected for quality control (QC) purposes. The duplicate samples are included in the referenced tables. All samples were analyzed for gross alpha and beta activities and gamma emitting radionuclides, and some samples were also analyzed for radium-226 and isotopes of uranium, plutonium, and thorium.

Surface water samples were collected by lowering a Wildco horizontal water sampling bottle to a depth of 3 feet (one sample at the Bremerton sewer outfall was collected at a depth of 30 feet) and then closing the bottle by releasing a "messenger" that activated a tripping mechanism. This process was repeated until 5 L of water were obtained. About 4 L of water was poured into a plastic sample container and acidified to a pH of < 2 with nitric acid. The acidified water sample was analyzed for gross alpha and beta activities and gamma emitting radionuclides, and some samples were also analyzed for radium-226 and isotopes of uranium, plutonium, and thorium. One liter of the water sample was poured into a glass container and, without being acidified, was analyzed for tritium.

Drinking water samples were collected from two taps representing the water supplies of Bremerton and Bangor. The 5 L drinking water sample was divided into two sample containers and analyzed in the same manner as were the surface water samples.

One hundred and thirty-one sediment samples were obtained during this study. Sediment sampling from boats was performed using a Peterson dredge to sample approximately the top 10 cm of sediment. Shoreline sediment samples were collected with a small trowel. Thirteen sediment core samples were also obtained to evaluate the vertical distribution of radioactivity in harbor bottom sediment. Core samples were collected by divers who pushed 2-inch diameter plastic tubes into the sediment as far as possible and then capped the ends. The cores were frozen and sectioned in up to four segments per core with each segment having a minimum length of 5 cm.

Fifty-nine biota samples were collected at 19 sites. Except for oysters collected on the shore by the EPA sampling team, all biota samples were collected by divers. Because of the interest in iodine-131, all biota samples were counted wet by gamma spectroscopy within 7 days after collection.

3.0 RESULTS AND DISCUSSION

The radioanalytical results for the PSNS and NSBB samples collected during this survey are reported in Appendix A. The tables were generated from Data Quality Packages (DQPs) produced from radioanalytical results. The quality assurance/quality control (QA/QC) results for the laboratory analyses and field sample QA/QC were presented in the DQPs for the sample analyses, and the results were within acceptable limits as specified in the Quality Assurance Project Plan (EPA96c) for this survey. Some of the reported radionuclide activity results are negative. Negative results occur when a previously determined background value is subtracted from a sample value that is less than the background value. Negative values represent a portion of the statistical distribution of negative and positive values around zero for samples containing very little or no radioactivity.

3.1 Water Samples

Twenty-four water samples were collected, and the gamma analysis results are shown in Tables A.1 - A.4. Only naturally occurring radionuclides were detected in water samples collected from PSNS and NSBB. Iodine-131 at a level of 26±4.0 pCi/L was detected at the discharge pipe location (30 ft water depth) from the Bremerton Public Owned Treatment Works (POTW) sewer outfall. The source of this iodine-131 is believed to be excreta from individuals undergoing medical diagnostic or therapeutic procedures at a nearby medical facility. Iodine-131 is often beneficially used in clinical medicine for the treatment of hyperthyroidism and thyroid cancer, both of which are common disorders. Excreta from individuals undergoing medical diagnosis or therapy with radioactive material is exempt from the U.S. Nuclear Regulatory Commission (NRC) regulations for the discharge of radioactive materials into municipal sewer systems in accordance with the Code of Federal Regulations, Title 10, Part 20.2003(b).

Tritium analyses were performed on all water samples, and results are presented in Tables A.9 - A.12. All of these concentrations were below the minimum detectable concentration (MDC) of about 130 pCi/L.

Results of the gross alpha and beta analyses of water samples are presented in Tables A.13 - A.16. Samples collected from PSNS and NSBB have concentrations similar to those found in the background samples and samples at the Bremerton sewer outfall. Two PSNS drinking water samples from the same location had gross alpha concentrations of 0.14±0.48 pCi/L and 0.45±0.51 pCi/L. The NSBB drinking water sample had a gross alpha concentration of 0.30±0.54 pCi/L. The National Drinking Water Regulations (EPA76), 40 CFR 141.15, state that the maximum allowed gross alpha particle radioactivity in community water systems is 15 pCi/L (including radium-226, but excluding radon and uranium). Gross alpha concentrations in PSNS and NSBB drinking water samples were below the maximum allowed gross alpha activity in drinking water for community water systems, and the samples meet the drinking water regulation.

3.2 Sediment and Sediment Core Samples

One hundred thirty-one sediment samples were collected, and the gamma analysis results are shown in Tables A.5 - A.8. There was not enough sediment for samples at PSNS location P-025-SD, nor NSSB locations B-006-SD and B-010-SD, nor for a duplicate sample at NSBB location B-028-SD. A trace amount of cobalt-60 was detected in one sediment sample at PSNS. The measured concentration of cobalt-60 at 100 ft offshore at the PSNS east boundary was 0.018±0.0080 pCi/g-dry (PUG-032-SD). No cobalt-60 was detected in any of the other 124 sediment samples collected at PSNS and NSBB. The cobalt-60 MDCs for sediment samples were in the range of 0.015 to 0.05 pCi/g-dry due to the detector used and the sample size. Except for the one sample with the trace amount of cobalt-60, gamma emitting radionuclides measured in the sediment samples were naturally occurring radionuclides or fallout from atmospheric nuclear tests. All samples were counted on a Ge detector for 1000 minutes.

Results of the gross alpha and beta analyses of sediment samples are presented in Tables A.23 - A.26. The maximum total gross alpha and beta concentrations were 20±8.0 pCi/g-dry and 19±3.5 pCi/g-dry, respectively, in samples collected from PSNS; 13±6.7 pCi/g-dry and 16±3.9 pCi/g-dry, respectively, in samples from NSBB; and 12±6.7 pCi/g-dry and 19±3.6 pCi/g-dry, respectively, in samples from background locations. The total gross alpha and beta concentrations were 2.8±4.8 pCi/g-dry and 7.1±3.0 pCi/g-dry in the one sediment sample collected at the Bremerton Publicly Owned Treatment Works (POTW). In summary, sediment samples from PSNS and NSBB have concentrations similar to the background and Bremerton sewer outfall samples.

Sediment core samples were taken at 13 sites (8 sites at PSNS, 2 sites at NSBB, 2 background sites, and 1 core sample at the Bremerton sewer outfall). Due to insufficient sediment, divers could not obtain a sediment core sample at the Manchester Park background location (P-002-BG-SDC). Gamma analysis results for the sediment core samples are shown in Tables A.19 - A.22. No cobalt-60 was detected in any of the sediment core samples collected at PSNS and NSBB. All radionuclides identified in the 13 cores were attributed to naturally occurring radionuclides or fallout. The radionuclide content of the core samples showed no significant differences with depth or with the dredge samples taken in the same general area. Underwater gamma scintillation probe measurements were also made at each core sampling site, and no radioactivity above background was detected. The probe was less sensitive than the laboratory detectors and was only used as a gross screening technique. If radioactivity above background had been detected with the underwater probe, additional sediment samples would have been taken in the area to quantify the radionuclide concentrations.

Results of the gross beta and alpha analyses of sediment core samples are shown in Tables A.27 and A.28 for PSNS and NSBB, Table A.24 for the Bremerton POTW Outfall, and Table A.25 for background locations. Gross alpha and beta concentrations in sediment

core samples at PSNS and NSBB are similar to concentrations found in sediment core samples at the background locations and at the Bremerton sewer outfall.

3.3 Biota Samples

Fifty-nine biota samples were collected, and the gamma analysis results for these samples are shown in Tables A.29 - A.32. Primarily, naturally occurring radionuclides were detected; however, iodine-131 was detected in some biota samples. Iodine-131 was detected in four PSNS biota samples as follows: 0.018±0.0036 pCi/g-wet in green sea lettuce at the east side of Pier 6 in 500 feet from the SE corner (PUG-003-BGSL); 0.0034±0.0033 pCi/g-wet in barnacles at the east side of Pier 6 in 120 feet from the SE corner (PUG-001-BB); 0.16±0.010 pCi/g-wet in brown kelp 1000 feet out from the SW corner of Dry Dock 5 (PUG-104-BBK); and 0.0052±0.0028 pCi/g-wet in mussel at the SE corner of Pier 9 (PUG-105-BM). The iodine-131 MDC for biota samples was approximately 0.006 pCi/g-wet with the samples counted for 1000 minutes on a Ge detector. Because iodine-131 was detected in a water sample at the discharge location from the Bremerton POTW sewer outfall, the source of the iodine-131 detected in PSNS biota is probably from this sewer outfall. Excreta from nuclear medicine patients undergoing medical diagnostic or therapeutic procedures with iodine-131 at a nearby hospital are probably being discharged from the Bremerton sewer outfall. No iodine-131 was detected in the NSBB biota samples. Iodine-131 was detected in biota at background locations as follows: 0.012±0.011 pCi/g-wet in green sea lettuce at Manchester Park (PUG-002-BG-BGSL) and 0.012±0.0096 pCi/g-wet in brown kelp at Kitsap Memorial Park (PUG-003-BG-BBK). The source of the iodine-131 at the background locations is believed to be a medical facility, but separate from the source at the Bremerton POTW sewer outfall since Kitsap Memorial Park is north of Bangor and would not likely be affected by medical facility releases at the Bremerton POTW sewer outfall.

Results of the gross alpha and beta analyses of biota samples are presented in Tables A.33 - A.36. Samples collected from PSNS and NSBB have concentrations similar to those found in the background samples and samples at the Bremerton sewer outfall.

3.4 External Radiation Measurements

External radiation measurements were made along the shoreline and in the harbor at PSNS and NSBB with emphasis on areas accessible to the public. Measurements were recorded every 10 minutes during the survey with a Genitron Instruments Gamma TRACER GM type survey instrument, and readings were downloaded at each external monitoring location. External exposure readings were also taken for 5 to 10 minutes at each location with a Reuter-Stokes pressurized ion chamber (PIC). Results of the external radiation measurements are shown in Table 11 for PSNS, Table 12 for NSBB, and Table 13 for background locations. External exposure readings at PSNS and NSBB were similar to those at background locations.

TABLE 11 Puget Sound Naval Shipyard: External Gamma Radiation Measurements		
Location ID	PIC Exposure Rates µR/hr	GENITRON Exposure Rates µR/hr
PUG-201-SDS	3.5 - 4.9	5 ± 1
PUG-202-SDS	4.0 - 5.0	5 ± 1
PUG-203-SDS	4.1 - 5.2	6 ± 1
PUG-204-SDS	3.7 - 5.0	4 ± 1
PUG-205-SDS	4.3 - 5.7	4 ± 1
PUG-206-SDS	4.3 - 5.1	5 ± 1
PUG-207-SDS	4.3 - 5.4	5 ± 1
PUG-208-SDS	4.1 - 5.4	5 ± 1
PUG-209-SDS	4.0 - 5.8	5 ± 1
PUG-210-SDS	3.6 - 5.0	4 ± 1
PUG-211-SDS	3.7 - 4.7	5 ± 1
PUG-212-SDS	4.0 - 4.9	6 ± 1
PUG-213-SDS	4.0 - 4.7	5 ± 1
PUG-214-SDS	4.1 - 4.8	5 ± 1

TABLE 12 Naval Submarine Base - Bangor: External Gamma Radiation Measurements		
Location ID	**PIC Exposure Rates µR/hr**	**GENITRON Exposure Rates µR/hr**
BAN-201-SDS	5.0 - 6.7	6 ± 1
BAN-202-SDS	5.4 - 6.6	6 ± 1
BAN-203-SDS	5.2 - 6.2	6 ± 1
BAN-204-SDS	5.5 - 6.8	8 ± 1
BAN-205-SDS	6.1 - 7.6	5 ± 1
BAN-206-SDS	4.2 - 5.3	6 ± 1
BAN-101-B-SDS	3.7 - 5.0	5 ± 1
BAN-101-SDC-SDS	4.3 - 5.3	6 ± 1
BAN-102-B-SDS	3.7 - 5.3	5 ± 1
BAN-102-SD-SDS	3.8 - 5.1	6 ± 1

TABLE 13 Background: External Gamma Radiation Measurements		
Location ID	**PIC Exposure Rates µR/hr**	**GENITRON Exposure Rates µR/hr**
PUG-201-BG-SDS Liberty Bay - shore	5.6 - 6.7	7 ± 1
PUG-202-BG-SDS Manchester State Park -shore	4.8 - 7.2	9 ± 1
PUG-203-BG-SDS Kitsap Memorial Park -shore Kitsap Memorial Park -over water	5.5 - 6.8 3.7 - 5.4	6 ± 1 5 ± 1

4.0 QUALITY ASSURANCE/QUALITY CONTROL

A Quality Assurance (QA) Plan applies to all work performed at NAREL (EPA96b). The purpose of the quality assurance program is to ensure that all measurements performed at NAREL are valid, technically defensible, and of known precision and accuracy. The Quality Assurance Project Plan (QAPP) NAREL prepared for U.S. Navy Environmental Studies (EPA96c) was in accordance with requirements described in "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations" (EPA94).

Quality assurance/quality control (QA/QC) for the laboratory analyses performed for this survey is detailed in the QAPP (EPA96c). Quality control (QC) samples are analyzed in conjunction with routine samples to ensure the quality of the analytical results. Corrective actions must be taken when it is shown by the results of QC samples that the radioanalytical procedure is beyond predetermined control limits. Quality assurance is equally important in the sample collection process. All documentation, including chain-of-custody forms, was properly completed. Sampling equipment was in good working order, and field measurement equipment was calibrated and properly maintained.

In the field, for each matrix and batch of up to 20 samples, a field duplicate was collected. The field duplicate results assess the consistency of the sampling process. In the laboratory, samples were grouped in batches for quality control purposes, with a maximum of 20 samples per matrix per analysis type. For each batch, the laboratory analyzed a reagent blank, a matrix spike, a matrix spike duplicate, and a laboratory replicate sample. Results of the QA samples were reviewed with the sample results as part of the data verification and review process. Specific criteria for acceptance are included in the QAPP (EPA96c). All blank sample results were maintained on control charts by analyst, matrix and analyte. Warning and rejection limits were used to assess acceptance of the blank results. No substantial corrective actions were required during the processing and analysis of the samples for this survey. Radioanalytical sample results complied with the terms and conditions of the QAPP as certified by the NAREL Quality Assurance Coordinator and the Chief of the Monitoring and Analytical Services Branch.

5.0 CONCLUSIONS

The radiological survey at the PSNS and NSBB provides the basis for the following conclusions:

1. Iodine-131 at a level of 26±4.0 pCi/L was detected in a water sample at the Bremerton POTW sewer outfall. The source of this iodine-131 is believed to be excreta from individuals undergoing medical diagnostic or therapeutic procedures at a nearby medical facility. Water samples from PSNS and NSBB contained no detectable levels of radioactivity other than those occurring naturally.

2. Iodine-131 was detected in four PSNS biota samples. The iodine-131 concentrations in pCi/g-wet are as follows: 0.018±0.0036 in green sea lettuce, 0.0034±0.0033 in barnacles, 0.16±0.010 in brown kelp, and 0.0052±0.0028 in mussel. Iodine-131 was also detected in two background biota samples with concentrations in pCi/g-wet as follows: 0.012±0.011 in green sea lettuce at Manchester Park and 0.012±0.0096 in brown kelp at Kitsap Memorial Park. The source of the iodine-131 is believed to be sewer discharges from nearby medical facilities. No iodine-131 was detected in the NSBB biota samples. All other radioactivity detected in the biota samples is attributed to naturally occurring radionuclides.

3. A trace amount of cobalt-60 (0.018±0.0080 pCi/g-dry) was detected in one sediment sample at PSNS. All other radioactivity detected in the 131 sediment samples is attributed to naturally occurring radionuclides or fallout from atmospheric nuclear tests and the Chernobyl reactor accident in 1986.

4. Results of core sampling did not indicate any previous deposit of cobalt-60 in the sediment.

5. External radiation measurements did not detect any increased radiation exposure above natural background levels.

6. Based on the results presented in this study, practices regarding nuclear-powered warship operations at PSNS and NSBB have resulted in no increases in radioactivity causing significant population exposure or contamination of the environment.

6.0 REFERENCES

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APPENDIX

Radioanalytical Results for

September 1996

PSNS and NSBB Samples

General Information for NAREL Analytical Methods

as Reported in the NAREL Data Quality Packages

Gamma Spectrometry

Gamma analysis was done on all collected samples. The activity and 2-sigma uncertainty for radionuclides measured by gamma spectroscopy are reported only if the nuclide is detected. Nuclides that are not detected do not appear in the report, with the exception of barium-140, cobalt-60, cesium-137, iodine-131, potassium-40, radium-226, and radium-228. If one of these seven nuclides is undetected, NAREL reports it as "Not Detected" or "ND".

Due to potential spectral interferences and other possible problems associated with the determination of the activity for certain radionuclides, the activities for thorium-234, protactinium-234m, radium-226, and uranium-235 are subject to greater possible error than other commonly reported radionuclides. Note that this potential error is not included in the 2-sigma counting error reported with each activity. Although in this report we do provide the calculated activities for these radionuclides, we recommend that the results be used only as a qualitative means of indicating the presence of these radionuclides and not as a quantitative measure of their concentration. The results for these nuclides are not used in the evaluation of quality control samples. Furthermore, because of mutual interference between radium-226 and uranium-235, NAREL's gamma analysis software tends to overestimate the amounts of these nuclides whenever both are present in a sample. Lower estimates for radium-226 activities can be obtained from the reported activities of its decay products, lead-214 and bismuth-214, which could be somewhat less than the radium-226 activity because of the potential escape of radon gas.

NAREL's gamma spectroscopy software corrects activities and MDCs for decay between collection and analysis, but only up to a limit of ten half-lives. So, if the decay time for a sample is more than ten half-lives of a radionuclide, that nuclide will almost for certain be undetected, and the reported MDC will be meaningless. This is usually a problem only for short-lived radionuclides, such as iodine-131 and barium-140, when there is a long delay between collection and analysis.

Gross Alpha and Beta Analysis

In comparison to the methods employed to determine radionuclide-specific activities, the method employed by NAREL to determine gross alpha and beta activity has the potential for greater analytical bias. This is especially true for soils. Note that this potential analytical error is not included in the 2-sigma counting error term. Therefore, gross alpha and beta results should be used as gross approximations of the alpha and beta activity present.

Plutonium Radiochemical Analysis

The analytical procedure used to measure plutonium does not distinguish between plutonium-239 and plutonium-240. Therefore, the total activity of these two isotopes is reported.

TABLE A.1 Puget Sound Naval Shipyard : Gamma-Emitting Nuclides in Water

Sample ID	NAREL ID	Activity (pCi/L ± 2σ counting error)								
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{224}Ra	^{226}Ra	^{228}Ra	^{212}Pb	^{208}Tl
PUG-001-DW	PSNS96.05544	ND	ND	ND	ND	ND	ND	ND	3.2±5.7	ND
PUG-001-DW-D1	PSNS96.05543	ND	ND	ND	ND	ND	ND	ND	ND	ND
PUG-001-W	PSNS96.05349	ND	ND	ND	273±45	ND	ND	ND	ND	3.2±3.6
PUG-003-W	PSNS96.05407	ND	ND	ND	263±49	ND	ND	ND	ND	ND
PUG-004-W	PSNS96.05385	ND	ND	ND	264±46	ND	ND	ND	ND	ND
PUG-004-W-D1	PSNS96.05386	ND	ND	ND	228±62	ND	ND	ND	ND	ND
PUG-006-W	PSNS96.05541	ND	ND	ND	281±46	ND	ND	ND	ND	ND
PUG-008-W	PSNS96.05361	ND	ND	ND	260±52	ND	ND	ND	6.2±6.2	ND
PUG-009-W	PSNS96.05375	ND	ND	ND	304±74	ND	ND	ND	ND	ND
PUG-010-W	PSNS96.05542	ND	ND	ND	247±51	ND	ND	ND	ND	ND

ND = Not Detected.

TABLE A.2 Naval Submarine Base -Bangor : Gamma-Emitting Nuclides in Water

Sample ID	NAREL ID	Activity (pCi/L ± 2σ counting error)								
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{224}Ra	^{226}Ra	^{228}Ra	^{212}Pb	^{208}Tl
BAN-001-DW	BANG96.05688	ND	ND	ND	ND	ND	ND	ND	ND	ND
BAN-001-W	BANG96.05680	ND	ND	ND	308±45	ND	ND	ND	ND	ND
BAN-002-W	BANG96.05683	ND	ND	ND	301±61	ND	ND	ND	ND	ND
BAN-002-W-D1	BANG96.05681	ND	ND	ND	260±46	ND	ND	ND	ND	1.9±3.5
BAN-003-W	BANG96.05682	ND	ND	ND	312±43	ND	ND	ND	4.0±5.1	ND
BAN-003-W-D1	BANG96.05686	ND	ND	ND	262±50	47±47	ND	ND	8.6±6.6	3.9±4.0
BAN-004-W	BANG96.05684	ND	ND	ND	246±41	ND	ND	ND	ND	ND
BAN-005-W	BANG96.05685	ND	ND	ND	304±42	ND	ND	ND	ND	ND
BAN-006-W	BANG96.05687	ND	ND	ND	280±46	ND	ND	ND	ND	ND

ND = Not Detected.

TABLE A.3 Bremerton POTW* Outfall : Gamma-Emitting Nuclides in Water

Sample ID	NAREL ID	Activity (pCi/L ± 2σ counting error)								
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{224}Ra	^{226}Ra	^{228}Ra	^{212}Pb	^{208}Tl
PUG-101-01-W	PSNS96.05399	ND	ND	ND	273±36	ND	ND	ND	ND	ND
PUG-101-02-W	PSNS96.05400	ND	26±4.0	ND	264±45	ND	ND	ND	ND	ND

* POTW = Public Owned Treatment Works.

ND = Not Detected.

TABLE A.4 Background : Gamma-Emitting Nuclides in Water

Sample ID	NAREL ID	Activity (pCi/L ± 2σ counting error)								
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{224}Ra	^{226}Ra	^{228}Ra	^{212}Pb	^{208}Tl
PUG-001-BG-W	PSNS96.05355	ND	ND	ND	308±64	ND	55±71	ND	ND	ND
PUG-002-BG-W	PSNS96.05363	ND	ND	ND	267±48	ND	ND	ND	ND	ND
PUG-003-BG-W	PSNS96.05545	ND	ND	ND	273±45	ND	ND	ND	ND	ND

ND = Not Detected.

TABLE A.5 Puget Sound Naval Shipyard : Gamma-Emitting Nuclides in Sediment

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)							
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{7}Be	^{212}Bi	^{214}Bi	^{234m}Pa
PUG-001-SD	PSNS96.05352	ND	ND	0.037±0.0063	2.5±0.15	0.088±0.070	0.13±0.068	0.13±0.016	0.58±0.82
PUG-003-SD	PSNS96.05372	ND	ND	0.17±0.014	9.0±0.31	0.19±0.13	0.41±0.18	0.26±0.030	0.95±1.4
PUG-007-SD	PSNS96.05389	ND	ND	0.15±0.015	9.8±0.34	0.24±0.16	0.36±0.19	0.29±0.030	1.4±1.7
PUG-008-SD	PSNS96.05393	ND	ND	0.096±0.012	8.7±0.29	0.16±0.13	0.25±0.13	0.46±0.029	1.5±1.6
PUG-010-SD	PSNS96.05412	ND	ND	0.079±0.0092	6.9±0.23	ND	0.24±0.12	0.47±0.024	0.79±1.1
PUG-013-SD	PSNS96.05395	ND	ND	0.13±0.013	9.6±0.32	0.18±0.15	0.18±0.18	0.30±0.029	1.2±1.4
PUG-014-SD	PSNS96.05405	ND	ND	0.10±0.012	8.8±0.30	ND	0.24±0.13	0.34±0.027	ND
PUG-015-SD	PSNS96.05536	ND	ND	0.011±0.0052	8.3±0.20	ND	0.30±0.074	0.29±0.015	0.86±0.82
PUG-016-SD	PSNS96.05511	ND	ND	0.062±0.0093	5.7±0.20	ND	0.42±0.10	0.83±0.026	1.4±1.1
PUG-018-SD	PSNS96.05504	ND	ND	0.062±0.016	8.2±0.39	ND	0.46±0.17	1.4±0.047	ND
PUG-019-SD	PSNS96.05514	ND	ND	0.11±0.014	8.3±0.31	ND	0.35±0.16	0.36±0.030	1.2±1.7
PUG-021-SD	PSNS96.05508	ND	ND	0.075±0.012	6.9±0.27	0.13±0.14	0.25±0.17	0.44±0.029	2.2±1.5
PUG-022-SD	PSNS96.05517	ND	ND	0.092±0.018	7.9±0.48	ND	0.34±0.20	0.26±0.038	ND
PUG-023-SD	PSNS96.05527	ND	ND	0.11±0.012	9.1±0.30	ND	0.26±0.16	0.34±0.026	ND
PUG-024-SD	PSNS96.05505	ND	ND	0.076±0.0092	3.9±0.19	0.20±0.10	ND	0.16±0.020	ND
PUG-026-SD	PSNS96.05523	ND	ND	0.076±0.018	8.5±0.48	0.21±0.20	0.25±0.21	0.32±0.038	ND
PUG-027-SD	PSNS96.05519	ND	ND	0.078±0.014	5.1±0.29	ND	0.15±0.20	0.25±0.033	ND
PUG-028-SD	PSNS96.05515	ND	ND	0.075±0.012	8.6±0.26	ND	0.38±0.16	3.4±0.047	3.0±1.4

ND = Not Detected.

TABLE A. 5–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)							
		^{212}Pb	^{214}Pb	^{224}Ra	^{226}Ra	^{228}Ra	^{234}Th	^{208}Tl	^{235}U
PUG-001-SD	PSNS96.05352	0.091±0.015	0.14±0.015	ND	ND	0.060±0.022	ND	0.031±0.0087	0.036±0.011
PUG-003-SD	PSNS96.05372	0.32±0.026	0.31±0.029	0.46±0.29	1.2±0.28	0.28±0.041	ND	0.11±0.015	0.072±0.017
PUG-007-SD	PSNS96.05389	0.36±0.029	0.34±0.028	0.32±0.36	1.1±0.32	0.27±0.042	0.43±0.29	0.12±0.017	ND
PUG-008-SD	PSNS96.05393	0.39±0.028	0.51±0.027	ND	1.4±0.27	0.34±0.037	0.44±0.20	0.14±0.014	ND
PUG-010-SD	PSNS96.05412	0.25±0.021	0.52±0.023	0.23±0.25	1.0±0.24	0.20±0.028	ND	0.084±0.011	0.066±0.014
PUG-013-SD	PSNS96.05395	0.34±0.029	0.36±0.026	0.31±0.32	1.2±0.28	0.29±0.039	0.60±0.26	0.12±0.015	ND
PUG-014-SD	PSNS96.05405	0.33±0.023	0.39±0.024	ND	1.4±0.25	0.27±0.035	0.72±0.17	0.095±0.014	0.084±0.015
PUG-015-SD	PSNS96.05536	0.28±0.015	0.32±0.015	0.31±0.14	0.67±0.15	0.26±0.021	0.18±0.10	0.085±0.0085	ND
PUG-016-SD	PSNS96.05511	0.30±0.021	0.91±0.024	ND	2.1±0.24	0.26±0.026	0.69±0.15	0.10±0.011	0.13±0.015
PUG-018-SD	PSNS96.05504	0.56±0.026	1.4±0.039	0.50±0.30	3.2±0.32	0.46±0.047	0.95±0.21	0.18±0.018	0.19±0.019
PUG-019-SD	PSNS96.05514	0.32±0.030	0.40±0.028	ND	1.2±0.29	0.28±0.038	0.36±0.23	0.11±0.016	ND
PUG-021-SD	PSNS96.05508	0.30±0.026	0.45±0.026	ND	1.4±0.27	0.26±0.033	0.52±0.16	0.096±0.014	ND
PUG-022-SD	PSNS96.05517	0.29±0.025	0.29±0.032	ND	1.1±0.32	0.25±0.046	ND	0.11±0.017	ND
PUG-023-SD	PSNS96.05527	0.33±0.026	0.34±0.026	ND	ND	0.29±0.034	0.46±0.17	0.12±0.014	0.087±0.016
PUG-024-SD	PSNS96.05505	0.15±0.017	0.16±0.016	ND	0.81±0.018	0.13±0.025	0.25±0.12	0.052±0.010	ND
PUG-026-SD	PSNS96.05523	0.34±0.026	0.36±0.034	ND	1.2±0.32	0.24±0.046	0.40±0.21	0.11±0.019	ND
PUG-027-SD	PSNS96.05519	0.24±0.032	0.24±0.035	0.42±0.33	1.2±0.37	0.18±0.045	0.31±0.12	0.065±0.019	ND
PUG-028-SD*	PSNS96.05515	0.48±0.025	3.5±0.042	0.26±0.31	6.1±0.36	0.40±0.034	0.93±0.18	0.16±0.014	0.35±0.021

* ^{223}Ra was also detected in this sample with an activity of 0.24 ± 0.078.

ND = Not Detected.

TABLE A.5–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)							
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{7}Be	^{212}Bi	^{214}Bi	^{234m}Pa
PUG-029-SD	PSNS96.05524	ND	ND	0.070±0.012	7.1±0.27	ND	0.37±0.13	0.88±0.033	ND
PUG-030-SD	PSNS96.05531	ND	ND	0.097±0.012	8.4±0.31	ND	0.32±0.13	0.34±0.028	1.5±1.5
PUG-031-SD	PSNS96.05533	ND	ND	0.084±0.012	7.8±0.28	0.18±0.16	0.33±0.16	0.27±0.027	ND
PUG-032-SD	PSNS96.05535	0.018±0.0080	ND	0.099±0.014	8.8±0.34	ND	0.54±0.21	0.39±0.034	ND
PUG-033-SD	PSNS96.05534	ND	ND	0.11±0.014	11±0.34	ND	0.41±0.18	0.42±0.030	ND
PUG-035-SD	PSNS96.05406	ND	ND	0.11±0.017	10±0.41	ND	0.24±0.18	0.37±0.041	ND
PUG-036-SD	PSNS96.05391	ND	ND	0.081±0.011	10±0.31	ND	0.48±0.13	0.42±0.027	1.1±1.4
PUG-037-SD	PSNS96.05367	ND	ND	0.16±0.013	10±0.32	ND	0.48±0.15	0.34±0.029	ND
PUG-039-SD	PSNS96.05528	ND	ND	0.12±0.015	9.3±0.36	ND	0.31±0.21	0.36±0.035	ND
PUG-040-SD	PSNS96.05526	ND	ND	0.14±0.014	9.8±0.31	ND	0.32±0.14	0.31±0.029	ND
PUG-041-SD	PSNS96.05513	ND	ND	0.066±0.010	5.4±0.26	ND	0.21±0.14	0.29±0.027	ND
PUG-042-SD	PSNS96.05516	ND	ND	0.078±0.014	6.5±0.29	0.18±0.14	ND	0.54±0.034	ND
PUG-043-SD	PSNS96.05525	ND	ND	0.075±0.015	6.3±0.32	ND	0.18±0.21	0.27±0.036	ND
PUG-044-SD	PSNS96.05529	ND	ND	0.10±0.020	9.3±0.53	ND	0.42±0.25	0.32±0.043	ND
PUG-044-SD-D1	PSNS96.05530	ND	ND	0.11±0.024	10±0.60	ND	0.23±0.20	0.41±0.048	ND
PUG-045-SD	PSNS96.05394	ND	ND	0.14±0.013	9.4±0.30	ND	0.36±0.16	0.30±0.026	2.2±1.1
PUG-046-SD	PSNS96.05388	ND	ND	0.12±0.013	9.2±0.29	ND	0.26±0.16	0.32±0.025	ND
PUG-047-SD	PSNS96.05411	ND	ND	0.027±0.0053	6.0±0.17	ND	0.22±0.078	0.23±0.014	ND

ND = Not Detected.

TABLE A.5–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)							
		^{212}Pb	^{214}Pb	^{224}Ra	^{226}Ra	^{228}Ra	^{234}Th	^{208}Tl	^{235}U
PUG-029-SD	PSNS96.05524	0.40±0.023	0.93±0.029	0.29±0.25	2.2±0.25	0.30±0.036	0.54±0.16	0.12±0.014	ND
PUG-030-SD	PSNS96.05531	0.33±0.026	0.41±0.026	0.30±0.27	1.3±0.26	0.28±0.038	0.51±0.18	0.12±0.015	ND
PUG-031-SD	PSNS96.05533	0.31±0.027	0.32±0.026	ND	1.1±0.26	0.23±0.034	ND	0.097±0.014	ND
PUG-032-SD	PSNS96.05535	0.38±0.30	0.45±0.032	ND	1.1±0.33	0.31±0.042	0.55±0.22	0.13±0.018	ND
PUG-033-SD	PSNS96.05534	0.40±0.029	0.44±0.029	0.26±0.32	1.5±0.32	0.38±0.040	0.33±0.20	0.14±0.016	ND
PUG-035-SD	PSNS96.05406	0.44±0.043	0.40±0.042	ND	1.5±0.46	0.30±0.057	0.54±0.15	0.13±0.023	ND
PUG-036-SD	PSNS96.05391	0.43±0.024	0.46±0.024	0.31±0.24	1.6±0.23	0.36±0.035	0.42±0.16	0.14±0.014	ND
PUG-037-SD	PSNS96.05367	0.36±0.027	0.35±0.027	ND	0.99±0.30	0.29±0.040	ND	0.11±0.016	ND
PUG-039-SD	PSNS96.05528	0.36±0.033	0.40±0.032	ND	1.1±0.35	0.30±0.047	0.59±0.28	0.12±0.018	0.070±0.021
PUG-040-SD	PSNS96.05526	0.35±0.027	0.35±0.026	ND	1.2±0.27	0.28±0.037	0.40±0.24	0.12±0.015	0.073±0.016
PUG-041-SD	PSNS96.05513	0.20±0.021	0.32±0.024	ND	0.99±0.23	0.20±0.034	0.32±0.16	0.067±0.014	ND
PUG-042-SD	PSNS96.05516	0.28±0.028	0.60±0.030	0.25±0.35	ND	0.22±0.039	0.49±0.25	0.10±0.016	0.093±0.020
PUG-043-SD	PSNS96.05525	0.28±0.037	0.26±0.035	0.52±0.41	0.85±0.39	0.19±0.048	0.21±0.13	0.084±0.019	ND
PUG-044-SD	PSNS96.05529	0.40±0.030	0.39±0.038	0.54±0.33	1.4±0.36	0.29±0.055	ND	0.14±0.021	ND
PUG-044-SD-D1	PSNS96.05530	0.41±0.034	0.40±0.040	0.34±0.32	1.3±0.41	0.26±0.059	0.38±0.26	0.15±0.023	ND
PUG-045-SD	PSNS96.05394	0.34±0.024	0.32±0.025	0.28±0.26	1.2±0.25	0.32±0.034	0.61±0.18	0.12±0.014	0.071±0.015
PUG-046-SD*	PSNS96.05388	0.32±0.024	0.33±0.025	ND	1.1±0.24	0.29±0.032	0.35±0.16	0.12±0.013	0.070±0.014
PUG-047-SD	PSNS96.05411	0.18±0.014	0.26±0.014	0.15±0.14	0.55±0.14	0.19±0.019	ND	0.057±0.008	ND

* ^{223}Ra was also detected in this sample with an activity of 0.055±0.047.

ND = Not Detected.

TABLE A.5–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)							
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{7}Be	^{212}Bi	^{214}Bi	^{234m}Pa
PUG-048-SD	PSNS96.05397	ND	ND	0.13±0.14	9.8±0.36	ND	0.42±0.15	0.32±0.031	ND
PUG-048-SD-D1	PSNS96.05398	ND	ND	0.13±0.018	10±0.46	ND	0.37±0.28	0.36±0.044	4.1±1.8
PUG-049-SD	PSNS96.05522	ND	ND	0.089±0.012	7.9±0.28	ND	0.18±0.14	0.33±0.026	ND
PUG-050-SD	PSNS96.05387	ND	ND	0.10±0.015	8.5±0.37	ND	0.38±0.23	0.34±0.038	ND
PUG-055-SD	PSNS96.05410	ND	ND	0.10±0.012	9.1±0.29	ND	0.39±0.13	0.27±0.026	ND
PUG-056-SD	PSNS96.05409	ND	ND	0.072±0.011	7.4±0.25	0.17±0.11	0.15±0.15	0.23±0.022	ND
PUG-057-SD	PSNS96.05390	ND	ND	0.12±0.019	8.8±0.47	ND	0.31±0.18	0.34±0.038	2.8±1.7
PUG-058-SD	PSNS96.05401	ND	ND	0.10±0.012	8.8±0.29	ND	0.27±0.14	0.39±0.028	ND
PUG-060-SD	PSNS96.05359	ND	ND	0.096±0.012	8.6±0.31	0.15±0.11	0.25±0.12	0.30±0.026	1.3±1.2
PUG-061-SD	PSNS96.05356	ND	ND	0.077±0.016	6.8±0.38	0.26±0.14	ND	0.22±0.028	ND
PUG-062-SD	PSNS96.05357	ND	ND	0.096±0.015	9.4±0.37	0.22±0.16	0.51±0.16	0.28±0.034	ND
PUG-063-SD	PSNS96.05358	ND	ND	0.088±0.015	6.7±0.36	ND	0.25±0.18	0.23±0.027	ND
PUG-064-SD	PSNS96.05362	ND	ND	0.11±0.012	9.3±0.29	ND	0.22±0.12	0.29±0.026	ND
PUG-065-SD	PSNS96.05366	ND	ND	0.10±0.012	9.5±0.31	0.37±0.14	0.29±0.18	0.30±0.030	1.5±1.6
PUG-066-SD	PSNS96.05373	ND	ND	0.14±0.013	9.3±0.32	ND	0.47±0.14	0.31±0.030	ND
PUG-067-SD	PSNS96.05370	ND	ND	0.87±0.015	10±0.40	ND	0.38±0.18	0.32±0.040	ND
PUG-068-SD	PSNS96.05374	ND	ND	0.84±0.014	8.4±0.42	0.20±0.18	0.17±0.17	0.28±0.030	ND
PUG-069-SD	PSNS96.05518	ND	ND	0.10±0.012	9.2±0.29	ND	0.41±0.13	0.33±0.026	ND

ND = Not Detected.

TABLE A. 5–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)							
		^{212}Pb	^{214}Pb	^{224}Ra	^{226}Ra	^{228}Ra	^{234}Th	^{208}Tl	^{235}U
PUG-048-SD	PSNS96.05397	0.36±0.028	0.36±0.028	0.20±0.27	1.1±0.29	0.31±0.041	0.49±0.20	0.13±0.016	ND
PUG-048-SD-D1	PSNS96.05398	0.44±0.048	0.39±0.046	ND	1.5±0.51	0.31±0.065	0.53±0.17	0.13±0.024	0.094±0.031
PUG-049-SD	PSNS96.05522	0.29±0.024	0.36±0.024	ND	0.91±0.26	0.28±0.034	0.38±0.22	0.11±0.014	0.056±0.016
PUG-050-SD	PSNS96.05387	0.35±0.039	0.35±0.038	0.63±0.43	1.4±0.42	0.26±0.052	0.47±0.14	0.12±0.020	ND
PUG-055-SD	PSNS96.05410	0.31±0.025	0.32±0.024	ND	0.84±0.24	0.23±0.035	0.39±0.21	0.096±0.013	ND
PUG-056-SD	PSNS96.05409	0.26±0.021	0.27±0.022	0.19±0.24	.099±0.23	0.24±0.029	0.60±0.14	0.097±0.012	0.062±0.014
PUG-057-SD	PSNS96.05390	0.37±0.025	0.33±0.032	0.48±0.28	1.4±0.30	0.30±0.044	0.65±0.19	0.12±0.017	0.084±0.018
PUG-058-SD	PSNS96.05401	0.36±0.026	0.43±0.026	0.42±0.30	1.1±0.27	0.32±0.034	0.41±0.21	0.11±0.013	0.068±0.016
PUG-060-SD	PSNS96.05359	0.31±0.022	0.32±0.022	ND	1.2±0.24	0.27±0.034	0.40±0.16	0.11±0.014	ND
PUG-061-SD	PSNS96.05356	0.24±0.023	0.24±0.024	ND	0.51±0.23	0.18±0.033	0.45±0.13	0.069±0.015	ND
PUG-062-SD	PSNS96.05357	0.31±0.031	0.31±0.032	ND	0.94±0.37	0.27±0.048	ND	0.10±0.019	ND
PUG-063-SD	PSNS96.05358	0.24±0.022	0.25±0.023	ND	0.79±0.24	0.20±0.035	0.24±0.13	0.066±0.014	0.048±0.014
PUG-064-SD	PSNS96.05362	0.32±0.024	0.31±0.023	0.20±0.20	1.1±0.24	0.25±0.031	0.56±0.18	0.10±0.015	ND
PUG-065-SD	PSNS96.05366	0.34±0.025	0.35±0.028	0.22±0.28	1.1±0.26	0.29±0.038	0.59±0.18	0.12±0.015	ND
PUG-066-SD	PSNS96.05373	0.32±0.028	0.34±0.028	ND	1.4±0.30	0.27±0.040	ND	0.11±0.016	ND
PUG-067-SD	PSNS96.05370	0.43±0.040	0.40±0.040	0.56±0.37	1.5±0.50	0.33±0.058	0.60±0.14	0.13±0.022	ND
PUG-068-SD	PSNS96.05374	0.31±0.026	0.32±0.027	0.33±0.25	1.0±0.29	0.26±0.038	0.54±0.16	0.10±0.018	ND
PUG-069-SD	PSNS96.05518	0.34±0.026	0.34±0.023	0.29±0.30	1.0±0.25	0.31±0.036	0.48±0.19	0.12±0.014	ND

ND = Not Detected.

TABLE A. 5–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)							
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{7}Be	^{212}Bi	^{214}Bi	^{234m}Pa
PUG-070-SD	PSNS96.05506	ND	ND	0.090±0.018	8.2±0.41	ND	ND	0.28±0.043	ND
PUG-071-SD	PSNS96.05402	ND	ND	0.12±0.013	9.1±0.31	0.19±0.14	0.38±0.18	0.31±0.028	ND
PUG-072-SD	PSNS96.05512	ND	ND	0.080±0.016	8.6±0.40	ND	0.20±0.25	0.36±0.044	1.9±1.6
PUG-102-SD	PSNS96.05392	ND	ND	0.11±0.017	8.7±0.37	0.18±0.18	0.42±0.25	0.38±0.040	2.3±1.6
PUG-103-SD	PSNS96.05403	ND	ND	0.13±0.015	9.6±0.38	ND	0.21±0.21	0.32±0.035	1.6±1.8
PUG-103-SD-D1	PSNS96.05404	ND	ND	0.12±0.018	9.0±0.50	ND	0.38±0.19	0.32±0.038	1.2±1.4
PUG-104-SD	PSNS96.05510	ND	ND	0.083±0.016	5.8±0.41	ND	ND	0.28±0.036	ND
PUG-105-SD	PSNS96.05368	ND	ND	0.098±0.017	9.0±0.48	ND	ND	0.33±0.036	ND
PUG-105-SD-D1	PSNS96.05369	ND	ND	0.13±0.014	9.6±0.34	0.21±0.15	0.25±0.13	0.31±0.030	1.7±1.2
PUG-106-SD	PSNS96.05521	ND	ND	0.11±0.016	1.0±0.40	ND	0.42±0.20	0.35±0.038	ND
PUG-107-SD	PSNS96.05532	ND	ND	0.12±0.019	9.9±0.48	ND	0.38±0.26	0.36±0.050	ND
PUG-108-SD	PSNS96.05520	ND	ND	0.12±0.013	9.9±0.32	ND	0.40±0.14	0.31±0.027	ND
PUG-109-SD	PSNS96.05507	ND	ND	0.14±0.015	9.6±0.33	ND	0.24±0.15	0.32±0.030	ND
PUG-110-SD	PSNS96.05509	ND	ND	0.11±0.014	9.4±0.33	ND	0.30±0.18	0.36±0.031	2.1±1.6
PUG-111-SD	PSNS96.05396	ND	ND	0.14±0.023	10.0±0.53	ND	0.32±0.23	0.35±0.042	ND
PUG-112-SD	PSNS96.05408	ND	ND	0.037±0.073	5.6±0.16	ND	0.34±0.080	0.82±0.021	0.75±0.80
PUG-113-SD	PSNS96.05360	ND	ND	0.15±0.017	10±0.40	ND	0.34±0.19	0.35±0.039	ND
PUG-114-SD	PSNS96.05371	ND	ND	.014±0.013	7.5±0.29	0.14±0.14	0.38±0.15	0.25±0.027	ND
PUG-115-SD	PSNS96.05351	ND	ND	0.14±0.013	9.6±0.28	ND	0.31±0.15	0.30±0.024	ND
PUG-116-SD	PSNS96.05353	ND	ND	0.15±0.010	7.0±0.21	0.16±0.11	0.18±0.093	0.20±0.019	ND
PUG-117-SD	PSNS96.05354	ND	ND	0.13±0.011	7.9±0.26	ND	0.29±0.14	0.26±0.025	ND
PUG-118-SD	PSNS96.05350	ND	ND	0.12±0.013	9.3±0.29	ND	0.36±0.13	0.32±0.027	ND

ND = Not Detected.

TABLE A. 5–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)							
		^{212}Pb	^{214}Pb	^{224}Ra	^{226}Ra	^{228}Ra	^{234}Th	^{208}Tl	^{235}U
PUG-070-SD	PSNS96.05506	0.37±0.045	0.30±0.042	0.52±0.49	1.0±0.48	0.25±0.059	0.63±0.16	0.11±0.024	ND
PUG-071-SD	PSNS96.05402	0.36±0.027	0.34±0.026	0.36±0.28	1.1±0.27	0.30±0.035	0.35±0.18	0.13±0.015	ND
PUG-072-SD	PSNS96.05512	0.37±0.045	0.35±0.044	0.44±0.50	1.3±0.49	0.29±0.058	0.40±0.15	0.10±0.023	ND
PUG-102-SD	PSNS96.05392	0.39±0.040	0.46±0.040	0.53±0.43	1.3±0.42	0.30±0.054	0.45±0.14	0.12±0.020	ND
PUG-103-SD	PSNS96.05403	0.39±0.033	0.37±0.032	0.31±0.39	0.94±0.35	0.34±0.048	ND	0.13±0.020	0.060±0.021
PUG-103-SD-D1	PSNS96.05404	0.37±0.027	0.33±0.033	ND	1.2±0.32	0.31±0.047	0.33±0.19	0.12±0.019	ND
PUG-104-SD	PSNS96.05510	0.25±0.023	0.30±0.031	ND	0.98±0.30	0.21±0.043	ND	0.075±0.015	ND
PUG-105-SD	PSNS96.05368	0.37±0.030	0.32±0.031	ND	1.2±0.31	0.29±0.046	0.64±0.19	0.12±0.019	0.073±0.018
PUG-105-SD-D1	PSNS96.05369	0.34±0.026	0.32±0.026	ND	1.1±0.27	0.27±0.037	0.34±0.17	0.11±0.017	ND
PUG-106-SD	PSNS96.05521	0.43±0.041	0.42±0.040	0.40±0.41	1.3±0.42	0.32±0.053	0.35±0.14	0.12±0.022	ND
PUG-107-SD	PSNS96.05532	0.46±0.052	0.41±0.052	0.73±0.52	1.4±0.56	0.32±0.071	0.51±0.19	0.12±0.028	ND
PUG-108-SD	PSNS96.05520	0.38±0.027	0.35±0.025	0.24±0.31	1.2±0.28	0.28±0.037	0.37±0.22	0.13±0.015	ND
PUG-109-SD	PSNS96.05507	0.34±0.029	0.34±0.028	ND	1.1±0.28	0.32±0.040	0.38±0.23	0.14±0.016	ND
PUG-110-SD	PSNS96.05509	0.35±0.029	0.37±0.028	0.22±0.33	1.0±0.32	0.29±0.042	ND	0.12±0.016	ND
PUG-111-SD	PSNS96.05396	0.44±0.030	0.36±0.035	0.51±0.28	1.6±0.36	0.33±0.050	0.43±0.21	0.14±0.019	ND
PUG-112-SD*	PSNS96.05408	0.26±0.017	0.85±0.019	0.29±0.18	1.8±0.17	0.26±0.021	0.52±0.11	0.091±0.0091	0.11±0.010
PUG-113-SD	PSNS96.05360	0.40±0.038	0.42±0.042	0.65±0.40	1.3±0.48	0.34±0.054	0.60±0.14	0.14±0.022	ND
PUG-114-SD	PSNS96.05371	0.27±0.025	0.28±0.026	0.39±0.26	1.2±0.27	0.25±0.035	0.54±0.21	0.082±0.015	0.074±0.016
PUG-115-SD	PSNS96.05351	0.33±0.022	0.36±0.023	ND	1.1±0.22	0.30±0.032	0.60±0.16	0.11±0.013	0.070±0.013
PUG-116-SD	PSNS96.05353	0.19±0.017	0.21±0.017	ND	0.80±0.19	0.15±0.025	0.37±0.13	0.060±0.0096	ND
PUG-117-SD	PSNS96.05354	0.28±0.022	0.28±0.022	0.22±0.22	1.1±0.23	0.24±0.031	0.43±0.14	0.090±0.012	0.068±0.014
PUG-118-SD	PSNS96.05350	0.32±0.024	0.34±0.022	0.20±0.20	1.2±0.24	0.30±0.034	0.41±0.17	0.12±0.014	ND

* ^{223}Ra was also detected in this sample with an activity of 0.044±0.030.

ND = Not Detected.

TABLE A.5–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)							
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{7}Be	^{212}Bi	^{214}Bi	^{234m}Pa
PUG-201-SDS	PSNS96.05376	ND	ND	ND	6.7±0.16	ND	0.16±0.069	0.22±0.014	ND
PUG-202-SDS	PSNS96.05377	ND	ND	0.067±0.0091	5.7±0.21	ND	0.16±0.098	0.58±0.022	ND
PUG-203-SDS	PSNS96.05378	ND	ND	0.053±0.0080	4.9±0.18	ND	0.24±0.083	0.44±0.020	1.2±0.82
PUG-204-SDS	PSNS96.05379	ND	ND	0.060±0.0080	4.7±0.16	0.078±0.076	0.19±0.082	0.23±0.017	ND
PUG-205-SDS	PSNS96.05380	ND	ND	0.036±0.0092	6.6±0.25	0.63±0.12	0.24±0.15	0.19±0.024	ND
PUG-206-SDS	PSNS96.05381	ND	ND	0.053±0.0089	3.8±0.21	ND	0.17±0.096	0.20±0.022	ND
PUG-207-SDS	PSNS96.05382	ND	ND	0.048±0.0082	5.8±0.22	ND	0.28±0.10	0.31±0.020	ND
PUG-208-SDS	PSNS96.05383	ND	ND	0.096±0.0086	6.6±0.19	ND	0.18±0.075	0.35±0.018	0.65±0.77
PUG-208-SDS-DI	PSNS96.05384	ND	ND	0.095±0.0089	7.0±0.18	ND	0.16±0.081	0.38±0.018	0.64±0.82

ND = Not Detected.

TABLE A.5–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)							
		^{212}Pb	^{214}Pb	^{224}Ra	^{226}Ra	^{228}Ra	^{234}Th	^{208}Tl	^{235}U
PUG-201-SDS	PSNS96.05376	0.21±0.013	0.23±0.012	0.13±0.11	0.65±0.14	0.20±0.017	ND	0.076±0.0070	ND
PUG-202-SDS	PSNS96.05377	0.25±0.016	0.60±0.019	ND	1.2±0.16	0.23±0.024	ND	0.086±0.0096	0.072±0.0093
PUG-203-SDS	PSNS96.05378	0.22±0.016	0.49±0.019	ND	0.92±0.18	0.21±0.023	ND	0.077±0.0096	ND
PUG-204-SDS	PSNS96.05379	0.17±0.016	0.24±0.015	0.15±0.14	0.54±0.16	0.16±0.020	ND	0.059±0.0086	ND
PUG-205-SDS	PSNS96.05380	0.20±0.020	0.21±0.021	0.28±0.22	0.61±0.22	0.14±0.031	ND	0.075±0.012	ND
PUG-206-SDS	PSNS96.05381	0.13±0.018	0.20±0.018	ND	0.48±0.21	0.12±0.027	ND	0.042±0.012	ND
PUG-207-SDS	PSNS96.05382	0.22±0.014	0.33±0.017	0.17±0.14	0.71±0.17	0.19±0.022	ND	0.075±0.0092	ND
PUG-208-SDS	PSNS96.05383	0.20±0.014	0.39±0.016	ND	0.82±0.16	0.20±0.022	ND	0.076±0.0084	0.050±0.0092
PUG-208-SDS-D1	PSNS96.05384	0.22±0.016	0.41±0.017	ND	0.89±0.17	0.21±0.021	ND	0.076±0.0085	ND

ND = Not Detected.

TABLE A.6
Bremerton POTW* Outfall : Gamma-Emitting Nuclides in Sediment.

Radionuclide	Activity (pCi/g-dry ±2σ counting error)
^{60}Co	ND
^{131}I	ND
^{137}Cs	0.056±0.0041
^{40}K	4.7±0.11
^{7}Be	0.038±0.021
^{212}Bi	0.12±0.040
^{214}Bi	0.16±0.0081
^{234m}Pa	0.59±0.34
^{212}Pb	0.15±0.0073
^{214}Pb	0.18±0.0081
^{224}Ra	0.094±0.078
^{226}Ra	0.60±0.082
^{228}Ra	0.13±0.010
^{234}Th	0.36±0.066
^{208}Tl	0.044±0.0039
^{235}U	0.037±0.0050

* POTW = Public Owned Treatment Works. Sample ID is PUG-101-SD, and NAREL ID is PSNS96.05282.
ND = Not Detected.

TABLE A.7 Background : Gamma-Emitting Nuclides in Sediment

Radionuclide	Activity ± 2σ counting error					
	PUG-001-BG-SD [1] (pCi/g-wet)	PUG-002-BG-SD[2] (pCi/g-wet)	PUG-003-BG-SD[3] (pCi/g-dry)	PUG-201-BG-SDS[4] (pCi/g-dry)	PUG-202-BG-SDS[5] (pCi/g-dry)	PUG-203-BG-SDS[6] (pCi/g-dry)
^{60}Co	ND	ND	ND	ND	ND	ND
^{131}I	ND	ND	ND	ND	ND	ND
^{137}Cs	0.013±0.0029	0.027±0.0038	0.034±0.012	0.019±0.0073	0.039±0.0074	0.012±0.0082
^{40}K	6.0±0.093	7.1±0.12	11±0.44	7.1±0.24	11±0.23	7.6±0.26
^{7}Be	0.020±0.016	ND	ND	ND	ND	ND
^{212}Bi	0.15±0.035	0.12±0.045	0.35±0.18	0.22±0.093	0.34±0.086	0.17±0.094
^{214}Bi	0.18±0.0069	0.20±0.0088	0.42±0.033	0.22±0.019	0.23±0.018	0.23±0.019
^{234m}Pa	0.50±0.34	ND	ND	ND	1.1±0.85	ND
^{212}Pb	0.16±0.0063	0.20±0.0083	0.45±0.025	0.21±0.015	0.26±0.016	0.21±0.014
^{214}Pb	0.19±0.0066	0.21±0.0085	0.43±0.028	0.25±0.016	0.26±0.016	0.24±0.016
^{224}Ra	0.15±0.069	0.17±0.094	0.41±0.27	0.21±0.16	ND	0.21±0.16
^{226}Ra	0.44±0.068	0.56±0.094	1.2±0.27	0.42±0.18	0.54±0.16	0.50±0.17
^{228}Ra	0.14±0.087	0.16±0.012	0.34±0.041	0.18±0.022	0.24±0.022	0.18±0.022
^{234}Th	0.35±0.059	0.44±0.094	0.46±0.16	ND	ND	0.44±0.13
^{208}Tl	0.048±0.0032	0.059±0.0043	0.16±0.016	0.072±0.0092	0.086±0.0095	0.064±0.0097
^{235}U	ND	ND	ND	ND	ND	ND

(1) NAREL ID = PSNS96.05364.
(2) NAREL ID = PSNS96.05365.
(3) NAREL ID = PSNS96.05540.
(4) NAREL ID = PSNS96.05537.
(5) NAREL ID = PSNS96.05538.
(6) NAREL ID = PSNS96.05539.

ND = Not Detected.

TABLE A.8 **Naval Submarine Base -Bangor : Gamma-Emitting Nuclides in Sediment**

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)							
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{7}Be	^{212}Bi	^{214}Bi	^{234m}Pa
BAN-001-SD	BANG96.05654	ND	ND	0.019±0.0069	8.6±0.22	ND	0.12±0.10	0.24±0.018	ND
BAN-002-SD	BANG96.05653	ND	ND	0.010±0.0065	8.2±0.22	0.12±0.088	0.26±0.090	0.22±0.017	ND
BAN-003-SD	BANG96.05655	ND	ND	0.024±0.0077	9.9±0.24	ND	0.34±0.13	0.30±0.020	1.5±1.1
BAN-004-SD	BANG96.05650	ND	ND	0.015±0.0066	8.1±0.21	ND	0.21±0.11	0.25±0.017	0.92±0.94
BAN-007-SD	BANG96.05656	ND	ND	0.0074±0.0057	8.2±0.21	ND	0.21±0.10	0.25±0.018	ND
BAN-008-SD	BANG96.05652	ND	ND	0.017±0.0071	8.3±0.26	ND	0.31±0.11	0.27±0.020	ND
BAN-009-SD	BANG96.05651	ND	ND	0.018±0.0057	8.10±0.20	ND	0.15±0.075	0.28±0.016	ND
BAN-011-SD	BANG96.05657	ND	ND	0.017±0.0054	9.1±0.21	ND	0.36±0.081	0.28±0.016	ND
BAN-013-SD	BANG96.05663	ND	ND	0.018±0.0062	8.7±0.21	ND	0.24±0.082	0.28±0.016	0.68±0.80
BAN-013-SD-D1	BANG96.05664	ND	ND	0.023±0.010	8.8±0.27	ND	0.29±0.10	0.27±0.020	1.2±0.91
BAN-014-SD	BANG96.05666	ND	ND	ND	8.0±0.20	ND	0.24±0.091	0.26±0.017	ND
BAN-015-SD	BANG96.05661	ND	ND	0.029±0.0072	9.4±0.22	ND	0.25±0.12	0.28±0.019	ND
BAN-016-SD	BANG96.05662	ND	ND	0.0084±0.0065	8.3±0.22	ND	0.20±0.10	0.27±0.018	ND
BAN-017-SD	BANG96.05659	ND	ND	0.010±0.0071	7.8±0.21	ND	0.30±0.087	0.25±0.017	1.2±0.91
BAN-017-SD-D1	BANG96.05660	ND	ND	0.013±0.0068	7.9±0.19	ND	0.21±0.080	0.25±0.016	ND
BAN-018-SD	BANG96.05665	ND	ND	0.016±0.0063	8.6±0.22	ND	0.19±0.085	0.24±0.018	ND
BAN-019-SD	BANG96.05649	ND	ND	0.026±0.0081	9.7±0,23	ND	0.34±0.12	0.31±0.019	ND
BAN-020-SD	BANG96.05648	ND	ND	0.021±0.0075	8.9±0.22	ND	0.26±0.092	0.29±0.018	ND
BAN-021-SD	BANG96.05678	ND	ND	0.041±0.0087	7.9±0.22	ND	0.26±0.12	0.28±0.019	ND

ND = Not Detected.

TABLE A.8–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)							
		^{212}Pb	^{214}Pb	^{224}Ra	^{226}Ra	^{228}Ra	^{234}Th	^{208}Tl	^{235}U
BAN-001-SD	BANG96.05654	0.25±0.017	0.26±0.017	0.20±0.22	0.64±0.18	0.21±0.024	0.43±0.14	0.091±0.0091	ND
BAN-002-SD	BANG96.05653	0.21±0.015	0.24±0.015	0.11±0.14	0.47±0.14	0.17±0.022	ND	0.076±0.0089	ND
BAN-003-SD	BANG96.05655	0.32±0.020	0.33±0.019	0.25±0.21	0.98±0.20	0.29±0.026	ND	0.11±0.011	ND
BAN-004-SD	BANG96.05650	0.26±0.017	0.27±0.016	0.24±0.21	0.63±0.18	0.24±0.025	ND	0.10±0.0097	ND
BAN-007-SD	BANG96.05656	0.27±0.018	0.27±0.016	0.23±0.20	0.53±0.18	0.25±0.024	ND	0.093±0.0094	ND
BAN-008-SD	BANG96.05652	0.30±0.017	0.28±0.018	0.19±0.17	0.68±0.18	0.26±0.024	0.49±0.14	0.10±0.011	ND
BAN-009-SD	BANG96.05651	0.30±0.016	0.30±0.015	0.20±0.14	0.69±0.16	0.28±0.021	ND	0.096±0.0087	ND
BAN-011-SD	BANG96.05657	0.30±0.016	0.29±0.015	0.19±0.15	ND	0.25±0.020	ND	0.097±0.0089	0.044±0.0095
BAN-013-SD	BANG96.05663	0.30±0.016	0.29±0.016	0.32±0.14	0.56±0.15	0.26±0.021	0.24±0.099	0.099±0.0092	ND
BAN-013-SD-D1	BANG96.05664	0.28±0.016	0.29±0.018	0.24±0.17	0.57±0.17	0.24±0.026	ND	0.092±0.011	ND
BAN-014-SD	BANG96.05666	0.26±0.018	0.27±0.016	0.17±0.19	0.54±0.16	0.24±0.022	ND	0.095±0.0088	ND
BAN-015-SD	BANG96.05661	0.32±0.018	0.31±0.018	0.22±0.20	0.80±0.18	0.28±0.024	ND	0.12±0.010	0.050±0.011
BAN-016-SD	BANG96.05662	0.24±0.017	0.29±0.017	0.17±0.20	0.69±0.20	0.23±0.025	ND	0.084±0.0098	ND
BAN-017-SD	BANG96.05659	0.26±0.016	0.27±0.016	0.16±0.15	0.59±0.16	0.23±0.022	0.28±0.11	0.096±0.0094	ND
BAN-017-SD-D1	BANG96.05660	0.26±0.016	0.27±0.016	ND	0.53±0.16	0.24±0.022	ND	0.091±0.0085	ND
BAN-018-SD	BANG96.05665	0.24±0.016	0.27±0.015	ND	0.70±0.17	0.21±0.024	0.20±0.13	0.086±0.0094	ND
BAN-019-SD	BANG96.05649	0.34±0.019	0.35±0.018	0.30±0.20	0.98±0.21	0.29±0.024	0.44±0.15	0.12±0.010	ND
BAN-020-SD	BANG96.05648	0.31±0.019	0.31±0.018	0.24±0.21	0.56±0.18	0.24±0.024	ND	0.096±0.0093	ND
BAN-021-SD	BANG96.05678	0.29±0.018	0.31±0.019	0.28±0.20	0.66±0.19	0.26±0.024	0.54±0.13	0.095±0.010	ND

ND = Not Detected.

TABLE A.8–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)							
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{7}Be	^{212}Bi	^{214}Bi	^{234m}Pa
BAN-022-SD	BANG96.05675	ND	ND	0.042±0.0078	9.3±0.25	0.11±0.11	0.26±0.12	0.33±0.022	0.94±1.1
BAN-023-SD	BANG96.05677	ND	ND	0.046±0.0078	10±0.25	ND	0.33±0.093	0.34±0.020	ND
BAN-024-SD	BANG96.05668	ND	ND	0.0078±0.0058	7.2±0.19	ND	0.23±0.098	0.24±0.017	1.0±0.83
BAN-025-SD	BANG96.05676	ND	ND	0.012±0.0057	8.6±0.21	ND	0.21±0.11	0.24±0.016	1.0±0.89
BAN-026-SD	BANG96.05679	ND	ND	ND	7.3±0.20	ND	0.12±0.076	0.23±0.016	ND
BAN-027-SD	BANG96.05667	ND	ND	0.035±0.0084	8.4±0.23	ND	0.24±0.14	0.33±0.021	1.1±1.1
BAN-028-SD	BANG96.05673	ND	ND	0.014±0.0071	8.3±0.22	ND	0.30±0.088	0.27±0.018	ND
BAN-029-SD	BANG96.05669	ND	ND	0.016±0.0055	7.4±0.18	ND	0.26±0.068	0.23±0.015	ND
BAN-031-SD	BANG96.05674	ND	ND	0.014±0.0064	8.0±0.20	ND	0.16±0.081	0.26±0.018	0.69±0.91
BAN-032-SD	BANG96.05672	ND	ND	0.011±0.0069	7.6±0.25	ND	0.19±0.099	0.26±0.019	ND
BAN-033-SD	BANG96.05671	ND	ND	0.010±0.0060	7.8±0.18	ND	0.25±0.075	0.26±0.015	ND
BAN-034-SD	BANG96.05670	ND	ND	0.017±0.0078	7.4±0.26	ND	0.24±0.10	0.23±0.019	ND
BAN-101-SD	BANG96.05658	ND	ND	0.015±0.0071	7.4±0.25	ND	0.18±0.095	0.23±0.018	1.1±0.79
BAN-102-SD	BANG96.05647	ND	ND	0.014±0.0059	6.8±0.20	ND	0.22±0.089	0.24±0.018	ND
BAN-201-SDS	BANG96.05641	ND	ND	0.022±0.0056	6.2±0.18	ND	0.24±0.079	0.21±0.015	ND
BAN-202-SDS	BANG96.05642	ND.	ND	0.0062±0.0058	7.3±0.20	ND	0.25±0.091	0.24±0.017	ND
BAN-203-SDS	BANG96.05643	ND	ND	0.014±0.0052	7.1±0.18	ND	0.26±0.095	0.22±0.016	ND
BAN-203-SDS-DI	BANG96.05644	ND	ND	0.015±0.0055	6.9±0.19	ND	0.28±0.094	0.23±0.016	ND
BAN-204-SDS	BANG96.05645	ND	ND	0.031±0.0060	7.3±0.18	ND	0.25±0.076	0.22±0.015	ND
BAN-205-SDS	BANG96.05646	ND	ND	0.016±0.0064	8.6±0.20	ND	0.29±0.080	0.32±0.017	ND

ND = Not Detected.

TABLE A.8–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)							
		^{212}Pb	^{214}Pb	^{224}Ra	^{226}Ra	^{228}Ra	^{234}Th	^{208}Tl	^{235}U
BAN-022-SD	BANG96.05675	0.36±0.021	0.34±0.021	ND	ND	0.30±0.027	0.54±0.16	0.12±0.011	0.066±0.012
BAN-023-SD	BANG96.05677	0.38±0.019	0.38±0.020	0.43±0.20	1.0±0.20	0.33±0.026	0.55±0.14	0.12±0.011	ND
BAN-024-SD	BANG96.05668	0.24±0.016	0.26±0.015	0.14±0.18	0.49±0.17	0.20±0.022	ND	0.082±0.0090	ND
BAN-025-SD	BANG96.05676	0.21±0.016	0.26±0.016	0.16±0.19	0.60±0.18	0.20±0.022	ND	0.083±0.0095	ND
BAN-026-SD	BANG96.05679	0.22±0.014	0.25±0.015	ND	0.50±0.14	0.22±0.022	ND	0.078±0.0087	ND
BAN-027-SD	BANG96.05667	0.32±0.020	0.34±0.020	0.40±0.22	0.94±0.20	0.29±0.025	0.45±0.16	0.12±0.011	ND
BAN-028-SD	BANG96.05673 *	0.27±0.016	0.29±0.016	0.19±0.18	0.57±0.16	0.24±0.024	0.32±0.12	0.092±0.0097	ND
BAN-029-SD	BANG96.05669	0.23±0.013	0.25±0.013	0.16±0.12	0.56±0.16	0.21±0.019	ND	0.079±0.0079	ND
BAN-031-SD	BANG96.05674	0.25±0.017	0.29±0.017	0.24±0.20	0.53±0.17	0.25±0.024	ND	0.091±0.0091	ND
BAN-032-SD	BANG96.05672	0.27±0.016	0.28±0.017	0.23±0.16	0.58±0.16	0.24±0.025	0.41±0.14	0.086±0.010	0.034±0.0091
BAN-033-SD	BANG96.05671	0.25±0.014	0.29±0.014	0.15±0.13	0.58±0.15	0.24±0.018	0.26±0.10	0.088±0.0081	ND
BAN-034-SD	BANG96.05670	0.21±0.014	0.24±0.016	ND	0.46±0.15	0.18±0.023	ND	0.077±0.0097	ND
BAN-101-SD	BANG96.05658	0.22±0.015	0.23±0.016	ND	0.52±0.15	0.21±0.023	ND	0.072±0.0096	ND
BAN-102-SD	BANG96.05647	0.25±0.016	0.26±0.016	ND	0.73±0.16	0.22±0.023	ND	0.089±0.0096	ND
BAN-201-SDS	BANG96.05641	0.17±0.014	0.22±0.014	ND	0.43±0.14	0.18±0.019	ND	0.068±0.0078	ND
BAN-202-SDS	BANG96.05642	0.24±0.017	0.26±0.016	0.22±0.20	0.47±0.18	0.23±0.023	0.19±0.12	0.082±0.0092	ND
BAN-203-SDS	BANG96.05643	0.25±0.015	0.25±0.016	0.22±0.19	0.55±0.15	0.21±0.020	0.43±0.11	0.084±0.0088	0.033±0.0090
BAN-203-SDS-D1	BANG96.05644	0.23±0.016	0.25±0.016	0.19±0.20	0.46±0.17	0.22±0.023	ND	0.085±0.0092	0.029±0.010
BAN-204-SDS	BANG96.05645	0.26±0.014	0.25±0.014	0.30±0.13	0.46±0.15	0.24±0.019	ND	0.089±0.0082	ND
BAN-205-SDS	BANG96.05646	0.36±0.016	0.22±0.16	0.89±0.17	0.34±0.022	0.34±0.022	ND	0.12±0.0092	ND

* ^{223}Ra was also detected in this sample with an activity of 0.055 ± 0.032.

ND = Not Detected.

TABLE A.9 Puget Sound Naval Shipyard : Tritium in Water		
Sample ID	**NAREL ID**	**Activity (pCi/L ± 2σ counting error)**
PUG-001-DW	PSNS96.05544	16±70
PUG-001-DW-D1	PSNS96.05543	40±71
PUG-001-W	PSNS96.05349	-2.9±71
PUG-003-W	PSNS96.05407	-49±67
PUG-004-W	PSNS96.05385	-34±70
PUG-004-W-D1	PSNS96.05386	-29±66
PUG-006-W	PSNS96.05541	-1.4±71
PUG-008-W	PSNS96.05361	-56±72
PUG-009-W	PSNS96.05375	-56±69
PUG-0010-W	PSNS96.05542	-38±70

TABLE A.10 Naval Submarine Base-Bangor : Tritium in Water		
Sample ID	**NAREL ID**	**Activity (pCi/L ± 2σ counting error)**
BAN-001-DW	BANG96.05688	47±70
BAN-001-W	BANG96.05680	-13±70
BAN-002-W	BANG96.05683	-40±65
BAN-002-W-D1	BANG96.05681	-55±69
BAN-003-W	BANG96.05682	12±71
BAN-003-W-D1	BANG96.05686	-27±68
BAN-004-W	BANG96.05684	6.8±66
BAN-005-W	BANG96.05685	-48±68
BAN-006-W	BANG96.05687	20±65

TABLE A.11 Bremerton POTW* Outfall : Tritium in Water		
Sample ID	NAREL ID	Activity (pCi/L ± 2σ counting error)
PUG-101-01-W	PSNS96.05399	10±72
PUG-101-02-W	PSNS96.05400	-7.3±71

*POTW = Public Owned Treatment Works.

TABLE A.12 Background : Tritium in Water		
Sample ID	NAREL ID	Activity (pCi/L ± 2σ counting error)
PUG-001-BG-W	PSNS96.05355	42±73
PUG-002-BG-W	PSNS96.05363	-29±70
PUG-003-BG-W	PSNS96.05545	66±67

TABLE A.13 Puget Sound Naval Shipyard : Gross Alpha and Beta Activities in Water			
Sample ID	NAREL ID	Activity (pCi/L ± 2σ counting error)	
		Gross Alpha	Gross Beta
PUG-001-DW	PSNS96.05544	0.14±0.48	0.71±0.87
PUG-001-DW-D1	PSNS96.05543	0.45±0.51	0.97±0.83
PUG-001-W	PSNS96.05349	117±149	236±97
PUG-003-W	PSNS96.05407	89±146	282±102
PUG-004-W	PSNS96.05385	9.8±80	281±97
PUG-004-W-D1	PSNS96.05386	91±140	261±97
PUG-006-W	PSNS96.05541	-83±88	379±103
PUG-008-W	PSNS96.05361	133±138	376±104
PUG-009-W	PSNS96.05375	4.6±87	204±88
PUG-010-W	PSNS96.05542	30±96	440±106

TABLE A.14 Naval Submarine Base-Bangor : Gross Alpha and Beta Activities in Water			
Sample ID	NAREL ID	Activity (pCi/L ± 2σ counting error)	
		Gross Alpha	Gross Beta
BAN-001-DW	BANG96.05688	0.30±0.54	1.3±0.90
BAN-001-W	BANG96.05680	-39±86	286±94
BAN-002-W	BANG96.05683	11±80	313±98
BAN-002-W-D1	BANG96.05681	21±83	286±95
BAN-003-W	BANG96.05682	89±117	354±103
BAN-003-W-D1	BANG96.05686	17±88	325±98
BAN-004-W	BANG96.05684	3.0±80	336±97
BAN-005-W	BANG96.05685	87±121	334±96
BAN-006-W	BANG96.05687	123±139	348±102

TABLE A.15 Bremerton POTW* Outfall : Gross Alpha and Beta Activities in Water			
Sample ID	NAREL ID	Activity (pCi/L ± 2σ counting error)	
		Gross Alpha	Gross Beta
PUG-101-01-W	PSNS96.05399	118±142	324±96
PUG-101-02-W	PSNS96.05400	63±130	307±99

* POTW = Public Owned Treatment Works.

TABLE A.16 Background : Gross Alpha and Beta Activities in Water			
Sample ID	NAREL ID	Activity (pCi/L ± 2σ counting error)	
		Gross Alpha	Gross Beta
PUG-001-BG-W	PSNS96.05355	-36±80	370±102
PUG-002-BG-W	PSNS96.05363	24±99	377±104
PUG-003-BG-W	PSNS96.05545	-18±107	361±105

TABLE A.17 Bremerton POTW * Outfall : Uranium, Thorium, Plutonium, and ^{226}Ra in Water, Sediment, Sediment Cores, and Biota

Sample ID	Activity (pCi/L water only or pCi/g-dry ± 2σ counting error)									
	^{234}U	^{235}U	^{238}U	^{227}Th	^{228}Th	^{230}Th	^{232}Th	^{238}Pu	$^{239/240}Pu$	^{226}Ra
PUG-101-01-W	1.90±0.53	0.38±0.25	1.2±0.42	0.29±0.28	-0.18±0.56	0.26±0.18	0.096±0.11	-0.11±0.31	0.13±0.18	0.25±0.028
PUG-101-02-W	1.1±0.28	0.081±0.081	1.0±0.27	0.17±0.15	-0.12±0.28	0.21±0.12	0.064±0.064	0.045±0.094	0.019±0.039	0.20±0.023
PUG-101-SD	0.49±0.080	0.045±0.026	0.56±0.086	0.0025±0.025	0.18±0.078	0.24±0.064	0.18±0.055	0.0045± 0.012	0.016±0.018	0.40±0.032
PUG-101-SDC-A	0.92±0.15	0.053±0.037	0.89±0.15	0.020±0.020	0.25±0.065	0.32±0.060	0.24±0.052	0.0066± 0.022	0.019±0.018	0.42±0.034
PUG-101-SDC-B	0.76±0.12	0.040±0.028	0.81±0.12	0.014±0.016	0.26±0.064	0.30±0.056	0.27±0.053	-0.011±0.023	0.027±0.027	0.49±0.032
PUG-101-SDC-C	0.76±0.12	0.069±0.038	0.70±0.12	0.019±0.019	0.22±0.060	0.33±0.058	0.29±0.055	-0.0018± 0.013	0.018±0.022	0.47±0.034
PUG-101-SDC-D	1.2±0.15	0.056±0.033	1.1±0.15	0.015±0.018	0.26±0.065	0.39±0.065	0.29±0.056	0.0066± 0.025	0.011±0.019	0.49±0.036
PUG-101-BSF	0.83±0.084	0.030±0.015	0.68±0.074	0.0013± 0.0088	-0.0048± 0.024	0.020±0.013	0.00069± 0.0046	0.00±0.0065	0.00±0.00	0.098±0.013
PUG-101-BSA	0.11±0.016	0.0090±0.0048	0.10±0.016	0.00095± 0.0019	0.00026± 0.0070	0.0058± 0.0033	0.00032± 0.0010	0.0018± 0.0055	0.00078± 0.0024	0.024±0.0039
PUG-101-BSC	0.68±0.10	0.063±0.032	0.66±.010	0.0021± 0.0098	0.035± 0.029	0.069±0.022	0078±0.023	0.0023± 0.013	0.0017± 0.0052	0.11±0.013

* POTW = Public Owned Treatment Works.

TABLE A.18 **Background : Uranium, Thorium, Plutonium, and ^{226}Ra in Water, Sediment, Sediment Cores and Biota**

Sample ID	Activity (pCi/L water only or pCi/g-dry ± 2σ counting error)									
	^{234}U	^{235}U	^{238}U	^{227}Th	^{228}Th	^{230}Th	^{232}Th	^{238}Pu	$^{239/240}Pu$	^{226}Ra
PUG-001-BG-W	1.3±0.32	0.15±0.12	1.0±0.28	0.061±0.087	-0.099±0.28	0.043±0.056	0.016±0.032	-0.027±0.17	-0.018±0.025	0.19±0.026
PUG-002-BG-W	1.2±0.18	0.049±0.039	0.91±0.16	0.015±0.029	-0.14±0.11	0.051±0.041	0.028±0.031	-0.049±0.069	0.045±0.052	0.17±0.022
PUG-001-BG-SD	0.29±0.064	0.015±0.016	0.24±0.057	0.012±0.027	0.52±0.10	0.22±0.059	0.44±0.084	-0.0036±0.033	0.0018±0.012	0.40±0.036
PUG-002-BG-SD	0.35±0.077	0.046±0.030	0.35±0.077	0.016±0.034	0.24±0.083	0.31±0.070	0.20±0.057	0.0058±0.066	-0.0029±0.0058	0.29±0.031
PUG-003-BG-SD	0.66±0.12	0.085±0.047	0.48±0.11	0.047±0.039	0.36±0.089	0.47±0.086	0.45±0.085	0.011±0.038	-0.0019±0.014	0.79±0.045
PUG-001-BG-SDC-A	0.28±0.065	0.22±0.019	0.24±0.062	0.0036±0.011	0.084±0.052	0.17±0.045	0.14±0.040	-0.0028±0.062	0.0085±0.017	0.22±0.027
PUG-001-BG-SDC-B	0.36±0.090	0.049±0.037	0.26±0.076	0.025±0.024	0.077±0.052	0.15±0.042	0.13±0.039	0.016±0.041	0.058±0.037	0.42±0.034
PUG-003-BG-SDC-A	0.54±0.10	0.043±0.032	0.64±0.12	0.039±0.035	0.36±0.087	0.46±0.081	0.40±0.076	-0.0048±0.048	0.0097±0.027	0.50±0.039
PUG-201-BG-SDS	0.25±0.068	0.0033±0.016	0.13±0.049	0.018±0.033	0.19±0.072	0.28±0.065	0.14±0.047	0.097±0.069	-0.060±0.029	0.62±0.039
PUG-202-BG-SDS	0.28±0.082	0.026±0.026	0.38±0.097	-0.0025±0.030	0.18±0.076	0.29±0.070	0.24±0.062	0.021±0.046	0.021±0.029	0.59±0.039
PUG-203-BG-SDS	0.27 ±0.069	0.020±0.023	0.22±0.062	0.014±0.031	0.34±0.090	0.22±0.059	0.40±0.079	0.040±0.050	0.0066±0.020	0.38±0.032
PUG-001-BG-BOSA	0.062 ± .019	0.0063±0.0063	0.049±0.016	0.0034±0.0075	-0.0015±0.013	0.023±0.010	0.0050±0.0048	-0.00083±0.0092	0.0021±0.0046	0.051±0.0062
PUG-001-BG-BSF	1.92±0.20	0.13±0.046	1.6±0.18	0.014±0.015	-0.15±0.025	0.028±0.015	0.0075±0.0075	0.047±0.041	0.00±0.015	0.089±0.014
PUG-001-BG-BC	0.040±0.023	0.00091±0.0060	0.026±0.016	0.0020±0.0062	-0.019±0.019	0.029±0.013	0.010±0.0078	0.0083±0.017	0.00±0.0052	0.11±0.014
PUG-002-BG-BC	0.063±0.021	0.011±0.010	0.034±0.015	0.016±0.020	-0.013±0.028	0.026±0.016	0.0054±0.0072	0.0074±0.017	0.0025±0.0094	0.13±0.015
PUG-002-BG-BSF	0.52±0.054	0.031±0.013	0.42±0.048	0.021±0.014	-0.0024±0.017	0.0053±0.0052	0.0046±0.0053	-0.0051±0.014	0.00±0.0050	0.083±0.010
PUG-002-BG-BGSL	0.038±0.013	0.0064±0.0058	0.040±0.014	-0.00077±0.0077	0.022±0.019	0.027±0.012	0.013±0.0085	0.0097±0.017	0.00069±0.0046	012±0.010
PUG-003-BG-BBK	0.22±0.046	0.011±0.013	0.17±0.040	0.0065±0.0092	-0.032±0.033	0.12±0.028	0.12±0.028	0.0084±0.019	0.0051±0.0093	0.22±0.019
PUG-003-BG-BGSL	0.20±0.047	0.022±0.018	0.22±0.049	0.022±0.018	0.084±0.036	0.12±0.030	0.095±0.026	0.0026±0.0074	0.016±0.011	0.23±0.019
PUG-003-BG-BC	0.063±0.024	0.016±0.013	0.060±0.023	0.014±0.014	0.021±0.027	0.054±0.019	0.014±0.0096	-0.0090±0.016	0.0041±0.0091	0.15±0.015
PUG-003-BG-B ? *	0.053±0.021	0.068±0.090	0.032±0.017	0.020±0.017	0.018±0.026	0.030±0.015	0.0028±0.0050	0.010±0.018	-0.0025±0.0065	0.094±0.014

* "?" refers to plant biota which could not be identified.

TABLE A.19	Bremerton POTW* Outfall : Gamma-Emitting Nuclides in Sediment Core			
Radionuclide	Activity (pCi/g-wet ± 2σ counting error)			
	Top 5 cm [1]	Second 5 cm [2]	Third 5 cm [3]	Bottom 8cm[4]
^{60}Co	ND	ND	ND	ND
^{131}I	ND	ND	ND	ND
^{137}Cs	0.040±0.013	0.050±0.013	0.042±0.013	0.039±0.011
^{40}K	2.4±0.26	3.0±0.27	3.3±0.33	3.8±0.26
^{7}Be	ND	ND	ND	ND
^{212}Bi	ND	ND	0.25±0.16	0.23±0.13
^{214}Bi	0.088±0.032	0.072±0.036	0.17±0.038	0.13±0.027
^{234m}Pa	ND	ND	ND	1.4±1.1
^{212}Pb	0.087±0.025	0.10±0.028	0.13±0.032	0.16±0.023
^{214}Pb	0.094±0.023	0.10±0.030	0.14±0.034	0.16±0.025
^{224}Ra	ND	ND	ND	ND
^{226}Ra	0.25±0.29	0.43±0.32	0.56±0.39	0.57±0.26
^{228}Ra	ND	ND	ND	0.12±0.036
^{234}Th	ND	ND	ND	0.28±0.17
^{208}Tl	0.029±0.017	0.040±0.017	0.037±0.019	0.046±0.015
^{235}U	ND	ND	ND	ND

* POTW = Public Owned Treatment Works.

[1] Sample ID = PUG-101-SDC-A; NAREL ID = PSNS96.07030.
[2] Sample ID = PUG-101-SDC-B; NAREL ID = PSNS96.07031.
[3] Sample ID = PUG-101-SDC-C; NAREL ID = PSNS96.07032.
[4] Sample ID = PUG-101-SDC-D; NAREL ID = PSNS96.07033.
ND = Not Detected.

TABLE A.20 **Background : Gamma-Emitting Nuclides in Sediment Cores**

Radionuclide	Activity (pCi/g-wet ± 2σ counting error)					
	PUG-001-BG-SDC-A [1] Top 5 cm	PUG-001-BG-SDC-B [2] Bottom 7 cm	PUG-003-BG-SDC-A [3] Top 5 cm	PUG-003-BG-SDC-B [4] Second 5 cm	PUG-003-BG-SDC-C [5] Third 5 cm	PUG-003-BG-SDC-D [6] Bottom 8 cm
^{60}Co	ND	ND	ND	ND	ND	ND
^{131}I	ND	ND	ND	ND	ND	ND
^{137}Cs	ND	.015±0.0068	0.017±0.016	0.026±0.013	0.020±0.013	0.018±0.011
^{40}K	5.9±0.42	7.3±0.26	5.4±0.34	7.1±0.36	7.0±0.37	6.4±0.37
^{7}Be	ND	ND	ND	ND	ND	ND
^{212}Bi	0.16±0.12	0.22±0.10	0.27±0.19	0.20±0.24	0.19±0.23	0.22±0.15
^{214}Bi	0.18±0.031	0.18±0.021	0.21±0.038	0.22±0.037	0.22±0.036	0.23±0.030
^{234m}Pa	ND	ND	ND	ND	1.1±1.8	ND
^{212}Pb	0.16±0.023	0.18±0.019	0.22±0.033	0.27±0.031	0.24±0.032	0.25±0.020
^{214}Pb	0.18±0.025	0.21±0.018	0.18±0.031	0.25±0.032	0.26±0.033	0.25±0.024
^{224}Ra	ND	0.19±0.18	ND	ND	ND	0.28±0.22
^{226}Ra	0.48±0.26	0.48±0.21	0.50±0.34	0.79±0.32	0.22±0.36	0.58±0.22
^{228}Ra	0.11±0.037	0.16±0.025	0.20±0.051	0.22±0.044	0.22±0.052	0.20±0.037
^{234}Th	ND	ND	ND	ND	ND	ND
^{208}Tl	0.041±0.016	0.060±0.011	0.071±0.020	0.093±0.019	0.081±0.021	0.092±0.014
^{235}U	ND	ND	ND	ND	ND	ND

(1) NAREL ID = PSNS96.07028.
(2) NAREL ID = PSNS96.07029.
(3) NAREL ID = PSNS96.07042.
(4) NAREL ID = PSNS96.07043.
(5) NAREL ID = PSNS96.07044.
(6) NAREL ID = PSNS96.07045.

ND = Not Detected.

NOTE: Divers could not obtain sediment core at location PUG-002-BG-SDC (Manchester Park).

TABLE A.21 Puget Sound Naval Shipyard : Gamma-Emitting Nuclides in Sediment Cores

Sample ID	NAREL ID	Activity (pCi/g-wet ± 2σ counting error)							
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{7}Be	^{212}Bi	^{214}Bi	^{234m}Pa
PUG-102-SDC-A Top 5 cm	PSNS96.07067	ND	ND	ND	2.0±0.50	ND	ND	0.15±0.075	ND
PUG-102-SDC-B Second 7 cm	PSNS96.07068	ND	ND	0.046±0.011	2.8±0.23	ND	ND	0.66±0.034	1.8±1.5
PUG-103-SDC-A Top 5 cm	PSNS96.07046	ND	ND	0.025±0.0096	1.8±0.23	ND	ND	0.091±0.027	ND
PUG-103-SDC-B Second 8 cm	PSNS96.07047	ND	ND	0.032±0.0090	1.9±0.23	ND	ND	0.095±0.023	ND
PUG-104-SDC-A Top 5 cm	PSNS96.07048	ND	ND	0.033±0.016	2.8±0.32	ND	ND	0.092±0.046	ND
PUG-104-SDC-B Second 5 cm	PSNS96.07049	ND	ND	0.044±0.025	2.8±0.48	ND	ND	0.13±0.067	ND
PUG-104-SDC-C Third 5 cm	PSNS96.07050	ND	ND	0.041±0.014	3.3±0.31	ND	0.25±0.17	0.074±0.035	ND
PUG-104-SDC-D Bottom 10 cm	PSNS96.07051	ND	ND	0.044±0.0092	3.6±0.21	ND	ND	0.11±0.023	ND
PUG-105-SDC-A Top 5 cm	PSNS96.07052	ND	ND	0.034±0.012	2.4±0.26	ND	ND	0.078±0.033	ND
PUG-105-SDC-B Second 5 cm	PSNS96.07053	ND	ND	0.022±0.018	3.3±0.48	ND	ND	0.13±0.051	ND
PUG-105-SDC-C Third 5 cm	PSNS96.07054	ND	ND	0.039±0.012	4.0±0.29	ND	ND	0.14±0.029	ND
PUG-105-SDC-D Bottom 10 cm	PSNS96.07055	ND	ND	0.040±0.011	3.8±0.28	ND	0.16±0.14	0.14±0.025	ND
PUG-105-SDC-D1-A Top 5 cm	PSNS96.07056	ND	ND	0.032±0.016	3.1±0.36	ND	ND	ND	ND
PUG-105-SDC-D1-B Second 5 cm	PSNS96.07057	ND	ND	0.021±0.019	3.4±0.47	ND	ND	ND	ND
PUG-105-SDC-D1-C Bottom 8 cm	PSNS96.07058	ND	ND	ND	4.0±0.22	ND	0.27±0.11	0.26±0.024	ND

ND = Not Detected.

TABLE A.21–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-wet ± 2σ counting error)							
		^{212}Pb	^{214}Pb	^{224}Ra	^{226}Ra	^{228}Ra	^{234}Th	^{208}Tl	^{235}U
PUG-102-SDC-A Top 5 cm	PSNS96.07067	0.13±0.067	0.12±0.073	ND	ND	ND	ND	0.037±0.042	ND
PUG-102-SDC-B Second 7 cm	PSNS96.07068	0.16±0.024	0.75±0.030	ND	1.3±0.28	0.13±0.037	0.52±0.24	0.052±0.016	0.078±0.017
PUG-103-SDC-A Top 5 cm	PSNS96.07046	0.078±0.022	0.094±0.022	ND	ND	ND	0.17±0.16	0.014±0.016	0.022±0.016
PUG-103-SDC-B Second 8 cm	PSNS96.07047	0.088±0.017	0.11±0.019	ND	0.32±0.21	0.073±0.025	ND	0.030±0.012	ND
PUG-104-SDC-A Top 5 cm	PSNS96.07048	0.11±0.032	0.070±0.035	ND	0.28±0.36	ND	ND	0.027±0.022	ND
PUG-104-SDC-B Second 5 cm	PSNS96.07049	0.18±0.057	0.10±0.065	ND	0.54±0.68	ND	ND	0.045±0.037	ND
PUG-104-SDC-C Third 5 cm	PSNS96.07050	0.12±0.029	0.11±0.028	ND	0.24±0.35	0.094±0.047	ND	0.040±0.019	ND
PUG-104-SDC-D Bottom 10 cm	PSNS96.07051	0.12±0.019	0.14±0.020	ND	0.49±0.20	0.11±0.028	0.35±0.13	0.045±0.012	ND
PUG-105-SDC-A Top 5 cm	PSNS96.07052	0.091±0.027	0.096±0.027	ND	ND	ND	ND	0.042±0.026	ND
PUG-105-SDC-B Second 5 cm	PSNS96.07053	0.16±0.026	0.15±0.036	ND	0.48±0.38	ND	ND	0.080±0.026	ND
PUG-105-SDC-C Third 5 cm	PSNS96.07054	0.14±0.023	0.15±0.024	0.35±0.30	0.43±0.28	0.14±0.039	ND	0.050±0.025	ND
PUG-105-SDC-D Bottom 10 cm	PSNS96.07055	0.15±0.018	0.16±0.020	ND	0.28±0.23	0.15±0.031	ND	0.084±0.019	ND
PUG-105-SDC-D1-A Top 5 cm	PSNS96.07056	0.12±0.035	0.12±0.035	ND	0.56±0.38	ND	ND	0.041±0.023	ND
PUG-105-SDC-D1-B Second 5 cm	PSNS96.07057	0.18±0.055	0.12±0.062	0.43±0.57	0.89±0.65	0.12±0.085	ND	0.041±0.034	ND
PUG-105-SDC-D1-C Bottom 8 cm	PSNS96.07058	0.27±0.021	0.30±0.021	0.16±0.24	0.72±0.21	0.26±0.031	0.31±0.14	0.088±0.013	ND

ND = Not Detected.

TABLE A.21–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-wet ± 2σ counting error)							
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{7}Be	^{212}Bi	^{214}Bi	^{234m}Pa
PUG-106-SDC-A Top 5 cm	PSNS96.07059	ND	ND	0.028±0.016	3.4±0.36	ND	0.26±0.30	0.083±0.046	ND
PUG-106-SDC-B Second 5 cm	PSNS96.07060	ND	ND	0.042±0.013	3.6±0.34	ND	ND	ND	ND
PUG-106-SDC-C Third 5 cm	PSNS96.07061	ND	ND	0.050±0.020	2.9±0.47	ND	ND	0.13±0.047	ND
PUG-106-SDC-D Bottom 9 cm	PSNS96.07062	ND	ND	0.040±0.012	3.1±0.32	ND	ND	0.14±0.029	ND
PUG-107-SDC-A Top 5 cm	PSNS96.07063	ND	ND	0.026±0.014	2.4±0.38	ND	ND	ND	ND
PUG-107-SDC-B Second 5 cm	PSNS96.07064	ND	ND	0.041±0.016	3.2±0.32	ND	ND	0.081±0.041	ND
PUG-107-SDC-C Third 5 cm	PSNS96.07065	ND	ND	0.034±0.019	2.8±0.45	ND	ND	ND	ND
PUG-107-SDC-D Bottom 18 cm	PSNS96.07066	ND	ND	0.065±0.0089	4.2±0.19	ND	0.18±0.085	0.15±0.018	ND
PUG-108-SDC-A Top 5 cm	PSNS96.07034	ND	ND	0.019±0.0097	1.2±0.22	0.056±0.056	0.11±0.12	0.16±0.026	ND
PUG-108-SDC-C Bottom 8 cm	PSNS96.07035	ND	ND	0.028±0.0075	1.6±0.16	ND	ND	0.14±0.020	ND

ND = Not Detected.

TABLE A.21–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-wet ± 2σ counting error)							
		^{212}Pb	^{214}Pb	^{224}Ra	^{226}Ra	^{228}Ra	^{234}Th	^{208}Tl	^{235}U
PUG-106-SDC-A Top 5 cm	PSNS96.07059	0.13±0.039	0.10±0.039	ND	0.32±0.41	0.12±0.055	ND	0.045±0.024	ND
PUG-106-SDC-B Second 5 cm	PSNS96.07060	0.11±0.033	0.11±0.032	ND	0.40±0.38	ND	ND	0.049±0.022	ND
PUG-106-SDC-C Third 5 cm	PSNS96.07061	0.16±0.023	0.13±0.039	ND	0.38±0.39	0.14±0.055	ND	0.048±0.019	ND
PUG-106-SDC-D Bottom 9 cm	PSNS96.07062	0.13±0.018	0.14±0.024	ND	0.35±0.25	0.093±0.032	ND	0.045±0.012	ND
PUG-107-SDC-A Top 5 cm	PSNS96.07063	0.10±0.027	ND	ND	ND	ND	ND	0.027±0.022	ND
PUG-107-SDC-B Second 5 cm	PSNS96.07064	0.11±0.030	0.084±0.033	ND	0.22±0.35	ND	ND	0.050±0.022	ND
PUG-107-SDC-C Third 5 cm	PSNS96.07065	0.12±0.058	0.088±0.063	ND	ND	ND	ND	0.023±0.035	ND
PUG-107-SDC-D Bottom 18 cm	PSNS96.07066	0.15±0.018	0.15±0.018	ND	0.56±0.20	0.14±0.024	0.24±0.13	0.052±0.0093	ND
PUG-108-SDC-A Top 5 cm	PSNS96.07034	0.058±0.018	0.16±0.020	ND	0.44±0.21	0.054±0.030	ND	0.016±0.012	ND
PUG-108-SDC-B Bottom 8 cm	PSNS96.07035	0.059±0.013	0.14±0.016	ND	0.26±0.17	ND	ND	0.022±0.0098	ND

ND = Not Detected.

TABLE A.22 Naval Submarine Base - Bangor : Gamma-Emitting Nuclides in Sediment Cores

Radionuclide	Activity (pCi/g-wet ± 2σ counting error)					
	BAN-101-SDC-A [1] Top 5 cm	BAN-101-SDC-B [2] Second 5 cm	BAN-101-SDC-C [3] Third 5 cm	BAN-101-SDC-D [4] Bottom 15 cm	BAN-102-SDC-A [5] Top 5 cm	BAN-102-SDC-B [6] Bottom 7 cm
^{60}Co	ND	ND	ND	ND	ND	ND
^{131}I	ND	ND	ND	ND	ND	ND
^{137}Cs	ND	ND	ND	ND	ND	0.024±0.0098
^{40}K	5.8±0.47	6.2±0.43	6.9±0.37	6.9±0.31	2.1±0.42	3.1±0.23
^{7}Be	ND	ND	ND	ND	ND	ND
^{212}Bi	ND	0.18±0.18	0.21±0.14	ND	ND	0.21±0.13
^{214}Bi	0.20±0.043	0.18±0.035	0.22±0.028	0.23±0.022	ND	0.12±0.026
^{234m}Pa	ND	ND	ND	ND	ND	ND
^{212}Pb	0.22±0.025	0.20±0.021	0.21±0.020	0.20±0.015	0.13±0.054	0.11±0.021
^{214}Pb	0.19±0.032	0.22±0.030	0.21±0.023	0.21±0.019	0.12±0.061	0.13±0.022
^{224}Ra	ND	ND	0.24±0.22	0.28±0.18	ND	ND
^{226}Ra	0.45±0.32	0.45±0.27	0.47±0.23	0.57±0.17	ND	0.45±0.23
^{228}Ra	0.16±0.050	0.19±0.040	0.20±0.035	0.19±0.026	ND	ND
^{234}Th	ND	ND	ND	ND	ND	ND
^{208}Tl	0.067±0.017	0.064±0.014	0.067±0.014	0.073±0.010	0.031±0.033	0.039±0.016
^{235}U	ND	ND	ND	ND	ND	ND

(1) NAREL ID = BANG96.07036.
(2) NAREL ID = BANG96.07037.
(3) NAREL ID = BANG96.07038.
(4) NAREL ID = BANG96.07039.
(5) NAREL ID = BANG96.07040.
(6) NAREL ID = BANG96.07041.

ND = Not Detected.

TABLE A.23 Puget Sound Naval Shipyard : Gross Alpha and Beta Activities in Sediment

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)	
		Gross Alpha	Gross Beta
PUG-001-SD	PSNS96.05352	5.0±4.7	5.5±2.6
PUG-003-SD	PSNS96.05372	5.7±4.6	14±3.3
PUG-007-SD	PSNS96.05389	11±6.8	14±3.5
PUG-008-SD	PSNS96.05393	20±8.0	15±3.4
PUG-010-SD	PSNS96.05412	11±6.2	11±3.2
PUG-013-SD	PSNS96.05395	14±6.8	12±3.2
PUG-014-SD	PSNS96.05405	7.4±6.7	13±3.7
PUG-015SD	PSNS96.05536	4.6±4.3	12±3.2
PUG-016SD	PSNS96.05511	8.2±5.6	6.4±2.8
PUG-018-SD	PSNS96.05504	5.6±5.0	15±3.4
PUG-019-SD	PSNS96.05514	11±6.4	12±3.2
PUG-021-SD	PSNS96.05508	7.5±6.0	14±3.5
PUG-022-SD	PSNS96.05517	7.0±5.3	12±3.2
PUG-023-SD	PSNS96.05527	11±6.2	11±3.1
PUG-024-SD	PSNS96.05505	8.9±5.4	7.7±2.8
PUG-026-SD	PSNS96.05523	18±7.9	12±3.2
PUG-027-SD	PSNS96.05519	7.1±5.8	11±3.2
PUG-028-SD	PSNS96.05515	11±5.8	19±3.5
PUG-029-SD	PSNS96.05524	11±6.2	13±3.2
PUG-030-SD	PSNS96.05531	12±6.5	11±3.1
PUG-031-SD	PSNS96.05533	9.3±5.7	10±3.1
PUG-032-SD	PSNS96.05535	18±7.2	13±3.2
PUG-033-SD	PSNS96.05534	12±6.4	15±3.4
PUG-035-SD	PSNS96.05406	8.8±7.1	15±3.8
PUG-036-SD	PSNS96.05391	11±6.2	14±3.3
PUG-037-SD	PSNS96.05367	8.4±5.6	14±3.4
PUG-039-SD	PSNS96.05528	6.0±5.0	15±3.5
PUG-040-SD	PSNS96.05526	6.9±5.0	15±3.2

TABLE A.23–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)	
		Gross Alpha	Gross Beta
PUG-041-SD	PSNS96.05513	8.6±5.7	11±3.1
PUG-042-SD	PSNS96.05516	6.1±5.0	11±3.1
PUG-043-SD	PSNS96.05525	9.1±6.0	8.4±2.9
PUG-044-SD	PSNS96.05529	14±7.3	13±3.5
PUG-044-SD-D1	PSNS96.05530	12±6.6	13±3.3
PUG-045-SD	PSNS96.05394	5.0±4.9	17±3.5
PUG-046-SD	PSNS96.05388	9.3±5.9	12±3.3
PUG-047-SD	PSNS96.05411	1.5±3.8	8.3±2.9
PUG-048-SD	PSNS96.05397	12±6.3	14±3.2
PUG-048-SD-D1	PSNS96.05398	8.4±5.9	13±3.3
PUG-049-SD	PSNS96.05522	6.4±5.0	8.9±2.9
PUG-050-SD	PSNS96.05387	6.7±5.2	13±3.3
PUG-055-SD	PSNS96.05410	8.8±6.0	13±3.2
PUG-056-SD	PSNS96.05409	7.3±5.4	10±3.1
PUG-057-SD	PSNS96.05390	6.7±5.3	16±3.4
PUG-058-SD	PSNS96.05401	8.5±5.7	16±3.4
PUG-060-SD	PSNS96.05359	12±6.7	9.3±3.1
PUG-061-SD	PSNS96.05356	7.1±5.0	11±3
PUG-062-SD	PSNS96.05357	15±7.2	16±3.5
PUG-063-SD	PSNS96.05358	7.6±5.5	11±3.2
PUG-064-SD	PSNS96.05362	9.8±5.8	15±3.3
PUG-065-SD	PSNS96.05366	7.3±6.1	10±3.2
PUG-066-SD	PSNS96.05373	2.3±3.8	15±3.4
PUG-067-SD	PSNS96.05370	8.8±5.4	12±3.1
PUG-068-SD	PSNS96.05374	8.3±5.4	15±3.2
PUG-069-SD	PSNS96.05518	14±7.6	14±3.5
PUG-070-SD	PSNS96.05506	12±6.4	16±3.5
PUG-071-SD	PSNS96.05402	7.8±5.4	14±3.4
PUG-072-SD	PSNS96.05512	3.4±4.5	14±3.3
PUG-102-SD	PSNS96.05392	9.3±5.8	12±3.2

TABLE A.23–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)	
		Gross Alpha	Gross Beta
PUG-103-SD	PSNS96.05403	4.6±4.5	15±3.3
PUG-103-SD-D1	PSNS96.05404	11±6.4	14±3.3
PUG-104-SD	PSNS96.05510	11±6.2	10±3.1
PUG-105-SD	PSNS96.05368	8.7±5.7	12±3.2
PUG-105-SD-D1	PSNS96.05369	10±5.9	12±3.2
PUG-106-SD	PSNS96.05521	11±6.0	12±3.1
PUG-107-SD	PSNS96.05532	6.8±5.7	14±3.2
PUG-108-SD	PSNS96.05520	10±6.0	14±3.3
PUG-109-SD	PSNS96.05507	16±7.6	14±3.4
PUG-110-SD	PSNS96.05509	7.5±6.1	13±3.4
PUG-111-SD	PSNS96.05396	12±6.4	15±3.4
PUG-112-SD	PSNS96.05408	7.5±6.0	8.7±3.1
PUG-113-SD	PSNS96.05360	10±6.2	16±3.4
PUG-114-SD	PSNS96.05371	8.6±5.7	12±3.2
PUG-115-SD	PSNS96.05351	7.1±5.4	14±3.3
PUG-116-SD	PSNS96.05353	2.2±4.0	9.3±3.0
PUG-117-SD	PSNS96.05354	8.4±5.8	10±3.1
PUG-118-SD	PSNS96.05350	8.4±6.1	14±3.3
PUG-201-SDS	PSNS96.05376	-0.66±2.8	7.1±2.8
PUG-202-SDS	PSNS96.05377	2.8±3.8	8.0±2.9
PUG-203-SDS	PSNS96.05378	2.1±3.3	9.3±3.0
PUG-204-SDS	PSNS96.05379	1.6±3.4	7.6±2.8
PUG-205-SDS	PSNS96.05380	2.3±3.6	8.5±2.8
PUG-206-SDS	PSNS96.05381	3.5±4.1	6.0±2.8
PUG-207-SDS	PSNS96.05382	-0.080±3.1	11±3.1
PUG-208-SDS	PSNS96.05383	-1.1±2.8	6.6±2.8
PUG-208-SDS-D1	PSNS96.05384	2.3±3.6	8.3±2.8

TABLE A.24 Bremerton POTW* Outfall : Gross Alpha and Beta Activities in Sediment and Sediment Core

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)	
		Gross Alpha	Gross Beta
PUG-101-SD	PSNS96.05282	2.8±4.8	7.1±3.0
PUG-101-SDC-A	PSNS96.07030	6.4±5.0	16±3.4
PUG-101-SDC-B	PSNS96.07031	2.0±3.8	7.3±2.8
PUG-101-SDC-C	PSNS96.07032	14±7.3	13±3.2
PUG-101-SDC-D	PSNS96.07033	9.3±5.7	15±3.4

* POTW = Public Owned Treatment Works.

TABLE A.25 Background : Gross Alpha and Beta Activities in Sediment and Sediment Cores

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)	
		Gross Alpha	Gross Beta
PUG-001-BG-SD	PSNS96.05364	2.7±3.7	10±3.0
PUG-002-BG-SD	PSNS96.05365	4.1±4.2	9.9±2.9
PUG-003-BG-SD	PSNS96.05540	12±6.7	19±3.6
PUG-001-BG-SDC-A	PSNS96.07028	1.6±3.9	10±3.2
PUG-001-BG-SDC-B	PSNS96.07029	12±6.5	12±3.3
PUG-003-BG-SDC-A	PSNS96.07042	21±8.8	16±4.3
PUG-003-BG-SDC-B	PSNS96.07043	11±6.4	14±3.4
PUG-003-BG-SDC-C	PSNS96.07044	11±6.4	16±3.4
PUG-003-BG-SDC-D	PSNS96.07045	8.2±5.2	14±3.3
PUG-201-BG-SDS	PSNS96.05537	3.8±4.3	9.5±3.0
PUG-202-BG-SDS	PSNS96.05538	5.1±4.6	12±3.1
PUG-203-BG-SDS	PSNS96.05539	5.4±4.9	11±3.2

TABLE A.26 Naval Submarine Base - Bangor : Gross Alpha and Beta Activities in Sediment

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)	
		Gross Alpha	Gross Beta
BAN-001-SD	BANG96.05654	2.9±4.1	11±3.7
BAN-002-SD	BANG96.05653	4.8±5.4	12±3.6
BAN-003-SD	BANG96.05655	6.7±5.8	16±3.9
BAN-004-SD	BANG96.05650	3.9±4.4	7.0±2.9
BAN-007-SD	BANG96.05656	-2.0±4.4	11±3.5
BAN-008-SD	BANG96.05652	7.6±5.0	11±3.4
BAN-009-SD	BANG96.05651	3.4±4.5	9.0±3.4
BAN-011-SD	BANG96.05657	3.7±4.0	10±3.6
BAN-013-SD	BANG96.05663	5.2±4.5	13±3.1
BAN-013-SD-D1	BANG96.05664	9.0±5.9	12±3.2
BAN-014-SD	BANG96.05666	6.0±4.8	12±3.2
BAN-015-SD	BANG96.05661	5.6±5.4	13±3.3
BAN-016-SD	BANG96.05662	11±6.2	10±3.0
BAN-017-SD	BANG96.05659	5.3±5.3	9.7±3.5
BAN-017-SD-D1	BANG96.05660	4.1±4.7	11±3.6
BAN-018-SD	BANG96.05665	13±6.7	8.6±2.9
BAN-019-SD	BANG96.05649	9.0±5.6	14±3.3
BAN-020-SD	BANG96.05648	3.8±3.8	12±3.0
BAN-021-SD	BANG96.05678	9.8±6.0	11±3.1
BAN-022-SD	BANG96.05675	5.9±4.9	14±3.3
BAN-023-SD	BANG96.05677	10±5.7	14±3.2
BAN-024-SD	BANG96.05668	8.7±5.3	10±2.9
BAN-025-SD	BANG96.05676	3.4±4.3	9.2±3.0
BAN-026-SD	BANG96.05679	5.7±5.1	6.4±2.8
BAN-027-SD	BANG96.05667	11±6.3	13±3.3
BAN-028-SD	BANG96.05673	8.5±5.8	10±3.0
BAN-029-SD	BANG96.05669	-1.0±1.6	8.0±2.9
BAN-031-SD	BANG96.05674	1.4±3.8	15±3.3
BAN-032-SD	BANG96.05672	1.9±4.0	11±3.0

TABLE A.26–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)	
		Gross Alpha	Gross Beta
BAN-033-SD	BANG96.05671	1.9±3.9	11±3.0
BAN-034-SD	BANG96.05670	6.3±4.8	6.1±2.8
BAN-101-SD	BANG96.05658	6.0±6.4	8.2±3.5
BAN-102-SD	BANG96.05647	3.2±4.3	8.2±2.9
BAN-201-SDS	BANG96.05641	-1.3±2.4	8.4±3.0
BAN-202-SDS	BANG96.05642	2.6±4.4	5.6±2.6
BAN-203-SDS	BANG96.05643	1.5±3.7	9.6±2.9
BAN-203-SDS-D1	BANG96.05644	0.077±2.0	7.6±2.8
BAN-204-SDS	BANG96.05645	-2.6±3.4	12±3.0
BAN-205-SDS	BANG96.05646	2.6±3.6	12±3.2

TABLE A.27 Puget Sound Naval Shipyard : Gross Alpha and Beta Activities in Sediment Cores

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)	
		Gross Alpha	Gross Beta
PUG-102-SDC-A Top 5 cm	PSNS96.07067	2.1±5.3	3.0±3.1
PUG-102-SDC-B Second 7 cm	PSNS96.07068	12±7.2	13±3.9
PUG-103-SDC-A Top 5 cm	PSNS96.07046	9.0±5.6	10±3.1
PUG-103-SDC-B Second 8 cm	PSNS96.07047	2.9±4.1	11±3.1
PUG-104-SDC-A Top 5 cm	PSNS96.07048	3.8±7.4	14±4.1
PUG-104-SDC-B Second 5 cm	PSNS96.07049	6.7±6.3	16±3.8
PUG-104-SDC-C Third 5 cm	PSNS96.07050	5.4±5.4	8.3±3.8
PUG-104-SDC-D Bottom 10 cm	PSNS96.07051	14±6.8	12±3.3
PUG-105-SDC-A Top 5 cm	PSNS96.07052	9.5±6.0	12±3.2
PUG-105-SDC-B Second 5 cm	PSNS96.07053	11±5.8	10±3.0
PUG-105-SDC-C Third 5 cm	PSNS96.07054	14±6.7	13±3.3
PUG-105-SDC-D Bottom 10 cm	PSNS96.07055	13±6.8	16±3.5
PUG-105-SDC-D1-A Top 5 cm	PSNS96.07056	4.1±4.4	12±3.2
PUG-105-SDC-D1-B Second 5 cm	PSNS96.07057	5.0±4.8	14±3.3
PUG-105-SDC-D1-C Bottom 8 cm	PSNS96.07058	13±6.3	15±3.3
PUG-106-SDC-A Top 5 cm	PSNS96.07059	7.5±5.2	15±3.4
PUG-106-SDC-B Second 5 cm	PSNS96.07060	13±6.8	16±3.5

TABLE A.27–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)	
		Gross Alpha	Gross Beta
PUG-106-SDC-C Third 5 cm	PSNS96.07061	7.2±5.4	12±3.2
PUG-106-SDC-D Bottom 9 cm	PSNS96.07062	9.6±5.5	14±3.2
PUG-107-SDC-A Top 5 cm	PSNS96.07063	13±6.6	14±3.4
PUG-107-SDC-B Second 5 cm	PSNS96.07064	6.6±5.3	13±3.3
PUG-107-SDC-C Third 5 cm	PSNS96.07065	8.7±6.7	14±3.8
PUG-107-SDC-D Bottom 18 cm	PSNS96.07066	11±6.7	13±4.1
PUG-108-SDC-A Top 5 cm	PSNS96.07034	5.4±5.5	8.9±3.6
PUG-108-SDC-B Bottom 8 cm	PSNS96.07035	8.0±5.4	9.4±3.6

TABLE A.28 Naval Submarine Base - Bangor : Gross Alpha and Beta Activities in Sediment Cores

Sample ID	NAREL ID	Activity (pCi/g-dry± 2σ counting error)	
		Gross Alpha	Gross Beta
BAN-101-SDC-A Top 5 cm	BANG96.07036	2.7±4.7	9.7±3.5
BAN-101-SDC-B Second 5 cm	BANG96.07037	2.8±4.4	9.1±3.5
BAN-101-SDC-C Third 5cm	BANG96.07038	2.1±4.2	11±3.4
BAN-101-SDC-D Bottom 15 cm	BANAG96.07039	0.0±2.0	9.1±3.5
BAN-102-SDC-A Top 5 cm	BANG96.07040	6.7±7.4	7.8±3.4
BAN-102-SDC-B Bottom 7 cm	BANG96.07041	12±7.3	13±3.9

TABLE A.29 Puget Sound Naval Shipyard : Gamma-Emitting Nuclides in Biota

Sample ID	NAREL ID	Activity (pCi/g-wet ± 2σ counting error)							
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{7}Be	^{212}Bi	^{214}Bi	^{234m}Pa
PUG-001-BSC	PSNS96.05304	ND	ND	ND	0.56±0.079	ND	ND	ND	ND
PUG-001-BB	PSNS96.05303	ND	0.0034±0.0033	ND	0.67±0.048	0.047±0.016	ND	0.035±0.0056	0.27±0.24
PUG-001-BSF	PSNS96.05343	ND	ND	ND	1.4±0.075	ND	ND	ND	ND
PUG-001-BC	PSNS96.05339	ND	ND	ND	1.8±0.086	ND	ND	0.011±0.0080	ND
PUG-002-BC	PSNS96.05341	ND	ND	ND	1.8±0.069	ND	ND	ND	ND
PUG-002-BC-D1	PSNS96.05342	ND	ND	ND	2.0±0.062	ND	ND	0.010±0.0048	ND
PUG-002-BSC	PSNS96.05305	ND	ND	ND	0.61±0.064	ND	ND	ND	ND
PUG-002-BSC-D1	PSNS96.05306	ND	ND	ND	0.71±0.059	ND	ND	ND	ND
PUG-002-BSF	PSNS96.05337	ND	ND	ND	1.2±0.063	ND	ND	ND	ND
PUG-002-BSF-D1	PSNS96.05338	ND	ND	ND	1.0±0.064	ND	ND	ND	0.42±0.34
PUG-003-BGSL	PSNS96.05309	ND	0.018±0.0036	ND	2.3±0.081	ND	ND	0.0070±0.0060	ND
PUG-003-BSF	PSNS96.05308	ND	ND	ND	1.1±0.074	ND	ND	ND	ND
PUG-003-BSC	PSNS96.05307	ND	ND	ND	0.79±0.072	ND	0.032±0.041	ND	0.50±0.44
PUG-003-BC	PSNS96.05340	ND	ND	ND	1.7±0.063	ND	ND	0.018±0.0052	ND
PUG-103-BC	PSNS96.05299	ND	ND	ND	1.8±0.081	ND	ND	0.012±0.0076	ND
PUG-103-BSC	PSNS96.05298	ND	ND	ND	0.74±0.062	ND	ND	ND	ND
PUG-103-BSF	PSNS96.05292	ND	ND	ND	1.1±0.078	ND	ND	ND	ND
PUG-104-BBK	PSNS96.05302	ND	0.16±0.010	ND	10±0.27	0.066±0.040	ND	ND	ND
PUG-105-BC	PSNS96.05293	ND	ND	ND	1.6±0.066	ND	ND	ND	ND
PUG-105-BSC	PSNS96.05284	ND	ND	ND	0.86±0.075	ND	ND	ND	ND
PUG-105-BSA	PSNS96.05300	ND	ND	ND	2.1±0.18	ND	ND	ND	ND
PUG-105-BM	PSNS96.05283	ND	0.0052±0.0028	ND	0.77±0.048	0.029±0.016	ND	0.023±0.0058	ND
PUG-105BSF	PSNS96.05301	ND	ND	ND	1.2±0.051	ND	ND	0.0075±0.0047	ND

ND = Not Detected.

TABLE A.29–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-wet ± 2σ counting error)							
		^{212}Pb	^{214}Pb	^{224}Ra	^{226}Ra	^{228}Ra	^{234}Th	^{208}Tl	^{235}U
PUG-001-BSC	PSNS96.05304	ND	ND	ND	ND	ND	ND	ND	ND
PUG-001-BB	PSNS96.05303	0.0087±0.0043	0.039±0.0046	ND	0.14±0.064	ND	0.17±0.054	0.0026±0.0027	ND
PUG-001-BSF	PSNS96.05343	ND	ND	ND	0.11±0.072	ND	ND	ND	ND
PUG-001-BC	PSNS96.05339	ND	ND	ND	ND	ND	ND	ND	ND
PUG-002-BC	PSNS96.05341	ND	0.013±0.0054	ND	ND	ND	ND	0.0021±0.0028	ND
PUG-002-BC-D1	PSNS96.05342	ND	0.013±0.0039	ND	ND	ND	ND	0.0015±0.0025	ND
PUG-002-BSC	PSNS96.05305	ND	ND	ND	ND	ND	ND	ND	ND
PUG-002-BSC-D1	PSNS96.05306	ND	ND	ND	0.055±0.068	ND	ND	0.0028±0.0040	ND
PUG-002-BSF	PSNS96.05337	ND	0.0064±0.0051	ND	0.15±0.062	ND	0.11±0.052	ND	0.0095±0.0037
PUG-002-BSF-D1	PSNS96.05338	ND	ND	ND	0.15±0.080	ND	0.21±0.061	ND	0.011±0.0042
PUG-003-BGSL	PSNS96.05309	ND	ND	ND	ND	ND	ND	ND	ND
PUG-003-BSF	PSNS96.05308	0.0047±0.0064	ND	0.068±0.055	0.17±0.10	ND	0.15±0.038	ND	ND
PUG-003-BSC	PSNS96.05307	ND	ND	ND	ND	ND	0.074±0.068	ND	ND
PUG-003-BC	PSNS96.05340	0.0050±0.0036	0.013±0.0038	ND	ND	ND	ND	ND	ND
PUG-103-BC	PSNS96.05299	0.0039±0.0062	0.012±0.0068	ND	ND	ND	ND	ND	ND
PUG-103-BSC	PSNS96.05298	ND	ND	ND	0.063±0.078	ND	ND	ND	ND
PUG-103-BSF	PSNS96.05292	ND	0.0084±0.0082	ND	0.13±0.11	ND	0.078±0.039	ND	0.0084±0.0064
PUG-104-BBK	PSNS96.05302	0.0070±0.0078	ND	ND	0.12±0.11	ND	0.16±0.073	ND	ND
PUG-105-BC	PSNS96.05293	ND	0.0085±0.0041	ND	ND	ND	ND	0.0022±0.0029	ND
PUG-105-BSC	PSNS96.05284	ND	ND	ND	ND	ND	0.19±0.080	ND	ND
PUG-105-BSA	PSNS96.05300	ND	ND	ND	ND	ND	ND	ND	ND
PUG-105-BM	PSNS96.05283	0.0057±0.0049	0.024±0.0051	ND	0.081±0.060	ND	0.13±0.052	0.0020±0.0031	0.0058±0.0036
PUG-105BSF	PSNS96.05301	ND	0.0086±0.0039	ND	0.058±0.051	ND	ND	ND	ND

ND = Not Detected.

TABLE A.30 Naval Submarine Base - Bangor : Gamma-Emitting Nuclides in Biota

Sample ID	NAREL ID	Activity (pCi/g-wet ± 2σ counting error)							
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{7}Be	^{212}Bi	^{214}Bi	^{234m}Pa
BAN-001-BC	BANG96.05567	ND	ND	ND	1.9±0.071	ND	ND	0.013±0.0062	ND
BAN-001-BSF	BANG96.05566	ND	ND	ND	0.93±0.054	ND	ND	0.0057±0.0054	ND
BAN-001-BBK	BANG96.05568	ND	ND	ND	12±0.22	ND	ND	ND	ND
BAN-002-BBK	BANG96.05576	ND	ND	ND	13±0.25	ND	ND	ND	ND
BAN-002-BSF	BANG96.05565	ND	ND	ND	1.2±0.071	ND	ND	ND	ND
BAN-101-BC	BANG96.05559	ND	ND	ND	1.8±0.073	ND	ND	0.019±0.0059	ND
BAN-101-BSF	BANG96.05560	ND	ND	ND	1.1±0.075	ND	ND	ND	ND
BAN-101-BGSL	BANG96.05557	ND	ND	ND	3.3±0.098	ND	ND	ND	ND
BAN-101-BSG	BANG96.05558	ND	ND	ND	4.6±0.011	0.11±0.022	ND	0.0086±0.0067	0.29±0.44
BAN-102-BC	BANG96.05570	ND	ND	ND	1.8±0.13	ND	ND	0.019±0.0093	ND
BAN-102-BSF	BANG96.05569	ND	ND	ND	1.4±0.069	ND	ND	ND	0.29±0.34
BAN-102-BSG	BANG96.05572	ND	ND	ND	5.1±0.24	0.13±0.048	ND	ND	ND
BAN-103-BSF	BANG96.05577	ND	ND	ND	1.5±0.065	ND	ND	ND	ND
BAN-103-BM	BANG96.05564	ND	ND	ND	0.95±0.072	0.11±0.026	ND	0.030±0.0083	0.73±0.51
BAN-103-BGSL	BANG96.05575	ND	ND	ND	3.5±0.10	0.060±0.021	0.055±0.047	0.062±0.0079	0.90±0.36
BAN-104-BSF	BANG96.05571	ND	ND	ND	1.0±0.062	ND	ND	ND	ND
BAN-104-BC	BANG96.05573	ND	ND	ND	2.0±0.081	ND	ND	0.014±0.0068	ND
BAN-104-BBK	BANG96.05561	ND	ND	ND	9.6±0.26	ND	ND	ND	ND
BAN-104-BBKR	BANG96.05574	ND	ND	ND	6.6±0.16	ND	ND	ND	ND
BAN-105-BGSL	BANG96.05563	ND	ND	ND	2.7±0.083	0.14±0.026	0.038±0.037	0.055±0.0070	ND
BAN-105-BBSH	BANG96.05562	ND	ND	ND	11±0.19	0.10±0.032	ND	0.024±0.0086	0.61±0.51
BAN-106-BO	BANG96.05595	ND	ND	ND	2.3±0.082	ND	ND	0.090±0.0084	ND
BAN-107-BO	BANG96.05596	ND	ND	ND	1.4±0.075	ND	ND	ND	ND

ND = Not Detected.

TABLE A.30–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-wet ± 2σ counting error)							
		^{212}Pb	^{214}Pb	^{224}Ra	^{226}Ra	^{228}Ra	^{234}Th	^{208}Tl	^{235}U
BAN-001-BC	BANG96.05567	0.0054±0.0047	0.013±0.0055	ND	0.055±0.056	ND	0.088±0.041	ND	ND
BAN-001-BSF	BANG96.05566	ND	0.0084±0.0042	ND	0.081±0.053	ND	0.11±0.038	0.0025± 0.0031	ND
BAN-001-BBK	BANG96.05568	0.0083±0.0093	ND	ND	0.12±0.12	ND	ND	ND	ND
BAN-002-BBK	BANG96.05576	ND	ND	ND	ND	ND	ND	ND	ND
BAN-002-BSF	BANG96.05565	ND	ND	ND	0.064±0.085	ND	0.11±0.058	ND	0.0059±0.0048
BAN-101-BC	BANG96.05559	ND	0.011±0.0055	ND	ND	ND	ND	ND	ND
BAN-101-BSF	BANG96.05560	ND	0.0072±0.0057	ND	0.10±0.072	ND	ND	ND	ND
BAN-101-BGSL	BANG96.05557	0.0051±0.0058	ND	ND	0.048±0.068	ND	0.13±0.053	ND	ND
BAN-101-BSG	BANG96.05558	0.0081±0.0062	ND	ND	ND	ND	0.34±0.064	ND	ND
BAN-102-BC	BANG96.05570	0.0062±0.0068	0.019±0.0072	ND	ND	ND	ND	ND	ND
BAN-102-BSF	BANG96.05569	0.0035±0.0043	ND	0.049±0.044	0.11±0.064	ND	0.10±0.048	ND	ND
BAN-102-BSG	BANG96.05572	0.023±0.011	0.025±0.012	ND	0.18±0.14	ND	0.38±0.11	0.0070±0.0083	0.012±0.0078
BAN-103-BSF	BANG96.05577	ND	ND	ND	0.085±0.057	ND	0.11±0.040	0.0018±0.0030	ND
BAN-103-BM	BANG96.05564	0.0051±0.0066	0.037±0.075	ND	0.13±0.10	ND	0.64±0.050	ND	ND
BAN-103-BGSL	BANG96.05575	0.062±0.0069	0.067±0.072	ND	0.13±0.083	0.058±0.010	0.86±0.067	0.020±0.0040	0.0091±0.0048
BAN-104-BSF	BANG96.05571	ND	0.0070±0.0050	ND	0.12±0.066	ND	0.12±0.046	ND	ND
BAN-104-BC	BANG96.05573	ND	0.015±0.0053	ND	ND	ND	0.062±0.045	ND	ND
BAN-104-BBK	BANG96.05561	ND	ND	ND	ND	ND	0.12±0.066	ND	ND
BAN-104-BBKR	BANG96.05574	ND	ND	ND	ND	ND	ND	0.0050±0.0059	ND
BAN-105-BGSL	BANG96.05563	0.058±0.0071	0.063±0.0067	ND	0.16±0.075	0.051±0.0089	0.28±0.076	0.021±0.0039	0.010±0.0044
BAN-105-BBSH	BANG96.05562	0.019±0.0073	0.031±0.0076	ND	ND	ND	0.24±0.065	0.0047±0.0047	ND
BAN-106-BO	BANG96.05595	0.023±0.0078	0.056±0.0079	ND	ND	ND	ND	0.011±0.0038	ND
BAN-107-BO	BANG96.05596	ND	ND	ND	0.063±0.071	ND	0.056±0.061	ND	ND

ND = Not Detected.

TABLE A.31 Bremerton POTW* Outfall : Gamma-Emitting Nuclides in Biota

Radionuclide	Activity (pCi/g-wet ± 2σ counting error)		
	PUG-101-BSF(1)	PUG-101-BSA(2)	PUG-101-BSC(3)
^{60}Co	ND	ND	ND
^{131}I	ND	ND	ND
^{137}Cs	ND	ND	ND
^{40}K	1.3±0.052	2.0±0.091	0.84±0.11
^{7}Be	ND	ND	ND
^{212}Bi	ND	ND	ND
^{214}Bi	ND	ND	ND
^{234m}Pa	ND	ND	ND
^{212}Pb	ND	ND	ND
^{214}Pb	0.0088±0.0039	ND	ND
^{224}Ra	ND	ND	ND
^{226}Ra	0.14±0.055	0.063±0.089	0.060±0.092
^{228}Ra	ND	ND	ND
^{234}Th	0.095±0.044	ND	0.16±0.058
^{208}Tl	ND	0.0032±0.0040	ND
^{235}U	0.0083±0.0033	ND	ND

* POTW = Public Owned Treatment Works.
(1) NAREL ID = PSNS96.05295.
(2) NAREL ID = PSNS96.05294.
(3) NAREL ID = PSNS96.05281.
ND = Not Detected.

TABLE A.32 Background : Gamma-Emitting Nuclides in Biota

Sample ID	NAREL ID	Activity (pCi/g-wet ± 2σ counting error)							
		^{60}Co	^{131}I	^{137}Cs	^{40}K	^{7}Be	^{212}Bi	^{214}Bi	^{234m}Pa
PUG-001-BG-BOSA	PSNS96.05285	ND	ND	ND	2.0±0.075	ND	ND	ND	ND
PUG-001-BG-BSF	PSNS96.05286	ND	ND	ND	1.0±0.060	ND	ND	ND	0.88±0.34
PUG-001-BG-BC	PSNS96.05287	ND	ND	ND	2.2±0.092	ND	ND	ND	ND
PUG-002-BG-BC	PSNS96.05291	ND	ND	ND	2.1±0.065	ND	ND	0.020±0.0052	ND
PUG-002-BG-BSF	PSNS96.05289	ND	ND	ND	1.9±0.072	ND	ND	ND	ND
PUG-002-BG-BGSL	PSNS96.05288	ND	0.012±0.011	ND	6.0±0.26	ND	ND	ND	ND
PUG-003-BG-BBK	PSNS96.05502	ND	0.012±0.0096	ND	16±0.33	ND	ND	ND	1.2±1.1
PUG-003-BG-BGSL	PSNS96.05503	ND	ND	ND	2.5±0.084	0.042±0.021	0.041±0.032	0.015±0.0063	ND
PUG-003-BG-BC	PSNS96.05500	ND	ND	ND	3.6±0.14	ND	ND	0.034±0.013	0.55±0.70
PUG-003-BG-B ? *	PSNS96.05501	ND	ND	ND	1.8±0.084	ND	ND	ND	ND

* "?" refers to plant biota which could not be identified.

ND = Not Detected.

TABLE A.32–*Continued*

Sample ID	NAREL ID	Activity (pCi/g-wet ± 2σ counting error)							
		^{212}Pb	^{214}Pb	^{224}Ra	^{226}Ra	^{228}Ra	^{234}Th	^{208}Tl	^{235}U
PUG-001-BG-BOSA	PSNS96.05285	0.0057±0.0045	ND	ND	ND	ND	ND	0.0028±0.0030	ND
PUG-001-BG-BSF	PSNS96.05286	ND	0.010±0.0054	ND	ND	ND	0.54±0.062	0.0020±0.0034	0.033±0.0040
PUG-001-BG-BC	PSNS96.05287	ND	ND	ND	ND	ND	ND	ND	ND
PUG-002-BG-BC	PSNS96.05291	0.0079±0.0046	0.018±0.0042	ND	ND	ND	ND	0.0018±0.0028	ND
PUG-002-BG-BSF	PSNS96.05289	0.0058±0.0047	0.0089±0.0057	ND	0.072±0.057	ND	0.10±0.047	0.0025±0.0029	ND
PUG-002-BG-BGSL	PSNS96.05288	0.012±0.020	ND	ND	ND	ND	ND	ND	ND
PUG-003-BG-BBK	PSNS96.05502	0.017±0.015	ND	ND	ND	ND	0.34±0.083	0.0082±0.0098	ND
PUG-003-BG-BGSL	PSNS96.05503	0.014±0.0051	0.018±0.0047	ND	0.053±0.061	ND	0.18±0.043	0.0061±0.0033	ND
PUG-003-BG-BC	PSNS96.05500	0.013±0.010	0.035±0.010	ND	0.071±0.11	ND	ND	0.0080±0.0070	ND
PUG-003-BG-B?*	PSNS96.05501	ND	ND	ND	ND	ND	ND	ND	ND

* "?" refers to plant biota which could not be identified.

ND = Not Detected.

TABLE A.33 Puget Sound Naval Shipyard : Gross Alpha and Beta Activities in Biota

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)	
		Gross Alpha	Gross Beta
PUG-001-BSC	PSNS96.05304	2.1±2.3	11±2.0
PUG-001-BB	PSNS96.05303	7.1±4.9	7.2±2.6
PUG-001-BSF	PSNS96.05343	1.0±1.8	3.9±1.4
PUG-001-BC	PSNS96.05339	1.8±2.5	6.2±1.8
PUG-002-BC	PSNS96.05341	-0.66±1.4	6.2±1.6
PUG-002-BC-D1	PSNS96.05342	2.0±2.1	8.4±1.6
PUG-002-BSC	PSNS96.05305	2.6±1.8	8.8±1.4
PUG-002-BSC-D1	PSNS96.05306	1.9±1.7	11±1.7
PUG-002-BSF	PSNS96.05337	1.8±2.2	3.9±1.4
PUG-002-BSF-D1	PSNS96.05338	1.2±2.1	5.2±1.6
PUG-003-BGSL	PSNS96.05309	0.61±1.4	23±2.2
PUG-003-BSF	PSNS96.05308	3.3±2.8	5.8±1.7
PUG-003-BSC	PSNS96.05307	3.8±2.5	13±1.9
PUG-003-BC	PSNS96.05340	0.49±1.9	6.5±1.7
PUG-103-BC	PSNS96.05299	1.6±2.4	11±2.0
PUG-103-BSC	PSNS96.05298	2.4±2.4	14±2.0
PUG-103-BSF	PSNS96.05577	0.28±1.8	24±2.6
PUG-104-BBK	PSNS96.05302	0.91±0.85	38±1.8
PUG-105-BC	PSNS96.05293	1.3±2.1	9.4±2.0
PUG-105-BSC	PSNS96.05284	0.090±0.18	1.2±0.19
PUG-105-BSA	PSNS96.05300	1.3±0.74	11±0.82
PUG-105-BM	PSNS96.05283	5.1±4.6	4.3±2.3
PUG-105-BSF	PSNS96.05301	3.0±2.7	6.6±1.8

TABLE A.34 Naval Submarine Base - Bangor : Gross Alpha and Beta Activities in Biota

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)	
		Gross Alpha	Gross Beta
BAN-001-BC	BANG96.05567	2.0±2.3	8.6±1.8
BAN-001-BSF	BANG96.05566	3.7±3.2	7.7±1.8
BAN-001-BBK	BANG96.05568	0.75±1.1	79±3.1
BAN-002-BBK	BANG96.05576	1.5±1.5	111±4.2
BAN-002-BSF	BANG96.05565	3.8±2.6	8.0±1.7
BAN-101-BC	BANG96.05559	1.5±2.0	6.4±1.6
BAN-101-BSF	BANG96.05560	1.8±2.3	8.4±1.8
BAN-101-BGSL	BANG96.05557	0.28±1.8	24±2.6
BAN-101-BSG	BANG96.05558	3.3±2.5	36±2.9
BAN-102-BC	BANG96.05570	2.8±2.7	7.5±1.8
BAN-102-BSF	BANG96.05569	5.0±2.7	13±1.8
BAN-102-BSG	BANG96.05572	4.6±3.4	32±3.1
BAN-103-BSF	BANG96.05577	3.8±2.2	15±1.7
BAN-103-BM	BANG96.05564	2.6±3.1	8.6±2.7
BAN-103-BGSL	BANG96.05575	7.6±4.8	17±3.1
BAN-104-BSF	BANG96.05571	2.4±2.7	8.2±1.9
BAN-104-BC	BANG96.05573	3.2±2.5	11±2.0
BAN-104-BBK	BANG96.05561	1.1±1.1	63±2.8
BAN-104-BBKR	BANG96.05574	*	*
BAN-105-BGSL	BANG96.05563	1.8±2.6	26±3.2
BAN-105-BBSH	BANG96.05562	1.7±2.2	110±5.6
BAN-106-BO	BANG96.05595	2.9±2.1	21±1.9
BAN-107-BO	BANG96.05596	2.5±2.0	12±1.8

* Vessel broke during the ashing process, and there was no sample left for the gross alpha and beta analysis.

TABLE A.35	Bremerton POTW* Outfall : Gross Alpha and Beta Activities in Biota		
Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)	
		Gross Alpha	Gross Beta
PUG-101-BSF	PSNS96.05295	2.9±2.6	7.1±1.7
PUG-101-BSA	PSNS96.05294	0.50±0.64	14±1.0
PUG-101-BSC	PSNS96.05281	2.7±2.6	13±2.0

*POTW = Public Owned Treatment Works.

TABLE A.36	Background : Gross Alpha and Beta Activities in Biota		
Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)	
		Gross Alpha	Gross Beta
PUG-001-BG-BOSA	PSNS96.05285	1.1±1.2	14±1.4
PUG-001-BG-BSF	PSNS96.05286	6.4±3.7	5.4±1.8
PUG-001-BG-BC	PSNS96.05287	0.43±1.8	9.5±1.8
PUG-002-BG-BC	PSNS96.05291	0.36±1.8	8.8±1.9
PUG-002-BG-BSF	PSNS96.05289	2.0±2.2	9.7±1.6
PUG-002-BG-BGSL	PSNS96.05288	0.053±1.2	29±2.1
PUG-003-BG-BBK	PSNS96.05502	1.6±2.1	90±4.8
PUG-003-BG-BGSL	PSNS96.05503	2.6±2.6	29±3.1
PUG-003-BG-BC	PSNS96.05500	0.88±2.5	7.7±1.8
PUG-003-BG-B ?*	PSNS96.05501	3.3±2.8	12±2.1

* "?" refers to plant biota which could not be identified.

TABLE A.37 Puget Sound Naval Shipyard : Uranium, Thorium, Plutonium and ^{226}Ra in Sediment, Sediment Cores and Biota

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)									
		^{234}U	^{235}U	^{238}U	^{227}Th	^{228}Th	^{230}Th	^{232}Th	^{238}Pu	$^{239/240}Pu$	^{226}Ra
PUG-008-SD	PSNS96.05393	0.91±0.14	0.035± 0.030	0.89±0.14	0.032± 0.030	0.34± 0.081	0.64± 0.092	0.42± 0.074	0.024± 0.086	0.020± 0.045	0.66± 0.042
PUG-026-SD	PSNS96.05523	0.73±0.12	0.054± 0.033	0.64±0.11	0.042± 0.033	0.24± 0.076	0.34± 0.069	0.23± 0.056	0.00± 0.068	0.016± 0.035	0.40± 0.031
PUG-032-SD	PSNS96.05535	0.78±0.11	0.040± 0.026	0.68±0.10	0.029± 0.028	0.24± 0.074	0.43± 0.076	0.29± 0.063	-0.017± 0.063	0.039± 0.045	0.47± 0.034
PUG-062-SD	PSNS96.05357	0.68±0.12	0.038± 0.031	0.47± 0.099	0.014± 0.024	0.33± 0.069	0.37± 0.061	0.31± 0.057	-0.033± 0.047	0.061± 0.049	0.40± 0.030
PUG-109-SD	PSNS96.05507	0.76± 0.097	0.064± 0.029	0.81±0.10	0.036± 0.026	0.25± 0.062	0.42± 0.065	0.35± 0.059	0.0024± 0.016	0.036± 0.036	0.47± 0.034
PUG-105-SDC-D1-C	PSNS96.07058	0.86±0.12	0.086± 0.038	0.82±0.11	0.025± 0.022	0.37± 0.075	0.46± 0.071	0.36± 0.062	0.014± 0.015	0.00± 0.00	0.62± 0.039
PUG-105-BSA	PSNS96.05300	0.030 ± 0.0084	0.00087± 0.0020	0.033± 0.0087	-0.00044± 0.00062	-0.0031± 0.0050	0.0018± 0.0016	0.00072± 0.0010	0.0020± 0.0014	-0.00041± 0.00058	0.014± 0.0028

TABLE A.38 Naval Submarine Base - Bangor : Uranium, Thorium, Plutonium and ^{226}Ra in Sediment, Water and Biota

Sample ID	NAREL ID	Activity (pCi/g-dry ± 2σ counting error)									
		^{234}U	^{235}U	^{238}U	^{227}Th	^{228}Th	^{230}Th	^{232}Th	^{238}Pu	$^{239/240}Pu$	^{226}Ra
BAN-002-BSF	BANG96.05565	1.0±0.10	0.035± 0.019	0.94± 0.097	-0.0023± 0.012	0.014± 0.028	0.0044± 0.0081	-0.0013± 0.0047	-0.0022± 0.015	0.0015± 0.0068	0.058± 0.012
BAN-006-W	BANG96.05687	1.1±0.36	-0.052± 0.11	0.98± 0.33	0.13± 0.18	0.10± 0.30	0.30± 0.18	0.055 ±0.15	-0.013± 0.13	0.0065± 0.062	0.12± 0.013
BAN-018-SD	BANG96.05665	0.25± 0.061	0.017± 0.017	0.23± 0.059	0.004± 0.019	0.22± 0.070	0.18± 0.049	0.22± 0.054	0.00± 0.013	0.011± 0.015	0.41± 0.034
BAN-019-SD	BANG96.05649	0.41± 0.074	0.023± 0.020	0.35± 0.068	0.039 0.031	0.28± 0.074	0.30± 0.062	0.30± 0.062	-0.019± 0.042	0.0024± 0.022	0.49± 0.037
BAN-103-BGSL	BANG96.05575	0.31± 0.069	0.014± 0.020	0.25± 0.062	-0.0057± 0.015	0.15± 0.062	0.16± 0.046	0.20± 0.050	0.026± 0.051	0.00± 0.00	0.33± 0.028