4/1/08-02214

FINAL

Perchlorate White Paper

Naval Weapons Station Yorktown

Yorktown, Virginia

Prepared For

NAVFAC
Naval Facilities Engineering Command

Norfolk, Virginia

Contract No. N62470-02-D-3052
CTO-0117

April 2008

Prepared by

CH2M HILL
Federal Group, Ltd.

Baker
Baker Environmental, Inc.

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ACRONYMS AND ABBREVIATIONS

ABL	Allegany Ballistics Laboratory
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CPEO	Center for Public Environmental Oversight
DoD	Department of Defense
DON	Department of the Navy
EDQWG	Environmental Data Quality Work Group
EOD	Explosive Ordnance Disposal
GAO	Government Accountability Office
IC/EC	Ion Chromatography with Electric Conductivity
ITRC	Interstate Technology and Regulatory Council
LOC	Level of Concern
MCL	Maximum Contaminant Level
MERIT	Materials Evolving Regulatory Interest Team
mg/kg	milligrams/kilogram
MIDAS	Munitions Items Disposition Action System
MS	Mass Spectrometry
NCP	National Contingency Plan
NEDED	Naval Explosives Development Engineering Department
NERP	Navy Environmental Restoration Program
NRC	Natural Resources Council
NSWC	Naval Surface Warfare Center
OB/OD	Open Burn and Open Detonation
ppb	parts per billion
ppm	parts per million
RfD	Reference Dose
TBC	to be considered
TNT	Trinitrotoluene
USEPA	United States Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality
WPNSTA	Naval Weapons Station

1.0 INTRODUCTION

This document presents a summary of information on the possible presence of perchlorate in the environment at Naval Weapons Station (WPNSTA) Yorktown, Yorktown, Virginia. It includes background information on the chemistry, properties and health effects of perchlorate, as well as information on the presence of perchlorate in the environment. Navy Environmental Restoration Program (NERP) sites at WPNSTA Yorktown were evaluated and ranked on the likelihood that perchlorates may be present. This report has been prepared by Baker Environmental, Inc. under the Department of the Navy's (DON) Comprehensive Long-Term Environmental Action Navy contract administered by the Naval Facilities Engineering Command, Mid-Atlantic Division.

WPNSTA Yorktown is a 10,624-acre installation located on the Virginia Peninsula in York and James City Counties and the City of Newport News (**Figure 1**). WPNSTA Yorktown (originally named the U.S. Navy Mine Depot) was established near Williamsburg, Virginia in 1918 to support the laying of mines in the North Sea during World War I. During World War I and for 20 years after, the depot received reclaimed, stored, and issued mines, depth charges, and related ordnance and munitions. WPNSTA Yorktown was expanded during World War II to include three trinitrotoluene (TNT) loading plants and new torpedo overhaul processes. A research and development laboratory for experimentation with high explosives was established in 1944. A quality evaluation laboratory was developed to monitor the design and development of depth charges and advanced underwater weapons in 1947. On 7 August 1959, the U.S. Navy Mine Depot was re-designated as "U.S. Naval Weapons Station Yorktown."

The current primary mission of WPNSTA Yorktown is to support ordnance operations and related services to sustain the war-fighting capability of the armed forces in support of the national military strategy.

2.0 BACKGROUND INFORMATION ON PERCHLORATE

This section presents a summary of background information on perchlorates, including perchlorate chemistry, existence in the environment, common uses and remediation techniques.

2.1 PERCHLORATE CHEMISTRY

Perchlorate is the negative ion (anion), ClO_4^-, produced when perchlorate salts dissolve in water. The primary perchlorate salt in use is ammonium perchlorate, although potassium and sodium perchlorate and perchloric acid are also used to a much lesser extent. Ammonium perchlorate (NH_4ClO_4) has a molecular mass of 117.488 gram/mol, a density of 1.952-gram/cubic centimeter, and an aqueous solubility of 217 to 220 x 10^3 milligram/Liter. The chlorine ion is in its highest oxidation state (+7), and is surrounded in a tetrahedron structure by four oxygen atoms.

2.2 NATURAL OCCURRENCE OF PERCHLORATE

Current theory regarding the origin of naturally occurring perchlorate in the environment centers on natural atmospheric processes. While the exact mechanism for the creation of perchlorate is unknown, the theory suggests that chloride, possibly in the form of sodium chloride from the sea or land-based chloride compounds blown in from the atmosphere, reacts with atmospheric ozone to create perchlorate. This process probably occurs over much of the earth and is analogous to nitrate formation in the atmosphere (Walvoord, et al., 2003).

The Department of Defense (DoD) Environmental Data Quality Work Group (DoD EDQWG) reported that perchlorate is known to occur in fertilizer produced from nitrate ores from the Atacama Desert of northern Chile (DoD EDQWG, 2007). Recent work by the U.S. Geological Survey has indicated that perchlorate can also occur naturally in other minerals and materials (Orris, 2003). Perchlorate has been detected in samples of the mineral hanksite and in potash ore. It is not known whether the perchlorate occurs as a potassium or a sodium salt, or whether it is an impurity in the crystal structure of another mineral or is trapped as an anion within fluid inclusions in minerals that form these materials (DoD EDQWG, 2007).

A recent study conducted by Texas Tech University indicates that perchlorate can be produced atmospherically through atmospheric processes either when chlorine aerosol becomes electrically charged or by exposing aqueous chlorine to high concentrations of ozone (Dascupta, et al., 2005).

2.3 PERCHLORATE CONTAMINATION IN SOIL AND SEDIMENTS

Very little is known about the distribution of perchlorate in soil. What is known is that perchlorate does not bind to soil particles appreciably and that the movement of perchlorate in soil is largely a function of the amount of water present. Perchlorate salts that are released to the soil in solid form will readily dissolve in whatever moisture is available. Perchlorate is extremely soluble in water; precipitation quickly depletes the ground surface contaminant mass (source area). This phenomenon is observed in sandy soil. While perchlorate does not adhere to soil particles, dissolved perchlorate can be trapped within the soil pores by capillary forces of surface tension (molecular attraction) or become trapped in dead-end pore spaces. Perchlorate can be retained in some propellant matrices and distributed in soil, and thus will not be immediately dissolved (DoD EDQWG, 2007).

2.4 PERCHLORATE CONTAMINATION IN GROUNDWATER AND SURFACE WATER

According to the Interstate Technology and Regulatory Council (ITRC), as of January 2005, perchlorate has been detected in 153 public water supply systems in 25 states (ITRC, 2005). A U.S. Government Accountability Office (GAO) report, "Perchlorate: A System to Track Sampling and Cleanup Results is Needed," noted that there was no standardized approach for reporting perchlorate data nationwide (GAO, 2005). Nonetheless, perchlorate had been found by federal and state agencies at almost 400 sites in groundwater, surface water, soil, or public drinking water in 35 states, the District of Columbia, and two Commonwealths (GAO, 2005). More than one-half of all sites were found in California and Texas, and sites in Arkansas, California, Texas, Nevada, and Utah had some of the highest concentration levels (GAO, 2005). Most of the attention focused on perchlorate contamination concerns groundwater and surface water contamination due to perchlorate's high solubility, mobility and stability in water (ITRC, 2005). These characteristics result in the formation of long and persistent contaminant plumes. Like nitrate, perchlorate is not attenuated by soil chemistry. However, it can be broken down by naturally occurring bacteria, primarily in anaerobic conditions in the environment when there is sufficient carbon material and the right type of microbes. Surface water may be the final medium of concern in the investigation, or it may be a pathway to the groundwater. The primary pathway for perchlorate to enter the surface water appears to be from a single source discharge (wastewater discharge point) or from surface runoff (DoD EDQWG, 2007).

2.5 COMMERCIAL AND MILITARY USES OF PERCHLORATE

Ammonium perchlorate is primarily used as an oxidant, or oxygen source, in rocket and missile propellants, as well in the manufacturing of munitions. Approximately 90% of the perchlorate compounds, primarily ammonium perchlorate, are manufactured for use in defense activities and the aerospace industry (ITRC, 2005). Perchlorate is also used for pyrotechnics to produce a blue color, in the manufacture of matches; in the chemical analytical industry as an additive in lubricating oils, tanning finished leather, and fabric fixer dyes; in electroplating operations and aluminum refining; and in the manufacture of rubber, paint, cattle feed, magnesium batteries, and air bag inflators. Large-scale production of perchlorate began in the 1940s and expanded along with the growth of the postwar military-industrial complex. **Table 1** lists activities that may result in the release of perchlorate (DoD EDQWG, 2007).

Table 1

Activities, Sources and Mechanisms
That Could Lead to Possible Perchlorate Contamination
(DoD EDQWG, 2007)

Activity	Primary Sources	Release Mechanism
Manufacturing	Wastewater Impoundments	Leaching, surface water runoff
	Storage Areas	Spills, surface water runoff (outside storage)
	Wastewater Outflow Points	Spills, surface water runoff, leaching, septic systems
	Open Burn Areas	Incomplete burning and associated leaching
	Landfills	Precipitation and leaching of buried waste material
Storage	Disposal Facility for Retrograde propellant/rocket fuel	Discharge of washout for disposal purposes
	Open Burn/Open Detonation Stations	Incomplete Detonations, kick outs from open burning, incomplete burning and associated leaching
Research and Development	Open Burn/Open Detonation Stations	Incomplete Detonations, kick outs from open burning, incomplete burning and associated leaching
	Wastewater Impoundments	Leaching, surface water runoff
	Wastewater Outflow Points	Spills, surface water runoff, leaching, septic systems
	Landfills	Precipitation and leaching of buried waste material
	Recycling Operations	Mishandling and spills, washout
Testing	Target Area	Incomplete Detonation, or deflagration after deployment
	Open Burn/Open Detonation Stations	Incomplete Detonations, kick outs from open burning, incomplete burning and associated leaching
	Firing Points	Burning of excess propellant, burial of excess munitions
Training	Target Area	Incomplete Detonation, or deflagration after deployment
	Open Burn/Open Detonation Stations	Incomplete Detonations, kick outs from open burning, incomplete burning and associated leaching
	Firing Points	Burning of excess propellant, burial of excess munitions

2.6 HUMAN HEALTH EFFECTS

Perchlorate is one of several chemicals that interfere with the uptake of iodide by the thyroid gland. The thyroid uses iodide, converted from ingested iodine, to produce key thyroid hormones, tetraiodothyronine (thyroxine) and triiodothyronine. These thyroid hormones play important roles in the body's metabolism, reproduction, growth and cardiovascular and central nervous systems. Significant or sustained decreases in thyroid hormone levels in the bloodstream have been found to

result in effects ranging from a decrease in metabolism, dry skin, cold intolerance, and tiredness to impairment in behavior, movement, speech, hearing, vision, and intelligence (Felz and Forren, 2004). In pregnant women, the decrease of thyroid glands can have negative effects on the fetus such as alterations in neurological development. Pregnant women are the most sensitive receptor population when considering exposure rates and risks associated with perchlorate. Iodide uptake inhibition is considered the mode of action for perchlorate. The primary route of exposure to humans is via ingestion of perchlorate-contaminated food or drinking water. Inhalation of perchlorate particles in the air is possible by individuals working where perchlorate is manufactured and during the launching of rockets, fireworks, and propellants.

2.7 ECOLOGICAL EFFECTS

The effects of perchlorate on ecosystems and ecosystem components have been evaluated through several studies; however, due to the limited amount of published data, there are still many uncertainties. Information on levels of perchlorate to which organisms were exposed and the effects on diverse taxonomic groups are limited because the number of species tested has been minimal. Animal perchlorate toxicity studies have determined that perchlorate interferes with the uptake of iodide by the thyroid gland and subsequently causing neurological development similar to the effects of humans. Wildlife is most likely to be exposed to perchlorate through contact with groundwater (at a groundwater seep or discharge point) and surface water due to its high solubility in water.

The U.S. Environmental Protection Agency (USEPA) released a draft paper, *Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization*, in January 2002, to derive a screening-level ecological risk assessment for perchlorate based on toxicity data that the agency received as of Fall 2001 (USEPA, 2002[1]). Using the procedures for deriving a Tier II water quality value, a secondary acute value of 5 mg/L (5000 ppb) ClO_4 was derived to be protective of 95% of aquatic species during short-term exposures with 80% confidence. The USEPA also calculated a secondary chronic value of 0.6 mg/L (600 ppb) ClO_4 to be protective of 95% of aquatic species during long-term exposures with 80% confidence. Both of these preliminary screening values for ecological risks are below the DoD level of concern (LOC) (see Section 4.0)

2.8 REMEDIATION TECHNIQUES

There are currently a variety of remedial technologies available for perchlorate remediation, some of which are proven and commercially available while others are still in the research and development phases. The majority of remediation technologies associated with perchlorate contamination address perchlorate in groundwater and drinking water. Thirty-nine treatment units for perchlorates are currently operational (ITRC, 2005). These include methods utilizing ion exchange, concentrated brine treatment, and various types of bioremediation including phytoremediation (USEPA, 1999a). Of these, ion exchange is the most common and involves a reversible chemical reaction wherein an ion from solution is exchanged with a similarly charged ion attached to an immobile solid. The presence and concentrations of existing ions in the water along with a high amount of total dissolved solids, suspended solids, or calcium may decrease the effectiveness of the ion exchanges and increase costs (USEPA, 2005).

[1] USEPA has not finalized this paper and the referenced screening values have not been accepted. These screening values are provided to allow a comparison of potential ecological screening criteria to human health screening criteria that is summarized in Section 4 of this document.

The most promising remedial technology for perchlorate in groundwater is the use of bioremediation, either *in situ* or *ex situ* (Coates and Achenbach, 2004). A 2001 report by the Ground Water Remediation Technologies Analysis Center noted 45 case studies of *in situ* or *ex situ* biological perchlorate treatment technologies using microorganisms to reduce perchlorate to chloride in anaerobic conditions (Roote, 2001).

2.9 DoD Perchlorate Efforts

Since the 1990s, the DoD has worked cooperatively with USEPA to better understand the scientific issues and uncertainties associated with perchlorate including:

- The human health effects from chronic, low-level perchlorate exposure in drinking water;
- The actual extent of perchlorate in groundwater and surface water;
- Ecological factors and how they affect contaminant concentrations; and
- Suitable treatment technologies.

The DoD EDQWG was established to effectively coordinate efforts related to perchlorate within the various branches of DoD (http://www.dodperchlorateinfo.net). In March 2006, the DoD Perchlorate Work Group released a DoD Perchlorate Handbook (http://www.navylabs.navy.mil/Archive/DODPerchlorateHandbookR1C1.pdf) which provides a practical and comprehensive guide for scoping and designing field sampling and laboratory analysis plans at sites suspected of containing perchlorate; Revision 1, Change 1 to the handbook occurred in August 2007. This handbook identifies specific activities, sources and mechanisms that could lead to possible perchlorate contamination. **Table 1** summarizes potential activities and sources of perchlorate presented in this handbook.

To date, the DoD has spent more than $76M in support of perchlorate research. In addition, the DoD participates in the Interagency Working Group, which includes representatives from USEPA, National Aeronautics and Space Administration, Department of Energy, the Food and Drug Administration, the U.S. Department of Agriculture, Agency for Toxic Substances and Disease Registry, the Department of Interior, the Office of Management and Budget, the White House Council on Environmental Quality, and the Office of Science and Technology Policy.

Additional information regarding the status of the DoD perchlorate program can be obtained by contacting Mr. Andy Rak, the DoD Perchlorate Work Group Outreach Coordinator, who may be reached by e-mail: andrew.rak@mitretek.org.

3.0 REGULATORY STATUS

The USEPA had previously issued guidance on perchlorates in 1999 (USEPA, 1999b) and 2003 (USEPA, 2003). This first guidance from USEPA's Office of Research and Development in 1999 had recommended a provisional oral reference dose (RfD) range of 0.0001 to 0.0005 milligrams/kilograms-day (mg/kg-day) until a final risk-based dose was determined. In the second guidance report issued in 2003, the USEPA's Office of Solid Waste and Emergency Response re-affirmed the RfD made in 1999. The previous guidance was issued to support activities within USEPA's Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program, and the National Contingency Plan (NCP), 40 CFR 300.

In January 2005, the National Academy of Sciences' Natural Resources Council (NRC) issued a final report, "Health Implications of Perchlorate Injection" that recommended an RfD of 0.0007 mg/kg-day for perchlorate (NRC, 2005). On 26 January 2006, USEPA issued a memorandum on "Assessment Guidance for Perchlorate" (**Attachment A**) that adopted the same RfD of 0.0007 mg/kg-day and noted that this reference dose applied to USEPA's CERCLA program. The USEPA also noted in this memorandum that this RfD is a "to be considered" (TBC) criteria as required in Section 300.400(g)(3) of the NCP (USEPA, 2006). As a TBC criterion, the reference dose represents the best available science with respect to the toxicity of perchlorate. The perchlorate reference dose of 0.0007 mg/kg-day equates to a drinking water equivalent level concentration, or screening value, of 24.5 parts per billion (ppb) in water.

Table 2 lists the states that have established action levels or Maximum Contaminant Levels (MCLs) for perchlorate. The Commonwealth of Virginia has not established an action level or MCL for perchlorate.

Table 2

State Perchlorate Advisory Levels
(As of 20 April 2005)

State	Action Level or MCL (ppb)	Regulatory Basis
Arizona	14	1998 Health Based Guidance based on child exposure
California	6	Public Health Goal
Maryland	1	Advisory Level
Massachusetts	2	Final MCL
Nevada	18	Public Notice Standard
New Mexico	1	Drinking water screening level
New York	5	Drinking water planning level
	18	Public Notification Level
Texas	17	Residential Protective Cleanup Level
	51	Industrial/Commercial Protective Cleanup Level

4.0 DOD/NAVY POLICY ON PERCHLORATE

Navy policy dated 15 April 2006 states that "it is Navy policy to sample all sites where there is reasonable expectation that a perchlorate release has occurred as a result of Navy activities" (DON, 2006). Until regulatory standards are established for perchlorate, the Navy follows the DoD established 24 ppb in water as the current LOC for managing perchlorate. The DoD will comply with applicable state or federal promulgated standards when they are established, whichever are more stringent (DON, 2006).

The Navy has specified:

> Any perchlorate detection at or greater than 24 ppb in water requires preparation of site-specific risk assessments in accordance with CERCLA, the Defense Environmental Restoration Program, and the NCP to evaluate the extent of actual or potential exposures. Where a site-specific risk assessment indicates perchlorate concentrations could potentially result in adverse health effects, the site will be prioritized for appropriate risk management. Where no federal or state [applicable, relevant and appropriate requirements] have been promulgated, risk assessors and risk managers may, when appropriate, identify other federal or state advisories, criteria, or guidance to be considered. (DON, 2006)

Sampling and Analysis

The Navy Perchlorate Sampling and Management Policy dated 15 April 2006 (**Attachment B)** specifies the management strategy for sites suspected of containing perchlorate. This policy identifies four functions that could potentially contribute to perchlorate occurrence in the environment. These include, but are not limited to:

a. The manufacture/maintenance of solid-fuel missile/rocket motors, and/or munitions containing perchlorates;
b. The use of perchlorate-containing munitions for training or testing purposes;
c. The demilitarization of perchlorate-containing munitions using techniques, such as "hog-out" of rockets and missiles containing solid propellant; and
d. Open burning/open detonation operations.

The April 2006 Navy policy also states "simple logistical handling of perchlorate-containing weapons/munitions is not a likely source of perchlorate into the environment."

The Navy recommends the August 2007 DoD Perchlorate Handbook be utilized when developing a sampling plan at a suspected perchlorate-contaminated site. Further, the Handbook specifies:

> Only the mass spectrometry (MS) methods (331.1 or 332.0) should be used for analysis of drinking water samples for DoD. In situations where 314.0 is used, all results above the method reporting limit must be confirmed using MS Methods employing Ion Chromatography with Electric Conductivity (IC/EC); however, these methods are not appropriate for sampling and testing associated with environmental restoration/cleanup or range assessment projects. Only methods employing MS are to be used for environmental restoration/cleanup or range assessment projects. (DoD EDQWG, 2007)

DoD has subsequently developed standard operating procedures for analysis using liquid chromatograpy/electrospray/mass spectrometry. The complete methods may be obtained from: http://www.navylabs.navy.mil/Perchlorate.htm.

5.0 STATUS OF PERCHLORATE TESTING AT OTHER DOD FACILITIES

The status of perchlorate testing at other Navy and Marine Corps bases in the Mid-Atlantic area is provided below. This information was obtained from the DoD Materials Evolving Regulatory Interest Team (MERIT) website whose interests are focused on emerging contaminants (DoD MERIT, 2007).

5.1 DAHLGREN NAVAL SURFACE WARFARE CENTER, DAHLGREN, VIRGINIA

Dahlgren Naval Surface Warfare Center (NSWC) is located approximately 55 miles south of Washington, D.C. along the Potomac River. Dahlgren provides research, development, test and evaluation, engineering, and fleet support for surface warfare, surface ship combat systems, ordnance, and proof and test weapons.

At Dahlgren, the Navy voluntarily began sampling for perchlorate in 2001[2]. Surface water, groundwater, soil and sediment have been sampled and analyzed using qualitative analytical methods (i.e., Method 314) to determine if there have been any releases to the environment from site activities. Results of this sampling are summarized in **Table 3**.

Table 3

Summary of Perchlorate Sampling at Dahlgren NSWC

	No. of samples	No. of positive detections	Average Detection (ppb)	Max. Detection (ppb)
Groundwater	220	120	118.2	2,700
Surface Water	19	3	12.7	230
Soil	111	9	21.4	1,200
Sediment	25	1	120	120

Dahlgren holds a Resource Conservation and Recovery Act Part B Permit for the Thermal Treatment of Hazardous waste by Open Burning and Open Detonation (OB/OD) issued by the Virginia Department of Environmental Quality (VDEQ). Perchlorate has been found in the groundwater in the vicinity of the OB/OD units. Dahlgren and the VDEQ are working together to address this issue. Dahlgren is also in the process of performing a Range Sustainability Environmental Program Assessment, Range Condition Assessment to assess the environmental conditions of land-based ranges and the potential for off-range migration of munitions constituents.

[2] This information was provided from the DoD MERIT website.

5.2 MARINE CORPS BASE QUANTICO, VIRGINIA

Marine Corps Base Quantico is located approximately 25 miles south of Washington D.C. along the western bank of the Potomac River. Quantico supports research, development, testing, and evaluation of military hardware and military training.

In 2003, Quantico tested four drinking water samples as part of Safe Drinking Water Act requirements. No perchlorate was detected in any of the samples.

5.3 ALLEGANY BALLISTICS LABORATORY, WEST VIRGINIA

Allegany Ballistics Laboratory (ABL) is located in Mineral County, West Virginia, along the West Virginia and Maryland border in the flood plain of the North Branch of the Potomac River. The facility began operations in 1942. At ABL, the DoD conducts research, develops and tests solid propellants, rocket motors, ammunition, and armaments for the military. There are historic and current sources of perchlorate at ABL. In the past, rocket casings were rinsed with water and chlorinated solvents and the waste products were burned in disposal pits. This combined with residues from the OB/OD process has contaminated groundwater in that area. A groundwater extraction system was installed in 1998 to address this problem. In addition, the Navy has installed an anion exchange system at the explosive wastewater treatment plant to remove perchlorate from the treated wastewater and is currently conducting a feasibility study for perchlorate treatment at the groundwater treatment plant.

Media Sampled and Findings

Drinking Water – Since 2004, ABL has monitored perchlorate in the drinking water supply. No samples have detected the presence of perchlorate above the method detection limit of 4 ppb. The ABL drinking water supply comes from six deep wells and two springs located hydraulically up-gradient of the main facility where production activities occur.

Wastewater – The Navy analyzed 170 wastewater samples for perchlorate. The maximum perchlorate concentration detected in the wastewater was 1,900 parts per million (ppm). Many of the wastewater samples were either taken prior to treatment or prior to the ion exchange system going on-line. The wastewater containing 1,900 ppm was collected from the explosive wastewater treatment plant effluent taken in November 2004. An unexpected breakthrough in the anion exchange resin was the cause for the high level. However, it must be emphasized that the wastewater is not directly discharged to the Potomac but is sent to the publicly owned treatment works for further treatment.

In 2005, the Navy tested 64 wastewater samples for perchlorate. Perchlorate was detected in 50 samples, and the maximum perchlorate detection was 150 ppm.

Surface Water – 92 surface water samples were collected throughout the facility. The perchlorate results ranged from non-detect to 690 ppb. Perchlorate was detected in 65 samples. Samples have also been taken from the North Potomac up-gradient and down-gradient of ABL. Most samples did not show the presence of detectable levels of perchlorate. There was one sampling event in August of 2004 that showed very low concentrations of perchlorate in both the up-gradient and down-gradient location from ABL.

In 2005, the Navy tested 53 surface water samples for perchlorate. Perchlorate was detected in 47 of these samples, all below the reporting limit of 4 ppb.

6.0 EXISTENCE OF PERCHLORATE CONTAMINATION AT WPNSTA YORKTOWN

Explosives-related activities and operations performed at WPNSTA Yorktown may have resulted in the release of perchlorate at several locations throughout the facility. A letter to USEPA dated 8 October 1998 from the United States Air Force (USAF) Deputy of Environmental Readiness (USAF, 1998) lists WPNSTA Yorktown as a facility where Navy activities have stored, handled, or used perchlorates (**Attachment C**).

6.1 EXPLOSIVES LOADING PLANTS AT WPNSTA YORKTOWN

Potential sources of perchlorates at WPNSTA Yorktown include the three former shell loading plants. In 2000, the Navy completed an evaluation of the existing buildings and structures of these facilities (Anderson, 2000). This evaluation included information on the types of munitions and explosive formulations handled at each plant. A summary of the three plants, based on information in the 2000 report, is represented below. **Figures 2** and **3** show the layout of the buildings of the three plants, and the NERP sites that are located near the plants.

6.1.1 Plant No. 1

Plant 1 was built in 1920 and started operations in 1922 with Buildings 10, 11, 13, and 14. The plant was used to pour TNT into mines, bombs, warheads and depth charges. Buildings 10A, 97, and 98 were added in 1932. From the start of loading operations through 1942, the explosive loading program was confined to TNT. TNT production at Plant 1 peaked at 13,000,000 pounds per month prior to Plant 2 startup. Plant 1 was modernized from September 1944 to August 1945 to convert from solely TNT filling to Amatol (highly explosive mixture of ammonium nitrate and TNT), tri-butyl phosphate (a.k.a. TBX), HBX [binary explosives that are castable mixtures of cyclotrimethylenetrinitramine (a.k.a. RDX), TNT, powdered aluminum, and D-2 wax with calcium chloride] and TNT operations. Building 528, 528A, 527, and 444 were added at this time. On 1 July 1945 Torpex (short for "torpedo explosive" and composed of 42% RDX, 40% TNT, and 18% powdered aluminum) and HBX pouring were started. In 1964, there were plant improvements and expansion of capability to include Terrier, Tarter, and Shrike warheads. In 1965 and 1966, conveyors were designed and installed on the pouring level of the pour room to assist in raw explosive handling for the low drag bomb assembly line. The assembly line was secured on 21 December 1973 after 1,721,939 bombs were produced in 8 years.

6.1.2 Plant No. 2

Foundations for Buildings 109 (reclamation) and 110 (purification and loading) were started in November 1940. TNT pouring commenced in Building 110 in August 1941. Torpex was first produced in the reclamation plant, R-1, on 30 October 1942. An expansion was completed in November 1943 that converted the reclamation and purification plant to a filling plant. The expansion included a shipping warehouse, ready magazine, screening house, conveyor tunnels (records of building numbers and date are not consistent with current numbers - i.e., they were not 500, 501, 627, 628, and 629) and additions to Buildings 109 and 110. In March 1943, Torpex loading started in Building 110. There was an explosion at the cooling warehouse, (near current location of 501) on 16 November 1943. Reconstruction of the damaged buildings was completed in December 1944. Another expansion of Plant 2 was performed between September 1944 and August 1945. This expansion included the construction of Buildings 500, 500A, 501, 501A. In 1965, a new hot melt kettle was installed. A new reclaiming tank was installed in Building 109 in 1965. From 1973 to 1974, the water treatment systems were designed and installed.

6.1.3 Plant No. 3

Building 375 was built between October 1942 and March 1943 and went into operation in 1943, loading and producing Torpex, thus was originally called the Torpex Plant. The explosion in Plant 2 (16 November 1943) interrupted production for 45 days. In 1944, ten barricaded pits were installed in the rear of the building to facilitate the vertical loading of British "Tall Boys." Torpex plant additions were made from September 1944 to August 1945, that included the addition of buildings 502, 502A, 503, 503A, 504, 505 and 505A, and repairs and alterations to Building 375. In 1955, Building 503 was used to load 2,4,6-trinitrophenyl-N-methylnitramine (a.k.a. Tetryl) pellets. The plant was renovated and modernized in 1961-1962 to provide facilities for loading guided missile warheads (no details available). In 1965, an addition was made to the pouring room for machining warheads. From 1973 to 1974, the water treatment systems were designed and installed. In 1973, a technique for processing and casting PBXW-104 remotely was developed. Modernization plans were started in 1977 to change the plant into a Plastic-Bonded Explosive production processing facility. Building 375 underwent extensive modification to install a new 300 gallon mixer, vacuum system, heptane recovery system, monorail and hoist, water heater, fume and dust exhaust system and remote cameras. Building 502 modifications included the installation of a monorail and hoist and a ventilation system and mixing equipment for the liner preparation. A conveyor was installed in building 505A. A water wash air tumbler system to remove dust and fumes was installed on the rear outside of Building 375. Two walk-in curing rooms, overhead monorail system with a lift section for thermal coating (Firex) and painting, and a water wash paint booth w/exhaust were installed in Building 503.

6.2 ASSESSING PERCHLORATE AT WPNSTA YORKTOWN

A preliminary review of NERP sites was completed for the possible presence of perchlorate using the screening factors identified by current Navy policy and the DoD Perchlorate Handbook. In addition, other data sources were reviewed to identify specific munitions' systems that contain perchlorate (**Attachment D**). The Center for Public Environmental Oversight (CPEO) has listed munitions containing perchlorate (http://www.cpeo.org/lists/military/2003/msg00179.html). The following munitions from the CPEO list were included in the inventory of munitions handled at the three loading plants:

- Shrike Warheads (Plants 1 and 3)
- Terrier Warheads (Plant 1)
- Phoenix Warheads (Plant 1)
- Asroc Warheads (Plant 3)
- Sparrow Warhead (unknown production location)

In addition to the munitions above, any rockets or missiles that used solid propellants and were produced after large scale production of perchlorate began in the 1940s, have a significant chance of containing perchlorate. It should also be noted that the renovation of Plant 3 in 1961-1962 was to provide facilities for loading guided missiles, another system in which perchlorate is used.

The Munitions Items Disposition Action System (MIDAS) database, which contains detailed information on the constituents (propellants, explosives, and pyrotechnics) found in specific munitions, was reviewed to determine if any of the munitions handled at WPNSTA Yorktown may have contained perchlorate. A review of the MIDAS database (of munition system components for munitions handled at WPNSTA Yorktown) did not identify any specific perchlorate compounds as

part of an explosive or propellant system. The website for the database is https://midas.dac.army.mil (DoD EDQWG, 2007).

Table 4 presents a summary of 20 of the 42 NERP sites[3] at WPNSTA Yorktown that have the potential for perchlorate contamination. Each NERP site with a potential for perchlorate contamination was ranked as High, Medium, or Low based on an evaluation of current or past operations.

[3] For purposes of this paper, SSA 2 and SSA 19 have been combined and are addressed as one NERP site. Without these SSAs being combined, twenty-one NERP sites are summarized for their possible perchlorate contamination.

Table 4
WPNSTA Yorktown NERP Sites with Possible Perchlorate Contamination

Site Name	Site History	Potential for Perchlorate Contamination
Site 2 - Turkey Road Landfill	Waste reported to have been disposed at this site include missile hardware (ex. wings, fins and power packs) also unidentified drums and/or tanks.	Low
Site 4 - Burning Pad Residue Landfill	Burning pad residues were reportedly buried at this site.	Medium
Site 6 - Explosives-Contaminated Wastewater Impoundment	Received explosives-contaminated wastewater from Plant 2	High
Site 7 - Plant 3 Explosives-Contaminated Wastewater Discharge Area	Received explosives-contaminated wastewater from Plant 3. Explosive concentrations in groundwater have declined since the 1997 removal action.	High
Site 8 –NEDED Explosives-Contaminated Wastewater Discharge Area	Received wastewater containing explosives, explosives residues and organic constituents from the Naval Explosives Development Engineering Department (NEDED) complex.	High
Site 9 - Plant 1 Explosives-Contaminated Wastewater Discharge Area	Received explosives-contaminated water from Plant 1.	High
Site 11 – Abandoned Explosives Burning Pit	Ashes and residues from open-burning of explosives were potentially present at this site. No explosives were detected in samples collected in the Round I Groundwater RI.	Medium
Site 12 – Barracks Road Landfill	Waste reported to have been disposed at this site included explosives-contaminated packaging.	Low
Site 16 - West Road Landfill	Wastes reported to have been disposed at this site included unknown types of chemicals and pressure transmitting fluids.	Low
Site 17 – Holm Road Landfill	Wastes reported to have been disposed at this site included acid batteries, hydraulic fluids, drums from Public Works Department and ordnance production shops, and scrap metal. However, previous investigations did not detect explosive contamination in soil. Only one explosive, Amino-DNT, was detected at low concentrations in groundwater.	Low
Site 22 - Burn Pad	An array of 11 steel burning pans was used for burning waste, plastic explosives, and spent solvents. Also drums of explosive contaminated material were stored at the northeast portion of the site.	High
Site 24 - Aviation Field	After being used as an aviation field until 1927, it was used for storage of munitions in underground caches. Also may have been an explosives burning area.	Medium
Site 25 – Building 373 Rocket Plant	Received batch wastes from NEDED assembly operations.	High
Site 26 - Building 1816 Mark 48 Otto Fuel Tank	Contained a leaking Otto fuel (torpedo propellant) storage tank. Otto fuel does not contain perchlorate.	Low
SSA 2 – Former Explosive Ordnance Disposal (EOD) Area &S SA 19 – Beaver Road/Ponds 11 and 12 Drainage Area and Environs	SSA 2 and SSA 19 lie within the boundaries of the operational EOD range.	High
SSA 3 - Fire Training Pits and Vicinity	Debris was reportedly placed in concrete oil pits and ignited using jet fuel.	Low
SSA 4 - Weapons Casing Drum Disposal Area	This area consists of a ravine in which, debris, including weapons casings and drums were deposited.	Medium
SSA 11 - Building 3 Neutralization Unit	A metal tank with associated trench and dump was used for neutralization of wastes by an unknown process.	Low
SSA 14 - Building 537 Discharge to Felgates Creek	Received wastewater from Building 537 in the NEDED complex.	High
SSA 17 - Mark 46 Waste Otto Fuel Tank	Contained a leaking Otto fuel (torpedo propellant) storage tank. Otto fuel does not contain perchlorate.	Low

7.0 CONCLUSIONS AND RECOMMENDATIONS

Navy policy requires that all sites be sampled where there is a reasonable expectation that a perchlorate release has occurred as a result of Navy activities (DON, 2006).

A review of past activities at WPNSTA Yorktown's NERP sites indicates the possible handling, processing and disposal of explosives and waste materials containing perchlorate. A number of sites received wastewater from explosives loading plants or explosive development and testing facilities. Specific munitions handled at the explosives loading plants included Shrike, Terrier, Phoenix, and Sparrow Warheads, that are known to contain perchlorate. As perchlorate is highly soluble, perchlorate-contaminated wastes disposed at a site could have resulted in a perchlorate release to soil and groundwater.

Recommendations:

Perchlorate sampling and analysis in groundwater should be performed at the eight WPNSTA Yorktown sites that have the highest probability of perchlorate use or disposal (**Table 5**). Perchlorate sampling should be incorporated into any upcoming planned groundwater investigations at these sites. Perchlorate sampling should be conducted in accordance with Navy policy and applicable DoD and regulatory guidance documents.

Following the CERCLA phased approach. if perchlorate is detected at sites that have a high potential for perchlorate contamination, the Navy will consider sampling WPNSTA Yorktown sites with a "medium" potential for perchlorate contamination, as listed in **Table 4**.

The DoD Perchlorate Handbook provides guidance on scoping and developing perchlorate sampling and analysis plans (DoD EDQWG, 2007). The Navy has established an LOC for perchlorate of 24 ppb in water until such time as state or federal regulations are promulgated. Site specific risk assessments should be considered, should it be determined that levels of perchlorate exist in groundwater at concentrations greater than 24 ppb. As part of this assessment process, consideration should be given to collecting background samples from groundwater to support the risk assessment. Where site-specific risk assessments indicate that perchlorate concentrations could potentially result in adverse health effects, the site will be prioritized for appropriate risk management funding.

Table 5
Specific Sites to Consider for Initial Perchlorate Sampling

Site Name	Perchlorate Sampling Justification
Site 6 - Explosives-Contaminated Wastewater Impoundment	Received explosives-contaminated wastewater from Loading Plant 2. Groundwater sampling planned for Round Two Groundwater Investigation.
Site 7 – Plant 3 Explosives-Contaminated Wastewater Discharge Area	The handling of perchlorate at buildings within the Site 7 area has been documented. Site is currently undergoing groundwater Long Term Monitoring.
Site 8 - NEDED Explosives-Contaminated Wastewater Discharge Area	Received wastewater containing explosives, explosives residues and organic constituents from the NEDED complex. Groundwater sampling planned for Round One Groundwater Investigation.
Site 9 - Plant 1 Explosives-Contaminated Wastewater Discharge Area	Received explosives-contaminated water from Loading Plant 1.
Site 22 - Burn Pad	Site was used for burning waste, plastic explosives, and spent solvents. Groundwater sampling planned for Round One Groundwater Investigation.
Site 25 - Building 373 Rocket Plant	Received batch wastes from (NEDED) assembly operations. Groundwater sampling planned for Round Two Groundwater Investigation.
SSA 2 - Former EOD Area and SSA 19 – Beaver Road/Ponds 11 and 12 Drainage Area and Environs	SSA 2 and SSA 19 lie within the boundaries of the operational EOD range.
SSA 14 - Building 537 Discharge to Felgates Creek	Received wastewater from Building 537. Groundwater sampling planned for Round One Groundwater Investigation.

8.0 REFERENCES

Anderson, Joseph. (2000) Explosive Decontamination Plan for Explosive Loading Plants 1, 2, and 3 at Naval Weapons Station Yorktown, Virginia.

Coates, John D. and Achenbach, Laurie A. (2004) Microbial Perchlorate Reduction: Rocket-Fueled Metabolism. Nature Reviews, Vol. 2, p. 569-580.

Dascupta, Purnendo K., et al. (2005) The Origin of Naturally Occurring Perchlorate: The Role of Atmospheric Processes. Environmental Science and Technology, Vol. 39, No. 6 2005, pp. 1569-1575.

Department of Defense (DoD) Environmental Data Quality Work Group (DoDEDQWG). (2007) DoD Perchlorate Handbook. http://www.navylabs.navy.mil/Archive/DODPerchlorateHandbookR1C1.pdf. Viewed April 14, 2007.

DoD MERIT. (2007) The Official DoD Source for Perchlorate Information: https://www.denix.osd.mil/denix/Public/Library/MERIT/Perchlorate, Viewed July 12 2007.

Department of Navy (DON), Office of the Chief of Naval Operations. (2006) Navy Perchlorate Sampling and Management Policy.

Felz, Michael W. and Forren, Amy C. (2004) Profound Hypothyroidism: A Clinical Review with Eight Recent Studies: Is it Right Before Our Eyes?. Southern Medical Journal, Vol. 97, pp. 490-498.

GAO. (2005) Perchlorate: A System to Track Sampling and Cleanup Results is Needed. GAO-05-462. http://www.gao.gov/new.items/d05462.pdf. Viewed April 14, 2007.

Interstate Technology and Remediation Council (ITRC). (2005) Perchlorate: Overview of Issues, Status, and Remedial Options. Washington D.C. September 2005.

National Research Council (NRC). (2005) Health Implications of Perchlorate Ingestion. National Academic Press; Washington D.C.

Orris, G.J. et al. (2003) Preliminary Analyses for Perchlorate in Selected Natural Materials and Their Derivative Products, U.S. Geological Survey Open-File Report, 03-314.

Roote, D. S. (2001) Technology Status Report Perchlorate Treatment Technologies, First Edition. Doc No. DAAE30-98-C-1050. Ground-Water Remediation Technologies Analysis Center, Pittsburgh.

United States Air Force, Office of Assistant Secretary. (1998) Navy Activities That Have Stored, Handled, or Used Perchlorates. Washington D.C. http://www.epa.gov/fedfac/pdf/afoct98.pdf

United States Environmental Protection Agency (USEPA), Office of Solid Waste and Emergency Response. (2006) Assessment Guidance for Perchlorate. Washington D.C.

USEPA, Office of Solid Waste and Emergency Response. (2005) Perchlorate Treatment Technology Update: A Federal Facilities Forum Issue Paper, Washington D. C. EPA/542/R-05/015.

USEPA, Office of Solid Waste and Emergency Response. (2003) Status of EPA's Interim Assessment Guidance for Perchlorate. Washington D.C.

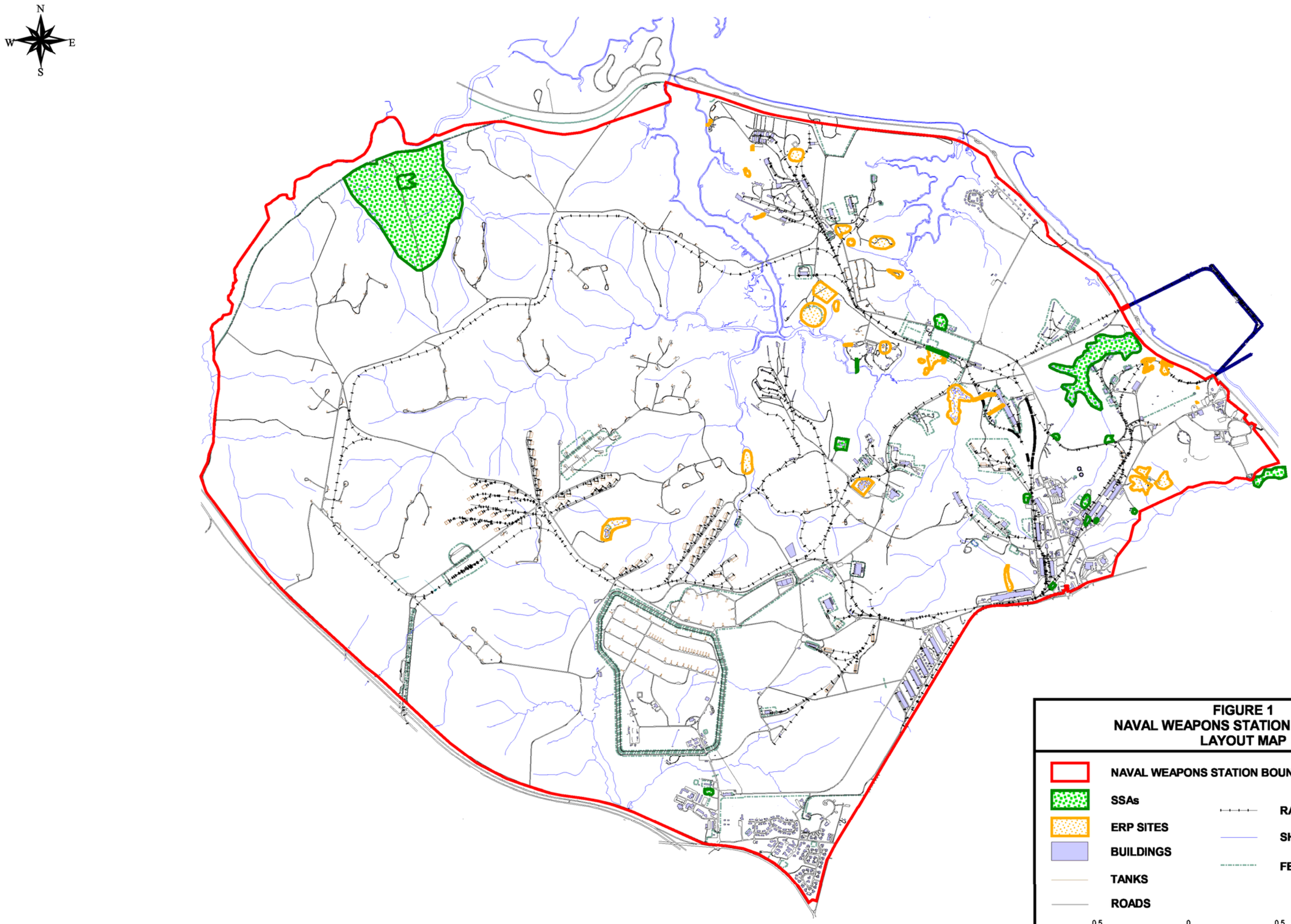
USEPA, Office of Research and Development. (2002) Draft Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization. Washington D.C.

USEPA, Office of Research and Development. (1999a) Potential Species for Phytoremediation of Perchlorate. Washington D.C., EPA/600/R-99/069.

USEPA, Office of Research and Development. (1999b) Interim Assessment Guidance for Perchlorate. Washington D.C.

Walvoord, M.A., Phillips, F.M., Stonestrom, D.A., Evans, R.D., Hartsough, P.C., Newman, B.D., Striegl, R.G., 2003. A Reservoir of Nitrate Beneath Desert Soils. Science 302, 1021–1024. (as quoted in Dascupta, et al., 2005)

FIGURES


N
W
E
S
FIGURE 1
NAVAL WEAPONS STATION YORKTOWN
LAYOUT MAP
NAVAL WEAPONS STATION BOUNDARY
SSAs
ERP SITES
BUILDINGS
TANKS
ROADS
RAILROADS
SHORELINES AND STREAMS
FENCES
0.5
0
0.5
1 Miles

SITE 16

SITE 9

SITE 19

SITE 29

LEE ROAD

MAIN ROAD

BOLLMAN ROAD

LEE POND

568

2050

664

665

1592

472

13

14

1761

671

11

10

10A

527

528A

666

97A

667

98

97

668

526

528

669

670

1964

523

1459

1727

522

1451

1407

1586

524

1371

2042

J

Q

LEGEND

IR Sites

PLANT NO. 1 BUILDINGS

BUILDINGS

SHORELINES AND STREAMS

ROADS

10 FT. TOPOGRAPHIC CONTOUR

RAILROADS

FENCES

250 0 250 Feet

FIGURE 2
PLANT NO. 1 COMPLEX
LOCATION MAP

NAVAL WEAPONS STATION YORKTOWN

YORKTOWN, VIRGINIA

N
W E
S

SITE 6

SITE 24

SITE 7

SITE 17

STORAGE AREA
HELO PAD
WINDSOCK
H
1813
506
GATE 5
1249
501
501A
1902
OWTU
MAIN
ROAD
500A
500 PLANT NO.2
OWTU
1903
109
110
1462
629
628
627
2007
503
1213
503A
118
1605
612
ROAD
DIGGS
101
1957
POE
1979
505
504
375
505A
1904
OWTU
502A
PLANT NO.3
502
2008
Felgates Creek
1833
1834
HOLM ROAD
491
10
20
30

LEGEND

- IR Sites
- PLANT NO. 2 BUILDINGS
- PLANT NO. 3 BUILDINGS
- BUILDINGS
- SHORELINES AND STREAMS
- ROADS
- 10 FT. TOPOGRAPHIC CONTOUR
- RAILROADS
- FENCES

275 0 275 Feet

FIGURE 3
PLANT NO. 2 & 3 COMPLEX
LOCATION MAP

NAVAL WEAPONS STATION YORKTOWN

YORKTOWN, VIRGINIA

ATTACHMENT A

USEPA ASSESSMENT GUIDANCE FOR PERCHLORATE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

January 26, 2006

OFFICE OF
SOLID WASTE AND EMERGENCY
RESPONSE

MEMORANDUM

SUBJECT: Assessment Guidance for Perchlorate

FROM: Susan Parker Bodine
Assistant Administrator

TO: Regional Administrators

This guidance replaces previous Office of Solid Waste and Emergency Response (OSWER) guidance and the accompanying questions and answers (referenced below) regarding perchlorate under the National Oil and Hazardous Substances Contingency Plan (National Contingency Plan, NCP), 40 CFR Part 300. As explained below, following the National Academy of Sciences' National Research Council (NRC) review, EPA adopted a reference dose (RfD) for perchlorate of 0.0007 milligram/kilogram-day (mg/kg-day), and this guidance applies that to EPA's CERCLA program. This RfD leads to a Drinking Water Equivalent Level (DWEL) of 24.5 micrograms/liter (ug/L) or 24.5 parts per billion (ppb).

Previous guidance on this topic included the 2003 guidance entitled "Status of EPA's Interim Assessment Guidance for Perchlorate," and the accompanying questions and answers, as well as the 1999 "Interim Assessment Guidance for Perchlorate." Those past guidances endorsed use of the provisional RfD range, 0.0001 to 0.0005 mg/kg-day, until the final health risk benchmark was established. They went on to use the standard default body weight (70 kg, approximately 154 pounds) and water consumption level (2 liters/day [L/day]) to calculate a DWEL of 4-18 ppb that was used as a recommended screening level.

Several agencies, including EPA, asked the NRC to review perchlorate toxicity. NRC's January 2005 final report, "Health Implications of Perchlorate Ingestion," recommended an RfD of 0.0007 mg/kg-day. Based on the NRC report and their recommended RfD, the EPA Integrated Risk Information System (IRIS) perchlorate RfD is now 0.0007 mg/kg-day. This IRIS RfD is now a value "to be considered" (TBC) in accordance with section 300.400(g)(3) of the NCP. As suggested by the NCP's preamble (55 Fed. Reg. 8745 (1990)), and subsequent guidance (OSWER Directive 9285.7-53 (2003)), use of the RfD in EPA's IRIS is preferred and consistent with the NCP's intent. EPA has determined that the RfD recommended by NRC and adopted by EPA represents the best available science regarding the toxicity of perchlorate.

Consequently, this IRIS RfD of 0.0007 mg/kg-day is now the appropriate value for use by risk assessors and project managers.

This RfD leads to a DWEL of 24.5 ppb. EPA calculates the DWEL using the RfD, multiplied by an adult body weight of 70 kg, and divided by a conservative tap water consumption value of 2 L/day.

The National Contingency Plan (40 CFR 300.430(e)(2)(i)(A)(1)) provides that when establishing acceptable exposure levels for use as remediation goals, consideration must be given to concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effects over a lifetime or part of a lifetime, incorporating an adequate margin of safety. The RfD for perchlorate, on which the acceptable exposure level would be based, is a conservative public health-protective value derived using an uncertainty factor to ensure protection of the most sensitive population. Specifically, because the RfD includes a full ten-fold intraspecies uncertainty factor to protect the most sensitive population, the fetuses of pregnant women who might have hypothyroidism or iodide deficiency, it is also protective of other sensitive populations such as neonates and developing children. As noted in the IRIS summary for perchlorate, an uncertainty factor of ten was viewed by the NRC as conservative and health-protective, particularly because the RfD is based on a non-adverse effect that would precede any adverse effect resulting from perchlorate exposure. (For a more detailed discussion of EPA's basis for adopting NRC's recommended RfD for perchlorate, see EPA's IRIS summary for perchlorate at http://www.epa.gov/iris/subst/1007.htm.). In addition, the Agency's practice of using the RfD to calculate a DWEL for perchlorate using a 70 kg body weight and a water consumption value of 2 L/day is further supported in this instance by the fact that the standard weight and consumption values also represent weight and consumption values relevant for protecting the most sensitive population.

The NCP calls for development of preliminary remediation goals based on readily available information. 40 CFR 300.430(e)(2)(i). Typically, preliminary remediation goals are specific statements of desired endpoint concentrations or risk levels (55 Fed. Reg. 8713 (March 8, 1990)) that are conservative, default endpoint concentrations used in screening and initial development of remedial alternatives before consideration of information from the site-specific risk assessment. Frequently, the determining values are those requirements that are applicable or relevant and appropriate (ARAR) requirements under federal environmental or state environmental or facility siting laws, although ARARs may be waived. Where (as with perchlorate) no federal or state ARARs have been promulgated, preliminary remediation goals may as appropriate be developed based on "to be considered" (TBC) values (40 CFR 300.400(g)(3)). The RfD and its corresponding DWEL of 24.5 ppb are respectively the recommended TBC value and preliminary remediation goal for perchlorate.

The NCP provides that "preliminary remediation goals should be modified, as necessary, as more information becomes available during the RI/FS" (remedial investigation / feasibility study). (40 CFR 300.430(e)(2)(i)). RIs at sites with perchlorate contamination should be conducted with the same approach as RIs at all other sites, assessing factors such as physical characteristics of the site; characteristics or classifications of air, surface water, and groundwater; general characteristics of the waste; the extent to which the source can be adequately identified

and characterized; actual and potential exposure pathways through environmental media; actual and potential exposure routes; and other factors, as set out in 40 CFR 300.430(d). For example, the RI may indicate that individuals at a site may be exposed to perchlorate through multiple pathways. In such cases, contribution from non-water sources should be considered based on site-specific data until further national guidance on relative source contribution is developed. The Regions should consult applicable guidance, such as "Risk Assessment Guidance for Superfund: Volume I, Part A" (EPA/540/1-89/002, Dec. 1989) at pp. 8-15; and "Risk Assessment Guidance for Superfund: Volume I, Part B" (EPA/540/R-92/003, Pub. 9285.7-01B, Dec. 1991) at p. 20. If you have questions on the application of this guidance contact the Science Policy Branch of OSWER's Office of Superfund Remediation and Technology Innovation.

Final remediation goals and remedy decisions are made in accordance with 40 CFR 300.430(e) and (f) and associated provisions.

ATTACHMENT B

NAVY PERCHLORATE SAMPLING AND MANAGEMENT POLICY

Navy Perchlorate Sampling and Management Policy
15 April 2006

Ref: (a) DoD Perchlorate Handbook, March 2006
http://www.navylabs.navy.mil/Archive/DODPerchlorateHandbook.pdf
(b) DoDI 4715.8, "Environmental Remediation for Overseas Activities"

Encl: (1) Policy on DoD Required Actions Related to Perchlorate, 26 January 2006

1. This policy provides Navy specific requirements to implement Enclosure (1). This policy supercedes Navy Perchlorate Assessment Policy of 5 December 2003.

2. Enclosure (1) establishes 24 ppb as the level of concern for managing perchlorate in the environment. Where there are properly promulgated federal or state regulatory standards for perchlorate, enclosure (1) directs use of whichever is most stringent. Throughout this policy "24 ppb" means 24 ppb or more stringent, properly promulgated federal or state regulatory standards for perchlorate.

3. It is Navy policy to sample all sites where there is reasonable expectation that a perchlorate release has occurred as a result of Navy activities, including those sites previously analyzed with EPA Method 314.0. This is because the new EPA mass-spectroscopy-based analytical methods discussed in paragraph 5 below are more definitive than the previous method 314.0 and will provide a higher level of confidence about the occurrence of perchlorate in the various environmental media at a given site.

4. In determining the likelihood of perchlorate, installations should consider the volume of perchlorate used or disposed, and/or the intensity of perchlorate related functions at the site. Functions that could potentially contribute to Perchlorate occurrence include, but are not limited to:

a. The manufacture/maintenance of solid-fuel missile/rocket motors, and/or munitions containing perchlorates;

b. The use of perchlorate-containing munitions for training or testing purposes;

c. The demilitarization of perchlorate-containing munitions using techniques, such as "hog-out" of rockets and missiles containing solid propellant; and

d. Open burning/open detonation operations.

Simple logistical handling of perchlorate-containing weapons/munitions is not a likely source of perchlorate into the environment.

5. Analytical methods employing mass spectrometry (MS) must be used for the analysis of environmental media for perchlorate, unless otherwise specified by permit. When using MS for the determination of perchlorate in drinking water, EPA Methods 331.0 or 332.0 shall be used. At this time, the EPA has not published any methods for the analysis of environmental media other than drinking water (e.g., wastewater, soil, sediment, etc.) for perchlorate using MS; therefore, required analytical method performance criteria are specified in Appendix G of reference (a). When EPA Methods 6850 and 6860 are published, the criteria specified in the published method will be followed unless more restrictive criteria are specified in Appendix G of reference (a).

6. Management actions to be taken in response to perchlorate detections are outlined below:

a. Environmental Restoration and Munitions Response Programs (MRP)
Any perchlorate detection at or greater than 24 ppb in water requires preparation of site-specific risk assessments in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Defense Environmental Restoration Program (DERP), and the National Contingency Plan (NCP) to evaluate the extent of actual or potential exposures. Where a site-specific risk assessment indicates perchlorate concentrations could potentially result in adverse health effects, the site will be prioritized for appropriate risk management. Where no federal or state Applicable or Relevant and Appropriate Requirements (ARARs) have been promulgated, risk assessors and risk managers may, when appropriate, identify other federal or state advisories, criteria, or guidance to be considered.

Sampling may be terminated for any individual DERP or MRP sampling point after analytical results indicate that perchlorate concentrations are likely to remain below the appropriate level of concern as established by the site-specific risk assessment for that media at that sample point, except where continued sampling is required by permit conditions, policy or agreement.

b. Operational Ranges

Assessment for perchlorate and any necessary follow-on actions are included in the Range Sustainability and Environmental Program Assessment (RSEPA). Design of any follow-on actions will be based on site-specific risk assessment.

c. Navy-Owned Drinking Water Systems

All Navy-owned drinking water systems (including distribution/consecutive systems) that currently sample for inorganic analytes pursuant to regulatory requirements shall sample for perchlorate at least once in each of the next two quarters using one of the new methods discussed in paragraph 5.

The first round of sampling shall be completed not later than 31 August 2006. Where confirmed analytical results indicate the presence of perchlorate in finished drinking water at any level above the method reporting limit for the analytical method used, installations shall notify and consult with their Budget Submitting Office (BSO) regarding appropriate follow on actions. Actions may include development of an action plan to reduce exposure to perchlorate as appropriate for the protection of human health and additional sampling. At a minimum, installations shall continue to sample quarterly, or in accordance with regulatory requirements, whichever is more frequent, until the installation and BSO are satisfied that perchlorate concentrations are likely to remain below 24 ppb.

If, after two consecutive quarterly sampling periods, the confirmed perchlorate sampling results are below 4 ppb, sampling may be discontinued, unless otherwise required to do so by regulation or permit terms.

The requirements of this paragraph also apply to water systems at overseas permanent facilities that are required to conduct drinking water sampling.

The first round of laboratory results should be reported to the BSO within 60 days of receipt, and not later than 30 September 2006.

d. Permitted Wastewater Effluent
Discharges at installations where the use of perchlorate is associated with processes related to the manufacture, maintenance, processing, recycling, or demilitarization of military munitions shall be sampled for perchlorate at permitted wastewater discharge points. Sampling will be conducted semi-annually and if possible in conjunction with effluent sampling already conducted under the applicable permit to each point source. The first sample shall be completed by 31 August 2006. The second sample shall be completed by 31 January 2007. Data results shall be reported to the headquarters by 30 September 06 and 31 March 07 for the first and second sample respectively. Installations with confirmed results that indicate the presence of perchlorate in wastewater effluent discharges at any level above the method reporting limit for the analytical method used shall consult with their headquarters on appropriate actions. Sample results are to be reported to the permitting regulatory authority if it is required by the NPDES permit or State regulations. Sampling requirements of this paragraph also apply to overseas wastewater systems.

7. Any overseas management actions will be conducted in accordance with international agreements and reference (b).

8. To adequately plan and budget for future program requirements necessary to comply with this policy BSOs are hereby authorized to program resources as follows:

a. Compliance actions are Environmental Quality Status Class I requirements. Compliance funding is to be used at installations for;

i. Suspected perchlorate contamination from installation operations that continued past or occurred after the DERP cut-off date of 17 October 1986;

ii. Current and future SDWA and CWA perchlorate sampling;

iii. Suspected perchlorate contamination from activities on an operational range;

iv. Suspected perchlorate contamination on a range closed after 30 September 2002; and

v. Analysis and maintenance of the perchlorate database.

b. ER,N funds are to be used at installations consistent with DERP-eligibility requirements.

c. BRAC funding is to be used for any case on installations closed or closing under any of the BRAC laws.

9. All perchlorate sampling results must be entered into the Navy Perchlorate Survey database. The perchlorate survey database is updated annually in Feb-Mar with data generated during the previous calendar year.

ATTACHMENT C

NAVY AND ARMY SITE LISTINGS FOR PERCHLORATE

DEPARTMENT OF THE AIR FORCE
WASHINGTON, DC

Office Of The Assistant Secretary

8 October 1998

SAF/MIQ
1660 Air Force Pentagon
Washington, DC 20330-1660

Mr. Mike Osinski
U.S. EPA, Office of Ground Water and Drinking Water
Mailcode 4607
401 M Street NW
Washington, DC 20460

Dear Mr. Osinski

Attached per EPA's request to DoD are the Army and Navy site listings for perchlorate. This is a follow-on to my letter of 24 July 98 which transmitted the Air Force list. If you have any questions concerning the Army list, please contact Mr. Rick Newsome, Office of DASA (ESOH), (703) 614-9531. For questions concerning the Navy list, please contact Mr. Paul Yaroschak, Office of DASN (E&S), (703) 588-6695.

Sincerely

EDMUND H. STERN, LT COL, USAF
Deputy for Environmental Readiness
Deputy Assistant Secretary of the
Air Force
(Environment, Safety, and
Occupational Health)

Attachments:
Army Site List
Navy Site List

cc:
ADUSD (CL)
DASA (ESOH)
DASN (E&S)
AFMC LO/JAV (Lt Col Rogers)

NAVY ACTIVITIES THAT HAVE STORED, HANDLED, OR USED PERCHLORATES

NO.	NAME	STATE
1.	Naval Air Weapons Station, China Lake	CA
2.	Naval Explosive Ordnance Disposal Technology Division	MD
3.	Naval Industrial Reserve Ordnance Plant, Allegany Ballistics Laboratory	WV
4.	Naval Industrial Reserve Ordnance Plant, Magna	UT
5.	Naval Inventory Control Point, Mechanicsburg	PA
6.	Naval Surface Warfare Center, Carderock Division*	MD
7.	Naval Surface Warfare Center, Carderock Division, SSES Philadelphia*	PA
8.	Naval Surface Warfare Center, Crane Division	IN
9.	Naval Surface Warfare Center, Indian Head Division	MD
10.	Naval Weapons Industrial Reserve Plant, McGregor	TX
11.	Naval Weapons Station, Yorktown	VA
12.	Space Warfare Systems Center, San Diego*	CA
13.	Weapons Support Facility, Seal Beach, Concord Detachment*	CA
14.	Weapons Support Facility, Seal Beach, Fallbrook Detachment*	CA
15.	Weapons Support Facility, Seal Beach, Port Hadlock Detachment*	WA

* Small scale laboratory operations

Enclosure (1)

Ammonium Perchlorate Inventory

MACOM: U.S. Army Materiel Command

MSC: U.S. Army Aviation and Missile Command
Installation: Redstone Arsenal, AL
Timeframe: 1941 to present
Purpose: Manufacture of rocket engines, rocket motors and propellant testing.
POC: Mr. Whitt Walker, commercial (205) 955-6967.

MSC: U.S. Army Tank-automotive and Armaments Command
Installation: Picatinny Arsenal
Timeframe: Currently used on an ongoing basis.
Purpose: Research and development.
POC: Mr. Terry Tighe, commercial (810) 574-5262

Evaluation MSC: U. S. Army Test and Command
Installation: White Sands Missile Range
Timeframe: >20 years
Purpose: Test large rockets and motors and small rockets.
POC: Robert Myers, commercial (505) 678-8751

Installation: Aberdeen Proving Ground
Timeframe: >20 years
Purpose: Test Pyrotechnics and small rockets
POC: Ken Stachiw, commercial (410) 436-3320

Installation: Dugway Proving Ground
Timeframe: >20 years
Purpose: Test pyrotechnics
POC: Bill Johnston, commercial (435) 831-3592

Installation: Yuma Proving Ground
Timeframe: >20 years
Purpose: Test pyrotechnics and small rockets
POC: Chuck Botdorf, commercial (52) 328-2754

MSC: U. S. Army Industrial Operations Command
Installation: Longhorn Army Ammunition Plant.
Purpose: Perchlorate has been used in many areas at Longhorn both with the Pershing and base burner.
POC: David Tolbert, DSN 566-2728

Installation: Pine Bluff Arsenal
Purpose: Pine Bluff has used ammonium perchlorate in the production of pyrotechnic smoke mixes. They have also used it in starter mixes for pyrotechnic munitions.
POC: Charlie Neel, commercial 870-540-2804, email: charlie_neel@pba-emh1.army.mil

Installation: Sierra Army Depot
Purpose: Treatment of rocket motors.
POC: Jim Ryan, DSN; 827-4725

Installation: Radford Army Ammunition Plant
Purpose: Ammonium perchlorate is a part of certain propellant formulations at Radford.
POC: Rob Davie, DSN: 931-8641

Installation: Tooele Army Depot
Purpose: Tooele is storing 5 inch projectiles in which ammonium perchlorate is contained in the amount of .005 pounds per projectile. It is in the tracer compound.
Timeframe: Many of these projectiles were detonated in the OB/OD area in 1996 and 1997.
POC: Dave Woodworth, DSN: 790-3504, commercial (435) 833-3504

Installation: McAlester Army Ammunition Plant
Purpose: The installation stores rockets with fuel that contains perchlorate. They use ammonium perchlorate in munitions loading.
POC: Darrell Elliot, DSN: 956-6551

Installation: Hawthorne Army Depot
Purpose: Hawthorne stored 4.5 million pounds of ammonium perchlorate from 1988-1990. In 1995 Hawthorne demilitarized 220 ammonium perchlorate-filled Hawk motors using high-pressure water to washout the material from the motors. Currently Hawthorne receives, stores and ships ammunition items that contain ammonium perchlorate.
POC: Herman Millsap, DSN 830-7317

Installation: Letterkenny Army Depot
Timeframe: Current
Purpose: Demilitarizing Shrike missiles.
POC: Randy Quinn, DSN 570-8438

MACOM: U. S. Army Space and Missile Defense Command
Installation: Kwajalein Atoll
Timeframe: 1970s to present
Purposes: Perchlorate is used in the fuels of rockets that have been fired on Kwajalein Atoll.
POC: Mr. Randy Gallien, (256) 955-5027

ATTACHMENT D

CPEO MILITARY LIST ARCHIVE: PERCHLORATE CONTAINING MUNITIONS

From: **info@cswab.com**

Date: **17 Feb 2003 22:28:57 -0000**

Reply: **cpeo-military**

Subject: [CPEO-MEF] perchlorate-containing munitions

Please post.

Following is a list of munitions and components that may contain perchlorate. Thought this might be helpful to other communities.

Laura

Grenade Hand OFF MK3A2

Propellant Grain M7

Signal Smoke and Illumination Marine Orange/Red MK124

Demolition Kit Cratering M180

Cartridge 40MM Target Practice M918 LNKD

Marker Location Marine MK38 Modificationi

Fuze Bomb Nose FMU-95/B

Fuze FMU-94/B

Fuze Hand Grenade M201A1

Fuze Hand Grenade M204A2

Fuze Hand Grenade M205A2

Fuze Hand Grenade M206A2

Fuze Hand Grenade M213

Fuze Incendiary M210

Fuze Mine Antitank PRAC M604

Fuze Mine M605

Fuze Point Detonation M567

Fuze Point Detonation M567 Delay with 0 Booster

Fuze Point Detonation M568

Fuze Point Detonation M935

Fuze Point Detonation M936

Fuze Smoke Pot M207A1

Fuze Time M84A1

Cartridge 105MM High Explosive Rocket-Assisted Projectile M548

Cartridge 40MM AA High Explosive Incendiary with Tracer-Dl-SD

Cartridge 40MM AA High Explosive Incendiary with Tracer-NSD

Cartridge 40MM AA High Explosive Incendiary with Tracer-SD

Cartridge 40MM AA High Explosive Incendiary-SD

Cartridge 40MM AA High Explosive with Tracer SD

Cartridge 60MM High Explosive M49A4

Cartridge 60MM High Explosive M888

Cartridge 60MM Target Practice M50A3

Cartridge 81MM High Explosive M374 with Point Detonation Fuze

Cartridge 81MM High Explosive M374A2 with Point Detonation Fuze

Cartridge 81MM High Explosive M374A3 with Point Detonation Fuze

Rocket Motor IGN MK165 Modification 0

Grenade Hand Fragmentation M26A1

Grenade Hand Fragmentation M67

Grenade Hand OFF MK3A2

Dispenser and Bomb Aircraft CBU 12/A

Dispenser and Bomb Aircraft CBU 22/A

Dispenser and Bomb Aircraft CBU 22A/A

Dispenser and Bomb Aircraft CBU 7A(T-1)/A

Dispenser and Bomb Aircraft CBU 7AIA

Projectile 155MM ADAM M692E1

Projectile 155MM ER DP M864

Projectile 155MM High Explosive ADAM M731

Rocket POD 298MM Practice M28 Multiple Launch Rocket System

Rocket POD 298MM Practice Reduced Range M28A1 Multiple Launch Rocket System

Rocket POD 298MM Tactical M26 Multiple Launch Rocket System

Mine Antipersonnel High Explosive M86

Mine Antipersonnel M16

Mine Antipersonnel M16A1

Mine Antipersonnel M1SA1 or M16A2

Mine Antipersonnel PRAC T34

Mine at Light M24 Off Route

Projectile 155MM High Explosive PA M549

Projectile 155MM High Explosive RA M549A1

Projectile 81N High Explosive Rocket-Assisted Projectile M650

Warhead Flare 2.75IN Rocket M257

Projectile 5lN/38 Caliber Rocket-Assisted Projectile MK57 Modification 2

Rocket High Explosive 3.5lN M28A2 High Explosive Antitank

Rocket High Explosive 66MM Antitank M72

Rocket High Explosive 66MM Antitank M721M72A1

Rocket High Explosive 66MM Antitank M72A1

Rocket High Explosive 66MM Antitank M72A2

Rocket Practice 115MM Simulant EG M61

Rocket Practice 35MM SubCaliber M73

Destroyer Cryptographic Equipment Incendiary TH4 MIA2

Destroyer Cryptographic Equipment Incendiary TH4 M2A1

Document Destroyer Incendiary IGN M25

Document Destroyer Incendiary M3

Grenade Hand Incendiary TH3 AN-M14

Incendiary Safe Destroying MIA1

Rocket Incendiary 66MM TPA 4-RD M74

Cartridge NC Fire Extinguisher High Explosive

Cartridge Actuated Initiator PCU-40/P

Cartridge Delay (.5 Second)

Cartridge Delay M252

Cartridge Impulse

Cartridge Impulse BBU-35/B

Cartridge Impulse CCU-107/B

Cartridge Impulse CCU-44/B

Cartridge Impulse MK8 Modification 0

Cutter Cartridge Actuated 2000LB

Delay Assembly F/8lN M650

Delay Element M53

Detonator Delay

Detonator Nonelectric MK12O Modification 0

Detonator Nonelectric MK122 Modification 0

Detonator Nonelectric MK123 Modification 0

Detonator Nonelectric MK124 Modification 0

Detonator Nonelectric MK125 Modification 0

Detonator Nonelectric MK126 Modification 0

Detonator Nonelectric MK127 Modification 0

Detonator Percussion M1A2

Detonator Percussion M2A1

Fuze Hand Grenade M213

Powder Actuated Cutter M21

Powder Actuated Cutter M22

Tracer MK14 Modification 0

Rocket 115MM Chemical Agent GB M55

Rocket 115MM Chemical Agent VX M55

Rocket Practice Smoke 2.751N with Warhead M274

Base Burner Assembly F/I 55MM M864

Cartridge 105MM Antipersonnel-Target Practice M546

Cartridge 105MM Antipersonnel-Target Practice M546E2

Cartridge 40MM Target Practice M918

Cartridge 5.125 Chaff MK182 Modification 1

Cartridge 5.1251N Chaff MK182 Modification 2

Cartridge 81MM Practice M879 with Point Detonation Fuze Practice M751

Cartridge 90MM Practice M371 with Fuze Point-Initiating Base-Detonating
(Fuze) M530A1

Cartridge Actuated Initiator

Cartridge Assembly

Cartridge Delay (.25 Second)

Cartridge Impulse

Cartridge Impulse BBU-46/B

Cartridge Impulse CCU-43/B

Cartridge Impulse CCU-45/B

Cartridge Retractor Release Assembly

Infrared Flare Assembly MJU-23/B

Infrared Flare Assembly MJ U-23A1B

Initiator Cartridge Actuated M28

Initiator Cartridge Actuated M3A2

Initiator Cartridge M27

Initiator Cartridge M53

Initiator Cartridge M99

Motor (Rocket) Loading Assembly

Rocket 3.5lN Practice M29A2

Rocket Motor 3.5IN

Rocket Motor IGN MK188 Modification 0

Rocket Motor JATO MK6 Modification 1

Rocket Motor JATO MK6 Modification 1

Rocket Motor MK23 Modification 2

Rocket Motor MK62 Modification 2

Rocket Practice 2.75lN with Warhead M267 and Fuze M439

Rocket Practice 35MM SubCa M73

Cartridge 40MM Green STAR Parachute M661

Cartridge 40MM RED STAR Parachute M662

Cartridge 40MM White STAR Cluster M585

Cartridge 40MM White STAR Parachute M583

Cartridge 40MM White STAR Parachute M583A1

Cartridge Photoflash Ml 12

Cartridge Photoflash Ml 12A1

Cartridge Photoflash M123A1

Detonation SIM Eexplosive M80

Flare Aircraft Countermeasure M206

Flare Aircraft Parachute MK24 Modification 2A with SUS BAND

Flare Aircraft Parachute MK24 Modification 4 with AF Cable Modification

Flare Aircraft Parachute MK45 Modification 0 with Drogue Tray

Flare Aircraft Parachute MK45 Modification 0 with 0 Drogue Tray

Flare Aircraft Parachute White MK45 Modification 0

Flare Cartridge ALA-17B

Projectile 155MM Practice M804

Rocket Illumination 2.75IN with Warhead M257 and Fuze M442

Signal Illumination Aircraft Double STAR Green/Green M39

Signal Illumination Aircraft Double STAR Green/Green M56

Signal Illumination Aircraft Double STAR Green/Red M55

Signal Illumination Aircraft Doubl STAR Green/Red M58

Signal Illumination Aircraft Double STAR Green/Yellow M42

Signal Illumination Aircraft Double STAR Red/Green M41

Signal Illumination Aircraft Double STAR Red/Red M37

Signal Illumination Aircraft Double STAR Red/Red M54

Signal Illumination Aircraft Double STAR Red/Red M57

Signal Illumination Aircraft Double STAR Red/Yellow M40

Signal Illumination Aircraft Double STAR Red/Yellow M53

Signal Illumination Aircraft Double STAR YLwith Yellow M38

Signal Illumination Aircraft Red STAR MK8O Modification 0

Signal Illumination Aircraft Single STAR Green M45

Signal Illumination Aircraft Single STAR Green M45A2

Signal Illumination Aircraft Single STAR Red M43A2

Signal Illumination Aircraft Single STAR Yellow M44A2

Signal Illumination Ground Green STAR M189

Signal Illumination Ground M125A1

Signal Illumination Ground M127

Signal Illumination Ground M158

Signal Illumination Ground M159

Signal Illumination Ground Parachute Green STAR M195

Signal Illumination Ground Parachute Red STAR M126A1

Signal Illumination Ground Parachute White STAR M127A1

Signal Illumination Ground Red STAR M158

Signal Illumination Ground Red STAR M187

Signal Illumination Ground White STAR M159

Signal Illumin=E9tion Marine Red STAR MK1 Modification 1

Signal Illumination Marine Yellow STAR MK1 Modification 0

Signal Illumination Red STAR M131

Signal Illumination STAR Red Comet MK1 Modification 0

Signal Kit Illumination MK79 Modification 0

Signal Smoke and Illumination Marine Green/Green MK67

Signal Smoke and Illumination Marine MK13 Modification 0

Signal Smoke and Illumination Marine Yellow with Yellow MK68

Simulator Atomic Explosive M142

Simulator Booby Trap Flash Ml 17

Simulator Booby Trap Illumination M118

Simulator Booby Trap Ml 19 Whistle

Simulator Flash ART M110

Simulator Hand Grenade M116A1

Simulator Projectile Ground Burst Ml l5A2

Simulator Target Kill M26

Tracer MK1 1 Modification 0 F/4OMM

Warhead Flare 2.75 IN Rocket M257

Warhead Flare 2.751N Rocket M278

Grenade Hand Riot Riot Control Agent (Chioroacetophenone) M7

Grenade Hand Riot Riot Control Agent (Chioroacetophenone) M7A1

Grenade Hand Riot Riot Control Agent (Chloroacetophenone)-DM M6

Grenade Hand Riot Riot Control Agent (O-chlorobenzylidene malonitrile)
M7

Grenade Hand Riot Riot Control Agent (O-chlorobenzylidene malonitrile)
M7A2

Grenade Hand Riot Riot Control Agent (O-chlorobenzylidene malonitrile)
M7A3

Cartridge 20MM 5 High Explosive Indendiary MK1O6/4 Armor-Piercing Incendiary MK107/1 Armor-Piercing with Tr

Cartridge 20MM 9 Armor-Piercing Incendiary MK107/1 Armor-Piercing

with
Tracer MK1O8

Cartridge 20MM Armor-Piercing Incendiary M53

Cartridge 20MM Armor-Piercing Incendiary MK1O7 Modification 0

Cartridge 20MM Armor-Piercing Incendiary MK107 Modification 1

Cartridge 20MM Armor-Piercing Incendiary T221 E2

Cartridge 20MM High Explosive Incendiary M56A1

Cartridge 20MM MPT-SD M940

Cartridge 20MM SAP High Explosive Incendiary PGU-28/B

Cartridge 22MM SUBCAL Practice M744

Cartridge 22MM SUBCAL Practice M745

Cartridge 22MM SUBCAL Practice M746

Cartridge 22MM SUBCAL Practice M747

Cartridge 20MM High Explosive Incendiary M56A1

Cartridge Caliber .50 4 Armor-Piercing Incendiary MK21 1 Modification 0/1 Armor-Piercing Incendiary-T M20

Cartridge Caliber .504 Armor-Piercing Incendiary MK211 Modification 0/1
Tracer M17

Cartridge Caliber .50 Armor-Piercing Incendiary MK21 1 Modification 0

Cartridge Caliber .50 Blank Electric MK209 Modification 0

Cartridge Caliber .50 Spotter Tracer M48A2

Cartridge 40MM Green Smoke Canopy M679

Cartridge 40MM RED Smoke Canopy M682

Cartridge 40MM White Smoke Canopy M680

Cartridge 40MM Yellow Smoke Canopy M676

Cartridge Delay M252

Cartridge Impulse MK44 Modification 0.

Grenade Hand Smoke Green M18

Grenade Hand Smoke Hexachloroethane (smoke mixture) AN-M8

Grenade Hand Smoke Red M18

Grenade Hand Smoke Violet M18

Grenade Hand Smoke Yellow M18

Grenade Rifle Smoke Green STRMR M23A1

Grenade Rifle Smoke Red STRMR M23A1

Grenade Rifle Smoke Violet STRMR M23A1

Launcher and Grenade Smoke Hexachloroethane (Smoke Mixture) M226

Signal Illumination Marine MK3 Modification 3 Green

Signal Smoke and Illumination Aircraft SDU-28/A

Signal Smoke Ground Green Parachute M 28A1

Signal Smoke Ground Red Parachute M129A1

Signal Smoke Ground White M166

Smoke Pot Floating Type Hexachloroethane (Smoke Mixture) M4A2

Smoke Pot Floating Type with SGF2 AN-M7AI

Smoke POT GreenD Type SGF2 M6

=20

TACTICAL MISSILE SYSTEM

AMRAAM AIM-120

ASROC (Rkt Mtr) MK37 Mod 0

ASROC (Rkt Mtr), Vertical Launch MK114 Mod 0

ATACMS, Block I

ATACMS, Block 1A

Falcon AIM-4

HARM AGM-88B

HARM AGM-88C

HAVNAP AGM-142A

HAVNAP AGM-142B

Hawk MIM-23

JSOW AGM-154B

Maverick AGM-65(NB/DIH)

Maverick AGM-65(EIFIG)

MLRS

Modular AGM-i 30

Nike Hercules M30 Rkt Mtr

Patriot MIM-104

Penguin AGM-119

Phoenix AIM-54

RAM RIM-116

Redeye M41

Sea Sparrow AIM-7

Shrike AGM-45

Shrike ATM-45

Sidewinder AIM-9E, 9J, 9N, 9P

Sidewinder AIM-9L, AIM-9M

Sparrow AIM-7E-3

Sparrow AIM-7F/M

Sparrow AIM-7M

Spartan Si

Spartan S2

Spartan S3

STANDARD (ARM) AGM-78

STANDARD (ER) RIM-67

STANDARD (MR) RIM-66

Standard Missile RIM-i 56A

Stinger Post FIM-92A

Stinger Post FIM-92B

Terrier RIM-2 (AGM-2)

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Laura Olah, Executive Director

Citizens for Safe Water Around Badger

E12629 Weigands Bay S

Merrimac, WI 53561

phone: (608)643-3124

fax: (608)643-0005

email: info@cswab.com

website: http://www.cswab.com <http://www.cswab.com/>

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Follow-Ups

- **Re: [CPEO-MEF] perchlorate-containing munitions** *uxogypfy (02/19/03)*

Prev by Date: **[CPEO-MEF] Digest for cpeo-military@igc.topica.com, issue 709**
Next by Date: **[CPEO-MEF] trivia for the day: window caulking may contain asbestos**
Prev by Thread: **[CPEO-MEF] Digest for cpeo-military@igc.topica.com, issue 709**
Next by Thread: **Re: [CPEO-MEF] perchlorate-containing munitions**

CPEO Home | CPEO Lists | Author Index | Date Index | Thread Index
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ATTACHMENT E

RESPONSES TO USEPA AND VDEQ COMMENTS ON DRAFT PAPER

Response to USEPA Comments
Draft Perchlorate White Paper
Naval Weapons Station Yorktown

The Draft Perchlorate White Paper for Naval Weapons Station (WPNSTA) Yorktown was submitted on December 8, 2006. The United States Environmental Protection Agency (USEPA), Region III provided the following comments in a letter dated March 8, 2007. The Navy has evaluated these comments and offers the following responses for consideration and action.

Comment 1:
The document should be revised to include a discussion of the potential ecological effects of perchlorate, comparable to that presented in Section 2.6, Health Effects. The discussion should include proposed screening benchmarks for representative receptors.

Response to Comment 1:
The effects of perchlorate on ecosystems and ecosystem components have been evaluated through several studies; however there are still many uncertainties. Information on levels of perchlorate to which organisms were exposed and the effects on diverse taxonomic groups are limited because the number of species tested has been minimal. The USEPA released a Draft Report in 2002, *Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization,* which provides example screening benchmarks based on past perchlorate investigations. An additional section will be added to the text discussing the limited available data regarding ecological effects of perchlorate.

Comment 2:
Based on the summary of potential ecological effects, the document must address the applicability of the collection of samples from media other than groundwater for perchlorate analyses.

Response to Comment 2:
In accordance with current DoD policy (26 January 2006), the Navy would consider groundwater and surface water as the initial media for sampling. If it is detected at levels above 24 ppb (the DoD's Level of Concern [LOC] for managing perchlorate) then the Navy would consider additional investigations to assess site risks to other media. It is important to note that the DoD LOC (DON, 2006) for perchlorate is based on drinking water exposure to humans determined through the Natural Academy of Sciences toxicological review of perchlorate (National Research Council, 2005) and does not include screening levels for soils and sediments. In addition, based on a review of available information, sites where multiple media were sampled for perchlorate, groundwater and surface water exhibited the highest concentrations as compared to others. The document will be revised to clarify this.

During a review of this Response to Comments on July 23, 2007, the USEPA stated concerns about changes in perchlorate policy or the recommended reference dose.

The January 2006 DoD policy states that "Until such time as EPA or the states promulgate standards for perchlorate DoD is establishing 24 ppb as the current level for managing perchlorate. Once established, DoD will comply with applicable state or federal promulgated standards whichever is more stringent." This policy is stated in Section 4.0 of the Draft Perchlorate White Paper.

Comment 3:
The document should clearly state why the recommendations for sampling and analysis of perchlorate in groundwater are only made for the sites identified as having a high potential for perchlorate contamination. It appears that sampling of the majority of sites identified as having a "medium" potential is also warranted.

Response to Comment 3:
The Draft Perchlorate White Paper recommends sampling for perchlorate at the sites with a higher potential of contamination. If perchlorate is not detected at theses sites, then it would be less likely to be detected at the sites with a lower potential. Following the CERCLA phased approach, if perchlorate is widely detected at sites with a high potential, the Navy will consider sampling "medium" sites as listed in Table 4. In accordance with DoD policy (26 January 2006), the Navy must have a reasonable expectation of perchlorate being present before sampling.

Comment 4:
In Section 7.2 of the draft paper, "seven of the eight sites that have the highest probability of perchlorate use or disposal" at Yorktown are recommended for groundwater sampling and analysis. Why not all eight sites? An explanation should be provided for the elimination of one of the Yorktown sites potentially impacted by the release of perchlorate.

Response to Comment 4:
Site 7 was not originally recommended for sampling of perchlorate due to past remediation activities performed at the site and the declining levels of explosives following the remediation. However, after a further review of the Explosive Decontamination Plan for Loading Plants 1, 2, and 3 at Naval Weapons Station Yorktown, Virginia, (Anderson, 2000) Site 7 may have a higher potential for perchlorate contamination than originally perceived. The report states that ammonium perchlorate was used in a number of the areas near Site 7 including the overhead trolley from buildings 505 and 504. In addition the report speculated that Building 504 "appeared to be used for ammonium perchlorate weigh-up". This documentation of known perchlorate use would qualify Site 7 for a high potential for perchlorate contamination. The document will be revised to clarify the use of perchlorate at Site 7 and the recommendation for sampling.

The Navy will prepare separate site specific work plans for perchlorate sampling at all sites recommended in Table 5.

In section 7.1, the recommendations will be revised to clarify proposed sampling at Site 7 and Site 25.

References:

Anderson, Joseph. (2000). Explosive Decontamination Plan for Explosive Loading Plants 1, 2, and 3 at Naval Weapons Station Yorktown, Virginia. April 2000.

Department of the Navy (DON), Office of the Chief of Naval Operations. (2006) Navy Perchlorate Sampling and Management Policy. 15 April 2006.

National Research Council. (2005). Health Implications of Perchlorate Ingestion. National Academic Press; Washington D.C. January 2005.

Response to VDEQ Comments
Draft Perchlorate White Paper
Naval Weapons Station Yorktown

The Draft Perchlorate White Paper for Naval Weapons Station (WPNSTA) Yorktown was submitted on December 8, 2006. The Virginia Department of Environmental Quality provided the following comments in a letter dated June 25, 2007. The Navy has evaluated these comments and offers the following responses for consideration and action.

Comment 1:
Page ii:
Please change to: 1.1 Naval Weapons Station Yorktown History and Mission
Please change to: 6.1.3 Plant 3

Response to Comment 1: These changes will be made.

Comment 2:
Page iii:
Please change to: 3 – Summary of Perchlorate Sampling at Dahlgren NSWC
Please change to: 4 – WPNSTA Yorktown NERP Sites with Possible Perchlorate Contamination
Please insert a "List of Figures"

Response to Comment 2: These changes will be made.

Comment 3:
Page iv:
Please change to: ABL Allegany Ballistics ~~Coordinator~~ Laboratory

Response to Comment 3: This change will be made.

Comment 4:
Page v:
Please change to: WPNSTA Naval Weapons Station

Response to Comment 4: This change will be made.

Comment 5:
Page 1:
Please change to: …Naval Weapons Station (WPNSTA) Yorktown, Yorktown, Virginia.
Please change to: 1.1 Naval Weapons Station Yorktown History and Mission

Response to Comment 5*:* This change will be made.

Comment 6:
Page 3:
Please indicate where "Perchlorate has been detected in groundwater and surface water;"

Response to Comment 6: Additional information will be cited in the paper to describe available information on reported perchlorate contamination in groundwater and surface water. As of January 2005, perchlorate had been detected in 153 public water supply systems in 25 states (ITRC, 2005). Also, a U.S. Government Accountability Office Report, "Perchlorate: A System to Track Sampling and Cleanup Results is Needed" (GAO, 2005), states perchlorate has been found by federal and state agencies at almost 400 sites in groundwater, surface water, soil, or public drinking water in the United States. However, because there is not a standardized approach for reporting perchlorate data nationwide, a greater number of sites than we identified may already exist in the United States. Perchlorate has been found in 35 states, the District of Columbia, and 2 commonwealths of the United States. More than one-half of all sites were found in California and Texas, and sites in Arkansas, California, Texas, Nevada, and Utah had some of the highest concentration levels.

Comment 7:
Page 6:
Please change to: …a final risk-based dose…

Response to Comment 7: This change will be made.

Comment 8:
Page 7:
Please change to: …DoD established 24 ppb in water as the current level of concern (LOC)…

Response to Comment 8: This change will be made.

Comment 9:
Page 8:
Please revise text that indicates, "sampling continues today."

Response to Comment 9: The text will be revised to indicate that "At Dahlgren, the Navy voluntarily began sampling for perchlorate in 2001. This information was provided from a website created by the DoD Materials Evolving Regulatory Interest Team (MERIT). MERIT summarized the perchlorate status at Dahlgren Naval Surface Warfare Center. For purposes of this report additional research for the analytical data on the perchlorate sampling at Dahlgren was not conducted."

Comment 10:
Page 9:
The text indicates that the method detection limit for perchlorate in drinking water is 4 ppb. Then, the text states that there were positive detections of perchlorate in surface water, all below the reporting limit of 4 ppb. Please include a discussion on why the drinking water analysis and surface water analysis have different method detection limits for perchlorate.
Please indicate when the 170 wastewater samples were analyzed.
Please indicate when the 92 surface water samples were tested.
Please include a summary table of perchlorate sampling at ABL (i.e. Table 3).

Response to Comment 10: Perchlorate data from the DoD bases in the Mid-Atlantic area noted in Section 5.0 is based on the DoD MERIT database, which neither provides details on analytical methods used for perchlorate analysis in the different media nor sample locations. A summary table of perchlorate sampling at ABL is outside the scope of this report.

Comment 11:
Page 11:
Please insert a reference to Attachment D in Section 6.2.

Response to Comment 11: A reference to Attachment D will be inserted in Section 6.2.

Comment 12:
Page 12:
Please indicate the total number of NERP sites at WPNSTA Yorktown (20 or 21).

Response to Comment 12: The WPNSTA Yorktown 2007-2008 Site Management Plan (Baker, 2007) lists 42 NERP sites (see Table 1-1). Through an evaluation of the 42 NERP sites, Baker determined that 20 (with SSAs 2 and 19 being combined for the purposes of perchlorate discussions) that have a potential for possible perchlorate contamination.

Comment 13:
Page 13:
Please clarify that SSA 2 – Former EOD Disposal Area and SSA – 19 Beaver Road/Ponds 11 and 12 Drainage Area and Environs are being considered one NERP Site. The Navy's Thermal Treatment Unit (TTU) lies within the boundary of SSA 19 [March 2007 Site Management Plan].
Please include a "Site History" of SSA 19 and/or the Navy's TTU.
Please change to: SSA 17 – Building 1456 Mark 46 ~~Torpedo Shop~~ Waste Otto Fuel ~~Storage~~ Tank [March 2007 Site Management Plan].

Response to Comment 13: The TTU is not a CERCLA site and has not been addressed as such. The clarification of SSA 2, SSA 19, and the TTU will be made and the name of SSA 17 will be revised to match the name used in the Site Management Plan.

Comment 14:
Page 14:
Please include an additional explanation on why perchlorate sampling and analysis in groundwater should not be performed at "High Potential" Site 7.
Please include a discussion on what perchlorate sampling and analysis in groundwater will be performed at "High Potential" Site 9 and SSA 19/Navy's TTU.
Section 7.1 indicates that a groundwater investigation is not planned for Site 25, but Table 5 indicates that a groundwater investigation is planned for Site 25. Please clarify.
Please change to:…LOC for perchlorate of 24 ppb in water until such time…

Response to Comment 14: Site 7 was not originally recommended for sampling of perchlorate due to past remediation activities performed at the site and the declining levels of explosives following the remediation. However, after a further review of the Explosive Decontamination Plan for Loading Plants 1, 2, and 3 at Naval Weapons Station Yorktown, Virginia (Anderson, 2000), Site 7 may have a higher

potential for perchlorate contamination than originally perceived. The report states ammonium perchlorate was used in a number of the areas near Site 7 including the overhead trolley from buildings 505 and 504. In addition the report speculated that Building 504 "appeared to be used for ammonium perchlorate weigh-up". This documentation of known perchlorate use would qualify Site 7 for a high potential for perchlorate contamination. The document will be revised to clarify the use of perchlorate at Site 7 and the recommendation for sampling.

The Navy will prepare separate site specific work plans for perchlorate sampling at all sites recommended in Table 5.

In section 7.1, the recommendations will be revised to clarify proposed sampling at Site 7 and Site 25. The text will be changed to state … LOC for perchlorate of 24 ppb in water until such time.

Comment 15:
Page 15:
Please clarify that SSA 2 – Former EOD Disposal Area and SSA – 19 Beaver Road/Ponds 11 and 12 Drainage Area and Environs are being considered one NERP Site. The Navy's Thermal Treatment Unit (TTU) lies within the boundary of SSA 19 [March 2007 Site Management Plan].

Response to Comment 15: Please see the response to comment no. 13.

References:

Anderson, Joseph. (2000). Explosive Decontamination Plan for Explosive Loading Plants 1, 2, and 3 at Naval Weapons Station Yorktown, Virginia. April 2000.

Baker, (2007). Final 2007-2008 Site Management Plan Naval Weapons Station Yorktown, Yorktown, Virginia and Cheatham Annex, Williamsburg, Virginia. Virginia Beach, VA, March 2007.

Interstate Technology and Remediation Council (ITRC). (2005). Perchlorate: Overview of Issues, Status, and Remedial Options. Washington D.C., September 2005.

United States Government Accountability Office (GAO), (2005). Perchlorate: A System to Track Sampling and Cleanup Results is Needed. Washington D.C, May 2005.