



Public Health Assessment for

**BREMERTON NAVAL COMPLEX
INCLUDING PUGET SOUND NAVAL SHIPYARD
BREMERTON, KITSAP COUNTY, WASHINGTON
EPA FACILITY ID: WA2170023418
SEPTEMBER 16, 2005**

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE**

Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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INCLUDING PUGET SOUND NAVAL SHIPYARD

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EPA FACILITY ID: WA2170023418

Prepared by:

Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the Superfund law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, the U.S. EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment process allows ATSDR scientists and public health assessment cooperative agreement partners flexibility in document format when presenting findings about the public health impact of hazardous waste sites. The flexible format allows health assessors to convey to affected populations important public health messages in a clear and expeditious way.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to evaluate possible the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who

live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the public comments that related to the document are addressed in the final version of the report.

Conclusions: The report presents conclusions about the public health threat posed by a site. Ways to stop or reduce exposure will then be recommended in the public health action plan. ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA or other responsible parties. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also recommend health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Manager, ATSDR Record Center Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E-60), Atlanta, GA 30333.

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LIST OF ABBREVIATIONS

ATSDR	Agency for Toxic Substances and Disease Registry
BEHP	Bis(2-ethylhexyl)phthalate
BNC	Bremerton Naval Complex
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CREG	Cancer risk evaluation guide (ATSDR)
CV	Comparison value
DRMO	Defense Reutilization Marketing Office
Ecology	Washington State Department of Ecology
EMEG	Environmental media evaluation guide (ATSDR)
EPA	U.S. Environmental Protection Agency
FISC	Fleet Industrial Supply Center
MCL	EPA's maximum contaminant level
MRL	ATSDR's minimal risk level
NBK	Naval Base Kitsap
NEESA	Naval Energy and Environmental Support Activity
NPL	National Priorities List
NSC	Naval Supply Command
OU	Operable unit
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
ppb	Parts per billion
ppm	Parts per million
PSNS & IMF	Puget Sound Naval Shipyard and Intermediate Maintenance Facility
RBC	Risk-based concentration (EPA)
RfD	Reference dose (EPA)
RMEG	Reference media evaluation guide (ATSDR)
SVOC	Semivolatile organic compound
TPH	Total petroleum hydrocarbons
URS	The URS Team contractors for the Navy
VOC	Volatile organic compound
WDOH	Washington Department of Health

I SUMMARY

The Agency for Toxic Substances and Disease Registry (ATSDR) prepared this public health assessment (PHA) to evaluate possible contaminant exposures resulting from activities related to Bremerton Naval Complex (BNC). The complex comprises Puget Sound Naval Shipyard and Intermediate Maintenance Facility (PSNS & IMF) and Naval Base Kitsap (NBK) Bremerton, previously referred to as Naval Station Bremerton (NSB). In May 2003, PSNS merged with the Naval Intermediate Maintenance Facility Northwest and is now called PSNS & IMF. PSNS & IMF is located in the northwest corner of Washington State, on the western shore of Puget Sound.

PSNS and NBK Bremerton were contiguous properties jointly listed on the U.S. Environmental Protection Agency's (EPA's) National Priorities List (NPL) in 1994 as a result of contamination identified during early environmental investigations. Although this site was originally listed as "PSNS" it is currently included under the EPA Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) designated site name of Bremerton Naval Complex. The entire area covered by BNC, which includes both PSNS and NBK Bremerton, occupies 409 acres of upland and approximately 1,000 acres of off-site railroad acreage and submerged land. BNC borders the largest community in Kitsap County, the city of Bremerton, and is situated on the northern side of Sinclair Inlet, adjacent to the downtown Bremerton area.

The facility began in September 1891 when the Navy constructed it as the first naval installation in the region on 190 acres of land. The overall mission of the installation has been to provide logistic support for assigned ships and service craft, perform authorized work in connection with specified activities (i.e., construction, conversion, overhaul, repair, alteration, dry-docking, and outfitting of ships), and to provide services and materials to other activities and units. The shipyard also provides refueling and defueling services for the naval fleet. The shipyard provides ship and submarine maintenance, modernization, repair, inactivation and recycling, and technical and logistics support. In the past, industrial wastes were disposed of at BNC using practices that were acceptable at the time before establishment of stricter environmental regulations. During the earlier years of operation, BNC released industrial wastes directly into Sinclair Inlet by way of a combined sanitary and storm sewer. Although direct discharge of pollutants into Sinclair Inlet no longer occurs, it is likely that historical releases from shipyard activities were a significant source of contamination for portions of the inlet. Previous Navy investigations identified several areas of contamination, initially designated as site areas and later reorganized into operable units. BNC currently has six operable units (OUs).

ATSDR evaluated information from environmental investigations associated with areas of contamination identified at BNC as well as independent studies evaluating water quality, sediments, and marine organisms within Sinclair Inlet. ATSDR identified two situations under which people could contact site-related contaminants.

1. Past, current, and future exposure from eating contaminated fish or shellfish from Sinclair Inlet.

ATSDR concludes that in Sinclair Inlet locations outside the BNC boundary, some people may have been exposed in the past to contaminants from eating bottom dwelling species of fish (e.g., flounder, rockfish, and sole) and shellfish. Chemical contaminants in most fish species within Sinclair Inlet have not been detected at levels that would result in illness or harm. However, English sole and other marine tissues such as rockfish, sea cucumbers, and mussels have the potential to accumulate compounds such as polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) and metals such as arsenic and mercury from contaminated sediments.

As a result of pollutants from BNC and other point sources such as municipal waste treatment facilities, harvesting of commercial and recreational shellfish from Sinclair Inlet has been prohibited since 1982, primarily due to bacteriological contamination resulting from untreated or partially treated sewage releases. Advisories are also posted warning people to avoid eating rockfish, crab, and all bottom fish because of the potential for chemical contamination. Despite fishing advisories, it is possible that subsistence populations who rely heavily on certain bottom dwelling species of fish or shellfish from Sinclair Inlet could be more highly exposed. A review of the toxicological literature does not indicate that the levels detected in these species, applying site-specific ingestion rates, would likely cause illness or harm to people. However, in keeping with ATSDR's objective of minimizing all chemical exposures, continuous long-term monitoring of shellfish and bottom fish, especially edible species that have not been previously sampled, should be required before commercial or recreational shellfish and bottom fish harvesting in Sinclair Inlet is permitted. ATSDR evaluated exposure levels for subsistence fishing and determined that eating subsistence amounts of salmon do not pose a health threat.

Although current levels of fecal coliform and other biological (microbial) contamination within Sinclair Inlet would pose a public health hazard if shellfish were consumed, there is no evidence that people are routinely harvesting shellfish from this area. Until state and county health officials remove the advisories that are currently in place, shellfish should not be consumed from any portion of Sinclair Inlet.

2. Future exposure from contact with surface soils within OU-D

Operable Unit (OU) - D comprises 5.3 acres of land located in the eastern most portion of BNC. As part of its economic development and revitalization plan, the city of Bremerton has received funding to develop approximately 2.8 acres of the Navy-owned property that is adjacent to Bremerton's ferry terminal. ATSDR evaluated the potential of future exposures to contaminated soil at OU-D because of proposed changes in land use that may result in people having access to formerly restricted areas. A review of data from a recent OU- D investigation identified low levels of contamination in soil that are below levels known to cause illness or health problems. ATSDR concludes that exposures to site-related contaminants at OU- D do not pose a future public health hazard.

II BACKGROUND

Site Description and Operational History

Puget Sound Naval Shipyard and Intermediate Maintenance Facility (PSNS & IMF) is located in the northwest corner of Washington State, on the western shore of Puget Sound (Figure 1). PSNS & IMF was originally referred to as PSNS. PSNS and Naval Base Kitsap (NBK) Bremerton; previously referred to as Naval Station Bremerton (NSB), were contiguous properties jointly listed on EPA's National Priorities List in 1994 because of contamination identified during early environmental investigations. NBK Bremerton was part of PSNS until 1998, when a separate command was established for NBK Bremerton (D. Ginn, Remedial Project Manager, EFANW. Personal Communication, April 6, 2004). Although this site was originally listed as PSNS, both PSNS and NBK Bremerton are included under the EPA Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) designated site name of "Bremerton Naval Complex" (BNC). For purposes of consistency, this report refers to PSNS & IMF and NBK Bremerton simply as BNC, unless it is in reference to past information that is specific to one of the commands (e.g., when reporting demographic information or past site activities, we will refer to the designated name referenced in the source report).

BNC occupies 409 acres of upland and approximately 1,000 acres of off-site railroad acreage and submerged land. The largest population center in close proximity to BNC is Seattle, located approximately 11 miles east of Bremerton (NEESA 1983; URS 2002a). The facility, which borders the largest community in Kitsap County, the city of Bremerton, is situated on the northern side of Sinclair Inlet adjacent to the downtown Bremerton area. Kitsap County, which encompasses the northern portion of Kitsap Peninsula, has over 200 miles of shoreline. Deep, sheltered inlets and embankments, and numerous natural harbors are evident along this shoreline (NEESA 1983).

BNC is occupied by two separate Navy organizations: 1) PSNS & IMF, which is under the Naval Sea Systems Command; and 2) Naval Base Kitsap (NBK) Bremerton, which is under the Navy Region Northwest Command. The Fleet Industrial Supply Center (FISC) is a tenant of NBK Bremerton and occupies an area in the center of the complex; it was designated Operable Unit (OU) NSC under the Navy's Installation Restoration (IR) program. BNC comprises three distinct areas:

1. *Puget Sound Naval Shipyard and Intermediate Maintenance Facility (PSNS & IMF)* This area occupies approximately 179 acres of land and represents most of the upland portion within BNC. PSNS & IMF are under the Naval Sea Systems Command.
2. *Fleet and Industrial Supply Center (FISC)* The land area of FISC is approximately 28 acres and is entirely surrounded by PSNS & IMF, but functions as a separate facility and is a tenant command within NBK Bremerton.
3. *The Naval Inactive Ship Maintenance Office (NISMO)* This was formerly called The Naval Inactive Ship Maintenance Facility (NISMF), and it is a tenant command within NBK Bremerton. Vessels under NISMOs control are primarily located at Mooring G, F, and E. The areas utilized by NISMO are primarily within OU- B (marine and terrestrial) (see Remedial and Regulatory History for description of OUs).

In September 1891, the Navy purchased 190 acres of land on Sinclair Inlet for construction of a ship dry-docking, repair, and overhaul facility. During this time, the region's first naval installation was activated and designated the Puget Sound Naval Station. In 1901, the naval station increased its support facilities and was renamed Puget Sound Naval Yard (PSNY) (URS 2002b). PSNY underwent a major expansion during World War II, including additional shore facilities, the construction of two new piers, and construction of Drydocks 4 and 5 (U.S. Navy 2000). In November 1945, the PSNY was renamed PSNS (URS 2002b). In May 2003, PSNS and IMF merged into a single maintenance organization named PSNS & IMF.

BNC's mission is to provide logistic support for assigned ships and service craft, perform authorized work in connection with specified activities (i.e., construction, conversion, overhaul, repair, alteration, dry-docking, and outfitting of ships), and to provide services and materials to other activities and units. The shipyard contributes to the building, repairing, overhauling, converting, inactivating, decommissioning, and outfitting of ships. These services include ordnance and electronics equipment installations, repairs and modification, and related special manufacturing. The shipyard also provides refueling and defueling services for the naval nuclear fleet (NEESA 1983).

Ships have not been constructed at BNC since the early 1970s. Instead, the shipyard engages in ship and submarine maintenance, modernization, repair, inactivation and recycling, and technical and logistics support. BNC facilities include six major piers, six large dry-docks, and more than 100 major buildings (URS 2002a). There is no evidence that use of outdoor large munitions firing ranges, ordnance manufacturing, or renovation of explosive items ever occurred at BNC. The total quantity of ordnance at the Bremerton Naval Complex was and is limited to less than 2,000 pounds. Explosives were used during dredging operations in 1928. However, ordnance was not used in more recent dredging operations (URS 2004).

FISC, originally designated the Naval Supply Command (NSC), was established in 1967 and was responsible for providing a variety of regional supply and support services for Navy activities (URS 1995). The Defense Reutilization Marketing Office (DRMO), which predated FISC, was situated within the confines of FISC and had been in operation at this location since the early 1900s. In 1998 the DRMO and its associated activities were relocated to the Industrial Fill Area (Site 1) (URS 1995).

Bremerton Naval Complex consists of the following major functional areas:

Controlled Industrial Area— a fenced, high-security area in which the bulk of shipyard production takes place. PSNS & IMF has six drydocks, seven piers, and numerous industrial shops to support its activities.

Military Support Area — the upland portion of BNC with facilities to provide a wide range of services to military personnel, (for example, housing, retail goods and services, recreation, counseling, dental care, and some minor industrial support functions such as petroleum-based fuel storage and the apprentice school).

Industrial Support Area — an area in the western shipyard with facilities to provide an assortment of industrial support functions including power plant, warehousing, steel yard, public works shops, and parking (URS 2002a; U.S. Navy 2003).

Industrial operations (e.g., machine, electrical, boilermaker, electronics, and paint shops) reportedly generated more than 100 gallons of waste per month in the early 1970s. Other waste generators or potential sources included print and photo shops, pesticide applications, the transportation department, fuel farms, firefighting, incinerators, and dental facilities. Most of these are active operations that continue to generate wastes at BNC and are regulated by law (URS 2004).

Radiological and very limited ordnance operations were also conducted in the past at the shipyard. Ordnance operations no longer occur at BNC; however, radiological operations are ongoing. No ordnance material disposal operation has ever been performed in the shipyard. Radiological operations include removing items from ships and nuclear-powered submarines that contained radioactive materials such as radioluminescent dials, electron tubes and other electronic radar devices, as well as nuclear fuel rods from submarines. Radioactive contamination has not been identified as a concern at this facility. All radioactive waste materials are and have been disposed of at approved off-site locations (Tetra Tech 1988).

Remedial and Regulatory History

During the early 1900s, the terrestrial land area at BNC was expanded significantly by upland filling with soils, dredged sediments, and construction debris. Some of the fill was later determined to contain hazardous substances such as sandblasting grit, copper slag, and other industrial materials (URS 2002b). Additionally, industrial wastes were disposed of at BNC using practices that were acceptable at the time before stricter environmental regulations were enacted. As required by the Navy Assessment and Control of Installation Pollutants program, an Initial Assessment Study (IAS) was released in March 1983. As part of the IAS process, the Navy collected and evaluated information on past operations at the shipyard, and six potentially contaminated areas were identified and investigated (NEESA 1983).

A Listing Site Inspection was conducted at BNC from October 1990 to April 1991. The main objective of the inspection was to collect sufficient data to characterize the areas of contamination and provide sufficient information for EPA to decide whether it should be listed on the agency's National Priorities List (NPL), which is part of Superfund. As a result of the LSI, EPA determined that the disposal of wastes and placement of contaminated fill during shipyard expansion combined with the potential impacts of the marine environment from contaminant migration warranted BNC being designated an NPL site and was added to the NPL on May 31, 1994 (URS 1996).

The Department of the Navy, the Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology) signed an interagency agreement in August 1998 (US Navy 1998). Previous Navy investigations identified several areas of contamination, initially designated as site areas and later reorganized into operable units. The interagency agreement between the Navy, EPA, and Ecology separates the investigations within OU-B into marine and terrestrial; however, they consider OU-B one administrative OU-and, therefore, divide BNC into five OUs rather than six. (Figure 2):

OU-A - This is a 12-acre area of filled land that was divided into three zones during the remedial investigation/feasibility study (RI/FS) process. All three zones contain parking lots and Zone II was the site of a former helicopter pad.

OU-B (Terrestrial) - The terrestrial portion of OU- B contains much of the land area within the BNC boundary except for OU- A, OU- NSC, and the Military Support Area in the northern section of BNC. OU- B Terrestrial is a flat mostly paved area that comprises most of the industrial activities at BNC, including all six drydocks.

OU-B (Marine) - This OU contains all the near shore marine environment associated with BNC extending east and west along the shorelines of OUs A, B, and NSC. This OU consists of approximately 270 acres of sub-tidal land.

OU-C - This area is located in the north-central portion of BNC. Petroleum storage tanks (above ground and underground) were located at OU- C.

OU-D - This area, situated within OU- B Terrestrial, was the most recent OU designated at BNC. OU-D contains the portion of land that is proposed for transfer to the city of Bremerton and used for recreational purposes. The remaining portion of OU-B Terrestrial will be maintained by BNC as industrial land.

OU-NSC (Naval Supply Center) - This is the portion of BNC currently referred to as the Fleet and Industrial Supply Center (FISC). This is an approximately 28-acre site created between 1900 and 1950 by continuously filling in tidelands. The current ground surface is flat and mostly paved.

Numerous remedial actions have occurred at BNC for terrestrial and marine sources of contamination since it was designated an NPL site. The Navy initiated a large-scale clean-up action in June 2000 for OU-B Marine. A confined aquatic disposal (CAD) pit was used as a capped repository for approximately 220,000 cubic yards of contaminated sediment from near-shore locations. Other smaller clean-up actions have occurred at various OUs, primarily to remove contaminated soils and to stabilize portions of the shoreline and prevent site-related contaminants from migrating into Sinclair Inlet. Additional descriptive information about waste disposal activities, environmental investigations, and clean-up actions at BNC's designated OUs is presented in Appendix A (URS 2002a; URS 2002b; BNC 2003).

ATSDR Involvement

ATSDR conducted an initial site visit at BNC in February 1994 to meet with BNC representatives and other federal, state, and local officials to identify any potential exposure pathways that need to be addressed immediately. During the visit, ATSDR toured the site and met with Navy personnel in support of its public health assessment for BNC.

ATSDR conducted another site visit to BNC on June 21 and 22, 2004 as follow-up to meet with state and federal regulators and BNC site personnel about the current status of the site, conduct a site visit, and review site documents needed to assist in preparing the PHA.

Demographics

The original inhabitants of the Port Madison Indian Reservation were primarily of the Suquamish Tribe (URS 1996). The Treaty of Point Elliott, signed in 1855, provides the Suquamish Tribe rights to use the marine waters of Puget Sound from the northern tip of Vashon Island to the Fraser River in Canada for fishing, harvesting shellfish, and exploring other interests in their habitat (e.g., using resources for ceremonial purposes). Despite concerns with water quality and habitat issues, tribal members continue to rely on fish and shellfish as a significant part of their diet. According to a recent fish consumption survey for the Suquamish Tribe, tribal members engage in subsistence, ceremonial, and commercial harvesting throughout the federally adjudicated usual and accustomed fishing grounds and stations (Suquamish Tribe 2000).

Kitsap County has a population of approximately 230,000 and has experienced relatively slow (about 3% annual) growth over the last 20 years (U.S. Census Bureau 1990; 2000). The largest minority population consists of Asian and Pacific Islanders, who comprise approximately 6% of the total population of Kitsap County. Figure 3 presents additional demographic information for residents within a 1-mile radius of BNC. The major population centers near BNC are Port Orchard, which is 2 miles southeast and across Sinclair Inlet, and the city of Bremerton, the largest city in the county, which surrounds BNC on three sides (URS 1996). According to the 2000 U.S. Census, the population of Bremerton is approximately 37,000, a small decline from the 1990 census.

Approximately 8,200 military personnel are stationed at BNC; approximately 600 additional personnel are stationed at NBK Bremerton. In addition to military personnel, BNC employs approximately 9,120 civilian workers and 8,500 civilian contractors. A total of 41 housing units are on BNC property. According to the most recent count (Spring 2004), 38 families live on site, which include a total of 133 total family members. No daycare facilities or schools on the Bremerton Naval Complex (A.Bazilwich, NBK Bremerton Environmental. Personal Communications, April 30, 2004). BNC contains a playground, skate park, and recreational area used by BNC residents. The recreational area is located in the upland portion of BNC, part of the military support area, and not in close proximity to any of the industrial operations.

Land Use, Topography, and Natural Resources

BNC is situated on the north side of the Sinclair Inlet along the southern portion of the Kitsap Peninsula. The area surrounding BNC is a mix of low-density residential areas along with forest, farms, and undeveloped land. The developed areas are mostly found in the city of Bremerton and surrounding unincorporated areas and along the shorelines. The Port Madison Indian Reservation consisting of nearly 7,500 acres is located on the Kitsap Peninsula, approximately 10 miles north-northeast of BNC.

In the late 1800s, the area mostly contained timber, marshes, and tidelands. The majority of Kitsap County remains relatively undeveloped and contains large areas of farmlands and forest. Current land use at BNC has not changed significantly since the shipyard was constructed in 1891(URS 1996).

The topography of the complex ranges from flat land at lower elevations (consisting of the industrial segment of the naval complex) to steep contours forming a plateau and rolling uplands.

Elevation at BNC ranges from sea level to 170 feet above mean sea level. The waterfront consists mainly of sea walls and riprap slopes along the shoreline to the east and west, and piers and dry-docks in the central portion of the complex (URS 2004).

The Sinclair Inlet shoreline has undergone considerable urban and industrial growth. In the past, the inlet was often used for commercial and recreational fishing and shellfish harvesting. However, recent tribal and angler concerns about contamination have reduced fishing activities. Sinclair Inlet has been closed to shellfish harvesting since 1982 primarily because of microbial contamination (URS 1996). The primary natural resource of commercial significance in the area other than Sinclair Inlet is timber (URS 1992).

Groundwater underneath BNC is not used, and no anticipated use is expected in the future. Data collected during the site investigation and the OU-B Remedial Investigation indicates that the groundwater is not a potable water source. Throughout most of the low-lying shoreline area at BNC, intruding seawater combines with the groundwater, producing a brackish mixture. BNC obtains water from the city of Bremerton's municipal water system (URS 2004).

The Bremerton Water Department supplies water to about 50,000 customers in the surrounding area as well as BNC. The city uses a combination of wells and surface water to provide water to its customers. Eighty percent of the city's water comes from the Casad Dam reservoir on the Union River. The remaining 20% is supplied from Anderson Creek reservoir and several deep, large-volume groundwater wells (URS 1992). Water from all sources is combined and tested before distribution. The shipyard uses a large portion (approximately 30%) of the total water supply. The surface water supplies used for drinking water are all up-stream and several miles from BNC (NEESA 1990). The Bremerton Water Department wells are located in the hills west of the city. Well number 2, 3, 7, & 8 are closest to BNC. These wells are located near Anderson Creek, about 1 mile east of the town of Gorst. Gorst is located about 2 miles Southwest of Site 3 (former Helicopter Pad) at BNC (NEESA 1990).

Many of the groundwater wells in Kitsap County are used for irrigation and for domestic, industrial, and public water supplies. Many private and public water wells lie just beyond the Bremerton urban area. Most local water wells are drilled into the Vashon Drift till formation. This is the primary aquifer used in the area. According to information from well logs compiled by the Washington Department of Ecology, there are only two water supply wells located within 1 mile of BNC; one located several hundred feet west of the western boundary and the other located about 0.5 mile north of BNC (Ecology 2003).

Approximately 95 miles of marine shoreline in Kitsap County are created by Puget Sound and Hood Canal. Sinclair Inlet is geologically and topographically similar to other coastal regions in Puget Sound. Port Orchard Narrows and Agate Passage to the north and Rich Passage to the southeast join Sinclair Inlet to the main basin of Puget Sound. The inlet is a shallow bay just under 1 mile wide and 3.5 miles long; a maximum depth is approximately 130 feet.

No perennial streams enter or exit the shipyard, and no freshwater bodies are located within its boundaries. Drains from the process water treatment plant once discharged directly to Sinclair Inlet. These drains are now connected to wastewater lines leaving the installation and entering the city of Bremerton sanitary waste treatment system (NEESA 1983). Surface water runoff from storm events typically flows from the higher terrain at BNC (uplands) toward Sinclair Inlet. Storm water drains installed at BNC collect runoff and direct it to Sinclair Inlet.

Quality Assurance and Quality Control

In preparing this document, ATSDR reviewed and evaluated information provided in the referenced documents. Documents prepared for the CERCLA program must meet standards for quality assurance and control measures for chain-of-custody, laboratory procedures, and data reporting. The environmental data presented in this PHA come from site characterization, remedial investigation, and monitoring reports prepared by BNC under CERCLA and RCRA. ATSDR determined that the quality of environmental data available for BNC is adequate for making public health decisions.

III ENVIRONMENTAL CONTAMINATION, HUMAN EXPOSURE PATHWAYS, AND PUBLIC HEALTH IMPLICATIONS

In this section, ATSDR evaluates whether community members have been (past), are (current), or will be (future) exposed to harmful levels of chemicals. Figure 4 describes the exposure evaluation process used by ATSDR. ATSDR screens the concentrations of contaminants in environmental media (e.g., groundwater or soil) against health-based comparison values (CVs) (Refer to Appendix B). Because CVs are not thresholds of toxicity, environmental levels that exceed CVs would not necessarily produce adverse health effects. If a chemical is found in the environment at levels exceeding its corresponding CV, ATSDR estimates site-specific exposure and evaluates the likelihood of adverse health effects. *ATSDR emphasizes that a public health hazard exists only if there is exposure to a hazardous substance at sufficient concentration, frequency, and duration for harmful effects to occur.*

What potential exposure situations were evaluated for BNC?

At BNC, industrial activities have occurred since the late 1800s, when the shipyard began operating. Access to the site has always been restricted. There is no evidence to indicate that soil or groundwater contamination has impacted off-site residential areas. However, contaminant releases in the terrestrial (on land) and marine environment occurred during the early operating years and may have affected people who lived in the area and used the inlet as a resource for food.

Sinclair Inlet was reportedly used as a resource for shellfish and bottom fish before 1982. Therefore, human exposures before 1982 were possible, but the nature and extent of chemicals in sediments and marine organisms were not known. This PHA will focus on consumption of fish and shellfish in the recent past, which covers the time period (about 22 years) since the commercial ban on shellfish was put in place by state health department. ATSDR acknowledges that people may have been exposed to chemical contaminants in shellfish and other marine organisms from Sinclair Inlet before 1982. The agency will provide perspectives, when possible, in the discussion of past exposures from the consumption of fish and shellfish. However, sampling data and reliable consumption information from the early 1900s through the 1970s are not sufficient to reliably estimate people's exposure during this time period.

Following the strategy outlined above, ATSDR reviewed the environmental data generated from environmental investigations conducted at BNC and within Sinclair Inlet to determine if there are any associated past, current, or future public health hazards. This included soil, sediment, groundwater, surface water, and fish and shellfish tissue) sampling data. ATSDR identified two potential exposure situations associated with site-related contaminants at BNC for further evaluation:

- 1. Eating contaminated fish or shellfish from Sinclair Inlet.*
- 2. Coming in contact with surface soils within OU-D*

The term “*exposure situation*” is used to describe conditions and circumstances by which people could come into contact with contaminants. On the basis of ATSDR’s site visit and review of environmental monitoring data and investigation results, ATSDR selected these two exposure situations for further evaluation.

As previously mentioned, a description of the sites (the source areas), waste disposal history, results of investigations, remedial activities, and ATSDR’s evaluation of public health hazards associated with each of the sites at BNC are presented in Appendix A. The two potential exposure situations evaluated in this PHA are summarized in the Potential Exposure Pathways table (Table 1) and discussed in detail below. Appendix C describes the evaluation process ATSDR used to identify potential exposure situations at BNC and the methods, assumptions, and calculations used to estimate exposure doses. Appendix D provides ATSDR’s recommended maximum safe consumption frequency tables and the methods used to develop the table. Appendix E contains ATSDR’s glossary of environmental health terms and Appendix F contains ATSDR’s responses to public comments received regarding this site.

Table 1: Exposure Situation and Hazard Summary Table for BNC				
Exposure Situation	Time Frame	Public Health Implications and Hazard Conclusions	Actions	ATSDR Recommendations
1. Exposure to contaminants through consumption of fish and shellfish collected from marine locations impacted by BNC				
Adults and children who eat fish or shellfish possibly contaminated with metals, organic solvents (VOCs), fuels, PCBs, PAHs from Sinclair Inlet.	Before 1989	Contaminant levels were likely higher than the initial sampling data of 1989 because of the generally accepted environmental practices prior to the mid-1980s. We do not have sampling data to determine if contaminant levels were at levels likely to result in adverse health effects.	<p>In 1979, the industrial wastewater treatment plant became operational and stopped discharging waste directly into Sinclair Inlet, thus significantly reduces pollution levels.</p> <p>In 1982 Washington Department of Health Kitsap County issued a seafood advisory because of fecal coliform contamination in Sinclair Inlet. This advisory still in effect has resulted in a reduction of human exposure to all contaminants.</p>	None
	1989 – Present	Data shows chemical contaminants are at levels lower than those shown to result in adverse health effect.	<p>The Bremerton-Kitsap County Health District has issued a health advisory against eating rockfish, crab, and bottom fish such as sole and flounder collected in the inlet. Advisory was based on mercury and PAH contamination. Signs are posed along the shoreline and on piers that warn against harvesting shellfish.</p> <p>BNC initiated a large-scale remediation effort in June 2000, which included dredging of approximately 220,000 cubic yards of contaminated sediment from near shore locations to a depth of 2 feet.</p> <p>Other corrective actions include shoreline stabilization at Site 1, placement of a thick cap off of OU-A in the southwest corner of BNC, and placement of clean material to a thickness of 1 foot to improve marine habitat in areas adjacent to the OU-A cap.</p> <p>The Navy is conducting long-term monitoring for specific chemical compounds (i.e., PCBs and mercury) in sediments and marine organisms.</p>	None

Table 1: Exposure Situation and Hazard Summary Table for BNC				
Exposure Situation	Time Frame	Public Health Implications and Hazard Conclusions	Actions	ATSDR Recommendations
	Future	Clean-up actions taken by the Navy and others in Sinclair Inlet and regulated environmental practices help reduce contaminant levels in seafood.	Most chemical contaminants were not at levels of health concern in fish and shellfish samples from Sinclair Inlet. However, some of the fish species sampled contained a few elevated levels of PCBs and some metals.	If Sinclair Inlet becomes available to use as a resource for fish and shellfish, ATSDR recommends that the Navy, in agreement with CERCLA requirements, conduct routine monitoring to identify any species that might pose a potential public health hazard.
2. Potential Future Exposures to contaminants in surface soil within OU-D.				
Potential exposures (adult and child) from coming in contact with surface soils within OU-D.	Past Current Future	The 2003 sampling data indicate contaminants are not at levels of public health concern and children or other susceptible populations will not be exposed to harmful levels of contaminants.	<p>In 2003, additional soil sampling was conducted as part of a focused RI/FS to evaluate impacts to human health and the environment. A total of 70 soil samples were collected and analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and total petroleum hydrocarbons (TPHs).</p> <p>OU-D was designated in August 2003 during the development of the Proposed Plan for OU-B Terrestrial. OU-D was originally part of the larger industrial area at BNC designated OU-B (terrestrial).</p> <p>This site was originally evaluated under industrial land use as part of the OU-B remedial investigation and feasibility study (RI/FS). OU-D includes land that is proposed for transfer to the city of Bremerton as well as some adjacent areas that will remain BNC property. The city plans to develop a municipal park on the transferred property.</p> <p>Site-related contaminants are not present at levels in soil that would pose a public health hazard for people (adults or children) that will use the park.</p>	None

1. Eating contaminated fish or shellfish collected from Sinclair Inlet

Since 1989, detected chemical contaminant concentrations in Sinclair Inlet fish and shellfish have not been at levels shown to result in adverse health effects. However, Washington State Department of Health has determined that current levels of fecal coliform and other microbial contamination in shellfish within Sinclair Inlet pose a public health hazard. Until state and county health officials remove the advisories that are currently in place, shellfish should not be consumed from any portion of Sinclair Inlet. However, some of the fish species sampled contained elevated levels of PCBs and some metals. If Sinclair Inlet is opened for fish and shellfish consumption, ATSDR recommends that the Navy sample various edible species to identify chemical contaminant levels in any species that might pose a potential public health hazard.

Background

BNC is located on the north side of Sinclair Inlet, which is usually accessed from Puget Sound by passing through Rich Passage and the waters of Port Orchard. During the earlier years of operation, BNC released industrial wastes directly into Sinclair Inlet by way of a combined sanitary and storm sewer. Although direct discharge of pollutants into Sinclair Inlet no longer occurs, it is likely that historical releases from shipyard activities were a significant source of contamination for portions of the inlet. Wastes from various operation include those from electroplating shops (copper, cadmium, silver, zinc cyanide), chromium plating shops (chromic acid), solvents and paints (trichloroethylene, acetone, Stoddard solvent), detergents and degreasing agents, electrical transformer wastes (PCB-containing oils), from batteries and industrial activities (sulfuric acid, nitric acid, hydrochloric acid, lead), petroleum products, and coolants (NEESA 1983; US Navy 1993).

During the earlier years of operation, BNC released industrial wastes directly into Sinclair Inlet by way of a combined sanitary and storm sewer. The most direct pathway for BNC-related contaminants to impact the sediments and biota in Sinclair Inlet was from discharges into the marine water. In 1957, all discharges were directed to the city of Charleston's wastewater treatment plant (Tetra Tech 1988). In 1975, a two-phase project to separate the sanitary and storm water sewer system was completed. Sanitary wastes were directed to the city of Bremerton's wastewater treatment plant, while industrial waste disposed of into the storm drain system was released into Sinclair Inlet. This direct discharge of industrial wastes continued until 1979, when the industrial wastewater treatment plant (IWTP) began operation. Since 1979, the IWTP has collected, treated, and routed industrial waste effluent to the city of Bremerton sanitary sewer system instead of discharging it directly into Sinclair Inlet (NEESA 1983; Tetra Tech 1988).

The extent to which BNC has contributed to the overall contamination of Sinclair Inlet is not known. There are numerous non-point sources of pollution that also contribute to the contaminant burden within Sinclair Inlet. Historical releases from shipyard activities were probably a significant source of chemical contamination for portions of the inlet. Previous marine investigations show many of the highest concentrations of industrial contaminants in sediments (e.g., lead, copper, and polychlorinated biphenyls [PCBs]) are found in close proximity to the shipyard, specifically the area designated as OU-B Marine (Site 6) (URS 2002). It is possible that low-level contamination from subsurface soil and groundwater contamination

continues to migrate into Sinclair Inlet from seeps and shoreline erosion of subsurface fill materials. However, most of the site-related contamination impacting Sinclair Inlet occurred before the construction of the IWTP.

Before 1982, Sinclair Inlet has been a popular commercial and recreational fishing and shellfish harvesting area. However, due to both microbial and chemical contamination from numerous industrial sources (e.g., BNC and Bremerton Wastewater Treatment Plant), the inlet has become polluted and its use as a fishing and shellfish harvesting resource has been significantly impacted. As a result of pollutants from BNC and other point sources such as municipal waste treatment facilities, harvesting of commercial and recreational shellfish from Sinclair Inlet has been prohibited since 1982.

Sampling - Nature and Extent of Contamination

Most of the environmental sampling conducted at BNC occurred between 1990 and 2000. Groundwater samples were collected from 66 monitoring wells within OU-B Terrestrial. Approximately 63 surface water samples were collected at drydock seeps, catch basins, and outfalls within OU-B Marine. Sediment samples were collected and analyzed within OU-B Marine. Most samples were analyzed for target analyte list VOCs, SVOCs, pesticides, PCBs, metals, and total petroleum hydrocarbons (TPH) (URS 2002).

Marine Tissue Sampling Data

The Navy sampled three marine species within the marine environment adjacent to BNC: 1) caged blue mussels, 2) English sole, and 3) sea cucumbers. In June 1994, blue mussels were collected at five sampling stations (four in Sinclair Inlet and one reference location in Holmes Harbor). Three replicates of 100 mussels were used at each station, for a total of 1,500 mussels. In June 1994, English sole, a bottom-dwelling flatfish that is common throughout Puget Sound, were collected from four locations in Sinclair Inlet and one reference location in Holmes Harbor. In August 1995, 40 sea cucumbers were collected at each of four locations in Sinclair Inlet, and a total of 17 sea cucumbers were collected from two Puget Sound reference locations: Rich Passage and Blake Island (URS 2002).

Most contaminants detected in marine tissues were found at low levels, with average concentrations not exceeding health-based screening values. Table 2 presents the results of marine tissue samples for contaminants that exceeded their respective health-based screening value. Arsenic (11.9 ppm) and Aroclors (i.e. PCBs) (0.2 ppm) were detected above health-based screening values in all three species analyzed. Mercury (0.2 ppm) was detected in all three species, but did not exceed health-based screening values. Some pesticides (aldrin and heptachlor) and common industrial contaminants such as bis 2-ethylhexyl phthalate were also detected at levels that exceeded their respective screening values. Isophorone (an industrial chemical used as a solvent in some printing inks, paints, lacquers, and adhesives) was detected in caged blue mussels. This compound does not typically accumulate in the food chain and has a relatively short half-life in the environment (URS 2000). Other contaminants detected in tissue samples included some common pesticides and PAHs.

Table 2. Navy Investigations: Fish and Shellfish Tissue Sampling Results (Sinclair Inlet)					
Chemical	Frequency of Detection	Range of Concentrations (ppm) ¹	Average Concentration (ppm)	Screening Value (ppm) ²	Requires further evaluation (Yes/No) ³
English Sole (Fillets or Whole Body)					
Arsenic	20/20	4.9 – 11.9	7.5	0.0005	Yes
Antimony	1/12 (WB)	ND - 0.5	0.5	0.14	No
Lead	15/20 12/12 (WB)	0.06 – 0.2 0.31 – 1.2	0.1 0.8	NS	Yes
Mercury	20/20	0.03 – 0.05	0.04	0.03	Yes
Aldrin	10/20	ND (0.0004) – 0.001	0.0007	0.00005	No
Arochlor 1260 (PCB)	20/20 12/12 (WB)	0.03 – 0.2 0.07 – 0.2	0.1 0.1	0.0004	Yes
4,4'-DDE	20/20	0.0006 – 0.006	0.003	0.0024	Yes
Dieldrin	1/5	ND – 0.01	0.01	0.0005	Yes
Heptachlor	11/20	ND (0.0005) – 0.003	0.001	0.0001	No
Lindane	1/20	ND - 0.001	0.001	0.0006	No
Bis 2-Ethylhexylphthalate	2/20	ND (0.6) – 1.4	1.02	0.06	No
Blue Mussel Tissue (Caged)					
Aroclor 1254 (PCB)*	9/12	ND (0.009) – 0.02	0.02	0.0004	Yes
Arsenic	12/12	0.4 – 0.9	0.5	0.0005	Yes
Isophorone	4/12	ND (27) – 33	30.3	0.84	Yes
Sea Cucumber					
Arsenic	29/29	0.1 – 2.4	0.8	0.0005	Yes
Aroclor 1254 (PCB)	9/29	ND (0.002) – 0.06	0.02	0.0004	Yes
Aroclor 1260 (PCB)	20/29	ND (0.002) – 0.01	0.004	0.0004	Yes
Benzo(a)anthracene	19/29	ND (0.0000007) – 0.03	0.005	0.001	Yes
Benzo(b)fluoranthene	27/29	ND (0.0000004) – 0.01	0.003	0.001	Yes
Benzo(a)pyrene	25/29	ND (0.0000002) – 0.004	0.001	0.0001	Yes
Dieldrin	4/29	ND (0.0001) – 0.0005	0.0003	0.00005	Yes
Indeno(1,2,3-cd)pyrene	22/29	ND (0.0000001) – 0.3	0.03	0.001	Yes
English sole samples were collected in July 1994; blue mussel samples were collected in June 1994					
¹ Numbers in parentheses represent minimum detected concentrations					
² The screening value is based on EPA's Region III Risk Based Concentrations (RBCs) for fish tissue using site-specific ingestion rates reported in the Suquamish Tribe Fish Consumption Survey (2000).					
³ See Appendix C (ATSDR's Methods, Assumptions, and Calculations) for a discussion of the rationale used by ATSDR to determine whether a chemical contaminant requires further evaluation.					
ND = Not detected					
NS = No screening value is currently in place					
WB = Whole body (If WB is not specified, then the samples are fillets.)					
Note: Average concentrations are based only on detected values. This will overestimate the exposure for those chemicals that were detected infrequently (e.g., Bis [2-Ethylhexyl] phthalate).					
*The levels detected in fish and shellfish tissue may represent a future exposure concern for subsistence fishers (e.g., 90 th percentile fish consumption rate reported by the Suquamish Tribe) if fishing and harvesting of shellfish is approved for Sinclair Inlet in the future.					

Table 3. Puget Sound Fish Sampling Investigations: Results for Sinclair Inlet (1989 - 1999).					
Chemical	Frequency of Detection	Range of Detected Values (ppm)	Average Concentration (ppm)	Screening Value (RBC-F) (ppm)	Requires further evaluation (Yes/No) ²
English Sole (Muscle)					
Aroclor 1260 (PCB)*	45/45	0.007– 0.3	0.07	0.0004	Yes
Arsenic*	17/17	6.5 – 14	10.9 7.74 [n=282] ¹	0.0005	Yes
4,4'-DDE	20/27	0.0002 – 0.006	0.002	0.0024	Yes
Lead	23/26	0.02 – 0.07	0.04 0.03 [n=351] ¹	NA	No
Mercury	49/49	0.03– 0.14	0.08 0.06 [n=492] ¹	0.03 (methyl)	Yes
Bis(2-thylhexyl)phthalate	6/15	0.004 – 1.2	0.1	0.06	Yes
English Sole (Liver)					
Aroclor 1260 (PCB)*	17/17	0.6 – 2.9	1.1	0.0004	Yes
Arsenic*	11/11	6.2 – 14.6	8.8 10.6 [n=117] ¹	0.0005	Yes
4,4'-DDE	13/15	0.013 – 0.3	0.05	0.0024	Yes
Lead	14/14	1.8 – 4.7	2.7 0.6 [n=137] ¹	NA	Yes
Mercury	14/14	0.08 – 0.17	0.1 0.1 [n=161] ¹	0.03 (methyl)	Yes
Bis(2-thylhexyl)phthalate	2/4	0.085 – 0.75	0.4	0.06	Yes
Chinook Salmon (Muscle)					
Aroclor 1260 (PCB)	6/6	0.006 – 0.033	0.02	0.0004	Yes
Arsenic	6/6	1.1 – 1.4	1.2 1.0 [n=101] ¹	0.0005	Yes
4,4'-DDE	6/6	0.01– 0.03	0.02	0.0024	Yes
Dieldrin	6/6	0.0008 – 0.002	0.001	0.0005	Yes
Lead	1/6	0.04	0.03 0.03 [n=101] ¹	NA	No
Mercury	6/6	0.07 – 0.12	0.1 0.09 [n=106]	0.03 (methyl)	Yes
Coho Salmon (Muscle)					
Aroclor 1260 (PCB)	2/2	0.006 – 0.01	0.009	0.0004	Yes
Arsenic	2/2	0.80– 1.2	1.0 0.6 [n=103] ¹	0.0005	Yes
4,4'-DDE	2/2	0.0097 – 0.01	0.01	0.0024	Yes
Dieldrin	2/2	0.0007– 0.0008	0.0007	0.0005	Yes
Mercury	2/2	0.06 – 0.06	0.06 0.05 [n=108] ¹	0.03 (methyl)	No

Brown Rockfish (Muscle)					
Aroclor 1260 (PCB)	11/11	0.013 – 0.34	0.1	0.0004	Yes
4,4'-DDE	7/10	0.0001 – 0.003	0.001	0.0024	Yes
Mercury*	11/11	0.33 – 1.2	0.8 0.75 [n=12] ¹	0.03 (methyl)	Yes

Source: Washington Department of Fish and Wildlife. 2001. Results of the Puget Sound Ambient Monitoring Program Fish Component, 1989-1999.

RBC-F = EPA Region III Risk Based Concentrations for Fish Tissue using site-specific ingestion rates reported in the Suquamish Tribe Fish Consumption Survey (2000).
 NA = Not Analyzed/Not Available; ND=Not Detected
 Value in parentheses represents the method detection limit

* The levels detected in fish/shellfish tissue may represent a future exposure concern for subsistence fishers (e.g., 90th percentile fish consumption rate reported by the Suquamish Tribe) if fishing and harvesting of shellfish is approved for Sinclair Inlet in the future.

¹ Average for all of Puget Sound. Numbers in brackets represent the sample size.
² See Appendix C (ATSDR's Methods, Assumptions, and Calculations) for a discussion of the rationale used by ATSDR to determine whether a chemical contaminant requires further evaluation.

Table 3 presents the results of fish sampling investigations conducted by the Washington State Department of Fish and Wildlife during 1989-1999. The average contaminant levels (e.g., PCBs and arsenic) in English sole tend to be higher than the average contaminant levels for all of Puget Sound. This same pattern is not evident with the salmon samples. This is likely due to the fact that salmon are migratory species and do not typically feed from the same area for very long (West et al. 2001; O'Neill and West 1998a, 1998b).

Groundwater and Surface Water Data

Most of the surface water samples were collected during Phase I and II of the OU-B RI, whereas groundwater samples were collected over multiple investigations mostly between 1990 and 2000. The analysis of samples from groundwater, marine water, drainage outfalls, catch basins, and drydock seeps at BNC showed generally low levels of contamination that would not be expected to significantly impact sediments and biota within Sinclair Inlet. The highest VOC concentrations detected in water were TCE (530 ppb) and PCE (200 ppb), which were released into the inlet through drydock seeps at levels that exceed state surface water regulatory criteria¹. It is likely that these VOCs were migrating towards the inlet from upland sources on and off base. Several metals including arsenic (8.4 ppb), copper (1,930 ppb), lead (78 ppb), nickel (445 ppb), and mercury (1.7 ppb) were also detected above surface water regulatory criteria. The marine water samples collected away from the drydocks and catch basins did not contain contaminants at levels of concern (URS 2002).

¹ Maximum concentration exceeded the Model Toxics Control Act Method B (MTCB), which are very stringent regulatory standards (i.e., cleanup levels) developed by Washington State's Department of Ecology. Surface water cleanup levels must be set at a concentration that would allow the water to be used for those beneficial uses identified under the State's water quality laws. Beneficial uses include use for a domestic water supply, irrigation, fish and shellfish rearing, recreation (such as swimming and sport fishing), commerce and navigation, and wildlife habitat.

Marine Sediment Data

Although most people are not likely to be directly exposed to sediments, marine organisms that are part of the food chain may accumulate contaminants that are deposited in sediments. Sediments within the most contaminated portions of Sinclair Inlet have been well characterized through numerous investigations conducted by the Navy, Ecology, and collaborative partnerships between private and/or state and federal entities (e.g., ENVVEST Project and the Puget Sound Ambient Monitoring Program [PSAMP] – see Appendix E). The most frequently detected contaminants in Sinclair Inlet sediments include certain metals such as mercury, cadmium, and lead. Organic compounds such as PCBs, bis (2-ethylhexyl) phthalate (BEHP), and polycyclic aromatic hydrocarbons (PAHs) were also frequently detected in sediment samples. Most of the organic compounds are byproducts of industrial activity; however, some (e.g., PAHs) may be formed naturally as a result of burning wood or petroleum-based materials.

Most of the marine sediment samples were collected during 1990 - 1994 for the site inspection and the OU-A and OU-B investigations. During these investigations, the highest sediment concentration of mercury (12.3 ppm) was recorded at a near shore sampling location near OU-A.

The sediment data also show that mercury concentrations in sediments are distributed by distance from the shipyard. Mercury levels decline the further away from the industrial areas around the shipyard. However, most of the sampling locations in Sinclair Inlet had detectable concentrations of mercury compared with the mercury levels found at reference locations, which were all below the method detection limit. Lead has also been detected at elevated levels in sediments near BNC. The maximum lead concentration (1,050 ppm) was detected at a sampling location between piers 5 and 6.

PCBs were also detected in almost half of the samples collected, with a maximum concentration of 74.2 ppm organic carbon². This sample was located in the near-shore zone, outside of the shipyard boundary (i.e., outside of what is designated OU-B Marine) (URS 2002). The Navy conducted a “specialized sampling program” during 1998 and 1999 to further evaluate the nature and extent of PCBs within the marine portion of the shipyard. The maximum PCB concentration measured in composite surface sediment was 61.7 ppm. A recent investigation by Ecology indicates that the elevated PCB levels found within the marine portions of the shipyard are not representative of most other portions of lower Sinclair Inlet, with the maximum PCB concentration detected for 18 samples collected in lower Sinclair Inlet being 0.2 ppm and an average of 0.1 ppm (Ecology 2000).

² Chlorinated organic compounds such as PCBs tend to be absorbed into the organic carbon in suspended or bed sediments rather than dissolved in the water column. Because of this tendency, these compounds can be present in sediments in concentrations that are orders of magnitude higher than those in the water column. When measuring PCBs in sediments the results are often expressed as the concentration of PCBs within the organic carbon fraction of the sediment sample. This allows comparison of PCBs among sediments or varying organic carbon content. When available, the PCB sediment data were presented as the concentration within the organic carbon fraction of sediment. However, it should be noted that PCB data were not always adjusted for organic carbon content.

Public Health Implications

At BNC, site-related contaminants have been released into Sinclair Inlet. The most significant releases were before 1979, when the industrial wastewater treatment plant became operational. Current releases via storm-water and drainage outfalls at BNC have been greatly reduced and are no longer contributing large amounts of pollutants into the inlet. Some of the pollutants that enter the marine environment break down very slowly (e.g., PCBs, mercury, and lead) and are deposited in the marine sediments. These persistent contaminants may accumulate over time in the biota (e.g., plants, fish, and shellfish). Shellfish and many varieties of bottom feeding fish ingest contaminants from sediments and smaller organisms that are found on the bottom surface and can be concentrated in their tissues. People who harvest and consume these fish and/or shellfish can be exposed to these contaminants.

The Washington State Department of Health (WDOH) Office of Food Safety and Shellfish is responsible for classifying commercial shellfish growing areas in the state. Areas are classified as “Approved,” “Conditionally Approved,” “Restricted,” or “Prohibited”. These classifications are based on a WDOH shoreline survey for potential contamination sources and WDOH marine water monitoring for microbial contamination. Most of Sinclair Inlet has been classified as prohibited and has been closed to shellfish harvesting because of microbial contamination since 1982 (NEESA 1983).

Specifically, all marine water west of Point Herron, located on the peninsula that separates Port Orchards Bay with Sinclair Inlet (Point Herron also abuts the entrance to Port Washington narrows) is classified by the WDOH as *Prohibited* for commercial shellfish harvesting because of concerns regarding pollution from the city of Bremerton and Port Orchard’s combined sewer overflows from the wastewater treatment plants and industrial activities within Sinclair Inlet. Advisories are in place warning people not to consume crabs, rockfish, and other bottom fish from the inlet because of elevated levels of mercury and PAHs and all shellfish because of microbial contamination. Although signs have been posted along the shoreline and on piers that

What are the differences between chemical and microbial pollutants?

Public health advisories for fish and shellfish consumption usually distinguish between microbial and chemical pollutants that enter surface water bodies and can potentially be harmful to people. Below is a brief explanation of the differences of each type of pollutant category and how they can impact public health.

- ❑ Chemical contaminants are often, but not always, a result of human activities such as industrial releases, application of pesticides, and use or accidental spills of petroleum-related compounds. Ambient releases of chemicals into the environment typically result in low-level exposures to people. If exposed over long periods of time, people’s health can be adversely impacted. However, unlike microbial contaminants, low-level exposures to chemicals in the environment rarely cause acute illnesses or immediate health problems.
- ❑ Microbial contamination is mostly an acute or short-term hazard that can make people very sick immediately (i.e., within 24 hours) after being exposed. The term microbial includes bacteria, viruses, fungi, and protozoans. Tests for fecal coliform bacteria generally measure the presence of microbial contamination, which may be an indicator of disease carrying microorganisms. The primary source of microbial pollution is human sewage or other animal feces that are discharged into the environment. WDOH prohibits harvesting shellfish when sanitary surveys and bacteriological monitoring indicate that fecal material or pathogenic microorganisms (microbes) are present at dangerous levels.

warn against harvesting shellfish, restrictions of recreational harvesting of shellfish is not strictly enforced by the state (KCHD 2003).

Washington State's Department of Ecology also generates a list of threatened and impaired water bodies not meeting water quality standards established by either EPA or Ecology. In 1998, Sinclair Inlet was placed on the list of impaired waters because of fecal coliform contamination and metals and organic contaminants in bottom sediments and fish tissues (KCHD 2003). The near-shore sediments closest to BNC are the most heavily contaminated, and levels generally decline with distance from the areas designated as OU-B marine.

People do not fish or harvest shellfish within BNC marine property boundaries. This area is heavily secured and there is no exposure to this restricted portion of the inlet that is most contaminated. Other portions of Sinclair Inlet are accessible to recreational fishers and shellfish harvesting. The Suquamish Tribe has expressed interest in using Sinclair Inlet as a future resource for fish and shellfish. Currently, the Suquamish Tribe maintains rearing ponds at Gorst Creek and releases hatchery chinook in the spring. The Tribe harvests salmon throughout Sinclair, from about the beginning of August through November, depending on the run of each type of salmon (Denice Taylor, Suquamish Tribe, Personal Communication, November 22, 2004). There may also be a small number of subsistence fishers from the tribe or from other Kitsap County communities in the area (e.g., Asian and/or Pacific Island populations). ATSDR used health-based screening values for fish and shellfish tissue consumption based on reported Suquamish Tribe ingestion rates. Refer to Appendix C for a more complete description of the methods and assumptions used in ATSDR's evaluation process.

Past and Current Exposure

It is unlikely that people have consumed fish or shellfish in the past or are currently eating fish or shellfish from within the Marine OU-B portion of BNC because this area is heavily secured.

All of Sinclair Inlet is closed for commercial harvesting of shellfish (e.g., clams, geoduck, scallops, mussels, oysters, snails) due to microbial and chemical contamination. Specific advisories have also been issued for mercury and PAH contamination in crabs, rockfish and other bottom fish (WDOH 2004). Signs are posted along portions of the shoreline of Sinclair Inlet advising people not to harvest and/or consume shellfish due to microbial and chemical hazards. Bremerton-Kitsap County Health District, Washington Department of Health, and the Washington Department of Fish and Wildlife also report these advisories on their web sites and fish/shellfish information Hotlines. Since these advisories have been in place since 1982, people who follow the advisories are not exposed. Persons who do not heed or are otherwise not aware of the current advisories and consume shellfish and bottom fish from Sinclair Inlet may be exposed to microbial and chemical contamination. The most significant concern is microbial contamination since fecal coliform levels continue to exceed acceptable levels in some portions of the inlet. This could potentially result in acute illness and is the primary reason to strictly adhere to state and county public health advisories pertaining to shellfish consumption from Sinclair Inlet.

Some chemical contaminants exceeded their reference dose values in English sole and other marine tissues such as rockfish, sea cucumbers, and mussels (see Appendix C). A review of the toxicological literature does not indicate that the levels detected in these species, even when assuming Suquamish Tribe-specific ingestion rates, would likely cause illness or harm to people.

It is unlikely that even very sensitive populations would experience harmful effects from chemical contaminants in shellfish and bottom fish from Sinclair Inlet since the detected contaminant levels in recent marine tissue sampling are not at levels known to cause harm. Therefore, exposures occurring in the recent past and current exposures from eating fish and shellfish from other portions of Sinclair Inlet beyond the BNC boundary do not pose a public health hazard.

As previously noted, ATSDR has focused on evaluating exposures that may have occurred in the recent past (i.e., since commercial shellfish harvesting was prohibited in 1982) rather than exposures that may have occurred before 1982. We believe that during the recent past consumption of bottom fish and shellfish from the remainder of Sinclair Inlet has not been occurring at a frequency that would result in illness or long-term harm. Prior to 1982, people may have been exposed to chemical contaminants in fish and shellfish, especially if they were harvesting and eating fish and shellfish in close proximity to the shipyard or in other locations that are near sources of contamination. Monitoring data is not available before 1982 and ATSDR considers these distant past exposures as indeterminate.

Future Exposure

ATSDR considered the possibility that in the future portions of Sinclair Inlet may be available for harvesting shellfish, bottom fish, crabs, or rockfish. It is important to emphasize current levels of fecal coliform and other microbial contamination within the inlet pose a public health hazard. Until state and county health officials remove the advisories that are currently in place, fish and shellfish should not be consumed from any portion of Sinclair Inlet. The most likely populations to utilize Sinclair Inlet as a future subsistence fishing resource include some members of the Suquamish Tribe and some Asian and Pacific Island populations. The Suquamish Tribe's seafood consumption rates are among the highest rates reported in consumption studies conducted in the region (The Suquamish Tribe 2000). ATSDR utilized consumption rates presented in a detailed fish consumption survey of the Suquamish Indian Tribe to evaluate the potential public health impact of chemical contaminants detected in fish and shellfish within Sinclair Inlet. ATSDR used very health-protective assumptions (e.g., 90th percentile fish consumption rate reported by the Suquamish Tribe) in calculating potential chemical-specific doses from eating fish and shellfish (see Appendix C for an explanation of methods and assumptions used to calculate dose).

ATSDR's evaluation of potential future public health hazards associated with chemical contaminants in fish and shellfish from Sinclair Inlet shows that salmon (chinook or Coho) collected from Sinclair Inlet generally contain low levels of chemical contaminants and would be safe to consume. English sole, however, contained higher concentrations of PCBs and arsenic and some of the calculated doses for these contaminants exceeded their respective reference values (ATSDR 2000a; 2000b) (see Appendix C). It also appears that elevated mercury levels in Brown Rockfish may pose a health concern if consumption levels of this species were high enough. However, reported consumption of Rockfish by the Tribe is low and it is unlikely that people would consume enough for mercury to pose a public health hazard. Overall, the available data show that salmon and other similar migratory species of fish and possibly some species of shellfish could be safely consumed, either at unlimited frequency or with some frequency restrictions, from Sinclair Inlet providing microbial contamination were not an issue.

Confirmation that chemical contaminant levels are within acceptable ranges for important mollusk species such as geoducks and other commonly consumed shellfish and bottom fish that have not been sampled would be needed before future harvesting should be permitted.

ATSDR also calculated the recommended maximum consumption frequency in days per year that people can safely consume fish and shellfish from Sinclair Inlet. Appendix D presents the assumptions and methodology used as well as the consumption frequency tables for adults and children. ATSDR recommends using the recommended frequencies presented in this table as a guide for future harvesting if the advisories that are currently in place for fecal coliform and other microbial contamination are lifted. It is important to understand that exceeding the recommended frequencies does not mean that a person will become ill or suffer health effects in the future. However, limiting consumption to the recommended frequencies presented in the tables should help minimize any potential risks from chemicals ingested in fish and shellfish from Sinclair Inlet.

2. Potential future exposures resulting from contact with surface soils within OU-D

OU-D was part of the industrial area within BNC. The Navy has proposed changes in current land use with the property to be transferred to the city of Bremerton for use as a recreational park. Because contaminants are buried, people would not have direct contact with contaminants in the subsurface soils. Contaminant levels in the subsurface were above screening levels, but lower than levels associated with harmful health effects. ATSDR does not expect exposures to site-related contaminants at OU-D to occur in the future at levels that would pose a public health hazard.

Background

As part of its economic development and revitalization plan, the city of Bremerton has received funding to develop approximately 2.8 acres of Navy-owned land that is adjacent to Bremerton's ferry terminal. This area was marshland before being gradually filled between 1905 and 1942. The Navy formerly used the area for industrial land uses and now is considering transferring a portion of the property to the city of Bremerton to be used as a Park.

OU-D was originally evaluated as part of OU-B during the OU-B RI/FS. However, the Navy decided to conduct a focused RI/FS of OU-D because of the proposed change from its present industrial land use to a recreational land use. During its history OU-D contained several buildings at various locations around the site. Buildings 371 and 453 served as the chemistry and geotechnical laboratory at BNC until their closure in 2003. Building 289 operated as a welding shop until its closure and demolition in 2003. Building 497 houses the BNC police station and specialized electrical systems. According to site documents and discussions with BNC representatives, the Navy plans to demolish buildings 371, 453, and 497 in the near future. The Navy proposes to transfer a portion of OU-D to the city of Bremerton for use as a public park (URS 2004; BNC 2004b).

The southern third of OU-D was initially evaluated as a portion of Site 10 East under the RI for OU-B. Site 10 East, which covers approximately 5 acres, extends from Pier 8 to the eastern edge of the shipyard and is a suspected disposal site. This area was filled in with miscellaneous materials. Spent sandblasting grit may have been used as fill in this area. Site 10 East was covered with gravel, with some asphalt pavement after filling was complete. All filling along the shoreline at BNC ceased in 1974. Sandblast grit was used primarily in drydocks up to the mid-1950s as blasting material for removing paint and cleaning ship hulls. Spent grit was used as fill material. The fill material at BNC consists primarily of a mixture of excavated soil or dredged sediments with debris. These materials were used to fill near-shore, tidal, and sub-tidal areas for land reclamation and waterfront construction. The fill material ranges from 5 feet or less in the areas of BNC above 15 feet mean sea level to approximately 40 feet in thickness at the waterfront (URS 2004).

Sampling - Nature and Extent of Contamination

The RI/FS investigation for OU-D was limited to terrestrial media (e.g., soil and groundwater). OU-D does not abut the shoreline, so there is no direct marine component to OU-D. Since groundwater is not being used and future use is not expected, the only media that will be evaluated in this section is surface soil. Additionally, there is no evidence that use of outdoor large munitions firing ranges, ordnance manufacturing, or renovation of ammunition or

explosive items ever occurred at any portions of BNC and there is no reason to believe that any physical hazards would be present at OU-D (NEESA 1983).

A total of 15 composite surface soil samples between 0 and 2 feet below ground surface (bgs) were collected in May 2003 as part of the RI/FS to further characterize soil contamination at OU-D. Earlier environmental sampling also occurred as part of the OU-B RI/FS when all of the land use at BNC was expected to remain industrial. All soil samples were analyzed for priority pollutant inorganics (metals), pesticides, and PCBs, SVOCs, VOCs, and gasoline and diesel range hydrocarbons (URS 2004).

Arsenic was detected at 9 ppm in surface soil, which is slightly above the general background range for the Bremerton area³. Although lead and chromium (maximum concentrations: 819 and 805 ppm respectively) were detected in all the soil samples collected, most samples were not detected at levels known to cause harm. For example, only one sample exceeded EPA's action level for lead of 400 ppm in residential soil and only two samples exceeded the screening value for chromium. Some PAHs were detected above ATSDR's health-based screening values. However, only benzo (a) pyrene (maximum concentration: 6.8 ppm) was detected frequently above its screening value. A small number of samples also contained TPH that exceeded the state of Washington's cleanup action level.

Public Health Implications

ATSDR evaluated potential future exposures to contaminated soil at OU-D because of proposed changes in land use that may result in people having access to formerly restricted areas. Under state and federal statutes, a public park must meet standards applied to residential properties. According to the Navy, the soil that exceeds preliminary remediation goals (PRGs) in areas of the northeastern portion of the site, which is proposed for transfer to the city, will be covered with clean soil and vegetation. The vegetated cover for this portion of OU-D will be backfilled with suitable imported material, including a minimum 6-inch topsoil layer for establishing the vegetative zone (URS 2004; PSNS&IMF 2004). Soils that exceed the PRGs on the southwestern portion of the site (approximately 2.5 acres that is to be retained by the Navy) will be capped with an asphalt cap and maintained secure within the ownership of the Navy.

A review of data from a recent OU-D investigation identified low levels of contamination in soil that are below levels known to cause illness or health problems. Some of the contaminants detected in surface soil at OU-D did exceed their respective health-based screening values for residential use. During the site tour of BNC, ATSDR observed that a significant portion of OU-D is currently unpaved and a large mound of excavated soil is present on the site. However, all of OU-D continues to be under Navy control and access is restricted. Any future use for OU-D is expected to meet all state and federal regulatory residential soil standards before transfer of property is completed and unrestricted access to the area is permitted. Therefore, ATSDR does not expect exposures to site-related contaminants to occur in the future at levels that would result in harm to people who use the park. According to the Navy, all remedial actions for OU D will be finalized prior to any transfer of property to the city of Bremerton. Additionally, the remedy includes institutional controls prohibiting residential construction.

³ The typical background levels for arsenic in soil for the Bremerton area range between 1.1 and 7.5 ppm.

IV COMMUNITY HEALTH CONCERNS

ATSDR typically identifies community health concerns through meetings or correspondence with community members, state and local officials, and site personnel, as well as through review of site documents, including RODs and Community Relations Plans.

During the site visit, ATSDR met with a representative of the Suquamish Tribe to discuss tribal concerns about the future use of Sinclair Inlet as a natural resource for harvesting fish and shellfish. The tribe's primary concern involves subsistence fishing/harvesting in Sinclair Inlet, which has been restricted by the state. Based on discussions with a Suquamish Tribe representative, the tribe understands the need for restrictions at this time but would like a possible timeline for having the restrictions lifted.

ATSDR will continue to compile any additional concerns that the community may have regarding site-related contamination associated with BNC.

V CHILD HEALTH CONSIDERATIONS

ATSDR recognizes that infants and children may be more sensitive to exposures than adults in communities with contamination in water, soil, air, or food. In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health. ATSDR is committed to evaluating their special interests at sites such as BNC as part of the ATSDR Child Health Initiative.

ATSDR has attempted to identify populations of children in the vicinity of BNC. A small number of children live in military housing within the Military Support Area of BNC. Approximately 32 children under the age of 10 and a total of 66 children under the age of 18 reside in military housing at BNC. These children do not have access to the Controlled Industrial Area or Industrial Support Area unless they are accompanied by an adult. There are residences with children in close proximity to BNC. However, the entire facility is fenced and closely monitored for security purposes. On the basis of ATSDR's exposure evaluation, *ATSDR concludes that exposure to site contamination at BNC does not pose unique health hazards for children.*

VI CONCLUSIONS

After evaluating available environmental information, ATSDR has reached the following conclusions regarding the identified exposure situations at BNC. On the basis of the most currently available information, there are no past, current or future public health hazards associated with site-related contaminants at BNC. ATSDR's pathway-specific conclusions regarding the potential exposure pathways evaluated are described below.

1. Eating contaminated fish or shellfish collected from Sinclair Inlet

Past and Current Exposure: *ATSDR concludes that past and current exposures from eating fish or shellfish from Sinclair Inlet since 1982 have been infrequent and do not pose a public health hazard.* Commercial harvesting of shellfish from Sinclair Inlet, west of Point Herron, has been prohibited since 1982. Commercial fishing is closely monitored and violators can be fined and prosecuted. Shellfish harvesting is also prohibited for recreational purposes as well. It is more difficult to monitor the activities of recreational fishers and harvesters of shellfish and state agencies do not fine or prosecute people who do not adhere to the prohibition. However, most information that ATSDR has gathered suggests that there is very little shellfish harvesting occurring in the inlet because of bacteriological contamination from waste and treatment facilities located in Bremerton and Port Orchard, Washington and because of chemical contamination from BNC and other point sources.

Future Exposure: Washington State Department of Health has determined that *current levels of fecal coliform and other microbial contamination within Sinclair Inlet pose a public health hazard.* Until state and county health officials remove the advisories that are currently in place, shellfish should not be consumed from any portion of Sinclair Inlet. ATSDR has evaluated levels of chemical contamination in fish and other marine tissue samples collected from Sinclair Inlet by the Navy and by the Washington Department of Fish and Wildlife. Contaminants measured in most fish and shellfish were not at levels that would cause harm for recreational fishers.

The most likely populations to utilize Sinclair Inlet as a subsistence fishing resource in the future include some members of the Suquamish Tribe and possibly some Asian and Pacific Island populations. ATSDR used health-protective consumption rates reported in the 2000 Suquamish Tribe's Fish and Seafood Consumption Survey to identify the potential for future exposures to chemical contaminants from eating fish and shellfish in Sinclair Inlet. The available data show that salmon are generally safe to consume from Sinclair Inlet. Confirmation that chemical contaminant levels are within acceptable ranges for species such as geoducks and other commonly consumed shellfish that have not been sampled would be needed before future harvesting is permitted. The state and Puget Sound treaty tribes would be responsible for managing future Sinclair inlet geoduck harvest and, therefore, would be responsible for establishing any sampling requirements.

2. Potential future exposures from coming in contact with surface soils within OU-D

Future Exposure: ATSDR does not expect exposures to site-related contaminants at OU-D to occur in the future at levels that would pose a public health hazard. We evaluated potential future exposures to contaminated soil at OU-D because of proposed changes in land use that may result in people having access to formerly restricted areas. A review of data from a recent OU-D investigation identified low levels of contamination in soil that are below levels known to cause illness or health problems. Some of the contaminants detected in surface soil at OU-D did exceed their respective health-based screening values for residential use. However, according to the Navy, the soil that exceeds regulatory screening levels (i.e. PRGs) in areas of the northeastern portion of the site will either be paved with asphalt or concrete or covered with clean soil and vegetation before any proposed transfer to the city. Soils that exceed the PRGs on the southwestern portion of the site that will remain property of the Navy will be capped with asphalt and access will continue to be restricted.

VII RECOMMENDATION

ATSDR recommends that the Navy modify their long-term monitoring plan to include sampling additional species of fish and shellfish (e.g. geoducks, crabs, or rockfish) that the Suquamish tribe and other native populations may be interested in harvesting and eating in the future providing all restrictions and advisories pertaining to bacteriological contamination are lifted.

VIII PUBLIC HEALTH ACTION PLAN

The Public Health Action Plan (PHAP) for BNC contains a description of actions taken and to be taken by ATSDR, BNC, EPA, and other state or local agencies subsequent to the completion of this PHA. The purpose of the PHAP is to ensure that this PHA not only identifies potential and ongoing public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. The public health actions that are completed, ongoing or planned, and recommended are listed below.

Completed Actions

1. In 2000 and 2001, as part of the selected remedy for addressing contaminated sediments in OU B Marine, the Navy conducted a dredging project to make contaminated sediments inaccessible to surface biota and marine life in the near shore areas. The Navy created the Confined Aquatic Disposal (CAD) pit in the westernmost portion of OU B Marine. Approximately 200,000 cubic yard of sediment containing PCBs and other site-related contaminants were excavated, placed into the CAD, and covered with a sand and native sediment cap (URS 2002; BNC 2004a; U.S. Navy 2005).

2. Because of unexpected contaminant releases from the CAD during dredging operations, the Navy conducted additional environmental monitoring to better characterize the nature and extent of contamination on a portion of state owned aquatic lands that border BNC property near the CAD. The Navy released a report titled "Explanation of Significant Differences" in February 2004 to address additional remedial work. The Navy completed enhanced natural recovery actions for this area in March 2004.
3. In 2003 and 2004, as part of the selected remedy for OU B Terrestrial, the Navy conducted shoreline stabilization by installing riprap and fish mix (i.e., boulders and pebbles) to help prevent soil erosion into the marine environment and enhance fish habitat.

Ongoing and Planned Actions

1. The Navy is continuing to upgrade its storm water drainage outfalls and catchment basin system in order to minimize contaminant releases into Sinclair Inlet. The Navy has planned remedial actions for the terrestrial portion of OU-B, which includes cleaning, inspecting, and repairing/replacing the storm drain systems (i.e., catch basins, manholes, and piping). The removal of historical sediment and repair of the storm drain lines is expected to reduce the potential for chemical transport of sediment and/or debris to the adjacent marine environment and from infiltration of soil and groundwater into the storm water system. According to the Navy, the cleaning and inspection phases of the remedial action are primarily complete now. The repairs are currently 90% complete, with an expected completion date of late 2005.
2. The Navy is conducting long-term monitoring of marine sediments and English sole.
3. The Navy has finalized a Record of Decision (ROD) for OU-D, which was signed in May 2005, and plans to complete remedial actions for this OU by the end of 2005.

REFERENCES

- Agency for Toxic Substances and Disease Registry [ATSDR]. 1989. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Isophorone. Atlanta: U.S. Department of Health and Human Services. 1989.
- ATSDR. 1999. Toxicological Profile for Mercury. Atlanta: US Department of Health and Human Services. March 1999.
- ATSDR. 2000a. Toxicological Profile for Arsenic. Atlanta: US Department of Health and Human Services. 2000.
- ATSDR. 2000b. Toxicological Profile for Polychlorinated Biphenyls (PCBs). Atlanta: US Department of Health and Human Services. November 2000.
- Bremerton Naval Complex (BNC). 2003. Restoration Advisory Board (RAB) Meeting Minutes. September 24, 2003.
- BNC. 2004a. Explanation of Significant Differences. BNC, OU-B Marine. February 2004.
- BNC. 2004b. Responses to ATSDR Questions Pertaining to BNC. Sent by Dina Ginn on July 29, 2004.
- Kitsap County Health District (KCHD). 2003. Surface and Stormwater Management (SSWM) 2001-2002 Water Quality Monitoring Report Sinclair Inlet Watershed. August 2003.
- Naval Energy and Environmental Support Activity (NEESA). 1983. Initial Assessment Study of Naval Shipyard Puget Sound. March 1983.
- [NEESA]. 1990. Preliminary Assessment Supplemental Report, Puget Sound Naval Shipyard. June 1990.
- O'Neill S and West J. 1998a. Persistent Pollutants and Factors Affecting their Accumulation in Rockfishes (*Sebastes* spp.) from Puget Sound, Washington. Pages 336- 345 in E. R. Strickland, editor. Puget Sound Research '98 Proceedings. Puget Sound Water Quality Action Team, Seattle, WA.
- O'Neill S and West J. 1998b. Spatial Trends in the Concentration of Polychlorinated Biphenyls (PCBs) in chinook (*Oncorhynchus tshawytscha*) and Coho Salmon (*O. kisutch*) in Puget Sound and Factors Affecting PCB Accumulation: Results from the Puget Sound Ambient Monitoring Program. Pages 312-328 in E. R. Strickland, editor. Puget Sound Research '98 Proceedings. Puget Sound Water Quality Action Team, Seattle, WA.
- Puget Sound Naval Shipyard. 1996. Historical Radiological Assessment, Puget Sound Naval Shipyard. Volume I Naval Nuclear Propulsion Program 1963-1993. January 1996.
- [PSNS & IMF] Puget Sound Naval Shipyard and Intermediate Maintenance Facility. 2004. Proposed Plan for Cleanup Action Operable Unit D. June 28, 2004.
- The Suquamish Tribe. 2000. Fish Consumption Survey of the Suquamish Indian Tribe of the Port Madison Indian Reservation, Puget Sound Region. August 2000.
- Tetra Tech, Inc. 1988. Sinclair and Dyes Inlets Action Program: Initial Data Summaries and Problem Identification. September 1988.

U.S. Navy. 1998. Interagency Agreement Under CERCLA for Bremerton Naval Complex. March 13, 1998.

U.S. Navy. 2000. Final Record of Decision (ROD) for OU-B Marine, Bremerton Naval Complex. June 6, 2000.

U.S. Navy. 2003. Final record of Decision (ROD) for OU-B Terrestrial, Bremerton Naval Complex. November 2003.

The URS Team (URS). 1992. Site Inspection Report, Puget Sound Naval Shipyard. May 15, 1992.

[URS]. 1995. Final Remedial Investigation Report, Operable Unit NSC —Fleet and Industrial Supply Center, Bremerton, Washington. Volume I. September 1995.

[URS]. 1996. Final Community Relations Plan/Public Participation Plan, Bremerton Naval Complex. October 1992. Updated April 1996.

[URS]. 2002a. Final RI Report, Bremerton Naval Complex OU-B. March 2002.

[URS]. 2002b. Final Five-Year Review of Record of Decision, Bremerton Naval Complex. October 17, 2002.

[URS]. 2004. Final Remedial Investigation/feasibility Study for OU-D, Bremerton Naval Complex. March 5, 2004.

United States Environmental Protection Agency [EPA]. 1989. Risk Assessment Guidance for Superfund—Volume I: Human Health Evaluation Manual, Part A (Interim Final) (RAGS). EPA/540-1-89/002. U.S. Environmental Protection Agency.

United States Census Bureau. 1990. US 1990 Census Statistics, Kitsap County.

United States Census Bureau. 2000. US 2000 Census Statistics, Kitsap County.

U.S. Navy. 2005. PSNS & IMF Comments on ATSDR Public Health Assessment Report for Public Comment. May 2005.

Washington State Department of Ecology [Ecology]. 2000. PCB Levels in Bottom Sediments from Lower Sinclair Inlet. Ecology Report No. 00-03-019. June 2000.

Ecology. 2003. Well Log Database. Updated February 2003. Web-link: <http://apps.ecy.wa.gov/welllog/>

Washington State Department of Health. 2004. Recreational Shellfish beach Closures due to Biotoxins or Pollution. Updated August 3, 2004. Web-link: <http://ww4.doh.wa.gov/scripts/esrimap.dll?name=BIOVIEW&Left=1006666&Bottom=760000&Right=1158334&Top=967000&Step=2&click.x=220&click.y=296>

West J., O'Neill S., Lippert G., and Quinnell S. 2001. Toxic Contaminants in Marine and Anadromous Fishes from Puget Sound, Washington: Results of the Puget Sound Ambient Monitoring Program Fish Component, 1989-1999. August, 2001