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Department of the Navy

Record of Decision for OU-1B

Naval Air Warfare Center

August 2000

DECLARATION

SITE NAME AND LOCATION

Naval Air Development Center

Area B Groundwater (Operable Unit 1B)

Warminster, Pennsylvania

CERCLIS ID # PA6170024545

STATEMENT OF BASIS AND PURPOSE

This decision document presents the determination that no action is necessary for Area B groundwater (Operable Unit 1B or OU-1B), at the Naval Air Development Center (NADC) ("the Site") in Warminster, Pennsylvania. This determination has been made in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This determination is the final remedy for OU-1B. This decision is based on the Administrative Record file for the Site.

In 1993, the Site was renamed the Naval Air Warfare Center (NAWC) Aircraft Division. NAWC was disestablished on September 30, 1996 and is targeted for transfer to the private sector.

The Commonwealth of Pennsylvania, as represented by the Pennsylvania Department of Environmental Protection (PADEP), concurs with the selected remedy for OU-1B at the Site.

DESCRIPTION OF THE SELECTED REMEDY

A No Action alternative is the selected final remedy for OU-1B at the Site. OU-1B consists of Area B groundwater, where Area B groundwater is defined as groundwater potentially impacted by disposal activities within Area B.

STATUTORY DETERMINATIONS

The No Action remedy selection is based upon a remedial investigation of OU-1B which indicates that no action is necessary at OU-1B to be protective of human health and the environment. A five-year review will not be necessary for OU-1B.

Orlando J. Monaco
BRAC Environmental Coordinator
Naval Air Warfare Center
Warminster, Pennsylvania

8/22/00
Date

Abraham Ferdas, Director
Hazardous Site Cleanup Division
U.S. EPA - Region III

9/1/00
Date

L/Documents/Navy/6883/14370

DECISION SUMMARY

I. SITE NAME, LOCATION, AND DESCRIPTION

The former Naval Air Development Center is located in Warminster Township and Ivyland Borough, Bucks County, Pennsylvania. The National Superfund electronic database identification number for the Naval Air Development Center is PA6170024545. The Naval Air Development Center was renamed the Naval Air Warfare Center (NAWC) Aircraft Division in January 1993 and was disestablished on September 30, 1996, in response to the requirements of the Base Realignment and Closure Act (BRAC). The Department of the Navy is the lead agency and EPA the support agency for CERCLA activities at NAWC. The Department of Defense is the source of cleanup monies for NAWC. Area B groundwater at NAWC has been identified as Operable Unit 1B at NAWC and is addressed by this Record of Decision (ROD). Groundwater within Area B is defined as groundwater potentially impacted by contamination attributable to Sites 5, 6 and 7, which are located within Area B at NAWC. Sites 5, 6 and 7 are three of eight sites reported by the Navy in 1980 to have been used for disposal of wastes which may contain CERCLA hazardous substances. Soils and wastes associated with Sites 6 and 7 are being addressed under a separate operable unit (OU-7). Site 5, which is located on property to be retained by the Navy, and surface water and sediment associated with Sites 5, 6, and 7 are also being addressed under a separate operable unit (OU-10).

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

A. Site History

NAWC is a 824-acre facility located in Warminster Township, Northampton Township, and Ivyland Borough, Bucks County, Pennsylvania (see Figure 1 for a site location map). As a result of the Base Realignment and Closure Act (BRAC), NAWC ceased operations on September 30, 1996. The majority of NAWC, including portions of Area B, is being transferred to the private sector.

The facility lies in a populated suburban area surrounded by private homes, various commercial and industrial activities, and a golf course. On-base areas include various buildings and other complexes connected by paved roads, the runway and ramp areas, mowed fields, and a small wooded area.

Commissioned in 1944, the facility's main function was research, development, testing, and evaluation for naval aircraft systems. NAWC also conducted studies in anti-submarine warfare systems and software development. Historically, wastes were generated during aircraft maintenance and repair, pest control, fire-fighting training, machine and plating shop operations, spray painting and various materials research and testing activities in laboratories. These wastes included paints, solvents, sludges from industrial wastewater treatment, and waste oils that were disposed in several pits, trenches, and landfills throughout the facility property.

NAWC was listed on the Superfund National Priorities List (NPL) in 1989. This list includes sites where uncontrolled hazardous substance releases present the most significant potential threats to human health and the environment. Areas reported by the Navy to have been potentially used for disposal of hazardous substances include eight locations covering more than 7 acres. These locations include the following:

- Three waste disposal locations (sites 1, 2, and 6).
- Two sludge disposal pit locations (sites 2 and 7).
- Two landfills (sites 4 and 5).
- One fire-fighting training area (site 8).

Area B has been identified as that area containing Sites 5, 6, and 7 (see Figure 2). Site 5 reportedly consisted of up to eight trenches that were used for the disposal of demolition wastes, paint, solvents, scrap metal, aircraft paints, cans, and asphalt. The trenches were reportedly operated from 1955 to 1970. Navy enlisted housing units have since been constructed within this area. Site 5 was investigated as part of the Phase III RI (Brown & Root Environmental, 1996) and is the subject of an ongoing focused RI being conducted by the Navy (under OU-10).

Sites 6 and 7 are located within the same area north of Site 5. Site 6 consisted of pits where paint, solvents, demolition waste, oil, flammable waste, and grease trap waste were disposed, backfilled, and covered. The disposal reportedly took place from 1960 to mid-1980. Site 7 was reported as an area where one or two trenches were used for the disposal of approximately 700 cubic yards of industrial waste sludge cake generated at the on-base wastewater treatment facility. The disposal reportedly took place between 1950 and 1955. Sites 6 and 7 have been extensively studied and the Navy, with the support of EPA, has issued a ROD for these sites (OU-7).

B. Enforcement Actions

No enforcement actions have been taken for Area B Groundwater. The Navy has owned the property since the mid-1900s and is the lead agency for CERCLA work at NAWC.

III. REMEDIAL INVESTIGATIONS AND RESPONSE ACTIONS

Initial Pre-Remedial investigations of Area B, consisting of the installation and sampling of shallow overburden wells, were performed in 1982 (JRB Associates, 1983). RI work has been conducted in phases beginning in 1989.

The Phase I RI (SMC Martin, 1991) was conducted from 1989 to 1991 and included a cursory soil gas study and electromagnetic survey to better define the location of the disposal site boundaries and the potential source areas. Limited test pitting was also conducted to delineate the disposal areas. Shallow and overburden wells were installed and sampled to characterize groundwater quality and to determine groundwater flow direction. The Phase II RI (Halliburton NUS, 1992 and 1993) was conducted in 1992 and 1993. Activities included installing additional overburden and shallow bedrock monitoring wells, sampling and analyzing groundwater, surface water, sediment, and soils, and evaluating aquifer characteristics through water-level monitoring and a pumping test. Groundwater-related RI and FS reports for OU-1 were released in April 1993 (Phase II RI, Halliburton NUS, 1993 and Focused Feasibility Study, Halliburton NUS, 1993). Based on trichloroethene (TCE) levels slightly in excess of the Maximum Contaminant Level (MCL) for public drinking water supplies in three monitoring wells, the RI and FS reports projected the presence of a TCE contamination plume attributable to Area B.

In September 1993, the Navy and the EPA signed a ROD for OU-1 that consists of contaminated overburden and shallow bedrock groundwater attributable to Area A and Area B at the base. The ROD selected an interim remedy to minimize the migration of contaminated groundwater while additional studies were to be performed to determine the full nature and extent of groundwater contamination. The interim remedy ROD called for pumping and treating Area B groundwater (as well as Area A groundwater) while additional groundwater studies were being performed.

In December 1994 and January 1995, the Navy installed two planned extraction wells and six observation wells downgradient of Sites 5, 6, and 7 within the projected TCE plume (OHM Remediation Services Corporation, 1995). The two planned extraction wells were sampled while pumping tests of various duration were performed. No TCE or other contaminants were detected above the MCL in the pumped water. This information suggested that pumping of Area B groundwater may be unnecessary. In response, the plan to pump and treat was abandoned while additional RI work was performed per the interim remedy ROD.

Ongoing RI work at this time included investigations conducted from 1993 through 1994. Activities included the installation and sampling of monitoring wells at multiple depths in and around Area B. Groundwater quality trends and hydrogeologic characteristics within the study area were evaluated to further define the nature and extent of the contamination and potential migration patterns. Water level studies and pumping tests were performed to better define the nature of the hydrogeologic setting. Based on this work, a draft hydrogeologic investigation report for Area B was released in April 1995 (Halliburton NUS, 1995).

After completion of the extraction well yield tests and the hydrogeologic investigation report of 1995, the Navy, EPA, and PADEP evaluated current and historical Area B groundwater data and the projected TCE plume area. Contaminant trends over time were evaluated and it was concluded that TCE concentrations in the well that contained the highest levels of TCE (up to 13 ug/l) appeared to be stable while TCE levels were either not detected or were present at levels consistently below the MCL in downgradient monitoring wells. Considering this contaminant trend along with the extraction well results, a consensus decision was reached to discontinue the plan to pump Area B groundwater but to continue monitoring and conduct additional investigations during Area B source investigation and removal activities.

A Phase III RI began in 1995. The objective of the Phase III RI was to characterize sources of contamination, primarily soils and wastes at known and potential waste disposal sites. Phase III RI work within Area B consisted of soil gas and electromagnetic studies to define potential source and/or disposal areas, surface and subsurface soil sampling, and sampling of area streams and sediments. The Phase III RI did not address groundwater. A draft Phase III RI report was issued in November 1996 (Brown & Root Environmental, 1996). In response to the findings in this report, a focused RI was conducted at Sites 6 and 7 (OU-7) from 1996 through 1999 to address potential sources of groundwater contamination and other media of concern within Area B. Based on the initial findings of these investigations, the Navy conducted a removal action within Sites 6 and 7 in 1997. Contaminated soils and wastes excavated during this action included all known potential source areas for groundwater contamination. The soils removed included soils containing elevated levels of TCE and tetrachloroethene, another contaminant detected in Area B groundwater. The excavations extended in depth to the bedrock surface and laterally to the point where sample analysis confirmed the lack of contamination above action levels protective of groundwater quality. Final RI and FS reports (TtNUS, 1999) were issued for OU-7 and the final remedy selected and documented in the ROD for OU-7. The OU-7 ROD concluded that soils at Sites 6 and 7 do not present a threat to groundwater quality. (Note: A Proposed Plan for Site 5 has indicated that Site 5 also does not pose a threat to groundwater quality and otherwise requires No Action).

As called for by the interim remedy ROD, Area B groundwater has been regularly monitored since 1994. This monitoring has been part of a basewide perimeter monitoring program and has included 14 rounds of groundwater monitoring in and downgradient of Area B to date. This effort is still ongoing. In addition to these sampling events, a comprehensive Area B water level measurement and groundwater sampling program was conducted in June and July 1998 (TtNUS, 1998). This study included all available Area B wells in addition to wells located downgradient of Area B

In May 2000, a final RI report was issued for Area B Groundwater (TtNUS, 2000). This report summarizes the results of all RI work for Area B groundwater, including all work performed since the Interim RI.

IV. HIGHLIGHTS OF COMMUNITY PARTICIPATION

In accordance with Section 113 and 117 of CERCLA, the Navy provided a public comment period from July 10, 2000 to August 9, 2000 for the No Action preference described in the Proposed Plan for OU-1B. The Proposed Plan along with the Remedial Investigation Report for Area B Groundwater were available to the public in the Administrative Record and information repositories maintained at the Navy Caretaker Site Office located at 860 Flamingo Alley, Warminster, Pennsylvania and at the Bucks County Library located at 150 South Pine Street, Doylestown, Pennsylvania. Public notice was provided in the *Bucks County Courier Times, Philadelphia Inquirer,* and *Intelligencer* and a public meeting was held on July 19, 2000 at the North American Technology Center located at 626 Jacksonville Road in Warminster, Pennsylvania. Comments received during the public comment period are presented in Appendix D. Additional community involvement, including Restoration Advisory Board (RAB) activities, are detailed in Section XI.

V. SCOPE AND ROLE OF OPERABLE UNIT 1B

Section 300.430 (a) (1) (ii) (A) of the NCP, 40 C.F.R. Section 300.340 (a) (1) (ii) (A) provides that CERCLA NPL sites "should generally be remediated in operable units when early actions are necessary or appropriate to achieve significant risk reduction quickly, when phase analysis or response is necessary or appropriate given the size or complexity of the site, or to expedite the completion of a total cleanup." In the case of NAWC Warminster, the Navy has organized work to date into ten operable units (OUs). These OUs are as follows:

- OU-1: Area A and Area B groundwaters.
- OU-2: Off-base private wells.
- OU-3: Area C groundwater.
- OU-4: Area D groundwater.
- OU-5: Soil, sediment and surface water at Site 8.
- OU-6: Soil, sediment and surface water at Site 4.
- OU-7: Soil and waste at Sites 6 and 7.
- OU-8: Soils in Area D.
- OU-9: Soil, sediment, and surface water at Area A.
- OU-10: Soil and waste at Site 5 and surface water and sediment at Area B.

The Navy and EPA selected an interim remedy for OU-1 in a ROD issued on September 23, 1993 and the removal action for OU-2 was selected by EPA in a Removal Action Memorandum signed on July 14, 1993. The Navy and EPA selected a final remedy for OU-3 in a ROD signed March 10, 1995. In September 1999, the Navy and EPA determined that institutional controls were necessary to prevent the use of Area C groundwater presenting an unacceptable human health risk and to protect the long-term effectiveness of the OU-3 remedy. An Explanation of Significant Differences (ESD) was signed to make changes to the OU-3 ROD. The institutional controls address portions of Area C (including Sites 4 and 8) on both current Navy and private property, and consist of restrictions on the use of water from existing wells, restrictions on the future installation of wells, and restrictions on the use wells installed in the future.

An interim remedy for OU-4 was selected in a ROD signed by the Navy and EPA on September 30, 1997 and a final ROD for OU-4 was signed in June 2000. A no further action ROD for OU-5 was signed by the Navy and EPA on September 30, 1999, while a no further action ROD for OU-6 was signed in June 2000. Final remedies for OU-7, OU-8, and OU-9 have also been selected and final RODs for these OU's were signed in June 2000. The final remedies for OU-7 and OU-9 are in the construction phase and a no action remedy was selected for OU-8. The selected interim remedies for OU-1 (Area A OU-1A) and OU-4 and the final remedy for OU-3 are all operational at this time, and the removal action addressing OU-2 has been completed. A Proposed Remedial Action Plan for soil and waste at Site 5 and surface water and sediment potentially impacted by Area B was issued for public comment on August 7, 2000. This ROD documents the selected final remedy for OU-1B, Area B Groundwater.

As described in Section III, the interim remedy for OU-1B selected pumping and treating of contaminated groundwater to minimize migration while additional investigations were completed. Based on an evaluation of data generated during the construction of the interim remedy extraction wells that showed the lack of contamination in excess of cleanup goals, that portion of the interim remedy requiring pumping and treating groundwater was deferred. Additional investigations have been completed and are presented in the May 2000 RI report. Based on the results of those investigations and the lack of contamination found during the

construction of the interim remedy extraction wells, this ROD documents a No Action determination as the final remedy for Area B groundwater.

VI. SITE CHARACTERISTICS

The geology of Area B consists of a thin veneer of residual soils overlying sedimentary bedrock of the Stockton Formation. The soils consist primarily of silt and clay, with some sand, and extend to an average depth of about 10 feet below ground surface. The transition from soils to competent bedrock occurs gradually over a distance of about 5 to 10 feet typically, due to the effects of weathering on the bedrock surface. The bedrock surface within Area B slopes gently to the south and southeast mimicking ground topography.

The bedrock of the Stockton Formation consists of alternating sequences of fine- and coarse-grained, gently dipping rock units. Lithologic units vary in thickness from less than a foot to a maximum observed thickness of about 60 feet within Area B. Locally, bedding within the Stockton Formation strikes approximately north 71 degrees east and dips approximately 5 degrees to 8 degrees to the northwest. This dip of the rock units is approximately opposite to the overall topographic slope of the ground surface within Area B. Beds encountered at shallow (< 100 to 150 feet) depths within northern portion of the study area crop out to the south, near the southern boundary of NAWC.

Fractures were encountered at varying depths of the well borings drilled in and around Area B. Based on geophysical and boring log information, the fractures included both bedding-plane fractures and cross-formation joints. Fractures were observed within both the sandstone and mudstone units, with the fractures in the sandstones more likely to yield significant quantities of water.

The fractured bedrock of the Stockton Formation is the major source of groundwater in the vicinity of NAWC Warminster. The middle arkose member of the Stockton Formation is considered to be the most productive bedrock aquifer in Bucks County. The Stockton Formation in the vicinity of NAWC Warminster forms a complex, multi-aquifer system. The individual water-bearing zones of the Stockton Formation may belong to one of three different aquifer types which, in descending subsurface order, include; Overburden (weathered bedrock) aquifer; Shallow bedrock aquifer; Deeper bedrock aquifer. The shallow bedrock aquifer may extend to depths of about 75 to 120 feet below the ground surface. The shallow bedrock aquifer is recharged by vertical percolation through the overburden and is the primary reservoir for groundwater storage in the Stockton Formation.

The overall direction of groundwater flow across Area B is to the south. Potentiometric surface measurements show groundwater gradients at increasing depths within the Stockton Formation, in and around Area B. Shallow groundwater (less than 60 feet deep) flow across Area B is generally to the south. Intermediate-depth (60 to 110 feet) groundwater flow across Area B is to the south and is similar to the shallow groundwater flow pattern. The horizontal flow gradient varies from north to south: it is slightly steeper to the north and lower to the south, which is consistent with the change in ground surface slope across the area. As with the shallow and intermediate-depth groundwater, deep (greater than 110 feet deep) groundwater flow across Area B is generally to the south at an approximate overall horizontal gradient.

Based on groundwater-level measurements made in wells completed at different depths within well cluster locations, the overall vertical groundwater flow gradient is downward. Hydraulic heads within the shallow bedrock wells were generally higher than the water levels in the deeper wells, with a few exceptions. This pattern of vertical flow reflects that the source of water to the deeper groundwater flow zones within the bedrock is primarily leakage from overlying flow zones.

The migration of contaminants in groundwater across Area B is influenced by several factors. Groundwater primarily moves through interconnected networks of fractures within the bedrock. Lateral groundwater (and contaminant) migration directions are to the south across Area B and are controlled by topography and by the presence of the tributary of Southampton Creek south of Area B. Groundwater flow follows the slope of the ground surface topography across Area B, flowing against the dip direction of the bedrock units.

VII. RESULTS OF RI WORK

As indicated in Section III, the investigation of Area B groundwater has been completed in phases. The Phase I RI (SMC Environmental Services Inc., 1991) included collecting samples from 12 Area B monitoring wells. All samples were analyzed for full TCL organics and TAL inorganics (unfiltered). Trichloroethene (TCE) was the only organic compound identified at concentrations in excess of the MCL (5 ug/l for TCE). TCE was identified at 6 ug/l and 8 ug/l in two monitoring wells There were no other organic contaminant detections above MCLs.

Inorganic analysis of the monitoring well samples identified the presence of two metals at concentrations in excess of Secondary MCLs (SMCLs). SMCLs are non-enforceable standards established for drinking water quality "based on taste, odor, color, and certain other non-aesthetic effects". Manganese was identified in monitoring wells, including background wells, at levels in excess of the SMCL (50 ug/l). Similarly, iron was found at levels in excess of the SMCL (300 ug/l) in all wells. It was noted in the Phase I RI report that manganese and iron concentrations may be related to natural levels occurring in Area B groundwater and weathered bedrock and that the concentrations may be in influenced by the presence of suspended solids in the samples.

The Phase II remedial investigation included collecting samples from 14 Area B monitoring wells. All samples were analyzed for full TCL organics and TAL inorganics. In addition, one set of samples were also field filtered and analyzed for dissolved metals. Analytical results are included in the Phase II RI Report (HNUS, 1993). TCE was the only organic compound identified at concentrations in excess of the MCL. TCE was identified 5 of the 14 wells ranging from 1 ug/l to 13 ug/l. Three monitoring well samples contained TCE (6 ug/l, 8 ug/l, and 13 ug/l) in excess of the MCL. The locations of the detected levels suggested the presence of a TCE contaminant plume. Organic compounds detected at levels below MCL included carbon tetrachloride, cis-1,2-dichloroethene (cis-1,2-DCE), tetrachloroethene (PCE), chloroform, and toluene. These detections were scattered throughout the area and not indicative of any contaminant pattern.

Analysis of the unfiltered samples identified the presence of numerous metals. Based on a comparison of these unfiltered results to background results and health-based screening criteria, arsenic, cadmium, barium, and manganese levels were identified as potential contaminants of concern for Area B groundwater. However, the Phase II RI Report (HNUS, 1993) also noted that significant quantities of suspended solids in the samples may have resulted in an overestimation of the metal levels in groundwater that would be pumped and used. A comparison of filtered (dissolved) groundwater sample results found that arsenic and cadmium were not detected in filtered samples and that barium and manganese levels were significantly lower in the filtered samples and similar to or below the levels identified in filtered background or upgradient samples.

As required by the interim ROD for OU-1, the Navy continued remedial investigations in Area B during 1994 and 1995. These investigations included the installation and sampling of additional monitoring wells. New and existing monitoring wells were sampled during an initial sampling effort in January 1994 and supplemented with additional sampling rounds as new wells were installed from August 1994 through January 1995.

The 1994 sampling and analysis event included collecting samples from 36 monitoring wells in and around Area B. All samples were analyzed for volatile organic compounds (VOCs). Six of the samples were analyzed for TCL semi-volatile compounds, pesticides, and PCBs and 15 samples were collected for total and dissolved TAL inorganic analysis.

TCE was the only VOC identified at levels above an MCL. TCE was identified in 10 of the 36 wells. Two samples contained TCE concentrations above the MCL of 5 ug/l (12 ug/l and 7 ug/l). Eight well samples contained levels of TCE ranging from 1 ug/l to 4 ug/l. Other VOCs identified included cis-1,2-DCE, PCE, toluene, chloroform, and carbon tetrachloride. These were all identified at low levels below MCLs and did not present any discernable pattern. No semivolatile organic or pesticide/PCB compounds were positively identified above background and/or detection limits.

Inorganic analysis of unfiltered (total metals) and filtered (dissolved metals) samples detected a variety of metals. However, the detections were not considered indicative of a pattern which would suggest a release from Area B (HNUS, 1995).

In 1995, the Navy initiated construction of extraction wells in response to the interim remedy ROD. Two potential extraction wells were installed in the downgradient portion of the projected TCE plume identified by the Phase II RI work. During construction, several yield and pumping tests were performed (OHM, 1995). Samples were collected from the planned extraction wells and analyzed for VOCs during both a 12-hour yield test and a 72-hour pumping test. TCE was identified in only one sample from one potential extraction well during the 12-hour yield test, at an estimated concentration of 1.5 ug/l. No other VOC was reported above detection limits. During the 72-hour pumping test, the only compound identified was 1,2-dichloropropane, which was found at concentrations ranging from 0.7 ug/l to 2 ug/l. The maximum detection was below the MCL of 5 ug/l for this compound.

Two additional sampling rounds were performed during this same time period. Samples were collected from six monitoring wells and the two planned extraction wells. TCE and benzene were the only compounds detected at levels above MCLs (5 ug/l for each). TEC was detected in well HN-36S at 12 ug/l. The intermediate and deep wells in this cluster contained levels below the MCL (non-detected to 1 ug/l). Three other wells contained TCE at concentrations ranging from 1 ug/l to 2 ug/l.

Benzene was detected in HN-36D at 20 ug/l and 18 ug/l. Benzene concentrations in the two intermediate wells in this cluster ranged from 1 ug/l to 4 ug/l. Benzene was not detected in the shallow well nor was it detected in any subsequent sampling rounds of HN-36D conducted in 1996 and 1999 (Summary Report for Perimeter Monitoring, TtNUS, 1999).

Also in 1995, an additional pumping test was performed. A 72-hour pumping test was performed using well HN-02I, located near the center of the suspected TCE plume, as the pumping well. Time-series samples were collected from HN-02I during the pumping test. TCE and PCE were the only compounds detected in the samples. The maximum TCE and PCE levels were 4 ug/l and 2 ug/l, respectively.

Additional sampling of Area B wells was performed in 1998. A focused sampling event, consisting of sampling seven wells within the enlisted housing area, was performed in June 1998 (Letter Report, Navy Enlisted Housing Well Installation and Sampling, TtNUS, 1998). Samples were analyzed for VOCs. The only VOC detected was carbon disulfide at concentrations ranging from 0.7 ug/l to 8 ug/l. There is no MCL established for carbon disulfide. EPA Region III has established 1,000 ug/l as the risk-based screening concentration for this compound.

A comprehensive sampling effort that included sampling all available wells within Area B was conducted in June and July 1998. The results of this sampling effort were initially presented in the Summary Report for Area B Monitoring (TtNUS, 1998). A total of 53 monitoring, extraction, and observation wells were sampled. All samples were analyzed for VOCs, 10 were analyzed for total metals, one was analyzed for dissolved metals, and two were analyzed for semivolatile organics, pesticides, and PCBs. Table 1 presents the occurrence and distribution statistics for compounds and elements identified in this comprehensive sampling round. The table provides the substances detected, the frequency and range of detection, the mean concentration, and the location of the maximum result.

VOC analysis identified six compounds in Area B groundwater. TCE was the only contaminant detected above MCLs. One well (HN-03S) contained TCE at 7 ug/l. No other well contained TCE at concentrations greater than the MCL. TCE was detected in six other wells at levels ranging from 1 ug/l to 4 ug/l. Other VOCs detected were cis-1,2-DCE, benzene, carbon disulfide, chloroform, and PCE. None of these VOCs were detected at levels above MCLs. No semivolatile organic or pesticide/PCB contaminants were detected in any well sample within Area B.

Ten wells were sampled and analyzed for total metals and one well sample was analyzed for dissolved metals. Well samples were collected using low-flow sampling techniques. Maximum site detections for samples from wells within Area B were compared to background levels identified in the Phase II RI. This comparison indicated that barium and manganese levels in Area B groundwater were elevated, but within the range of background levels.

The Navy has maintained a perimeter monitoring program for Area B since 1994. As part of this monitoring program, Area B well clusters located near the base perimeter (HN-10, HN-38, HN-39, and HN-40) are sampled and analyzed on a periodic basis. Each well was sampled between 5 and 12 times from 1994 to 1999. During the 14 rounds of sampling, no VOC above an MCL has been detected in any of these well samples.

The perimeter monitoring program also included the periodic sampling of wells within Area B. The perimeter monitoring program sampling results were initially presented in perimeter monitoring summary reports issued by the Navy. The sampling results were evaluated and presented along with the RI sampling results in the final RI Report for Area B Groundwater (TtNUS, 2000).

A review of these data indicates that only two monitoring wells, HN-36S and HN-03S, have consistently contained any contaminant above an MCL. TCE has been detected in both of these wells at levels above MCL. Samples collected and analyzed from HN-03S in 1990, 1992, 1994, 1998, and 1999 contained TCE at 6, 8, 7, 7, and 8.4 ug/l, respectively. HN-36S was sampled in 1990, 1992, 1994, 1995, 1998, and 1999 and contained TCE levels of 8, 13, 12, 12, non-detect, and 6.2 ug/l, respectively. The intermediate and deeper wells in these well clusters did not contain TCE levels above the MCL during any of the sampling events conducted during this time period.

Wells HN-03S and HN-36S are about 300 feet apart. Monitoring wells located between these wells (HN-02 and HN-35) and monitoring wells adjacent to and downgradient (HN-64, DG-19, HN-37, HN-38, and HN-39) did not contain TCE at consistent elevated levels above the MCL. Samples analyzed from wells HN-02S and HN-35S during this same time period varied from non-detect to 3 ug/l.

TCE was detected at 6 ug/l in well HN-37S in 1992 but three subsequent sampling events from 1994 to 1998 did not detect TCE at levels above the MCL. Wells HN-64S, HN-39S, HN-38S, and DG-19 were sampled between 4 and 12 times during the period from 1992 through 1999 and TCE was not detected above the MCL in any of these well samples.

The planned extraction well EW-14 was installed adjacent to HN-03S at a similar depth and within the same hydrogeologic zone as HN-03S. TCE was not detected at levels above the MCL in this planned extraction well during or after pumping tests.

VIII. CURRENT AND POTENTIAL FUTURE LAND AND GROUNDWATER USES

Area B includes Sites 5, 6, and 7 and downgradient areas. Site 5 is currently covered with Navy enlisted housing. Sites 6 and 7 are currently undeveloped and consist of open space covered with grass, shrubs, and trees. There are no structures in the area of Sites 6 and 7 at this time. Areas downgradient of Sites 5, 6, and 7 which include monitoring wells consist of open space covered with grass and a ballfield. The reuse plan for the former NAWC developed by the Federal Lands Reuse Authority (FLRA) of Bucks County and approved by representatives of Warminster Township and other municipalities identifies the future use of the area of Sites 6 and 7 as recreational. Available information suggests that residential use of the property is not reasonably anticipated. However, it has been suggested that limited industrial/commercial use of Sites 6 and 7 may also be possible. The enlisted housing area is serviced by public water. The Navy is retaining this portion of the property and there are no plans to change its current use. Groundwater identified as containing hazardous substances attributable to releases from Area B is not used for water supply purposes. The closest groundwater supply users are located about ½ mile from Area B and are not immediately downgradient.

IX. SUMMARY OF SITE RISKS

A. Summary of Human Health Risk Assessment

A baseline human health risk assessment identifies the contaminants and exposure pathways of concern and estimates the risks posed to human health if no action is taken. This section of the ROD summarizes the results of the baseline human health risk assessment for Area B groundwater. Although Area B groundwater is not known to be currently used, the human health risk assessment performed under the RI assumed that Area B groundwater may potentially be used by residents for domestic purposes

B. Summary of Interim RI and Interim Remedy ROD Human Health Risk Assessment

A human health risk assessment for Area B groundwater was initially performed as part of the interim RI and conclusions regarding the estimated human health risks presented in the interim remedy ROD for OU-1. The interim remedy ROD estimated that Area B groundwater presented an incremental carcinogenic risk of up to 8.4×10^{-5}, while the noncarcinogenic risk was estimated to correspond to a Hazard Index of up to 28. (See Section IX.E. below for further information regarding risk characterization.) The primary contributors to the carcinogenic risk were identified as TCE, PCE, carbon tetrachloride, and arsenic. The primary contributors to the non-carcinogenic risk were identified as arsenic, barium, cadmium, and manganese. The calculation of these risks incorporated the results of the unfiltered groundwater analyses. However, the interim RI suggested that the metals detected in unfiltered samples may be within background levels and not attributable to releases from Area B.

The interim RI found that TCE exceeded the MCL of 5 ug/l in three shallow bedrock walls.

C. Identification of Potential Contaminants of Concern Based on Post-Interim RI Data

The final RI for Area B groundwater further assessed the risks posed by Area B groundwater. These risks were evaluated using sampling data generated by the comprehensive RI sampling event of June and July 1998.

Table 1 summarizes the range of detected concentrations (minimum and maximum) and the frequency of detection of hazardous substances in Area B groundwater from this sampling event. Table 2 presents the statistical analysis of these results and presents the comparison of the detected hazardous substances to background and risk-based screening concentrations. The "concentration used for screening" in Table 2 is the lower of the upper 95% confidence limit (UCL) of the mean concentration and the maximum concentration detected. These concentrations are the exposure point concentrations (EPCs) which were used to conduct an updated estimate of risk to human health. These exposure point concentrations were compared to tap water screening levels protective of residential use as published by EPA Region III. The table identifies the potential contaminants of concern, which are the focus of the quantitative risk assessment conducted as part of the final RI.

D. Exposure Assessment

A human health risk assessment was conducted assuming potential residential use of the groundwater. Industrial/commercial use was not evaluated as residential use evaluates the most sensitive receptors. Future users were evaluated for life-time exposure to groundwater. The exposure routes for human receptors were identified as ingestion, dermal absorption during bathing, and inhalation of volatile organic vapors during showering.

E. Toxicity Assessment

The toxicity assessment characterizes the nature and magnitude of potential health effects associated with human exposure to potential contaminants of concern (PCOCs) at a site. Quantitative risk estimates for each

PCOC and exposure pathway are developed by integrating chemical-specific toxicity factors with estimated chemical intakes.

Quantitative risk estimates are calculated using cancer slope factors (CSFs) for PCOCs exhibiting carcinogenic effects and reference doses (RfDs) for PCOCs exhibiting systemic (noncarcinogenic) effects. The RfDs and CSFs used in the baseline human health risk assessment are presented in Tables 3 through 6.

CSFs and RfDs developed by EPA are based on ingestion (oral) or inhalation routes of exposure rather than dermal contact. Therefore, these values reflect administered doses rather than absorbed doses. EPA guidance on assessment of dermal exposure recommends that oral toxicity factors used in dermal risk assessment be adjusted for gastrointestinal absorption efficiency, if such data are available. The dermal RfDs and CSFs adjusted for gastrointestinal absorption are listed in the tables. The dermal toxicity criteria are derived per the methodology presented in Appendix A of the Risk Assessment Guidance for Superfund, Part A (EPA, 1989).

F. Risk Characterization

A risk characterization was performed in the RI to quantify carcinogenic and non-carcinogenic risks presented by Area B groundwater under the hypothetical future residential use scenario.

Excess lifetime carcinogenic risks were quantified by multiplying the intake level and the CSF. These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6} or 1E-6). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime, under the specific exposure conditions at a site. EPA considered the acceptable risk range to be from 1×10^{-4} to 1×10^{-6}. Noncarcinogenic risks were estimated using the concept of a hazard quotient (HQ) and a hazard index (HI). The HQ is the ratio of the estimated intake and the RfD for a selected chemical of concern. HIs are the sums of the individual HQs for the PCOCs. If the value of the HQ or the HI exceeds unity (1.0), the potential noncarcinogenic health risks associated with exposure to that particular chemical or particular chemical mixture are considered to be unacceptable. If the individual HQs are less than 1.0 and the HI is greater than 1.0, particular attention should be paid to the target organ(s) affected by each chemical because these are generally the organ(s) associated with RfD-derived effects, and toxicity for different organs is not truly additive. The HI is not a mathematical prediction of the severity of toxic effects; it is simply a numerical indicator of the possibility of the occurrence of noncarcinogenic (threshold) effects.

Carcinogenic Risks

Tables 7 and 8 present the life-time cancer risk which would be incurred by ingestion of and dermal contact with Area B groundwater as well as inhalation of volatile vapors from Area B groundwater under residential use. The total incremental carcinogenic risk (or the combined risk under all three pathways) has been estimated at 1.8×10^{-6} (1.8E-6), which is within the EPA's acceptable risk range of 1×10^{-4} to 1×10^{-6}

Noncarcinogenic Risks

Table 9 presents the HQs and HIs for noncancer risks which would be incurred by a child through ingestion of and dermal contact with Area B groundwater under the reasonable maximum exposure (RME) for residential use. The RME is considered the high end, but not worse case, exposure expected under the given scenario. The estimated RME HI is 4.1. Manganese is the major contributor to this estimated risk, accounting for 3.5 of the total HI of 4.1

Table 10 presents the HQs and HIs for noncancer risks which would be incurred by a child through ingestion of and dermal contact with Area B groundwater under the central tendency exposure (CTE) for residential use. The CTE is considered the average exposure expected under the given scenario. The estimated CTE HI is 0.52, which is below the EPA threshold level of 1.

Tables 11 and 12 present the HQs and HIs for noncancer risks which would be incurred by an adult through ingestion of, dermal contact with and inhalation of vapors during showering from Area B groundwater under the reasonable maximum exposure (RME) for residential use. The RME is considered the high end, but not worse case, exposure expected under the given scenario. The estimated RME HI is 1.8. Manganese is the major contributor to this estimated risk, accounting for 1.5 of the total HI of 1.8.

Table 13 presents the HQs and HIs for noncancer risks which would be incurred by an adult through ingestion of and dermal contact with Area B groundwater under the central tendency exposure (CTE) for residential use. The CTE is considered the average exposure expected under the given scenario. The estimated CTE HI is 0.16, which is below the EPA threshold level of 1.

Uncertainty Analysis

There is uncertainty regarding the calculated risks associated with manganese in Area B groundwater and with attributing these risks to Area B. For manganese, the primary contributor to risk in this assessment, the EPC used in the risk calculation was based on the maximum value. However, an evaluation of the sampling data indicates that the manganese HI for individual wells exceeds 1.0 only in one well cluster, HN-64S (shallow) and HN-64I (intermediate). The remaining positive manganese results in the data set would not contribute to an HI greater than 1.0, so the calculated human health risks attributable to manganese in Area B groundwater may be considered to be appropriate for use of groundwater pumped from only this one location. Therefore, the estimated risks from manganese exposure may not be considered representative of Area B groundwater and may be overly conservative.

In addition, the metal concentrations utilized in the risk assessment were total rather than dissolved concentrations. According to the RI, total metal results for Area B groundwater have varied significantly from one sampling round to another and may be naturally occurring. The maximum manganese level identified in the 1998 sampling results for well cluster HN-64 (1,320 ug/l) is less than the maximum site-specific total manganese background sample result (HN-01S at 1,680 ug/l) identified in the Phase II RI (HNUS, 1993). The HN-64 well cluster results are also within the background range for manganese of 80 ug/l to 4,830 ug/l established by sampling fifteen area wells upgradient of NAWC study areas (HNUS, 1993).

The presence of suspended solids in samples from well cluster HN-64 add further uncertainty regarding the nature of the risk estimates calculated using the total manganese results. The field sampling records for this well cluster indicate that although low-flow purging was used, HN-64I was purged dry after removing less than two well volumes. The sample was obtained after the water level in the well recovered, but the turbidity levels in the well at the time of sampling were high.

Based on the above, manganese levels utilized to calculate risk may be associated with background conditions and with suspended solids, which are unlikely to be present in water used for supply purposes.

Conclusions of Risk Assessment

The total cumulative carcinogenic risks presented by Area B groundwater under residential use are within EPA's acceptable cancer risk range. The noncarcinogenic HIs for residential use were calculated as greater than 1.0 and potentially unacceptable. However, per the Uncertainty Analysis section above, the estimated noncarcinogenic risk is associated with manganese concentrations which are within background levels and not attributable to releases within Area B. In this case, Area B groundwater is not considered to present an unacceptable noncarcinogenic risk.

Two monitoring wells have continued to exhibit TCE levels above the MCL of 5 ug/l. The TCE levels in these wells have varied from 5 ug/l to 12 ug/l since the interim RI was completed. However, monitoring of groundwater between these two wells, which are 300 feet apart, has not detected TCE above the MCL and groundwater samples collected up- and down-gradient of these wells have not contained TCE above the MCL. These data indicate that there is no discernable plume of TCE which exceeds the MCL. In addition, the results of groundwater sampling during pumping and yield tests indicate that Area B groundwater pumped for use would not exceed MCLs. For these reasons, TCE in Area B groundwater is not considered to affect the beneficial use of the aquifer or to present a threat to human health.

A review of RI data also found no information which would suggest that Area B groundwater is or may adversely impact surface water quality.

X. SELECTED REMEDY

The results of the risk assessment and the RI indicate that, based on available information, Area B groundwater does not present an unacceptable risk to human health and the environment. In this case, the Navy, with support from EPA, selects a final remedy of No Action. There are no costs associated with this remedy. Based on available information, the Navy and EPA believe that this final remedy is protective of human health and the environment and is cost-effective.

The No Action determination was presented in the Proposed Plan and was presented to the public at the public meeting held July 19, 2000. No changes were made to the No Action determination presented in the Proposed Plan.

XI. RESPONSIVENESS SUMMARY

In a Proposed Plan released for public comment on July 10, 2000, the Navy, with the support of the EPA, identified No Action as the preferred final remedy for Area B groundwater. A public comment period on the Proposed Plan was open from July 10, 2000 through August 9, 2000. A public meeting was held on July 19, 2000 to present the Proposed Plan for OU-1B and to answer any questions on the Proposed Plan and on the documents in the information repositories.

This Responsiveness Summary presents a review of the community involvement in the CERCLA process at NAWC and provides a summary of the comments received during the public comment period for OU-1B along with responses to those comments.

A. Background on Community Involvement

The Navy and NAWC Warminster have had a comprehensive public involvement program for the last ten years. The Navy organized a Technical Review Committee (TRC) in January 1989 to review and discuss NAWC CERCLA issues with local community officials and concerned citizens. The TRC was reorganized into the Restoration Advisory Board (RAB) in November 1993. The RAB consists of representatives of the Navy, EPA, PADEP, the Bucks County Health Department, the Northampton Township Municipal Authority, the Warminster Township Municipal Authority, Ivyland Borough, and Upper Southampton Township, as well as members of the community and concerned environmental organizations. In 1994, NAWC Warminster prepared a Community Relations Plan for environmental activities at the base. Community relations activities have been conducted in accordance with this plan. These activities have included regular technical and restoration activity meetings with local officials, communications with the media and the establishment of information repositories. The RAB and

a technical subcommittee (TSC), consisting of representatives from the RAB, have met on a regular monthly basis since its formation. The RAB has been assisting in the planning and review of environmental investigation, remedial alternative evaluation, and remediation activities, along with future land use planning.

RAB meeting minutes along with reports presenting the results and findings of investigations are maintained in two local information repositories that contain the Administrative Record for NAWC Warminster. One repository is located at the base; Navy Caretaker Site Office located at 860 Flamingo Alley Warminster, Pennsylvania; and the other is located in a local library; Bucks County Library located at 150 South Pine Street, Doylestown, Pennsylvania.

Community relations activities for the final selected remedy include the items below:

- The documents concerning the investigation and analysis at OU-1B were presented in RAB and TSC meetings and draft and final copies were provided to all RAB members for review, discussion, and comment.
- The documents concerning the investigations and analysis at OU-1B, as well as a copy of the Proposed Plan, were placed in the information repositories.
- The Navy mailed copies of the Proposed Plan to about 450 local area residents whose names appeared on the RAB mailing list.
- Newspaper announcements on the availability of documents and the public meeting and comment period were published in the *Bucks County Courier Times, Philadelphia Inquirer,* and *Intelligencer.*
- The Navy established a 30-day public comment period starting July 10, 2000 and ending August 9, 2000.
- A Public Meeting was held on July 19, 2000 to present the Proposed Plan and to answer questions concerning OU-1B.

B. Summary of Comments and Responses

The local community and representatives of local municipalities did not express significant concern regarding the preferred No Action alternative presented in the Proposed Plan. Written comments were submitted on behalf of Warminster Township (Appendix D). These comments and responses to these comments are provided below. The Navy and EPA have taken these concerns into consideration and believe that the No Action determination adequately and appropriately addresses Area B groundwater.

Comment 1: The PRAP and the RI report address a redefined Area B which only includes the groundwater from Sites 5, 6, and 7. Previous investigations included groundwater in the vicinity of the base boundary with Casey Village. Although we do not object to the "No Action" planned for the groundwater from Sites 5, 6, and 7, the groundwater in the vicinity of the base boundary and Casey Village requires additional investigation and evaluation.

Response 1: Additional groundwater samples were collected from monitoring wells in the vicinity of the base boundary in May 2000. The Navy is currently preparing a report summarizing the results of this sampling effort and evaluating the nature and extent of groundwater contamination in this general area. The report should be completed by September 30, 2000.

Comment 2: Although no further action is planned for Area B groundwater, a representative number of monitoring wells should be retained to monitor the effect of remediation to Site 6 and Site 7 soils and wastes (OU-7).

Response 2: No additional Area B groundwater monitoring is planned by the Navy to monitor the effectiveness of clean-up work at Sites 6 and 7. The RI report and the results of the risk assessment for Area

B groundwater indicate that this groundwater does not present an unacceptable risk to human health, regardless of the implementation of the remedy selected for Sites 6 and 7 soil and wastes. As such, the Navy plans to terminate the perimeter groundwater monitoring program that has been conducted in the vicinity of Area B since the interim ROD for OU-1 was signed in 1993. Some monitoring wells present in the general vicinity of Area B may be retained for possible use in any future U.S. Environmental Protection Agency-lead investigations focused on Casey Village groundwater contamination.

APPENDIX A

TABLES

TABLE 1

REMEDIAL INVESTIGATION REPORT FOR AREA B GROUNDWATER
OCCURANCE AND DISTRIBUTION OF ANALYTICAL RESULTS
1998 COMPREHENIVE SAMPLING ROUND

Substance	SITE DATA					
	Frequency of Detection	Range of Positive Detection			Mean of All Data	Location of Maximum
Aluminum	4/11	340 K	-	502	159	W-HN-87S
Arsenic	1/11	2.4	-	2.4	1.2	W-DG-19
Barium	11/11	4.6	-	591	148	W-HN-64I
Beryllium	1/11	0.21	-	0.21	0.11	W-HN-39X
Cadmium	1/11	0.55	-	0.55	0.186	W-HN-87S
Calcium	11/11	3750	-	78200	33500	W-HN-64I
Chromium	10/11	1	-	6.7	2.11	W-HN-640-DUP
Cobalt	5/11	0.44	-	10.7	1.3	W-HN-640-DUP
Iron	7/11	23.5 L	-	696	223	W-HN-87S
Lead	5/11	2.1	-	16.6	3.51	W-HN-87S
Magnesium	11/11	1460	-	24600	11500	W-HN-640-DUP
Manganese	8/11	5.6	-	1320	218	W-HN-640-DUP
Nickel	8/11	0.8	-	9.2	2.88	W-HN-640-DUP
Potassium	10/11	799 J	-	2660	1310	W-HN-39X
Selenium	1/11	1.6 J	-	1.6 J	1.05	W-HN-640-DUP
Sodium	11/11	6300	-	32300	13700	W-HN-39X
1,2-Dichloroethene (cis)	5/53	1	-	5	0.67	W-HN-640-DUP
Benzene	1/53	0.9 J	-	0.9 J	0.508	W-HN-36I1
Carbon Disulfide	5/53	2	-	3	0.66	W-HN-35D
Chloroform	1/53	1	-	1	0.509	W-DG-19
Tetrachloroethene	3/53	2	-	3	0.604	W-HN-35S
Trichloroethene	7/53	1	-	7	0.858	W-HN-03S

Notes:

NA = Not Applicable.

Units are ug/L.

Number of samples may vary based on the number of usable results. Rejected or blank-qualified results were not considered valid samples. Duplicates are consolidated into one result.

Mean of all data includes positive detections and non-detected results. Detection limits are divided by two for non-detected results.

Frequency of detection refers to number of times substance was detected among all samples versus total number of samples (minus number of unusable results).

TABLE 2 (RAGS D TABLE 2)

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WARMINSTER AREA B GROUNDWATER

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Toxicity Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
7429-90-5	Aluminum	340	K	502		ug/L	W-HN-87S	4/11	13-209	502	588000 N	3700 N	-	MCL	N	BKG
7440-38-2	Arsenic	2.4		2.4		ug/L	W-DG-19	1/11	2.1-2.6	2.4	N/A N	0.045 C	50	MCL	N	BKG
7440-39-3	Barium	4.6		591		ug/L	W-HN-64I	11/11	N/A	591	345 Y	260 N	2000	MCL	Y	ASL
7440-41-7	Beryllium	0.21		0.21		ug/L	W-HN-39X	1/11	0.2-0.2	0.21	N/A N	7.3 N	4	MCL	N	BKG
7440-43-9	Cadmium	0.55		0.55		ug/L	W-HN-87S	1/11	0.3-0.3	0.55	N/A N	1.8 N	5	MCL	N	BKG
7440-70-2	Calcium	3750		78200		ug/L	W-HN-64I	11/11	N/A	78200	27300 Y		-	MCL	N	NUT
7440-47-3	Chromium	1		6.7		ug/L	W-HN-640-DUP	10/11	0.8-0.8	6.7	N/A NA	11 N	100	MCL	N	BKG
7440-48-4	Cobalt	0.44		10.7		ug/L	W-HN-640-DUP	5/11	0.4-0.4	10.7	N/A N	220 N	-	MCL	N	BKG
7439-89-6	Iron	23.5	L	696		ug/L	W-HN-87S	7/11	12.5-93.3	696	8880 N	1100 N	-	MCL	N	BKG
7439-92-1	Lead	2.1		16.6		ug/L	W-HN-87S	5/11	1.7-1.7	16.6	76.9 N	15 C	15	MCL	N	BKG
7439-95-4	Magnesium	1460		24600		ug/L	W-HN-640-DUP	11/11	N/A	24600	21000 Y		-	MCL	N	NUT
7439-96-5	Manganese	5.6		1320		ug/L	W-HN-640-DUP	8/11	1-2.9	1320	725 Y	73 N	-	MCL	Y	ASL
7440-02-0	Nickel	0.8		9.2		ug/L	W-HN-640-DUP	8/11	1.6-2.3	9.2	N/A NA	73 N	100	MCL	N	BKG
7440-09-7	Potassium	799	J	2660		ug/L	W-HN-39X	10/11	708-708	2660	3540 N		-	MCL	N	NUT
7782-49-2	Selenium	1.6	J	1.6	J	ug/L	W-HN-640-DUP	1/11	1.6-2.2	1.6	N/A N	18 N	50	MCL	N	BKG
7440-23-5	Sodium	6300		32300		ug/L	W-HN-39X	11/11	N/A	32300	18200 Y		-	MCL	N	NUT
156-59-4	1,2-Dichloroethene (cis	1		5		ug/L	W-HN-640-DUP	5/53	1-4	5	N/A NA	6.1 N	70	MCL	Y	DEG
71-43-2	Benzene	0.9	J	0.9	J	ug/L	W-HN-36I1	1/53	1-1	0.9	N/A NA	0.36 C	5	MCL	Y	ASL
75-15-0	Carbon Disulfide	2		3		ug/L	W-HN-35D	5/53	1-1	3	N/A NA	100 N	-	MCL	N	BSL
67-66-3	Chloroform	1		1		ug/L	W-DG-19	1/53	1-1	1	N/A NA	0.15 C	100	MCL	Y	ASL
127-18-4	Tetrachloroethene	2		3		ug/L	W-HN-35S	3/53	1-1	3	N/A NA	1.1 C	5	MCL	Y	ASL
79-01-6	Trichloroethene	1		7		ug/L	W-HN-03S	7/53	1-5	7	N/A NA	1.6 C	5	MCL	Y	ASL

(1) Minimum/maximum detected concentration.
(2) N/A - Refer to supporting information for background discussion.
Background values derived from statistical analysis. Follow Regional guidance and provide supporting information.
(3) Provide reference for screening toxicity value.
(4) Rationale Codes Selection Reason: Infrequent Detection but Associated Historically (HIST)
Frequent Detection (FD)
Degradation Product of Another COPC (DEG)
Toxicity Information Available (TX)
Above Screening Levels (ASL)
Deletion Reason: Infrequent Detection (IFD)
Background Levels (BKG)
No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

Definitions: N/A = Not Applicable
SQL = Sample Quantitation Limit
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
MCL = Federal Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
J = Estimated Value
C = Carcinogenic
N = Non-Carcinogenic

TABLE 3 (RAGS D TABLE 5.1)

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

WARMINSTER AREA B GROUNDWATER

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (3) (MM/DD/YY)
Barium	Chronic	7.00E-02	mg/kg-day	1.00E+00	7.00E-02	mg/kg-day	Cardiovascular/Kidney	3	IRIS	12/08/99
Manganese	Chronic	2.40E-02	mg/kg-day	1.00E+00	2.40E-02	mg/kg-day	CNS	3	IRIS	12/08/99
1,2-Dichloroethene (cis)	Chronic	1.00E-02	mg/kg-day	1.00E+00	1.00E-02	mg/kg-day	Blood	3000	HEAST	1997
Benzene		3.00E-03	mg/kg-day	1.00E+00	3.00E-03	mg/kg-day	Blood/Immune	3000	EPA-NCEA	7/2/96
Chloroform	Chronic	1.00E-02	mg/kg-day	1.00E+00	1.00E-02	mg/kg-day	Liver	1000	IRIS	12/08/99
Tetrachloroethene	Chronic	1.00E-02	mg/kg-day	1.00E+00	1.00E-02	mg/kg-day	Liver	1000	IRIS	12/08/99
Trichloroethene	Chronic	6.00E-03	mg/kg-day	1.00E+00	6.00E-03	mg/kg-day	Liver/Kidney	3000	EPA-NCEA	3/5/92

N/A = Not Applicable

(1) Refer to RAGS, Part A

(2) Provide equation used for derivation.

(3) For IRIS values, provide the date IRIS was searched.

For HEAST values, provide the date of HEAST.

For NCEA values, provide the date of the article provided by NCEA.

Table 4 (RAGS D TABLE 5.2)

NON-CANCER TOXICITY DATA -- INHALATION

WARMINSTER AREA B GROUNDWATER

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD (1)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC:RfD: Target Organ	Dates (2) (MM/DD/YY)
Barium		---	---	1.43E-04	mg/kg-day	Fetotoxicity	1000	HEAST Alternative	12/08/99
Manganese	Chronic	---	---	1.43E-05	mg/kg-day	CNS	1000	IRIS	12/08/99
1,2-Dichloroethene (cis)	N/A	---	---	N/A	N/A	N/A	N/A	N/A	N/A
Benzene		---	---	1.70E-03	mg/kg-day	Blood	1000	EPA-NCEA	7/2/96
Chloroform		---	---	8.60E-05	mg/kg-day	Respiratory	1000	EPA-NCEA	12/1/97
Tetrachloroethene	Chronic	---	---	1.40E-01	mg/kg-day	Liver/Kidney	300	EPA-NCEA	6/20/97
Trichloroethene	N/A	---	---	N/A	N/A	N/A	N/A	N/A	N/A

N/A = Not Applicable

(1) Provide equation used for derivation in text.

(2) For IRIS values, provide the date IRIS was searched.

For HEAST values, provide the date of HEAST.

For NCEA values, provide the date of the article provided by NCEA.

Table 5 (RAGS D TABLE 6.1)

CANCER TOXICITY DATA -- ORAL/DERMAL

WARMINSTER AREA B GROUNDWATER

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor	Adjusted Dermal Cancer Slope Factor (1)	Units	Weight of Evidence/ Cancer Guideline Description	Source Target Organ	Date (2) (MM/DD/YY)
Barium	N/A	N/A	N/A	N/A	D	N/A	N/A
Manganese	N/A	N/A	N/A	N/A	D	N/A	N/A
1,2-Dichloroethene (cis)	N/A	N/A	N/A	N/A	D	N/A	N/A
Benzene	2.90E-02	1.00E+00	2.90E-02	1/(mg/kg-day)	A	IRIS	12/08/99
Chloroform	6.10E-03	1.00E+00	6.10E-03	1/(mg/kg-day)	B2	IRIS	12/08/99
Tetrachloroethene	5.20E-02	1.00E+00	5.20E-02	1/(mg/kg-day)	C	EPA-NCEA	31868
Trichloroethene	1.10E-02	1.00E+00	1.10E-02	1/(mg/kg-day)	C	EPA-NCEA	32690

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

(1) Provide equation for derivation in text.

(2) For IRIS values, provide the date IRIS was searched.
For HEAST values, provide the date of HEAST.
For NCEA values, provide the date of article provided by NCEA.

EPA Group:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

Weight of Evidence:

Known/Likely

Cannot be Determined

Not Likely

Table 6 (RAGS D TABLE 6.2)

CANCER TOXICITY DATA – INHALATION

WARMINSTER AREA B GROUNDWATER

Chemical of Potential Concern	Unit Risk	Units	Adjustment	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guideline Description	Source	Date (1) (MM/DD/YY)
Barium	---	---	---	N/A	N/A	D	N/A	N/A
Manganese	---	---	---	N/A	N/A	D	N/A	N/A
1,2-Dichloroethene (cis)	---	---	---	N/A	N/A	D	N/A	N/A
Benzene	---	---	---	2.90E-02	1/(mg/kg-day)	A	IRIS	12/08/99
Chloroform	---	---	---	8.10E-02	1/(mg/kg-day)	B2	IRIS	12/08/99
Tetrachloroethene	---	---	---	2.03E-03	1/(mg/kg-day)	B2 - C	EPA-NCEA	4/1/87
Trichloroethene	---	---	---	6.00E-03	1/(mg/kg-day)	B2 - C	EPA-NCEA	7/1/89

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

Weight of Evidence:

Known/Likely

Cannot be Determined

Not Likely

(1) For IRIS values, provide the date IRIS was searched.

For HEAST values, provide the date of HEAST.

For NCEA values, provide the date of the article provided by NCEA.

EPA Group:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

TABLE 7 (RAGS D TABLE 8)
CALCULATION OF CANCER RISKS - LIFETIME RESIDENT TAP WATER CONTACT WITH GROUNDWATER
REASONABLE MAXIMUM EXPOSURE
WARMINSTER AREA B RI

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water Contact with Groundwater
Receptor Population: Resident
Receptor Age: Child/Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Barium	5.91E+02	ug/l	5.91E+02	ug/l	M	5.55E-03	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	1.32E+03	ug/l	1.32E+03	ug/l	M	1.24E-02	mg/kg-day	--	1/(mg/kg-day)	--
	1,2-Dichloroethene (cis)	7.09E-01	ug/l	7.09E-01	ug/l	M	6.66E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Benzene	5.17E-01	ug/l	5.17E-01	ug/l	M	7.69E-06	mg/kg-day	2.90E-02	1/(mg/kg-day)	2.23E-07
	Chloroform	5.20E-01	ug/l	5.20E-01	ug/l	M	7.73E-06	mg/kg-day	6.10E-03	1/(mg/kg-day)	4.72E-08
	Tetrachloroethene	6.35E-01	ug/l	6.35E-01	ug/l	M	9.44E-06	mg/kg-day	5.20E-02	1/(mg/kg-day)	4.91E-07
	Trichloroethene	9.05E-01	ug/l	9.05E-01	ug/l	M	1.35E-05	mg/kg-day	1.10E-02	1/(mg/kg-day)	1.48E-07
	(Total)										9.09E-07
Dermal	Barium	5.91E+02	ug/l	5.91E+02	ug/l	M	1.26E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	1.32E+03	ug/l	1.32E+03	ug/l	M	2.81E-05	mg/kg-day	--	1/(mg/kg-day)	--
	1,2-Dichloroethene (cis)	7.09E-01	ug/l	7.09E-01	ug/l	M	2.26E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Benzene	5.17E-01	ug/l	5.17E-01	ug/l	M	6.23E-07	mg/kg-day	2.90E-02	1/(mg/kg-day)	1.81E-08
	Chloroform	5.20E-01	ug/l	5.20E-01	ug/l	M	3.85E-07	mg/kg-day	6.10E-03	1/(mg/kg-day)	2.35E-09
	Tetrachloroethene	6.35E-01	ug/l	6.35E-01	ug/l	M	2.25E-06	mg/kg-day	5.20E-02	1/(mg/kg-day)	1.17E-07
	Trichloroethene	9.05E-01	ug/l	9.05E-01	ug/l	M	9.15E-07	mg/kg-day	1.10E-02	1/(mg/kg-day)	1.01E-08
	(Total)										1.48E-07
										Total of Routes	1.06E-06

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8 (RAGS D TABLE 8)
CALCULATION OF CANCER RISKS - LIFETIME RESIDENT INHALATION OF GROUNDWATER VAPORS DURING SHOWERING
REASONABLE MAXIMUM EXPOSURE
WARMINSTER AREA B RI

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air
Exposure Point: Inhalation of Groundwater Vapors During Showering
Receptor Population: Resident
Receptor Age: Child/Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	1,2-Dichloroethene (cis)	7.09E-01	ug/l	7.09E-01	ug/l	M	8.12E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Benzene	5.17E-01	ug/l	5.17E-01	ug/l	M	6.45E-06	mg/kg-day	2.90E-02	1/(mg/kg-day)	1.87E-07
	Chloroform	5.20E-01	ug/l	5.20E-01	ug/l	M	5.48E-06	mg/kg-day	8.10E-02	1/(mg/kg-day)	4.44E-07
	Tetrachloroethene	6.35E-01	ug/l	6.35E-01	ug/l	M	6.10E-06	mg/kg-day	2.03E-03	1/(mg/kg-day)	1.24E-08
	Trichloroethene	9.05E-01	ug/l	9.05E-01	ug/l	M	9.43E-06	mg/kg-day	6.00E-03	1/(mg/kg-day)	5.66E-08
	(Total)										7.00E-07
										Total Risk Across All Exposure Routes/Pathways	7.00E-07

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 9 (RAGS D TABLE 7)
CALCULATION OF NON-CANCER HAZARDS - CHILD RESIDENT TAP WATER CONTACT WITH GROUNDWATER
REASONABLE MAXIMUM EXPOSURE
WARMINSTER AREA B RI

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water Contact with Groundwater
Receptor Population: Resident
Receptor Age: Child Ages 0-6

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Barium	5.91E+02	ug/l	5.91E+02	ug/l	M	3.78E-02	mg/kg-day	7.00E-02	mg/kg-day	N/A	N/A	5.40E-01
	Manganese	1.32E+03	ug/l	1.32E+03	ug/l	M	8.44E-02	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	3.52E+00
	1,2-Dichloroethene (cis)	7.09E-01	ug/l	7.09E-01	ug/l	M	4.53E-05	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	4.53E-03
	Benzene	5.17E-01	ug/l	5.17E-01	ug/l	M	3.31E-05	mg/kg-day	3.00E-03	mg/kg-day	N/A	N/A	1.10E-02
	Chloroform	5.20E-01	ug/l	5.20E-01	ug/l	M	3.32E-05	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	3.32E-03
	Tetrachloroethene	6.35E-01	ug/l	6.35E-01	ug/l	M	4.06E-05	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	4.06E-03
	Trichloroethene	9.05E-01	ug/l	9.05E-01	ug/l	M	5.79E-05	mg/kg-day	6.00E-03	mg/kg-day	N/A	N/A	9.64E-03
	(Total)												4.09E+00
Dermal	Barium	5.91E+02	ug/l	5.91E+02	ug/l	M	6.33E-05	mg/kg-day	7.00E-02	mg/kg-day	N/A	N/A	9.05E-04
	Manganese	1.32E+03	ug/l	1.32E+03	ug/l	M	1.41E-04	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	5.89E-03
	1,2-Dichloroethene (cis)	7.09E-01	ug/l	7.09E-01	ug/l	M	2.02E-06	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	2.02E-04
	Benzene	5.17E-01	ug/l	5.17E-01	ug/l	M	3.28E-06	mg/kg-day	3.00E-03	mg/kg-day	N/A	N/A	1.09E-03
	Chloroform	5.20E-01	ug/l	5.20E-01	ug/l	M	1.88E-06	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	1.88E-04
	Tetrachloroethene	6.35E-01	ug/l	6.35E-01	ug/l	M	1.06E-05	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	1.06E-03
	Trichloroethene	9.05E-01	ug/l	9.05E-01	ug/l	M	4.45E-06	mg/kg-day	6.00E-03	mg/kg-day	N/A	N/A	7.42E-04
	(Total)												1.01E-02
												Total of Routes	4.10E+00

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 10 (RAGS D TABLE 7)

CALCULATION OF NON-CANCER HAZARDS - CHILD RESIDENT TAP WATER CONTACT WITH GROUNDWATER
CENTRAL TENDENCY EXPOSURE
WARMINSTER AREA B RI

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water Contact with Groundwater
Receptor Population: Resident
Receptor Age: Child Ages 0-6

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Barium	1.70E+02	ug/l	1.70E+02	ug/l	M	7.27E-03	mg/kg-day	7.00E-02	mg/kg-day	N/A	N/A	1.04E-01
	Manganese	2.20E+02	ug/l	2.20E+02	ug/l	M	9.40E-03	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	3.92E-01
	1,2-Dichloroethene (cis)	6.31E-01	ug/l	6.31E-01	ug/l	M	2.70E-05	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	2.70E-03
	Benzene	5.07E-01	ug/l	5.07E-01	ug/l	M	2.17E-05	mg/kg-day	3.00E-03	mg/kg-day	N/A	N/A	7.22E-03
	Chloroform	5.09E-01	ug/l	5.09E-01	ug/l	M	2.18E-05	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	2.18E-03
	Tetrachloroethene	5.80E-01	ug/l	5.80E-01	ug/l	M	2.48E-05	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	2.48E-03
	Trichloroethene	7.65E-01	ug/l	7.65E-01	ug/l	M	3.27E-05	mg/kg-day	6.00E-03	mg/kg-day	N/A	N/A	5.45E-03
	(Total)												5.16E-01
Dermal	Barium	1.70E+02	ug/l	1.70E+02	ug/l	M	2.44E-05	mg/kg-day	7.00E-02	mg/kg-day	N/A	N/A	3.49E-04
	Manganese	2.20E+02	ug/l	2.20E+02	ug/l	M	3.16E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	1.32E-03
	1,2-Dichloroethene (cis)	6.31E-01	ug/l	6.31E-01	ug/l	M	2.94E-06	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	2.94E-04
	Benzene	5.07E-01	ug/l	5.07E-01	ug/l	M	5.27E-06	mg/kg-day	3.00E-03	mg/kg-day	N/A	N/A	1.76E-03
	Chloroform	5.09E-01	ug/l	5.09E-01	ug/l	M	3.02E-06	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	3.02E-04
	Tetrachloroethene	5.80E-01	ug/l	5.80E-01	ug/l	M	1.59E-05	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	1.59E-03
	Trichloroethene	7.65E-01	ug/l	7.65E-01	ug/l	M	6.17E-06	mg/kg-day	6.00E-03	mg/kg-day	N/A	N/A	1.03E-03
	(Total)												6.64E-03
												Total of Routes	5.22E-01

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 11 (RAGS D TABLE 7)

CALCULATION OF NON-CANCER HAZARDS - ADULT RESIDENT TAP WATER CONTACT WITH GROUNDWATER
REASONABLE MAXIMUM EXPOSURE
WARMINSTER AREA B RI

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water Contact with Groundwater
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Barium	5.91E+02	ug/l	5.91E+02	ug/l	M	1.62E-02	mg/kg-day	7.00E-02	mg/kg-day	N/A	N/A	2.31E-01
	Manganese	1.32E+03	ug/l	1.32E+03	ug/l	M	3.62E-02	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	1.51E+00
	1,2-Dichloroethene (cis)	7.09E-01	ug/l	7.09E-01	ug/l	M	1.94E-05	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	1.94E-03
	Benzene	5.17E-01	ug/l	5.17E-01	ug/l	M	1.42E-05	mg/kg-day	3.00E-03	mg/kg-day	N/A	N/A	4.72E-03
	Chloroform	5.20E-01	ug/l	5.20E-01	ug/l	M	1.42E-05	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	1.42E-03
	Tetrachloroethene	6.35E-01	ug/l	6.35E-01	ug/l	M	1.74E-05	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	1.74E-03
	Trichloroethene	9.05E-01	ug/l	9.05E-01	ug/l	M	2.48E-05	mg/kg-day	6.00E-03	mg/kg-day	N/A	N/A	4.13E-03
	(Total)												1.75E+00
Dermal	Barium	5.91E+02	ug/l	5.91E+02	ug/l	M	3.67E-05	mg/kg-day	7.00E-02	mg/kg-day	N/A	N/A	5.25E-04
	Manganese	1.32E+03	ug/l	1.32E+03	ug/l	M	8.20E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	3.42E-03
	1,2-Dichloroethene (cis)	7.09E-01	ug/l	7.09E-01	ug/l	M	6.59E-07	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	6.59E-05
	Benzene	5.17E-01	ug/l	5.17E-01	ug/l	M	9.97E-07	mg/kg-day	3.00E-03	mg/kg-day	N/A	N/A	3.32E-04
	Chloroform	5.20E-01	ug/l	5.20E-01	ug/l	M	6.52E-07	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	6.52E-05
	Tetrachloroethene	6.35E-01	ug/l	6.35E-01	ug/l	M	3.91E-06	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	3.91E-04
	Trichloroethene	9.05E-01	ug/l	9.05E-01	ug/l	M	1.56E-06	mg/kg-day	6.00E-03	mg/kg-day	N/A	N/A	2.59E-04
	(Total)												5.06E-03
												Total of Routes	1.76E+00

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 12 (RAGS D TABLE 7)
CALCULATION OF NON-CANCER HAZARDS - ADULT RESIDENT INHALATION OF GROUNDWATER VAPORS DURING SHOWERING
REASONABLE MAXIMUM EXPOSURE
WARMINSTER AREA B RI

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air
Exposure Point: Inhalation of Groundwater Vapors During Showering
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	1,2-Dichloroethene (cis)	7.09E-01	ug/l	7.09E-01	ug/l	M	2.37E-05	mg/kg-day	--	--	--	mg/kg-day	--
	Benzene	5.17E-01	ug/l	5.17E-01	ug/l	M	1.88E-05	mg/kg-day	--	--	1.70E-03	mg/kg-day	1.11E-02
	Chloroform	5.20E-01	ug/l	5.20E-01	ug/l	M	1.60E-05	mg/kg-day	--	--	8.60E-05	mg/kg-day	1.86E-01
	Tetrachloroethene	6.35E-01	ug/l	6.35E-01	ug/l	M	1.78E-05	mg/kg-day	--	--	1.40E-01	mg/kg-day	1.27E-04
	Trichloroethene	9.05E-01	ug/l	9.05E-01	ug/l	M	2.75E-05	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												1.97E-01
												Total Hazard Index Across All Exposure Routes/Pathways	1.97E-01

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 13 (RAGS D TABLE 7)
CALCULATION OF NON-CANCER HAZARDS - ADULT RESIDENT TAP WATER CONTACT WITH GROUNDWATER
CENTRAL TENDENCY EXPOSURE
WARMINSTER AREA B RI

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water Contact with Groundwater
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Barium	1.70E+02	ug/l	1.70E+02	ug/l	M	2.18E-03	mg/kg-day	7.00E-02	mg/kg-day	N/A	N/A	3.11E-02
	Manganese	2.20E+02	ug/l	2.20E+02	ug/l	M	2.82E-03	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	1.18E-01
	1,2-Dichloroethene (cis)	6.31E-01	ug/l	6.31E-01	ug/l	M	8.09E-06	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	8.09E-04
	Benzene	5.07E-01	ug/l	5.07E-01	ug/l	M	6.50E-06	mg/kg-day	3.00E-03	mg/kg-day	N/A	N/A	2.17E-03
	Chloroform	5.09E-01	ug/l	5.09E-01	ug/l	M	6.53E-06	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	6.53E-04
	Tetrachloroethene	5.80E-01	ug/l	5.80E-01	ug/l	M	7.44E-06	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	7.44E-04
	Trichloroethene	7.65E-01	ug/l	7.65E-01	ug/l	M	9.81E-06	mg/kg-day	6.00E-03	mg/kg-day	N/A	N/A	1.63E-03
	(Total)												1.55E-01
Dermal	Barium	1.70E+02	ug/l	1.70E+02	ug/l	M	4.72E-06	mg/kg-day	7.00E-02	mg/kg-day	N/A	N/A	6.74E-05
	Manganese	2.20E+02	ug/l	2.20E+02	ug/l	M	6.11E-06	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	2.54E-04
	1,2-Dichloroethene (cis)	6.31E-01	ug/l	6.31E-01	ug/l	M	3.20E-07	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	3.20E-05
	Benzene	5.07E-01	ug/l	5.07E-01	ug/l	M	5.34E-07	mg/kg-day	3.00E-03	mg/kg-day	N/A	N/A	1.78E-04
	Chloroform	5.09E-01	ug/l	5.09E-01	ug/l	M	3.49E-07	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	3.49E-05
	Tetrachloroethene	5.80E-01	ug/l	5.80E-01	ug/l	M	1.95E-06	mg/kg-day	1.00E-02	mg/kg-day	N/A	N/A	1.95E-04
	Trichloroethene	7.65E-01	ug/l	7.65E-01	ug/l	M	7.18E-07	mg/kg-day	6.00E-03	mg/kg-day	N/A	N/A	1.20E-04
	(Total)												8.82E-04
												Total of Routes	1.56E-01

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

APPENDIX B

FIGURES

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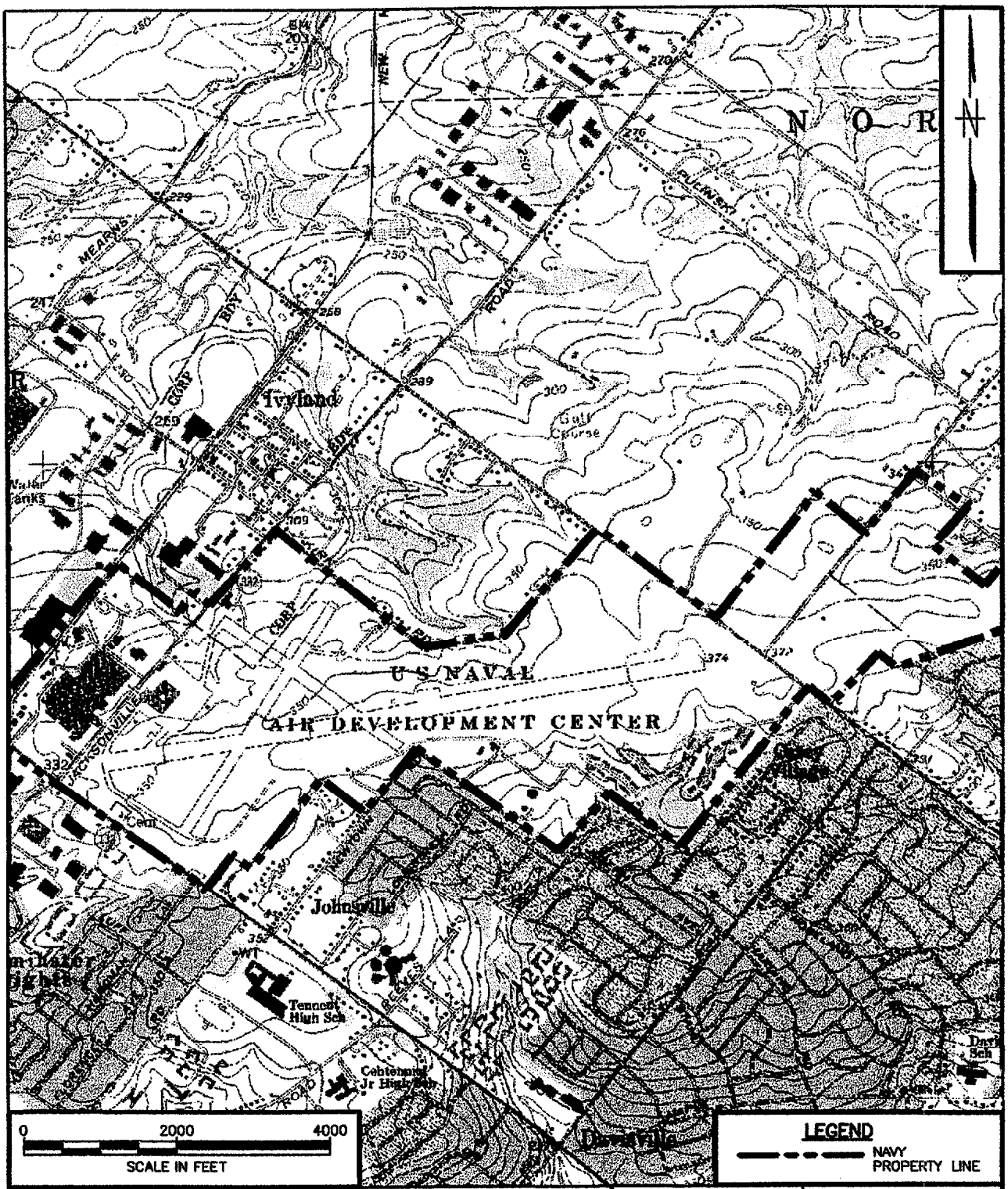
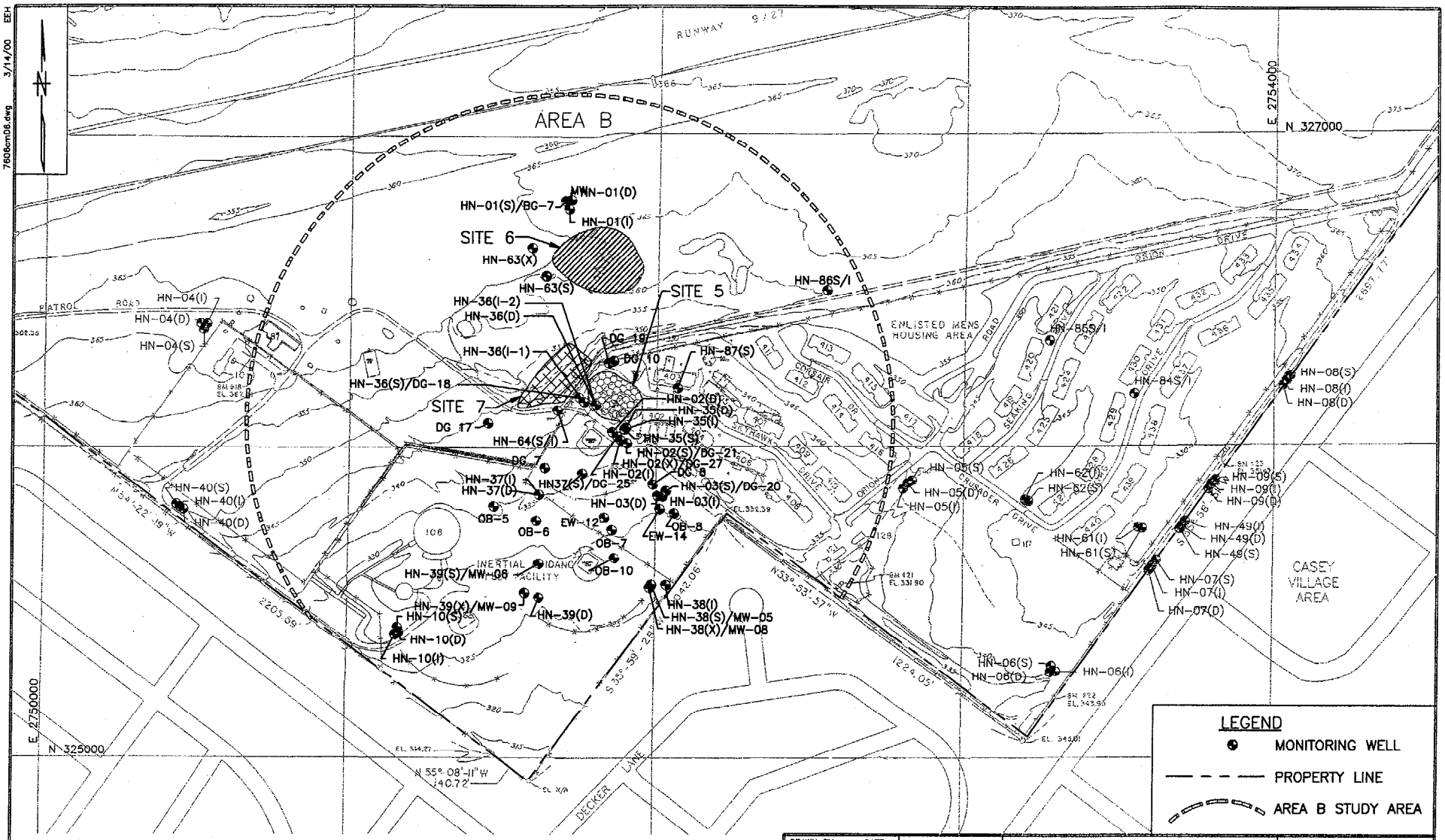


DRAWN BY A.S.M. DATE 11/24/1998	Tetra Tech NUS Inc.	CONTRACT NO. N62472-90-D-1298	OWNER NO. CTO 0252
CHECKED BY DATE	SITE LOCATION MAP	APPROVED BY	DATE 6/29/99
COST/SCHED-AREA	FORMER NAWC WARMINSTER	APPROVED BY	DATE
SCALE 1 in.=2000 ft.	WARMINSTER, PENNSYLVANIA	DRAWING NO. FIGURE 1	REV. 0

FORM L:\AUTOCAD\BLOCKS\BORDERS\TETRA TECH\ TTNUS_AV3.DWG – REV 0 – 11/18/1998



DRAWN BY	DATE
LDL/EEH	3/14/00
CHECKED BY	DATE
REVISED BY	DATE
SCALE	
AS NOTED	

Tetra Tech NUS, Inc.

AREA B SITE FEATURES

NAWC WARMINSTER, PA

CONTRACT NO. 7606

OWNER NO. 0101

APPROVED BY | DATE

DRAWING NO. FIGURE 2 | REV.

7606cm06.dwg 3/14/00 EEH

APPENDIX C

PADEP CONCURRENCE LETTER

APPENDIX D

PUBLIC COMMENTS REGARDING OU-1B

Pennoni

PENNONI ASSOCIATES INC.
CONSULTING ENGINEERS

One Drexel Plaza
3001 Market Street Suite 200
Philadelphia PA 19104-2897
Tel 215-222-3000
Fax 215-222-3588

August 9, 2000

WARM 9608.002.01

Mr. Lonnie Monaco
Naval Facilities Engineering Command (NAVFACENGCOM)
Northern Division
Environmental Contracts Branch, Mail Stop No. 82
10 Industrial Highway
Lester, Pennsylvania 19113

RE: Review Comments
PRAP for Area B Groundwater
Former NAWC Warminster

Dear Mr. Monaco:

Pennoni Associates, Inc. ("Pennoni"), on behalf of Warminster Township, has reviewed the Proposed Remedial Action Plan (PRAP) for Area B Groundwater prepared by the Navy and dated July 2000. In addition, we have reviewed the supporting report entitled *Remedial Investigation Report for Area B Groundwater* dated May 2000, which was prepared by Tetra Tech NUS, Inc. Based on our review we offer the following comments:

1. The PRAP and the Remedial Investigation report address a redefined Area B which only includes the groundwater from Sites 5, 6, and 7. Previous investigations included groundwater in the vicinity of the base boundary with Casey Village. Although we do not object to the "No Action" planned for the groundwater from Sites 5, 6, and 7, the groundwater in the vicinity of the base boundary and Casey Village requires additional investigation and evaluation.

2. All though no further action is planned for Area B groundwater, a representative number of monitoring wells should be retained to monitor the effect of remediation to Sites 6 and 7.

Should you have any questions concerning the above comments, please do not hesitate to contact us.

Very truly yours,

PENNONI ASSOCIATES INC.

J. Anthony Sauder, P.E., P.G.
Senior Hydrogeologist

Terrence Davis /for
Kevin J. Davis, P.E.
Associate Vice President

cc: Robert Camarata, Warminster Township