UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 155
Seattle, WA 98101-3188

SUPERFUND &
EMERGENCY
MANAGEMENT DIVISION

SEP 30 2019

Captain Matt Arny
Commanding Officer
Naval Air Station Whidbey Island
3730 North Charles Porter Avenue
Oak Harbor, Washington 98278-5000

Dear Captain Arny:

The United States Environmental Protection Agency concurs with the United States Department of the Navy on the remedial action set forth in the Record of Decision Amendment for Operable Unit 1 Area 6 of Naval Air Station Whidbey Island Superfund Site. The EPA plans to continue its working relationship with the Navy during implementation of the remedial action. In addition, in keeping with EPA guidance, during the phase of the remedial action which involves monitored natural attenuation, should the data show that MNA is not an effective enough approach for cleanup of the groundwater, the EPA expects there may need to be an alternate remedy for that area of the Site.

The EPA appreciates the continuing efforts by the Navy in addressing contamination at the Site. If there are any questions concerning this letter, please contact the EPA Site Manager, Chan Pongkhamsing, at (206) 553-1806 or by email to pongkhamsing.chan@epa.gov.

Sincerely,

R. David Allnutt
Acting Division Director

cc: Ms. Dina R. Ginn, PE
Environmental Restoration Manager
Naval Facilities Engineering Command, Northwest

FINAL
September 2019

Record of Decision
Amendment No. 1
Operable Unit 1 Area 6

NAS Whidbey
Oak Harbor, Washington

Department of the Navy
Naval Facilities Engineering Command Northwest
1101 Tautog Circle
Silverdale, WA 98315

PART 1
DECLARATION OF THE RECORD OF DECISION
AMENDMENT NO. 1
OPERABLE UNIT 1, AREA 6
NAVAL AIR STATION WHIDBEY ISLAND, OAK HARBOR, WASHINGTON

SITE NAME AND LOCATION

Naval Air Station Whidbey Island
Ault Field
Operable Unit 1, Area 6
Oak Harbor, Washington

EPA ID: WA5170090059

STATEMENT OF BASIS AND PURPOSE

This decision document is an amendment to the Naval Air Station (NAS) Whidbey Island Operable Unit (OU) 1 Record of Decision (ROD), executed in December 1993. The 1993 ROD included requirements specified in the 1992 Interim ROD. The purpose of this document is to amend the selected remedial action for impacted groundwater at OU 1 Area 6 (also referred to as "the site"), located within the NAS Whidbey Island Ault Field Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site in Oak Harbor, Washington. In 2003, the United States (U.S.) Environmental Protection Agency (EPA) requested the U.S. Navy (Navy) evaluate groundwater at the site for 1,4-dioxane as they had identified it at non-Navy sites that had solvent contamination present. The Navy identified 1,4-dioxane at OU 1 Area 6 in 2003. EPA set screening levels for 1,4-dioxane as no federal maximum contaminant level has been established. The Washington State Department of Ecology (Ecology) Model Toxics Control Act (MTCA) Method B groundwater cleanup level for1,4-dioxane decreased from 7.95 micrograms per liter (µg/L) in 2005 to 0.44 µg/L in 2010. The 1993 ROD did not identify 1,4-dioxane as a chemical of concern (COC) and, as such, the remedy did not consider the presence of 1,4-dioxane. As a result, technology prescribed for the treatment portion of the implemented remedy was not designed to remove 1,4-dioxane from groundwater.

This ROD Amendment documents a fundamental change to the selected remedy for the OU 1 Area 6. The original selected remedy in the OU 1 ROD, namely groundwater extraction, treatment with air stripping, and reinjection, was designed to remove chlorinated volatile organic compounds (VOCs) from groundwater. The system has been effective at removing VOCs. However, the system does not remove 1,4-dioxane from groundwater, which was identified in groundwater in 2003 after the 1993 ROD was executed and system operation was initiated in 1995. The Navy has evaluated the extent of 1,4-dioxane in groundwater, addressed exposures, and evaluated treatment options. The maximum February 2018 groundwater concentration for 1,4-dioxane of 10 micrograms per liter poses a 2×10^{-5} risk. Therefore, the primary treatment method of the groundwater extraction, treatment, and recharge (GETR) system must change. Based on results of the 2018 focused feasibility study (FFS), this change will involve ex-situ advanced oxidization using a commercially available HiPOx unit along with an enhanced groundwater extraction network. This amended remedy utilizes a proven treatment technology to remove VOCs and 1,4-dioxane at the same time. This modification to the scope, performance, and cost of the selected remedy represents a fundamental change to the 1993 ROD and therefore requires this ROD Amendment.

This ROD Amendment presents the selected amended remedy for the NAS Whidbey Island Ault Field OU 1 Area 6, in Oak Harbor, Washington, which was chosen in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision was based on the Administrative Record file for the site, which is maintained at Naval Base Kitsap Bangor, 1101 Tautog Avenue (Building 1101, 1st floor), Silverdale, Washington. This ROD Amendment will become part of the Administrative Record in accordance with the NCP, 40 Code of Federal Regulations § 300.825(a)(2).

The Navy is the lead agency for this decision. The EPA is the lead regulatory agency. The EPA and the Navy jointly selected the amended remedy for the site.

ASSESSMENT OF THE SITE

The response action selected for Area 6 in the OU 1 ROD, as modified by this ROD Amendment, is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substance into the environment. Such a release, or threat of release, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The Navy, EPA, and Ecology executed or approved an Interim ROD in April 1992 and the OU 1 ROD in December 1993. The 1992 Interim ROD specifies the selected interim remedial action for Area 6 to significantly reduce the mobility of groundwater contaminants, thereby reducing the potential risk to human health and the environment. Major components of the interim action remedy were:

- Extracting groundwater in the shallow aquifer beneath Area 6 using extraction wells to minimize the spread of the contaminated plume

- Treating the extracted groundwater using metal precipitation, air stripping, and vapor-phase activated carbon
- Discharging treated water back to the shallow aquifer by irrigation or reinjection
- Monitoring of groundwater and treated water to measure effectiveness of the action

The interim remedy was constructed and began operation in 1995.

The OU 1 ROD presents the selected remedy for OU 1 Area 5 and Area 6. Major remedial components of the OU 1 ROD for Area 6 were:

- Capping the landfill operations area trenches with a minimum functional standards cap
- Assessing the interim action extraction system to ensure that it achieves aquifer cleanup levels to determine the need for additional source area extraction wells
- Extracting groundwater from the shallow aquifer at the western boundary of the landfill, treating it by air stripping, and returning the treated groundwater to the shallow aquifer at an on-site location
- Monitoring groundwater in the shallow, intermediate, and deep aquifers to assess the effectiveness of the groundwater treatment system
- Monitoring private drinking water wells in the vicinity of the landfill
- Implementing institutional controls

In accordance with the OU 1 ROD, 10 groundwater extraction wells were installed along with subsurface piping, an air stripping treatment system, and piping for treated water discharge. Injection wells were installed to reinject the treated water back into the shallow aquifer. The GETR system construction was completed and operations began in 1995. The system has operated nearly continuously since that time.

This ROD Amendment modifies the groundwater treatment technology component of the remedy selected for OU 1 Area 6 in the 1992 Interim ROD and 1993 OU 1 ROD, but does not affect the selected remedy components for the landfill or Area 5 that have already been successfully implemented. The remedy selected by this ROD Amendment (amended remedy) consists of the following elements by plume area:

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Off-Site (Southern) Plume- Southern System

- Add five new extraction wells off-site to address the 1,4-dioxane plume through strategic placement along the northern shoulder of State Route 20 (SR20) or as approved in the Remedial Design
- Connect these wells to a piping system to transport extracted water to a treatment system
- Install an advanced oxidation process (AOP) (HiPOx treatment system by APTwater LLC) treatment system, which uses ozone and hydrogen peroxide. This is referred to as the "southern system."

On-Site (Western) Plume- Western System

- Using the existing extraction well network and piping infrastructure to the maximum extent possible.
- Optimize the extraction well network (maintain/add/subtract) with the objective to contain the plume. The optimization could include the strategic addition of up to four new extraction wells with the existing three wells in the western plume. The specific number of extraction wells will be determined during remedial design and based on current data at that time.
- Replacing the existing air stripping tower in the northwestern portion of the site with a second AOP treatment system. Implementation of the AOP system will be initiated following one year of continuous operation of the southern AOP system. The one year of continuous operation will be used to determine if the AOP is working properly with site conditions and to apply any lessons learned to the western plant.

Each of the plumes is expected to transition from an active remedy component to a passive remedy component (monitored natural attenuation). This process will occur as prescribed in Section 8.5. Land use controls and groundwater monitoring implemented as part of the original remedy will remain in place until COC concentrations have been reduced to levels allowing unrestricted land use.

The HiPOx treatment systems are designed to remove VOCs and 1,4-dioxane from groundwater via chemical oxidization.

The selected remedy also adds 1,4-dioxane as a COC, adds a 1,4-dioxane cleanup level, removes 1,1-dichloroethane and cis-1,2-dichloroethene, and modifies cleanup levels for 1,1-dichloroethene and vinyl chloride.

Perfluorooctane Sulfonate and Perfluorooctanoic Acid at Area 6 Relative to the AOP Systems

Per- and polyfluoroalkyl substances (PFAS) are a suite of "emerging" contaminants. There are currently no maximum contaminant levels (MCLs) established under the Safe Drinking Water Act for PFAS chemicals. EPA initiated the steps to evaluate the need for a MCL for PFOA and PFOS under the regulatory determination process. In May 2016, the EPA issued the lifetime health advisory (LHA) level for two PFAS compounds, perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). PFAS comprise of thousands of individual compounds, but the initial focus of the EPA has generally been PFAS termed perfluoroalkyl acids (PFAAs), which include PFOS and PFOA. PFAS, including PFOA and PFOS, are not listed as CERCLA hazardous substances, but in some circumstances could be responded to as CERCLA pollutants or contaminants. EPA is beginning the necessary steps to propose designating PFOA and PFOS as "hazardous substances" through one of the available statutory mechanisms, including potentially CERCLA Section 102.

The Navy sampled groundwater at Area 6 for PFOS and PFOA beginning in December 2017 to identify the presence of PFAS and to see if it would affect the preferred remedy in the FFS. PFOA identified in groundwater at one on-site groundwater monitoring well location was greater than the EPA's LHA level for PFOA, 70 parts per trillion. PFOA was also detected in the treatment system influent and effluent at concentrations below its LHA level. PFAS is currently being evaluated separately under the CERCLA process. The Navy has completed a PFAS preliminary assessment/site inspection for Area 6. A separate ROD will be prepared relative to PFAS if determined to be appropriate based on CERCLA.

In addition to PFAS, there are thousands of polyfluorinated "PFAA precursors," which can transform in the environment to create PFAAs. Oxidation used by the new southern and northern AOP Systems could cause PFAA precursors to oxidize and potentially convert to PFAAs including PFOS and PFOA. In order to assess if oxidation of PFAA precursors would be an issue at the site, the Navy conducted Total Oxidizable Precursor (TOP) assays on groundwater samples from Area 6. Based on the TOP assay results, PFAAs precursors at Area 6 are low and do not yield concern for oxidizing precursors. The Navy will be re-evaluating the potential precursor issue based on future site conditions at Area 6 (including monitoring), the evolving health advisory levels, and potential future regulatory requirements. If it is determined to be necessary, the Navy will address PFOS/PFOA in the effluent.

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STATUTORY DETERMINATIONS

The amended remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial actions, and is cost effective. The amended remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. The amended remedy satisfies the statutory preference for treatment as a principal element of the remedy and reduces toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment. Because the amended remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, statutory reviews will be required at least once every five years after initiation of the amended remedial action under this ROD Amendment to ensure that the remedy is, or will be, protective of human health and the environment.

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RECORD OF DECISION AMENDMENT DATA CERTIFICATION CHECKLIST

The information listed below is included in the Decision Summary section of this ROD Amendment. Section numbers in the list below refer to sections of this ROD Amendment. Additional information can be found in the Administrative Record file for the site.

Checklist Element	Section	Pages
COCs and their respective concentrations	5.2 and 5.3	5-13 to 5-27
Baseline risk represented by the COCs	5.7	5-32 to 5-36
Cleanup levels established for COCs and the basis for these levels	6.3.6	6-5
How source materials constituting principal threats are addressed	8.0	8-1 to 8-20
Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and this ROD Amendment	5.6	5-31 and 5-32
Potential land and groundwater use that will be available at the site as a result of the amended remedy	8.8	8-19
Remedial actions in the original selected remedy that are modified by this ROD Amendment	2.3 6.2 and 6.3	2-2 to 2-3 6-2 to 6-8
Estimated capital, annual operation and maintenance, and total present-worth costs, discount rate, and the number of years over which the remedy cost estimates are projected	7.2.7 8.7	7-12 to 7-14 8-12 to 8-18
Key factor(s) that led to selection of the remedy	8.1	8-1 and 8-2

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RECORD OF DECISION
AMENDMENT NO. 1
OPERABLE UNIT 1 AREA 6
NAVAL AIR STATION WHIDBEY ISLAND

Signature sheet for the foregoing Amendment No. 1 to the Record of Decision for Operable Unit 1 Area 6 at Naval Air Station Whidbey Island between the United States Navy and the United States Environmental Protection Agency.

M.L. ARNY
Captain, U.S. Navy
Commanding Officer
Naval Air Station Whidbey Island

9/27/19
Date

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OPERABLE UNIT 1 AREA 6
NAVAL AIR STATION WHIDBEY ISLAND

Signature sheet for the foregoing Amendment No. 1 to the Record of Decision for Operable Unit 1 Area 6 at Naval Air Station Whidbey Island between the United States Navy and the United States Environmental Protection Agency.

R. David Allnutt
Acting Director, Superfund & Emergency Management Division U.S. Environmental Protection Agency, Region 10

Date 9/27/19

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TABLES

CONTENTS (Continued)

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ABBREVIATIONS AND ACRONYMS

µg/kg	microgram per kilogram
µg/L	microgram per liter
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane
AOP	advanced oxidation process
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Cis-1,2-DCE	cis-1,2-dichloroethene
COC	chemical of concern
CSM	conceptual site model
DCC	direct capital cost
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Difference
FFS	focused feasibility study
FS	feasibility study
GETR	groundwater extraction, treatment, and recharge
gpm	gallon per minute
GPR	ground-penetrating radar
HI	hazard index
Hp	horsepower
HQ	hazard quotient
IC	institutional control
ID	identification
IRIS	Integrated Risk Information System
ISCO	in-situ chemical oxidation
LHA	lifetime health advisory
LUC	land use control
MCL	maximum contaminant level
msl	mean sea level
MFS	minimum functional standards
MNA	monitored natural attenuation
MTCA	Model Toxics Control Act (Washington State)
NAS	Naval Air Station

ABBREVIATIONS AND ACRONYMS (Continued)

NAVFAC	Naval Facilities Engineering Command
Navy	United States Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NHPA	National Historic Preservation Act
no.	number
NPL	National Priority List
O&M	operation and maintenance
OU	operable unit
PFAAs	perfluoroalkyl acids
PFAS	per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PQL	practical quantitation limit
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RG	remediation goal
RI	remedial investigation
ROD	Record of Decision
SDR	standard dimension ration
SR	State Route
TCE	trichloroethene
TOP	Total Oxidizable Precursor
U.S.	United States
U.S.C.	United States Code
VOC	volatile organic compound
WAC	Washington Administrative Code
WWTP	Wastewater Treatment Plant

PART 2
DECISION SUMMARY

1.0 INTRODUCTION

1.1 STATEMENT OF PURPOSE

This document amends the Naval Air Station (NAS) Whidbey Island Operable Unit (OU) 1 Record of Decision (ROD) for Area 6, executed by the United States (U.S.) Navy (Navy) on December 22, 1993 (U.S. Navy, Ecology, and EPA 1993a). The OU 1 ROD selected a remedy for OU 1 Area 6 (also referred to in this document as “the site”), which is located within the NAS Whidbey Island Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Ault Field site near the city of Oak Harbor, Island County, Washington (Figure 1-1). This ROD Amendment documents a fundamental change to the selected remedy for the OU 1 Area 6.

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Section 300.435(c)(2)(ii) requires that a fundamental change to the scope, performance, or cost of a remedy selected in a ROD be documented with a revised proposed plan and amended ROD. The original selected groundwater remedy at the NAS Whidbey Island, OU 1 Area 6 will be amended to utilize a significantly different treatment technology and upgrade the extraction network. The preferred alternative from the focused feasibility study (FFS) is described in the Proposed Plan for NAS Whidbey Island dated November 2018 (U.S. Navy 2018b). This ROD Amendment presents the remedial alternative selected to amend the original selected remedy in the OU 1 ROD for Area 6 at NAS Whidbey Island. The original selected groundwater remedy in the OU 1 ROD, groundwater extraction, treatment with air stripping, and reinjection was designed to remove chlorinated volatile organic compounds (VOCs) from groundwater. The system has made significant progress towards removing VOCs and meeting the remedial action objectives (RAOs). The selected remedy also adds 1,4-dioxane as a chemical of concern (COC), adds a 1,4-dioxane cleanup level, removes 1,1-dichloroethane (1,1-DCA) and cis-1,2-dichloroethene (cis-1,2-DCE), and modifies cleanup levels for 1,1-dichloroethene (1,1-DCE) and vinyl chloride.

In 2003, the U.S. Environmental Protection Agency (EPA) requested the Navy evaluate the groundwater at the site for 1,4-dioxane as they had identified it at non-Navy sites that had solvent contamination present and the Navy identified 1,4-dioxane at Area 6 in 2003. The current air stripper system does not remove 1,4-dioxane from groundwater since it was identified in groundwater after the 1992 interim ROD and the 1993 ROD were executed and system operation was initiated in 1995. As a result, the 1992 interim ROD and the 1993 ROD did not consider 1,4-dioxane when specifying air stripping as the primary treatment technology.

The Navy has evaluated the extent of 1,4-dioxane in groundwater and addressing exposures. However, 1,4-dioxane remains in groundwater at concentrations greater than the Washington State Department of Ecology (Ecology) Model Toxics Control Act (MTCA) Method B groundwater cleanup level in and around Area 6. Therefore, the primary treatment method of the groundwater extraction, treatment, and recharge (GETR) system will be changed to ex-situ advanced oxidization using a commercially available HiPOx unit. This amended remedy utilizes a proven treatment technology to remove VOCs and 1,4-dioxane at the same time. The amended remedy also includes an enhancement and optimization of the extraction well network. Because of the addition of 1,4-dioxane and the significant progress made towards removing VOCs, the COC list and the remediation goals (RGs) are also revised in this ROD Amendment.

These modifications to the scope, performance, and cost of the selected groundwater remedy represents a fundamental change and therefore requires this ROD Amendment.

This ROD Amendment has been developed in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act, and, to the extent practicable, the NCP. This decision is based on the Administrative Record for the site. In accordance with the NCP, 40 CFR Sections 300.825(a)(2) and 300.435(c)(2)(ii), and Section 117 of CERCLA, 423 United States Code (U.S.C.) § 9617, this ROD Amendment will become part of the Administrative Record file, which is maintained at Naval Base Kitsap Bangor, 1101 Tautog Avenue (Building 1101, 2nd floor), Silverdale, Washington. Members of the public may request a copy of these items by contacting the Naval Facilities Engineering Command (NAVFAC) Northwest Public Affairs Officer at (360) 396-1030. Currently, the FFS Report and other major Area 6 decision documents may be reviewed at the Oak Harbor/Sno-Isle Library, 1000 SE Regatta Dr., Oak Harbor, WA 98277 and may be viewed online at https://navfac.navy.mil/NASWIRAB.

The Navy is the lead agency for this decision. The EPA is the lead regulatory agency. Ecology has transferred lead regulatory agency status for NAS Whidbey Island to the EPA and was therefore not involved in this ROD Amendment.

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U.S. NAVY	**Figure 1-1** **Site Location Map**	N62742-12-D-1829 N4425517F4073 Area 6 NAS Whidbey Island ROD AMENDMENT

1.2 SITE NAME, LOCATION, AND DESCRIPTION

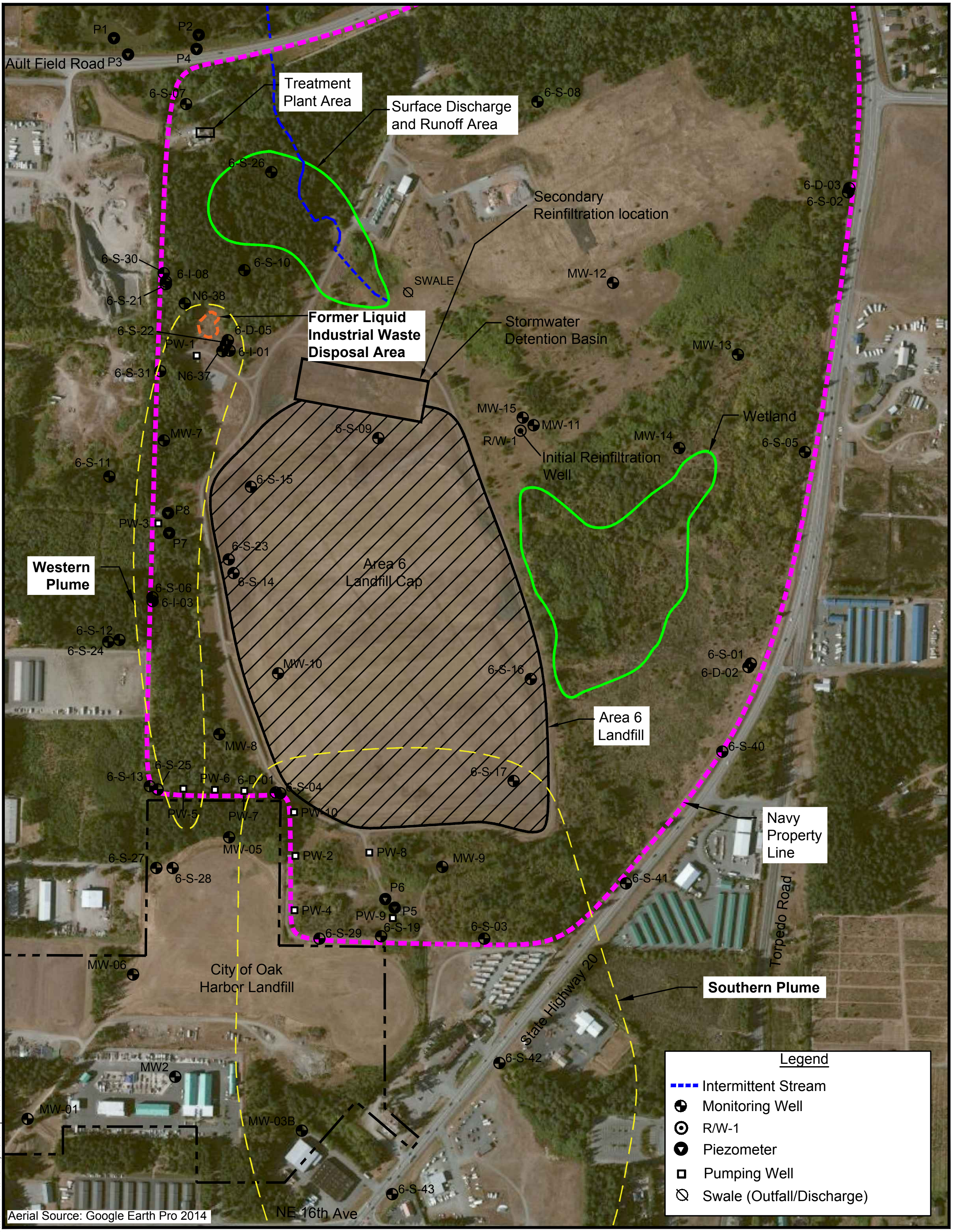
The Superfund site name as listed on the National Priorities List (NPL) is NAS Whidbey Island. This name encompasses two separate and proximal installations: Ault Field and Seaplane Base. Separate EPA identification (ID) numbers were issued, one for Ault Field and one for Seaplane Base (Figure 1-1). OU 1 Area 6 is located within the NAS Whidbey, Ault Field site (EPA ID number WA5170090059). The EPA placed NAS Whidbey Island on the NPL in 1990 for management of chemical contaminants under CERCLA. The NAS Whidbey CERCLA site has been divided into five separate OUs:

- The ROD for OU 1 was prepared in 1993 (U.S. Navy, Ecology, and EPA 1993a). OU 1 consists of:
  - Area 5, Highway 20/Hoffman Road Landfill
  - Area 6, Former Industrial Waste Disposal Area and the Navy Municipal Landfill
- The ROD for OU 2 was prepared in 1994 (U.S. Navy, Ecology, and EPA 1994). OU 2 consists of:
  - Area 2, Former Western Highlands Landfill
  - Area 3, Former 1969–1970 Landfill
  - Area 4, Former Walker Barn Storage Area
  - Area 14, Former Pesticide Rinsate Disposal Area
- The ROD for OU 3 was prepared in 1995 (U.S. Navy, Ecology, and EPA 1995). OU 3 addresses environmental concerns at select runaway ditches at NAS Whidbey Ault Field.
- The ROD for OU 4 was prepared in 1993 (U.S. Navy, Ecology, and EPA 1993b). OU 4 addresses environmental concerns at NAS Whidbey Seaplane Base. OU 4 consists of:
  - Area 39, Auto Repair and Paint Shop
  - Area 41, Building 25/26 Disposal Area
  - Area 44, Seaplane Base Nose Hangar
  - Area 48, Salvage Yard
  - Area 49, Seaplane Base Landfill

- The ROD for OU 5 was prepared in 1996 (U.S. Navy, Ecology, and EPA 1996). OU 5 consists of:
  - Area 1, Former Beach Landfill
  - Area 31, Former Runway Fire Training School
  - Area 52, Jet Engine Test Cell

Area 6 is a 260-acre tract in the southeastern corner of Ault Field (Figure 1-2) with buildings related to the NAS Whidbey Island composting operation in the northern central portion and the current GETR system in the northwestern portion. Area 6 is contiguous with Ault Field but separated from it by Ault Field Road. Area 6 is bordered by Ault Field Road to the north, State Route (SR) 20 to the east, and the City of Oak Harbor Landfill on the south and southwest. Privately owned forested or logged land, a planned housing development, and a commercial sand and gravel quarry operation are located immediately west of Area 6. The City of Oak Harbor vehicle maintenance operation, an auto salvage yard, a transmission repair shop, the Auld Holland Inn, a mobile home park, and the Oak Harbor landfill are located in or near the southern boundary of the property. Private residences are located to the east, west, and south of the Area 6 landfill.

There are two areas where wastes are known to have been disposed of at Area 6 (the former industrial liquid waste disposal area and the Area 6 landfill) and the history of site activities related to these areas is discussed further in Section 2.1.



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U.S. NAVY	N; 0 300 600 SCALE IN FEET	**Figure 1-2** **Site Aerial Photograph Showing Current and Historical Features**	N62742-12-D-1829 N44255517F4073 Area 6, NAS Whidbey Island ROD Amendment

2.0 SITE ENVIRONMENTAL HISTORY AND ORIGINAL SELECTED REMEDY

This section describes the history of Area 6 and the original remedy selected for the site in the OU 1 ROD. The history of the NAS Whidbey Island CERCLA site and the selected remedies for the remainder of OU 1 are described in the OU 1 ROD.

2.1 WASTE DISPOSAL HISTORY

Within Area 6, there are two areas where wastes are known to have been disposed of at Area 6: the former industrial liquid waste disposal area and the Area 6 landfill.

Liquid wastes were disposed of at the former industrial liquid waste disposal area. These wastes reportedly consisted of solvents, oily sludges, thinners, and other compounds. Waste disposal began in 1969 and ended in the early 1980s. The former industrial liquid waste disposal area is approximately 15 feet wide by 40 feet long. During operation, it was a pit (also called the former waste oil pit) approximately 10 feet deep. Prior to remedy implementation, it was filled and covered with natural vegetation. This has been identified as a source of VOCs to groundwater at the site (U.S. Navy 1993).

A separate portion of Area 6 was used as a landfill from 1969 to 1992. Wastes disposed in the Area 6 landfill include asbestos, acids, caustics, solvents, oily sludges, construction debris, and animal remains. Most of the landfill area received and contains Navy household municipal waste (U.S. Navy 1993). This landfill operations area was approximately 40 acres and is now covered with a synthetic cap, soil, and natural vegetation, which were constructed in 1995. The synthetic cap, which was an OU 1 ROD remedy component, prevents infiltration of rainwater (U.S. Navy 1993).

2.2 SITE ENVIRONMENTAL HISTORY

An initial assessment study was completed in 1984 that resulted in NAS Whidbey (Ault Field and Seaplane Base) being proposed for inclusion on the NPL. A current situation report was completed in 1988 and NAS Whidbey Island was added to the NPL in 1990. The final remedial investigation (RI)/feasibility study (FS) for OU 1 was completed in 1993. The RI/FS identified two groundwater plumes in the upper (first) groundwater aquifer (approximately 80 to 120 feet deep) at the site. One groundwater contaminant plume contained a range of VOCs and was located along the western property boundary. This plume is referred to as the “western plume” and its location is shown on Figure 1-2. A second groundwater contaminant plume was identified in the southern portion of the site and was thought to contain vinyl chloride only. This plume is referred to as the "southern plume" (Figure 1-2). In 1993, the western plume was estimated to be approximately 2,500 feet long and 800 feet wide. The southern plume was estimated to be approximately 2,900 feet long and 1,600 feet wide. The downgradient extent of the southern plume had not been defined in 1993 (U.S. Navy 1993).

2.3 ORIGINAL SELECTED REMEDY

The Navy, EPA, and Ecology executed or approved an Interim ROD in April 1992 (U.S. Navy, Ecology, and EPA 1992) and the OU 1 ROD in December 1993 (U.S. Navy, Ecology, and EPA 1993a). The 1992 Interim ROD specifies the selected interim remedial action for Area 6 to significantly reduce the mobility of groundwater contaminants, thereby reducing the potential risk to human health and the environment. Major components of the interim action remedy were:

- Extracting groundwater in the shallow aquifer beneath Area 6 using extraction wells to minimize the spread of the contaminated plume
- Treating the extracted groundwater using metal precipitation, air stripping, and vapor-phase activated carbon
- Discharging treated water back to the shallow aquifer by irrigation or reinjection
- Monitoring of groundwater and treated water to measure effectiveness of the action

The 1993 OU 1 ROD describes the original selected remedy for soil and groundwater at OU 1 Area 6 as follows:

A combination of landfill capping and groundwater control actions is the best way to achieve the broader goal of restoring groundwater in the shallow aquifer to levels that are protective of human health and the environment. The Navy's selected remedy for Area 6, to meet this goal at OU 1, incorporates the interim action remedy (groundwater extraction and treatment by air stripping) and capping the landfill operations area with a minimum functional standards (MFS) cap.

The major components of the selected remedial action were:

- Capping the landfill operations area trenches with an MFS cap
- Assessing the interim action extraction system to ensure that it achieves aquifer cleanup levels and specifically to determine the need for additional source area (former industrial liquid waste disposal area) extraction wells

- Extracting groundwater from the shallow aquifer at the western boundary of the landfill, treating it by air stripping, and returning the treated groundwater to the shallow aquifer at an on-site location
- Monitoring groundwater in the shallow, intermediate, and deep aquifers to assess the effectiveness of the groundwater treatment system
- Monitoring private drinking water wells in the vicinity of the landfill
- Implementing institutional controls (ICs)

The former industrial liquid waste disposal area was not capped as part of the ROD, and rainwater is allowed to infiltrate through the contaminated subsurface soils. Concentrations of VOCs present in the soils do not present an unacceptable CERCLA risk. Per the ROD, the concentrations are below levels that are considered to be protective of groundwater (100 times groundwater cleanup levels).

The 1993 OU 1 ROD did not identify any COCs for soil. The following COCs were identified for groundwater: trichloroethene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), 1,1-DCA, 1,1-DCE, cis-1,2-DCE, and vinyl chloride.

Construction of the original remedy selected in the OU 1 ROD was completed in 1995. Eight groundwater extraction wells had been installed and were pumping water to the air stripping tower at the treatment facility. Treated system effluent was initially discharged to reinfiltration wells (R/W-1, MW-15, and MW-11) located near the northeast corner of the landfill. Reinfiltration well plugging issues resulted in construction of an infiltration gallery in this area. Plugging issues continued with the infiltration gallery and effluent was then surface discharged to a secondary reinfiltration location (the stormwater detention basin) north of the landfill. Infiltration issues in the detention basin and issues with migratory birds resulted in abandonment of this approach. Since then, treatment system effluent has been directly discharged to the ground surface discharge and runoff area north of the landfill for reinfiltration (Figure 1-2). The current system includes 10 groundwater extraction wells, eight of which are operating. (The two wells that are not operational are production well PW-2 and PW-10. PW-2 is no longer used due to structural issues, and well PW-10 was not incorporated into the extraction system.) Existing system components are shown on Figure 2-1.

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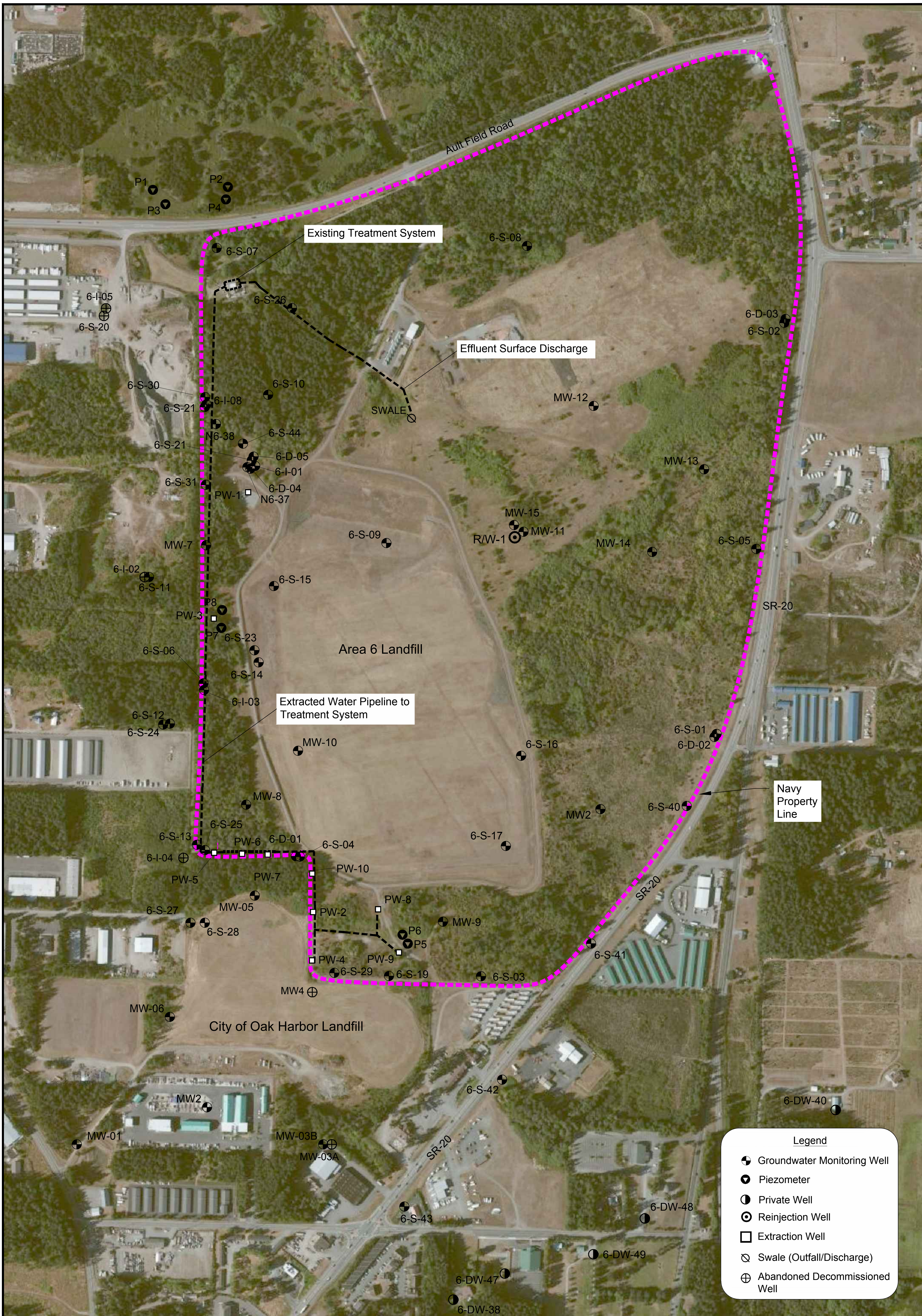

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Figure 2-1
Current Treatment System Components

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Area 6, NAS Whidbey Island
ROD Amendment

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2.4 POST-ROD ACTIONS, INVESTIGATIONS, AND STUDIES

A removal action, additional investigations and studies have been completed since the ROD was executed in 1993.

A chronology of remedial actions conducted at Area 6 is:

- 1992 – Interim ROD execution (U.S. Navy, Ecology, and EPA 1992)
- 1993 – ROD execution (U.S. Navy, Ecology, and EPA 1993a)
- 1993 to 1994 – GETR system construction
- 1995 to present – GETR system operation and maintenance (O&M)
- 1999 to 2001 – Supplemental site characterization (U.S. Navy 2001)
- 2001 – Interim soil removal action
- 2007 – Explanation of Significant Difference (ESD) to formally institute land use controls (LUCs)
- 2010 to 2011 – Additional vadose zone investigation and Update Conceptual Site Model (CSM)
- 2009 to 2012 – Bench-scale treatability studies
- 2014 – Data Gap Sampling
- 2014 – In-Situ Chemical Oxidation (ISCO) Field Treatability Study
- 2017 – ISCO Bench Scale Treatability Study by APTwater

Post-ROD actions and investigations are described in the following subsections.

2.4.1 1999 to 2001 Supplemental Site Characterization

In 1999, the EPA issued a letter to Engineering Field Activity Northwest (now NAVFAC Northwest) indicating the need to focus a potential source area investigation in the area to the north/northeast of the original presumed source area (the former liquid industrial waste disposal area) (Figure 1-2) to determine if there is a continuing source of contamination in the area.

In response to the EPA's request, the Navy agreed to conduct three field activities for supplemental source area characterization including a ground-penetrating radar (GPR) survey, a soil gas survey, and test pit excavation with soil sampling (U.S. Navy 2001).

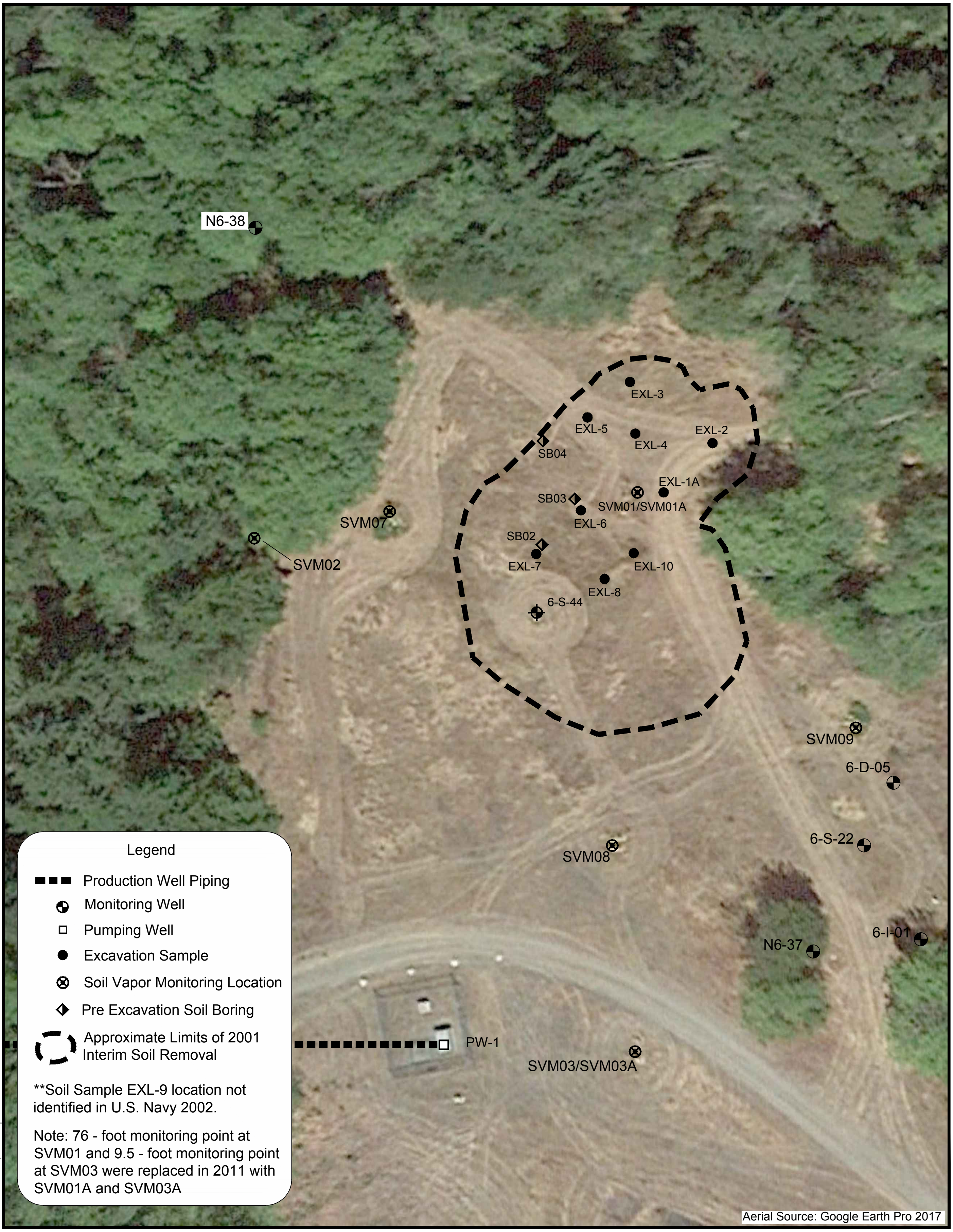
The GPR survey succeeded in identifying the depth and lateral extent of disturbed ground that delineated three large, irregular areas of the former liquid industrial waste disposal area. Based on soil gas survey and test pit sampling results, the report concluded that some soil contamination at elevated concentrations existed in the former liquid waste disposal area, although the extent and nature were not well delineated for the most part.

2.4.2 2001 Investigations and Removal Action

To reduce the residual contaminant mass within the known source area (former industrial liquid waste disposal area) identified in the "supplemental investigation," the Navy conducted an interim soil removal action in 2001. To support the removal action, soil and soil vapor sampling was conducted in the former source area to evaluate the lateral and vertical extent of residual impacts. Soil sampling was conducted during installation of six soil vapor monitoring probes (SVM01 through SVM06) and completion of three pre-excavation characterization borings (SB02, SB03, and SB04). TCE was measured in these soil samples at concentrations ranging from 16 to 390 micrograms per kilogram (µg/kg). The highest concentrations were measured in samples from SB02 and SB03 (Figure 2-2). Soil vapor probes SVM04 and SVM06 were installed immediately adjacent to the western property boundary and are off the Figure 2-2 area. The locations of SVM04 and SVM06 were not identified as a potential residual source area.

During the 2001 interim action, soil was excavated to a depth of approximately 20 feet. Quantities of materials treated and disposed of during the interim removal action were (U.S. Navy 2002):

- 1,360 yards (2,040 tons) of non-hazardous soils and materials were sent to an off-site facility for thermal desorption and disposal
- 600 yards (900 tons) of hazardous soils and materials were sent to Chemical Waste Management for direct landfill disposal
- 354 yards (531 tons) of hazardous soil and material were sent to Chemical Waste Management for pre-treatment (bioremediation) and disposal



U.S. NAVY	0 20 40 SCALE IN FEET	**Figure 2-2 Source Area Investigation Locations And Extent of 2001 Soil Removal Former Industrial Liquid Waste Disposal Area**	N62742-12-D-1829 N4425517F4073 Area 6, NAS Whidbey Island ROD Amendment

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A total of 2,315 cubic yards of soil were removed. The estimated total amount of TCE removed from the waste oil pit area was 166.5 pounds (U.S. Navy 2002).

The approximate limits of this soil removal are shown on Figure 2-2. Subsequent soil and soil vapor sampling identified the continued presence of VOCs in vadose zone soil beneath this excavation. The excavation base soil samples were collected from 10 locations (EXL-1 through EXL 10) (Figure 2-2). The source document does not show a location for EXL-9. These samples contained TCE at concentrations ranging from 210 to 8,200 µg/kg and represent soil that was left in place after the interim removal action. The excavation soil samples did not contain 1,1,1-TCA, 1,1-DCA, 1,2-DCE, cis-1,2-DCE, or vinyl chloride at concentrations greater than their respective reporting limits (U.S. Navy 2002).

TCE and 1,1,1-TCA were measured in soil vapor samples collected during 2001 (pre-removal action) and 2003 (post-removal action). The 2001 and 2003 vapor concentrations were similar. Sampling data concluded that VOC concentrations in vadose zone soil, particularly soil close to the groundwater surface, were elevated and had not decreased subsequent to the interim removal action (U.S. Navy 2004). The 2001 and 2003 sampling occurred prior to identification of the emerging contaminant 1,4-dioxane; therefore, samples were not analyzed for it.

2.4.3 2007 Explanation of Significant Difference to Formally Institute Land Use Controls

The Navy prepared an ESD to·the RODs for OUs 1 through 5 on NAS Whidbey Island (U.S. Navy 2007). The Navy and EPA signed the RODs with the concurrence of Ecology. The five RODs specifically addressed by the ESD are:

- OU 1, Ault Field, 20 December 1993, *EPAIRODIRIO-94/075*
- OU 2, Ault Field, 2 June 1994, *EPAlROD1R1O-94/077*
- OU 3, Ault Field, 29 March 1995, *EPAIROD1R10-95/113*
- OU 4, Seaplane Base, 20 December 1993, *EPAIRODIRI0-94/074*
- OU 5, Ault Field, 10 July 1996, *EPAIRODIRI0-961142*

The ESD was prepared per Section 117 (c) of CERCLA, 42 U.S.C. § 9617(c), and the NCP, 40 CFR § 300.435(c) (2), and an October 2003 interim guidance document titled, *Navy Principles and Procedures for Specifying, Monitoring and Enforcement of Land Use Controls and Other Post-ROD Actions.*

The ESD identifies or clarifies the LUC requirements for individual areas within the RODs, and documents the procedures the NAS Whidbey Island will undertake to ensure effective implementation of LUCs for the individual areas. The ESD is part of the administrative record for the Ault Field and Seaplane Base facilities.

The ESD specifies Area 6 includes the plumes of contaminated groundwater above the maximum contaminant levels (MCLs) originating from this area. Area 6 is bordered by: Ault Field Road to the north, State Highway 20 to the east and the Oak Harbor Landfill on the south and southwest boundaries (Figure 1-2).

The following LUCs or restrictions were applied to OU 1 Area 6 in the 2007 ESD:

- No down-gradient well drilling except for monitoring wells and or remediation system wells authorized by the EPA and Ecology in approved plans
- Protect existing monitoring wells
- No use of groundwater from or downgradient of the area except for monitoring and remediation as approved by the EPA and Ecology
- Prevention of any disturbance to the landfill cap, except as necessary for authorized cap maintenance and maintenance activities
- Ensure that land use at Area 6 remains commercial and/or industrial, which includes a prohibition on development and use of this property for residential housing, elementary and secondary schools, child care facilities, and playgrounds

2.4.4 2010 to 2011 Additional Vadose Zone Investigation

Drilling and soil sampling were conducted at three locations in the former liquid industrial waste disposal area to the groundwater surface. Two of these drilling locations were to replace vapor probes that were no longer functioning. The third was to install another set of vapor monitoring points. The drilling locations, depths, and purpose were:

- SVM-01A, 80 feet, replacement for the 76 foot probe at SVM-01
- SVM-03A, 89 feet, replacement probe for the 9.5- to 10-foot probe at SVM-03
  - Please note SVM-03A was drilled to the top of the groundwater surface and soil samples were collected for analysis. The boring was completed as a soil vapor monitoring probe screened from 9.5 to 10. 5 feet below ground surface (bgs) as a replacement for SVM-03, which was no longer functioning as needed.
- SVM-07, 82 feet, new vapor probes at 10, 32, 54, and 76.5 feet

The replacement locations were collected as close to the original locations as possible to provide a general comparison of 2001 and 2011 soil conditions. TCE and 1,1,1-TCA concentrations in soil samples collected during the 2010 replacement vapor probe installation decreased to varying degrees when compared to soil samples collected in 2001 at similar depths (U.S. Navy 2013). TCE and 1,1,1-TCA soil vapor concentrations also decreased to varying degrees in samples collected during 2010 and 2011 compared to samples collected in 2001 and 2003.

Leaching of residual TCE in vadose zone soil was simulated using SESOIL. The highest TCE concentration measured in 2011 soil samples was used. Results indicate that vadose zone soil is not impacting groundwater at concentrations greater than the MCL of 5 micrograms per liter (µg/L) (U.S. Navy 2013). It should be noted the SESOIL conclusion was based on the soil data available at that time.

2.4.5 2009 to 2012 Bench-Scale Treatability Studies

During 2009, the Navy began evaluating the use of microbial mats and advanced oxidation as potential alternatives for treating groundwater containing 1,4-dioxane.

2.4.6 Biomats

Biomats were evaluated for application at the site. Biomats are engineered green remediation systems consisting of constructed photosynthetic microbial mats used to remove organic and inorganic contaminants from water. Microbial mats will rapidly and non-selectively remove organic and inorganic compounds from water via biosorption and biodegradation of the degradable constituents. Biomats were evaluated to perform ex situ treatment of extracted groundwater as a replacement to the existing air stripping system which does not treat 1,4-dioxane. A bench-scale, biomat study was performed by the Navy (U.S. Navy 2011). The treatability study was conducted by an independent contractor with biomat experience.

Additional pilot testing was recommended to further evaluate a microbial mat with bioaugmented constructed treatment wetland system at the site. The proposed pilot test system consisted of at least four ponds capable of treating the full discharge of the existing treatment system, 200 gallons per minute (gpm). The size of each pond would be approximately 23,800 square feet (about 0.55 acre), and each pond would be at least 2 feet deep. It was recommended the root zones be augmented with actinomycetes CB-1190 to enhance the biodegradation of 1,4-dioxane.

The team (Navy, EPA, and stakeholders) evaluated the bench-scale test data and concluded that bioaugmentation with actinomycetes CB-1190 would be required to treat 1,4-dioxane. The ability to maintain a significant population of 1,4-dioxane-degrading bacteria would be very difficult under current field conditions, especially with the relatively low levels of 1,4-dioxane in the 200 gpm effluent. Additionally, the construction of a three- to four-acre wetland near the airfield would not be acceptable to Naval operations due to the influx of birds impacting airport safety. The operation of a plate and tray bioreactor with microbial mats was not considered practical at the high flow rates associated with the treatment system. Based on these conclusions, biomats were screened out during the FFS.

2.4.7 Ex Situ Advanced Oxidization

Advanced oxidization was evaluated via bench-scale testing and found to be effective at reducing VOC and 1,4-dioxane concentrations in groundwater from the site using an ex situ treatment system (U.S. Navy 2018c). Ex situ treatment using advanced oxidation was retained as a treatment technology employed in conjunction with groundwater extraction.

2.4.8 2014 Data Gap Sampling

Soil Sampling

Additional soil, soil vapor, and groundwater samples were collected from the former liquid industrial waste disposal area in 2014. One groundwater monitoring well (6-S-44) was installed through the excavated area to monitor groundwater directly beneath the former liquid industrial waste disposal area. Two additional vapor monitoring point clusters were installed (SVM-08 and SVM-09) to measure soil vapor concentrations in two areas that had elevated soil vapor concentrations based on soil vapor sampling conducted during the RI. These locations are shown on Figure 2-2.

TCE was measured in soil samples at concentrations ranging from 52 to 230 µg/kg at depths of 25 feet bgs to approximately 80 feet bgs (the groundwater surface) from these three locations. 1,4-Dioxane was measured at concentrations of 2.6 µg/kg and 34 µg/kg in the samples collected from 55 feet bgs and 80 feet bgs at well 6-S-44, respectively. The 80-foot sample was collected at the top of the groundwater surface (U.S. Navy 2015a). The calculated Washington State MTCA Method B protection of groundwater cleanup level for TCE in soil is 33 µg/kg and for 1,4-dioxane in soil is 1.8 µg/kg.

Soil Vapor Sampling

Soil vapor was collected from 24 monitoring points at six locations (SVM-01A, SVM-02, SVM-03A, SVM-07, SVM-08, and SVM-09) during 2014 (Figure 2-2). Each of these vapor monitoring locations have four depth-specific sampling ports. The 76-foot monitoring point at SVM-01 and 9.5- to 10-foot monitoring point at SVM-03 were replaced in 2011 with SVM-01A and SVM-03A. A total of 24 primary soil vapor samples were collected for analysis between August 4 and 9, 2014.

The 2014 source area (former industrial liquid waste disposal area) sampling indicated concentrations of almost all target compounds in soil vapor continue to decrease at varying rates (U.S. Navy 2015a). The decreasing vadose zone vapor concentrations indicate the residual volatile contaminant mass in soil is decreasing, which results in a decreasing contribution to groundwater.

Former Source Area Well Installation

Well 6-S-44 was installed and sampled within the former source area excavation prior to installation of the injection wells for the ISCO treatability study. It is screened from approximately 5 to 15 feet below the groundwater surface, which is beneath the interim removal action area. Initial sample results from well 6-S-44 showed very low TCE and 1,4-dioxane concentrations. Six groundwater samples were collected from 6-S-44 during July 2014 to December 2014 and concentrations of TCE ranged from 0.62 to 27 µg/L. The highest TCE concentration measured in groundwater directly beneath the former source area was 27 µg/L (U.S. Navy 2015b) and these concentrations do not reflect a strong residual source in vadose zone beneath the former source area. Some uncertainty exists relative to residual source mass to groundwater in the former source area vadose zone soil, but data collected to date indicate that the potential for an ongoing contribution to groundwater is very low.

2.4.9 2014 Treatability Study

Injection wells IW-01 through IW-08 and monitoring wells 6-S-46, 6-S-47, and 6-S-48 were installed during August 2014 to support an ISCO treatability study (Figure 2-3). Two areas were tested for two separate oxidants, catalyzed hydrogen peroxide, and activated persulfate. These areas were selected because both TCE and 1,4-dioxane were expected to be present, and they were sufficiently separated to not have overlapping influences. Peroxide was selected because the oxidization reaction occurs very quickly after injection and the chemical degrades rapidly. Persulfate was selected because it persists for up to 30 days in the subsurface.

Field screening of soil samples collected during well installation showed elevated total VOC concentrations in vadose zone soil samples collected from wells IW-05 through IW-08. This line of injection wells is located just north of well PW-1 and just south and downgradient of the former source area (former industrial liquid waste disposal area). Groundwater flow at the site under active pumping conditions is to the south. Under nonpumping conditions, groundwater flow is to the south-southwest. Field screening results for soil samples from IW-01 through IW-04, approximately 120 feet south of IW-05 through IW-08, noted higher VOC concentrations in vadose zone samples closer to the groundwater surface (U.S. Navy 2015b).

TCE was measured in soil samples from wells IW-01 through IW-08 at concentrations ranging from 37 to 290 µg/kg. All but one of these samples were collected from just above the groundwater surface (U.S. Navy 2015b).

Baseline groundwater samples were collected from the ISCO treatability study injection and associated monitoring wells prior to oxidant injection for the treatability study. Baseline sample results for the southern line of injection wells (IW-01 through IW-04) (Figure 2-3) show that TCE was highest in groundwater samples from the westernmost well IW-01 (45 µg/L). Concentrations were less than half that value in wells IW-02 through IW-04 and downgradient monitoring wells 6-S-46 and 6-S-48 (U.S. Navy 2015b). Baseline groundwater samples from the northern line of injection wells contained TCE at concentrations ranging from 6.9 to 42 µg/L, with the sample from IW-05 containing 42 µg/L. Baseline groundwater samples from the downgradient monitoring points (PW-1 and 6-S-47) contained TCE at concentrations of 0.62 and 25 µg/L, respectively (U.S. Navy 2015b).

Baseline 1,4-dioxane groundwater sample results from the southern line of injection wells (IW-01 through IW-04) ranged from 1.8 to 2.7 µg/L. Baseline 1,4-dioxane concentrations were consistent in samples from the southern injection wells ranging in concentrations from 1.8 to 1.9 µg/L and were higher in the downgradient monitoring wells. Baseline groundwater samples from the northern line of injection wells (IW-05 through IW-08) contained 1,4-dioxane at concentrations ranging from 1.8 to 3.7 µg/L.

Baseline results show the test areas, located immediately downgradient of the former liquid industrial waste disposal area, had residual TCE and 1,4-dioxane concentrations sufficient for the treatability study at the time of testing.

After the single peroxide injection, TCE concentrations decreased by 60 percent. In some cases concentrations then rebounded. This is expected since ISCO can release adsorbed concentrations during the initial injections. The single persulfate injection had similar results.

The ISCO treatability study concluded catalyzed hydrogen peroxide and activated persulfate have the potential to reduce TCE and 1,4-dioxane concentrations to levels below the RG for TCE (5 µg/L) and the current MTCA Method B groundwater cleanup level for 1,4-dioxane (0.44 µg/L).

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Figure 2-3
Injection Well Locations Map
2014 Treatability Study

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However, treating large dilute plumes with ISCO is difficult because it is a challenge to deliver the oxidant to all the areas within the plume. In addition, ISCO is designed to treat significantly elevated concentration areas or “hotspots” that are acting as secondary sources. Multiple injections over an extended period of time (likely years) would be required over a very large area to reduce concentrations across the entire plume area. Groundwater flow has a westerly deflection under non-pumping conditions, particularly along the western landfill boundary. Under these circumstances, pumping would likely need to be maintained during the initial stages of injection (at a minimum) to prevent off-site migration in the plume along the western edge of the landfill.

The study recommended ISCO using catalyzed hydrogen peroxide and activated persulfate be considered as an alternative in the optimization evaluation. The optimization will evaluate the technical feasibility and cost of large-scale ISCO application at the site against other treatment technologies and approaches.

2.4.10 2017 – ISCO Bench Scale Treatability Study by APTwater

An additional bench-scale treatability study was conducted by APTwater in 2017 to evaluate potential system design and further advance the site-specific feasibility as part of the FFS (U.S. Navy 2018c). Advanced oxidization was found to be effective at reducing VOC and 1,4-dioxane concentrations in groundwater from the site using an ex-situ treatment system. Ex-situ treatment using advanced oxidation was retained in the FFS as a treatment technology employed in conjunction with groundwater extraction.

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3.0 PUBLIC PARTICIPATION

40 CFR Section 300.435(c)(2)(ii) of the NCP requires public participation in the process of approving a ROD Amendment. Specific requirements for public participation include releasing the proposed plan for public comment, providing responses to significant public comments in the ROD Amendment, and making the ROD Amendment and supporting information available to the public in the Administrative Record. This section documents public involvement in the amended remedy selection at OU 1 Area 6, NAS Whidbey Island, and compliance with the public participation requirements set forth in 40 CFR Section 300.435(c)(2)(ii) of the NCP.

Public participation activities related to the selection of the Amended Remedy at OU 1 Area 6 are part of the ongoing overall investigations and cleanup activities at NAS Whidbey Island and are guided by a community relations plan last updated in July 2008. The Navy has conducted Restoration Advisory Board and stakeholder meetings to address specific issues of public interest. In addition, the Navy publishes information in project-specific notices concerning the progress of investigation and cleanup activities.

As lead regulatory agency, the EPA participated in the development of the proposed plan to amend the OU 1 ROD and this ROD Amendment. The Navy provided for a 30-day public review of the proposed plan from November 21, 2018, through December 21, 2018. A public meeting was held at the Veterans of Foreign Wars in Oak Harbor on December 17, 2018, to present the proposed plan and solicit community input. Comments on the proposed plan from the community are summarized and addressed in the Responsiveness Summary in Part 3.

The FFS and proposed plan are part of the Administrative Record for the site. This ROD Amendment is based on, and will become part of, the Administrative Record. The Administrative Record is maintained on file at the following location:

Naval Base Kitsap Bangor
1101 Tautog Avenue (Building 1101, 1st floor)
Silverdale, Washington
(360) 396-6387

The FFS report, proposed plan, and ROD Amendment are also available for public review at the following information repositories:

- Online at NAVFAC Northwest public RAB website: https://navfac.navy.mil/NASWIRAB

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4.0 SCOPE AND ROLE OF OPERABLE UNIT

Potential source areas at NAS Whidbey Island, Ault Field, have been grouped into separate OUs, for which different schedules have been established. OU 1 is the first OU at NAS Whidbey Island, Ault Field, for which a final cleanup action has been selected. Cleanup actions have also been selected for OU 4 (Seaplane Base) and in 1994 for OUs 2, 3, and 5 (Ault Field).

The cleanup actions for OU 1 Area 6 described in this ROD Amendment address on-site groundwater contamination, which was identified in the OU 1 ROD, and 1,4-dioxane, which was identified after the OU 1 ROD was executed. This ROD Amendment solely addresses changes to the groundwater remedy from the 1993 ROD since the air stripper does not treat 1,4-dioxane. The cleanup actions described in this ROD Amendment address all current and potential risks to human health and the environment associated with the OU 1 Area 6 site resulting from COCs identified by the 1993 ROD, which this document amends, and 1,4-dioxane.

This ROD Amendment does not change the selected remedy for OU 1 Area 5 nor its current status.

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5.0 SITE CHARACTERISTICS

This ROD Amendment is based on current site conditions and how they have changed since the remedy was constructed. The following site conditions and information from the post-ROD removal actions, investigation, and treatability studies (Section 2.4) were considered when evaluating remedial options and making the decision presented herein:

- Hydrogeology
- Current COC distribution in groundwater
- Current COC distribution in soil
- Post-ROD removal actions, investigations, and treatability studies (Section 2.4)

This section summarizes the information that prompted and supports fundamentally changing the remedy selected in the 1993 OU 1 ROD for Area 6.

5.1 SITE HYDROGEOLOGY

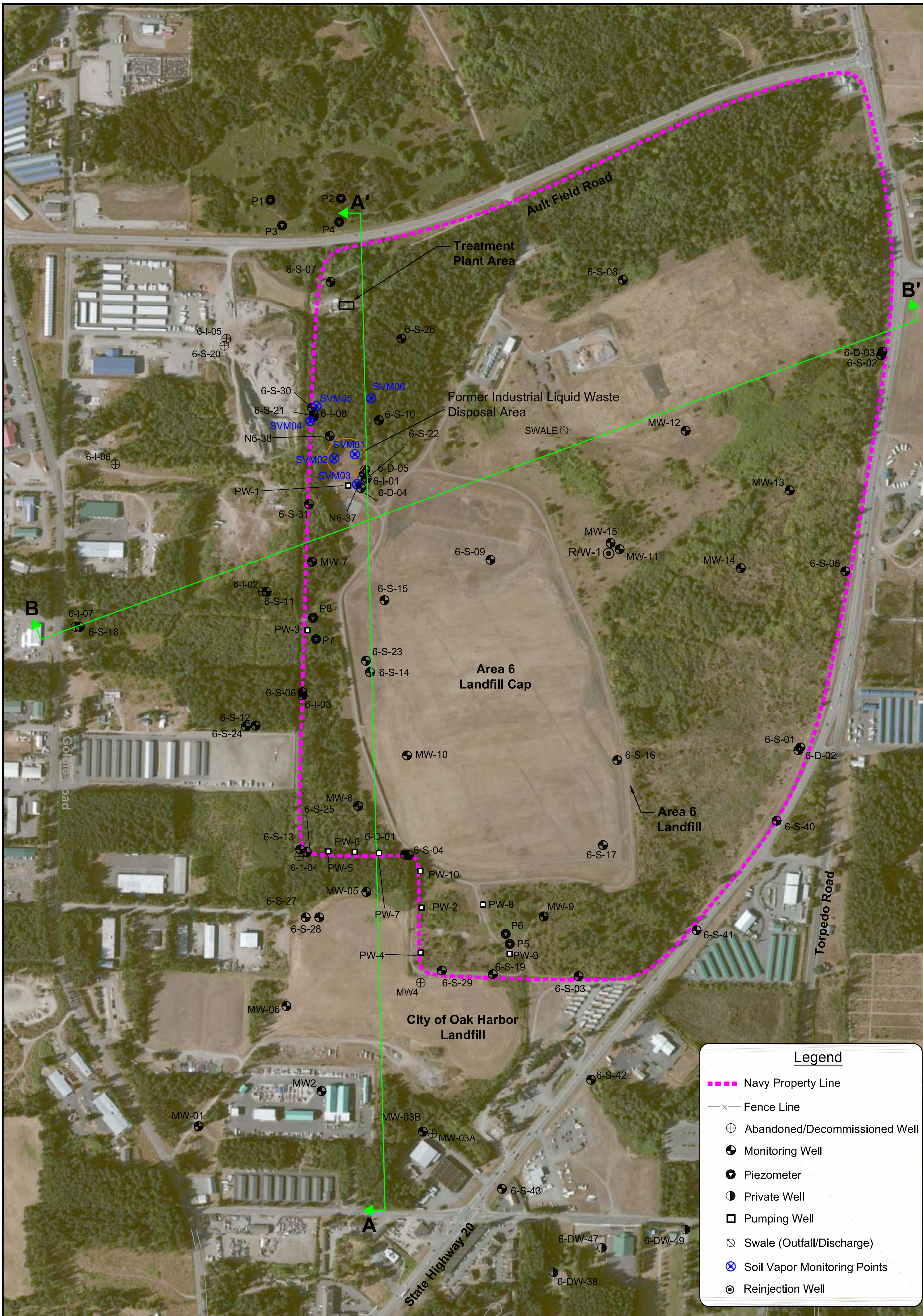
A review of the site hydrogeology is important to the amended remedy selection.

The U.S. Geological Survey has identified up to five major hydrogeologic units (aquifers) above bedrock in Island County (Jones 1985 and Sapik et al. 1988). The existing aquifer units are composed of sand or sand and gravel, while the adjacent confining layers are composed of till, glaciomarine drift, or nonglacial clay and silt. Perched, saturated zones may exist locally above noncontinuous areas of till or other clay-rich units.

Four glacial units were identified at Area 6: the Vashon Till, Vashon Recessional Outwash, Vashon Advance Outwash, and Whidbey Formation. The Whidbey formation comprises multiple aquifers and confining units. The Vashon Recessional Outwash or the underlying Vashon Till are typically encountered at the ground surface. Where these units are eroded away, sand and gravel of underlying Vashon Advance Outwash is exposed at the surface. The Vashon Advance Outwash is the shallow aquifer at the site. Beneath the Vashon Advance Outwash are sand, silt, and clay of the Whidbey Formation (Units 1 through 4). Whidbey Unit Number (No.) 1 is an aquitard at the base of the shallow aquifer. Whidbey Unit No. 2 is the next aquifer at the site. Whidbey Unit No. 3 is the aquitard at the base of the No. 2 unit and Whidbey Unit No. 4 is the deep aquifer at the site. A description of the units can be found in U.S. Navy 2013. Stratigraphy at the site is shown in cross-section views. Cross-section locations are shown on Figure 5-1. Cross-sections A-A’ and B-B’ are shown on Figure 5-2 and Figure 5-3, respectively.

Three of these five upper aquifers were encountered at Area 6 and are termed the shallow aquifer (Vashon Advance Outwash), the intermediate aquifer (Whidbey Unit No. 2), and the deep aquifer (Whidbey Unit No. 4). The shallow aquifer is an unconfined groundwater unit located in Vashon Advance Outwash beneath Area 6 and the Oak Harbor Landfill. The former liquid industrial waste disposal pits discharged directly into this unit. The intermediate aquifer is a moderately continuous groundwater body found in the sandy unit that corresponds to the Whidbey Formation Unit 2. Near Area 6 and the Oak Harbor Landfill, this aquifer is confined below the silt and clay of Whidbey Formation Unit 1. The deep aquifer is also a nearly continuous confined groundwater body found in the vicinity of Area 6 and the Oak Harbor Landfill. This aquifer is confined below the silt and clay of Whidbey Formation Unit 3 and occupies a thick sand layer in Whidbey Formation Unit 4. Groundwater data show that the upper aquifer is the only aquifer impacted by former actions at the site.

Groundwater in the upper aquifer at the site is unconfined. The depth to groundwater varies significantly because of an approximate 100-foot difference in the ground surface elevation across the site. Surface elevation is approximately 100 feet above mean sea level (msl) upgradient of the former source area (former industrial liquid waste disposal area) and rises to approximately 200 feet at the source area. Surface elevation remains at around 200 feet above msl from the source area to the southern site property line. Surface elevation decreases slightly from this point to around 180 feet above msl. Surface elevation also decreases to approximately 175 feet from the eastern edge of the landfill to the southeast at SR 20.



U.S. NAVY	N 0 250 500 SCALE IN FEET	**Figure 5-1** **Cross Section Locations, Area 6**	N62742-12-D1829 N4425517F4073 NAS Whidbey Island ROD Amendment

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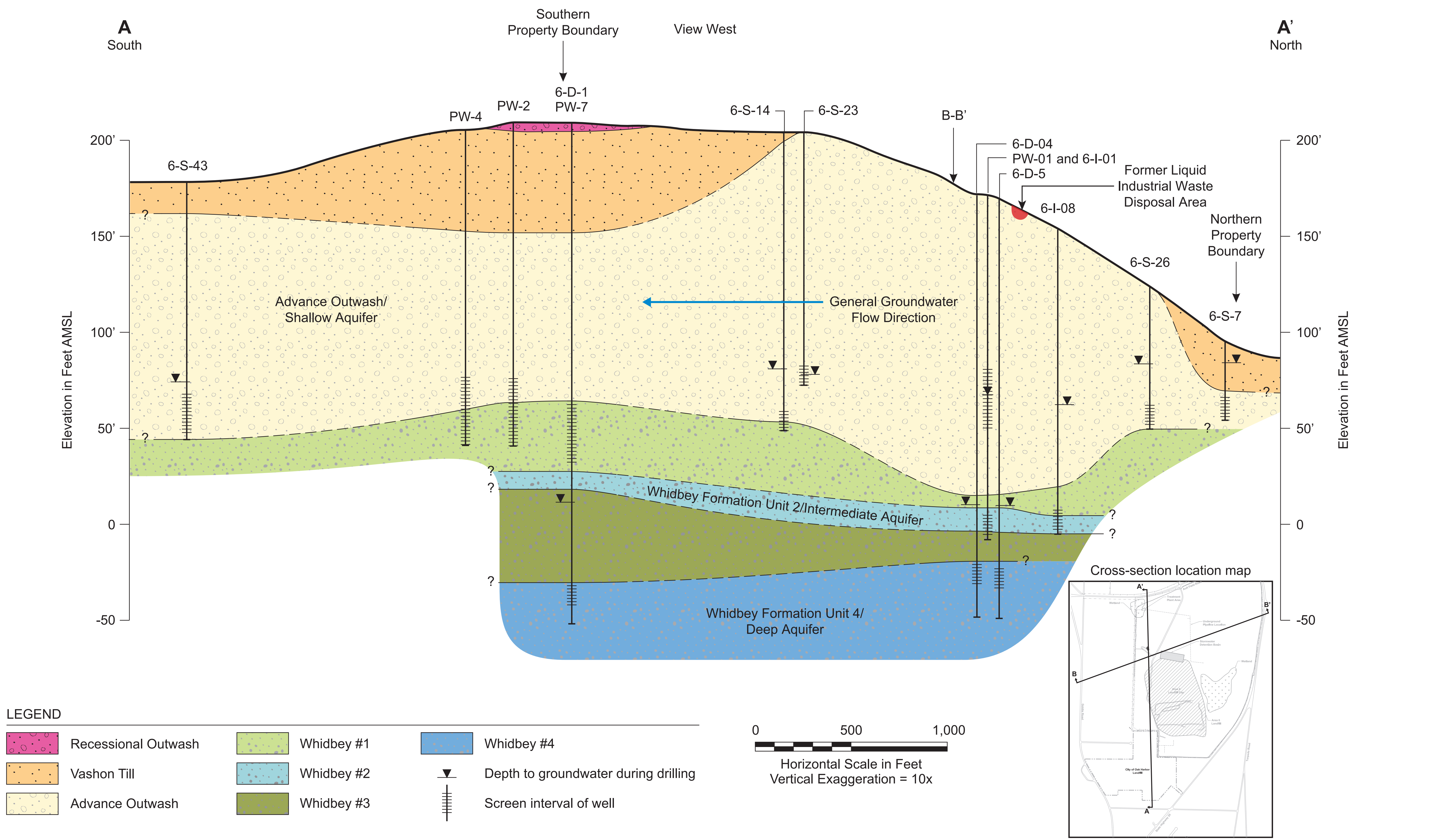

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N62742-12-D-1829
N4425517F4073
Area 6
NAS Whidbey Island
ROD AMENDMENT

Figure 5-2
Area 6 Stratigraphy
Cross Section A-A'

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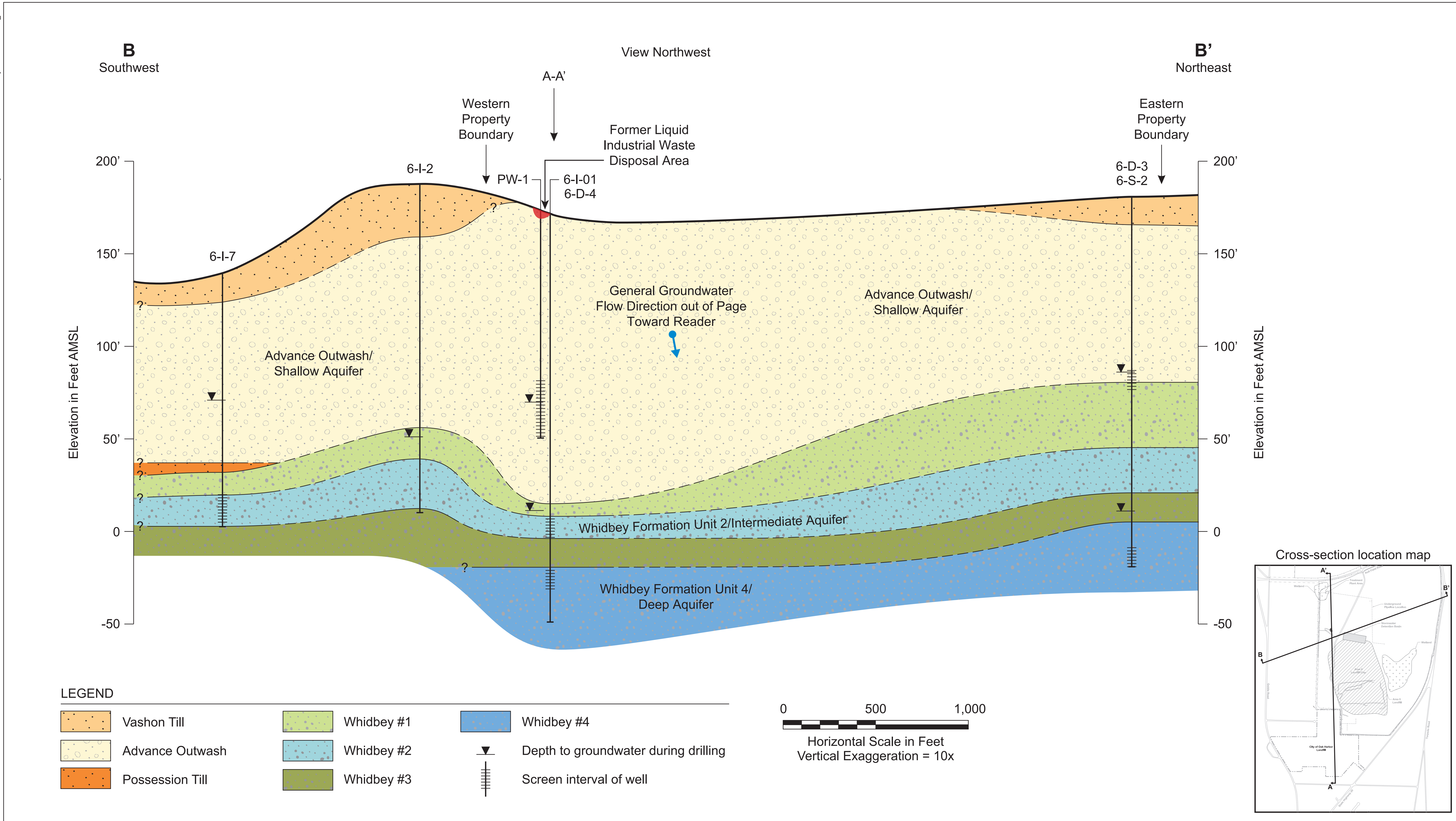

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Area 6
NAS Whidbey Island
ROD AMENDMENT

Figure 5-3
Area 6 Stratigraphy
Cross Section B-B'

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Depth to water was monitored during February 2018 (wet season). Groundwater surface elevations and elevation contours are shown on Figure 5-4 (U.S. Navy 2018a). Groundwater at Area 6 flows generally southward and discharges to Crescent Harbor and Oak Harbor. Under non-pumping conditions, groundwater flow is to the south-southwest in the northern and central portion of the site. Groundwater flow direction bends to the southeast at and south of the southern property boundary.

The groundwater velocity within two portions of the site was estimated using the following parameters:

- Under pumping conditions, February 2018 hydraulic gradients across the site:
  - 0.004 in the western plume area based on data for wells 6-S-10 and 6-S-29 (U.S. Navy 2018a)
  - 0.0014 in the southern plume area based on data for wells 6-S-27 and 6-S-43 (U.S. Navy 2018a)
- RI-assumed effective porosity of 0.25 (U.S. Navy 1993)
- An average hydraulic conductivity calculated from the pump test data of 71.67 feet per day (U.S. Navy 1993)

A flattening of the groundwater surface is evident south of the Area 6 property boundary (Figure 5-4). This is reflected in calculated groundwater flow velocities for each area.

Using the above inputs, the average linear groundwater flow in the plume area along the western landfill edge (western plume) is approximately 1.1 feet per day or 400 feet per year. The average linear groundwater flow in the southern plume area is approximately 0.4 foot per day or approximately 147 feet per year. The slowing in the southern plume region could be a result of a normal gradient change or a reduction in gradient as a result of the upgradient pumping for the extraction and treatment system.

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U.S. NAVY	N62742-12-D-1829 N4425517F4073 AREA 6 NAS WHIDBEY ISLAND ROD AMENDMENT	**FIGURE 5-4** OU 1, AREA 6 GROUNDWATER SURFACE ELEVATIONS FEBRUARY 2018

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5.2 NATURE AND EXTENT OF CONTAMINANTS IN GROUNDWATER

Groundwater analytical results for samples collected in February 2018 were compared to 1997 results for each of the COCs. The 1997 results were selected because these were the oldest data for samples that were collected from a sufficient number of wells to fully evaluate COC distribution in groundwater at that time. Groundwater monitoring for 1,4-dioxane began in 2003. Data for COCs from 1997 and February 2018 were contoured to evaluate system performance over this time period. Data from 2003 and 2018 were contoured to evaluate 1,4-dioxane distribution over this time period.

Interpolated contours for TCE results from 1997 and 2018 are shown on Figure 5-5. This figure shows that the TCE plume has decreased from approximately 2,500 feet long by 800 feet wide in 1997 to approximately 2,300 feet long by 300 feet wide in February 2018. The highest measured TCE concentration has decreased from 440 µg/L in 1997 to 57 µg/L in February 2018. These results show that the GETR has been very successful at reducing the areal extent of the TCE plume and the overall mass of TCE in groundwater.

Interpolated contours for 1,1,1-TCA results from 1997 and 2018 are shown on Figure 5-6. This figure shows that 1,1,1-TCA was present as two plumes that coincided with the TCE plume. The highest measured 1,1,1-TCA concentration in 1997 was 680 µg/L. The February 2018 data show that a sample from only one well contained 1,1,1-TCA at a concentration greater than the RG of 200 µg/L (monitoring well 6-S-6 – 245 µg/L). These results show that the GETR has removed nearly all identified 1,1,1-TCA from groundwater at the site above the RG and there is no active 1,1,1-TCA source contributing to groundwater at a concentration above the RG.

Interpolated contours for 1,1-DCE results from 1997 and 2018 are shown on Figure 5-7. This figure shows that the 1,1-DCE plume has decreased from approximately 2,700 feet long by 500 feet wide in 1997 to approximately 1,500 feet long by 300 feet wide in February 2018. The highest measured 1,1-DCE concentration has decreased from 130 µg/L in 1997 to 64 µg/L in February 2018. These results show that the GETR has been very successful at reducing the areal extent of the 1,1-DCE plume and the overall mass of 1,1-DCE in groundwater. These results also indicate that there is not a strong, naturally occurring, sequential dechlorinization mechanism at the site.

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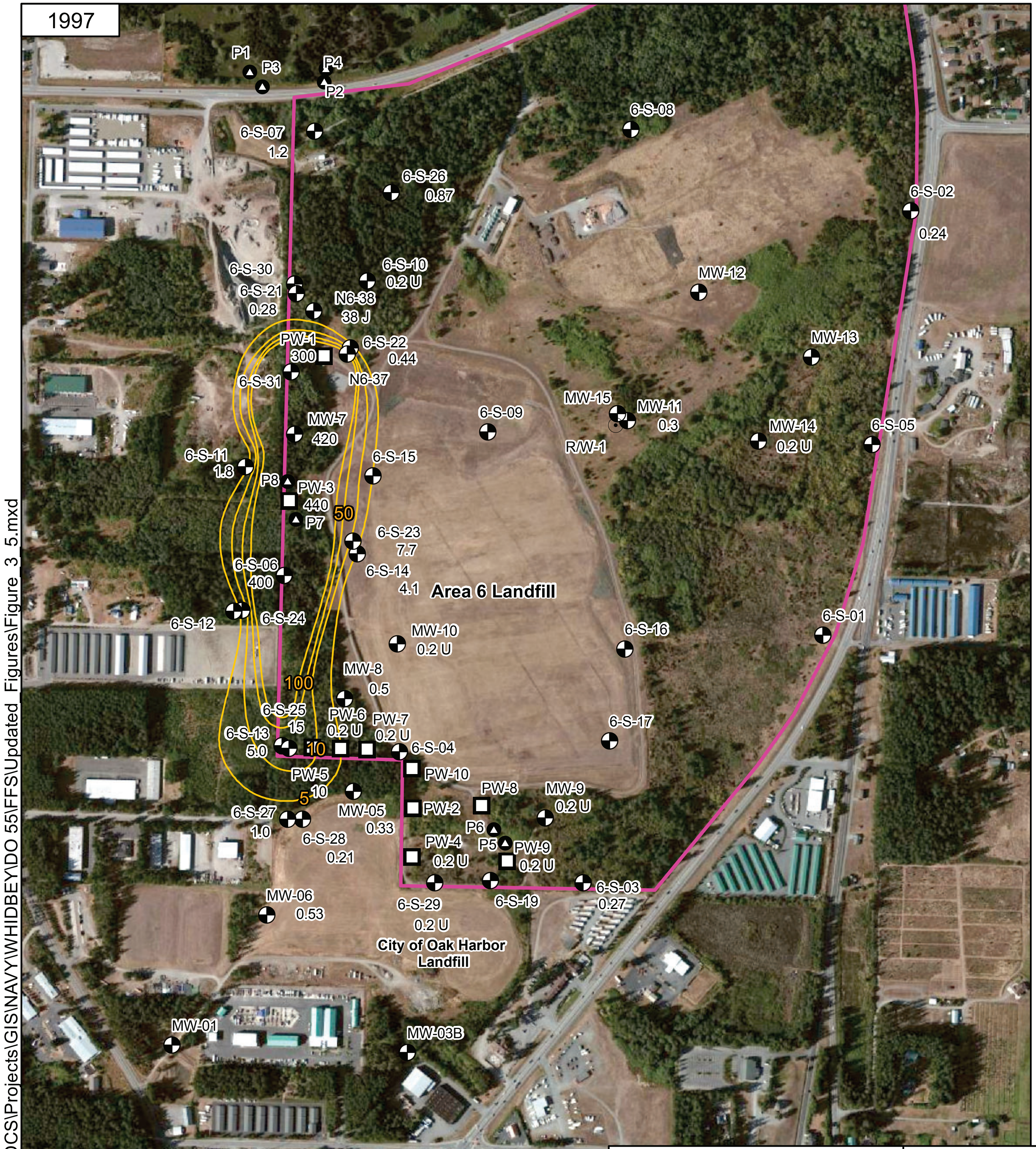

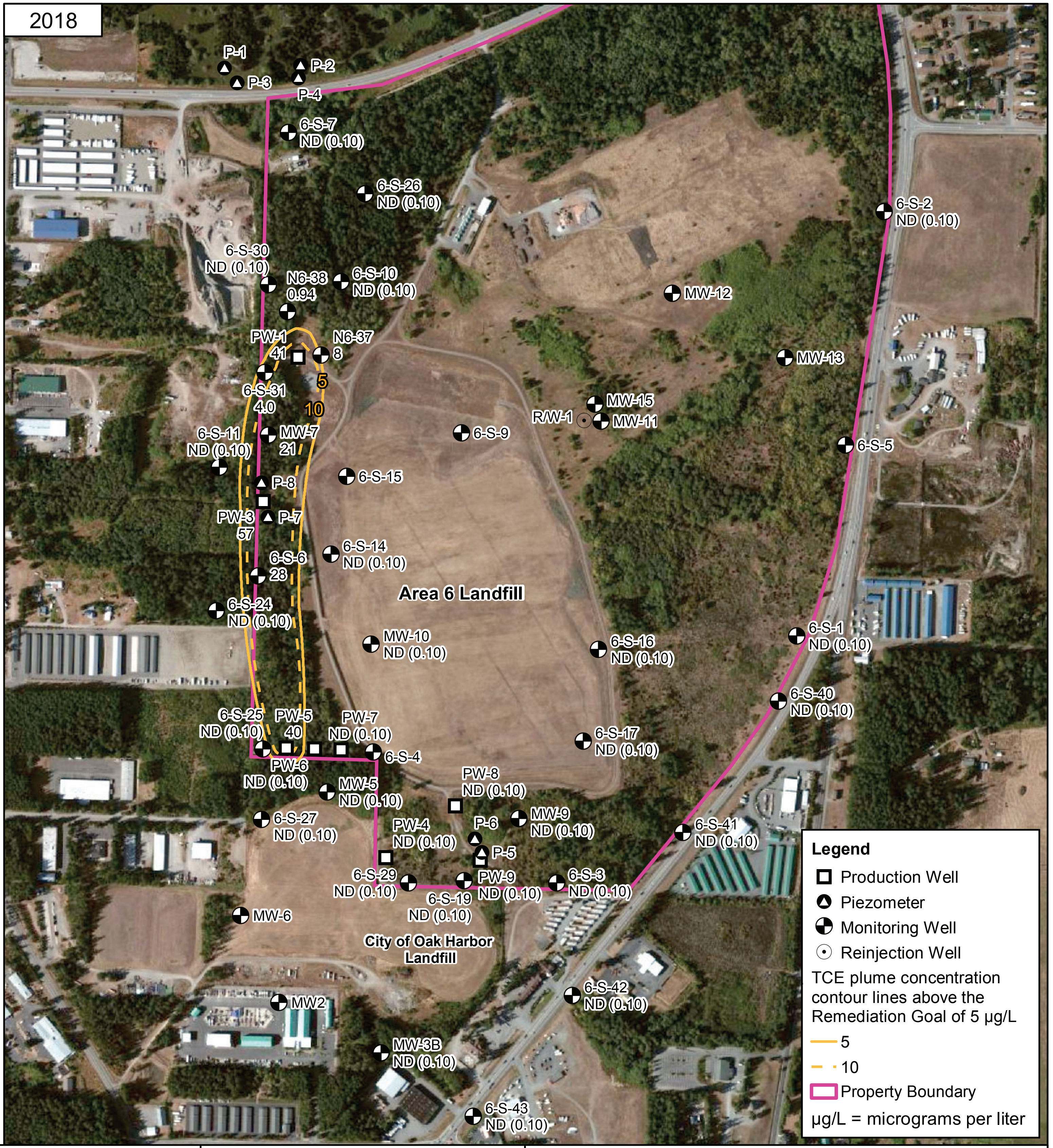

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0 287.5 575 1,150 Feet

Figure 5-5
TCE Concentrations Above Remedial Goal, 1997 and February 2018

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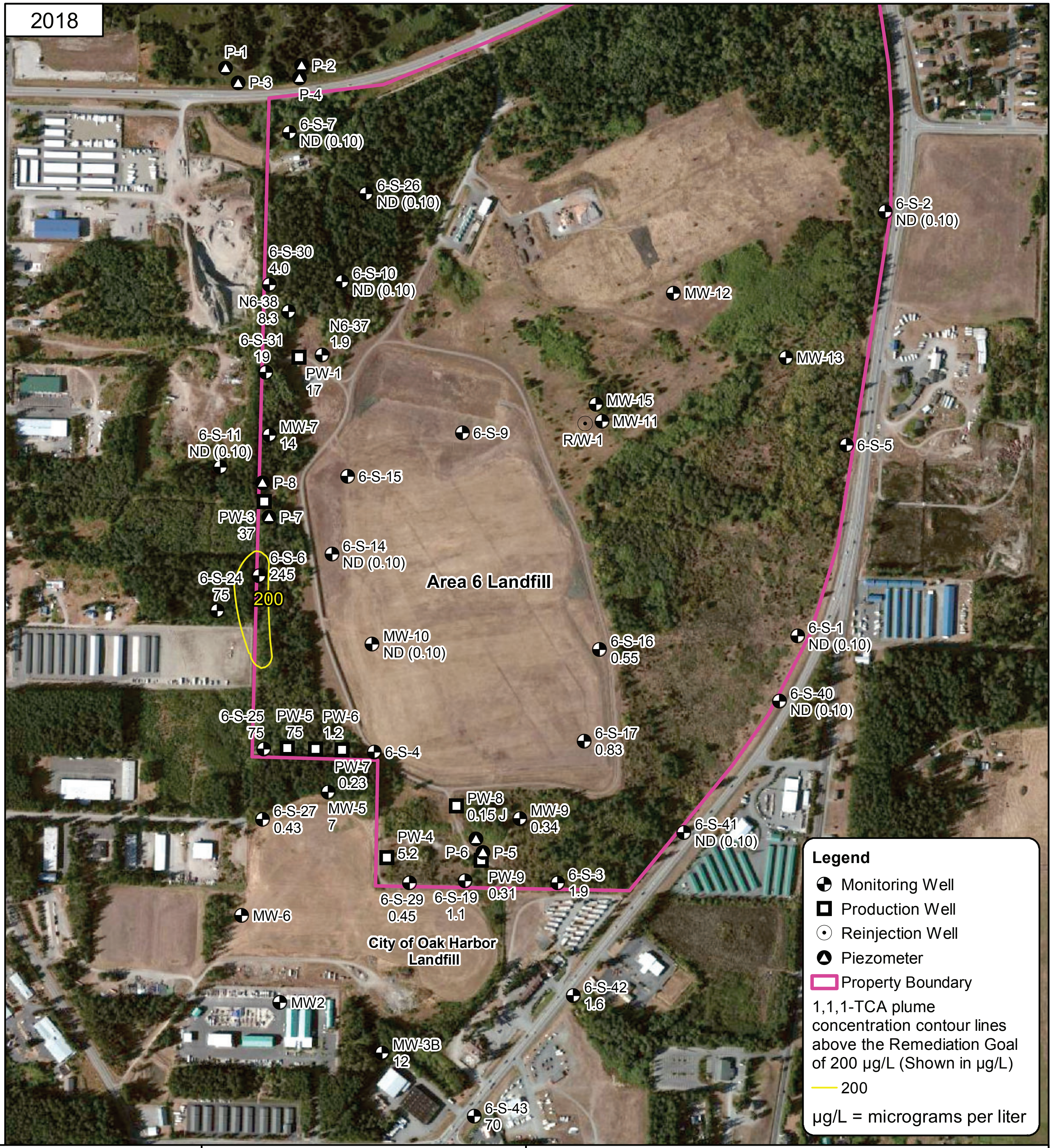

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ROD AMENDMENT

N

0 285 570 1,140 Feet

Figure 5-6
1,1,1-TCA Concentrations Above Remedial Goal, 1997 and February 2018

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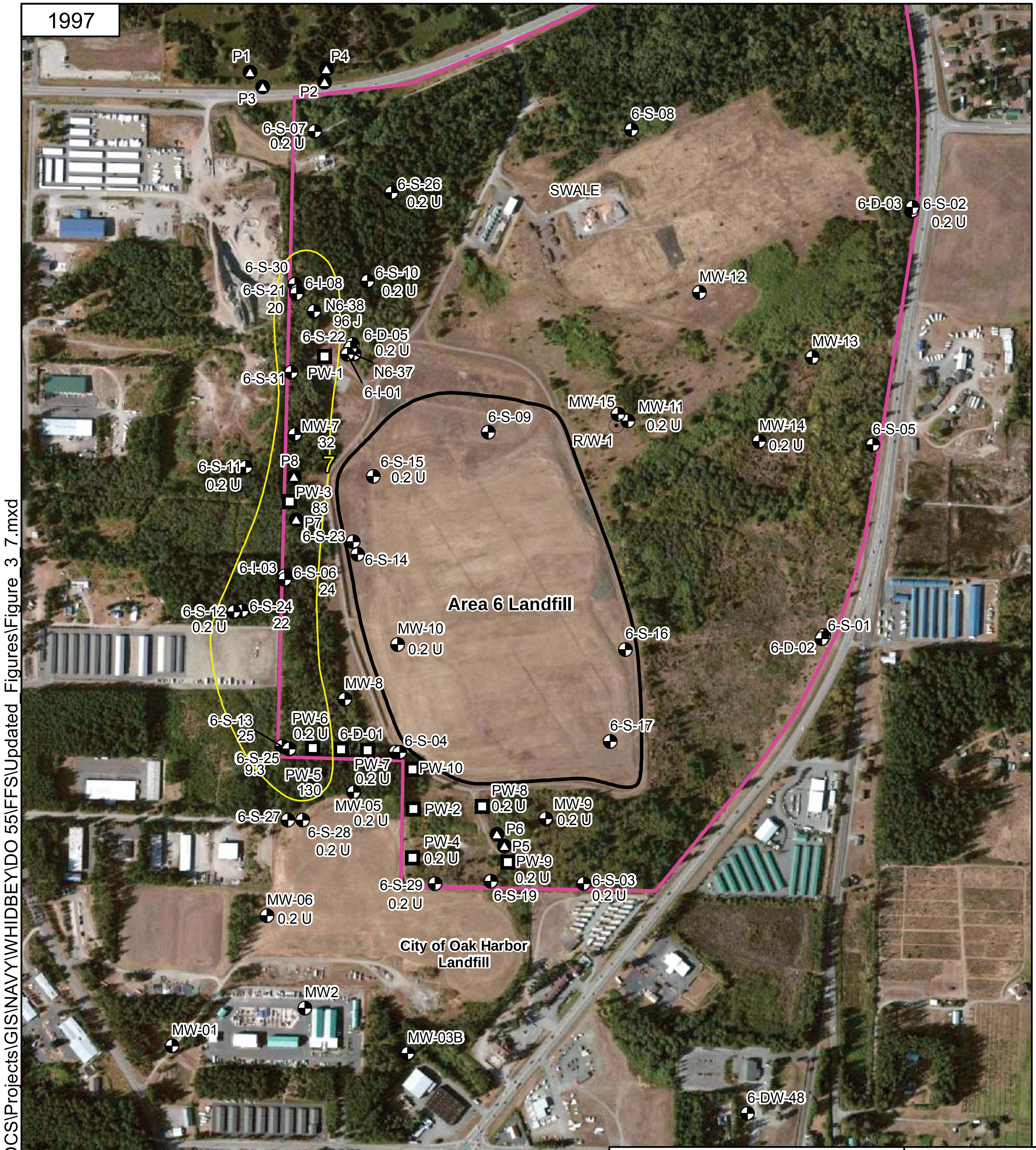

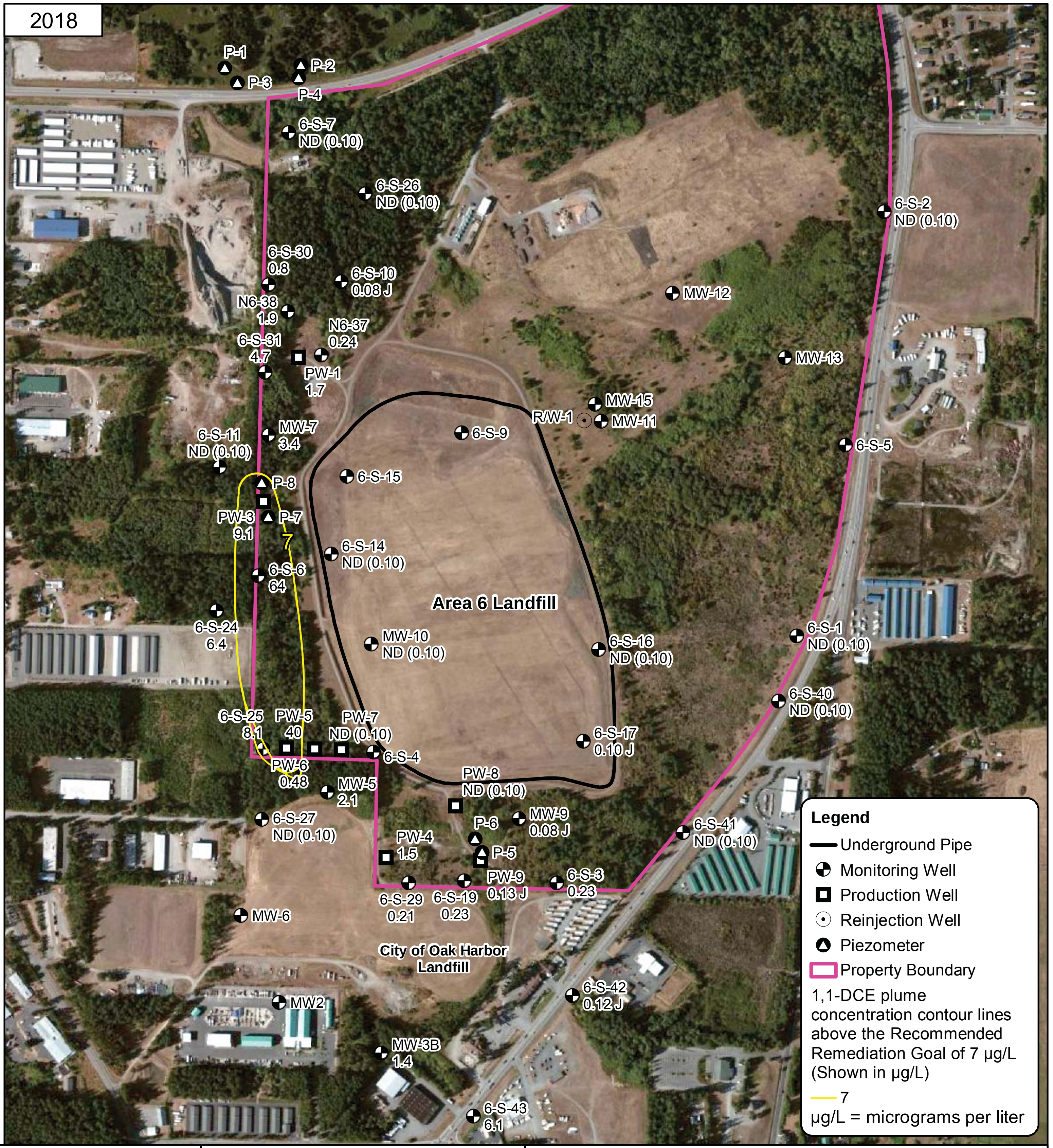

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Area 6, NAS Whidbey Island
ROD AMENDMENT

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0 287.5 575 1,150
Feet

Figure 5-7
1,1-DCE Concentrations Above Remedial Goal, 1997 and February 2018

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Interpolated contours for vinyl chloride results from 1997 and 2018 are shown on Figure 5-8. The limited monitoring network did not allow for delineation of the downgradient extent of vinyl chloride in 1997. The 2008 addition of monitoring wells along SR 20 allowed delineation of the downgradient extent shown for 2018. In 1997, the identified vinyl chloride plume was at least 3,400 feet long and 1,700 feet wide. These dimensions do not include the unknown distribution beyond the monitoring well network at that time. In 2018, the downgradient extent was delineated and the plume is approximately 2,300 feet long, 1,100 feet wide at the northern end, and approximately 500 feet wide in the southern end. The 1997 maximum vinyl chloride concentration was 4.4 µg/L at the southern property boundary. However, well 6-S-43 was installed in 2008 where higher concentrations have been measured. The February 2018 vinyl chloride concentration in groundwater was measured at 0.56 µg/L.

Interpolated contours for 1,4-dioxane results from 2003 and 2018 are shown on Figure 5-9. The 2008 addition of monitoring wells along SR 20 allowed additional delineation of the downgradient nature and extent of the 1,4-dioxane plume. In 2003, the identified 1,4-dioxane plume was at least 4,500 feet long, 1,300 feet wide in the northern end, and at least 1,700 feet wide in the southern end. In 2014, the 1,4-dioxane plume was at least 6,000 feet long, 1,000 feet wide in the north plume, 2,000 feet wide in the central plume, and 1,200 feet wide in the southern plume. The 2003 maximum 1,4-dioxane concentration of 14 µg/L has decreased to 10 µg/L in February 2018 with the highest concentration moving from northern portion of the plume at PW-1 to the southern site boundary. Figure 5-9 shows that 1,4-dioxane has been redistributed at the site by reinjection and surface discharge at multiple locations.

Data for 1,1-DCA was not contoured since it has never been measured in monitoring samples at concentrations above the RG of 800 µg/L. Data for cis-1,2-DCE was not contoured because monitoring results have been below the RG of 70 µg/L since 2008.

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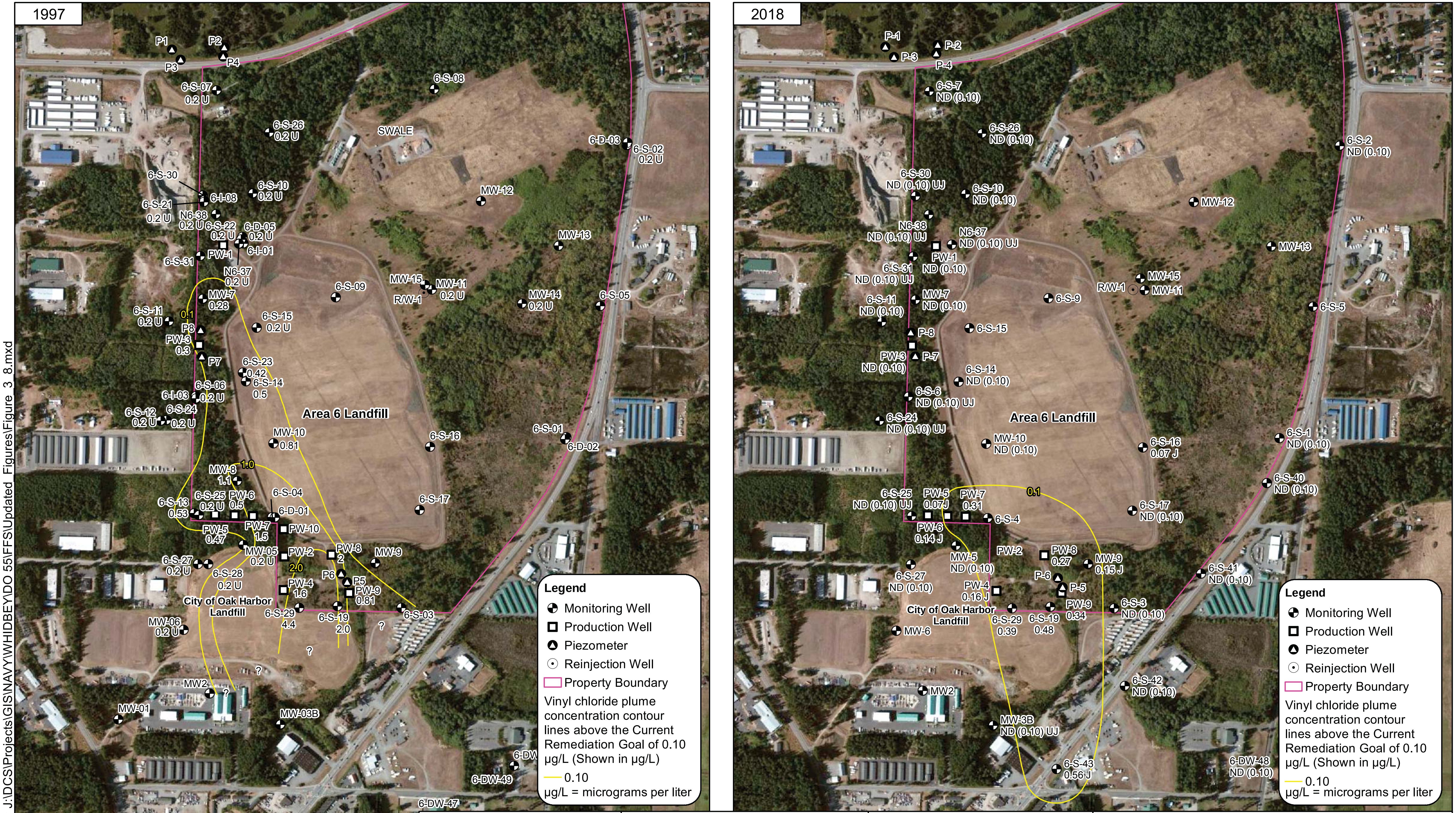

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0 287.5 575 1,150 Feet

Figure 5-8
Vinyl Chloride Concentrations Above Remedial Goal, 1997 and February 2018

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Area 6, NAS Whidbey Island
ROD AMENDMENT

Figure 5-9
1,4-Dioxane Concentrations Above Recommended Remedial Goal, 2003 and February 2018

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5.3 NATURE AND EXTENT OF CONTAMINANTS IN SOIL

The 2001 soil removal addressed residual soil contamination in the former liquid industrial waste disposal area (U.S. Navy 2002). Subsequent study of the former liquid industrial waste disposal area indicated that the residual impacts to soil may continue to contribute to groundwater but the concentrations were expected to be low (U.S. Navy 2013).

5.4 OFF-SITE RESIDENTIAL WELL SAMPLING

Groundwater at the site is considered to be a potential drinking water source downgradient of the site. However, this condition is impacted by the presence of the landfill at the site and the City of Oak Harbor landfill immediately adjacent to the site. The State of Washington restricts well installation within 1,000 feet of landfills (discussed further in Section 6.3.4 and depicted on Figure 6-2). Groundwater is used as a drinking water source at some of these residences downgradient of Area 6.

The Navy has conducted numerous rounds of off-base water sampling around Area 6 including most recently in 2018. In 2005, the Navy conducted off-base drinking water sampling of 13 wells, and none of the drinking water wells had 1,4-dioxane concentrations greater than the Washington State cleanup level for 1,4-dioxane in groundwater at that time (7.95 µg/L). The Washington State cleanup level is a chemical concentration based on protecting human health and is at least as stringent as applicable federal laws. As a result of the 2005 sampling effort, the Navy did replace one well for a private off-site owner with a deeper well (free of 1,4-dioxane). This residential well was converted into sampling location 6-DW-38. During 2008, four additional groundwater monitoring wells were installed along the northwestern shoulder of SR 20 to further refine the extent of 1,4-dioxane in groundwater. In 2018, 16 drinking water wells and 10 groundwater wells were sampled south and west of Area 6, and no drinking water or groundwater wells had 1,4-dioxane concentrations greater than the current Washington State cleanup level for 1,4-dioxane in groundwater.

As part of the annual LUC inspection process, Island County Public Health is contacted regarding well installation or drilling activities within the boundary of Ault Field and Seaplane Base as well as within an approximate 1-mile buffer around their boundaries. Restrictions on well installation activities and groundwater use within and downgradient of Area 6 are considered to have been properly and effectively implemented based on the findings of the 2018 LUC inspection.

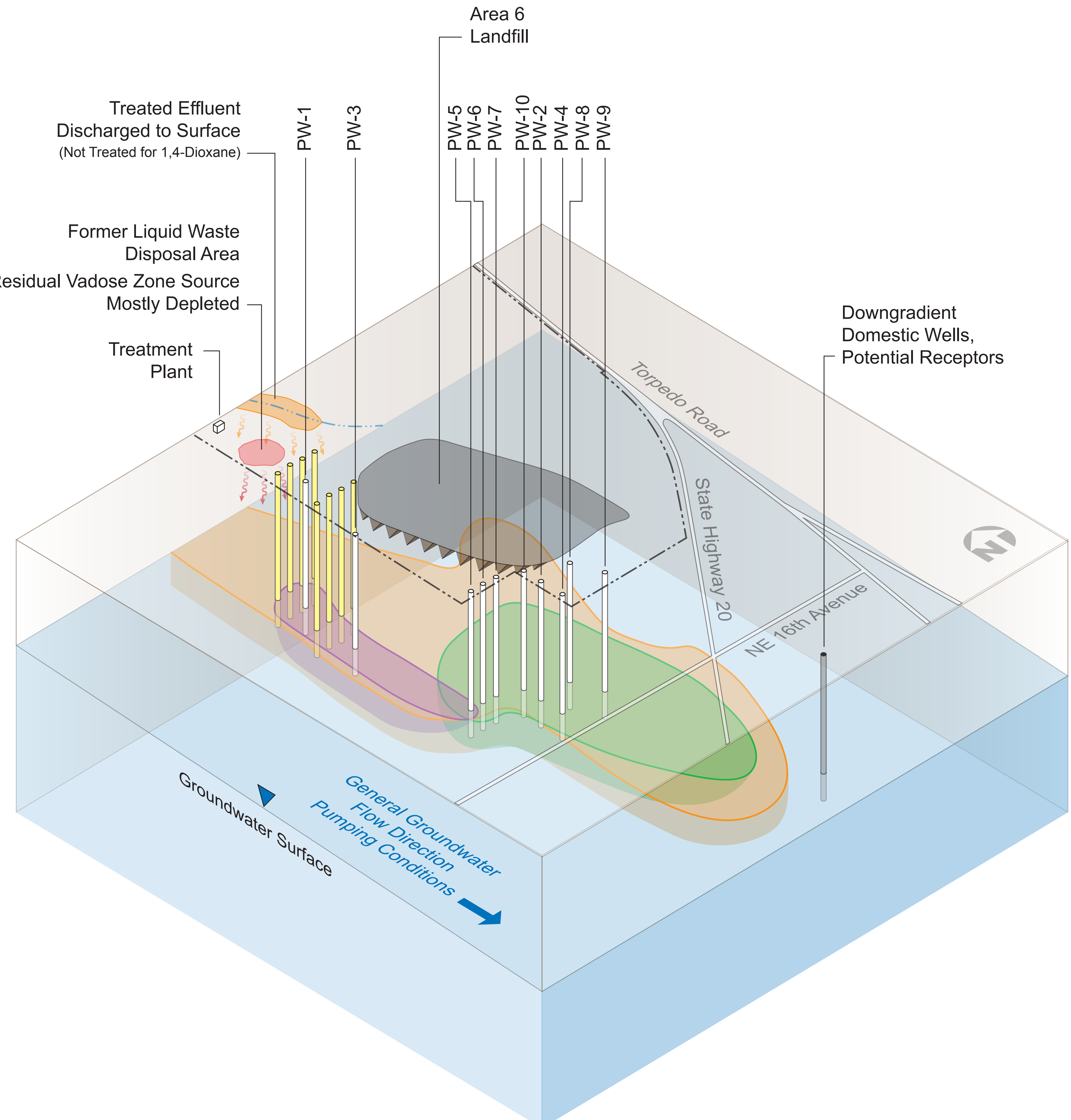
5.5 UPDATED CONCEPTUAL SITE MODEL

The current CSM is shown graphically on Figure 5-10. The former source area (former industrial liquid waste disposal area) contaminant mass in soil was mostly depleted during the 2001 interim removal action. Data collected since the 2001 interim removal action have shown that contaminant concentrations in soil below the removal action are decreasing due to natural attenuation. The former source area does have residual VOC contaminant mass in the vadose zone, but its contribution to groundwater continues to decrease. Source studies and vadose zone modeling indicate that the residual vadose zone impacts will not contribute significant residual contaminant mass to groundwater, and groundwater concentrations will decrease to levels suitable for natural attenuation (U.S. Navy 2013).

The areal extent of VOCs in the groundwater western plume has been successfully reduced by the extraction system. Continued operation of this system will maintain control of the western plume and continue to decrease the areal extent and overall VOC mass. The 1,4-dioxane in this western plume area is recirculated by extraction and upgradient surface discharge.

Vinyl chloride and 1,4-dioxane are present downgradient of the site and outside the extraction system capture zone in the southern plume. Based on data presented in the RI (U.S. Navy 1993), the Navy interpreted that the vinyl chloride plume had migrated beyond the southern site boundary prior to construction of the extraction system. Although, no data exist prior to 2003, it is likely that the 1,4-dioxane was also present outside of the capture zone prior to the GETR system construction and startup. Vinyl chloride and 1,4-dioxane continue to migrate downgradient: however, groundwater modeling shows that operating the GETR system serves to reduce the downgradient migration rates of vinyl chloride and 1,4-dioxane.

The present day distribution of 1,4-dioxane is a result of groundwater effluent redistribution by extraction and treatment system operations. As previously stated, the treatment system does not remove 1,4-dioxane from captured groundwater. Previously, discharged groundwater effluent were reinjected in two different locations and surface infiltrated in two different locations throughout the site. Discharged groundwater effluent continues to be surface infiltrated.



Legend

—··—	Site Boundary
	Pump well
	Injection well related to 2014 Treatability Study
	1,4-Dioxane concentrations, 2018, above recommended remedial goal of 0.44 µg/L
	TCE concentrations, 2018, above remedial goal of 5 µg/L
	Vinyl chloride concentrations, 2018, above current remedial goal of 0.1 µg/L
-··-	Intermittent stream
µg/L	Micrograms per liter

Not to Scale

U.S. NAVY

Figure 5-10
Conceptual Site Model
OU 1, Area 6

N62742-12-D-1829
N4425517F4073
Area 6
NAS Whidbey Island
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COCs for groundwater identified in the ROD were (U.S. Navy, Ecology, and EPA 1993a):

- TCE
- 1,1,1-TCA
- 1,1-DCA
- 1,1-DCE
- cis-1,2-DCE
- Vinyl chloride

The ROD established RGs for each COC based on the protection of human health, assuming Area 6 groundwater is ingested as drinking water. The ROD stipulates that the cumulative excess cancer risk associated with the site will be reduced to, at most, 1×10^{-5}, consistent with MTCA.

1,1-DCA has never been measured at a concentration greater than the RG in any of the groundwater samples collected. Cis-1,2-DCE has not been measured at a concentration greater than the RG in any of the groundwater samples collected since 2008. Based on these results, 1,1-DCA and cis-1,2-DCE will be removed as COCs. Based on its presence in groundwater at concentrations above the MTCA Method B cleanup level of 0.44 µg/L, 1,4-dioxane will be added as a COC for groundwater at Area 6.

The revised COC list will be:

- TCE
- 1,1,1-TCA
- 1,1-DCE
- Vinyl chloride
- 1,4-dioxane

5.6 CURRENT AND REASONABLY ANTICIPATED FUTURE LAND USE

The 40-acre Area 6 landfill and the installation composting facility are currently present at the site. The anticipated future land use is for the site to remain as a landfill and continue as a composting facility. It is reasonable to assume future use by the installation will remain industrial with no residential or commercial use.

Land use off-site is either Navy property, residential, or commercial, and is expected to be so for the foreseeable future. Ault Field is north of the site. A quarry and storage business is located adjacent to the northwest corner of the site. Businesses, storage facilities, the City of Oak Harbor maintenance facility, and a bar are located along the western site boundary. The City of Oak Harbor Landfill is located along the southern site boundary along with an inn, trailer park, restaurant, and storage facility. Residences, a church, and cemetery are located further to the south (downgradient). There are wells in these areas but Navy has connected the properties with wells in areas of impacted groundwater to the City of Oak Harbor system and/or drilled deeper replacement wells (6-DW-38B). Groundwater at the site is considered to be a potential drinking water source downgradient of the site. However, the State of Washington restricts well installation adjacent to landfills (Section 6.3.4). Additionally, based on discussions with the City of Oak Harbor, all parcels south of 6-DW-38 between SR 20 and NE Regatta Dr are on City of Oak Harbor water.

5.7 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

Conditions have changed since the 1993 ROD. The GETR has been successful at reducing concentrations of COCs identified in the 1993 ROD. Concentrations of COCs remain above the RGs; however, the risk they pose has changed. Although LUCs are in place, the risk assessment was updated to evaluate potential risk from consumption of groundwater if LUCs were not in place.

5.7.1 Current Human Health Risks

Figure 5-5 through Figure 5-8 present side-by-side comparisons of the 1997 and 2018 groundwater concentrations for TCE, 1,1-DCE, 1,1,1-TCA, and vinyl chloride in groundwater. Figure 5-9 presents the 2003 and 2018 extent of 1,4-dioxane in groundwater. A screening level risk evaluation was performed for these five groundwater COCs using the February 2018 data assuming a drinking water exposure pathway using the following equations:

- Current excess cancer risk = Maximum Site Concentration × 0.000001/ carcinogenic EPA tapwater Regional Screening Levels (RSLs)
- Current noncarcinogenic hazard = Maximum Site Concentration/noncarcinogenic EPA tapwater RSL

Cumulative risk was assessed by summing the individual cancer risks to achieve a total excess cancer risk. Cumulative hazards were assessed by summing noncancer hazard quotients (HQs) for each chemical to calculate a hazard index (HI). To assess the current worst-case risk scenario, maximum concentrations were used. Even if RGs are based on MCLs, the EPA tapwater RSLs were used because MCLs consider other factors besides risk. Only three of the five COCs are considered both carcinogenic and noncarcinogenic.

1,1,1-TCA. Although the maximum detected concentration of 245 µg/L for 1,1,1-TCA exceeds the RG of 200 µg/L, the noncarcinogenic hazard based on the current EPA tapwater RSL of 8,000 µg/L (HQ of 0.03) is less than one. As such, this chemical poses a low hazard. However, the MCL is set at 200 µg/L, and it will be retained as a groundwater COC in the ROD based on the need to comply with an ARAR.

1,1-DCE. Although the maximum detected concentration of 64 µg/L for 1,1-DCE exceeds the RG of 0.07 µg/L, the noncarcinogenic hazard based on the current EPA tapwater RSL of 280 µg/L (HQ of 0.23) is less than one. Although this chemical poses a low hazard, because EPA has set an MCL lower than the EPA tapwater RSL, the RG will be revised in the ROD to the MCL of 7 µg/L based on the need to comply with an ARAR.

TCE. Although the TCE RG is based on the MCL, the EPA tapwater RSL of 0.49 µg/L was compared to the maximum concentration of 57 µg/L to achieve an excess cancer risk of 1×10^{-4}. The maximum detected concentration of TCE exceeds the noncarcinogenic EPA tapwater RSL of 2.8 µg/L (HQ of 20).

Vinyl Chloride. Using the current EPA tapwater RSL of 0.019 µg/L, which is based on a cancer risk of 10^{-6}, would result in an excess cancer risk of 3×10^{-5} using the maximum detected concentration of 0.56 µg/L. The maximum detected concentration of vinyl chloride is well below the noncarcinogenic EPA tapwater RSL of 44 µg/L (HQ of 0.01).

1,4-dioxane. Using the carcinogenic EPA tapwater RSL of 0.46 µg/L for 1,4-dioxane which is based on a cancer risk of 10^{-6} would result in an excess cancer risk of 2×10^{-5} using the maximum detected concentration of 10 µg/L. As such, 1,4-dioxane should be added as a COC and the noncarcinogenic EPA tapwater of 0.46 µg/L should be included in the ROD. The maximum detected concentration of 1,4-dioxane of 10 µg/L is below the noncarcinogenic EPA tapwater RSL of 57 µg/L (HQ of 0.18).

A cumulative risk summary table based on the maximum February 2018 groundwater sample COC concentration at the site is provided below.

Table 5-1
Cumulative Risk Summary Table based on February 2018 Groundwater Data

Analyte	Excess Cancer Risk	Noncarcinogenic Hazards
1,1,1-TCA	NC	0.03
1,1-Dichloroethene	NC	0.23
TCE	1×10^{-4}	20.4
Vinyl chloride	3×10^{-5}	0.01
1,4-dioxane	2×10^{-5}	0.18
Cumulative Risks & Hazard Index:	**2×10^{-4}**	**21**

Notes:
NC - Not carcinogenic

5.7.2 Ecological Risk Evaluation

The 1993 ROD did not identify ecological risk associated with the groundwater COCs.

The discharged groundwater effluent continues to be surface infiltrated and discharged to the surface since at least 1997. Groundwater monitoring at the site indicates that 1,4-dioxane is successfully reinfiltrating back to groundwater. This is demonstrated on Figure 5-9 showing 1,4-dioxane extending upgradient of the former source area. If reinfiltration were not occurring, 1,4-dioxane would not be present in groundwater upgradient of the former source area. The February 2018 1,4-dioxane effluent concentration was 1.9 µg/L. The risk associated with effluent values is within the 10^{-6} risk range compared to the MTCA Method B groundwater cleanup level of 0.44 µg/L.

There is no promulgated comparison criteria for the surface water exposure pathway. The EPA Technical Fact Sheet - 1,4-dioxane (November 2017) indicates 1,4-dioxane does not bioaccumulate, biomagnify, or bioconcentrate in the food chain (ATSDR 2012, Mohr 2001).

The EPA and Office of Pollution Prevention and Toxics evaluated available ecotoxicity studies (USEPA, 2015). 1,4-dioxane has been tested for acute and chronic aquatic toxicity. In order to characterize the effects of 1,4-dioxane to the environment, a hazard rating was assigned based on EPA methodology for existing chemical classification. Included in this assessment were eight acute aquatic toxicity studies and three chronic aquatic toxicity studies. There is one study that characterizes the toxicity of 1,4-dioxane for aquatic plants. Acute and chronic toxicity data for 1,4-dioxane exist for freshwater and saltwater fish, daphnia, and green algae. There are no available sediment, soil, or avian toxicity studies found in literature for 1,4-dioxane. The lowest toxicity threshold based on this compilation of data is >100 mg/L based on a median lethal concentration (LC_{50}) for a fathead minnow (*Pimephales promelas*), which is orders of magnitudes higher than concentrations observed at the site and the latest effluent concentration (0.0019 mg/L). The EPA ecological evaluation concluded there is a low acute and chronic ecotoxicity for fish, aquatic invertebrates and aquatic plants. The hazard of 1,4-dioxane is expected to be low for soil organisms due to its high potential to volatilize from soil surfaces and low for sediment-dwelling organisms due to its low adsorption potential to sediment.

The lack of bioconcentration potential of this chemical also suggests that uptake of 1,4-dioxane into prey items that are subsequently consumed by waterfowl that could visit the marsh is an insignificant exposure pathway. As such, 1,4-dioxane from the current GETR effluent poses an insignificant hazard to ecological receptors.

The selected remedy will result in even lower 1,4-dioxane surface discharge concentrations when the southern plant is operational, and 1,4-dioxane is expected to be reduced to concentrations to at least less than the MTCA Method B cleanup level of 0.44 µg/L once both plants are operational.

5.7.3 Risk Summary

The most significant current health risk at Area 6 is that 1,4-dioxane or chlorinated VOCs could migrate offsite to private wells south and west of the property. The public could potentially be exposed if the water were used as a household source of drinking water. The Navy has conducted numerous rounds of off-base water sampling around Area 6 including most recently in 2018. In 2018, 16 drinking water wells and 10 groundwater wells were sampled south and west of Area 6 and no drinking water or groundwater wells had 1,4-dioxane concentrations greater than the carcinogenic EPA tapwater RSL for 1,4-dioxane in groundwater.

The expectation of the amended remedy proposed in this ROD Amendment is to reduce the cumulative excess cancer risk for all COCs and exposure pathways to less than 1 in 100,000, the noncancer HI for other health effects to less than 1, and the excess cancer risk for individual COCs to less than 1 in 1,000,000.

5.8 CURRENT REMEDIAL ACTION, BASIS AND RATIONALE FOR THE AMENDMENT

The response action selected in this ROD Amendment is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

Construction of the original selected remedy in the OU 1 ROD, described in Section 2.2, was completed in 1995 and since then, the remedy has made significant progress towards meeting

RAOs for the COCs identified in the ROD. This is evident by the smaller areal extent of VOCs in groundwater and the greater than an order of magnitude concentration reduction. In addition, concentrations of 1,1-DCA and cis-1,2-DCE have decreased to levels well below the 1993 ROD RGs. Therefore, these two chemicals were removed from the COC list in this ROD Amendment.

Groundwater sampling identified 1,4-dioxane in groundwater after the 1992 interim ROD and the 1993 ROD were executed and operation of the GETR was initiated. The current treatment system does not remove 1,4-dioxane from groundwater. Because concentrations of 1,4-dioxane at the site exceed the MTCA Method B groundwater cleanup level of 0.44 µg/L, addition of this chemical to the list of COCs is required, and additional actions to address this contaminant were evaluated in the FFS (U.S. Navy 2018c).

The Navy conducted several treatability studies, both bench- and field-scale to test treatment technologies capable of addressing both VOCs and 1,4-dioxane in groundwater. Therefore, the primary groundwater treatment method will be changed to utilize a treatment technology that will address both 1,4-dioxane and VOCs in groundwater. The Navy also conducted investigations in the source area (former industrial liquid waste disposal area) to develop a better understanding of site conditions. This information along with 20 years of groundwater monitoring data were used to update the CSM and to develop and evaluate remedial alternatives in the FFS (U.S. Navy 2018c).

6.0 REMEDIAL ACTION OBJECTIVES

This section starts with a discussion of the key chemical-specific applicable or relevant and appropriate requirements (ARARs) that apply to the amended remedy and the development of the RAOs and the RGs. This section then summarizes the original RAOs and RGs from the OU 1 ROD for Area 6 and concludes with a description of the revised RAOs and RGs for the amended remedy.

6.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The primary cleanup authority for the NAS Whidbey Island Area 6 site is CERCLA. Pursuant to CERCLA, the NCP, and Executive Order 12580, other cleanup authorities and programs will also be used in the risk and hazard reduction decisions and actions.

"Applicable" requirements are defined by the NCP (40 CFR § 300.5) as those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or state environmental and facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. "Relevant and appropriate" requirements are defined (40 CFR § 300.5) as those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or state environmental and facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site, address problems or situations sufficiently similar to those encountered at CERCLA sites and are well suited to a particular site.

A requirement that is "relevant and appropriate" must be complied with to the same degree as if it were "applicable." In addition to ARARs, the lead agency may, as appropriate, identify other advisories, criteria, or guidance as "to be considered." It is important to note that only those state standards identified by the state in a timely manner and that are more stringent than federal requirements may be considered ARARs (40 CFR § 300.400(g)(4)).

ARARs specified in the 1993 ROD (U.S. Navy, Ecology, and EPA, 1993) are applicable to this remedial action without revision or amendment. Activities conducted entirely on a site need only comply with the substantive aspects of ARARs and not the administrative aspects, such as permitting (specifically exempted under Section 121(e)(1) of CERCLA, 42 U.S.C. § 9621(e)) or administrative reviews. Administrative procedures are not considered ARARs.

Any off-site activities (e.g., waste transport and disposal) must comply with all necessary federal, state, and local requirements. The NCP identifies specific Occupational Safety and

Health Administration requirements that must be complied with during all CERCLA response actions (i.e., 29 CFR §§ 1910 and 1926).

6.2 1993 ROD REMEDIAL ACTION OBJECTIVES AND REMEDIATION GOALS

This subsection presents the 1993 OU 1 ROD RAOs and RGs.

6.2.1 1993 OU 1 ROD RAOs

The 1993 OU 1 ROD established the following RAOs for Area 6:

- Reduce concentrations of contaminants that have already migrated into the shallow aquifer with the ultimate goal of meeting state and federal drinking water standards at point of compliance locations.
- Prevent the further spread of VOCs in the shallow aquifer and treat extracted water to meet state and federal standards prior to discharge.
- Reduce the potential risk to existing and future groundwater users downgradient of the site.
- Minimize infiltration of rainwater in the Area 6 landfill operations area to prevent leachate generation and migration into the groundwater.
- Prevent potential impacts to downgradient surface water bodies and aquatic organisms as a result of stormwater erosion of the surface soils at the Area 6 landfill operations area.
- Prevent further migration of contaminated groundwater across the site boundary into the lower aquifers.
- Prevent exposure to contaminants within subsurface soil and debris in the landfill operations area.

6.2.2 1993 OU 1 ROD RGs

The 1993 OU 1 ROD identified six COCs for Area 6:

- TCE
- 1,1,1-TCA
- 1,1-DCA
- 1,1-DCE

- cis-1,2-DCE
- Vinyl chloride

The 1993 OU 1 ROD established RGs for each COC at Area 6. The ROD RGs in Table 6-1 are based on the protection of human health, assuming Area 6 groundwater is ingested as drinking water. The ROD stipulates that the cumulative excess cancer risk associated with the site will be reduced to, at most, 1×10^{-5}, consistent with MTCA.

Table 6-1
1993 ROD Chemicals of Concern and Remediation Goals for Groundwater at Area 6

Constituent	EPA Safe Drinking Water Act (40 CFR 141-MCL) (µg/L)	MTCA Method B at time of ROD (WAC 173-340) (µg/L)	Remediation Goals (µg/L)
Trichloroethene	5	4	5
1,1,1-Trichloroethane	200	720	200
1,1-Dichloroethane	NE	800	800
1,1-Dichloroethene	7	0.07	0.07
cis-1,2-Dichloroethene	70	80	70
Vinyl chloride	2	0.02	0.1

Notes:
NE - not established.
CFR - Code of Federal Regulations
EPA - U.S. Environmental Protection Agency
MCL - maximum contaminant level
µg/L - microgram per liter
MTCA - Model Toxics Control Act
WAC - Washington Administrative Code

6.3 AMENDED REMEDIAL ACTION OBJECTIVES AND REMEDIATION GOALS

This section describes the amended RAOs and RGs, and the rationale for their selection.

6.3.1 Amended RAOs

The FFS developed revised RAOs for groundwater based on the revised CSM (U.S. Navy, 2018c). These RAOs address 1,4-dioxane and the original 1993 OU 1 ROD COCs that remain above RGs. Given the refined understanding of the site conditions relative to groundwater and limitations of technologies available to effectively address large, dilute, 1,4-dioxane and TCE plumes, the FFS established the following RAOs for an integrated groundwater remedy, which will supersede the 1993 OU 1 ROD groundwater RAOs:

- Reduce the potential TCE, 1,1,1-TCA, 1,1-DCE, vinyl chloride, and 1,4-dioxane risk to current and future groundwater users downgradient of the site.
- Actively remediate TCE, 1,1,1-TCA, 1,1-DCE, vinyl chloride, and 1,4-dioxane in the western and southern plume followed by monitored natural attenuation (MNA) until RGs are met.

Installation of the landfill cap has met the 1993 ROD RAOs relative to the landfill and the landfill operations area. Operation, maintenance, and monitoring of the groundwater extraction and treatment system have been performed since 1995 with the objective of meeting groundwater RAOs.

6.3.2 Amended RGs

The 1993 ROD identified COCs and established RGs for each. The ROD COCs and RGs in Table 6-1 are based on the protection of human health, assuming Area 6 groundwater is ingested as drinking water. The ROD stipulates that the cumulative excess cancer risk associated with the site will be reduced to, at most, $1\times l0^{-5}$, consistent with MTCA. However, the 1993 ROD did not address the MTCA requirement that the excess cancer risk posed by individual chemicals be reduced to 1×10^{-6}. The RGs for TCE and 1,1,1-TCA are not being amended and will remain the same as the ROD. The ROD Amendment COCs and RGs are shown in Table 6-2.

6.3.3 Removal of 1,1-DCA and cis-1,2-DCE as COCs

1,1-DCA has never been measured at a concentration greater than the RG in any of the groundwater samples collected at the site. Cis-1,2-DCE has not been measured at a concentration greater than the RG in any of the groundwater samples collected since 2008. Based on the measured concentrations of 1,1-DCA and cis-1,2-DCE throughout the plume, 1,1-DCA and cis-1,2-DCE are removed as COCs in this ROD Amendment. Data supporting this recommendation can be found in the Annual Long Term Monitoring Reports for Area 6.

6.3.4 Amended RG for 1,1-DCE

The ROD used the MTCA Method B value for 1,1-DCE of 0.07 μg/L. It was derived based on the MTCA Method B groundwater cleanup level equations and using the old cancer slope factor. Since then, the MTCA Method B value for 1,1-DCE has increased from 0.07 to 400 μg/L because the EPA no longer considers this chemical a carcinogen based on updated EPA IRIS information. The 1,1-DCE RfD was revised in 2002. The revised value indicates 1,1-DCE is less toxic to humans than previously thought. The MCL of 7 μg/L for 1,1-DCE, which is higher than the ROD cleanup level but lower than the current MTCA Method B value, is the amended RG for groundwater.

6.3.5 Amended RG for Vinyl Chloride

The ROD cleanup level was selected as 0.02 µg/L; however, the MTCA Method B cleanup level has increased to 0.029 µg/L since the ROD was signed. Note that the ROD compliance level of 0.1 µg/L for vinyl chloride was based on the practical quantitation limit (PQL) at the time the ROD was signed. Analytical methods are available today that can achieve a PQL of 0.020 µg/L and method detection limit as low as 0.005 µg/L (refer to the Tier II Sampling and Analysis Plan [U.S. Navy, 2018c]). The MTCA Method B cleanup level of 0.029 µg/L for vinyl chloride is the amended RG for groundwater.

6.3.6 RG for 1,4-Dioxane

Since an MCL has not been established for 1,4-dioxane, the RG will be set at the MTCA Method B groundwater cleanup level of 0.44 µg/L.

Table 6-2
ROD Amendment Chemicals of Concern [a] and Remediation Goals for Groundwater at Area 6

Constituent	EPA Safe Drinking Water Act (40 CFR 141-MCL) (µg/L)	MTCA Method B (WAC 173-340) (µg/L)	Remediation Goals (µg/L)
1,1-Dichloroethene	7	400	7
Vinyl chloride	2	0.029	0.029
1,4-Dioxane	NE	0.44	0.44

[a] TCE and 1,1,1-TCA are still COCs. The RGs for TCE and 1,1,1-TCA are not being amended and will remain the same as the ROD (Table 6-1). 1,1-DCA and cis-1,2-DCE have been removed as COCs.
Notes:
NE - not established.
CFR - Code of Federal Regulations
EPA - U.S. Environmental Protection Agency
MCL - maximum contaminant level
µg/L - microgram per liter
MTCA - Model Toxics Control Act
WAC - Washington Administrative Code

6.3.7 Points of Compliance

The points of compliance are not being amended and will remain the same as the ROD for TCE, 1,1,1-TCA, 1,l-DCE, and vinyl chloride. A brief summary of the ROD points of compliance is presented below per Section 8 of the 1993 ROD.

The 1993 ROD established conditional points of compliance for groundwater in the former source area (Former Industrial Waste Disposal Area). For the shallow aquifer groundwater, the conditional points of compliance for TCE, 1,1,1-TCA, and 1,l-DCE will be no greater than the circumference of a circle centered on a point halfway between wells N6-37 and N6-38 and not to exceed the western property boundary. Wells N6-37 and N6-38 were selected because they were located at the Former Industrial Waste Disposal Area and had the highest concentrations of TCE and 1,1,1-TCA, respectively.

The 1993 ROD also identified conditional points of compliance for the vinyl chloride plume within and south of the landfill as the perimeter of the landfill operations area because it corresponds to the edge of the source area per the ROD. The presence of a capped landfill at the site prevents restoration of groundwater directly beneath the landfill. Natural attenuation is expected to address residual impacts to groundwater from the landfilled area. This point of compliance will also be used for 1,4-dioxane. These conditional points of compliance from the 1993 ROD are identified on Figure 6-1 and summarized in Table 6-3.

6.3.8 Groundwater Well Installation Restrictions Around Landfills

Washington Administrative Code (WAC) 173-160-171(3)(b)(vi) establishes a minimum 1,000-foot set-back distance from the boundary of a permitted or previously permitted solid waste landfill, as defined by chapter 173-304, 173-306, 173-351, or 173-350 WAC; or 1,000 feet from the property boundary of other permitted solid waste landfills. This boundary is shown on Figure 6-2. Based on these conditions, the 1993 OU 1 ROD conditional points of compliance will remain unchanged, except for the addition of 1,4-dioxane. Table 6-3 presents the conditional points of compliance by COC.

Table 6-3
Conditional Points of Compliance from 1993 ROD by Amended Chemical of Concern

Amended Chemicals of Concern	Conditional Point of Compliance
TCE, 1,1,1-TCA, and 1,l-DCE	Conditional points of compliance for TCE, 1,1,1-TCA, and 1,l-DCE will be “no greater than the circumference of a circle centered on a point halfway between wells N6-37 and N6-38 and not to exceed the western property boundary” (Figure 6-1).
Vinyl Chloride and 1,4-dioxane	Perimeter of the landfill operations area (Figure 6-1).

Notes:
1,1-DCE - 1,1-Dichloroethene
1,1,1-TCA - 1,1,1-Trichloroethane
TCE - Trichloroethene

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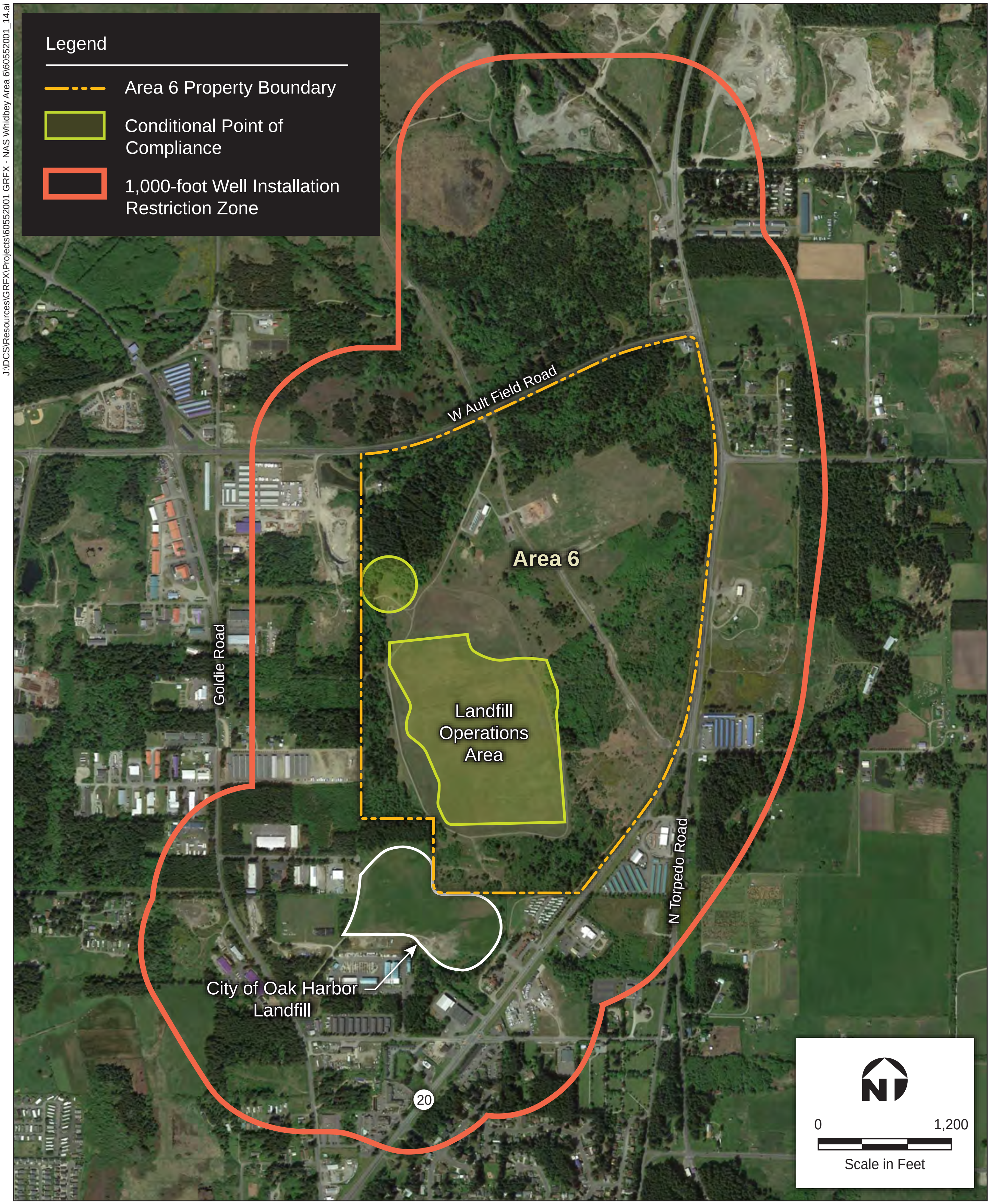
Figure 6-1
Conditional Points of Compliance for Groundwater

N62742-12-D-1829
N4425517F4073
Area 6
NAS Whidbey Island
ROD AMENDMENT



U.S. NAVY	**Figure 6-2** **Conditional Points of Compliance for Groundwater and 1,000-Foot Domestic Well Installation Restriction Zone for Landfills**	N62742-12-D-1829 N4425517F4073 Area 6 NAS Whidbey Island ROD AMENDMENT

7.0 EVALUATION OF ALTERNATIVES

7.1 ALTERNATIVES EVALUATED IN THE FFS

Remedial alternatives that would meet the RAOs were identified in the FFS including five primary alternatives and a sixth alternative created from a combination of two of the primary alternatives. All the alternatives include common elements that are:

- Continued O&M of the groundwater wells
- Preparation of 5-year review reports
- Residential and monitoring well sampling
- Implementation of existing site-wide ICs like the landfill caps and groundwater use restrictions per the ESD to Formally Institute LUCs described in Section 2.4.3
- Transitioning from an active phase to a MNA passive phase

Groundwater modeling was conducted to support evaluation of all alternatives during the FFS. Two groundwater modeling concepts were developed:

1) Groundwater extraction with *ex situ* treatment, which applies to Alternatives 2, 5, and 6
2) *In situ* groundwater treatment which applies to Alternatives 3 and 4

All evaluated alternatives are integrated remedies with an active treatment phase and a passive (natural attenuation) phase. The modeling was used to estimate the time for transition from the active phase to the passive phase. The modeling was also used to evaluate the time to reach RGs under the passive phase, once the active phase had been terminated. These metrics were used in the evaluation.

The costs to perform these baseline elements are assumed equal for each of the six alternatives so have not been discussed under each alternative. The six remedial alternatives considered are as follows:

7.1.1 Alternative 1 – No action, existing actions continue

A "No-action" alternative is retained as a baseline for comparison of other alternatives and to help ensure that unnecessary remedial action is not taken where the current action is appropriate. The "continue with the current system" alternative consists of allowing the site to remain in its present condition with continued operation of the groundwater treatment system with the existing air stripper tower which does not treat 1,4-dioxane.

7.1.2 Alternative 2 (Preferred Alternative) – Groundwater treatment using AOP including new additional treatment plant to south, upgrading current treatment plant to AOP from air stripper and expanding the well network.

A new groundwater treatment system (southern plant) with five new extraction wells would be installed along SR 20 or as approved in the Remedial Design that will use advanced oxidation process (AOP) to remove chlorinated COCs and 1,4-dioxane from extracted groundwater. The existing air stripper treatment system at Area 6 (western plant) would be replaced with an AOP system. The implementation of the replacement AOP system (western plant) would be initiated following one year of continuous operation of the southern AOP system. The one year of continuous operation will be used to determine if the AOP is working properly with site conditions and to apply any lessons learned to the western plant. As part of this replacement, based on groundwater modeling, the Navy may expand the groundwater extraction network in the western plume with up to four new pumping wells.

The western and southern plants would be operated until the transition points as prescribed in Section 8.5.

The estimated time for design and construction of the south plant is 2 years. Construction of the western plant will be completed after one year of successful south plant operation. The estimated costs, discussed in Section 7.2.7, assumes 30 years to achieve RGs. The capital, annual O&M, and total present worth costs estimated by the FFS are $14,500,000.

7.1.3 Alternative 3 – *In-situ* groundwater treatment with chemical oxidation using base-activated persulfate

This alternative would treat impacted groundwater migrating off site along the western and southwestern boundaries of the site and along the southern leading edge of the plume near SR 20 by using *in-situ* injection via reusable injection wells. Along the southern and western boundaries, 110 reusable injection wells (up to 140 feet deep) and 135 reusable injection wells (up to 110 feet deep) would be drilled, respectively. The injection of ISCO chemicals (base-activated persulfate) into the groundwater zone would chemically destroy the 1,4-dioxane and the chlorinated COCs. The area needing treatment is large, so ISCO injections were assumed to require 7 years of injection cycles to complete. The current groundwater treatment system would continue operation for 5 years during ISCO treatment until ISCO can prevent off-site migration and hydraulic containment is no longer required.

The estimated costs, discussed in Section 7.2.7, assumes 7 years of injections to achieve RGs with 15 years of post-injection monitoring. The capital, annual O&M, and total present worth costs estimated by the FFS are $41,800,000.

7.1.4 Alternative 4 – *In-situ* groundwater treatment with chemical oxidation using catalyzed hydrogen peroxide

This alternative is similar to Alternative 3 with the main difference being that the ISCO chemical used would be catalyzed hydrogen peroxide instead of base-activated persulfate. Along the southern and western boundaries, 150 reusable injection wells (up to 140 feet deep) and 180 reusable injection wells (up to 110 feet deep) would be drilled, respectively. Using catalyzed hydrogen peroxide would require more injection points since it reacts faster than base-activated persulfate but it is a less expensive chemical. The current groundwater treatment system would continue operation for 5 years during ISCO treatment until ISCO can prevent off-site migration and hydraulic containment is no longer required.

The estimated time for design and construction is 2 years. The estimated costs, discussed in Section 7.2.7, assumes 7 years of injections to achieve RGs with 15 years of post-injection monitoring. The capital, annual O&M, and total present worth costs estimated by the FFS are $38,600,000.

7.1.5 Alternative 5 –Continued groundwater treatment system with expanded well network, discharging all water to the Navy Ault Field Wastewater Treatment Plant

Existing and new extraction wells would be used to extract groundwater containing chlorinated COCs and 1,4-dioxane around Area 6 including to the south along SR-20. The major deviation from other alternatives is that the treatment will be completed off-site by pumping the extracted groundwater to the existing Navy Ault Field Wastewater Treatment Plant (WWTP). The WWTP would need to be modified to process the extracted groundwater and the WWTP permit would require modification.

The western and southern plants would be operated until the transition points as prescribed in Section 8.5.

The estimated time for design and construction of the south plant is 2 years. Construction of the western plant will be completed after one year of successful south plant operation. The estimated costs, discussed in Section 7.2.7, assumes 30 years to achieve RGs. The capital, annual O&M, and total present worth costs estimated by the FFS are $16,000,000.

7.1.6 Alternative 6 – Combination of Alternatives 2 and 4 – Groundwater treatment using AOP including new additional treatment plant to south, upgrading current treatment plant to AOP from air stripper and expanding the well network and *in-situ* groundwater treatment using chemical oxidation with catalyzed hydrogen peroxide injections

Catalyzed hydrogen peroxide injections would be used in the western and southern plume areas (part of Alternative 4) in conjunction with the AOP groundwater treatment systems (Alternative 2) to accelerate treatment and reduce the required operation time of the western plant.

The western and southern plants would be operated until the transition points as prescribed in Section 8.5.

The estimated time for design and construction of the south plant is 2 years. Construction of the western plant will be completed after one year of successful south plant operation. The estimated costs, discussed in Section 7.2.7, assumes 30 years to achieve RGs. The capital, annual O&M, and total present worth costs estimated by the FFS are $27,600,000.

A comprehensive analysis of each alternative against the CERCLA criteria was performed in the FFS (U.S. Navy 2018c). Based on the analysis, the proposed plan presented Alternative 2 as the highest rated remedy. The basis of this conclusion is provided in the following sections.

7.2 COMPARATIVE ANALYSIS

Nine evaluation criteria have been developed to address the CERCLA requirements and considerations and the technical and policy considerations that have proven to be important for selecting among remedial alternatives. These evaluation criteria served as the basis for conducting the detailed analyses in the FFS and for subsequently selecting an appropriate remedial action.

Assessments against the first two criteria relate directly to statutory findings that must ultimately be made in the ROD. Therefore, these are categorized as threshold criteria in that each alternative must meet them in order to be selected. These two threshold criteria are:

- Overall protection of human health and the environment – This criterion describes how the alternative, as a whole, achieves and maintains protection of human health and the environment.
- Compliance with ARARs – This criterion describes how the alternative complies with ARARs, or, if a waiver is required, how it is justified. The assessment also addresses other information from advisories, criteria, and guidance that the lead and support agencies have agreed is to be considered.

The balancing criteria distinguish and measure differences between alternatives:

- Long-term effectiveness and permanence – The assessment of alternatives against this criterion evaluates the long-term effectiveness of alternatives in maintaining protection of human health and the environment after response objectives have been met.
- Reduction of toxicity, mobility, and volume through treatment – The assessment against this criterion evaluates the anticipated performance of the specific treatment technologies an alternative may employ.
- Short-term effectiveness – The assessment against this criterion examines the effectiveness of alternatives in protecting human health and the environment during the construction and implementation of a remedy until response objectives have been met.
- Implementability – This assessment evaluates the technical and administrative feasibility of alternatives and the availability of required goods and services.
- Cost – This assessment evaluates the capital and O&M costs of each alternative.

These five criteria were used to consider and scale the different strengths and weaknesses of the alternatives relative to one another. A graphical representation of the comparative evaluation of the four alternatives using the threshold and balancing criteria is shown on Figure 7-1.

The modifying criteria are evaluated throughout the remedy selection process, but most directly through formal and informal comment periods:

- Acceptance by appropriate state agencies or agencies with jurisdiction over affected resources
- Community acceptance

Alternative 1 (continue with current system) does not meet the threshold criteria and is therefore not included in this comparative analysis. Alternatives 2 and 5 are basically the same alternative with treatment process differences. Alternatives 3 and 4 are also similar and differ primarily in the type of oxidant and the number of injection wells. Figure 7-1 graphically illustrates results of the comparative analysis.

CERCLA Criteria	Alternative 1 Continue with Current System	Alternative 2 Continue P&T With Ex Situ Groundwater Treatment Using Advanced Oxidation Process and Additional Extraction Wells	Alternative 3 In Situ Groundwater Treatment with ISCO Using Base-Activated Persulfate	Alternative 4 In Situ Groundwater Treatment with ISCO Using Catalyzed Hydrogen Peroxide	Alternative 5 Expanded Groundwater Capture With All Untreated Effluent Discharged to Navy WWTF at Ault Field	Combined Alternatives 2 and 4
Overall Protection of Human Health and the Environment	Does Not Meet Criteria	Meet Criteria	Meet Criteria	Meet Criteria	Meet Criteria	Meet Criteria
Compliance with ARARs	Does Not Meet Criteria	Meet Criteria	Meet Criteria	Meet Criteria	Meet Criteria	Meet Criteria
Long-Term Effectiveness and Permanence	Not Rated	Excellent	Good	Good	Excellent	Excellent
Reduction of Toxicity, Mobility, and Volume Through Treatment	Not Rated	Excellent	Good	Good	Good	Excellent
Short-Term Effectiveness	Not Rated	Good	Adequate	Adequate	Good	Adequate
Implementability	Not Rated	Good	Adequate	Adequate	Adequate	Adequate
Cost	Not Rated	Superior	Poor	Poor	Excellent	Adequate
State and Community Acceptance	Not Rated	Accepted	Not Rated	Not Rated	Not Rated	Not Rated

Legend:
- Poor
- Adequate
- Good
- Excellent
- Superior

Notes:

AOP advanced oxidation process

ARARs applicable or relevant and appropriate requirements

ISCO in situ chemical oxidation

WWTF wastewater treatment facility

U.S. NAVY

Figure 7-1
Comparative Evaluation of Alternatives

7.2.1 Overall Protection of Human Health and the Environment

Alternatives 2, 3, 4, 5, and 6 meet criteria for *overall protection of human health and the environment*.

7.2.2 Compliance with ARARs

Compliance with ARARs is summarized in Table 7-1.

Chemical-Specific ARARs

All of the alternatives brought forward have been judged to meet chemical-specific ARARs.

Location-Specific ARARs

All alternatives will meet location-specific ARARs equally.

Action-Specific ARARs

All alternatives will meet action-specific ARARs equally.

Overall ARAR Compliance Assessment

Based on the assessments presented above, Alternatives 2, 3, 4, 5, and 6 meet criteria for overall compliance with ARARs.

Table 7-1
Summary of Alternatives Compliance with ARARs

ARAR	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Chemical-Specific ARARs					
RCRA Subpart C – Characteristics of Hazardous Waste	Yes	Yes	Yes	Yes	Yes
Safe Drinking Water Act - MCLs for organics	Yes	Yes	Yes	Yes	Yes
Washington State Model Toxics Control Act	Yes	Yes	Yes	Yes	Yes
Clean Water Act (Water Quality Standards)	Yes	Yes	Yes	Yes	Yes
National Oil and Hazardous Substances Pollution Contingency Plan	Yes	Yes	Yes	Yes	Yes
Location-Specific ARARs					
Migratory Bird Treaty Act	Yes	Yes	Yes	Yes	Yes
Bald and Golden Eagle Protection Act	Yes	Yes	Yes	Yes	Yes
Endangered Species Act	Yes	Yes	Yes	Yes	Yes
Executive Order 11990 (Protection of Wetlands)	Yes	Yes	Yes	Yes	Yes
Archeological Resources Protection Act	Yes	Yes	Yes	Yes	Yes
National Historic Preservation Act	Yes	Yes	Yes	Yes	Yes
Action-Specific ARARs					
RCRA, Subtitle D, Solid Waste Regulations	Yes	Yes	Yes	Yes	Yes
Standards Applicable to Transporters of Hazardous Waste	Yes	Yes	Yes	Yes	Yes
Groundwater Monitoring Program	Yes	Yes	Yes	Yes	Yes
Clean Water Act - NPDES Industrial Wastewater Discharge Permits	Yes	Yes	Yes	Yes	Yes
RCRA, Subtitle C, Regulations for Hazardous Waste	Yes	Yes	Yes	Yes	Yes
RCRA, Subtitle D, Regulations for Hazardous Waste	Yes	Yes	Yes	Yes	Yes
Air Emission Standards for Process Vents and Equipment Leaks	Yes	Yes	Yes	Yes	Yes
State of Washington Hazardous Waste Management Act	Yes	Yes	Yes	Yes	Yes
State of Washington Solid Waste Management Act	Yes	Yes	Yes	Yes	Yes
State of Washington Fugitive Dust Control Measures	Yes	Yes	Yes	Yes	Yes
State of Washington Clean Air Act	Yes	Yes	Yes	Yes	Yes
State Underground Injection Control Program	Yes	Yes	Yes	Yes	Yes
State Waste Discharge Permit Program	Yes	Yes	Yes	Yes	Yes

Notes:
NPDES – National Pollutant Discharge Elimination System
RCRA – Resource Conservation and Recovery Act

7.2.3 Long-Term Effectiveness and Permanence

Alternatives 2, 5, and 6 have the lowest uncertainty for maintaining plume control and treating groundwater. Some uncertainty exists relative to residual source mass to groundwater in the former source area vadose zone soil, but data collected to date indicate that the potential for an ongoing contribution to groundwater is very low.

Alternative 2 and Alternative 6 provide the highest degree of overall *long-term effectiveness and permanence* as there is greater certainty in treating extracted groundwater, and treated groundwater is returned to the aquifer. Alternative 5 would discharge groundwater to the surface water of Puget Sound via discharge from the Ault Field WWTP.

Alternatives 3 and 4 would provide overall protection of human health and the environment. The effectiveness of ISCO was found to be marginal for this large, dilute plume, based on the treatability testing. However, this conclusion is based on a single injection; it is expected that multiple injections would significantly enhance the performance of ISCO at the site. Treating large dilute plumes with ISCO as the primary treatment component has challenges. Delivery of the oxidant to impacted groundwater is the single biggest challenge. These alternatives rely on setting up ISCO barriers along the western site boundary and SR 20. Operation of the existing groundwater extraction and treatment system would provide hydraulic control at least until the ISCO barriers have been established. These alternatives would also allow a portion of the southern plume to go untreated and therefore would rely on natural attenuation. Alternatives 3 and 4 have greater uncertainty related to *long-term effectiveness and permanence* compared to Alternatives 2 and 5 for the following reasons:

- The uncertainty regarding plume control after the ISCO barrier is established
- The uncertainty of the required frequency and well density to establish and maintain the ISCO barrier along the western site boundary and SR 20

Alternatives 2, 5, and 6 reduce uncertainty in meeting RGs (Safe Drinking Water Act and MTCA) relative to Alternatives 3 and 4. Reliance on a National Pollutant Discharge Elimination System permit and surface water discharge of treated groundwater reduces the certainty of Alternative 5 relative to Alternative 2. There is greater uncertainty of Alternatives 3 and 4 to maintain plume control, injection frequency, and injection radius of influence relative to Alternatives 2, 5, and 6.

As previously stated, the data gap analysis (U.S. Navy 2015a) concluded TCE in vadose zone soil has a low potential to act as a source to groundwater. If vadose zone soil poses a residual source to groundwater at concentrations above RGs or above an acceptable natural attenuation level, this uncertainty could be managed, if required, with additional residual source removal methods.

The modeling used to predict plume extent and the timeframe to reach the transition point between active and passive cleanup (and to reach RGs) used ModFlow and MT3D, a well-accepted methodology that is the industry standard. However, using this methodology may result in optimistic time predictions when compared to using ModFlow and MT3D incorporating matrix diffusion. Matrix diffusion could be simulated by assuming a very low concentration constant source assigned to low permeability zones. There are no significant, low permeability zones identified within the shallow aquifer. A low permeability layer forms the base of the shallow aquifer at the site. Because the model does not incorporate matrix diffusion there is some uncertainty in the timeframes estimated to reach RGs.

Ratings for long-term effectiveness and performance are:

- Alternative 2 “excellent”
- Alternative 3 “good”
- Alternative 4 “good”
- Alternative 5 “excellent”
- Alternative 6 “excellent”

7.2.4 Reduction of Toxicity, Mobility, and Volume Through Treatment

Individually, Alternative 2 and 6 were rated highest for reduction of toxicity, mobility, and volume through treatment. This is because of the lower uncertainty for groundwater extraction to contain the plumes, reduce their mobility, and treat the extracted groundwater. Alternative 5 rating was reduced because the WWTP will not directly treat 1,4-dioxane in extracted groundwater. It would rely on dilution to decrease 1,4-dioxane concentrations prior to discharge. Alternatives 3 and 4 have higher uncertainty in all three criteria. For these reasons, the alternatives were rated as follows:

- Alternative 2 “excellent”
- Alternative 3 “good”
- Alternative 4 “good”
- Alternative 5 “good”
- Alternative 6 “excellent”

7.2.5 Short-Term Effectiveness

Individually, Alternatives 2, 5, and 6 were rated highest for short-term effectiveness. These alternatives represent the least amount of effort required off Navy property that would expose the community and workers to potential construction hazards and inconveniences. Alternatives 3 and 4 would require a much longer construction time along SR 20 for injection well installation. Alternative 6 would expose workers to risks for a longer period of time by installing up to 100 injection wells within the Area 6 boundary, in addition to the exposure from Alternative 2 actions. Based on these conditions, the short-term effectiveness alternative ratings are:

- Alternative 2 “good”
- Alternative 3 “adequate”
- Alternative 4 “adequate”
- Alternative 5 “good”
- Alternative 6 “adequate”

7.2.6 Implementability

Alternative 2 was rated best for implementability as it utilizes the existing infrastructure to the maximum extent possible. Because Alternative 5 requires installation and maintenance of a carbon substrate management system at the Ault Field WWTP, Alternative 5 was rated lower than Alternative 2. Alternatives 3 and 4 are also rated lower than Alternative 2 because of the higher level of off-site infrastructure installation and long-term injections required along SR 20. These alternatives 3 and 4 require installation of 110 to 180 injection wells along SR 20, depending on the alternative. Following installation, crews would need to occupy these locations multiple times per year to inject oxidant to create the ISCO barrier.

Based on these considerations, alternatives were rated for implementability as follows:

- Alternative 2 “good”
- Alternative 3 “adequate”
- Alternative 4 “adequate”
- Alternative 5 “adequate”
- Alternative 6 “adequate”

7.2.7 Estimated Cost

The alternatives were rated against Cost based on the estimated cost for each alternative to achieve RGs and RAOs presented in the FFS (U.S. Navy 2018c). A summary of estimated costs is presented in Table 7-2.

Alternatives are rated for total cost as follows:

- Alternative 2 “excellent”
- Alternative 3 “poor”
- Alternative 4 “poor”
- Alternative 5 “good”
- Alternative 6 “adequate”

Table 7-2
Comparison of Alternative Costs

Task	Alternative 1: Continue with Current System	Alternative 2: Continue P&T With Ex-Situ Groundwater Treatment Using Advanced Oxidation Process and Additional Extraction Wells North System 9 years South System 17 years	Alternative 3: In-Situ Groundwater Treatment with ISCO Using Base-Activated Persulfate	Alternative 4: In-Situ Groundwater Treatment with ISCO Using Catalyzed Hydrogen Peroxide	Alternative 5: Expanded Groundwater Capture with All Untreated Effluent Discharged to Navy WWTP at Ault Field North System 9 years South System 17 years	Alternative 6 Combination Groundwater Pump and Treat (Alternative 2) and ISCO (Alternative 4)
Implementation Costs						
Capital Direct Costs (Construction)	$423,000	$3,460,000	$37,280,000	$33,630,000	$3,450,000	$14,280,000
Unlisted Items and Services Assumed (%)	25%	25%	25%	25%	25%	25%
Capital Indirect Costs (Engineering)	$118,000	$508,000	$1,210,000	$1,130,000	$492,000	$1,148,000
Unlisted Engineering Services Assumed	15%	15%	15%	15%	15%	15%
Total Capital Implementation Costs	**$541,000**	**$3,970,000**	**$38,490,000**	**$34,760,000**	**$3,940,000**	**$15,970,000**
Operational Costs (30 years)						
Annual O&M Costs (North System)	$305,000	$222,000	$158,000	$158,000	$358,000	$445,000
Years of O&M Assumed (North System)	30	9	5	5	9	5
Annual O&M Costs (South System)	NA	$139,000	NA	NA	$194,000	$335,00
Years of O&M Assumed (South System)	NA	17	NA	NA	17	13.5
Annual Monitoring Costs	$289,000	$301,000	$308,000	$308,000	$300,000	$301,000
Years of Monitoring Assumed	30	30	15	15	30	30
Nonroutine O&M and Closure Costs	$1,026,000	$1,215,000	$1,049,000	$1,151,000	$934,000	$1,688,000

Table 7-2 (Continued)
Comparison of Alternative Costs

Task	Alternative 1: Continue with Current System	Alternative 2: Continue P&T With Ex-Situ Groundwater Treatment Using Advanced Oxidation Process and Additional Extraction Wells North System 9 years South System 17 years	Alternative 3: In-Situ Groundwater Treatment with ISCO Using Base-Activated Persulfate	Alternative 4: In-Situ Groundwater Treatment with ISCO Using Catalyzed Hydrogen Peroxide	Alternative 5: Expanded Groundwater Capture with All Untreated Effluent Discharged to Navy WWTP at Ault Field North System 9 years South System 17 years	Alternative 6 Combination Groundwater Pump and Treat (Alternative 2) and ISCO (Alternative 4)
Unlisted Operational Tasks Assumed	20%	20%	20%	20%	20%	20%
Total Operational Costs	**$18,850,000**	**$14,610,000**	**$6,460,000**	**$6,570,000**	**$16,460,000**	**$15,790,000**
TOTALS						
Total Capital and Operational Costs	**$19,391,000**	**$18,580,000**	**$44,930,000**	**$41,310,000**	**$20,400,000**	**$31,760,000**
Present-Worth Implementation Costs	$483,000	$3,870,000	$35,740,000	$32,450,000	$3,840,000	$15,120,000
Present-Worth Operational Costs	$12,260,000	$10,290,000	$5,210,000	$5,290,000	$11,810,000	$11,820,000
Site Inspection and Overhead	$77,000	$310,000	$715,000	$649,000	$307,000	$535,000
Agency Oversight	$19,300	$77,400	$178,700	$123,900	$76,800	$133,700
Total Project Present Worth [a]	**$12,800,000**	**$14,500,000**	**$41,800,000**	**$38,600,000**	**$16,000,000**	**$27,600,000**

[a] Present-worth costs were calculated using a 3% discount rate with a base year of 2015.

Notes:
Discount Rate (3%) = Interest Rate (6%) − Inflation (3%)
ISCO – in-situ chemical oxidation
P&T - pump and treat

7.3 ALTERNATIVES ASSESSMENT

Results of the comparative evaluation of alternatives are summarized on Figure 7-1.

Alternatives 3 and 4 are the lowest rated alternatives because of the uncertainty with respect to plume containment and reduction of mobility. The rationale for these ratings is that groundwater extraction is a more dependable and also more easily measured process than ISCO injections. ISCO injections come with an inherent level of uncertainty as consistent delivery of the chemical oxidant to impacted groundwater at depths of up to 140 feet is challenging. This results in lower ratings for the threshold criteria as well.

Alternative 2 is the highest rated alternative. It is also rated equivalent to the Alternative 6 for the following:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume through treatment

Alternative 2 is rated higher than Alternative 6 for the following reasons:

- Short-term effectiveness
- Implementability
- Cost

The portion of Alternative 4 that is included in Alternative 6 can be applied to Alternative 2 at any time and at any level. If reaching the RGs in a portion of the western plume proves problematic or an accelerated restoration time is desired and is cost effective, a portion of Alternative 4 can be strategically added at a significantly reduced level.

Table 7-3 summarizes the comparative analysis ratings of the Alternatives discussed in Section 7.2. Overall, Alternatives 2 and 6 received the highest overall ratings, but Alternative 2 is better than 6 for its short term effectiveness, implementability, and total cost. As noted above, the two groundwater extraction and treatment plants will have a higher certainty of controlling the plume than ISCO injections. The rating for ISCO is decreased further by the high costs necessary for the large number of injection wells required to saturate the entire plume with oxidizing chemicals. Based on this qualitative evaluation, Alternative 2 (Continue P&T with Ex-Situ Groundwater Treatment Using AOP and Additional Extraction Wells) rates the highest and is the selected remedy.

Table 7-3
Summary of Comparative Analysis Rating for Alternatives

CERCLA Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Overall protection of human health and the environment	Does not meet criteria	Meets Criteria	Meets Criteria	Meets Criteria	Meets Criteria	Meets Criteria
Compliance with ARARs	Does not meet criteria	Meets Criteria	Meets Criteria	Meets Criteria	Meets Criteria	Meets Criteria
Long-term effectiveness and permanence	Not rated	Excellent	Good	Good	Excellent	Excellent
Reduction of toxicity, mobility, and volume through treatment	Not rated	Excellent	Good	Good	Good	Excellent
Short-term effectiveness	Not rated	Good	Adequate	Adequate	Good	Adequate
Implementability	Not rated	Good	Adequate	Adequate	Adequate	Poor
Cost	Not rated	Superior	Poor	Poor	Excellent	Adequate
State and community acceptance	Not rated	Accepted	Not rated	Not rated	Not rated	Not rated
Overall	Not rated	Excellent	Poor	Poor	Good	Adequate

8.0 AMENDED REMEDY - CONTINUE P&T WITH EX-SITU GROUNDWATER TREATMENT USING ADVANCED OXIDATION PROCESS AND ADDITIONAL EXTRACTION WELLS

The FFS developed and evaluated remedial alternatives intended to meet revised RAOs for groundwater at OU 1 Area 6 (U.S. Navy 2018b). The amendment to the remedy described herein is based on the FFS evaluation. Two independent GETR systems will be constructed to replace the existing GETR system. One system will be constructed in the southern portion of the site to address the southern plume. The second system will be constructed at the current system location to address the western plume. The selected remedy also adds 1,4-dioxane as a COC, adds a 1,4-dioxane cleanup level, removes 1,1-DCA and cis-1,2-DCE, and modifies cleanup levels for 1,1-DCE and vinyl chloride.

The southern system will be constructed and operated first. The implementation of the replacement AOP system (western plant) would be initiated following one year of continuous operation of the southern AOP system. The one year of continuous operation will be used to determine if the AOP is working properly with site conditions and to apply any lessons learned to the western plant. Groundwater model simulations indicate the western system will reach transition to passive remediation in a significantly shorter operational period than the southern plume (U.S. Navy 2018c). Materials constituting principal threats (i.e., COCs) are addressed by groundwater extraction and treatment with the amended remedy described below. The municipal landfill and the Former Industrial Waste Disposal Area constitute the principal threat wastes. The cap has addressed the landfill threat to the extent possible. Removal of impacted soil in the Former Industrial Waste Disposal Area has reduced this principal threat. The remaining principal threat waste is residual material in groundwater or soil that could leach to groundwater. The selected remedy addresses the residual, low concentration principal threat waste.

8.1 RATIONALE FOR SELECTION OF THE AMENDED REMEDY

The rationale for the selection of ex-situ groundwater treatment using AOP as the preferred remedial action alternative is as follows:

- It will concurrently treat all COCs in groundwater, including 1,4-dioxane
- It will provide the highest overall protection of human health and the environment in the most cost-effective manner

The selected remedy is an integrated remedy that will comprise of an active treatment component, MNA (passive treatment), and ICs. The transition from the active remedy portion to

MNA/ICs (passive) will occur when whichever of the active endpoint conditions presented in Section 8.5 is met. The MNA component of the integrated remedy is consistent with EPA's OSWER Directive 9200.4-17P Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. Based on the CSM and taking into account the ICs, the use of MNA is projected to be protective of human health and the environment as the latter part of the integrated remedy. It is expected that RGs will be achieved in a reasonable timeframe using an integrated remedy approach. If the southern plant is turned off as predicted by the model, the residual plume mass is predicted to reach the RGs via MNA in 30 to 40 years.

The transition from the active remedy portion to MNA/ICs (passive) will proceed as discussed in Section 8.5.

8.2 OFF-SITE SOUTHERN PLUME SYSTEM DESCRIPTION

A line of five extraction wells will be installed along SR 20 or as approved in the Remedial Design. These wells will be positioned at 225 foot intervals in the locations shown on Figure 8-1. Groundwater modeling (U.S. Navy 2018c) and the results of the site investigations show that the position of these wells will capture the width of 1,4-dioxane and vinyl chloride plume along this line when pumped at 25 gpm each. The location of the Southern system extraction wells was refined after the FFS, using the 2018 1,4-dioxane distribution in groundwater as the starting concentration and iterative numeric modeling to choose the optimal extraction locations (U.S. Navy 2018c).

The extracted water will be piped to a new south treatment plant located near the southeastern corner of the Area 6 landfill operations area (Figure 8-1). The new southern treatment pad will be constructed from concrete with secondary containment features and have a new AOP unit contained in a permanent fabric cover structure. The water will be treated for 1,4-dioxane and vinyl chloride concurrently using an AOP. The extracted water will enter a chamber where hydrogen peroxide and ozone will be injected. These strong oxidizers will destroy 1,4-dioxane and vinyl chloride. Bench-scale testing has confirmed the effectiveness on these compounds in water taken directly from the site (U.S. Navy 2018c).

Treated water will be routed via gravity flow along the eastern edge of the landfill and will surface discharge just north east of where the existing treatment system is surface discharging for re-infiltration.

Specific elements of the southern plume system are:

- Add five extraction wells off-site to address the 1,4-dioxane plume through strategic placement along the northern shoulder of SR 20 (Figure 8-1) or as approved in the Remedial Design.
- Install an AOP (HiPOx treatment system by APTwater LLC) treatment system, which uses ozone and hydrogen peroxide for the southern plume.
- Connect discharge from the new extraction wells along the northern shoulder of SR 20 to a stand-alone southern ex-situ AOP system (Figure 8-1).
- Install a new pipeline to route treated effluent from the southern ex-situ AOP system to a discharge point near the existing discharge swale (Figure 8-1).
- Gather relevant data to assess MNA rate.
- Transition from the active portion of the remedy to MNA when one of the active endpoint conditions presented in Section 8.5 has been met and validation complete per Section 8.5.
- Continue to implement LUCs from OU 1 ROD.
- Monitor groundwater until RGs are met.
- Continue to conduct off-site drinking water sampling if necessary and conduct annual LUC inspections as discussed in Section 8.6.
- Complete 5-year reviews as prescribed by CERCLA.

Groundwater modeling (U.S. Navy 2018c) predicts that the southern system should reach the transition point concentration for 1,4-dioxane in approximately 17 years. Once the transition point concentration or asymptotic condition has been reached for the southern system as provided in Section 8.5, validation per Section 8.5 will be performed prior to the Navy transitioning to MNA.

8.3 ON-SITE WESTERN PLUME SYSTEM DESCRIPTION

The existing 10 extraction wells will remain and be used as appropriate to recover COCs in the western plume area. The current treatment system will be replaced with an AOP system as described for the southern plume system. Implementation of the AOP system will be initiated following one year of continuous operation of the southern AOP system. The one year of continuous operation will be used to determine if the AOP is working properly with site conditions and to apply any lessons learned to the western plant. Treated water will be discharged through the same piping network for surface discharge and re-infiltration. The extraction well network will be optimized (maintain/add/subtract extraction wells) with the objective to contain the plume. The optimization could include the strategic addition of up to four new extraction wells. The specific number and locations of additional extraction wells will be determined during remedial design and based on current data at that time. Four conceptual wells along the centerline of the plume have been shown on Figure 8-1. These new wells will be connected to the existing pipeline to the treatment system.

Specific elements of the western plume system are:

- Optimize the extraction wells (maintain/add/subtract) with the objective to contain the plume.
- Replace existing air stripper treatment system with an AOP system to address 1,4-dioxane.
- Install a new pipeline to route untreated effluent from up to four new western plume wells to the new northern AOP system at the existing treatment pad.
- Gather relevant data to assess MNA rate.
- Transition from the active portion of the remedy to MNA when one of the active endpoint conditions presented in Section 8.5 is met and validation complete per Section 8.5.
- Continue to implement LUCs from OU 1 ROD.
- Implement groundwater use restrictions where there is potential drinking water use and concentrations exceed the RGs downgradient of the identified plume.
- Monitor groundwater until RGs are met.
- Complete 5-year reviews as prescribed by CERCLA.

Groundwater modeling (U.S. Navy 2018c) predicts that the western system should reach the transition point concentration for 1,4-dioxane RG in approximately 9 years. Once the transition point concentration or asymptotic condition has been reached for the western system as provided in Section 8.5, validation per Section 8.5 will be performed prior to the Navy transitioning to MNA.

8.4 GROUNDWATER MODELING PREDICTIONS

The results of modeling at Area 6 NAS Whidbey Island relative to TCE and 1,4-dioxane remedy optimization indicate the following:

1. The model predicts that TCE in the western plume will be reduced to the transition point concentration approximately 7 years after optimized system startup. This does not take into account potential residual sources, matrix diffusion, or biological decay. The conservative estimate is the TCE transition point concentration will be reached in 9 to 12 years of western system operation.

2. The model predicts that 1,4-dioxane in the western plume will be reduced to the transition point concentration approximately 9 years after optimized system startup. This does not take into account potential residual sources, matrix diffusion, or biological decay. The conservative estimate is the 1,4-dioxane transition point concentration will be reached in 9 to 15 years of western system operation.

3. Based on predictions 1 and 2 above, the western plant and extraction network was simulated to be shut down after 9 years. Continued simulation with pumping from the southern wells only shows no westerly deflection of residual TCE or 1,4-dioxane. Continued simulation with pumping from the southern wells only shows residual western plume and southern plume containment.

4. The model predicts 1,4-dioxane in the southern plume will be reduced to the transition point concentration approximately 17 years after optimized system startup. This does not take into account potential residual sources, matrix diffusion, or biological decay. The conservative estimate is the 1,4-dioxane transition point concentration will be reached in 17 to 25 years of southern system operation.

5. The southern system was simulated to be shut down after 17 years of operation. The remaining residual mass (1,4-dioxane concentration less than 1 µg/L) needing natural attenuation is predicted to move downgradient past SR 20 during this time. The residual plume mass was predicted to reach the RG via natural attenuation in 30 to 40 years. This does not take into account potential residual sources, matrix diffusion, or biological decay.

The potential for natural attenuation at the site is documented in USGS Water-Resources Investigations Report 00-4060.

8.5 PERFORMANCE MONITORING

The Navy will conduct performance monitoring as prescribed in a plan to be prepared during the design phase. The EPA and Ecology will have an opportunity to review and concur on this plan.

The selected remedy presented herein is an integrated remedy that will comprise of an active treatment component, MNA (passive treatment), and ICs. The transition from the active remedy portion to MNA/ICs (passive) will follow the steps below.

Transition points are met - The transition from the active remedy portion to MNA/ICs (passive) will be validated when whichever one of the following conditions is met first, per plume:

- Groundwater concentrations of the Table 6-2 COCs throughout the plume are equal to or less than their transition point goal values (presented on Table 8-1) based on the statistical mean concentration for four consecutive events; or
- Groundwater concentrations of Table 6-2 COCs in a "majority" of extraction well samples approach asymptotic conditions, as identified using asymptote analysis via linear regression, or first order decay, or other statistical evaluation.

The specific statistical conditions will be further defined in the Performance Monitoring Plan to be prepared during the design phase. Transition point goals are provided in Table 8-1.

Validation - Prior to the transition from active to passive remediation, the Navy will validate the efficacy of MNA by doing the following to support the transition to MNA:

- plume configuration, which will include additional delineation of the southern plume, as part of the performance monitoring;
- data trends demonstrate active treatment mass reduction; and,
- modeling predictions based on the data available at that time.

The Navy will validate the modeling predictions to assure that RGs will be achieved in a reasonable timeframe using an integrated remedy approach. This validation will be subject to review and concurrence by the EPA, as part of an updated performance monitoring plan, prior to the Navy transitioning to MNA. Assuming validation of MNA, the transition to MNA may occur when the active remedy has achieved asymptotic conditions.

Ongoing Performance Monitoring - The effectiveness of the MNA will be demonstrated to EPA by ongoing performance monitoring. The Navy will be conducting performance monitoring to verify that both the active and passive (MNA) remediation phases are performing as anticipated.

Termination of passive remediation will occur when the RGs for all COCs are achieved as specified in a performance monitoring plan that will be developed during the design phase.

Table 8-1
ROD Amendment Chemicals of Concern, Remediation Goals, and Transition Point Goals for Groundwater at Area 6

Constituent	Remediation Goals (µg/L)	Transition Point Goals (µg/L) [a]
Trichloroethene	5	15
1,1,1-Trichloroethane	200	600
1,1-Dichloroethene	7	21
Vinyl chloride	0.029	2
1,4-Dioxane	0.44	1.32

[a] Active treatment followed by MNA will be performed until the RGs are met.
Notes:
NE - not established
µg/L - microgram per liter

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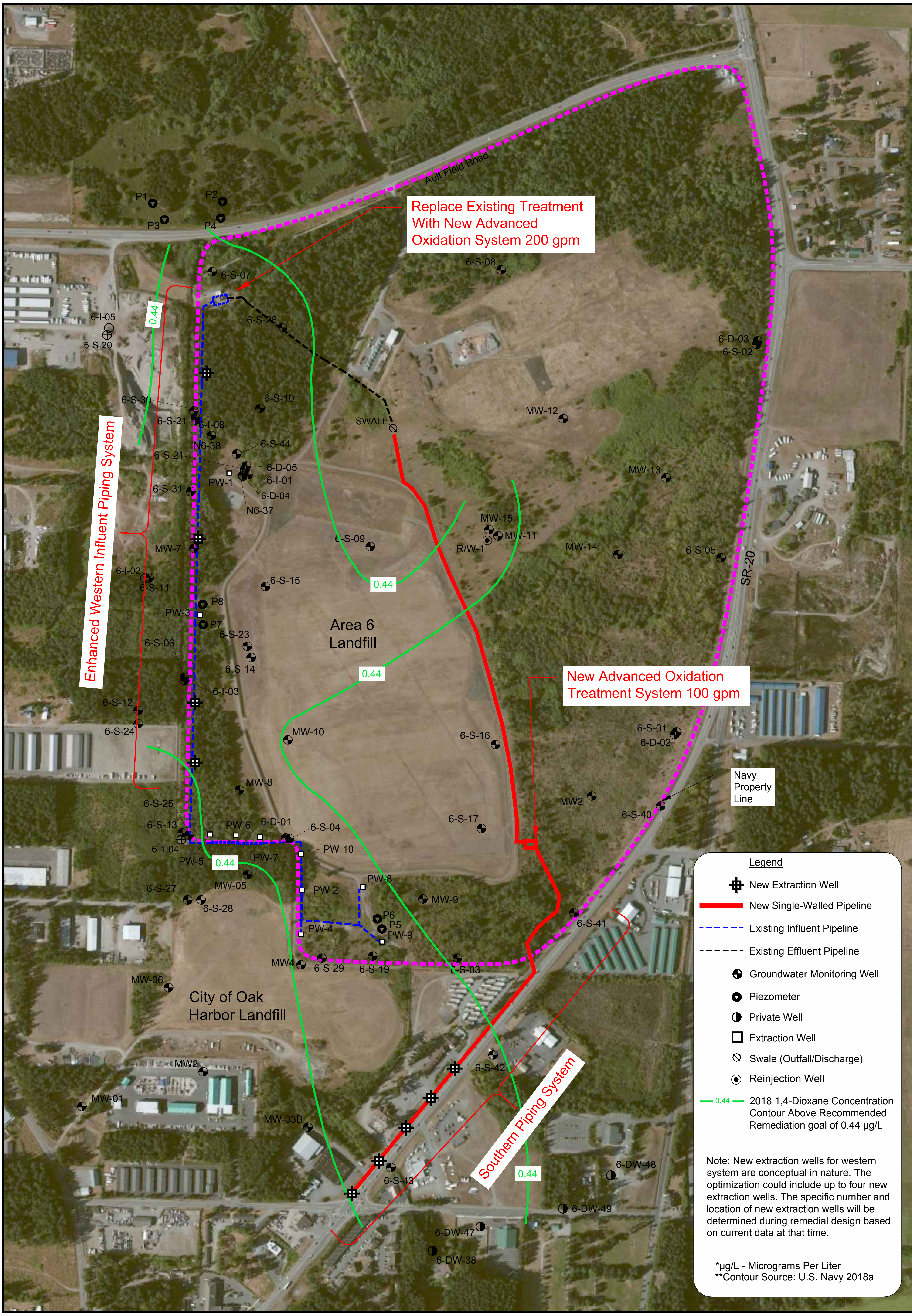

U.S. NAVY

0 250 500
SCALE IN FEET

Figure 8-1
Selected Alternative 2 - Continue Pump and Treat With Ex Situ Treatment Using Advanced Oxidation Process and Additional Extraction Wells

N62742-12-D-1829
N44255F174073
Area 6, NAS Whidbey Island

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8.6 INSTITUTIONAL CONTROLS

ICs are specified in the OU 1 ROD and repeated in the ESDs for OUs 1, 2, 3, 4, and 5 (U.S. Navy 2007). The Navy will be using existing ICs and LUCs per the ESD described in Section 2.4.3. The LUCs currently in place at Area 6 are:

- Prohibit drilling of downgradient well except for monitoring wells and remediation system wells authorized by the EPA and Ecology in approved plans.
- Protect existing monitoring wells.
- Prohibit use of groundwater from, or downgradient of, the area except for monitoring and remediation as approved by the EPA and Ecology.
- Prevent any disturbance to the landfill cap, except as necessary for authorized cap maintenance and maintenance activities.
- Ensure that land use at Area 6 remains commercial and/or industrial, which includes a prohibition on development and use of this property for residential housing, elementary and secondary schools, child care facilities, and playgrounds.

As previously discussed, groundwater at the site is considered to be a potential drinking water source downgradient of the site. However, this condition is impacted by the presence of the landfill at the site and the City of Oak Harbor landfill immediately adjacent to the site. The State of Washington restricts well installation within 1,000 feet of landfills (Section 6.3.4). The Navy has conducted numerous rounds of off-base water sampling around Area 6 including most recently in 2018. In 2018, 16 drinking water wells and 10 groundwater wells were sampled south and west of Area 6 and no drinking water or groundwater wells had 1,4-dioxane concentrations greater than the Washington State regulatory level for 1,4-dioxane in groundwater (report is pending). The Navy has connected the properties with wells in areas of COCs impacted groundwater to the City of Oak Harbor system and/or drilled deeper replacement wells (6-DW-38B). Additionally, based on discussions with the City of Oak Harbor, all parcels south of 6-DW-38 (southernmost well) between SR 20 and NE Regatta Dr are on City of Oak Harbor water. There are no current known groundwater receptors offsite of Area 6 to the south. Additional off-base sampling will be conducted if off-base plume conditions warrant sampling to verify there are no receptors.

As part of the annual LUC inspection process, Island County Public Health is contacted regarding well installation or drilling activities within the boundary of Ault Field and Seaplane Base as well as within an approximate 1-mile buffer around their boundaries. Restrictions on well installation activities and groundwater use within and downgradient of Area 6 are considered to have been properly and effectively implemented based on the findings of the 2018 LUC inspection.

These LUCs will be retained under this ROD Amendment and annual LUC inspections will be conducted to verify that groundwater restrictions around Area 6 remain in-place.

8.7 SUMMARY OF REMEDY COSTS

A summary of the estimated remedy cost is included as Table 8-2. The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information during the engineering design. This is an order of magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

The estimated capital cost of Alternative 2 (the selected remedy) is $3,970,000. Operational costs over a 30-year period are estimated at $14,610,000 with 9 years of northern system operation, 17 years of southern system operation, and the 30 years of monitoring. The total capital and operational costs over a 30-year period are estimated at $18,580. The present worth total cost is estimated at $14,500,000 using a discount rate of 3 percent.

Table 8-2
Focused Feasibility Cost Estimate – Selected Alternative

Category	Task #	Task Description	Quantity	Unit	Unit Cost	Total Cost
CONTRACTOR COSTS (CAPITAL DIRECT)						
Remedial Action Construction						
General	1	Mobilization	7.50	%	$927,900	$69,600
$133,600	2	Contractor Work Plans	300	HR	$100	$30,000
	3	Bench Scale Testing of HiPOx with 4 samples by APTwater	1	LS	$11,000	$11,000
	4	Analytical Testing for Bench Scale Testing	1	LS	$8,000	$8,000
	5	Surveying and Utility Locates	1	LS	$15,000	$15,000
Main HiPOx	1	Modify Existing Concrete SC Treatment Pad	1	LS	$10,000	$10,000
System	2	New Effluent Centrifugal Transfer Pump	1	LS	$5,000	$5,000
$516,500	3	Electrical connection for HiPOx System	1	LS	$7,500	$7,500
	4	New 200 gpm HiPOx AOP Treatment System	1	LS	$425,000	$425,000
	5	Transportation of HiPOx System to Site	1	LS	$5,000	$5,000
	6	Crane to unload new HiPOx System at the Site	1	LS	$3,000	$3,000
	7	Installation and connection of new HiPOx System	1	LS	$10,000	$10,000
	8	Integrate control system of HiPOx System with well field	1	LS	$5,000	$5,000
	9	Initial batch of Hydrogen Peroxide Chemical (3-month supply)	300	Gal	$6	$1,800
	10	Startup and Training of O&M personnel (3 people for 1 week)	120	HR	$100	$12,000
	11	Training by Manufacture Rep (1 person for 1 week)	50	HR	$155	$7,800
	12	Commissioning and Initial Analytical Testing	1	LS	$10,000	$10,000
	13	Update O&M Manual with HiPOx System information	120	HR	$120	$14,400

Table 8-2 (Continued)
Focused Feasibility Cost Estimate – Selected Alternative

Category	Task #	Task Description	Quantity	Unit	Unit Cost	Total Cost
Southern	1	Silt Fence	1,000	LF	$2	$2,400
HiPOx	2	Clearing for new Secondary Containment Treatment Pad	1	AC	$1,975	$2,000
System	3	Construct new Concrete SC Treatment Pad	1	LS	$20,000	$20,000
$490,300	4	New Effluent Batch Tank and Centrifugal Transfer Pump	1	LS	$15,000	$15,000
	5	New electrical service and connection for HiPOx System	1	LS	$15,000	$15,000
	6	New 100 gpm HiPOx AOP Treatment System	1	LS	$367,000	$367,000
	7	Transportation of HiPOx System to Site	1	LS	$5,000	$5,000
	8	Crane to unload new HiPOx System at the Site	1	LS	$3,000	$3,000
	9	Installation and connection of new HiPOx System	1	LS	$10,000	$10,000
	10	Integrate control system of HiPOx System with well field	1	LS	$5,000	$5,000
	11	Initial batch of Hydrogen Peroxide Chemical (3-month supply)	150	Gal	$6	$900
	12	Startup and Training of O&M personnel (2 people for 1 week)	80	HR	$100	$8,000
	13	Training by Manufacture Rep (1 person for 1 week)	50	HR	$155	$7,800
	14	Commissioning and Initial Analytical Testing	1	LS	$10,000	$10,000
	15	Write new O&M Manual for Southern HiPOx System	160	HR	$120	$19,200
Air Stripper	1	Remove Existing Tower Air Stripper	1	LS	$80,000	$80,000
Demo	2	Off-site Disposal Costs for debris	1	LS	$5,000	$5,000
$85,000	3	Not Used	0	EA	$0	$0
New Western	1	Install 4 new pumping wells to 120 ft deep - 6-inch dia.	4	EA	$13,000	$52,000
Pumps	2	Logging of New Well Install by Geologist (1 well in 2 days)	8	DY	$1,200	$9,600
$236,800	3	Analytical Soil Samples (2 samples per well + QC)	9	EA	$300	$2,700
	4	Pumping Well Development and Water Disposal in System	4	EA	$2,500	$10,000
	5	Install 4 new pumps, vaults, and associated equipment	4	EA	$10,000	$40,000
	6	Install 6-inch pipeline - Single Wall on Navy Property	2,500	FT	$49	$122,500

Table 8-2 (Continued)
Focused Feasibility Cost Estimate – Selected Alternative

Category	Task #	Task Description	Quantity	Unit	Unit Cost	Total Cost
New Southern	1	Install 5 new pumping wells to 150 ft deep - 6-inch dia.	5	EA	$15,000	$75,000
Pumps	2	Logging of New Well Install by Geologist (1 well in 2 days)	10	DY	$1,200	$12,000
$643,300	3	Analytical Soil Samples (2 samples per well + QC)	11	EA	$300	$3,300
	4	Pumping Well Development and Water Disposal in System	5	EA	$2,500	$12,500
	5	Install 5 new pumps, vaults, and associated equipment	5	EA	$11,000	$55,000
	6	Install 6-inch pipeline - Single Wall on Navy Property	4,500	FT	$49	$220,500
	7	Install 5hp booster pump station on Navy Property	1	LS	$15,000	$15,000
	8	City of Oak Harbor Franchise Agreement	1	LS	$5,000	$5,000
	9	Install 6-inch pipeline - Double Wall off Navy Property	2,500	FT	$98	$245,000
Subtotal Contractor Costs						**$2,105,500**
Unlisted Items and Services (%)			**25**	%	$2,105,500	$526,375
Contractor Overhead and Profit (%)			**20**	%	$2,631,875	$526,375
Washington State Sales Tax			**9.5**	%	$3,158,250	$300,034
TOTAL CONTRACTOR COST						**$3,460,000**
PRESENT-WORTH CONTRACTOR COST			**1**	**Year Implemented**		**$3,360,000**
ENGINEERING COSTS (CAPITAL INDIRECT)						
	1	General Coordination, Meetings, and Planning	1	LS	$50,000	$50,000
	2	Regulatory Review, Coordination, and Meetings	1	LS	$25,000	$25,000
	3	Engineering Design Plans and Specs (% DCC)	5	%	$3,360,000	$168,000
	4	Engineers Estimate	80	HR	$135	$10,800
	5	Bid & RFI Support	40	HR	$135	$5,400
	6	Permitting	120	HR	$135	$16,200
	7	Compliance Monitoring Plan	160	HR	$135	$21,600
	8	Construction Oversight and QA (% DCC)	3	%	$3,360,000	$100,800
	9	Closure Documentation & Reporting	400	HR	$110	$44,000
Subtotal Engineering Costs						**$441,800**
Unlisted Engineering Services (%)			**15**	%	$441,800	$66,270
Total Engineering Costs						**$508,000**

Table 8-2 (Continued)
Focused Feasibility Cost Estimate – Selected Alternative

Category	Task #	Task Description	Quantity	Unit	Unit Cost	Total Cost
O&M, MONITORING, AND CLOSURE COSTS						
Annual O&M Cost (North System)		***Years of Annual O&M***	***9***			
$184,704	1	Common Elements - Existing 10 Pumping Well O&M	10	EA	$3,000	$30,000
With Unlisted	2	Common Elements - Power for Ext 10 Pumping Wells (4hp)	10	EA	$2,837	$28,370
Costs	3	Routine Inspections for N HiPOx System (8 hours per week)	416	LS	$100	$41,600
$222,000	4	O&M for N HiPOx System (2 people 12 hours per month)	288	HR	$100	$28,800
	5	Power for North HiPOx System	1	LS	$10,000	$10,000
	6	Hydrogen Peroxide for North System (100 gal/month)	1,200	GAL	$5.00	$6,000
	7	Misc Supplies & Spare Parts for HiPOx Systems (3% of new)	1	LS	$12,750	$12,750
	8	New Pumping Well O&M (4 wells)	4	EA	$2,500	$10,000
	9	Power for pumping to North System (10hp)	0	LS	$7,466	$0
	10	Power for 4 new Pumping Wells (5hp each)	4	EA	$3,546	$14,184
	11	Power for Booster Pump for new Pumping Wells (5hp)	0	EA	$3,546	$0
	12	Institutional Controls Implementation and Inspection (1/2)	1	LS	$3,000	$3,000
Annual O&M Cost (South System)		***Years of Annual O&M***	***17***			
$116,152	1	Common Elements - Existing 10 Pumping Well O&M	0	EA	$3,000	$0
With Unlisted Costs	2	Common Elements - Power for Ext 10 Pumping Wells (4hp)	0	EA	$2,837	$0
$139,000	3	Routine Inspections for S HiPOx System (6 hours per week)	312	LS	$100	$31,200
	4	O&M for 2 HiPOx System (2 people 8 hours per month)	192	HR	$100	$19,200
	5	Power for South HiPOx System	1	LS	$7,500	$7,500
	6	Hydrogen Peroxide for South System (50 gal/month)	600	GAL	$5.00	$3,000
	7	Misc Supplies & Spare Parts for HiPOx Systems (3% of new)	1	LS	$11,010	$11,010
	8	New Pumping Well O&M (5 wells)	5	EA	$2,500	$12,500
	9	Power for pumping to North System (10hp)	1	LS	$7,466	$7,466
	10	Power for 5 new Pumping Wells (5hp each)	5	EA	$3,546	$17,730
	11	Power for Booster Pump for new Pumping Wells (5hp)	1	EA	$3,546	$3,546
	12	Institutional Controls Implementation and Inspection (1/2)	1	LS	$3,000	$3,000

Table 8-2 (Continued)
Focused Feasibility Cost Estimate – Selected Alternative

Category	Task #	Task Description	Quantity	Unit	Unit Cost	Total Cost
Annual LTM Cost		***Years of Annual LTM***	***30***			
$251,000	1	Common Elements - Treatment System Monitoring	1	LS	$80,000	$80,000
With Unlisted Costs	2	Common Elements - GW Sampling 35 wells (semi-annual)	70	EA	$500	$35,000
$301,000	3	Common Elements - Analytical Testing (70 samples + QC)	80	EA	$250	$20,000
	4	Common Elements - GW Monitoring (semi-annual gauging)	2	Events	$3,000	$6,000
	5	Common Elements - Annual Reporting	1	LS	$80,000	$80,000
	6	Treatment System Monitoring of 2nd HiPOx System	1	LS	$20,000	$20,000
	7	Visual Monitoring of Double Walled Pipeline for Leaks	4	Events	$1,000	$4,000
	8	HiPOx Specific Equipment Inspection	4	Events	$1,500	$6,000
Subtotal Maximum Combined Annual Costs						**$551,856**
Non-Routine O&M and Closure Costs						
$1,012,650	1	Common Elements - 5 Year Reviews (6 total for 30 years)	6	EA	$100,000	$600,000
With Unlisted Costs	2	Common Elements - Pumping Well Rehab (2 every 5 years)	3	Events	$18,750	$56,250
$1,215,000	3	HiPOx System Repair Minor (at Year 5) - 5% of new	1	EA	$39,600	$39,600
	4	HiPOx System Repair Major (at Year 10) - 15% of new	1	EA	$118,800	$118,800
	5	HiPOx System Repair Minor (at Year 15) - 25% of new	1	EA	$198,000	$198,000
	6	HiPOx System Repair Major (at Year 20) - 5% of new	0	EA	$39,600	$0
	7	HiPOx System Repair Minor (at Year 25) - 15% of new	0	EA	$118,800	$0
	8	HiPOx System Repair Major (at Year 30) - 25% of new	0	EA	$198,000	$0
Subtotal O&M, Monitoring, Non-Routine O&M, and Closure Costs						**$12,179,570**
Unlisted Operational Tasks (%)			**20**	%	$12,179,570	$2,435,914

Table 8-2 (Continued)
Focused Feasibility Cost Estimate – Selected Alternative

Category	Task #	Task Description	Quantity	Unit	Unit Cost	Total Cost
Total O&M, Monitoring, Non-Routine O&M, and Closure Costs						**$14,620,000**
Annualized Cost		***Years until project completion***	***30***			$487,333.33
Present-Worth Operational Cost		***Presumed Discount Rate***	***3.0%***			**$10,290,000**
SELECTED ALTERNATIVE COST SUMMARY				**Rounded Total**		**Cumulative Total**
PRESENT-WORTH TOTAL CAPITAL COSTS (DIRECT & INDIRECT)				$3,870,000		**$3,870,000**
TOTAL O&M COSTS (PRESENT WORTH)				$10,290,000		**$14,160,000**
SITE INSPECTION AND OVERHEAD (OWNER)		Percentage of Capital Costs	8.0%	$310,000		**$14,470,000**
AGENCY OVERSIGHT (EPA)		Percentage of Capital Costs	2.0%	$77,400		**$14,547,400**
TOTAL PRESENT-WORTH COST						**$14,500,000**

9. A new underground pipeline will be installed offsite to connect the 5 new southern extraction wells.
10. The southern pipeline is assumed is single-wall 6-inch HDPE (SDR 17)/10-inch HDPE (SDR 26).
11. A new underground pipeline will be installed onsite to connect the 4 new western extraction wells.
12. The western pipeline is assumed is single-wall 6-inch HDPE (SDR 17).
13. Sufficient electrical power is available at the site to power the main HiPOx treatment system.
14. A new electrical service will be needed to power the southern HiPOx treatment system.
15. Leak monitoring will be performed visually at leak monitoring stations, spaced 500 feet along the dual-walled pipeline.
16. Contaminated soils will not be encountered during construction of the new pipelines.
17. The Northern HiPOx system will run for 9 years and the Southern HiPOx system will run for 17 years.

Notes:
DCC – direct capital cost
HDPE – high-density polyethylene
hp - horsepower
SDR – standard dimension ration

8.8 ANTICIPATED OUTCOME OF THE REMEDY

The remedy is anticipated to result in restoration of groundwater to the RGs presented in Table 6-2 outside of the conditional points of compliance identified in Table 6-3. The result will be that groundwater will be usable as a drinking water source downgradient of Area 6. This does not consider the potential impacts of the City of Oak Harbor landfill on downgradient receptors.

The OU 1 ROD did not specifically predict when the original selected remedy would achieve RGs at the site. The original remedy has operated for 20 years and made significant progress towards achieving RGs relative to the COCs identified in the 1993 ROD. However, 1,4-dioxane has not been addressed during this time. The amended remedy utilizes an optimized pumping strategy for the western portion of the site that potentially includes additional extraction wells. The existing wells and the potential new wells will be pumped at a total flow rate that is approximately equal to the rate that was being pumped from only the original wells from the western plume. This means the amended system will be pumping from more locations to cover the same plume area, and each well will be pumped at a lower flow rate. The anticipated result will be to increase the volume of contaminated water captured from within the plume interior and reduce the relatively clean water captured from the edges of the plume. Also, it is anticipated there will be an increase in the overall mass removal rate, and a decrease in the time to achieve RGs or conditions suitable for MNA relative to the original western plume extraction well system.

Extraction wells will be added along the northern shoulder of SR 20 (or as approved in the Remedial Design) where extraction wells do not currently exist, but where 1,4-dioxane and vinyl chloride are present at concentrations above RGs. This is expected to help the extraction system reach further downgradient, and reduce the time to achieve active remedy termination and eventually RGs through MNA. The Navy is currently pursuing access agreements with Washington Department of Transportation to install the system in the SR 20 right of way.

The amended remedy will not change the current or future anticipated land use of the site. As long as the Navy owns the property, the current land use will remain unchanged. This property will remain the Navy's for the foreseeable future.

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9.0 STATUTORY DETERMINATIONS

Under Section 121 of CERCLA, 42 U.S.C. § 121, and the NCP, the Navy must select an amended remedy that is protective of human health and the environment, complies with ARARs, is cost effective, and utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a permanent element, with a bias against off-site disposal of untreated wastes. The following sections discuss how the amended remedy meets these statutory requirements.

9.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Groundwater modeling (U.S. Navy 2018c) predicts that the proposed expanded pumping network for this alternative would maintain containment of the western plume and expand the capture and treatment of the southern plume. The proposed advanced oxidization treatment system is a commercially available technology that has been shown to successfully remove both VOCs and 1,4-dioxane from Area 6 groundwater.

The proposed extraction system in combination with MNA is expected to reduce VOC and 1,4-dioxane concentrations in groundwater to RGs.

Based on the groundwater model predictions, the performance of the existing system to contain the western plume, and the documented performance of the proposed advanced oxidization systems (including site-specific bench-scale tests), it is expected the amended remedy (Alternative 2) will provide *overall protection of human health and the environment.*

9.2 COMPLIANCE WITH ARARS

The amended remedy for the Area 6 groundwater will comply with federal and state ARARs that have been identified. No ARAR waivers are deemed necessary for the amended remedy. The ARARs identified for the amended remedy are discussed in this section.

9.2.1 Chemical-Specific ARARs

Chemical-specific ARARs set health or risk-based concentrations in environmental media (i.e., soil, sediment, groundwater, and surface water) for specific hazardous substances, pollutants, or contaminants. The selected amended remedy (Alternative 2) will comply with chemical-specific

ARARs. Chemical-specific ARARs for Area 6 groundwater are summarized in Table 6-1 and described below.

Resource Conservation and Recovery Act Subpart C, Characteristics of Hazardous Waste (40 CFR 261.20): Resource Conservation and Recovery Act (RCRA) Subpart C requirements would relate to off-site disposal of materials and waste generated during remedy construction and O&M. Compliance with these requirements is not process specific. Characterization and designation of generated waste streams will determine which RCRA requirements (C or D) apply.

Safe Drinking Water Act (40 CFR 141.61) and Washington Model Toxics Control Act (173-340-720 through 173-340-760): The Safe Water Drinking Act presents the national primary drinking water standards for public water systems and establishes MCLs. Because groundwater at the site is a potential drinking water source, the Safe Drinking Water Act, specifically the regulation at 40 CFR § 141.61, is applicable. MTCA describes the cleanup process at a hazardous waste site in the State of Washington. Since this is a federal facility and the Navy is the lead agency, the cleanup action is being conducted under CERCLA. MTCA applies where State of Washington cleanup criteria are more stringent than the federal requirements. Specific RGs for each COC and the establishing ARAR are:

- TCE – 5 µg/L (MCL)
- 1,1,1-TCA – 200 µg/L (MCL)
- 1,1-DCE – 7 µg/L (MCL)
- Vinyl chloride – 0.029 µg/L (MTCA)
- 1,4-Dioxane – 0.44 µg/L (MTCA)

A bench-scale treatability study was conducted by APTwater LLC in 2017 for Area 6 to evaluate potential system design, and the results demonstrated RGs can be obtained (U.S. Navy 2018c).

9.2.2 Location-Specific ARARs

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because the substances occur or activities are conducted in specified locations. These requirements may limit the type of remedial action that can be implemented, or may impose additional constraints on remedial alternatives. The selected remedy (Alternative 2) will comply with all identified location-specific ARARs. Location-specific ARARs for Area 6 groundwater are summarized in Table 6-2 and described below.

Migratory Bird Treaty Act of 1972 (50 CFR 10.13): This act provides protection of most species of native nongame, migratory birds from uncontrolled take, such as poisoning at hazardous waste sites or other environmental degradation. The remedy will not present a risk to migratory birds during construction or operations. Contaminated water and remedy-related chemicals that could pose a risk to migratory birds will be contained until treatment has been completed.

Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d): This requires project activities to protect and preserve eagle habitat. Eagles have been identified at the site. Design documents will require that construction contractor identify potential eagle habitats and preserve those habitats.

Archeological Resources Protection Act (43 CFR 7): This act stipulates that action must be taken to preserve archeological and historic properties and to minimize harm to National Historic Landmarks. Activities may not cause irreparable harm, loss, or destruction of significant artifacts. There are no identified National Historic Landmarks identified at the site or off-site work areas.

National Historic Preservation Act (36 CFR Parts 800 60, and 65): Under Sections 106 and 110 of the National Historic Preservation Act (NHPA), CERCLA remedial actions are required to take into account effects on any historic property included or eligible for inclusion on the National Register of Historic Places. The NHPA provides for consultation with the Tribe regarding the area of any potential effect and any additional action, such as cultural resource surveys that may be necessary to identify and protect cultural resources during remediation of the site. The Navy will consult with the local Native American Tribes and the State Historic Preservation Officer regarding the potential need for cultural resource surveys or other protective or mitigation actions prior to the amended remedy implementation.

Rare and Endangered Species Act (16 U.S.C. $ 1531, et seq.; 50 C.F.R. parts 200 and 402): This act is applicable because a bald eagle has been sighted in the area.

9.2.3 Action-Specific ARARs

Action-specific ARARs set controls or restrictions on particular types of activities included in the selected remedial alternative. The selected amended remedy (Alternative 2) will comply with location-specific ARARs. Action-specific ARARs for Area 6 groundwater are summarized in Table 6-3 and described below.

RCRA, Subtitle D (40 CFR 204 through 259, 42 U.S.C. 6941–6949) and C (40 CFR Parts 275 and 258, 40 CFR 260 through 270): Subtitle D (40 CFR 204 through 259) describes comprehensive cradle-to-grave program requirements for the safe management of solid waste and actions that generate solid waste. Subtitle D (42 U.S.C. 6941–6949 and 40 CFR Parts 275 and 258) is applicable to the management of debris and other solid wastes generated during project activities, including recyclable materials. Subtitle C (40 CFR 260 through 270) describes requirements for management and disposal of solid wastes that are not RCRA hazardous waste. Excavation and drilling are required for the selected remedy which will result in generation of solid waste in the form of soil. Since the excavation will not be conducted in identified source areas (former industrial liquid waste disposal area), hazardous waste is not anticipated. Drilling will not be conducted in identified source areas; however, it will be conducted within areas with groundwater containing COCs. Drilling into impacted groundwater will result in generation of soil that contains COCs. Based on current COCs measured in groundwater across the site, drilling is not anticipated to generate hazardous waste. However, in both cases, these waste streams will be characterized and managed as required by these two ARARs.

Standards Applicable to Transporters of Hazardous Waste (40 CFR 263): These regulations address procedures for the transport of hazardous materials within the United States. If drill cuttings, excavated soil, or other wastes generated during construction or operation of the remedy are designated as hazardous waste, they would require off-site transport and these requirements would apply.

Groundwater Monitoring Program 40 CFR 264.91 to 264.100: These are applicable to compliance monitoring programs established for landfills and surface impoundments. They are applicable if hazardous constituents affecting groundwater quality are detected at a predefined compliance point. The Navy is currently executing monitoring that satisfies these requirements. Monitoring plans will be revised to maintain compliance with this ARAR relative to the selected amended remedy.

State of Washington Hazardous Waste Management Act and State of Washington Solid Waste Management Act (173-351 WAC): These statutes and implementing regulations specify the requirements for identification, accumulation, manifesting, transport, treatment, storage, and disposal of dangerous waste (including state-only dangerous wastes) and requirements for handling siting, storage, and disposal of solid waste. These requirements are similar to RCRA Subtitles C and D.

Washington State is authorized to implement portions of the Hazardous and Solid Waste Amendment and Non-Hazardous and Solid Waste Amendment provisions of the RCRA. These regulations specify requirements for the identification, accumulation, manifesting, transport, treatment, storage, and disposal of dangerous waste. The dangerous waste regulations may apply to the active management, treatment, and disposition of soils or other waste materials. The potential applicability of these requirements is triggered only when the materials are actively managed. These waste streams will be characterized and managed as required by these two ARARs.

Washington Solid Waste Management Act and Solid Waste Management Handling Standards Regulations (WAC 173-350-300): The solid waste requirements are potentially applicable to the off-site disposal of solid nonhazardous wastes and contaminated media that may be generated as part of the cleanup action. Implementation of the selected remedy will generate solid waste during installation of wells, pipelines, and other relevant components. Solid waste from the pre-design investigation and remedy implementation will be stored, collected, and transported in accordance with this ARAR and sent to facilities licensed and permitted to accept the specific waste material.

State Underground Injection Control Program (WAC 173-218): Requirements of the State Underground Injection Control Program (WAC 173-218) as approved under the Safe Drinking Water Act are applicable because they set forth the procedures and practices for the injection of fluids through wells into the waters of the state and specify that all known available and reasonable methods of prevention, control, and treatment be used to preserve and protect underground sources of drinking water.

State Waste Discharge Permit Program (WAC 173-216): The State Waste Discharge Permit Program (WAC 173-216), which governs nonpermitted discharges or injection to groundwater, is applicable because groundwater will be reintroduced to the shallow aquifer via vertical drains.

9.2.4 Cost Effectiveness

Based on the evaluation performed in the FFS, the amended remedy provides the most cost-effective means of reliably protecting human health and the environment in the long term. Remedial alternatives evaluated in the FFS for the source area are listed in Section 7.2.7. Total capital and operational costs for the selected remedy are estimated at $18,580,000 and net present worth costs are estimated at $14,500,000 with 9 years of northern system operation, 17 years of southern system operation, and the 30 years of monitoring. Based on the range of estimated costs for all alternatives, Alternative 2 ranks least expensive of all of the alternatives that meet the required criteria.

9.3 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The amended remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a cost-effective manner for Area 6. It is protective of human health and the environment, complies with ARARs, and provides the best balance of trade-offs in terms of long-term effectiveness; permanence; short-term effectiveness; implementability; cost; and reductions in toxicity, mobility, or volume achieved through treatment. The amended remedy meets the statutory requirement to use permanent solutions to the maximum extent practicable.

9.4 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The amended remedy will rely principally on active treatment technologies followed by passive treatment. The Navy will implement the active treatment technologies at two areas of the site: the southern plume area and the western plume area. Treated water from both plume areas will be surface discharged upgradient of the primary plume area for reinfiltration. This reinfiltrated clean water will flush downgradient through the aquifer over time. By utilizing groundwater extraction, treatment, and reinfiltration followed by MNA, the amended remedy satisfies the statutory preference for remedies that employ treatment as a principal element.

9.5 FIVE-YEAR REVIEW REQUIREMENTS

Because the amended remedy will allow contaminants to remain in place at concentrations that do not allow unlimited site use and unrestricted exposure, periodic reviews of the amended remedy at the Area 6 will be required at least once every 5 years. The purpose of the 5-year review is to ensure that the remedial actions selected in this ROD Amendment are functioning properly and remain protective of human health and the environment. Five-year reviews are currently conducted at OU 1, including Area 6, for remedial actions selected in the OU 1 ROD. The amended remedy presented in this ROD Amendment will be evaluated as part of the subsequent 5-year reviews of the remedial actions at OU 1.

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PART 3
RESPONSIVENESS SUMMARY

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PART 3
RESPONSIVENESS SUMMARY

The public comment period extended from 21 November 2018 to 21 December 2018. An open house was held on 5 December 2018 at the Oak Harbor Veterans of Foreign Wars. Written comments were received from one community member, Island County Health Department, and U.S. Environmental Protection Agency Region 10 (EPA).

Seven comments were received from Island County, two comments were received from the RAB Co-Chair, and 81 comments were from EPA.

Comments can be summarized into the following categories as indicated in the following table. The number of comments received by general category is also indicated in the following table.

Number of Comments by Category

Remedy Performance	11
Document Format	9
Risk	8
Clarification	8
Monitored Natural Attenuation (MNA)	8
Per- and Poly Fluoroalkyl Substances (PFAS)	7
ARARs	7
Remedial Goals	6
Site Characterization	5
Remedy Evaluation	5
General	3
Policy	3
Transition Point from Active to Passive	3
Conditional Point of Compliance	3
RAOs	2
Administrative Record	2
Site Conditions	2
Institutional Controls	2
Total	90

The largest number of comments were related to remedy performance. The general theme of the comments were related to residual source area concerns, potential source area treatment technologies, and discharge of treated water to the current system discharge location.

Document format comments were generally related to document organization and desired contents.

Risk comments were generally related to discharge of extracted water containing 1,4-dioxane to the surface, evaluating risk against state criteria versus CERCLA criteria, and evaluating current risk versus risk at in 1993 when the original ROD was signed.

Clarification comments requested additional information or language changes.

Monitored natural attenuation (MNA) comments generally requested additional information to support the use of MNA as a component of the integrated remedy.

Per- and Poly Fluoroalkyl Substances (PFAS) comments related to the recent identification of low-level PFAS concentrations in groundwater at Area 6. There was concern that the remedy will not address PFAS in groundwater.

ARAR comments requested inclusion of National Historic Preservation Act, Endangered Species Act, and ARARs related to surface discharge of the treated water.

Remedial goals comments related to justification of or adjustments to selected cleanup levels.

Site characterization comments related to the downgradient extent of 1,4-dioxane and vinyl in groundwater and conditions in the former source area.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF
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EPA Response to Navy RTC on 5/14/19 (in red)
Navy Response to EPA Evaluation on May 3, 2019
EPA Response to Navy RTC on 4/19/19
Navy Response to USEPA Comments on March 15, 2019
USEPA Region 10 Review/Comments from 12/28/18
Project Site: NAS Whidbey Island Ault Field
DOCUMENT: Draft Record of Decision Amendment No. 1 Operable Unit 1 Area 6
Prepared for Department of the Navy – Naval Facilities Engineering Command Northwest

USEPA Reviewers:
Chan Pongkhamsing (CP), Allison Hiltner (AH), Richard Mednick (RM), Ted Repasky (TR), Elizabeth Allen (EA)

Notes:

- Orange highlighting indicates the comment is related to the MNA, transition point, and 3xRGs topics that were heavily discussed during the February 22, 2019 meeting with EPA. The Navy's initial response to these comments was added on May 3, 2019.

Comment # (Commenter)	Section / Page / Lines	EPA Comment	Navy Response	EPA Response Evaluation	Navy Response to EPA Evaluation / EPA Response
General	Word doc	Edits made via track changes & reference comments to this table spreadsheet - attached draft Word doc	Comment noted. Thank you.	OK	
General – for future reference		Per the ROD guidance a RODA does not have to be as detailed as a ROD, and many sections can be omitted. See attached ROD guidance. Don't have to repeat a lot of stuff that's in the previous ROD, for example, don't have to repeat the 1993 risk assessment…just need to establish that there is a risk due to 1,4-dioxane.	Comment noted.	OK	
General – for future reference	Part 1 / Pg.1/ line 12	FYI - "the site" should not be used in a RODA. The "site" is the site as listed on the NPL – NAS Whidbey Ault Field in the ROD and NPL. We are fine with it here as it would take more work to change it.	Comment noted.	OK	
1 (AH)	Part 1 / 2 / 1	Define "risk levels"? Is it EPA screening levels?	The subject sentence will be replaced with: "Groundwater concentrations of 1,4-dioxane are above the MTCA Method B groundwater cleanup level in and around Area 6."	Exceedance of a state cleanup goal isn't sufficient to trigger an action under CERCLA. The text here should state that concentrations of 1,4-doxane poses a risk equal to whatever the results of the screening risk assessment indicate.	The subject sentence will be replaced with: "The maximum February 2018 groundwater concentration for 1,4-dioxane of 10 micrograms per liter poses a 2×10^{-5} risk." OK
2 (CP)	Part 1 / 2 / 19-20	Statement, "The EPA and the Navy jointly selected the amended remedy for this site" is still under discussion/consideration. Hold off on these statements until we are in full agreement on the RODA.	The Navy understands the EPA comment. However, these statements will need to go eventually into the document and the Navy is confident a mutually acceptable document will be produced. The Navy has highlighted the text in yellow to indicate it needs to be finalized but no wording change is recommended at this time.	OK	
3 (AH)	Part 1 / Pg.2 / 27	The selected remedy also adds 1,4-dioxane as a COC, adds a 1,4-dioxane cleanup level, removes some COCs and modifies cleanup levels for (list COCs). This should be mentioned in the selected remedy summary.	The following was added in three text locations: • Description of the Selected Remedy Section • end of the second paragraph, page 1-1 (addressing comment #10) • the end of the first paragraph, Section 8.0, page 8-1 "The selected remedy also adds 1,4-dioxane as a COC, adds a 1,4-dioxane cleanup level, removes 1,1-DCA and cis-1,2-DCE, and modifies cleanup levels for 1,1-dichloroethene and vinyl chloride."	Agreed	

Comment # (Commenter)	Section / Page / Lines	EPA Comment	Navy Response	EPA Response Evaluation	Navy Response to EPA Evaluation / EPA Response
4 (TR)	Part 1 / Pg. 4 / lines 2-3	The additional 5 wells that will be placed on the northern shoulder of SR20 will not be able to capture or reduce the portion of the plume that has already migrated south of SR20.	Acknowledged. However, these wells will be able to pull some of the plume back and slow migration of the portion not captured. The Navy has investigated potential downgradient receptors and none have been identified. All private residences downgradient of well 6-DW-38 are on the City of Oak Harbor water system. This condition was identified and discussed with the EPA during development of the Focused Feasibility Study.	OK	
5 (TR)	Part 1 / 4 / 17-18	Neither the AOP in the southern System nor the AOP in the Western System will be able to address the PFAS contamination measured in both areas on and around Area 6. This chemical, with a HA level, will continue to be released.	This RODA is focused on addressing 1,4-dioxane. PFAS, including PFOA and PFOS, are not listed as CERCLA hazardous substances. The EPA is beginning the necessary steps to propose designating PFOA and PFOS as "hazardous substances." The Navy policy is to not select cleanup remedies for any media other than drinking water until a promulgated cleanup level is set for that media. The LHA for PFOS and PFOA is only applicable for drinking water and cannot be applied to groundwater and/or surface water not used as drinking water. PFOA was measured at a concentration greater than 70 ppt in one of ten groundwater samples collected across Area 6. Additionally, the current treatment plant influent and effluent were analyzed for PFOS and PFOA and the results were below the LHA (35.1 and 35.8 ppt). PFAS is being evaluated separately under the CERCLA process. The Navy has performed PFAS Sampling and TOP assay analysis to determine if AOP would potentially increase the PFOA and PFOS levels above the current LHA. Based on the TOP assay results, PFAAs precursors at Area 6 are low and do not yield concern for oxidizing precursors. The Navy will be re-evaluating the potential precursor issue based on future site conditions at Area 6, the evolving health advisory levels, and potential future regulatory requirements. The remedy designs include space for PFAS treatment if the Navy determines it to be appropriate. This approach was discussed between the Navy and EPA during the February 22, 2019 meeting at EPA Region 10 offices. During this meeting it was concluded that PFAS will be handled separately from the current ROD Amendment being prepared for Area 6. Based on this meeting, the Navy needs to directly state in the ROD Amendment that PFAS is being handled separately; we will be monitoring it as we operate the AOP system, and if there appears to be an issue, we will address it. Paragraph text page 5 line 6 edited/added: "The Navy sampled groundwater at Area 6 for PFOS and PFOA beginning in December 2017 to identify the presence of PFAS and to see if it would affect the preferred remedy in the FFS. PFOA identified in groundwater at one on-site groundwater monitoring well location was greater than the EPA's LHA level for PFOA, 70 parts per trillion (ppt). PFOA was also detected in the treatment system influent and effluent at concentrations below its LHA level. PFAS is currently being evaluated separately under the CERCLA process. The Navy has completed preliminary assessment/site inspection (PA/SI) for Area 6 and will continue to follow the CERCLA process	The language here is confusing and appears to imply that action will only be taken after a "promulgated standard" is established and assuming concentrations in groundwater exceed that standard. CERCLA provides authority to undertake a response action when there is the potential for unacceptable risk and provides a process for determining that threshold. Since sufficient information exists to make such a determination now, the reference to apparently waiting for a promulgated standard may be misleading as to the Navy's intentions. We suggest the reference to a promulgated standard be deleted and the sentence should just indicate that a separate ROD will be prepared if found to be appropriate based on CERCLA.	The last sentence of the subject paragraph will be replaced with the following: "The Navy has completed preliminary assessment/site inspection (PA/SI) for PFAS compounds at Area 6. A separate ROD will be prepared relative to PFAS if determined to be appropriate based on CERCLA." Agreed

Comment # (Commenter)	Section / Page / Lines	EPA Comment	Navy Response	EPA Response Evaluation	Navy Response to EPA Evaluation / EPA Response
			(including a separate ROD if deemed appropriate based on promulgated cleanup levels).” The final sentence has been edited (page 5 line 24): “If it is determined to be necessary, the Navy will address PFOS/PFOA in the effluent.”		
6 (AH)	Part 1 / 4 / 23-24	Endpoint conditions in Section 8.4 are not consistent the EPA guidance. See comments in that section.	Noted.	OK	
7 (TR)	Part 1 / 5 / 5-7	PFOS was found at a monitoring well above LHA levels, yet this chemical will not be addressed in this RODA, not removed by the AOP, and will ultimately discharged to the surface.	Please see comment response #5.	OK	
8 (RM)	Part 1 / 5 / 8-16	PFOS may not yet be a CERCLA hazaardous substance, but it is a CERCLA contaminant or pollutant. As such, the Navy should be evaluating (Focused RI/FS, if necessary) and taking action (ROD amendment - if possible as part of this ROD Amendment) to cleanup PFAS issues.	Please see comment response #5.	OK	
9 (TR)	Part 1 / 5 / 16-18	“If it is determined to be necessary, the remedy proposed herein will be flexible and allow pre-treatment for PFOS, PFOA, and precursors.” Is this up to the regulators to make this decision? How much time is needed to get this into the ROD? Or detail the proactive measures to be implemented? Will discuss in meeting.	Please see comment response #5.	OK	
10 (AH)	Section 1 / Pg.1-1 / 25	Per previous comments, the RODA also modifies the COC list and modifies cleanup levels for several COCs. This should be mentioned.	Please see comment response #3.	Agreed	
11 (AH)	1 / 1-2 / 16-17	The NCP requires that the AR be available to the public at a location near the site. If it’s impossible to find such a place, then this will have to suffice.	The Navy previously had the AR at the Oak Harbor/Sno-Isle Library. During the Proposed Plan, it was discovered that the AR had been disposed of at the library. As part of the Proposed Plan, the Navy put copies of the Proposed Plan and CDs with important AR documents at the Oak Harbor/Sno-Isle Library. The library simply does not have the space to house the entire hard copy AR. Added to text: “Members of the public may request a copy of these items by contacting the NAVFAC Northwest Public Affairs Officer at (360) 396-1030. Currently, the FFS Report and other major Area 6 decision documents may be reviewed at the Oak Harbor/Sno-Isle Library, 1000 SE Regatta Dr, Oak Harbor, WA 98277 and may be viewed online at **https://navfac.navy.mil/NASWIRAB**.”	Agreed	
12 (RM)	2.1 / 2-1 / 8-9	This does not seem to be true. RCRA came into being in 1976 and CERCLA in 1980.	The subject sentence will be replaced with: "Liquid wastes were disposed of at the former industrial liquid waste disposal area.”	Agreed	
13 (TR)	2.1 / 2-1 / 16-19	It appears in this description of the Area 6 landfill that only “household municipal waste” was disposed of at this site. Sludge from the Navy’s water treatment plant was also disposed of at this location.	This sentence is directly from Page 4 Paragraph 3 from the 1993 ROD. No change is recommended.	Is there documentation that sludge from WTP was disposed? If not, OK. USGS report: “2.2 million gallons of liquids and sludges containing hazardous wastes were reportedly disposed of in the northern two-thirds of the landfill between 1969–83.” So not all of it is “municipal waste”.	Updated based on RI: “A separate portion of Area 6 was used as a landfill from 1969 to 1992. Wastes disposed in the Area 6 landfill include asbestos, acids, caustics, solvents, oily sludges, construction debris, and animal remains. Most of the landfill area received and contains Navy household municipal waste (U.S. Navy 1993).” OK
14 (TR)	2.3 / 2-3 / 11-12	Even though the original ROD did not identify any COCs for soil, the levels in the vadose zone may be 100 times the	This statement is related to the original remedy selection in the 1993 ROD. The 2001 removal action addressed most of this	OK, here’s comment from Ted:	It is documented in U.S. Navy 2015a “*Data Gap Sampling Results, Area 6, Naval Air Station Whidbey Island.*” OK

Comment # (Commenter)	Section / Page / Lines	EPA Comment	Navy Response	EPA Response Evaluation	Navy Response to EPA Evaluation / EPA Response
		groundwater cleanup levels. Thus, there may be a continuing source of contamination to the groundwater.	condition. Natural attenuation has reduced residual source area concentrations as indicated in Sections 2.4.2, 5.3 and 5.5. The subject sentence will be replaced with: "Per the ROD, the concentrations are below levels that are considered to be protective of groundwater (100 times groundwater cleanup levels)."	"2001 removal only to the depth excavated depth, not deeper in the vadose zone. How was "natural attenuation has reduced residual source area concentrations quantified in the soil?"	
15 (TR)	2.4.4 / 2-11 / 25	The description states that the replacement locations were chosen as close to the original locations as possible to provide a comparison of 2001 and 2011 soil conditions and at similar depths. However, SVM-03A, identified as a "replacement probe" drilled to 89 feet, and replacing a previous probe that was only 10 feet deep. These are not similar depths.	The boring for SVM-03A was drilled to the top of the groundwater surface for collection and analysis of soil samples. The boring was completed as a soil vapor monitoring probe screened from 9.5 to 10.5 feet bgs as a replacement for SVM-03, which was no longer functioning. The following will be added as a sub-bullet line 28 of page 2-11: "Please note SVM-03A was drilled to the top of the groundwater surface and soil samples were collected for analysis. The boring was completed as a soil vapor monitoring probe screened from 9.5 to 10. 5 feet bgs as a replacement for SVM-03, which was no longer functioning as needed."	Agreed	
16 (TR)	2.4.6 / 2-13 / 26-30	There is an inconsistency of well identification names. Some places in the document have dashes before the well numbers, and in others it is missing.	The dashes will be added to make the location IDs consistent.	Agreed	
17 (EA)	2 / 2-14 / 25	Please expand on peroxide as "immediate"…is it the reaction?	The subject sentence (pg 2-14 line 25) will be replaced with the following: "Peroxide was selected because the oxidization reaction occurs very quickly after injection and the chemical degrades rapidly."	Agreed	
18 (RM)	4 / 4-1 / 11-13	Statement is not true as it does not include PFOS/PFOA. Need to modify this statement.	The subject sentence (pg 4-1 line 11) will be replaced with the following. "The cleanup actions described in this ROD Amendment address all current and potential risks to human health and the environment associated with the OU 1 Area 6 site resulting from COCs identified by the 1993 ROD, which this document amends, and 1,4-dioxane."	Agreed	
19 (TR)	5.2 / 5-21 / 3-8,16	There is not a boundary well located at the southern extent of the vinyl chloride plume. Thus the 2008 monitoring wells drilled along SR 20 may not accurately depict the downgradient extent of the plume. This also applies to 1,4-dioxane. See the figures below.	*Vinyl Chloride* The maximum 1997 vinyl chloride concentration was measured in a groundwater sample from a well located along the southern "property boundary." It is not intended to represent the southern extent or "boundary" of the vinyl chloride plume in 1997. Vinyl chloride is delineated to the south by 6-DW-38. *1,4-dioxane* The following sentence was edited (pg 5-21 line 13) to: "The 2008 addition of monitoring wells along SR 20 allowed additional delineation of the downgradient nature and extent of the 1,4-dioxane plume."	OK. Just comment from Ted for the record, "The 2018 data shows concentrations increasing in well 6-DW-38 for 1,4-dioxane south of SR 20. The plume is unbounded and the extent unknown. Figure 5-9 cuts this off with the legend, but the outline makes it appear to be coming together. I just am concerned about the extent of the plume without any data."	Navy's priority is to get this ROD Amendment completed and the remedy in place to address conditions as soon as possible. The Navy will be conducting further plume delineation after the southern plant is in. Additionally, any wells to the south will require significant lead time as this area is not Navy property and access agreements will require time to procure. Agreed
20 (EA)	5.3 / 5-27 / 2-5	The first two sentences discuss the result of the ecological risk assessment and conclusions regarding the potential effects of remedial options on habitat quality. These topics are no related to the subject heading.	The first two sentences of this paragraph will be deleted ("Ecological risk was identified for Area 6 soils and for sediments and surface water from the intermittent stream at Area 6. However, the OU 1 ROD (U.S. Navy 1993a) concluded that no source area was located and remedial action could cause more environmental harm than the low levels of existing chemicals are likely to cause.").	Agreed	
21 (TR)	5.4 / 5-27 / 13-16	"The State of Washington restricts well installation within 1,000 feet of landfills (discussed further in Section 6.3.4 and depicted on Figure 6-2). Groundwater is used as a drinking	Comment noted. It should be noted as discussed in the February 22, 2019 meeting at EPA Region 10 offices that all	OK, but is the yellow highlighted text incorrect? If so, it should be deleted.	The yellow text is correct as 6-D-38 was replaced with a deeper well for that resident so technically groundwater is still being used as a drinking water source.

Comment # (Commenter)	Section / Page / Lines	EPA Comment	Navy Response	EPA Response Evaluation	Navy Response to EPA Evaluation / EPA Response
		water source at some of these residences downgradient of Area 6." It appears that at least the 1,4-dioxane plume has already extended past the 1000-foot boundary of the Area 6 landfill depicted on Figure 6-2.	parcels south of 6-DW-38 are on City of Oak Harbor water and there are no known receptors.		OK
22 (EA)	5.5 / 5-28 / 10-12	The sentence states that "it is believed source area groundwater concentrations will decrease to levels that would be suitable for natural attenuation in the very near future." This conclusion appears to be based on the results of the SESOIL analysis that residual contaminant mass in the vadose zone is not expected to further degrade groundwater at concentrations greater than the selected cleanup goals. While this information may represent one facet of a lines-of-evidence approach to indicate whether MNA may ultimately be a suitable remedy from groundwater contamination at Area 6, belief is not a CERCLA criteria,	Comment noted. This is a discussion of the conceptual site model and not justification of MNA. No change is recommended.	It may be acceptable to state that the results of modeling, or a trend analysis indicate that concentrations may achieve some value in a defined time frame, but not that the Navy "believes" so. Since there is no consensus regarding what concentrations may be amenable to natural attenuation as a remedy, the statement should be omitted. Further, if the statement isn't intended as a justification for MNA, then conceptual model shouldn't discuss whether or not it's an option? Suggest waiting for MNA modeling results to change this language or omit all together.	The subject sentence will be replaced with: "Source studies and vadose zone modeling indicate that the residual vadose zone impacts will not contribute significant residual contaminant mass to groundwater and groundwater concentrations will decrease to levels suitable for natural attenuation (U.S. Navy 2013)." OK
23 (AH)	5.6 / 5-32 / 3-6	Confusing paragraph. State clearly what the land use is in off-site areas impacted by the gw plume. Ok to say as a point of information that well installation is restricted, but ICs are often ignored, so state whether there are any wells in the area despite these restrictions. Paragraph needs to be restructured.	The subject paragraph will be replaced with the following: "Land use off-site is either Navy property, residential, or commercial, and is expected to be for the foreseeable future. Ault Field is north of the site. A quarry and storage business is located adjacent to the northwest corner of the site. Businesses, storage facilities, the City of Oak Harbor maintenance facility, and a bar are located along the western site boundary. The City of Oak Harbor Landfill is located along the southern site boundary along with an inn, trailer park, restaurant, and storage facility. Residences, a church, and cemetery are located further to the south (downgradient). There are wells in these areas but Navy has connected the properties with wells in areas of impacted groundwater to the City of Oak Harbor system and/or drilled deeper replacement wells (6-DW-38B). Groundwater at the site is considered to be a potential drinking water source downgradient of the site. However, the State of Washington restricts well installation adjacent to landfills (Section 6.3.4). Additionally, based on discussions with the City of Oak Harbor, all parcels south of 6-DW-38 between SR20 and NE Regatta Dr are on City of Oak Harbor water."	Agreed	
24 (All)	5.7 / 5-32 / 10-13	It states that there are no complete 1,4-dioxane exposure pathways currently due to institutional controls and land use controls. Surface water was eliminated from the risk assessment. However, as stated in Section 5.5, discharged groundwater effluent continues to be surface infiltrated. This water is discharged to a marsh area that becomes the headwaters for at least an intermittent stream that flows north. Thus, the eco risk has existed in the past and will continue to exist for the PFAS chemicals that could be within the waters after AOP treatment. Might this also be source of storm-water drain PFAS findings? Is it also creating waterfowl habitat in aircraft flight path? See map below. Need to establish there is a risk due to 1.4-dioxane in order to take action. Need to say something like: Although LUCs are in place, the risk assessment was updated to evaluate potential future risk from consumption of groundwater if LUCs were not in place.	The Navy concurs that the groundwater conditions discussed in 1993 are no longer relevant as significant reductions in concentrations have occurred. Section 5.7, 5.7.1, and 5.7.2 will be replaced with new text (located at end of Table). Regarding the PFAS question, PFOA was detected in the treatment system influent and effluent at concentrations below its LHA level (~35 ppt). The LHA for PFOS and PFOA is only applicable for drinking water and cannot be applied to groundwater and/or surface water not used as drinking water.	Neither the response nor the revised text in Section 5.7.1.2 address the comment. The potential for ecological exposure and risk isn't associated with groundwater. Rather, it occurs when water from the treatment plant is surface discharged to ecological habitat and may still contamination at concentrations that may pose a risk to ecological receptors.	The driver of this ROD Amendment is human risk. Navy's priority is to get this ROD Amendment completed and the remedy in place to address conditions as soon as possible. The proposed remedy (AOP systems) will address discharge of 1,4-dioxane in the effluent. The Section 5.7.2 text was updated to reflect an EPA ecological hazard evaluation based on available hazard data. The EPA ecological evaluation concluded there is a low acute and chronic ecotoxicity for fish, aquatic invertebrates and aquatic plants. Based on the available data, the 1,4-dioxane concentrations at Area 6 do not pose an unacceptable ecological risk. Ref: USEPA. 2015. TSCA Work Plan Chemical Problem Formulation and Initial Assessment. EPA 740-R1-5003. April 2015. OK
25	5.7.1	As extensively noted elsewhere, the extraction and treatment system at Area 6 has made "significant progress made towards	See response to comment #24	OK	

Comment # (Commenter)	Section / Page / Lines	EPA Comment	Navy Response	EPA Response Evaluation	Navy Response to EPA Evaluation / EPA Response
(EA)		removing VOCs." The groundwater concentrations used in the 1993 risk assessment are no longer relevant to current conditions, and the conditions in 1993 are no longer relevant to the ROD Amendment. The basis for the remedy at this point is that cleanup goals established in the 1993 ROD (and those modified in the Amendment) have not yet been attained. Thus, references to the risks posed by concentrations measured in 1993 should be deleted. In its place, a justification for adding 1,4-dioxane as a COC and establishing a cleanup goal is needed, either as posing a current or potential unacceptable risk or due to needing to comply with an ARAR.			
26 (AH)	5.7.2	Because ecological risk evaluation for 1,4-dioxane was not completed, the conclusions of the 1993 risk assessment are not relevant to this decision. Need to state whether 1,4-dioxane poses a threat to ecological receptors in this section.	Please see response to comment #24	The response does not address the comment.	Please see response to comment #24 OK
27 (TR)	5.7.2 / 5-38 / 12-16	Ecological risk was identified for Area 6 from the intermittent stream. I am not sure as to why it then states that no source area was located. Isn't the source area the discharge location from the current GETR system?	The ecological risk identified from the intermittent stream in the 1993 ROD was pre-remedial action. There was no surface discharge of treatment system effluent at that time. Sentence has been clarified by adding "per the ROD"	This statement appears to be factually-challenged, as Ted conforms that treated water is discharged to the surface.	As discussed in comment #24, based on the available data, the 1,4-dioxane concentrations at Area 6 do not pose an unacceptable ecological risk. The proposed remedy will address discharge of 1,4-dioxane. OK
28 (AH)	5.7.2 / 5-38 / 12-16	Not a major issue, but this is no longer about ecological risks. Suggest a new section header here.	Please see response to comment #24	OK	
29 (TR & AH)	5.7.2 / 5-38 / 17	States that in 2018, 16 drinking water wells and 10 groundwater wells were sampled south and west of Area 6 and no drinking water or groundwater wells had 1,4-dioxane concentrations greater than the Washington State regulatory level for 1,4-dioxane in groundwater. Just a note that even though WA State doesn't have regulatory levels for PFAS chemicals yet, values were obtained that exceeded the EPA LHA levels for PFAS chemicals. *It is ok to narrowly focus this RODA on 1,4-dioxane and say that PFAS will be address in the future. Also ok to narrowly focus this risk assessment and decision on 1,4-dioxane, and just say that risks due to PFAS will be evaluated at another time.*	Please see comment response #5.	OK	
30 (AH)	5.7.2 / 5-38 / 23	Cannot use the state ARAR to establish risk. Per CERCLA and the NCP, they must establish risk first using EPA risk methodology, then consider ARARs when coming up with a cleanup level. Can do this simply by comparing to an EPA screening level for 1,4-dioxane in drinking water, or say that the methods used to establish the MTCA Method B cleanup level are similar to those used to establish risk for use of drinking water under CERCLA.	The state ARAR is not being used to establish risk in this paragraph. This is stating the results of the 2018 drinking water well sampling effort relative to the state ARAR. The second paragraph indicates the risk. No change is recommended.	MTCA Method B is not consistent with CERCLA risk assessment methodology. The values are not acceptable for use in a screening level risk assessment. The test in this section must be revised to evaluate potential risks using EPA's regional screening levels in place of the MTCA Method B values.	The section was revised using EPA RSLs. The revised section 5.7 is included below. Agreed
31 (AH)	5.8 / 5-39 / 3-5	Standard language that should appear in this section – see highlight 6-12 in the ROD guidance.	The standard language will be included: "The response action selected in this ROD Amendment is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment"	Agreed	
32 (AH)	6 / 6-1 / 6	Just a note: Usually RAOs come first, then the ARARs and risk-based cleanup levels to meet the RAOs come next.	Comment noted.	OK	

Comment # (Commenter)	Section / Page / Lines	EPA Comment	Navy Response	EPA Response Evaluation	Navy Response to EPA Evaluation / EPA Response
33 (AH)	6.1/ 6-1	Just a note: It is not necessary to repeat information about ARARs that are in the previous ROD – you can just refer the reader to that ROD. This section should focus on ARARs relevant to this decision – modifying the treatment plant to treat 1,4-dioxane. May not be worth changing at this point.	Please note all ARARs in ROD Amendment are in the original ROD. The original ROD includes injection and surface discharge. As shown in the text, parts of Section 6.1 will be deleted and replaced with the following: "Applicable or relevant and appropriate requirements (ARARs) specified in the 1993 ROD (U.S. Navy, Ecology, and U.S. EPA, 1993) are applicable to this remedial action without revision or amendment."	Agreed	
34 (AH)	6 / 6-2 / 24	Per the ROD guidance we would typically only discuss ARARs relevant to the development of cleanup levels in this section, then discuss ARARs relevant to the cleanup alternatives in the section where they are described.	Comment noted. Section deleted per comment response #33	Agreed	
35 (AH)	6 / 6-4 / Table 6-1	The alternatives include two options for discharge of treated water: underground injection or treatment in the existing POTW then discharge. The ARARs table and discussion should discuss the ARARs for each of these discharge alternatives and how they will be met.	Section deleted per comment response #33	Agreed	
36 (AH)	6 / 6-5 / Table 6-1	This should be stated in the ecological risk assessment section.	Section deleted per comment response #33. Section 5.7 rewritten per comment #24	Agreed	
37 (RM)	6 / 6-7 / Table 6-2	Endangered Species Act should be included.	Section deleted per comment response #33	Agreed	
38 (AH)	6 / 6-7 / Table 6-2	Add actions to be taken in the comments section.	Section deleted per comment response #33	Agreed	
39 (EA)	6.6.2 / 6-11 / Table 6-4	The cleanup goal for 1,1-DCE established in the 1993 ROD should be listed as 0.07 µg/L. Cleanup goals established in a ROD cannot simply changed "by agreement," a ROD Amendment or Explanation is Significant Differences is required.	The 1993 ROD 1,1-DCE RG will be revised to 0.07 and the note deleted on Table 6-4.	Agreed	
40 (AH)	6.3.1 / 6-11 / 23-24	Does not make sense to say these RAOs supersede all previous RAOs. The new RAOs only address TCE and 1,4-dioxane, and do not mention other COCs still present at the site. Need to be specific about what RAOs remain and what exactly is being superseded.	Page 6-11 to 6-12 changed to the following to clarify: …the FFS established the following RAOs for an integrated groundwater remedy, which will supersede the 1993 OU 1 ROD groundwater RAOs: • Reduce the potential TCE, 1,1,1-TCA, 1,1-DCE, vinyl chloride and 1,4-dioxane risk to current and future groundwater users downgradient of the site. • Actively remediate TCE, 1,1,1-TCA, 1,1-DCE, vinyl chloride and 1,4-dioxane in the western and southern plume followed by MNA until RGs are met.	OK	
41 (EA)	6.3.2 / 6-12 / 26-30	As noted previously, while the Navy and EPA may have agreed to change the cleanup goal for 1,1-DCE to 7 µg/L, the Navy has not indicated that either an ESD or ROD Amendment was ever issued to do so, and the text here should not imply that the cleanup has been revised prior to the finalization of this ROD Amendment. The Navy has previously identified MTCA as applicable for this site, thus the	The Navy has deleted the sentence "In 2006, the Navy and the EPA agreed to an updated RG of 7 µg/L in groundwater for 1,1-DCE based on the MCL of 7 µg/L." The following text section 6.3.4 has been added to address 1,1-DCE: "The ROD used the MTCA Method B value for 1,1-DCE of 0.07 µg/L. It was derived based on the MTCA Method B GW	Modify the proposed text to say that the RfD for 1,1-DCE was revised in 2002, and that the revised value indicates that it is less toxic to human than thought previously.	The section 6.3.4 will be revised to: The following text section 6.3.4 has been added to address 1,1-DCE: "The ROD used the MTCA Method B value for 1,1-DCE of 0.07 µg/L. It was derived based on the MTCA Method B GW CUL equations and using the old cancer slope factor. Since then the MTCA Method B value for 1,1-DCE has increased

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		Navy has no authority to modify the risk-based cleanup goal upwards to an individual risk greater than 10-6. Thus, the cleanup goal for vinyl chloride should be established as 0.029 µg/L. The discussion of the "trigger levels" here should be deleted, as they are not cleanup goals.	CUL equations and using the old cancer slope factor. Since then the MTCA Method B value for 1,1-DCE has increased from 0.07 to 400 µg/L, because the EPA no longer considers this chemical a carcinogen based on updated EPA Integrated Risk Information System (IRIS) information. EPA IRIS has withdrawn the cancer slope factor and modified the noncancer RfD to a less toxic level. The MCL of 7 µg/L for 1,1-DCE, which is higher than the ROD cleanup level, but lower than the current MTCA Method B value, is the amended remedial goal for groundwater." The following text section 6.3.2.3 has been added to address VC: "The ROD cleanup level was selected as 0.02 mg/L; however, the MTCA Method B cleanup level has increased to 0.029 µg/L since the ROD was signed. Note that the ROD compliance level of 0.1 µg/L for vinyl chloride was based on the PQL at the time the ROD was signed. Analytical methods are available today that can achieve a PQL of 0.020 µg/L and method detection limit (MDL) as low as 0.005 µg/L (refer to the Tier II SAP [U.S. Navy, 2018c]). The MTCA Method B cleanup level of 0.029 µg/L for vinyl chloride is the amended remedial goal for groundwater."		from 0.07 to 400 µg/L, because the EPA no longer considers this chemical a carcinogen based on updated EPA Integrated Risk Information System (IRIS) information. The 1,1-DCE RfD was revised in 2002. The revised value indicates 1,1-DCE is less toxic to humans than previously thought. ~~EPA IRIS has withdrawn the cancer slope factor and modified the noncancer RfD to a less toxic level~~. The MCL of 7 µg/L for 1,1-DCE, which is higher than the ROD cleanup level, but lower than the current MTCA Method B value, is the amended remedial goal for groundwater." Agreed
42 (EA, AH)	6.3.2 / 6-12 / 29-30	RG should be current MTCA Method B groundwater cleanup level for vinyl chloride of 0.029 µg/L based on a $1x10^{-6}$ risk and 4 for TCE based on non-cancer risk. See attached Ecology reference documents. The rationale of using 10-5 cancer risk to set the VC cleanup levels because it was used in the 1993 ROD must be deleted. This rationale is inconsistent with MTCA, which requires that individual chemicals meet 10-6 cancer risk. This 25-year-old incorrect statement should not be carried forward into a 2018 RODA. *(See CLARC attachments provided Jim White of Ecology)*	The MTCA Method B cleanup level of 0.029 µg/L for vinyl chloride is the amended remedial goal for groundwater. As discussed in the February 22nd meeting with EPA, ARARs are generally "frozen" at the time of ROD signature, unless new or modified requirements call into question the protectiveness of the selected remedy. The TCE RG of 5 µg/L is still protective and will not be changed. The following sentence has been added under Section 6.3.2 Amended Remedial Goals: "The RGs for TCE and 1,1,1-TCA are not being amended and will remain the same as the ROD." Table 6-5 has been updated.	OK	
43 (TR)	6.3.2 / 6-13 / 1-29	There are several potential issues with this section. They state that they are transitioning from active treatment (until three times the remediation goals) to passive treatment when either 1) two consecutive semi-annual events are collected for the "statistical mean concentration" for the entire plume; or 2) groundwater concentrations of COCs in a "majority" of extraction well samples approach asymptotic conditions as defined in the performance monitoring plan to be developed during the design phase. The exception to this is for VC which will be the MCLs, or nearly 10 times the remediation goals. Thus, some of the monitoring wells within the plume could still have levels above the remediation goals, but they could say it has reached the goal due to a "statistical mean concentration" or has approached an asymptotic value. If a plume is approaching an asymptotic value, then it appears that there could still be an unidentified source present and further cleanup is needed rather than stating they have reached their goal. I would only expect MNA to be selected when a contaminant source has been removed and only low concentrations of contaminants remain in soil or groundwater. In Section 2.3	The MNA, transition point, and 3xRGs topics were heavily discussed during the February 22, 2019 meeting with EPA. The mutual agreement point that the Navy understood is that the EPA does not have an objection to having a transition point but the Navy needs to present evidence in the ROD to validate that 3xRGs is an appropriate transition to meet the RGs via MNA in a reasonable time frame. The potential for natural attenuation at the site is documented in USGS Water-Resources Investigations Report 00-4060. Additionally, the Navy will conduct further evaluation on the natural attenuation potential for Area 6 based on then "current" conditions as groundwater concentrations approach 3 times RG. The following will be added to Section 8.4: The results of modeling at Area 6 NASWI relative to TCE and 1,4-dioxane remedy optimization indicate the following: 1. The model predicts that TCE in the western plume will be reduced to 3 times the RG approximately 7 years after optimized system startup. This does not take into account potential residual sources, matrix diffusion, or biological	USGS report states the following: • "In the **western contaminant plume** where TCA, TCE, and selected degradation products are the primary contaminants of concern, natural attenuation has **not** been as effective at controlling the migration of contaminants disposed of near the former hazardous waste storage area." • "Redox conditions are not favorable for reductive dechlorination of TCA and TCE in the upper part of the aquifer, but they are more favorable at depth. (For the Western Plume)" • "Natural attenuation alone could likely achieve all remediation objectives for the southern contaminant plume, with the exception that the cessation of pump and treat would allow some off-base migration of small amounts of VC." • "Although the capture zone of the Navy extraction wells did not extend to MW-6, the extraction wells did quickly alter the ground-water flow field (Foster Wheeler Environmental, 1998a) so that contaminants	Stopping the P&T wells could alter the direction of the plumes. Especially the western plume. This is a question of whether wells are appropriately placed to pick this up. It could migrate under the city of Oak Harbor landfill. Then it would be an issue of who's waste is it. Perhaps, from the vadose zone.

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		ORIGINAL SELECTED REMEDY, Page 2-3, Line 11-12 stated that the levels in the vadose zone may be 100 times the groundwater cleanup levels. This does not sound like "low concentrations" and not all the source in the vadose zone has been removed down to the groundwater. This could result in a rebound. Currently, pump and treat and MNA may be degrading some constituents into VC if you compare plume size. However, the lack of downgradient monitoring wells, and the current distance this VC plume has moved doesn't support that MNA would continue to be effective to degrade the VC nor the 1,4-dioxane plume. The source of pollutants isn't yet under control, and the full extent of the contamination has never been accurately mapped. There should be evidence that MNA will actively reduce the contaminants in a reasonable time. Currently the plume is being reduced with active remediation; and we would not expect there would be reduction via dilution or dispersion. There should be (1) documented loss of contaminants from the site; (2) laboratory assays or technical literature showing that microorganisms from site samples have the potential to transform the contaminants under the expected site conditions; and (3) one or more pieces of information is needed showing that the biodegradation potential is realized in the field. The presence of electron donors should be documented and be present to continue this degradation including evidence that the biodegradation is not stalling. This should be moved to the selected remedy section. This section should focus on the remedial goals, not the means to achieve them.	decay. The conservative estimate is 3 times the TCE RG will be reached in 9 to 12 years of western system operation. 2. The model predicts that 1,4-dioxane in the western plume will be reduced to 3 times the RG approximately 9 years after optimized system startup. This does not take into account potential residual sources, matrix diffusion, or biological decay. The conservative estimate is 3 times the 1,4-dioxane RG will be reached in 9 to 15 years of western system operation. 3. Based on predictions 1 and 2 above, the western plant and extraction network was simulated to be shut down after 9 years. Continued simulation with pumping from the southern wells only shows no westerly deflection of residual TCE or 1,4-dioxane. Continued simulation with pumping from the southern wells only shows residual western plume and southern plume containment. 4. The model predicts 1,4-dioxane in the southern plume will be reduced to 3 times the RG approximately 17 years after optimized system startup. This does not take into account potential residual sources, matrix diffusion, or biological decay. The conservative estimate is 3 times the 1,4-dioxane RG will be reached in 17 to 25 years of southern system operation. 5. The southern system was simulated to be shut down after 17 years of operation. The remaining residual mass (1,4-dioxane concentration less than 1 ug/L) needing natural attenuation is predicted to move downgradient past SR 20 during this time. The residual plume mass was predicted to reach the RG via natural attenuation in 30 to 40 years. This does not take into account potential residual sources, matrix diffusion, or biological decay. The potential for natural attenuation at the site is documented in USGS Water-Resources Investigations Report 00-4060.	south of the site boundary may have been drawn eastward of MW-6." • "A capture-zone analysis of the pump and treat system (Foster Wheeler Environmental, 1998a) did suggest that hydraulic containment was being maintained by the extraction wells." • "Given that TCA, TCE, and DCE concentrations already exceed cleanup standards at the southern site boundary, immediate cessation of pump and treat would allow the existing western plume to spread southward beyond the site boundary." • "Those data suggest that extraction well PW-1 has removed much of the TCA that was in ground water in 1995, but a continuing source for TCA in ground water is still present."	
44 (AH)	Table 6-5	Suggest moving "active treatment goals" column to the selected remedy section. This is not a remedial goal, it's a means to achieve a remedial goal. Remediation Goals: TCE RG should be 4 ug/l per MTCA Method B Vinyl chloride CUL should be 0.029 ug/l per MTCA Method B. Rationale provided is not a is not acceptable because it does not meet the MTCA requirement to achieve 10-6 risk for individual chemicals.	The active treatment goals presentation will be moved to the selected remedy section. See response to comment #42	Agreed	
45 (TR)	6.3.3 / 6-14 / 2-16	If NAPL residuals are present in the aquifer or vadose zone near the former source area, did the ROD consider using air sparging, soil vapor extraction, or thermal treatment for removing these NAPLs? The text states that there is "no way to remove NAPL or residual oils if they are present." Even a liquid carbon amendment may help to stabilize the contaminants until they can naturally be broken down.	NAPL is not present based on sampling data and investigations. Please see responses to comment #53 and #46	OK	
46 (AH)	6.3.3	This is another aspect of the 1993 ROD that is not in compliance with CERCLA or the NCP. The Navy needs to either restore the entire aquifer to its beneficial use as a source of drinking water and meet all ARARs throughout the aquifer or seek an ARAR waiver.	This section is from the 1993 ROD and is the justification for the conditional point of compliance in 1993. The points of compliance are not being amended. The section text has been edited to the following:	OK, comment from Ted: "The highest source now extends beyond the area between the circumference of a circle centered on a point halfway between wells N6-37 and N6-38 and it does exceed the western property boundary."	Acknowledged, however, the highest source concentrations reported in the RI are 12,000 ug/L for 1,1,1-TCA and 1,500 ug/L for TCE. The 1,1,1-TCA concentration has decreased by three orders of magnitude. The TCE concentration has decreased by two orders of magnitude. So overall, the plume

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		See previous comment, these points of compliance are inconsistent with CERCLA. Even if they were, this is not something you can change in a FYR. It would have to be changed in a decision document. It looks like the Navy wants to consider the landfill a waste management area per the NCP, but in order to do that, the groundwater under the landfill that exceeds remedial goals must be fully contained in perpetuity.	"The points of compliance are not being amended and will remain the same as the ROD for TCE, 1,1,1-TCA, 1,l-DCE, and vinyl chloride. A brief summary of the ROD points of compliance is presented below per Section 8 of the 1993 ROD. The 1993 ROD established conditional points of compliance for groundwater in the former source area (former industrial liquid waste disposal area). For the shallow aquifer groundwater, the conditional points of compliance for TCE, 1,1,1-TCA, and 1,l-DCE will be no greater than the circumference of a circle centered on a point halfway between wells N6-37 and N6-38 and not to exceed the western property boundary. Wells N6-37 and N6-38 were selected, because they were located at the suspected source area and had the highest concentrations of TCE and 1,1,1-TCA, respectively."		mass has decreased substantially in the source area and the current conditions do not support a change in the original ROD points of compliance. OK
47 (AH)	6.3.4 / 6-14 / 30-31	LUCs do not substitute for the CERCLA and NCP requirement that remedial goals be met throughout the plume unless groundwater is fully contained in a waste management area or a TI waiver is approved in a decision document.	Please see comment response #46	OK	
48 (TR)	6.3.3 / 6-16 & 6-17 / Fig. 6-1 & 6-2	The "Conditional Point of Compliance" outlines do not match each other even considering the slight differences in scale.	The figures will be revised to be consistent.	Agreed	
49 (AH)	7.0 / 7-1	Separate into two sections: 1) description of alternatives; 2) evaluation of alternatives. See ROD guidance.	The Section 7.0 language was repositioned after Section 7.1	Agreed	
50 (AH)	7.1 / 7-2 / 16-17	I believe these are existing ICs, but please clarify whether these are new ICs or just reaffirming ones that are already in the ROD. If they are new ICs, they should include information in the LUC checklist.	These are LUCs required by the original 1993 ROD and ESD. The following clarification was added (Section 7.1 line 16) "Implementation of existing site-wide ICs like the landfill caps and groundwater use restrictions per the Explanation of Significant Difference to Formally Institute Land Use Controls described in Section 2.4.3."	Agreed	
51 (AH)	7 / 7-3	Comment 51: Per ROD guidance, for each alternative, provide • Estimated time for design and construction • Estimated time to reach remediation goals • Estimated capital, annual O&M, and total present worth costs.	The following will be added for Alternative 2. The estimated time for design and construction of the south plant is 2 years. Construction of the western plant will be completed after one year of successful south plant operation. The estimated costs, discussed in 7.2.1.7, assumes 30 years to achieve RGs. The capital, annual O&M, and total present worth costs estimated by the FFS are $14,500,000. The following will be added for Alternative 3. The estimated time for design and construction is 2 years. The estimated costs, discussed in 7.2.1.7, assumes 7 years of injections to achieve RGs with 15 years of post-injection monitoring. The capital, annual O&M, and total present worth costs estimated by the FFS are $41,800,000. The following will be added for Alternative 4. The estimated time for design and construction is 2 years. The estimated costs, discussed in 7.2.1.7, assumes 7 years of injections to achieve RGs with 15 years of post-injection monitoring. The capital, annual O&M, and total present worth costs estimated by the FFS are $38,600,000. The following will be added for Alternative 5. The estimated time for design and construction of the south plant is 2 years. Construction of the western plant will be completed after one	Agreed	

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			year of successful south plant operation. The estimated costs, discussed in 7.2.1.7, assumes 30 years to achieve RGs. The capital, annual O&M, and total present worth costs estimated by the FFS are $16,000,000. The following will be added for Alternative 6. The estimated time for design and construction of the south plant is 3 years. Construction of the western plant will be completed after one year of successful south plant operation. The estimated costs, discussed in 7.2.1.7, assumes 30 years to achieve RGs. The capital, annual O&M, and total present worth costs estimated by the FFS are $27,600,000.		
52 (TR)	7.1 / 7-3 / 1-12	Alternative 2 or the Preferred Alternative may be effective but we would recommend the addition of a GAC system to take out any of the PFAS that still exists in the water before discharging it to the environment.	Please see comment response #5.	OK	
53 (TR)	7.1 / general	I noticed there are no alternatives mentioned that included a soil vapor extraction system, air sparging, or thermal treatment to reduce these contaminants.	Comment noted. There is no reasonable source area identified that would merit thermal, SVE or air-sparging technology. Additionally, the focus of this ROD Amendment is 1,4-dioxane which is not treated by these technologies. Evaluations of remedial technologies were presented in the approved FFS. No change is recommended.	OK, here's comment from Ted: "Would a liquid carbon retain the contamination until it can be broken down naturally? Must be a source area if you are still getting a plume in the same location over time. Some plumes appear to have migrated, but others have not."	Evaluations of remedial technologies were presented in the approved FFS. Navy's priority is to get this ROD Amendment completed and the remedy in place to address conditions as soon as possible. OK
54 (AH)	7.2.1 /	The first two criteria should be a yes/no answer for each alternative, either the alternative meets the criteria, or it does not. Elaboration such as the discussion of greater certainty should go into the five balancing criteria, such as long-term effectiveness and permanence.	The text was revised as indicated.	Agreed	
55 (TR)	7.2.1 / 7.6 / 4-6	The text states that the extracted treated groundwater is "returned to the aquifer from which it was extracted." Actually, the extracted water is not returned to the aquifer. It is discharged to the surface. Some of it may infiltrate. This could then flow north through the aquifer at a groundwater divided, or flow north from the stream discharge. Why is this more uncertain than reinjection?	Groundwater monitoring at the site indicates that 1,4-dioxane is successfully reinfiltrating back to groundwater. This is demonstrated on Figure 5-9 of the document showing 1,4-dioxane extending upgradient of the former source area. If reinfiltration was not occurring, 1,4-dioxane would not be present in groundwater upgradient of the former source area. Not understanding the uncertainty question as the text states the groundwater extraction has greater certainty of success than the injection technologies.	OK, here's comment from Ted: "Sounds like we are assuming TOTAL infiltration into the aquifer? The discharged is at the headwaters for this surface stream. Thus, as stated, SOME of it may infiltrate (and contaminate the aquifer further). Some is also in the surface water. This surface/groundwater is then a new source of contamination that is migrating to the north (see Figure 5-9). This is beyond the boundaries of the original source area."	Acknowledged, however, there are no surface water quality criteria for 1,4-dioxane or PFAS compounds. As discussed in comment #24, based on the available data, the 1,4-dioxane concentrations at Area 6 do not pose an unacceptable ecological risk. OK
56 (RM)	Abbre & Acro / 7-8 / Table 7-1	National Historic Preservation Act and Endangered Species Act need to be added to this Table.	As recommended in comment #33, all ARARs in ROD Amendment are in the original ROD. The original ROD includes Endangered Species Act. The National Historic Preservation Act was not included in the original ROD and historic buildings are not present in the area where the remedial action will be executed. It is recommended that the National Historic Preservation Act not be included as an ARAR.	OK	
57 (TR)	7.2.3 / 7-9 / 3-9	Since there exists some uncertainty about the impacts from residual source mass in the vadose zone, this could be addressed with a soil vapor extraction, air sparging, or thermal treatment technology. A liquid carbon method could also help to stabilize the plume from further migration. There is some concern because if the contamination levels are allowed to approach an "asymptotic value", the site may revert to MNA without removing a continuing source of contamination.	There is some uncertainty relative to the vadose zone, but all data collected to date suggests that the residual contaminant mass will have minimal impact to groundwater. Soil vapor concentrations have decreased on groundwater concentrations immediately under the former source area were 5.1 ug/L in the November 2014 sample from 6-S-44 and 1.2 ug/L in the December 2014 sample from 6-S-44. The observed conditions do not warrant further remedial action. Section 2.4.6, page 2-14, lines 5-16 discuss the conditions observed directly beneath the former source area. The following will replace the subject	OK, see comment from Ted: In 2014, TCE was measured in soil samples at concentrations to 230 µg/kg at depths of approximately 80 feet bgs. 1,4-Dioxane was measured at concentrations of 34 µg/kg in samples collected 80 feet bgs. The calculated Washington State Model Toxics Control Act (MTCA) Method B protection of groundwater cleanup level for TCE in soil is 33 µg/kg and 1,4-dioxane in soil is 1.8 µg/kg.	Evaluations of remedial technologies were presented in the approved FFS. Navy's priority is to get this ROD Amendment completed and the remedy in place to address conditions as soon as possible. During implementation of the ROD Amendment, the Navy will be evaluating progress of the remedy as required in Five Year Reviews. OK

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			sentence: "Some uncertainty exists relative to residual source mass to groundwater in the former source area vadose zone soil, but data collected to date indicate that the potential for an ongoing contribution to groundwater is very low."	No rebound study yet, so we don't know impacts to groundwater. We weren't talking about soil vapor concentrations. Would it be worth updating the 2014 sampling to determine if trends are continuing?	
58 (AH)	7.2.3 / 7-9 / 25	Just a note for future - should avoid using value judgements like "excellent" and "good" – makes the 9 criteria analysis look more subjective than objective. Stick to statements like Alt A performs better or worse than B, etc.	Comment noted.	OK	
59 (AH)	Table 7-2	Explain the basis for discount rate numbers.	At the time these cost estimates were prepared, a 3 and 5% discount rate was used for projects like this one. This evaluation used 3% as the interest rate earned on investments minus the rate of inflation. In other words, the 3% discount rate assumes a 6% rate of return on invested money, with a 3% loss in buying power because of inflation.	OK	
60 (AH)	Table 7-3	Strongly suggest deleting this table and any discussion of numerical ratings. EPA, by policy, uses a qualitative and not a quantitative analysis of the 5 balancing criteria, because it's so difficult to come up with an objective numerical rating system, and it is not transparent. Some of the ratings always end up being subjective and it's not worth your time to dive into the rating system to determine if you agree or disagree with how they came up with all these numbers. Also, there is not enough information here for the public to understand what went into these numbers. For all these reasons, EPA relies on narrative statements rather than numerical ratings. Instead, the Navy should provide a narrative discussion of which alternative provides the best balance of the 5 balancing criteria and why.	Table 7-3 updated to reflect narrative description. Additionally the following narrative was added "Table 7-3 summarizes the comparative analysis ratings of the Alternatives discussed in Section 7.2. Overall, Alternatives 2 and 6 received the highest overall ratings, but Alternative 2 is better than 6 for its short term effectiveness, implementability, and total cost. As noted above, the two groundwater extraction and treatment plants will have a higher certainty of controlling the plume than ISCO injections. The rating for ISCO is decreased further by the high costs necessary for the large number of injection wells required to saturate the entire plume with oxidizing chemicals. Based on this qualitative evaluation, Alternative 2 (Continue P&T with Ex-Situ Groundwater Treatment Using Advanced Oxidation Process and Additional Extraction Wells) rates the highest and is the selected remedy."	Agreed	
61 (AH)	8.0 /8-1 / 16	Was principle threat wastes (PTW) described in the 1993 ROD? If so, the same definition should be used here, or it should be modified if it does not conform to the NCP and guidance. Delineation of PTW should meet the NCP criteria: From 40 CFR 300.430(a)(1)(iii)(A): Principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials. See also ROD guidance section 6.3.11 for more information on how principal threat wastes should be defined.	The following will be added to the end of the second paragraph of Section 8.0: "The municipal landfill and the former liquid industrial waste disposal area constitute the principal threat wastes. The cap has addressed the landfill threat to the extent possible. Removal of impacted soil in the former liquid industrial waste disposal area has reduced this principal threat. The remaining principal threat waste is residual material in groundwater or soil that could leach to groundwater. The selected remedy addresses the residual, low concentration principal threat waste."	Agreed	
61 (AH)	8.2 / 8.2 / 21-26	Explain what ARARs are associated with reinjection of treated water and what numerical criteria will be used to determine whether reinjection is allowable. Also see other comments in the bullets.	The 1993 ROD identifies both UIC and surface discharge ARARs. Please see comment response #33	OK	
62 (TR)	8.2 / 8-3 / 2-3	As a hydro, I don't recommend terminating treatment once the contamination levels have reached 3 times the remediation goals. What is this based on?	The basis of this was discussed during the February 22, 2019 meeting with EPA. It is based on the natural attenuation potential of the site as indicated in USGS Water-Resources Investigations Report 00-4060, the 10^{-5} to 10^{-6} risk range for 3 times the RGs and the lack of downgradient receptors (all downgradient residents are on city water). Please see response to comment #43.	Yes, TBD	Please see response to comment #43. See EPA comments in #43 & General (in red)

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63 (TR)	8.3 / 8-3 / 10-11	The treated water will be discharged to the surface for "re-infiltration". Actually, part of this water will flow off of the site to the north as headwaters to a creek.	Please see comment response #24	OK, see comment #55	
64 (TR)	8.3 / 8-3 / 13	Isn't the objective not just "contain" the plume but rather to eliminate it?	The objective is to contain and treat the plume to meet cleanup goals for COCs at point of compliance.	OK	
65 (TR)	8.3 / 8-4 /1-3	I do not think three times the RG is viable grounds to terminate the active remedy since the source of contamination is still present at potentially high levels and has not been addressed.	Comment noted regarding the 3xRGs concern however there is no source area present as suggested. The basis of the 3xRGs is discussed in comment response #62.	Yes, TBD	Please see response to comment #43. See EPA comments in #43 & General (in red)
66 (AH)	8.4 / 8-4 / 12-15	Per our MNA guidance. Must do an MNA analysis to show that when wells are shut off, gw concentrations will reach CULs in a defined timeframe. Need for an acceptable transition point from pump and treat to MNA.	Please see response to comment #43.	Yes, TBD	Please see response to comment #43. See EPA comments in #43 & General (in red)
67 (TR)	8.4 / 8-4 / 16-18	Don't recommend using the approach of only looking at the COC's in the "majority of wells" approaching asymptotic conditions since this is potentially ignoring an un-removed source. What is the basis for using a conversion to MNA at three times the RG (except for VC which is almost ten times)?	This approach was taken from the FFS. Specific methodology will be determined in the performance monitoring plan (which EPA will need to review and approve). The basis of the 3xRGs is discussed in comment response #62.	Yes, TBD	Please see response to comment #43. See EPA comments in #43 and General (in red)
68 (RM)	8 / 8-7 / 5-14	Need to explain here what ICs are being used (i.e. environmental covenants or zoning laws etc.). This is a critical omission and is essential to understanding the protectiveness of the amended remedy.	The following sentence was added "The Navy will be using existing ICs and LUCs per the ESD described in Section 2.4.3."	OK	
69 (RM)	8 / 8-7 / 31	How, by use of what ICs? Need to add details about the particular ICs here.	The Navy will be using existing ICs and LUCs per the ESD described in Section 2.4.3. This approach was discussed between the Navy and EPA during the February 22, 2019 meeting at EPA Region 10 offices. The Navy believes that existing ICs and LUCs are sufficient to ensure that there is not an unacceptable risk to human health based on potential groundwater use for drinking water. 1. There are no known receptors. • The Navy added residences on city water starting back during the RI/SI and/or drilling deeper replacement wells (6-DW-38B). • Based on discussions with the City of Oak Harbor, all parcels south of 6-DW-38 (southernmost well) between SR20 and NE Regatta Dr are on City of Oak Harbor water. A city water map was presented during the meeting. • As part of the annual LUC inspection process, Island County Public Health is contacted regarding well installation or drilling activities within the boundary of Ault Field and Seaplane Base as well as within an approximate 1-mile buffer around their boundaries. 2. Based on the southern plume nature and extent, there is not an unacceptable risk to human health. • 1,4-dioxane is the only COC above its RG that has migrated past the WAC 1,000-foot landfill restriction on well installation area. • The risk range based on the 1,4-dioxane concentrations is less than 10^{-4}. From off-site sampling, the Navy (with direct input from EPA)	OK	

Comment # (Commenter)	Section / Page / Lines	EPA Comment	Navy Response	EPA Response Evaluation	Navy Response to EPA Evaluation / EPA Response
			adopted 35 ppb as the drinking water exposure assessment action level (level at which the Navy would supply bottled water). No bottled water would be supplied for any of the Area 6 well concentrations. In summary, given the site conditions (1,4-dioxane only and the concentrations) and the lack of groundwater use in the plume area, the existing ICs and LUCs are protective. No change is recommended to the text.		
70 (RM)	8 / 8-14 / 27	Need an IC - preferably the filing of an environmental covenant, to assure this use restriction.	Please see response to comment #69. Added "This property will remain the Navy's for the foreseeable future."	OK	
71 (TR)	9.1 / 9-1 / 16-18	Method will not remove PFAS contamination.	Comment noted and acknowledged. Please see comment response #5.	OK	
72 (RM)	9 / 9-3 / 26	Need to add Endangered Species Act compliance here.	The following will be included in Section 9.2.2: "The Rare and Endangered Species Act (16 U.S.C. $ 1531, et seq.; 50 C.F.R. parts 200 and 402) is applicable because a bald eagle has been sighted in the area."	Agreed	
73 (AH)	9.2.3	Need to add ARARs associated with reinjection of treated groundwater.	The following will be included in Section 9.2.3: "Requirements of the State Underground Injection Control Program (WAC 173-218) as approved under the Safe Drinking Water Act are applicable, because they set forth the procedures and practices for the injection of fluids through wells into the waters of the state and specify that all known available and reasonable methods of prevention, control, and treatment be used to preserve and protect underground sources of drinking water. The State Waste Discharge Permit Program (WAC 173-216), which governs nonpermitted discharges or injection to groundwater, is applicable, because groundwater will be reintroduced to the shallow aquifer via vertical drains."	Agreed	
74 (TR)	9.2.3 / 9-4 / 6-7	I don't understand if the proposed drilled wells will be in the path of the plume, why do they not anticipate that the drilling will generate hazardous waste. The groundwater is contaminated which will contaminate the aquifer they will drill through.	Soil and groundwater samples collected and analyzed from past drilling activities in this area of the site did not characterize as hazardous waste. No change is recommended.	OK, comment from Ted: "The groundwater is above MCLs. Water will be encountered in the drilling. Thus the potential for generating hazardous waste."	The concentrations are well below the toxicity characteristic threshold for hazardous waste characterization as per 40 CFR Part 261. Under these known conditions, hazardous waste is not anticipated. Waste will be properly characterized prior to disposal. OK
75 (TR)	9.4 / 9-5 / 19-20	Since the proposed treatment is not proposing to use thermal treatment, air sparging, or soil vapor removal, I am not sure they can claim that they are representing the "maximum extent to which permanent solutions and treatment technologies can be used in a cost-effective manner for Area 6."	Please see response to comment #53.	OK	
76 (TR)	9.5 / 9-5 / 30-31	The discharged water will not necessarily re-infiltrate through the aquifer over time. It is likely that much will leave the site through surface flow.	Please see response to comment #55.	OK	
General (EA)	Section 7	Although it appears that the selected remedy described in Section 8 includes a change of remedial technology from extraction and ex-situ treatment using AOP to monitored natural attenuation when groundwater contaminant concentrations are greater than the final cleanup goals by a factor of 3. However, this change of remedial technology is not discussed in the description of any of the alternative considered. and there is no evidence that it was considered in the analysis of alternatives. Thus, the presentation of	Please see response to comment #43. The following will be added to Section 7.1: Groundwater modeling was conducted to support evaluation of all alternatives during the FFS. Two groundwater modeling concepts were developed: 1) Groundwater extraction with exsitu treatment, which applies to Alternatives 2, 5, and 6	Yes, TBD USGS report states: "Natural attenuation has not been particularly effective at controlling the migration of contaminants in the western contaminant plume….That is because the predominantly aerobic redox conditions in the western plume are not favorable for reductive dechlorination of TCA and TCE". "In contrast to the southern plume, contaminant concentration trends in the western plume demonstrate limited degradation	There will be need for several confirmation samples of a contaminant level over time to say we have reached MCLs (and other RGs) before cessation of the P&T. There could be variation in short-term measurements. Also frequent measurements afterwards to watch for rebound.

Comment # (Commenter)	Section / Page / Lines	EPA Comment	Navy Response	EPA Response Evaluation	Navy Response to EPA Evaluation / EPA Response
		alternatives appears to discuss a MODFLOW analysis that evaluated the relative timeframes between achieving final cleanup goals by continuing extraction and treatment versus switching to MNA. According to OSWER Directive 9200.4-17P, "MNA should be selected only where it meets all relevant remedy selection criteria, and where it will meet site remediation objectives within a timeframe that is reasonable compared to that offered by other methods." Absent a discussion of whether the criteria for selecting MNA has been conducted, it is not clear the Navy can select it as a remedial technology. Rather than arbitrarily assume a transition point, the Navy should conduct an alternatives analysis that evaluates active treatment technology remedies compared to hybrid remedies that include the transition to MNA so that the balancing criteria can effectively assess the performance of the different alternatives to each other. Additionally, since it is unlikely that the "trigger levels" for all COCs identified in this ROD Amendment will be achieved simultaneously, the criteria for the transition from extractions and treatment to MNA may actually occur is insufficiently defined. Although transitions points for all COCs are presented in Table 6-5, the description of the selected remedy in Section 8.2 appears to only discuss concentrations of 1,4-dioxane as a transition point. Absent an MNA analysis consistent with EPA policy and guidance and without full consideration of the relative merits of including MNA as a remedy component relative to alternative that do not include it as a technology, the Navy cannot select it as a component of the remedy for this ROD Amendment. The Navy may wish to state an intent to consider whether MNA represents a viable remedial alternative when certain groundwater COC concentrations are attained. However, even if such analysis indicates that MNA represents a viable technology, it can only be selected through an additional ROD Amendment.	2) Insitu groundwater treatment which applies to Alternatives 3 and 4 All evaluated alternatives are integrated remedies with an active treatment phase and a passive (natural attenuation) phase. The modeling was used to estimate the time for transition from the active phase to the passive phase. The modeling was also used to evaluate the time to reach RGs under the passive phase, once the active phase had been terminated. These metrics were used in the evaluation. The following will be added to Section 7.1, Alternatives 2, 5, and 6: The western and southern plants would be operated until dissolved COC concentrations reach 3 times the RGs, as discussed in Section 8.4 Modeling predictions indicate western system operation will reach 3 times the RG for both TCE and 1,4-dioxane much sooner than the southern system.	and substantial downgradient transport of contaminants from the original source area." "At this time, natural attenuation is a less clearly viable alternative to pump and treat for meeting remediation objectives in the western contaminant plume."	

From comment #12:

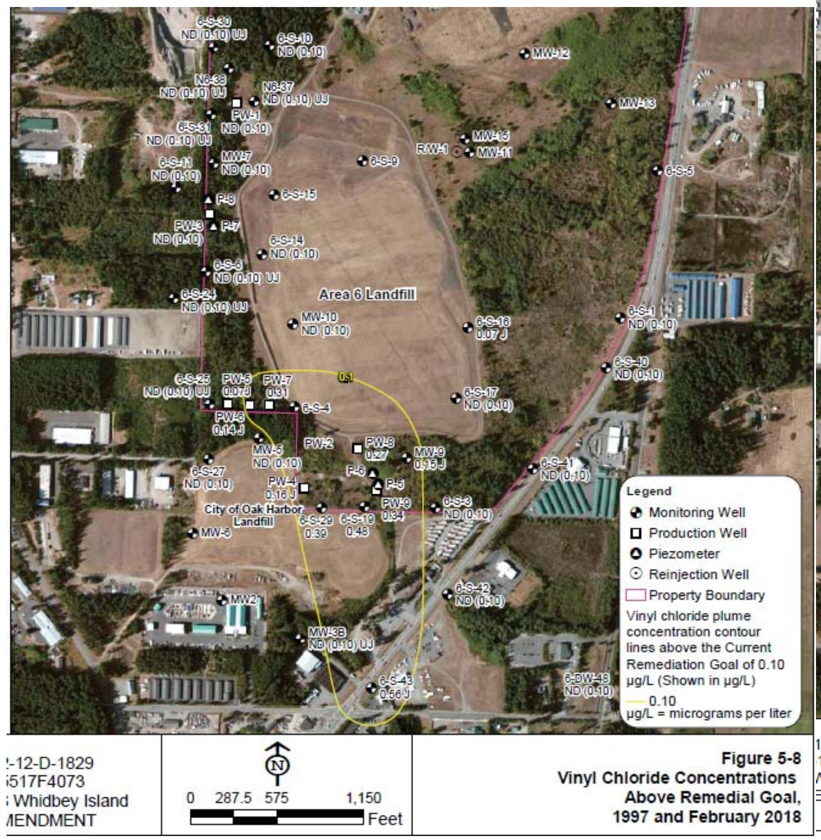


Figure 5-8
Vinyl Chloride Concentrations Above Remedial Goal, 1997 and February 2018

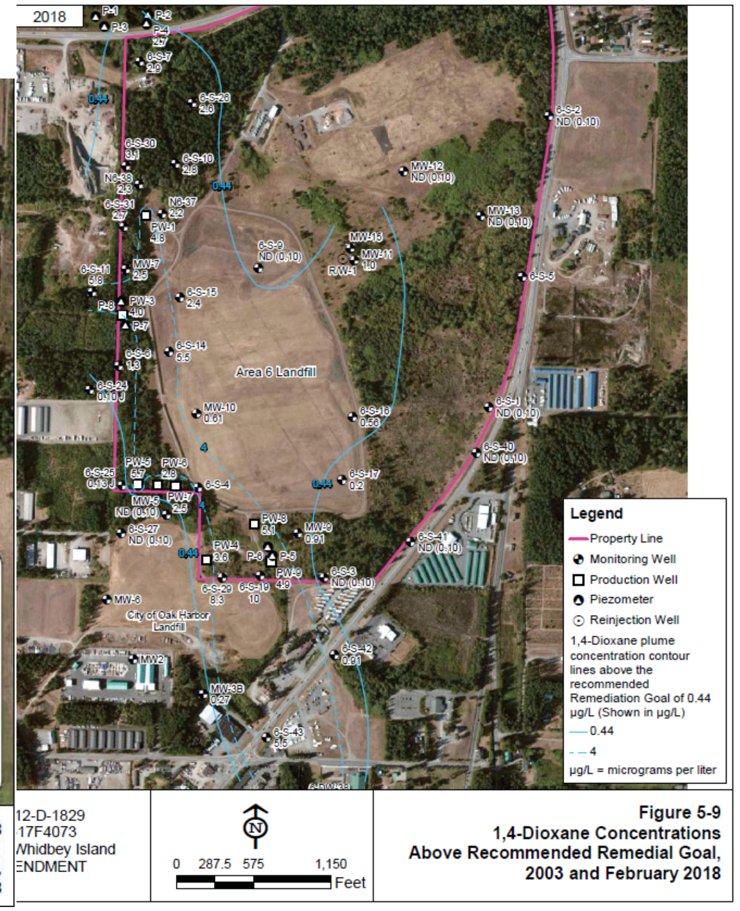
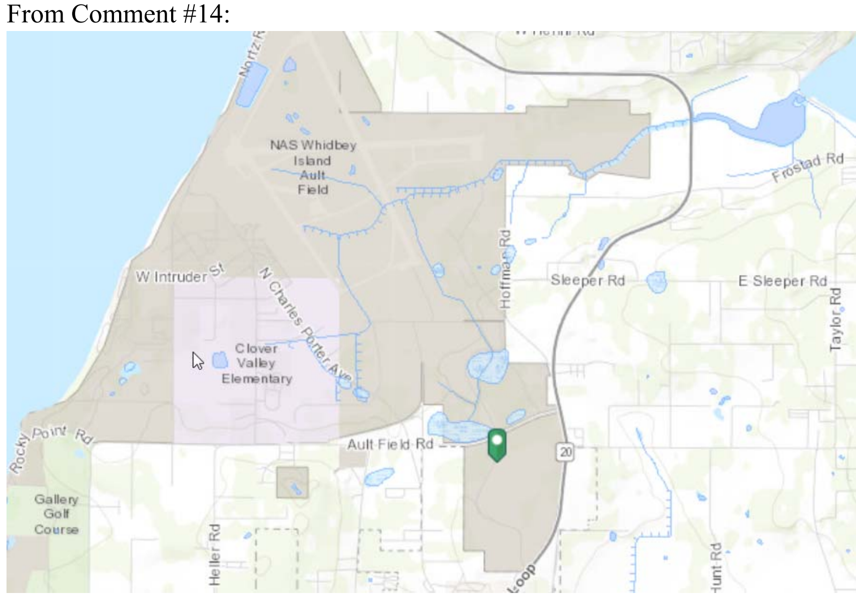
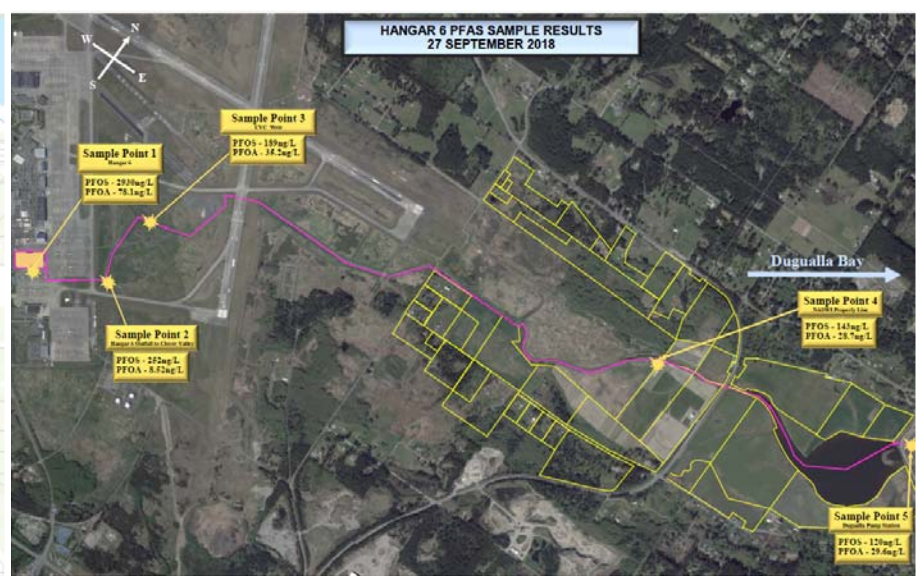


Figure 5-9
1,4-Dioxane Concentrations Above Recommended Remedial Goal, 2003 and February 2018

From Comment #14:





RESPONSE TO COMMENTS 24 & 25

5.7 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

Conditions have changed since the 1993 ROD. The GETR has been successful at reducing concentrations of COCs identified in the 1993 ROD. Concentrations of COCs remain above the RGs; however, the risk they pose has changed. Although LUCs are in place, the risk assessment was updated to evaluate potential risk from consumption of groundwater if LUCs were not in place.

5.7.1 Current Human Health Risks

Figures 5-5 through 5-8 present side-by-side comparisons of the 1997 and 2018 groundwater concentrations for TCE, 1,1-DCE, 1,1,1-TCA, and vinyl chloride in groundwater. Figure 5-9 presents the 2003 and 2018 extent of 1,4-dioxane in groundwater. A screening level risk evaluation was performed for these five groundwater COCs using the February 2018 data assuming a drinking water exposure pathway using the following equations:

- Current excess cancer risk = Maximum Site Concentration * 0.000001/MTCA Method B Cancer Endpoint
- Current noncarcinogenic hazard = Maximum Site Concentration/ MTCA Method B noncancer Endpoint

Cumulative risk was assessed by summing the individual cancer risks to achieve a total excess cancer risk. Cumulative hazards were assessed by summing noncancer hazard quotients (HQs) for each chemical to calculate a hazard index (HI). To assess the current worst-case risk scenario, maximum concentrations were used. Even if RGs are based on MCLs, the EPA tapwater Regional Screening Levels (RSLs) were used because MCLs consider other factors besides risk. Only three of the five COCs are considered both carcinogenic and noncarcinogenic.

1,1,1-TCA. Although the maximum detected concentration of 245 μg/L for 1,1,1-TCA exceeds the RG of 200 μg/L, the noncarcinogenic hazard based on the current EPA tapwater RSL of 8,000 μg/L (HQ of 0.03) is less than one. As such, this chemical poses a low hazard. However, the MCL is set at 200 μg/L and it will be retained as a groundwater COC in the ROD based on the need to comply with an ARAR.

1,1-DCE. Although the maximum detected concentration of 64 μg/L for 1,1,1-TCA exceeds the RG of 0.07 μg/L, the noncarcinogenic hazard based on the current EPA tapwater RSL of 280 μg/L (HQ of 0.23) is less than one. Although this chemical poses a low hazard, because EPA has set an MCL lower than the EPA tapwater RSL, the RG will be revised in the ROD to the MCL of 7 μg/L based on the need to comply with an ARAR.

TCE. Although the TCE RG is based on the MCL, the EPA tapwater RSL of 0. 49 μg/L was compared to the maximum concentration of 57 μg/L to achieve an excess cancer risk of 1×10^{-4}.

The maximum detected concentration of TCE exceeds the noncarcinogenic EPA tapwater RSL of 2.8 µg/L (HQ of 20).

Vinyl Chloride. Using the current EPA tapwater RSL of 0.019 µg/L, which is based on a cancer risk of 10^{-6}, would result in an excess cancer risk of 3×10^{-5} based on the maximum detected concentration of 0.56 µg/L. The maximum detected concentration of vinyl chloride is well below the noncarcinogenic EPA tapwater RSL of 44 µg/L (HQ of 0.01).

1,4-dioxane. Using the carcinogenic EPA tapwater RSL of 0.46 ug/L for 1,4-dioxane, which is based on a cancer risk of 10^{-6}, would result in an excess cancer risk of $2 \times 10^{-}5$ using the maximum detected concentration of 10 µg/L. As such, 1,4-dioxane should be added as a COC and the noncarcinogenic EPA tapwater of 0.46 µg/L should be included in the ROD. The maximum detected concentration of 1,4-dioxane of 10 µg/L is below the noncarcinogenic EPA tapwater RSL of 57 µg/L (HQ of 0.18).

A cumulative risk summary table is provided below.

Table 0-1
Cumulative Risk Summary Table based on February 2018 Groundwater Data

Analyte	Excess Cancer Risk	Noncarcinogenic Hazards
1,1,1-TCA	NC	0.03
1,1-Dichloroethene	NC	0.23
TCE	1×10^{-4}	20.4
Vinyl chloride	3×10^{-5}	0.01
1,4-dioxane	2×10^{-5}	0.18
Cumulative Risks & Hazard Index:	**2×10^{-4}**	**21**

NC = Not carcinogenic

5.7.2 Ecological Risk Evaluation

The 1993 ROD did not identify ecological risk associated with the groundwater COCs.

The discharged groundwater effluent continues to be surface infiltrated and has been discharge to the surface since at least 1997. Groundwater monitoring at the site indicates that 1,4-dioxane is successfully reinfiltrating back to groundwater. This is demonstrated on Figure 5-9 showing 1,4-dioxane extending upgradient of the former source area. If reinfiltration was not occurring, 1,4-dioxane would not be present in groundwater upgradient of the former source area. The February 2018 1,4-dioxane effluent concentration was 1.9 ug/L. The risk associated with effluent values is within the 10^{-6} risk range compared the MTCA Method B groundwater cleanup level of 0.44 ug/L.

There is no promulgated comparison criteria for the surface water exposure pathway. The EPA Technical Fact Sheet - 1,4-dioxane (November 2017) indicates 1,4-dioxane does not bioaccumulate, biomagnify, or bioconcentrate in the food chain (ATSDR 2012, Mohr 2001).

The EPA and Office of Pollution Prevention and Toxics evaluated available ecotoxicity studies (USEPA, 2015). 1,4-dioxane has been tested for acute and chronic aquatic toxicity. In order to characterize the effects of 1,4-dioxane to the environment, a hazard rating was assigned based on

EPA methodology for existing chemical classification. Included in this assessment were eight acute aquatic toxicity studies and three chronic aquatic toxicity studies. There is one study that characterizes the toxicity of 1,4-dioxane for aquatic plants. Acute and chronic toxicity data for 1,4-dioxane exist for freshwater and saltwater fish, daphnia, and green algae. There are no available sediment, soil, or avian toxicity studies found in literature for 1,4-dioxane. The lowest toxicity threshold based on this compilation of data is >100 mg/L based on a median lethal concentration (LC_{50}) for a fathead minnow (*Pimephales promelas*), which is orders of magnitudes higher than concentrations observed at the site and the latest effluent concentration (0.0019 mg/L). The EPA ecological evaluation concluded there is a low acute and chronic ecotoxicity for fish, aquatic invertebrates, and aquatic plants. The hazard of 1,4-dioxane is expected to be low for soil organisms due to its high potential to volatilize from soil surfaces and low for sediment-dwelling organisms due to its low adsorption potential to sediment.

The lack of bioconcentration potential of this chemical also suggests that uptake of 1,4-dioxane into prey items that are subsequently consumed by waterfowl that could visit the marsh is an insignificant exposure pathway. As such, 1,4-dioxane from the current GETR effluent poses an insignificant hazard to ecological receptors.

The selected remedy will result in even lower 1,4-dioxane surface discharge concentrations when the southern plant is operational and 1,4-dioxane is expected to be reduced to concentrations to at least less than the MTCA Method B cleanup level of 0.44 ug/L once both plants are operational.

5.7.3 Risk Summary

The most significant current health risk at Area 6 is that 1,4-dioxane or chlorinated VOCs could migrate offsite to private wells south and west of the property. The public could potentially be exposed if the water were used as a household source of drinking water. The Navy has conducted numerous rounds of off-base water sampling around Area 6 including most recently in 2018. In 2018, 16 drinking water wells and 10 groundwater wells were sampled south and west of Area 6 and no drinking water or groundwater wells had 1,4-dioxane concentrations greater than the carcinogenic EPA tapwater RSL for 1,4-dioxane in groundwater.

The expectation of the amended remedy proposed in this ROD Amendment is to reduce the cumulative excess cancer risk for all COCs and exposure pathways to less than 1 in 100,000 and the noncancer hazard index for other health effects to less than 1, and the excess cancer risk for individual COCs to less than 1 in 1,000,000.

Final Navy Responses 7/19/2019 to
USEPA Region 10 Review/Comments 6/28/19
Project Site: NAS Whidbey Island Ault Field
DOCUMENT: Draft Record of Decision Amendment No. 1 Operable Unit 1 Area 6
Prepared for Department of the Navy – Naval Facilities Engineering Command Northwest

USEPA Reviewers:
Chan Pongkhamsing, David Einan, Richard Mednick, Ted Repasky, Elizabeth Allen
Navy Commenters:
Laura Himes and Dina Ginn

The EPA understands the reality that the Navy is constrained with the commitment to have an end point to this Advanced Oxidation Process pump and treat system. We also understand the importance of addressing 1,4-dioxane, vinyl chloride, and other VOCs immediately. However, the EPA is unwilling to set a precedent to include 3X the Remedial Goal (Clean-up Level) as a transition point to MNA in this RODA without any scientific evaluation and analysis. We, therefore, are proposing the following potential solutions:

1. We can commit to an evaluation of using MNR as a component of a final remedy, assuming additional demonstrations during implementation that MNR is working, will achieve the final cleanup goals/levels within a reasonable time frame, and after a comparative analysis that evaluates how well switching to MNR compares relative to having to continue to operate the P&T system.

    - MNA Directive: "MNA may be evaluated and compared to other viable remediation methods (including innovative technologies) during the study phases leading to the selection of a remedy. As with any other remedial alternative, MNA should be selected only where it meets all relevant remedy selection criteria, and where it will meet site remediation objectives within a timeframe that is reasonable compared to that offered by other methods."
    - By not evaluating an alternative of active remediation to compare to the "integrated" remedy, no proper comparative analysis exists which can serve as the basis to select one over the other.

Navy Response:

The following language is proposed to be included in the RODA under Section 8.1 to clarify the MNA component of the remedy and MNA implementation after transition points have been met.

"The selected remedy is an integrated remedy that will comprise of an active treatment component, MNA (passive treatment), and ICs. The transition from the active remedy portion to MNA/ICs (passive) will occur when whichever of the active endpoint conditions presented in Section 8.4 is met. The MNA component of the integrated remedy is consistent with EPA's OSWER Directive 9200.4-17P Use of Monitored Natural Attenuation at Superfund, RCRA

Corrective Action, and Underground Storage Tank Sites. Based on the CSM and ICs, the use of MNA will be protective of human health and the environment as part of the integrated remedy. The Navy has demonstrated RGs can be achieved in a reasonable timeframe using an integrated remedy approach. Based on modeling results, after the southern plant is turned off, the residual plume mass was predicted to reach the RGs via MNA in 30 to 40 years. At the time of transition from active to passive treatment, the Navy will validate plume configuration, which will include additional delineation of the southern plume, as part of the performance monitoring. The effectiveness of the MNA will be demonstrated to EPA by ongoing performance monitoring. The Navy will be conducting performance monitoring to verify that both the active and passive (MNA) treatment phases are performing as anticipated. Transition points, modeling results and performance monitoring are discussed in further detail in Section 8.4."

Additionally for clarification, references of 3 times the Remedial Goal (Clean-up Level) in the RODA text have been changed to the "transition point concentration/transition point goal."

Also the following language is proposed to be included in the RODA under Section 8.4:

"At the time of transition from active to passive treatment, the Navy will validate plume configuration, which will include additional delineation of the southern plume, as part of the performance monitoring."

The transition points have been evaluated for risk and analyzed for achieving the Remedial Goal (Clean-up Level) via MNA within a reasonable timeframe. The following validates that the selected concentrations are an appropriate transition to meet the RGs via MNA in a reasonable time frame consistent with the MNA guidance.

EPA MNA Directive sections of note:

> "EPA expects that **MNA will be an appropriate remediation method only where its use will be protective of human health and the environment and it will be capable of achieving site-specific remediation objectives within a timeframe that is reasonable compared to other alternatives.** The effectiveness of MNA in both near-term and long-term timeframes should be demonstrated to EPA (or other overseeing regulatory authority) through: 1) sound technical analyses which provide confidence in natural attenuation's ability to achieve remediation objectives; 2) performance monitoring; and 3) contingency (or backup) remedies where appropriate. **In summary, use of MNA does not imply that EPA or the responsible parties are "walking away" from the cleanup or financial responsibility at a site."**
>
> "EPA expects that MNA will be most appropriate when used in conjunction with other remediation measures (*e.g.*, source control, groundwater extraction), or as a follow-up to active remediation measures that have already been implemented."

The Navy has demonstrated the MNA directive requirements:

1. Directive -"its use will be protective of human health and the environment"

The transition point goals were selected iteratively based on the evaluation of site specific conditions, reasonable risk range and predictive modeling. The transition point goals are protective of human health and the environment during the MNA period. Additionally, ICs and LUCs ensure that there is not an unacceptable risk to human health based on potential groundwater use for drinking water.

- *There are no known receptors.*
  - *The Navy added residences on city water starting back during the RI/SI and/or drilling deeper replacement wells (6-DW-38B).*
  - *Based on discussions with the City of Oak Harbor, all parcels south of 6-DW-38 (southernmost well) between SR20 and NE Regatta Dr are on City of Oak Harbor water. A city water map was presented during the February meeting.*
  - *As part of the annual LUC inspection process, Island County Public Health is contacted regarding well installation or drilling activities within the boundary of Ault Field and Seaplane Base as well as within an approximate 1-mile buffer around their boundaries.*
- *Based on the southern plume nature and extent, there is not an unacceptable risk to human health.*
  - *1,4-dioxane is the only COC above its RG that has migrated past the WAC 1,000-foot landfill restriction on well installation area.*
  - *The risk based on the 1,4-dioxane concentrations is less than 10^{-4} based on the highest 1,4 dioxane concentrations. Off-site sampling confirmed that interim removal actions were not required for the area supporting an integrated remedy that includes reduction of contaminant mass from active treatment and transition to MNA.*

In summary, given the current site conditions (1,4-dioxane only and the concentrations), the transition point goals and the lack of groundwater use in the plume area, use of MNA will be protective of human health and the environment as part of the integrated remedy.

2. Directive -" it will be capable of achieving site-specific remediation objectives within a timeframe that is reasonable compared to other alternatives" and " 1) sound technical analyses which provide confidence in natural attenuation's ability to achieve remediation objectives" and "EPA expects that MNA will be most appropriate when used in conjunction with other remediation measures (*e.g.*, source control, groundwater extraction), or as a follow-up to active remediation measures that have already been implemented."

   Based on modeling results presented below, the Navy has demonstrated that remedial goals can be achieved in a reasonable timeframe using an integrated remedy approach. The EPA directive uses the following example which closely mirrors our situation "An example of a situation where MNA may be appropriate is a remedy that includes source control, a pump-and-treat system to mitigate the highly-contaminated plume areas, and MNA in the lower concentration portions of the plume. In combination, these methods would maximize groundwater restored to beneficial use in a timeframe consistent with future demand on the aquifer, while utilizing natural attenuation processes to reduce the reliance on active remediation methods and reduce remedy cost."

The Navy used a model to verify that the transition point concentrations would achieve the Remedial Goal (Clean-up Level) via MNA within a reasonable timeframe. The results of modeling at Area 6 NASWI relative to TCE and 1,4-dioxane remedy optimization indicate the following:

1. *The model predicts that TCE in the western plume will be reduced to the transition point concentration approximately 7 years after optimized system startup. This does not take into account potential residual sources, matrix diffusion, or biological decay. The conservative estimate is the TCE transition point concentration will be reached in 9 to 12 years of western system operation.*
2. *The model predicts that 1,4-dioxane in the western plume will be reduced to the transition point concentration approximately 9 years after optimized system startup. This does not take into account potential residual sources, matrix diffusion, or biological decay. The conservative estimate is the 1,4-dioxane transition point concentration will be reached in 9 to 15 years of western system operation.*
3. *Based on predictions 1 and 2 above, the western plant and extraction network was simulated to be shut down after 9 years. Continued simulation with pumping from the southern wells only shows no westerly deflection of residual TCE or 1,4-dioxane. Continued simulation with pumping from the southern wells only shows residual western plume and southern plume containment.*
4. *The model predicts 1,4-dioxane in the southern plume will be reduced to the transition point concentration approximately 17 years after optimized system startup. This does not take into account potential residual sources, matrix diffusion, or biological decay. The conservative estimate is the 1,4-dioxane transition point concentration will be reached in 17 to 25 years of southern system operation.*
5. *The southern system was simulated to be shut down after 17 years of operation. The remaining residual mass (1,4-dioxane concentration less than 1 ug/L) needing natural attenuation is predicted to move downgradient past SR 20 during this time. The residual plume mass was predicted reach the RG via natural attenuation in 30 to 40 years. This does not take into account potential residual sources, matrix diffusion, or biological decay.*

3. Directive – "2) performance monitoring"

   The Navy has been conducting performance monitoring at Area 6 since the original ROD was implemented. Land use controls and groundwater monitoring implemented as part of the original remedy will remain in place until COC concentrations have been reduced to levels allowing unrestricted land use. The Navy will conduct performance monitoring as *prescribed in a plan to be prepared during the design phase. The EPA and Ecology will have an opportunity to review and comment on this plan. At the time of transition from active to passive treatment, the Navy will validate plume configuration, which will include additional delineation of the southern plume, as part of the performance monitoring.*

4. Directive – "and 3) contingency (or backup) remedies where appropriate."

   The Navy will be conducting performance monitoring to verify that both the active and passive (MNA) treatment phases are performing as anticipated. The AOP plants will still be onsite and in operational condition during the transition to MNA.

5. Directive – "In summary, use of MNA does not imply that EPA or the responsible parties are "walking away" from the cleanup or financial responsibility at a site."

   The Navy is committed to the CERCLA process at this NPL site. As discussed during the February 22, 2019 meeting, the Navy wants to responsibly reduce risk at Area 6. The Navy is not "walking away" from Area 6 as supported by continued performance monitoring, ICs, and Five Year Reviews.

2. The current description of "asymptotic conditions" raises some concerns. See pages 6-11, 6-12, 8-4. The EPA does not believe this to be a viable option because:

   - An asymptotic condition for this site must be defined rather than just using a generic "asymptotic" trend.
   - Averaging several wells together to get the asymptotic value is not acceptable. Depending on which wells are used, this evaluation can greatly sway the analysis.

Navy Response: The specific statistical conditions will be further defined in the Performance Monitoring Plan to be prepared during the design phase. The EPA and Ecology will have an opportunity to review and comment on this plan.

The following language is proposed to be included in the RODA under Section 8.4:

"The specific statistical conditions will be further defined in the Performance Monitoring Plan to be prepared during the design phase."

Navy Responses to
USEPA Region 10 Richard Mednick Review/Comments August 2019
Project Site: NAS Whidbey Island Ault Field
DOCUMENT: Draft Record of Decision Amendment No. 1 Operable Unit 1 Area 6
Prepared for Department of the Navy – Naval Facilities Engineering Command Northwest

USEPA Commenter:
Richard Mednick
Navy Commenters:
Laura Himes and Dina Ginn

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1) Universal Change – Request to change Ault Field Site to Facility - Pg 1, Sections 1.1, 1.2, 2.0

The Navy does not agree with this change. No changes are planned.

2) Page 2 Comment on "The State of Washington concurs with the amended remedy."

The Navy has removed this sentence. Ecology is aware of the amended remedy of Area 6 and has verbally agreed that it seems appropriate. The Navy has offered Ecology the chance to review documents associated with the amended remedy but Ecology has deferred review to EPA.

3) Page 5 PFAS Comments

This section was previously revised as part of EPA comment #5 and the current language was previously agreed to by the EPA in May 2019. If additional clarification is necessary on the status of EPA's actions for PFAS, language from EPA's website has been added to the proposed Navy revision. Below is the original version, then the proposed EPA changes, and lastly the changes Navy proposes (if necessary).

Original:

Per- and polyfluoroalkyl substances (PFAS) are a suite of "emerging" contaminants, which have no Safe Drinking Water Act or routine water quality testing requirements. The EPA is currently studying PFAS to determine if regulation is needed. In May 2016, the EPA announced the lifetime health advisory (LHA) level for two PFAS compounds, perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). PFAS comprise of thousands of individual compounds, but the focus of analyses and anticipated regulations has generally been PFAS termed perfluoroalkyl acids (PFAAs), which include PFOS and PFOA.

EPA comment version:

Per- and polyfluoroalkyl substances (PFAS) are a suite of "emerging" contaminants, which do not yet have maximum contaminant levels (MCLs) established under the Safe Drinking Water Act or routine water quality testing requirements. The EPA is currently considering MCLs, cleanup standards, and hazardous substance designations under CERCLA for PFAS. In May 2016, the EPA issued the lifetime health advisory (LHA) level for two PFAS compounds, perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). PFAS comprise of thousands of individual compounds, but the initial focus of the EPA has generally been PFAS termed perfluoroalkyl acids (PFAAs), which include PFOS and PFOA. The EPA considers PFOS and PFOA to be pollutants or contaminants under CERCLA.

Navy Proposed Revision (if additional clarification is necessary):

Per- and polyfluoroalkyl substances (PFAS) are a suite of "emerging" contaminants. There are currently no maximum contaminant levels (MCLs) established under the Safe Drinking Water Act for PFAS chemicals. EPA initiated the steps to evaluate the need for an MCL for PFOA and PFOS under the regulatory determination process. In May 2016, the EPA issued the lifetime health advisory (LHA) level for two PFAS compounds, perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). PFAS comprise of thousands of individual compounds, but the initial focus of the EPA has generally been PFAS termed perfluoroalkyl acids (PFAAs), which include PFOS and PFOA. PFAS, including PFOA and PFOS, are not listed as CERCLA hazardous substances, but in some circumstances could be responded to as CERCLA pollutants or contaminants. EPA is beginning the necessary steps to propose designating PFOA and PFOS as "hazardous substances" through one of the available statutory mechanisms, including potentially CERCLA Section 102.

Please note greyed text is directly from EPA's website - https://www.epa.gov/pfas/pfas-laws-and-regulations

4) Section 7 – Evaluation of Alternatives

Section 7 should reflect the FFS language. The proposed change has been made to be consistent with the FFS.

Original Text:

The western and southern plants would be operated until dissolved COC concentrations reach the transition point concentrations, as discussed in Section 8.4.

EPA comment version:

The western and southern plants would be operated until the transition points as prescribed in Section 8.4.

Navy Proposed Revision:

The western and southern plants would be operated until the transition points concentrations or asymptotic conditions have been reached as prescribed in Section 8.4.

EPA comment version:

The western and southern plants would be operated at least until the transition points concentrations or asymptotic conditions have been reached as prescribed in Section 8.4.

5) Section 8.1 – Rationale for Selection of the Amended Remedy

EPA comment version:

The selected remedy is an integrated remedy that will comprise an active treatment component, MNA (passive treatment), and ICs. The transition from the active remedy portion to MNA (passive) will occur as prescribed in Section 8.4. The MNA component of the integrated remedy is anticipated to be consistent with EPA's OSWER Directive 9200.4-17P Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. Based on the CSM and taking into account the ICs, the use of MNA is projected to be protective of human health and the environment as the latter part of the integrated remedy. It is expected that RGs will be achieved in a reasonable timeframe using an integrated remedy approach. If the southern plant is turned off as proffered by the model, the residual plume mass is predicted to reach the RGs via MNA in 30 to 40 years.

Prior to the transition from active to passive remediation, the Navy will validate the following to the satisfaction of the EPA to support the transition to MNA:

- plume configuration, which will include additional delineation of the southern plume, as part of the performance monitoring;
- the efficacy of MNA;
- data trends demonstrate active treatment mass reduction; and,
- modeling predictions based on the data available at that time.

The effectiveness of the MNA will be demonstrated to EPA by ongoing performance monitoring. The Navy will be conducting performance monitoring to verify that both the active and passive (MNA) remediation phases are performing as anticipated. Transition points, modeling results and performance monitoring are discussed in further detail in Section 8.4.

Navy Proposed Revision:

The selected remedy is an integrated remedy that will comprise an active treatment component, MNA (passive treatment), and ICs. The transition from the active remedy portion to MNA (passive) will occur as prescribed in Section 8.4. The MNA component of the integrated remedy is anticipated to be consistent with EPA's OSWER Directive 9200.4-17P Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. Based on the CSM and taking into account the ICs, the use of MNA is projected towill be protective of human health and the environment as the latter part of the integrated remedy. It is expected that RGs will be achieved in a reasonable timeframe using an integrated remedy approach. If the southern plant is turned off as proffered predicted by the model, the residual plume mass is predicted to reach the RGs via MNA in 30 to 40 years.

Prior to the transition from active to passive remediation, the Navy will validate the efficacy of MNA by doing the following ~~to the satisfaction of the EPA~~ to support the transition to MNA:

- plume configuration, which will include additional delineation of the southern plume, as part of the performance monitoring;
- data trends demonstrate active treatment mass reduction; and,
- modeling predictions based on the data available at that time.

The effectiveness of the MNA will be demonstrated to EPA by ongoing performance monitoring. The Navy will be conducting performance monitoring to verify that both the active and passive (MNA) remediation phases are performing as anticipated. Transition points, modeling results and performance monitoring are discussed in further detail in Section 8.4.

6) Section 8.2 & 8.3 – System Descriptions

This sentence repeats in each section. This example sentence is for the southern system.

Original Text:

Once the transition point concentration has been reached, the active remedy component (groundwater extraction and treatment) will be terminated.

EPA comment version:

Once the transition point concentration or asymptotic condition has been reached for the southern system as provided in Section 8.4, an evaluation will be performed to determine whether it is appropriate to discontinue the active remedy component (groundwater extraction and treatment).

Navy Proposed Revision:

Once the transition point concentration or asymptotic condition has been reached for the southern system as provided in Section 8.4, ~~an evaluation~~validation will be performed prior to the Navy transitioning to MNA. ~~to determine whether it is appropriate to discontinue the active remedy component (groundwater extraction and treatment).~~

7) Section 8.4 – Performance monitoring

EPA comment text: (Changes are highlighted in yellow)

The Navy will conduct performance monitoring as prescribed in a plan to be prepared during the design phase. The EPA and Ecology will have an opportunity to review and comment on this plan.

The selected remedy presented herein is an integrated remedy that will comprise an active treatment component, MNA (passive treatment), and ICs. At the time of transition from active to passive remediation, the Navy will validate plume configuration, which will include additional delineation of the southern plume, as part of the performance monitoring. The transition from the active remedy portion to MNA (passive) will be evaluated when whichever one of the following conditions is met first, per plume:

- Groundwater concentrations of the Table 6-2 COCs throughout the plume are equal to or less than their transition point goal values (presented on Table 8-1) based on the statistical mean concentration for two consecutive semi-annual events; or
- Groundwater concentrations of Table 6-2 COCs in a "majority" of extraction well samples approach asymptotic conditions, as identified using asymptote analysis via linear regression, or first order decay, or other statistical evaluation.

The focus of the transition evaluation will be to compare the efficacy of active and passive remediation with the aim of returning the contaminated groundwater to its beneficial use as a drinking water source within a reasonable timeframe. This evaluation will lead to the establishment of a schedule for active and passive remediation for each plume at the site.

Navy Proposed Revision 8/12:

The Navy will conduct performance monitoring as prescribed in a plan to be prepared during the design phase. The EPA and Ecology will have an opportunity to review and comment on this plan.

The selected remedy presented herein is an integrated remedy that will comprise an active treatment component, MNA (passive treatment), and ICs. At the time of transition from active to passive remediation, the Navy will validate plume configuration, which will include additional delineation of the southern plume, as part of the performance monitoring. The transition from the active remedy portion to MNA (passive) will be ~~evaluated~~ validated when whichever one of the following conditions is met first, per plume:

- Groundwater concentrations of the Table 6-2 COCs throughout the plume are equal to or less than their transition point goal values (presented on Table 8-1) based on the statistical mean concentration for two consecutive semi-annual events; or
- Groundwater concentrations of Table 6-2 COCs in a "majority" of extraction well samples approach asymptotic conditions, as identified using asymptote analysis via linear regression, or first order decay, or other statistical evaluation.

The Navy will validate the modeling predictions to assure that RGs will be achieved in a reasonable timeframe using an integrated remedy approach. The EPA will have an opportunity to review and comment on the Navy's validation findings, as part of an updated performance monitoring plan, prior to the Navy transitioning to MNA.

EPA Proposed Language 8/14:

The Navy will conduct performance monitoring as prescribed in a plan to be prepared during the design phase. The EPA and Ecology will have an opportunity to review and comment on this plan.

The selected remedy presented herein is an integrated remedy that will comprise an active treatment component, MNA (passive treatment), and ICs. At the time of transition from active to passive remediation, the Navy will validate plume configuration, which will include additional delineation of the southern plume, as part of the performance monitoring. The transition from the active remedy portion to MNA (passive) may occur when groundwater concentrations of Table 6-2 COCs in a "majority" of extraction well samples achieve asymptotic conditions, as identified using asymptote analysis via linear regression, or first order decay, or other statistical evaluation. Unless operation of the active remedy component has been removing contamination or reducing the plume at a faster rate or otherwise more effectively than predicted by modeling, the transition from the active remedy to MNA (passive) may occur when groundwater concentrations of the Table 6-2 COCs throughout the plume are equal to or less than their transition point goal values (presented on Table 8-1) based on the statistical mean concentration for two consecutive semi-annual events. If there should be continuation of the active remedy component beyond either of these transition points, the period of time for such continued operation will be determined at a later time.

The Navy will validate the modeling predictions to assure that RGs will be achieved in a reasonable timeframe using an integrated remedy approach. This validation will be subject to concurrence by the EPA, as part of an updated performance monitoring plan, prior to the Navy transitioning to MNA. If at any time MNA is determined to not be effective at reducing the size of, or concentration of COCs in a groundwater plume, the Navy will return to operation of the active remedy for that plume.

EPA Proposed Language 8/19:

The Navy will conduct performance monitoring as prescribed in a plan to be prepared during the design phase. The EPA and Ecology will have an opportunity to review and ~~comment~~ concur on this plan.

The selected remedy presented herein is an integrated remedy that will comprise an active treatment component, MNA (passive treatment), and ICs. At the time of transition from active to passive remediation, the Navy will validate plume configuration, which will include additional delineation of the southern plume, as part of the performance monitoring. ~~The transition from the active remedy portion to~~ MNA (passive) will be validated when whichever one of the following conditions is met first, per plume:

- Groundwater concentrations of the Table 6-2 COCs throughout the plume are equal to or less than their transition point goal values (presented on Table 8-1) based on the statistical mean concentration for ~~two~~ four consecutive semi-annual events; or

- Groundwater concentrations of Table 6-2 COCs in a "majority" of extraction well samples approach asymptotic conditions, as identified using asymptote analysis via linear regression, or first order decay, or other statistical evaluation.

Assuming validation of MNA, the transition to MNA may occur when the active remedy has achieved asymptotic conditions. If the transition point goal values or reduction of plume size have been achieved at a faster rate than predicted by the modeling, active remediation will continue until such time as is later determined to be appropriate, followed if necessary by validated MNA.

The Navy will validate the modeling predictions to assure that RGs will be achieved in a reasonable timeframe using an integrated remedy approach. ~~The EPA will have an opportunity to review and comment on the Navy's validation findings~~This validation will be subject to review and concurrence by the EPA, as part of an updated performance monitoring plan, prior to the Navy transitioning to MNA.

Navy Proposed Revision 8/22 based on 8/21 call:

The Navy will conduct performance monitoring as prescribed in a plan to be prepared during the design phase. The EPA and Ecology will have an opportunity to review and ~~comment~~ concur on this plan.

The selected remedy presented herein is an integrated remedy that will comprise an active treatment component, MNA (passive treatment), and ICs. At the time of transition from active to passive remediation, the Navy will validate plume configuration, which will include additional delineation of the southern plume, as part of the performance monitoring. The transition from the active remedy portion to MNA (passive) will be validated when whichever one of the following conditions is met first, per plume:

- Groundwater concentrations of the Table 6-2 COCs throughout the plume are equal to or less than their transition point goal values (presented on Table 8-1) based on the statistical mean concentration for ~~two~~ four consecutive ~~semi-annual~~ events; or
- Groundwater concentrations of Table 6-2 COCs in a "majority" of extraction well samples approach asymptotic conditions, as identified using asymptote analysis via linear regression, or first order decay, or other statistical evaluation.

The Navy will validate the modeling predictions to assure that RGs will be achieved in a reasonable timeframe using an integrated remedy approach. ~~The EPA will have an opportunity to review and comment on the Navy's validation findings~~This validation will be subject to review and concurrence by the EPA, as part of an updated performance monitoring plan, prior to the Navy transitioning to MNA.

Assuming validation of MNA, the transition to MNA may occur when the active remedy has achieved asymptotic conditions. As discuss in Section 8.1, if the transition point goal values have been achieved at a faster rate than predicted by the modeling, active remediation could continue until the predicted modeling timeframe if is determined by the evaluation to be appropriate to achieve program management goals and is mutually agreed upon by EPA and the Navy.

Adding Calvin requested language to Section 8.1 to make consistent with Section 8.4

Navy Proposed Revision Section 8.1:

The selected remedy is an integrated remedy that will comprise an active treatment component, MNA (passive treatment), and ICs. The transition from the active remedy portion to MNA (passive) will occur as prescribed in Section 8.4. The MNA component of the integrated remedy is anticipated to be consistent with EPA's OSWER Directive 9200.4-17P Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. Based on the CSM and taking into account the ICs, the use of MNA is projected to be protective of human health and the environment as the latter part of the integrated remedy. It is expected that RGs will be achieved in a reasonable timeframe using an integrated remedy approach. If the southern plant is turned off as predicted by the model, the residual plume mass is predicted to reach the RGs via MNA in 30 to 40 years.

Prior to the transition from active to passive remediation, the Navy will validate the efficacy of MNA by doing the following to support the transition to MNA:

- plume configuration, which will include additional delineation of the southern plume, as part of the performance monitoring;
- data trends demonstrate active treatment mass reduction; and,
- modeling predictions based on the data available at that time.

The effectiveness of the MNA will be demonstrated to EPA by ongoing performance monitoring. The Navy will be conducting performance monitoring to verify that both the active and passive (MNA) remediation phases are performing as anticipated. Transition points, modeling results and performance monitoring are discussed in further detail in Section 8.4.

Additionally separate but concurrent to the MNA validation, the Navy will perform an additional evaluation if the transition point goals (presented on Table 8-1) have been achieved at a faster rate than predicted by the modeling timelines presented in Section 8.4. If the transition point goal values have been achieved at a faster rate than predicted by the modeling, active remediation could continue until the predicted modeling timeframe if it is determined by the evaluation to be appropriate to achieve program management goals and is mutually agreed upon by EPA and the Navy.

Navy Proposed Revision 9/19 based on call with EPA on 9/12

The Navy updated Section 8. All changes are consistent with the Final ROD Amendment with the exception of the following paragraph in Section 8.5, which is not part of the Final ROD Amendment.

"Additional Evaluation if transition point concentrations met faster than predicted - Additionally separate but concurrent to the MNA validation, the Navy will perform an additional evaluation if the transition point goals (presented on Table 8-1) have been achieved at a faster rate than predicted by the modeling timelines presented in Section 8.4. If the transition point goal values have been achieved at a faster rate than predicted by the modeling, active remediation could continue until the predicted modeling timeframe if it is determined by the evaluation to be appropriate to achieve program management goals and is mutually agreed upon by EPA and the Navy."

Based on an EPA internal discussion on 9/23, this paragraph was deleted in the Final ROD Amendment.

Responses to Island County Health Department Comments on Final Proposed Plan

1. Pg 1, First Paragraph, Last Sentence

Relevant Proposed Plan Text

At the time the 1993 ROD was signed, the cleanup actions described in that ROD addressed all known current and potential risks to human health and the environment.

Comment

The 1993 ROD addressed all known current and potential risks. If we continue that tact, shouldn't we include PFAS compounds in this update? It needs to be part of the discussion of potential remedies for 1,4 dioxane given it plays a part in the remedy selection process, even if we are not providing a remedy for PFAS.

Response

Please see responses to EPA comment number 5.

2. Pg 3, 5th Paragraph, 1st Sentence

Relevant Proposed Plan Text

Additionally, as part of the ROD Amendment, the Navy plans to eliminate 1,1-DCA and cis-1,2-DCE as COCs for OU 1. 1,1-DCA has never been measured at concentrations greater than the remediation goal in any of the groundwater samples collected from OU 1.

Comment

I believe that 1,1-DCA is a potential breakdown product of TCA. Given that TCA is still a COC at this site, is it wise to take 1,1-DCA off the list? Although there is evidence that currently this path is not prevalent, changes to the groundwater system could change this in the future. Perhaps a reduced sampling frequency would be more appropriate?

I believe that cis-1,2-DCE is a potential breakdown product of TCE. Given that TCE is still a COC at this site, is it wise to take cis-1,2-DCE off the list? Although there is evidence that currently this path is not prevalent, changes to the groundwater system could change this in the future. Perhaps a reduced sampling frequency would be more appropriate?

Response

It is acknowledged that 1,1-DCA and cis-1,2-DCE are breakdown products of 1,1,1-TCA and TCE. However, the concentrations of these two compounds in groundwater have been below RGs for many years. In addition, the current system has reduced 1,1,1-TCA to concentrations below the 200 µg/L in samples from all but one of the wells being monitored. The one 1,1,1-TCA concentration measured above the RG in February 2018 was 245 g/L. The active component of the remedy will be operated until 1,1,1-TCA and TCE concentrations reach levels that are amenable to natural attenuation. At that point, breakdown products of these compounds are expected to be at or below RGs and subject the natural attenuation. No change is recommended.

3. Pg 5, Last Bullet

Relevant Proposed Plan Text

- Figure 7 showing 1,4-dioxane concentrations in groundwater and groundwater plumes are illustrated with shading showing concentrations above the proposed remediation goal of 0.44 µg/L.

Comment

Given the southern-most data points are some of the highest concentrations, it appears that the extent of the 1,4-dioxane plume has not been fully delineated. However I am not finding any discussions in this document of continued investigation of the plume extent.

Response

Please see responses to EPA comment number 19.

4. Page 7, Scope and Role of Operable Unit or Response Action, 2nd Paragraph, Second Sentence

Relevant Proposed Plan Text

There were concerns at the time that Area 5 was used for disposal of domestic garbage, construction debris and demolition rubble, excavation spoils, and liquid wastes (including paints, thinners, solvents, strippers, hydraulic fluid, waste oils, and waste fuel) from aircraft service and maintenance activities.

Comment

This seems counter-intuitive; if there were concerns of solvents being disposed of, why were VOC's not sampled for? Perhaps this section needs a bit more of an explanation on why VOC's are not a concern.

Response

The OU 1 ROD, Page 12, Section 6.2.2 Second Paragraph states:

"Shallow groundwater in Area 5 had low concentrations of relatively few contaminants. Volatile organic compounds (trichloroethene, 1,l-dichloroethene) were detected at low levels bordering on the detection limit and less than regulatory screening criteria; no semivolatile organics or pesticides were detected."

Based on the results, the COCs for Area 5 were limited to metals in groundwater. Additionally this ROD Amendment is limited to Area 6. No change is recommended.

5. Page 8, Summary of Site Risks, 5th Paragraph, First Sentence

Relevant Proposed Plan Text

The closest surface water exposure would be at Crescent Harbor, located approximately 1.7 miles south-southeast of the southern site boundary.

Comment

Is there a potential exposure risk for 1,4 dioxane in the discharge from the treatment plan (with 1,4-dioxane left untreated at this time)? It is my understanding that the output from the plant is discharges to surface water. I am unsure to what degree this discharge immediately infiltrates into the ground, or if it flows overland to the north? Has contamination in this surface water body been investigated?

Response

Please see response to EPA Comment #24.

6. Page 15, Figure 8

Comment

Why not fully delineate the plume, and install your extraction wells at the leading edge? There appear to be roads in throughout the area.

Response

Response to comment number 3 indicates that the Navy will include downgradient southern plume delineation as a component of the final remedy.

Southern system extraction wells were located in areas that were as close to Navy property as possible and provided the maximum downgradient extent without crossing or occupying private property, outside of right of ways, and avoiding high subsurface utility density areas.

Based on the known southern plume nature and extent, there is not an unacceptable risk to human health. 1,4-dioxane is the only COC above its RG that has migrated past the WAC 1,000-foot landfill restriction area for well installation area. The risk based on the 1,4-dioxane concentrations is less than 10^{-4} based on the highest 1,4 dioxane concentrations. Off-site sampling confirmed that interim removal actions were not required for the area supporting an integrated remedy that includes reduction of contaminant mass from active treatment and transition to MNA. Also, there are no known receptors. The Navy added residences on city water starting back during the original RI/FS and/or drilling deeper replacement wells (6-DW-38B). Based on discussions with the City of Oak Harbor, all parcels south of 6-DW-38 (southernmost well) between SR20 and NE Regatta Dr are on City of Oak Harbor water. As part of the annual LUC inspection process, Island County Public Health is contacted regarding well installation or drilling activities within the boundary of Ault Field and Seaplane Base as well as within an approximate 1-mile buffer around their boundaries.

Based on the above, no change is recommended.

7. Pg 16, Community Participation, last sentence

Relevant Proposed Plan Language

During the public comment period, the FFS Report may be reviewed at the Oak Harbor/Sno-Isle Library, 1000 SE Regatta Dr, Oak Harbor, WA 98277. The FFS Report may be viewed online at **https://navfac.navy.mil/NASWIRAB.**

Comment

Although this link to the RAB web page works, I cannot get the link to the FFS to work. It takes a very long-time in attempting to load (progress bar moves slowly) but always times out before getting 50-60% loaded.

EDIT: After about 15 minutes of hitting reload, I was finally able to download the FFS. My web connection here at the county is fast (240 mb/sec) so the problem is on your end.

Response

Navy will investigate the speed of connection for interested readers to download the FFS. It is possible that government security measures are resulting in the slow download speeds.

Responses to Restoration Advisory Board Co-Chair Comments

1. Summary of Risks, 4th paragraph: "The closest surface water exposure would be at Crescent Harbor, located approximately 1.7 miles south-southeast of the southern site boundary. " The current treatment plant has been discharging water that has been contaminated with 1, 4- Dioxane since it has been built in 1993. Surface discharge samples have been collected from a small stream that is culverted under the site maintenance road. This water flows north and crosses under Ault Field Road into a large wetland and then discharges north toward the base runway ditch system. Monitoring wells were sampled for 1, 4-Dioxane in what used to be a large peat bog that is now flooded wetland.

   This plan amendment does not address the possible extent of contamination in this location or if it has migrated via surface water or ground water toward the north. The existing monitoring wells that showed 1, 4-Dioxane in this area (peat bog) were made unusable when the area was flooded as part of a wetland mitigation. The discharge water concentrations of 1, 4-Dioxane under the preferred alternative should not be a problem, however that does not negate the past and current practice of discharging water above the ROD goals to the surface as is done now and will be done until the plant is updated.

   I would recommend the amendment to the Rod include natural attenuation of this wetland and any other impacted surface water contaminated area to the north of the site by the current treatment plant discharge. Also new monitoring wells should be installed downgradient of the this wetland to see the extent of the 1,4-Dioxane contamination.

   Response

   Please see the revised Section 5.7.2 “Ecological Risk” provided in response to EPA comments.

2. Page 9 of 18, Table 1. Preliminary Remediation Goals for Groundwater, "Transition Point from Active to Passive Remediation. The treatment plant and the current well configuration are keeping a majority of contaminates on Navy property. When the treatment plants are shut down the plums begin to move off site. This has been seen between MW-5 and PW-5 when PW-5 was off for an extended time. The transition point would allow contaminates at levels above the cleanup level to move off site on to private property where they cannot be cleaned up. The Rod Recommended goals should be achieved before the treatment plants are shut down. Natural Attenuation should not be an option for the delineated plums moving to the south and west.

   Response

   This is a large, dilute plume. The transition point concentrations risk range is from 10^{-5} to 10^{-6}. These concentrations are expected to attenuate in a reasonable time frame as evidenced by groundwater modeling. Modeling predicts that the western plant will be shutdown before the southern plant. Continued simulation with pumping from the southern wells only shows no westerly deflection of residual TCE or 1,4-dioxane. Additionally, there are no known receptors to the south of Area 6. All residences south of Area 6 are on city water.

   No change is recommended.