UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

December 14, 2005

Mr. Douglas Thelin
Department of the Navy
Naval Facilities Engineering Command Northwest
19917 7th Avenue NE
Poulsbo, WA 98370

Dear Mr. Thelin:

EPA Region 10 has reviewed the Second Five Year Review report for Naval Undersea Warfare Center, Keyport, Washington, dated May 2005; the Errata Sheet to the Second Five Year Review, signed October 27, 2005; and the transmittal letter signed by Cindy O'Hare, dated November 9, 2005. EPA has reviewed the report and supplemental documents for technical adequacy, accuracy, and consistency with EPA guidance. EPA's conclusions are based primarily on the information presented in this report. The Washington Department of Ecology is the lead regulatory agency overseeing this cleanup.

Based on this review, EPA concurs with the Navy's October 2005 recommendations and findings. However, it is important that the Navy works with Ecology to ensure that adequate data will be collected over the next few years to assess the concentration trends and the need for further action, particularly at OU 8.

If you have any questions, please contact Nancy Harney of my staff at (206) 553-6635.

Sincerely,

Daniel D. Opalski, Director
Office of Environmental Cleanup

cc: Cindy O'Hare, NAVFAC NW
Chung Yee, Ecology
Denise Taylor, Suquamish Tribe

Final
12 May 2005

Second Five-Year Review of Records of Decision

Operable Unit 1 and Operable Unit 2

Naval Undersea Warfare Center
Keyport, Washington

Department of the Navy
Naval Facilities Engineering Command
Engineering Field Activity, Northwest
19917 Seventh Avenue NE
Poulsbo, WA 98370-7570

EXECUTIVE SUMMARY

As lead agency for environmental cleanup of Naval Undersea Warfare Center (NUWC), Keyport, Washington, the U.S. Navy has completed the second 5-year review of the remedial actions at Operable Unit 1 (OU 1) and OU 2 conducted pursuant to Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The purpose of this 5-year review is to ensure that the remedial actions selected in the Records of Decision (ROD) for OU 1 and OU 2 at NUWC remain protective of human health and the environment. A 5-year review is required for this site because the remedies allow contaminants to remain in place at concentrations that do not allow unlimited site use and unrestricted exposure. This second 5-year review was prepared in accordance with *Navy/Marine Corps Policy for Conducting Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Statutory Five-Year Reviews*, November 2001 (Revised May 2004) and the U.S. Environmental Protection Agency's *Comprehensive Five-Year Review Guidance* (OSWER 9355.7-03B-P, June 2001).

The remedies for all areas of OU 1 and OU 2 are expected to be protective of human health once natural attenuation processes degrade chemicals of concern (COCs) to below remediation goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled and monitored. Future protectiveness requires adherence to the institutional controls and operation and maintenance programs necessary to prevent unacceptable exposures. With the exception of OU 2 Area 8, the remedies for OU 1 and OU 2 are also expected to be protective of the environment, and exposure pathways that could result in unacceptable risks are being controlled and monitored. At OU 2 Area 8, additional evaluation is required to determine whether there are unacceptable impacts to marine biota from cadmium.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from WasteLAN)*: Naval Undersea Warfare Center (NUWC) Keyport

EPA ID *(from WasteLAN)*: WA11700243419

Region: 10	**State:** WA	**City/County:** Kitsap

SITE STATUS

NPL status: Final **X** Deleted Other (specify)____________________

Remediation status (choose all that apply): Under Construction Operating **X** Complete **X**

Multiple OUs?* YES **X** NO	**Construction completion date:** 06/27/2000 (OU 1)

Has site been put into reuse? YES **X** NO

REVIEW STATUS

Lead agency: EPA State Tribe Other Federal Agency: <u>Navy</u>

Author name: Douglas Thelin

Author title: Remedial Project Manager	**Author affiliation:** Engineering Field Activity NW, Navy

Review period:** 08/30/00 to 06/28/05

Date(s) of site inspection: October 6, 2004

Type of review:

Post-SARA **X** Pre-SARA NPL-Removal only
Non-NPL Remedial Action Site NPL State/Tribe-lead
Regional Discretion

Review number: 2 (second)

Triggering action:

Actual RA Onsite Construction at OU 1
Construction Completion
Other (specify):____________________
Actual RA Start at OU 1
[✓ Previous Five-Year Review Report]

Triggering action date *(from WasteLAN)*: August 2000

Due date *(five years after triggering action date)*: 08/31/2005

*[“OU” refers to operable unit.]

**[Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form (Cont'd)

Issues:

- The institutional controls management plan has not yet been revised to include Site 23.
- An unacceptable risk to marine biota may be present at OU 2 Area 8.
- Possible upward-trending chemicals of concern (COC) concentrations in a beach seep at OU 2 Area 8 suggest the possibility of a future human health risk.
- New information regarding 1,4-dioxane indicates that it may be a new chemical of interest at OU 1 and OU 2 Area 8.

Recommendations and Follow-up Actions:

- Revise the institutional controls management plan to include Site 23.
- Discontinue independent remedial action petroleum monitoring at OU 2 Area 8.
- Continue long-term monitoring programs as currently established at OU 1 and OU 2, including sediment and shellfish monitoring.
- Perform further investigation of aquatic biota in Liberty Bay offshore from OU 2 Area 8 to assess possible impacts from cadmium.
- During the next 5-year review, assess the protectiveness of the remediation goal for trichloroethene (TCE), considering the final revised value for the TCE oral slope factor.
- Consider assessing the presence or absence of 1,4-dioxane in groundwater at OU 1 and OU 2 Area 8.

Protectiveness Statement(s):

The remedies for all areas of OU 1 and OU 2 are expected to be protective of human health once natural attenuation processes degrade chemicals of concern (COCs) to below remediation goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled and monitored. Future protectiveness requires adherence to the institutional controls and operation and maintenance programs necessary to prevent unacceptable exposures. With the exception of OU 2 Area 8, the remedies for OU 1 and OU 2 are also expected to be protective of the environment, and exposure pathways that could result in unacceptable risks are being controlled and monitored. At OU 2 Area 8, additional evaluation is required to determine whether there are unacceptable impacts to marine biota from cadmium.

Other Comments:

Signature sheet for the Naval Undersea Warfare Center second five-year review of Record of Decision for Operable Unit 1 and Operable Unit 2 report.

D. Biesel

D.T. Biesel
Captain
Naval Base Kitsap
Commanding Officer

6/5/05
Date

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ABBREVIATIONS AND ACRONYMS

AE	assessment endpoint
AET	apparent effects threshold
ARAR	applicable or relevant and appropriate requirement
ASIL	acceptable source impact level
bgs	below ground surface
CAHs	chlorinated aliphatic hydrocarbons
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chemical of concern
COI	chemical of interest
COPEC	chemical of potential ecological concern
CRA	contingent remedial action
CR(VI)	chromium VI
DCA	dichloroethane
DCE	dichloroethene
DNAPL	dense nonaqueous-phase liquid
Ecology	Washington State Department of Ecology
EFA NW	Engineering Field Activity, Northwest
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Difference
FS	feasibility study
g/day	gram per day
HQ	hazard quotient
IAS	initial assessment study
IRIS	Integrated Risk Information System
LTM	long-term monitoring
MATC	maximum acceptable tissue concentration
MCL	maximum contaminant level
µg/kg	microgram per kilogram
µg/L	microgram per liter
mg/kg	milligram per kilogram
mg/kg-d	milligram per kilogram per day
msl	mean sea level
MTCA	Model Toxics Control Act
MW	monitoring well
Navy	U.S. Navy
NCEA	National Center for Environmental Assessment

ABBREVIATIONS AND ACRONYMS (Continued)

NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NTR	national toxics rule
NUWC	Naval Undersea Warfare Center
OEHHA	Office of Environmental Health Hazard Assessment (State of California)
O&M	operation and maintenance
OM&M	operation, maintenance, and monitoring
OU	operable unit
PCB	polychlorinated biphenyl
PCS	petroleum-contaminated soil
PQL	practical quantitation limit
PRG	preliminary remediation goal
PSCAA	Puget Sound Clean Air Agency
PSEP	Puget Sound Estuary Program
RAB	Restoration Advisory Board
RAO	remedial action objective
redox	oxidation reduction
RfD	reference dose
RG	remediation goal
RI	remedial investigation
RME	reasonable maximum exposure
ROD	Record of Decision
SIM	selected ion monitoring
SLERA	screening level ecological risk assessment
SQS	sediment quality standard
SVOC	semivolatile organic compound
TCA	trichloroethane
TCE	trichloroethene
TPH	total petroleum hydrocarbons
TRC	Technical Review Committee
TSV	tissue screening value
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compound
WAC	Washington Administrative Code

1.0 INTRODUCTION

This report presents the results of the second 5-year review performed for the Naval Undersea Warfare Center, Keyport (NUWC Keyport) National Priorities List (NPL) site (Figure 1-1). The purpose of a 5-year review is to determine whether the remedies selected for implementation in the Record of Decision (ROD) for a site are protective of human health and the environment. The methods, findings, and conclusions of 5-year reviews are documented in 5-year review reports, which identify any issues found during the review and provide recommendations to address them.

The U.S. Navy (Navy), the lead agency for NUWC Keyport, is preparing this 5-year review report pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40 Code of Federal Regulations [CFR] Part 300). CERCLA Section 121 states the following:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

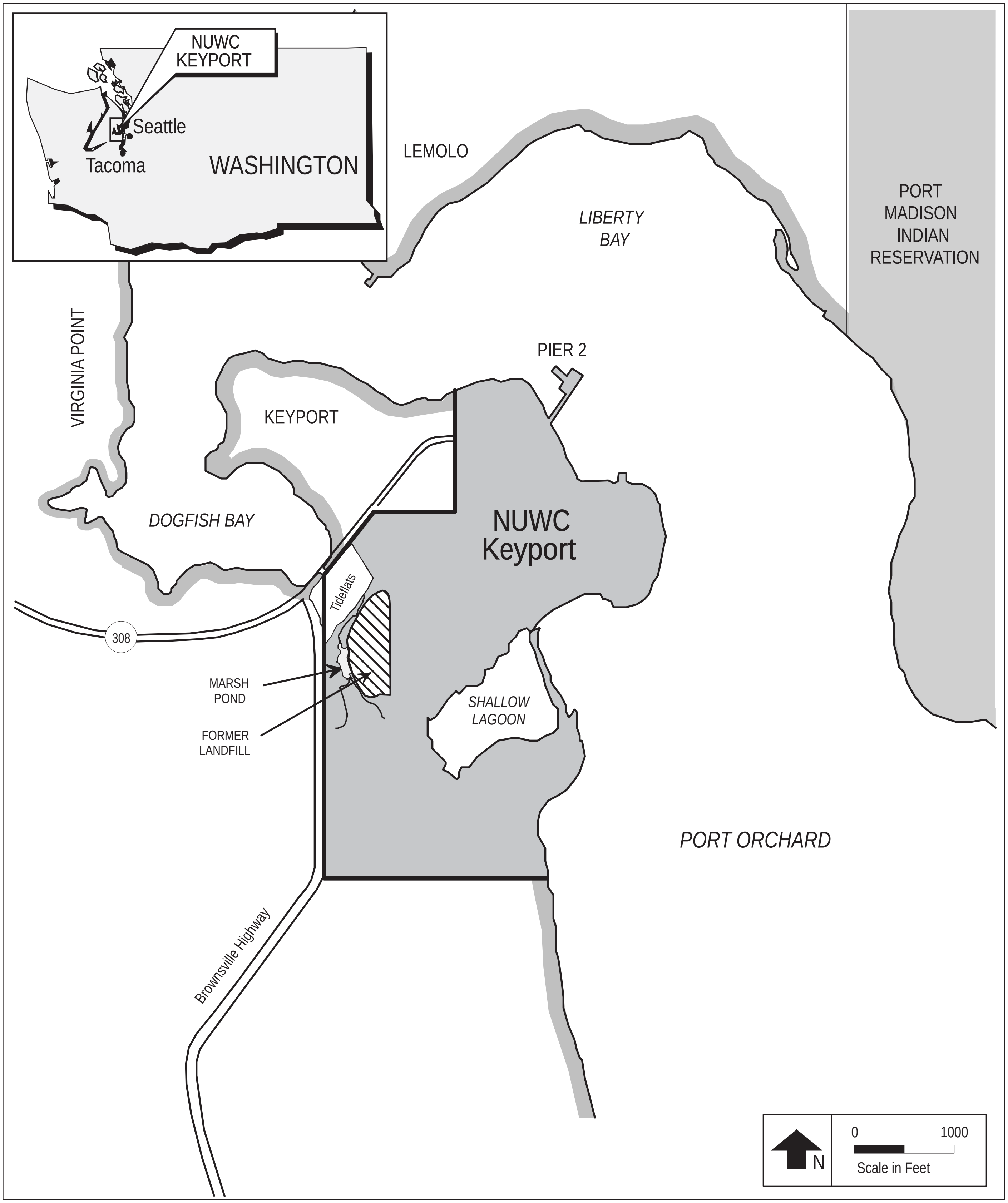
The Navy's Engineering Field Activity, Northwest (EFA NW) has conducted this 5-year review of the remedial actions implemented at NUWC Keyport. This review was conducted from September 2004 through April 2005, and this report documents the results of the review.

This report covers the remedies selected in the signed RODs for Operable Unit 1 (OU 1) and OU 2 (U.S. Navy, USEPA, and Ecology 1998; U.S. Navy, USEPA, and Ecology 1994).

This is the second 5-year review for NUWC Keyport. The triggering action for this review was the completion of the first 5-year review in August 2000. Contaminants have been left at NUWC Keyport above levels that allow for unlimited use and unrestricted exposure.

The RODs documenting the remedies implemented at NUWC Keyport OU 1 and OU 2 were signed after October 17, 1986. Therefore, this is considered a statutory, rather than a policy, review.

This report was prepared as part of the CERCLA 5-year review process using Navy and U.S. Environmental Protection Agency (EPA) guidance (U.S. Navy 2004b and USEPA 2001a).



U.S. NAVY

Figure 1-1
NUWC Keyport Vicinity Map

Delivery Order 0043
NUWC Keyport
SECOND FIVE-YEAR REVIEW

2.0 SITE CHRONOLOGY

The substantive events in the chronology of NUWC Keyport related to site discovery, investigation, and remediation are listed below. Details of these site activities follow.

- 1984: Discovery and preliminary assessment
- 1989: Placed on National Priorities List
- 1990: Navy, EPA, and Washington State Department of Ecology (Ecology) enter into interagency agreement
- 1993: Remedial investigation/feasibility study (RI/FS) complete
- 1994: Separation of site into OU 1 and OU 2
- 1994: Record of Decision for OU 2
- 1996: Explanation of Significant Difference (ESD) for the OU 2 ROD
- 1998: Record of Decision for OU 1
- 1999: Time-critical removal action conducted for Site 23 discovered post-OU 2 ROD
- 2000: Remedial actions complete at OU 2
- 2000: First 5-year review for OU 1 and OU 2 completed
- 2000: Final closeout report completed for Site 23; site added to institutional controls program

In September 1984, the Navy conducted an initial assessment study (IAS), under the Navy Assessment and Control of Installation Pollutants program, to identify areas of possible environmental contamination resulting from past methods of storage, handling, and disposal of hazardous substances at NUWC Keyport (U.S. Navy 1984). In October 1989, NUWC Keyport was officially listed on the NPL. In response to the NPL designation, the Navy, EPA, and Ecology entered into an interagency federal facilities agreement (FFA) in July 1990 for the investigation, remediation, and restoration of the site.

Subsequent to the IAS, six specific areas (Areas 1, 2, 3, 5, 8, and 9) were recommended for further investigation in the RI/FS. Under the Environmental Restoration Program, the RI/FS process for these six areas began in 1988 and the final RI/FS reports were submitted in October and November of 1993 (U.S. Navy 1993). During the public comment period for the proposed plan, significant public concerns were identified regarding Area 1 (the former base landfill). Therefore, it was determined that the site should be divided into two OUs for efficient administrative handling of the remediation of the site (Figure 2-1). OU 1 consists of Area 1 (the former base landfill), and OU 2 consists of the remaining areas of concerns (Areas 2, 3, 5, 8, and 9).

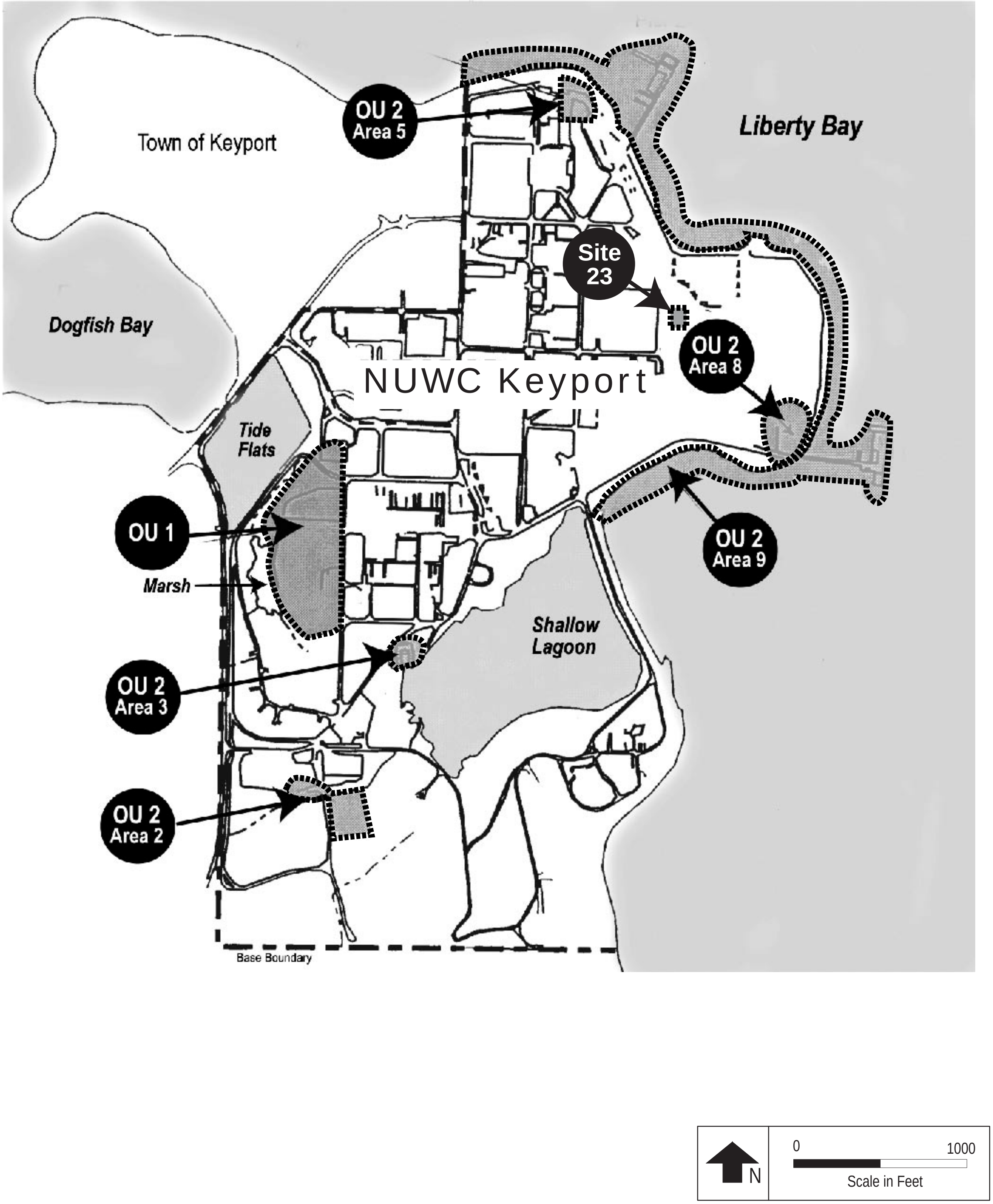
Two separate RODs were prepared for NUWC Keyport: the ROD for OU 2 was signed September 28, 1994 (U.S. Navy, USEPA, and Ecology 1994), and the ROD for OU 1 was signed September 30, 1998 (U.S. Navy, USEPA, and Ecology 1998). The ROD for OU 2 was modified by one ESD dated March 15, 1996 (U.S. Navy, USEPA, and Ecology 1996). The ESD delayed completing soil removal at OU 2 Area 8 until after the plating building was demolished and changed the determination of the amount of soil to be removed to be based on total chromium analyses instead of hexavalent chromium analyses.

After the ROD for OU 2 was approved in September 1994, remedial actions were implemented at the five areas within OU 2 from 1995 through 2000. After remedial actions were completed at Areas 3, 5, and 9, determinations of “no further action” were issued for these areas (U.S. Navy 2000b).

The ROD for OU 1 was signed in September of 1998, and remedial actions occurred from late 1998 through 2000.

The Navy performed a time-critical removal action at Site 23 under CERCLA as a part of the Building 21 demolition. The time-critical removal action was conducted under an Action Memorandum signed in July 1999. Although Site 23 was not included as one of the original sites to be investigated and was not included in the OU 2 ROD, the results of this time-critical removal action were included in the first 5-year review because the removal action was performed under CERCLA (U.S. Navy 2000b). The risks remaining at the site after completion of the time-critical removal action were demonstrated to be protective of human health and the environment with institutional controls (U.S. Navy 2000b). This site was therefore to be added to the institutional controls plan (U.S. Navy 2000a). However, no documentation of a revision to the institutional controls plan was found as part of this second 5-year review.

Post-ROD activities at the site are described in Sections 4 and 6.



U.S. NAVY	Figure 2-1 Location of Operable Units and Areas	Delivery Order 0043 NUWC Keyport SECOND FIVE-YEAR REVIEW

3.0 BACKGROUND

NUWC Keyport occupies 340 acres (including tidelands) adjacent to the town of Keyport in Kitsap County, Washington, on a small peninsula in the central portion of Puget Sound. The Keyport property was acquired by the Navy in 1913, with property acquisition continuing through World War II. The property was first used as a quiet-water range for torpedo testing. The first range facility was located in Port Orchard Inlet southeast of the site.

During the early1960s, Keyport's role was expanded to include manufacturing and fabrication, such as welding, metal plating, carpentry, and sheet metal work. Further expansion in 1966 consisted of a new torpedo shop, and, in 1978, the functions broadened to include various undersea warfare weapons and systems engineering and development activities. Operations currently include engineering, fabrication, assembly, and testing of underwater weapons systems.

NUWC Keyport is bordered by Liberty Bay on the east and north and Port Orchard Inlet on the southeast (Figure 1-1). The topography of the site rises gently from the shoreline to an average of 25 to 30 feet above mean sea level (msl) and then rises steeply to approximately 130 feet above msl at the southeast corner of the site.

Marine or brackish water bodies on and near the site consist of Liberty Bay, Dogfish Bay, the tide flats, a marsh, and the shallow lagoon. Freshwater bodies include two creeks draining into the marsh pond and two creeks that discharge into the shallow lagoon.

The terrestrial soil in the Keyport area generally includes coarse-grained glacial deposits and finer-grained nonglacial deposits. Most of NUWC Keyport is underlain by a thick nonglacial silt and clay informally known as the Clover Park Unit. This unit is commonly about 100 feet thick, and is an aquitard separating the unconfined aquifer above (referred to as the "upper aquifer") and the intermediate aquifer beneath it.

3.1 OPERABLE UNIT 1

OU 1 consists of Area 1, the former base landfill, which comprises approximately 9 acres in the western part of the base next to a wetland area and the tide flats that flow into Dogfish Bay (Figure 3-1). Most of the landfill area was formerly a marshland. The landfill is unlined at the bottom, and the top is covered with areas of grass, trees, and asphalt. The landfill was the primary disposal area for domestic and industrial wastes generated by the base from the 1930s until 1973, when the landfill was closed. A burn pile for trash and demolition debris was located at the north end of the landfill from the 1930s to the 1960s. Unburned or partially burned materials from this pile were buried in the landfill or pushed into the marsh. A trash incinerator was operated at the north end of the landfill from the 1930s to the 1960s; incinerator ash was disposed of in the landfill. Burning continued at the landfill until the early 1970s.

During various site investigation and assessment studies between 1984 and 1988, Area 1 was determined to have possible environmental contamination that might impact the environment. An RI/FS was conducted at Area 1 between 1988 and 1993, after which human health and ecological risk assessments were conducted (U.S. Navy 1993). Based on the results of these studies, seven remedial alternatives were evaluated in the FS for Area 1 and the Navy, Ecology, and EPA selected a preferred remedial alternative. This preferred alternative was described in the 1994 proposed plan. Because public comments were not favorable to the preferred remedial alternative, the proposed plan was withdrawn and Area 1 was separated from the other areas to become OU 1.

To address the public's concerns, the Navy, Ecology, and EPA conducted further site characterization to collect data to supplement the RI. Starting in 1995 and ending in September 1996, five quarterly rounds of sampling were conducted. The additional data were used to evaluate the potential risks from the following three key chemical of concern (COC) pathways at OU 1:

- Drinking water
- Seafood ingestion
- Ecological

The environmental media that might have impacted the pathways are groundwater, surface water, and sediment downgradient of OU 1. New data from the site characterizations were discussed and evaluated in the summary data assessment report (U.S. Navy 1997a), which supplemented the RI. A supplemental focused feasibility study then evaluated several additional alternatives, from which a new preferred remedial alternative was selected and eventually accepted based on public comments. The OU 1 ROD was executed in September 1998.

Based on the original RI and the supplemental data assessment, two classes of contaminants were identified as COCs for the three main potential exposure pathways of interest (see above): chlorinated aliphatic hydrocarbons (CAHs, a class of volatile organic compounds [VOCs]) and polychlorinated biphenyls (PCBs). The VOCs were identified as COCs because of the drinking water and seafood ingestion pathways and PCBs because of their potential to bioaccumulate, possibly impacting the seafood ingestion pathway.

VOCs are present in the upper and intermediate aquifers, with concentrations in the upper aquifer greater than those in the intermediate aquifer by an order of magnitude or more. The VOCs have formed plumes in both aquifers, although field data do not indicate the presence of dense nonaqueous-phase liquid (DNAPL) bodies in either aquifer. Groundwater from the southern part of the landfill has the highest concentrations of VOCs, and some VOCs have been detected in the adjacent surface water, particularly in the marsh downgradient of the landfill. The presence of these compounds in the marsh water appears to be the direct result of ongoing discharge from the upper aquifer into the marsh. Data also indicated that mobile VOC contaminants in the intermediate aquifer would eventually be discharged to surface water in the tide flats or Dogfish Bay.

Current hydrogeologic conditions direct groundwater from both the upper and intermediate aquifers into the adjacent surface water and away from areas where drinking water wells exist or could exist in the future.

PCBs were detected in the groundwater of the upper aquifer, seeps, aquatic sediment, and clam tissue samples. PCBs were not detected in the intermediate aquifer. Because the PCBs measured in the seep are discharging directly into the marsh, it is likely that many of the PCBs currently migrating from the landfill into the marsh are coming from the seep, instead of from the groundwater where detected PCB levels are low. Although PCB concentrations in the creek sediments were below levels requiring active cleanup, a decision was reached to remove the sediments to prevent future movement into the tideflats and Dogfish Bay via this pathway.

Risk assessments indicated that direct exposure to the COCs within the landfill could cause human health risk above acceptable risk levels.

3.2 OPERABLE UNIT 2

OU 2 consists of the following areas:

- Area 2 – Van Meter Road Spill/Drum Storage Area
- Area 3 – Otto Fuel Leak Area (not subject to 5-year review)
- Area 5 – Sludge Disposal Area (not subject to 5-year review)
- Area 8 – Plating Shop Waste/Oil Spill Area
- Area 9 – Liberty Bay (not subject to 5-year review)

The OU 2 ROD specified that only Areas 2 and 8 are subject to the 5-year review. No further action was selected for Area 3; confirmation sampling was required at Areas 5 and 9 to determine their eligibility for the 5-year review. Confirmation sampling was conducted at

Area 5 for groundwater and at Area 9 for marine sediment in 1995 (U.S. Navy 1996a and 1996b). Results of the confirmation sampling at both areas indicated contamination did not exceed any of the remediation goals (RGs) set for those areas; therefore, no further action was selected for Areas 5 and 9 in the ROD. The land use continues to be unrestricted at these areas; as such, they are not subject to this 5-year review.

3.2.1 Area 2 – Van Meter Road Spill/Drum Storage Area

Area 2 is located on the southwest corner of NUWC Keyport (Figure 2-1). It is bounded to the north and east by Westfall Road, to the west by Keys Road, and to the south by a sharp topographic rise representing the southern limit of NUWC Keyport. Van Meter Road essentially bisects the area in a north-south direction. Area 2 is composed of three distinct sites: Van Meter Road spill area, Building 734 drum storage area located just west of Van Meter Road, and Building 957 drum storage area located immediately east of Van Meter Road (Figure 3-2).

In 1976, approximately 2,000 to 5,000 gallons of plating shop wastes spilled from a tanker truck on the pavement near Van Meter Road and impacted a nearby stream (U.S. Navy 1984). Additionally, two unpaved areas associated with the two drum storage areas were active from the 1940s through the 1960s. These two areas were reportedly used to store all chemicals (including solvents and fuel/oil) used at NUWC Keyport during this time period. It was estimated that between 4,000 and 8,000 gallons of these chemicals were discharged into the two unpaved areas as a result of spills and leaks (U.S. Navy 1984).

The 1984 IAS identified Area 2 for further investigation in the RI/FS. The RI/FS process for OU 2 began in 1988, and the final RI/FS reports were submitted in October and November of 1993. Media sampled during the Area 2 RI include air, soil, stream sediment, and groundwater. Based on the sampling results, human health and ecological risk assessments were conducted. The ecological risk assessment did not identify any significant risks to terrestrial or aquatic organisms at Area 2. For the drum storage area, the human health risk assessment did not identify any significant risk to current workers; however, it did indicate possible risks to hypothetical future residents at the drum storage area from exposure to soil and groundwater. These risks are primarily associated with trichloroethene (TCE) and vinyl chloride. No significant risk was identified at the Van Meter Road plating shop waste spill.

Based on the risk analyses, other COCs do not present significant additional risk (U.S. Navy, USEPA, and Ecology 1994).

TCE and vinyl chloride were detected in some of the groundwater samples collected from the upper aquifer at levels that exceeded the drinking water standards. Because of the relatively low concentration levels of VOCs in the groundwater, the potential for off-site migration was determined to be low. While levels of the primary COCs exceeded the applicable or relevant and appropriate requirements (ARARs), a decision was reached in the ROD that active measures to remediate the groundwater were not presently appropriate given the low contaminant concentrations, the high cost to remediate such low concentrations, and the ability to effectively preclude future residential use and groundwater use at this area through appropriate institutional controls.

3.2.2 Area 8 – Plating Shop Waste/Oil Spill Area

Area 8 occupies about 1 acre on the eastern portion of NUWC Keyport and surrounds the location of the former plating shop (Building 72) (Figures 2-1 and 3-3). Building 72 was demolished in 1999 and replaced by an asphalt-paved parking area. The site is located in a heavily industrialized part of the facility bordered by Liberty Bay to the south and east (Figure 3-3). The area is predominantly flat and almost entirely paved or covered by buildings.

Past releases at Area 8 include spillage of chrome plating solution onto the ground; discharge of plating wastes into a utility trench; and leakage of plating solutions through cracks in the plating shop floor, waste disposal pipes, and sumps. VOCs present in the solvents used in the plating shop were released during plating shop operation. Petroleum hydrocarbons (diesel and heavy oil) were released to the environment from leaky underground storage tanks (USTs) and underground concrete vaults located within Area 8.

Area 8 was investigated and characterized together with other areas during the IAS and RI/FS. In addition, limited investigations and removal actions were performed to contain and remove plating solutions and wastes that were released from the 1980s through the early 1990s. Media sampled during the remedial investigation included subsurface soil, groundwater, and seeps and piezometer water at the adjacent beach.

For subsurface soil, arsenic, cadmium, and chromium were identified as COCs and are considered major contributors to human health risk at the site. The source of inorganic chemicals detected at Area 8 is believed to be the metal plating activities associated with Building 72, except for low concentrations of detected arsenic that were suspected to be related to background concentrations. As a result, arsenic was dropped as one of the COCs at the site.

For groundwater, 10 inorganic chemicals (antimony, arsenic, cadmium, chromium [hexavalent], copper, lead, manganese, nickel, thallium, and zinc) exceeded the federal and state maximum contaminant levels (MCLs) for surface water protection, or the Model Toxics Control Act (MTCA) Method B levels (for protection of human health in groundwater). An inorganic chemical plume was found extending from the western portion of Building 72 toward Liberty Bay to the east and southeast (U.S. Navy, USEPA, and Ecology 1994). The inorganic concentrations generally decrease eastward towards Liberty Bay. Within the inorganic plume, the distribution of cadmium and chromium were well defined and could be traced to former operations of Building 72 (e.g., the chromium plume could be traced to the former chrome room in Building 72). Several other metals (copper, nickel, and zinc) detected in this area have similar distribution patterns as well.

For groundwater, 12 VOCs exceeded the federal and state MCLs (for surface water protection criteria), or MTCA Method B levels (for protection of human health in groundwater). The most frequently detected organic compounds in samples from shallow groundwater monitoring wells and seeps were TCE; 1,1,1-trichloroethane (1,1,1-TCA); 1,2-dichloroethene (1,2-DCE); and 1,1-DCE. These compounds form a plume in the upper aquifer that extends from the eastern and southern sides of Building 72 eastward and southeastward to the intertidal zone of Liberty Bay (U.S. Navy, USEPA, and Ecology 1994).

Based on the remedial investigation results, the areal extent of the VOC plume is larger than the inorganic plume. Three of the four VOCs were also detected at lower concentrations in groundwater samples from an intermediate-depth well (MW8-16, screened at 45 feet below ground surface [bgs]). No VOCs were found in the deepest well (MW8-15) above the Clover Park unit. As a result, the presence or absence of DNAPL was not conclusive during the RI. The principal source of these VOCs is believed to be solvents used in Building 72. It is also possible that some of the VOCs originated from historical use of solvents in adjacent buildings.

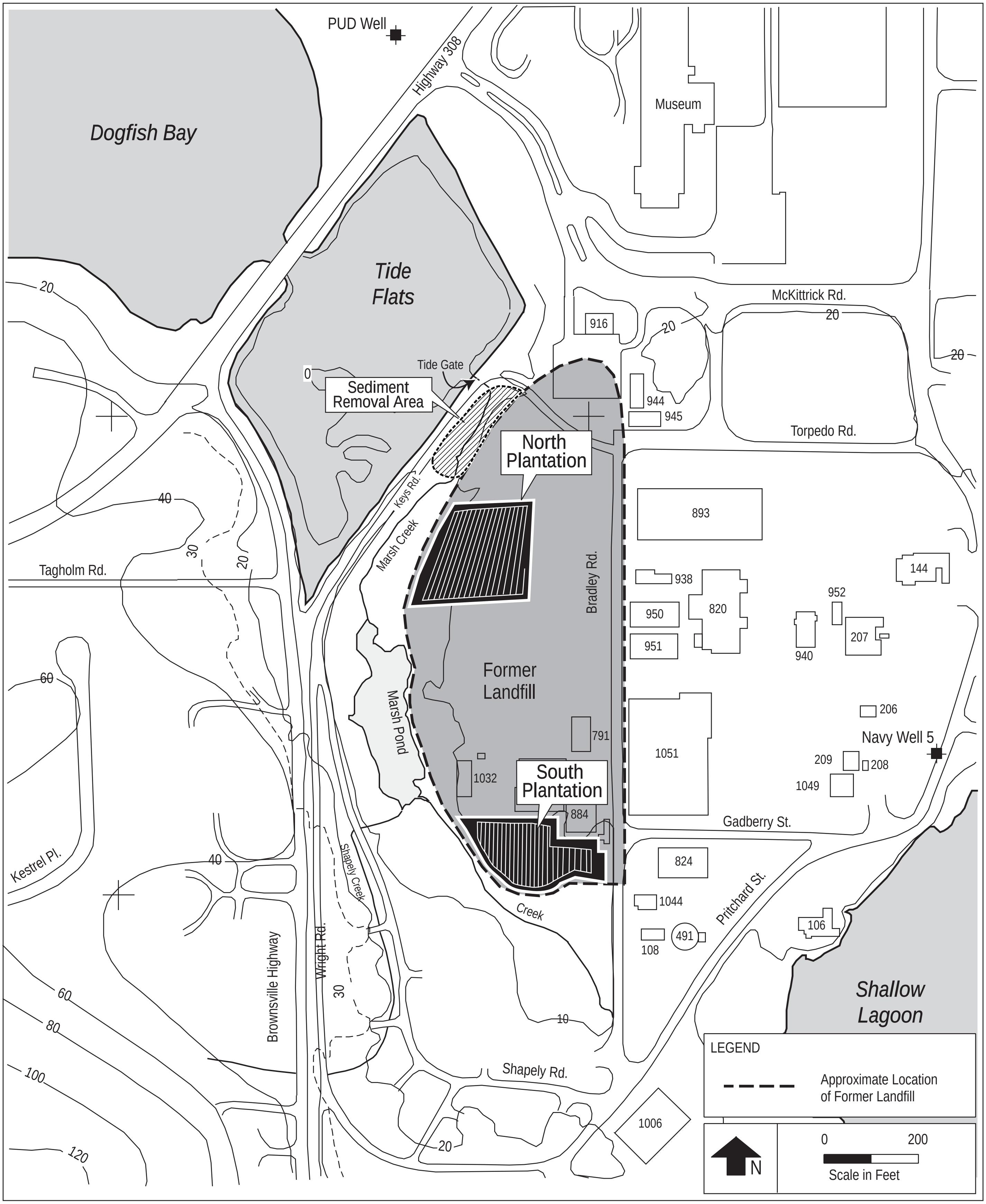
Petroleum hydrocarbons and aromatic compounds identified as heavy fuel oils were detected in groundwater samples from locations around Buildings 181 and 804. The source of these compounds is believed to be the former fuel storage vaults at these two buildings. The petroleum hydrocarbon contamination was remediated under the UST program, rather than CERCLA. The remediation was conducted as an independent action under MTCA regulations (Washington Administrative Code [WAC] 173-340-450), and it is not discussed in detail in this 5-year review.

Because of Area 8 groundwater discharges into Liberty Bay, there is a potential for chemical migration from the groundwater to the marine environment. During the RI, some beach seep samples at Area 8 exceeded surface water quality criteria for metals. No exceedances were identified in samples taken from Liberty Bay surface water.

The baseline risk assessment did not find unacceptable human health risks for the current industrial exposure scenario. However, chemicals in soils and groundwater at Area 8 pose unacceptable risk to hypothetical future residents, although site use will remain industrial for the foreseeable future. Exposure pathways driving risk to the hypothetical future residents included ingestion of groundwater, inhalation of volatiles during household use of groundwater, and ingestion of homegrown vegetables.

No ecological risks were identified for terrestrial organisms, because of lack of significant habitat at Area 8. Based on the remedial investigation data, ecological risk assessment for current conditions indicated that shallow groundwater from Area 8 discharging to Liberty Bay has not caused significant risk to marine organisms. However, as Area 8 groundwater continues to discharge into Liberty Bay, the groundwater contaminants could lead to future risks in the marine environment if chemical concentrations increase.

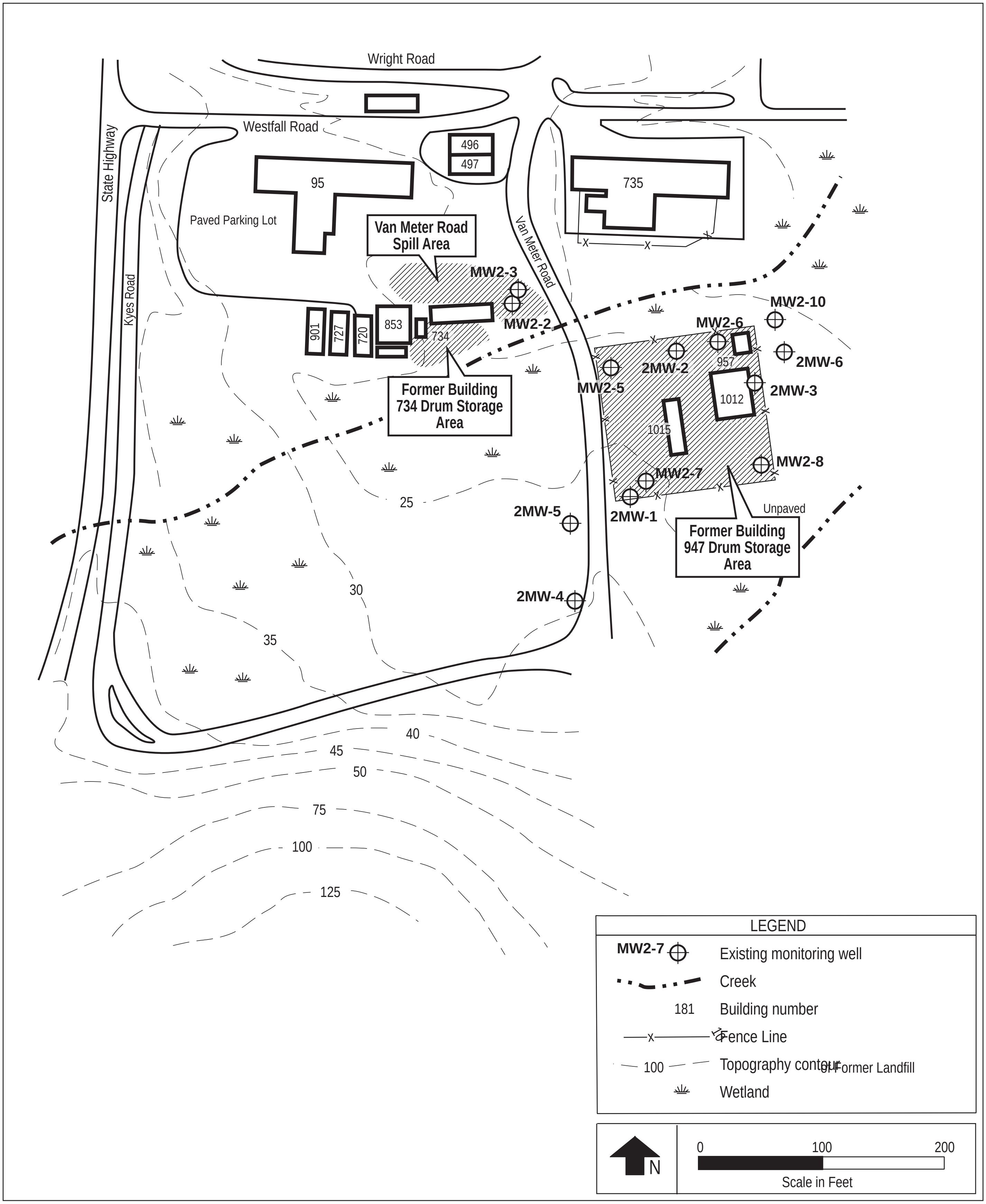
33755543-103



U.S. NAVY

Figure 3-1
Operable Unit 1

Delivery Order 0043
NUWC Keyport
SECOND FIVE-YEAR REVIEW

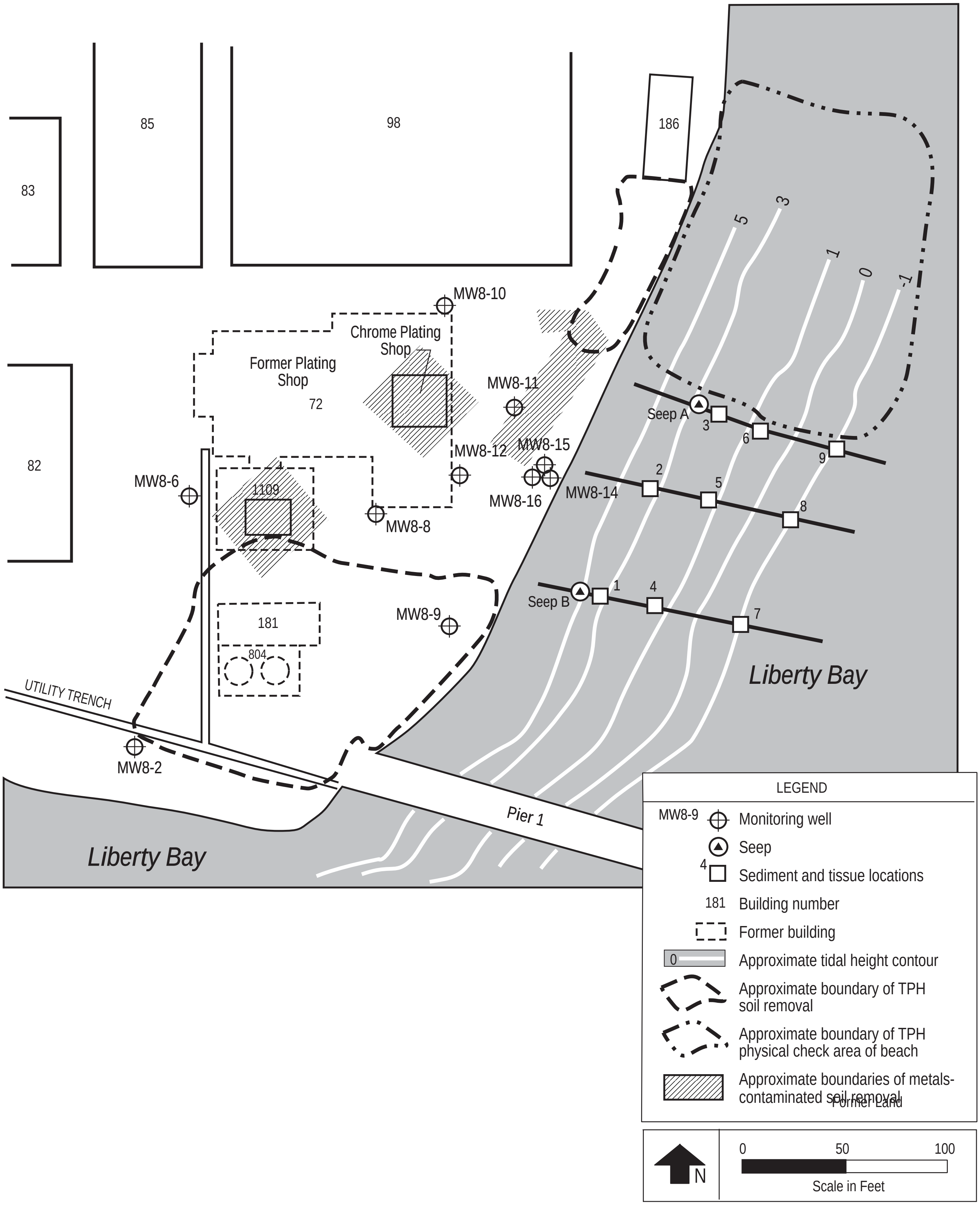


U.S. NAVY

Figure 3-2
Operable Unit 2, Area 2

Delivery Order 0043
NUWC Keyport
SECOND FIVE-YEAR REVIEW

33755543-104



U.S. NAVY

Figure 3-3
Operable Unit 2, Area 8

Delivery Order 0043
NUWC Keyport
SECOND FIVE-YEAR REVIEW

4.0 REMEDIAL ACTIONS

The RODs for NUWC Keyport required remedial actions for Area 1 at OU 1 and Areas 2 and 8 at OU 2. This section provides a brief description of the selected remedy and the specific remedial actions for each of these areas.

4.1 OU 1

4.1.1 OU 1 Remedial Action Objectives

The OU 1 ROD established remedial action objectives (RAOs) for each medium impacted by COCs. The RAOs are described below by medium.

RAOs for Soil, Waste, and Vapor within the Landfill

- Prevent exposures to humans due to dermal contact with or ingestion of soil or waste material within the landfill that contains contaminants that may result in unacceptable risk. For this objective, unacceptable risk is defined by exposure of humans to concentrations of landfill contaminants above state cleanup levels for soil (MTCA Method B).

- Prevent exposures to humans due to inhalation of vapor from the landfill that contains contaminants that may result in unacceptable risk. For this objective, unacceptable risk is defined by exposure of humans to concentrations of landfill contaminants above state cleanup levels for air (MTCA Method B).

RAOs for Groundwater

- Prevent exposures to humans due to drinking water ingestion of groundwater that contains landfill contaminants at concentrations above state and federal drinking water standards and state cleanup levels for groundwater (MTCA Method B).

- Prevent unacceptable risks to humans and aquatic organisms due to migration of landfill contaminants via groundwater into the adjacent aquatic environments, as defined in the RAOs discussed below for surface water.

RAOs for Surface Water

- Prevent exposures to humans due to ingestion of seafood that contains contaminants at concentrations that pose unacceptable risk, as a result of chemicals migrating from the landfill via groundwater into the adjacent marine water. For this objective, unacceptable risk is defined by exposure of seafood resources to concentrations of landfill contaminants in surface water above state water quality standards, federal water quality criteria, and state cleanup levels for surface water (MTCA Method B). This refers to those surface water criteria and standards developed for the protection of human health (i.e., seafood ingestion).

- Prevent exposures to aquatic organisms due to contaminants present in surface water at concentrations that pose unacceptable risk, as a result of chemicals migrating from the landfill via groundwater into the adjacent surface water. For this objective, unacceptable risk is defined by concentrations in surface water above state water quality standards or federal water quality criteria developed for the protection of marine organisms.

RAOs for Sediments

- Prevent exposures to humans due to ingestion of seafood that contains contaminants at concentrations that pose unacceptable risk, as a result of chemicals migrating from the landfill via groundwater into the sediments of the adjacent aquatic systems and thence into seafood tissues. For this objective, unacceptable risk is defined by concentrations in littleneck clam tissues, as defined in the seafood ingestion RAO discussed below for shellfish.

- Prevent exposures to aquatic organisms due to contaminants present in sediments at concentrations that pose unacceptable risk, as a result of chemicals migrating from the landfill via groundwater into the adjacent aquatic systems. For this objective, unacceptable risk is defined by concentrations in sediments above state sediment quality standards for chemistry and bioassays.

RAOs for Shellfish

- Prevent exposures to humans due to ingestion of seafood that contains contaminants at concentrations that pose unacceptable risk, as a result of chemicals migrating from the landfill via groundwater into the adjacent aquatic systems. For this objective, unacceptable risk is defined by concentrations in littleneck clam tissues above a cumulative incremental cancer risk of 1×10^{-5} or a noncancer hazard index of 1.0, using exposure assumptions for subsistence harvesters as identified in Appendix C. These risk levels are within EPA's acceptable risk range, which refers to an incremental cancer risk range of 10^{-6} to 10^{-4} and a noncancer hazard index of 1.0 as acceptable targets for Superfund sites. The risk levels are also in accord with the risk assessment framework used in MTCA to establish state cleanup levels for exposures to multiple hazardous substances (WAC 173-340-708). MTCA does not establish cleanup levels that are specific for shellfish samples.

- Prevent exposures of aquatic organisms to contaminants migrating from the landfill that pose unacceptable risk. For this objective, unacceptable risk is defined by concentrations of landfill contaminants in littleneck clams above the ecological risk-based screening values (i.e., the maximum acceptable tissue concentrations, or MATCs) in Appendix J of the summary data assessment report (U.S. Navy 1997a).

4.1.2 OU 1 Remedy Selection

To achieve RAOs, the remedial action components specified in the OU 1 ROD included the following:

- Treat VOC hot spots in the landfill by phytoremediation using poplar trees.
- Remove PCB-contaminated sediments from around the seep area, which has the highest PCB concentrations.
- Upgrade the tide gate to protect landfill from flooding and erosion during extreme tide events.
- Upgrade and maintain the landfill cover.
- Conduct long-term monitoring (LTM), including phytoremediation monitoring, intrinsic bioremediation monitoring, and risk and compliance monitoring.
- Take contingent actions for off-base domestic wells, if necessary.
- Implement institutional controls.

4.1.3 OU 1 Remedy Implementation

Phytoremediation

The phytoremediation remedy component was implemented in accordance with the ROD in spring 1999 with the planting of two plantations of hybrid poplar trees. Each plantation was located above a hot spot of VOC contamination in groundwater. The goal of phytoremediation is to utilize the soil moisture and groundwater uptake capability of the hybrid poplar trees to remove and treat VOC-contaminated groundwater, thus reducing the long-term potential for VOC migration from the site.

Design criteria specified in the ROD (U.S. Navy, USEPA, and Ecology 1998) for implementation of phytoremediation at OU 1 included selecting a planting density with consideration of water uptake by poplar trees to accomplish the following:

- Avoid adverse dewatering of the wetlands adjacent to the landfill.
- Avoid adverse changes in groundwater flow (such as drawing saline water from the marsh pond to the tree stands).
- Maximize contaminant removal by the trees.

The first two design criteria were met by the groundwater modeling performed by the U.S. Geological Survey (USGS), which showed that the trees would not adversely affect the wetlands, or cause adverse changes in groundwater flow (U.S. Navy 1999a, Appendix B). The third design criterion was met by selecting an initial planting density that maximized water usage by the young trees and then thinning the trees as they grew to create a closed canopy of healthy, properly spaced trees.

Process monitoring and control criteria specified in the ROD included the following:

- *Air quality*: assessment of whether the mature stands of trees comply with action-specific regulatory requirements for air quality (i.e., acceptable source impact levels [ASILs] of the Puget Sound Clean Air Agency [PSCAA])
- *Leaf management*: assessment of whether the leaves retain toxic substances that require special leaf management (i.e., can the leaves be allowed to fall and degrade naturally, or do they pose unacceptable risks to human health and the environment and thus need to be collected for proper disposal?)

- *Limb management*: assessment of whether the tree limbs resulting from process operation and maintenance (O&M) (e.g., pruning and thinning) retain toxic substances that require special management to comply with action-specific ARARs (e.g., land disposal regulation) or pose no unacceptable risk to human health and the environment

The process monitoring and control criteria were met by the demonstration sampling results reported in the October–December 2001 status report (U.S. Navy 2002a). Transpired air was found to contain TCE and tetrachloroethene concentrations below the applicable ASILs and therefore do not represent a threat to human health and the environment. The results of tree tissue sampling indicated that all types of tree tissue were safe for disposal without restrictions, including burning in residential fireplaces.

Performance monitoring criteria are specified in the ROD as follows:

- Water-level measurements and contouring of the water table surface
- Sampling for VOCs and natural attenuation parameters in groundwater at selected locations

Tree planting began in April 1999, and, by June 1999, planting and construction activities (e.g., irrigation system implementation, fencing, and fertilization) of the two plantations were completed (U.S. Navy 1999b). The two plantations, named the “north” and “south” plantations are each slightly less than 1 acre in size. Construction work for the two plantations included the following:

- Establishing the plantation boundary locations, based on the figures in the ROD
- Asphalt and fencing removal
- Storm drain relocation
- Curb and fence construction
- Landfill surface preparation and debris removal
- Placement of planting soil and soil amendments
- Installation of 3 wells (MW1-41 and 2 irrigation wells), 10 piezometers, and 2 lysimeters

- Installation of irrigation systems at both plantations
- Planting the hybrid poplar trees

Landfill debris and soil removed during plantation construction were sampled, characterized, and recycled or disposed of at appropriate facilities.

The tree planting process included loosening the soil with a single-tined plow and then pressing dormant hardwood cuttings of the hybrid poplars into the plowed furrow. Trees were planted in north-south rows spaced approximately 10 feet apart, with individual trees spaced 6 feet apart within rows. A total of 545 trees were planted at the north plantation, and 360 trees were planted at the south plantation. A summary of the construction activities, specifications for on-site equipment, and as-built drawings are included in the phytoremediation closure report (U.S. Navy 1999b). Figure 3-1 shows the locations of the two plantations.

The work plan for phytoremediation implementation established that the effectiveness of phytoremediation will be evaluated on the basis of a “weight of evidence,” rather than specific numerical criteria. Performance evaluation criteria, actions to be taken on the basis of performance evaluations, and the timing of performance evaluations were selected on the basis of the experience of the phytoremediation expert retained by the Navy, as applied to the site conditions.

Performance criteria include the following:

- *Tree health:* Healthy trees indicate water uptake by the trees. When the trees take up water containing TCE-family compounds, those compounds are metabolized. Tree health will be assessed according to standard forestry practices.

- *Groundwater flow:* Changes to the groundwater flow pattern that reduce contaminant migration are expected as the result of groundwater withdrawal either directly by the trees or through the irrigation wells. Changes in the groundwater flow pattern will be demonstrated by contour maps produced as part of periodic status reports. The contour maps will be based on depth-to-groundwater data from monitoring wells and piezometers.

- *Contaminant concentrations:* A downward trend in concentrations of TCE-family compounds in groundwater and surface water samples collected from the immediate vicinity of the plantations will be considered evidence of phytoremediation effectiveness.

Phytoremediation is to be considered effective if the conditions in item 1 and either item 2 or 3 in the following list are met.

1. Two healthy stands of trees are present at the selected locations at OU 1 after the second growing season and subsequent growing seasons.

2. The groundwater gradient in the area of the two plantations is reduced for at least 4 months out of every year, as evaluated at the end of the second growing season and subsequent growing seasons.

3. The downward trend in concentrations of TCE-family compounds in groundwater and surface water described previously is notable in the overall data set at the end of the fifth growing season.

Regarding the potential ineffectiveness of phytoremediation, the OU 1 ROD (U.S. Navy, USEPA, and Ecology 1998) states the following: “If phytoremediation is determined to be ineffective and is discontinued, natural attenuation and intrinsic biodegradation will be evaluated to determine whether they satisfy the key objectives for which the phytoremediation action was intended to address.”

Sediment Removal

PCB-contaminated sediment removal was completed in 1999 (U.S. Navy 1999c). The objective of the sediment removal was to decrease the amount of PCBs found in the marsh sediments, thereby reducing current ecological risks to the marsh and reducing the potential for PCBs to migrate and cause unacceptable risks elsewhere in the future. Although the PCB concentrations were below levels requiring active cleanup, this remedial action was selected to reduce the potential for PCBs to move into the tideflats and Dogfish Bay and to accumulate in harmful quantities in the future.

The goal of the sediment removal component of the remedy was to remove approximately the top 6 inches of surface sediments from the area of the marsh downgradient of the landfill seep (Figure 3-1), where previous sampling had shown the highest PCB concentrations. To minimize disruptions and short-term impacts on the marsh (as required by the ROD), a high-pressure vacuum truck was used with a suction line for vacuuming the sediment directly from the marsh into sludge boxes (heavily reinforced roll-off boxes suitable for transporting material having high moisture content). Prior to sediment removal, grade stakes were set on a 10-foot grid throughout the marsh to establish control over the depth of removal. A small tiller was used as needed to loosen the sediment and organic matter before vacuuming. Overall, approximately 75 tons of sediment was removed from the site and transported to a Subtitle D landfill for solidification and disposal.

No additional sampling was conducted during the sediment removal action. Instead marsh sediment sampling was incorporated into the LTM program.

Tide Gate Upgrade

The tide gate upgrade was completed and fully operational by November 1999 (U.S. Navy 1999c). The intent of upgrading the existing tide gate was to improve the control of tidal flow between the tide flats and the marsh, thereby ensuring that the landfill is protected from extreme tidal action that could flood its surface, erode its banks, or adversely affect the groundwater level within the landfill mass. The existing flap gate was replaced with a Waterman/Nekton self-regulating tide gate. In order to provide adequate support to the new tide gate system, a reinforced concrete collar was constructed at the downstream end of the existing culvert adjacent to the tide flats, and a new 36-inch reinforced concrete culvert was installed to replace the existing corrugated metal pipe, which was in poor condition. During culvert installation, soil that was unsuitable as bedding material and embankment material for the new culvert was excavated and disposed of along with the excavated sediment. Crushed, recycled concrete was laid down as bedding material for the pipe and the culvert. A similar concrete collar was installed at the upstream end of the culvert and equipped with a security grate to prevent unauthorized entry to the facility via the culvert.

Upgrade Landfill Cover

The requirements for the landfill cover upgrade remedy component were described in the OU 1 ROD (U.S. Navy, USEPA 1998, and Ecology) as follows:

> This element of the selected remedy involves upgrading the landfill cover and maintaining it in good condition. The existing asphalt will be removed from those parts of the landfill where the poplar trees are to be planted. The landfill surface in these planted areas will be maintained as described in Section 11.1 (of the OU 1 ROD). The remainder of the existing asphalted areas will be upgraded to repair cracks and other damaged pavement. Portions of the landfill not presently covered with asphalt will be left unpaved.

To implement this component of the remedy, the Navy first assessed the existing conditions of the asphalt on the paved portions of the landfill, and considered approaches for repair or repaving (U.S. Navy 2002b). Based on this assessment in 2002, the Navy concluded that the existing paving between the two phytoremediation plantations (Figure 3-1) should be removed and replaced with new asphalt. It was also concluded that the repaving project should minimize regrading of the landfill surface, should minimize import and export of subgrade material, and should provide upgraded stormwater flow control and water quality treatment.

The Navy finalized a design for the repaving effort in August 2002 (U.S. Navy 2002c) and contracted for construction in fall 2002. Construction was performed in two phases because of weather delays over the winters of 2002 to 2003 and because shallow landfill debris was found to be more pervasive than expected beneath the area to be repaved. Phase I construction activities were conducted between November 4 and December 12, 2002. Phase II construction activities were conducted between July 21 and December 4, 2003. The construction work was accepted by the Navy in January 2005.

Major components of the repaving included the following:

- Construction of upgraded stormwater facilities, including catch basins, piping, oil-water separators, and bioswales on the east and west sides of the paved area
- Removal, pulverization, and reuse of existing asphalt
- Regrading of the subgrade material to achieve drainage to the upgraded stormwater facilities
- Placement of geotextile grid and imported base course material
- Paving the site with new asphaltic concrete and adding striping and curbing for parking use
- Planting the bioswales

Soil and landfill debris that could not be reincorporated into the landfill was sampled, characterized for disposal, and disposed of off site at the Olympic View Sanitary Landfill in Port Orchard, Washington. Groundwater pumped from open excavations was temporarily stored on site during construction, sampled, characterized for disposal, and disposed of off site at Philip Service Facility in Kent, Washington (U.S. Navy 2004e).

Long-Term Monitoring

The LTM program at OU 1 began in 1999 when sampling of two deep water supply wells and groundwater sampling at and adjacent to the two phytoremediation plantations took place. During the first 4 years following phytoremediation implementation, the OU 1 LTM program consisted of three parallel programs performed by the Navy and the USGS. The Navy performed the phytoremediation monitoring and risk and compliance monitoring, while the USGS performed intrinsic bioremediation monitoring. Beginning in 2003, risk and compliance monitoring and phytoremediation monitoring were consolidated as a single program. The USGS continued to perform intrinsic bioremediation monitoring.

Additional discussion of the operation, maintenance, and monitoring conducted at OU 1 since the first 5-year review is included in Section 4.1.4.

Contingent Remedial Actions

This component of the selected remedy required the Navy to prepare for implementing additional remedial actions to “prevent drinking water risks if the long-term monitoring results show that off-base domestic wells could become contaminated in the future” (U.S. Navy, USEPA, and Ecology 1998). To satisfy this component of the selected remedy, the Navy prepared a contingent remedial action plan (CRA plan), which was finalized in March 2003 (U.S. Navy 2003a).

The CRA plan specifies the conditions under which the Navy will implement additional remedial actions related to OU 1 and describes the actions to be implemented. The basis for additional remedial actions are defined by the CRA plan as the identification of significant contaminant concentrations migrating from OU 1 to water supply wells in the area. Contaminant migration is to be identified by comparing groundwater sampling data from certain wells (called “sentinel wells”) to a decision matrix. The plan describes the source of the groundwater sampling data and the decision matrix.

The plan also describes the remedial actions to be implemented, which may include the following:

- Additional sampling of the sentinel well
- Sampling of potentially affected water supply wells
- Providing bottled water to homeowners
- Installing of filtration systems at specific water supply wells
- Replacing affected water supply wells with either a connection to the county water supply, or a new and deeper water supply well

Institutional Controls

An institutional controls plan was prepared and finalized on May 19, 2000, to address the requirements outlined in the ROD (U.S. Navy 2000a). The intent of the institutional controls is to prevent undue exposure to landfill contaminants in the future. The institutional controls plan outlines administrative procedures and actions that will limit or prevent activities that could interfere with the remedial activities at the site. These controls will preclude installation of water wells at OU 1 (except environmental [monitoring or remedial action] resource wells) and prevent development or activity that would disturb the landfill, tideflat, or adjoining marsh and shoreline in a manner that could lead to unacceptable risks to human health.

In addition to the institutional controls plan, Naval Base Kitsap is in the process of drafting a Regional Land Use Control Instruction covering the Bremerton naval complex, Jackson Park Housing Complex, Naval Hospital Bremerton, Bangor, Keyport, and Indian Island.

4.1.4 OU 1 Operation, Maintenance, and Monitoring

Since the first 5-year review in 2000 (U.S. Navy 2000b), the Navy has continued operation, maintenance and monitoring of the OU 1 remedy. As discussed in Section 4.1.3, monitoring at OU 1 was initially conducted under three parallel programs:

- Phytoremediation operation, maintenance, and monitoring
- Risk and compliance monitoring
- Intrinsic biodegradation monitoring

Institutional controls inspections have been carried out concurrently with these monitoring programs.

Phytoremediation Operation, Maintenance, and Monitoring

Phytoremediation operation, maintenance, and monitoring activities that were begun immediately after planting were continued over the last 5 years. The primary objective of the initial monitoring and nurturing phase was to establish mature, healthy stands of trees. A closed canopy of healthy trees covering the two hot spots at the plantations is expected to maximize contaminant uptake by the trees. The objective of later monitoring was to ensure that tree health had been maintained and to assess the effectiveness of the phytoremediation component of the remedy.

The original work plan anticipated that 2 years of initial monitoring and nurturing would be required to establish stands of trees that would begin taking up contaminants (U.S. Navy 1999a). Monitoring during this time would be used to establish background concentrations of contaminants in sampled media, document initial contaminant uptake by the trees, document the effects of the trees on the shallow aquifer, and satisfy the “demonstration” sampling requirements of the ROD (U.S. Navy, USEPA, and Ecology 1998). Demonstration sampling was specified in the ROD to show that tree products such as transpired air, stems, and leaves did not remain contaminated after the uptake and metabolization of contaminants by the trees. The demonstration sampling defined in the original work plan also addressed issues such as (1) possible increased leaching of contaminants from soil to groundwater as a result of removing the asphalt cap on the landfill to plant trees and (2) effects from irrigating the plantations during the summer.

At the end of the second growing season (through November 2000), it was apparent that the trees had not grown as quickly as anticipated and were not yet taking up contaminated groundwater. Because of this, the original work plan was amended to include a third year of monitoring and nurturing (U.S. Navy 2001a). Some of the demonstration sampling planned for the second growing season was rescheduled for the third growing season on the basis of the growth rates at the plantations.

At the end of the third growing season (November 2001), the Navy decided to extend the existing sampling schedule for a fourth growing season (through 2002). The results of the fourth growing season were intended to help assess the effectiveness of phytoremediation and test procedures to be used for long-term O&M. All of the demonstration sampling requirements of the ROD were met by the end of the third growing season, and, therefore, no demonstration sampling was carried forward into later work plans. The O&M plan dated April 12, 2002 (U.S. Navy 2003b) included separate sampling plans for the fourth year of monitoring and long-term O&M.

Operation, maintenance, and monitoring activities since the last 5-year review have included the following:

- Periodic groundwater elevation measurements in monitoring wells and piezometers in and around the plantations
- Periodic groundwater and surface water sampling and analysis from wells and surface water stations in and around the plantations
- Plantation inspections and maintenance necessary to maintain healthy trees

Groundwater elevation measurements were initially collected monthly, decreasing to quarterly in April 2003. These measurements have been used to assess changes to the groundwater flow pattern in the shallow aquifer attributable to the phytoremediation plantations. As of the end of the fifth growing season (through November 2003), analysis of the groundwater elevation data did not show that phytoremediation is affecting the pattern of groundwater flow (U.S. Navy 2004d).

Groundwater and surface water sampling was initially conducted quarterly, decreasing to semi-annually in 2003. As of the end of the fifth growing season, analysis of VOC concentration trends indicated that phytoremediation has had no discernable effect on VOC concentrations (U.S. Navy 2004d). This conclusion is partly based on the observation that the decreasing VOC concentration trend began before the tree roots reached the upper aquifer in 2002.

Plantation inspections and maintenance have occurred periodically as necessary to maintain healthy stands of trees. In spite of challenges with pest infestations and uncommonly dry summers, tree health has been maintained.

Risk and Compliance Monitoring

Long-term monitoring for risk and compliance was described in the ROD as consisting of groundwater, seep, marine sediment, and tissue sampling. The overall objective of the LTM program is to monitor trends in chemical concentrations and evaluate whether the selected remedy meets the RAOs and remains protective of human health and the environment (U.S. Navy 2004h). LTM data are also used to monitor the need for contingent remedial actions under the CRA plan (U.S. Navy 2003a).

Activities under the LTM program consist of the following:

- Groundwater sampling and analysis of nine monitoring wells screened within the upper aquifer and two water supply wells screened in the deep aquifer
- Sampling and analysis of five surface water locations (two of which include sediment) and one seep
- Sampling and analysis of six sediment and shellfish tissue locations

The sampling locations and frequency of sampling for each of these media are summarized in Table 4-1. Sampling locations are shown on Figure 4-1. The sampling program is described by medium in the subsections that follow. The most recent monitoring results are discussed in Section 6.4.

Groundwater Monitoring. The groundwater sampling program at OU 1 is conducted to fulfill the following three components of the LTM program at OU 1:

- Monitor the effectiveness of, and track the contamination trends associated with, phytoremediation.
- Monitor the effectiveness of intrinsic bioremediation (and natural attenuation in general).
- Assess the current level of risk and compliance of the remedy with RGs.

Periodic groundwater sampling is conducted to monitor the extent and concentrations of VOC contamination in the upper and intermediate aquifers underneath and downgradient of the former landfill. The analytical results are compared to the groundwater RGs established in the ROD (based on drinking water and seafood ingestion pathways), and the long-term groundwater contamination trends are tracked to evaluate if the remediation goals have been met.

In addition to groundwater sampling, water-level measurements are collected throughout OU 1 once every 2 years. These data are used to estimate groundwater gradient and flow directions beneath and downgradient of the former landfill in both the upper and intermediate aquifers.

Surface Water and Seep Monitoring. Five surface water locations (MA-09, MA-11, MA-12, TF-19, and DB-14) and one seep (SP1-1) are sampled periodically, as specified in the ROD, for monitoring of fate, transport, and natural attenuation of VOCs in surface water. These stations are located in a series running downstream, beginning in the marsh pond adjacent to the landfill, through the outlet channel to the tide flats, and out to Dogfish Bay. The results of the surface water sampling are compared to the surface water RGs, which are based on risks via the seafood ingestion and ecological risk pathways.

Sediment Monitoring. The OU 1 ROD selected sediment locations scattered throughout the marsh, tide flats, and Dogfish Bay for monitoring of fate and transport of contaminants coming out of the landfill through the marsh pond. New location MA-14 was established prior to the first long-term monitoring event and added to the sampling program. This location is located at the downgradient end of the sediment removal area and is used to monitor chemical concentrations along the outlet of the marsh.

Sediment samples have been collected in 1996, 2000, 2002, and 2004. A total of 10 sediment stations have been sampled, but not every station was sampled during every sampling event. In 1996 new station MA-14 did not exist and so was not sampled. In 2000, the eight locations designated in the ROD were sampled, in addition to new location MA-14. In 2002, only 2 of the

10 stations were sampled (MA-09 and MA-14), in accordance with the LTM plan (U.S. Navy 2002d). In 2004, the same nine stations were sampled as were sampled in 2000.

Samples were analyzed for semivolatile organic compounds (SVOCs), pesticides, PCBs, and metals, and their results were compared to the established RGs.

Shellfish Tissue Monitoring. Six tissue sampling locations were selected for long-term monitoring (U.S. Navy 2002d), corresponding to locations sampled in 1996 prior to signing of the OU 1 ROD. These six locations were sampled again in 2000 and 2004.

The samples collected in 2000 were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. Because no concentrations of target VOCs were detected in tissue samples, it was concluded that the RGs had been reached for these COCs in shellfish tissue (U.S. Navy 2002e). Based on this finding, VOCs were not included on the 2004 analyte list.

Intrinsic Biodegradation Monitoring

As described in the summary data assessment report (U.S. Navy 1997a) and the ROD for OU 1 (U.S. Navy, USEPA, and Ecology 1998), groundwater oxidation reduction (redox) conditions at the site appear to be generally favorable for complete degradation of chlorinated VOCs into their harmless byproducts—carbon dioxide, water, and chloride. The favorable conditions identified are strongly reducing groundwater beneath the source area (which is favorable for reductive dechlorination of TCE and some DCE), followed by mildly reducing groundwater downgradient of the source area (which is favorable for direct oxidation of DCE and vinyl chloride). Because phytoremediation activities could potentially affect redox conditions at the site, the ROD specified that performance monitoring should include the redox conditions beneath the plantations to check for potential adverse effects due to phytoremediation. The ROD also allowed for an evaluation of natural attenuation processes in the event that the phytoremediation component of the remedy was discontinued.

The Navy began a cooperative effort with the USGS in 1995 to investigate various natural attenuation mechanisms at OU 1 (USGS 2003). The investigations performed under this cooperative effort have been used to meet the OU 1 ROD goals related to natural attenuation evaluation. Field and laboratory studies conducted from 1996 through 2000 showed that natural attenuation and biodegradation of VOCs in shallow groundwater at OU 1 are substantial (U.S. Navy 1997, Bradley et al. 1998, and USGS 2002). Since the first 5-year review in 2000, the USGS has continued to monitor the geochemistry of OU 1 groundwater to verify that conditions remain favorable for VOC biodegradation. Sampling and analysis for VOCs and biodegradation indicator parameters have been conducted annually since 2000 in June of each year.

Institutional Controls Inspections

Annual inspections of the institutional controls have been conducted since 2002. Annual inspections have included completion of the inspection checklist included in the institutional controls plan and preparation of a brief narrative report. Inspected institutional controls match the requirements of the OU 1 and OU 2 RODs. Each narrative report summarizes and evaluates the findings of the inspection for each area and OU, discusses any corrective actions needed, and then presents conclusions regarding the ongoing effectiveness of the institutional controls.

4.2 OU 2

4.2.1 OU 2 Remedial Action Objectives

RAOs were developed for Areas 2 and 8 in the OU 2 ROD and were stated in a narrative format. Descriptions of the RAOs have been paraphrased in the sections below by area.

RAOs for Area 2

The RAOs for OU 2 Area 2 are the following:

- Prevent human health exposures to TCE and vinyl chloride in soil and groundwater by pathways such as ingestion of groundwater, inhalation of volatiles while showering, or ingestion of soil or vegetables grown in the soil.
- Restore the groundwater to drinking water quality for VOCs such as TCE and vinyl chloride.

RAOs for Area 8

The RAOs for OU 2 Area 8 are the following:

- Prevent human ingestion of groundwater containing metals and VOCs at concentrations above drinking water standards or acceptable human health risk levels.
- Protect sediments and surface water quality offshore of Area 8 in Liberty Bay from contaminants in groundwater that could cause future adverse impacts or human health risks.

- Prevent humans from coming into direct contact with, or ingesting, soil containing COCs at concentrations that would present an unacceptable risk to human health.
- Protect groundwater and surface water quality from soil containing COCs.

4.2.2 OU 2 Remedy Selection

The remedial action components specified in the OU 2 ROD to meet the RAOs for each area are described by area in the sections that follow.

Area 2 Remedy Selection

The selected remedy for Area 2 consists of institutional controls and groundwater monitoring. The institutional controls were to prohibit residential use of the site and to prevent construction of domestic wells. The monitoring was to be used to establish COC trends in groundwater and to determine when institutional controls could be discontinued. As part of the monitoring program, the Navy agreed to install additional upgradient wells to confirm that no upgradient source of COCs exists.

Area 8 Remedy Selection

The selected remedy for Area 8 includes the following components:

- Removal and off-site disposal of vadose-zone soil from COC hot spots
- Groundwater monitoring in the water table aquifer
- Sediment and tissue monitoring to assess the potential long-term impacts of contaminated groundwater discharge to Liberty Bay
- Contingent groundwater control actions based on risk assessment of sediment and tissue monitoring data
- Institutional controls

Following signing of the OU 2 ROD, an ESD was developed to clarify that the soil remedial action at Area 8 would be based on total chromium content in the soil, conservatively assuming all of the chromium was in the most toxic +6 form (based on previous groundwater sampling results on chromium speciation) (U.S. Navy, USEPA, and Ecology 1996). The ESD explained that this approach would be taken to minimize the risks of error and to be conservative. The

ESD also revised the work schedule to allow for testing and removal of soils based on total chromium content after a new plating area was constructed.

The remedy selected for Area 8 was not expected to meet groundwater RGs based on drinking water criteria, nor the goals for the protection of adjacent surface water throughout the site. Virtually all of the fill area would have to be excavated to meet these goals, and the cost of doing this was deemed disproportionate to the benefit. A risk management decision was made that the groundwater compliance criteria would be measured at the nearshore wells as conditional points of compliance. Additional protectiveness was to be achieved by implementing institutional control measures at the site (U.S. Navy 2000b).

4.2.3 OU 2 Remedy Implementation

The implementation of the remedy components for Areas 2 and 8 of OU 2 are described by area in the subsections that follow.

Area 2 Remedy Implementation

The investigation component of the selected remedy was satisfied by the installation and sampling of three new wells (2MW-4, 2MW-5, and 2MW-6). Ongoing monitoring of these wells and other wells at Area 2 satisfies the monitoring component of the remedy. Monitoring at Area 2 is discussed further in Section 4.2.4. The institutional controls management plan discussed in Section 4.1.3 covers Area 2 and satisfies the institutional controls component of the remedy.

Area 8 Remedy Implementation

Soil Removal. Building 72, the former plating shop, was demolished in 1999 after industrial operations were transferred to the new plating shop at the facility. Building 72 demolition was accompanied by soil removal at hot spots delineated during the RI/FS and specified in the OU 2 ROD. The soil hot spot removal remedy involved excavating soil contaminated with cadmium and chromium to 9 feet bgs. Hot spot areas were defined as areas with cadmium and chromium concentrations exceeding state MTCA Method B cleanup levels for soil ingestion, which are 80 mg/kg for cadmium and 400 mg/kg for chromium.

Extensive sampling programs were implemented for the Building 72 demolition and hot spot removal to delineate and characterize the nature of soil contamination at Area 8 for proper soil removal and disposal. A preliminary sampling and analysis program was conducted in 1996, which included perimeter soil sampling and soil sampling under the building. Sampling results indicated the presence of soil contaminated with total petroleum hydrocarbons (TPH), but no soil contamination from plating operations beyond the perimeter of Area 8.

A delineation sampling program was conducted as part of the Building 72 demolition and hot spot removal. The program was implemented in three phases from April 1998 through January 1999, with subsurface soil sampling by soil borings located on a grid setting across the site. Samples were collected from selected intervals based on the requirements of the remedial action work plan (U.S. Navy 1997b) and were analyzed for total metals, VOCs, SVOCs, and TPH-diesel. Overall, a total of 107 soil borings were drilled, and 78 of the 107 borings were used for soil characterization under the ROD. The rest of the borings were used for TPH-diesel characterization. The results were used to identify contaminated areas for subsequent removal. TPH removal actions and demolition were conducted at Buildings 181 and 804 (U.S. Navy 1999d and 2000c). Results of the subsequent independent remedial actions for diesel contamination are described in separate remedial action closure reports for TPH removal and demolition at Buildings 181 and 804 (U.S. Navy 1999d and 2000c).

Detailed discussions of the delineation program and sampling results can be found in the final closure report for Building 72 demolition and hot spot soil removal (U.S. Navy 1999d). In general, 7 inorganic and 19 organic compounds were detected in subsurface soils during the delineation program. Of the seven detected inorganics, only cadmium (six locations) and chromium (three locations) exceeded the ROD action levels. The delineation sampling results were used to define the hot spot areas, as shown in Figure 3-3.

The soil hot spot removal action was conducted in two phases in July 1998 and March 1999. In accordance with the ROD, cadmium- and chromium-contaminated soil was removed to groundwater level at 9 feet bgs. The hot spot areas were excavated and backfilled with imported granular material the same day. Contaminated soil was transported and disposed of at Waste Management in Arlington, Oregon. Overall, 1,100 tons of metal-contaminated soil were excavated from the hot spot areas and properly disposed of.

Monitoring. Four new groundwater monitoring wells were installed in 1995 to support the post-ROD groundwater monitoring program. The first round of post-ROD groundwater monitoring at Area 8 was conducted in fall 1995, and groundwater monitoring has been ongoing since that time. Sediment and tissue monitoring offshore of Area 8 has been conducted approximately every four years since 1996, with the most recent event in spring 2004. Monitoring is discussed further in Section 4.2.4.

Contingent Groundwater Control Actions. No actions have been taken to control the movement of groundwater from Area 8 to Liberty Bay, because the data set for sediment and clam tissue has not yet been sufficiently large to allow meaningful trend analysis. The need for contingent groundwater control actions is discussed in Section 7.2.2, based on the results of the most recent sediment and tissue sampling and subsequent risk assessment.

Institutional Controls. The institutional controls management plan discussed in Section 4.1.3 covers Area 8 and satisfies the institutional controls component of the remedy.

4.2.4 OU 2 Operation, Maintenance, and Monitoring

Area 2 Monitoring

Groundwater monitoring at Area 2 has been conducted since 1995, with annual sampling events historically occurring in the fall of each year. Beginning in 2002, the sampling season was changed from fall to spring to coordinate with other sampling at Area 8 and OU 1. Since the first 5-year review in 2000, samples have been collected from three monitoring wells at the site during each sampling event—wells 2MW-1, 2MW-6, and either MW2-6 or MW2-8.

Institutional controls inspections and reporting for Area 2 have been performed concurrently with those for OU 1, as described in Section 4.1.4.

Area 8 Monitoring

Monitoring at Area 8 has been conducted since the signing of the ROD and has included groundwater, seep, sediment, and tissue sampling and analysis. After the first 11 rounds of sampling (up through 2001), slight modifications to the sampling program were made by the Navy and Ecology (U.S. Navy 2002d). The two upgradient wells were dropped from the list of wells sampled. One-time sampling of wells MW8-10 and MW8-15 was added, with analysis for VOCs. One sample was to be collected from well MW8-12 and analyzed for cyanide, and then cyanide was to be dropped from the analyte list for all media. Chromium speciation was discontinued after the 2000 sampling event. The revised sampling schedule is shown in Table 4-2.

The revised sampling plan for Area 8 (U.S. Navy 2002d) also added monitoring in the area of an independent remedial action undertaken by the Navy within Area 8. During the removal action, petroleum-contaminated soil (PCS) was removed from around and beneath two petroleum USTs. The additional monitoring consisted of the following:

- Sampling wells MW8-2 and MW8-9 for TPH as heavy oil (TPH-heavy oil)
- Sampling of Seep A for TPH-heavy oil

- A physical check of the beach immediately north of Seep A to identify any physical evidence of petroleum on the beach

This monitoring, termed “independent remedial action TPH monitoring,” was conducted in 2000 and 2004. Further monitoring was to be determined by the Navy and Ecology based on the results of these two rounds of sampling (U.S. Navy 2002d).

Institutional controls inspection and reporting for Area 8 have been performed concurrently with those for OU 1, as described in Section 4.1.4.

The results of monitoring conducted since the first 5-year review are summarized in Section 6.4.

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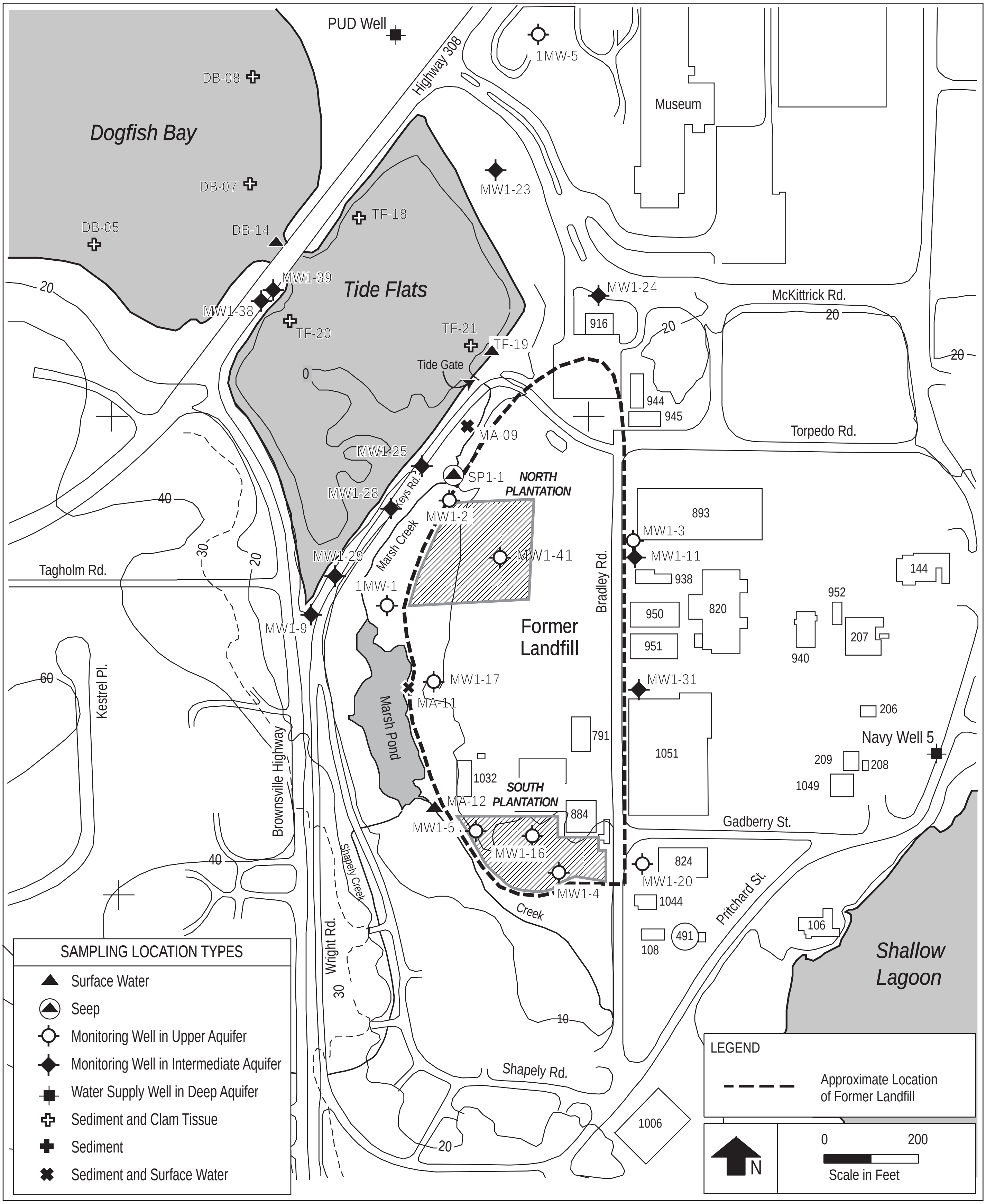

U.S. NAVY	Figure 4-1 Long-Term Monitoring Sampling Locations at OU 1	Delivery Order 0043 NUWC Keyport SECOND FIVE-YEAR REVIEW

Table 4-1
Sampling Locations, Frequencies, and Analytical Requirements for OU 1 Monitoring

Sampling Location	Sampling Frequency				Analytes			
	Spring 2002[a]	Once/ Year[a]	Once/2 Years	Once/5 Years	VOCs	SVOCs	PCBs Pesticides	Metals[b]
Upper Aquifer Wells								
1MW-1		X			X			
MW1-2		X			X			
MW1-4		X			X			
MW1-5		X			X			
MW1-16		X			X			
MW1-17		X			X			
MW1-41		X			X			
Intermediate Aquifer Wells								
MW1-25			X		X			
MW1-28			X		X			
MW1-39			X		X			
MW1-9	X				X			
Deep Wells								
PUD	X				X			
Navy #5	X				X			
Seep								
SP1-1			X				X	
Surface Water								
DB-14		X			X			
TF-19		X			X			
MA-09		X			X			
MA-11		X			X			
MA-12		X			X			
Sediment								
MA-09			X	X		X	X	X
MA-11				X		X	X	X
MA-14			X	X		X	X	X
TF-18				X		X	X	X
TF-20				X		X	X	X
TF-21				X		X	X	X
DB-05				X		X	X	X
DB-07				X		X	X	X
DB-08				X		X	X	X

Table 4-1 (Continued)
Sampling Locations, Frequencies, and Analytical Requirements for OU 1 Monitoring

Sampling Location	Sampling Frequency				Analytes			
	Spring 2002[a]	Once/ Year[a]	Once/2 Years	Once/5 Years	VOCs	SVOCs	PCBs Pesticides	Metals[b]
Tissue (Clams)								
TF-18				X		X	X	X
TF-20				X		X	X	X
TF-21				X		X	X	X
DB-05				X		X	X	X
DB-07				X		X	X	X
DB-08				X		X	X	X

[a] Spring 2002 represents additional one-time sampling agreed upon by the Navy and the Washington State Department of Ecology. This sampling was added to the annual (once/year) sampling program.
[b] Metal analyses include arsenic, beryllium, chromium, lead, mercury, nickel, and zinc.

Notes:
PCBs - polychlorinated biphenyls
SVOCs - semivolatile organic compounds
VOCs - volatile organic compounds

Table 4-2
Sampling Locations, Frequencies, and Analytical Requirements for OU 2 Area 8 Monitoring

	Sampling Frequency			**Analysis**					
Sampling Location	**Spring 2002[a]**	**Once/ Year[a]**	**Once/5 Years**	**VOCs**	**Cyanide**	**Dissolved Metals**	**Total Metals**	**pH-Heavy Oil**	**SVOCs[b]**
Groundwater Monitoring Wells									
MW8-8		X		X		X			
MW8-9		X		X		X			
MW8-11		X		X		X			
MW8-12		X		X	X[c]	X			
MW8-14		X		X		X			
MW-8-16				X					
MW8-10	X								
MW8-15[d]		X		X					
Seeps									
Seep A		X		X		X			
Seep B		X		X		X			
Sediment and Tissue									
1		X	X				X		
2		X	X				X		
3		X	X				X		
4		X	X				X		
5		X	X				X		
6		X	X				X		
7		X	X				X		
8		X	X				X		
9		X	X				X		
	X		X				X		
Independent Remedial Action TPH Monitoring[e]									
MW8-2			X					X	
MW8-9			X					X	
Seep A			X					X	
Physical Check			X					X	

[a] Spring 2002 represents additional sampling agreed upon by the Navy and Ecology.
[b] SVOC analyses include phenol.
[c] Well MW8-12 was sampled for dissolved cyanide during the spring 2002 sampling event only.
[d] Groundwater-level measurement will be conducted at MW8-15, but no environmental sample will be collected for MW8-15.

Table 4-2 (Continued)
Sampling Locations, Frequencies, and Analytical Requirements for OU 2 Area 8 Monitoring

[e] Total petroleum hydrocarbon (TPH) monitoring was conducted once in 2000 and will be again in 2004 before the next 5-year review. At that time, Navy and Ecology will determine if further monitoring is required.

Notes:
SVOCs - semivolatile organic compounds
VOCs - volatile organic compounds

5.0 PROGRESS SINCE LAST FIVE-YEAR REVIEW

Since the first 5-year review in June 2000, the Navy has implemented the following remaining remedy components:

- Upgrading the landfill cap at OU 1 by repaving the central portion of the landfill
- Preparing a contingent remedial action plan for OU 1
- Preparing a risk assessment for sediment and clam tissue immediately offshore of Area 8 to assess the need for contingent groundwater actions or further investigations

With the completion of these remedy components, the remedies for OU 1 and OU 2 have been fully implemented in accordance with the RODs.

Also since the first 5-year review, the Navy has continued the monitoring and institutional controls programs required by the RODs. The monitoring programs have generated data necessary for evaluating the continued protectiveness of the remedy and for decisions regarding the effectiveness of phytoremediation at OU 1 and the potential need for contingent remedial actions at OU 1 and OU 2 Area 8. The institutional controls program has prevented exposures to remaining site contaminants.

Although no deficiencies were noted in the first 5-year review, several recommendations were made. The recommendations focused on continuation of monitoring programs, with slight revisions to some monitoring programs. An annual monitoring report was recommended for OU 1, tying together the monitoring data from the phytoremediation, LTM, and intrinsic biodegradation monitoring programs. The Navy implemented all of these recommendations.

6.0 FIVE-YEAR REVIEW PROCESS

6.1 FIVE-YEAR REVIEW TEAM

The Navy is the lead agency for this 5-year review. Personnel from EFA NW, Naval Base Kitsap, and NUWC Keyport represented the Navy in this 5-year review. Project managers and other staff from the EPA and Ecology, the other 5-year review team members, have also participated in the review process. Both the EPA and Ecology are cosignatories of the RODs for NUWC Keyport. All team members had the opportunity to provide input to this report.

6.2 COMMUNITY NOTIFICATION AND INVOLVEMENT

There are specific requirements pursuant to CERCLA Section 117(a), as amended, for certain reports to be released to the public and that the public be notified of proposed cleanup plans and remedial actions. The community notification and involvement activities are described below.

6.2.1 History of Community Involvement

The Navy has maintained an ongoing commitment to community involvement since the time of the first investigations at NUWC Keyport. The community has been informed of progress at the site through fact sheets, published public notices, open houses, public meetings, and bus tours of the sites. The proposed plans were circulated for public comment prior to finalization of the RODs. The community had substantial input into the remedy for the former landfill, causing the Navy to re-evaluate the proposed plan and segregate OUs 1 and 2. Key documents have been made available for review at Navy facilities and at the Kitsap Regional Library in Bremerton, Washington, and the Poulsbo Branch Library in Poulsbo, Washington.

A community relations plan was prepared in 1990 and updated in 1997. In 1988, a Technical Review Committee (TRC) was established, with representatives from the public and governmental entities. The TRC was replaced with a Restoration Advisory Board (RAB) in March 1995. The RAB members include representatives of the Navy, regulatory agencies, civic groups, private citizens, tribal governments, local governments, and environmental activist groups. The RAB met yearly during the past 5 years was terminated in October 2004.

6.2.2 Community Involvement During the Five-Year Review

A notice was published by the Navy on October 6, 2004, in the *Kitsap Sun* and on October 6 and 9, 2004, in the *North Kitsap Herald* informing the public that the site is currently undergoing a 5-year review, when, where, and how they could receive information, and how to provide comments on the protectiveness of the remedy. Also, selected community members (primarily RAB members) were interviewed as part of the site interview process described in Section 6.6. The Navy received no feedback or comments as a result of the public notices.

6.3 DOCUMENT REVIEW

Documents reviewed during this 5-year review were primarily those describing the construction and monitoring of the selected remedies during the time period August 2000 to the present. The primary documents that were reviewed are listed below:

- The signed RODs (U.S. Navy, USEPA, Ecology 1994 and 1998)
- The first 5-year review report (U.S. Navy 2000b)
- The work plan for long-term monitoring (U.S. Navy 2002d)
- The most recent monitoring reports (U.S. Navy 2004a, 2004c, 2004d, 2004f, and 2004g)
- The revised operation and maintenance plan for phytoremediation at OU 1 (U.S. Navy 2003b)
- The draft closure report for the landfill paving upgrade (U.S. Navy 2004e)
- The contingent remedial action plan for OU 1 (U.S. Navy 2003a)
- The most recent data for sediment and shellfish tissue at Area 8 (U.S. Navy 2004a)

Review of these documents provided much of the information included in Sections 3 and 4 regarding the description of the sites, the RAOs and selected remedy components for each site, and the status of remedy implementation and monitoring at each site.

6.4 DATA REVIEW

This section summarizes trends in data collected through the various monitoring programs at NUWC Keyport, with emphasis on data collected since the last 5-year review. The monitoring programs are described in Section 4, and the implications of the data on the functionality and protectiveness of the remedies are discussed in Section 7.

The data trends are discussed in the subsections that follow by OU, area, and medium.

6.4.1 OU 1 Monitoring Data

OU 1 Groundwater Monitoring Data

Historical and recent groundwater monitoring data for OU 1 are summarized in Table 6-1 and discussed by aquifer in the subsections that follow. Sampling locations are shown on Figure 4-1.

Upper Aquifer. Since the last 5-year review, VOCs have been consistently detected in most of the monitoring wells selected for regular sampling. RGs for some target VOCs (particularly TCE, cis-1,2-DCE, and vinyl chloride) have been consistently exceeded in wells located in or immediately downgradient from the phytoremediation plantations (U.S. Navy 2004a). Overall, the concentrations of VOCs have remained within the historical range for each well, although some wide seasonal fluctuations have been observed at some wells (e.g., MW1-4) for some VOCs. VOC concentrations remain highest in groundwater beneath the south phytoremediation plantation (U.S. Navy 2004f).

Beneath the north phytoremediation plantation, VOC concentrations have trended slightly downward overall, except for vinyl chloride in well 1MW-1, which exhibits an upward trend. Beneath the south plantation, VOC concentrations have generally trended downward. This is true overall even for well MW1-4, which exhibits seasonal concentration increases in the summer and decreases in the fall, but an overall decline in the long term. VOC concentrations in well MW1-16 have decreased dramatically since monitoring began, although the 1,1-dichloroethane (1,1-DCA) concentration spiked in 2002 in this well and well MW1-5, returning to historical levels in 2003 (U.S. Navy 2004f).

Intermediate Aquifer. VOCs continued to be detected in the three intermediate aquifer wells sampled over the last 5 years. In MW1-39, only vinyl chloride has been detected above the RG, at concentrations up to 2.0 μg/L, with no strong increasing or decreasing trend. In MW1-28 and MW1-25, the VOCs 1,1-DCE, cis-1,2-DCE, TCE, and vinyl chloride have all been detected above RGs in the last 5 years. The concentrations of these contaminants have not exhibited strongly increasing or decreasing trends (U.S. Navy 2004f).

Deep Aquifer. Two wells (Navy Well #5 and the Kitsap County Public Utility District well) screened in the deep aquifer were sampled annually since the last 5-year review. Target VOCs were not detected in these two wells during any sampling event (U.S. Navy 2004f).

OU 1 Surface Water and Seep Monitoring Data

Historical and recent surface water monitoring data for OU 1 are summarized in Table 6-2. Sampling locations are shown on Figure 4-1.

Recent sampling at the five surface water stations situated along the outward flow of surface water from the marsh pond to Dogfish Bay shows target VOCs at all locations. At the most upstream location, MA-12, both the TCE and vinyl chloride concentrations continue to exceed RGs, but exhibit a declining trend. Farther downstream, samples from locations MA-11, MA-09, and TF-19 (in downstream order, ending at the tide flats) all contained vinyl chloride concentrations exceeding the RG in at least two sampling events over the last 5 years. No other target VOC concentrations exceeded the RG in the samples from these locations. Cis-1,2-DCE is the only target VOC regularly detected at station DB-14 in Dogfish Bay. This VOC is consistently detected at low concentrations.

Target VOCs are intermittently detected in samples from the landfill seep, SP1-1. Only vinyl chloride has exceeded the RGs in samples from this seep. Samples from 2000, 2002, and 2004 ranged from not detected to a high of 43 µg/L (2002). Vinyl chloride concentrations at the seep in 2004 were 1.1 µg/L. Seep samples are also periodically analyzed for PCBs. Samples from 2000, 2002, and 2004 contained PCB concentrations ranging from 0.42 to 0.45 µg/L (U.S. Navy 2004a).

OU 1 Intrinsic Biodegradation Monitoring Data

In general, results of the latest intrinsic biodegradation sampling in June 2004 are consistent with sampling conducted in 2000, with no dramatic changes in redox conditions over the 5-year period covered by this review. Strongly reducing conditions favorable for reductive dechlorination of VOCs were found in fewer upper-aquifer wells beneath the landfill during June 2003 and 2004, compared to 2001 and 2002. However, at least mildly reducing conditions were found in most wells, and the VOC concentration trends indicate continued biodegradation. The historical data on redox conditions show significant variation from year to year, and the apparent decrease from strongly to mildly reducing conditions in some wells over the last 2 years may be a result of that variation, rather than any consistent downward trend. Redox conditions in intermediate aquifer wells located just downgradient of the landfill (MW1-25 and MW1-28) have remained somewhat favorable for reductive dechlorination (USGS 2003 and 2004).

Overall, intrinsic biodegradation monitoring has not found any adverse impact on biodegradation parameters as a result of implementing phytoremediation, and some unproven benefit may exist from the increased soil microbial activity associated with the trees. Natural biodegradation of VOCs is substantial along the groundwater pathway from the landfill to the adjacent marsh, and from the shallow aquifer to the intermediate aquifer. Biodegradation is also substantial in surface water as it flows through the marsh to the tide flats (USGS 2002). However, as has been observed since the initial studies at the site, natural biodegradation is still not sufficient to reduce VOC concentrations to below the surface water RGs established for the marsh (USGS 2004). This is in part due to the relatively short distance between the landfill and the adjacent marsh and in part due to the high VOC concentrations remaining beneath the landfill (USGS 2002).

OU 1 Sediment Monitoring Data

Historical and recent sediment monitoring data for OU 1 are summarized in Table 6-3. Sampling locations are shown on Figure 4-1.

During both the 2000 and 2004 sampling events, most sediment samples exhibited very low concentrations of SVOCs, pesticides, and PCBs. However, in 2000 the phenol concentration from location TF-21 exceeded the sediment quality standard (SQS) for this compound, while the PCB concentrations at locations MA-09 and MA-14 exceeded the Puget Sound Estuary Program (PSEP) apparent effects threshold (AET) screening level. In the 2002 and 2004 samples from these locations, the PCB concentrations were below the AET screening level, and no SVOCs exceeded the SQS (U.S. Navy 2004a).

The metals results for all four sampling events were similar, with no apparent spatial or temporal trends (U.S. Navy 2004a).

OU 1 Shellfish Monitoring Data

Historical and recent shellfish monitoring data for OU 1 are summarized in Table 6-4. Sampling locations are shown on Figure 4-1.

As noted in Section 4.1.4, because no target VOCs were detected in the 2000 tissues samples, it was concluded that the RGs had been reached for these COCs in tissue (U.S. Navy 2002e). Based on this finding, VOCs were not included on the 2004 analyte list with the concurrence of Ecology.

Several SVOCs were detected at low concentrations in 2000, but RGs were not established for SVOCs in tissue at OU 1. Overall, there were fewer SVOC detections in the 2004 tissue samples as compared to 2000. The only two compounds that were detected in all six tissue samples were 2-methylphenol and benzoic acid. Phenol and benzyl alcohol were not detected in 2004, although they were detected in all six tissue samples in 2000 (U.S. Navy 2004a).

No PCBs were detected in any of the 2004 shellfish tissue samples. Eight pesticide compounds were detected at low concentrations, ranging from 0.22 (estimated) to 5.4 μg/kg. No RGs were established for these compounds. Although there were more pesticides detected in 2004 than in 2000, the detected concentrations were consistent between the two rounds (U.S. Navy 2004a).

Six of the seven metals analytes were detected in all 2004 tissue samples at low concentrations. Beryllium was not detected in any of the tissue samples. Overall, most 2004 metals concentrations were equal to or lower than the 1996 and 2000 concentrations, indicating a decreasing trend in target metals concentrations (U.S. Navy 2004a).

OU 1 Phytoremediation Monitoring

Contouring of the periodic groundwater elevation data in and around the phytoremediation plantations has not yet revealed a discernible drawdown of shallow groundwater attributable to the plantations. Analysis of groundwater elevation data collected at 10-minute intervals using downwell data loggers indicates that any effect on groundwater elevation by the plantations may be masked by a diurnal groundwater elevation fluctuation associated with tides. Test pits have been excavated next to the trees at several locations, and root mapping in these test pits indicates that the tree roots have reached shallow groundwater.

Periodic sampling and analysis of groundwater and surface water samples is conducted as part of phytoremediation monitoring and other monitoring of OU 1. The data trends from these sampling efforts are summarized in other subsections of Section 6.4.1. In general, the data trends so far are not indicative of substantial COC concentration reduction by phytoremediation. The ROD anticipated that COC concentration reductions in groundwater “may not be observed for a fairly long time,” because of the time required to establish mature plantations that use a significant quantity of contaminated groundwater. Also as anticipated by the ROD, surface water sampling in 1999 showed a temporary COC concentration increase at location MA-12, probably resulting from increased infiltration through the south plantation hot spot as a result of removing asphalt to plant trees. COC concentrations at this surface water sampling location have since exhibited a declining trend.

The periodic plantation inspection results indicate that the two plantations remain healthy. The Navy has monitored and controlled pests and competing weeds as necessary and has provided regular fertilization and irrigation to ensure healthy stands of trees.

6.4.2 OU 2 Area 2 Monitoring Data

Historical and recent groundwater monitoring data for Area 2 are summarized in Table 6-5. Sampling locations are shown on Figure 3-2.

At Area 2, concentration trends in groundwater for the COCs TCE and vinyl chloride, as well as for the related compound cis-1,2-DCE, have been tracked since signing of the ROD. COC concentrations exhibit a decreasing trend at 2MW-1 and 2MW-6, which are located at the source area and downgradient of the site, respectively. The observed concentration decline may be the result of natural biodegradation (U.S. Navy 2004c). In spite of this decreasing trend, concentrations of TCE at well 2MW-1 and vinyl chloride at well 2MW-6 continue to exceed the RGs for these COCs.

6.4.3 OU 2 Area 8 Monitoring Data

Historical and recent monitoring data for Area 8 are summarized in Tables 6-6 through 6-9. Sampling locations are shown on Figure 3-3. Trends in the data observed over the last 5 years are summarized in the subsections that follow, by medium.

OU 2 Area 8 Groundwater Monitoring Data

Trends for six target analytes are tracked during Area 8 reporting – dissolved cadmium and chromium and the VOCs TCE, TCA, tetrachloroethene, and DCE. In general, the concentration ranges of target analytes detected in groundwater at Area 8 are slightly lower than those detected during the RI.

VOC concentrations in groundwater generally have been declining or have remained stable over the last 5 years, except for VOCs at MW8-11 and MW8-16, which have shown an increasing trend in recent years (DCE at MW8-11 and tetrachloroethene and TCE at MW8-16). VOC concentrations in five of the six wells regularly sampled consistently exceed RGs. There is little evidence of natural biodegradation of these chlorinated VOCs in groundwater beneath the site, and the RGs are not expected to be met for VOCs in groundwater in the foreseeable future (U.S. Navy 2004g).

The target metals cadmium and chromium have been consistently detected in the six wells selected for periodic sampling (Table 6-7). Cadmium and chromium concentrations have generally decreased or remained stable over the last 5 years, except that chromium at MW8-14 has exhibited a slight upward trend (at concentrations below the RG). Groundwater samples from one or more wells have continued to exhibit concentrations exceeding the RGs for cadmium, chromium, arsenic, copper, silver, and zinc over the last 5 years (U.S. Navy 2004g).

OU 2 Area 8 Seep Monitoring Data

VOC concentrations at Seeps A and B (Table 6-6) have exhibited declining trends over the past 5 years, except that the 2004 results at Seep A indicate an order-of-magnitude increase or more compared to the 2000 to 2003 results. This increase might be indicative of a future increasing concentration trend. The TCE concentrations at both seeps have occasionally exceeded the RG, and the 1,1-DCE concentration at seep A exceeded the RG during the 2004 sampling event (U.S. Navy 2004g).

Concentrations of cadmium and chromium have been detected above RGs at both seeps, and the concentration trend for cadmium is upward at both seeps (Table 6-7). The trend for chromium is also upward at Seep B (U.S. Navy 2004g).

OU 2 Area 8 Sediment Monitoring Data

Sediment sampling is conducted at the time of each 5-year review, and data are now available from 1996 (the post-ROD sampling event), 2000, and 2004 (Table 6-8). Samples are collected from nine stations along three transects on the beach bordering Liberty Bay (Figure 3-3) and analyzed for SVOCs and metals. The 2004 analytical results were generally consistent with the 2000 results (U.S. Navy 2004g).

Six of the 2004 samples exhibited metals concentrations exceeding SQSs. The highest metals concentrations, and a clear grouping of locations with exceedances, occurs along Transect 3 (Figure 3-3), which is located at and downslope from Seep A (U.S. Navy 2004g).

Two different samples exhibited concentrations of the SVOC phenol exceeding the SQS of 420 μg/kg (dry weight): locations 7 and 8 at 1,400 and 1,000 μg/kg, respectively. Phenol was previously detected at elevated concentrations at locations 8 and 9 (1,500 and 2,000 μg/kg, respectively) during the 2000 sampling event. Phenol was not detected at location 9 in 2004 (U.S. Navy 2004g).

OU 2 Area 8 Shellfish Tissue Monitoring Data

As with sediment sampling, shellfish sampling is conducted at the time of each 5-year review, and data are now available from 1996 (the post-ROD sampling event), 2000, and 2004 (Table 6-9). Shellfish samples are collected along the same beach transects, and at the same sampling locations, used for sediment sampling (U.S. Navy 2004g).

The 2004 shellfish results are generally consistent with the 2000 results, although there were fewer SVOC detections in 2004 when compared to 1996. Six of the seven metals of interest (except cadmium) exhibited relatively uniform concentrations across the nine sampling location. Cadmium concentrations exhibited a greater variation, ranging from 0.57 mg/kg at location 1 to 4.54 mg/kg at location 5. No specific spatial distribution patterns were observed for the detected metals in tissue samples (U.S. Navy 2004g).

When compared to the 1996 and 2000 data, average concentrations of three of the seven metals of interest were lower in 2004, while the other four had similar concentrations among the three sampling rounds. Because the concentrations varied less than an order of magnitude between the three sampling rounds, no strong concentration trends over time can be discerned (U.S. Navy 2004g).

A variety of SVOCs were detected in tissue samples at low concentrations. Of particular interest is phenol, which was also detected in sediment at locations 1, 3, 4, 6, 7, and 8. While phenol was detected in tissue at locations 8 and 9 (240 and 230 mg/kg, respectively) in 2000, no phenol was detected in tissue at any of the locations in 2004 (U.S. Navy 2004g).

The risk assessment discussions in Section 7 address the risks to human health and the environment posed by the detected concentrations of metals and SVOCs in shellfish tissue.

Independent Remedial Action TPH Monitoring

No petroleum compounds were detected in samples collected from the well and seep locations selected for monitoring (MW8-2, MW8-9, and Seep A) in 2004 (U.S. Navy 2004g). In addition, the beach along Liberty Bay was inspected and no visual indications of petroleum contamination (oily sheens or seeps) were found within the inspection area. The shallow seawater bordering the inspected beach also showed no signs of petroleum impacts (U.S. Navy 2004g).

6.4.4 Institutional Controls Inspection Data

The findings of the May 19, 2004, institutional controls inspection are summarized below.

- OU 1, Area 1, the former landfill:
  - The area is being used as a parking lot and also has phytoremediation plantations.
  - Security procedures for base entry have maintained a restricted access.
  - Water wells have not been installed in Areas A (between the marsh and tide flats), B (between the tide flats and Pass and ID Building), or D (the former landfill), or on Navy property within 1,000 feet of the former landfill, except those installed for monitoring or remedial action purposes.
  - Activities that could interfere with or compromise monitoring or remedial actions have not occurred in Area C, the tide flats.

  - Employees are not permanently assigned to work in buildings in Area D, the former landfill.

  - The only land use activities for Area D, the former landfill, are those involving only occasional occupancy by workers. The inspection included a comment about two temporary trailers being used periodically by contractors.

  - Construction and digging activities at Area D, the former landfill, were controlled by the base excavation/dig permit procedure. The permit requirements were effective in maintaining the requirements of the institutional controls plan.

  - No activities occurred in the marsh pond or marsh system that disturbed the wetlands, resulted in an exposure hazard, or interfered with or compromised the monitoring or remedial actions for the landfill.

- OU 2, Area 2, Van Meter Road Spill/Drum Storage Area:

  - The area is being used as a recycling yard.

  - Security procedures for base entry have maintained a restricted access.

  - Construction and digging activities have been controlled by the base excavation/dig permit procedure and were effective in maintaining the requirements of the institutional controls plan.

  - No water wells have been installed, except those for monitoring or remedial actions.

  - Residential development has not occurred.

- OU 2, Area 8, Plating Shop Waste/Oil Spill Area:

  - The area is being used as a parking lot.

  - Security procedures for base entry have maintained a restricted access.

  - Construction and digging activities have been controlled by the base excavation/dig permit procedure and were effective in maintaining the requirements of the institutional controls plan.

- No water wells have been installed, except those for monitoring or remedial actions.

- Residential development has not occurred.

6.5 RESULTS OF SITE INSPECTION

The site inspection checklist is included as Appendix A. This section contains a summary of the site inspection findings. The site visit occurred on October 6, 2004, and was conducted by the following personnel:

- Douglas Thelin, EFA NW
- Barbara Chafin-Tissier, Naval Base Kitsap
- Daniel Gravning, EFA NW
- Michael Meyer, URS Corporation
- Sharon Quiring, URS Corporation

The site visit included verifying that remedial actions were complete and operational (for those items that could be visually inspected) and inspecting all portions of the site covered by institutional controls.

The upgrade of the landfill paving was the only physical remedy component completed during this 5-year review period. The paving was visually inspected, as were the stormwater control facilities. The paving and stormwater facilities appeared to be complete and in good condition. The stormwater bioswales had been recently revegetated.

The phytoremediation plantations were in good health, with the exception of some rust on the tree leaves. The Navy is addressing the rust issue. The most recent operation and maintenance plan and the most recent monitoring data are not kept on site, but are on file at EFA NW.

The institutional controls requirements are being met at OU 1, OU 2 Area 2, and OU 2 Area 8. Institutional controls inspections are being performed and documented yearly, and documentation is available.

6.6 RESULTS OF INTERVIEWS

Interviews were conducted with persons familiar with the CERCLA actions at NUWC Keyport. Interviewees were selected from the Navy (including EFA NW, Naval Base Kitsap, and NUWC Keyport), Navy contractors working at NUWC Keyport, EPA, Ecology, Kitsap County Health, the Suquamish Tribe, and the community. Interview instructions and questions were sent to potential interviewees via hard-copy mail or e-mail; responses to questions were returned either by e-mail or in hard copy (at the discretion of the interviewee). Not all those invited to comment chose to do so. Interview responses are documented in Appendix B. Highlights of the interview responses are summarized in the following subsections.

6.6.1 Navy Personnel

Two broad categories of Navy personnel were interviewed: personnel associated directly with the facility (Naval Base Kitsap and NUWC Keyport) and EFA NW personnel.

NUWC Keyport and Naval Base Kitsap

Personnel from both Naval Base Kitsap and NUWC Keyport indicated that the remedy was functioning well for the most part, except that the phytoremediation plantations do not seem to show effectiveness as yet. Community input has been positive regarding the remedies, and no complaints have been received.

EFA NW Personnel

The EFA NW respondent generally agreed with the other Navy respondents that the remedy components were generally functioning well. The respondent opined that it is too early to expect phytoremediation to be fully effective, since the trees are not yet fully mature, and points out that a delayed effectiveness for this remedy component was anticipated by the ROD. The respondent also noted that the tide gate was not maintained for several years, but is now being maintained. The lack of maintenance did not cause any detrimental effects at the landfill.

6.6.2 Agency Personnel

Ecology responded that the available information implied that the effectiveness of phytoremediation at the site may be limited, and that the effects could not be differentiated from natural biodegradation effects. The PCB sediment removal was effective, but PCB concentrations in a seep sample from 2002 were above the RGs for PCBs, indicating that future monitoring will be necessary to assess effectiveness. The tide gate is an effective remedy. The asphalt upgrade meets with Ecology approval. However, Ecology pointed out that this upgrade does not constitute a landfill cover in accordance with state regulations and that the ROD requires that LTM data be used to assess whether a landfill cover is necessary in the future. Although LTM has been effective at assessing contaminant trends, it has not been effective at differentiating natural biodegradation from the effects of phytoremediation. Ecology has approved the contingent remedial action plan and believes that land use controls are effective.

Contaminants remain at Areas 2 and 8 above RGs, and Ecology believes that the effectiveness of institutional controls and monitoring in achieving RGs at these areas cannot be assessed at this time.

No other Agency personnel responded to the request for an interview.

6.6.3 Community

The Suquamish Tribe responded, noting that the remedy components have been implemented as intended. However, the Tribe noted that contaminants were still present above RGs and that the protectiveness of the remedies could only be assessed after reviewing the 2004 sediment and tissue data. The Tribe noted that contamination within traditional fishing areas limited the Tribe’s ability to safely gather resources. The Tribe stated that risk assessment scenarios should include recent Suquamish consumption survey data.

One community member responded and indicated that the community was proud to have been a part of the remedial decision making at the site. The community stated that they have been well informed so far, and hope to continue to be. The community also stated that they are very attached to the phytoremediation plantations.

Table 6-1
Summary of Analytical Results for OU 1 Groundwater Sampling Through April 2004

Location	Sampling Date	Analyte Concentration (μg/L)								
		1,1-DCA	1,2-DCA	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	PCE	1,1,1-TCA	TCE	Vinyl Chloride
RG (Drinking Water)		800	5	0.5	70	100	5	200	5	0.50
RG (Surface Water)			59	1.9		33,000	4.2	41,700	56	2.9
1MW-1	08/25/95	14	1 U	**5.1**	**590 J**	**180 J**	1 U	1 U	1 U	**1000 J**
	12/06/95	1	1 U	1 U	**87 J**	7.7	1 U	1 U	1 U	**210 J**
	03/12/96	8.5	0.5 U	**2.6**	**450 J**	**120 J**	0.5 U	0.5 U	0.62	**710 J**
	06/26/96	15	0.5 U	**3.2**	**460 J**	**220 J**	0.5 U	0.5 U	.51 U	**1200 J**
	06/11/99	19	3 U	**4**	**310**	**170**	3 U	3 U	3 U	**960**
	10/20/99	17	0.5 U	**2.9**	**320**	**190**	0.5 U	0.5 U	0.5 U	**970**
	04/25/00	18	0.5 U	**3.1**	**380 J**	**210 J**	0.5 U	0.5 U	0.5 U	**1200 J**
	06/07/00	13	0.5 U	**1.7**	**240 J**	**210 J**	0.5 U	0.5 U	0.58	**1200 J**
	07/24/00	25 U	25 U	25 U	**280 J**	**170 J**	25 U	25 U	25 U	**920 J**
	10/31/00	17	1 U	**2**	**270**	**160**	1 U	1 U	1 U	**1300**
	04/27/01	17	1 UJ	**3.9**	**250 J**	**170 J**	1 U	1 UJ	0.6 J	**770 J**
	06/20/01	19	0.58 U	**2.5 J**	**240**	**170**	0.55 U	0.56 U	0.59 U	**860**
	07/30/01	14 J	1 U	**2.4**	**240 J**	**170**	1 U	1 U	1 U	**1500 J**
	10/29/01	14 J	1 U	**1.5**	**160 J**	**130**	1 U	1 U	1 U	**970 J**
	04/30/02	16 J	2.5 U	**2.6 J**	**280 J**	**180 J**	2.5 U	2.5 U	2.5 U	**750 J**
	06/19/02	12 D	2.5 U	**1.7 JD**	**170 D**	**130 D**	2.5 U	2.5 U	2.5 U	**970 D**
	07/23/02	15 J	2.5 U	**2.6 J**	**280 J**	**200 J**	2.5 U	2.5 U	2.5 U	**1100 J**
	10/24/02	15 J	2 U	2 U	**180 J**	**130 J**	2 U	2 U	2 U	**570 J**
	04/29/03	10 D	1.0 U	**1.4 D**	**160 D**	94 D	1.0 U	1.0 U	1.0 U	**780 D**
	10/14/03	14	2.5 U	**1.4 J**	**140**	**140**	2.5 U	2.5 U	2.5 U	**840**
	04/22/04	12	0.5 U	**1.9**	**150 D**	**130 D**	0.5 U	0.5 U	0.31 J	**750 D**
MW1-2	08/28/95	1 U	1 U	**4.2**	**1400 J**	23	1 U	1 U	**36 J**	**150 J**
	12/06/95	1 U	1 U	**3.5**	**1300 J**	22	1 U	1 U	**35 J**	**140 J**
	03/11/96	0.5 U	0.5 U	**4.8**	**1800 J**	30 J	0.5 U	0.5 U	**41**	**200 J**
	06/25/96	0.23 J	0.5 U	**5.1 J**	**1500 J**	31 J	0.5 U	0.5 U	**43 J**	**180 J**
	06/11/99	3 U	3 U	**5**	**980**	26	3 U	3 U	**27**	**160**
	10/20/99	0.5 U	0.5 U	**3.4**	**1000**	21	0.5 U	0.5 U	**23**	**110**
	04/25/00	0.5 U	0.5 U	**6**	**1900 J**	49 J	0.5 U	0.5 U	**13**	**230 J**
	06/08/00	0.30 J	0.20 J	**3.2 J**	**890 J**	21 J	0.5 U	0.5 U	**22 J**	**110 J**
	07/24/00	25 U	25 U	25 U	**750 J**	25 U	25 U	25 U	25 U	**87 J**
	10/31/00	1 U	1 U	**2.2**	**810**	15	1 U	1 U	**12**	**85**
	04/26/01	1 U	1 UJ	**6.3**	**1200 J**	44	1 U	1 UJ	**21**	**120 J**
	06/20/01	0.91 U	1.2 U	**3.6 J**	**950**	18	1.1 U	1.2 U	**19**	**89**
	07/30/01	1 U	1 U	**2.1**	**660 J**	43 J	1 U	1 U	**19**	**130 J**
	10/29/01	1 U	1 U	**2.4**	**700 J**	18	1 U	1 U	**14**	**93**
	04/30/02	2.5 U	2.5 U	**3.6 J**	**1200 J**	29 J	2.5 U	2.5 U	**5 J**	**140 J**
	06/19/02	0.26 J	1.0 U	**2.2 D**	**660 D**	13 D	1.0 U	1.0 U	**15 D**	**75 D**
	07/23/02	1 U	1 U	**2.6 J**	**720 J**	16 J	1 U	1 U	**17 J**	**100 J**
	10/24/02	2.5 U	2.5 U	**2.7 J**	**910 J**	17 J	2.5 U	2.5 U	**21 J**	**120 J**
	04/30/03	2.0 U	2.0 U	**3.4 D**	**870 D**	18 D	2.0 U	2.0 U	**13 D**	**130 D**
	10/15/03	0.26 J	0.5 U	**2.6**	**710**	15	0.5 U	0.5 U	**19**	**120**
	04/22/04	0.37 J	0.5 U	**3.9**	**1200 D**	22	0.5 U	0.5 U	**14**	**200 D**
MW1-3	03/08/96	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	06/21/96	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	09/11/96	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	06/21/99	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/20/99	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.7	0.5 U
	04/25/00	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	07/24/00	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	10/31/00	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
	04/27/01	1 U	1 UJ	1 U	1 U	1 U	1 U	1 UJ	1 U	1 U

Table 6-1 (Continued)
Summary of Analytical Results for OU 1 Groundwater Sampling Through April 2004

Location	Sampling Date	Analyte Concentration (µg/L)								
		1,1-DCA	**1,2-DCA**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**PCE**	**1,1,1-TCA**	**TCE**	**Vinyl Chloride**
MW1-3 (Continued)	07/30/01	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
	10/29/01	1 U	1 U	1 U	1	1.1	1 U	1 U	1 U	**3.3**
	04/30/02	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	07/23/02	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	10/24/02	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	04/29/03	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	10/14/03	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	04/21/04	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW1-4	08/23/95	1 U	1 U	**7.7**	**6400 J**	80 J	2.2	1 U	**11000 J**	**2000 J**
	12/05/95	1 U	1 U	**5.2**	**3900 J**	500 U	1.7	1 U	**8600 J**	**2800 J**
	03/05/96	.67 J	0.5 UJ	**5.6 J**	**3500 J**	56 J	.96 J	0.5 UJ	**6300 J**	**1100 J**
	06/20/96	.64	0.5 U	**13**	**5900 J**	41	4	0.5 U	**22000 J**	**970 J**
	06/14/99	2 J	3 U	**24**	**12000**	**140**	4	3 U	**2600 E**	**1500**
	10/21/99	0.8	0.5 U	**10**	**5300**	70	0.7	0.5 U	**3600**	**1100**
	04/26/00	1.4	0.5 U	**16**	**8500 J**	250 U	250 U	250 U	**18000 J**	**860 J**
	06/13/00	250 U	250 U	250 U	**15000 J**	**100 J**	250 U	250 U	**38000**	**1300**
	07/25/00	250 U	250 U	250 U	**8500 J**	250 U	250 U	250 U	**18000 J**	**860 J**
	11/09/00	1 U	1 U	**0.9 J**	**660**	12	1 U	1 U	**490**	**190**
	04/27/01	1 U	1 UJ	**6.6**	**3700 J**	74 J	0.8 J	1 UJ	**3900 J**	**700 J**
	06/20/01	4.6 U	5.7 U	**18 J**	**12000**	**110**	5.5 U	5.6 U	**13000**	**1700**
	07/31/01	1 U	1 U	**2.9**	**2200 J**	95 J	0.6 J	1 U	**2700 J**	**400 J**
	10/30/01	1 U	1 U	**0.5 J**	**270 J**	3	1 U	1 U	**170**	**49**
	05/01/02	2.5 U	2.5 U	2.5 U	**600 J**	3.7 J	2.5 U	2.5 U	**730 J**	**54 J**
	06/17/02	50 U	50 U	**30 J**	**15000 D**	**100 D**	50 U	50 U	**42000 D**	**970 D**
	07/25/02	1 U	1 U	**1.1 J**	**600 J**	2.7 J	1 U	1 U	**580 J**	**95 J**
	10/25/02	0.5 U	0.5 U	**0.8**	**430 J**	3.9	0.5 U	0.5 U	**490 J**	**36 J**
	04/29/03	25 U	25 U	25 U	**7000 D**	53 D	25 U	25 U	**11000 D**	**1100 D**
	10/15/03	13 U	13 U	**9.0 J**	**4000**	50	13 U	13 U	**2500**	**1800**
	04/21/04	50 U	50 U	**18 J**	**8100 D**	71 D	50 U	50 U	**20000 D**	**460 D**
MW1-5	08/23/95	5.8 J	1 U	1 U	17	1.3	1 U	1 U	1.9	**140**
	12/05/95	110 J	1 U	1 U	**74 J**	16	1 U	1 U	**7.3**	**4300 J**
	03/06/96	34	0.5 U	0.5 U	60	7	0.5 U	0.5 U	3	**1100**
	06/20/96	29 J	0.5 U	.24 J	**93 J**	6.5	0.5 U	0.5 U	1.7	**1500 J**
	06/14/99	9	3 U	3 U	9	2 J	3 U	3 U	2 J	**260**
	10/21/99	9.6	0.5 U	0.5 U	0.50	0.50	0.5 U	0.5 U	0.5 U	**18**
	04/25/00	1.1	0.5 U	0.5 U	1.2	0.5 U	0.5 U	0.5 U	0.5 U	**30**
	06/07/00	6.9	0.5 U	0.5 U	1.8	.64	0.5 U	0.5 U	1.6	**22**
	07/25/00	1.8	0.5 U	0.5 U	3.4	0.5 U	0.5 U	0.5 U	0.5 U	**31**
	11/06/00	1.7	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**7**
	04/26/01	1 U	1 UJ	1 U	1 U	1 U	1 U	1 UJ	1 U	**24**
	06/20/01	1.5	0.12 U	0.12 U	0.46 J	0.28 J	0.11 U	0.12 U	0.46 J	**32**
	07/31/01	0.5 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**13**
	10/30/01	1.7	1 U	1 U	0.5 J	1 U	1 U	1 U	1 U	**3.5**
	05/01/02	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**1.7**
	06/17/02	0.93	0.5 U	0.5 U	0.74	0.16 J	0.5 U	0.5 U	0.85	**11**
	07/24/02	0.65	0.5 U	0.5 U	0.63 J	0.5 U	0.5 U	0.5 U	0.66	**2.5**
	10/25/02	15	0.5 U	0.5 U	0.82	0.5 U	0.5 U	0.5 U	0.8	**5.6**
	04/29/03	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**5.1**
	10/15/03	2.0	0.5 U	0.5 U	0.41 J	0.22 J	0.5 U	0.5 U	0.24 J	**3.1**
	04/22/04	0.24 J	0.5 U	0.5 U	0.27 J	0.5 U	0.5 U	0.5 U	0.24 J	**0.83**
MW1-16	08/31/95	**12000 J**	**15 J**	**680 J**	**14000 J**	**520 J**	.51 J	**5600 J**	**250 J**	**12000 J**
	06/20/96	**30000 J**	**35 J**	**180 J**	**3100 J**	**180 J**	1.3 J	**430 J**	**34 J**	**2200 J**
	06/14/99	**15000**	**17**	**48**	**6800**	160	1 J	140	**530**	**1700**

Table 6-1 (Continued)
Summary of Analytical Results for OU 1 Groundwater Sampling Through April 2004

Location	Sampling Date	Analyte Concentration (µg/L)								
		1,1-DCA	**1,2-DCA**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**PCE**	**1,1,1-TCA**	**TCE**	**Vinyl Chloride**
MW1-16 (Continued)	10/21/99	**6500**	**9**	**5**	28	26	1.2	23	**9.2**	**28**
	04/26/00	**1700 J**	0.5 U	0.5 U	**70 J**	7.4	0.69	16	3.3	**4.3**
	06/07/00	**2500**	2.7	**2 J**	13	13	1 J	29	**20**	**6.6**
	07/25/00	**2300 J**	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
	11/06/00	**3900**	4.2	**1.3**	12	16	1 U	21 J	4.1	1 U
	04/27/01	**1100 J**	1.6 J	1 U	2.4	7.5	0.4 J	7.2 J	2.2	**19**
	06/20/01	**2900**	**7 J**	**23 J**	**9300**	98	5.5 U	28	**370**	**1400**
	07/31/01	**1900 J**	1.9	**2.2**	60	12	1 U	15	**8.3**	**68 J**
	10/30/01	**3400 J**	4.1	**2.1**	13	17	1 U	13	3.5	**11**
	05/01/02	**1200 J**	2.5 U	2.5 U	3.9 J	7.9 J	2.5 U	5.6 J	2.5 U	**2.7 J**
	06/17/02	**10000 D**	50 U	**42 J**	**24000 D**	**240 D**	50 U	38 J	**150 D**	**3000D**
	07/24/02	**3200 J**	5 U	5 U	**340 J**	17 J	5 U	10 J	**5.5 J**	**86 J**
	10/25/02	**9000 J**	25 U	25 U	**190 J**	38 J	25 U	25 U	25 U	**80 J**
	04/29/03	330 D	0.5 U	0.5 U	1.6	3.9	0.5 U	0.52	1.3	**2.1**
	10/15/03	**1700**	5.0 U	5.0 U	6.2	13	5.0 U	5.3	2.4 J	**5.5**
	04/21/04	160 D	0.21 J	0.24 J	1.8	3	0.13 J	0.20 J	1	**1.7**
MW1-17	08/29/95	1 U	1 U	1 U	6.4	0.93 J	1 U	1 U	1 U	**6.9**
	12/04/95	1 U	1 U	1 U	5.1	1 U	1 U	1 U	1 U	**4.3**
	03/06/96	0.5 U	0.5 U	0.5 U	0.32 J	0.29 J	0.5 U	0.5 U	0.5 U	**0.47 J**
	06/24/96	0.5 U	0.20 J	0.5 U	1.4 U	0.51	0.40 J	0.5 U	0.5 U	1.2 U
	06/07/00	0.10 J	0.5 U	0.5 U	0.5 U	0.64	0.5 U	0.5 U	0.30 J	0.5 U
	06/20/01	0.12 J	0.12 U	0.12 U	0.12 U	0.71	0.11 U	0.12 U	0.12 U	0.22 U
	06/17/02	0.11 J	0.5 U	0.5 U	0.5 U	0.43 J	0.5 U	0.5 U	0.5 U	**0.66**
	04/29/03	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**1.4**
	04/22/04	0.5 U	0.5 U	0.5 U	3.4	0.31 J	0.5 U	0.5 U	0.89	**3.8**
MW1-20	08/30/95	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
	12/08/95	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
	03/11/96	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	06/27/96	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	06/21/99	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/21/99	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	04/26/00	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	07/25/00	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	10/31/00	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
	04/27/01	NA	NA	NA	NA	NA	NA	NA	NA	NA
	07/31/01	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
	10/30/01	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
	05/01/02	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	07/25/02	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	10/25/02	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	04/29/03	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	10/14/03	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	04/21/04	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW1-25	08/17/95	4.8	1 U	7.3	440 R	35 R	1 U	1 U	98 R	340 R
	12/06/95	3.9	1 U	6.1	630 R	38 R	1 U	1 U	74 R	230 R
	03/11/96	0.50 U	0.50 U	1.1	260	6.3	0.50 U	0.50 U	11	44
	06/25/96	0.50 U	0.50 U	4.7 J	630 R	45 R	0.50 U	0.50 U	74 R	240 R
	06/08/00	6.9	0.30 J	7.2	2000	41	0.50 U	0.50 U	39	260
	08/06/02	8.6 J	10 U	7.6 J	2000 D	41 D	10 U	10 U	20 D	240 D
	06/19/03	67 U	NA	67 U	**1800**	34	67 U	67 U	**14**	**210**
	04/22/04	5.9 D	2.5 U	**6.6 D**	**1600 D**	33 D	2.5 U	2.5 U	7.5 D	170 D

Table 6-1 (Continued)
Summary of Analytical Results for OU 1 Groundwater Sampling Through April 2004

Location	Sampling Date	Analyte Concentration (µg/L)								
		1,1-DCA	1,2-DCA	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	PCE	1,1,1-TCA	TCE	Vinyl Chloride
MW1-28	12/07/95	1.1	1 U	**5.1**	720 R	58 R	1 U	1 U	2.3	420 R
	03/08/96	2.1	0.50 U	**5**	320	78	0.50 U	0.50 U	1.6	480
	06/25/96	2.4 J	0.50 U	**6.3 J**	540 R	78 R	0.50 U	0.50 U	2.2 J	480 R
	09/09/96	2.3	0.50 U	**5.4**	510 R	66 R	0.50 U	0.50 U	1.2	540 R
	06/07/00	3.2	0.50 U	**5.1**	1300 J	74	0.50 U	0.50 U	0.81	520
	08/06/02	4.6 J	10 U	**5.4 J**	1500 D	84 D	10 U	10 U	10 U	600 D
	06/19/03	50 U	NA	50 U	**1200**	34	50 U	50 U	50 U	**470**
	04/22/04	3.9	0.50 U	**5.3**	**1300 D**	71 D	0.50 U	0.50 U	0.52	**540 D**
MW1-38[a]										
	04/23/04	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW1-39	06/17/96	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	**0.80**
	06/27/96	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1 U
	09/10/96	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	**0.76**
	06/08/00	0.50 U	0.50 U	0.50 U	0.40 J	0.50 U	0.50 U	0.50 U	0.50 U	**2**
	08/06/02	0.50 U	0.50 U	0.50 U	0.32 J	0.50 U	0.50 U	0.50 U	0.50 U	**1.8**
	06/19/03	1.0 U	NA	1.0 U	0.56	1.0 U	1.0 U	1.0 U	1.0 U	**1.3**
	04/23/04	0.50 U	0.50 U	0.50 U	0.33 J	0.50 U	0.50 U	0.50 U	0.50 U	**2**
MW1-41	06/21/99	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/21/99	0.5 U	0.5 U	0.5 U	0.60	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	04/26/00	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	06/08/00	0.20 J	0.5 U	0.5 U	0.82	0.5 U	0.5 U	0.5 U	0.5 U	**0.53**
	07/24/00	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	11/02/00	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
	04/26/01	1 U	1 UJ	1 U	1 U	1U	1 U	1 UJ	1 U	1 U
	06/20/01	0.10 J	0.12 U	0.12 U	0.40 J	0.14 U	0.11 U	0.12 U	0.12 U	0.40 J
	07/30/01	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**0.6 J**
	10/29/01	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 J
	04/30/02	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	06/19/02	0.5 U	0.5 U	0.5 U	0.41 J	0.5 U	0.5 U	0.5 U	0.5 U	0.43 J
	07/23/02	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	10/25/02	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	04/30/03	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	10/15/03	0.5 U	0.5 U	0.5 U	0.37 J	0.5 U	0.5 U	0.5 U	0.5 U	0.28 J
	04/22/04	0.5 U	0.5 U	0.5 U	0.30 J	0.5 U	0.5 U	0.5 U	0.5 U	0.30 J

[a] Well was recently added to the program, therefore no historical information to include.

Notes:
Bolded value indicates it exceeds or is equal to the remediation goal for drinking water. Shaded columns indicate current sampling period results.
DCE - dichloroethene
E - The value shown exceeds the instrument calibrating range
D - The reported result is from a dilution.
J - The result is an estimated concentration that is less than the MRL, but greater than or equal to the MDL.
MDL - method detection limit
MRL - method reporting limit
µg/L - microgram per liter
NA- not analyzed
PCE - tetrachlorothene
R - Quality control indicates the data are not usable.
RG - remediation goal
TCA - trichloroethane
TCE - trichloroethene
U - The compound was analyzed for, but was not detected ("nondetect") at or above the MRL/MDL.

Table 6-2
Summary of Analytical Results for OU 1 Surface Water and Seep Sampling Through April 2004

Location	Sampling Date	Analyte Concentration (µg/L)								
		1,1-DCA	**1,2-DCA**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**PCE**	**1,1,1-TCA**	**TCE**	**Vinyl Chloride**
Remediation Goals		N/A	59	1.9	N/A	33,000	4.2	41,700	56	2.9
MA-09	09/05/95	1 U	1 UJ	1 U	4	1 UJ	1 U	1 U	1 U	1.3
	12/05/95	1 U	1 U	1 U	14	1 U	1 U	1 U	1 U	5.4
	03/14/96	.29 J	.5 U	.5 U	11	.5 U	.5 U	.5 U	1.2	8
	07/02/96	.5 U	.5 U	.5 U	0.79	.5 U	.5 U	.5 U	.5 U	.5 U
	06/06/00	.5 U	.5 U	.5 U	3	.5 U	.5 U	.5 U	0.63	0.64
	06/22/01	1.2	0.12 U	0.12 U	37	0.51	0.11 U	0.12 U	4.7	8.3
	06/27/02	0.13 J	0.5 U	0.5 U	6.3	0.5 U	0.5 U	0.5 U	0.82	1.4
	04/29/03	0.50 U	0.50 U	0.50 U	18	0.50 U	0.50 U	0.50 U	3.5	4.9
	04/21/04	0.22 J	0.50 U	0.50 U	15	0.21 J	0.50 U	0.50 U	3.2	1.9
MA-12	03/14/96	5 U	.5 U	0.56	180 J	1.6	.5 U	.5 U	26	56 J
	07/01/96	11	.5 U	1	480 J	3.5	.5 U	.5 U	64 J	56 J
	06/11/99	15	3 U	2 J	710	8	3 U	3 U	130	150
	10/20/99	12	.5 U	**1.9**	600	5.5	.5 U	.5 U	110	130
	04/25/00	21	0.5 U	1.3	630 J	10	0.5 U	0.5 U	190 J	250 J
	06/06/00	16	5 U	5 U	670	5.5	5 U	5 U	110	140
	07/25/00	25 U	25 U	25 U	750 J	25 U	25 U	25 U	180 J	140 J
	11/09/00	14	1 U	1.2	680	5.2	1 U	1 U	170	140
	04/27/01	15	1 UJ	1.6	600J	12	1 U	1UJ	100J	92 J
	06/22/01	15	0.29 U	0.98 J	520	6.8	0.28 U	0.28 U	62	80
	07/31/01	17	1 U	1.1	500 J	28 J	1 U	1 U	90	150
	10/30/01	6.8	1 U	0.8 J	260 J	2.7	1 U	1 U	82	67
	05/01/02	7 J	1 U	1 U	440 J	3.1 J	1 U	1 U	96 J	49 J
	06/19/02	7.2	0.5 U	0.7	340 D	3.0	0.5 U	0.5 U	53 D	57 D
	07/25/02	8.3 J	1 U	1.2 J	580 J	4.7 J	1 U	1 U	86 J	94 J
	10/25/02	5.1 J	1.3 U	1.3 U	420 J	2.7 J	1.3 U	1.3 U	59 J	55 J
	04/30/03	4.0 D	1.0 U	1.0 U	390 D	2.8 D	1.0 U	1.0 U	60 D	49 D
	10/23/03	3.5	0.50 U	0.52	160	1.3	0.50 U	0.50 U	28	45
	04/21/04	5.7	0.50 U	0.81	430 D	3.2	0.50 U	0.50 U	83 D	46
MA-11	09/06/95	1 U	1 U	1 U	.51 J	1 UJ	1 U	1 U	1 U	1 U
	12/06/95	1 U	1 U	1 U	10	1 U	1 U	1 U	1 U	3.5
	03/13/96	.43 J	.5 U	.5 U	13	.5 U	.5 U	.5 U	.5 U	5.9
	07/02/96	.5 U	.5 U	.5 U	0.52	.5 U	.5 U	.5 U	.5 U	.5 U
	06/06/00	1.2	.5 U	.5 U	33	0.56	.5 U	.5 U	7.9	9.2
	06/22/01	0.16 J	0.12 U	0.12 U	4.6	0.14 U	0.11 U	0.12 U	0.66	0.98
	06/19/02	0.54	0.5 U	0.5 U	22	0.24 J	0.5 U	0.5 U	4.2	5.6
	04/30/03	0.50 U	0.50 U	0.50 U	33	0.50 U	0.50 U	0.50 U	6.1	6.0
	04/21/04	0.33 J	0.50 U	0.50 U	23	0.31 J	0.50 U	0.50 U	4.9	4.0
TF-19	09/05/95	1 U	1 U	1 U	4	1 U	1 U	1 U	1 U	.92 J
	12/04/95	1 U	1 U	1 U	8.4	1 U	1 U	1 U	1 U	2.8
	03/12/96	.39 J	.5 U	.5 UJ	18	.5 U	.5 U	.5 U	1.3 J	19
	07/01/96	.5 U	.5 U	.5 U	5.9	.5 U	.5 U	.5 U	0.68	2.3
	06/06/00	.4 J	.5 U	.5 U	12	.2 J	.5 U	.5 U	2.3	3.1
	06/22/01	0.55	0.12 U	0.12 U	18	0.22 J	0.11 U	0.12 U	2.1	3.2
	06/19/02	0.22 J	0.5 U	0.5 U	8.5	0.5 U	0.5 U	0.5 U	1.3	1.9
	04/29/03	0.50 U	0.50 U	0.50 U	26	0.50 U	0.50 U	0.50 U	4.9	6.1
	04/23/04	0.13 J	0.50 U	0.50 U	9	0.17 J	0.50 U	0.50 U	1.6	1.1
DB-14	09/05/95	1 U	1 UJ	1 U	1 U	1 UJ	1 U	1 U	1U	1 U
	12/04/95	1 U	1 U	1 U	1.9	1U	1 U	1 U	1 U	1 U
	03/13/96	.5 U	.5 U	.5 U	.5 U	.5 U	.5 U	.5 U	.5 U	.5 U

Table 6-2 (Continued)
Summary of Analytical Results for OU 1 Surface Water and Seep Sampling Through April 2004

Location	Sampling Date	Analyte Concentration (µg/L)								
		1,1-DCA	1,2-DCA	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	PCE	1,1,1-TCA	TCE	Vinyl Chloride
DB-14 (Continued)	07/01/96	.5 U	.5 U	.5 U	.5 U	.5 U	.5 U	.5 U	.5 U	.5 U
	06/06/00	.5 U	.5 U	.5 U	0.59	.5 U	.5 U	.5 U	.5 U	.5 U
	06/22/01	0.091 U	0.12 U	0.12 U	0.7	0.14 U	0.11 U	0.12 U	0.12 U	0.22 U
	06/19/02	0.50 U	0.5 U	0.5 U	0.53	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	04/29/03	0.50 U	0.50 U	0.50 U	1.8	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
	04/23/04	0.50 U	0.50 U	0.50 U	0.63	0.50 U	0.50 U	0.50 U	0.12 J	0.50 U
SP1-1	09/05/95	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.66 J
	12/05/95	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
	03/13/96	0.5 U	0.5 U	0.5 U	170 J	1.8	0.5 U	0.5 U	0.5 U	**420 J**
	07/02/96	0.5 U	0.5 U	0.5 U	7.4	0.76	0.5 U	0.5 U	0.5 U	**31 J**
	09/10/96	0.2 J	0.5 U	0.5 U	0.33 J	0.5 U	0.5 U	0.5 U	0.5 U	1.1
	06/11/99	3 U	3 U	3 U	4	3 U	3 U	3 U	3 U	**32**
	10/20/99	0.5 U	0.5 U	0.5 U	0.5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	04/25/00	0.5 U	0.5 U	0.5 U	32	2.5	0.5 U	0.5 U	1.7	**210 J**
	07/25/00	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	11/09/00	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1
	04/27/01	1 U	1 UJ	1 U	1.3	0.7 J	1 U	1 UJ	1 U	**8.4**
	07/31/01	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
	10/30/01	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
	05/01/02	0.5 U	0.5 U	0.5 U	5	1	0.5 U	0.5 U	0.5 U	**43**
	07/25/02	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	10/25/02	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
	04/29/03	0.50 U	0.50 U	0.50 U	2.2	0.80	0.50 U	0.50 U	0.50 U	**31**
	10/23/03	0.50 U	0.50 U	0.50 U	0.17 J	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
	04/21/04	0.20 J	0.50 U	0.50 U	0.16 J	0.34 J	0.50 U	0.50 U	0.50 U	1.1

Notes:
Shaded columns indicate current sampling period results.
DCA - dichloroethane
DCE - dichloroethene
J - The result is an estimated concentration that is less than the MRL but greater or equal to the MDL.
MDL - method detection limit
MRL - method reporting limit
N/A - not applicable
PCE - tetrachloroethene
TCA - trichloroethane
TCE - trichloroethene
U - The compound was analyzed for, but was not detected ("nondetect") at or above the MRL/MDL.

Table 6-3
Summary of Analytical Results for Polychlorinated Biphenyls and Metals in OU 1 Sediment From April 1996 Through June 2004

Analyte	SQS and AET Screening Levels[a]	Location												
		DB-05	DB-07	DB-08	MA-09	MA-09 FD	MA-10	MA-11	MA-14	MA-14 FD	TF-18	TF-20	TF-21	FLD-004[b]
POST-RI SAMPLING, APRIL 1996														
Total PCBs (µg/kg)														
Aroclor 1254	130	3 U	3 U	3 UJ	56	141	22	53	--	--	3 U	3 U	42	--
Aroclor 1260		3 U	3 U	3 UJ	6 J	14	15 U	10 U	--	--	3 U	3 U	4 J	--
Metals (mg/kg)														
Arsenic	57	3	3	4	3	6	5	21	--	--	2	3	4	--
Beryllium	N/A	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	--	--	0.2 U	0.2 U	0.2 U	--
Chromium	260	19	15	20	21	32	146	104	--	--	19	14	23	--
Lead	450	8	6	7	6	6	11	12	--	--	7	6	9	--
Mercury	0.41	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.06	0.05	--	--	0.05 U	0.05 U	0.05 U	--
Nickel	N/A	15	14	17	25	24	33	39	--	--	13	15	19	--
Zinc	410	26	22	30	27	27	69	80	--	--	21	34	30	--
LTM, JUNE 2000														
Total PCBs (µg/kg)														
Aroclor 1254	130	10 U	10 U	10 UJ	**200**	--	--	17	**140**	--	6 J	10 U	32	28
Aroclor 1260		10 U	10 U	10 UJ	10 U	--	--	10 U	10 U	--	10 U	10 U	10 U	10 U
Metals (mg/kg)														
Arsenic	57	4.3	9.6	3.2	5.5	--	--	7	6.2	--	3.3	3.3	5.5	5.9
Beryllium	N/A	0.16	0.12	0.13	0.21	--	--	0.17	0.16	--	0.14	0.14	0.16	0.19
Chromium	260	25.9	27.7	23	43.4	--	--	74.5	34.1	--	25.1	26.4	34.5	36.2
Lead	450	8.58	129	7.13	13.9	--	--	12.1	20.8	--	10.9	8.12	14.1	14.6
Mercury	0.41	0.06	0.08	0.05	0.07	--	--	0.07	0.09	--	0.05	0.03	0.06	0.06

Table 6-3 (Continued)
Summary of Analytical Results for Polychlorinated Biphenyls and Metals in OU 1 Sediment From April 1996 Through June 2004

Analyte	SQS and AET Screening Levels[a]	Location												
		DB-05	DB-07	DB-08	MA-09	MA-09 FD	MA-10	MA-11	MA-14	MA-14 FD	TF-18	TF-20	TF-21	FLD-004[b]
Nickel	N/A	21.1 J	18.8 J	22.9 J	37.4 J	--	--	28.3 J	33 J	--	20.4 J	26.2 J	27.7 J	29.5 J
Zinc	410	33.4 J	216 J	30.4 J	58.5 J	--	--	68.3 J	81.8 J	--	36 J	32.6 J	51.2 J	53 J
LTM, JUNE 2002														
Total PCBs (µg/kg)														
Aroclor 1254	130	NA	NA	NA	3.7 J	--	--	NA	9.7 J	9.6 J	NA	NA	NA	--
Aroclor 1260		NA	NA	NA	12 U	--	--	NA	13 U	12 U	NA	NA	NA	--
Metals (mg/kg)														
Arsenic	57	NA	NA	NA	2.6	--	--	NA	2.5	1.6	NA	NA	NA	--
Beryllium	N/A	NA	NA	NA	0.18	--	--	NA	0.16	0.14	NA	NA	NA	--
Chromium	260	NA	NA	NA	29.7 J	--	--	NA	20.9 J	15.4 J	NA	NA	NA	--
Lead	450	NA	NA	NA	3.21	--	--	NA	10	7.47	NA	NA	NA	--
Mercury	0.41	NA	NA	NA	0.03	--	--	NA	0.03	0.02	NA	NA	NA	--
Nickel	N/A	NA	NA	NA	43.9 J	--	--	NA	32.4 J	21.8 J	NA	NA	NA	--
Zinc	410	NA	NA	NA	25.5 J	--	--	NA	63.7 J	50.1 J	NA	NA	NA	--
LTM, JUNE 2004														
Total PCBs (µg/kg)														
Aroclor 1254	130	10 U	4.6 J	10 U	84	--	--	10 U	13	22	4.7	3.3	37	--
Aroclor 1260		10 U	10 U	10 U	10 U	--	--	10 U	10 U	10 U	10 U	10 U	10 U	--
Metals (mg/kg)														
Arsenic	57	2.9	6.3	4.1	10.4	--	--	5.0	3.9	4.9	2.6	3.3	7.0	--
Beryllium	N/A	0.14	0.16	0.17	0.25	--	--	0.21	0.15	0.22	0.12	0.16	0.21	--

Table 6-3 (Continued)
Summary of Analytical Results for Polychlorinated Biphenyls and Metals in OU 1 Sediment From April 1996 Through June 2004

Analyte	**SQS and AET Screening Levels**[a]	**Location**												
		DB-05	**DB-07**	**DB-08**	**MA-09**	**MA-09 FD**	**MA-10**	**MA-11**	**MA-14**	**MA-14 FD**	**TF-18**	**TF-20**	**TF-21**	**FLD-004**[b]
Chromium	260	20.2	23.8	25.6	37.3	--	--	28.4	22.5	29.1	19.9	24.4	38.3	--
Lead	450	7.91	40.2	8.71	50.6	--	--	5.04	13.5	15.7	7.67	9.55	19.4	--
Mercury	0.41	0.04	0.17	0.04	0.04	--	--	0.03	0.02	0.03	0.04	0.03	0.07	--
Nickel	N/A	18.9	25.2	26.8	48.3	--	--	27.8	29.4	31.2	23.4	25.6	30.6	--
Zinc	410	31.1	74.7	37.0	173	--	--	29.0	84.3	74.5	35.9	37.6	70.2	--

[a] Sediment quality standards (SQS) for metals and apparent effects threshold (AET) level of total polychlorinated biphenyls
[b] PCB-contaminated sediment was removed in October 1999. FLD-004 is a field duplicate of TF-21 in 2000.

Notes:
J - The result is an estimated concentration that is less than the MRL, but greater than the MDL.
LTM - long-term monitoring
MDL - method detection limit
mg/kg - milligram per kilogram
MRL - method reporting limit
µg/kg - microgram per kilogram
PCBs - polychlorinated biphenyls
RI - remedial investigation
SQS - sediment quality standard
U - The compound was analyzed for, but was not detected ("nondetect") at or above the MRL/MDL.

Table 6-4
Summary of Analytical Results for OU 1 Shellfish Tissue Sampling From 1996 to 2004

Analyte	Sampling Location					
	DB-05	**DB-07**	**DB-08**	**TF-18**	**TF-20**	**TF-21**
POST-RI SAMPLING, APRIL 1996						
PCB (μg/kg, wet weight)						
Aroclor 1254	5 J	3 U	3 U	3 U	3 U	13
Metals (mg/kg, wet weight)						
Arsenic	3.1	3.6	4.1	2.65	3	3.52
Beryllium	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.002 J
Chromium	0.74	0.76	0.68	0.52	0.83	0.79
Lead	0.128 J	0.116 J	0.138 J	0.114 J	0.109 J	0.177 J
Mercury	0.03	0.03	0.02	0.02	0.02	0.02
Nickel	0.92	0.75	1.01	0.63	0.81	1.42
Zinc	9.6	9.7	10.1	9	9.4	9.6
LTM, JUNE 2000						
PCB (μg/kg, wet weight)						
Aroclor 1254	10U	10U	10U	10U	10U	23
Metals (mg/kg, wet weight)						
Arsenic	2.23	2.26	2.14	1.88	1.88	2.15
Beryllium	0.003 U	0.003 UJ	0.003 UJ	0.003 UJ	0.003 UJ	0.003 UJ
Chromium	0.38	0.48	0.65	1.05	0.72	0.86
Lead	0.12	0.42	0.11	0.09	0.09	0.14
Mercury	0.02	0.01	0.01	0.02	0.02	0.02
Nickel	0.64	0.37 J	0.50 J	1.05 J	0.93 J	1.04 J
Zinc	13.86	16.50	19.42	15.66	15.00	14.08
LTM, JUNE 2004						
PCB (μg/kg, wet weight)						
Aroclor 1254	10U	10U	10U	10U	10U	10U
Metals (mg/kg, wet weight)						
Arsenic	2.11	1.98	2.92	2.59	2.04	2.46
Beryllium	0.003 U	0.003 UJ	0.003 UJ	0.003 UJ	0.003 UJ	0.003 UJ
Chromium	0.15	0.11	0.13	0.12	0.08 U	0.11
Lead	0.10	0.12	0.07	0.12	0.10	0.17
Mercury	0.02	0.01 U	0.02	0.02	0.02	0.02
Nickel	0.63	0.52	0.78	0.77	0.72	0.66
Zinc	12.09	14.15	12.94	15.01	14.21	12.48

Table 6-4 (Continued)
Summary of Analytical Results for OU 1 Shellfish Tissue Sampling From 1996 to 2004

Notes:
The remediation goal for total PCBs is 15 µg/kg for the seafood ingestion pathway and 2,600 µg/kg for the ecological risk pathway.
Field Duplicate results were not included in this table.
J - The result is an estimated concentration that is less than the MRL, but greater than or equal to the MDL.
LTM - long-term monitoring
MDL - method detection limit
mg/kg - milligram per kilogram
MRL - method reporting limit
µg/kg - microgram per kilogram
PCB - polychlorinated biphenyl
RI - remedial investigation
U - The compound was analyzed for, but not detected ("nondetect") at or above the MRL/MDL.

Table 6-5
Summary of Target Analytes Detected in Groundwater at OU 2 Area 2 From Fall 1995 to Spring 2004

Chemical	Date Collected	Drinking Water Remediation Goal[a] (µg/L)	Sampling Location (µg/L)						
			2MW-1	2MW-3	2MW-4	2MW-5	2MW-6b	MW2-6c	MW2-8d
Trichlorethene (TCE)	11/95	5[e]	40	1 J	1 U	11	1 U	NS	NS
	09/96		28	NS	NS	2	1 U	NS	NS
	10/97		27	NS	NS	2	1 U	NS	NS
	10/98		28	NS	NS	2.1	0.2 U	NS	NS
	11/99		17	NS	NS	0.4 J	0.5 U	NS	NS
	11/00		22	NS	NS	NS	0.5 U	0.5 U	NS
	11/01		16	NS	NS	NS	0.2 UJ	NS	0.2 U
	06/02		11	NS	NS	NS	0.5 U	NS	0.5 U
	06/03		12	NS	NS	NS	0.5 U	NS	0.5 U
	06/04		9.7	NS	NS	NS	0.5 U	NS	0.5 U
cis,1,2-Dichloroethene (DCE)	11/95	70	1 U	19	1 U	7	10	NS	NS
	09/96		1 U	NS	NS	1	15	NS	NS
	10/97		1 U	NS	NS	1	11	NS	NS
	10/98		0.2 U	NS	NS	0.26	9.5	NS	NS
	11/99		0.5 U	NS	NS	0.5	12	NS	NS
	11/00		0.5 U	NS	NS	NS	14	0.5 U	NS
	11/01		0.1 U	NS	NS	NS	6.9 J	NS	0.72
	06/02		0.5 U	NS	NS	NS	13	NS	0.97
	06/03		0.5 U	NS	NS	NS	9.9	NS	1.4
	06/04		0.5 U	NS	NS	NS	6.9	NS	1.9
Vinyl chloride	11/95	1[f]	1 U	4	1 U	1	4	NS	NS
	09/96		1 U	NS	NS	1	5	NS	NS
	10/97		1 U	NS	NS	1	4	NS	NS
	10/98		0.2 U	NS	NS	0.2	2.7	NS	NS

Table 6-5 (Continued)
Summary of Target Analytes Detected in Groundwater at OU 2 Area 2 From Fall 1995 to Spring 2004

Chemical	**Date Collected**	**Drinking Water Remediation Goal[a] (µg/L)**	**Sampling Location (µg/L)**						
			2MW-1	**2MW-3**	**2MW-4**	**2MW-5**	**2MW-6[b]**	**MW2-6[c]**	**MW2-8[d]**
Vinyl chloride (Continued)	11/99		0.5 U	NS	NS	0.5	2.7	NS	NS
	11/00		0.5 U	NS	NS	NS	2.75 J	0.5 U	NS
	11/01		0.2 U	NS	NS	NS	1.15 J	NS	0.2 U
	06/02		0.5 U	NS	NS	NS	2.1	NS	0.5 U
	06/03		0.5 U	NS	NS	NS	1.5	NS	0.5 U
	06/04		0.5 U	NS	NS	NS	0.86	NS	0.2 J

[a] Protection of human health by ingestion

[b] The 11/00 and 11/01 results for 2MW-6 are the average concentrations of the 2MW-6 sample and its field duplicate.

[c] MW2-6 was last sampled in 1991 during the remedial investigation. Trichloroethene was detected at 0.6 (J) µg/L.

[d] The 06/02 results for MW2-8 aree the average concentrations of the MW2-8 sample and its field duplicate.

[e] Value listed accounts for adjustment when the maximum contaminant level or water quality standard is sufficiently protective to serve as the Washington State Model Toxics Control Act (MTCA) cleanup level for that individual chemical. Individual chemical cleanup level may require downward adjustment for multiple chemical contaminants or multiple exposure pathways (MTCA Implementation Memo No. 1). Value does not account for adjustments due to background levels or practical laboratory quantitation limits.

[f] The MTCA Method B cleanup level for vinyl chloride is 0.023 µg/L. This cleanup level is below the practical quantitation limits (PQL) of standard EPA analytical methods for drinking water. In such cases, the MTCA cleanup standard was adjusted based on the PQL, as stipulated in WAC 173-340-700(6). The PQL for EPA Method 524.2 with a 25 ml purge is 1 µg/L.

Notes:
J - Estimated
NS - not sampled
U - not detected

Table 6-6
Summary of Selected Volatile Organic Compounds Detected in Groundwater at OU2 Area 8 (Fall 1995 to Spring 2004)

Chemical	Date Collected	Remediation Goal		Sampling Location (µg/L)								
		Drinking Water[a] (µg/L)	Surface Water[a] (µg/L)	MW8-8	MW8-9	MW8-10	MW8-11	MW8-12	MW8-14	MW8-16	Seep A	Seep B
Trichloroethene (TCE)	11/95	5[b]	81[b,c]	190	1600	NS	84	85	1 U	58	NS	NS
	6/96			110	800	NS	84	63	1 U	72	68	14
	9/96			190	1000	NS	80	120	1 U	69	NS	NS
	5/97			68	1600	NS	63	120	1 U	57	NS	NS
	10/97			78	720	NS	62	44	1 U	47	NS	NS
	5/98			63	370	NS	61	46	1 U	61	NS	NS
	10/98			76	610	NS	62	46	1 U	47	NS	NS
	5/99			58	84	NS	27	25	1 U	40	NS	NS
	11/99			150 H	500	NS	54 H	50 H	0.50 U	63	NS	NS
	6/00			120	170	22	41 J	54	0.50 U	51	7.4	2.2
	6/01			84	330	NS	62	76	0.12 U	74	3	3.1
	6/02			81	60	31	92	47	0.50 U	130	1.2	5.4
	6/03			81 D	21	NS	99 D	36	0.50 U	190 D	0.36 J	1.9
	6/04			80 D	25	NS	110 D	40	0.50 U	120 D	49	0.61
Tetrachloroethene (PCE)	11/95	5[b]	8.9[b,c]	49	50 U	NS	1 U	13	1 U	0.60 J	NS	NS
	6/96			34	1 U	NS	1 U	5	1 U	0.80 J	3	1 U
	9/96			58	0.40 J	NS	1 U	23	1 U	0.80 J	NS	NS
	5/97			15	0.30 J	NS	1 U	12	1 U	0.80 J	NS	NS
	10/97			19	1 U	NS	1 U	7	1 U	0.60 J	NS	NS
	5/98			12	1 U	NS	1 U	10	1 U	0.80 J	NS	NS
	10/98			30	1 U	NS	1 U	15	1 U	1 U	NS	NS
	5/99			5 U	1 U	NS	2 U	4 U	1 U	1 U	NS	NS
	11/99			2	0.60	NS	0.50 U	9.7	0.50 U	0.80	NS	NS
	6/00			23	2.5 U	1.2	0.50 U	16	0.50 U	0.70	0.30 J	0.50 U
	6/01			20	0.26 J	NS	0.27 J	14	0.11 U	0.84	0.31 J	0.13 J
	6/02			17	0.23 J	0.84	0.79	14	0.50 U	0.99	0.50 U	0.12 J
	6/03			12	0.50 U	NS	0.6	9.8	0.50 U	1.5	0.24 J	0.14 J
	6/04			13	0.18 J	NS	0.66	8.5	0.50 U	0.75	0.92	0.39 J
1,1-Dichloroethene (DCE)	11/95	7[b]	3.2[b,c]	1	50 U	NS	44	10	1 U	1 U	NS	NS
	6/96			0.90 J	1 U	NS	47	14	1 U	1 U	16	1 U
	9/96			1	1 U	NS	27	20	1 U	1 U	NS	NS
	5/97			1 U	1 U	NS	42	6	1 U	1 U	NS	NS
	10/97			0.60 U	1 U	NS	30	4	1 U	1 U	NS	NS
	5/98			1 U	1 U	NS	33	2	1 U	1 U	NS	NS
	10/98			1 U	1 U	NS	35	1 U	1 U	1 U	NS	NS
	5/99			5 U	1 U	NS	8	1 U	1 U	1 U	NS	NS
	11/99			1	0.50 U	NS	12	0.9	0.50 U	0.50 U	NS	NS
	6/00			1 J	2.5 U	0.54	12	0.50 J	0.50 U	0.59	3.1	0.50 U
	6/01			1.3	0.24 U	NS	15	0.67	0.12 U	0.77	1.4	0.12 U
	6/02			1.1	0.50 U	0.24 J	1.1	0.50 U	0.50 U	0.67	1.0	0.50 U
	6/03			0.94	0.50 U	NS	20	0.31 J	0.50 U	0.57	0.50 U	0.50 U
	6/04			1.1	0.50 U	NS	25	0.34 J	0.50 U	0.61	13.0	0.50 U
cis,1,2-Dichloroethene	11/95	70	--	2	27 J	NS	1 U	1	1 U	2	NS	NS
	6/96			1	28	NS	1 U	1 U	1 U	2	7	0.70 J
	9/96			2	28	NS	0.30 J	2	1 U	3	NS	NS

Table 6-6 (Continued)
Summary of Selected Volatile Organic Compounds Detected in Groundwater at OU2
Area 8 (Fall 1995 to Spring 2004)

		Remediation Goal		Sampling Location (µg/L)								
Chemical	**Date Collected**	**Drinking Water[a] (µg/L)**	**Surface Water[a] (µg/L)**	**MW8-8**	**MW8-9**	**MW8-10**	**MW8-11**	**MW8-12**	**MW8-14**	**MW8-16**	**Seep A**	**Seep B**
cis,1,2-Dichloroethene (Continued)	5/97			1	34	NS	1 U	1	1 U	2	NS	NS
	10/97			1 U	1 U	NS	2	1 U	1 U	1 U	NS	NS
	5/98			.9 J	12	NS	1 U	2	1 U	2	NS	NS
	10/98			1 U	34	NS	1 U	1 U	1 U	3	NS	NS
	5/99			5 U	6	NS	2 U	1 U	1 U	6	NS	NS
	11/99			3.2	30	NS	0.50 U	2.1	3.2	5.3	NS	NS
	6/00			4.5	15	1.8	0.40 J	3	0.50 U	16	3.7	0.50 U
	6/01			7.3	18	NS	0.38 J	4.8	0.12 U	21	1.3	0.44 J
	6/02			7.3	7.5	2.4	0.46 J	4.5	0.50 U	30 U	0.68	0.52
	6/03			6.8	1.3 U	NS	0.47 J	3.2	0.50 U	28	0.50 U	0.20 J
	6/04			8.5	1.7	NS	0.37 J	3.1	0.50 U	130 D	9.9	0.23 J
1,1,1-Trichloroethane (TCA)	11/95	200	42,000	23	50 U	NS	520	140	1 U	2	NS	NS
	6/96			11	2	NS	460	180	1 U	2	88	1
	9/96			19	2	NS	420	250	1 U	2	NS	NS
	5/97			3	2	NS	500	67	1 U	2	NS	NS
	10/97			9	1	NS	300	41	1 U	2	NS	NS
	5/98			3	0.70 J	NS	200	20	1 U	1	NS	NS
	10/98			9	3	NS	220	22	1 U	1 U	NS	NS
	5/99			5 U	1 U	NS	45	8	1 U	2	NS	NS
	11/99			10	1.4	NS	64 H	14	0.50 U	1.7	NS	NS
	6/00			6.6	1 J	4.2	82 J	6.8	0.50 U	1.1	19	0.30 J
	6/01			3.9	0.44 J	NS	91	6.5	0.84	1.2	11	0.26 J
	6/02			3.9	0.69	0.74	84	5	0.18 J	0.83	9.5	0.15 J
	6/03			2.7	0.23 J	NS	80 D	3.2	0.50 U	0.94	1.6	0.50 U
	6/04			2.9	0.44 J	NS	80	4.1	0.12 J	0.59 J	77	0.80

[a] Protection of human health for ingestion

[b] Value listed accounts for adjustment when the maximum contaminant level or water quality standard is sufficiently protective to serve as the remediation goal for that individual chemical. Individual cleanup levels may require downward adjustment for multiple chemical contaminants or multiple exposure pathways. Value does not account for adjustments due to background levels or practical laboratory quantitation limits.

[c] Protection of human health for fish ingestion

Notes:
-- - no value given
D - The reported result is from a dilution.
H - Analytical result is from an analysis reported past the holding time.
J - The result is an estimated concentration that is less than the method reporting limit (MRL), but greater than or equal to the method method detection limit (MDL).
µg/L - microgram per liter
NS - not sampled
U - The compound was analyzed for, but was not detectd ("nondetect") at or above the MRL/MDL.

Table 6-7
Summary of Inorganics Detected in Groundwater and Seeps at OU 2 Area 8 Exceeding One-Half of the MTCA Method B Cleanup Levels (Fall 1995 to Spring 2003)

		Remediation Goal		Sampling Location (μg/L)														
Analyte	**Date Collected**	**Drinking Water (μg/L)**	**Surface Water (μg/L)**	**MW8-6**	**MW8-8**	**MW8-9**	**MW8-11**	**MW8-12**	**MW8-14**	**MW8-16**	**Seep A**	**Seep B**	**MW8-7**	**MW8-15**	**MW8-17**	**MW8-18**	**MW8-19**	**MW8-20**
Arsenic, total	11/95	0.05	0.14[a]	NS	(-)	3.0 NW	2.0 W+	5.1 N	5.1 W+	2.3 +	NS	NS	3.3 +	(-)	3.0 N	1.8 N	3.3 NW	(-)
Arsenic, dissolved	11/95			NA	NA	NA	NA	NA	NA	NA	NS	NS	NA	1.0 UN	NA	1.2 N	1.9 N	NA
Arsenic, dissolved (ICP)	6/96			1.1 B	1.4 B	2.6 B	1.0 U	3.6 B	3.3 B	2.8 B	1.3 B	4.6 B	NS	NS	NS	NS	NS	NS
Arsenic, total (ICP)	6/96			NA	NA	NA	NA	NA	NA	NA	NS	3.0 B	NS	NS	NS	NS	NS	NS
Arsenic dissolved	9/96			NS	(-)	3.4 BW	2.4 BW	1.9 B	3.1 BW	2.9 B	NS	NS	NS	NS	NS	NS	NS	NS
	5/97			NS	2.0 UN	3.2 NW	2.1 NW	2.0 UN	2.8 NW	2.3 N	NS	NS	NS	NS	NS	NS	NS	NS
	10/97			NS	0.50 UN	1.4 BNW	0.66 BNW	1.8 BN	1.0 BNW	1.4 BN	NS	NS	NS	NS	NS	NS	NS	NS
	5/98			NS	0.50 U	1.1 BW	0.50 UW	2.4 BW	0.86 BW	1.2 B	NS	NS	NS	NS	NS	NS	NS	NS
	10/98			NS	1.8 U	5.4 B	2.1 B	1.8 U	10.8	1.8 U	NS	NS	NS	NS	NS	NS	NS	NS
	5/99			NS	1.7 U	2.0 B	2.6 B	1.7 U	2.2 B	1.7 U	NS	NS	NS	NS	NS	NS	NS	NS
	11/99			NS	5 U	5 U	5 U	NA	5 U	5 U	NS	NS	NS	NS	NS	NS	NS	NS
	6/00			NS	0.20 J	0.80 J	0.80 J	0.20 J	2	1.14 J	2.4 J	2.5 J	NS	NS	NS	NS	NS	NS
	6/01			NS	0.3 UJ	0.5 J	0.7 J	0.3 J	1.3 J	1.5 J	0.9 J	1.4 J	NS	NS	NS	NS	NS	NS
	6/02			NS	0.13 J	0.43 J	0.52 J	0.37 J	1.53 J	1.82 J	1.95 J	1.29 J	NS	NS	NS	NS	NS	NS
	6/03			NS	0.43 J	0.58 J	0.61 J	0.32 J	2.08 J	2.37 J	1.29 J	1.33 J	NS	NS	NS	NS	NS	NS
	6/04			NS	0.32 B	0.42 B	0.57	0.43 B	1.63	2.75	0.66	1.02	NS	NS	NS	NS	NS	NS
Cadmium, total	11/95	5	8	NS	(-)	(-)	251	28.6	22.4	(-)	NS	NS	(-)	(-)	(-)	(-)	(-)	(-)
Cadmium, dissolved	11/95			NA	NA	NA	NA	NA	NA	NA	NS	NS	NA	(-)	NA	(-)	(-)	NA
Cadmium, total	6/96			NA	NA	NA	NA	NA	NA	NA	46.7	(-)	NS	NS	NS	NS	NS	NS
Cadmium, dissolved	6/96			(-)	(-)	(-)	444	46.1	10.9	(-)	33.9	(-)	NS	NS	NS	NS	NS	NS
	9/96			NS	(-)	3.5 B	262	53.8	19.9	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/97			NS	(-)	(-)	210	565	9.8	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	10/97			NS	(-)	(-)	278	154	3.2	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/98			NS	(-)	(-)	320	7.3	12.6	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	10/98			NS	(-)	(-)	126 E	6.5 E	16.9 E	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/99			NS	(-)	(-)	33.5 N	45.7 N	10.5 N	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	11/99			NS	2.5	14	205	(-)	13	4 U	NS	NS	NS	NS	NS	NS	NS	NS
	6/00			NS	1.33	1.05	106	20	13.8	0.16	0.14	0.82	NS	NS	NS	NS	NS	NS
	6/01			NS	0.58	1.13	129	20.7	13.2	0.21	23.2	1.52	NS	NS	NS	NS	NS	NS
	6/02			NS	0.83 J	0.65 J	420 J	4.42 J	14.9 J	0.065 J	2.57 J	2.23 J	NS	NS	NS	NS	NS	NS
	6/03			NS	0.15	0.98	353	7.84	14.6	0.42	38.3	4.18	NS	NS	NS	NS	NS	NS
	6/04			NS	0.2	0.51	357	3.23	13.5	0.055	88.9	8.33	NS	NS	NS	NS	NS	NS
Chromium, total	9/96	50 [c]	50 [d]	NS	330	(-)	626	1740	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
Chromium, dissolved[b]	5/97			NS	319	(-)	441	1280	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	10/97			NS	372	(-)	377	961	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS

Table 6-7 (Continued)
Summary of Inorganics Detected in Groundwater and Seeps at OU 2 Area 8
Exceeding One-Half of the MTCA Method B Cleanup Levels (Fall 1995 to Spring 2003)

		Remediation Goal		Sampling Location (µg/L)														
Analyte	**Date Collected**	**Drinking Water (µg/L)**	**Surface Water (µg/L)**	**MW8-6**	**MW8-8**	**MW8-9**	**MW8-11**	**MW8-12**	**MW8-14**	**MW8-16**	**Seep A**	**Seep B**	**MW8-7**	**MW8-15**	**MW8-17**	**MW8-18**	**MW8-19**	**MW8-20**
	5/98			NS	344	(-)	303	728	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	10/98			NS	322	(-)	459	1090	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/99			NS	184 N	(-)	198	815 N	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	11/99			NS	154	8	201	(-)	7	5U	NS	NS	NS	NS	NS	NS	NS	NS
	6/00			NS	95.7	9.8	221	163	14.4	.17 U	0.6	6.4	NS	NS	NS	NS	NS	NS
	6/01			NS	71.4	9.7	429	193	29.7	0.45	5.6	4.4	NS	NS	NS	NS	NS	NS
	6/02			NS	191	6.43	608	238	15.8	0.04 U	0.44 U	3.54	NS	NS	NS	NS	NS	NS
	6/03			NS	84.1 J	6.9 J	302 J	107 J	16.2 J	1.0 UJ	7.6 J	2.9 J	NS	NS	NS	NS	NS	NS
	6/04			NS	111	7.09	290	146	22.2	0.04 U	45.5	15.9	NS	NS	NS	NS	NS	NS
Chromium VI, total	11/95	80	50	NS	390	(-)	950	1500	90	(-)	NS	NS	(-)	(-)	(-)	(-)	(-)	(-)
Chromium VI, total	6/96			(-)	380	380	800	380	(-)	(-)	240	(-)	NS	NS	NS	NS	NS	NS
Chromium VI, total	9/96			NS	320	(-)	720	1800	(-)	(-)	450	13	NS	NS	NS	NS	NS	NS
Chromium VI, dissolved	5/97			NS	350	(-)	610	1400	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	6/00			NS	102 J	16 J	227 J	216 J	58.8 J	4.0 U	NS	NS	NS	NS	NS	NS	NS	NS
	6/01			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Copper, total	11/95	590	2.5	NS	4.8 +	3.6 W+	13.4 S	329 S+	152 S	(-)	NS	NS	(-)	2.5 +	26.7 S+	3.8 +	22.9 S+	7.9 +
Copper, dissolved	11/95			NA	NA	NA	NA	NA	NA	NA	NS	NS	NA	(-)	NA	(-)	1.3 +	NA
Copper, total	6/96			NA	NA	NA	NA	NA	NA	NA	7.8 B	24.5 B	NS	NS	NS	NS	NS	NS
Copper, dissolved	6/96			(-)	(-)	(-)	18.9 B	(-)	6.7 B	(-)	5.1 B	8.5 B	NS	NS	NS	NS	NS	NS
	9/96			NS	(-)	(-)	14.3 B	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/97			NS	2.0 U	2.0 U	12.4	64.4	2.0 U	2.0 U	NS	NS	NS	NS	NS	NS	NS	NS
	10/97			NS	2.3 B	(-)	11.7 B	150	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/98			NS	(-)	(-)	12.5 B	5.2 B	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	10/98			NS	(-)	(-)	9.0 B	4.0 B	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/99			NS	(-)	(-)	5.3 B	19.9 B	13.2	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	11/99			NS	10 U	10 U	10 U	NA	10 U	10 U	NS	NS	NS	NS	NS	NS	NS	NS
	6/00			NS	0.46 J	0.95 J	4.44 J	5.65 J	1.22 J	0.20 J	0.27	0.76	NS	NS	NS	NS	NS	NS
	6/01			NS	0.29 J	0.78 J	4.95 J	6.14 J	1.16 J	0.2 R	1 J	0.8 J	NS	NS	NS	NS	NS	NS
	6/02			NS	0.40	0.90	4.90	4.10	1.70	0.20	0.80	0.90	NS	NS	NS	NS	NS	NS
	6/03			NS	0.49	1.38	5.15	2.78	1.53	0.10 U	0.89	0.76	NS	NS	NS	NS	NS	NS
	6/04			NS	0.45	0.73	5.29	5.15	1.37	0.38	1.08	0.71	NS	NS	NS	NS	NS	NS
Lead, total	11/95	15	5.8	NS	(-)	(-)	(-)	11.7	203 N	(-)	NS	NS	(-)	(-)	(-)	(-)	3.2	(-)
Lead, dissolved	11/95			NA	NA	NA	NA	NA	NA	NA	NS	NS	NA	(-)	NA	(-)	NS	NA
	5/97			NS	(-)	(-)	(-)	20 UN	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	10/97			NS	(-)	(-)	(-)	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/98			NS	(-)	(-)	(-)	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS

Table 6-7 (Continued)
Summary of Inorganics Detected in Groundwater and Seeps at OU 2 Area 8
Exceeding One-Half of the MTCA Method B Cleanup Levels (Fall 1995 to Spring 2003)

Analyte	Date Collected	Remediation Goal		Sampling Location (µg/L)														
		Drinking Water (µg/L)	Surface Water (µg/L)	MW8-6	MW8-8	MW8-9	MW8-11	MW8-12	MW8-14	MW8-16	Seep A	Seep B	MW8-7	MW8-15	MW8-17	MW8-18	MW8-19	MW8-20
	10/98			NS	(-)	(-)	(-)	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/99			NS	(-)	(-)	(-)	3.2 N	(-)	3.4 N	NS	NS	NS	NS	NS	NS	NS	NS
	11/99			NS	2 U	2U	2U	NA	2U	2 U	NS	NS	NS	NS	NS	NS	NS	NS
	6/00			NS	0.03	0.97	0.16	0.75	0.61	7 U	1.3 J	.22 J	NS	NS	NS	NS	NS	NS
	6/01			NS	0.04 U	0.04 U	0.062	1.2	0.959	0.04 U	0.06	0.04 U	NS	NS	NS	NS	NS	NS
	6/02			NS	0.15 UJ	0.049 UJ	0.047 UJ	0.17 UJ	0.74 UJ	0.011 UJ	0.054 UJ	0.024 UJ	NS	NS	NS	NS	NS	NS
	6/03			NS	0.04	0.23	0.02 U	0.15	0.74	0.10 U	0.03	0.02 U	NS	NS	NS	NS	NS	NS
	6/04			NS	0.009 B	0.52	0.036	0.096	0.89	0.011 B	0.032	0.27	NS	NS	NS	NS	NS	NS
Mercury, total	11/95	2	0.025	NS	(-)	(-)	0.22	0.19	0.52	0.16	NS	NS	0.11	(-)	0.11	(-)	(-)	(-)
Mercury, dissolved	5/97			NS	0.20 U	0.20 UN	0.20 UN	0.20 UN	0.20 UN	0.20 UN	NS	NS	NS	NS	NS	NS	NS	NS
	10/97			NS	0.10 U	0.35	0.32	0.10 U	0.48	0.10 U	NS	NS	NS	NS	NS	NS	NS	NS
	5/98			NS	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	NS	NS	NS	NS	NS	NS	NS	NS
	10/98			NS	0.10 U	0.13 B	0.17 B	0.15 B	0.15 B	0.10 U	NS	NS	NS	NS	NS	NS	NS	NS
	5/99			NS	0.10 U	0.10 U	0.10 B	0.10 U	0.10 U	0.11 B	NS	NS	NS	NS	NS	NS	NS	NS
	11/99			NS	0.2 U	0.2 U	0.2 U	NA	0.2U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS
	6/00			NS	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	NS	NS	NS	NS	NS	NS	NS	NS
Mercury	6/01			NS	0.0022	0.0036	0.0071	0.0022	.0009 B	.0003 B	0.0034	.0009 B	NS	NS	NS	NS	NS	NS
Mercury, dissolved	6/02			NS	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	NS	NS	NS	NS	NS	NS
	6/03			NS	0.10 U	0.10 B	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	NS	NS	NS	NS	NS	NS
	6/04			NS	0.04 U	0.05 U	0.08 U	0.05 U	0.06 U	0.04 U	0.06 U	0.06 U	NS	NS	NS	NS	NS	NS
Nickel, total	11/95	100	7.9	NS	12.8 +	(-)	51.3	34.6 +	100	(-)	NS	NS	(-)	(-)	35.2 +	16.0 +	25.7 +	18.6 +
Nickel, dissolved	11/95			NA	NA	NA	NA	NA	NA	NA	NS	NS	NA	9.3 +	NA	9.0 +	9.0 U +	NA
	6/96			(-)	(-)	(-)	39.5 B	17.9 B	(-)	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS
	9/96			NS	(-)	(-)	42.3	49.3	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/97			NS	5.0 U	5.0 U	30.5	673	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS
	10/97			NS	11.0 U	11.0 U	40.0	423	11.0 U	11.0 U	NS	NS	NS	NS	NS	NS	NS	NS
	5/98			NS	4.0 U	7.0 B	36.9 B	7.5 B	4.8 B	5.7 B	NS	NS	NS	NS	NS	NS	NS	NS
	10/98			NS	(-)	38.2 B	16.2 B	8.9 B	4 B	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/99			NS	3.5 BN	16.3 BN	4.6 BN	70.0 N	(-)	4,1 BN	NS	NS	NS	NS	NS	NS	NS	NS
	11/99			NS	20 U	20 U	20 U	NA	20 U	20 U	NS	NS	NS	NS	NS	NS	NS	NS
	6/00			NS	3.21 J	8.57 J	10.2 J	26.8 J	3.71 J	1.02 J	5.59 J	.83 J	NS	NS	NS	NS	NS	NS
	6/01			NS	1.5	4.2	13	22	2.4	1.4	1	1	NS	NS	NS	NS	NS	NS
	6/02			NS	1.45	4.97	9.46	2.77	4.63	2.59	0.95	1.95	NS	NS	NS	NS	NS	NS
	6/03			NS	0.76 J	4.85 J	9.10 J	4.36 J	4.71 J	9.34 J	1.22 J	1.26 J	NS	NS	NS	NS	NS	NS
	6/04			NS	0.79	3.91	31.9	2.55	5.61	3.76	4.29	4.31	NS	NS	NS	NS	NS	NS

Table 6-7 (Continued)
Summary of Inorganics Detected in Groundwater and Seeps at OU 2 Area 8
Exceeding One-Half of the MTCA Method B Cleanup Levels (Fall 1995 to Spring 2003)

		Remediation Goal		Sampling Location (µg/L)														
Analyte	Date Collected	Drinking Water (µg/L)	Surface Water (µg/L)	MW8-6	MW8-8	MW8-9	MW8-11	MW8-12	MW8-14	MW8-16	Seep A	Seep B	MW8-7	MW8-15	MW8-17	MW8-18	MW8-19	MW8-20
Silver, total	11/95	48	1.2	NS	(-)	(-)	4.2	(-)	(-)	(-)	NS	NS	(-)	(-)	(-)	(-)	(-)	(-)
Silver, dissolved	11/95			NA	NA	NA	NA	NA	NA	NA	NS	NS	NA	3.0 UNW	NA	3.0 UNW	3.0 UNW	NA
	9/96			NS	(-)	(-)	(-)	(-)	8.6 B	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/97			NS	4.0 U	4.0 U	7.0 N	40 UN	7.3 N	4.0 UN	NS	NS	NS	NS	NS	NS	NS	NS
	10/97			NS	1.8 B	1.0 U	4.4 B	1.8 B	2.0 B	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS
	5/98			NS	1.0 UN	1.0 UN	5.2 BN	1.0 BN	1.2 BN	1.0 UN	NS	NS	NS	NS	NS	NS	NS	NS
	10/98			NS	1.0 UN	2.0 B	2.2 B	1.2 B	1.0 U	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS
	5/99			NS	2.2 U	2.7 B	2.2 U	2.2 U	2.2 U	2.2 U	NS	NS	NS	NS	NS	NS	NS	NS
	11/99			NS	10 U	10	10	NA	10 U	10 U	NS	NS	NS	NS	NS	NS	NS	NS
	6/00			NS	0.907	3.7	2.09	0.88	0.564	0.020 B	1.14 J	0.297 J	NS	NS	NS	NS	NS	NS
	6/01			NS	0.62	1.61	2.29	1.24	0.31	0.07 U	0.1	0.1 U	NS	NS	NS	NS	NS	NS
	6/02			NS	0.47 J	1.44 J	3.87 J	0.27 K	0.44 J	0.001 J	0.011 UJ	0.049 J	NS	NS	NS	NS	NS	NS
	6/03			NS	0.17	1.66	5.87	0.47	0.38	0.04 U	0.02	0.09	NS	NS	NS	NS	NS	NS
	6/04			NS	0.489	1.3	6.45	-0.197	0.351	0.005 U	0.031	0.097	NS	NS	NS	NS	NS	NS
Thallium, total	11/95	1.1	1.6	NS	(-)	(-)	(-)	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
Thallium, dissolved	11/95			NA	NA	NA	NA	NA	NA	NA	NS	NS	2.4 +	(-)	(-)	(-)	(-)	(-)
	6/96			(-)	1.2 BN	(-)	(-)	(-)	(-)	1.1 BNW	NS	NS	NA	2.0 U	NA	2.0 U	2.0 U	NA
	5/97			NS	1.0 UN	134 N	10.0 UW	1.0 UNW	10.0 UN	1.0 UNW	(-)	(-)	NS	NS	NS	NS	NS	NS
	10/97			NS	1.8 UN	1.8 UNW	9.0 UNW	1.8 UNW	1.8 UBN	1.8 UN	NS	NS	NS	NS	NS	NS	NS	NS
	5/98			NS	1.2 U	6.0 U	6.0 U	1.2 U	6.0 U	1.2 U	NS	NS	NS	NS	NS	NS	NS	NS
	10/98			NS	1.2 U	6.0 UW	1.2 UW	1.2 U	6.0 UW	1.2 U	NS	NS	NS	NS	NS	NS	NS	NS
	5/99			NS	1.0 UN	10.0 UNW	10.0 UNW	1.0 UNW	10.0 UNW	1.0 UNW	NS	NS	NS	NS	NS	NS	NS	NS
	11/99			NS	5 U	5 U	5 U	NA	5 U	5 U	NS	NS	NS	NS	NS	NS	NS	NS
	6/00			NS	0.01 U	0.01 U	0.04	0.01 U	0.01 U	0.03 U	0.02	0.01 U	NS	NS	NS	NS	NS	NS
	6/01			NS	0.005 U	0.005 B	0.038	0.013 B	0.007 B	0.005 U	0.022	0.011 B	NS	NS	NS	NS	NS	NS
	6/02			NS	0.006 J	0.003 J	0.040 J	0.006 J	0.007 J	0.002 J	0.003 J	0.011 J	NS	NS	NS	NS	NS	NS
	6/03			NS	0.005 B	0.015 B	0.041	0.013 B	0.006 B	0.02 U	0.012 B	0.013 B	NS	NS	NS	NS	NS	NS
	6/04			NS	0.003 U	0.003 U	0.053	0.007 B	0.007 B	0.001 U	0.015 B	0.017 B	NS	NS	NS	NS	NS	NS
Zinc, total	11/95	4,800	77	NS	(-)	(-)	207	(-)	241	(-)	NS	NS	(-)	(-)	(-)	(-)	(-)	(-)
Zinc, dissolved	11/95			NA	NA	NA	NA	NA	NA	NA	NS	NS	NA	35.6	NA	(-)	(-)	NA
	6/96			54.8	(-)	(-)	248	29.7	29.9	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS
	9/96			NS	(-)	(-)	166	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/97			NS	(-)	(-)	161	727	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	10/97			NS	(-)	(-)	178	325	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/98			NS	(-)	(-)	193	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS

Table 6-7 (Continued)
Summary of Inorganics Detected in Groundwater and Seeps at OU 2 Area 8
Exceeding One-Half of the MTCA Method B Cleanup Levels (Fall 1995 to Spring 2003)

		Remediation Goal		Sampling Location (µg/L)														
Analyte	**Date Collected**	**Drinking Water (µg/L)**	**Surface Water (µg/L)**	**MW8-6**	**MW8-8**	**MW8-9**	**MW8-11**	**MW8-12**	**MW8-14**	**MW8-16**	**Seep A**	**Seep B**	**MW8-7**	**MW8-15**	**MW8-17**	**MW8-18**	**MW8-19**	**MW8-20**
	10/98			NS	(-)	(-)	50.9	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/99			NS	(-)	(-)	(-)	48.9	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	11/99			NS	10 U	10 U	89	NA	10 U	10 U	NS	NS	NS	NS	NS	NS	NS	NS
	6/00			NS	3.1	8.6	109	24.9	3.2	4	0.8	1.4	NS	NS	NS	NS	NS	NS
	6/01			NS	2 U	3 U	110	25.3	3 U	36.5	7.6 B	3.4 U	NS	NS	NS	NS	NS	NS
	6/02			NS	0.8	3.2	221	1.8	4	1.7	1.3	1.9	NS	NS	NS	NS	NS	NS
	6/03			NS	0.7	4.9	134	2.3	2.6	2.3 B	4.5 B	9.0 B	NS	NS	NS	NS	NS	NS
	6/04			NS	1.45	1.57	157	0.92	2.6	1.07	0.83	0.97	NS	NS	NS	NS	NS	NS
Cyanide, total	11/95	320	1	NS	(-)	(-)	24	47	(-)	(-)	NS	NS	(-)	(-)	(-)	(-)	(-)	(-)
	6/96			(-)	(-)	(-)	20	31	(-)	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS
	5/97			NS	(-)	(-)	(-)	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	10/97			NS	(-)	(-)	(-)	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	5/98			NS	(-)	(-)	(-)	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
	10/98			NS	10 U	10 U	11	58	10 U	10 U	NS	NS	NS	NS	NS	NS	NS	NS
	5/99			NS	(-)	(-)	(-)	(-)	(-)	(-)	NS	NS	NS	NS	NS	NS	NS	NS
Cyanide, dissolved	11/99			NS	0.01 U	0.01 U	0.03 U	NA	0.01 U	0.01 U	NS	NS	NS	NS	NS	NS	NS	NS
	6/00			NS	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	NS	NS	NS	NS	NS	NS
	6/02			NS	NS	NS	NS	0.06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[a] Value listed is the lower of the cancer or noncancer value.

[b] Results for chromium are less than the results reported for chromium (VI) due to variation in analytical methods. Variance in results for these analytes is common.

[c] Value is for total chromium. Chromium (VI) is 80 µg/L.

[d] 50 µg/L is for chromium (VI). There is no goal for total chromium.

Notes:
(-) - undetected above one-half of the Model Toxics Control Act Method B cleanup levels
+ - Duplicate analysis is not within control limits.
B - between instrument detection limit and contract required detection limit
J - The result is an estimated concentration that is less than the method reporting limit, but greater than or equal to the method detection limit.
µg/L - microgram per liter
N - Spiked sample is outside of control limits.
NA - not analyzed
NS - not sampled
S - determined by method of standard additions
W - Post-digestion spike for furnace atomic absorption spectrophotometric analysis is out of control limits (85% to 115%) and sample is less than 50% of spike absorbance.
U - not detected at or above method detection limit

Table 6-8
Chemical Concentrations in OU 2 Area 8 Sediment (1996 Through 2004)

Location	Location No.	Fluoranthene (µg/kg)	Phenanthrene (µg/kg)	Phenol (µg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)
Remedial Investigation												
Subtital Sediments	LB17[a]	110 J	110	210	0.45 J	120	18	12	0.018	NA	ND	55
	LB18	ND	ND	650	ND	92	15	ND	0.02	NA	0.38 J	63
	BSV	NA	NA	NA	0.68	88	34	36	0.109	NA	<0.23	96
1996 Sampling												
Seep Sediments	1	110	14	3000	0.59	14.1	6.4	6.6	0.07	10.2	0.27	29.5
	2	8.9	3.9	1700	1.8	30.3	12.1	3.05	1.26	14.1	0.58	35.8
	3	19	9.4	110 J	7.8	159	11.1	5.25	0.15	23	0.70	40.2
Midzone Sediments	4	9.1	3.5	240 J	4.8	46.4	10.6	6.5	0.06	29.5	0.62	47
	5	44	12	530	2	65.4	8.7	5.5	0.06	19.8	0.28	35.1
	6	8.2	3[b]	390 U	2.75	167.5	9.35	8.3	0.05	21.7	0.32	37.6
Deeper Sediments (-1 MLLW)	7	11	13	460 U	0.07	54	10.5	7.8	0.07	24.8	0.07	46.8
	8	49	22	5200	0.22	48	7.4	4.4	0.06	14.0	0.24	27.3
	9	59	22	240 J	0.46	83.7	11.3	7.4	0.05	20.7	0.32	38.3
	Mean	35.4	11.4	1224	2.3	74.3	9.7	6.1	0.20	19.8	0.38	37.5
2000 LTM Sampling												
Seep Sediments	1	17	7 J	140	0.79 J	26.9	10.3	5.15	0.03	19.3 J	0.23	34.7 J
	2	28	5 J	20 J	3.96 J	45.4	10	4.64	0.89	20.2 J	0.33	38.4 J
	3	7 J	3 J	50 U	4.87 J	89.8	12.3	7.33	0.21	21.2 J	0.26	38.9 J
Midzone Sediments	4	65	9 J	300	1.38 J	36.3	9.37	5.93	0.06	20.4 J	0.72	30.5
	5	15	7 J	20 J	6.23 J	26.9	12.6	6.24 J	0.06	26.4 J	0.59	39.7 J
	6	8 J	4 J	30 J	1.98 J	75.4	10.6	6.22	0.16	21.2 J	0.23	35.5 J
Deeper Sediments (-1 MLLW)	7	16	4 J	79	.22 J	19.5	7.74	5.59	0.04	17 J	0.09	27 J
	8	6 J	10 U	1500	.97 J	67.1	8.05	4.83	0.04	17.9 J	0.22	30.1 J
	9	48	23	2000	1.46 J	86.9	10.2	37.6	0.07	21 J	0.23	45 J
	Mean	23.3	6.9	424.1	2.4	52.7	10.1	9.3	0.17	20.5	0.32	36.6
2004 LTM Sampling												
Seep Sediments	1	7.2 J	4.3 J	270	0.25	22	14.6	7.4	0.03	30.3	0.33	42.2
	2	7.8 J	10 U	30 U	4.49	38.3	20.8	8.88	0.09	31.3	0.3	94.8
	3	56	100	410	8.32	62.1	13.9	5.44	1.58	30.9	0.73	45.8
Midzone Sediments	4	5.4 J	7.5 J	75	1.9	26	13.6	6.32	0.02 B	31.6	0.25	39
	5	19	2.1 J	30 U	2.85	31.5	10.7	4.49	0.46	26.9	0.32	37.3
	6	14	2.8 J	69	9.13	64.5	13.1	4.93	0.72	24.1	1.25	39.3

Table 6-8 (Continued)
Chemical Concentrations in OU 2 Area 8 Sediment (1996 Through 2004)

Location	Location No.	Fluoranthene (µg/kg)	Phenanthrene (µg/kg)	Phenol (µg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)
Deeper Sediments (-1 MLLW)	7	5.9 J	10 UJ	1400 D	2.66	34.6	10.5	6.31	0.04	24.4	1.54	33.1
	8	5.8 J	2.0 J	1000 D	5.64	43.9	11.5	4.88	0.07	21.9	0.42	31.8
	9	89	65	30 U	6.44	59.5	13	8.35	0.21	27.7	0.36	40.6
	Mean	23.3	20.4	358	4.63	42.5	13.5	6.3	0.36	27.7	0.61	44.9
Sediment quality standard		3200[c]	1500[c]	420	5.1	260	390	450	0.41	NA	6.1	410

[a] Locations LB17 and LB18 from the remedial investigation (U.S. Navy 1993) were immediately offshore of Area 8 and are considered subtidal, whereas Area 8 sedimer locations (i.e., 1 through 9) are intertidal. LB18 was located close to Pier 2, and sediments might be affected by pier-related activities. Thus, results of sediment sampling at these remedial investigation locations and the 1996 monitoring locations are likely not directly comparable.

[b] Undetected (one-half detection limit used for all nondetects`

[c] This is the apparent effects threshold screening level value in dry weight

Notes:
J - The result is an estimated concentration that is less than the method reporting limit, but greater than or equal to the MDL.
U - not detected at or above MDL
MDL - method detection limit
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
MLLW - mean lower low water
NA - not available or analyses not performed
ND - not detected

Table 6-9
Chemical Concentrations in OU 2 Area 8 Clam Tissues (1996 Through 2004)

Location	Location No.	Fluoranthene (µg/kg)	Pyrene (µg/kg)	Phenol (µg/kg)	Benzoic Acid (µg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)
Remedial Investigation													
Subtidal Clam Tissues	LB17[a]	660 U	660 UJ	660 U	1600 UJ	0.09	0.49	1.0	0.14 U	0.01	0.44	0.07	10.9 U
1996 Sampling													
Seep Clam Tissues	1	NA	NA	240	2000	1.30	2.42	1.48	0.16	0.03	0.85	1.46	14.10
	2	NA	NA	NA	2000	5.40	1.86	1.71	NA	0.18	0.50	0.73	16.50
	3	12 J	NA	NA	2150	5.70	7.28	1.54	0.12 J	0.02	0.55	0.27	17.25
Midzone Clam Tissues	4	10	15 J	NA	1600	2.20	2.41	1.50	NA	0.02	0.60	0.81	13.60
	5	11	13 J	NA	2000 J	1.01	2.75	1.38	0.14 J	0.02	1.30	0.28	13.20
	6	NA	NA	NA	NA	1.50	2.57	1.11	NA	0.01	0.40	0.11	13.70
Deeper Clam Tissues (-1 foot MLLW)	7	20	18 J	NA	1900 J	0.25	0.39	1.66	NA	0.01	0.40	0.43	15.00
	8	12	NA	NA	1800 J	0.22	2.20	1.53	0.21	0.01	1.30	0.49	11.10
	9	16.5	NA	NA	2700 J	0.21	2.82	1.39	NA	0.01	1.75	0.30	12.45
	Mean	13.58	15.33	240	2019	1.98	2.74	1.48	0.16	0.03	0.85	0.54	14.10
2000 LTM Sampling													
Seep Clam Tissues	1	8 J	6 J	50 U	4300	0.6 J	0.74	1.03 J	0.05 J	0.02	0.62 J	0.31	14.59
	2	8 J	5 J	20 J	4700	1.94 J	1.53	1.15 J	0.07 J	0.04	0.57 J	0.29	14.71
	3	7 J	2.5	50 U	6700	0.8 J	1.52	1.12 J	0.05 J	0.05	0.73 J	0.28	16.13
Midzone Clam Tissues	4	10	6 J	20 J	6400	0.93 J	0.50	1.02 J	0.05 J	0.01	0.52 J	0.40	16.13
	5	8 J	7 J	30 J	7300	1.21 J	0.67	0.96 J	0.05 J	0.02	0.43 J	0.17	14.16
	6	6 J	19	20 J	8500	0.54 J	0.44	1.09 J	0.04 J	0.02	0.41 J	0.13	18.5
Deeper Clam Tissues (-1 foot MLLW)	7	11	29	30 J	10000	0.19 J	0.60	1.5 J	0.06 J	0.01	0.47 J	0.14	14.37
	8	10 U	10 U	240	10000	0.31 UJ	0.49	1.35 J	0.06 J	0.01	0.41 J	0.12	13.74
	9	10 J	10 J	230	11000	0.24 J	0.71	1.34 J	0.06 J	0.02	0.54 J	0.20	13.94
	Mean	8.11	9.94	71.11	7656	0.81	0.80	1.17	0.05	0.02	0.52	0.23	15.14
2004 LTM Sampling													
Seep Clam Tissues	1	6.7 U	8.2 U	54 U	1300 J	0.57	0.43	1.15	0.06	0.02	0.86	0.9	12
	2	6.7 U	8.2 U	54 U	1600 J	1.25	0.57	1.2	0.06	0.02	0.87	0.57	16.5
	3	6.7 U	8.2 U	54 U	3700 J	1.81	1.05	1.17	0.07	0.04	0.81	0.57	15.1
Midzone Clam Tissues	4	6.7 U	8.2 U	54 U	4500 J	1.33	0.77	1.01	0.06	0.02	0.82	0.83	13
	5	6.7 U	8.2 U	54 U	5300 J	4.54	1.11	1.21	0.05	0.16	0.42	0.48	12.4
	6	6.7 U	8.2 U	54 U	5400 J	2.48	0.64	1.17	0.07	0.03	0.53	0.48	14.4
Deeper Clam Tissues (-1 foot MLLW)	7	6.7 U	8.2 U	54 U	6500 J	1.31	0.28	1.27	0.07	0.02	0.43	0.63	13.8
	8	6.7 U	8.2 U	54 U	1700 J	1.57	0.51	1.17	0.08	0.02	0.48	0.33	13.7
	9	6.7 U	8.2 U	54 U	4200 J	0.66	0.20	1.03	0.07	0.02	0.59	0.48	14.5
	Mean	6.7	8.2	54	3800	1.72	0.62	1.15	0.07	0.04	0.65	0.59	13.93
Background Screening Value													
	BSV	NA	NA	NA	NA	0.26	<0.95	0.76	NA	0.01	<0.58	0.35	NA

Table 6-9 (Continued)
Chemical Concentrations in OU 2 Area 8 Clam Tissues (1996 Through 2004)

[a] Locations LB17 and LB18 from the remedial investigation (U.S. Navy 1993) were immediately offshore of Area 8 and are considered subtidal, whereas Area 8 sediment locations (i.e., 1 to 9) are intertidal. LB18 was located close to Pier 2, and sediments might be affected by pier-related activities. Thus, results of sediment sampling at these remedial investigation locations and the 1996 monitoring locations are likely not directly comparable.

Notes:

Chemicals selected were metals that were elevated above BSVs at any location in Liberty Bay (U.S. Navy 1993). Organic chemicals were not detected in clam tissues from locations LB17 and LB18 during the remedial investigation.
Results are in wet-weight basis.
BSV - background screening value (95th percentile, maximum value, or minimum detection limit value of samples from reference locations [U.S. Navy 1993])
J - The result is an estimated concentration that is less than the method reporting limit, but greater than or equal to the method detection limit.
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
MLLW - mean lower low water
NA - not available for comparison or analyses not performed
U - not detected at or above method detection limit

7.0 TECHNICAL ASSESSMENT

7.1 FUNCTIONALITY OF REMEDY

This section answers the question, "Is the remedy functioning as intended by the decision documents?" Each component of the remedy for each OU is discussed in the sections that follow, generally in the order that the components were described in Section 4.

7.1.1 Functionality of Remedy for OU 1

Overall, the remedy for OU 1 is functioning as intended by the ROD. All components of the remedy have been implemented. Implementation of phytoremediation, PCB-contaminated sediment removal, and the tide gate upgrade were complete prior to the first 5-year review. Institutional controls were also implemented prior to the first 5-year review, and long-term monitoring, maintenance, and inspection programs are in place. The landfill cover was upgraded during this review period, and the Navy prepared and implemented a contingent remedial action plan in March 2003.

The functionality and effectiveness of the phytoremediation component of the remedy has not been established. Direct effects of phytoremediation on groundwater flow patterns or contaminant concentrations have not been demonstrated to date, but may be more apparent as the trees continue to grow. As stated in the OU 1 ROD, it was anticipated that "source reduction by the poplar trees will work in concert with natural attenuation processes and decrease the overall time frame for cleansing of the site . . ." (U.S. Navy, USEPA, and Ecology 1998). Thus, phytoremediation was not expected to perform as a stand-alone remedy. The ROD also allowed for reliance on natural attenuation and intrinsic biodegradation in the absence of phytoremediation, if necessary.

The ongoing monitoring and evaluation of intrinsic biodegradation has shown the continued existence of conditions, as stated in the ROD, "favorable for controlling the migration of contaminants downgradient from the landfill" (U.S. Navy, USEPA, and Ecology 1998). Intrinsic biodegradation has been found to consistently and substantially reduce concentrations of VOCs as they migrate in groundwater from the landfill to the adjacent marsh. This mechanism is not sufficient to reduce VOC concentrations to below RGs in the marsh. However, this was also recognized in the ROD, which states the following:

> Test results have shown downgradient concentrations that (1) do not indicate current unacceptable risk to human health via the seafood ingestion pathway at locations where seafood resources now exist, (2) do not flow toward off-base

> drinking water resources, and (3) do not pose sufficient ecological risk to require active remediation of downgradient resources at this time. The site characterization studies indicate that this favorable situation will most likely continue in the future.

The conditions and COC concentrations found today in the landfill, marsh, and downstream receptors are similar to those at the time of the ROD, when those conditions were found to be sufficiently protective of human health and the environment as long as exposures were controlled. The favorable intrinsic biodegradation conditions are functioning as intended by the ROD to maintain the protection of human health and the environment and slowly reduce COC concentrations over time. This process may or may not be aided by phytoremediation, but phytoremediation at least is not impairing the functionality of intrinsic biodegradation.

The removal of PCB-contaminated sediment successfully reduced the amount of PCBs present in marsh sediments. The ROD did not anticipate or require complete removal of PCB-contaminated sediment throughout the marsh, and PCBs are still detected in marsh sediments. PCB concentrations found in 2002 and 2004 sediment samples are below the AET screening values. PCBs were also detected in water samples from landfill seep SP1-1, and the ongoing monitoring program is functioning to assess the potential for long-term recontamination of the marsh.

The tide gate is functioning to regulate the marsh water level, and no erosion of the landfill is apparent. Maintenance of the tide gate is being performed and documented.

The upgraded landfill cover is functioning to reduce infiltration into the landfill by improving the integrity of the existing impervious surface and by better controlling stormwater runoff.

Institutional controls are being inspected annually and the findings documented. These controls are functioning to control human exposures to contaminated soil and groundwater at OU 1.

Long-term monitoring is being conducted regularly for all required media and is functioning to ensure the ongoing effectiveness of the remedy. The results are regularly evaluated to assess the remedy, assess the need to implement contingent remedial actions, and assess the need for modifications to the monitoring program.

7.1.2 Functionality of Remedy for OU 2

Functionality of Remedy for Area 2

The remedy for Area 2 is functioning as intended by the OU 2 ROD. The institutional controls component of the selected remedy has been implemented and maintained and acts to prevent human exposures to COCs in soil and groundwater. The groundwater monitoring component of the remedy has also been implemented. Groundwater wells are sampled regularly and the results evaluated to assess the need for continued institutional controls. The results are also evaluated to assess the adequacy of monitoring and the monitoring, program is adjusted as necessary, with input from Ecology.

Functionality of Remedy for Area 8

The remedy for Area 8 is functioning as intended by the OU 2 ROD. The institutional controls component of the selected remedy has been implemented and maintained and acts to prevent human exposures to COCs in soil and groundwater. The removal and off-site disposal of vadose-zone soil from COC hot spots was complete prior to the first 5-year review. Groundwater, sediment, and tissue monitoring has been ongoing since 1995, with the results evaluated regularly to assess the effectiveness of the remedy and the adequacy of the monitoring. The evaluation of the need for contingent groundwater control actions is included in this 5-year review based on the results of the 2004 sediment and clam tissue data and the subsequent risk assessment (Section 7.3).

7.1.3 Operation and Maintenance Costs

Annual operation, maintenance, and monitoring (OM&M) costs after the first 3 years were estimated in the RODs to total approximately $250,000 per year. Actual annual OM&M costs for fiscal years 2000 through 2004 ranged from $188,000 to $404,000 per year. The actual costs are near the costs expected in the ROD.

7.2 CONTINUED VALIDITY OF ROD ASSUMPTIONS

This section answers the question, “Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?” Therefore, this section reviews any changes to ARARs used to establish RGs in the RODs and reviews any changes to risk assessment assumptions (exposure and toxicity) to evaluate the protectiveness of the remedy.

The findings documented in this section are that changes in the ARARs exposure and toxicity assumptions that have occurred since the RODs were signed do not affect the protectiveness of the remedy. Concentrations of chemicals in groundwater remain above the RGs at the majority of locations in OU 1 and OU 2, resulting in the need for continued institutional controls to prevent exposure and ongoing monitoring. Although some of the RGs might be lower if calculated today, the remedy components continue to protect against exposures, just as they did at the time the ROD was signed. Institutional controls preventing exposure and ongoing monitoring will need to continue until COC concentrations in groundwater and surface water are below the RGs.

7.2.1 Review of Applicable or Relevant and Appropriate Requirements

In the preamble to the NCP, EPA stated that ARARs are generally “frozen” at the time of ROD signature, unless new or modified requirements call into question the protectiveness of the selected remedy. Five-year review guidance (USEPA 2001a) indicates that the question of interest in developing the 5-year review is not whether a standard identified as an ARAR in the ROD has changed in the intervening period, but whether this change to a regulation calls into question the protectiveness of the remedy. If the change in the standard would be more stringent, the next stage is to evaluate and compare the old and the new standards and their associated risk. This comparison is done to assess whether the currently calculated risk associated with the standard identified in the ROD is still within EPA’s acceptable excess cancer risk range of 10^{-4} to 10^{-6}. If the old standard is not considered protective, a new cleanup standard may need to be adopted after the 5-year review through CERCLA’s processes for modifying a remedy.

During the first 5-year review for NUWC Keyport, no substantive changes were found to ARARs that would call into question the protectiveness of the remedy. For this 5-year review, all the ARARs identified in the RODs for OU 1 and OU 2 Area 8 were again reviewed for changes that could affect the assessment of whether the remedy is protective.

Some ARARs that were used in the determination of cleanup levels have been amended since publication of one or both of the two RODs. These regulations are the following:

- Washington State MTCA regulations
- Federal and state drinking water regulations (maximum contaminant levels, or MCLs)
- Washington State marine surface water quality standards for protection of aquatic life

The result of the amendments to the regulations is sometimes the lowering of a numeric ARAR. In these instances, the revised ARAR must be evaluated to determine whether there is a negative effect on the protectiveness of the remedy. In other instances, the ARAR remains unchanged or has been raised. In these instances, no further discussion is provided, because the protectiveness of the remedy is not affected.

Operable Unit 1

Groundwater. Table 7-1 compares current ARARs values for the groundwater pathway with those presented in the OU 1 ROD (U.S. Navy, USEPA, and Ecology 1998, Table 11-4). The ARARs are defined for groundwater as a source of drinking water and as a contributor to surface water. For two chemical constituents listed in the OU 1 ROD, the new ARAR values are lower (more stringent):

- **1,1-Dichloroethene:** The ROD cleanup value for the drinking water pathway is based on the practical quantitation limit (PQL) available at the time the ROD was prepared, 0.5 μg/L. (MTCA allows for use of the PQL when the MTCA cleanup level is below the PQL.) However, most laboratories now routinely run a selected ion monitoring (SIM) analysis, which typically provides a PQL of 0.2 μg/L for 1,1-DCE.

- **Vinyl chloride:** The ROD cleanup value for vinyl chloride for the drinking water pathway is also based on the PQL available when the ROD was written. As with 1,1-DCE, most laboratories routinely run a SIM analysis, which typically provides a PQL of 0.2 μg/L for vinyl chloride.

Surface Water. Table 7-2 compares current ARAR values for surface water with those provided in the OU 1 ROD (U.S. Navy, USEPA, and Ecology 1998, Table 11-5). No ARAR revisions were found for surface water.

Operable Unit 2 Area 8

Groundwater. Table 7-3 compares current ARARs values for the groundwater pathway with those presented in the OU 2 ROD (U.S. Navy, USEPA, and Ecology 1994, Table 10-12). The ARARs are defined for groundwater as a source of drinking water and as a contributor to surface water. The current RG for one chemical constituent is lower than the value listed in the ROD: hexavalent chromium (chromium VI). The former MTCA Method B calculated value was 80 μg/L; the current value is 48 μg/L.

Surface Water. Table 7-4 compares current ARARs values for the surface water pathway with those provided in the OU 2 ROD (U.S. Navy, USEPA, and Ecology 1994, Table 10-12). The only RG value that has been lowered is benzene. Benzene's MTCA Method B value was formerly 43 μg/L; now it is 22.7 μg/L.

7.2.2 Review of Risk Assessment Assumptions

Risk assessment assumptions were also reviewed as part of the requirement to assess protectiveness of the remedy. For human health, the two areas where changes have occurred since the RODs are toxicity values for seven chemicals and the shellfish ingestion exposure parameter. How these changes to toxicity and ingestion parameters might affect the protectiveness of the remedy is discussed below. The focus of this discussion is the surface water and clam tissue RGs, since the RGs for these media are risk-based values that would be affected by changes in toxicity.

For OU 1, two sets of RGs were based on risk assessment values: the surface water RGs that were the MTCA Method B values protective of surface water, and the clam tissue RGs that were calculated risk-based concentrations protective of subsistence seafood harvesters.

For OU 2, MTCA Method B values protective of surface water were ARARs and, in some cases, also RGs (see Tables 7-2 and 7-4 for OU 1 and OU 2 surface water RGs, respectively). The drinking water RG for hexavalent chromium in groundwater was also a risk-based value (MTCA Method B protective of drinking water).

Toxicity Criteria

If Method B values were to be calculated now, revisions to the toxicity criteria for seven chemicals would result in different MTCA Method B values than those presented in the RODs. Toxicity values have changed for benzene, 1,1-DCE, hexavalent chromium, tetrachloroethene, 1,1,1-TCA, trichloroethene, TCE, and vinyl chloride since completion of the RODs. Therefore, MTCA Method B values were recalculated using current toxicity values and compared to the ROD RGs. The results of the recalculation and the specific toxicity changes are presented in Table 7-5 and are discussed below by chemical.

Clam tissue RGs are not discussed in this section because, while the changes in toxicity criteria would affect the clam tissue RGs for the VOCs, target VOCs have not been detected in clam tissue and VOCs analysis in clam tissue has been discontinued. Consequently, RGs for the target VOCs in clam tissue are not a concern at OU 1.

Benzene. Benzene was a COC only for OU 2 Area 8. The federal national toxics rule value of 71 µg/L was selected as the RG and the Method B value (43 µg/L) was listed as an ARAR. When the current oral slope factor (i.e., the toxicity criteria for carcinogenic chemicals) is used to calculate the MTCA Method B value, the value changes from 43 to 22.7 µg/L, and this change is presented on Table 7-4. Using the new slope factor, the cancer risk of the OU 2 RG of 71 µg/L is 3×10^{-6}, below the ROD cancer risk goal of 1×10^{-5}. Therefore, the remedy designed to achieve the surface water RG for benzene at OU 2 is still protective.

Chromium VI. Cr(VI) is a COC in OU 2 Area 8. The drinking water RG in the ROD is 80 µg/L, based on the drinking water MTCA Method B value at the time the ROD was signed in 1994. In 1998, the reference dose (RfD) for Cr(VI) was lowered to 0.003 mg/kg-day in EPA's Integrated Risk Information System (IRIS). Therefore, if the MTCA drinking water value was calculated today, the value would be 48 µg/L. Using the new RfD, the noncancer hazard of the RG of 80 µg/L is 2, which is above the ROD target health goal of 1. However, the groundwater concentrations at Area 8 are generally above the RGs for all the COCs. Consequently, the remedy preventing use of the water for drinking is protective and not affected by the change in Cr(VI) toxicity.

The Cr(VI) surface water RG for OU 2 is based on protection of marine life. The marine life RG of 50 µg/L has not changed and is also protective of human health, even when the adjusted toxicity of Cr(VI) is taken into consideration.

1,1-Dichloroethene. 1,1-DCE is a COC for both OU 1 and OU 2. The surface water protection pathway RG for 1,1-DCE at OU 1 is the MTCA Method B surface water value (1.9 µg/L). For OU 2, the federal national toxics rule value of 3.2 µg/L was selected as the RG and the Method B value (1.9 µg/L) was listed as an ARAR. EPA has withdrawn the cancer slope factor for this chemical and no longer considers it a potential carcinogen. Therefore, if an MTCA Method B surface water value were calculated now, it would be based on noncancer toxicity and would be 23,150 µg/L, which is considerably higher than the RG listed in either ROD. Therefore, there are no impacts on the protectiveness of the remedy.

Tetrachloroethene. Tetrachloroethene is a COC for both OU 1 and OU 2. The RG for the chemical at OU 1 is the MTCA Method B surface water value (4.2 µg/L). For OU 2, the federal national toxics rule value of 8.9 µg/L was selected as the RG and the Method B value (4.2 µg/L) was listed as an ARAR. Based on the latest proposed toxicity criteria for tetrachloroethene, new risk-based values for tetrachloroethene would be more than an order of magnitude lower than these two RGs.

EPA is recommending new oral slope factor for tetrachloroethene of 0.54 $(\text{mg/kg-day})^{-1}$ developed by California's Office of Environmental Health Hazard Assessment (OEHHA)

(OEHHA 2002). This is considered a provisional value to be used until EPA completes the ongoing IRIS review process and places its own slope factor on IRIS. Ecology recommends the use of the provisional toxicity criteria in Method B calculations.

Using the California OEHHA oral slope factor, the MTCA Method B value would change from 4.2 to 0.39 µg/L. Using the proposed slope factor, the cancer risk of the former MTCA Method B surface water value of 4.2 µg/L is 1×10^{-5}, and a value of 8.9 µg/L is 2×10^{-5}, both approximately equal to the ROD's cancer risk goal of 1×10^{-5}. Therefore, the remedy designed to achieve the Method B surface water value is likely still protective. These health risks are in the middle of EPA's target risk range of 10^{-4} to 10^{-6}.

Tetrachloroethene was not detected in surface water at OU 1 in 2004. At OU 2, the 2004 samples collected at Seeps A and B had TCE concentrations of 0.92 and 0.39 µg/L, respectively. The Seep A concentration slightly exceeds the revised value of 0.39 µg/L.

1,1,1-Trichloroethane. This chemical is a COC at both OU 1 and OU 2. The RG for this chemical in both RODs was 42,000 µg/L. The EPA's National Center for Environmental Assessment (NCEA) has revised their provisional reference dose (RfD) for 1,1,1-TCA from 0.02 mg/kg-day used in the surface water RG calculations to 0.28 mg/kg-day based on updated toxicity information. If the current oral RfD is used to calculate the MTCA Method B surface water value, the value would change from 42,000 µg/L to 129,600 µg/L. Therefore, the remedy designed to achieve the Method B surface water value is still protective.

Trichloroethene. TCE is a COC at both OU 1 and OU 2. The RG for OU 1 is 55.6 µg/L and the RG for OU 2 is 81 µg/L. As with tetrachloroethene, EPA has proposed a new oral slope factor for TCE of 0.4 $(\text{mg/kg-day})^{-1}$ (USEPA 2001b). The new value is still considered provisional (not yet in EPA's IRIS database). However, EPA Region 10 and most other EPA regions recommend the use of the new slope factor as protective of all potential human receptors. Ecology recommends the use of the provisional toxicity criteria in Method B calculations.

If the provisional oral slope factor for TCE is used to calculate the MTCA Method B value, the new value is 1.53 µg/L, much lower than the RGs of 55.6 and 81 µg/L. Using the provisional slope factor, the OU 1 RG represents a health risk of 4×10^{-5} and the OU 2 RG represents a health risk of 5×10^{-5}. These health risks are within EPA's target risk range of 10^{-4} to 10^{-6}, but they both exceed the cancer risk goal stated in the RODs of 1×10^{-5}.

At OU 1, concentrations of TCE in surface water at some locations still exceed the RG of 55.6 μg/L. Almost all detected concentrations of TCE in surface water in OU 1 exceed 1.5 μg/L.

At OU 2, concentrations of TCE at Seeps A and B have been declining over time. At Seep A, the 2004 sampling found a concentration of 49 μg/L, which is below the RG of 81 μg/L, but above 1.5 μg/L. The concentration of TCE in Seep B in 2004 was 0.61 μg/L.

Vinyl Chloride. This chemical is only a COC at OU 1. The oral slope factor for vinyl chloride, as reported in IRIS (USEPA 2004), has changed from 1.9 to 1.5 $(mg/kg\text{-}d)^{-1}$. If the current oral slope factor is used to calculate the MTCA Method B value, a slightly higher cleanup level (for the surface water protection pathway) would be calculated, changing it from 2.92 to 3.7 µg/L. This change would not influence the protectiveness of the remedy.

While there have been occasional exceedances of the vinyl chloride RG in the tide flats (TF-19), the surface water RG is based on protection of human health via the fish ingestion pathway, and clam tissue analysis confirms that VOCs are not being taken up into clam tissue. Therefore, occasional vinyl chloride exceedances over the RG in the tide flats do not represent a human health concern.

The 2004 surface water sample results for vinyl chloride showed that all samples, with the exception of MA-12, were equal to or below a value of 4 µg/L, which is the new MTCA Method B value. Based on these results, the majority of the surface water does not exceed the current vinyl chloride surface water standard. Outside of the marsh area, the tide flats vinyl chloride 2004 sample was 1.1 µg/L, and vinyl chloride was not detected in the 2004 Dogfish Bay sample.

Exposure Parameters

The original risk assessment for both OUs did not find health risks in excess of target health goals from consumption of shellfish in Liberty Bay or Dogfish Bay adjacent to NUWC Keyport. However, in OU 1 (in Dogfish Bay) it was noted that concentrations of COCs, particularly PCBs, could be increasing. Therefore, periodic monitoring of shellfish was established as part of the long term monitoring program, and risk-based RGs were established for clam tissue. The exposure parameters used in the baseline risk assessment for subsistence harvesters were a combination of EPA default parameters and parameters obtained from peer-reviewed literature. None of these values has changed substantively since the ROD was signed.

PCBs were not detected in the latest round of tissue sampling conducted in Dogfish Bay in June 2004. Other COCs originally identified in shellfish have never been detected. Therefore, any changes in exposure assumptions would not affect the protectiveness of the remedy.

The OU 2 ROD did not provide tissue-based RGs for shellfish. Shellfish near Area 8 were identified in the ROD as requiring further evaluation to assess whether active measures were needed to address contamination in groundwater impacting the bay. The results of this risk evaluation are discussed in Section 7.3 for both human and ecological receptors.

Currently, shellfish harvesting is restricted in both bays by the Washington State Department of Health. Restrictions were originally due to biological contamination from septic and sewage discharges, not from any chemical impacts from activities at Keyport. Recent communication with the Department of Health indicated that closure is being maintained primarily because of two large marinas in the immediate area (marina closure zone) (Woolrich 2004). Water samples from the two bays have not been collected and analyzed by the Department of Health since the early 1990s.

7.3 RISK EVALUATIONS OF SEDIMENT AND CLAM TISSUE AT OU 2 AREA 8

As noted in Section 4.2.2, the ROD specified that post-ROD sediment and clam tissue samples from Liberty Bay were to be evaluated, using risk assessment procedures, to assess whether health risks were present. The results of the evaluation were to be used to assess whether further remedial actions were needed for groundwater entering Liberty Bay. The sections below summarize the human health and ecological risk assessments. The detailed assessments are presented in Appendices C and D.

7.3.1 Human Health Risk Assessment For Sediment and Clam Tissue at OU 2 Area 8

The risk assessment evaluated potential health risks to two populations — subsistence and recreational users — who could encounter Area 8 chemicals while harvesting and eating clams. The ROD specified that the factors used in the risk assessment equations for the post-ROD evaluation were to be the same factors as were used in the original baseline risk assessment. The risk results using the baseline risk assessment exposure factors are referred to as “baseline assumption” risks. In addition, because of the 5-year review requirements to evaluate the effects of new information, a second set of risk calculations was performed using new information. This second set of risk results are referred to as “revised assumption” risks.

This risk assessment was prepared in accordance with current EPA guidelines for human health risk assessment (USEPA 1989, 1991a, 1997, and 1998). The assessment follows available science where appropriate regulatory guidance is not available to accommodate site-specific conditions. Where information is incomplete, conservative assumptions are made so that risk to public health is not underestimated. An overview of the chemicals selected for quantitative evaluation, exposure factors, toxicity, and risk characterization using both the baseline and revised information is provided in the next sections.

Chemical Selection Process

Typically, not all chemicals present at a site pose health risks or contribute significantly to overall site risks. EPA guidelines recommend focusing on a group of chemicals of potential concern based on inherent toxicity, site concentration, and behavior of the chemicals in the environment (USEPA 1989). To identify these chemicals of concern, risk-based screening toxicity values are compared to site concentrations of chemicals. If site concentrations of a chemical exceed their respective screening concentrations, then the chemicals are retained for quantification in the risk assessment.

The Post-ROD data collected from nine stations during 1996, 2000, and 2004 were included in the risk assessment. These sampling locations are depicted on Figure 3-3. The OU 2 ROD (U.S. Navy, USEPA, and Ecology 1994) identified only lead and mercury as COCs in both sediment and clam tissue. However, the OU 2 ROD also required that sediment and clam tissue be analyzed for several other chemicals, including additional metals and SVOCs. Therefore, total metals and SVOCs analyzed in sediment and clam tissue and results were screened for quantitative evaluation in the risk assessment.

In the absence of screening values specifically defined for EPA Region 10, values from other EPA regions were used. EPA's Region 9 preliminary remediation goals (PRGs) residential soil values were used as sediment screening values (USEPA 2004b). The lower of EPA's Region 3 fish ingestion risk-based concentrations (RBCs) (USEPA 2004b) and the tissue RBCs calculated for OU 1 were used for screening clam tissue concentrations, except for lead. No screening value is available for lead in tissue; therefore, this chemical was automatically selected for quantitative evaluation. Chemical concentrations in sediment and tissue were compared to one-tenth of their respective screening value for noncarcinogens and the full value for carcinogens. Screening values represent concentrations below which there is no health concern. If the maximum concentration of a chemical was less than the screening value, or if the exceedance above the screening value was slight and infrequent, the chemical was eliminated from the risk assessment because it would not be a health concern. Using this approach, the following chemicals were selected for quantitative evaluation in the risk assessment:

- In sediment:
    - Cadmium
    - Chromium
    - Mercury
- In clam tissue:
    - Cadmium
    - Chromium
    - Lead
    - Mercury
    - Silver

All chromium was assumed to be in the most toxic hexavalent form. No SVOCs were selected for quantitative evaluation, because their detections were either below a screening level or the exceedance above the screening level was slight and infrequent.

Exposure Assessment

For this evaluation, only exposures to sediments and clams were evaluated as specified by the ROD. Currently, clam harvesting is closed at Liberty Bay by the Washington State Department of Health (WDFW 2004). Therefore, the pathways selected for quantitative evaluation are not currently “complete” or “in effect.” The future pathways by which people could be exposed to chemicals in sediment and clam tissue are the following:

- Subsistence harvesters (adults and children) digging clams in marine sediments through incidental ingestion and dermal contact
- Subsistence harvesters (adults and children) ingesting clam tissues
- Recreational harvesters (adults and children) digging clams in marine sediments through incidental ingestion and dermal contact
- Recreational harvesters (adults and children) ingesting clam tissues

Toxicity Assessment

The third step in risk assessment is an evaluation of the toxicity of the COCs by an assessment of the relationship between the dose of a chemical and the occurrence of toxic effects. Chemical toxicity criteria, which are based on this relationship, consider both cancer effects and effects other than cancer (noncancer effects). The toxicity criteria are required in order to quantify the potential health risks due to the COCs. All chemicals for which toxicity information exists were evaluated. The evaluations focused exclusively on noncancer effects, because none of the chemicals selected for quantitative evaluation are carcinogens by the ingestion or dermal routes.

Risk Characterization

The last step in human health risk assessment is a characterization of the health risks. The exposure factors, media concentrations, and toxicity criteria are combined to calculate health risks. Health risks are calculated differently for cancer and noncancer effects. Lead hazards are addressed by a different methodology than all other chemicals. Only noncancer effects were evaluated at this site, because none of the selected chemicals are carcinogenic by the routes evaluated in this assessment.

A “threshold” dose exists for chemicals with noncancer effects. Noncancer hazards assume there is a level of chemical intake that is not associated with an adverse health effect even in sensitive individuals. EPA’s target health goal is a “hazard quotient” (HQ) of 1 for noncancer chemicals. At an HQ of 1, the site dose equals the threshold (i.e., safe) dose. The HQ is defined as the ratio of a single substance exposure level to a reference dose. A hazard index is the sum of more than one HQ for multiple substances or exposure pathways.

Noncancer hazards for all chemicals except lead were calculated for recreational and subsistence exposures to chemicals in sediment and clam tissue. Hazards were calculated using both the baseline assumptions used in the original risk assessment and revised assumptions based on newer information. Target health goals were not exceeded under any exposure scenario for either subsistence or recreational exposures. Therefore, concentrations of chemicals in sediment and clam tissue are not likely present in concentrations that are a health concern for the recreational or subsistence populations. The results are presented on Table 7-6 and Table 7-7 for baseline and revised assumptions, respectively. Shellfish consumption contributed the majority of the hazards and both the baseline assumptions and revised assumptions resulted in a hazard index of 2, slightly above EPA’s target health goal of 1, when rounded to one significant figure, as is recommended by EPA guidance. Hazards are presented to two significant figures in the detailed risk calculations in Appendix C, and the revised assumption hazards were slightly higher than those for the baseline assumptions. The majority of the shellfish ingestion hazard is due to cadmium (hazard = 0.9 for baseline assumptions), followed by chromium and mercury.

The default assumption in risk assessment is that all toxic effects of chemicals are additive. However, EPA recognizes that chemicals with toxic effects on different body systems or target organs are unlikely to be additive. All chemicals quantitatively evaluated in this risk assessment have different toxic endpoints. Therefore, even though hazards exceed 1 for all chemicals added together, hazards for the individual chemicals are below 1, indicating that no chemicals evaluated at this site are present at concentrations that warrant a health concern, based on the exposure assumptions used in this assessment.

Lead is a ubiquitous chemical and exposures to lead occur through many sources unrelated to site exposures (e.g., lead paint, lead in drinking water, and background lead in air). Therefore, lead is evaluated differently than all other chemicals. As recommended by the U.S. Food and Drug Administration (USFDA 1993), a total lead level of concern in shellfish can be estimated by dividing the provisional total tolerable intake level by the daily intake rate of shellfish, which in this case is the clam ingestion rate. The average lead concentration does not exceed the shellfish lead level of concern for any age group under either the recreational or subsistence scenario. Therefore, lead is not likely to be present in clam tissue in concentrations that are a concern for recreational or subsistence populations who consume clams from Liberty Bay.

Conclusions

As stated earlier, the results of the risk assessment were to be used to assess whether further remedial actions were needed for groundwater entering Liberty Bay. Based on the results of the human health evaluation, no additional remediation measures are necessary to protect human health from exposures in Liberty Bay. However, because concentrations in tissue have not declined and because there is evidence of increasing concentrations of chromium and cadmium at Seeps A and B, continuation of the shellfish and sediment monitoring program is recommended.

7.3.2 Screening Level Ecological Risk Assessment Summary for Sediment and Clam Tissue at OU 2 Area 8

A screening level ecological risk assessment (SLERA) was conducted as specified in the ROD for OU 2. The overall objective of the SLERA was to evaluate the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to chemicals of potential ecological concern (COPECs) identified in sediment at the site. As described for human health, the results of the SLERA will be used to evaluate whether additional remediation measures are needed for the impacted groundwater entering Liberty Bay.

The general approach for the SLERA involved an initial screening of sediment quality data against sediment screening levels to identify COPECs for further consideration in the SLERA. The sediment screening step was followed by screening the shellfish tissue data for the COPECs against tissue screening levels. Following the screening of tissue data, HQs were calculated based on the measured tissue data. Where HQs were found to be less than 1, risk to aquatic biota was considered acceptable. Where HQs exceeded 1, further investigation may be warranted as a potential exists for risks to aquatic biota.

Chemicals of Potential Concern

To determine whether a chemical of interest (COI) would be carried forward as a COPEC in the SLERA, the analytical data available for each COI were compared to a sediment screening value. If the concentration of the COI measured in the sediment sample was greater than the sediment screening value, the COI was considered to be a COPEC. The sediment screening values used in the SLERA in order of preference included the following:

- MTCA Cleanup Regulation, WAC 173-340
- Ecology's *Progress Re-evaluating Puget Sound Apparent Effects Thresholds (AETs)*, Vol. 1, *1994 Amphipod and Echinoderm Larval AETs* (NOAA 1999)
- Oregon Department of Environmental Quality *Guidance for Ecological Risk Assessment, Level II Screening Level Values* (ODEQ 2001)
- Personal communication with Peter Adolphson of Ecology regarding cyanide in marine sediment (Adolphson 2004)

Sediment screening values are presented in Table D2-3 in Appendix D.

The following chemicals were identified as COPECs in sediments:

- 1,2,4-Trichlorobenzene
- bis(2-Ethylhexyl)phthalate
- Cadmium
- Hexachlorobenzene
- Hexachloroethane
- Hexavalent chromium (in tissue)
- Mercury
- Phenol

Assessment Endpoints

The selected assessment endpoints (AE) for the site included:

- AE#1: sediment quality

- AE#2: benthic marine invertebrate community
- AE#3: aquatic biota in general

To facilitate addressing AE#1, sediment samples were collected at the site and were analyzed for constituents potentially associated with NUWC Keyport operations. To address AE#2 and to reduce uncertainty regarding extrapolation of sediment results to higher trophic level species, shellfish tissue samples were collected from the site and analyzed for constituents potentially associated with NUWC Keyport. The final assessment endpoint, AE#3, was addressed based on the HQ results developed for shellfish tissue, i.e., the comparison of site tissue concentrations with TSVs. Where HQs exceeded 1, it was concluded that there existed a potential for sediment at the site to pose a risk to aquatic biota in general.

Risk Characterization

The risk characterization for the SLERA was based on the calculation of HQs for each identified COPEC. The HQs were calculated by dividing the measured shellfish tissue concentrations by the tissue screening values (TSVs) to calculate HQs as follows:

$$HQ = \frac{\text{Tissue Concentration}}{\text{TSV}}$$

Where estimated HQs exceeded 1, it was concluded that there exists a potential for that chemical to pose an ecological risk to aquatic receptors.

The HQs for aquatic biota were less than 1 for all COPECs, except cadmium. The maximum HQ for cadmium was 22.5 (Table 7-8). The HQs for the other seven chemicals were each less than 1.

The use of TSVs provides a conservative initial screen capable of eliminating from the SLERA chemicals that do not pose significant risks to aquatic biota. However, exceedance of a TSV does not automatically imply that an observed tissue residue poses an adverse risk to biota. It does, however, identify those chemicals that may require more detailed investigation in an in-depth ecological risk assessment (Shepard 1998).

Conclusions

Based on the above results, there is a potential for cadmium in sediments to pose a risk to aquatic biota and further investigation may be warranted. Cadmium concentrations in Seep A and in sediment exceed RGs, and cadmium may be adversely affecting aquatic biota.

7.4 NEW INFORMATION

This section is in response to the question "Has any other information come to light that could call into question the protectiveness of the remedy?"

EPA is currently in the process of reassessing the solvent stabilizer chemical 1,4-dioxane. This stabilizer has been associated with some of the solvents identified as COCs in groundwater at OU 1 and OU 2, Area 8. EPA had an established advisory level for 1,4-dioxane for more than 10 years prior to the issuance of the OU 1 ROD, yet 1,4-dioxane was not identified as a COC in the ROD, and the health advisory was not identified as a "to be considered" criterion. However, the reassessment of this chemical by EPA is expected to result in a final revised chemical assessment by June 2006. When finalized, this new information should be considered when evaluating the future protectiveness of the remedy.

The chemical 1,4-dioxane is short-lived in the atmosphere, but persists in surface water and groundwater and is relatively more mobile than other solvent-related chemicals. It is not easily biodegraded or bioconcentrated (Mohr 2001).

No other information reviewed during this 5-year review, apart from what is included previously in this document, affects the protectiveness of the remedy.

7.5 TECHNICAL ASSESSMENT SUMMARY

The remedies at OU 1 and OU 2 are functioning as intended by the RODs. Concentration trends are slightly downward for most COCs in most media at most monitoring locations, indicating modest progress towards meeting RAOs. Natural attenuation processes are functioning to reduce COC concentrations, while exposures are prevented by institutional controls. COC concentration trends are tracked and evaluated through regular monitoring.

Although some of the RGs might be lower if calculated today, the remedy components continue to protect against exposures, just as they did at the time of ROD signing.

There is a potential for cadmium in sediments to pose a risk to aquatic biota at Area 8 OU 2 and further investigation may be warranted. The initial step in further investigation is an assessment of the health of aquatic biota in Liberty Bay offshore from Area 8.

New information is becoming available regarding the solvent stabilizer chemical 1,4-dioxane.

7.6 ISSUES

Table 7-9 lists the issues identified as a result of this 5-year review that appear to have the potential to affect the protectiveness of the remedies at NUWC at Keyport.

Table 7-1
Groundwater ARARs for OU 1

	Drinking Water Pathway								Surface Water Protection Pathway				
Chemical	**Current MTCA Method B Formula Value (µg/L)**	**ROD MTCA Method B Formula Value (µg/L)**	**Current Federal MCL (µg/L)**	**ROD Federal MCL (µg/L)**	**Current State MCL (µg/L)**	**ROD State MCL (µg/L)**	**ROD GW Cleanup Level (µg/L)**	**Current PQL as Applicable (µg/L)**	**Current NTR - Organisms Only (µg/L)**	**ROD Seafood Ingestion (µg/L)**	**Current MTCA Method B Value (µg/L)**	**ROD MTCA Method B Value (µg/L)**	**ROD Remediation Goal (µg/L)**
1,1-DCA	800	800	None	None	None	None	800		None	None	None	None	None
1,2-DCA	0.48	**5[a]**	5	5	5	5	5		99	99	59.4	59	59
1,1-DCE	0.073	0.073	7	7	7	7	0.5[b]	0.02	3.2	3.2	1.93	1.9	1.9
1,2-DCE (cis)	80	80	70	70	70	None	70		None	None	None	None	None
1,2-DCE (trans)	160	160	100	100	100	None	100		None	None	32,800	33,000	33,000
Tetrachloroethene	0.858	5[a]	5	5	5	None	5		8.85	8.9	4.15	4.2	4.2
1,1,1-TCA	7,200	7,200	200	200	200	200	200		None	None	417,000	41,700	41,700
TCE	3.98	5[a]	5	5	5	5	5		81	81	55.6	56	56
Vinyl chloride	0.029	0.023	2	2	2	2	0.5[b]	0.02	525	525	3.96	2.9	2.9
PCBs	0.16	0.011	0.5	0.5	0.5	None	0.04[b]	0.02-0.04	0.00017	0.000045	0.0058	0.000027	0.04[b]

[a] The ROD states that cleanup level equals drinking water MCL because it is "sufficiently protective" in accordance with Washington Administrative Code 173-340-720(3)(a). Review of Ecology Implementation Memo No. 1 indicates that the MCL for 1,2-DCA is NOT sufficiently protective.

[b] The ROD states that compliance with cleanup standards is based on the PQL. Note that the PQL has changed over time. See discussion in Section 7.2.

Source: ROD Table 11-4, Remediation Goals for Groundwater (U.S. Navy, USEPA, and Ecology 1998).

Table 7-1 (Continued)
Groundwater ARARs for OU 1

Notes:
ARARs - applicable or relevant and appropriate requirements
DCA - dichloroethane
DCE - dichloroethene
MCL - maximum contaminant level
µg/L - microgram per liter
MTCA - Model Toxics Control Act
NTR - national toxics rule
PCBs - polychlorinated biphenyls
PQL - practical quantitation limit
ROD - Record of Decision
TCA - trichloroethane
TCE - trichloroethene

Source: ROD Table 11-4 (U.S. Navy, USEPA, and Ecology 1998)

Table 7-2
Surface Water ARARs for OU 1

Chemical	Current NTR - Organisms Only (µg/L)	ROD Seafood Ingestion (µg/L)	Current MTCA Method B Value (µg/L)	ROD MTCA Method B Value (µg/L)	ROD Remediation Goal (µg/L)	PQL Value Where Applicable (µg/L)
1,1-DCA	None	None	None	None	None	
1,2-DCA	99	99	59.4	59	59	
1,1-DCE	3.2	3.2	1.93	1.9	1.9	
1,2-DCE (cis)	None	None	None	None	None	
1,2-DCE (trans)	None	None	32,800	33,000	33,000	
Tetrachloroethene	8.85	8.9	4.15	4.2	4.2	
1,1,1-TCA	None	None	417,000	41,700	41,700	
TCE	81	81	55.6	56	56	
Vinyl chloride	525	525	3.96	2.9	2.9	
PCBs	0.00017	0.000045	0.0058	0.000027	0.04[a]	0.02-0.04

[a] The ROD states that the goal is based on the PQL, which is allowed by Washington Administrative Code 173-340 if cleanup levels are below the PQL. Note, however, that the PQLs have changed since the ROD was published. See discussion in Section 7.2.

Notes:
ARARs - applicable or relevant and appropriate requirements
DCA - dichloroethane
DCE - dichloroethene
µg/L - microgram per liter
MTCA - Model Toxics Control Act
NTR - national toxics rule
PCBs polychlorinated biphenyls
PQL - practical quantitation limit
ROD - Record of Decision
TCA - trichloroethane
TCE - trichloroethene

Source: ROD Table 11-5 (U.S. Navy, USEPA, and Ecology 1998)

Table 7-3
Groundwater ARARs for OU 2 Area 8

Chemical	Current MTCA Method B Formula Value (µg/L)	ROD MTCA Method B Formula Value (µg/L)	Current Federal MCL (µg/L)	ROD Federal MCL (µg/L)	Current State MCL (µg/L)	ROD State MCL (µg/L)	ROD Cleanup Level (µg/L)
Metals							
Arsenic	0.058	0.05	10	50	10	50	0.05
Barium	1,120	1,100	2,000	2,000	2,000	1,000	1,000
Cadmium	8	8	5	5	5	10	5
Chromium III	24,000	16,000	None	None	None	None	16,000
Chromium VI	48	80	None	None	None	None	**80**
Chromium (total)	None	None	100	100	100	50	50
Copper	592	590	1,300	1,300	1,300	None	590
Lead	None	None	15	15	15	50	15
Mercury	4.8	4.8	2	2	2	2	2
Nickel	320	320	None	100	None	100	100
Silver	80	48	None	None	None	None	48
Thorium	1.12	1.1	2	2	2	None	1.1
Tin	9,600	9,600	None	None	None	None	9,600
Zinc	4,800	4,800	None	None	None	None	4,800
Cyanide	320	320	200	200	200	None	320
Volatile Organic Compounds							
Acetone	800	800	None	None	None	None	None
Benzene	0.795	1.5	5	5	5	5	5
Carbon tetrachloride	0.337	0.34	5	5	5	5	0.34
Chloroform	7.17	7.2	100	100	100	100	7.2
1,1-DCA	800	800	None	None	None	None	800
1,1-DCE	0.073	0.073	7	7	7	7	7
1,2-DCA	0.48	0.48	5	5	5	5	**5**
1,2-DCE (cis)	80	80	70	70	70	None	70
1,2-DCE (trans)	160	160	100	100	100	None	100
Ethylbenzene	800	800	700	700	700	None	700

Table 7-3 (Continued)
Groundwater ARARs for OU 2 Area 8

Chemical	Current MTCA Method B Formula Value (µg/L)	ROD MTCA Method B Formula Value (µg/L)	Current Federal MCL (µg/L)	ROD Federal MCL (µg/L)	Current State MCL (µg/L)	ROD State MCL (µg/L)	ROD Cleanup Level (µg/L)
Styrene	1.46	1.5	100	100	100	None	1.5
Tetrachloroethene	0.858	0.86	5	5	5	None	5
Toluene	1,600	1,600	1,000	1,000	1,000	None	1,000
1,1,1-TCA	7,200	720	200	200	200	200	200
1,1,2-TCA	0.768	0.77	5	5	5	None	5
TCE	3.98	4	5	5	5	5	5
Xylenes	16,000	16,000	None	10,000	None	None	10,000
Semivolatile Organic Compounds							
Butylbenzyl phthalate	3,200	3,200	None	None	None	None	3,200
Di-n-butyl phthalate	1,600	1,600	None	None	None	None	1,600
Di-n-octyl phthalate	320	320	None	None	None	None	320
Dimethyl phthalate	16,000	16,000	None	None	None	None	16,000
Bis(2-ethylhexyl)phthalate	6.25	6.3	6	6	6	None	6

Notes:

ARARs - applicable or relevant and appropriate requirements

DCA - dichloroethane
DCE - dichloroethene
MCL - maximum contaminant level
µg/L - microgram per liter
MTCA - Model Toxics Control Act
ROD - Record of Decision
TCA - trichloroethane
TCE - trichloroethene

Table 7-4
Surface Water ARARs for OU 2 Area

Chemical	Current MTCA Method B Formula Value (µg/L)	ROD MTCA Method B Formula Value (µg/L)	Current WAC 173-201A: Aquatic Life - Marine Chronic (µg/L)	ROD WAC 173-201A: Aquatic Life - Marine Chronic (µg/L)	Current National Toxics Rule: Human Health Organisms Only (µg/L)	ROD National Toxics Rule: Human Health Organisms Only (µg/L)	ROD Cleanup Level (µg/L)
Metals							
Arsenic	0.098	0.084	36	36	0.14	0.14	0.14
Barium	None	None	None	None	None	None	None
Cadmium	20.3	20	9.3	8	None	170	8
Chromium III	243,000	160,000	None	None	None	None	160,000
Chromium VI	486	810	50	50	None	None	50
Chromium (total)	None	None	None	None	None	None	None
Copper	2,660	2,700	3.1	2.5	None	None	2.5
Lead	None	None	8.1	5.8	None	None	5.8
Mercury	None	None	0.025	0.025	0.15	0.15	0.025
Nickel	1,100	1,100	8.2	7.9	4,600	4,600	7.9
Silver	25,900	16,000	1.9[a]	1.2	None	None	1.2
Thorium	1.56	1.6	None	None	6.3	6.3	1.6
Tin	None	None	None	None	None	None	None
Zinc	16,500	17,000	81	77	None	None	77
Cyanide	51,900	52,000	1[a]	1	220,000	220,000	1
Volatile Organic Compounds							
Acetone	None	None	None	None	None	None	None
Benzene	22.7	43	None	None	71	71	**71**
CCl4	2.66	2.7	None	None	4.4	4.4	4.4

Table 7-4 (Continued)
Surface Water ARARs for OU 2 Area

Chemical	Current MTCA Method B Formula Value (µg/L)	ROD MTCA Method B Formula Value (µg/L)	Current WAC 173-201A: Aquatic Life - Marine Chronic (µg/L)	ROD WAC 173-201A: Aquatic Life - Marine Chronic (µg/L)	Current National Toxics Rule: Human Health Organisms Only (µg/L)	ROD National Toxics Rule: Human Health Organisms Only (µg/L)	ROD Cleanup Level (µg/L)
Chloroform	283	280	None	None	470	470	470
1,1-DCA	None	None	None	None	None	None	None
1,1-DCE	1.93	1.9	None	None	3.2	3.2	3.2
1,2-DCA	59.4	5.9	None	None	99	99	5.9
1,2-DCE (cis)	None	None	None	None	None	None	None
1,2-DCE (trans)	32,800	33,000	None	None	None	140,000	33,000
Ethylbenzene	6,910	6,900	None	None	29,000	29,000	6,900
Styrene	None	None	None	None	None	None	None
Tetrachloroethene	4.15	4.2	None	None	8.85	8.9	8.9
Toluene	48,500	49,000	None	None	200,000	200,000	49,000
1,1,1-TCA	417,000	42,000	None	None	None	170,000	42,000
1,1,2-TCA	25.3	25	None	None	42	42	42
TCE	55.6	56	None	None	81	81	81
Xylenes	None	None	None	None	None	None	None
Semivolatile Organic Compounds							
Butylbenzyl phthalate	1,250	1,300	None	None	None	5,200	1,300
Di-n-butyl phthalate	2,900	2,900	None	None	12,000	12,000	2,900
Di-n-octyl phthalate	None	None	None	None	None	None	None
Dimethyl phthalate	72,000	72,000	None	None	2,900,000	2,900,000	72,000
Bis(2-ethylhexyl)phthalate	3.56	3.6	None	None	5.9	5.9	5.9

Table 7-4 (Continued)
Surface Water ARARs for OU 2 Area

[a] Acute exposure value; no chronic criteria provided.

Notes:

ARARs - applicable or relevant and appropriate requirements
DCA - dichloroethane
DCE - dichloroethene
MCL - maximum contaminant level
µg/L - microgram per liter
MTCA - Model Toxics Control Act
ROD - Record of Decision
TCA - trichloroethane
TCE - trichloroethene
WAC - Washington Administrative Code

Table 7-5
Surface Water Remediation Goals With Changes in Toxicity Values

Chemical	**OU 2 RG (μg/L)**	**OU 1 RG (μg/L)**	**Revised MTCA Method B Value for Surface Water Based on New Toxicity (μg/L)**	**OU 2 Health Risk or Hazard of the RG Based on New Toxicity**	**OU 1 Health Risk or Hazard of the RG Based on New Toxicity**	**Remedy Is Still Protective?**	**Reason for Toxicity Revision**
Benzene	71	Not a COC at OU 1	22.7	Cancer risk = 3×10^{-6}	Not a COC at OU 1	Yes	Previously, an inhalation slope factor of 0.029 $(mg/kg\text{-}d)^{-1}$ was used; currently, an oral slope factor of 0.055 $(mg/kg\text{-}d)^{-1}$ is available.
Chromium VI	80[a]	Not a COC at OU 1	48[a]	Hazard = 2	Not a COC at OU 1	Yes	The reference dose for this chemical was lowered in 1998.
1,1-Dichloroethene	3.2	1.9	23,150	New value is higher. Risks meet target goals.	New value is higher. Risks meet target goals.	Yes	No longer considered a carcinogen by EPA. Revised value is based on noncancer toxicity.
Tetrachloroethene	8.9	4.2	0.39	Cancer risk = 2×10^{-5}	Cancer risk = 1×10^{-5}	Yes	Oral slope factor changed from 0.051 $(mg/kg\text{-}d)^{-1}$ to 0.54 $(mg/kg\text{-}d)^{-1}$.
1,1,1-Trichloroethane	42,000	41,700	129,600	New value is higher. Risks meet target goals.	New value is higher. Risks meet target goals.	Yes	Oral reference dose changed from 0.9 mg/kg-d to 0.28 mg/kg-d.
Trichloroethene	81	55.6	1.53	5×10^{-5}	4×10^{-5}	Yes, but may need further evaluation[b]	Oral slope factor changed from 0.011 to 0.4 $(mg/kg\text{-}d)^{-1}$.

Table 7-5 (Continued)
Surface Water Remediation Goals With Changes in Toxicity Values

Chemical	OU 2 RG (µg/L)	OU 1 RG (µg/L)	Revised MTCA Method B Value for Surface Water Based on New Toxicity (µg/L)	OU 2 Health Risk or Hazard of the RG Based on New Toxicity	OU 1 Health Risk or Hazard of the RG Based on New Toxicity	Remedy Is Still Protective?	Reason for Toxicity Revision
Vinyl chloride	Not a COC at OU 2	2.92	3.7	Not a COC at OU 2	New value is higher. Risks meet target goals.	Yes	Oral slope factor changed from 1.9 to 1.5 $(mg/kg\text{-}d)^{-1}$.

[a] The chromium VI RG for OU 2 was selected for drinking water. All other RGs on this table were selected for the surface water pathway. The chromium VI surface water RG is based on protecting marine life and is lower than a value protective of human health.

[b] There are no changes necessary to the remedy. However, if the provisional trichloroethene (TCE) slope factor is finalized, it may be necessary to recalculate the RG before considering that the RG for TCE has been achieved at NUWC Keyport.

Notes:
COC - chemical of concern
EPA - U.S. Environmental Protection Agency
µg/L - microgram per liter
mg/kg-d - milligram per kilogram per day
MTCA - Model Toxics Control Act
RG - remediation goal

Table 7-6
Summary of Total Reasonable Maximum Exposure Hazards—Baseline Risk Assumptions

Chemical of Concern	Sediment		Clam Tissue		Total		
	Child HI	Adult HI	Child HI	Adult HI	Child HI	Adult HI	Toxic Endpoint in IRIS
Subsistence							
Cadmium	NE	NE	NE	0.9	NE	0.9	Renal effects
Chromium[a]	NE	NE	NE	0.3	NE	0.3	None reported
Mercury (Mercuric chloride)	NE	NE	(2)	(2)	NE	NE	Autoimmune effects
Methylmercury	NE	NE	NE	0.3	NE	0.3	CNS
Silver	NE	NE	NE	0.05	NE	0.05	Discoloration of skin
Total Hazard/Risk	NE	NE	NE	2	NE	2	
Recreational							
Cadmium	0.01	0.0004	NE	0.4	0.01	0.4	Renal effects
Chromium[a]	0.06	0.002	NE	0.1	0.06	0.1	None reported
Mercury (Mercuric chloride)	0.008	0.0002	NE	NE	0.008	0.0002	Autoimmune effects
Methylmercury	(b)	(b)	NE	0.1	NE	0.1	CNS
Silver	(b)	(b)	NE	0.02	NE	0.02	Discoloration of skin
Total Hazard/Risk	0.08	0.002	NE	0.6	0.08	0.6	

[a] It was assumed that chromium is composed of 100% Chromium VI.
[b] Chemical was not selected for further evaluation in this medium.

Notes:
CNS - central nervous system
HI - hazard index
IRIS - Integrated Risk Information System (U.S. Environmental Protection Agency's online database)
NE - not evaluated
RME - reasonable maximum exposure

Table 7-7
Summary of Total RME Hazards—Revised Risk Assumptions

Chemical of Concern	Sediment		Clam Tissue[a]		Total		
	Child HI	**Adult HI**	**Child HI**	**Adult HI**	**Child HI**	**Adult HI**	**Toxic Endpoint in IRIS**
Subsistence							
Cadmium	0.09[b]	0.007[b]	NE	0.9	0.09	0.9	Renal effects
Chromium[c]	0.4	0.03	NE	0.3	0.4	0.3	None reported
Mercury (Mercuric chloride)	0.05	0.004	(d)	(d)	0.05	0.004	Autoimmune effects
Methylmercury	(d)	(d)	NE	0.3	NE	0.3	CNS
Silver	(d)	(d)	NE	0.05	NE	0.05	Discoloration of skin
Total Hazard/Risk	0.5	0.04	NE	2	0.5	2	
Recreational							
Cadmium	0.007[e]	0.0002[e]	NE	0.1	0.01	0.1	Renal effects
Chromium[c]	0.03	0.0008	NE	0.04	0.03	0.04	None reported
Mercury (Mercuric chloride)	0.004	0.0001	(d)	(d)	0.004	0.0001	Autoimmune effects
Methylmercury	(d)	(d)	NE	0.04	NE	0.04	CNS
Silver	(d)	(d)	NE	0.01	NE	0.01	Discoloration of skin
Total Hazard/Risk	0.04	0.001	NE	0.2	0.04	0.2	

[a] These clam tissue risks are from the baseline risk assumptions shown on Table C6-1.

[b] The hazard index for cadmium exposures in sediment for the revised risk calculations includes the hazards from both the ingestion and dermal pathways. For the child receptor age, the ingestion hazard for cadmium in sediment is 0.08 and the dermal hazard for cadmium in sediment is 0.006. For the adult receptor, the ingestion hazard for cadmium in sediment is 0.006 and the dermal hazard for cadmium in sediment is 0.001.

[c] It was assumed that chromium is composed of 100% Chromium VI.

[d] Chemical was not selected for further evaluation in this medium.

[e] The hazard index for cadmium exposure in sediment for the revised risk calculations includes the hazards from both the ingestion and dermal pathways. For the child receptor age, the ingestion hazard for cadmium in sediment is 0.006 and the dermal hazard for cadmium in sediment is 0.0005. For the adult receptor, the ingestion hazard for cadmium in sediment is 0.0002 and the dermal hazard for cadmium in sediment is 0.00007.

Table 7-7 (Continued)
Summary of Total RME Hazards—Revised Risk Assumptions

Notes:
CNS - central nervous system
HI - hazard index
IRIS - Integrated Risk Information System (U.S. Environmental Protection Agency's online database)
NE - not evaluated
RME - reasonable maximum exposure

Table 7-8
Hazard Quotients for Chemicals of Potential Ecological Concern in Sediment

Chemical	Maximum Tissue Concentration (mg/kg)	Tissue Screening Value (mg/kg)	Hazard Quotient	Poses Potential Ecological Risk?	Rationale
1,2,4-Trichlorobenzene	0.0048	0.2	0.03	**NO**	Site chemical concentration less than TSV
bis(2-Ethylhexyl)phthalate	0.14	9.3	0.02	**NO**	Site chemical concentration less than TSV
Cadmium	4.536	0.2	22.2	**YES**	Site chemical concentration greater than TSV
Chromium VI	1.106	4.4	0.3	**NO**	Site chemical concentration greater than TSV
Hexachlorobenzene	0.0055	32.0	0.00017	**NO**	Site chemical concentration less than TSV
Hexachloroethane	0.005	0.0071	0.70	**NO**	Site chemical concentration less than TSV
Mercury	0.04699	2.0	0.02	**NO**	Site chemical concentration less than TSV
Phenol	0.24	1.8	0.13	**NO**	Site chemical concentration less than TSV

Notes:
mg/kg - milligram per kilogram
TSV - tissue screening value

Table 7-9
Issues

Issue	Affects Protectiveness	
	Current	**Future**
The institutional controls management plan has not yet been revised to include Site 23.	Yes	Yes
An unacceptable risk to marine biota may be present at OU 2 Area 8.	Yes	Yes
Possible upward-trending chemicals of concern concentrations in a beach seep at OU 2 Area 8 suggest the possibility of a future human health risk.	No	Yes
New information regarding 1,4-dioxane indicates that it may be a new chemical of interest at OU 1 and OU 2 Area 8.	No	Yes

Note:
OU – operable unit

8.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

This section presents the recommendations and follow-up actions identified as a result of the 5-year review process. Table 8-1 summarizes the recommendations.

Table 8-1
Recommendations and Follow-Up Actions

Recommendation/ Follow-Up Action	Party Responsible	Oversight Agency	Milestone Date	Follow-Up Action: Affects Protectiveness	
				Current	Future
Revise the institutional controls management plan to include Site 23.	U.S. Navy	Ecology	September 2005	Yes	Yes
Discontinue independent remedial action petroleum monitoring at OU 2 Area 8.	U.S. Navy	Ecology	2005	No	No
Continue long-term monitoring programs as currently established at OU 1 and OU 2, including sediment and shellfish monitoring.	U.S. Navy	Ecology	Ongoing	No	Yes
Perform further investigation of the aquatic biota in Liberty Bay offshore from OU 2 Area 8 to assess possible impacts from cadmium.	U.S. Navy	Ecology	September 2006	Yes	Yes
During the next 5-year review, assess the protectiveness of the remediation goal for TCE, considering the final revised value for the TCE oral slope factor.	U.S. Navy	Ecology	September 2005	No	Yes
Consider assessing the presence of absence of 1,4-dioxane in groundwater at OU 1 and OU 2 Area 8	U.S. Navy	Ecology	September 2010	No	Yes

Notes:
Ecology - Washington State Department of Ecology
OU – operable unit
TCE - trichloroethene

9.0 CERTIFICATION OF PROTECTIVENESS

The remedy implemented at OU 1, NUWC Keyport, is expected to be protective of human health and the environment once intrinsic biodegradation, with possible assistance from phytoremediation, degrades contaminant concentrations to below RGs. In the interim, exposure pathways that could result in unacceptable risks are being controlled and monitored. The conditions and COC concentrations found today in the landfill, marsh, and downstream receptors are similar to those at the time of the ROD, when those conditions were found to not pose unacceptable risks to human health and the environment as long as exposures were controlled. Future protectiveness will be assessed based on continued monitoring of COC concentrations and trend analysis.

The remedy implemented at OU 2 Area 2, NUWC Keyport, is expected to be protective of human health and the environment once natural attenuation degrades contaminant concentrations to below RGs. In the interim, exposure pathways that could result in unacceptable risks are being controlled and monitored. The conditions and COC concentrations found today in groundwater are similar to those at the time of the ROD, when those conditions were found to not pose unacceptable risks to human health and the environment, as long as exposures were controlled. Future protectiveness will be assessed based on continued monitoring of COC concentrations and trend analysis.

An ecological protectiveness determination for the remedy at OU 2 Area 8, NUWC Keyport, cannot be made until further information is obtained regarding the condition of the intertidal community. Further information will be obtained by assessing the health of aquatic biota in Liberty Bay offshore from Area 8.

The OU 2, Area 8 remedy is currently protective of human health, as shown by the risk assessment performed during this 5-year review, in combination with the protectiveness determinations at the time of the OU 2 ROD. In order for the remedy to be protective of human health in the long term, the COC concentration trends must be monitored and any increasing concentrations trends must be evaluated and addressed.

10.0 NEXT REVIEW

The next 5-year review is tentatively scheduled for 2010.

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APPENDIX A

Site Inspection Form

Site Inspection Checklist

I. SITE INFORMATION

Site name: *NUWC, Division Keyport*	**Date of inspection:** *October 6, 2004*
Location and Region: *Keyport, WA, Region 10*	**EPA ID:** *110001920075*
Agency, office, or company leading the five-year review: *US Navy, URS Corporation*	**Weather/temperature:**

Remedy Includes: (Check all that apply)

☒ Landfill cover/containment
☒ Access controls
☒ Institutional controls
☐ Groundwater pump and treatment
☐ Surface water collection and treatment
☐ Monitored natural attenuation
☐ Groundwater containment
☐ Vertical barrier walls
☒ Other *Phytoremediation; Sediment and soil removal; tide gate upgrade; groundwater, sediment, and shellfish monitoring; contingent actions*

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **Navy Staff**

Contact *Barbara Chafin-Tissier* *IR Program Coordinator – NBK*
Name Title
Problems; suggestions; ☒ Report attached ____________________

Contact *Douglas Thelin* *Remedial Project Manager – EFA NW*
Name Title
Problems; suggestions; ☒Report attached ____________________

Contact *Diane Jennings* *Public Affairs Officer – NUWC Keyport*
Name Title
Problems; suggestions; ☒ Report attached ____________________

Contact *Carl Haselman* *NUWC Keyport Environmental Department*
Name Title
Problems; suggestions; ☐ Report attached *No response*

Contact *Jerry Gray* *NUWC Keyport Facilities Engineering*
Name Title
Problems; suggestions; ☐ Report attached *No response*

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2. **O&M/LTM Contractor** *The Environmental Company*
Name
Interviewed ☐ at site ☐ at office ☐ by phone
Problems, suggestions; ☐ Report attached *No response to interview request – reports reviewed.*

---

3. **Regulatory and Tribal authorities and response agencies**

Agency *Suquamish Tribe*
Contact *Denice Taylor* *Environmental Scientist*
Name Title
Problems; suggestions; ☒ Report attached

Agency *Washington State Department of Ecology*
Contact *Chung Ki Yee* *Project Manager*
Name Title
Problems; suggestions; ☒ Report attached

Agency *U.S. EPA*
Contact *Nancy Harney*
Name
Problems; suggestions; ☐ Report attached *No Response*

Agency *Kitsap County Health*
Contact *Bill Lum*
Name
Problems; suggestions; ☐ Report attached *No Response*

4. **Members of the public**

Contact (b) (6)
Name
Problems; suggestions; ☐ Report attached *Has passed away*

Contact (b) (6)
Name
Problems; suggestions; ☐ Report attached *No Response*

Contact (b) (6)
Name
Problems; suggestions; ☒ Report attached

Contact (b) (6)
Name Date Phone no.
Problems; suggestions; ☐ Report attached *No response*

5. **Other interviews** (optional) ☐ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Records**

☐ O&M manual	☐ Readily available	☐ Up to date	☐ N/A
☒ As-built drawings	☒ Readily available	☒ Up to date	☐ N/A
☐ Maintenance logs	☐ Readily available	☐ Up to date	☐ N/A

Remarks *O&M Manual not on site at OU 1. Recent maintenance logs not on site.*

2. **Institutional Controls Inspection Records** ☒ Readily available ☒ Up to date
Remarks *Records and reports being sent to agencies yearly*

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☒ Contractor for Federal Facility
☐ Other

2. **O&M Cost Records**

☒ Readily available ☒ Up to date
☒ Funding mechanism/agreement in place
Original O&M cost estimate *$251,552* ☐ Breakdown attached

Total annual cost by year for review period if available

From	Date	To	Date	Total cost	
From	*FY 2000*	To	___________	*$309,447*	☐ Breakdown attached
From	*FY 2001*	To	___________	*$403,763*	☐ Breakdown attached
From	*FY 2002*	To	___________	*$342,302*	☐ Breakdown attached
From	*FY 2003*	To	___________	*$188,391*	☐ Breakdown attached
From	*FY 2004*	To	___________	*$256,876*	☐ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: *None*

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. OU 1

1. **Access to landfill and plantations controlled?** ☒ Yes ☐ No
Remarks *Base is secure at main gate, plantations are separately fenced.*

2. **Groundwater wells installed?** ☐ Yes ☒ No
Remarks______________________________

3. **Any activities that could interfere with remedy or monitoring?** ☐ Yes ☒ No
Remarks______________________________

4. **Any permanent workers on landfill?** ☐ Yes ☒ No
Remarks______________________________

5. **Any digging in landfill without dig permit?** ☐ Yes ☒ No
Remarks *No evidence of digging observed. IC report indicates no unpermitted digging.*

6. **Any disturbance to wetlands?** ☐ Yes ☒ No
Remarks______________________________

B. OU 2

1. **Access to Areas 2 and 8 controlled?** ☒ Yes ☐ No
Remarks *Base is secure at main gate. Water patrols along shoreline.*

2. **Groundwater wells installed?** ☐ Yes ☒ No
Remarks *Per IC inspection.*

3. **Any digging without dig permit?** ☐ Yes ☒ No
Remarks *Per IC inspection.*

4. **Any residential development?** ☐ Yes ☒ No
Remarks

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs properly implemented ☒ Yes ☐ No
Site conditions imply ICs being fully enforced ☒ Yes ☐ No

Type of monitoring (*e.g.*, self-reporting, drive by) *Self-inspected by Navy*
Frequency *Yearly*
Responsible party *IR Program coordinator - NBK*
Contact *Barbara Chafin-Tissier*
Name

Reporting is up-to-date ☒ Yes ☐ No

Specific requirements in decision documents have been met ☒ Yes ☐ No
Violations have been reported ☐ Yes ☒ No
Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks

VI. REMEDY COMPONENTS

A. Paved Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident
Areal extent______________ Depth____________
Remarks____
____

2. **Cracks** ☐ Location shown on site map ☒ Cracking not evident
Lengths____________ Widths___________ Depths__________
Remarks____
____

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
Areal extent______________ Depth____________
Remarks____
____

4. **Holes** ☐ Location shown on site map ☒ Holes not evident
Areal extent______________ Depth____________
Remarks____
____

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established ☐ No signs of stress
☒ Trees/Shrubs (indicate size and locations on a diagram)
Remarks *See phyotoremediation below*

6. **Alternative Cover (armored rock, concrete, etc.)** ☒ N/A
Remarks____
____

7. **Bulges** ☐ Location shown on site map ☒ Bulges not evident
Areal extent______________ Height____________
Remarks____
____

8. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent______________
☐ Ponding ☐ Location shown on site map Areal extent______________
☐ Seeps ☐ Location shown on site map Areal extent______________
☐ Soft subgrade ☐ Location shown on site map Areal extent______________
Remarks____
____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Areal extent______________
Remarks____
____

10. **Monitoring Wells** (within surface area of landfill)
☒ Properly secured/locked ☒Functioning ☒ Routinely sampled ☒ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks *Per ongoing monitoring reports*
____

B. Surface Water Structures at Paved Landfill

1. **Siltation** ☐ Location shown on site map ☒ Siltation not evident
Areal extent______________ Depth____________
Remarks____
____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
☒ Vegetation does not impede flow
Areal extent______________ Type____________
Remarks *Bioswales recently revegetated.*
____

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
Areal extent______________ Depth____________
Remarks____
____

4. **Discharge Structure** ☒ Functioning ☐ N/A
Remarks____
____

C. Phytoremediation

1. **Condition of Trees** ☐ Excellent health ☒ Some apparent health stress
☐ Severe stress observed
Area of most stress____
Remarks *Some rust on leaves – being addressed by Navy.*
____

2. **Performance Monitoring**
Type of monitoring *Water levels, surface and groundwater sampling, tree health*

Frequency *Spring and fall sampling, quarterly water levels, monthly health inspections*

Remarks____
____

3. **Effectiveness**

☐ Data indicate effective uptake and metabolism of COCs

☐ Data indicate not effective

☒ Data inconclusive
Remarks *Effects may not yet be evident because of youth of plantations*

D. Groundwater, Sediment, and Shellfish Monitoring

1. **Monitoring Wells**
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks *Per ongoing monitoring reports*

2. **Monitoring**
Types of monitoring being conducted:
☒ Groundwater (OU 1 and OU 2) ☒ Sediment (OU 2 Area 8) ☒ Shellfish (OU 2 Area 8)

Frequency *Groundwater in spring, sediment and shellfish every five years*

Remarks

3. **Data Trends**

Describe results and trends: *Inconclusive*

E. Other Remedy Components

1. Soil and Sediment excavations ☒ Completed ☐ Not Completed

2. Contingent Remedial Action Plan ☒ Completed ☐ Not Completed

3. Tide Gate Upgrade ☒ Completed ☐ Not Completed

VII. OVERALL OBSERVATIONS

A. **Implementation of the Remedy**

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).
See text

B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. *See text*
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. *None*
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. *See Text*

APPENDIX B

Interview Responses

INTERVIEW RECORD FOR SECOND FIVE-YEAR REVIEW
June 2000 through September 2005
Type 1 Interview – Navy Personnel
Naval Undersea Warfare Center, Division Keyport
Keyport, Washington

Individual Contacted:	**Barbara Chafin-Tissier**
Telephone:	**360.396.5094**
E-mail:	**barbara.chafin@navy.mil**
Contact made by:	**Susan King**
Response type:	**Emailed questionnaire**
Date:	**Sept. 30, 2004**

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your degree of familiarity with the Naval Undersea Warfare Center, Division Keyport, the Records of Decision (RODs) for OUs 1 and 2, the implementation of the remedies at these OUs, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since June 2000.

   Response: I have been working in the IR program for a year now and I am somewhat familiar with all of the above. I have not read the entire ROD, but am familiar with the remedies and LTM. I began work in the IR Program for NUWC in mid 2003.

2. What is your overall impression of the on-going effectiveness of the components of the OU 1 remedy? For reference, the remedy components included:
   - Phytoremediation at the former landfill using hybrid poplar trees
   - Removal of PCB-contaminated sediments from the marsh
   - Upgrade of the tide gate
   - Upgrade and maintenance of the landfill cover
   - Long-term monitoring
   - Contingent actions for off-base domestic wells
   - Institutional controls

   Response: Overall there are no findings that show that phytoremediation is affecting the groundwater flow and gradient. The trees are healthy despite several pest infestations, due to good controls. Most wells have

decreasing trends for the three target VOCs, also surface water continue to show decreasing trends.

Removal of sediments from the marsh and upgrade of tide gate were completed as required. Tide gate is working well as of last inspection.

The upgrade and maintenance of the landfill cover went well, only a few minor corrections were needed before recent completion.

Long term monitoring is on schedule and producing good results, with decreasing trends continuing and Institutional Controls are in place and working as planned.

3. What is your overall impression of the on-going effectiveness of the components of the OU 2 remedy? For reference, the remedy components included:
   - Institutional controls and groundwater monitoring at Area 2
   - Excavation and off-site disposal of vadose-zone soil at Area 8
   - Institutional controls and monitoring of groundwater, sediments, and shellfish at Area 8.

   Response: For Area 2, trend analyses at LTM wells indicate that target VOCs have decreased. COCs have also declined. Institutional controls are being performed by me and are being reported out as required with no findings to date.

   Institutional controls and monitoring are being conducted at Area 8 as required. Target VOCs in GW have been declining, except TCE and PCE. Biodegrations of the later have been slow. Cadmium and Chromium concentrations have been declining in most samples. In general, the water quality in Liberty Bay is improving relative to the remedial actions implemented. My impression is that it is going to be a very slow process that will need continual monitoring, as we have been doing.

4. Are you aware of any violations of the institutional controls requirements at any of the OUs that could impact the protectiveness of this component of the remedies (e.g., unauthorized excavation, unauthorized use of groundwater)?

   Response: No, I have done the IC inspections myself and there have been no violations.

5. To the best of your knowledge, are regular inspections of the institutional controls remedy components being conducted and documented?

   Response: Yes, I conduct these and they are reported as required.

6. To the best of your knowledge, has the on-going environmental monitoring performed at both the OUs since June 2000 been sufficiently thorough and frequent to meet the goals of the RODs? Have the monitoring data been timely and of acceptable quality?

   Response: Yes, the monitoring has been performed and sufficient. Data has been of good quality. The RPM is very capable and experienced and does an excellent job managing the sites as required.

7. Do you know of any significant operation and maintenance difficulties with the phytoremediation or tide gate components of the OU 1 remedy that could have impacted the protectiveness of these components of the remedy?

   Response: Difficulties with pest infestations have been dealt with in a timely manner and healthy trees indicate the precautions taken have been sufficient. The tide gate installed in 1998 is working as intended and in good condition, according to the inspections completed to date. Maintenance done during the last inspection included removal of barnacles and painting.

8. The phytoremediation component of the OU 1 remedy was not expected to become effective until the trees matured. What is your impression of the effectiveness of this remedy component now that the trees have been growing for more than 5 years?

   Response: Although the trees have matured, there is still not evidence that the trees are being as effective as was hoped.

9. The US Geologic Survey (USGS), on behalf of the Navy, has been conducting intrinsic bioremediation studies at OU 1 to assess the effects of phytoremediation on intrinsic bioremediation. Monitored natural attenuation was also listed in the OU 1 ROD as a potential “fallback” remedy if phytoremediation is determined to be ineffective. Based on your knowledge of the USGS studies, what is your opinion of the effectiveness of intrinsic bioremediation in protecting human health and the environment at OU 1?

   Response: I haven’t studied this enough to answer.

10. Are you aware of any community concerns regarding implementation of the remedies either OU? If so, please give details.

    Response: No, as a matter of fact, the RAB members are proud of their accomplishments and the Navy’s accomplishments. They are considering the disestablishment of the RAB at the next scheduled RAB meeting in October.

11. Do you have any overall comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at NUWC, Division Keyport?

    Response: Overall I believe that the Navy has done a good job implementing the remedies at all of these sites and has taken a pro-active approach to ensure the remedial actions are completed. All of the people that I have worked with in the Installation Restoration Program are very professional and are doing a good job.

INTERVIEW RECORD FOR SECOND FIVE-YEAR REVIEW
June 2000 through September 2005
Type 3 Interview – Community Member
Naval Undersea Warfare Center, Division Keyport
Keyport, Washington

Individual Contacted: (b) (6)
Organization: **Keyport Improvement Club**
Telephone: (b) (6)
E-mail: **--**
Address: (b) (6)
Keyport, WA 98345

Contact made by: **Susan King**
Response type: **Mailed questionnaire**
Date: **October 8, 2004**

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your degree of familiarity with the Naval Undersea Warfare Center, Division Keyport, the Records of Decision (RODs) for OUs 1 and 2, the implementation of the remedies at these OUs, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since June 2000.

   Response: I was the initial community representative when the group was called the Technical Review Committee in 1989. I have been with the RAB since its inception. There have been times when I have been inactive—1992–93 and 2001 til now, during which I attended only one meeting. At each of the stages of monitoring, reporting, and decisions, I have been instrumental in assuring the community of Keyport was aware through the Keyport Improvement Club meetings.

2. What is your overall impression of the on-going protectiveness of the remedies at NUWC, Division Keyport?

   Response: My impression is that the Navy is striving to satisfy the remedial needs. The different remedies, whether soil removal for the plating shop or removal of PCBs near the outlet, have been very protective. Though phytoremediation is a new concept, I feel it is adequate for what needs to take place.

3. Do you feel well informed about the remediation activities and progress at NUWC, Division Keyport? Please elaborate.

   Response: Diane Jennings and her staff have kept the community up to date on findings and evaluations. May it ever remain so. The town of Keyport has been interested in the whole process. When there was second guessing taking place about the landfill, the people wanted monitoring and accurate definition of contaminants.

4. What effects on the community have you observed as a result of on-going remedy implementation?

   Response: Not knowing breeds anxiety. Information that is accurate assures solutions most will live with contentedly. I believe we are proud to have obtained this level of completeness.

5. Are you aware of any community concerns regarding implementation of the remedies? If so, please give details.

   Response: We love our poplar trees. When RAB experts question the science, I have to agree. We questioned the engineered solutions. Natural attenuation seemed a cop-out. Capping in a wetland area seemed a shame. I feel we may question the science long after the VOCs are dissipated.

6. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented so far in protecting human health and the environment at NUWC, Division Keyport?

   Response: We would like a copy of the first five-year review. The community of Keyport has been a repository in that my bookshelves ran out of room long ago. I passed the books. (I believe they are still in the fire station.)

INTERVIEW RECORD FOR SECOND FIVE-YEAR REVIEW
June 2000 through September 2005
Type 1 Interview – Navy Personnel
Naval Undersea Warfare Center, Division Keyport
Keyport, Washington

Individual Contacted:	**Diane Jennings**
Title:	**Public Affairs Officer**
Organization:	**NUWC Division, Keyport**
Telephone:	**360.396.2699**
E-mail:	**jenningsdm@kpt.nuwc.navy.mil**
Contact made by:	**Susan King**
Response type:	**Emailed questionnaire**
Date:	**October 15, 2004**

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate “none” after “response.”

1. Please describe your degree of familiarity with the Naval Undersea Warfare Center, Division Keyport, the Records of Decision (RODs) for OUs 1 and 2, the implementation of the remedies at these OUs, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since June 2000.

   Response: In the time of remedial investigation through the implementation of the alternatives at OU 1 and OU 2, I was the coordinator for NUWC Keyport and Navy Co-Chair for the RAB. I’m familiar with the remedies, and have discussed them with many people many times over the years, but not expert on the regulatory details. I left the environmental staff in May 2000. Since that time, I have continued with the project only as the Navy’s Co-Chair for the RAB. I’ve attended all RAB meeting, and approve the final minutes which describe the actions. Also, around that time, a MOA was signed with SUBASE Bangor (now Naval Base Kitsap) that they would take over responsibility for the management of the OU’s, so Keyport no longer has that responsibility.

   What is your overall impression of the on-going effectiveness of the components of the OU 1 remedy? For reference, the remedy components included:

   - Phytoremediation at the former landfill using hybrid poplar trees – **I’m hearing from the last few years of sampling that phytoremediation has**

not performed as well as anticipated for groundwater cleanup of VOCs. However, due to groundwater direction flow and the location of private wells, I do not believe that there is a threat to the community or the environment.

- Removal of PCB-contaminated sediments from the marsh **– Adequate.**
- Upgrade of the tide gate - **Adequate.**
- Upgrade and maintenance of the landfill cover – **Current landfill cover is a few years old now, and is well maintained, and likely prevents influx of rainwater into the covered soils.**
- Long-term monitoring **– This continues on an annual basis, with shell fish monitored every five years. This seems to be adequate.**
- Contingent actions for off-base domestic wells **– Adequate.**
- Institutional controls **– The ICP is adequate and is being maintained by Naval Base Kitsap Bangor personnel.**

Response: See bolded response after each bulleted item above.

2. What is your overall impression of the on-going effectiveness of the components of the OU 2 remedy? For reference, the remedy components included:
   - Institutional controls and groundwater monitoring at Area 2.
   - Excavation and off-site disposal of vadose-zone soil at Area 8.
   - Institutional controls and monitoring of groundwater, sediments, and shellfish at Area 8.

   Response: Each component seems to be adequate.

3. Are you aware of any violations of the institutional controls requirements at any of the OUs that could impact the protectiveness of this component of the remedies (e.g., unauthorized excavation, unauthorized use of groundwater)?

   Response: No.

4. To the best of your knowledge, are regular inspections of the institutional controls remedy components being conducted and documented?

   Response: Yes.

5. To the best of your knowledge, has the on-going environmental monitoring performed at both the OUs since June 2000 been sufficiently thorough and frequent to meet the goals of the RODs? Have the monitoring data been timely and of acceptable quality?

   Response: Yes to both questions.

6. Do you know of any significant operation and maintenance difficulties with the phytoremediation or tide gate components of the OU 1 remedy that could have impacted the protectiveness of these components of the remedy?

   Response: No.

7. The phytoremediation component of the OU 1 remedy was not expected to become effective until the trees matured. What is your impression of the effectiveness of this remedy component now that the trees have been growing for more than 5 years?

   Response: The trees look healthy, but my understanding is that they are not as effective as we had thought they would be.

8. The US Geologic Survey (USGS), on behalf of the Navy, has been conducting intrinsic bioremediation studies at OU 1 to assess the effects of phytoremediation on intrinsic bioremediation. Monitored natural attenuation was also listed in the OU 1 ROD as a potential “fallback” remedy if phytoremediation is determined to be ineffective. Based on your knowledge of the USGS studies, what is your opinion of the effectiveness of intrinsic bioremediation in protecting human health and the environment at OU 1?

   Response: I haven’t been directly involved for such a long time, but my impression when I departed the Environmental staff in 2000, and some data discussions since, is that natural attenuation is occurring and has been measurable over time. If this is continuing, it seems adequate to me - Especially since the landfill poses no risk to the community or the environment in its present condition.

9. Are you aware of any community concerns regarding implementation of the remedies either OU? If so, please give details.

   Response: No. The community was pleased with the efforts of the phase 2 RI on OU 1 and the resulting remedies that were put in place. And they seem satisfied with the work done on OU 2 as well. I visited the Keyport Improvement Club on 12 October, and invited them to our next RAB meeting, and there were no concerns stated by the community.

10. Do you have any overall comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at NUWC, Division Keyport?

    Response: I believe with the existing site conditions and the actions taken to date that they are adequate for all areas at both OUs.

INTERVIEW RECORD FOR SECOND FIVE-YEAR REVIEW
June 2000 through September 2005
Naval Undersea Warfare Center, Division Keyport
Keyport, Washington

Individual Contacted:	**Denice Taylor**
Title:	**Environmental Scientist**
Organization:	**Suquamish Tribe**
Telephone:	**360.394.8449**
E-mail:	**dtaylor@suquamish.nsn.us**
Address:	**PO Box 498** **Suquamish, WA 98392-0498**
Contact made by:	**Susan King**
Response type:	**Emailed questionnaire**
Date:	**September 30, 2004**

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your degree of familiarity with the Naval Undersea Warfare Center, Division Keyport, the Records of Decision (RODs) for OUs 1 and 2, the implementation of the remedies at these OUs, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since June 2000.

   Response: I am familiar with the CERCLA administrative records for OUs 1 and 2, and am involved in the review of long term monitoring reports. I have been the Suquamish Tribe's representative on these sites since October 2002. Prior to October 2002, Scott Pozarycki and/or Rich Brooks represented the Tribe's priorities and interests.

2. What is your overall impression of the on-going effectiveness of the components of the OU 1 remedy? For reference, the remedy components included:
   - Phytoremediation at the former landfill using hybrid poplar trees
   - Removal of PCB-contaminated sediments from the marsh
   - Upgrade of the tide gate
   - Upgrade and maintenance of the landfill cover
   - Long-term monitoring
   - Contingent actions for off-base domestic wells
   - Institutional controls

Response: Overall, the OU 1 remedy components appear to have been implemented as intended. However, it is not apparent from existing data if or when the remedial action objectives specified in the ROD will be achieved. Although some decreasing trends have been noted, long-term monitoring results indicate that contaminants exceeding remediation goals are still present in most environmental media. Because 2004 sediment and tissue sample data are not yet available for review, it is not possible to fully assess the effectiveness of the actions to date.

3. What is your overall impression of the on-going effectiveness of the components of the OU 2 remedy? For reference, the remedy components included:
   - Institutional controls and groundwater monitoring at Area 2
   - Excavation and off-site disposal of vadose-zone soil at Area 8
   - Institutional controls and monitoring of groundwater, sediments, and shellfish at Area 8.

   Response: OU 2 remedy components, including institutional controls, excavation and disposal of soil and monitoring appear to have been implemented as intended. Although trend analysis indicates concentrations are generally consistent or decreasing, long-term monitoring results show that contaminants continue to migrate from Area 8. Because 2004 sediment and tissue data are not yet available for review, it is not possible to fully assess if the measures taken, specifically for Area 8, are protective of the environment or human health, considering exposure via subsistence seafood consumption.

4. Do you feel well informed about the remediation activities and progress at NUWC, Division Keyport? Please elaborate.

   Response: I feel informed about the remediation activities and progress at NUWC, Division Keyport, although there sometimes seem to be delays in the release of monitoring reports.

5. What effects have on-going remedy implementation had on the Tribe and the surrounding community?

   Response: The site is within the usual and accustomed fishing area of the Suquamish Tribe and, by treaty, the Tribe retains traditional access and harvest rights. The presence of contamination can serve to limit the Tribe's ability to safely gather and consume resources from the area. On-going remedial actions and monitoring are important steps in helping to restore resources.

6. Are you aware of any Tribal or other community concerns regarding implementation of the remedies? If so, please give details.

Response: The 5-year review process should incorporate Suquamish consumption survey data in the review of risk assessment exposure scenarios and the evaluation of protectiveness. The review should also include estimations for meeting RAOs and remediation goals, or recommendations for additional actions.

7. The phytoremediation component of the OU 1 remedy was not expected to become effective until the trees matured. What is your impression of the effectiveness of this remedy component now that the trees have been growing for more than 5 years?

   Response: Phytoremediation has not yet had a demonstrated affect on groundwater levels, flow patterns or contaminant concentrations. However, according to long-term monitoring reports, the trees were only deemed established and reaching maturity in 2002. It seems that additional monitoring is necessary to adequately evaluate the effectiveness of this remedy.

8. The US Geologic Survey (USGS), on behalf of the Navy, has been conducting intrinsic bioremediation studies at OU 1 to assess the effects of phytoremediation on this remediation mechanism. Monitored natural attenuation was also listed as a potential alternative to phytoremediation in the OU 1 ROD. Based on your knowledge of the USGS studies, what is your opinion of the effectiveness of intrinsic bioremediation in protecting human health and the environment at OU 1?

   Response: Intrinsic bioremediation, as measured by the potential for reductive dechlorination, appears to be an effective remediation mechanism, especially in the upper aquifer at OU 1. However, the most recent results indicate that conditions in the upper aquifer may be changing to be less reductive. The long-term effectiveness of this alternative needs to be more fully addressed in the 5-year review.

9. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented so far in protecting human health and the environment at NUWC, Division Keyport?

   Response: Please refer to previous comments regarding the assessment of human health risks associated with subsistence seafood consumption and the inclusion of estimated times for meeting RAOs and remediation goals. Any evaluations or assessments regarding subsistence seafood consumption should actively involve the Suquamish Tribe, and the Tribe should continue to be involved in site review and management processes.

   Additional comments may be submitted once the 2004 sediment and tissue results are available for review and/or in the Five-Year Review process.

INTERVIEW RECORD FOR SECOND FIVE-YEAR REVIEW
June 2000 through September 2005
Type 1 Interview – Navy Personnel
Naval Base Kitsap - Keyport
Keyport, Washington

Individual Contacted:	**Douglas Thelin**
Title:	**RPM**
Organization:	**EFA NW**
Telephone:	**360.396.0206**
E-mail:	**douglas.thelin@navy.mil**
Address:	

Contact made by:	**Susan King**
Response type:	**Email**
Date:	**September 8, 2004**

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your degree of familiarity with the Naval Base Kitsap - Keyport, the Records of Decision (RODs) for OUs 1 and 2, the implementation of the remedies at these OUs, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since June 2000.

   Response: I was assigned to be the Navy Remedial Project Manager for the Keyport Site in the Fall of 2002. I am responsible for ensuring the actions in the RODs are carried out so am very familiar with the base, the RODs and the monitoring and maintenance that has occurred since the Fall of 2002.

2. What is your overall impression of the on-going effectiveness of the components of the OU 1 remedy? For reference, the remedy components included:
   - Phytoremediation at the former landfill using hybrid poplar trees
   - Removal of PCB-contaminated sediments from the marsh
   - Upgrade of the tide gate
   - Upgrade and maintenance of the landfill cover
   - Long-term monitoring
   - Contingent actions for off-base domestic wells
   - Institutional controls

Response:

Phytoremediation: I don't think that the trees are mature enough to be fully effective in remediating the groundwater.

Removal of PCB-contaminated sediments: The removal has been effective.

Upgrade the tide gate: This has been effective so long as the tide gate has been maintained. A quarterly inspection and maintenance program for the tide gate was initiated in 2003.

Upgrade and maintenance of the landfill cover. Upgrade of the landfill cover was completed in the summer of 2003 and is effective.

Long-term monitoring: Effective

Contingent actions: Effective, no off base domestic water wells have been contaminated.

Institutional controls: Effective, actions prohibited by the institutional controls have not occurred.

3. What is your overall impression of the on-going effectiveness of the components of the OU 2 remedy? For reference, the remedy components included:
   - Institutional controls and groundwater monitoring at Area 2
   - Excavation and off-site disposal of vadose-zone soil at Area 8
   - Institutional controls and monitoring of groundwater, sediments, and shellfish at Area 8.

   Response: The OU 2 remedies appear to be effective.

4. Are you aware of any violations of the institutional controls requirements at any of the OUs that could impact the protectiveness of this component of the remedies (e.g., unauthorized excavation, unauthorized use of groundwater)?

   Response: No, I'm not aware of any violations of the institutional controls.

5. To the best of your knowledge, are regular inspections of the institutional controls remedy components being conducted and documented?

   Response: Yes, Naval Base Kitsap inspects the institutional control plan remedy components annually using the checklists in the "Institutional Controls Plan."

6. To the best of your knowledge, has the on-going environmental monitoring performed at both the OUs since June 2000 been sufficiently thorough and frequent to meet the goals of the RODs? Have the monitoring data been timely and of acceptable quality?

   Response: Yes, I think that the on-going environmental monitoring has been sufficiently thorough and frequent to meet the goals of the RODs. Monitoring data has been timely and of acceptable quality.

7. Do you know of any significant operation and maintenance difficulties with the phytoremediation or tide gate components of the OU 1 remedy that could have impacted the protectiveness of these components of the remedy?

   Response: The trees used in the phytoremediation component of the remedy have been stressed by infestations of pests such as tent caterpillars, borers, and aphids, as well as by hot dry summer conditions but we have been able to counteract these with pest control measures and irrigation.

   The tide gate was not maintained for several years and became encrusted with barnacles, and mussels which inhibited the tide gate's operation. The landfill does not exhibit erosion due to the tide gate's inhibited function. Since 2003, we have implemented quarter inspections and maintenance to insure the tide gate functions properly.

8. The phytoremediation component of the OU 1 remedy was not expected to become effective until the trees matured. What is your impression of the effectiveness of this remedy component now that the trees have been growing for more than 5 years?

   Response: I think that it is too early to expect phytoremediation to be fully effective as the trees have not reached their fully mature size. The OU-1 ROD recognizes that the mass flux of contaminants from the landfill will not be reduced by phytoremediation in the early years of phytoremediation's implementation. I think we are still in the early years of phytoremeditation.

9. The US Geologic Survey (USGS), on behalf of the Navy, has been conducting intrinsic bioremediation studies at OU 1 to assess the effects of phytoremediation on intrinsic bioremediation. Monitored natural attenuation was also listed in the OU 1 ROD as a potential "fallback" remedy if phytoremediation is determined to be ineffective. Based on your knowledge of the USGS studies, what is your opinion of the effectiveness of intrinsic bioremediation in protecting human health and the environment at OU 1?

Response: Based upon my discussions with Mr. Dinicola of USGS and reviews of the analytical results from OU-1, I think intrinsic bioremediation is very effect at OU-1 as it reduces the high VOC concentrations found in the aquifer in the "hot spots" to much lower concentrations when the groundwater discharges to the adjacent surface water.

10. Are you aware of any community concerns regarding implementation of the remedies either OU? If so, please give details.

    Response: I have not heard or seen any concerns regarding implementation of the remedies at either OU.

11. Do you have any overall comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at Naval Base Kitsap - Keyport?

    Response: No further comments at this time.

INTERVIEW RECORD FOR SECOND FIVE-YEAR REVIEW
June 2000 through September 2005
Type 4 Interview – Navy Contractor Personnel
Naval Base Kitsap - Keyport
Keyport, Washington

Individual Contacted:	**Bernie Wong**
Title:	**Project Manager**
Organization:	**CH2M Hill**
Telephone:	**425-453-5005 ext. 5378**
E-mail:	**bwong3@ch2m.com**
Contact made by:	**Susan King**
Response type:	**Written**
Date:	**September 10, 2004**

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate "none" after "response."

1. Please describe your involvement in implementing, operating, maintaining, and monitoring the remedy components for Operable Units (OUs) 1 and 2 at Naval Base Kitsap - Keyport since June 2000.

   Response: I am the project manager under the EFA NW LTM Contract (Prime Contractor: The Environmental Company) who have been managing the LTM programs for NUWC Keyport OU 1 and OU 2 since June 2000.

2. For the OUs at which you are conducting monitoring, has the monitoring performed since June 2000 been sufficiently thorough and frequent to meet the goals of the RODs? What are the trends or other overall results of the monitoring that you have conducted?

   Response: Yes, the ROD LTM requirements have been fully implemented at OU 1 and OU 2 under the Navy LTM Program since June 2000. The overall contaminant trends at OU 1 have been declining, although VOC concentrations at the south hot spot (especially at MW1-4) have shown variations over the years. Although target VOCs have been consistently detected at the upgradient end of the Marsh Pond (at MA-12), no target VOC exceedence has ever been detected at Dogfish Bay (DB-14), where the Marsh Pond water is discharged into.

At OU 2, the source area wells within the former Plating Shop area still have had VOCs and metals above the remediation goals, and some of these compounds were also detected at the two seeps on the beach bordering OU 2 in low concentrations.

We have seen decreases in chemical contaminations found in the shellfish samples at both OU1 and OU 2.

3. For the remedy component(s) that you operate and maintain, what is the frequency and staffing of site inspections and maintenance?

   Response: We have been maintaining the two plantations and the tidegate at OU 1 since 2003. Eight inspection events (6 monthly events during the growing season) were conducted at the two plantations every year, and numerous scheduled and unscheduled maintenance events were conducted at the plantations throughout the year.

   Quarterly inspection and maintenance events have been conducted at the tidegate since 2003.

4. Do you know of any significant operation and maintenance difficulties with the tide gate or with phytoremediation that could have impacted the protectiveness of these components of the remedies?

   Response: None.

5. Do you have any recommendations for optimizing the tide gate operation, or for optimizing phytoremediation?

   Response: The current program, which is specified in the ROD with minor operational changes (improvements), is doing just fine.

6. Do you have any overall comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at Naval Base Kitsap - Keyport?

   Response: I think the existing remedies, which are outlined in the 1999 ROD, are effective and should be continued, although I wish the results from the phytoremediation program are more apparent.

INTERVIEW RECORD FOR SECOND FIVE-YEAR REVIEW
June 2000 through September 2005
Type 2 Interview – Regulatory Agency
Naval Base Kitsap - Keyport
Keyport, Washington

Individual Contacted:	**Chung Ki Yee**
Title:	**Ecology RPM**
Organization:	**Washington State Department of Ecology**
Telephone:	**360.407.6991**
E-mail:	**cyee461@ecy.wa.gov**
Address:	**Toxics Cleanup Section** **Washington State Department of Ecology** **P.O. Box 47600** **Olympia, Washington 98504-7600**
Contact made by:	**Susan King**
Response type:	**Email**
Date:	**September 8, 2004**

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a particular question, or have no information or opinion to offer, please indicate “none” after “response.”

1. Please describe your degree of familiarity with the Naval Base Kitsap - Keyport, the Records of Decision (RODs) for OUs 1 and 2, the implementation of the remedies at these OUs, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since June 2000.

   Response: Since July 2001, I have been the assigned Ecology staff for the Keyport site. I have reviewed submitted documents/reports and am reasonably familiar with this site.

2. What is your overall impression of the on-going effectiveness of the components of the OU 1 remedy? For reference, the remedy components included:
   - Phytoremediation at the former landfill using hybrid poplar trees
   - Removal of PCB-contaminated sediments from the marsh
   - Upgrade of the tide gate
   - Upgrade and maintenance of the landfill cover
   - Long-term monitoring
   - Contingent actions for off-base domestic wells
   - Institutional controls

Response:

- **The hybrid poplar trees have reached the ground water table. Based on reported monitoring data, it is not possible to differentiate the impacts of phytoremediation by the poplar tress from the impacts of natural attenuation. Therefore it is not possible to assess the effectiveness of phytoremediation independent of natural attenuation at the landfill. Based on available information, the impacts of the hybrid poplar trees in the removal of chlorinated volatile organic compounds may be limited.**
- **The post PCB-contaminated sediment removal sediment samples comply with regulatory levels. However, a 2002 seep sample shows exceedance above the remediation goal for total PCBs. The overall effectiveness of PCB-contaminated sediment removal will be assessed based on future sediment and seep monitoring.**
- **The September 3, 2004 Tidegate Inspection and Maintenance Report concluded "the tidegate is functioning as intended and designed" and thus is an effective remedy.**
- **The Navy has upgraded pavement over the landfill at OU 1. This asphalt pavement is designed for vehicle parking. Ecology has approved this upgrade. However, this is not a landfill cover constructed in accordance with WAC 173-304. The Record of Decision specifies long-term monitoring "will be used to determine whether conditions change such that an impermeable cover should be considered or required."**
- **The long-term monitoring is effective in assessing the trends of chlorinated volatile organic compounds in the landfill. The monitoring program is not effective in assessing the individual impacts of phytoremediation and natural attenuation. The effectiveness of monitoring in achieving compliance with numerical remediation goals can not be assessed at this time.**
- **The Navy has prepared the *Contingent Remedial Action Plan for Operable Unit 1* in March 2003. Ecology has approved this plan.**
- **The site is fenced with control access. It is effective in controlling access from the public. Within the site, exposure to contamination by site workers is to be controlled by a Regional Land Use Control Instruction. The Navy is finalizing this document.**

3. What is your overall impression of the on-going effectiveness of the components of the OU 2 remedy? For reference, the remedy components included:
   - Institutional controls and groundwater monitoring at Area 2
   - Excavation and off-site disposal of vadose-zone soil at Area 8
   - Institutional controls and monitoring of groundwater, sediments, and shellfish at Area 8.

Response:

- **Institutional controls and ground water monitoring are the Record of**

Decision selected remedies for Area 2. The spring 2003 monitoring results show TCE was exceeded at monitoring well 2MW-1, vinyl chloride was exceeded at monitoring well 2MW-6. The contaminant trends are downward. The effectiveness of the ground water monitoring remedy can only be assessed by the results of future monitoring results. The site is fenced with control access. It is effective in controlling access from the public. Within the site, exposure to contamination by site workers is to be controlled by a Regional Land Use Control Instruction. The Navy is finalizing this document.

- **The excavation and off-site disposal of vadose-zone soil at Area 8 is effective for the removal of hot spots but not effective enough to meet numerical remediation goals**
- **The spring 2003 monitoring results show exceedances of chlorinated volatile organic compounds and dissolved metals in the ground water monitoring wells and in seep samples. These contaminants have been migrating towards Liberty Bay. Attainment of remediation goals is not expected to occur in the near future. The effectiveness of Institutional controls and monitoring in achieving compliance with numerical remediation goals can not be assessed at this time.**

4. Do you feel well informed about the remediation activities and progress at Naval Base Kitsap - Keyport? Please elaborate.

   Response: Yes. The various reports have provided information on activities and progress at the Keyport site.

5. To the best of your knowledge, since June 2000 have there been any new scientific findings that relate to potential site risks and that might call into question the protectiveness of the remedies?

   Response: No.

6. What is your overall impression of the on-going effectiveness of the institutional controls components of the remedies?

   Response: The site is fenced with control access. It is effective in controlling access from the public. Within the site, exposure to contamination by site workers is to be controlled by a Regional Land Use Control Instruction. The Navy is finalizing this document.

7. The phytoremediation component of the OU 1 remedy was not expected to become effective until the trees matured. What is your impression of the effectiveness of this remedy component now that the trees have been growing for more than 5 years?

Response: Based on reported monitoring data, it is not possible to differentiate the impacts of phytoremediation by the poplar tress from the impacts of natural attenuation. Therefore it is not possible to assess the effectiveness of phytoremediation independent of natural attenuation at the landfill. Based on available information, the impacts of the hybrid poplar trees in the removal of chlorinated volatile organic compounds may be limited.

8. The US Geologic Survey (USGS), on behalf of the Navy, has been conducting intrinsic bioremediation studies at OU 1 to assess the effects of phytoremediation on intrinsic bioremediation. Monitored natural attenuation was also listed in the OU 1 ROD as a potential "fallback" remedy if phytoremediation is determined to be ineffective. Based on your knowledge of the USGS studies, what is your opinion of the effectiveness of intrinsic bioremediation in protecting human health and the environment at OU 1?

   Response: Based on the USGS reports, natural attenuation of chlorinated volatile organic compounds in shallow ground water is substantial and less significant in the intermediate aquifer. Due to the short distance between the landfill and marsh, natural attenuation is not effective enough to meet numerical remediation goals.

9. Since September 2000, have there been any complaints, violations, or other incidents related to Naval Base Kitsap - Keyport installation restoration issues that required a response by your office? If so, please provide details of the events and results of the responses.

   Response: No.

10. To the best of your knowledge, has the on-going program of environmental monitoring at Naval Base Kitsap - Keyport been sufficiently thorough and frequent to meet the goals of the RODs?

    Response: Yes, but not the numerical remediation goals.

11. Are you aware of any community concerns regarding implementation of the remedies at Naval Base Kitsap - Keyport? If so, please give details.

    Response: No

12. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented so far in protecting human health and the environment at Naval Base Kitsap - Keyport?

    Response: No

APPENDIX C

Human Health Risk Assessment – OU 2 Area 8

CONTENTS

CONTENTS (Continued)

ATTACHMENTS

CONTENTS (Continued)

FIGURE

TABLES

ABBREVIATIONS AND ACRONYMS

ARAR	applicable or relevant and appropriate requirement
ATSDR	Agency for Toxic Substances and Disease Registry
COC	chemical of concern
COPC	chemical of potential concern
CSM	conceptual site model
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
g/day	gram per day
g/kg/day	gram per kilogram per day
HQ	hazard quotient
IRIS	Integrated Risk Information System
kg	kilogram
LOAEL	lowest-observed-adverse-effect level
MCL	maximum contaminant level
MDL	method detection limit
mg/kg	milligram per kilogram
mg/kg-day	milligram per kilogram per day
MTCA	Model Toxics Control Act
NOAEL	no-observed-adverse-effect level
NUWC	Naval Undersea Warfare Center
OU	operable unit
Pb/dL	lead per deciliter
PRG	preliminary remediation goal
PTTIL	provisional total tolerable intake level
RBC	risk-based concentration
RfD	reference dose
RME	reasonable maximum exposure
ROD	Record of Decision
SF	slope factor
SQL	sample quantitation limit
SVOC	semivolatile organic compound
UCL95	95 percent upper confidence limit
UF	uncertainty factor
URS	URS Group, Inc.
WAC	Washington Administrative Code

1.0 INTRODUCTION

A human health risk assessment (HHRA) was conducted for Naval Undersea Warfare Center (NUWC) Keyport Operable Unit 2 (OU 2) Area 8. The purpose of the risk assessment was to assess, subsequent to the record of decision (ROD), chemical concentrations in marine sediment and clam tissue from Liberty Bay. The risk assessment evaluated potential health risks to two populations—subsistence and recreational—who could encounter Area 8 chemicals while harvesting and eating clams. The results of the evaluation were to be used to assess whether further remedial actions were needed for groundwater entering Liberty Bay.

The ROD specified that the factors used in the risk assessment equations for the post-ROD evaluation were to be the same factors as were used in the original baseline risk assessment. The risk results using the baseline risk assessment exposure factors are referred to as “baseline” risks. In addition, because of the 5-year review requirements to evaluate the effects of new information, a second set of risk calculations was performed using new information. This second set of risk results are referred to as “revised” risks.

According to U.S. Environmental Protection Agency (EPA) guidance, risk assessments are composed of four basic steps. The first step involves an initial screening of the sampling data to select the applicable data set for humans and, within that data set, select chemicals that could be a health concern. Secondly, chemical sources, pathways, receptors, exposure duration and frequency, and routes of exposure are evaluated to quantitatively assess the amount of exposure to the chemicals of potential concern (COPCs). Next, a toxicity assessment is performed, which qualitatively summarizes the carcinogenic and noncarcinogenic effects associated with the COPCs and provides toxicity values that are used to calculate the dose-response relationship. The final step in an HHRA is the risk characterization that integrates the quantitative and qualitative results of the data evaluation, exposure, and toxicity assessment sections.

This risk assessment is prepared in accordance with current EPA guidelines for HHRA (USEPA 1989, 1991a, 1997a, and 1998). The assessment follows available science where appropriate regulatory guidance is not available to accommodate site-specific conditions. The accuracy of this assessment depends in part on the quality and representativeness of the available sample, exposure, and toxicological data. Where information is incomplete, conservative assumptions were made so that risk to public health was not underestimated. Section 7 presents a discussion of uncertainties in the HHRA.

A risk assessment evaluates the likelihood of adverse effects occurring in human populations potentially exposed to contaminants released in the environment. Risk assessments are not intended to predict the actual risk for an individual. Rather, they provide upper-bound estimates of risk with an adequate margin of safety, according to the EPA (USPEA 1989), for the protection of virtually all people that may potentially come into contact with contaminants at the site.

This risk assessment is organized as follows:

- **Section 2** contains a site description and describes the source of contamination.
- **Section 3** evaluates the data used in the risk assessment and discusses the selected chemicals.
- **Section 4** provides the conceptual site model, the rationale for the selection or exclusion of exposure pathways, and the inputs used to calculate chemical dose.
- **Section 5** describes the oral and dermal toxicity criteria used in the hazard calculations.
- **Section 6** provides the methodology used to calculate noncancer hazards.
- **Section 7** discusses the uncertainties in the risk assessment.
- **Section 8** provides a summary and presents the conclusions of the risk assessment.
- **Section 9** provides references cited in this assessment.

2.0 SITE DESCRIPTION AND BACKGROUND

Area 8 occupies about 1 acre on the eastern portion of NUWC Keyport and surrounds the location of the former plating shop (Building 72) (see Figures 2-1 and 3-3 of the second 5-year review). Building 72 was demolished in 1999 and replaced by an asphalt-paved parking area. The site is located in a heavily industrialized part of the facility, bordered by Liberty Bay to the south and east (see Figure 3-3 of the second 5-year review). The area is predominantly flat and almost entirely paved or covered by buildings. Section 3 in the second 5-year review report provides additional background information for OU 2 Area 8.

Past releases at Area 8 include spillage of chrome plating solution onto the ground; discharge of plating wastes into a utility trench; and leakage of plating solutions through cracks in the plating shop floor, waste disposal pipes, and sumps.

There were 10 inorganic chemicals in groundwater (antimony, arsenic, cadmium, chromium (hexavalent), copper, lead, manganese, nickel, thallium, and zinc) that exceeded the federal and state maximum contaminant levels (MCLs) for surface water protection, or the Model Toxics Control Act (MTCA) Method B levels (for protection of human health in groundwater).

Because of Area 8 groundwater discharges into Liberty Bay, there is a potential for chemical migration from the groundwater to the marine environment. Therefore, sediment and marine tissue monitoring was specified in the ROD, among other remediation alternatives.

3.0 DATA EVALUATION AND SELECTION OF CHEMICALS OF CONCERN

The OU 2 ROD (U.S. Navy, USEPA, and Ecology 1994) identified only lead and mercury as chemicals of concern (COCs) in both sediment and clam tissue. At the time the ROD was completed, there were no screening values for either mercury or lead, which is the reason for their selection as COCs. The OU 2 ROD identified several other chemicals, including additional metals and volatile organic chemicals (VOCs) as COCs in groundwater at Area 8. In the ROD, SVOCs and metals were identified as the required analytes in sediment and tissue and, therefore, are considered for quantitative evaluation in this assessment.

The post-ROD data collected from nine stations during 1996, 2000, (U.S. Navy 2001) and 2004 were included in this HHRA. These sampling locations are depicted on Figure 3-3 of the second 5-year review.

Data are available from 30 sediment and 30 clam tissue samples collected from these nine stations over these three sampling events. All the clam tissue data were converted to wet weight, as this is most appropriate for quantifying human exposures to chemicals in fish tissue. The dry-weight concentration (for each sample) and the percent solid (an average at each station) were reported by the laboratory. The following formula was used to convert the dry-weight data to wet weight:

$$\text{wet weight} = \text{dry weight} \times \text{percent solid}$$

All the data collected during the three sampling events were included in the risk assessment, except for six clam tissue samples collected in 1996 that were analyzed for hexavalent chromium using Analytical Method 7197. The analytical method used to speciate chromium in environmental samples is uncertain. Method 6010 for total inorganics is a more widely accepted method for analyzing concentrations of metals in environmental samples. The hexavalent chromium results were greater in 4 of the 6 samples than the total chromium results analyzed by Method 6010. Therefore, the hexavalent chromium data are not likely representative of actual hexavalent chromium concentrations in clam tissue. Therefore, these results were excluded from the data evaluation. The total chromium results analyzed by Method 6010 were assumed to be composed of 100 percent hexavalent chromium, because the source of chromium from the former plating shop at Area 8 is hexavalent chromium. These data are discussed further in the uncertainty section.

3.1 DATA USABILITY AND QUALITY

Optimizing data usability reduces uncertainty in environmental data used in a risk assessment. Data usability and quality issues are discussed below according to EPA guidelines (USEPA 1992a), which provide practical guidance on how to obtain an appropriate level of quality of all environmental analytical data. All data have been collected following EPA guidelines, and the data are generally of sufficient quality for use in risk assessment. Where multiple analyses of a sample exist, the highest detected or lowest nondetected value was selected as the single most valid analytical result for the sample.

3.1.1 Data Usability

The four data application questions requiring an answer for risk assessment from EPA's data usability guidance (USEPA 1992a) are as follows:

1. **What contamination is present, and at what levels?** The baseline HHRA and ROD identified lead and mercury as the COCs for sediment and clam tissue. The maximum lead concentrations in sediment and tissue are 37.6 and 0.21 mg/kg, respectively. The maximum mercury concentrations in sediment and tissue are 1.9 and 0.18 mg/kg, respectively.

2. **Are site concentrations different from background?** Concentrations of chemicals that occur on site in the absence of site activities are defined as background concentrations. Comparison of site data to background concentrations allows determination of the degree of contamination. Background concentrations for NUWC Keyport were determined in the baseline HHRA (U.S. Navy 1993) and used for comparison with sediment and tissue samples. In general, comparison with natural background levels is applicable only to inorganic contaminants (metals), because the majority of organic contaminants are not naturally occurring (USEPA 1989). For SVOCs, background is assumed to be zero. At this site metals and SVOCs in sediment and clam tissue samples exceeded background values for all chemicals except copper, nickel, and zinc in sediment.

3. **Are all exposure pathways and areas identified and examined?** Sufficient site knowledge exists to understand potential current and future exposure pathways, although in some cases the ability to quantify the pathway may be limited. Exposure pathways are identified and discussed in detail in Section 4.1.3.

4. **Are all exposure areas fully characterized?** Sufficient data are available for sediment and clam tissue. The post-ROD sampling investigations collected sediment and tissue data from nine stations during 1996, 2000, and 2004. There are between 6 and 30 samples for each chemical, allowing adequate sample numbers to quantify exposure concentrations. The sampling locations are depicted in Figure 3-3 of the second 5-year review.

3.1.2 Data Quality: Sample Quantitation Limits

All data have been collected following EPA requirements; consequently, the data are generally of sufficient quality for use in risk assessment. Therefore, the focus of this section is to address any sample quantitation limit (SQL) issues that are specifically applicable to human health. A SQL is the laboratory quantitation limit (also referred to as the reporting limit) that is adjusted to reflect sample-specific factors such as dilution, use of a smaller sample aliquot for analysis, or for matrix interference. The method detection limit (MDL) is defined as the minimum concentration of an analyte that can be routinely identified using a specific method. The reporting limit is the minimum level at which an analyte can be accurately and reproducibly quantified. SQLs are used in risk assessment data evaluations because they “take into account sample characteristics, sample preparation, and analytical adjustments” (USEPA 1989), and they are considered to be the most relevant quantitative limits for evaluating nondetected chemicals.

Some of the SQLs in the data set may not meet risk assessment requirements, i.e., the SQL could be above the screening value of the chemical. If a chemical is not detected in a sample, it could be present at a concentration just below the reported SQL, or it may not be present in the sample at all. If the quantitation limit is below the screening value, the resulting data set provides the risk assessor with a higher degree of certainty in identifying COPCs. SQLs exceeding screening values may be a particular concern for chemicals that are not selected for quantitative evaluation, because those chemicals could potentially be present at levels that warrant a health concern. For chemicals selected for quantitative evaluation, a surrogate concentration of half the SQL is included in the risk calculations for nondetected samples, as per EPA guidance (USEPA 1989); thus, while the use of half the SQL could either under- or overestimate chemical concentrations, at least an attempt is made to quantify possible risks.

If a chemical was never detected, it was assumed not to be present. However, if the chemical is detected at least once in any sample, then the range of SQLs was further evaluated. The SQLs of all detected chemicals in sediment were less than the applied screening values at this site. For clam tissue, cadmium, benzo(a)pyrene, and dibenz(a,h) anthracene had SQLs above screening values. Cadmium was selected for quantitative evaluation in the risk assessment; therefore, detection limits exceeding SQLs are not a concern. Benzo(a)pyrene and dibenz(a,h)anthracene were not selected for quantitative evaluation in this assessment based on infrequent detection. In addition, these chemicals were not identified as COCs in the ROD for OU 2, are not related to site operations, and were not detected above screening values in sediment. Therefore, although the SQLs for benzo(a)pyrene and dibenz(a,h)anthracene are above screening levels, they were not included for further evaluation in the risk assessment. See the uncertainty section, Section 7 for further details.

3.2 CHEMICAL SELECTION PROCESS

Typically, not all chemicals present at a site pose health risks or contribute significantly to overall site risks. EPA guidelines (USEPA 1989) recommend focusing on a group of COPCs based on site concentration, inherent toxicity, and behavior of the chemicals in the environment. Because COCs have already been identified for sediment and clam tissue, COPCs were not selected. Rather, those chemicals that warrant quantitative evaluation in this assessment were identified. To identify the chemicals needing risk quantification, risk-based screening values are compared to site concentrations of chemicals. If site concentrations of a chemical exceed their respective screening concentrations, then further evaluation in the risk assessment is warranted.

EPA's Region 9 preliminary remediation goals (PRGs) for residential soil were used as sediment screening values (USEPA 2004a). The lower of EPA's (USEPA 2004b) Region 3 fish ingestion risk-based concentrations (RBCs) and the tissue RBCs calculated for OU 1 (U.S. Navy 1998) were used for screening clam tissue concentrations. Chemical concentrations in sediment and tissue were compared to one-tenth of their respective screening value for noncarcinogens and the full value for carcinogens. Screening values represent concentrations below which there is no health concern.

In addition, data were compared to applicable or relevant and appropriate requirements (ARARs) to determine if additional COCs could be a health concern. The sediment ARARs were the marine sediment quality standards (Washington Administrative Code [WAC] 173-204) and those listed in the NUWC Keyport baseline HHRA (U.S. Navy 1993). For tissue, there were few ARARs available from the NUWC Keyport baseline HHRA, and these values were used for comparison.

The screening process to select chemicals in sediment and clam tissue that warrant quantitative evaluation consisted of the steps listed below, and the results are discussed in Section 3.3.

1. **Determination of the frequency of chemical detection.** EPA guidance allows the elimination of chemicals from the quantitative evaluation, if they are detected infrequently and the magnitude of exceedance is not a concern (USEPA 1989). In this assessment, a frequency of detection of 5 percent was used as a criterion for

the elimination of chemicals from quantitative evaluation. In other words, if a chemical was detected in fewer than 5 percent of the samples for a particular medium, it was eliminated if the magnitude of exceedance was not a concern. It should be noted that for data sets containing fewer than 20 samples, evaluation of the frequency of detection is generally not applicable.

2. **Comparison of the maximum detected chemical concentration in a particular medium to the screening value.** If the maximum detected chemical concentration exceeds the screening value, the chemical was retained for further evaluation in the risk assessment. In this step of the screening process, all chemicals with a maximum concentration exceeding a screening value are identified. However, in some cases, an exceedance of the screening value by a maximum concentration does not necessarily represent a health concern within the context of a particular site. Consequently, the chemical could be safely eliminated from quantitative evaluation and not affect the outcome of the risk assessment. The following two steps describe the process used to further evaluate the chemicals with maximum concentrations that exceed the screening level.

3. **Evaluation of the frequency of exceedance over screening levels.** The frequency of exceedance of concentrations above the screening level was also evaluated. Estimates of risk are calculated using the 95 percent upper confidence limit (UCL95) of the mean concentration for each chemical, because the risk calculations are based on an estimate of average exposure concentration over time, not the maximum concentration. Therefore, if only a handful of concentrations of a chemical exceed a screening level, and the magnitude of exceedance is not large, the chemical will not represent a health risk and can potentially be eliminated from the risk evaluation, particularly if the screening level is below a level that is a health concern. Chemicals with few concentrations exceeding their screening level may be eliminated from further evaluation.

4. **Evaluation of the magnitude of exceedance over screening levels.** If the frequency of exceedance was 10 percent or less, then the magnitude of exceedance was evaluated. A magnitude of exceedance of up to 10 times the screening level was considered a potentially acceptable reason for exclusion from quantitative evaluation, if the screening level was one-tenth of a risk-based value. However, exclusion of a chemical based on frequency and magnitude of exceedance is evaluated on a case-by-case basis, depending on the toxicity of the chemical, the specific screening level, and the magnitude of exceedance.

3.3 RESULTS OF SCREENING

This section describes the results of the screening process, including the rationale for selecting or eliminating chemicals from further evaluation.

3.3.1 Sediment

Table C3-1 summarizes the screening process for sediment. A total of 36 chemicals were detected in analyzed sediment samples and their maximum concentrations were compared to their respective screening values. Of the 36 detected chemicals, cadmium and chromium had maximum concentrations greater than their respective screening values, 33 chemicals had maximum concentrations less than their screening values, and gold had no applicable screening value (gold is not a human health concern).

The two chemicals with maximum concentrations greater than the screening values (cadmium and chromium) were further evaluated, according to the steps outlined in Section 3.2, for frequency and magnitude of exceedance above screening levels (Table C3-2). Both were selected because their frequencies and magnitude of exceedance above screening levels warrant in-depth evaluation in the risk assessment, according to screening Steps 4 and 5. Mercury was selected because it maximum concentration was close to the screening value, and it was identified as a COC in the ROD. Although lead was selected as a COC in the ROD, the maximum concentration in sediment was well below the screening value; therefore, it was not selected for further evaluation. At the time the ROD was completed there were no screening values for either mercury or lead, which is the reason for their selection as COCs. The three selected chemicals are listed below.

- Cadmium
- Chromium
- Mercury

3.3.2 Clam Tissue

Table C3-3 summarizes the screening process for clam tissue. A total of 27 chemicals were detected in analyzed clam tissue samples and their maximum concentrations were compared to their respective screening values. Of the 27 detected chemicals, 7 had maximum concentrations greater than their respective screening values, 19 chemicals had maximum concentrations less than their screening values, and lead had no applicable screening value.

The seven chemicals with maximum concentrations greater than the screening values were further evaluated, according to the steps outlined Section 3.2, for frequency and magnitude of exceedance above screening levels. Four were selected because their frequencies and magnitude of exceedance above screening levels warrant in-depth evaluation in the risk assessment, according to screening Steps 4 and 5 (Table C-2). Mercury was assumed to exist in tissue as methylmercury, thus, the methylmercury screening value was used. Benzo(a)pyrene, bis(2-ethylhexyl)phthalate, and dibenz(a,h)anthracene were not selected based on EPA's (1989) criteria: (a) chemicals were not detected above screening criteria in other media, (b) chemicals were infrequently detected, and (c) chemicals were not related to site operations. Lead was selected for quantification in this revised HHRA because it was previously selected as a COPC in the baseline HHRA, because there was no applicable screening value, and because it was identified as a COC in the ROD. The five selected chemicals are summarized below.

- Cadmium
- Chromium
- Lead
- Mercury
- Silver

Table C3-1
Occurence, Distribution, and Selection of Chemicals in Marine Sediment

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	Chemical Selected?
Metals															
7440-43-9	**Cadmium**	**0.2**		**9.13**	**J**	**mg/kg**	**S.STATION6**	**26/26**	**--**	**9.13**	**0.68**	**4**	**5.1**	**SMS**	**YES**
7440-47-3	**Chromium (4)**	**14.1**		**194**		**mg/kg**	**S.STATION6**	**30/30**	**--**	**194**	**88**	**30 c**	**260 / 900**	**SMS / BHHRA**	**YES**
7440-50-8	Copper	6.4		20.8	J	mg/kg	S.STATION2	30/30	--	20.8	35	313	390	SMS	NO
7440-57-5	Gold	1.1		2.5		mg/kg	S.STATION4	12/12	--	2.5	na	NE	NE	SMS	NO
7439-92-1	Lead	1.9		37.6		mg/kg	S.STATION9	30/30	--	37.6	36	400	450	SMS	NO
7439-97-6	**Mercury**	**0.02**		**1.9**		**mg/kg**	**S.STATION2**	**20/20**	**--**	**1.9**	**0.11**	**2.3**	**0.41**	**SMS**	**YES**
7440-02-0	Nickel	10.2		31.6		mg/kg	S.STATION4	30/30	--	31.6	57	160	NE	SMS	NO
7440-22-4	Silver	0.09		1.54		mg/kg	S.STATION7	26/26	--	1.54	0.23	39	6.1 / 900	SMS / BHHRA	NO
7440-31-5	Tin	0.8		2.7		mg/kg	S.STATION10	12/12	--	2.7	na	4700	NE	SMS	NO
7440-66-6	Zinc	22.8		94.8		mg/kg	S.STATION2	30/30	--	94.8	96	2300	410	SMS	NO
Semi-volatile Organic Compounds (SVOCs)															
120-82-1	1,2,4-Trichlorobenzene	0.002	J	0.003	J	mg/kg	S.STATION1	3/18	0.0018 - 0.01	0.003	0	62	0.81	SMS	NO
91-57-6	2-Methylnaphthalene (5)	0.001	J	0.013		mg/kg	S.STATION3	2/18	0.0015 - 0.01	0.013	0	6	99	SMS	NO
106-44-5	4-Methylphenol (5)	0.064		1.5		mg/kg	S.STATION7	11/25	0.0035 - 0.2	1.5	0	310	670	SMS	NO
83-32-9	Acenaphthene	0.002	J	0.17		mg/kg	S.STATION1	10/25	0.0012 - 0.01	0.17	0	370	16	SMS	NO
208-96-8	Acenaphthylene (5)	0.0024	J	0.0024	J	mg/kg	S.STATION9	1/18	0.0017 - 0.01	0.0024	0	370	16	SMS	NO
120-12-7	Anthracene	0.0017	J	0.02		mg/kg	S.STATION9	20/25	0.0018 - 0.01	0.02	0	2200	220	SMS	NO
56-55-3	Benzo(a)anthracene	0.0014	J	0.069		mg/kg	S.STATION9	28/28	--	0.069	0	0.62 c	110	SMS	NO
50-32-8	Benzo(a)pyrene	0.0014	J	0.058		mg/kg	S.STATION1	29/29	--	0.058	0	0.062 c	99	SMS	NO
205-99-2	Benzo(b)fluoranthene	0.0022	J	0.088		mg/kg	S.STATION1	29/29	--	0.088	0	0.62 c	160	SMS	NO
191-24-2	Benzo(g,h,i)perylene (5)	0.001	J	0.038		mg/kg	S.STATION1	28/28	--	0.038	0	230	31	SMS	NO
207-08-9	Benzo(k)fluoranthene	0.002	J	0.055		mg/kg	S.STATION9	27/27	--	0.055	0	6.2 c	160	SMS	NO
117-81-7	bis(2-Ethylhexyl)phthalate	0.005	J	0.27		mg/kg	S.STATION9	5/18	0.01 - 0.2	0.27	0	35 c	47	SMS	NO
85-68-7	Butylbenzylphthalate	0.002	J	0.33	J	mg/kg	S.STATION8	6/19	0.0018 - 0.01	0.33	0	1200	4.9	SMS	NO
218-01-9	Chrysene	0.005	J	0.12		mg/kg	S.STATION9	27/27	--	0.12	0	62 c	110	SMS	NO
53-70-3	Dibenz(a,h)anthracene	0.001	J	0.007	J	mg/kg	S.STATION9	10/22	0.0027 - 0.01	0.007	0	0.062 c	12	SMS	NO
132-64-9	Dibenzofuran	0.002	J	0.0031	J	mg/kg	S.STATION9	3/18	0.0016 - 0.01	0.0031	0	150	15	SMS	NO
84-66-2	Diethylphthalate	0.067		0.067		mg/kg	S.STATION9	1/18	0.0042 - 0.01	0.067	0	4900	61	SMS	NO
84-74-2	Di-n-butylphthalate	0.0037	J	0.0037	J	mg/kg	S.STATION1	1/18	0.0032 - 0.011	0.0037	0	610	220	SMS	NO
117-84-0	Di-n-octylphthalate	0.002	J	0.26		mg/kg	S.STATION9	6/18	0.0015 - 0.01	0.26	0	240	58	SMS	NO
206-44-0	Fluoranthene	0.0054	J	0.11		mg/kg	S.STATION1	28/28	--	0.11	0	230	160	SMS	NO
86-73-7	Fluorene	0.004	J	0.0095	J	mg/kg	S.STATION3	5/18	0.0021 - 0.01	0.0095	0	270	23	SMS	NO
193-39-5	Indeno(1,2,3-cd)pyrene	0.001	J	0.025		mg/kg	S.STATION9	27/27	--	0.025	0	0.62 c	34	SMS	NO

Table C3-1 (Continued)
Occurence, Distribution, and Selection of Chemicals in Marine Sediment

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	Chemical Selected?
Semi-volatile Organic Compounds (SVOCs) (Continued)															
91-20-3	Naphthalene	0.001	J	0.011		mg/kg	S.STATION3	4/18	0.0016 - 0.01	0.011	0	6	99	SMS	NO
85-01-8	Phenanthrene (5)	0.002	J	0.1		mg/kg	S.STATION3	23/25	0.0016 - 0.01	0.1	0	220	100	SMS	NO
108-95-2	Phenol	0.02	J	5.2		mg/kg	S.STATION8	24/27	0.03 - 0.03	5.2	0	1800	420 / 1E+05	SMS / BHHRA	NO
129-00-0	Pyrene	0.0028	J	0.11		mg/kg	S.STATION1	28/28	--	0.11	0	230	1000	SMS	NO

(1) Minimum/maximum detected concentration.

(2) Background is assumed to be zero for SVOCs.

Metals background was taken from the BHHRA (U.S. Navy 1993).

(3) Screening values are one-tenth the Region 9 PRG for noncancer or full value for cancer; unless otherwise marked.

(4) Because the source was Cr IV, the screening value used for Total Cr is the Cr IV value.

(5) The following surrogate chemicals were used for screening values:

Chemical Name	Surrogate Chemical
2-Methylnaphthalene	Naphthalene
Acenaphthylene	Acenaphthene
Phenanthrene	Anthracene
Benzo(g,h,i)perylene	Pyrene
4-Methylphenol	2-Methylphenol

Notes:
Chemicals bolded exceeded their screening value or ARAR.
-- compound has 100 % detection frequency
ARAR/TBC - applicable or relevant and appropriate requirement/to be considered
BHHRA - Baseline Human Health Risk Assessment
c - Cancer PRG
COPC - chemical of potential concern
Cr - Chromium
Cr IV - Hexavalent Chromium
J - estimated concentration
mg/kg - milligrams per kilogram dry weight
na - not available
NE - not established
PRG - EPA's Region 9 Preliminary Remediation Goal for residental soil
SMS - Marine Sediment Quality Standards from Chpt 173-204 WAC

Table C3-2
Frequency and Magnitude of Exceedance of Detected Chemicals in Sediment and Clam Tissue Over Screening Criteria

Chemical	Maximum Concentration (mg/kg)	Screening Concentration (mg/kg)	Frequency of Detection	Frequency of Exceedance	Magnitude of Exceedance
Sediment - Chemicals Selected for Evaluation					
Cadmium	9.13	4	26/26 (100%)	9/26 (35%)	2.3 times screening
Chromium	194	30	30/30 (100%)	21/30 (70%)	6.5 times screening
Tissue - Chemicals Selected for Evaluation					
Cadmium	5.75	0.14	29/30 (97%)	29/29 (100%)	41 times screening
Chromium	8.78	4.1	30/30 (100%)	1/30 (3%)	2.1 times screening
Mercury	0.18	0.014	30/30 (100%)	23/30 (77%)	13 times screening
Silver	2.2	0.68	30/30 (100%)	5/30 (17%)	3.2 times screening
Tissue – Chemicals Not Selected for Evaluation					
Benzo(a)pyrene	0.002	0.0004	2/18 (11%)	2/2 (100%)	5 times screening
bis(2-Ethylhexyl)phthalate	0.4	0.23	2/18 (11%)	1/2 (50%)	1.7 times screening
Dibenz(a,h)anthracene	0.002	0.0004	1/18 (5%)	1/1 (100%)	5 times screening

Note:
mg/kg - milligrams per kilogram

Table C3-3
Occurence, Distribution, and Selection of Chemicals in Clam Tissue

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units (wet weight)	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	Chemical Selected?
Metals															
7440-43-9	**Cadmium**	**0.19096**	**J**	**5.75**		**mg/kg**	**S.STATION3**	**29/30**	**0.31164**	**5.75**	**0.38**	**0.14**	**NE**	**NE**	**YES**
7440-47-3	**Chromium (4)**	**0.1956**		**8.78**		**mg/kg**	**S.STATION3**	**30/30**	**--**	**8.78**	**0.87**	**4.1 c**	**3**	**BHHRA**	**YES**
7440-50-8	Copper	0.9		1.82		mg/kg	S.STATION1	30/30	--	1.82	1.4	150	NE	NE	NO
7439-92-1	**Lead**	**0.04375**	**J**	**0.21**		**mg/kg**	**S.STATION1 & 8**	**24/24**	**--**	**0.21**	**0.088**	**NE**	**NE**	**NE**	**YES**
7439-97-6	**Mercury (5)**	**0.01**		**0.18**		**mg/kg**	**S.STATION2**	**30/30**	**--**	**0.18**	**0.011**	**0.014**	**NE**	**NE**	**YES**
7440-02-0	Nickel	0.4		2.3		mg/kg	S.STATION12	30/30	--	2.3	na	2.7	NE	NE	NO
7440-22-4	**Silver**	**0.04**		**2.2**		**mg/kg**	**S.STATION1**	**30/30**	**--**	**2.2**	**0.62**	**0.68**	**NE**	**NE**	**YES**
7440-66-6	Zinc	11.1		18.5		mg/kg	S.STATION6	30/30	--	18.5	13.4	41	NE	NE	NO
Semi-volatile Organic Compounds (SVOCs)															
91-57-6	2-Methylnaphthalene (5)	0.001	J	0.002	J	mg/kg	S.STATION4	2/18	0.004 - 0.01	0.002	0	2.7	NE	NE	NO
95-48-7	2-Methylphenol	0.059	J	0.11		mg/kg	S.STATION4	8/18	0.025 - 0.1	0.11	0	6.8	NE	NE	NO
120-12-7	Anthracene	0.001	J	0.003	J	mg/kg	S.STATION9	4/18	0.0047 - 0.01	0.003	0	41	NE	NE	NO
50-32-8	**Benzo(a)pyrene**	**0.002**	**J**	**0.002**	**J**	**mg/kg**	**S.STATION4 & 2**	**2/18**	**0.0034 - 0.01**	**0.002**	**0**	**0.0004 c**	**NE**	**NE**	**NO**
205-99-2	Benzo(b)fluoranthene	0.002	J	0.004	J	mg/kg	S.STATION4	2/18	0.0035 - 0.01	0.004	0	0.004 c	NE	NE	NO
191-24-2	Benzo(g,h,i)perylene (5)	0.006	J	0.008	J	mg/kg	S.STATION7	4/18	0.0053 - 0.02	0.008	0	4.1	NE	NE	NO
65-85-0	Benzoic acid	1.3	J	11		mg/kg	S.STATION9	28/28	--	11	0	540	2000	BHHRA	NO
100-51-6	Benzyl alcohol	0.027	J	0.22		mg/kg	S.STATION8	14/18	0.014 - 0.014	0.22	0	41	NE	NE	NO
117-81-7	**bis(2-Ethylhexyl)phthalate**	**0.2**	**J**	**0.4**	**J**	**mg/kg**	**S.STATION1**	**2/18**	**0.01 - 0.2**	**0.4**	**0**	**0.23 c**	**NE**	**NE**	**NO**
53-70-3	**Dibenz(a,h)anthracene**	**0.002**	**J**	**0.002**	**J**	**mg/kg**	**S.STATION4**	**1/18**	**0.006 - 0.01**	**0.002**	**0**	**0.0004 c**	**NE**	**NE**	**NO**
84-66-2	Diethylphthalate	0.002	J	0.008	J	mg/kg	S.STATION9	8/18	0.02 - 0.034	0.008	0	110	NE	NE	NO
131-11-3	Dimethylphthalate	0.002	J	0.002	J	mg/kg	S.STATION9	1/18	0.0053 - 0.01	0.002	0	1400	NE	NE	NO
84-74-2	Di-n-butylphthalate	0.003	J	0.005	J	mg/kg	S.STATION2, 3, 9	4/18	0.006 - 0.04	0.005	0	14	NE	NE	NO
206-44-0	Fluoranthene	0.006	J	0.021	J	mg/kg	S.STATION9	15/25	0.0067 - 0.01	0.021	0	5.4	NE	NE	NO
86-73-7	Fluorene	0.002	J	0.002	J	mg/kg	S.STATION9	1/18	0.006 - 0.01	0.002	0	5.4	NE	NE	NO
91-20-3	Naphthalene	0.001	J	0.002	J	mg/kg	S.STATION8 & 9	3/18	0.004 - 0.01	0.002	0	2.7	NE	NE	NO
85-01-8	Phenanthrene (5)	0.004	J	0.014	J	mg/kg	S.STATION12	12/19	0.005 - 0.01	0.014	0	41	NE	NE	NO
108-95-2	Phenol	0.02	J	0.24		mg/kg	S.STATION1 & 8	8/19	0.05 - 0.054	0.24	0	41	NE	NE	NO
129-00-0	Pyrene	0.006	J	0.029		mg/kg	S.STATION7	11/21	0.0082 - 0.01	0.029	0	4.1	NE	NE	NO

(1) Minimum/maximum detected concentration.

(2) Background is assumed to be zero for SVOCs.

Metals background was taken from the BHHRA (U.S. Navy 1993).

(3) Screening values are one-tenth the Region 3 RBCs for noncancer or full value for cancer; unless otherwise marked.

(4) Because the source was Cr IV, the screening value used for Total Cr is the Cr IV value.

(5) The following surrogate chemicals were used for screening values:

Chemical Name	Surrogate Chemical
2-Methylnaphthalene	Naphthalene
Phenanthrene	Anthracene
Benzo(g,h,i)perylene	Pyrene
Mercury	Methyl mercury

Notes:

Chemicals bolded exceeded their screening value or ARAR.

-- compound has 100 % detection frequency

ARAR/TBC - applicable or relevant and appropriate requirement/to be considered

BHHRA - Baseline Human Health Risk Assessment

c - cancer RBC

COPC - chemical of potential concern

Cr - chromium

J - estimated concentration

mg/kg - milligrams per kilogram wet weight

na - not available

NE - not established

4.0 EXPOSURE ASSESSMENT

This section evaluates sources, pathways, receptors, exposure duration and frequency, and routes of exposure to assess total human exposure to the substances of concern at each site. The goal of this section is to quantify a calculated dose of chemical per body weight per day for each COC, receptor, and exposure pathway combination. Three elements are required to calculate a dose: first, a conceptual site model (CSM) must be developed that identifies exposure pathways and populations; second, estimates of media concentrations at the exposure point must be developed; and, third, factors must be selected that quantify the amount of exposure. These exposure factors are then combined with the media concentrations to quantify a dose for each chemical.

4.1 CONCEPTUAL SITE MODEL

A CSM describes the sources of contaminants at a site, their release and transfer through environmental media (e.g., soil and air), and the points and means by which human populations might contact the contaminants. The goal of the CSM is to provide an understanding of where the site-related contaminants are present and where they may be present in the future, in order that the populations that could encounter the contaminants can be identified. The populations and applicable exposure pathways can then be selected for quantitative evaluation of health risks.

The purpose of this risk assessment is to assess post-ROD concentrations in marine sediment and clam tissue from Liberty Bay. Therefore, only exposures to chemicals in these media were evaluated in this assessment.

4.1.1 Exposed Populations

Populations identified in risk assessments include those who receive the most exposure to site contaminants or are more sensitive to the toxic effects of contaminants. The most-exposed or most-sensitive groups differ depending on whether carcinogenic or noncarcinogenic effects of contaminants are considered. Carcinogenic risks are usually greatest for the population that spends the longest time at the site and receives the longest exposure to site contaminants (i.e., largest dose over a lifetime). Noncarcinogenic effects, on the other hand, are assessed based on the daily intake or dose per body weight together with sensitivity to toxic effects. The populations that were selected for quantitative evaluation in this revised risk assessment are the same as those that were selected in the baseline HHRA (U.S. Navy 1993), as specified in the ROD for OU 2 (U.S. Navy 1994). The following populations were selected for quantitative evaluation:

- Child and adult recreational site visitors
- Child and adult subsistence populations

Area 8 is zoned for light industrial land use (U.S. Navy 2000). However, residential populations are within a short distance of the bay shoreline, and subsistence tribal members may use the area. The on-shore area of the site is paved, and riprap is along the bay shoreline. At low tide, a significant stretch of sandy beach is exposed. Currently, clam harvesting is closed at Liberty Bay by the Washington State Department of Health (WDFW 2004). However, in the future, nearby residents and subsistence populations could harvest clams from Liberty Bay. During harvesting, recreational and subsistence populations could be exposed to chemicals in sediment during low tide. In addition, area recreational and subsistence populations could be exposed to chemicals in clam tissue.

Selected populations and exposure pathways are discussed further in subsequent sections.

4.1.2 Identification of Exposure Pathways

Several possible pathways of exposure may exist at the site. An exposure pathway is the mechanism by which a receptor (human) is exposed to contaminants from a source. The following four elements constitute a complete exposure pathway:

- A source and mechanism of contaminant release
- A retention or transport medium (e.g., soil)
- A point of potential human contact with the affected medium
- A means of entry into the body (e.g., ingestion) at the contact point

Only complete pathways containing all four elements result in exposures. The CSM (Figure C4-1) summarizes potential exposure pathways for the site under future conditions. In addition, the future exposure pathways considered for the characterization of the site are discussed in more detail below. The rationale for selecting pathways for quantitative evaluation are discussed in the following subsections.

4.1.3 Exposure Pathways

As specified in the ROD for OU 2, the same pathways of exposures to chemicals in sediment and clam tissue that were evaluated in the baseline HHRA were also evaluated in this risk assessment. The baseline HHRA evaluated the following pathways of exposure:

- For site visitors and nearby residents, recreational exposure to chemicals in sediment through ingestion and exposure to chemicals in clam tissue through ingestion (Children were not evaluated for clam tissue ingestion.)

- For subsistence populations, exposure to chemicals in clam tissue through ingestion (Children were not evaluated for clam tissue ingestion.)

As it has been over a decade since the baseline HHRA was conducted, the risk assessment process has evolved and has incorporated newer science and data. The baseline HHRA did not evaluate subsistence exposures to chemicals in sediment. However, if the subsistence populations are harvesting their clams from Liberty Bay, then direct contact with sediment would be inevitable. In addition, there is now a greater understanding of the transfer of chemicals from contaminated material through the skin upon dermal contact. The dermal pathway is often evaluated in more recent risk assessments, particularly for exposures to sediments when the material is wet and adheres to the skin effectively. Therefore, in addition to the pathways that were evaluated in the baseline risk assessment, the following pathways were also evaluated in this revised risk assessment:

- For site visitors and nearby residents, recreational exposure to chemicals in sediment through dermal contact

- For subsistence populations, exposures to chemicals in sediment through ingestion and dermal contact

4.2 EXPOSURE POINT CONCENTRATIONS

To calculate a cancer risk or a noncancer hazard, an estimate must be made of the chemical concentration to which an individual may be exposed. According to EPA (USEPA 1992b and 1992c), the concentration term at the exposure point (the exposure point concentration [EPC]) should be an estimate of the average concentration to which an individual would be exposed over a significant part of a lifetime.

Because of the uncertainties surrounding the true average, EPCs were calculated using the UCL95 as the appropriate estimate of the average site concentration for a reasonable maximum exposure scenario (RME) for each of the chemicals selected, except lead (see Section 6 for further lead discussion). At the UCL95, the probability of underestimating the true mean is less than 5 percent. The UCL95 is used to estimate risks and hazards because a person is not continuously exposed to the maximum concentration of a chemical at a particular site, but rather to an average value of the range of concentrations at a given location. The use of the UCL95 of the mean is generally recommended as the conservative estimate of the average concentration and is recommended by EPA and Ecology (USEPA 1992b, 1997b, and Ecology 2001).

USEPA's ProUCL software (USEPA 2004c) was used to calculate UCL95s for all chemicals except lead. As per EPA guidance, half the SQL was used as a surrogate concentration for nondetected samples (USEPA 1989 and 2004c). The ProUCL outputs are provided in Attachment C-1. The method used to calculate the UCL95 of a sample population depends on the distribution of the data. ProUCL performs distribution tests on the data set and then recommends a UCL95 appropriate for the distribution, size, and "skewness" (a measure of variability) of the data set. A summary of EPCs is included on Table C4-1.

The complete pathways of exposures selected for quantitative evaluation at this site are contact with sediments while harvesting clams and ingestion of clam tissue. Therefore, all sediment and tissue data were used in the screening to select chemicals for quantitative evaluation and in the EPC calculations. The post-ROD data collected from the nine stations during 1996, 2000 (U.S. Navy 2001), and 2004 were included in this HHRA. These sample locations are depicted on Figure 3-3 of the second 5-year review.

4.3 CALCULATION OF CHEMICAL DOSE

This section defines the magnitude, frequency, and duration of exposure for the populations and pathways selected for quantitative evaluation. Doses are calculated assuming RME, as defined by EPA. Cleanup actions are generally determined from RME risks and hazards. Therefore, the calculation of central tendency (CT) risks and hazards was not done, because it is not necessary information for this 5-year review.

In general, risks and hazards were quantitatively evaluated using the same exposure assumptions that were used in the baseline HHRA (U.S. Navy 1993), as specified in the ROD for OU 2. Because it has been over a decade since the baseline HHRA was conducted, some of the default exposure assumptions used to evaluate sediment and seafood exposures have changed. Therefore, the current available science on evaluating recreational and subsistence exposures to sediments and seafood was reviewed for this revised HHRA.

The exposure factors used in the baseline HHRA and this revised HHRA are summarized on Tables C4-2 through C4-5. The differences between the exposure pathways and factors used in the baseline HHRA and this revised HHRA are the following:

- Exposure to chemicals in marine sediment through ingestion and dermal contact by a subsistence population was not evaluated in the baseline.

- Exposure to chemicals in marine sediment through dermal contact by a recreational population was not evaluated in the baseline.

- The exposure frequency to chemicals in marine sediment through ingestion by a recreational visitor was reduced from 52 to 24 days per year.

- The adult fish ingestion rate for recreational visitors was reduced from 54 to 17.5 grams per day.

Default exposure factors used in this revised risk assessment are discussed in Attachment C-2. For details concerning the exposure factors used in the baseline HHRA, refer to Appendix E in the baseline HHRA (U.S. Navy 1993).

The only site-specific factor used in this HHRA was the exposure frequency for recreational exposures to chemicals in marine sediments. An exposure frequency of 24 days per year was assumed for recreational site visitor intermittent exposures to sediments in Liberty Bay while harvesting clams. This value is based on the assumption that the beach will be visited 1 day per week for 24 weeks. Twenty-four weeks, or 6 months, is the longest length of time that a water body is open for the clam season in the State of Washington. Therefore, recreational site visitors will not be allowed to harvest clams from Liberty Bay for longer than 6 months. The assumption that the beach will be visited once a week while clam season is open is appropriate for recreational site visitors.

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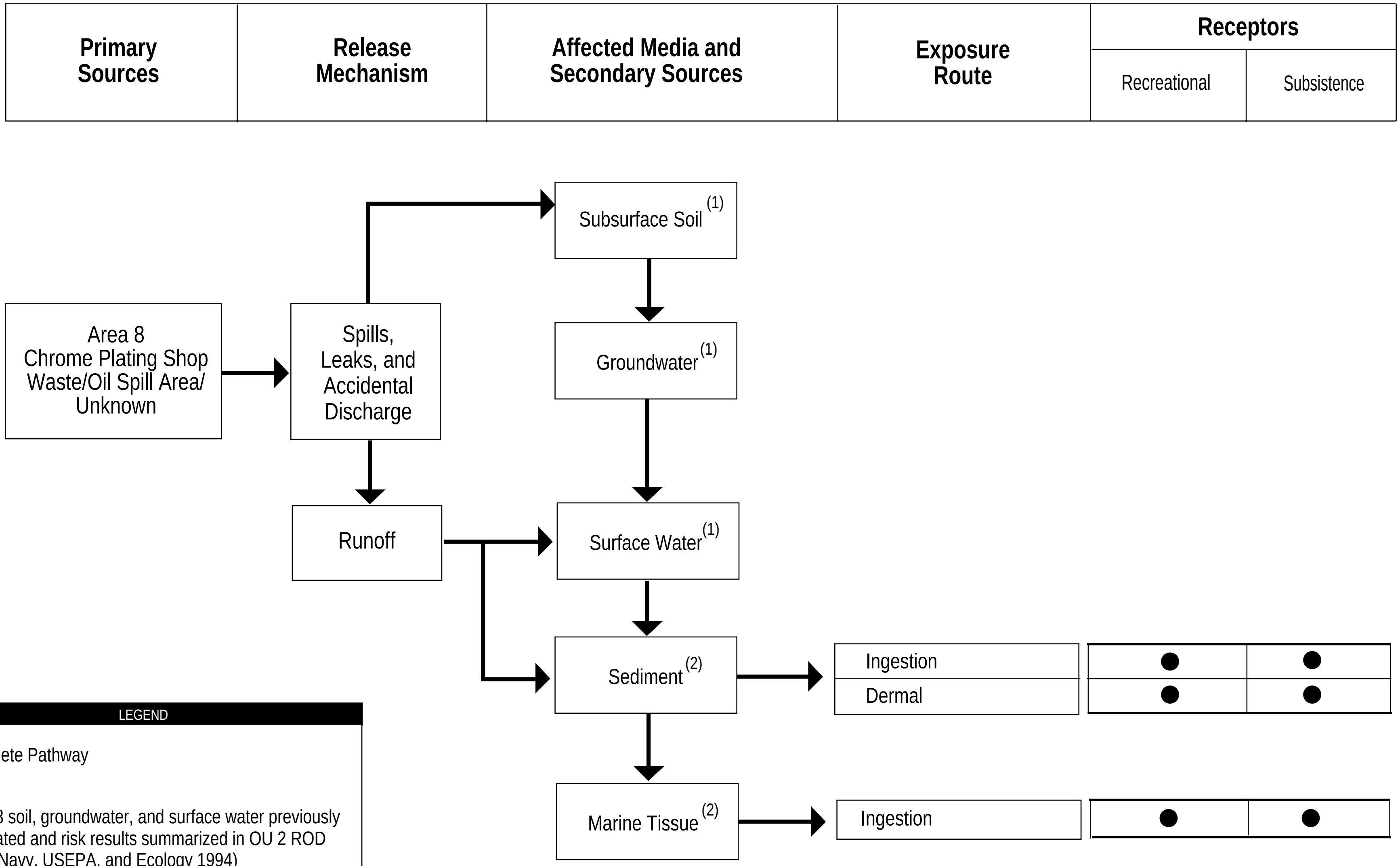

LEGEND

● Complete Pathway

(1) Area 8 soil, groundwater, and surface water previously evaluated and risk results summarized in OU 2 ROD (U.S. Navy, USEPA, and Ecology 1994)

(2) Only post-ROD monitoring data for sediment and clam tissue evaluated in this risk assessment. (U.S. Navy 1996, 2001, 2004)

U.S.NAVY

Figure C4-1
Human Health Conceptual Site Model
NUWC Keyport

Delivery Order 0043
NUWC Keyport
SECOND FIVE-YEAR REVIEW

Table C4-1
Summary of Exposure Point Concentrations

Chemical	Subsistence and Recreational Exposures	
	Sediment (mg/kg dry weight)	**Tissue (mg/kg wet weight)**
Cadmium	4.6	1.9
Chromium	67.3	2.2
Mercury	0.8	0.06
Silver	NE[a]	0.6

[a] This chemical was not evaluated (NE) in this medium.

Table C4-2
Exposures to Sediment–
Subsistence Exposure Assumptions and Intake Equations

Equations:

Chemical intake (mg/kg-day) = CS x SIF (1)

$$SIF_{ing} = \frac{IR \bullet CF \bullet EF \bullet ED}{BW \bullet AT}$$

$$SIF_{derm} = \frac{CF \bullet SA \bullet AF \bullet ABS \bullet EF \bullet}{BW \bullet AT}$$

Where:

SIF_{ing} $(day)^{-1}$ = summary intake factor for ingestion of sediment
SIF_{derm} $(day)^{-1}$ = summary intake factor for dermal contact with sediment

Parameter	Definition	Unit	Baseline Risk Assessment Values		Revised Risk Assessment Values		
			Child Value	Adult Value	Child Value	Adult Value	Source
CS	Chemical concentration in soil/sediment	mg/kg	chemical specific	chemical specific	chemical specific	chemical specific	Analytical data
IR	Ingestion rate	mg/day	NE	NE	200	100	Residential Default Value (USEPA 2002a)
CF	Conversion factor	kg/mg	NE	NE	1.00E-06	1.00E-06	NA
SA	Surface area	cm^2/day	NE	NE	2,800	5,700	Residential Default Value (USEPA 2002a)
AF	Soil to skin adherence factor	mg/cm^2	NE	NE	0.2	0.07	Residential Default Value (USEPA 2002a)
ABS	Absorption factor	unitless	NE	NE	chemical specific	chemical specific	Residential Default Value (USEPA 2002a)
EF	Exposure frequency	days/year	NE	NE	365	365	Exposure Frequency from Original Risk Assessment (U.S Navy 1993)
ED	Exposure duration	year	NE	NE	6	64	Exposure Duration from Original Risk Assessment (U.S Navy 1993)
BW	Body weight	kg	NE	NE	15	70	Default Value (USEPA 2002a)
ATnc	Averaging time for noncarcinogenic effects	days	NE	NE	ED x 365	ED x 365	Default Value (USEPA 1991a)
ATc	Averaging time for carcinogenic effects	days	NE	NE	25,550	25,550	Default Value (USEPA 1991a)

(1)This equation is for noncancer. Cancer is not evaluated at this site because there are no chemicals of concern associated with cancerous effects by these routes.

Notes:
cm^2 - square centimeters
kg - kilogram
mg - milligram
NA- not applicable
NE - This pathway was not evaluated in the original risk assessment.

Table C4-3
Exposures to Clam Tissues–
Subsistence Exposure Assumptions and Intake Equations

Equations:

Chemical intake (mg/kg-day) = CTi x SIF(1)

$$SIF_{ing} = \frac{IR \bullet CF \bullet EF \bullet ED \bullet FC}{BW \bullet AT}$$

Where:

SIF_{ing} $(day)^{-1}$ = summary intake factor for ingestion of clam tissue

Parameter	**Definition**	**Units**	**Baseline Risk Assessment Values**		
			Child Value	**Adult Value**	**Source**
CTi	Chemical concentration in clam tissue	mg/kg	chemical specific	chemical specific	Analytical data
IR	Ingestion rate	g/day	NE	132	Value used in original risk assssment (U.S. Navy 1993 and USEPA 1991b)
CF	Conversion factor	kg/g	NE	1.00E-03	NA
FC	Fraction of clam diet collected from	unitless	NE	0.25	Value used in the original risk assessment (U.S Navy 1993)
EF	Exposure frequency	days/year	NE	350	Exposure frequency from original risk assessment (U.S Navy
ED	Exposure duration	year	NE	30	Exposure duration from original risk assessment (U.S Navy 1993)
BW	Body weight	kg	NE	70	Default value (USEPA 2002a)
ATnc	Averaging time for noncarcinogenic effects	days	NE	ED x 365	Default Value (USEPA 1991a)
ATc	Averaging time for carcinogenic effects	days	NE	25,550	Default Value (USEPA 1991a)

(1)This equation is for noncancer. Cancer is not evaluated at this site because there are no COCs associated with cancerous effects by these routes.

Notes:
g - gram
kg - kilogram
mg - milligram
NA - not applicable
NE - This pathway was not evaluated in the baseline risk assessment.

Table C4-4
Exposures to Sediment–
Recreational Exposure Assumptions and Intake Equations

Equations:

Chemical intake (mg/kg-day) = CS x SIF (1)

$$SIF_{ing} = \frac{IR \bullet CF \bullet EF \bullet ED}{BW \bullet AT}$$

$$SIF_{derm} = \frac{CF \bullet SA \bullet AF \bullet ABS \bullet EF \bullet ED}{BW \bullet AT}$$

Where:

SIF_{ing} $(day)^{-1}$ = summary intake factor for ingestion of sediment
SIF_{derm} $(day)^{-1}$ = summary intake factor for dermal contact with sediment

			Baseline Risk Assessment Values		**Revised Risk Assessment Values**		
Parameter	**Definition**	**Unit**	**Child Value**	**Adult Value**	**Child Value**	**Adult Value**	**Source**
CS	Chemical concentration in soil/sediment	mg/kg	chemical specific	chemical specific	chemical specific	chemical specific	Analytical data
IR	Ingestion rate	mg/day	200	100	200	100	Residential Default Value (USEPA 2002a)
CF	Conversion factor	kg/mg	1.00E-06	1.00E-06	1.00E-06	1.00E-06	NA
SA	Surface area	cm^2/day	NE	NE	2,800	5,700	Residential Default Value (USEPA 2002a)
AF	Soil to skin adherence factor	mg/cm^2	NE	NE	0.2	0.07	Residential Default Value (USEPA 2002a)
ABS	Absorption factor	unitless	chemical specific	chemical specific	chemical specific	chemical specific	Residential Default Value (USEPA 2002a)
EF	Exposure frequency	days/year	52	52	24	24	Professional Judgement (2)
ED	Exposure duration	year	6	24	6	24	Residential Default Value (USEPA 2002a)
BW	Body weight	kg	15	70	15	70	Residential Default Value (USEPA 2002a)
ATnc	Averaging time for noncarcinogenic effects	days	ED x 365	ED x 365	ED x 365	ED x 365	Default Value (USEPA 1991a)
ATc	Averaging time for carcinogenic effects	days	25,550	25,550	25,550	25,550	Default Value (USEPA 1991a)

(1)This equation is for non-cancer. Cancer is not evaluated at this site because there are no COCs associated with cancerous effects by these routes.
(2)Based on 1 day at the beach per week for 24 weeks (a 6-month clam season)

Notes:
cm^2 - square centimeters
kg - kilogram
mg - milligram
NA - not applicable
NE - The dermal pathway was not evaluated in the baseline risk assessment.

Table C4-5
Exposures to Clam Tissues –
Recreational Exposure Assumptions and Intake Equations

Equations:

Chemical intake (mg/kg-day) = CTi x SIF [1]

$$SIF_{ing} = \frac{IR \cdot CF \cdot EF \cdot ED \cdot FC}{BW \cdot AT}$$

Where:

SIF_{ing} $(day)^{-1}$ = summary intake factor for ingestion of clam tissue

Parameter	**Definition**	**Unit**	**Baseline Risk Assessment Values**		**Revised Risk Assessment Values**		
			Child Value	**Adult Value**	**Child Value**	**Adult Value**	**Source**
CTi	Chemical concentration in clam tissue	mg/kg	chemical specific	chemical specific	chemical specific	chemical specific	Analytical data
IR	Ingestion rate	g/day	NE	54	NE [2]	17.5	Revised Residential Default Value (USEPA 2000, 2002b)
CF	Conversion factor	kg/g	NE	1.00E-03	NE	1.00E-03	NA
FC	Fraction of clam diet collected from contaminated source	unitless	NE	0.25	NE	0.25	Value used in the original risk assessment (U.S Navy 1993)
EF	Exposure frequency	days/year	NE	350	NE	350	Residential Default Value (USEPA 2002a)
ED	Exposure duration	year	NE	30	NE	30	Residential Default Value (USEPA 2002a)
BW	Body weight	kg	NE	70	NE	70	Default Value (USEPA 1991a)
ATnc	Averaging time for noncarcinogenic effects	days	NE	ED x 365	NE	ED x 365	Default Value (USEPA 1991a)
ATc	Averaging time for carcinogenic effects	days	NE	25,550	NE	25,550	Default Value (USEPA 1991a)

[1] This equation is for non-cancer. Cancer is not evaluated at this site because there are no COCs associated with cancerous effects by these routes.

[2] Ingestion of clams by child recreational site visitors was not evaluated in the revised risk assessment because no child seafood ingestion rate is available to quantify child exposures.

Notes:
g - gram
kg - kilogram
mg - milligram
NA - not applicable
NE - Pathway was not evaluated in the baseline risk assessment.

5.0 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to weigh the available and relevant evidence regarding the potential for chemicals to cause adverse health effects in exposed individuals and to provide a quantitative estimate of the relationship between the magnitude of exposure and the likelihood of adverse effects (USEPA 1989). A fundamental principle of toxicology is that the dose determines the severity of the effect. Accordingly, the toxicity criteria describe the quantitative relationship between the dose of a chemical and the type and incidence of the toxic effect. This relationship is referred to as the dose-response. The types of toxicity criteria are described in the following subsections. Table C5-1 present toxicity criteria used in this assessment. Attachment C-3 contains discussions of the specific criteria and associated health effects for each chemical selected for quantitative evaluation.

5.1 ORAL TOXICITY CRITERIA

A dose-response evaluation is the process of quantitatively evaluating toxicity information and characterizing the relationship between the dose of the chemical and the incidence of adverse health effects in the exposed population. From this quantitative dose-response relationship, toxicity criteria are derived that can be used to estimate the potential for adverse health effects as a function of exposure to the chemical. Toxicity values are combined with the summary intake factors listed on Tables C4-2 through C4-5 and are used to calculate human risks for various exposure scenarios. Exposure to chemicals can result in cancer or noncancer effects, which are characterized separately. Essential dose-response criteria are the EPA slope factor (SF) values for assessing cancer risks and the EPA-verified reference dose (RfD) values for evaluating noncancer effects. These criteria are from the EPA’s online database, Integrated Risk Information System (IRIS) (USEPA 2004d). Where IRIS criteria were not available, other EPA sources of toxicity criteria were investigated, as described in Attachment C-3 for individual chemicals.

Mercury toxicity varies depending on the form of mercury. For mercury in sediment and tissue, there are two risk assessment choices for evaluating toxicity: inorganic or organic. The default RfD for inorganic mercury is based on a study using mercuric chloride (USEPA 2004d). For organic mercury, the compound of most concern is methyl mercury. Therefore, methyl mercury’s RfD is used to evaluate organic forms of the element. While fate and transport of mercury can be very complex, the most likely predominant mercury form in sediment is inorganic (ATSDR 1999); thus, mercury’s inorganic RfD, based on mercuric chloride, is used to evaluate sediment toxicity. For seafood tissue, the most likely predominant form of mercury is organic (ATSDR 1999), and, therefore, methyl mercury’s RfD was used to evaluate mercury toxicity in seafood. Additional information concerning the toxicity of mercury is provided in Attachment C-3.

5.1.1 Cancer Effects

The cancer SF (expressed as $[\text{mg/kg-day}]^{-1}$) expresses excess cancer risk as a function of dose. The dose-response model is based on high- to low-dose extrapolation and assumes that there is no lower threshold for the initiation of toxic effects. Specifically, cancer effects observed at high doses in laboratory animals, or from occupational or epidemiological studies, are extrapolated using mathematical models to low doses common to environmental exposures. These models are essentially linear at low doses, such that no dose is without some risk of cancer. None of the chemicals selected for quantitative evaluation are associated with carcinogenic effects by the pathways evaluated in either the baseline risk assessment or this revised risk assessment.

5.1.2 Noncancer Effects

Chronic RfDs are defined as an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without appreciable risk of noncancer effects during a lifetime of exposure (USEPA 1989). Chronic RfDs are specifically developed to be protective for long-term exposure to a chemical and are generally used to evaluate the potential noncancer effects associated with exposure periods of 7 years to a lifetime. RfDs are expressed as mg/kg-day and are calculated using lifetime average body weight and intake assumptions. The noncancer toxicity criteria is presented in Table C5-1.

RfD values are derived from experimental data on the no-observed-adverse-effect level (NOAEL) or lowest-observed-adverse-effect level (LOAEL) in animals or humans. The NOAEL is the highest tested chemical dose given to animals or humans that has not been associated with any adverse health effects. The LOAEL is the lowest chemical dose at which health effects have been reported. RfDs are calculated by dividing the NOAEL or LOAEL by a total uncertainty factor, which represents a combination of individual factors for various sources of uncertainty associated with the database for a particular chemical or with the extrapolation of animal data to humans. IRIS also assigns a level of confidence in the RfD. The level of confidence is rated as either high, medium, or low based on confidence in the study and confidence in the database.

In EPA's methodology, which is used to derive chronic RfDs, uncertainty factors (UFs) are applied to the NOAEL or LOAEL of the critical research study. These UFs are used to address the uncertainties and variabilities that are present in the data set for each individual chemical (see Section 4.4.5 of USEPA 2002c). The uncertainty factors (up to 5) are assigned values of either

10 or 3, these values are multiplied together, and then the critical study NOAEL or LOAEL is divided by the total UF (see Section 4.4.5 of USEPA 2002c).

5.2 DERMAL TOXICITY CRITERIA

Most oral RfDs are expressed as an administered dose, i.e., the amount of substance taken into the body by swallowing. In contrast, exposure estimates for the dermal route of exposure are expressed as an absorbed dose, i.e., the amount of chemical that is actually absorbed through the skin. Because dermal toxicity criteria are not readily available, oral toxicity values are used in conjunction with an absorption correction factor to adjust for the difference in administered to absorbed dose. The magnitude of the dermal absorption correction factor is inversely proportional. For example, assume a chemical has an oral (administered) RfD of 10 mg/kg-day. If 100 percent of the administered safe dose is absorbed, then the absorbed dose will be equal to 10 mg/kg-day. If only 50 percent of the administered safe dose is absorbed, then the absorbed safe dose is 50 percent less, or 5 mg/kg-day. Therefore, essentially only half of the amount of chemical that is actually swallowed will cause adverse effects, because only half is actually absorbed into the body. EPA recommends absorption correction factors for a limited amount of inorganic chemicals in Exhibit 4-1 of their supplemental guidance for dermal risk assessment (USEPA 2003). For those chemicals that do not appear on the table, the recommendation is to assume 100 percent absorption (USEPA 2003). In other words, the dermal toxicity criteria would not differ from the oral toxicity criteria.

In this instance, only cadmium has a recommended absorption correction factor of 2.5 percent. The cadmium oral RfD was adjusted downward by multiplying the RfD by 2.5 percent (0.025) to derive a dermal RfD for cadmium. For the remaining chemicals quantitatively evaluated in this risk assessment, the default assumption of 100 percent absorption was used. Assuming 100 percent absorption is a nonconservative approach (USEPA 1989).

Table C5-1
Noncarcinogenic Chronic Toxicity Criteria for the Selected Chemicals

Chemical	Chronic RfD (mg/kg-day)	Toxic Endpoint	Critical Study	Chronic RfD UF[a]	RfD Source
Oral Exposures					
Cadmium	1.0E-03	Renal effects	Chronic human studies	10	IRIS
Hexavalent chromium	3.0E-03	None reported	Chronic rat studies	300	IRIS
Mercuric chloride[b]	3.0E-04	Autoimmune effects	Chronic rat studies	1,000	IRIS
Methyl mercury[b]	1.0E-04	Central nervous system	Chronic human studies	10	IRIS
Silver	5.0E-03	Discoloration of the skin	Chronic human studies	3	IRIS
Dermal Exposures					
Cadmium	2.5E-04 [c]	Renal effects	Chronic human studies	10	IRIS

[a] EPA indicates that there are generally 5 areas of uncertainty where an application of a UF may be warranted:

1. variation between species (applied when extrapolating from animal to human)
2. variation within species (applied to account for differences in human response and sensitive subpopulations)
3. use of a subchronic study to evaluate chronic exposure
4. use of a LOAEL, rather than a NOAEL
5. deficiencies in the data base

[b] The RfD for mercuric chloride was used to evaluated mercury exposures in sediment. The RfD for methylmercury, the more toxic form of the metal, was used to evaluate mercury exposures in clam tissue.

[c] The cadmium dermal RfD was derived by applying the gastrointestinal absorption factor of 2.5 percent to the oral RfD, as recommended in EPA (USEPA 2003). Cadmium is the only chemical evaluated by the dermal route in this assessment.

Notes:
EPA - U.S. Environmental Protection Agency
IRIS - Integrated Risk Information System (EPA's online data base)
LOAEL - lowest-observed-adverse-effect-level
mg/kg-day - milligram per kilogram per day
NOAEL - no-observed-adverse-effect-level
RfD - Reference Dose
UF - Uncertainty factor

6.0 RISK CHARACTERIZATION

Risk characterization is the summarizing step of risk assessment (USEPA 1989). In the risk characterization, the toxicity values (RfDs and SFs) are applied in conjunction with the concentrations of COCs and intake assumptions to estimate cancer risks and health hazards other than cancer.

Noncancer health hazards and cancer risks were calculated for RME exposure conditions. RME hazard/risk estimates are based on the maximum exposure that is reasonably expected to occur at a site. Intake parameter values were selected so that the combination of all parameters resulted in an estimate of the RME for a particular exposure pathway. By design, the estimated RME is higher than that expected to be experienced by most of the exposed population.

6.1 METHODOLOGY FOR ASSESSING NONCANCER HAZARDS FOR CHEMICALS OTHER THAN LEAD

The potential for adverse health effects other than cancer (noncancer effects) was characterized by dividing estimated chemical intakes by chemical-specific RfDs. The resulting ratio is the hazard quotient (HQ), derived as follows:

$$\text{HQ} \quad \frac{\text{Chemical Intake (mg/kg-day)}}{\text{RfD (mg/kg-day)}}$$

EPA risk assessment guidelines consider the additive effects associated with simultaneous exposure to several chemicals by specifying that all HQs initially be summed across exposure pathways and chemicals to estimate the total hazard index (USEPA 1989). This summation conservatively assumes that the toxic effects of all chemicals would be additive, or, in other words, that all chemicals cause the same toxic effect and act by the same mechanism.

If the total hazard index is less than or equal to 1, multiple-pathway exposures to COCs at the site are considered unlikely to result in an adverse effect (USEPA 1989 and Ecology 2001). If the total hazard index is greater than 1, further evaluation of exposure assumptions and toxicity, including consideration of specific affected target organs and the mechanisms of toxic actions of COCs, is warranted to ascertain whether the cumulative exposure would in fact be likely to harm exposed individuals.

Lead is evaluated differently than all other chemicals. Lead will be discussed separately in Section 6.4.

6.2 METHODOLOGY FOR EVALUATING CANCER RISK

The potential for carcinogenic effects are evaluated by estimating the probability of developing cancer over a lifetime, based on exposure assumptions and chemical-specific toxicity criteria. The increased likelihood of cancer due to exposure to a particular chemical is defined as the excess cancer risk (i.e., in excess of a background cancer risk of one chance in three [0.3, or 3×10^{-1}] for every American female and one chance in two [0.5, or 5×10^{-1}] for every American male of eventually developing cancer [ACS 2001]). Excess lifetime cancer risk is estimated by multiplying the estimated chemical intake by the cancer SF, as follows.

$$\text{Cancer Risk} = \text{Chemical Intake (mg/kg-day)} \times \text{SF (mg/kg-day)}^{-1}$$

None of the chemicals selected for quantitative evaluation are associated with carcinogenic effects by the pathways evaluated in either the baseline HHRA or this revised HHRA.

6.3 RISK CHARACTERIZATION RESULTS FOR NON-LEAD CHEMICALS

The ROD specified that the factors used in the risk assessment equations for the post-ROD evaluation were to be the same factors as were used in the original baseline HHRA. The risk results using the baseline HHRA exposure factors are referred to as “baseline” risks. In addition, because of the 5-year review requirements to evaluate the effects of new information, a second set of risk calculations was performed using new information. This second set of risk results are referred to as “revised” risks.

Total RME risks and hazards are summarized on Tables C6-1 and C6-2. Note that all final hazard estimates are presented to one significant figure only, as recommended by EPA (USEPA 1989). Therefore, an HQ of 1 could range between 0.95 and 1.4. Details of the calculations with hazards presented to two significant figures can be found in Attachment C-4. The hazards for each exposure scenario are discussed in the following subsections.

6.3.1 Risk Results Based on Baseline Risk Assumptions

Noncancer hazards were estimated for subsistence and recreational exposures using the same exposure assumptions that were used in the baseline HHRA: ingestion of clams by subsistence populations; and ingestion of clams by recreational populations and recreational exposures to sediment through ingestion (U.S. Navy 1993). None of the chemicals that were selected for quantitative evaluation are associated with carcinogenic effects by these pathways. Therefore, cancer risks were not estimated. This subsection summarizes the results of the risk calculations using the baseline assumptions.

As shown on Table C6-1, for subsistence exposures to chemicals in clam tissue, the cumulative hazard index is 2 (or 1.5 if not rounded up), slightly above EPA and Ecology's target health goal of 1. Cadmium contributed (60 percent) the majority to the total hazards from ingestion of clam tissue, with a hazard quotient of 0.9. Chromium and methylmercury both had hazard quotients of 0.3, and each contributed 20 percent to the total hazard. Although the cumulative hazard index slightly exceeds the target health goal of 1, it is likely an overestimate of risk because the toxic endpoint for each chemical of concern is different, as listed on Table C6-1. The EPA (USEPA 1989) recommends only summing hazard indices for those chemicals with the same toxic effect. Therefore, the concentrations of chemicals in clam tissue are not a health concern to subsistence populations, based on the assumptions used in the baseline HHRA.

Also shown on Table C6-1, the cumulative hazard index for combined recreational exposures to sediments and clams is 0.08 and 0.6 for children and adults, respectively. Children were not evaluated for the clam ingestion pathway; therefore, the total hazard for children of 0.08 is due completely to exposures to chemicals in sediment through ingestion. This hazard index is well below the target health goal of 1, indicating that concentrations of chemicals in sediment are not likely present in concentrations that are a health concern for children. The cumulative total hazard index for adults of 0.6 is almost completely due (99 percent) to ingestion of clam tissue. The hazard index for adult ingestion of clams is 0.6, and the hazard index for adult ingestion of sediment 0.002. Cadmium contributed (57 percent) the majority to the total hazards from ingestion of clam tissue, with a hazard quotient of 0.4. Chromium and methylmercury both had hazard quotients of 0.1, and each contributed 20 percent to the total hazard. Because the total hazard index does not exceed the target health goal of 1, concentrations of chemicals in sediments and clam tissue are not likely to be present in concentrations that are a health concern to recreational populations, based on the assumptions used in the baseline HHRA.

6.3.2 Risk Results Based on Revised Risk Assumptions

Noncancer hazards were estimated for subsistence and recreational exposures using updated and more recent exposure assumption data for the populations identified in the baseline HHRA: dermal contact and incidental ingestion of sediment by subsistence populations; and ingestion of clams by recreational populations and dermal contact and incidental ingestion of sediment by recreational populations. None of the chemicals that were selected for quantitative evaluation is associated with carcinogenic effects by these pathways. Therefore, cancer risks were not estimated. This subsection summarizes the results of the risk calculations using the revised exposure assumptions.

As shown on Table C6-2, for subsistence combined exposures to chemicals in sediment and clam tissue, the cumulative hazard index for adults is 2, slightly above EPA and Ecology's target health goal of 1. The cumulative hazard index for children is 0.5, which is below target health goals. The cumulative total hazard index for adults is almost completely due (99 percent) to ingestion of clam tissue (sediment hazard index is 0.04). Cadmium contributed (60 percent) the majority to the total hazards from ingestion of clam tissue, with a hazard quotient of 0.9. Chromium and methylmercury both had hazard quotients of 0.3, and each contributed 20 percent to the total hazard. As mentioned previously in Section 6.3.1, although the cumulative hazard index for clam tissue slightly exceeds the target health goal, no individual hazard index exceeds the target goal of 1. Therefore, the concentrations of chemicals in clam tissue are not a health concern to adult subsistence populations, based on the revised risk assumptions.

For the child subsistence scenario, the cumulative hazard index is 0.5 for sediment. Children were not evaluated for the clam ingestion pathway. Chromium is the greatest contributor to hazards in sediment, contributing 80 percent. Because the total hazard index does not exceed the target health goal of 1, concentrations of chemicals in sediment are not likely to be present in concentrations that are a health concern to child subsistence populations, based on the revised risk assumptions.

Also shown on Table C6-2, the cumulative hazard index for combined recreational exposures to sediments and clams is 0.04 for children and 0.2 for adults. Children were not evaluated for the clam ingestion pathway. Therefore, the total hazard for children of 0.04 is due completely to exposures to chemicals in sediment through ingestion and dermal contact. This hazard index is well below the target health goal of 1, indicating that concentrations of chemicals in sediment are not likely present in concentrations that are a health concern for children. The cumulative total hazard index for adults of 0.2 is almost completely due (99 percent) to ingestion of clam tissue. The hazard index for adult ingestion of clams is 0.2, and the hazard index for adult ingestion and dermal contact with sediment is 0.001. Cadmium contributed (57 percent) the majority to the total hazards from ingestion of clam tissue, with a hazard quotient of 0.1. Chromium and methylmercury both had hazard quotients of 0.04, and each contributed 20 percent to the total hazard. Because the total hazard index does not exceed the target health goal of 1, concentrations of chemicals in sediments and clam tissue are not likely to be present in concentrations that are a health concern to adult recreational populations, based on the revised risk assumptions.

6.4 RISK CHARACTERIZATION RESULTS FOR LEAD IN CLAM TISSUE

Lead in clam tissue was selected as a chemical requiring quantitative evaluation (see Section 3.2). Exposures to lead are evaluated differently than all other chemicals. Lead is a ubiquitous chemical, and exposures to lead occur through many sources unrelated to site exposures (e.g., lead paint, lead in drinking water, and background lead in air). Because lead is a developmental toxicant, children and unborn fetuses are of most concern for exposures to lead.

Unlike other chemicals, health effects associated with lead have been related to a specific biological measure—blood lead levels. Therefore, lead exposure is assessed by estimating its affect on increasing blood lead levels, rather than by comparison of a calculated dose to a health-protective reference dose. EPA has determined blood lead effect levels of 10 µg lead per deciliter (Pb/dL) for children and of 30 µg Pb/dL for pregnant women and adults (USFDA 1993). These values are the lowest blood lead levels where observable health effects have been reported (USFDA 1993).

To estimate the effects of environmental lead exposures on increasing blood lead levels, a great deal of site-specific information is required, including the amount of lead in residential soil, house dust, drinking water, etc. For this assessment, a more semi-quantitative approach was used to determine whether lead in clam tissue could present a health concern. A lead level of concern in clam tissue was estimated, and the concentration measured in clam tissue was compared to the lead level of concern. The approach used to calculate the lead level of concern in clam tissue is discussed below.

The relationship between lead intake and blood lead levels in children and adults has been estimated to be 0.16 and 0.04 µg Pb/dL blood per µg Pb/day ingested, respectively. Therefore, the target blood lead levels can be converted to dietary effect levels for each population of concern by applying these conversion factors. The lowest dietary effect level of 60 µg Pb/day is calculated for children ages 0 to 6 years, followed by a dietary effect level of 150 µg Pb/day for children 7 years and older, a dietary effect level of 250 µg Pb/day for pregnant women, and a dietary effect level of 750 µg Pb/day for adults. The FDA has adjusted these values by a factor of 10 to establish a provisional total tolerable intake level (PTTIL) of 6, 15, 25, and 75 µg Pb/day for each population (USFDA 1993). This adjustment factor of 10 was applied to achieve a level where some margin of safety would be reached when assuming that total lead exposure is derived solely from shellfish, which is often not the case.

The FDA has developed a methodology for determining a level of concern in shellfish protective of the PTTIL for children and adult populations (USFDA 1993). A total lead level of concern in shellfish can be estimated by dividing the PTTIL by the daily intake rate of shellfish, in this case, the clam ingestion rate (see Section 4.3 for a discussion of clam ingestion rates). For example, the lead level of concern of 0.7 mg/kg for subsistence children aged 0 to 6 years is calculated by dividing the PTTIL for subsistence children of 6 µg Pb/day by the intake rate of 8.6 g/day. The following is the equation used for this calculation:

$$PbLOC = \frac{PTTIL}{IR} \times CF$$

where:

PbLOC = lead level of concern in clam tissue (mg/kg)
PTTIL = provisional total tolerable intake level (µg Pb/day)
IR = clam intake rate (mg/day)
CF = conversion factor (10^3 g/kg x 10^{-3}mg/µg)

Table C6-3 summarizes the clam ingestion rates used in the risk assessment for each population and the resulting shellfish lead level of concern.

For evaluating exposures to lead, the arithmetic mean lead concentration is typically used as the EPC, rather the UCL95. The average lead concentration in clam tissue at this site is 0.089 mg/kg. The average lead concentration does not exceed the shellfish lead level of concern for any age group under either the recreational or subsistence scenario. Therefore, lead is not likely to be present in clam tissue in concentrations that are a concern for recreational or subsistence populations who consume clams from Liberty Bay.

6.5 RISK CHARACTERIZATION SUMMARY AND CONCLUSIONS

Noncancer hazards were calculated for recreational and subsistence exposures to chemicals in sediment and clam tissue using both the baseline assumptions used in the baseline HHRA and revised assumptions developed for this risk assessment. Target health goals were not exceeded under any exposure scenario for either subsistence or recreational exposures. Therefore, concentrations of chemicals in sediment and clam tissue are not likely present in concentrations that are a health concern for the recreational or subsistence populations. The results and conclusions of the risk characterization are summarized below:

- Based on baseline risk assumptions, the hazard indices for adult subsistence exposure to chemicals in clam tissue are below EPA and Ecology’s target health goal of 1.
- Based on baseline risk assumptions, the cumulative hazard for child and adult recreational exposures to sediment were 0.08 and 0.002, respectively, which are well below the target health goal of 1.
- Based on baseline risk assumptions, the cumulative hazard index for adult recreational exposures to chemicals in clam tissue is 0.6, which is below target health goals.

- Based on revised risk assumptions, the cumulative hazard for child and adult subsistence exposures to sediment were 0.5 and 0.04, respectively, which are well below target health goals.

- Based on revised risk assumptions, the cumulative hazard index for adult recreational exposures to chemicals in clam tissue is 0.2, which is below target health goals.

- Based on revised risk assumptions, the cumulative hazard for child and adult recreational exposures to sediment were 0.04 and 0.001, respectively, which are well below target health goals.

- All chemicals quantitatively evaluated in this risk assessment have different toxic endpoints (see Table C5-1). All hazards for the individual chemicals are below 1 indicating that no chemicals evaluated at this site are present in concentrations that warrant a health concern based on the exposure assumptions used in this assessment.

- Chromium was evaluated assuming its composition is 100 percent hexavalent chromium, the most toxic form of the chromium compounds. While the source of chromium from the former plating shop at Area 8 is hexavalent chromium, hexavalent chromium typically rapidly reduces to the less toxic form, trivalent chromium. Therefore, a smaller portion of the total chromium concentrations is likely composed of hexavalent chromium. However, as hexavalent chromium is the more toxic form of the chemical, it was conservatively assumed that the chromium measured in sediment and tissue is 100 percent hexavalent chromium. See further discussion in the uncertainty section (Section 7).

- The average lead concentration does not exceed the shellfish lead level of concern for any group under either the recreational or subsistence scenario. Therefore, lead is not likely to be present in clam tissue in concentrations that are a concern for recreational or subsistence populations who consume clams from Liberty Bay.

Table C6-1
Summary of Total RME Hazards–Baseline Risk Assumptions

Chemicals of Concern	Sediment Child HI	Sediment Adult HI	Clam Tissue Child HI	Clam Tissue Adult HI	Total Child HI	Total Adult HI	Toxic Endpoint in IRIS
Subsistence							
Cadmium	NE	NE	NE	0.9	NE	0.9	Renal effects
Chromium [(1)]	NE	NE	NE	0.3	NE	0.3	None reported
Mercury (Mercuric chloride)	NE	NE	[(2)]	[(2)]	NE	NE	Autoimmune effects
Methylmercury	NE	NE	NE	0.3	NE	0.3	CNS
Silver	NE	NE	NE	0.05	NE	0.05	Discoloration of skin
Total Hazard/Risk	NE	NE	NE	2	NE	2	
Recreational							
Cadmium	0.01	0.0004	NE	0.4	0.01	0.4	Renal effects
Chromium [(1)]	0.06	0.002	NE	0.1	0.06	0.1	None reported
Mercury (Mercuric chloride)	0.008	0.0002	NE	NE	0.008	0.0002	Autoimmune effects
Methylmercury	[(2)]	[(2)]	NE	0.1	NE	0.1	CNS
Silver	[(2)]	[(2)]	NE	0.02	NE	0.02	Discoloration of skin
Total Hazard/Risk	0.08	0.002	NE	0.6	0.08	0.6	

[(1)] It was assumed that chromium is composed of 100% Chromium VI.

[(2)] Chemical was not selected for further evaluation in this medium.

Notes:
CNS - central nervous system
HI - hazard index
IRIS - Integrated Risk Information System (U.S. Environmental Protection Agency's online database)
NE - not evaluated
RME - reasonable maximum exposure

Table C6-2
Summary of Total RME Hazards–Revised Risk Assumptions

Chemicals of Concern	Sediment		Clam Tissue (1)		Total		
	Child HI	Adult HI	Child HI	Adult HI	Child HI	Adult HI	Toxic Endpoint in IRIS
Subsistence							
Cadmium	0.09 (2)	0.007 (2)	NE	0.9	0.09	0.9	Renal effects
Chromium (3)	0.4	0.03	NE	0.3	0.4	0.3	None reported
Mercury (Mercuric chloride)	0.05	0.004	(4)	(4)	0.05	0.004	Autoimmune effects
Methylmercury	(4)	(4)	NE	0.3	NE	0.3	CNS
Silver	(4)	(4)	NE	0.05	NE	0.05	Discoloration of skin
Total Hazard/Risk	0.5	0.04	NE	2	0.5	2	
Recreational							
Cadmium	0.007 (5)	0.0002 (5)	NE	0.1	0.01	0.1	Renal effects
Chromium (3)	0.03	0.0008	NE	0.04	0.03	0.04	None reported
Mercury (Mercuric chloride)	0.004	0.0001	(4)	(4)	0.004	0.0001	Autoimmune effects
Methylmercury	(4)	(4)	NE	0.04	NE	0.04	CNS
Silver	(4)	(4)	NE	0.01	NE	0.01	Discoloration of skin
Total Hazard/Risk	0.04	0.001	NE	0.2	0.04	0.2	

(1) These clam tissue risks are from the baseline risk assumptions shown on Table C6-1.

(2)The hazard index for cadmium exposures in sediment for the revised risk calculations includes the hazards from both the ingestion and dermal pathways. For the child receptor age, the ingestion hazard for cadmium in sediment is 0.08 and the dermal hazard for cadmium in sediment is 0.006. For the adult receptor, the ingestion hazard for cadmium in sediment is 0.006 and the dermal hazard for cadmium in sediment is 0.001.

(3)It was assumed that chromium is composed of 100% Chromium VI.

(4)Chemical was not selected for further evaluation in this medium.

(5)The hazard index for cadmium exposure in sediment for the revised risk calculations includes the hazards from both the ingestion and dermal pathways. For the child receptor age, the ingestion hazard for cadmium in sediment is 0.006 and the dermal hazard for cadmium in sediment is 0.0005. For the adult receptor, the ingestion hazard for cadmium in sediment is 0.0002 and the dermal hazard for cadmium in sediment is 0.00007.

Notes:
CNS - central nervous system
HI - hazard index
IRIS - Integrated Risk Information System (U.S. Environmental Protection Agency's online database)
NE - not evaluated
RME - reasonable maximum exposure

Table C6-3
Summary of Lead Levels of Concern in Shellfish

Scenario	Clam Ingestion Rate (g/day)		Lead Levels of Concern in Shellfish (mg/kg)			
	Child (0 to 6 yr)	Adult	Child 0 to 6 yr (PTTIL = 6 µg Pb/day)	Child >7 yr (PTTIL = 15 µg Pb/day)	Pregnant Woman (PTTIL = 25 µg Pb/day)	Adult (PTTIL = 75 µg Pb/day)
Recreational	--	17.5	--	0.86	1.4	4.3
Subsistence[a]	8.6	132	0.7	0.11	0.19	0.57

[a] Clam ingestion rates for children were obtained from Toy, et al. (1996) and for adults from U.S. Environmental Protection Agency's (USEPA 1991b) subsistence default.

Notes:
g/day – gram per day
µg Pb/day – microgram of lead per day
mg/kg – milligram/kilogram
yr – year

7.0 UNCERTAINTIES IN RISK ASSESSMENT

The purpose of the uncertainty section is to describe, in a qualitative way, where there are major uncertainties in the risk assessment process that could affect the conclusions of the risk assessment. Estimating and evaluating health risk from exposure to environmental chemicals is a complex process with inherent uncertainties. Uncertainty reflects limitations in knowledge, and simplifying assumptions must be made in order to quantify health risks.

This section is organized according to uncertainties relating to (1) the data and chemical selection, (2) the assumptions about exposure, (3) the assumptions about toxicity, and (4) the characterization of health risks.

There are uncertainties regarding the quantification of health risks in terms of a number of assumptions about both exposure and toxicity, including both site-specific and general uncertainties. Based on anticipation of uncertainty when quantifying exposure and toxicity, the health risks and hazards presented in this risk assessment are more likely to indicate that chemicals are exceeding target risk goals, although health risks may actually be negligible. Risk assessment methodology is less likely to indicate that chemicals are not a health risk when they actually are. This process is necessary to ensure the protection of public health and the environment.

Uncertainty in the risk assessment produces the potential for two kinds of errors. The first potential, or Type I, error is the identification of a specific chemical, area, or activity as a health concern when, in fact, it is not a concern (a false positive conclusion). The second potential, or Type II, error is the elimination of a chemical, area, or activity from further consideration when, in fact, there should be a concern (a false negative conclusion). In the risk assessment, uncertainties were handled conservatively (i.e., health protective choices were preferentially made). This strategy is more likely to produce false positive errors than false negative errors.

The following sections provide additional detail regarding uncertainties in the estimations of health risks.

7.1 DATA COLLECTION AND EVALUATION

The data evaluation process addresses whether (1) chemicals are potentially present in various environmental media at levels of health concern, (2) site concentrations are different from background, and (3) sufficient samples have been collected to fully characterize each exposure pathway.

A total of 30 sediment and clam tissue samples from nine stations were collected during post-ROD monitoring in 1996, 2000 (U.S. Navy 2001), and 2004. Sufficient samples are available to adequately characterize chemical concentrations in sediment and clam tissue.

Chemicals were selected appropriately for sediment and clam tissue based on the available data. All chemicals in sediment that exceeded a screening criterion were selected for quantitative evaluation. Three chemicals were screened out of clam tissue based on infrequent detection and infrequent exceedance or low magnitude of exceedance of its screening values: dibenzo(a,h)anthracene, benzo(a)pyrene, and bis(2-ethylhexyl)phthalate (see Table C3-2). These chemicals were only detected in 1 or 2 out of 18 samples (5 and 11 percent). However, the SQLs for all three of these chemicals are greater than their respective screening values. Therefore, even though these chemicals were detected infrequently, it is not known with certainty whether these chemicals are present in concentrations greater than their respective screening values. Cancer risks and noncancer hazards could be underestimated for the clam ingestion pathway, because these chemicals were excluded from quantitative evaluation.

Because the possibility of underestimating risk, cancer risks were calculated for the three SVOC chemicals using the maximum detected concentrations for the subsistence clam ingestion scenario, assuming the baseline risk assumptions. Cumulative cancer risks were 6×10^{-6}, which is within EPA's target risk range of 1×10^{-6} to 1×10^{-4} and below Ecology's target risk level of 1×10^{-5}. Noncancer hazards were also calculated using the maximum detected concentrations of these three chemicals for the subsistence scenario. Noncancer hazards were 0.001 and 0.01 for child and adult exposures, respectively, which are well below target health goals. Therefore, while exclusion of these chemicals from quantitative evaluation may have underestimated risks for the clam ingestion pathway, the conclusions of the risk assessment would not change. Using the maximum detected concentrations of these three chemicals in the most conservative scenario evaluated in this risk assessment resulted in risks that were equal to target health goals. If risks were calculated using the UCL95, the cumulative risks would likely decrease to below target health goals for these chemicals.

All the data collected during the three sampling events were included in the risk assessment, except six clam tissue samples collected in 1996 that were analyzed for hexavalent chromium using Analytical Method 7197. The analytical method used to speciate chromium in environmental samples is uncertain (see chapters 1.2 and 3 of the EPA's Method SW-846). Method 6010 for total inorganics is a more widely accepted method for analyzing concentrations of metals in environmental samples. The hexavalent chromium results were greater in four of the six samples than the total chromium results analyzed by Method 6010, as shown in Table C7-1. Therefore, the hexavalent chromium data are not likely representative of actual hexavalent chromium concentrations in clam tissue. These results were, therefore, excluded from the data evaluation. The total chromium results analyzed by Method 6010 were assumed to be composed of 100 percent hexavalent chromium, because the source of chromium from the former plating shop at Area 8 is hexavalent chromium. While assuming that the total chromium results are composed of 100 percent hexavalent chromium likely overestimates the actual hexavalent chromium concentrations in the environmental samples, this assumption was assumed to be a better approximation of hexavalent chromium concentrations than the speciated data. If the hexavalent chromium data were used to calculate hazards for clam tissue, then noncancer hazards for chromium for adult subsistence exposures to clam tissue based on the revised assumptions would increase from 0.3 to 0.8, and the cumulative hazards would still round to 2, which is slightly above the target health goal of 1.

7.2 EXPOSURE

For estimating the RME, UCL95 values, or upper-bound estimates of national averages are generally used for exposure assumptions. The intent of RME, as discussed by the EPA Deputy Administrator and the Risk Assessment Council (Habicht 1992) is to present risks as a range from central tendency to high-end risk (“above the 90th percentile of the population distribution”). This descriptor is intended to estimate the risks that are expected to occur in “small but definable ‘high end’ segments of the subject population” (Habicht 1992). EPA makes a distinction between scenarios that are possible, but highly improbable, and those that are conservative, but more likely to occur within a population, with the latter being favored in risk assessment. RME calculations thus overestimate risk for the majority of a hypothetical population, even though all assumptions may not be at their maximum.

Individuals within a population may have higher exposure rates than assumed by the separate exposure assumptions. However, the RME values used represent the maximum exposures that could reasonably be expected to occur in the population.

The assumption of a 70-year averaging time used in EPA RME assumptions tends to overestimate carcinogenic risks, which are prorated over the lifetime. The current life expectancy in the United States is actually 75.7 years (Bureau of the Census 1994). Thus, technically, 75.7 years should be used in the risk calculations rather than the default 70-year value.

The clam ingestion rate used in the baseline HHRA (U.S. Navy 1993) was 132 g/day, which was EPA’s default fish ingestion rate for subsistence populations (USEPA 1991b). This value is considered to be a reasonable maximum estimate of clam ingestion rates by subsistence populations in the Liberty Bay area. However, there may be some individuals who consume more or less clams than this ingestion rate assumes. In addition, seafood consumers may be exposed to chemicals in shellfish other than clams.

The sediment ingestion rate used in both the baseline risk assumptions and the revised risk assumptions is the EPA's residential default soil ingestion rate for children of 200 mg/day and for adults of 100 mg/day. Using this ingestion rate to evaluate recreational exposures to sediment while digging for clams is likely an overestimation. This assumes that 100 percent of their daily ingestion of soil is occurring during the time spent while claming at the beach at Liberty Bay.

7.3 TOXICITY ASSESSMENT AND HAZARD CALCULATIONS

Toxicity values have been developed by the EPA from the available toxicological data. These values frequently involve high-to-low-dose extrapolations and are often derived from animal rather than human data. In addition, there may be few studies available for a particular chemical. As the unknowns increase, the uncertainty of the value increases. Uncertainty is addressed by reducing RfDs using uncertainty factors and by deriving SF using a conservative model. The greater the uncertainty, the greater the uncertainty factors and tendency to overestimate the toxicity.

7.4 SUMMARY

Every aspect of the risk assessment contains multiple sources of uncertainty. Simplifying assumptions are often made so that health risks can be estimated quantitatively. Because the exact amount of uncertainty cannot be quantified, the risk assessment is intended to overestimate rather than underestimate probable risk. The results of this assessment therefore, are likely to be protective of health despite the inherent uncertainties in the process.

Table C7-1
Comparison of Hexavalent Chromium and Total Chromium Results in Clam Tissues Collected in 1996

Location	Method 7197 Hexavalent Chromium (wet weight mg/kg)	Method 6010 Total Chromium (wet weight mg/kg)
No. 12	3.6	3.39
No. 3	2.2	8.78
No. 5	1.7	2.75
No. 7	6.5	0.39
No. 8	4	2.2
No. 9	5.9	3.24

Notes:
mg/kg – milligram per kilogram
No. - number

8.0 SUMMARY AND CONCLUSIONS

The ROD specified that post-ROD sediment and clam tissue samples from Liberty Bay were to be evaluated, using risk assessment procedures, to assess whether health risks were present. The results of the evaluation were to be used to assess whether further remedial actions were needed for groundwater entering Liberty Bay. This section provides a summary of the HHRA for sediment and clam tissue conducted for OU 2 Area 8. The risk assessment evaluated potential health risks to two populations—subsistence and recreational—who could encounter Area 8 chemicals while harvesting and eating clams.

The ROD specified that the factors used in the risk assessment equations for the post-ROD evaluation were to be the same factors as were used in the original baseline HHRA. The risk results using the baseline risk assessment exposure factors are referred to as “baseline assumption” risks. In addition, because of the 5-year review requirements to evaluate the effects of new information, a second set of risk calculations was performed using new information. This second set of risk results are referred to as “revised assumption” risks.

This risk assessment is prepared in accordance with current EPA guidelines for human health risk assessment (USEPA 1989, 1991a, 1997a, and 1998). The assessment follows available science where appropriate regulatory guidance is not available to accommodate site-specific conditions. Where information is incomplete, conservative assumptions are made so that risk to public health is not underestimated. An overview of the chemicals selected for quantitative evaluation, exposure factors, toxicity, and risk characterization using both the baseline and revised information is provided in the next sections.

8.1 CHEMICAL SELECTION PROCESS

Typically, not all chemicals present at a site pose health risks or contribute significantly to overall site risks. EPA guidelines recommend focusing on a group of COPCs based on inherent toxicity, site concentration, and behavior of the chemicals in the environment (USEPA 1989). To identify these chemicals of potential concern, risk-based screening toxicity values are compared to site concentrations of chemicals. If site concentrations of a chemical exceed their respective screening concentrations, then the chemicals are retained for quantification in the risk assessment.

The Post-ROD data collected from nine stations during 1996, 2000 (U.S. Navy 2001), and 2004 were included in the risk assessment. The OU 2 ROD (U.S. Navy, USEPA, and Ecology 1994) identified only lead and mercury as COCs in both sediment and clam tissue. At the time the

ROD was completed, there were no screening values for either mercury or lead, which, is the reason for their selection as COCs. The OU 2 ROD also required that sediment and clam tissue be analyzed for several other chemicals, including additional metals and SVOCs. Therefore, total metals and SVOCs were analyzed in sediment and clam tissue and were considered for quantitative evaluation in the risk assessment.

EPA's Region 9 PRGs for residential soil were used as sediment screening values (USEPA 2004a). The lower of EPA's (2004b) Region 3 fish ingestion RBCs (USEPA 2004a) and the tissue RBCs calculated for OU 1 (U.S. Navy 1998) were used for screening clam tissue concentrations. Chemical concentrations in sediment and tissue were compared to one-tenth of their respective screening value for noncarcinogens and the full value for carcinogens. Screening values represent concentrations below which there is no health concern. If the maximum concentration of a chemical was less than the screening value, the chemical was eliminated from the risk assessment because it would not be a health concern. The following chemicals were selected for quantitative evaluation in the risk assessment:

- In sediment:
    - Cadmium
    - Chromium
    - Mercury
- In clam tissue:
    - Cadmium
    - Chromium
    - Lead
    - Mercury
    - Silver

All chromium was assumed to be in the most toxic hexavalent form. Mercury in clams was assumed to be in the methylmercury form.

8.2 EXPOSURE ASSESSMENT

Once chemicals were selected for further evaluation, the exposure pathways by which people could encounter chemicals were assessed. Currently, clam harvesting is closed at Liberty Bay by the Washington State Department of Health (WDFW 2004). However, the future pathways selected for quantitative evaluation by which people could be exposed to chemicals in sediment and clam tissue were:

- Subsistence tribal members (adults) who dig in marine sediments while gathering clams through incidental ingestion and dermal contact
- Subsistence tribal members (adults) who ingest clam tissues
- Residents (adults and children) who dig in marine sediments while gathering clams through incidental ingestion and dermal contact
- Residents (adults) who ingest clam tissues

8.3 TOXICITY ASSESSMENT

The third step in risk assessment is an evaluation of the toxicity of the COCs by an assessment of the relationship between the dose of a chemical and the occurrence of toxic effects. Chemical toxicity criteria, which are based on this relationship, consider both cancer effects and effects other than cancer (noncancer effects). The toxicity criteria are required in order to quantify the potential health risks due to the COCs. All chemicals (where toxicity information exists) were evaluated for only noncancer effects, because none of the chemicals selected for quantitative evaluation are carcinogens by the ingestion or dermal pathway.

8.4 RISK CHARACTERIZATION

The last step in human health risk assessment is a characterization of the health risks. The exposure factors, media concentrations, and toxicity criteria are combined to calculate health risks. Health risks are calculated differently for chemicals that cause cancer and for chemicals that cause noncancer effects. Only noncancer effects were evaluated at this site. A “threshold” dose exists for chemicals with noncancer effects. Hazards (for noncancer effects) are calculated for an RME scenario for each pathway, a calculation that overestimates risks for the majority of the population to ensure that public health is protected. Noncancer hazards assume there is a level of chemical intake that is not associated with an adverse health effect even in sensitive individuals. EPA’s target health goal is 1 for noncancer chemicals.

Noncancer hazards were calculated for recreational and subsistence exposures to chemicals in sediment and clam tissue using both the baseline assumptions used in the baseline HHRA and revised assumptions developed for this risk assessment. Target health goals were not exceeded under any exposure scenario for either subsistence or recreational exposures. Therefore, concentrations of chemicals in sediment and clam tissue are not likely present in concentrations that are a health concern for the recreational or subsistence populations. Shellfish consumption contributed the majority of the hazards, and both the baseline assumptions and revised assumptions resulted in a hazard quotient of 2, which is slightly above EPA's target health goal when rounded to one significant figure, as is recommended by EPA guidance. Hazards are presented to two significant figures in the detailed risk calculations in Attachment C-4, and the revised assumption hazards were slightly higher than those for the baseline assumptions. The majority of the shellfish ingestion hazard is due to cadmium (hazard = 0.9 for baseline assumptions), followed by chromium and mercury.

The default assumption in risk assessment is that all toxic effects of chemicals are additive. However, EPA recognizes that chemicals with toxic effects on different body systems or target organs are unlikely to be additive. All chemicals quantitatively evaluated in this risk assessment have different toxic endpoints. Therefore, even though hazards exceed 1 for all chemicals added together, hazards for the individual chemicals are below 1, indicating that no chemicals evaluated at this site are present in concentrations that warrant a health concern based on the exposure assumptions used in this assessment.

Lead is a ubiquitous chemical and exposures to lead occur through many sources unrelated to site exposures (e.g., lead paint, lead in drinking water, and background lead in air). Therefore, lead is evaluated differently than all other chemicals. The FDA has developed a methodology for determining a level of concern in shellfish protective of the PTTIL for children and adult populations (USFDA 1993). A total lead level of concern in shellfish can be estimated by dividing the PTTIL by the daily intake rate of shellfish, in this case the clam ingestion rate. The average lead concentration does not exceed the shellfish lead level of concern for any age group under either the recreational or subsistence scenario. Therefore, lead is not likely to be present in clam tissue in concentrations that are a concern for recreational or subsistence populations who consume clams from Liberty Bay.

8.5 CONCLUSIONS

As stated earlier, the results of the evaluation were to be used to assess whether further remedial actions were needed for groundwater entering Liberty Bay. Based on the results of the human health evaluation, no additional remediation measures are necessary to protect human health from exposures in Liberty Bay. Because concentrations in tissue have not declined and because there is some evidence of increasing concentrations of chromium and cadmium at Seep A, continuation of the shellfish and sediment monitoring program is recommended.

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ATTACHMENT C-1

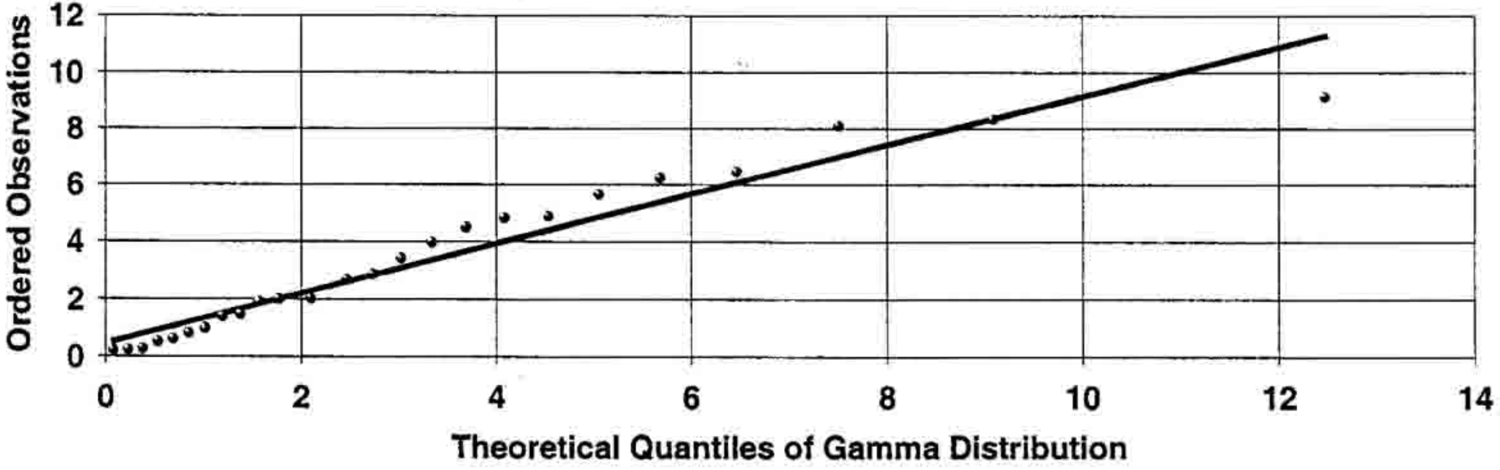
Summary Statistics and Distribution Analysis of Data Used to Calculate Sediment Exposure Point Concentrations

Summary of Statistics for Sediment

From File E:\Navy 5-year reviews\Keyport 5 year RA\Data\EPCs Sediment Keyport.xls

Variable name	NumObs	Minimum	Maximum	Mean	Median	Sd	CV	Skewness	Variance
Cd	26	0.2	9.13	3.274692	2.33	2.703491	0.825571	0.760435	7.308862
Hg	20	0.02	1.9	0.3465	0.08	0.53492	1.543782	2.115286	0.28614
Cr	30	14.1	194	54.41	44.65	40.94171	0.752467	2.093486	1676.224

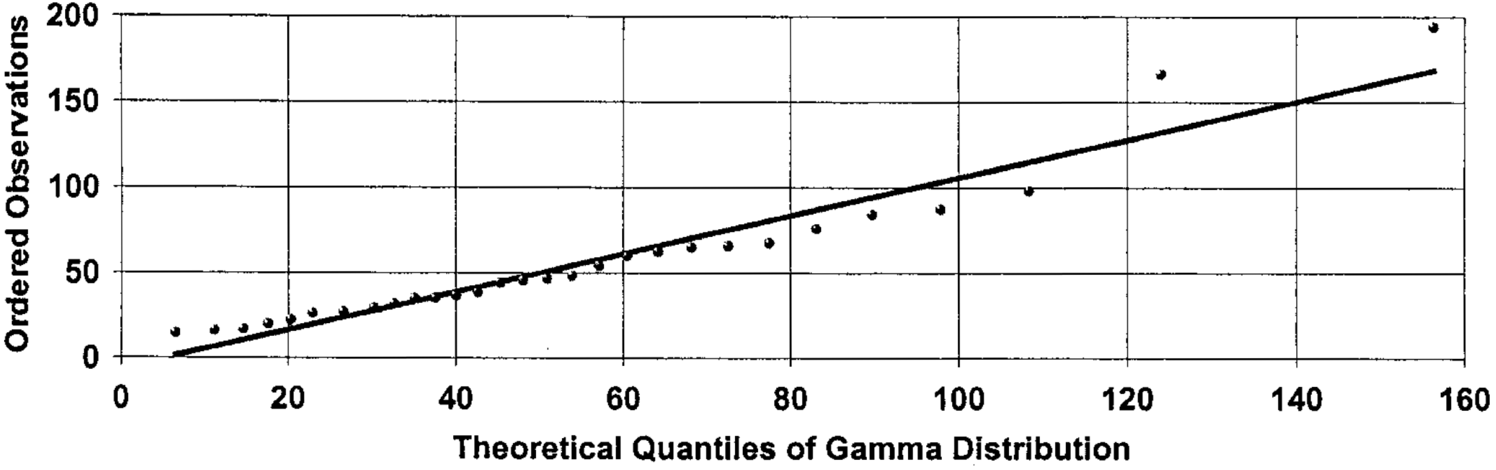
Gamma Q-Q Plot for Sediment Cd



N = 26, Mean = 3.275, k hat = 1.198
Slope = 0.869, Intercept = 0.465, Correlation, R = 0.970
K-S Test Statistic = 0.093, Critical Value(0.05) = 0.176, Data are Gamma Distributed

```
Data File    E:\Navy 5-year reviews\Keyport 5 year RA\EPCs Sediment Keyport.xls
                                                          Variable:   Cd
Number of Valid Samples                   26
Number of Distinct Samples                25
Minimum                                  0.2
Maximum                                 9.13
Mean                                3.274692
Standard Deviation                  2.703491
Variance                            7.308862
k hat                               1.197913
k star (bias corrected)             1.085333
Theta hat                           2.733665
Theta star                          3.017223
nu hat                              62.29147
nu star                             56.43733
Approx.Chi Square Value (.05)       40.16751
Adjusted Level of Significance        0.0398
Adjusted Chi Square Value           39.26045

A-D Test Statistic                   0.28169
A-D 5% Critical Value               0.768747
K-S Test Statistic                  0.093186
K-S 5% Critical Value               0.175519
Data follow gamma distribution
at 5% signifcance level

   95% UCLs (Adjusted for Skewness)
Adjusted-CLT UCL                    4.231279
Modified-t UCL                      4.193524

   95% Non-parametric UCLs
Bootstrap-t UCL                      4.31637
Hall's Bootstrap UCL                4.169608

   95% Gamma UCLs (Assuming Gamma Distribution)
Approximate Gamma UCL               4.601104
Adjusted Gamma UCL                  4.707407

Data follow gamma distribution (0.05)

Recommended UCL to use:

      Use Approximate Gamma UCL
```

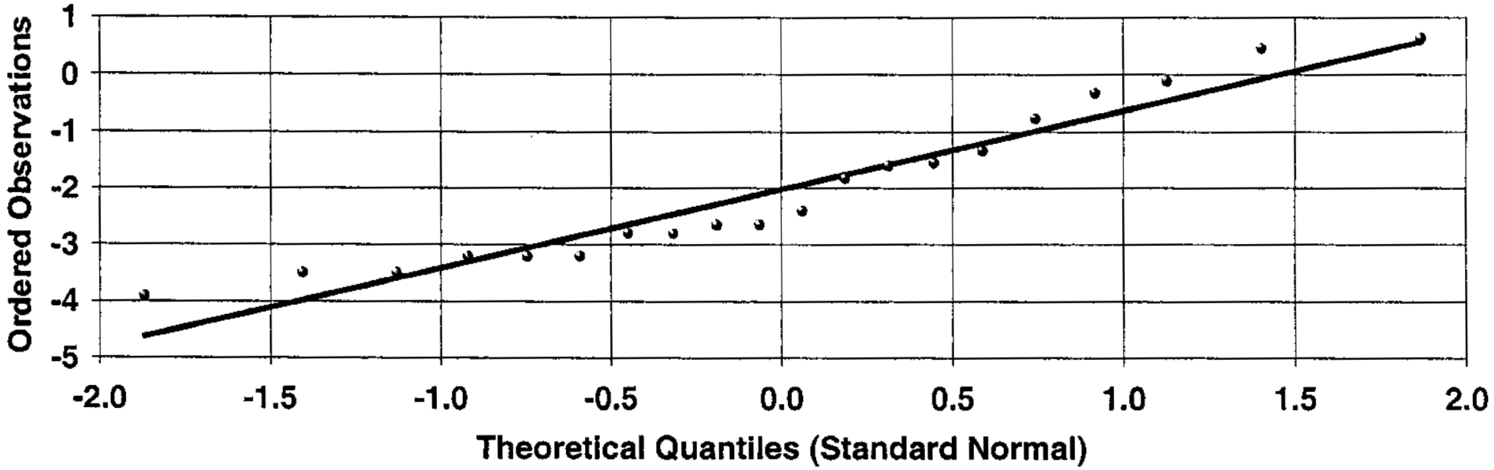
Gamma Q-Q Plot for Sediment Cr



N = 30, Mean = 54.410, k hat = 2.498
Slope = 1.116, Intercept = -5.981, Correlation, R = 0.964
K-S Test Statistic = 0.092, Critical Value(0.05) = 0.162, Data are Gamma Distributed

```
Data File    E:\Navy 5-year reviews\Keyport 5 year RA\Data\EPCs Sediment Keyport.xls
                                                       Variable:  Cr
           Raw Statistics                                Normal Distribution Test
Number of Valid Samples                30      Shapiro-Wilk Test Statisitic              0.783388
Number of Unique Samples               29      Shapiro-Wilk 5% Critical Value               0.927
Minimum                              14.1      Data not normal at 5% significance level
Maximum                               194
Mean                                54.41        95% UCL (Assuming Normal Distribution)
Median                              44.65      Student's-t UCL                            67.1108
Standard Deviation               40.94171
Variance                         1676.224               Gamma Distribution Test
Coefficient of Variation         0.752467      A-D Test Statistic                        0.427947
Skewness                         2.093486      A-D 5% Critical Value                     0.755469
                                               K-S Test Statistic                        0.091835
           Gamma Statistics                    K-S 5% Critical Value                     0.161647
k hat                            2.498462      Data follow gamma distribution
k star (bias corrected)          2.270838      at 5% significance level
Theta hat                         21.7774
Theta star                       23.96032       95% UCLs (Assuming Gamma Distribution)
nu hat                           149.9077      Approximate Gamma UCL                     67.22554
nu star                          136.2503      Adjusted Gamma UCL                        68.05636
Approx.Chi Square Value (.05)    110.2762
Adjusted Level of Significance      0.041              Lognormal Distribution Test
Adjusted Chi Square Value          108.93      Shapiro-Wilk Test Statisitic              0.977499
                                               Shapiro-Wilk 5% Critical Value               0.927
     Log-transformed Statistics                Data are lognormal at 5% significance level
Minimum of log data              2.646175
Maximum of log data              5.267858       95% UCLs (Assuming Lognormal Distribution)
Mean of log data                 3.783275      95% H-UCL                                 69.52989
Standard Deviation of log data   0.648454      95% Chebyshev (MVUE) UCL                  83.53226
Variance of log data             0.420492      97.5% Chebyshev (MVUE) UCL                 96.3991
                                               99% Chebyshev (MVUE) UCL                  121.6735

                                                        95% Non-parametric UCLs
                                               CLT UCL                                   66.70512
                                               Adj-CLT UCL (Adjusted for skewness)       69.75789
                                               Mod-t UCL (Adjusted for skewness)         67.58697
                                               Jackknife UCL                              67.1108
                                               Standard Bootstrap UCL                    66.60108
                                               Bootstrap-t UCL                           73.69288
           RECOMMENDATION                      Hall's Bootstrap UCL                      81.67757
  Data follow gamma distribution (0.05)        Percentile Bootstrap UCL                  67.20667
                                               BCA Bootstrap UCL                         69.14667
  Use Approximate Gamma UCL                    95% Chebyshev (Mean, Sd) UCL              86.99233
                                               97.5% Chebyshev (Mean, Sd) UCL            101.0907
                                               99% Chebyshev (Mean, Sd) UCL              128.7843
```

Lognormal Q-Q Plot for Sediment Hg



N = 20, Mean = -2.0204, Sd = 1.3890
Slope = 1.3941, Intercept = -2.0204, Correlation, R = 0.96685423
Shapiro-Wilk Statistic = 0.922, Critical Value(0.05) = 0.905, Data are Lognormal

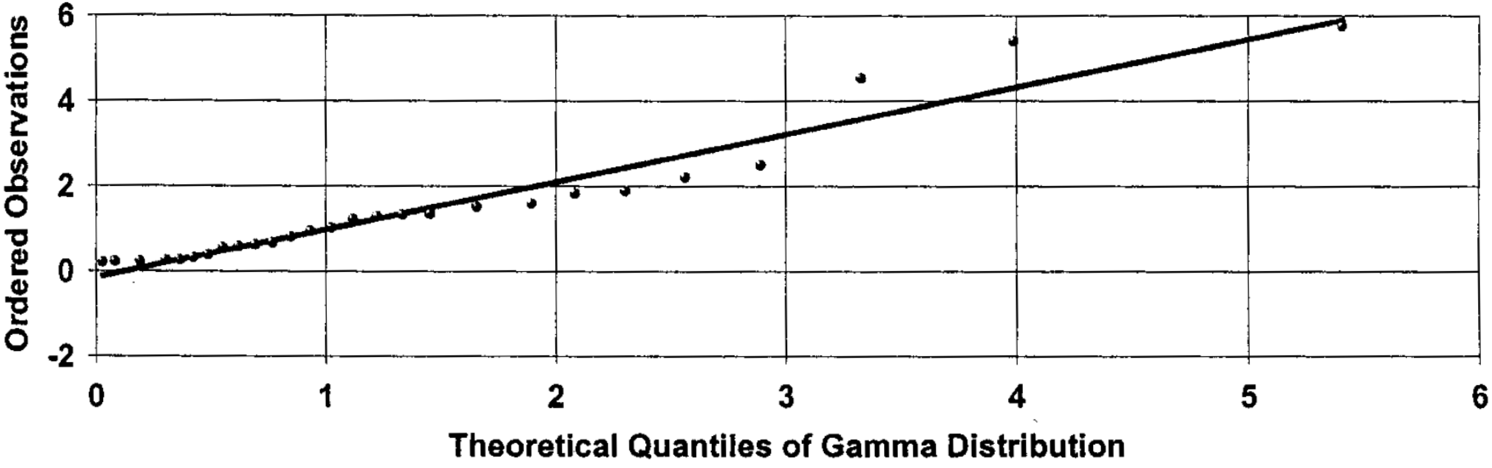
```
Data File   E:\Navy 5-year reviews\Keyport 5 year RA\EPCs Sediment Keyport.xls
                                                        Variable:  Hg
Number of Valid Samples                            20
Number of Distinct Samples                         15
Minimum of log data                         -3.912023
Maximum of log data                          0.641854
Mean of log data                            -2.020354
Standard Deviation of log data               1.389043
Variance of log data                          1.92944

Shapiro-Wilk Test Statisitic                 0.921823
Shapiro-Wilk 5% Critical Value                  0.905
Data are lognormal at 5% significance level

     95% UCL (Assuming Normal Distribution)
Student's-t                                  0.553325

     Estimates Assuming Lognormal Distribution
MLE Mean                                     0.347972
MLE Standard Deviation                       0.844192
MLE Coefficient of Variation                 2.426037
MLE Skewness                                 21.55692
MLE Median                                   0.132608
MLE 80% Quantile                             0.428865
MLE 90% Quantile                             0.790228
MLE 95% Quantile                             1.302938
MLE 99% Quantile                             3.355362

MVU Estimate of Median                        0.12635
MVU Estimate of Mean                         0.319777
MVU Estimate of Sd                           0.586958
MVU Estimate of SE of Mean                   0.117314

     95% Non-parametric UCLs
Adjusted-CLT UCL (Adjusted for Skewness)     0.603696
Modified-t UCL (Adjusted for Skewness)       0.562754
Hall's Bootstrap UCL                          0.70851
95% Chebyshev (Mean, Sd) UCL                 0.867876
97.5% Chebyshev (Mean, Sd) UCL               1.093476
99% Chebyshev (Mean, Sd) UCL                 1.536623

     UCLs (Assuming Lognormal Distribution)
95% H-UCL                                    0.958871
95% Chebyshev (MVUE) UCL                     0.831137
97.5% Chebyshev (MVUE) UCL                   1.052403
99% Chebyshev (MVUE) UCL                     1.487038

Data are lognormal (0.05)

Recommended UCL to use:
      Use 95% Chebyshev (MVUE) UCL
```

Summary of Statistics for Tissue

From File E:\Navy 5-year reviews\Keyport 5 year RA\EPCs Tissue Keyport.xls

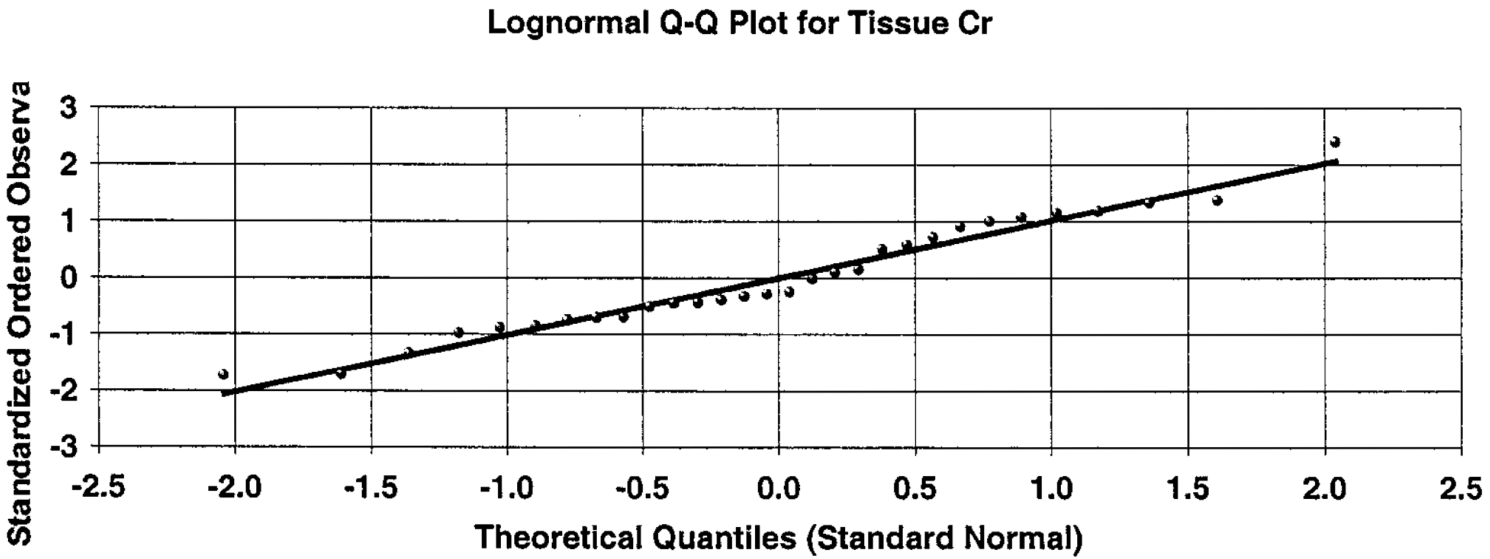
Variable name	NumObs	Minimum	Maximum	Mean	Median	Sd	CV	Skewness	Variance
Cd	30	0.19096	5.75	1.369903	0.97069	1.466345	1.070401	1.9732918	2.150168
Cr	30	0.1956	8.78	1.48357	0.753	1.685059	1.135814	3.0220697	2.839423
Hg	30	0.01	0.18	0.029324	0.019125	0.039255	1.338664	3.399071	0.001541
Ag	30	0.04	2.2	0.445296	0.348	0.405976	0.911699	2.9356391	0.164817
Hex Cr	6	1.7	6.5	3.983333	3.8	1.926049	0.483527	0.2245672	3.709667

Gamma Q-Q Plot for Tissue Cd



N = 30, Mean = 1.370, k hat = 1.178
Slope = 1.120, Intercept = -0.148, Correlation, R = 0.970
K-S Test Statistic = 0.100, Critical Value(0.05) = 0.164, Data are Gamma Distributed

```
Data File    E:\Navy 5-year reviews\Keyport 5 year RA\EPCs Tissue Keyport.xls
                                                                 Variable:   Cd
Number of Valid Samples                      30
Number of Distinct Samples                   27
Minimum                                 0.19096
Maximum                                    5.75
Mean                                   1.369903
Standard Deviation                     1.466345
Variance                               2.150168
k hat                                   1.17804
k star (bias corrected)                1.082458
Theta hat                              1.162867
Theta star                             1.265548
nu hat                                 70.68238
nu star                                64.94748
Approx.Chi Square Value (.05)          47.40139
Adjusted Level of Significance            0.041
Adjusted Chi Square Value              46.53665

A-D Test Statistic                      0.67278
A-D 5% Critical Value                  0.771047
K-S Test Statistic                     0.100147
K-S 5% Critical Value                  0.164106
Data follow gamma distribution
at 5% signifcance level

   95% UCLs (Adjusted for Skewness)
Adjusted-CLT UCL                       1.913317
Modified-t UCL                         1.840863

   95% Non-parametric UCLs
Bootstrap-t UCL                        1.961633
Hall's Bootstrap UCL                   1.960469

   95% Gamma UCLs (Assuming Gamma Distribution)
Approximate Gamma UCL                  1.876986
Adjusted Gamma UCL                     1.911864

Data follow gamma distribution (0.05)

Recommended UCL to use:

      Use Approximate Gamma UCL
```

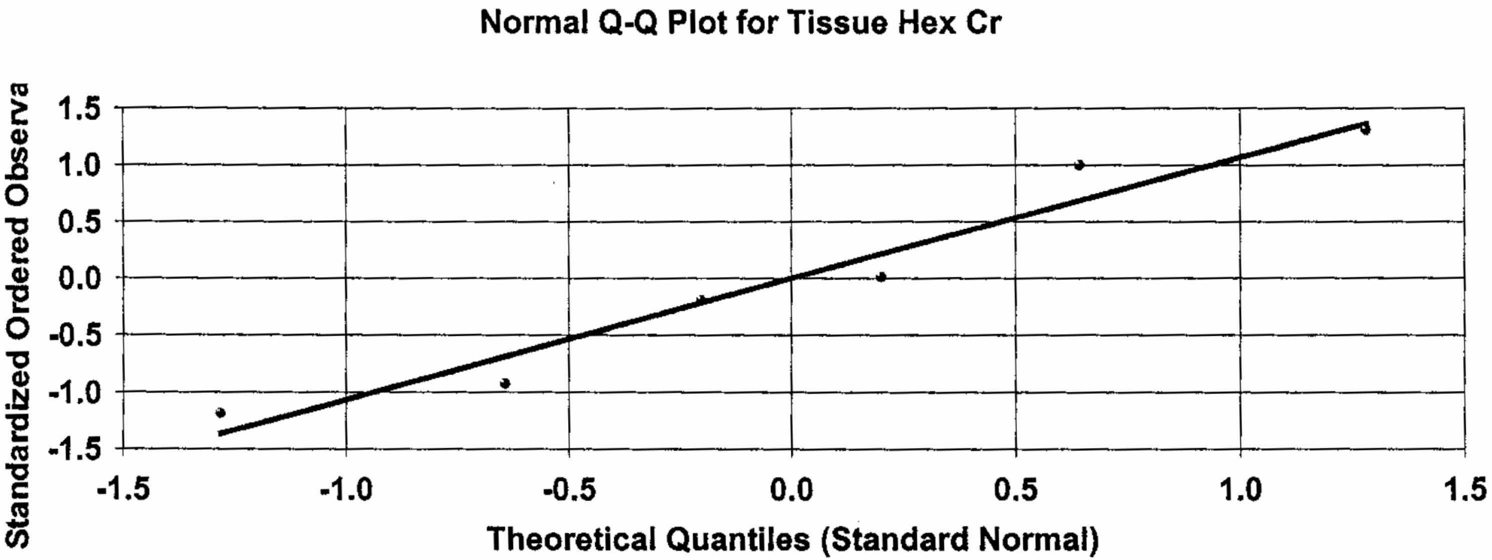


N = 30, Mean = -0.0353, Sd = 0.9190

Slope = 1.0125, Intercept = 0.0000, Correlation, R = 0.98493745

Shapiro-Wilk Statistic = 0.966, Critical Value(0.05) = 0.927, Data are Lognormal

```
Data File   E:\Navy 5-year reviews\Keyport 5 year RA\EPCs Tissue Keyport.xls
                                                         Variable:  Cr
Number of Valid Samples                          30
Number of Distinct Samples                       30
Minimum of log data                       -1.631684
Maximum of log data                        2.172476
Mean of log data                          -0.035339
Standard Deviation of log data             0.918993
Variance of log data                       0.844548

Shapiro-Wilk Test Statisitic               0.966381
Shapiro-Wilk 5% Critical Value                0.927
Data are lognormal at 5% significance level

     95% UCL (Assuming Normal Distribution)
Student's-t                                2.006303

     Estimates Assuming Lognormal Distribution
MLE Mean                                    1.47246
MLE Standard Deviation                     1.696161
MLE Coefficient of Variation               1.151923
MLE Skewness                               4.984285
MLE Median                                 0.965278
MLE 80% Quantile                           2.098473
MLE 90% Quantile                           3.144223
MLE 95% Quantile                           4.377178
MLE 99% Quantile                            8.18447

MVU Estimate of Median                      0.95178
MVU Estimate of Mean                       1.444342
MVU Estimate of Sd                         1.551549
MVU Estimate of SE of Mean                 0.273835

     95% Non-parametric UCLs
Adjusted-CLT UCL (Adjusted for Skewness)   2.170982
Modified-t UCL (Adjusted for Skewness)     2.034594
Hall's Bootstrap UCL                       4.158772
95% Chebyshev (Mean, Sd) UCL               2.824578
97.5% Chebyshev (Mean, Sd) UCL             3.404833
99% Chebyshev (Mean, Sd) UCL               4.544631

     UCLs (Assuming Lognormal Distribution)
95% H-UCL                                  2.196533
95% Chebyshev (MVUE) UCL                   2.637962
97.5% Chebyshev (MVUE) UCL                 3.154442
99% Chebyshev (MVUE) UCL                   4.168967

Data are lognormal (0.05)

Recommended UCL to use:
      Use H-UCL
```

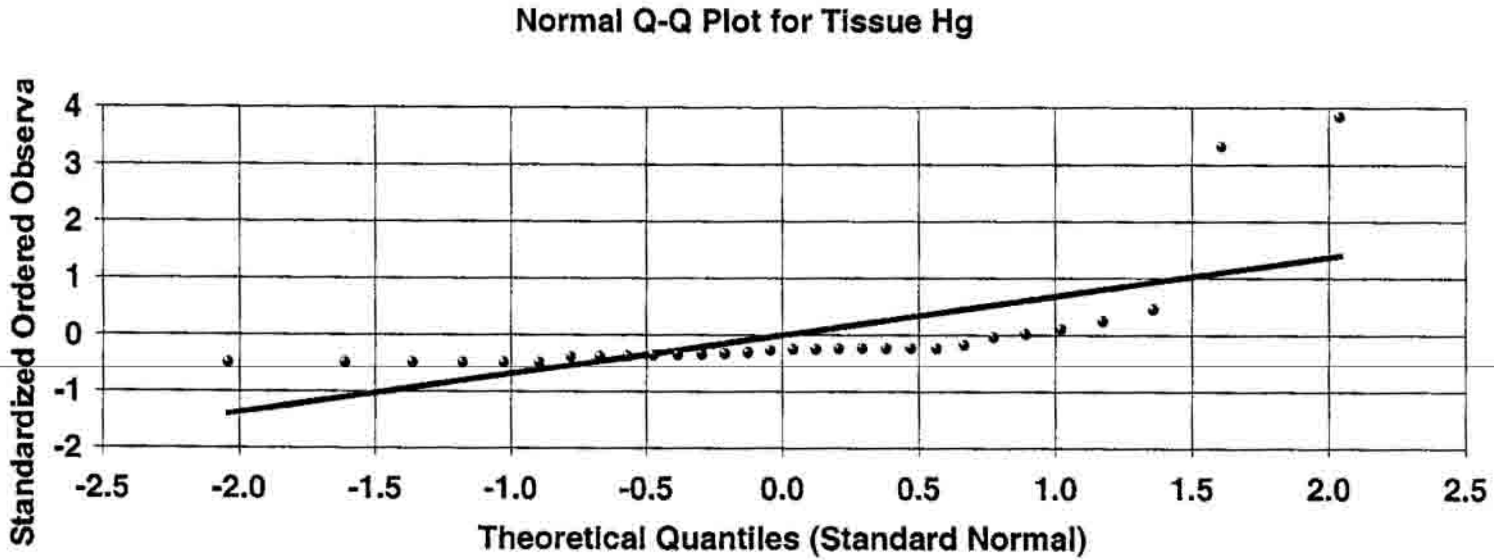


N = 6, Mean = 3.9833, Sd = 1.9260

Slope = 1.0662, Intercept = 0.0000, Correlation, R = 0.97648097

Shapiro-Wilk Statistic = 0.933, Critical Value(0.05) = 0.788, Data are Normal

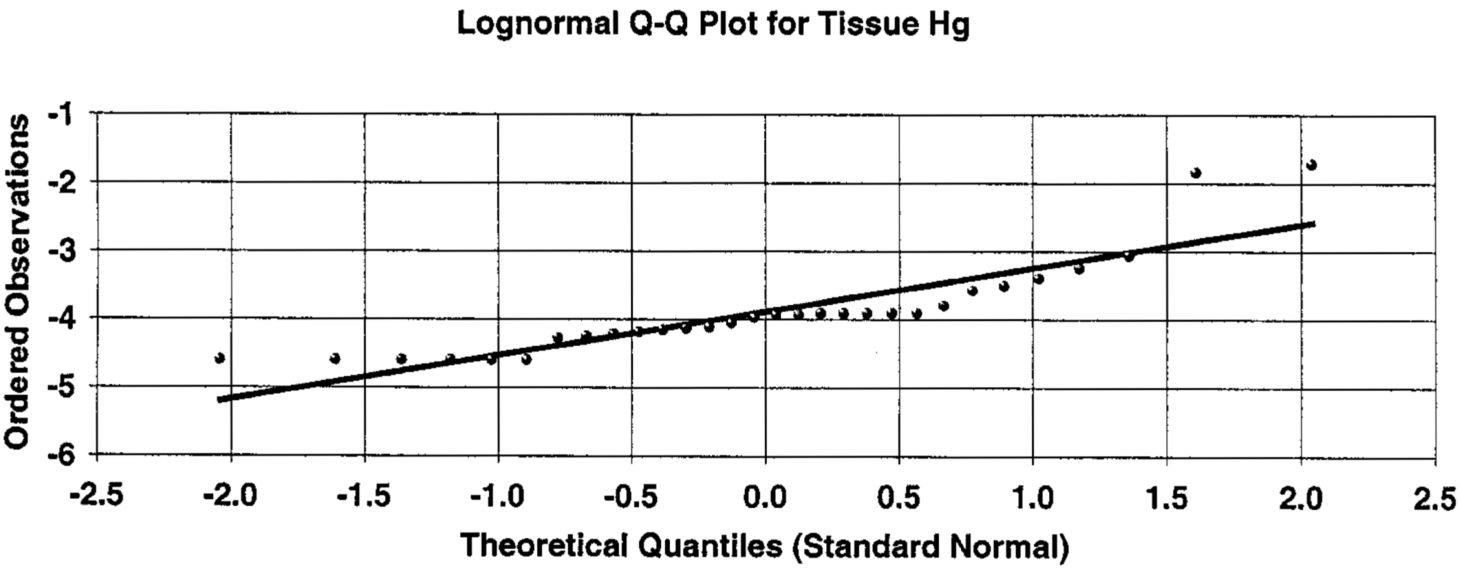
```
Data File   E:\Navy 5-year reviews\Keyport 5 year RA\EPCs Tissue Keyport.xls
                                                  Variable:   Hex Cr
          Raw Statistics                                Normal Distribution Test
Number of Valid Samples                   6    Shapiro-Wilk Test Statisitic          0.933045
Number of Unique Samples                  6    Shapiro-Wilk 5% Critical Value           0.788
Minimum                                 1.7    Data are normal at 5% significance level
Maximum                                 6.5
Mean                               3.983333       95% UCL (Assuming Normal Distribution)
Median                                  3.8    Student's-t UCL                       5.567779
Standard Deviation                 1.926049
Variance                           3.709667             Gamma Distribution Test
Coefficient of Variation           0.483527    A-D Test Statistic                    0.268369
Skewness                           0.224567    A-D 5% Critical Value                 0.698613
                                               K-S Test Statistic                    0.189008
            Gamma Statistics                   K-S 5% Critical Value                 0.333009
k hat                              4.708178    Data follow gamma distribution
k star (bias corrected)              2.4652    at 5% significance level
Theta hat                          0.846046
Theta star                         1.615826     95% UCLs (Assuming Gamma Distribution)
nu hat                             56.49814    Approximate Gamma UCL                 6.487777
nu star                             29.5824    Adjusted Gamma UCL                    7.842239
Approx.Chi Square Value (.05)      18.16286
Adjusted Level of Significance      0.01222           Lognormal Distribution Test
Adjusted Chi Square Value          15.02588    Shapiro-Wilk Test Statisitic          0.936017
                                               Shapiro-Wilk 5% Critical Value           0.788
    Log-transformed Statistics                 Data are lognormal at 5% significance level
Minimum of log data                0.530628
Maximum of log data                1.871802      95% UCLs (Assuming Lognormal Distribution)
Mean of log data                   1.272178    95% H-UCL                             7.963146
Standard Deviation of log data     0.530907    95% Chebyshev (MVUE) UCL              7.783662
Variance of log data               0.281862    97.5% Chebyshev (MVUE) UCL            9.418393
                                               99% Chebyshev (MVUE) UCL              12.62951

                                                     95% Non-parametric UCLs
                                               CLT UCL                               5.276692
                                               Adj-CLT UCL (Adjusted for skewness)   5.353719
                                               Mod-t UCL (Adjusted for skewness)     5.579793
                                               Jackknife UCL                         5.567779
                                               Standard Bootstrap UCL                5.179123
                                               Bootstrap-t UCL                       5.962547
         RECOMMENDATION                        Hall's Bootstrap UCL                  6.069779
      Data are normal (0.05)                   Percentile Bootstrap UCL              5.183333
                                               BCA Bootstrap UCL                     5.166667
    Use Student's-t UCL                        95% Chebyshev (Mean, Sd) UCL          7.410764
                                               97.5% Chebyshev (Mean, Sd) UCL        8.893815
                                               99% Chebyshev (Mean, Sd) UCL          11.80698
```



N = 30, Mean = 0.0293, Sd = 0.0393

Slope = 0.6862, Intercept = 0.0000, Correlation, R = 0.66752439

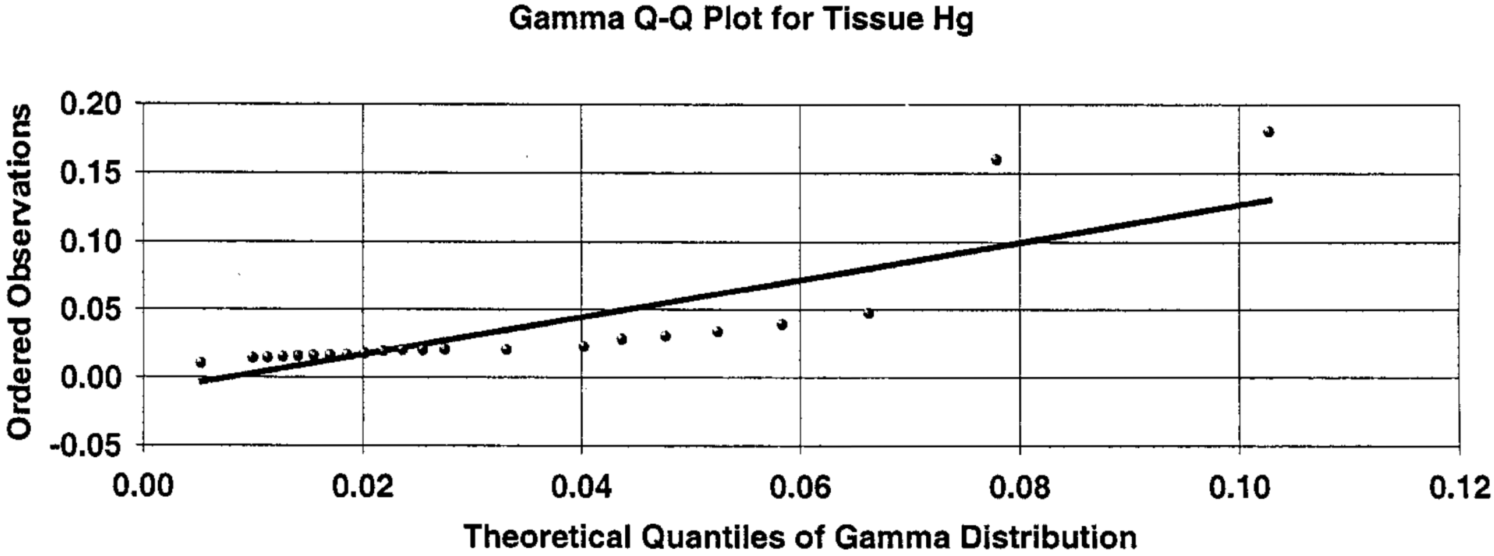
Shapiro-Wilk Statistic = 0.464, Critical Value(0.05) = 0.927, Data not Normal



N = 30, Mean = -3.8869, Sd = 0.7029

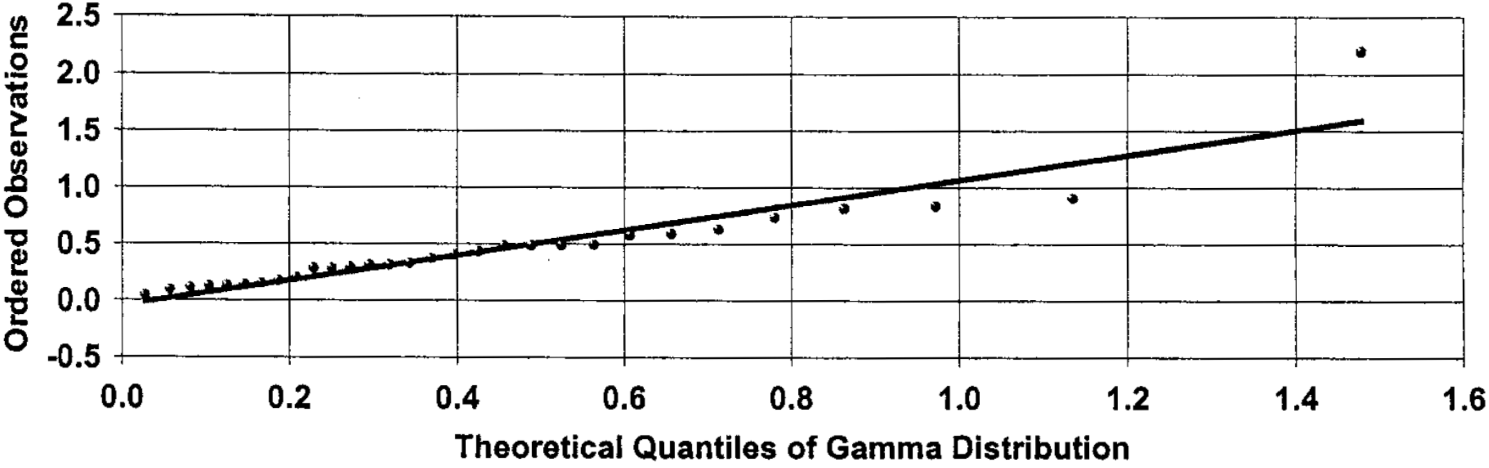
Slope = 0.6430, Intercept = -3.8869, Correlation, R = 0.88981228

Shapiro-Wilk Statistic = 0.795, Critical Value(0.05) = 0.927, Data not Lognormal



N = 30, Mean = 0.029, k hat = 1.544
Slope = 1.378, Intercept = -0.011, Correlation, R = 0.839
K-S Test Statistic = 0.300, Critical Value(0.05) = 0.163, Data not Gamma Distributed

```
Data File   E:\Navy 5-year reviews\Keyport 5 year RA\EPCs Tissue Keyport.xls
                                                   Variable:  Hg
        Raw Statistics                                   Normal Distribution Test
Number of Valid Samples               30      Shapiro-Wilk Test Statisitic                 0.464274
Number of Unique Samples              22      Shapiro-Wilk 5% Critical Value                  0.927
Minimum                             0.01      Data not normal at 5% significance level
Maximum                             0.18
Mean                            0.029324         95% UCL (Assuming Normal Distribution)
Median                          0.019125      Student's-t UCL                              0.041502
Standard Deviation              0.039255
Variance                        0.001541               Gamma Distribution Test
Coefficient of Variation        1.338664      A-D Test Statistic                           3.393422
Skewness                        3.399071      A-D 5% Critical Value                        0.762628
                                              K-S Test Statistic                           0.300365
          Gamma Statistics                    K-S 5% Critical Value                        0.162806
k hat                           1.544078      Data do not follow gamma distribution
k star (bias corrected)         1.411892      at 5% significance level
Theta hat                       0.018991
Theta star                       0.02077        95% UCLs (Assuming Gamma Distribution)
nu hat                          92.64467      Approximate Gamma UCL                        0.038517
nu star                         84.71354      Adjusted Gamma UCL                           0.039134
Approx.Chi Square Value (.05)   64.49534
Adjusted Level of Significance     0.041              Lognormal Distribution Test
Adjusted Chi Square Value       63.47811      Shapiro-Wilk Test Statisitic                 0.795488
                                              Shapiro-Wilk 5% Critical Value                  0.927
      Log-transformed Statistics              Data not lognormal at 5% significance level
Minimum of log data             -4.60517
Maximum of log data            -1.714798        95% UCLs (Assuming Lognormal Distribution)
Mean of log data               -3.886856      95% H-UCL                                      0.0346
Standard Deviation of log data   0.70293      95% Chebyshev (MVUE) UCL                     0.041732
Variance of log data             0.49411      97.5% Chebyshev (MVUE) UCL                   0.048542
                                              99% Chebyshev (MVUE) UCL                     0.061917

                                                     95% Non-parametric UCLs
                                              CLT UCL                                      0.041113
                                              Adj-CLT UCL (Adjusted for skewness)          0.045866
                                              Mod-t UCL (Adjusted for skewness)            0.042243
                                              Jackknife UCL                                0.041502
                                              Standard Bootstrap UCL                       0.041347
                                              Bootstrap-t UCL                              0.076076
         RECOMMENDATION                       Hall's Bootstrap UCL                         0.100945
   Data are Non-parametric (0.05)             Percentile Bootstrap UCL                     0.041913
                                              BCA Bootstrap UCL                            0.046639
  Use 95% Chebyshev (Mean, Sd) UCL            95% Chebyshev (Mean, Sd) UCL                 0.060565
                                              97.5% Chebyshev (Mean, Sd) UCL               0.074082
                                              99% Chebyshev (Mean, Sd) UCL                 0.100635
```



Gamma Q-Q Plot for Tissue Ag

N = 30, Mean = 0.445, k hat = 1.752
Slope = 1.109, Intercept = -0.045, Correlation, R = 0.936
K-S Test Statistic = 0.085, Critical Value(0.05) = 0.163, Data are Gamma Distributed

```
Data File   E:\Navy 5-year reviews\Keyport 5 year RA\EPCs Tissue Keyport.xls
                                                    Variable:  Ag
Number of Valid Samples                 30
Number of Distinct Samples              30
Minimum                               0.04
Maximum                                2.2
Mean                              0.445296
Standard Deviation                0.405976
Variance                          0.164817
k hat                             1.751657
k star (bias corrected)           1.598714
Theta hat                         0.254214
Theta star                        0.278534
nu hat                            105.0994
nu star                           95.92281
Approx.Chi Square Value (.05)     74.32837
Adjusted Level of Significance       0.041
Adjusted Chi Square Value         73.23254

A-D Test Statistic                0.294465
A-D 5% Critical Value             0.760735
K-S Test Statistic                0.084896
K-S 5% Critical Value             0.162503
Data follow gamma distribution
at 5% signifcance level

   95% UCLs (Adjusted for Skewness)
Adjusted-CLT UCL                  0.609663
Modified-t UCL                    0.577858

   95% Non-parametric UCLs
Bootstrap-t UCL                   0.642558
Hall's Bootstrap UCL              1.143346

   95% Gamma UCLs (Assuming Gamma Distribution)
Approximate Gamma UCL             0.574667
Adjusted Gamma UCL                0.583266

Data follow gamma distribution (0.05)

Recommended UCL to use:

      Use Approximate Gamma UCL
```

ATTACHMENT C-2

Exposure Factors

ATTACHMENT C-2
DETAILED CALCULATIONS OF SUMMARY INTAKE FACTORS AND EXPOSURE ASSUMPTIONS

This attachment contains the detailed description of the exposure factors used in the equations. In general, U.S. Environmental Protection Agency’s soil screening guidance (USEPA 2001a and 1991a) defaults for future recreational site visitor, where available. The exposure factors for the recreational population is discussed below.

RECREATIONAL EXPOSURE FACTORS

The recreational exposure factors apply to children and adults to chemicals in sediment and clam tissue in a future recreational clam harvesting scenario. In general U.S. Environmental Protection Agency’s (EPA’s) residential default values were used to evaluate these recreational exposures.

Body Weight

An adult body weight of 70 kilograms (kg) was assumed. This is the average body weight for adult men and women combined, rounded to 70 kg (USEPA 1991a, 1991b). For children aged 0 to 6 years, an average body weight of 15 kg was assumed (USEPA 1991a, 1991b). For children ages 6 to 12 years, a value of 33 kg was used; this is the 50th percentile body weight for boys and girls combined (USEPA 1997). Average body weights were used because when combined with the other variables in the intake equation, it is believed to result in the most reasonable estimate of intake (USEPA 1989). For example, it would not be reasonable to assume that the smallest person would have the highest intake.

Exposure Duration

For reasonable maximum exposure (RME) recreational exposures, an exposure duration of 30 years was assumed. This represents the 90th percentile for time spent at one residence (USEPA 1991a). Of the 30 years total exposure duration, ages 0 to 6 accounts for the period of highest soil ingestion and lowest body weight. A 24-year duration was assessed for older children and adults, and a 6-year duration for ages 0 to 6 years for children (USEPA 1991a).

Exposure Frequency

The EPA default residential exposure frequency of 350 days/year was used for the RME recreational scenario (USEPA 1991a).

Clam Tissue Ingestion Rate

EPA's clam ingestion rate of 17.5 g/day was used to quantify recreational exposures to chemicals in clam tissue (USEPA 2000). This value is the fish consumption default for the general adult populations and recreational fishers. This value is the estimated 90th percentile weight intake of uncooked freshwater/estuarine finfish and shellfish. EPA considers this rate to be protective of the majority of the populations (i.e., fish consumers and nonconsumers). EPA further considers this rate to be indicative of the average consumption rate among recreational fishers. Ingestion of clams by child recreational site visitors was not evaluated in the revised risk assessment, because no child seafood ingestion rate is available to quantify child exposures.

Soil Ingestion Rate

An adult soil ingestion rate of 100 mg/day and a child soil ingestion rate of 200 mg/day were used. These values are EPA's default RME adult and child soil ingestion rates (USEPA 1991a).

Adherence Factor

A soil adherence factor of 0.07 and 0.2 were assumed for an adult and child for recreational sediment exposures (USEPA 2003). This value is based on data reported by Kissel et al. (1996a, 1996b, 1998) and Holmes et al. (1999) as cited in EPA (2003).

Skin Surface Area

EPA (2003) default values for child and adult dermal exposures assume an exposed skin surface area of 2,800 and 5,700 cm^2, respectively. This value corresponds to exposure to head, forearms, hands, and lower legs for adult exposures; and exposure to head, forearms, hands, lower legs and feet for child exposures.

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ATTACHMENT C-3

Toxicological Profiles

ATTACHMENT C-3
CHEMICAL PROFILES

Toxic effects of the chemicals of potential concern are presented in this Attachment. In general, the information has been summarized from the latest available Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS), and Oak Ridge National Laboratory Toxicity Values online databases.

CONTENTS

CADMIUM

Elemental cadmium is a soft, silver-white metal; however, cadmium is not usually found in the environment as a metal. Cadmium is found in the earth's crust at concentrations of about 1 to 2 parts per million (ppm), primarily in association with zinc ores. Cadmium (as cadmium oxide) is obtained mainly as a by-product during the processing of zinc-bearing ores and also from the refining of lead and copper from sulfide ores. Cadmium is used primarily for the production of nickel-cadmium batteries, in metal plating, and for the production of pigments, plastics, synthetics and metallic alloys (ATSDR, 1999).

Cadmium has been shown to be toxic to human populations from occupational inhalation exposure and accidental ingestion of cadmium-contaminated food. Inhalation of cadmium dust in certain occupational settings may be associated with an increased incidence of lung cancer. Ingestion of elevated levels of cadmium has resulted in toxicity to the kidney and skeletal system, and may be associated with an elevated incidence of hypertension and cardiovascular disease.

Cadmium is poorly absorbed from the gastrointestinal tract. Long-term absorption and retention of cadmium is approximately 5 to 6 percent the amount ingested. Absorption of cadmium from food may be lower than absorption from water or solution (i.e., approximately 2.5 percent). The body stores of iron influence cadmium absorption. Individuals with low iron stores exhibit higher absorption of cadmium. Dietary deficiencies in calcium and protein also enhance cadmium absorption (ASTDR, 1999; USEPA [IRIS], 2000, Goyer, 1991). Absorption of inhaled cadmium is approximately 5 to 20 percent. Absorption of cadmium inhaled in cigarette smoke is higher than absorption of cadmium inhaled in aerosols, as measured in laboratory animals. Dermal absorption of cadmium from solution or soil is very limited (ATSDR, 1999).

The issue of bioavailability of cadmium is especially important at mining, milling, and smelting sites. The cadmium at these sites can often exist, at least in part, as a poorly soluble sulfide, and may also occur in particles of inert or insoluble material. These factors can collectively reduce the bioavailability of cadmium.

Oral exposure to cadmium in high concentrations causes severe irritation to the gastrointestinal tract. Common symptoms in humans following ingestion of food or beverages containing high concentrations of cadmium include nausea, vomiting, salivation, abdominal pain, cramps, and diarrhea. The emetic dose has been estimated to be approximately 0.07 mg/kg. Acute inhalation exposure to high concentrations of cadmium oxide fume is intensely irritating to the respiratory tract. Signs and symptoms include irritation, coughing dyspnea, tightness in the chest and flu-like symptoms (ASTDR, 1999).

The USEPA recommended two oral reference doses (RfDs) for cadmium, one for cadmium exposure from food and one for cadmium exposure from water. Both RfDs recognize that a concentration of 200 µg/g (wet weight) in the human kidney cortex is the highest renal level not associated with significant proteinuria. A toxicokinetic model was used by USEPA to determine the level of chronic human oral exposure (NOAEL) which results in the critical concentration of cadmium in the kidney of 200 µg/g; the model assumes that 0.01 percent day of the cadmium body burden is eliminated per day (USEPA, 1985, as cited in IRIS). Assuming 2.5 percent absorption of cadmium from food or 5 percent from water, the toxicokinetic model predicts that the NOAEL for chronic cadmium exposure is 0.005 and 0.01 mg/kg-day from water and food, respectively (i.e., the doses corresponding to the 200 µg/g critical kidney concentration). An uncertainty factor of 10 to account for intrahuman variability was applied to these NOAELs to obtain an RfD of 0.0005 mg/kg-day (water) and an RfD of 0.001 mg/kg-day (food) (USEPA [IRIS], 2000). No inhalation RfD or reference concentration (RfC) is currently listed for cadmium.

An inhalation unit risk factor of 1.8×10^{-3} $(\mu g/m^3)^{-1}$ has been estimated from lung cancer incidence in the United States cohort of workers (i.e., from the cadmium recovery facility in Colorado). This corresponds to an inhalation cancer slope factor of 6.3 $(mg/kg\text{-}day)^{-1}$. Quantitative estimates of oral carcinogenicity have not been developed, based on inadequate evidence that cadmium is carcinogenic in humans by the oral route of exposure (USEPA [IRIS], 2000).

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CHROMIUM

Chromium is a naturally occurring element found in rocks, soil, plants, animals, and in volcanic dust and gases. The most common environmental forms are Chromium (0), Chromium (III), and Chromium (VI). Chromium (0), the metal chromium, is a gray solid and has a high melting point. This form is primarily used to make steel and other alloys. Chromium (III) is used to line high-temperature industrial furnaces. Chromium-containing compounds are used in many industrial processes, such as, stainless steel welding, chrome plating, and leather tanning.

Chromium (III) is considered an essential nutrient that helps to maintain normal metabolism of glucose, cholesterol, and fat in humans. The minimum human daily requirement of chromium for optimal health is not known, but a daily ingestion of 50 to 200 µg/day (0.0007 to 0.003 mg/kg bw/day) has been estimated to be safe and adequate. The long-term effects of eating diets low in chromium are difficult to evaluate.

The three major forms differ in their effects on health. Chromium (VI) is irritating, and short-term, high-level exposure can result in adverse effects at the site of contact, such as ulcers of the skin, irritation of the nasal mucosa and perforation of the nasal septum, and irritation of the GI tract. Chromium (VI) may also cause adverse effects in the kidney and liver. Chromium (III) does not result in these effects and is the form that is an essential food nutrient when ingested in small amounts, although very large doses may be harmful. For example, ingesting large amounts can cause stomach upset and ulcers, convulsions, kidney and liver damage. Very limited data suggest that chromium (III) may have respiratory effects on humans. No data on chronic or subchronic effects of inhaled chromium (III) in animals can be found. Adequate reproductive and developmental toxicity data do not exist. Information on chromium (0) health effects is limited. Animal studies have found that inhalation exposure had increased frequencies of chromosomal aberrations and sister chromatid exchanges in peripheral lymphocytes (ATSDR 1993c).

Of the three forms of chromium of toxicological importance, chromium (VI) is the most toxic. Chromium (VI) is classified by the EPA as a Group A carcinogen by inhalation, based on evidence that indicates sufficient cancer data in both animals and humans. Several epidemiological studies found an association between chromium exposure and lung cancer. The inhalation cancer SF for total chromium (one-sixth ratio of chromium VI:III) is 42 $(mg/kg-day)^{-1}$ and is based on benign and malignant stomach tumor data in female mice (DTSC 1999; USEPA 2001a). This SF was used in this HHRA for assessing inhalation exposures to chromium at the site.

The overall confidence in this RfD assessment was rated low because of the lack of explicit detail on study protocol and results, the lack of high-dose supporting data, and the lack of an observed effect level. Thus, the RfD as given should be considered conservative (USEPA 2001a).

The oral toxicity factor is adjusted to characterize risk from the dermal exposure pathway. This adjustment is made to estimate the absorbed dose from the toxicity indices that are based on administered dose. The percent GI absorption for chromium (VI) is 2.5 percent of the oral reference dose as recommended in the Supplemental Guidance for Dermal Risk Assessment (USEPA 2001b).

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LEAD

Lead is a soft, bluish-gray metal. Lead acetate and lead nitrate are soluble in water; lead chloride is slightly soluble; and lead sulfide, lead phosphate, and lead oxides are not soluble in water. Some primary uses of lead in the United States are in lead-acid storage batteries, ammunition, bearing metals, brass, bronze, cable covering, extruded products, sheet lead, solder, ceramics, type metal, ballast or weights, tubes or containers, oxides, and gasoline additives.

Substantial quantities of both human and animal data are available regarding the toxicity of lead. This toxicity profile relies primarily on human data. Adverse effects of lead in humans are most often related to the blood lead (PbB) level as an indicator of internal lead dose. Therefore, whenever possible, this text relates adverse effects to PbB levels rather than to external exposure.

Lead absorption is influenced by the route of exposure, the exposure medium, speciation and physiochemical characteristics of lead, and the age and physiological state of the exposed individual. Approximately 30 to 50 percent of airborne particulate lead is absorbed. Nonfasted adults may absorb less than 10 percent of soluble lead ingested in food or water and only 2.5 percent of lead ingested in soil. The amount of lead absorbed from the skin in humans is unknown.

Women with occupational exposures to lead during pregnancy have an increased rate of miscarriages and stillbirths. There is no evidence of teratogenic effects in humans or animals due to exposure to low levels of lead. There is conflicting information regarding the potential effects of lead on birth weight, gestational age, and growth in children. There is conflicting evidence regarding the potential effects of lead on human chromosomes. In men with occupational exposures some reproductive effects (e.g., decreased sperm count, abnormal sperm morphology, decreased sperm mobility, and hormonal changes) can occur.

Although lead is considered to be carcinogenic in animals, evidence of its carcinogenicity in humans is generally considered to be inadequate. EPA’s IRIS database classifies lead as a probable human carcinogen (Group B2), based on sufficient evidence in animals, but inadequate evidence in humans.

Sensitive members of the population are children, women, and individuals with chronic neurological dysfunction or kidney disease. Children may be especially at risk because compared to adults they absorb more lead from the gastrointestinal tract; retain more absorbed lead; and have a greater prevalence of nutritional deficiencies (e.g., calcium, iron, and zinc). Women who are pregnant or have osteoporosis may be at greater risk due to lead because each of these conditions may intensify the mobilization of lead from bone.

Ingestion is the primary route of exposure for children and other nonoccupationally exposed receptors. However, dose-response data based on external ingestion dose (mg/kg-day) in humans were limited. Hematological effects were observed in adult humans who ingested 0.02 to 0.03 mg lead acetate/kg-day for 14 days or 0.01 to 0.02 mg lead acetate/kg-day for 3 to 7 weeks.

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MERCURY

Elemental mercury is a silvery metallic liquid that is volatile at room temperature. Mercury is found in soil and rocks typically as an ore known as cinnabar, consisting of insoluble mercuric sulfide. Concentrations in soil and rock average 0.5 parts per million (ppm), though actual concentrations vary considerably depending upon location. Much of the mercury produced in the United States comes from secondary sources, such as recycling. The largest use of mercury is for electrolytic production of chlorine and caustic soda. Other uses include electrical devices, switches and batteries, measuring and control instruments, medical and dental applications, and electric lighting.

Mercury has been shown to be toxic to human populations as a result of occupational exposure and accidental ingestion of mercury-contaminated food. The nature of mercury toxicity differs with the chemical form. Elemental mercury vapor and organic mercury vapor have produced toxicity to the central nervous system and kidneys from inhalation exposure in workers. Ingestion of inorganic mercury salts in laboratory animals also has produced toxicity in the kidney. Accidental ingestion exposure to high levels of organic mercury compounds has produced developmental toxicity in humans.

Adverse effects observed in humans following ingestion exposure principally have been associated with consumption of grain products or seafood contaminated with organic mercury. Methylmercury, an organic form of mercury, is accumulated in biological tissues more readily than inorganic forms (ATSDR 1999). The principal adverse effects have been neurological effects and developmental toxicity.

Ingestion of inorganic mercury, the form most likely to be found in soil, has been associated with kidney toxicity in laboratory animals. Inorganic mercury forms such as mercuric chloride are expected to sorb to sediment particulate (ATSDR 1999). The adverse effect of concern with soil or sediment exposure scenarios therefore is likely to be kidney toxicity. Ingestion studies with inorganic mercury also suggest carcinogenic effects in laboratory animals. The U.S. Environmental Protection Agency (USEPA) has classified mercuric chloride and methylmercury into Group C, possible human carcinogens, based on the absence of data in humans and limited evidence of carcinogenicity in animals.

Children are considered a sensitive population for exposure to mercury. Differences in sensitivity between children and adults results largely from greater permeability of the underdeveloped blood-brain barrier *in utero* and in infants. Also contributing are differences in routes of exposure and intake rates (for example exposure via ingestion of mothers milk), and importance of developmental milestones during childhood exposure periods (such as language or cognitive development).

In general, young children are exposed to higher doses of methylmercury than are adults (e.g., approximately 1.5- to 2-fold or higher on a body-weight basis). It is recognized that the postnatal nervous system remains vulnerable to methylmercury; however, it is uncertain whether the young child's sensitivity to neurological effects of methylmercury is more like that of the fetus or that of the adult. Children also appear to have different patterns of tissue distribution of mercury and methylmercury (i.e., biokinetic patterns) than do adults.

USEPA has published chronic oral reference doses (RfDs) of 0.0003 mg/kg-day and 0.0001 mg/kg-day for mercuric chloride and methylmercury, respectively in the Integrated Risk Information System (IRIS) database. The critical effects reported are autoimmune kidney effects for mercuric chloride, and developmental effects for methylmercury. For elemental mercury vapor, a reference concentration (RfC) of 0.0003 mg/m3 is provided in IRIS, based on neurotoxicity observed in humans.

The basis of USEPA's chronic oral RfD of 0.0001 mg/kg-day for methylmercury was described recently in USEPA's Mercury Study Report to Congress. The Agency for Toxic Substances and Disease Registry (ATSDR) derived a chronic oral Minimum Risk Level (MRL) of 0.0003 mg/kg-day, based on information from several recent studies of human populations. Although not identical to the RfD, the ATSDR "safe level" has been reviewed in a number of recent workgroup sessions, and represents the Department of Health and Human Services official position.

More recently, USEPA has developed the Mercury Research Strategy to address key scientific questions in order to reduce uncertainties currently limiting the Agency's ability to assess and manage mercury and methylmercury risks. This will include evaluations to link toxicity to exposure using a biokinetic model, assessment of sensitive subpopulations, evaluation of recent epidemiological studies, and evaluation of immunological effects.

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SILVER

As reported by ATSDR (1990), silver is naturally occurring and is one of the basic elements found all over the earth. There are no man-made sources of silver. The element is rare and is primarily used to make jewelry, in dentistry, silverware, and electronics. Photographers use silver compounds for film development. Silver is stable and does not break down in the environment. Silver's most common state is elemental (0) and monovalent (+1). It also occurs primarily as sulfides with lead and iron, and with gold.

There are few human studies conducted on ingestion of silver. The primary study the oral reference dose is based on was from 1935, where humans ingested organic and colloidal silver medications. The reported effects were "argyria" a cosmetic and medically benign bluish-gray discoloring of the skin. Thus, no associated adverse health effects were reported (USEPA 2004).

The overall confidence in this RfD assessment was rated low. While the critical effect has been demonstrated in humans following oral administration of silver, the quantitative risk estimate is based on a study utilizing intravenous administration and thus necessitates a dose conversion with inherent uncertainties (USEPA 2004).

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ATTACHMENT C-4

Detailed Risk Calculations

TABLES

Table 1: Subsistence Exposures to Clam Tissues Liberty Bay - Baseline Risk Results

Ingestion of Clam Tissue

Future

Exposure Medium: Clam Tissue
Exposure Point: Clams in Liberty Bay
Receptor Population: Tribal Subsistence
Receptor Age: Children and Adults

Noncancer Hazard = CTi x SIFnc / RfD
Cancer Risk = CTi x SIFc x CSF

		RME	
Parameter	**Unit**	**Child**	**Adult**
Chemical Conc'n in Tissue (CTi)	mg/kg	chem-specific	chem-specific
Ingestion Rate of Clam Tissue (IR)	g/day	--	132
Fracton of Clam from Contaminated Source (FC)	unitless	--	0.25
Exposure Frequency (EF)	days/year	--	350
Exposure Duration (ED)	years	--	30
Conversion Factor (CF)	kg/g	--	1.00E-03
Body Weight (BW)	kg	--	70
Averaging Time (noncancer) (ATnc)	days	--	10,950
Averaging Time (cancer) (ATc)	days	--	25,550
SIFnc = (IR*FC*EF*ED*CF)/(BW*Atnc)	$(day)^{-1}$	--	4.52E-04
IngFadj (Ingestion Adjusted Factor) = (IRch*EDch/BWch) + (IRa*EDa/BWa)	g-yr/day-kg	--	
SIFc = (IngFadj*FC*EF*CF)/ATc	$(day)^{-1}$	--	

Chemical	**RfDo** (mg/kg-d)	**CSFo** (mg/kg-d)-1
Cadmium	1.0E-03	--
Chromium	3.0E-03	--
Mercury (Methyl)	1.0E-04	--
Silver	5.0E-03	--

	Reasonable Maximum Exposure						
Chemical	**CTi** (mg/kg)	**Intake$_{nc}$ child** (mg/kg-d)	**Intake$_{nc}$ adult** (mg/kg-d)	**Intake$_{c}$ lifetime** (mg/kg-d)	**HQ child**	**HQ adult**	**Cancer Risk lifetime**
Cadmium	1.88	--	8.50E-04	--	--	0.85	--
Chromium	2.2	--	9.95E-04	--	--	0.3315	--
Methylmercury	0.06	--	2.76E-05	--	--	0.28	--
Silver	0.57	--	2.58E-04	--	--	0.05	--
Total					**--**	**1.5**	**0.0E+00**

Table 2: Recreational Exposures to Sediments Liberty Bay - Baseline Risk Results

Sediment Ingestion

Future

Exposure Medium: Sediment
Exposure Point: Liberty Sediment
Receptor Population: Recreational Site Visitor
Receptor Age: Children and Adults

Noncancer Hazard = CSed x SIFnc x ABSo / RfD
Cancer Risk = CSed x SIFc x ABSo x CSF

Parameter	Unit	RME Child	RME Adult
Chemical conc'n in sediment (Csed)	mg/kg	chem-specific	chem-specific
Ingestion rate of sediment (IR)	mg/day	200	100
Exposure frequency (EF)	days/year	52	52
Exposure duration (ED)	years	6	24
Conversion factor (CF)	kg/mg	1.0E-06	1.0E-06
Body weight (BW)	kg	15	70
Averaging time (noncancer) (ATnc)	days	1,460	23,360
Averaging time (cancer) (ATc)	days	25,550	25,550
SIFnc = (IR*EF*ED*CF)/(BW*ATnc)	$(day)^{-1}$	2.85E-06	7.63E-08
IngFadj (Ingestion Adjusted Factor) = (IRch*EDch/BWch) + (IRa*EDa/BWa)	mg-yr/day-kg	114.29	114.29
SIFc = (IngFadj*EF*CF)/ATc	$(day)^{-1}$	2.33E-07	2.33E-07

Chemical	RfDo (mg/kg-d)	CSFo (mg/kg-d)-1
Cadmium	1.00E-03	--
Mercury & comps.	3.00E-04	--
Chromium	3.00E-03	--

	Reasonable Maximum Exposure						
Chemical	Csed (mg/kg)	$Intake_{nc}$ child (mg/kg-d)	$Intake_{nc}$ adult (mg/kg-d)	$Intake_{c}$ lifetime (mg/kg-d)	HQ child	HQ adult	Cancer Risk lifetime
Cadmium	4.6	1.3E-05	3.5E-07	--	0.013	0.0004	--
Mercury (mercuric chloride)	0.83	2.4E-06	6.3E-08	--	0.008	0.0002	--
Chromium	67	1.9E-04	5.1E-06	--	0.064	0.0017	--
Total					**0.08**	**0.0023**	**0.0E+00**

Table 3: Recreational Exposures to Clam Tissues Liberty Bay - Baseline Risk Results
Ingestion of Clam Tissue
Future

Exposure Medium: Clam Tissue
Exposure Point: Clams in Liberty Bay
Receptor Population: Recreational Site Visitor
Receptor Age: Children and Adults

Noncancer Hazard = CTi x SIFnc / RfD
Cancer Risk = CTi x SIFc x CSF

Parameter	Unit	RME Child	RME Adult
Chemical Conc'n in Tissue (CTi)	mg/kg	chem-specific	chem-specific
Ingestion Rate of Clam Tissue (IR)	g/day	--	54
Fracton of Clam from Contaminated Source (FC)	unitless	--	0.25
Exposure Frequency (EF)	days/year	--	350
Exposure Duration (ED)	years	--	30
Conversion Factor (CF)	kg/g	--	1.00E-03
Body Weight (BW)	kg	--	70
Averaging Time (noncancer) (ATnc)	days	--	10,950
Averaging Time (cancer) (ATc)	days	--	25,550
SIFnc = (IR*FC*EF*ED*CF)/(BW*Atnc)	$(day)^{-1}$	--	1.85E-04
IngFadj (Ingestion Adjusted Factor) = (IRch*EDch/BWch) + (IRa*EDa/BWa)	g-yr/day-kg	--	
SIFc = (IngFadj*FC*EF*CF)/ATc	$(day)^{-1}$	--	

Chemical	RfDo (mg/kg-d)	CSFo (mg/kg-d)-1
Cadmium	1.0E-03	--
Chromium	3.0E-03	--
Mercury (Methyl)	1.0E-04	--
Silver	5.0E-03	--

	Reasonable Maximum Exposure						
Chemical	CTi (mg/kg)	$Intake_{nc}$ child (mg/kg-d)	$Intake_{nc}$ adult (mg/kg-d)	$Intake_{c}$ lifetime (mg/kg-d)	HQ child	HQ adult	Cancer Risk lifetime
Cadmium	1.88	--	3.48E-04	--	--	0.348	--
Chromium	2.2	--	4.07E-04	--	--	0.1356	--
Methylmercury	0.06	--	1.13E-05	--	--	0.11	--
Silver	0.57	--	1.05E-04	--	--	0.02	--
Total					**--**	**0.62**	**0.0E+00**

Table 4: Subsistence Exposures to Sediments Liberty Bay - Revised Risk Results

Sediment Ingestion

Future

Exposure Medium: Sediment
Exposure Point: Liberty Sediment
Receptor Population: Tribal Subsistence
Receptor Age: Children and Adults

Noncancer Hazard = CSed x SIFnc x ABSo / RfD
Cancer Risk = CSed x SIFc x ABSo x CSF

		RME	
Parameter	**Unit**	**Child**	**Adult**
Chemical conc'n in sediment (Csed)	mg/kg	chem-specific	chem-specific
Ingestion rate of sediment (IR)	mg/day	200	100
Exposure frequency (EF)	days/year	365	365
Exposure duration (ED)	years	6	64
Conversion factor (CF)	kg/mg	1.0E-06	1.0E-06
Body weight (BW)	kg	15	70
Averaging time (noncancer) (ATnc)	days	1,460	23,360
Averaging time (cancer) (ATc)	days	25,550	25,550
SIFnc = (IR*EF*ED*CF)/(BW*ATnc)	$(day)^{-1}$	2.00E-05	1.43E-06
IngFadj (Ingestion Adjusted Factor) = (IRch*EDch/BWch) + (IRa*EDa/BWa)	mg-yr/day-kg	171.43	171.43
SIFc = (IngFadj*EF*CF)/ATc	$(day)^{-1}$	2.45E-06	2.45E-06

Chemical	**RfDo** (mg/kg-d)	**CSFo** (mg/kg-d)-1
Cadmium	1.00E-03	--
Mercury & comps.	3.00E-04	--
Chromium	3.00E-03	--

	Reasonable Maximum Exposure						
Chemical	**Csed** (mg/kg)	**Intake_{nc} child** (mg/kg-d)	**Intake_{nc} adult** (mg/kg-d)	**Intake_{c} lifetime** (mg/kg-d)	**HQ child**	**HQ adult**	**Cancer Risk lifetime**
Cadmium	4.6	9.2E-05	6.6E-06	--	0.092	0.007	--
Mercury (mercuric chloride)	0.83	1.7E-05	1.2E-06	--	0.055	0.004	--
Chromium	67	1.3E-03	9.6E-05	--	0.448	0.032	--
Total					**0.6**	**0.04**	**0.0E+00**
Total Summary of Ingestion and Dermal					**0.6**	**0.04**	**0.0E+00**

Table 5: Subsistence Exposures to Sediments Liberty Bay - Revised Risk Results
Dermal Contact with Sediment
Future

Exposure Medium: Sediment
Exposure Point: Liberty Sediment
Receptor Population: Tribal Subsistence
Receptor Age: Children and Adults

Noncancer Hazard = CS x SIFnc x Absd / RfD
Cancer Risk = CS x SIFc x Absd x CSF

Parameter	Units	RME child	RME adult
Chemical Concentration in Soil (CS)	mg/kg	chem-specific	chem-specific
Exposure Frequency (EF)	days/year	365	365
Exposure Duration (ED)	years	6	64
Surface Area Available for Contact (SA)	cm^2/day	2800	5700
Adherence Factor (AF)	mg/cm^2	0.2	0.07
Conversion Factor (CF)	kg/mg	1.0E-06	1.0E-06
Body Weight (BW)	kg	15	70
Averaging Time (noncancer) (ATnc)	days	2190	23360
Averaging Time (cancer) (ATc)	days	25550	25550
SIFnc = (EF*ED*SA*AF*CF)/(BW*ATnc)	$(day)^{-1}$	3.73E-05	5.70E-06
DFadj (Dermal Adjusted Factor) = (EDch*SAch*AFch /BWch) +(EDa*SAa*AFa/BWa)	mg-yr/day-kg	588.80	588.80
SIFc = (DFadj*EF*CF)/ATc	$(day)^{-1}$	8.41E-06	8.41E-06

Chemical	RfDd (mg/kg-d)	CSFd $(mg/kg\text{-}d)^{-1}$	Absd unitless
Cadmium	2.5E-05	--	1.0E-03
Mercury & comps.	--	--	--
Chromium	--	--	--

	Reasonable Maximum Exposure						
Chemical	CS (mg/kg)	Intake$_{nc}$ child (mg/kg-d)	Intake$_{nc}$ adult (mg/kg-d)	Intake$_{c}$ lifetime (mg/kg-d)	HQ child	HQ adult	Cancer Risk lifetime
Cadmium	4.60	1.72E-07	2.62E-08	--	0.0069	0.001	--
Mercury (mercuric chloride)	(a)	--	--	--	--	--	--
Chromium	(a)	--	--	--	--	--	--
Total					**0.007**	**0.001**	**0.0E+00**

(a) - a dermal reference dose is not available for elemental mercury; therefore, this pathway could not be evaluated.

Table 6: Recreational Exposures to Sediments Liberty Bay - Revised Risk Results
Sediment Ingestion
Future

Exposure Medium: Sediment
Exposure Point: Liberty Sediment
Receptor Population: Recreational Site Visitor
Receptor Age: Children and Adults

Noncancer Hazard = CSed x SIFnc x ABSo / RfD
Cancer Risk = CSed x SIFc x ABSo x CSF

Parameter	Unit	RME Child	RME Adult
Chemical conc'n in sediment (Csed)	mg/kg	chem-specific	chem-specific
Ingestion rate of sediment (IR)	mg/day	200	100
Exposure frequency (EF)	days/year	24	24
Exposure duration (ED)	years	6	24
Conversion factor (CF)	kg/mg	1.0E-06	1.0E-06
Body weight (BW)	kg	15	70
Averaging time (noncancer) (ATnc)	days	1,460	23,360
Averaging time (cancer) (ATc)	days	25,550	25,550
SIFnc = (IR*EF*ED*CF)/(BW*ATnc)	$(day)^{-1}$	1.32E-06	3.52E-08
IngFadj (Ingestion Adjusted Factor) = (IRch*EDch/BWch) + (IRa*EDa/BWa)	mg-yr/day-kg	114.29	114.29
SIFc = (IngFadj*EF*CF)/ATc	$(day)^{-1}$	1.07E-07	1.07E-07

Chemical	RfDo (mg/kg-d)	CSFo (mg/kg-d)-1
Cadmium	1.00E-03	--
Mercury & comps.	3.00E-04	--
Chromium	3.00E-03	--

	Reasonable Maximum Exposure						
Chemical	**Csed** (mg/kg)	**Intake$_{nc}$ child** (mg/kg-d)	**Intake$_{nc}$ adult** (mg/kg-d)	**Intake$_{c}$ lifetime** (mg/kg-d)	**HQ child**	**HQ adult**	**Cancer Risk lifetime**
Cadmium	4.6	6.0E-06	1.6E-07	--	0.006	0.0002	--
Mercury (mercuric chloride)	0.83	1.1E-06	2.9E-08	--	0.004	0.0001	--
Chromium	67	8.8E-05	2.4E-06	--	0.029	0.0008	--
Total					**0.04**	**0.0010**	**0.0E+00**

	HQ child	HQ adult	Cancer Risk lifetime
Total Summary of Ingestion and Dermal	**0.04**	**0.0011**	**0.0E+00**

Table 7: Recreational Exposures to Sediments Liberty Bay - Revised Risk Results

Dermal Contact with Sediment

Future

Exposure Medium: Sediment
Exposure Point: Liberty Sediment
Receptor Population: Resident
Receptor Age: Children and Adults

Noncancer Hazard = CS x SIFnc x Absd / RfD
Cancer Risk = CS x SIFc x Absd x CSF

Parameter	Units	RME child	 adult
Chemical Concentration in Soil (CS)	mg/kg	chem-specific	chem-specific
Exposure Frequency (EF)	days/year	24	24
Exposure Duration (ED)	years	6	24
Surface Area Available for Contact (SA)	cm^2/day	2800	5700
Adherence Factor (AF)	mg/cm^2	0.2	0.07
Conversion Factor (CF)	kg/mg	1.0E-06	1.0E-06
Body Weight (BW)	kg	15	70
Averaging Time (noncancer) (ATnc)	days	2190	8760
Averaging Time (cancer) (ATc)	days	25550	25550
SIFnc = (EF*ED*SA*AF*CF)/(BW*ATnc)	$(day)^{-1}$	2.45E-06	3.75E-07
DFadj (Dermal Adjusted Factor) =	mg-yr/day-kg	360.80	360.80
(EDch*SAch*AFch /BWch) +(EDa*SAa*AFa/BWa)			
SIFc = (DFadj*EF*CF)/ATc	$(day)^{-1}$	3.39E-07	3.39E-07

Chemical	RfDd (mg/kg-d)	CSFd $(mg/kg\text{-}d)^{-1}$	Absd unitless
Cadmium	2.5E-05	--	1.0E-03
Mercury & comps.	--	--	--

Chemical	Reasonable Maximum Exposure CS (mg/kg)	$Intake_{nc}$ child (mg/kg-d)	$Intake_{nc}$ adult (mg/kg-d)	$Intake_c$ lifetime (mg/kg-d)	HQ child	HQ adult	Cancer Risk lifetime
Cadmium	4.60	1.13E-08	1.72E-09	--	0.0005	0.00007	--
Mercury (mercuric chloride)	(a)	--	--	--	--	--	--
Chromium	(a)	--	--	--	--	--	--
Total					**0.0005**	**0.0001**	**0.0E+00**

(a) - a dermal reference dose is not available for elemental mercury; therefore, this pathway could not be evaluated.

Table 8: Recreational Exposures to Clam Tissues Liberty Bay - Revised Risk Results
Ingestion of Clam Tissue
Future

Exposure Medium: Clam Tissue
Exposure Point: Clams in Liberty Bay
Receptor Population: Recreational
Receptor Age: Children and Adults

Noncancer Hazard = CTi x SIFnc / RfD
Cancer Risk = CTi x SIFc x CSF

Parameter	Unit	RME	
		Child	**Adult**
Chemical Conc'n in Tissue (CTi)	mg/kg	chem-specific	chem-specific
Ingestion Rate of Clam Tissue (IR)	g/day	--	17.5
Fracton of Clam from Contaminated Source (FC)	unitless	--	0.25
Exposure Frequency (EF)	days/year	--	350
Exposure Duration (ED)	years	--	30
Conversion Factor (CF)	kg/g	--	1.00E-03
Body Weight (BW)	kg	--	70
Averaging Time (noncancer) (ATnc)	days	--	10,950
Averaging Time (cancer) (ATc)	days	--	25,550
SIFnc = (IR*FC*EF*ED*CF)/(BW*Atnc)	$(day)^{-1}$	--	5.99E-05
IngFadj (Ingestion Adjusted Factor) = (IRch*EDch/BWch) + (IRa*EDa/BWa)	g-yr/day-kg	--	
SIFc = (IngFadj*FC*EF*CF)/ATc	$(day)^{-1}$	--	

Chemical	RfDo (mg/kg-d)	CSFo (mg/kg-d)-1
Cadmium	1.0E-03	--
Chromium	3.0E-03	--
Mercury (Methyl)	1.0E-04	--
Silver	5.0E-03	--

Chemical	Reasonable Maximum Exposure						
	CTi (mg/kg)	**Intake$_{nc}$ child** (mg/kg-d)	**Intake$_{nc}$ adult** (mg/kg-d)	**Intake$_{c}$ lifetime** (mg/kg-d)	**HQ child**	**HQ adult**	**Cancer Risk lifetime**
Cadmium	1.88	--	1.13E-04	--	--	0.113	--
Chromium	2.2	--	1.32E-04	--	--	0.0439	--
Methylmercury	0.06	--	3.66E-06	--	--	0.04	--
Silver	0.57	--	3.42E-05	--	--	0.01	--
					--		
Total					**--**	**0.2**	**0.0E+00**

APPENDIX D

Ecological Risk Assessment - OU 2 Area 8

CONTENTS

CONTENTS (Continued)

ATTACHMENT

FIGURE

TABLES

ABBREVIATIONS AND ACRONYMS

AE	assessment endpoint
AWQG	ambient water quality criteria
BCF	bioconcentration factor
◦C	degree Celsius
COI	chemical of interest
COPEC	chemical of potential ecological concern
EC50	effective concentration that causes a stated effect in 50 percent of the group of test organisms
Ecology	Washington State Department of Ecology
HQ	hazard quotient
LC1	lethal concentration that causes death in 1 percent of the group of test organisms
LC50	lethal concentration that causes death in 50 percent of the group of test organisms
MCB	monochlorobenzene
µg/L	microgram per liter
mg/kg	milligram per kilogram
msl	mean sea level
MTCA	Model Toxics Control Act
Navy	U.S. Navy
NOEC	no-observed-effect concentration
NOED	no-observed-effect does
NPL	National Priorities List
NUWC	Naval Undersea Warfare Center
ODEQ	Oregon Department of Environmental Quality
PeCB	pentachlorobenzene
ppm	part per million
SLERA	screening level ecological risk assessment
TSC	tissue screening concentration
TSV	tissue screening value
WAC	Washington Administrative Code

1.0 INTRODUCTION

This report presents the results of a screening level ecological risk assessment (SLERA) for OU 2 Area 8 conducted as part of the second 5-year review performed for the Naval Undersea Warfare Center (NUWC) National Priorities List (NPL) site located in Keyport, Washington (see Figures 1-1 and 2-1 of the second 5-year review).

1.1 OBJECTIVES AND APPROACH

The overall objective of the SLERA was to evaluate the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to chemicals of potential ecological concern (COPECs) identified in sediment for OU 2 Area 8 at NUWC Keyport. The specific assessment endpoints considered in the SLERA are presented in Section 2.3.

The general approach for the SLERA involved an initial screening of sediment quality data against screening levels set for the protection of aquatic life to identify COPECs for further consideration in the SLERA. The sediment screening step was followed by screening the shellfish tissue data for the COPECs against tissue screening levels. Following the screening of tissue data, hazard quotients (HQs) were calculated based on the measured tissue data. Where HQs were found to be less than 1, risk to aquatic biota was considered acceptable. Where HQs exceeded 1, further investigation may be warranted, because a potential exists for risks to aquatic biota.

The SLERA consists of the following components:

- Introduction (Section 1)
- Problem Formulation (Section 2)
- Exposure Assessment (Section 3)
- Effects Assessment (Section 4)
- Risk Characterization (Section 5)
- Uncertainty Analysis and Conclusions (Section 6)
- References (Section 7)

1.2 SITE BACKGROUND

The Keyport property was acquired by the Navy in 1913, with property acquisition continuing through World War II. The property was first used as a quiet-water range for torpedo testing.

The first range facility was located in Port Orchard Inlet southeast of the site. During the early 1960s, Keyport's role was expanded to include manufacturing and fabrication, such as welding, metal plating, carpentry, and sheet-metal work. Further expansion in 1966 consisted of a new torpedo shop, and, in 1978, the functions broadened to include various undersea warfare weapons and systems engineering and development activities. Operations currently include engineering, fabrication, assembly, and testing of underwater weapons systems.

Further details pertaining to the site's history and operations are presented in Sections 2 and 3 of the second 5-year review.

2.0 PROBLEM FORMULATION

The problem formulation is the planning phase of the risk assessment. The primary components of the problem formulation include the following:

- Description of the exposure setting
- Data evaluation and determination of COPECs
- Selection of assessment and measurement endpoints
- Preparation of a conceptual model

2.1 EXPOSURE SETTING

2.1.1 Site Description

NUWC Keyport occupies 340 acres (including tidelands) adjacent to the town of Keyport in Kitsap County, Washington, on a small peninsula in the central portion of Puget Sound. NUWC Keyport is bordered by Liberty Bay on the east and north and Port Orchard Inlet on the southeast (see Figure 1-1 of the second 5-year review).

The topography of the site rises gently from the shoreline to an average of 25 to 30 feet above mean sea level (msl) and then rises steeply to approximately 130 feet above msl at the southeast corner of the site.

Marine or brackish water bodies on and near the site consist of Liberty Bay, Dogfish Bay, the tide flats, a marsh, and the shallow lagoon. Freshwater bodies include two creeks draining into the marsh pond and two creeks that discharge into the lagoon.

The terrestrial sediment in the Keyport area generally includes coarse-grained glacial deposits and finer-grained nonglacial deposits. Most of NUWC Keyport is underlain by a thick nonglacial silt and clay informally known as the Clover Park Unit. This unit is commonly about 100 feet thick and is an aquitard separating the unconfined aquifer above (referred to as the “upper aquifer”) and the intermediate aquifer beneath it.

2.1.2 Future Land Use

No change in land use is expected in the foreseeable future.

2.2 DATA EVALUATION

This section describes the types and sources of data used in the SLERA and how the data were evaluated.

2.2.1 Data Sources

Data considered in the SLERA consisted of surficial sediment quality and shellfish tissue data collected offshore from OU 2 Area 8. The data include sediment and tissue samples collected from locations 1 through 9 in Area 8. In 1996, there were three additional sediment locations, locations 10 through 12. All of these data are presented in Tables D1 and D2 in Attachment D-1. These sampling locations are illustrated on Figure 3-3 of the second 5-year review.

It should be noted that hexavalent chromium was measured in shellfish tissue, but not in sediment (i.e., Chromium VI). As a result, hexavalent chromium was, by default, carried forward as a COPEC, despite not being analyzed for in sediment.

2.2.2 Screening Levels

To determine whether a chemical of interest (COI) would be carried forward as a COPEC in this SLERA, the analytical data available for each COI were as compared to a sediment screening value. If the concentration of the COI measured in the sediment sample was greater than the sediment screening value, the COI was considered to be a COPEC. The sediment screening values used in this SLERA, in order of preference included:

- Washington State Model Toxics Control Act (MTCA) sediment management standards (Chapter 173-204 Washington Administrative Code [WAC])

- Washington State Department of Ecology’s (Ecology’s). *Progress Re-evaluating Puget Sound Apparent Effects Thresholds (AETs),* Vol. 1, *1994 Amphipod and Echinoderm Larval AETs* (NOAA 1999)

- Oregon Department of Environmental Quality (ODEQ). *Guidance for Ecological Risk Assessment, Level II Screening Level Values.* (ODEQ 2001)

- Personnel communication with Peter Adolphson of Ecology regarding cyanide in marine sediment (Adolphson 2004)

The sediment screening values are presented in Table D2-1.

2.2.3 Chemicals of Concern

There are no Washington State marine sediment quality standards for benzo(b)fluoranthene and benzo(k)fluoranthene. Therefore, the concentrations for these two chemicals in each sample were summed and compared with the Washington State marine sediment quality standard for total benzofluoranthene. The summation result for total benzofluoranthene was less than the screening value in each case and, hence, were not carried forward in the SLERA as COPECs.

There is a paucity of toxicological information for gold, but it is generally considered relatively nontoxic. It is also considered the most inert of all metals (Merchant 1998). As a result, gold was not carried forward as a COPEC despite the lack of sediment screening values.

About 2 percent of the earth's crust is made up of sodium, potassium, and magnesium (World Book 2004). Marine seawater contains 1,300 parts per million (ppm) magnesium, 10,700 ppm sodium, and 3,900 ppm potassium (Swenson 1998). These elements are naturally present in marine sediment at concentrations much greater than those measured at the site. As a result, these chemicals were not considered COPECs in the risk assessment.

Seventeen chemicals were detected at concentrations exceeding their respective screening values or, for not detected chemicals, had detection limits greater than their respective screening values:

- 1,2,4-Trichlorobenzene
- 1,2-Dichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 2,4-Dimethylphenol
- 2-Methylphenol
- 4-Methylphenol
- Bis(2-ethylhexyl)phthalate
- Butylbenzylphthalate
- Cadmium
- Cyanide
- Di-n-octylphthalate
- Hexachlorobenzene
- Hexachlorobutadiene
- Hexachloroethane
- Mercury
- Phenol

When first measured in 1996 or 2000, six of the above chemicals had detection limits that exceeded the SLERA screening values. However, when resampled in 2000 and/or 2004, these chemicals were still not detected when sufficient detection limits were used. As a result, these six COIs were not considered to be COPECs in this SLERA:

- 1,2-Dichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 2,4-Dimethylphenol
- 2-Methylphenol
- Hexachlorobutadiene

Three COIs, were detected in sediments at one or more stations when first sampled, but when resampled did not exceed the SLERA screening values:

- 4-Methylphenol
- Butylbenzylphthalate
- Di-n-octylphthalate

In 1996, 4-methylphenol was detected in samples from three locations 2, Station 7, and 8 in excess of its screening value. Re-sampling in 2000 and 2004 revealed that 4-methylphenol was present below SLERA screening values. Therefore, 4-methylphenol was not considered a COPEC in the SLERA.

In 1996, butylbenzylphthalate was detected in a sample (location 8) in excess of its screening value. Re-sampling in 2000 and 2004 revealed that butylbenzylphthalate was present below SLERA screening values. Therefore, butylbenzylphthalate was not considered a COPEC in the SLERA.

When first sampled in 2000, di-n-octylphthalate was detected in one sample (location 9) in excess of its screening value. Resampling in 2004 revealed that di-n-octylphthalate was present below SLERA screening values and, therefore, was not considered a COPEC in the SLERA.

No screening value was available for cyanide in marine sediments. Peter Adolphson of Ecology (Adolphson 2004) stated that cyanide was not generally an issue in marine sediment in the state of Washington. Mr. Adolphson stated that a cyanide concentration of less than 1 mg/kg in marine sediment in Washington state was not considered to be of concern. As cyanide was less than the reported detection limit of 0.4 mg/kg, cyanide was not considered a COPEC in the SLERA.

The following chemicals were identified as COPECs at the site:

- 1,2,4-Trichlorobenzene
- Hexachlorobenzene
- Hexachloroethane
- Bis(2-ethylhexyl)phthalate
- Phenol
- Cadmium
- Hexavalent chromium (in tissue)
- Mercury

2.3 ASSESSMENT ENDPOINTS

Assessment endpoints (AEs) are expressions of the environmental values to be protected and establish a clear connection between management goals, valued ecological receptors, and the objectives of the risk assessment (USEPA 1998). Assessment endpoints are typically at the population or community levels (e.g., Chinook salmon population or terrestrial vegetation community), but in some cases may be at the individual (e.g., rare or endangered species) or even ecosystem levels.

The overall management goal for the ecological risk assessment was the preservation of valued ecological components and properties of the aquatic environment.

The selected assessment endpoints for the site included the following:

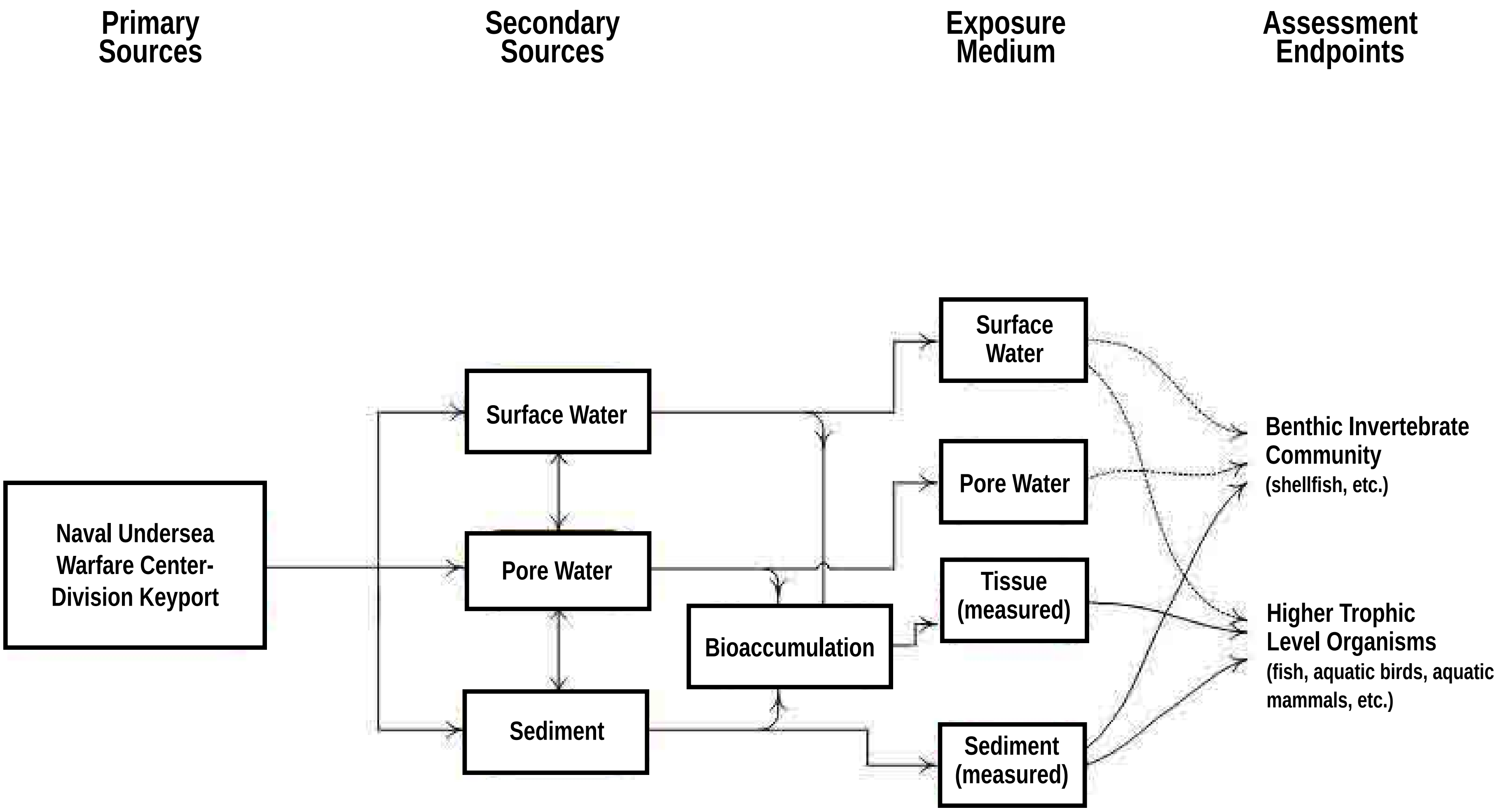
- AE #1): sediment quality
- AE #2): benthic marine invertebrate community
- AE #3): aquatic biota in general

To facilitate addressing AE#1, sediment samples were collected at the site and were analyzed for constituents potentially associated with NUWC Keyport operations. To address AE#2 and to reduce uncertainty regarding extrapolation of sediment results to higher trophic level species, shellfish tissue samples were collected from the site and analyzed for constituents potentially associated with NUWC Keyport. The AE#2 endpoint was evaluated based on HQs calculated from comparison of shellfish tissue data with tissue screening values. The final assessment endpoint, AE#3, was also based on the HQ results developed for shellfish. Where shellfish HQs exceeded 1, it was concluded that there existed a potential for sediment at the site to pose a risk to aquatic receptors in general.

2.4 CONCEPTUAL MODEL

A conceptual model indicating the source, exposure routes, and potential aquatic receptors is illustrated on Figure D2-1.

33755543-107



U.S.NAVY

Figure D2-1
Aquatic Conceptual Exposure Model
NUWC Keyport

NAVAL UNDERSEA WARFARE CENTER
DIVISION KEYPORT
Keyport, Washington

Table D2-1
Results of the Sediment Screening to Identify Potential Chemicals of Potential Ecological Concern in Marine Sediment at OU 2 Area 8

Chemical	Maximum Detected Concentration (mg/kg)	Sediment Screening Value (mg/kg)	Exceeds Sediment Screening Values?	Rationale
1,2,4-Trichlorobenzene	4.35	0.81[a]	**YES**	Site chemical concentration greater than SV
1,2-Dichlorobenzene	4.35	2.3 [a]	**YES**	Site chemical concentration greater than SV
1,3-Dichlorobenzene	4.35	2.3[b]	**YES**	Site chemical concentration greater than SV
1,4-Dichlorobenzene	4.35	3.1[a]	**YES**	Site chemical concentration greater than SV
2,4-Dimethylphenol	0.2	0.029[a]	**YES**	Site chemical concentration greater than SV
2-Methylnaphthalene	4.35	38[a]	**NO**	Site chemical concentration less than SV
2-Methylphenol	0.1	0.063[a]	**YES**	Site chemical concentration greater than SV
4-Methylphenol	1.5	0.67[a]	**YES**	Site chemical concentration greater than SV
Acenaphthene	12.13	16[a]	**NO**	Site chemical concentration less than SV
Acenaphthylene	4.35	66[a]	**NO**	Site chemical concentration less than SV
Acetone	0.11	290[a]	**NO**	Site chemical concentration less than SV
Aluminum	9180	18000[c]	**NO**	Site chemical concentration less than SV
Anthracene	5.56	220[a]	**NO**	Site chemical concentration less than SV
Antimony	0.18	9.3[c]	**NO**	Site chemical concentration less than SV
Arsenic	2.6	57[a]	**NO**	Site chemical concentration less than SV
Barium	17.3	48[c]	**NO**	Site chemical concentration less than SV
Benzo(a)anthracene	19.17	110[a]	**NO**	Site chemical concentration less than SV
Benzo(a)pyrene	15.28	99[a]	**NO**	Site chemical concentration less than SV
Benzo(b)fluoranthene	-	-	**-**	See total benzofluoranthenes
Benzo(g,h,i)perylene	5.83	31[a]	**NO**	Site chemical concentration less than SV
Benzo(k)fluoranthene	-	-	**-**	See total benzofluoranthenes
Total Benzofluoranthenes	32.2	230[a]	**NO**	Site chemical concentration less than SV
Benzoic acid	0.25	0.65[a]	**NO**	Site chemical concentration less than SV
Benzyl alcohol	0.05	0.057[a]	**NO**	Site chemical concentration less than SV
Beryllium	0.15	122[d]	**NO**	Site chemical concentration less than SV
bis(2-Ethylhexyl)phthalate	86.96	47[a]	**YES**	Site chemical concentration greater than SV
Butylbenzylphthalate	8.44	4.9[a]	**YES**	Site chemical concentration greater than SV
Cadmium	9.13	5.1[a]	**YES**	Site chemical concentration greater than SV
Chromium	194	260[a]	**NO**	Site chemical concentration less than SV
Chrysene	33.33	110[a]	**NO**	Site chemical concentration less than SV

Table D2-1 (Continued)
Results of the Sediment Screening to Identify Potential Chemicals of Potential Ecological Concern in Marine Sediment at OU 2 Area 8

Chemical	Maximum Detected Concentration (mg/kg)	Sediment Screening Value (mg/kg)	Exceeds Sediment Screening Values?	Rationale
Cobalt	5.81	10[c]	**NO**	Site chemical concentration less than SV
Copper	20.8	390[a]	**NO**	Site chemical concentration less than SV
Cyanide	0.4	-	**NO**	No sediment screening value
Dibenz(a,h)anthracene	4.35	12[a]	**NO**	Site chemical concentration less than SV
Dibenzofuran	4.35	15[a]	**NO**	Site chemical concentration less than SV
Diethylphthalate	18.61	61[a]	**NO**	Site chemical concentration less than SV
Dimethylphthalate	4.35	53[a]	**NO**	Site chemical concentration less than SV
Di-n-butylphthalate	4.35	220[a]	**NO**	Site chemical concentration less than SV
Di-n-octylphthalate	72.22	58[a]	**YES**	Site chemical concentration greater than SV
Fluoranthene	24.72	160[a]	**NO**	Site chemical concentration less than SV
Fluorene	4.35	23[a]	**NO**	Site chemical concentration less than SV
Gold	2.50	-	**NO**	Site chemical concentration less than SV
Hexachlorobenzene	4.35	0.38[a]	**YES**	Site chemical concentration greater than SV
Hexachlorobutadiene	4.35	3.9[a]	**YES**	Site chemical concentration greater than SV
Hexachloroethane	1.26	0.073[c]	**YES**	Site chemical concentration greater than SV
Indeno(1,2,3-cd)pyrene	6.94	34[a]	**NO**	Site chemical concentration less than SV
Lead	37.6	450[a]	**NO**	Site chemical concentration less than SV
Magnesium	5780	20000[e]	**NO**	Site chemical concentration less than SV
Manganese	253	260[c]	**NO**	Site chemical concentration less than SV
Mercury	1.9	0.41[a]	**YES**	Site chemical concentration greater than SV
Naphthalene	4.35	99[a]	**NO**	Site chemical concentration less than SV
Nickel	31.6	110[c]	**NO**	Site chemical concentration less than SV
N-Nitrosodiphenylamine	4.35	11[a]	**NO**	Site chemical concentration less than SV
Pentachlorophenol	0.3	0.36[a]	**NO**	Site chemical concentration less than SV
Phenanthrene	27.78	100[a]	**NO**	Site chemical concentration less than SV
Phenol	5.2	0.42[a]	**YES**	Site chemical concentration greater than SV
Pyrene	23.06	1000[a]	**NO**	Site chemical concentration less than SV
Selenium	1.25	1[c]	**NO**	Site chemical concentration less than SV
Silver	1.54	6.1[a]	**NO**	Site chemical concentration less than SV
Thallium	0.073	0.7[a]	**NO**	Site chemical concentration less than SV

Table D2-1 (Continued)
Results of the Sediment Screening to Identify Potential Chemicals of Potential Ecological Concern in Marine Sediment at OU 2 Area 8

Chemical	Maximum Detected Concentration (mg/kg)	Sediment Screening Value (mg/kg)	Exceeds Sediment Screening Values?	Rationale
Tin	2.7	5[c]	**NO**	Site chemical concentration less than SV
Vanadium	26.2	57[c]	**NO**	Site chemical concentration less than SV
Zinc	94.8	410[a]	**NO**	Site chemical concentration less than SV

[a] WDOE 1996
[b] 1,2-dichlorobenzene used as a surrogate
[d] NOAA 1999
[c] ODEQ 2001
[e] World Book 2004

Notes:
mg/kg - milligram per kilogram
SV - screening value

3.0 EXPOSURE ASSESSMENT

The purpose of the exposure assessment is to describe the degree or extent to which aquatic biota are exposed to COPECs at the site.

3.1 ENVIRONMENTAL EXPOSURE CONCENTRATIONS

The exposure concentration term considered in the SLERA was, by default, the maximum concentration from each sampling location. The reason for this was that only one sample was collected at each location per sampling event, and each location was considered discrete. The Record of Decision allowed for a natural attenuation approach to remediation at the site. As such, it was assumed that data collected more recently was more representative of current exposure conditions.

3.2 RECEPTOR EXPOSURE CONCENTRATIONS

Shellfish tissue samples were collected from nine sampling locations during three sampling events (1996, 2000, and 2004). The tissue samples were analyzed for the identified COPECs and were reported in dry weight for metals and wet weight for the organic COPECs. The dry weight metal results were subsequently converted to wet weights, based on the measured tissue moisture content (Table D3-1).

The important point regarding exposure concentrations in lower trophic level organisms, is that these were measured, rather than modeled, using bioconcentration and exposure assumptions. The use of measured tissue information is considered more representative of actual exposures occurring at the site. The shellfish tissue data are presented in Table D2 in Attachment D-1.

Table D3-1
Percent Solid in Shellfish Tissue Samples Used to Convert Dry Weight Metals Data to Wet Weight

Location	Tissue in 2000 % Solid	Tissue in 2004 % Solid
1	11.4	13.3
2	11.5	16
3	12.7	15.5
4	12.9	15
5	12	14
6	12.5	15.5
7	15.4	15.7
8	14.7	16.3
9	15.1	16.3

4.0 EFFECTS ASSESSMENT

4.1 ECOTOXICOLOGY

The toxicity profiles for identified COPECs are presented in this section.

4.1.1 Chlorinated Benzenes (1,2,4-Trichlorobenzene and Hexachlorobenzene)

The bioaccumulation of chlorobenzenes by aquatic organisms is determined by their relative water and lipid solubilities (thus reflecting the octanol/water partition coefficients) and the number of chlorine substitutions. Uptake from water increases with increasing chlorination and increasing temperature.

In general, aquatic toxicity increases with the degree of chlorination of the benzene ring. Seventy-two-hour effective concentrations that cause a stated effect in 50 percent of the group of test organisms (EC50s) for green algae range from 5,280 µg/L for 1,3-dichlorobenzene to 200,000 µg/L for monochlorobenzene (MCB). Similarly, 48-hour EC50s for diatoms range from 8 to 235,000 µg/L. Ninety-six-hour LC50s for fish range from 135 µg/L for pentachlorobenzene (PeCB)to 21,000 µg/L for 1,2,4-trichlorobenzene. Chronic no-observed-effect concentrations (NOECs) for freshwater invertebrates range from 32 µg/L for PeCB to 19,000 µg/L for MCB. In fish, NOECs range from 18 µg/L for PeCB to 8,500 µg/L for MCB.

4.1.2 Phenol

Based on reported and estimated bioconcentration factors for aquatic organism, phenol is not expected to bioaccumulate significantly in the aquatic environment. Phenol is toxic to aquatic organisms. The lowest EC50 for water organisms is estimated to be 3.1 mg/L (48-hour lethal concentration that causes death in 50 percent of the group of test organisms [LC50] for *Ceriodaphnia dubia*). The lowest chronic NOEC is estimated to be 0.2 µg/L (8-day lethal concentration that causes death in 1 percent of the group of test organisms [LC1] for *Salmo gairdneri*). Applying the modified U.S. Environmental Protection Agency (EPA) method, an environmental concern level of 0.02 µg/L can be derived for water. In general, fish are the most sensitive species and the sensitivities of marine and freshwater organisms are similar.

4.1.3 Bis(2-Ethylhexyl)phthalate (BEHP)

The toxicity of sediment-associated phthalates was investigated in a comprehensive research project carried out at the University of Wisconsin in conjunction with the EPA. In 10-day sediment toxicity tests with *Chironomous tentans and Hyalella azteca*, no effects were observed for dihexyl, diethylhexyl, diisononyl, 711P, and diisodecyl phthalate at the maximum concentration tested (3,000 mg/kg dry weight).

These findings are in line with those of two other independent studies. A 28-day chronic sediment toxicity study for both BEHP and diisodecyl phthalate indicated no effects on the time to emergence or sex ratio of the midge (*Chironomus riparius*) at sediment concentrations up to 10,000 mg/kg dry weight. In another study, no effects were observed on moor frog (*Rana arvalis*) egg hatching or tadpole survival at the highest sediment concentrations tested, i.e. 600 mg/kg dry weight for both BEHP and diisodecyl phthalate.

4.1.4 Hexachloroethane (USEPA 1980)

In general, the toxicity of the chlorinated ethanes to freshwater organisms increases with increasing chlorination. The least chlorinated tested compound was 1,2-dichloroethane, for which the 50 percent effect concentrations for *Daphnia magna*, fathead minnow, and bluegill were in the range of 118,000 to 550,000 µg/L; the various trichloroethanes and tetrachloroethanes are generally intermediate in toxicity, and penta-chloroethane and hexachloroethane are most toxic. The 50 percent effect concentration for hexachloroethane and *Daphnia magna*, midge larvae, rainbow trout, fathead minnow, and bluegill are in the range of 980 to 8,070 µg/L. Embryo-larval tests have been conducted with 1,2-dichloro-ethane, 1,1,2-trichloroethane, 1,1,2,2-tetrachloroethane, pentachloro-ethane, and hexachloroethane, and the chronic values were 20,000, 9,400, 2,400, 1,100, and 540 µg/L, respectively. The range of acute-chronic ratios was 2.8 to 8.7. The range of 96-hour EC50 values for a freshwater alga were from 136,000 µg/L for 1,1,2,2-tetrachloroethane to 87,000 µg/L for hexachloroethane. The chlorinated ethanes do not bioconcentrate in the bluegill to any great extent, although the effect of a chlorination is apparent with bioconcentration factors increasing from 2 for 1,2-dichloroethane to 139 for hexachloroethane for a series of five compounds. As with the freshwater toxicity tests with fish and invertebrate species, there was an increase in effects with the more highly chlorinated compounds for saltwater toxicity tests. Under comparable test conditions, the 96-hour LC50 values for the mysid shrimp were in the range of 113,000 µg/L for 1,2-dichloroethane to 940 µg/L for hexachloroethane. For the sheepshead minnow, the range was from 70,900 µg/L for 1,1,1-trichloro-ethane to 2,400 µg/L for hexachloroethane. Only one chronic value has been determined for the chlorinated ethanes and saltwater species, and the chronic value for pentachloroethane and the mysid shrimp is 281 µg/L. The 96-hour EC50 values for a saltwater alga ranged from 6,230 to 58,200 µg/L. Criteria: The available freshwater data for chlorinated ethanes indicate that toxicity increases greatly with increasing chlorination and that acute toxicity occurs at concentrations as low 118,000 µg/L for 1,2-dichloro-ethane, 18,000 µg/L for two trichloroethanes, 9,320 µg/L for two tetra-chloroethanes, 7,240 µg/L for pentachloroethane, and 980 µg/L for hexa-chloroethane. Chronic toxicity occurs at concentrations as low as 20,000 µg/L for 1,2-dichloroethane, 9,400 µg/L for 1,1,2-trichloroethane, 2,400 µg/L for 1,1,2,2-tetrachloroethane, 1,100 µg/L for pentachloroethane, and 540 µg/L for hexachloroethane. Acute and chronic toxicity would occur at lower concentrations among species that are more sensitive than those tested. The available saltwater data for chlorinated ethanes indicate that toxicity increases greatly with increasing chlorination and that acute toxicity to fish and invertebrate species occurs at concentrations as low as 113,000 µg/L for 1,2-dichloroethane, 31,200 µg/L for 1,1,1-trichloroethane, 9,020 µg/L for 1,1,2,2-tetrachloroethane, 390 µg/L for pentachloroethane, and 940 µg/L for hexachloroethane.

4.1.5 Cadmium (WHO 1992)

Cadmium is toxic to a wide range of microorganisms. However, in the presence of sediment, high concentrations of dissolved salts or organic matter all reduce the toxic impact. The main effect is on growth and replication.

Zinc increases the toxicity of cadmium to aquatic invertebrates. Sublethal effects have been reported on the growth and reproduction of aquatic invertebrates: there are structural effects on invertebrate gills. There is evidence of the selection of resistant strains of aquatic invertebrates after exposure to cadmium in the field.

An increase in toxicity has been noted as temperature increases and salinity decreases. This implies that the same cadmium concentration may have the potential to cause greater toxicity to estuarine rather than to marine species. For example, Rosenberg and Costlow (1976) reported increased cadmium toxicity during larval development of two estuarine crab species as salinity decreased and increased toxicity as temperature increased.

O'Hara (1973) investigated the effects of temperature and salinity on the toxicity of cadmium to adult male and female fiddler crabs, *Uca pugilator*. Mortality was greatest at high temperatures and low salinities in tests lasting 240 hours. LC50 values varied from 2.9 mg l-1 for the lowest salinity (10 percent) and highest temperature (30°C) to 47.0 mg l-1 for the highest salinity (30 percent) and lowest temperature (10°C). Frank and Robertson (1979) exposed the blue crab *Callinectes sapidus* to cadmium chloride at salinities of 1, 15, and 35 percent. Like O'Hara, they found a decrease in cadmium toxicity with increase in salinity. For example, 96-hour LC50 values were 0.32, 4.7, and 11.6 mg cadmium l-1 for the three salinities, respectively.

Cadmium toxicity has been found to be variable in fish, with salmonids being particularly susceptible to cadmium. Sublethal effects in fish, notably malformation of the spine, have been reported. The most susceptible life-stages are the embryo and early larva, while eggs are the least susceptible. There is no consistent interaction between cadmium and zinc in fish (WHO 1992b).

4.1.6 Hexavalent Chromium

There have been many studies of toxic effects of hexavalent chromium salts (chromates and dichromates) and trivalent and divalent oxides, sulfates, and chlorides on freshwater organisms, but data on chromium toxicity in marine organisms are much fewer. Both marine and freshwater studies indicate that hexavalent chromium is considerably more toxic and less likely to exist than other forms (Muller 1980).

The acute toxicity of hexavalent chromium for both marine and freshwater organisms appears to range between 1 and 330 ppm (actual values vary greatly with species, salinity, pH, alkalinity, and temperature). Our results of an acute toxicity value of about 1 ppm chromium for *Neanthes arenaceodentata* indicate this to be a particularly sensitive species. Chronic toxicity value for polychaete worms is in the range of 17 to 38 µg/L (Eisler 1981).

4.1.7 Mercury

Toxicity is influenced by the form of mercury, the environmental media, environmental conditions, the sensitivity or tolerance of the organism, and the life history stage. Inorganic mercury is less acutely toxic to aquatic organisms than methylmercury, but the range in sensitivity among individual species for either compound is large. Toxicity has been found to be greater at elevated temperatures, lower oxygen content, reduced salinities in marine environments, and in the presence of metals such as zinc and lead.

In general, toxic effects occur because mercury binds to proteins and alters protein production or synthesis. Toxicological effects include reproductive impairment, growth inhibition, developmental abnormalities, and altered behavioral responses. Reproductive endpoints are generally more sensitive than growth or survival, with embryos and the early developmental stages the most sensitive. Mercury can be transferred from tissues of the adult female to developing eggs. Exposure to low concentrations of mercury may not result in mortality directly, but may retard growth, thereby, increasing the risk of predation.

Data available on the effects of mercury-contaminated sediment on aquatic organisms reviewed by Long and MacDonald (1992) resulted in effects-range-low and effects-range-median concentrations of 0.15 and 0.71 mg/kg, respectively. However, these numbers were less accurate than other metals in predicting adverse effects, which highlights the need for site-specific effects data to determine concentrations of mercury in sediment that pose a threat to aquatic biota.

Few studies report both tissue residues and effects in long-term exposure to low concentrations of mercury. However, results from studies on different freshwater species indicate that reproductive effects could be expected to occur in sensitive fish species at tissue concentrations close to the U.S. Federal Drug Administration action level of 1 mg/kg (ppm).

The interaction of mercury and other trace elements (e.g., cadmium, copper, selenium, and zinc) can be both antagonistic and synergistic, primarily depending on exposure concentrations and form of mercury. Effects were generally less than additive (antagonistic) at lower exposure levels and greater than additive (synergistic) at higher levels. Zinc and cadmium were reported to reduce the teratogenic effects of methylmercury to killifish, while selenium reduced mercury's toxic effects on development in medaka embryos.

4.2 TOXICITY SCREENING VALUES

To assess the potential for COPECs to adversely affect shellfish and, potentially, other aquatic receptors, the concentrations of COPECs in shellfish tissue were compared to tissue screening values (TSVs). TSVs were based on calculated tissue screening concentrations (TSCs) and published tissue residue data. The more conservative (lower) of the TSC and the tissue residue data for each COPEC was carried forward as the TSV. The TSVs used in this SLERA are presented in Table D4-1.

4.2.1 Tissue Screening Concentrations

TSCs represent concentrations of chemicals within a given species that, if exceeded, may result in adverse effects to the organism. The TSCs were derived by multiplying the EPA ambient water quality criteria (AWQC) by an appropriate bioconcentration factor (BCF) as described in Dyer et al. (2000) and Shephard (1998).

To provide a more conservative screening value, the AWQC used in the calculation of TSCs was the lower of the EPA marine acute or chronic AWQCs.

The BCFs considered were those selected from the EPA AWQC documents. BCFs for marine environments were preferentially selected over those for freshwater environments (USEPA 1980). When aquatic BCFs were not available, those from the human health portion of the EPA AWQC documents were used (USEPA 2002).

4.2.2 Tissue Residue Concentrations

Tissue residue concentrations are derived from tests with organisms to determine the tissue concentration at which adverse effects occur. The tissue residue concentrations considered for this SLERA were based on tests involving benthic and epibenthic biota in marine ecosystems, as published in USACE (2004) and Jarvinen and Ankley (1999). Where no marine-based information was available, freshwater-based information was considered.

The preferred toxicological endpoint for the SLERA was the no-observed-effect dose (NOEDs) for sensitive effects such as mortality, growth, development, and reproduction. The NOED represents the highest concentration at which no discernible adverse effect was observed in the test.

Table D4-1
Tissue Screening Values for Chemicals of Potential Ecological Concern in Sediment

Chemical	AWQC[a] USEPA (µg/L)	BCF[b]	TSC[c] (mg/kg)	Tissue Residue NOED		TSV (mg/kg)
				Concentration (mg/kg)	Effect	
1,2,4-Trichlorobenzene	129	114[d]	14.71	0.18	Survival, *Oncorhynchus mykiss*[e]	0.2
Bis(2-ethylhexyl)phthalate	360	130[d]	46.80	9.3	*Mytilus edulis*[f]	9.3
Cadmium	9.3	22.0[g]	0.20	1.12	Growth, reproduction, survival, *Neanthes a.*[f]	0.2
Chromium VI	50	125.0[h]	6.25	4.42	Reproduction, *Neanthes a.*[e]	4.4
Hexachlorobenzene	3.68	8690[d]	31.98	46.5	Survival, growth, *Pimephales p.*[e]	32.0
Hexachloroethane	540	86.9[d]	46.93	0.0071	Survival, growth, *Oncorhynchus mykiss*[e]	0.0071
Mercury	0.94	10,000[i]	9.40	2.0	growth, reproduction, survival, *Hexagenia rigida*[f]	2.0
Phenol	2560	1.4[d]	3.58	1.8	reproduction, development, cellular, *Strongylocentrotus purpuratus*[f]	1.8

[a] Ambient water quality criteria (taken from NOAA 1999) (chronic)
[b] BCF is the ratio between a chemical concentration in tissue and water, L/kg.
[c] TSC (mg/kg) = AWQC (µg/L) X BCF (L/kg)/1000
[d] USEPA 2002
[e] Jarvinen A.W., and G.T. Ankley 1999
[f] From the Environmental Residue-Effects Database (USACE 2004)
[g] USEPA 2001
[h] USEPA 1980b
[i] USEPA 1984

Notes:
AWQC - ambient water quality criteria
BCF - bioconcentration factor
L/kg - liter per kilogram
µg/L - microgram per liter
mg/kg - milligram per kilogram
NOED - no-observed-effect dose
TSC - tissue screening concentration
TSV - tissue screening value
USEPA - U.S. Environmental Protection Agency

5.0 RISK CHARACTERIZATION

The risk characterization for the SLERA was based on the calculation of HQs for each identified COPEC. The HQs were calculated by dividing the measured shellfish tissue concentrations by the tissue screening values (TSVs) as follows:

$$HQ = \frac{\text{Tissue Concentration}}{\text{TSV}}$$

Where estimated HQs exceeded 1, it was concluded that there exists a potential for that chemical to pose an ecological risk to aquatic biota.

The HQs for aquatic biota were less than 1 for all COPECs, except cadmium. The maximum HQ for cadmium was 22.2 (Table D5-1). The HQs for the other seven chemicals were each less than 1.

The shellfish tissue data collected in 2000 and 2004 both exhibited instances where cadmium exceeded its respective TSV at each of the nine locations. In 2004, cadmium in tissue samples from locations 2 through 9 exceeded the cadmium TSV. Shellfish cadmium tissue concentrations exhibit an increasing trend in locations 3 to 6 and a decreasing trend in locations 1 to 3 between 1996 and 2004.

Table D5-1
Hazard Quotients for Chemicals of Potential Ecological Concern in Sediment

Chemical	Maximum Tissue Concentration (mg/kg)	Tissue Screening Value (mg/kg)	Hazard Quotient	Poses Potential Ecological Risk?	Rationale
1,2,4-Trichlorobenzene	0.0048	0.2	0.03	**NO**	Site chemical concentration less than TSV
Bis(2-ethylhexyl)phthalate	0.14	9.3	0.02	**NO**	Site chemical concentration less than TSV
Cadmium	4.536	0.2	22.2	**YES**	Site chemical concentration greater than TSV
Chromium VI	1.106	4.4	0.3	**NO**	Site chemical concentration less than TSV
Hexachlorobenzene	0.0055	32.0	0.00017	**NO**	Site chemical concentration less than TSV
Hexachloroethane	0.005	0.0071	0.70	**NO**	Site chemical concentration less than TSV
Mercury	0.04699	2.0	0.02	**NO**	Site chemical concentration less than TSV
Phenol	0.24	1.8	0.13	**NO**	Site chemical concentration less than TSV

Notes:
mg/kg - milligram per kilogram
TSV - tissue screening value

6.0 UNCERTAINTY ANALYSIS AND CONCLUSIONS

The interpretation of risk is subject to a number of uncertainties, because of the numerous assumptions inherent in the risk assessment process. Risk estimates can most appropriately be viewed as upper-bound estimates of risks. Actual risks may be substantially lower than those calculated using quantitative risk assessment techniques. In general, sources of uncertainty can be categorized into those associated with standard risk assessment procedures and those associated with site-specific factors (i.e., variability in analytical data, modeling results, and exposure parameter assumptions).

Uncertainty exists in the estimation of risk. The following items were considered with respect to their potential to contribute uncertainty to the results of the SLERA:

- Laboratory analytical results
- Toxicity assumptions
- Exposure assumptions

6.1 UNCERTAINTY ANALYSIS

For the majority of this SLERA, reported detection limits were sufficient to adequately evaluate whether constituents were present at levels that may present a risk to the environment. The uncertainty associated with detection limits was considered low to moderate.

TSVs selected for the ERA are assumed to represent the tissue concentrations at which adverse environmental effects could occur in aquatic biota. For the majority of COPECs only a limited data set of tissue residue values were available. Because of this, it was also necessary to estimate acceptable tissue residues (TSCs). The final TSVs selected for each COPEC were conservative estimates of a tissue concentration at which adverse environmental effects to aquatic biota may occur. The uncertainty associated with TSVs was assumed to be low to moderate.

The measured COPEC shellfish tissue concentrations are assumed to represent tissue concentrations that would exist in other aquatic species exposed to similar levels of a given COPEC in the aquatic environment. It is also assumed that all aquatic biota similarly distribute the COPEC in their bodies and, thus, a similar concentration of the COPEC is present at the active site of the chemical. There is a moderate level of uncertainty associated with this assumption. However, the uncertainty is far less than the uncertainty associated with using sediment concentrations to assess environmental effects to aquatic biota.

6.2 CONCLUSIONS

The use of TSVs provides a conservative initial screen capable of eliminating from an SLERA chemicals that do not pose significant risks to aquatic biota. However, exceedance of a TSV does not automatically imply that an observed tissue residue poses an adverse risk to biota. It does, however, identify those chemicals that may require more detailed investigation in a SLERA (Shepard 1998).

Seven chemicals were present in sediment at concentrations greater than their screening value at one or more of the 12 locations where sediment samples were collected. For these seven chemicals and hexavalent chromium, shellfish tissue concentrations were compared to TSVs and an HQ was calculated. Only cadmium had a tissue HQ greater than 1.

Based on the above results, it was concluded that there is a potential for cadmium in sediments to pose a risk to aquatic biota, and further evaluation may be required to assess the ecological health of the marine environment. Specifically, the next step should be a biological assessment of the health of the aquatic biota in OU 2 Area 8. If the OU 2 Area 8 biota appear healthy when compared to a suitable reference area, this would provide confidence that the biota are not being adversely affected. If a biological assessment indicates adverse affects on the various aquatic populations, specific toxicity testing may be justified.

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ATTACHMENT D-1

Analytical Sampling Results

CONTENTS

TABLES

Table D1
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION1	IT	215472	5/4/1996	MS	9060	Total Organic Carbon	16600		
S.STATION1	IT	215472	5/4/1996	MS	8310	Acenaphthene	0.17		10.241
S.STATION1	IT	215472	5/4/1996	MS	8310	Anthracene	0.012		0.723
S.STATION1	IT	215472	5/4/1996	MS	8310	Benzo(a)anthracene	0.055		3.313
S.STATION1	IT	215472	5/4/1996	MS	8310	Benzo(a)pyrene	0.058		3.494
S.STATION1	IT	215472	5/4/1996	MS	8310	Benzo(b)fluoranthene	0.088		5.301
S.STATION1	IT	215472	5/4/1996	MS	8310	Benzo(g,h,i)perylene	0.038		2.289
S.STATION1	IT	215472	5/4/1996	MS	8310	Benzo(k)fluoranthene	0.036		2.169
S.STATION1	IT	215472	5/4/1996	MS	8310	Chrysene	0.075		4.518
S.STATION1	IT	215472	5/4/1996	MS	8310	Dibenz(a,h)anthracene	0.0042		0.253
S.STATION1	IT	215472	5/4/1996	MS	8310	Fluoranthene	0.11		6.627
S.STATION1	IT	215472	5/4/1996	MS	8310	Indeno(1,2,3-cd)pyrene	0.024		1.446
S.STATION1	IT	215472	5/4/1996	MS	8310	Phenanthrene	0.014		0.843
S.STATION1	IT	215472	5/4/1996	MS	8310	Phenol	3	J	
S.STATION1	IT	215472	5/4/1996	MS	8310	Pyrene	0.11		6.627
S.STATION1	IT	215472	5/4/1996	MS	8270	4-Methylphenol	0.22	J	
S.STATION1	IT	215472	5/4/1996	MS	8260	Acetone	0.11	J	
S.STATION1	IT	215472	5/4/1996	MS	6010	Cadmium	0.6		
S.STATION1	IT	215472	5/4/1996	MS	6010	Chromium	14.1		
S.STATION1	IT	215472	5/4/1996	MS	6010	Copper	6.4		
S.STATION1	IT	215472	5/4/1996	MS	6010	Gold	1.4		
S.STATION1	IT	215472	5/4/1996	MS	6010	Lead	6.6		
S.STATION1	IT	215472	5/4/1996	MS	6010	Nickel	10.2		
S.STATION1	IT	215472	5/4/1996	MS	6010	Silver	0.3		
S.STATION1	IT	215472	5/4/1996	MS	6010	Tin	0.8		
S.STATION1	IT	215472	5/4/1996	MS	6010	Zinc	29.5		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION1	IT	216472	6/1/2000	MS	9012	Cyanide	0.4	U	
S.STATION1	IT	216472	6/1/2000	MS	8270	1,2,4-Trichlorobenzene	0.003	J	1.304
S.STATION1	IT	216472	6/1/2000	MS	8270	1,2-Dichlorobenzene	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	1,3-Dichlorobenzene	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	1,4-Dichlorobenzene	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	2,4-Dimethylphenol	0.2	U	
S.STATION1	IT	216472	6/1/2000	MS	8270	2-Methylnaphthalene	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	2-Methylphenol	0.1	U	
S.STATION1	IT	216472	6/1/2000	MS	8270	4-Methylphenol	0.2	U	
S.STATION1	IT	216472	6/1/2000	MS	8270	Acenaphthene	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	Acenaphthylene	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	Anthracene	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	Benzo(a)anthracene	0.002	J	0.870
S.STATION1	IT	216472	6/1/2000	MS	8270	Benzo(a)pyrene	0.002	J	0.870
S.STATION1	IT	216472	6/1/2000	MS	8270	Benzo(b)fluoranthene	0.003	J	1.304
S.STATION1	IT	216472	6/1/2000	MS	8270	Benzo(g,h,i)perylene	0.001	J	0.435
S.STATION1	IT	216472	6/1/2000	MS	8270	Benzo(k)fluoranthene	0.002	J	0.870
S.STATION1	IT	216472	6/1/2000	MS	8270	Benzoic acid	0.25	U	
S.STATION1	IT	216472	6/1/2000	MS	8270	Benzyl alcohol	0.05	U	
S.STATION1	IT	216472	6/1/2000	MS	8270	bis(2-Ethylhexyl)phthalate	0.02	U	8.696
S.STATION1	IT	216472	6/1/2000	MS	8270	Butylbenzylphthalate	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	Chrysene	0.005	J	2.174
S.STATION1	IT	216472	6/1/2000	MS	8270	Dibenz(a,h)anthracene	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	Dibenzofuran	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	Diethylphthalate	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	Dimethylphthalate	0.01	U	4.348

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION1	IT	216472	6/1/2000	MS	8270	Di-n-butylphthalate	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	Di-n-octylphthalate	0.004	J	1.739
S.STATION1	IT	216472	6/1/2000	MS	8270	Fluoranthene	0.017		7.391
S.STATION1	IT	216472	6/1/2000	MS	8270	Fluorene	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	Hexachlorobenzene	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	Hexachlorobutadiene	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	Indeno(1,2,3-cd)pyrene	0.001	J	0.435
S.STATION1	IT	216472	6/1/2000	MS	8270	Naphthalene	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	N-Nitrosodiphenylamine	0.01	U	4.348
S.STATION1	IT	216472	6/1/2000	MS	8270	Pentachlorophenol	0.3	UJ	
S.STATION1	IT	216472	6/1/2000	MS	8270	Phenanthrene	0.007	J	3.043
S.STATION1	IT	216472	6/1/2000	MS	8270	Phenol	0.14		
S.STATION1	IT	216472	6/1/2000	MS	8270	Pyrene	0.011		4.783
S.STATION1	IT	216472	6/1/2000	MS	7471	Mercury	0.03		
S.STATION1	IT	216472	6/1/2000	MS	6010	Aluminum	4680	J	
S.STATION1	IT	216472	6/1/2000	MS	6010	Antimony	0.08	J	
S.STATION1	IT	216472	6/1/2000	MS	6010	Arsenic	1.8		
S.STATION1	IT	216472	6/1/2000	MS	6010	Barium	13.7		
S.STATION1	IT	216472	6/1/2000	MS	6010	Beryllium	0.13		
S.STATION1	IT	216472	6/1/2000	MS	6010	Cadmium	0.79	J	
S.STATION1	IT	216472	6/1/2000	MS	6010	Calcium	64200		
S.STATION1	IT	216472	6/1/2000	MS	6010	Chromium	26.9		
S.STATION1	IT	216472	6/1/2000	MS	6010	Cobalt	3.99		
S.STATION1	IT	216472	6/1/2000	MS	6010	Copper	10.3		
S.STATION1	IT	216472	6/1/2000	MS	6010	Iron	8120		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION1	IT	216472	6/1/2000	MS	6010	Magnesium	3680		
S.STATION1	IT	216472	6/1/2000	MS	6010	Manganese	132		
S.STATION1	IT	216472	6/1/2000	MS	6010	Nickel	19.3	J	
S.STATION1	IT	216472	6/1/2000	MS	6010	Potassium	613		
S.STATION1	IT	216472	6/1/2000	MS	6010	Selenium	1.13	U	
S.STATION1	IT	216472	6/1/2000	MS	6010	Silver	0.23		
S.STATION1	IT	216472	6/1/2000	MS	6010	Sodium	2380		
S.STATION1	IT	216472	6/1/2000	MS	6010	Thallium	0.05		
S.STATION1	IT	216472	6/1/2000	MS	6010	Vanadium	25.7		
S.STATION1	IT	216472	6/1/2000	MS	6010	Zinc	34.7	J	
S.STATION1	IT	229117	6/3/2004	MS	TOC-PSEP	Total Organic Carbon	0.23		
S.STATION1	IT	229117	6/3/2004	MS	8270	1,2,4-Trichlorobenzene	0.002	UJ	0.870
S.STATION1	IT	229117	6/3/2004	MS	8270	1,2-Dichlorobenzene	0.0017	UJ	0.739
S.STATION1	IT	229117	6/3/2004	MS	8270	1,3-Dichlorobenzene	0.0021	UJ	0.913
S.STATION1	IT	229117	6/3/2004	MS	8270	1,4-Dichlorobenzene	0.0025	UJ	1.087
S.STATION1	IT	229117	6/3/2004	MS	8270	2,4-Dimethylphenol	0.0072	U	
S.STATION1	IT	229117	6/3/2004	MS	8270	2-Methylnaphthalene	0.0016	UJ	0.696
S.STATION1	IT	229117	6/3/2004	MS	8270	2-Methylphenol	0.0045	U	
S.STATION1	IT	229117	6/3/2004	MS	8270	4-Methylphenol	0.11		
S.STATION1	IT	229117	6/3/2004	MS	8270	Acenaphthene	0.0013	UJ	0.565
S.STATION1	IT	229117	6/3/2004	MS	8270	Acenaphthylene	0.0019	UJ	0.826
S.STATION1	IT	229117	6/3/2004	MS	8270	Anthracene	0.0027	J	1.174
S.STATION1	IT	229117	6/3/2004	MS	8270	Benzo(a)anthracene	0.0066	J	2.870
S.STATION1	IT	229117	6/3/2004	MS	8270	Benzo(a)pyrene	0.009	J	3.913
S.STATION1	IT	229117	6/3/2004	MS	8270	Benzo(b)fluoranthene	0.012		5.217

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION1	IT	229117	6/3/2004	MS	8270	Benzo(g,h,i)perylene	0.0058	J	2.522
S.STATION1	IT	229117	6/3/2004	MS	8270	Benzo(k)fluoranthene	0.0079	J	3.435
S.STATION1	IT	229117	6/3/2004	MS	8270	Benzoic acid	0.13	U	
S.STATION1	IT	229117	6/3/2004	MS	8270	Benzyl alcohol	0.0048	UJ	
S.STATION1	IT	229117	6/3/2004	MS	8270	bis(2-Ethylhexyl)phthalate	0.005	J	2.174
S.STATION1	IT	229117	6/3/2004	MS	8270	Butylbenzylphthalate	0.002	UJ	0.870
S.STATION1	IT	229117	6/3/2004	MS	8270	Chrysene	0.034		14.783
S.STATION1	IT	229117	6/3/2004	MS	8270	Dibenz(a,h)anthracene	0.0029	UJ	1.261
S.STATION1	IT	229117	6/3/2004	MS	8270	Dibenzofuran	0.0017	UJ	0.739
S.STATION1	IT	229117	6/3/2004	MS	8270	Diethylphthalate	0.0046	UJ	2.000
S.STATION1	IT	229117	6/3/2004	MS	8270	Dimethylphthalate	0.0024	UJ	1.043
S.STATION1	IT	229117	6/3/2004	MS	8270	Di-n-butylphthalate	0.0037	J	1.609
S.STATION1	IT	229117	6/3/2004	MS	8270	Di-n-octylphthalate	0.0016	UJ	0.696
S.STATION1	IT	229117	6/3/2004	MS	8270	Fluoranthene	0.015		6.522
S.STATION1	IT	229117	6/3/2004	MS	8270	Fluorene	0.0023	UJ	1.000
S.STATION1	IT	229117	6/3/2004	MS	8270	Hexachlorobenzene	0.0028	UJ	1.217
S.STATION1	IT	229117	6/3/2004	MS	8270	Hexachlorobutadiene	0.0019	UJ	0.826
S.STATION1	IT	229117	6/3/2004	MS	8270	Hexachloroethane	0.0029	UJ	1.261
S.STATION1	IT	229117	6/3/2004	MS	8270	Indeno(1,2,3-cd)pyrene	0.0058	J	2.522
S.STATION1	IT	229117	6/3/2004	MS	8270	Naphthalene	0.0026	J	1.130
S.STATION1	IT	229117	6/3/2004	MS	8270	N-Nitrosodiphenylamine	0.0029	UJ	1.261
S.STATION1	IT	229117	6/3/2004	MS	8270	Pentachlorophenol	0.012	UJ	
S.STATION1	IT	229117	6/3/2004	MS	8270	Phenanthrene	0.0043	J	1.870
S.STATION1	IT	229117	6/3/2004	MS	8270	Phenol	0.4		
S.STATION1	IT	229117	6/3/2004	MS	8270	Pyrene	0.01		4.348
S.STATION1	IT	229117	6/3/2004	MS	7471	Mercury	0.03		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION1	IT	229117	6/3/2004	MS	6020	Antimony	0.18	J	
S.STATION1	IT	229117	6/3/2004	MS	6020	Arsenic	2.1		
S.STATION1	IT	229117	6/3/2004	MS	6020	Beryllium	0.15		
S.STATION1	IT	229117	6/3/2004	MS	6020	Cadmium	0.252	J	
S.STATION1	IT	229117	6/3/2004	MS	6020	Chromium	22		
S.STATION1	IT	229117	6/3/2004	MS	6020	Cobalt	5.81		
S.STATION1	IT	229117	6/3/2004	MS	6020	Copper	14.6	J	
S.STATION1	IT	229117	6/3/2004	MS	6020	Lead	7.4		
S.STATION1	IT	229117	6/3/2004	MS	6020	Nickel	30.3		
S.STATION1	IT	229117	6/3/2004	MS	6020	Selenium	0.3		
S.STATION1	IT	229117	6/3/2004	MS	6020	Silver	0.332		
S.STATION1	IT	229117	6/3/2004	MS	6020	Thallium	0.034		
S.STATION1	IT	229117	6/3/2004	MS	6020	Vanadium	26.2	J	
S.STATION1	IT	229117	6/3/2004	MS	6020	Zinc	42.2		
S.STATION1	IT	229117	6/3/2004	MS	6010	Aluminum	5470		
S.STATION1	IT	229117	6/3/2004	MS	6010	Barium	9.62	J	
S.STATION1	IT	229117	6/3/2004	MS	6010	Calcium	72400		
S.STATION1	IT	229117	6/3/2004	MS	6010	Iron	9320		
S.STATION1	IT	229117	6/3/2004	MS	6010	Magnesium	4010		
S.STATION1	IT	229117	6/3/2004	MS	6010	Manganese	210		
S.STATION1	IT	229117	6/3/2004	MS	6010	Potassium	803		
S.STATION1	IT	229117	6/3/2004	MS	6010	Sodium	3880		
S.STATION10	IT	215484	5/5/1996	MS	9060	Total Organic Carbon	7830		
S.STATION10	IT	215487	5/5/1996	MS	8310	Acenaphthene	0.039	J	4.981
S.STATION10	IT	215487	5/5/1996	MS	8310	Anthracene	0.0057		0.728
S.STATION10	IT	215487	5/5/1996	MS	8310	Benzo(a)anthracene	0.0074		0.945

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION10	IT	215487	5/5/1996	MS	8310	Benzo(a)pyrene	0.01		1.277
S.STATION10	IT	215487	5/5/1996	MS	8310	Benzo(b)fluoranthene	0.012		1.533
S.STATION10	IT	215487	5/5/1996	MS	8310	Benzo(g,h,i)perylene	0.0073		0.932
S.STATION10	IT	215487	5/5/1996	MS	8310	Benzo(k)fluoranthene	0.0051		0.651
S.STATION10	IT	215487	5/5/1996	MS	8310	Chrysene	0.012		1.533
S.STATION10	IT	215487	5/5/1996	MS	8310	Fluoranthene	0.038		4.853
S.STATION10	IT	215487	5/5/1996	MS	8310	Indeno(1,2,3-cd)pyrene	0.0051		0.651
S.STATION10	IT	215487	5/5/1996	MS	8310	Phenol	0.28	J	
S.STATION10	IT	215487	5/5/1996	MS	8310	Pyrene	0.027		3.448
S.STATION10	IT	215484	5/5/1996	MS	8270	4-Methylphenol	0.14	J	
S.STATION10	IT	215484	5/5/1996	MS	6010	Chromium	16.4		
S.STATION10	IT	215484	5/5/1996	MS	6010	Copper	7.1		
S.STATION10	IT	215484	5/5/1996	MS	6010	Gold	1.6		
S.STATION10	IT	215484	5/5/1996	MS	6010	Lead	2.7		
S.STATION10	IT	215484	5/5/1996	MS	6010	Nickel	16.8		
S.STATION10	IT	215484	5/5/1996	MS	6010	Tin	2.7		
S.STATION10	IT	215484	5/5/1996	MS	6010	Zinc	25		
S.STATION11	IT	215485	5/5/1996	MS	9060	Total Organic Carbon	3180		
S.STATION11	IT	215485	5/5/1996	MS	8310	Phenol	0.45		
S.STATION11	IT	215485	5/5/1996	MS	8270	4-Methylphenol	0.097	J	
S.STATION11	IT	215485	5/5/1996	MS	6010	Chromium	15.7		
S.STATION11	IT	215485	5/5/1996	MS	6010	Copper	6.4		
S.STATION11	IT	215485	5/5/1996	MS	6010	Gold	1.4		
S.STATION11	IT	215485	5/5/1996	MS	6010	Lead	1.9		
S.STATION11	IT	215485	5/5/1996	MS	6010	Nickel	17.9		
S.STATION11	IT	215485	5/5/1996	MS	6010	Tin	1.6		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION11	IT	215485	5/5/1996	MS	6010	Zinc	22.8		
S.STATION12	IT	215486	5/5/1996	MS	9060	Total Organic Carbon	4350		
S.STATION12	IT	215486	5/5/1996	MS	8310	Benzo(a)anthracene	0.0014	J	0.322
S.STATION12	IT	215486	5/5/1996	MS	8310	Benzo(a)pyrene	0.0022	J	0.506
S.STATION12	IT	215486	5/5/1996	MS	8310	Benzo(b)fluoranthene	0.004		0.920
S.STATION12	IT	215486	5/5/1996	MS	8310	Benzo(g,h,i)perylene	0.0018	J	0.414
S.STATION12	IT	215486	5/5/1996	MS	6010	Chromium	29.2		
S.STATION12	IT	215486	5/5/1996	MS	6010	Copper	10.6		
S.STATION12	IT	215486	5/5/1996	MS	6010	Gold	2		
S.STATION12	IT	215486	5/5/1996	MS	6010	Lead	3.5		
S.STATION12	IT	215486	5/5/1996	MS	6010	Nickel	29		
S.STATION12	IT	215486	5/5/1996	MS	6010	Tin	1.3		
S.STATION12	IT	215486	5/5/1996	MS	6010	Zinc	38.7		
S.STATION2	IT	215473	5/4/1996	MS	9060	Total Organic Carbon	6180		
S.STATION2	IT	215477	5/4/1996	MS	8310	Anthracene	0.0042	J	0.680
S.STATION2	IT	215477	5/4/1996	MS	8310	Benzo(a)anthracene	0.0075		1.214
S.STATION2	IT	215477	5/4/1996	MS	8310	Benzo(a)pyrene	0.014		2.265
S.STATION2	IT	215477	5/4/1996	MS	8310	Benzo(b)fluoranthene	0.018		2.913
S.STATION2	IT	215477	5/4/1996	MS	8310	Benzo(g,h,i)perylene	0.01		1.618
S.STATION2	IT	215477	5/4/1996	MS	8310	Benzo(k)fluoranthene	0.0065		1.052
S.STATION2	IT	215477	5/4/1996	MS	8310	Chrysene	0.017		2.751
S.STATION2	IT	215473	5/4/1996	MS	8310	Fluoranthene	0.013		2.104
S.STATION2	IT	215477	5/4/1996	MS	8310	Indeno(1,2,3-cd)pyrene	0.0064		1.036
S.STATION2	IT	215477	5/4/1996	MS	8310	Phenanthrene	0.0045	J	0.728
S.STATION2	IT	215473	5/4/1996	MS	8310	Phenol	1.9		
S.STATION2	IT	215473	5/4/1996	MS	8310	Pyrene	0.0099		1.602

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION2	IT	215473	5/4/1996	MS	8270	4-Methylphenol	0.89		
S.STATION2	IT	215477	5/4/1996	MS	7471	Mercury	1.9		
S.STATION2	IT	215477	5/4/1996	MS	6010	Cadmium	2		
S.STATION2	IT	215477	5/4/1996	MS	6010	Chromium	34.9		
S.STATION2	IT	215473	5/4/1996	MS	6010	Copper	16.5		
S.STATION2	IT	215473	5/4/1996	MS	6010	Gold	2.1		
S.STATION2	IT	215477	5/4/1996	MS	6010	Lead	3.1		
S.STATION2	IT	215473	5/4/1996	MS	6010	Nickel	15.8		
S.STATION2	IT	215473	5/4/1996	MS	6010	Silver	0.8		
S.STATION2	IT	215473	5/4/1996	MS	6010	Tin	1.6		
S.STATION2	IT	215473	5/4/1996	MS	6010	Zinc	39.1		
S.STATION2	IT	216474	6/1/2000	MS	9012	Cyanide	0.4	U	
S.STATION2	IT	216474	6/1/2000	MS	8270	1,2,4-Trichlorobenzene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	1,2-Dichlorobenzene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	1,3-Dichlorobenzene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	1,4-Dichlorobenzene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	2,4-Dimethylphenol	0.2	U	
S.STATION2	IT	216474	6/1/2000	MS	8270	2-Methylnaphthalene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	2-Methylphenol	0.1	U	
S.STATION2	IT	216474	6/1/2000	MS	8270	4-Methylphenol	0.2	U	
S.STATION2	IT	216474	6/1/2000	MS	8270	Acenaphthene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Acenaphthylene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Anthracene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzo(a)anthracene	0.004	J	1.739
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzo(a)pyrene	0.003	J	1.304
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzo(b)fluoranthene	0.005	J	2.174

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzo(g,h,i)perylene	0.002	J	0.870
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzo(k)fluoranthene	0.004	J	1.739
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzoic acid	0.25	U	
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzyl alcohol	0.05	U	
S.STATION2	IT	216474	6/1/2000	MS	8270	bis(2-Ethylhexyl)phthalate	0.05	U	21.739
S.STATION2	IT	216474	6/1/2000	MS	8270	Butylbenzylphthalate	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Chrysene	0.01	J	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Dibenz(a,h)anthracene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Dibenzofuran	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Diethylphthalate	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Dimethylphthalate	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Di-n-butylphthalate	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Di-n-octylphthalate	0.018		7.826
S.STATION2	IT	216474	6/1/2000	MS	8270	Fluoranthene	0.028		12.174
S.STATION2	IT	216474	6/1/2000	MS	8270	Fluorene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Hexachlorobenzene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Hexachlorobutadiene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Indeno(1,2,3-cd)pyrene	0.003	J	1.304
S.STATION2	IT	216474	6/1/2000	MS	8270	Naphthalene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	N-Nitrosodiphenylamine	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Pentachlorophenol	0.3	UJ	
S.STATION2	IT	216474	6/1/2000	MS	8270	Phenanthrene	0.005	J	2.174
S.STATION2	IT	216474	6/1/2000	MS	8270	Phenol	0.02	J	
S.STATION2	IT	216474	6/1/2000	MS	8270	Pyrene	0.017		7.391
S.STATION2	IT	216474	6/1/2000	MS	7471	Mercury	0.89		
S.STATION2	IT	216474	6/1/2000	MS	6010	Aluminum	5860	J	

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzo(g,h,i)perylene	0.002	J	0.870
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzo(k)fluoranthene	0.004	J	1.739
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzoic acid	0.25	U	
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzyl alcohol	0.05	U	
S.STATION2	IT	216474	6/1/2000	MS	8270	bis(2-Ethylhexyl)phthalate	0.05	U	21.739
S.STATION2	IT	216474	6/1/2000	MS	8270	Butylbenzylphthalate	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Chrysene	0.01	J	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Dibenz(a,h)anthracene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Dibenzofuran	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Diethylphthalate	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Dimethylphthalate	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Di-n-butylphthalate	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Di-n-octylphthalate	0.018		7.826
S.STATION2	IT	216474	6/1/2000	MS	8270	Fluoranthene	0.028		12.174
S.STATION2	IT	216474	6/1/2000	MS	8270	Fluorene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Hexachlorobenzene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Hexachlorobutadiene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Indeno(1,2,3-cd)pyrene	0.003	J	1.304
S.STATION2	IT	216474	6/1/2000	MS	8270	Naphthalene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	N-Nitrosodiphenylamine	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Pentachlorophenol	0.3	UJ	
S.STATION2	IT	216474	6/1/2000	MS	8270	Phenanthrene	0.005	J	2.174
S.STATION2	IT	216474	6/1/2000	MS	8270	Phenol	0.02	J	
S.STATION2	IT	216474	6/1/2000	MS	8270	Pyrene	0.017		7.391
S.STATION2	IT	216474	6/1/2000	MS	7471	Mercury	0.89		
S.STATION2	IT	216474	6/1/2000	MS	6010	Aluminum	5860	J	

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzo(g,h,i)perylene	0.002	J	0.870
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzo(k)fluoranthene	0.004	J	1.739
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzoic acid	0.25	U	
S.STATION2	IT	216474	6/1/2000	MS	8270	Benzyl alcohol	0.05	U	
S.STATION2	IT	216474	6/1/2000	MS	8270	bis(2-Ethylhexyl)phthalate	0.05	U	21.739
S.STATION2	IT	216474	6/1/2000	MS	8270	Butylbenzylphthalate	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Chrysene	0.01	J	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Dibenz(a,h)anthracene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Dibenzofuran	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Diethylphthalate	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Dimethylphthalate	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Di-n-butylphthalate	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Di-n-octylphthalate	0.018		7.826
S.STATION2	IT	216474	6/1/2000	MS	8270	Fluoranthene	0.028		12.174
S.STATION2	IT	216474	6/1/2000	MS	8270	Fluorene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Hexachlorobenzene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Hexachlorobutadiene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Indeno(1,2,3-cd)pyrene	0.003	J	1.304
S.STATION2	IT	216474	6/1/2000	MS	8270	Naphthalene	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	N-Nitrosodiphenylamine	0.01	U	4.348
S.STATION2	IT	216474	6/1/2000	MS	8270	Pentachlorophenol	0.3	UJ	
S.STATION2	IT	216474	6/1/2000	MS	8270	Phenanthrene	0.005	J	2.174
S.STATION2	IT	216474	6/1/2000	MS	8270	Phenol	0.02	J	
S.STATION2	IT	216474	6/1/2000	MS	8270	Pyrene	0.017		7.391
S.STATION2	IT	216474	6/1/2000	MS	7471	Mercury	0.89		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION2	IT	216474	6/1/2000	MS	6010	Aluminum	5860	J	
S.STATION2	IT	216474	6/1/2000	MS	6010	Antimony	0.13	J	
S.STATION2	IT	216474	6/1/2000	MS	6010	Arsenic	1.4		
S.STATION2	IT	216474	6/1/2000	MS	6010	Barium	10.9		
S.STATION2	IT	216474	6/1/2000	MS	6010	Beryllium	0.1		
S.STATION2	IT	216474	6/1/2000	MS	6010	Cadmium	3.96	J	
S.STATION2	IT	216474	6/1/2000	MS	6010	Calcium	93300		
S.STATION2	IT	216474	6/1/2000	MS	6010	Chromium	45.4		
S.STATION2	IT	216474	6/1/2000	MS	6010	Cobalt	3.68		
S.STATION2	IT	216474	6/1/2000	MS	6010	Copper	10		
S.STATION2	IT	216474	6/1/2000	MS	6010	Iron	9530		
S.STATION2	IT	216474	6/1/2000	MS	6010	Lead	4.64		
S.STATION2	IT	216474	6/1/2000	MS	6010	Magnesium	4460		
S.STATION2	IT	216474	6/1/2000	MS	6010	Manganese	180		
S.STATION2	IT	216474	6/1/2000	MS	6010	Nickel	20.2	J	
S.STATION2	IT	216474	6/1/2000	MS	6010	Potassium	619		
S.STATION2	IT	216474	6/1/2000	MS	6010	Selenium	1.15	U	
S.STATION2	IT	216474	6/1/2000	MS	6010	Silver	0.33		
S.STATION2	IT	216474	6/1/2000	MS	6010	Sodium	2960		
S.STATION2	IT	216474	6/1/2000	MS	6010	Thallium	0.03		
S.STATION2	IT	216474	6/1/2000	MS	6010	Vanadium	21		
S.STATION2	IT	216474	6/1/2000	MS	6010	Zinc	38.4	J	
S.STATION2	IT	229119	6/3/2004	MS	TOC-PSEP	Total Organic Carbon	0.23%		
S.STATION2	IT	229119	6/3/2004	MS	8270	1,2,4-Trichlorobenzene	0.0019	U	0.8261
S.STATION2	IT	229119	6/3/2004	MS	8270	1,2-Dichlorobenzene	0.0016	U	0.696
S.STATION2	IT	229119	6/3/2004	MS	8270	1,3-Dichlorobenzene	0.002	U	0.8696

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION2	IT	229119	6/3/2004	MS	8270	1,4-Dichlorobenzene	0.0024	U	1.043
S.STATION2	IT	229119	6/3/2004	MS	8270	2,4-Dimethylphenol	0.0067	U	
S.STATION2	IT	229119	6/3/2004	MS	8270	2-Methylnaphthalene	0.0015	U	0.6522
S.STATION2	IT	229119	6/3/2004	MS	8270	2-Methylphenol	0.0042	U	
S.STATION2	IT	229119	6/3/2004	MS	8270	4-Methylphenol	0.0036	U	
S.STATION2	IT	229119	6/3/2004	MS	8270	Acenaphthene	0.0013	U	0.5652
S.STATION2	IT	229119	6/3/2004	MS	8270	Acenaphthylene	0.0018	U	0.7826
S.STATION2	IT	229119	6/3/2004	MS	8270	Anthracene	0.0018	U	0.7826
S.STATION2	IT	229119	6/3/2004	MS	8270	Benzo(a)anthracene	0.003	J	1.304
S.STATION2	IT	229119	6/3/2004	MS	8270	Benzo(a)pyrene	0.0033	J	1.4348
S.STATION2	IT	229119	6/3/2004	MS	8270	Benzo(b)fluoranthene	0.0058	J	2.522
S.STATION2	IT	229119	6/3/2004	MS	8270	Benzo(g,h,i)perylene	0.0036	J	1.565
S.STATION2	IT	229119	6/3/2004	MS	8270	Benzo(k)fluoranthene	0.0046	J	2.00
S.STATION2	IT	229119	6/3/2004	MS	8270	Benzoic acid	0.12	U	
S.STATION2	IT	229119	6/3/2004	MS	8270	Benzyl alcohol	0.0046	U	
S.STATION2	IT	229119	6/3/2004	MS	8270	bis(2-Ethylhexyl)phthalate	0.2	U	86.96
S.STATION2	IT	229119	6/3/2004	MS	8270	Butylbenzylphthalate	0.0019	U	0.8261
S.STATION2	IT	229119	6/3/2004	MS	8270	Chrysene	0.0059	J	2.565
S.STATION2	IT	229119	6/3/2004	MS	8270	Dibenz(a,h)anthracene	0.0027	U	1.174
S.STATION2	IT	229119	6/3/2004	MS	8270	Dibenzofuran	0.0016	U	0.696
S.STATION2	IT	229119	6/3/2004	MS	8270	Diethylphthalate	0.0043	U	1.870
S.STATION2	IT	229119	6/3/2004	MS	8270	Dimethylphthalate	0.0022	U	0.9565
S.STATION2	IT	229119	6/3/2004	MS	8270	Di-n-butylphthalate	0.01	U	4.3478
S.STATION2	IT	229119	6/3/2004	MS	8270	Di-n-octylphthalate	0.0015	U	0.6522
S.STATION2	IT	229119	6/3/2004	MS	8270	Fluoranthene	0.0078	J	3.3913
S.STATION2	IT	229119	6/3/2004	MS	8270	Fluorene	0.0021	U	0.9130

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION2	IT	229119	6/3/2004	MS	8270	Hexachlorobenzene	0.0026	U	1.130
S.STATION2	IT	229119	6/3/2004	MS	8270	Hexachlorobutadiene	0.0018	U	0.7826
S.STATION2	IT	229119	6/3/2004	MS	8270	Hexachloroethane	0.0027	U	1.174
S.STATION2	IT	229119	6/3/2004	MS	8270	Indeno(1,2,3-cd)pyrene	0.0034	J	1.478
S.STATION2	IT	229119	6/3/2004	MS	8270	Naphthalene	0.0016	U	0.696
S.STATION2	IT	229119	6/3/2004	MS	8270	N-Nitrosodiphenylamine	0.0027	U	1.174
S.STATION2	IT	229119	6/3/2004	MS	8270	Pentachlorophenol	0.011	U	
S.STATION2	IT	229119	6/3/2004	MS	8270	Phenanthrene	0.0016	U	0.696
S.STATION2	IT	229119	6/3/2004	MS	8270	Phenol	0.03	U	
S.STATION2	IT	229119	6/3/2004	MS	8270	Pyrene	0.0057	J	2.4783
S.STATION2	IT	229119	6/3/2004	MS	7471	Mercury	0.09		
S.STATION2	IT	229119	6/3/2004	MS	6020	Antimony	0.13	UJ	
S.STATION2	IT	229119	6/3/2004	MS	6020	Arsenic	1.8		
S.STATION2	IT	229119	6/3/2004	MS	6020	Beryllium	0.093		
S.STATION2	IT	229119	6/3/2004	MS	6020	Cadmium	4.49	J	
S.STATION2	IT	229119	6/3/2004	MS	6020	Chromium	38.3		
S.STATION2	IT	229119	6/3/2004	MS	6020	Cobalt	5.42		
S.STATION2	IT	229119	6/3/2004	MS	6020	Copper	20.8	J	
S.STATION2	IT	229119	6/3/2004	MS	6020	Lead	8.88		
S.STATION2	IT	229119	6/3/2004	MS	6020	Nickel	31.3		
S.STATION2	IT	229119	6/3/2004	MS	6020	Selenium	0.4		
S.STATION2	IT	229119	6/3/2004	MS	6020	Silver	0.301		
S.STATION2	IT	229119	6/3/2004	MS	6020	Thallium	0.039		
S.STATION2	IT	229119	6/3/2004	MS	6020	Vanadium	22.1	J	
S.STATION2	IT	229119	6/3/2004	MS	6020	Zinc	94.8		
S.STATION2	IT	229119	6/3/2004	MS	6010	Aluminum	5140		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION2	IT	229119	6/3/2004	MS	6010	Barium	10.9	J	
S.STATION2	IT	229119	6/3/2004	MS	6010	Calcium	95100		
S.STATION2	IT	229119	6/3/2004	MS	6010	Iron	8720		
S.STATION2	IT	229119	6/3/2004	MS	6010	Magnesium	3900		
S.STATION2	IT	229119	6/3/2004	MS	6010	Manganese	236		
S.STATION2	IT	229119	6/3/2004	MS	6010	Potassium	780		
S.STATION2	IT	229119	6/3/2004	MS	6010	Sodium	3370		
S.STATION3	IT	215474	5/4/1996	MS	9060	Total Organic Carbon	5220		
S.STATION3	IT	215474	5/4/1996	MS	8310	Acenaphthene	0.04	J	7.66
S.STATION3	IT	215474	5/4/1996	MS	8310	Anthracene	0.0077		1.48
S.STATION3	IT	215474	5/4/1996	MS	8310	Benzo(a)anthracene	0.011		2.11
S.STATION3	IT	215474	5/4/1996	MS	8310	Benzo(a)pyrene	0.041		7.85
S.STATION3	IT	215474	5/4/1996	MS	8310	Benzo(b)fluoranthene	0.056		10.73
S.STATION3	IT	215474	5/4/1996	MS	8310	Benzo(g,h,i)perylene	0.026		4.98
S.STATION3	IT	215474	5/4/1996	MS	8310	Benzo(k)fluoranthene	0.018		3.45
S.STATION3	IT	215474	5/4/1996	MS	8310	Chrysene	0.03		5.75
S.STATION3	IT	215474	5/4/1996	MS	8310	Dibenz(a,h)anthracene	0.0032		0.61
S.STATION3	IT	215474	5/4/1996	MS	8310	Fluoranthene	0.019		3.64
S.STATION3	IT	215474	5/4/1996	MS	8310	Indeno(1,2,3-cd)pyrene	0.017		3.26
S.STATION3	IT	215474	5/4/1996	MS	8310	Phenanthrene	0.012		2.30
S.STATION3	IT	215474	5/4/1996	MS	8310	Phenol	0.11	J	
S.STATION3	IT	215474	5/4/1996	MS	8310	Pyrene	0.02		3.83
S.STATION3	IT	215475	5/4/1996	MS	7471	Mercury	0.2		
S.STATION3	IT	215474	5/4/1996	MS	6010	Cadmium	8.1		
S.STATION3	IT	215474	5/4/1996	MS	6010	Chromium	166		
S.STATION3	IT	215474	5/4/1996	MS	6010	Copper	12.5		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION3	IT	215474	5/4/1996	MS	6010	Gold	2.3		
S.STATION3	IT	215474	5/4/1996	MS	6010	Lead	5.5		
S.STATION3	IT	215474	5/4/1996	MS	6010	Nickel	28		
S.STATION3	IT	215474	5/4/1996	MS	6010	Silver	0.8		
S.STATION3	IT	215474	5/4/1996	MS	6010	Tin	2.1		
S.STATION3	IT	215474	5/4/1996	MS	6010	Zinc	42.7		
S.STATION3	IT	216477	6/2/2000	MS	9012	Cyanide	0.4	U	
S.STATION3	IT	216477	6/2/2000	MS	8270	1,2,4-Trichlorobenzene	0.01	U	2.7778
S.STATION3	IT	216477	6/2/2000	MS	8270	1,2-Dichlorobenzene	0.01	U	2.7778
S.STATION3	IT	216477	6/2/2000	MS	8270	1,3-Dichlorobenzene	0.01	U	2.7778
S.STATION3	IT	216477	6/2/2000	MS	8270	1,4-Dichlorobenzene	0.01	U	2.7778
S.STATION3	IT	216477	6/2/2000	MS	8270	2,4-Dimethylphenol	0.2	U	
S.STATION3	IT	216478	6/2/2000	MS	8270	2-Methylnaphthalene	0.001	J	0.2778
S.STATION3	IT	216477	6/2/2000	MS	8270	2-Methylphenol	0.1	U	
S.STATION3	IT	216477	6/2/2000	MS	8270	4-Methylphenol	0.2	U	
S.STATION3	IT	216478	6/2/2000	MS	8270	Acenaphthene	0.002	J	0.5556
S.STATION3	IT	216477	6/2/2000	MS	8270	Acenaphthylene	0.01	U	2.7778
S.STATION3	IT	216478	6/2/2000	MS	8270	Anthracene	0.004	J	1.1111
S.STATION3	IT	216478	6/2/2000	MS	8270	Benzo(a)anthracene	0.007	J	1.9444
S.STATION3	IT	216478	6/2/2000	MS	8270	Benzo(a)pyrene	0.005	J	1.3889
S.STATION3	IT	216478	6/2/2000	MS	8270	Benzo(b)fluoranthene	0.01		2.7778
S.STATION3	IT	216478	6/2/2000	MS	8270	Benzo(g,h,i)perylene	0.003	J	0.8333
S.STATION3	IT	216478	6/2/2000	MS	8270	Benzo(k)fluoranthene	0.007	J	1.9444
S.STATION3	IT	216477	6/2/2000	MS	8270	Benzoic acid	0.25	U	
S.STATION3	IT	216477	6/2/2000	MS	8270	Benzyl alcohol	0.05	U	
S.STATION3	IT	216478	6/2/2000	MS	8270	bis(2-Ethylhexyl)phthalate	0.02	U	5.5556

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION3	IT	216477	6/2/2000	MS	8270	Butylbenzylphthalate	0.01	U	2.7778
S.STATION3	IT	216478	6/2/2000	MS	8270	Chrysene	0.02		5.5556
S.STATION3	IT	216477	6/2/2000	MS	8270	Dibenz(a,h)anthracene	0.01	U	2.7778
S.STATION3	IT	216478	6/2/2000	MS	8270	Dibenzofuran	0.002	J	0.5556
S.STATION3	IT	216477	6/2/2000	MS	8270	Diethylphthalate	0.01	U	2.7778
S.STATION3	IT	216477	6/2/2000	MS	8270	Dimethylphthalate	0.01	U	2.7778
S.STATION3	IT	216477	6/2/2000	MS	8270	Di-n-butylphthalate	0.01	U	2.7778
S.STATION3	IT	216477	6/2/2000	MS	8270	Di-n-octylphthalate	0.002	J	0.5556
S.STATION3	IT	216478	6/2/2000	MS	8270	Fluoranthene	0.082		22.7778
S.STATION3	IT	216478	6/2/2000	MS	8270	Fluorene	0.004	J	1.1111
S.STATION3	IT	216477	6/2/2000	MS	8270	Hexachlorobenzene	0.01	U	2.7778
S.STATION3	IT	216477	6/2/2000	MS	8270	Hexachlorobutadiene	0.01	U	2.7778
S.STATION3	IT	216478	6/2/2000	MS	8270	Indeno(1,2,3-cd)pyrene	0.003	J	0.8333
S.STATION3	IT	216478	6/2/2000	MS	8270	Naphthalene	0.001	J	0.2778
S.STATION3	IT	216477	6/2/2000	MS	8270	N-Nitrosodiphenylamine	0.01	U	2.7778
S.STATION3	IT	216477	6/2/2000	MS	8270	Pentachlorophenol	0.3	UJ	
S.STATION3	IT	216478	6/2/2000	MS	8270	Phenanthrene	0.053		14.7222
S.STATION3	IT	216478	6/2/2000	MS	8270	Phenol	0.062		
S.STATION3	IT	216478	6/2/2000	MS	8270	Pyrene	0.047		13.0556
S.STATION3	IT	216478	6/2/2000	MS	7471	Mercury	0.26		
S.STATION3	IT	216478	6/2/2000	MS	6010	Aluminum	7430	J	
S.STATION3	IT	216477	6/2/2000	MS	6010	Antimony	0.18	J	
S.STATION3	IT	216478	6/2/2000	MS	6010	Arsenic	2		
S.STATION3	IT	216477	6/2/2000	MS	6010	Barium	13.7		
S.STATION3	IT	216477	6/2/2000	MS	6010	Beryllium	0.13		
S.STATION3	IT	216477	6/2/2000	MS	6010	Cadmium	4.87	J	

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION3	IT	216478	6/2/2000	MS	6010	Calcium	69100		
S.STATION3	IT	216478	6/2/2000	MS	6010	Chromium	97.7		
S.STATION3	IT	216478	6/2/2000	MS	6010	Cobalt	4.6		
S.STATION3	IT	216478	6/2/2000	MS	6010	Copper	12.9		
S.STATION3	IT	216478	6/2/2000	MS	6010	Iron	10900		
S.STATION3	IT	216477	6/2/2000	MS	6010	Lead	7.33		
S.STATION3	IT	216478	6/2/2000	MS	6010	Magnesium	5040		
S.STATION3	IT	216478	6/2/2000	MS	6010	Manganese	177		
S.STATION3	IT	216478	6/2/2000	MS	6010	Nickel	25	J	
S.STATION3	IT	216478	6/2/2000	MS	6010	Potassium	720		
S.STATION3	IT	216477	6/2/2000	MS	6010	Selenium	1.05	U	
S.STATION3	IT	216477	6/2/2000	MS	6010	Silver	0.26		
S.STATION3	IT	216477	6/2/2000	MS	6010	Sodium	3380		
S.STATION3	IT	216477	6/2/2000	MS	6010	Thallium	0.05		
S.STATION3	IT	216477	6/2/2000	MS	6010	Vanadium	25.9		
S.STATION3	IT	216478	6/2/2000	MS	6010	Zinc	44.5	J	
S.STATION3	IT	229121	6/3/2004	MS	TOC-PSEP	Total Organic Carbon	0.36%		
S.STATION3	IT	229121	6/3/2004	MS	8270	1,2,4-Trichlorobenzene	0.0019	U	0.5278
S.STATION3	IT	229121	6/3/2004	MS	8270	1,2-Dichlorobenzene	0.0017	U	0.4722
S.STATION3	IT	229121	6/3/2004	MS	8270	1,3-Dichlorobenzene	0.002	U	0.5556
S.STATION3	IT	229121	6/3/2004	MS	8270	1,4-Dichlorobenzene	0.0024	U	0.6667
S.STATION3	IT	229121	6/3/2004	MS	8270	2,4-Dimethylphenol	0.0068	U	
S.STATION3	IT	229121	6/3/2004	MS	8270	2-Methylnaphthalene	0.013		3.6111
S.STATION3	IT	229121	6/3/2004	MS	8270	2-Methylphenol	0.0042	U	
S.STATION3	IT	229121	6/3/2004	MS	8270	4-Methylphenol	0.0036	U	
S.STATION3	IT	229121	6/3/2004	MS	8270	Acenaphthene	0.0079	J	2.1944

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION3	IT	229121	6/3/2004	MS	8270	Acenaphthylene	0.0018	U	0.5000
S.STATION3	IT	229121	6/3/2004	MS	8270	Anthracene	0.016		4.4444
S.STATION3	IT	229121	6/3/2004	MS	8270	Benzo(a)anthracene	0.032		8.8889
S.STATION3	IT	229121	6/3/2004	MS	8270	Benzo(a)pyrene	0.028		7.7778
S.STATION3	IT	229121	6/3/2004	MS	8270	Benzo(b)fluoranthene	0.019		5.2778
S.STATION3	IT	229121	6/3/2004	MS	8270	Benzo(g,h,i)perylene	0.019		5.2778
S.STATION3	IT	229121	6/3/2004	MS	8270	Benzo(k)fluoranthene	0.02		5.5556
S.STATION3	IT	229121	6/3/2004	MS	8270	Benzoic acid	0.12	U	
S.STATION3	IT	229121	6/3/2004	MS	8270	Benzyl alcohol	0.0046	U	
S.STATION3	IT	229121	6/3/2004	MS	8270	bis(2-Ethylhexyl)phthalate	0.2	U	55.5556
S.STATION3	IT	229121	6/3/2004	MS	8270	Butylbenzylphthalate	0.002	J	0.5556
S.STATION3	IT	229121	6/3/2004	MS	8270	Chrysene	0.051		14.1667
S.STATION3	IT	229121	6/3/2004	MS	8270	Dibenz(a,h)anthracene	0.0059	J	1.6389
S.STATION3	IT	229121	6/3/2004	MS	8270	Dibenzofuran	0.0028	J	0.7778
S.STATION3	IT	229121	6/3/2004	MS	8270	Diethylphthalate	0.0044	U	1.2222
S.STATION3	IT	229121	6/3/2004	MS	8270	Dimethylphthalate	0.0023	U	0.6389
S.STATION3	IT	229121	6/3/2004	MS	8270	Di-n-butylphthalate	0.01	U	2.7778
S.STATION3	IT	229121	6/3/2004	MS	8270	Di-n-octylphthalate	0.0015	U	0.4167
S.STATION3	IT	229121	6/3/2004	MS	8270	Fluoranthene	0.056		15.5556
S.STATION3	IT	229121	6/3/2004	MS	8270	Fluorene	0.0095	J	2.6389
S.STATION3	IT	229121	6/3/2004	MS	8270	Hexachlorobenzene	0.0026	U	0.7222
S.STATION3	IT	229121	6/3/2004	MS	8270	Hexachlorobutadiene	0.0018	U	0.5000
S.STATION3	IT	229121	6/3/2004	MS	8270	Hexachloroethane	0.0028	U	0.7778
S.STATION3	IT	229121	6/3/2004	MS	8270	Indeno(1,2,3-cd)pyrene	0.017		4.7222
S.STATION3	IT	229121	6/3/2004	MS	8270	Naphthalene	0.011		3.0556
S.STATION3	IT	229121	6/3/2004	MS	8270	N-Nitrosodiphenylamine	0.0028	U	0.7778

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION3	IT	229121	6/3/2004	MS	8270	Pentachlorophenol	0.011	U	
S.STATION3	IT	229121	6/3/2004	MS	8270	Phenanthrene	0.1		27.7778
S.STATION3	IT	229121	6/3/2004	MS	8270	Phenol	0.41		
S.STATION3	IT	229121	6/3/2004	MS	8270	Pyrene	0.083		23.0556
S.STATION3	IT	229121	6/3/2004	MS	7471	Mercury	1.58		
S.STATION3	IT	229121	6/3/2004	MS	6020	Antimony	0.13	UJ	
S.STATION3	IT	229121	6/3/2004	MS	6020	Arsenic	1.7		
S.STATION3	IT	229121	6/3/2004	MS	6020	Beryllium	0.107		
S.STATION3	IT	229121	6/3/2004	MS	6020	Cadmium	8.32	J	
S.STATION3	IT	229121	6/3/2004	MS	6020	Chromium	62.1		
S.STATION3	IT	229121	6/3/2004	MS	6020	Cobalt	5.01		
S.STATION3	IT	229121	6/3/2004	MS	6020	Copper	13.9	J	
S.STATION3	IT	229121	6/3/2004	MS	6020	Lead	5.44		
S.STATION3	IT	229121	6/3/2004	MS	6020	Nickel	30.9		
S.STATION3	IT	229121	6/3/2004	MS	6020	Selenium	0.8		
S.STATION3	IT	229121	6/3/2004	MS	6020	Silver	0.732		
S.STATION3	IT	229121	6/3/2004	MS	6020	Thallium	0.028	U	
S.STATION3	IT	229121	6/3/2004	MS	6020	Vanadium	22	J	
S.STATION3	IT	229121	6/3/2004	MS	6020	Zinc	45.8		
S.STATION3	IT	229121	6/3/2004	MS	6010	Aluminum	4170		
S.STATION3	IT	229121	6/3/2004	MS	6010	Barium	9.25	J	
S.STATION3	IT	229121	6/3/2004	MS	6010	Calcium	104000		
S.STATION3	IT	229121	6/3/2004	MS	6010	Iron	6940		
S.STATION3	IT	229121	6/3/2004	MS	6010	Magnesium	3710		
S.STATION3	IT	229121	6/3/2004	MS	6010	Manganese	165		
S.STATION3	IT	229121	6/3/2004	MS	6010	Potassium	886		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION3	IT	229121	6/3/2004	MS	6010	Sodium	4120		
S.STATION4	IT	215476	5/4/1996	MS	9060	Total Organic Carbon	11300		
S.STATION4	IT	215476	5/4/1996	MS	8310	Benzo(a)anthracene	0.0072		0.637
S.STATION4	IT	215476	5/4/1996	MS	8310	Benzo(a)pyrene	0.0071		0.628
S.STATION4	IT	215476	5/4/1996	MS	8310	Benzo(b)fluoranthene	0.01		0.885
S.STATION4	IT	215476	5/4/1996	MS	8310	Benzo(g,h,i)perylene	0.0047		0.416
S.STATION4	IT	215476	5/4/1996	MS	8310	Benzo(k)fluoranthene	0.0039		0.345
S.STATION4	IT	215476	5/4/1996	MS	8310	Chrysene	0.012		1.062
S.STATION4	IT	215476	5/4/1996	MS	8310	Fluoranthene	0.0091		0.805
S.STATION4	IT	215476	5/4/1996	MS	8310	Indeno(1,2,3-cd)pyrene	0.0027		0.239
S.STATION4	IT	215476	5/4/1996	MS	8310	Phenol	0.24	J	
S.STATION4	IT	215476	5/4/1996	MS	8310	Pyrene	0.0095		0.841
S.STATION4	IT	215476	5/4/1996	MS	8270	4-Methylphenol	0.11	J	
S.STATION4	IT	215476	5/4/1996	MS	6010	Cadmium	4.8		
S.STATION4	IT	215476	5/4/1996	MS	6010	Chromium	46.4		
S.STATION4	IT	215476	5/4/1996	MS	6010	Copper	10.6		
S.STATION4	IT	215476	5/4/1996	MS	6010	Gold	2.5		
S.STATION4	IT	215476	5/4/1996	MS	6010	Lead	6.5		
S.STATION4	IT	215476	5/4/1996	MS	6010	Nickel	29.5		
S.STATION4	IT	215476	5/4/1996	MS	6010	Silver	0.6		
S.STATION4	IT	215476	5/4/1996	MS	6010	Tin	1.3		
S.STATION4	IT	215476	5/4/1996	MS	6010	Zinc	47		
S.STATION4	IT	216480	6/1/2000	MS	9012	Cyanide	0.4	U	
S.STATION4	IT	216480	6/1/2000	MS	8270	1,2,4-Trichlorobenzene	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	1,2-Dichlorobenzene	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	1,3-Dichlorobenzene	0.01	U	3.4483

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION4	IT	216480	6/1/2000	MS	8270	1,4-Dichlorobenzene	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	2,4-Dimethylphenol	0.2	U	
S.STATION4	IT	216480	6/1/2000	MS	8270	2-Methylnaphthalene	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	2-Methylphenol	0.1	U	
S.STATION4	IT	216480	6/1/2000	MS	8270	4-Methylphenol	0.07	J	
S.STATION4	IT	216480	6/1/2000	MS	8270	Acenaphthene	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	Acenaphthylene	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	Anthracene	0.004	J	1.3793
S.STATION4	IT	216480	6/1/2000	MS	8270	Benzo(a)anthracene	0.022	J	7.5862
S.STATION4	IT	216480	6/1/2000	MS	8270	Benzo(a)pyrene	0.02	J	6.8966
S.STATION4	IT	216480	6/1/2000	MS	8270	Benzo(b)fluoranthene	0.029	J	10.0000
S.STATION4	IT	216480	6/1/2000	MS	8270	Benzo(g,h,i)perylene	0.01	J	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	Benzo(k)fluoranthene	0.019	J	6.5517
S.STATION4	IT	216480	6/1/2000	MS	8270	Benzoic acid	0.25	U	86.2069
S.STATION4	IT	216480	6/1/2000	MS	8270	Benzyl alcohol	0.05	U	
S.STATION4	IT	216480	6/1/2000	MS	8270	bis(2-Ethylhexyl)phthalate	0.06	U	20.6897
S.STATION4	IT	216480	6/1/2000	MS	8270	Butylbenzylphthalate	0.01	UJ	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	Chrysene	0.03		10.3448
S.STATION4	IT	216480	6/1/2000	MS	8270	Dibenz(a,h)anthracene	0.002	J	0.6897
S.STATION4	IT	216480	6/1/2000	MS	8270	Dibenzofuran	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	Diethylphthalate	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	Dimethylphthalate	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	Di-n-butylphthalate	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	Di-n-octylphthalate	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	Fluoranthene	0.065	J	22.4138
S.STATION4	IT	216480	6/1/2000	MS	8270	Fluorene	0.01	U	3.4483

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION4	IT	216480	6/1/2000	MS	8270	Hexachlorobenzene	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	Hexachlorobutadiene	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	Indeno(1,2,3-cd)pyrene	0.011	J	3.7931
S.STATION4	IT	216480	6/1/2000	MS	8270	Naphthalene	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	N-Nitrosodiphenylamine	0.01	U	3.4483
S.STATION4	IT	216480	6/1/2000	MS	8270	Pentachlorophenol	0.3	UJ	
S.STATION4	IT	216480	6/1/2000	MS	8270	Phenanthrene	0.009	J	3.1034
S.STATION4	IT	216480	6/1/2000	MS	8270	Phenol	0.3		
S.STATION4	IT	216480	6/1/2000	MS	8270	Pyrene	0.041	J	14.1379
S.STATION4	IT	216480	6/1/2000	MS	7471	Mercury	0.06		
S.STATION4	IT	216480	6/1/2000	MS	6010	Aluminum	6190	J	
S.STATION4	IT	216480	6/1/2000	MS	6010	Antimony	0.06	J	
S.STATION4	IT	216480	6/1/2000	MS	6010	Arsenic	1.9		
S.STATION4	IT	216480	6/1/2000	MS	6010	Barium	15.1		
S.STATION4	IT	216480	6/1/2000	MS	6010	Beryllium	0.11		
S.STATION4	IT	216480	6/1/2000	MS	6010	Cadmium	1.38	J	
S.STATION4	IT	216480	6/1/2000	MS	6010	Calcium	38800		
S.STATION4	IT	216480	6/1/2000	MS	6010	Chromium	36.3		
S.STATION4	IT	216480	6/1/2000	MS	6010	Cobalt	3.72		
S.STATION4	IT	216480	6/1/2000	MS	6010	Copper	9.37		
S.STATION4	IT	216480	6/1/2000	MS	6010	Iron	10200		
S.STATION4	IT	216480	6/1/2000	MS	6010	Lead	5.93		
S.STATION4	IT	216480	6/1/2000	MS	6010	Magnesium	4150		
S.STATION4	IT	216480	6/1/2000	MS	6010	Manganese	161		
S.STATION4	IT	216480	6/1/2000	MS	6010	Nickel	20.4	J	
S.STATION4	IT	216480	6/1/2000	MS	6010	Potassium	733		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION4	IT	216480	6/1/2000	MS	6010	Selenium	1.18	U	
S.STATION4	IT	216480	6/1/2000	MS	6010	Silver	0.72		
S.STATION4	IT	216480	6/1/2000	MS	6010	Sodium	2690		
S.STATION4	IT	216480	6/1/2000	MS	6010	Thallium	0.06		
S.STATION4	IT	216480	6/1/2000	MS	6010	Vanadium	24.6	J	
S.STATION4	IT	216480	6/1/2000	MS	6010	Zinc	30.5		
S.STATION4	IT	229123	6/3/2004	MS	TOC-PSEP	Total Organic Carbon	0.29%		
S.STATION4	IT	229134	6/3/2004	MS	8270	1,2,4-Trichlorobenzene	0.0019	U	0.6552
S.STATION4	IT	229123	6/3/2004	MS	8270	1,2-Dichlorobenzene	0.0017	U	0.5862
S.STATION4	IT	229123	6/3/2004	MS	8270	1,3-Dichlorobenzene	0.0021	U	0.7241
S.STATION4	IT	229123	6/3/2004	MS	8270	1,4-Dichlorobenzene	0.0025	U	0.8621
S.STATION4	IT	229134	6/3/2004	MS	8270	2,4-Dimethylphenol	0.007	U	
S.STATION4	IT	229123	6/3/2004	MS	8270	2-Methylnaphthalene	0.0016	U	0.5517
S.STATION4	IT	229134	6/3/2004	MS	8270	2-Methylphenol	0.0043	U	
S.STATION4	IT	229134	6/3/2004	MS	8270	4-Methylphenol	0.0037	U	
S.STATION4	IT	229123	6/3/2004	MS	8270	Acenaphthene	0.0013	U	0.4483
S.STATION4	IT	229134	6/3/2004	MS	8270	Acenaphthylene	0.0018	U	0.6207
S.STATION4	IT	229123	6/3/2004	MS	8270	Anthracene	0.013		4.4828
S.STATION4	IT	229123	6/3/2004	MS	8270	Benzo(a)anthracene	0.022		7.5862
S.STATION4	IT	229123	6/3/2004	MS	8270	Benzo(a)pyrene	0.012		4.1379
S.STATION4	IT	229123	6/3/2004	MS	8270	Benzo(b)fluoranthene	0.021		7.2414
S.STATION4	IT	229123	6/3/2004	MS	8270	Benzo(g,h,i)perylene	0.0052	J	1.7931
S.STATION4	IT	229123	6/3/2004	MS	8270	Benzo(k)fluoranthene	0.013		4.4828
S.STATION4	IT	229123	6/3/2004	MS	8270	Benzoic acid	0.13	U	
S.STATION4	IT	229134	6/3/2004	MS	8270	Benzyl alcohol	0.0047	U	
S.STATION4	IT	229123	6/3/2004	MS	8270	bis(2-Ethylhexyl)phthalate	0.2	U	68.9655

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION4	IT	229134	6/3/2004	MS	8270	Butylbenzylphthalate	0.0019	U	0.6552
S.STATION4	IT	229123	6/3/2004	MS	8270	Chrysene	0.09		31.0345
S.STATION4	IT	229134	6/3/2004	MS	8270	Dibenz(a,h)anthracene	0.0028	U	0.9655
S.STATION4	IT	229123	6/3/2004	MS	8270	Dibenzofuran	0.0017	U	0.5862
S.STATION4	IT	229134	6/3/2004	MS	8270	Diethylphthalate	0.0045	U	1.5517
S.STATION4	IT	229134	6/3/2004	MS	8270	Dimethylphthalate	0.0023	U	0.7931
S.STATION4	IT	229123	6/3/2004	MS	8270	Di-n-butylphthalate	0.01	U	3.4483
S.STATION4	IT	229123	6/3/2004	MS	8270	Di-n-octylphthalate	0.0016	U	0.5517
S.STATION4	IT	229123	6/3/2004	MS	8270	Fluoranthene	0.0054	J	1.8621
S.STATION4	IT	229123	6/3/2004	MS	8270	Fluorene	0.0046	J	1.5862
S.STATION4	IT	229134	6/3/2004	MS	8270	Hexachlorobenzene	0.0027	U	0.9310
S.STATION4	IT	229134	6/3/2004	MS	8270	Hexachlorobutadiene	0.0018	U	0.6207
S.STATION4	IT	229134	6/3/2004	MS	8270	Hexachloroethane	0.0028	U	0.9655
S.STATION4	IT	229123	6/3/2004	MS	8270	Indeno(1,2,3-cd)pyrene	0.0058	J	2.0000
S.STATION4	IT	229123	6/3/2004	MS	8270	Naphthalene	0.0017	U	0.5862
S.STATION4	IT	229134	6/3/2004	MS	8270	N-Nitrosodiphenylamine	0.0028	U	0.9655
S.STATION4	IT	229123	6/3/2004	MS	8270	Pentachlorophenol	0.011	U	
S.STATION4	IT	229123	6/3/2004	MS	8270	Phenanthrene	0.0075	J	2.5862
S.STATION4	IT	229123	6/3/2004	MS	8270	Phenol	0.075		
S.STATION4	IT	229134	6/3/2004	MS	8270	Pyrene	0.0028	J	0.9655
S.STATION4	IT	229123	6/3/2004	MS	7471	Mercury	0.02		
S.STATION4	IT	229123	6/3/2004	MS	6020	Antimony	0.11	UJ	
S.STATION4	IT	229123	6/3/2004	MS	6020	Arsenic	2.2		
S.STATION4	IT	229134	6/3/2004	MS	6020	Beryllium	0.108		
S.STATION4	IT	229123	6/3/2004	MS	6020	Cadmium	1.9	J	
S.STATION4	IT	229123	6/3/2004	MS	6020	Chromium	26		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION4	IT	229123	6/3/2004	MS	6020	Cobalt	5.68		
S.STATION4	IT	229123	6/3/2004	MS	6020	Copper	13.6	J	
S.STATION4	IT	229123	6/3/2004	MS	6020	Lead	6.32		
S.STATION4	IT	229123	6/3/2004	MS	6020	Nickel	31.6		
S.STATION4	IT	229123	6/3/2004	MS	6020	Selenium	0.3		
S.STATION4	IT	229123	6/3/2004	MS	6020	Silver	0.251		
S.STATION4	IT	229123	6/3/2004	MS	6020	Thallium	0.06		
S.STATION4	IT	229134	6/3/2004	MS	6020	Vanadium	24.6	J	
S.STATION4	IT	229123	6/3/2004	MS	6020	Zinc	39		
S.STATION4	IT	229134	6/3/2004	MS	6010	Aluminum	6280		
S.STATION4	IT	229134	6/3/2004	MS	6010	Barium	13.5	J	
S.STATION4	IT	229123	6/3/2004	MS	6010	Calcium	129000		
S.STATION4	IT	229134	6/3/2004	MS	6010	Iron	9720		
S.STATION4	IT	229123	6/3/2004	MS	6010	Magnesium	4080		
S.STATION4	IT	229134	6/3/2004	MS	6010	Manganese	198		
S.STATION4	IT	229134	6/3/2004	MS	6010	Potassium	788		
S.STATION4	IT	229123	6/3/2004	MS	6010	Sodium	3870		
S.STATION5	IT	215478	5/4/1996	MS	9060	Total Organic Carbon	6020		
S.STATION5	IT	215478	5/4/1996	MS	8310	Acenaphthene	0.073		12.126
S.STATION5	IT	215478	5/4/1996	MS	8310	Anthracene	0.0031	J	0.515
S.STATION5	IT	215478	5/4/1996	MS	8310	Benzo(a)anthracene	0.011		1.827
S.STATION5	IT	215478	5/4/1996	MS	8310	Benzo(a)pyrene	0.017		2.824
S.STATION5	IT	215478	5/4/1996	MS	8310	Benzo(b)fluoranthene	0.024		3.987
S.STATION5	IT	215478	5/4/1996	MS	8310	Benzo(g,h,i)perylene	0.014		2.326
S.STATION5	IT	215478	5/4/1996	MS	8310	Benzo(k)fluoranthene	0.0085		1.412
S.STATION5	IT	215478	5/4/1996	MS	8310	Chrysene	0.027		4.485

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION5	IT	215478	5/4/1996	MS	8310	Dibenz(a,h)anthracene	0.0015	J	0.249
S.STATION5	IT	215478	5/4/1996	MS	8310	Fluoranthene	0.044		7.309
S.STATION5	IT	215478	5/4/1996	MS	8310	Indeno(1,2,3-cd)pyrene	0.0082		1.362
S.STATION5	IT	215478	5/4/1996	MS	8310	Phenanthrene	0.012		1.993
S.STATION5	IT	215478	5/4/1996	MS	8310	Phenol	0.53		
S.STATION5	IT	215478	5/4/1996	MS	8310	Pyrene	0.032		5.316
S.STATION5	IT	215478	5/4/1996	MS	6010	Cadmium	2		
S.STATION5	IT	215478	5/4/1996	MS	6010	Chromium	65.4		
S.STATION5	IT	215478	5/4/1996	MS	6010	Copper	8.7		
S.STATION5	IT	215478	5/4/1996	MS	6010	Gold	1.2		
S.STATION5	IT	215478	5/4/1996	MS	6010	Lead	5.5		
S.STATION5	IT	215478	5/4/1996	MS	6010	Nickel	19.8		
S.STATION5	IT	215478	5/4/1996	MS	6010	Silver	0.3		
S.STATION5	IT	215478	5/4/1996	MS	6010	Tin	0.9		
S.STATION5	IT	215478	5/4/1996	MS	6010	Zinc	35.1		
S.STATION5	IT	216482	6/2/2000	MS	9012	Cyanide	0.4	U	
S.STATION5	IT	216482	6/2/2000	MS	8270	1,2,4-Trichlorobenzene	0.002	J	0.7692
S.STATION5	IT	216482	6/2/2000	MS	8270	1,2-Dichlorobenzene	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	1,3-Dichlorobenzene	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	1,4-Dichlorobenzene	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	2,4-Dimethylphenol	0.2	U	
S.STATION5	IT	216482	6/2/2000	MS	8270	2-Methylnaphthalene	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	2-Methylphenol	0.1	U	
S.STATION5	IT	216482	6/2/2000	MS	8270	4-Methylphenol	0.2	U	
S.STATION5	IT	216482	6/2/2000	MS	8270	Acenaphthene	0.01	U	3.8462

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION5	IT	216482	6/2/2000	MS	8270	Acenaphthylene	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	Anthracene	0.002	J	0.7692
S.STATION5	IT	216482	6/2/2000	MS	8270	Benzo(a)anthracene	0.009	J	3.4615
S.STATION5	IT	216482	6/2/2000	MS	8270	Benzo(a)pyrene	0.016		6.1538
S.STATION5	IT	216482	6/2/2000	MS	8270	Benzo(b)fluoranthene	0.021		8.0769
S.STATION5	IT	216482	6/2/2000	MS	8270	Benzo(g,h,i)perylene	0.01		3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	Benzo(k)fluoranthene	0.013		5.0000
S.STATION5	IT	216482	6/2/2000	MS	8270	Benzoic acid	0.25	U	
S.STATION5	IT	216482	6/2/2000	MS	8270	Benzyl alcohol	0.05	U	
S.STATION5	IT	216482	6/2/2000	MS	8270	bis(2-Ethylhexyl)phthalate	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	Butylbenzylphthalate	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	Chrysene	0.015		5.7692
S.STATION5	IT	216482	6/2/2000	MS	8270	Dibenz(a,h)anthracene	0.002	J	0.7692
S.STATION5	IT	216482	6/2/2000	MS	8270	Dibenzofuran	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	Diethylphthalate	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	Dimethylphthalate	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	Di-n-butylphthalate	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	Di-n-octylphthalate	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	Fluoranthene	0.015		5.7692
S.STATION5	IT	216482	6/2/2000	MS	8270	Fluorene	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	Hexachlorobenzene	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	Hexachlorobutadiene	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	Indeno(1,2,3-cd)pyrene	0.011		4.2308
S.STATION5	IT	216482	6/2/2000	MS	8270	Naphthalene	0.01	U	3.8462
S.STATION5	IT	216482	6/2/2000	MS	8270	N-Nitrosodiphenylamine	0.01	U	3.8462

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION5	IT	216482	6/2/2000	MS	8270	Pentachlorophenol	0.3	UJ	
S.STATION5	IT	216482	6/2/2000	MS	8270	Phenanthrene	0.007	J	2.6923
S.STATION5	IT	216482	6/2/2000	MS	8270	Phenol	0.02	J	
S.STATION5	IT	216482	6/2/2000	MS	8270	Pyrene	0.012		4.6154
S.STATION5	IT	216482	6/2/2000	MS	7471	Mercury	0.06		
S.STATION5	IT	216482	6/2/2000	MS	6010	Aluminum	6940	J	
S.STATION5	IT	216482	6/2/2000	MS	6010	Antimony	0.05	J	
S.STATION5	IT	216482	6/2/2000	MS	6010	Arsenic	1.2		
S.STATION5	IT	216482	6/2/2000	MS	6010	Barium	9.18		
S.STATION5	IT	216482	6/2/2000	MS	6010	Beryllium	0.12		
S.STATION5	IT	216482	6/2/2000	MS	6010	Cadmium	6.23	J	
S.STATION5	IT	216482	6/2/2000	MS	6010	Calcium	12600		
S.STATION5	IT	216482	6/2/2000	MS	6010	Chromium	26.9		
S.STATION5	IT	216482	6/2/2000	MS	6010	Cobalt	4.45		
S.STATION5	IT	216482	6/2/2000	MS	6010	Copper	12.6		
S.STATION5	IT	216482	6/2/2000	MS	6010	Iron	10600		
S.STATION5	IT	216482	6/2/2000	MS	6010	Lead	6.24		
S.STATION5	IT	216482	6/2/2000	MS	6010	Magnesium	4520		
S.STATION5	IT	216482	6/2/2000	MS	6010	Manganese	160		
S.STATION5	IT	216482	6/2/2000	MS	6010	Nickel	26.4	J	
S.STATION5	IT	216482	6/2/2000	MS	6010	Potassium	608		
S.STATION5	IT	216482	6/2/2000	MS	6010	Selenium	1.06	U	
S.STATION5	IT	216482	6/2/2000	MS	6010	Silver	0.59		
S.STATION5	IT	216482	6/2/2000	MS	6010	Sodium	2240		
S.STATION5	IT	216482	6/2/2000	MS	6010	Thallium	0.04		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION5	IT	216482	6/2/2000	MS	6010	Vanadium	25.5		
S.STATION5	IT	216482	6/2/2000	MS	6010	Zinc	39.7	J	
S.STATION5	IT	229125	6/3/2004	MS	TOC-PSEP	Total Organic Carbon	0.26%		
S.STATION5	IT	229125	6/3/2004	MS	8270	1,2,4-Trichlorobenzene	0.0018	U	0.6923
S.STATION5	IT	229125	6/3/2004	MS	8270	1,2-Dichlorobenzene	0.0016	U	0.6154
S.STATION5	IT	229125	6/3/2004	MS	8270	1,3-Dichlorobenzene	0.002	U	0.7692
S.STATION5	IT	229125	6/3/2004	MS	8270	1,4-Dichlorobenzene	0.0023	U	0.8846
S.STATION5	IT	229125	6/3/2004	MS	8270	2,4-Dimethylphenol	0.0066	U	
S.STATION5	IT	229125	6/3/2004	MS	8270	2-Methylnaphthalene	0.0015	U	0.5769
S.STATION5	IT	229125	6/3/2004	MS	8270	2-Methylphenol	0.0041	U	
S.STATION5	IT	229125	6/3/2004	MS	8270	4-Methylphenol	0.0035	U	
S.STATION5	IT	229125	6/3/2004	MS	8270	Acenaphthene	0.0012	U	0.4615
S.STATION5	IT	229125	6/3/2004	MS	8270	Acenaphthylene	0.0017	U	0.6538
S.STATION5	IT	229125	6/3/2004	MS	8270	Anthracene	0.0017	J	0.6538
S.STATION5	IT	229125	6/3/2004	MS	8270	Benzo(a)anthracene	0.0068	J	2.6154
S.STATION5	IT	229125	6/3/2004	MS	8270	Benzo(a)pyrene	0.0061	J	2.3462
S.STATION5	IT	229125	6/3/2004	MS	8270	Benzo(b)fluoranthene	0.0084	J	3.2308
S.STATION5	IT	229125	6/3/2004	MS	8270	Benzo(g,h,i)perylene	0.0031	J	1.1923
S.STATION5	IT	229125	6/3/2004	MS	8270	Benzo(k)fluoranthene	0.0067	J	2.5769
S.STATION5	IT	229125	6/3/2004	MS	8270	Benzoic acid	0.12	U	
S.STATION5	IT	229125	6/3/2004	MS	8270	Benzyl alcohol	0.0045	U	
S.STATION5	IT	229125	6/3/2004	MS	8270	bis(2-Ethylhexyl)phthalate	0.2	U	76.9231
S.STATION5	IT	229125	6/3/2004	MS	8270	Butylbenzylphthalate	0.0018	U	0.6923
S.STATION5	IT	229125	6/3/2004	MS	8270	Chrysene	0.014		5.3846
S.STATION5	IT	229125	6/3/2004	MS	8270	Dibenz(a,h)anthracene	0.0027	U	1.0385
S.STATION5	IT	229125	6/3/2004	MS	8270	Dibenzofuran	0.0016	U	0.6154

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION5	IT	229125	6/3/2004	MS	8270	Diethylphthalate	0.0042	U	1.6154
S.STATION5	IT	229125	6/3/2004	MS	8270	Dimethylphthalate	0.0022	U	0.8462
S.STATION5	IT	229125	6/3/2004	MS	8270	Di-n-butylphthalate	0.01	U	3.8462
S.STATION5	IT	229125	6/3/2004	MS	8270	Di-n-octylphthalate	0.0015	U	0.5769
S.STATION5	IT	229125	6/3/2004	MS	8270	Fluoranthene	0.019		7.3077
S.STATION5	IT	229125	6/3/2004	MS	8270	Fluorene	0.0021	U	0.8077
S.STATION5	IT	229125	6/3/2004	MS	8270	Hexachlorobenzene	0.0026	U	1.0000
S.STATION5	IT	229125	6/3/2004	MS	8270	Hexachlorobutadiene	0.0017	U	0.6538
S.STATION5	IT	229125	6/3/2004	MS	8270	Hexachloroethane	0.0027	U	1.0385
S.STATION5	IT	229125	6/3/2004	MS	8270	Indeno(1,2,3-cd)pyrene	0.0043	J	1.6538
S.STATION5	IT	229125	6/3/2004	MS	8270	Naphthalene	0.0041	J	1.5769
S.STATION5	IT	229125	6/3/2004	MS	8270	N-Nitrosodiphenylamine	0.0027	U	1.0385
S.STATION5	IT	229125	6/3/2004	MS	8270	Pentachlorophenol	0.011	U	
S.STATION5	IT	229125	6/3/2004	MS	8270	Phenanthrene	0.0021	J	0.8077
S.STATION5	IT	229125	6/3/2004	MS	8270	Phenol	0.03	U	
S.STATION5	IT	229125	6/3/2004	MS	8270	Pyrene	0.0045	J	1.7308
S.STATION5	IT	229125	6/3/2004	MS	7471	Mercury	0.46		
S.STATION5	IT	229125	6/3/2004	MS	6020	Antimony	0.13	UJ	
S.STATION5	IT	229125	6/3/2004	MS	6020	Arsenic	1.6		
S.STATION5	IT	229125	6/3/2004	MS	6020	Beryllium	0.061		
S.STATION5	IT	229125	6/3/2004	MS	6020	Cadmium	2.85	J	
S.STATION5	IT	229125	6/3/2004	MS	6020	Chromium	31.5		
S.STATION5	IT	229125	6/3/2004	MS	6020	Cobalt	4.63		
S.STATION5	IT	229125	6/3/2004	MS	6020	Copper	10.7	J	
S.STATION5	IT	229125	6/3/2004	MS	6020	Lead	4.49		
S.STATION5	IT	229125	6/3/2004	MS	6020	Nickel	26.9		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION5	IT	229125	6/3/2004	MS	6020	Selenium	0.3		
S.STATION5	IT	229125	6/3/2004	MS	6020	Silver	0.317		
S.STATION5	IT	229125	6/3/2004	MS	6020	Thallium	0.035		
S.STATION5	IT	229125	6/3/2004	MS	6020	Vanadium	17.4	J	
S.STATION5	IT	229125	6/3/2004	MS	6020	Zinc	37.3		
S.STATION5	IT	229125	6/3/2004	MS	6010	Aluminum	3620		
S.STATION5	IT	229125	6/3/2004	MS	6010	Barium	8.58	J	
S.STATION5	IT	229125	6/3/2004	MS	6010	Calcium	96200		
S.STATION5	IT	229125	6/3/2004	MS	6010	Iron	6920		
S.STATION5	IT	229125	6/3/2004	MS	6010	Magnesium	3290		
S.STATION5	IT	229125	6/3/2004	MS	6010	Manganese	174		
S.STATION5	IT	229125	6/3/2004	MS	6010	Potassium	625		
S.STATION5	IT	229125	6/3/2004	MS	6010	Sodium	2930		
S.STATION6	IT	215479	5/4/1996	MS	9060	Total Organic Carbon	7080		
S.STATION6	IT	215479	5/4/1996	MS	8310	Acenaphthene	0.025	J	3.531
S.STATION6	IT	215479	5/4/1996	MS	8310	Benzo(a)anthracene	0.0096		1.356
S.STATION6	IT	215479	5/4/1996	MS	8310	Benzo(a)pyrene	0.019		2.684
S.STATION6	IT	215479	5/4/1996	MS	8310	Benzo(b)fluoranthene	0.026		3.672
S.STATION6	IT	215479	5/4/1996	MS	8310	Benzo(g,h,i)perylene	0.011		1.554
S.STATION6	IT	215479	5/4/1996	MS	8310	Benzo(k)fluoranthene	0.0085		1.201
S.STATION6	IT	215479	5/4/1996	MS	8310	Chrysene	0.026		3.672
S.STATION6	IT	215479	5/4/1996	MS	8310	Fluoranthene	0.011		1.554
S.STATION6	IT	215479	5/4/1996	MS	8310	Indeno(1,2,3-cd)pyrene	0.0072		1.017
S.STATION6	IT	215479	5/4/1996	MS	8310	Pyrene	0.012		1.695
S.STATION6	IT	215479	5/4/1996	MS	6010	Cadmium	3.4		
S.STATION6	IT	215480	5/4/1996	MS	6010	Chromium	194		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION6	IT	215480	5/4/1996	MS	6010	Copper	10.4		
S.STATION6	IT	215479	5/4/1996	MS	6010	Gold	1.9		
S.STATION6	IT	215479	5/4/1996	MS	6010	Lead	10.5		
S.STATION6	IT	215479	5/4/1996	MS	6010	Nickel	21.7		
S.STATION6	IT	215479	5/4/1996	MS	6010	Silver	0.4		
S.STATION6	IT	215479	5/4/1996	MS	6010	Tin	1.7		
S.STATION6	IT	215480	5/4/1996	MS	6010	Zinc	41.8		
S.STATION6	IT	216484	6/2/2000	MS	9012	Cyanide	0.4	U	
S.STATION6	IT	216484	6/2/2000	MS	8270	1,2,4-Trichlorobenzene	0.002	J	0.6061
S.STATION6	IT	216484	6/2/2000	MS	8270	1,2-Dichlorobenzene	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	1,3-Dichlorobenzene	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	1,4-Dichlorobenzene	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	2,4-Dimethylphenol	0.2	U	
S.STATION6	IT	216484	6/2/2000	MS	8270	2-Methylnaphthalene	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	2-Methylphenol	0.1	U	
S.STATION6	IT	216484	6/2/2000	MS	8270	4-Methylphenol	0.2	U	
S.STATION6	IT	216484	6/2/2000	MS	8270	Acenaphthene	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	Acenaphthylene	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	Anthracene	0.002	J	0.6061
S.STATION6	IT	216484	6/2/2000	MS	8270	Benzo(a)anthracene	0.003	J	0.9091
S.STATION6	IT	216484	6/2/2000	MS	8270	Benzo(a)pyrene	0.004	J	1.2121
S.STATION6	IT	216484	6/2/2000	MS	8270	Benzo(b)fluoranthene	0.005	J	1.5152
S.STATION6	IT	216484	6/2/2000	MS	8270	Benzo(g,h,i)perylene	0.003	J	0.9091
S.STATION6	IT	216484	6/2/2000	MS	8270	Benzo(k)fluoranthene	0.004	J	1.2121
S.STATION6	IT	216484	6/2/2000	MS	8270	Benzoic acid	0.25	U	
S.STATION6	IT	216484	6/2/2000	MS	8270	Benzyl alcohol	0.05	U	

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION6	IT	216484	6/2/2000	MS	8270	bis(2-Ethylhexyl)phthalate	0.2	J	60.6061
S.STATION6	IT	216484	6/2/2000	MS	8270	Butylbenzylphthalate	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	Chrysene	0.007	J	2.1212
S.STATION6	IT	216484	6/2/2000	MS	8270	Dibenz(a,h)anthracene	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	Dibenzofuran	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	Diethylphthalate	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	Dimethylphthalate	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	Di-n-butylphthalate	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	Di-n-octylphthalate	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	Fluoranthene	0.008	J	2.4242
S.STATION6	IT	216484	6/2/2000	MS	8270	Fluorene	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	Hexachlorobenzene	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	Hexachlorobutadiene	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	Indeno(1,2,3-cd)pyrene	0.003	J	0.9091
S.STATION6	IT	216484	6/2/2000	MS	8270	Naphthalene	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	N-Nitrosodiphenylamine	0.01	U	3.0303
S.STATION6	IT	216484	6/2/2000	MS	8270	Pentachlorophenol	0.3	UJ	
S.STATION6	IT	216484	6/2/2000	MS	8270	Phenanthrene	0.004	J	1.2121
S.STATION6	IT	216484	6/2/2000	MS	8270	Phenol	0.03	J	
S.STATION6	IT	216484	6/2/2000	MS	8270	Pyrene	0.006	J	1.8182
S.STATION6	IT	216484	6/2/2000	MS	7471	Mercury	0.16		
S.STATION6	IT	216484	6/2/2000	MS	6010	Aluminum	6040	J	
S.STATION6	IT	216484	6/2/2000	MS	6010	Antimony	0.07	J	
S.STATION6	IT	216484	6/2/2000	MS	6010	Arsenic	2		
S.STATION6	IT	216484	6/2/2000	MS	6010	Barium	11.7		
S.STATION6	IT	216484	6/2/2000	MS	6010	Beryllium	0.11		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION6	IT	216484	6/2/2000	MS	6010	Cadmium	1.98	J	
S.STATION6	IT	216484	6/2/2000	MS	6010	Calcium	85100		
S.STATION6	IT	216484	6/2/2000	MS	6010	Chromium	75.4		
S.STATION6	IT	216484	6/2/2000	MS	6010	Cobalt	4.1		
S.STATION6	IT	216484	6/2/2000	MS	6010	Copper	10.6		
S.STATION6	IT	216484	6/2/2000	MS	6010	Iron	8650		
S.STATION6	IT	216484	6/2/2000	MS	6010	Lead	6.22		
S.STATION6	IT	216484	6/2/2000	MS	6010	Magnesium	4290		
S.STATION6	IT	216484	6/2/2000	MS	6010	Manganese	151		
S.STATION6	IT	216484	6/2/2000	MS	6010	Nickel	21.2	J	
S.STATION6	IT	216484	6/2/2000	MS	6010	Potassium	686		
S.STATION6	IT	216484	6/2/2000	MS	6010	Selenium	1.25	U	
S.STATION6	IT	216484	6/2/2000	MS	6010	Silver	0.23		
S.STATION6	IT	216484	6/2/2000	MS	6010	Sodium	3730		
S.STATION6	IT	216484	6/2/2000	MS	6010	Thallium	0.04		
S.STATION6	IT	216484	6/2/2000	MS	6010	Vanadium	23.4		
S.STATION6	IT	216484	6/2/2000	MS	6010	Zinc	35.5	J	
S.STATION6	IT	229127	6/3/2004	MS	TOC-PSEP	Total Organic Carbon	0.33%		
S.STATION6	IT	229127	6/3/2004	MS	8270	1,2,4-Trichlorobenzene	0.0019	U	0.5758
S.STATION6	IT	229127	6/3/2004	MS	8270	1,2-Dichlorobenzene	0.0016	U	0.4848
S.STATION6	IT	229127	6/3/2004	MS	8270	1,3-Dichlorobenzene	0.002	U	0.6061
S.STATION6	IT	229127	6/3/2004	MS	8270	1,4-Dichlorobenzene	0.0024	U	0.7273
S.STATION6	IT	229127	6/3/2004	MS	8270	2,4-Dimethylphenol	0.0068	U	
S.STATION6	IT	229127	6/3/2004	MS	8270	2-Methylnaphthalene	0.0015	U	0.4545
S.STATION6	IT	229127	6/3/2004	MS	8270	2-Methylphenol	0.0042	U	
S.STATION6	IT	229127	6/3/2004	MS	8270	4-Methylphenol	0.0036	U	

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION6	IT	229127	6/3/2004	MS	8270	Acenaphthene	0.0013	U	0.3939
S.STATION6	IT	229127	6/3/2004	MS	8270	Acenaphthylene	0.0018	U	0.5455
S.STATION6	IT	229127	6/3/2004	MS	8270	Anthracene	0.0019	J	0.5758
S.STATION6	IT	229127	6/3/2004	MS	8270	Benzo(a)anthracene	0.006	J	1.8182
S.STATION6	IT	229127	6/3/2004	MS	8270	Benzo(a)pyrene	0.01		3.0303
S.STATION6	IT	229127	6/3/2004	MS	8270	Benzo(b)fluoranthene	0.014		4.2424
S.STATION6	IT	229127	6/3/2004	MS	8270	Benzo(g,h,i)perylene	0.0058	J	1.7576
S.STATION6	IT	229127	6/3/2004	MS	8270	Benzo(k)fluoranthene	0.0094	J	2.8485
S.STATION6	IT	229127	6/3/2004	MS	8270	Benzoic acid	0.12	U	
S.STATION6	IT	229127	6/3/2004	MS	8270	Benzyl alcohol	0.0046	U	
S.STATION6	IT	229127	6/3/2004	MS	8270	bis(2-Ethylhexyl)phthalate	0.014	J	4.2424
S.STATION6	IT	229127	6/3/2004	MS	8270	Butylbenzylphthalate	0.002	J	0.6061
S.STATION6	IT	229127	6/3/2004	MS	8270	Chrysene	0.011		3.3333
S.STATION6	IT	229127	6/3/2004	MS	8270	Dibenz(a,h)anthracene	0.0027	U	0.8182
S.STATION6	IT	229127	6/3/2004	MS	8270	Dibenzofuran	0.0016	U	0.4848
S.STATION6	IT	229127	6/3/2004	MS	8270	Diethylphthalate	0.0043	U	1.3030
S.STATION6	IT	229127	6/3/2004	MS	8270	Dimethylphthalate	0.0023	U	0.6970
S.STATION6	IT	229127	6/3/2004	MS	8270	Di-n-butylphthalate	0.0032	U	0.9697
S.STATION6	IT	229127	6/3/2004	MS	8270	Di-n-octylphthalate	0.0015	U	0.4545
S.STATION6	IT	229127	6/3/2004	MS	8270	Fluoranthene	0.014		4.2424
S.STATION6	IT	229127	6/3/2004	MS	8270	Fluorene	0.0021	U	0.6364
S.STATION6	IT	229127	6/3/2004	MS	8270	Hexachlorobenzene	0.0026	U	0.7879
S.STATION6	IT	229127	6/3/2004	MS	8270	Hexachlorobutadiene	0.0018	U	0.5455
S.STATION6	IT	229127	6/3/2004	MS	8270	Hexachloroethane	0.0027	U	0.8182
S.STATION6	IT	229127	6/3/2004	MS	8270	Indeno(1,2,3-cd)pyrene	0.0063	J	1.9091
S.STATION6	IT	229127	6/3/2004	MS	8270	Naphthalene	0.0016	U	0.4848

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION6	IT	229127	6/3/2004	MS	8270	N-Nitrosodiphenylamine	0.0027	U	0.8182
S.STATION6	IT	229127	6/3/2004	MS	8270	Pentachlorophenol	0.011	U	
S.STATION6	IT	229127	6/3/2004	MS	8270	Phenanthrene	0.0028	J	0.8485
S.STATION6	IT	229127	6/3/2004	MS	8270	Phenol	0.069		
S.STATION6	IT	229127	6/3/2004	MS	8270	Pyrene	0.01		3.0303
S.STATION6	IT	229127	6/3/2004	MS	7471	Mercury	0.72		
S.STATION6	IT	229127	6/3/2004	MS	6020	Antimony	0.1	UJ	
S.STATION6	IT	229127	6/3/2004	MS	6020	Arsenic	1.6		
S.STATION6	IT	229127	6/3/2004	MS	6020	Beryllium	0.106		
S.STATION6	IT	229127	6/3/2004	MS	6020	Cadmium	9.13	J	
S.STATION6	IT	229127	6/3/2004	MS	6020	Chromium	64.5		
S.STATION6	IT	229127	6/3/2004	MS	6020	Cobalt	4.66		
S.STATION6	IT	229127	6/3/2004	MS	6020	Copper	13.1	J	
S.STATION6	IT	229127	6/3/2004	MS	6020	Lead	4.93		
S.STATION6	IT	229127	6/3/2004	MS	6020	Nickel	24.1		
S.STATION6	IT	229127	6/3/2004	MS	6020	Selenium	0.5		
S.STATION6	IT	229127	6/3/2004	MS	6020	Silver	1.25		
S.STATION6	IT	229127	6/3/2004	MS	6020	Thallium	0.038		
S.STATION6	IT	229127	6/3/2004	MS	6020	Vanadium	19.1	J	
S.STATION6	IT	229127	6/3/2004	MS	6020	Zinc	39.3		
S.STATION6	IT	229127	6/3/2004	MS	6010	Aluminum	8810		
S.STATION6	IT	229127	6/3/2004	MS	6010	Barium	15	J	
S.STATION6	IT	229127	6/3/2004	MS	6010	Calcium	54200		
S.STATION6	IT	229127	6/3/2004	MS	6010	Iron	13900		
S.STATION6	IT	229127	6/3/2004	MS	6010	Magnesium	5650		
S.STATION6	IT	229127	6/3/2004	MS	6010	Manganese	253		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION6	IT	229127	6/3/2004	MS	6010	Potassium	825		
S.STATION6	IT	229127	6/3/2004	MS	6010	Sodium	3190		
S.STATION7	IT	215481	5/4/1996	MS	9060	Total Organic Carbon	34000		
S.STATION7	IT	215481	5/4/1996	MS	8310	Benzo(a)pyrene	0.0014	J	0.0412
S.STATION7	IT	215481	5/4/1996	MS	8310	Benzo(b)fluoranthene	0.0022	J	0.0647
S.STATION7	IT	215481	5/4/1996	MS	8310	Fluoranthene	0.011		0.3235
S.STATION7	IT	215481	5/4/1996	MS	8310	Phenanthrene	0.013		0.3824
S.STATION7	IT	215481	5/4/1996	MS	8310	Pyrene	0.0092	J	0.2706
S.STATION7	IT	215481	5/4/1996	MS	8270	4-Methylphenol	1.5		
S.STATION7	IT	215481	5/4/1996	MS	6010	Chromium	54		
S.STATION7	IT	215481	5/4/1996	MS	6010	Copper	10.5		
S.STATION7	IT	215481	5/4/1996	MS	6010	Gold	1.9		
S.STATION7	IT	215481	5/4/1996	MS	6010	Lead	7.8		
S.STATION7	IT	215481	5/4/1996	MS	6010	Nickel	24.8		
S.STATION7	IT	215481	5/4/1996	MS	6010	Tin	1.5		
S.STATION7	IT	215481	5/4/1996	MS	6010	Zinc	46.8		
S.STATION7	IT	216486	6/1/2000	MS	9012	Cyanide	0.4	U	
S.STATION7	IT	216486	6/1/2000	MS	8270	1,2,4-Trichlorobenzene	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	1,2-Dichlorobenzene	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	1,3-Dichlorobenzene	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	1,4-Dichlorobenzene	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	2,4-Dimethylphenol	0.2	U	
S.STATION7	IT	216486	6/1/2000	MS	8270	2-Methylnaphthalene	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	2-Methylphenol	0.1	U	
S.STATION7	IT	216486	6/1/2000	MS	8270	4-Methylphenol	0.2	U	
S.STATION7	IT	216486	6/1/2000	MS	8270	Acenaphthene	0.01	U	2.6316

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION7	IT	216486	6/1/2000	MS	8270	Acenaphthylene	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	Anthracene	0.004	J	1.0526
S.STATION7	IT	216486	6/1/2000	MS	8270	Benzo(a)anthracene	0.007	J	1.8421
S.STATION7	IT	216486	6/1/2000	MS	8270	Benzo(a)pyrene	0.006	J	1.5789
S.STATION7	IT	216486	6/1/2000	MS	8270	Benzo(b)fluoranthene	0.01	J	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	Benzo(g,h,i)perylene	0.004	J	1.0526
S.STATION7	IT	216486	6/1/2000	MS	8270	Benzo(k)fluoranthene	0.007	J	1.8421
S.STATION7	IT	216486	6/1/2000	MS	8270	Benzoic acid	0.25	U	
S.STATION7	IT	216486	6/1/2000	MS	8270	Benzyl alcohol	0.05	U	
S.STATION7	IT	216486	6/1/2000	MS	8270	bis(2-Ethylhexyl)phthalate	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	Butylbenzylphthalate	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	Chrysene	0.013		3.4211
S.STATION7	IT	216486	6/1/2000	MS	8270	Dibenz(a,h)anthracene	0.001	J	0.2632
S.STATION7	IT	216486	6/1/2000	MS	8270	Dibenzofuran	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	Diethylphthalate	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	Dimethylphthalate	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	Di-n-butylphthalate	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	Di-n-octylphthalate	0.002	J	0.5263
S.STATION7	IT	216486	6/1/2000	MS	8270	Fluoranthene	0.016		4.2105
S.STATION7	IT	216486	6/1/2000	MS	8270	Fluorene	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	Hexachlorobenzene	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	Hexachlorobutadiene	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	Indeno(1,2,3-cd)pyrene	0.004	J	1.0526
S.STATION7	IT	216486	6/1/2000	MS	8270	Naphthalene	0.01	U	2.6316
S.STATION7	IT	216486	6/1/2000	MS	8270	N-Nitrosodiphenylamine	0.01	U	2.6316

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION7	IT	216486	6/1/2000	MS	8270	Pentachlorophenol	0.3	UJ	
S.STATION7	IT	216486	6/1/2000	MS	8270	Phenanthrene	0.004	J	1.0526
S.STATION7	IT	216486	6/1/2000	MS	8270	Phenol	0.079		
S.STATION7	IT	216486	6/1/2000	MS	8270	Pyrene	0.011		2.8947
S.STATION7	IT	216486	6/1/2000	MS	7471	Mercury	0.04		
S.STATION7	IT	216486	6/1/2000	MS	6010	Aluminum	5700	J	
S.STATION7	IT	216486	6/1/2000	MS	6010	Antimony	0.08	J	
S.STATION7	IT	216486	6/1/2000	MS	6010	Arsenic	1.7		
S.STATION7	IT	216486	6/1/2000	MS	6010	Barium	13.2		
S.STATION7	IT	216486	6/1/2000	MS	6010	Beryllium	0.1		
S.STATION7	IT	216486	6/1/2000	MS	6010	Cadmium	0.22	J	
S.STATION7	IT	216486	6/1/2000	MS	6010	Calcium	71800		
S.STATION7	IT	216486	6/1/2000	MS	6010	Chromium	19.5		
S.STATION7	IT	216486	6/1/2000	MS	6010	Cobalt	3.36		
S.STATION7	IT	216486	6/1/2000	MS	6010	Copper	7.74		
S.STATION7	IT	216486	6/1/2000	MS	6010	Iron	8500		
S.STATION7	IT	216486	6/1/2000	MS	6010	Lead	5.59		
S.STATION7	IT	216486	6/1/2000	MS	6010	Magnesium	3840		
S.STATION7	IT	216486	6/1/2000	MS	6010	Manganese	135		
S.STATION7	IT	216486	6/1/2000	MS	6010	Nickel	17	J	
S.STATION7	IT	216486	6/1/2000	MS	6010	Potassium	585		
S.STATION7	IT	216486	6/1/2000	MS	6010	Selenium	1.19	U	
S.STATION7	IT	216486	6/1/2000	MS	6010	Silver	0.09		
S.STATION7	IT	216486	6/1/2000	MS	6010	Sodium	2210		
S.STATION7	IT	216486	6/1/2000	MS	6010	Thallium	0.07		
S.STATION7	IT	216486	6/1/2000	MS	6010	Vanadium	21.8		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION7	IT	216486	6/1/2000	MS	6010	Zinc	27	J	
S.STATION7	IT	229129	6/3/2004	MS	TOC-PSEP	Total Organic Carbon	0.38%		
S.STATION7	IT	229129	6/3/2004	MS	8270	1,2,4-Trichlorobenzene	0.002	UJ	0.5263
S.STATION7	IT	229129	6/3/2004	MS	8270	1,2-Dichlorobenzene	0.0018	UJ	0.4737
S.STATION7	IT	229129	6/3/2004	MS	8270	1,3-Dichlorobenzene	0.0022	UJ	0.5789
S.STATION7	IT	229129	6/3/2004	MS	8270	1,4-Dichlorobenzene	0.0026	UJ	0.6842
S.STATION7	IT	229129	6/3/2004	MS	8270	2,4-Dimethylphenol	0.0073	U	
S.STATION7	IT	229129	6/3/2004	MS	8270	2-Methylnaphthalene	0.0016	UJ	0.4211
S.STATION7	IT	229129	6/3/2004	MS	8270	2-Methylphenol	0.0045	U	
S.STATION7	IT	229129	6/3/2004	MS	8270	4-Methylphenol	0.55		
S.STATION7	IT	229129	6/3/2004	MS	8270	Acenaphthene	0.0014	UJ	0.3684
S.STATION7	IT	229129	6/3/2004	MS	8270	Acenaphthylene	0.0019	UJ	0.5000
S.STATION7	IT	229129	6/3/2004	MS	8270	Anthracene	0.0019	UJ	0.5000
S.STATION7	IT	229129	6/3/2004	MS	8270	Benzo(a)anthracene	0.0059	J	1.5526
S.STATION7	IT	229129	6/3/2004	MS	8270	Benzo(a)pyrene	0.0046	J	1.2105
S.STATION7	IT	229129	6/3/2004	MS	8270	Benzo(b)fluoranthene	0.0065	J	1.7105
S.STATION7	IT	229129	6/3/2004	MS	8270	Benzo(g,h,i)perylene	0.0034	J	0.8947
S.STATION7	IT	229129	6/3/2004	MS	8270	Benzo(k)fluoranthene	0.0061	J	1.6053
S.STATION7	IT	229129	6/3/2004	MS	8270	Benzoic acid	0.13	U	34.2105
S.STATION7	IT	229129	6/3/2004	MS	8270	Benzyl alcohol	0.0049	UJ	
S.STATION7	IT	229129	6/3/2004	MS	8270	bis(2-Ethylhexyl)phthalate	0.0059	J	1.5526
S.STATION7	IT	229129	6/3/2004	MS	8270	Butylbenzylphthalate	0.01		2.6316
S.STATION7	IT	229129	6/3/2004	MS	8270	Chrysene	0.011		2.8947
S.STATION7	IT	229129	6/3/2004	MS	8270	Dibenz(a,h)anthracene	0.003	UJ	0.7895
S.STATION7	IT	229129	6/3/2004	MS	8270	Dibenzofuran	0.0018	UJ	0.4737
S.STATION7	IT	229129	6/3/2004	MS	8270	Diethylphthalate	0.0047	UJ	1.2368

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION7	IT	229129	6/3/2004	MS	8270	Dimethylphthalate	0.0024	UJ	0.6316
S.STATION7	IT	229129	6/3/2004	MS	8270	Di-n-butylphthalate	0.0035	U	0.9211
S.STATION7	IT	229129	6/3/2004	MS	8270	Di-n-octylphthalate	0.0016	U	0.4211
S.STATION7	IT	229129	6/3/2004	MS	8270	Fluoranthene	0.013		3.4211
S.STATION7	IT	229129	6/3/2004	MS	8270	Fluorene	0.0023	UJ	0.6053
S.STATION7	IT	229129	6/3/2004	MS	8270	Hexachlorobenzene	0.0028	UJ	0.7368
S.STATION7	IT	229129	6/3/2004	MS	8270	Hexachlorobutadiene	0.0019	UJ	0.5000
S.STATION7	IT	229129	6/3/2004	MS	8270	Hexachloroethane	0.003	UJ	0.7895
S.STATION7	IT	229129	6/3/2004	MS	8270	Indeno(1,2,3-cd)pyrene	0.0036	J	0.9474
S.STATION7	IT	229129	6/3/2004	MS	8270	Naphthalene	0.0018	UJ	0.4737
S.STATION7	IT	229129	6/3/2004	MS	8270	N-Nitrosodiphenylamine	0.003	UJ	0.7895
S.STATION7	IT	229129	6/3/2004	MS	8270	Pentachlorophenol	0.012	U	
S.STATION7	IT	229129	6/3/2004	MS	8270	Phenanthrene	0.0028	J	0.7368
S.STATION7	IT	229129	6/3/2004	MS	8270	Phenol	2		
S.STATION7	IT	229129	6/3/2004	MS	8270	Pyrene	0.0091	J	2.3947
S.STATION7	IT	229129	6/3/2004	MS	7471	Mercury	0.04		
S.STATION7	IT	229129	6/3/2004	MS	6020	Antimony	0.1	UJ	
S.STATION7	IT	229129	6/3/2004	MS	6020	Arsenic	2.3		
S.STATION7	IT	229129	6/3/2004	MS	6020	Beryllium	0.14		
S.STATION7	IT	229129	6/3/2004	MS	6020	Cadmium	2.66	J	
S.STATION7	IT	229129	6/3/2004	MS	6020	Chromium	34.6		
S.STATION7	IT	229129	6/3/2004	MS	6020	Cobalt	4.43		
S.STATION7	IT	229129	6/3/2004	MS	6020	Copper	10.5	J	
S.STATION7	IT	229129	6/3/2004	MS	6020	Lead	6.31		
S.STATION7	IT	229129	6/3/2004	MS	6020	Nickel	24.4		
S.STATION7	IT	229129	6/3/2004	MS	6020	Selenium	0.5		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION7	IT	229129	6/3/2004	MS	6020	Silver	1.54		
S.STATION7	IT	229129	6/3/2004	MS	6020	Thallium	0.073		
S.STATION7	IT	229129	6/3/2004	MS	6020	Vanadium	23.5	J	
S.STATION7	IT	229129	6/3/2004	MS	6020	Zinc	33.1		
S.STATION7	IT	229129	6/3/2004	MS	6010	Aluminum	5840		
S.STATION7	IT	229129	6/3/2004	MS	6010	Barium	17.3	J	
S.STATION7	IT	229129	6/3/2004	MS	6010	Calcium	53800		
S.STATION7	IT	229129	6/3/2004	MS	6010	Iron	10100		
S.STATION7	IT	229129	6/3/2004	MS	6010	Magnesium	4210		
S.STATION7	IT	229129	6/3/2004	MS	6010	Manganese	173		
S.STATION7	IT	229129	6/3/2004	MS	6010	Potassium	925		
S.STATION7	IT	229129	6/3/2004	MS	6010	Sodium	3780		
S.STATION8	IT	215482	5/4/1996	MS	9060	Total Organic Carbon	39100		
S.STATION8	IT	215482	5/4/1996	MS	8310	Acenaphthene	0.06		1.5345
S.STATION8	IT	215482	5/4/1996	MS	8310	Anthracene	0.0073		0.1867
S.STATION8	IT	215482	5/4/1996	MS	8310	Benzo(a)anthracene	0.013		0.3325
S.STATION8	IT	215482	5/4/1996	MS	8310	Benzo(a)pyrene	0.019		0.4859
S.STATION8	IT	215482	5/4/1996	MS	8310	Benzo(b)fluoranthene	0.023		0.5882
S.STATION8	IT	215482	5/4/1996	MS	8310	Benzo(g,h,i)perylene	0.011		0.2813
S.STATION8	IT	215482	5/4/1996	MS	8310	Benzo(k)fluoranthene	0.009		0.2302
S.STATION8	IT	215482	5/4/1996	MS	8310	Chrysene	0.026		0.6650
S.STATION8	IT	215482	5/4/1996	MS	8310	Dibenz(a,h)anthracene	0.0013	J	0.0332
S.STATION8	IT	215482	5/4/1996	MS	8310	Fluoranthene	0.049		1.2532
S.STATION8	IT	215482	5/4/1996	MS	8310	Indeno(1,2,3-cd)pyrene	0.0071		0.1816
S.STATION8	IT	215482	5/4/1996	MS	8310	Phenanthrene	0.022		0.5627
S.STATION8	IT	215482	5/4/1996	MS	8310	Phenol	5.2		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION8	IT	215482	5/4/1996	MS	8310	Pyrene	0.041		1.0486
S.STATION8	IT	215482	5/4/1996	MS	8270	4-Methylphenol	1.2		
S.STATION8	IT	215482	5/4/1996	MS	8270	Butylbenzylphthalate	0.33	J	8.4399
S.STATION8	IT	215482	5/4/1996	MS	8260	Acetone	0.071		
S.STATION8	IT	215482	5/4/1996	MS	6010	Cadmium	0.2		
S.STATION8	IT	215482	5/4/1996	MS	6010	Chromium	48		
S.STATION8	IT	215482	5/4/1996	MS	6010	Copper	7.4		
S.STATION8	IT	215482	5/4/1996	MS	6010	Gold	1.1		
S.STATION8	IT	215482	5/4/1996	MS	6010	Lead	4.4		
S.STATION8	IT	215482	5/4/1996	MS	6010	Nickel	14		
S.STATION8	IT	215482	5/4/1996	MS	6010	Silver	0.2		
S.STATION8	IT	215482	5/4/1996	MS	6010	Tin	0.9		
S.STATION8	IT	215482	5/4/1996	MS	6010	Zinc	27.3		
S.STATION8	IT	216488	6/2/2000	MS	9012	Cyanide	0.4	U	
S.STATION8	IT	216488	6/2/2000	MS	8270	1,2,4-Trichlorobenzene	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	1,2-Dichlorobenzene	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	1,3-Dichlorobenzene	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	1,4-Dichlorobenzene	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	2,4-Dimethylphenol	0.2	U	
S.STATION8	IT	216488	6/2/2000	MS	8270	2-Methylnaphthalene	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	2-Methylphenol	0.1	U	
S.STATION8	IT	216488	6/2/2000	MS	8270	4-Methylphenol	0.2	U	
S.STATION8	IT	216488	6/2/2000	MS	8270	Acenaphthene	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	Acenaphthylene	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	Anthracene	0.003	J	0.8824
S.STATION8	IT	216488	6/2/2000	MS	8270	Benzo(a)anthracene	0.004	J	1.1765

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION8	IT	216488	6/2/2000	MS	8270	Benzo(a)pyrene	0.006	J	1.7647
S.STATION8	IT	216488	6/2/2000	MS	8270	Benzo(b)fluoranthene	0.009	J	2.6471
S.STATION8	IT	216488	6/2/2000	MS	8270	Benzo(g,h,i)perylene	0.003	J	0.8824
S.STATION8	IT	216488	6/2/2000	MS	8270	Benzo(k)fluoranthene	0.007	J	2.0588
S.STATION8	IT	216488	6/2/2000	MS	8270	Benzoic acid	0.25	U	
S.STATION8	IT	216488	6/2/2000	MS	8270	Benzyl alcohol	0.05	U	
S.STATION8	IT	216488	6/2/2000	MS	8270	bis(2-Ethylhexyl)phthalate	0.03	U	8.8235
S.STATION8	IT	216488	6/2/2000	MS	8270	Butylbenzylphthalate	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	Chrysene	0.007	J	2.0588
S.STATION8	IT	216488	6/2/2000	MS	8270	Dibenz(a,h)anthracene	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	Dibenzofuran	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	Diethylphthalate	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	Dimethylphthalate	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	Di-n-butylphthalate	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	Di-n-octylphthalate	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	Fluoranthene	0.006	J	1.7647
S.STATION8	IT	216488	6/2/2000	MS	8270	Fluorene	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	Hexachlorobenzene	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	Hexachlorobutadiene	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	Indeno(1,2,3-cd)pyrene	0.004	J	1.1765
S.STATION8	IT	216488	6/2/2000	MS	8270	Naphthalene	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	N-Nitrosodiphenylamine	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	Pentachlorophenol	0.3	UJ	
S.STATION8	IT	216488	6/2/2000	MS	8270	Phenanthrene	0.01	U	2.9412
S.STATION8	IT	216488	6/2/2000	MS	8270	Phenol	1.5		
S.STATION8	IT	216488	6/2/2000	MS	8270	Pyrene	0.004	J	1.1765

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION8	IT	216488	6/2/2000	MS	7471	Mercury	0.04		
S.STATION8	IT	216488	6/2/2000	MS	6010	Aluminum	5710	J	
S.STATION8	IT	216488	6/2/2000	MS	6010	Antimony	0.09	J	
S.STATION8	IT	216488	6/2/2000	MS	6010	Arsenic	2		
S.STATION8	IT	216488	6/2/2000	MS	6010	Barium	12.2		
S.STATION8	IT	216488	6/2/2000	MS	6010	Beryllium	0.1		
S.STATION8	IT	216488	6/2/2000	MS	6010	Cadmium	0.97	J	
S.STATION8	IT	216488	6/2/2000	MS	6010	Calcium	101000		
S.STATION8	IT	216488	6/2/2000	MS	6010	Chromium	67.1		
S.STATION8	IT	216488	6/2/2000	MS	6010	Cobalt	3.31		
S.STATION8	IT	216488	6/2/2000	MS	6010	Copper	8.05		
S.STATION8	IT	216488	6/2/2000	MS	6010	Iron	8210		
S.STATION8	IT	216488	6/2/2000	MS	6010	Lead	4.83		
S.STATION8	IT	216488	6/2/2000	MS	6010	Magnesium	4080		
S.STATION8	IT	216488	6/2/2000	MS	6010	Manganese	134		
S.STATION8	IT	216488	6/2/2000	MS	6010	Nickel	17.9	J	
S.STATION8	IT	216488	6/2/2000	MS	6010	Potassium	615		
S.STATION8	IT	216488	6/2/2000	MS	6010	Selenium	1.06	U	
S.STATION8	IT	216488	6/2/2000	MS	6010	Silver	0.22		
S.STATION8	IT	216488	6/2/2000	MS	6010	Sodium	3340		
S.STATION8	IT	216488	6/2/2000	MS	6010	Thallium	0.06		
S.STATION8	IT	216488	6/2/2000	MS	6010	Vanadium	23.1		
S.STATION8	IT	216488	6/2/2000	MS	6010	Zinc	30.1	J	
S.STATION8	IT	229131	6/3/2004	MS	TOC-PSEP	Total Organic Carbon	0.34%		
S.STATION8	IT	229131	6/3/2004	MS	8270	1,2,4-Trichlorobenzene	0.002	U	0.5882
S.STATION8	IT	229131	6/3/2004	MS	8270	1,2-Dichlorobenzene	0.0017	U	0.5000

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION8	IT	229131	6/3/2004	MS	8270	1,3-Dichlorobenzene	0.0021	U	0.6176
S.STATION8	IT	229131	6/3/2004	MS	8270	1,4-Dichlorobenzene	0.0025	U	0.7353
S.STATION8	IT	229131	6/3/2004	MS	8270	2,4-Dimethylphenol	0.0071	U	
S.STATION8	IT	229131	6/3/2004	MS	8270	2-Methylnaphthalene	0.0016	U	0.4706
S.STATION8	IT	229131	6/3/2004	MS	8270	2-Methylphenol	0.0044	U	
S.STATION8	IT	229131	6/3/2004	MS	8270	4-Methylphenol	0.064		
S.STATION8	IT	229131	6/3/2004	MS	8270	Acenaphthene	0.0013	U	0.3824
S.STATION8	IT	229131	6/3/2004	MS	8270	Acenaphthylene	0.0018	U	0.5294
S.STATION8	IT	229131	6/3/2004	MS	8270	Anthracene	0.0018	U	0.5294
S.STATION8	IT	229131	6/3/2004	MS	8270	Benzo(a)anthracene	0.005	J	1.4706
S.STATION8	IT	229131	6/3/2004	MS	8270	Benzo(a)pyrene	0.006	J	1.7647
S.STATION8	IT	229131	6/3/2004	MS	8270	Benzo(b)fluoranthene	0.0076	J	2.2353
S.STATION8	IT	229131	6/3/2004	MS	8270	Benzo(g,h,i)perylene	0.0039	J	1.1471
S.STATION8	IT	229131	6/3/2004	MS	8270	Benzo(k)fluoranthene	0.0051	J	1.5000
S.STATION8	IT	229131	6/3/2004	MS	8270	Benzoic acid	0.13	U	
S.STATION8	IT	229131	6/3/2004	MS	8270	Benzyl alcohol	0.0048	U	
S.STATION8	IT	229131	6/3/2004	MS	8270	bis(2-Ethylhexyl)phthalate	0.2	U	58.8235
S.STATION8	IT	229131	6/3/2004	MS	8270	Butylbenzylphthalate	0.0074	J	2.1765
S.STATION8	IT	229131	6/3/2004	MS	8270	Chrysene	0.007	J	2.0588
S.STATION8	IT	229131	6/3/2004	MS	8270	Dibenz(a,h)anthracene	0.0029	U	0.8529
S.STATION8	IT	229131	6/3/2004	MS	8270	Dibenzofuran	0.0017	U	0.5000
S.STATION8	IT	229131	6/3/2004	MS	8270	Diethylphthalate	0.0045	U	1.3235
S.STATION8	IT	229131	6/3/2004	MS	8270	Dimethylphthalate	0.0023	U	0.6765
S.STATION8	IT	229131	6/3/2004	MS	8270	Di-n-butylphthalate	0.011	U	3.2353
S.STATION8	IT	229131	6/3/2004	MS	8270	Di-n-octylphthalate	0.0016	U	0.4706
S.STATION8	IT	229131	6/3/2004	MS	8270	Fluoranthene	0.0058	J	1.7059

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION8	IT	229131	6/3/2004	MS	8270	Fluorene	0.0022	U	0.6471
S.STATION8	IT	229131	6/3/2004	MS	8270	Hexachlorobenzene	0.0027	U	0.7941
S.STATION8	IT	229131	6/3/2004	MS	8270	Hexachlorobutadiene	0.0018	U	0.5294
S.STATION8	IT	229131	6/3/2004	MS	8270	Hexachloroethane	0.0029	U	0.8529
S.STATION8	IT	229131	6/3/2004	MS	8270	Indeno(1,2,3-cd)pyrene	0.0036	J	1.0588
S.STATION8	IT	229131	6/3/2004	MS	8270	Naphthalene	0.0017	U	0.5000
S.STATION8	IT	229131	6/3/2004	MS	8270	N-Nitrosodiphenylamine	0.0029	U	0.8529
S.STATION8	IT	229131	6/3/2004	MS	8270	Pentachlorophenol	0.011	U	
S.STATION8	IT	229131	6/3/2004	MS	8270	Phenanthrene	0.002	J	0.5882
S.STATION8	IT	229131	6/3/2004	MS	8270	Phenol	1		
S.STATION8	IT	229131	6/3/2004	MS	8270	Pyrene	0.0039	J	1.1471
S.STATION8	IT	229131	6/3/2004	MS	7471	Mercury	0.07		
S.STATION8	IT	229131	6/3/2004	MS	6020	Antimony	0.16	J	
S.STATION8	IT	229131	6/3/2004	MS	6020	Arsenic	1.9		
S.STATION8	IT	229131	6/3/2004	MS	6020	Beryllium	0.118		
S.STATION8	IT	229131	6/3/2004	MS	6020	Cadmium	5.64	J	
S.STATION8	IT	229131	6/3/2004	MS	6020	Chromium	43.9		
S.STATION8	IT	229131	6/3/2004	MS	6020	Cobalt	4.32		
S.STATION8	IT	229131	6/3/2004	MS	6020	Copper	11.5	J	
S.STATION8	IT	229131	6/3/2004	MS	6020	Lead	4.88		
S.STATION8	IT	229131	6/3/2004	MS	6020	Nickel	21.9		
S.STATION8	IT	229131	6/3/2004	MS	6020	Selenium	0.3		
S.STATION8	IT	229131	6/3/2004	MS	6020	Silver	0.42		
S.STATION8	IT	229131	6/3/2004	MS	6020	Thallium	0.055		
S.STATION8	IT	229131	6/3/2004	MS	6020	Vanadium	17.8	J	
S.STATION8	IT	229131	6/3/2004	MS	6020	Zinc	31.8		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION8	IT	229131	6/3/2004	MS	6010	Aluminum	5900		
S.STATION8	IT	229131	6/3/2004	MS	6010	Barium	10.8	J	
S.STATION8	IT	229131	6/3/2004	MS	6010	Calcium	38400		
S.STATION8	IT	229131	6/3/2004	MS	6010	Iron	9730		
S.STATION8	IT	229131	6/3/2004	MS	6010	Magnesium	4090		
S.STATION8	IT	229131	6/3/2004	MS	6010	Manganese	150		
S.STATION8	IT	229131	6/3/2004	MS	6010	Potassium	818		
S.STATION8	IT	229131	6/3/2004	MS	6010	Sodium	3180		
S.STATION9	IT	215483	5/4/1996	MS	9060	Total Organic Carbon	17700		
S.STATION9	IT	215483	5/4/1996	MS	8310	Acenaphthene	0.067		3.7853
S.STATION9	IT	215483	5/4/1996	MS	8310	Anthracene	0.0047	J	0.2655
S.STATION9	IT	215483	5/4/1996	MS	8310	Benzo(a)anthracene	0.0094		0.5311
S.STATION9	IT	215483	5/4/1996	MS	8310	Benzo(a)pyrene	0.01		0.5650
S.STATION9	IT	215483	5/4/1996	MS	8310	Benzo(b)fluoranthene	0.015		0.8475
S.STATION9	IT	215483	5/4/1996	MS	8310	Benzo(g,h,i)perylene	0.0076		0.4294
S.STATION9	IT	215483	5/4/1996	MS	8310	Benzo(k)fluoranthene	0.0059		0.3333
S.STATION9	IT	215483	5/4/1996	MS	8310	Chrysene	0.029		1.6384
S.STATION9	IT	215483	5/4/1996	MS	8310	Fluoranthene	0.059		3.3333
S.STATION9	IT	215483	5/4/1996	MS	8310	Indeno(1,2,3-cd)pyrene	0.0044		0.2486
S.STATION9	IT	215483	5/4/1996	MS	8310	Phenanthrene	0.022		1.2429
S.STATION9	IT	215483	5/4/1996	MS	8310	Phenol	0.24	J	
S.STATION9	IT	215483	5/4/1996	MS	8310	Pyrene	0.041		2.3164
S.STATION9	IT	215483	5/4/1996	MS	6010	Cadmium	0.5		
S.STATION9	IT	215483	5/4/1996	MS	6010	Chromium	83.7		
S.STATION9	IT	215483	5/4/1996	MS	6010	Copper	11.3		
S.STATION9	IT	215483	5/4/1996	MS	6010	Gold	1.3		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION9	IT	215483	5/4/1996	MS	6010	Lead	7.4		
S.STATION9	IT	215483	5/4/1996	MS	6010	Nickel	20.7		
S.STATION9	IT	215483	5/4/1996	MS	6010	Silver	0.3		
S.STATION9	IT	215483	5/4/1996	MS	6010	Tin	2.2		
S.STATION9	IT	215483	5/4/1996	MS	6010	Zinc	38.3		
S.STATION9	IT	216490	6/2/2000	MS	9012	Cyanide	0.4	U	
S.STATION9	IT	216490	6/2/2000	MS	8270	1,2,4-Trichlorobenzene	0.01	U	2.7778
S.STATION9	IT	216490	6/2/2000	MS	8270	1,2-Dichlorobenzene	0.01	U	2.7778
S.STATION9	IT	216490	6/2/2000	MS	8270	1,3-Dichlorobenzene	0.01	U	2.7778
S.STATION9	IT	216490	6/2/2000	MS	8270	1,4-Dichlorobenzene	0.01	U	2.7778
S.STATION9	IT	216490	6/2/2000	MS	8270	2,4-Dimethylphenol	0.2	U	
S.STATION9	IT	216490	6/2/2000	MS	8270	2-Methylnaphthalene	0.01	U	2.7778
S.STATION9	IT	216490	6/2/2000	MS	8270	2-Methylphenol	0.1	U	
S.STATION9	IT	216490	6/2/2000	MS	8270	4-Methylphenol	0.2	U	
S.STATION9	IT	216490	6/2/2000	MS	8270	Acenaphthene	0.01	U	2.7778
S.STATION9	IT	216490	6/2/2000	MS	8270	Acenaphthylene	0.01	U	2.7778
S.STATION9	IT	216490	6/2/2000	MS	8270	Anthracene	0.02		5.5556
S.STATION9	IT	216490	6/2/2000	MS	8270	Benzo(a)anthracene	0.069		19.1667
S.STATION9	IT	216490	6/2/2000	MS	8270	Benzo(a)pyrene	0.055		15.2778
S.STATION9	IT	216490	6/2/2000	MS	8270	Benzo(b)fluoranthene	0.061		16.9444
S.STATION9	IT	216490	6/2/2000	MS	8270	Benzo(g,h,i)perylene	0.021		5.8333
S.STATION9	IT	216490	6/2/2000	MS	8270	Benzo(k)fluoranthene	0.055		15.2778
S.STATION9	IT	216490	6/2/2000	MS	8270	Benzoic acid	0.25	U	
S.STATION9	IT	216490	6/2/2000	MS	8270	Benzyl alcohol	0.05	U	
S.STATION9	IT	216490	6/2/2000	MS	8270	bis(2-Ethylhexyl)phthalate	0.27		75.0000
S.STATION9	IT	216490	6/2/2000	MS	8270	Butylbenzylphthalate	0.01	U	2.7778

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION9	IT	216490	6/2/2000	MS	8270	Chrysene	0.12		33.3333
S.STATION9	IT	216490	6/2/2000	MS	8270	Dibenz(a,h)anthracene	0.007	J	1.9444
S.STATION9	IT	216490	6/2/2000	MS	8270	Dibenzofuran	0.01	U	2.7778
S.STATION9	IT	216490	6/2/2000	MS	8270	Diethylphthalate	0.067		18.6111
S.STATION9	IT	216490	6/2/2000	MS	8270	Dimethylphthalate	0.01	U	2.7778
S.STATION9	IT	216490	6/2/2000	MS	8270	Di-n-butylphthalate	0.01	U	2.7778
S.STATION9	IT	216490	6/2/2000	MS	8270	Di-n-octylphthalate	0.26		72.2222
S.STATION9	IT	216490	6/2/2000	MS	8270	Fluoranthene	0.048		13.3333
S.STATION9	IT	216490	6/2/2000	MS	8270	Fluorene	0.004	J	1.1111
S.STATION9	IT	216490	6/2/2000	MS	8270	Hexachlorobenzene	0.01	U	2.7778
S.STATION9	IT	216490	6/2/2000	MS	8270	Hexachlorobutadiene	0.01	U	2.7778
S.STATION9	IT	216490	6/2/2000	MS	8270	Indeno(1,2,3-cd)pyrene	0.025		6.9444
S.STATION9	IT	216490	6/2/2000	MS	8270	Naphthalene	0.01	U	2.7778
S.STATION9	IT	216490	6/2/2000	MS	8270	N-Nitrosodiphenylamine	0.01	U	2.7778
S.STATION9	IT	216490	6/2/2000	MS	8270	Pentachlorophenol	0.3	UJ	
S.STATION9	IT	216490	6/2/2000	MS	8270	Phenanthrene	0.023		6.3889
S.STATION9	IT	216490	6/2/2000	MS	8270	Phenol	2		
S.STATION9	IT	216490	6/2/2000	MS	8270	Pyrene	0.031		8.6111
S.STATION9	IT	216490	6/2/2000	MS	7471	Mercury	0.07		
S.STATION9	IT	216490	6/2/2000	MS	6010	Aluminum	9180	J	
S.STATION9	IT	216490	6/2/2000	MS	6010	Antimony	0.06	J	
S.STATION9	IT	216490	6/2/2000	MS	6010	Arsenic	2.1		
S.STATION9	IT	216490	6/2/2000	MS	6010	Barium	13.7		
S.STATION9	IT	216490	6/2/2000	MS	6010	Beryllium	0.11		
S.STATION9	IT	216490	6/2/2000	MS	6010	Cadmium	1.46	J	
S.STATION9	IT	216490	6/2/2000	MS	6010	Calcium	50600		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION9	IT	216490	6/2/2000	MS	6010	Chromium	86.9		
S.STATION9	IT	216490	6/2/2000	MS	6010	Cobalt	4.15		
S.STATION9	IT	216490	6/2/2000	MS	6010	Copper	10.2		
S.STATION9	IT	216490	6/2/2000	MS	6010	Iron	13100		
S.STATION9	IT	216490	6/2/2000	MS	6010	Lead	37.6		
S.STATION9	IT	216490	6/2/2000	MS	6010	Magnesium	5780		
S.STATION9	IT	216490	6/2/2000	MS	6010	Manganese	184		
S.STATION9	IT	216490	6/2/2000	MS	6010	Nickel	21	J	
S.STATION9	IT	216490	6/2/2000	MS	6010	Potassium	866		
S.STATION9	IT	216490	6/2/2000	MS	6010	Selenium	1.24	U	
S.STATION9	IT	216490	6/2/2000	MS	6010	Silver	0.23		
S.STATION9	IT	216490	6/2/2000	MS	6010	Sodium	3660		
S.STATION9	IT	216490	6/2/2000	MS	6010	Thallium	0.06		
S.STATION9	IT	216490	6/2/2000	MS	6010	Vanadium	24.7		
S.STATION9	IT	216490	6/2/2000	MS	6010	Zinc	45	J	
S.STATION9	IT	229133	6/3/2004	MS	TOC-PSEP	Total Organic Carbon	0.36%		
S.STATION9	IT	229133	6/3/2004	MS	8270	1,2,4-Trichlorobenzene	0.0019	U	0.5278
S.STATION9	IT	229133	6/3/2004	MS	8270	1,2-Dichlorobenzene	0.0016	U	0.4444
S.STATION9	IT	229133	6/3/2004	MS	8270	1,3-Dichlorobenzene	0.002	U	0.5556
S.STATION9	IT	229133	6/3/2004	MS	8270	1,4-Dichlorobenzene	0.0024	U	0.6667
S.STATION9	IT	229133	6/3/2004	MS	8270	2,4-Dimethylphenol	0.0067	U	
S.STATION9	IT	229133	6/3/2004	MS	8270	2-Methylnaphthalene	0.0015	U	0.4167
S.STATION9	IT	229133	6/3/2004	MS	8270	2-Methylphenol	0.0042	U	
S.STATION9	IT	229133	6/3/2004	MS	8270	4-Methylphenol	0.0036	U	
S.STATION9	IT	229133	6/3/2004	MS	8270	Acenaphthene	0.003	J	0.8333
S.STATION9	IT	229133	6/3/2004	MS	8270	Acenaphthylene	0.0024	J	0.6667

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION9	IT	229133	6/3/2004	MS	8270	Anthracene	0.0039	J	1.0833
S.STATION9	IT	229133	6/3/2004	MS	8270	Benzo(a)anthracene	0.01		2.7778
S.STATION9	IT	229133	6/3/2004	MS	8270	Benzo(a)pyrene	0.0082	J	2.2778
S.STATION9	IT	229133	6/3/2004	MS	8270	Benzo(b)fluoranthene	0.016		4.4444
S.STATION9	IT	229133	6/3/2004	MS	8270	Benzo(g,h,i)perylene	0.0072	J	2.0000
S.STATION9	IT	229133	6/3/2004	MS	8270	Benzo(k)fluoranthene	0.013		3.6111
S.STATION9	IT	229133	6/3/2004	MS	8270	Benzoic acid	0.12	U	
S.STATION9	IT	229133	6/3/2004	MS	8270	Benzyl alcohol	0.0045	U	
S.STATION9	IT	229133	6/3/2004	MS	8270	bis(2-Ethylhexyl)phthalate	0.2	U	55.5556
S.STATION9	IT	229133	6/3/2004	MS	8270	Butylbenzylphthalate	0.0028	J	0.7778
S.STATION9	IT	229133	6/3/2004	MS	8270	Chrysene	0.028		7.7778
S.STATION9	IT	229133	6/3/2004	MS	8270	Dibenz(a,h)anthracene	0.0037	J	1.0278
S.STATION9	IT	229133	6/3/2004	MS	8270	Dibenzofuran	0.0031	J	0.8611
S.STATION9	IT	229133	6/3/2004	MS	8270	Diethylphthalate	0.0043	U	1.1944
S.STATION9	IT	229133	6/3/2004	MS	8270	Dimethylphthalate	0.0022	U	0.6111
S.STATION9	IT	229133	6/3/2004	MS	8270	Di-n-butylphthalate	0.01	U	2.7778
S.STATION9	IT	229133	6/3/2004	MS	8270	Di-n-octylphthalate	0.0024	J	0.6667
S.STATION9	IT	229133	6/3/2004	MS	8270	Fluoranthene	0.089		24.7222
S.STATION9	IT	229133	6/3/2004	MS	8270	Fluorene	0.004	J	1.1111
S.STATION9	IT	229133	6/3/2004	MS	8270	Hexachlorobenzene	0.0026	U	0.7222
S.STATION9	IT	229133	6/3/2004	MS	8270	Hexachlorobutadiene	0.0017	U	0.4722
S.STATION9	IT	229133	6/3/2004	MS	8270	Hexachloroethane	0.0027	U	0.7500
S.STATION9	IT	229133	6/3/2004	MS	8270	Indeno(1,2,3-cd)pyrene	0.0076	J	2.1111
S.STATION9	IT	229133	6/3/2004	MS	8270	Naphthalene	0.0016	U	0.4444
S.STATION9	IT	229133	6/3/2004	MS	8270	N-Nitrosodiphenylamine	0.0027	U	0.7500
S.STATION9	IT	229133	6/3/2004	MS	8270	Pentachlorophenol	0.011	U	

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	TOC - Normalized (mg/kg-organic carbon)
S.STATION9	IT	229133	6/3/2004	MS	8270	Phenanthrene	0.065		18.0556
S.STATION9	IT	229133	6/3/2004	MS	8270	Phenol	0.03	U	
S.STATION9	IT	229133	6/3/2004	MS	8270	Pyrene	0.061		16.9444
S.STATION9	IT	229133	6/3/2004	MS	7471	Mercury	0.21		
S.STATION9	IT	229133	6/3/2004	MS	6020	Antimony	0.13	UJ	
S.STATION9	IT	229133	6/3/2004	MS	6020	Arsenic	2.6		
S.STATION9	IT	229133	6/3/2004	MS	6020	Beryllium	0.111		
S.STATION9	IT	229133	6/3/2004	MS	6020	Cadmium	6.44	J	
S.STATION9	IT	229133	6/3/2004	MS	6020	Chromium	59.5		
S.STATION9	IT	229133	6/3/2004	MS	6020	Cobalt	5.03		
S.STATION9	IT	229133	6/3/2004	MS	6020	Copper	13	J	
S.STATION9	IT	229133	6/3/2004	MS	6020	Lead	8.35		
S.STATION9	IT	229133	6/3/2004	MS	6020	Nickel	27.7		
S.STATION9	IT	229133	6/3/2004	MS	6020	Selenium	0.4		
S.STATION9	IT	229133	6/3/2004	MS	6020	Silver	0.364		
S.STATION9	IT	229133	6/3/2004	MS	6020	Thallium	0.061		
S.STATION9	IT	229133	6/3/2004	MS	6020	Vanadium	20.7	J	
S.STATION9	IT	229133	6/3/2004	MS	6020	Zinc	40.6		
S.STATION9	IT	229133	6/3/2004	MS	6010	Aluminum	6800		
S.STATION9	IT	229133	6/3/2004	MS	6010	Barium	15	J	
S.STATION9	IT	229133	6/3/2004	MS	6010	Calcium	114000		
S.STATION9	IT	229133	6/3/2004	MS	6010	Iron	10800		
S.STATION9	IT	229133	6/3/2004	MS	6010	Magnesium	4740		
S.STATION9	IT	229133	6/3/2004	MS	6010	Manganese	196		
S.STATION9	IT	229133	6/3/2004	MS	6010	Potassium	827		
S.STATION9	IT	229133	6/3/2004	MS	6010	Sodium	3490		

Table D1 (Continued)
Analytical Results for Marine Sediment Samples

Notes:
IT - intertidal
J - The result is an estimated concentration that is less than the method reporting limit (MRL), but greater than or equal to the method detection limit (MDL).
mg/kg - milligram per kilogram
MS - marine sediment
TOC - total organic carbon
U - The compound was analyzed for, but was not detected ("nondetect") at or above the MRL/MDL.

Table D2
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION1	IT	215489	5/4/1996	FD	8270	Phenol	0.24		wet
S.STATION1	IT	215488	5/4/1996	ES	8270	Benzoic acid	2.6		wet
S.STATION1	IT	215488	5/4/1996	ES	6010	Nickel	1.2		wet
S.STATION1	IT	215488	5/4/1996	ES	6010	Silver	2.2		wet
S.STATION1	IT	215488	5/4/1996	ES	6010	Chromium	2.84		wet
S.STATION1	IT	215488	5/4/1996	ES	6010	Copper	1.82		wet
S.STATION1	IT	215488	5/4/1996	ES	6010	Zinc	14.1		wet
S.STATION1	IT	215489	5/4/1996	FD	7131	Cadmium	1.5		wet
S.STATION1	IT	215488	5/4/1996	ES	7421	Lead	0.21		wet
S.STATION1	IT	215488	5/4/1996	ES	7471	Mercury	0.03		wet
S.STATION1	IT	216471	6/1/2000	ES	9012	Cyanide	0.1026	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Benzyl alcohol	0.091		wet
S.STATION1	IT	216471	6/1/2000	ES	8270	2,4-Dimethylphenol	0.2	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	4-Methylphenol	0.2	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	1,4-Dichlorobenzene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Phenol	0.05	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	bis(2-Ethylhexyl)phthalate	0.09	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Di-n-octylphthalate	0.02	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Hexachlorobenzene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Anthracene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	1,2,4-Trichlorobenzene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Pyrene	0.006	J	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Dimethylphthalate	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Dibenzofuran	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Benzo(g,h,i)perylene	0.006	J	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Indeno(1,2,3-cd)pyrene	0.02	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Benzo(b)fluoranthene	0.01	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION1	IT	216471	6/1/2000	ES	8270	Fluoranthene	0.008	J	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Benzo(k)fluoranthene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Acenaphthylene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Chrysene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Benzo(a)pyrene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Dibenz(a,h)anthracene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	1,3-Dichlorobenzene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Benzo(a)anthracene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Acenaphthene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Diethylphthalate	0.003	J	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Di-n-butylphthalate	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Phenanthrene	0.007	J	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Butylbenzylphthalate	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	N-Nitrosodiphenylamine	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Fluorene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Hexachlorobutadiene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Pentachlorophenol	0.3	UJ	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Naphthalene	0.001	J	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	2-Methylnaphthalene	0.001	J	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	2-Methylphenol	0.1	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	1,2-Dichlorobenzene	0.01	U	wet
S.STATION1	IT	216471	6/1/2000	ES	8270	Benzoic acid	4.3		wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Aluminum	32.604	J	wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Iron	46.74		wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Magnesium	840.18	J	wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Potassium	1755.6	J	wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Chromium	0.741		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION1	IT	216471	6/1/2000	ES	6010	Zinc	14.592		wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Calcium	848.16		wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Lead	0.05016	J	wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Manganese	1.2996		wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Nickel	0.62016	J	wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Silver	0.31122		wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Thallium	0.00114	UJ	wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Antimony	0.00228	UJ	wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Arsenic	2.4738		wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Barium	0.16986	J	wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Beryllium	0.00228	UJ	wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Cadmium	0.6099	J	wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Cobalt	0.08322	J	wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Copper	1.02828	J	wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Vanadium	0.1311	J	wet
S.STATION1	IT	216471	6/1/2000	ES	6010	Sodium	6281.4	J	wet
S.STATION1	IT	216471	6/1/2000	ES	7471	Mercury	0.01596		wet
S.STATION1	IT	216471	6/1/2000	ES	7740	Selenium	0.4104		wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Phenol	0.054	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	1,3-Dichlorobenzene	0.005	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	1,4-Dichlorobenzene	0.0054	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	1,2-Dichlorobenzene	0.005	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Benzyl alcohol	0.014	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	2-Methylphenol	0.025	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Hexachloroethane	0.005	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	4-Methylphenol	0.028	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	2,4-Dimethylphenol	0.042	UJ	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION1	IT	229116	6/3/2004	ES	8270	Benzoic acid	1.3	J	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	1,2,4-Trichlorobenzene	0.0048	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Naphthalene	0.004	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Hexachlorobutadiene	0.0052	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	2-Methylnaphthalene	0.004	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Acenaphthylene	0.0052	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Dimethylphthalate	0.0053	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Acenaphthene	0.0045	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Dibenzofuran	0.0053	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Fluorene	0.006	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Diethylphthalate	0.034	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	N-Nitrosodiphenylamine	0.0095	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Hexachlorobenzene	0.0055	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Pentachlorophenol	0.091	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Phenanthrene	0.005	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Anthracene	0.0047	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Di-n-butylphthalate	0.04	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Fluoranthene	0.0067	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Pyrene	0.0082	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Butylbenzylphthalate	0.019	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Benzo(a)anthracene	0.0055	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Chrysene	0.0028	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	bis(2-Ethylhexyl)phthalate	0.4	J	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Di-n-octylphthalate	0.007	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Benzo(b)fluoranthene	0.0035	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Benzo(k)fluoranthene	0.0034	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Benzo(a)pyrene	0.0034	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION1	IT	229116	6/3/2004	ES	8270	Indeno(1,2,3-cd)pyrene	0.0031	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Dibenz(a,h)anthracene	0.006	U	wet
S.STATION1	IT	229116	6/3/2004	ES	8270	Benzo(g,h,i)perylene	0.0053	U	wet
S.STATION1	IT	229116	6/3/2004	ES	6010	Chromium	0.4256		wet
S.STATION1	IT	229116	6/3/2004	ES	6010	Aluminum	15.428		wet
S.STATION1	IT	229116	6/3/2004	ES	6010	Calcium	696.92	J	wet
S.STATION1	IT	229116	6/3/2004	ES	6010	Iron	34.447		wet
S.STATION1	IT	229116	6/3/2004	ES	6010	Magnesium	703.57	J	wet
S.STATION1	IT	229116	6/3/2004	ES	6010	Potassium	1729	J	wet
S.STATION1	IT	229116	6/3/2004	ES	6010	Sodium	4814.6	J	wet
S.STATION1	IT	229116	6/3/2004	ES	6010	Vanadium	0.0532	UJ	wet
S.STATION1	IT	229116	6/3/2004	ES	6020	Arsenic	2.793		wet
S.STATION1	IT	229116	6/3/2004	ES	6020	Beryllium	0.000931	UJ	wet
S.STATION1	IT	229116	6/3/2004	ES	6020	Lead	0.056658		wet
S.STATION1	IT	229116	6/3/2004	ES	6020	Nickel	0.85918		wet
S.STATION1	IT	229116	6/3/2004	ES	6020	Zinc	11.9567		wet
S.STATION1	IT	229116	6/3/2004	ES	6020	Antimony	0.001862	UJ	wet
S.STATION1	IT	229116	6/3/2004	ES	6020	Barium	0.13965	J	wet
S.STATION1	IT	229116	6/3/2004	ES	6020	Cadmium	0.56791		wet
S.STATION1	IT	229116	6/3/2004	ES	6020	Cobalt	0.109326		wet
S.STATION1	IT	229116	6/3/2004	ES	6020	Copper	1.14779		wet
S.STATION1	IT	229116	6/3/2004	ES	6020	Manganese	1.3965		wet
S.STATION1	IT	229116	6/3/2004	ES	6020	Silver	0.90174		wet
S.STATION1	IT	229116	6/3/2004	ES	6020	Thallium	0.000532	J	wet
S.STATION1	IT	229116	6/3/2004	ES	7471	Mercury	0.01995		wet
S.STATION1	IT	229116	6/3/2004	ES	7740	Selenium	0.6916		wet
S.STATION10	IT	215500	5/5/1996	ES	6010	Nickel	0.5		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION10	IT	215500	5/5/1996	ES	6010	Silver	0.04		wet
S.STATION10	IT	215500	5/5/1996	ES	6010	Chromium	0.2		wet
S.STATION10	IT	215500	5/5/1996	ES	6010	Copper	0.9		wet
S.STATION10	IT	215500	5/5/1996	ES	6010	Zinc	16.1		wet
S.STATION10	IT	215500	5/5/1996	ES	7131	Cadmium	0.37		wet
S.STATION10	IT	215500	5/5/1996	ES	7421	Lead	0.16		wet
S.STATION10	IT	215500	5/5/1996	ES	7471	Mercury	0.02		wet
S.STATION11	IT	215502	5/5/1996	ES	8270	Benzoic acid	1.3	J	wet
S.STATION11	IT	215502	5/5/1996	ES	6010	Nickel	0.9		wet
S.STATION11	IT	215502	5/5/1996	ES	6010	Silver	0.15		wet
S.STATION11	IT	215502	5/5/1996	ES	6010	Chromium	0.95		wet
S.STATION11	IT	215502	5/5/1996	ES	6010	Copper	1.11		wet
S.STATION11	IT	215502	5/5/1996	ES	6010	Zinc	15.4		wet
S.STATION11	IT	215502	5/5/1996	ES	7131	Cadmium	0.22		wet
S.STATION11	IT	215502	5/5/1996	ES	7471	Mercury	0.01		wet
S.STATION12	IT	215501	5/5/1996	ES	8270	Fluoranthene	0.011	J	wet
S.STATION12	IT	215501	5/5/1996	ES	8270	Benzoic acid	1.6	J	wet
S.STATION12	IT	215501	5/5/1996	ES	8270	Phenanthrene	0.014	J	wet
S.STATION12	IT	215501	5/5/1996	ES	6010	Nickel	2.3		wet
S.STATION12	IT	215501	5/5/1996	ES	6010	Silver	0.09		wet
S.STATION12	IT	215501	5/5/1996	ES	6010	Chromium	3.39		wet
S.STATION12	IT	215501	5/5/1996	ES	6010	Copper	1.65		wet
S.STATION12	IT	215501	5/5/1996	ES	6010	Zinc	15.8		wet
S.STATION12	IT	215503	5/5/1996	FD	7131	Cadmium	0.21		wet
S.STATION12	IT	215503	5/5/1996	FD	7197	Hexavalent Chromium	3.6		wet
S.STATION12	IT	215501	5/5/1996	ES	7421	Lead	0.19		wet
S.STATION12	IT	215501	5/5/1996	ES	7471	Mercury	0.01		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION2	IT	215490	5/7/1996	ES	8270	Benzoic acid	2		wet
S.STATION2	IT	215490	5/7/1996	ES	6010	Nickel	0.5		wet
S.STATION2	IT	215490	5/7/1996	ES	6010	Silver	0.73		wet
S.STATION2	IT	215490	5/7/1996	ES	6010	Chromium	1.86		wet
S.STATION2	IT	215490	5/7/1996	ES	6010	Copper	1.71		wet
S.STATION2	IT	215490	5/7/1996	ES	6010	Zinc	16.5		wet
S.STATION2	IT	215490	5/7/1996	ES	7131	Cadmium	5.4		wet
S.STATION2	IT	215490	5/7/1996	ES	7471	Mercury	0.18		wet
S.STATION2	IT	216473	6/1/2000	ES	9012	Cyanide	0.1035	U	wet
S.STATION2	IT	216475	6/1/2000	FD	8270	Pyrene	0.01		wet
S.STATION2	IT	216475	6/1/2000	FD	8270	Benzo(a)pyrene	0.002	J	wet
S.STATION2	IT	216475	6/1/2000	FD	8270	Benzoic acid	6.9		wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Benzyl alcohol	0.097		wet
S.STATION2	IT	216473	6/1/2000	ES	8270	2,4-Dimethylphenol	0.2	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	4-Methylphenol	0.2	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	1,4-Dichlorobenzene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Phenol	0.02	J	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	bis(2-Ethylhexyl)phthalate	0.07	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Di-n-octylphthalate	0.02	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Hexachlorobenzene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Anthracene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	1,2,4-Trichlorobenzene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Dimethylphthalate	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Dibenzofuran	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Benzo(g,h,i)perylene	0.006	J	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Indeno(1,2,3-cd)pyrene	0.02	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Benzo(b)fluoranthene	0.002	J	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION2	IT	216473	6/1/2000	ES	8270	Fluoranthene	0.008	J	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Benzo(k)fluoranthene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Acenaphthylene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Chrysene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Dibenz(a,h)anthracene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	1,3-Dichlorobenzene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Benzo(a)anthracene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Acenaphthene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Diethylphthalate	0.003	J	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Di-n-butylphthalate	0.005	J	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Phenanthrene	0.006	J	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Butylbenzylphthalate	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	N-Nitrosodiphenylamine	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Fluorene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Hexachlorobutadiene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Pentachlorophenol	0.3	UJ	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	Naphthalene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	2-Methylnaphthalene	0.01	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	2-Methylphenol	0.1	U	wet
S.STATION2	IT	216473	6/1/2000	ES	8270	1,2-Dichlorobenzene	0.01	U	wet
S.STATION2	IT	216475	6/1/2000	FD	6010	Chromium	1.6445		wet
S.STATION2	IT	216475	6/1/2000	FD	6010	Zinc	14.49		wet
S.STATION2	IT	216475	6/1/2000	FD	6010	Calcium	1909		wet
S.STATION2	IT	216475	6/1/2000	FD	6010	Lead	0.0874	J	wet
S.STATION2	IT	216475	6/1/2000	FD	6010	Nickel	0.6509	J	wet
S.STATION2	IT	216475	6/1/2000	FD	6010	Silver	0.2898		wet
S.STATION2	IT	216475	6/1/2000	FD	6010	Arsenic	2.5875		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION2	IT	216475	6/1/2000	FD	6010	Cadmium	1.8745	J	wet
S.STATION2	IT	216475	6/1/2000	FD	6010	Cobalt	0.1173	J	wet
S.STATION2	IT	216473	6/1/2000	ES	6010	Aluminum	31.74	J	wet
S.STATION2	IT	216473	6/1/2000	ES	6010	Iron	48.76		wet
S.STATION2	IT	216473	6/1/2000	ES	6010	Magnesium	833.75	J	wet
S.STATION2	IT	216473	6/1/2000	ES	6010	Potassium	1851.5	J	wet
S.STATION2	IT	216473	6/1/2000	ES	6010	Manganese	1.3455		wet
S.STATION2	IT	216473	6/1/2000	ES	6010	Thallium	0.00115	UJ	wet
S.STATION2	IT	216473	6/1/2000	ES	6010	Antimony	0.0023	J	wet
S.STATION2	IT	216473	6/1/2000	ES	6010	Barium	0.16445	J	wet
S.STATION2	IT	216473	6/1/2000	ES	6010	Beryllium	0.0023	UJ	wet
S.STATION2	IT	216473	6/1/2000	ES	6010	Copper	1.1615	J	wet
S.STATION2	IT	216473	6/1/2000	ES	6010	Vanadium	0.1564	J	wet
S.STATION2	IT	216473	6/1/2000	ES	6010	Sodium	5991.5	J	wet
S.STATION2	IT	216475	6/1/2000	FD	7471	Mercury	0.03335		wet
S.STATION2	IT	216473	6/1/2000	ES	7740	Selenium	0.46		wet
S.STATION2	IT	229135	6/3/2004	FD	8270	2-Methylphenol	0.081		wet
S.STATION2	IT	229135	6/3/2004	FD	8270	Benzoic acid	2.1	J	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Phenol	0.054	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	1,3-Dichlorobenzene	0.005	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	1,4-Dichlorobenzene	0.0054	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	1,2-Dichlorobenzene	0.005	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Benzyl alcohol	0.014	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Hexachloroethane	0.005	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	4-Methylphenol	0.028	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	2,4-Dimethylphenol	0.042	UJ	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	1,2,4-Trichlorobenzene	0.0048	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION2	IT	229118	6/3/2004	ES	8270	Naphthalene	0.004	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Hexachlorobutadiene	0.0052	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	2-Methylnaphthalene	0.004	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Acenaphthylene	0.0052	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Dimethylphthalate	0.0053	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Acenaphthene	0.0045	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Dibenzofuran	0.0053	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Fluorene	0.006	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Diethylphthalate	0.034	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	N-Nitrosodiphenylamine	0.0095	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Hexachlorobenzene	0.0055	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Pentachlorophenol	0.091	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Phenanthrene	0.0069	J	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Anthracene	0.0047	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Di-n-butylphthalate	0.006	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Fluoranthene	0.0067	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Pyrene	0.0082	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Butylbenzylphthalate	0.019	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Benzo(a)anthracene	0.0055	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Chrysene	0.0028	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	bis(2-Ethylhexyl)phthalate	0.14	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Di-n-octylphthalate	0.007	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Benzo(b)fluoranthene	0.0035	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Benzo(k)fluoranthene	0.0034	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Benzo(a)pyrene	0.0034	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Indeno(1,2,3-cd)pyrene	0.0031	U	wet
S.STATION2	IT	229118	6/3/2004	ES	8270	Dibenz(a,h)anthracene	0.006	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION2	IT	229118	6/3/2004	ES	8270	Benzo(g,h,i)perylene	0.0053	U	wet
S.STATION2	IT	229135	6/3/2004	FD	6010	Chromium	0.64		wet
S.STATION2	IT	229135	6/3/2004	FD	6010	Aluminum	22.4		wet
S.STATION2	IT	229135	6/3/2004	FD	6010	Calcium	756.8	J	wet
S.STATION2	IT	229135	6/3/2004	FD	6010	Iron	49.92		wet
S.STATION2	IT	229135	6/3/2004	FD	6010	Magnesium	822.4	J	wet
S.STATION2	IT	229135	6/3/2004	FD	6010	Potassium	2400	J	wet
S.STATION2	IT	229135	6/3/2004	FD	6010	Sodium	5440	J	wet
S.STATION2	IT	229135	6/3/2004	FD	6010	Vanadium	0.08	J	wet
S.STATION2	IT	229135	6/3/2004	FD	6020	Arsenic	2.656		wet
S.STATION2	IT	229135	6/3/2004	FD	6020	Lead	6.58%		wet
S.STATION2	IT	229135	6/3/2004	FD	6020	Antimony	0.00144	UJ	wet
S.STATION2	IT	229135	6/3/2004	FD	6020	Barium	0.168	J	wet
S.STATION2	IT	229135	6/3/2004	FD	6020	Manganese	1.808		wet
S.STATION2	IT	229135	6/3/2004	FD	6020	Silver	0.5872		wet
S.STATION2	IT	229118	6/3/2004	ES	6020	Beryllium	0.00112	UJ	wet
S.STATION2	IT	229118	6/3/2004	ES	6020	Nickel	0.8864		wet
S.STATION2	IT	229118	6/3/2004	ES	6020	Zinc	16.8		wet
S.STATION2	IT	229118	6/3/2004	ES	6020	Cadmium	1.2688		wet
S.STATION2	IT	229118	6/3/2004	ES	6020	Cobalt	0.11968		wet
S.STATION2	IT	229118	6/3/2004	ES	6020	Copper	1.2192		wet
S.STATION2	IT	229118	6/3/2004	ES	6020	Thallium	0.0008	J	wet
S.STATION2	IT	229118	6/3/2004	ES	7471	Mercury	0.0224		wet
S.STATION2	IT	229135	6/3/2004	FD	7740	Selenium	0.608	U	wet
S.STATION3	IT	215492	5/7/1996	FD	8270	Fluoranthene	0.012	J	wet
S.STATION3	IT	215492	5/7/1996	FD	8270	Benzoic acid	2.4		wet
S.STATION3	IT	215492	5/7/1996	FD	6010	Nickel	0.6		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION3	IT	215492	5/7/1996	FD	6010	Silver	0.31		wet
S.STATION3	IT	215492	5/7/1996	FD	6010	Chromium	8.78		wet
S.STATION3	IT	215492	5/7/1996	FD	6010	Copper	1.73		wet
S.STATION3	IT	215491	5/7/1996	ES	6010	Zinc	17.5		wet
S.STATION3	IT	215492	5/7/1996	FD	7131	Cadmium	5.75		wet
S.STATION3	IT	215491	5/7/1996	ES	7197	Hexavalent Chromium	2.2		wet
S.STATION3	IT	215492	5/7/1996	FD	7421	Lead	0.12		wet
S.STATION3	IT	215491	5/7/1996	ES	7471	Mercury	0.02		wet
S.STATION3	IT	216476	6/2/2000	ES	9012	Cyanide	0.1143	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Benzyl alcohol	0.097		wet
S.STATION3	IT	216476	6/2/2000	ES	8270	2,4-Dimethylphenol	0.2	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	4-Methylphenol	0.2	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	1,4-Dichlorobenzene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Phenol	0.05	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	bis(2-Ethylhexyl)phthalate	0.2	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Di-n-octylphthalate	0.02	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Hexachlorobenzene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Anthracene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	1,2,4-Trichlorobenzene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Pyrene	0.025		wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Dimethylphthalate	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Dibenzofuran	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Benzo(g,h,i)perylene	0.02	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Indeno(1,2,3-cd)pyrene	0.02	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Benzo(b)fluoranthene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Fluoranthene	0.007	J	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Benzo(k)fluoranthene	0.01	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION3	IT	216476	6/2/2000	ES	8270	Acenaphthylene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Chrysene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Benzo(a)pyrene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Dibenz(a,h)anthracene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	1,3-Dichlorobenzene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Benzo(a)anthracene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Acenaphthene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Diethylphthalate	0.004	J	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Di-n-butylphthalate	0.005	J	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Phenanthrene	0.005	J	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Butylbenzylphthalate	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	N-Nitrosodiphenylamine	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Fluorene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Hexachlorobutadiene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Pentachlorophenol	0.3	UJ	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Naphthalene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	2-Methylnaphthalene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	2-Methylphenol	0.1	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	1,2-Dichlorobenzene	0.01	U	wet
S.STATION3	IT	216476	6/2/2000	ES	8270	Benzoic acid	6.7		wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Aluminum	20.193	J	wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Iron	46.609		wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Magnesium	755.65	J	wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Potassium	1854.2	J	wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Sodium	5486.4	J	wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Chromium	1.524		wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Zinc	16.129		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION3	IT	216476	6/2/2000	ES	6010	Calcium	1562.1		wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Lead	0.04826	J	wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Manganese	1.4986		wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Nickel	0.72644	J	wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Silver	0.28067		wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Thallium	0.00127	UJ	wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Antimony	0.00254	UJ	wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Arsenic	3.1369		wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Barium	0.14605	J	wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Beryllium	0.00254	UJ	wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Cadmium	0.79629	J	wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Cobalt	0.11303	J	wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Copper	1.1176	J	wet
S.STATION3	IT	216476	6/2/2000	ES	6010	Vanadium	0.14478	J	wet
S.STATION3	IT	216476	6/2/2000	ES	7471	Mercury	0.04699		wet
S.STATION3	IT	216476	6/2/2000	ES	7740	Selenium	0.4191		wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Phenol	0.054	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	1,3-Dichlorobenzene	0.005	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	1,4-Dichlorobenzene	0.0054	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	1,2-Dichlorobenzene	0.005	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Benzyl alcohol	0.014	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	2-Methylphenol	0.085		wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Hexachloroethane	0.005	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	4-Methylphenol	0.028	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	2,4-Dimethylphenol	0.042	UJ	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	1,2,4-Trichlorobenzene	0.0048	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Naphthalene	0.004	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION3	IT	229120	6/3/2004	ES	8270	Hexachlorobutadiene	0.0052	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	2-Methylnaphthalene	0.004	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Acenaphthylene	0.0052	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Dimethylphthalate	0.0053	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Acenaphthene	0.0045	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Dibenzofuran	0.0053	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Fluorene	0.006	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Diethylphthalate	0.034	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	N-Nitrosodiphenylamine	0.0095	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Hexachlorobenzene	0.0055	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Pentachlorophenol	0.091	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Phenanthrene	0.005	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Anthracene	0.0047	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Di-n-butylphthalate	0.04	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Fluoranthene	0.0067	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Pyrene	0.0082	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Butylbenzylphthalate	0.019	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Benzo(a)anthracene	0.0055	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Chrysene	0.0028	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	bis(2-Ethylhexyl)phthalate	0.14	UJ	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Di-n-octylphthalate	0.007	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Benzo(b)fluoranthene	0.0035	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Benzo(k)fluoranthene	0.0034	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Benzo(a)pyrene	0.0034	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Indeno(1,2,3-cd)pyrene	0.0031	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Dibenz(a,h)anthracene	0.006	U	wet
S.STATION3	IT	229120	6/3/2004	ES	8270	Benzo(g,h,i)perylene	0.0053	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION3	IT	229120	6/3/2004	ES	8270	Benzoic acid	3.7	J	wet
S.STATION3	IT	229120	6/3/2004	ES	6010	Chromium	1.054		wet
S.STATION3	IT	229120	6/3/2004	ES	6010	Aluminum	33.79		wet
S.STATION3	IT	229120	6/3/2004	ES	6010	Calcium	571.95	J	wet
S.STATION3	IT	229120	6/3/2004	ES	6010	Iron	64.945		wet
S.STATION3	IT	229120	6/3/2004	ES	6010	Magnesium	683.55	J	wet
S.STATION3	IT	229120	6/3/2004	ES	6010	Potassium	1844.5	J	wet
S.STATION3	IT	229120	6/3/2004	ES	6010	Sodium	4495	J	wet
S.STATION3	IT	229120	6/3/2004	ES	6010	Vanadium	0.186	J	wet
S.STATION3	IT	229120	6/3/2004	ES	6020	Arsenic	2.604		wet
S.STATION3	IT	229120	6/3/2004	ES	6020	Beryllium	0.001085	UJ	wet
S.STATION3	IT	229120	6/3/2004	ES	6020	Lead	0.073625		wet
S.STATION3	IT	229120	6/3/2004	ES	6020	Nickel	0.806		wet
S.STATION3	IT	229120	6/3/2004	ES	6020	Zinc	15.097		wet
S.STATION3	IT	229120	6/3/2004	ES	6020	Antimony	0.00155	UJ	wet
S.STATION3	IT	229120	6/3/2004	ES	6020	Barium	0.2418	J	wet
S.STATION3	IT	229120	6/3/2004	ES	6020	Cadmium	1.8135		wet
S.STATION3	IT	229120	6/3/2004	ES	6020	Cobalt	0.1147		wet
S.STATION3	IT	229120	6/3/2004	ES	6020	Copper	1.17335		wet
S.STATION3	IT	229120	6/3/2004	ES	6020	Manganese	1.9685		wet
S.STATION3	IT	229120	6/3/2004	ES	6020	Silver	0.57195		wet
S.STATION3	IT	229120	6/3/2004	ES	6020	Thallium	0.000775	J	wet
S.STATION3	IT	229120	6/3/2004	ES	7471	Mercury	0.03875		wet
S.STATION3	IT	229120	6/3/2004	ES	7740	Selenium	0.589	U	wet
S.STATION4	IT	215493	5/7/1996	ES	8270	Pyrene	0.015	J	wet
S.STATION4	IT	215493	5/7/1996	ES	8270	Fluoranthene	1.00%		wet
S.STATION4	IT	215493	5/7/1996	ES	8270	Benzoic acid	1.6		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION4	IT	215493	5/7/1996	ES	6010	Nickel	0.6		wet
S.STATION4	IT	215493	5/7/1996	ES	6010	Silver	0.81		wet
S.STATION4	IT	215493	5/7/1996	ES	6010	Chromium	2.41		wet
S.STATION4	IT	215493	5/7/1996	ES	6010	Copper	1.5		wet
S.STATION4	IT	215493	5/7/1996	ES	6010	Zinc	13.6		wet
S.STATION4	IT	215493	5/7/1996	ES	7131	Cadmium	2.2		wet
S.STATION4	IT	215493	5/7/1996	ES	7471	Mercury	0.02		wet
S.STATION4	IT	216479	6/1/2000	ES	9012	Cyanide	0.1161	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Benzyl alcohol	0.12		wet
S.STATION4	IT	216479	6/1/2000	ES	8270	2,4-Dimethylphenol	0.2	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	4-Methylphenol	0.2	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	1,4-Dichlorobenzene	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Phenol	0.02	J	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	bis(2-Ethylhexyl)phthalate	0.08	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Di-n-octylphthalate	0.02	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Hexachlorobenzene	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Anthracene	0.001	J	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	1,2,4-Trichlorobenzene	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Pyrene	0.006	J	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Dimethylphthalate	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Dibenzofuran	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Benzo(g,h,i)perylene	0.007	J	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Indeno(1,2,3-cd)pyrene	0.02	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Benzo(b)fluoranthene	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Fluoranthene	0.01		wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Benzo(k)fluoranthene	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Acenaphthylene	0.01	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION4	IT	216479	6/1/2000	ES	8270	Chrysene	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Benzo(a)pyrene	0.002	J	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Dibenz(a,h)anthracene	0.002	J	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	1,3-Dichlorobenzene	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Benzo(a)anthracene	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Acenaphthene	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Diethylphthalate	0.002	J	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Di-n-butylphthalate	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Phenanthrene	0.008	J	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Butylbenzylphthalate	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	N-Nitrosodiphenylamine	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Fluorene	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Hexachlorobutadiene	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Pentachlorophenol	0.3	UJ	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Naphthalene	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	2-Methylnaphthalene	0.002	J	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	2-Methylphenol	0.1	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	1,2-Dichlorobenzene	0.01	U	wet
S.STATION4	IT	216479	6/1/2000	ES	8270	Benzoic acid	6.4		wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Aluminum	26.187	J	wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Iron	41.667		wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Magnesium	795.93	J	wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Potassium	1922.1	J	wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Sodium	5792.1	J	wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Chromium	0.5031		wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Zinc	16.125		wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Calcium	905.58		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION4	IT	216479	6/1/2000	ES	6010	Lead	0.04773	J	wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Manganese	1.0965		wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Nickel	0.51729	J	wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Silver	0.3999		wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Thallium	0.00129	UJ	wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Antimony	0.00258	UJ	wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Arsenic	2.5284		wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Barium	0.15996	J	wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Beryllium	0.00258	UJ	wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Cadmium	0.93138	J	wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Cobalt	0.08772	J	wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Copper	1.01781	J	wet
S.STATION4	IT	216479	6/1/2000	ES	6010	Vanadium	0.12126	J	wet
S.STATION4	IT	216479	6/1/2000	ES	7471	Mercury	0.01419		wet
S.STATION4	IT	216479	6/1/2000	ES	7740	Selenium	0.3354		wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Phenol	0.054	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	1,3-Dichlorobenzene	0.005	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	1,4-Dichlorobenzene	0.0054	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	1,2-Dichlorobenzene	0.005	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Benzyl alcohol	0.014	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	2-Methylphenol	0.11		wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Hexachloroethane	0.005	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	4-Methylphenol	0.028	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	2,4-Dimethylphenol	0.042	UJ	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	1,2,4-Trichlorobenzene	0.0048	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Naphthalene	0.004	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Hexachlorobutadiene	0.0052	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION4	IT	229122	6/3/2004	ES	8270	2-Methylnaphthalene	0.004	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Acenaphthylene	0.0052	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Dimethylphthalate	0.0053	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Acenaphthene	0.0045	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Dibenzofuran	0.0053	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Fluorene	0.006	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Diethylphthalate	0.034	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	N-Nitrosodiphenylamine	0.0095	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Hexachlorobenzene	0.0055	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Pentachlorophenol	0.091	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Phenanthrene	0.0069	J	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Anthracene	0.0047	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Di-n-butylphthalate	0.04	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Fluoranthene	0.0067	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Pyrene	0.0082	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Butylbenzylphthalate	0.019	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Benzo(a)anthracene	0.0055	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Chrysene	0.0028	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	bis(2-Ethylhexyl)phthalate	0.14	UJ	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Di-n-octylphthalate	0.007	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Benzo(b)fluoranthene	0.004	J	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Benzo(k)fluoranthene	0.0034	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Benzo(a)pyrene	0.0034	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Indeno(1,2,3-cd)pyrene	0.0031	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Dibenz(a,h)anthracene	0.006	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Benzo(g,h,i)perylene	0.0053	U	wet
S.STATION4	IT	229122	6/3/2004	ES	8270	Benzoic acid	4.5	J	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION4	IT	229122	6/3/2004	ES	6010	Chromium	0.765		wet
S.STATION4	IT	229122	6/3/2004	ES	6010	Aluminum	18.6		wet
S.STATION4	IT	229122	6/3/2004	ES	6010	Calcium	595.5	J	wet
S.STATION4	IT	229122	6/3/2004	ES	6010	Iron	41.7		wet
S.STATION4	IT	229122	6/3/2004	ES	6010	Magnesium	663	J	wet
S.STATION4	IT	229122	6/3/2004	ES	6010	Potassium	1830	J	wet
S.STATION4	IT	229122	6/3/2004	ES	6010	Sodium	4470	J	wet
S.STATION4	IT	229122	6/3/2004	ES	6010	Vanadium	0.075	J	wet
S.STATION4	IT	229122	6/3/2004	ES	6020	Arsenic	2.715		wet
S.STATION4	IT	229122	6/3/2004	ES	6020	Beryllium	0.00105	UJ	wet
S.STATION4	IT	229122	6/3/2004	ES	6020	Lead	0.0627		wet
S.STATION4	IT	229122	6/3/2004	ES	6020	Nickel	0.8175		wet
S.STATION4	IT	229122	6/3/2004	ES	6020	Zinc	12.975		wet
S.STATION4	IT	229122	6/3/2004	ES	6020	Antimony	0.00165	UJ	wet
S.STATION4	IT	229122	6/3/2004	ES	6020	Barium	0.183	J	wet
S.STATION4	IT	229122	6/3/2004	ES	6020	Cadmium	1.329		wet
S.STATION4	IT	229122	6/3/2004	ES	6020	Cobalt	0.1083		wet
S.STATION4	IT	229122	6/3/2004	ES	6020	Copper	1.005		wet
S.STATION4	IT	229122	6/3/2004	ES	6020	Manganese	1.461		wet
S.STATION4	IT	229122	6/3/2004	ES	6020	Silver	0.831		wet
S.STATION4	IT	229122	6/3/2004	ES	6020	Thallium	0.00075	J	wet
S.STATION4	IT	229122	6/3/2004	ES	7471	Mercury	0.0195		wet
S.STATION4	IT	229122	6/3/2004	ES	7740	Selenium	0.72	U	wet
S.STATION5	IT	215494	5/4/1996	ES	8270	Pyrene	0.013	J	wet
S.STATION5	IT	215494	5/4/1996	ES	8270	Fluoranthene	0.011		wet
S.STATION5	IT	215494	5/4/1996	ES	8270	Benzoic acid	2	J	wet
S.STATION5	IT	215494	5/4/1996	ES	6010	Nickel	1.3		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION5	IT	215494	5/4/1996	ES	6010	Silver	0.28		wet
S.STATION5	IT	215494	5/4/1996	ES	6010	Chromium	2.75		wet
S.STATION5	IT	215494	5/4/1996	ES	6010	Copper	1.38		wet
S.STATION5	IT	215494	5/4/1996	ES	6010	Zinc	13.2		wet
S.STATION5	IT	215494	5/4/1996	ES	7131	Cadmium	1.01		wet
S.STATION5	IT	215494	5/4/1996	ES	7197	Hexavalent Chromium	1.7		wet
S.STATION5	IT	215494	5/4/1996	ES	7421	Lead	0.14		wet
S.STATION5	IT	215494	5/4/1996	ES	7471	Mercury	0.02		wet
S.STATION5	IT	216481	6/2/2000	ES	9012	Cyanide	0.108	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Benzyl alcohol	12.00%		wet
S.STATION5	IT	216481	6/2/2000	ES	8270	2,4-Dimethylphenol	0.2	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	4-Methylphenol	0.2	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	1,4-Dichlorobenzene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Phenol	0.03	J	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	bis(2-Ethylhexyl)phthalate	0.04	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Di-n-octylphthalate	0.02	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Hexachlorobenzene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Anthracene	0.001	J	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	1,2,4-Trichlorobenzene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Pyrene	0.007	J	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Dimethylphthalate	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Dibenzofuran	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Benzo(g,h,i)perylene	0.02	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Indeno(1,2,3-cd)pyrene	0.02	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Benzo(b)fluoranthene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Fluoranthene	0.008	J	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Benzo(k)fluoranthene	0.01	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION5	IT	216481	6/2/2000	ES	8270	Acenaphthylene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Chrysene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Benzo(a)pyrene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Dibenz(a,h)anthracene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	1,3-Dichlorobenzene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Benzo(a)anthracene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Acenaphthene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Diethylphthalate	0.004	J	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Di-n-butylphthalate	0.003	J	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Phenanthrene	0.006	J	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Butylbenzylphthalate	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	N-Nitrosodiphenylamine	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Fluorene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Hexachlorobutadiene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Pentachlorophenol	0.3	UJ	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Naphthalene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	2-Methylnaphthalene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	2-Methylphenol	0.1	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	1,2-Dichlorobenzene	0.01	U	wet
S.STATION5	IT	216481	6/2/2000	ES	8270	Benzoic acid	7.3		wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Aluminum	34.08	J	wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Iron	49.68		wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Magnesium	765.6	J	wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Potassium	1680	J	wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Sodium	5568	J	wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Chromium	0.672		wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Zinc	14.16		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION5	IT	216481	6/2/2000	ES	6010	Calcium	879.6		wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Lead	0.0504	J	wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Manganese	1.344		wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Nickel	0.4296	J	wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Silver	0.174		wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Thallium	0.0012	UJ	wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Antimony	0.0024	UJ	wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Arsenic	2.268		wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Barium	0.1908	J	wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Beryllium	0.0024	UJ	wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Cadmium	1.212	J	wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Cobalt	0.096	J	wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Copper	0.9552	J	wet
S.STATION5	IT	216481	6/2/2000	ES	6010	Vanadium	0.1572	J	wet
S.STATION5	IT	216481	6/2/2000	ES	7471	Mercury	0.0156		wet
S.STATION5	IT	216481	6/2/2000	ES	7740	Selenium	0.372		wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Phenol	0.054	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	1,3-Dichlorobenzene	0.005	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	1,4-Dichlorobenzene	0.0054	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	1,2-Dichlorobenzene	0.005	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Benzyl alcohol	0.03	J	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	2-Methylphenol	0.08		wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Hexachloroethane	0.005	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	4-Methylphenol	0.028	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	2,4-Dimethylphenol	0.042	UJ	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	1,2,4-Trichlorobenzene	0.0048	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Naphthalene	0.004	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION5	IT	229124	6/3/2004	ES	8270	Hexachlorobutadiene	0.0052	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	2-Methylnaphthalene	0.004	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Acenaphthylene	0.0052	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Dimethylphthalate	0.0053	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Acenaphthene	0.0045	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Dibenzofuran	0.0053	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Fluorene	0.006	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Diethylphthalate	0.034	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	N-Nitrosodiphenylamine	0.0095	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Hexachlorobenzene	0.0055	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Pentachlorophenol	0.091	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Phenanthrene	0.005	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Anthracene	0.0047	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Di-n-butylphthalate	0.04	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Fluoranthene	0.0067	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Pyrene	0.0082	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Butylbenzylphthalate	0.019	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Benzo(a)anthracene	0.0055	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Chrysene	0.0028	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	bis(2-Ethylhexyl)phthalate	0.14	UJ	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Di-n-octylphthalate	0.007	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Benzo(b)fluoranthene	0.0035	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Benzo(k)fluoranthene	0.0034	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Benzo(a)pyrene	0.0034	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Indeno(1,2,3-cd)pyrene	0.0031	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Dibenz(a,h)anthracene	0.006	U	wet
S.STATION5	IT	229124	6/3/2004	ES	8270	Benzo(g,h,i)perylene	0.0053	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION5	IT	229124	6/3/2004	ES	8270	Benzoic acid	5.3	J	wet
S.STATION5	IT	229124	6/3/2004	ES	6010	Chromium	1.106		wet
S.STATION5	IT	229124	6/3/2004	ES	6010	Aluminum	28.28		wet
S.STATION5	IT	229124	6/3/2004	ES	6010	Calcium	737.8	J	wet
S.STATION5	IT	229124	6/3/2004	ES	6010	Iron	43.12		wet
S.STATION5	IT	229124	6/3/2004	ES	6010	Magnesium	817.6	J	wet
S.STATION5	IT	229124	6/3/2004	ES	6010	Potassium	2016	J	wet
S.STATION5	IT	229124	6/3/2004	ES	6010	Sodium	5782	J	wet
S.STATION5	IT	229124	6/3/2004	ES	6010	Vanadium	0.112	J	wet
S.STATION5	IT	229124	6/3/2004	ES	6020	Arsenic	2.114		wet
S.STATION5	IT	229124	6/3/2004	ES	6020	Beryllium	0.00098	UJ	wet
S.STATION5	IT	229124	6/3/2004	ES	6020	Lead	0.05334		wet
S.STATION5	IT	229124	6/3/2004	ES	6020	Nickel	0.4228		wet
S.STATION5	IT	229124	6/3/2004	ES	6020	Zinc	12.362		wet
S.STATION5	IT	229124	6/3/2004	ES	6020	Antimony	0.00224	UJ	wet
S.STATION5	IT	229124	6/3/2004	ES	6020	Barium	0.189	J	wet
S.STATION5	IT	229124	6/3/2004	ES	6020	Cadmium	4.536		wet
S.STATION5	IT	229124	6/3/2004	ES	6020	Cobalt	0.0854		wet
S.STATION5	IT	229124	6/3/2004	ES	6020	Copper	1.2138		wet
S.STATION5	IT	229124	6/3/2004	ES	6020	Manganese	1.3706		wet
S.STATION5	IT	229124	6/3/2004	ES	6020	Silver	0.4844		wet
S.STATION5	IT	229124	6/3/2004	ES	6020	Thallium	0.00084	J	wet
S.STATION5	IT	229124	6/3/2004	ES	7471	Mercury	0.1596		wet
S.STATION5	IT	229124	6/3/2004	ES	7740	Selenium	0.63	U	wet
S.STATION6	IT	215495	5/7/1996	ES	6010	Nickel	0.4		wet
S.STATION6	IT	215495	5/7/1996	ES	6010	Silver	0.11		wet
S.STATION6	IT	215495	5/7/1996	ES	6010	Chromium	2.57		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION6	IT	215495	5/7/1996	ES	6010	Copper	1.11		wet
S.STATION6	IT	215495	5/7/1996	ES	6010	Zinc	13.7		wet
S.STATION6	IT	215495	5/7/1996	ES	7131	Cadmium	1.5		wet
S.STATION6	IT	215495	5/7/1996	ES	7471	Mercury	0.01		wet
S.STATION6	IT	216483	6/2/2000	ES	9012	Cyanide	0.1125	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Benzyl alcohol	0.08		wet
S.STATION6	IT	216483	6/2/2000	ES	8270	2,4-Dimethylphenol	0.2	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	4-Methylphenol	0.2	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	1,4-Dichlorobenzene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Phenol	0.02	J	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	bis(2-Ethylhexyl)phthalate	0.2	J	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Di-n-octylphthalate	0.02	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Hexachlorobenzene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Anthracene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	1,2,4-Trichlorobenzene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Pyrene	0.019		wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Dimethylphthalate	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Dibenzofuran	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Benzo(g,h,i)perylene	0.02	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Indeno(1,2,3-cd)pyrene	0.02	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Benzo(b)fluoranthene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Fluoranthene	0.006	J	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Benzo(k)fluoranthene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Acenaphthylene	1.00%	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Chrysene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Benzo(a)pyrene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Dibenz(a,h)anthracene	0.01	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION6	IT	216483	6/2/2000	ES	8270	1,3-Dichlorobenzene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Benzo(a)anthracene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Acenaphthene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Diethylphthalate	0.002	J	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Di-n-butylphthalate	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Phenanthrene	0.004	J	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Butylbenzylphthalate	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	N-Nitrosodiphenylamine	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Fluorene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Hexachlorobutadiene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Pentachlorophenol	0.3	UJ	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Naphthalene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	2-Methylnaphthalene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	2-Methylphenol	0.1	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	1,2-Dichlorobenzene	0.01	U	wet
S.STATION6	IT	216483	6/2/2000	ES	8270	Benzoic acid	8.5		wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Aluminum	26.25	J	wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Iron	39.75		wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Magnesium	765	J	wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Potassium	1775	J	wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Sodium	5612.5	J	wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Chromium	0.4375		wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Zinc	18.5		wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Calcium	806.25		wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Lead	0.04375	J	wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Manganese	1.2875		wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Nickel	0.41375	J	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION6	IT	216483	6/2/2000	ES	6010	Silver	0.1325		wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Thallium	0.00125	UJ	wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Antimony	0.0025	UJ	wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Arsenic	2.8		wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Barium	0.15125	J	wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Beryllium	0.0025	UJ	wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Cadmium	0.54125	J	wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Cobalt	0.11	J	wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Copper	1.085	J	wet
S.STATION6	IT	216483	6/2/2000	ES	6010	Vanadium	0.12625	J	wet
S.STATION6	IT	216483	6/2/2000	ES	7471	Mercury	0.01875		wet
S.STATION6	IT	216483	6/2/2000	ES	7740	Selenium	0.35		wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Di-n-octylphthalate	0.007	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Benzo(b)fluoranthene	0.0035	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Benzo(k)fluoranthene	0.0034	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Benzo(a)pyrene	0.0034	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Indeno(1,2,3-cd)pyrene	0.0031	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Dibenz(a,h)anthracene	0.006	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Benzo(g,h,i)perylene	0.0053	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Phenol	0.054	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	1,3-Dichlorobenzene	0.005	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	1,4-Dichlorobenzene	0.0054	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	1,2-Dichlorobenzene	0.005	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Benzyl alcohol	0.054		wet
S.STATION6	IT	229126	6/3/2004	ES	8270	2-Methylphenol	0.09		wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Hexachloroethane	0.005	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	4-Methylphenol	0.028	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION6	IT	229126	6/3/2004	ES	8270	2,4-Dimethylphenol	0.042	UJ	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	1,2,4-Trichlorobenzene	0.0048	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Naphthalene	0.004	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Hexachlorobutadiene	0.0052	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	2-Methylnaphthalene	0.004	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Acenaphthylene	0.0052	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Dimethylphthalate	0.0053	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Acenaphthene	0.0045	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Dibenzofuran	0.0053	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Fluorene	0.006	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Diethylphthalate	0.034	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	N-Nitrosodiphenylamine	0.0095	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Hexachlorobenzene	0.0055	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Pentachlorophenol	0.091	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Phenanthrene	0.005	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Anthracene	0.0047	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Di-n-butylphthalate	0.04	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Fluoranthene	0.0067	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Pyrene	0.0082	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Butylbenzylphthalate	0.019	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Benzo(a)anthracene	0.0055	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Chrysene	0.0028	U	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	bis(2-Ethylhexyl)phthalate	0.14	UJ	wet
S.STATION6	IT	229126	6/3/2004	ES	8270	Benzoic acid	5.4	J	wet
S.STATION6	IT	229126	6/3/2004	ES	6010	Chromium	0.6355		wet
S.STATION6	IT	229126	6/3/2004	ES	6010	Aluminum	26.66		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION6	IT	229126	6/3/2004	ES	6010	Calcium	761.05	J	wet
S.STATION6	IT	229126	6/3/2004	ES	6010	Iron	49.6		wet
S.STATION6	IT	229126	6/3/2004	ES	6010	Magnesium	829.25	J	wet
S.STATION6	IT	229126	6/3/2004	ES	6010	Potassium	2201	J	wet
S.STATION6	IT	229126	6/3/2004	ES	6010	Sodium	5719.5	J	wet
S.STATION6	IT	229126	6/3/2004	ES	6010	Vanadium	0.093	J	wet
S.STATION6	IT	229126	6/3/2004	ES	6020	Arsenic	2.542		wet
S.STATION6	IT	229126	6/3/2004	ES	6020	Beryllium	0.001085	UJ	wet
S.STATION6	IT	229126	6/3/2004	ES	6020	Lead	0.070835		wet
S.STATION6	IT	229126	6/3/2004	ES	6020	Nickel	0.5332		wet
S.STATION6	IT	229126	6/3/2004	ES	6020	Zinc	14.3685		wet
S.STATION6	IT	229126	6/3/2004	ES	6020	Antimony	0.002015	UJ	wet
S.STATION6	IT	229126	6/3/2004	ES	6020	Barium	0.2015	J	wet
S.STATION6	IT	229126	6/3/2004	ES	6020	Cadmium	2.48		wet
S.STATION6	IT	229126	6/3/2004	ES	6020	Cobalt	0.1023		wet
S.STATION6	IT	229126	6/3/2004	ES	6020	Copper	1.1687		wet
S.STATION6	IT	229126	6/3/2004	ES	6020	Manganese	1.43375		wet
S.STATION6	IT	229126	6/3/2004	ES	6020	Silver	0.48205		wet
S.STATION6	IT	229126	6/3/2004	ES	6020	Thallium	0.00093	J	wet
S.STATION6	IT	229126	6/3/2004	ES	7471	Mercury	0.0279		wet
S.STATION6	IT	229126	6/3/2004	ES	7740	Selenium	0.496	U	wet
S.STATION7	IT	215496	5/7/1996	ES	8270	Pyrene	0.018	J	wet
S.STATION7	IT	215496	5/7/1996	ES	8270	Fluoranthene	0.02		wet
S.STATION7	IT	215496	5/7/1996	ES	8270	Benzoic acid	1.9	J	wet
S.STATION7	IT	215496	5/7/1996	ES	6010	Nickel	0.4		wet
S.STATION7	IT	215496	5/7/1996	ES	6010	Silver	0.43		wet
S.STATION7	IT	215496	5/7/1996	ES	6010	Chromium	0.39		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION7	IT	215496	5/7/1996	ES	6010	Copper	1.66		wet
S.STATION7	IT	215496	5/7/1996	ES	6010	Zinc	15		wet
S.STATION7	IT	215496	5/7/1996	ES	7131	Cadmium	0.25		wet
S.STATION7	IT	215496	5/7/1996	ES	7197	Hexavalent Chromium	6.5		wet
S.STATION7	IT	215496	5/7/1996	ES	7471	Mercury	0.01		wet
S.STATION7	IT	216485	6/1/2000	ES	9012	Cyanide	0.1386	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Benzyl alcohol	0.14		wet
S.STATION7	IT	216485	6/1/2000	ES	8270	2,4-Dimethylphenol	0.2	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	4-Methylphenol	0.2	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	1,4-Dichlorobenzene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Phenol	0.03	J	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	bis(2-Ethylhexyl)phthalate	0.2	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Di-n-octylphthalate	0.02	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Hexachlorobenzene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Anthracene	0.001	J	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	1,2,4-Trichlorobenzene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Pyrene	0.029		wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Dimethylphthalate	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Dibenzofuran	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Benzo(g,h,i)perylene	0.008	J	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Indeno(1,2,3-cd)pyrene	0.02	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Benzo(b)fluoranthene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Fluoranthene	0.011		wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Benzo(k)fluoranthene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Acenaphthylene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Chrysene	0.01	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION7	IT	215496	5/7/1996	ES	6010	Copper	1.66		wet
S.STATION7	IT	215496	5/7/1996	ES	6010	Zinc	15		wet
S.STATION7	IT	215496	5/7/1996	ES	7131	Cadmium	0.25		wet
S.STATION7	IT	215496	5/7/1996	ES	7197	Hexavalent Chromium	6.5		wet
S.STATION7	IT	215496	5/7/1996	ES	7471	Mercury	0.01		wet
S.STATION7	IT	216485	6/1/2000	ES	9012	Cyanide	0.1386	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Benzyl alcohol	0.14		wet
S.STATION7	IT	216485	6/1/2000	ES	8270	2,4-Dimethylphenol	0.2	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	4-Methylphenol	0.2	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	1,4-Dichlorobenzene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Phenol	0.03	J	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	bis(2-Ethylhexyl)phthalate	0.2	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Di-n-octylphthalate	0.02	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Hexachlorobenzene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Anthracene	0.001	J	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	1,2,4-Trichlorobenzene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Pyrene	0.029		wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Dimethylphthalate	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Dibenzofuran	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Benzo(g,h,i)perylene	0.008	J	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Indeno(1,2,3-cd)pyrene	0.02	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Benzo(b)fluoranthene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Fluoranthene	0.011		wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Benzo(k)fluoranthene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Acenaphthylene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Chrysene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Benzo(a)pyrene	0.01	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION7	IT	216485	6/1/2000	ES	8270	Dibenz(a,h)anthracene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	1,3-Dichlorobenzene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Benzo(a)anthracene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Acenaphthene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Diethylphthalate	0.002	J	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Di-n-butylphthalate	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Phenanthrene	0.008	J	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Butylbenzylphthalate	1.00%	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	N-Nitrosodiphenylamine	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Fluorene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Hexachlorobutadiene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Pentachlorophenol	0.3	UJ	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Naphthalene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	2-Methylnaphthalene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	2-Methylphenol	0.1	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	1,2-Dichlorobenzene	0.01	U	wet
S.STATION7	IT	216485	6/1/2000	ES	8270	Benzoic acid	10		wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Aluminum	40.04	J	wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Iron	64.372		wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Magnesium	756.14	J	wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Potassium	2310	J	wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Sodium	5159	J	wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Chromium	0.6006		wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Zinc	14.3682		wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Calcium	1236.62		wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Lead	0.05544	J	wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Manganese	1.848		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION7	IT	216485	6/1/2000	ES	6010	Nickel	0.46662	J	wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Silver	0.14014		wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Thallium	0.00154	UJ	wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Antimony	0.00308	UJ	wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Arsenic	2.5256		wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Barium	0.21252	J	wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Beryllium	0.00308	UJ	wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Cadmium	0.19096	J	wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Cobalt	0.11088	J	wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Copper	1.49534	J	wet
S.STATION7	IT	216485	6/1/2000	ES	6010	Vanadium	0.2233	J	wet
S.STATION7	IT	216485	6/1/2000	ES	7471	Mercury	0.01386		wet
S.STATION7	IT	216485	6/1/2000	ES	7740	Selenium	0.5082		wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Phenol	0.054	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	1,3-Dichlorobenzene	0.005	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	1,4-Dichlorobenzene	0.0054	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	1,2-Dichlorobenzene	0.005	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Benzyl alcohol	0.048		wet
S.STATION7	IT	229128	6/3/2004	ES	8270	2-Methylphenol	0.1		wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Hexachloroethane	0.005	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	4-Methylphenol	0.028	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	2,4-Dimethylphenol	0.042	UJ	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	1,2,4-Trichlorobenzene	0.0048	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Naphthalene	0.004	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Hexachlorobutadiene	0.0052	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	2-Methylnaphthalene	0.004	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Acenaphthylene	0.0052	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION7	IT	229128	6/3/2004	ES	8270	Dimethylphthalate	0.0053	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Acenaphthene	0.0045	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Dibenzofuran	0.0053	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Fluorene	0.006	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Diethylphthalate	0.034	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	N-Nitrosodiphenylamine	0.0095	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Hexachlorobenzene	0.0055	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Pentachlorophenol	0.091	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Phenanthrene	0.005	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Anthracene	0.0047	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Di-n-butylphthalate	0.04	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Fluoranthene	0.0067	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Pyrene	0.0082	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Butylbenzylphthalate	0.019	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Benzo(a)anthracene	0.0055	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Chrysene	0.0028	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	bis(2-Ethylhexyl)phthalate	0.14	UJ	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Di-n-octylphthalate	0.007	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Benzo(b)fluoranthene	0.0035	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Benzo(k)fluoranthene	0.0034	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Benzo(a)pyrene	0.0034	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Indeno(1,2,3-cd)pyrene	0.0031	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Dibenz(a,h)anthracene	0.006	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Benzo(g,h,i)perylene	0.0053	U	wet
S.STATION7	IT	229128	6/3/2004	ES	8270	Benzoic acid	6.5	J	wet
S.STATION7	IT	229128	6/3/2004	ES	6010	Chromium	0.2826		wet
S.STATION7	IT	229128	6/3/2004	ES	6010	Aluminum	35.953		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION7	IT	229128	6/3/2004	ES	6010	Calcium	745.75	J	wet
S.STATION7	IT	229128	6/3/2004	ES	6010	Iron	57.305		wet
S.STATION7	IT	229128	6/3/2004	ES	6010	Magnesium	769.3	J	wet
S.STATION7	IT	229128	6/3/2004	ES	6010	Potassium	2339.3	J	wet
S.STATION7	IT	229128	6/3/2004	ES	6010	Sodium	5259.5	J	wet
S.STATION7	IT	229128	6/3/2004	ES	6010	Vanadium	0.1099	J	wet
S.STATION7	IT	229128	6/3/2004	ES	6020	Arsenic	2.4806		wet
S.STATION7	IT	229128	6/3/2004	ES	6020	Beryllium	0.001099	UJ	wet
S.STATION7	IT	229128	6/3/2004	ES	6020	Lead	0.074732		wet
S.STATION7	IT	229128	6/3/2004	ES	6020	Nickel	0.42704		wet
S.STATION7	IT	229128	6/3/2004	ES	6020	Zinc	13.8474		wet
S.STATION7	IT	229128	6/3/2004	ES	6020	Antimony	0.001884	UJ	wet
S.STATION7	IT	229128	6/3/2004	ES	6020	Barium	0.25905	J	wet
S.STATION7	IT	229128	6/3/2004	ES	6020	Cadmium	1.31252		wet
S.STATION7	IT	229128	6/3/2004	ES	6020	Cobalt	0.087292		wet
S.STATION7	IT	229128	6/3/2004	ES	6020	Copper	1.27484		wet
S.STATION7	IT	229128	6/3/2004	ES	6020	Manganese	1.50092		wet
S.STATION7	IT	229128	6/3/2004	ES	6020	Silver	0.62643		wet
S.STATION7	IT	229128	6/3/2004	ES	6020	Thallium	0.000942	J	wet
S.STATION7	IT	229128	6/3/2004	ES	7471	Mercury	0.01727		wet
S.STATION7	IT	229128	6/3/2004	ES	7740	Selenium	0.4867	U	wet
S.STATION8	IT	215497	5/7/1996	ES	8270	Fluoranthene	0.012		wet
S.STATION8	IT	215497	5/7/1996	ES	8270	Benzoic acid	1.8	J	wet
S.STATION8	IT	215497	5/7/1996	ES	6010	Nickel	1.3		wet
S.STATION8	IT	215497	5/7/1996	ES	6010	Silver	0.49		wet
S.STATION8	IT	215497	5/7/1996	ES	6010	Chromium	2.2		wet
S.STATION8	IT	215497	5/7/1996	ES	6010	Copper	1.53		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION8	IT	215497	5/7/1996	ES	6010	Zinc	11.1		wet
S.STATION8	IT	215497	5/7/1996	ES	7131	Cadmium	0.22		wet
S.STATION8	IT	215497	5/7/1996	ES	7197	Hexavalent Chromium	4		wet
S.STATION8	IT	215497	5/7/1996	ES	7421	Lead	0.21		wet
S.STATION8	IT	215497	5/7/1996	ES	7471	Mercury	0.01		wet
S.STATION8	IT	216487	6/2/2000	ES	9012	Cyanide	0.1323	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Benzyl alcohol	0.22		wet
S.STATION8	IT	216487	6/2/2000	ES	8270	2,4-Dimethylphenol	0.2	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	4-Methylphenol	0.2	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	1,4-Dichlorobenzene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Phenol	0.24		wet
S.STATION8	IT	216487	6/2/2000	ES	8270	bis(2-Ethylhexyl)phthalate	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Di-n-octylphthalate	0.02	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Hexachlorobenzene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Anthracene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	1,2,4-Trichlorobenzene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Pyrene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Dimethylphthalate	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Dibenzofuran	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Benzo(g,h,i)perylene	0.02	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Indeno(1,2,3-cd)pyrene	0.02	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Benzo(b)fluoranthene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Fluoranthene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Benzo(k)fluoranthene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Acenaphthylene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Chrysene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Benzo(a)pyrene	0.01	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION8	IT	216487	6/2/2000	ES	8270	Dibenz(a,h)anthracene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	1,3-Dichlorobenzene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Benzo(a)anthracene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Acenaphthene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Diethylphthalate	0.02	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Di-n-butylphthalate	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Phenanthrene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Butylbenzylphthalate	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	N-Nitrosodiphenylamine	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Fluorene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Hexachlorobutadiene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Pentachlorophenol	30.00%	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Naphthalene	0.002	J	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	2-Methylnaphthalene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	2-Methylphenol	0.1	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	1,2-Dichlorobenzene	0.01	U	wet
S.STATION8	IT	216487	6/2/2000	ES	8270	Benzoic acid	10		wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Aluminum	44.982	J	wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Iron	64.827		wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Magnesium	724.71	J	wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Potassium	2146.2	J	wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Sodium	4968.6	J	wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Chromium	0.4851		wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Zinc	13.7445		wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Calcium	940.8		wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Lead	0.06027	J	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION8	IT	216487	6/2/2000	ES	6010	Manganese	1.8228		wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Nickel	0.41307	J	wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Silver	0.12495		wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Thallium	0.00147	UJ	wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Antimony	0.00294	UJ	wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Arsenic	2.8665		wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Barium	0.21168	J	wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Beryllium	0.00294	UJ	wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Cadmium	0.31164	UJ	wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Cobalt	0.11025	J	wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Copper	1.34946	J	wet
S.STATION8	IT	216487	6/2/2000	ES	6010	Vanadium	0.16905	J	wet
S.STATION8	IT	216487	6/2/2000	ES	7471	Mercury	0.0147		wet
S.STATION8	IT	216487	6/2/2000	ES	7740	Selenium	0.4998		wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Phenol	0.054	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	1,3-Dichlorobenzene	0.005	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	1,4-Dichlorobenzene	0.0054	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	1,2-Dichlorobenzene	0.005	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Benzyl alcohol	0.12		wet
S.STATION8	IT	229130	6/3/2004	ES	8270	2-Methylphenol	0.059	J	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Hexachloroethane	0.005	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	4-Methylphenol	0.028	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	2,4-Dimethylphenol	0.042	UJ	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Benzoic acid	1.7	J	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	1,2,4-Trichlorobenzene	0.0048	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Naphthalene	0.004	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Hexachlorobutadiene	0.0052	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION8	IT	229130	6/3/2004	ES	8270	2-Methylnaphthalene	0.004	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Acenaphthylene	0.0052	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Dimethylphthalate	0.0053	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Acenaphthene	0.0045	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Dibenzofuran	0.0053	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Fluorene	0.006	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Diethylphthalate	0.034	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	N-Nitrosodiphenylamine	0.0095	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Hexachlorobenzene	0.0055	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Pentachlorophenol	0.091	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Phenanthrene	0.005	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Anthracene	0.0047	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Di-n-butylphthalate	0.04	UJ	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Fluoranthene	0.0067	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Pyrene	0.0082	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Butylbenzylphthalate	0.019	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Benzo(a)anthracene	0.0055	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Chrysene	0.0028	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	bis(2-Ethylhexyl)phthalate	0.14	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Di-n-octylphthalate	0.007	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Benzo(b)fluoranthene	0.0035	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Benzo(k)fluoranthene	0.0034	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Benzo(a)pyrene	0.0034	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Indeno(1,2,3-cd)pyrene	0.0031	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Dibenz(a,h)anthracene	0.006	U	wet
S.STATION8	IT	229130	6/3/2004	ES	8270	Benzo(g,h,i)perylene	0.0053	U	wet
S.STATION8	IT	229130	6/3/2004	ES	6010	Chromium	0.5053		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION8	IT	229130	6/3/2004	ES	6010	Aluminum	42.543		wet
S.STATION8	IT	229130	6/3/2004	ES	6010	Calcium	785.66	J	wet
S.STATION8	IT	229130	6/3/2004	ES	6010	Iron	69.275		wet
S.STATION8	IT	229130	6/3/2004	ES	6010	Magnesium	790.55	J	wet
S.STATION8	IT	229130	6/3/2004	ES	6010	Potassium	2396.1	J	wet
S.STATION8	IT	229130	6/3/2004	ES	6010	Sodium	5330.1	J	wet
S.STATION8	IT	229130	6/3/2004	ES	6010	Vanadium	0.163	J	wet
S.STATION8	IT	229130	6/3/2004	ES	6020	Arsenic	2.3472		wet
S.STATION8	IT	229130	6/3/2004	ES	6020	Beryllium	0.001141	UJ	wet
S.STATION8	IT	229130	6/3/2004	ES	6020	Lead	0.076284		wet
S.STATION8	IT	229130	6/3/2004	ES	6020	Nickel	0.48085		wet
S.STATION8	IT	229130	6/3/2004	ES	6020	Zinc	13.7246		wet
S.STATION8	IT	229130	6/3/2004	ES	6020	Antimony	0.002119	UJ	wet
S.STATION8	IT	229130	6/3/2004	ES	6020	Barium	0.27873	J	wet
S.STATION8	IT	229130	6/3/2004	ES	6020	Cadmium	1.57295		wet
S.STATION8	IT	229130	6/3/2004	ES	6020	Cobalt	0.103179		wet
S.STATION8	IT	229130	6/3/2004	ES	6020	Copper	1.1736		wet
S.STATION8	IT	229130	6/3/2004	ES	6020	Manganese	1.7115		wet
S.STATION8	IT	229130	6/3/2004	ES	6020	Silver	0.326		wet
S.STATION8	IT	229130	6/3/2004	ES	6020	Thallium	0.000978	J	wet
S.STATION8	IT	229130	6/3/2004	ES	7471	Mercury	0.0163		wet
S.STATION8	IT	229130	6/3/2004	ES	7740	Selenium	0.5542	U	wet
S.STATION9	IT	215498	5/7/1996	ES	8270	Fluoranthene	0.021	J	wet
S.STATION9	IT	215498	5/7/1996	ES	8270	Benzoic acid	2.7	J	wet
S.STATION9	IT	215499	5/7/1996	FD	6010	Nickel	1.9		wet
S.STATION9	IT	215499	5/7/1996	FD	6010	Chromium	3.24		wet
S.STATION9	IT	215498	5/7/1996	ES	6010	Silver	0.37		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION9	IT	215498	5/7/1996	ES	6010	Copper	1.64		wet
S.STATION9	IT	215498	5/7/1996	ES	6010	Zinc	14		wet
S.STATION9	IT	215498	5/7/1996	ES	7131	Cadmium	0.22		wet
S.STATION9	IT	215498	5/7/1996	ES	7197	Hexavalent Chromium	5.9		wet
S.STATION9	IT	215498	5/7/1996	ES	7471	Mercury	0.01		wet
S.STATION9	IT	216489	6/2/2000	ES	9012	Cyanide	0.1359	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Benzyl alcohol	0.12		wet
S.STATION9	IT	216489	6/2/2000	ES	8270	2,4-Dimethylphenol	0.2	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	4-Methylphenol	0.2	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	1,4-Dichlorobenzene	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Phenol	0.23		wet
S.STATION9	IT	216489	6/2/2000	ES	8270	bis(2-Ethylhexyl)phthalate	0.2	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Di-n-octylphthalate	0.02	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Hexachlorobenzene	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Anthracene	0.003	J	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	1,2,4-Trichlorobenzene	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Pyrene	0.01	J	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Dimethylphthalate	0.002	J	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Dibenzofuran	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Benzo(g,h,i)perylene	0.02	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Indeno(1,2,3-cd)pyrene	0.02	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Benzo(b)fluoranthene	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Fluoranthene	0.01	J	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Benzo(k)fluoranthene	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Acenaphthylene	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Chrysene	0.01	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION9	IT	216489	6/2/2000	ES	8270	Benzo(a)pyrene	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Dibenz(a,h)anthracene	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	1,3-Dichlorobenzene	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Benzo(a)anthracene	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Acenaphthene	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Diethylphthalate	0.008	J	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Di-n-butylphthalate	0.005	J	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Phenanthrene	0.007	J	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Butylbenzylphthalate	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	N-Nitrosodiphenylamine	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Fluorene	0.002	J	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Hexachlorobutadiene	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Pentachlorophenol	0.3	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Naphthalene	0.002	J	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	2-Methylnaphthalene	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	2-Methylphenol	0.1	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	1,2-Dichlorobenzene	0.01	U	wet
S.STATION9	IT	216489	6/2/2000	ES	8270	Benzoic acid	11		wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Aluminum	49.528	J	wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Iron	72.48		wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Magnesium	755	J	wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Potassium	2159.3	J	wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Sodium	5224.6	J	wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Chromium	0.7097		wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Zinc	13.9373		wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Calcium	943.75		wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Lead	0.06493	J	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION9	IT	216489	6/2/2000	ES	6010	Manganese	1.8724		wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Nickel	0.53605	J	wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Silver	0.20083		wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Thallium	0.15%	UJ	wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Antimony	0.00302	UJ	wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Arsenic	2.5066		wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Barium	0.24009	J	wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Beryllium	0.00302	UJ	wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Cadmium	0.2416	J	wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Cobalt	0.12231	J	wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Copper	1.33937	J	wet
S.STATION9	IT	216489	6/2/2000	ES	6010	Vanadium	0.20234	J	wet
S.STATION9	IT	216489	6/2/2000	ES	7471	Mercury	0.0151		wet
S.STATION9	IT	216489	6/2/2000	ES	7740	Selenium	0.4379		wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Phenol	0.054	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	1,3-Dichlorobenzene	0.005	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	1,4-Dichlorobenzene	0.0054	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	1,2-Dichlorobenzene	0.005	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Benzyl alcohol	0.027	J	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	2-Methylphenol	0.091		wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Hexachloroethane	0.005	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	4-Methylphenol	0.028	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	2,4-Dimethylphenol	0.042	UJ	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	1,2,4-Trichlorobenzene	0.0048	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Naphthalene	0.004	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Hexachlorobutadiene	0.0052	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	2-Methylnaphthalene	0.004	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION9	IT	229132	6/3/2004	ES	8270	Acenaphthylene	0.0052	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Dimethylphthalate	0.0053	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Acenaphthene	0.0045	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Dibenzofuran	0.0053	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Fluorene	0.006	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Diethylphthalate	0.034	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	N-Nitrosodiphenylamine	0.0095	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Hexachlorobenzene	0.0055	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Pentachlorophenol	0.091	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Phenanthrene	0.0055	J	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Anthracene	0.0047	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Di-n-butylphthalate	0.04	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Fluoranthene	0.0067	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Pyrene	0.0082	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Butylbenzylphthalate	0.019	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Benzo(a)anthracene	0.0055	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Chrysene	0.0028	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	bis(2-Ethylhexyl)phthalate	0.14	UJ	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Di-n-octylphthalate	0.007	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Benzo(b)fluoranthene	0.0035	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Benzo(k)fluoranthene	0.0034	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Benzo(a)pyrene	0.0034	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Indeno(1,2,3-cd)pyrene	0.0031	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Dibenz(a,h)anthracene	0.006	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Benzo(g,h,i)perylene	0.0053	U	wet
S.STATION9	IT	229132	6/3/2004	ES	8270	Benzoic acid	4.2	J	wet
S.STATION9	IT	229132	6/3/2004	ES	6010	Chromium	0.1956		wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Location	Location Type	Field Sample Number	Sample Date	Sample Type	Method	Analyte	Value (mg/kg)	Data Qualifier	Weight Type
S.STATION9	IT	229132	6/3/2004	ES	6010	Aluminum	30.481		wet
S.STATION9	IT	229132	6/3/2004	ES	6010	Calcium	652	J	wet
S.STATION9	IT	229132	6/3/2004	ES	6010	Iron	57.05		wet
S.STATION9	IT	229132	6/3/2004	ES	6010	Magnesium	780.77	J	wet
S.STATION9	IT	229132	6/3/2004	ES	6010	Potassium	2445	J	wet
S.STATION9	IT	229132	6/3/2004	ES	6010	Sodium	5248.6	J	wet
S.STATION9	IT	229132	6/3/2004	ES	6010	Vanadium	0.1141	J	wet
S.STATION9	IT	229132	6/3/2004	ES	6020	Arsenic	2.8036		wet
S.STATION9	IT	229132	6/3/2004	ES	6020	Beryllium	0.001141	UJ	wet
S.STATION9	IT	229132	6/3/2004	ES	6020	Lead	0.07172		wet
S.STATION9	IT	229132	6/3/2004	ES	6020	Nickel	0.59006		wet
S.STATION9	IT	229132	6/3/2004	ES	6020	Zinc	14.4581		wet
S.STATION9	IT	229132	6/3/2004	ES	6020	Antimony	0.00163	UJ	wet
S.STATION9	IT	229132	6/3/2004	ES	6020	Barium	0.22331	J	wet
S.STATION9	IT	229132	6/3/2004	ES	6020	Cadmium	0.65689		wet
S.STATION9	IT	229132	6/3/2004	ES	6020	Cobalt	0.107417		wet
S.STATION9	IT	229132	6/3/2004	ES	6020	Copper	1.02853		wet
S.STATION9	IT	229132	6/3/2004	ES	6020	Manganese	1.50612		wet
S.STATION9	IT	229132	6/3/2004	ES	6020	Silver	0.48411		wet
S.STATION9	IT	229132	6/3/2004	ES	6020	Thallium	0.000815	J	wet
S.STATION9	IT	229132	6/3/2004	ES	7471	Mercury	0.01956		wet
S.STATION9	IT	229132	6/3/2004	ES	7740	Selenium	0.6683	U	wet

Table D2 (Continued)
Analytical Results for Shellfish Tissue Samples

Notes:
ES - environmental sample
FD - field duplicate
IT - intertidal
J - The result is an estimated concentration that is less than the method reporting limit (MRL), but greater than or equal to the method detection limit (MDL).
U - The compound was analyzed for, but was not detected ("nondetect") at or above the MRL/MDL.