EXHIBIT N

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1999

EPA Superfund
Record of Decision:

NAVAL AIR ENGINEERING CENTER
EPA ID: NJ7170023744
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LAKEHURST, NJ
09/27/1999

Final
Record of Decision
for
Areas I & J
Groundwater

at

Naval Air Engineering Station

Lakehurst, New Jersey

30 August 1990

DECLARATION STATEMENT
DRAFT RECORD OF DECISION
AREAS I & J GROUNDWATER
NAVAL AIR ENGINEERING STATION

FACILITY NAME AND LOCATION

Naval Air Engineering Station
Lakehurst, New Jersey 08733

STATEMENT OF BASIS AND PURPOSE

This decision document presents the final remedy to address Areas I and J groundwater at the Naval Air Engineering Station in Lakehurst, New Jersey. The selected alternative was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, Section 117), as amended by the Superfund Amendments and Reauthorization Act (SARA) and, to the extent practicable, the National Oil and Hazardous Substance Pollution Contingency Plan.

This decision is based on information contained in the Proposed Plan for Areas I and J Groundwater (NAES, June 1999), the Areas I and J Groundwater Natural Restoration Study (Tetra Tech NUS, May 1999), the Interim Record of Decision for Areas I and J Groundwater (NAES, November 1994), the Areas I and J Pre-Design Groundwater Remedial Investigation (Dames & Moore, April 1994), the Aquifer Characterization Investigation (Dames & Moore, October 1992), the Phase III Remedial Investigation Report (Dames & Moore, October 1992), and the Endangerment Assessment (EA) Report (Dames & Moore, October 1992). These reports and other information used in the remedy selection process are part of the facility's Administrative Record located in the Ocean County Library in Toms River, NJ.

This document provides background information on the site, presents the selected alternative and reviews the public's response to the Proposed Plan.

The United States Environmental Protection Agency (EPA), Region II Regional Administrator, and the Commissioner of the New Jersey Department of Environmental Protection (NJDEP) concur with the selected remedy.

DESCRIPTION OF THE SELECTED REMEDY

Areas I and J are areas of the Naval Air Engineering Station that were used for the testing of aircraft launching and recovery activities. Historical activities in these areas resulted in the contamination of groundwater. Practices that resulted in groundwater contamination have been terminated by the Navy. Source removal actions were taken at Sites 3 and 6 pursuant to a separate ROD for those sites.

The selected alternative is natural restoration with long-term groundwater monitoring to address the groundwater contamination in and downgradient of Areas I and J and co-metabolism to treat the higher area of groundwater contamination. Co-metabolism is a process in which microorganisms growing on one compound produce an enzyme that chemically transforms another compound on

which they cannot grow. The implementation of this alternative would require monitoring of the aquifer for both contaminant levels and parameters indicative of natural restoration to check the progress of the contaminant reduction. Modeling would also be conducted to provide updated predictions of the time required to meet applicable or relevant and appropriate requirements (ARARs). If natural attenuation and co-metabolism are not effective, air sparging, if demonstrated to be effective, will be implemented as a contingency remedy. The Classification Exception Area (CEA) will be established as an institutional control component of the remedy. Natural resource injuries will be evaluated and addressed as part of this remedy.

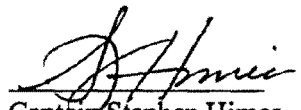
The objectives of the selected actions are to:

- Use co-metabolism to treat the higher area of groundwater contamination.
- Allow natural restoration to reduce the remaining groundwater contamination to levels that are protective of human health and the environment and comply with ARARs.
- Monitor the migration of the contaminated groundwater plume to ensure protection of human health and the environment.
- Protect human health and the environment by implementing institutional controls as necessary to restrict exposure to contaminated groundwater until cleanup has been achieved.

STATUTORY DETERMINATIONS

This final action for Areas I and J groundwater is protective of human health and the environment. This action will attain Federal and State applicable or relevant and appropriate requirements.

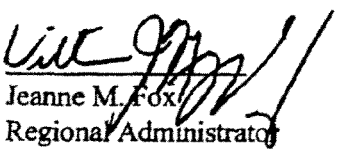
The remedies selected in this Record of Decision (ROD) are intended to allow for unrestricted use upon attainment of cleanup levels. It is the policy of EPA to conduct five-year reviews when the attainment of cleanup levels will take longer than five years. A five- year review covering this area will be conducted within five years of the date for construction completion of this site.



9/26/99
(Date)

Captain Stephen Himes
Commanding Officer
Naval Air Engineering Station
Lakehurst, New Jersey

With the concurrence of:



9/27/99
(Date)

Jeanne M. Fox
Regional Administrator
U.S. Environmental Protection Agency, Region II

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NAVAL AIR ENGINEERING STATION

1.0 SITE DESCRIPTION

The Naval Air Engineering Station (NAES) is located in Jackson and Manchester Townships, Ocean County, New Jersey, approximately 14 miles inland from the Atlantic Ocean (Figure 1). NAES is approximately 7,400 acres and is bordered by Route 547 to the east, the Fort Dix Military Reservation to the west, woodland to the north (portions of which are within Colliers Mill Wildlife Management Area), Lakehurst Borough and woodland, including the Manchester Wildlife Management Area, to the south. NAES and the surrounding area are located within the Pinelands National Reserve, the most extensive undeveloped land tract of the Middle Atlantic Seaboard. The groundwater at NAES is currently classified by NJDEP as Class I-PL (Pinelands).

NAES lies within the Outer Coastal Plain physiographic province, which is characterized by gently rolling terrain with minimal relief. Surface elevations within NAES range from a low of approximately 60 feet above mean sea level in the east central part of the base, to a high of approximately 190 feet above mean sea level in the southwestern part of the base. Maximum relief occurs in the southwestern part of the base because of its proximity to the more rolling terrain of the Inner Coastal Plain. Surface slopes are generally less than five percent.

NAES lies within the Toms River Drainage Basin. The basin is relatively small (191 square miles) and the residence time for surface drainage waters is short. Drainage from NAES discharges to the Ridgeway Branch to the north and to the Black and Union Branches to the south. All three streams discharge into the Toms River. Several headwater tributaries to these branches originate at NAES. Northern tributaries to the Ridgeway Branch include the Elisha, Success, Harris and Obhanan Ridgeway Branches. The southern tributaries to the Black and Union Branches include the North Ruckles and Middle Ruckles Branches and Manapaqua Brook. The Ridgeway and Union Branches then feed Pine Lake; located approximately 2.5 miles east of NAES before joining Toms River. Storm drainage from NAES is divided between the north and south, discharging into the Ridgeway Branch and Union Branch, respectively. The Paint Branch, located in the east-central part of the base, is a relatively small stream which feeds the Manapaqua Brook.

Three small water bodies are located in the western portion of NAES: Bass Lake, Clubhouse Lake, and Pickerel Pond. NAES also contains over 1,300 acres of flood-prone areas, occurring primarily in the south-central part of the base, and approximately 1,300 acres of prime agricultural land in the western portion of the base.

The history of the site dates back to 1916, when the Eddystone Chemical Company leased property from the Manchester Land Development Company to develop an experimental firing range for the testing of chemical artillery shells. In 1919, the U.S. Army assumed control of the site and named it Camp Kendrick. Camp Kendrick was turned over to the Navy and formally commissioned Naval Air Station (NAS) Lakehurst, New Jersey on June 28, 1921. The Naval Air Engineering Center (NAEC) was moved from the Naval Base, Philadelphia to Lakehurst in December 1974. At that time, NAEC

became the host activity, thus, the new name NAEC. In January 1992, NAEC was renamed the Naval Air Warfare Center Aircraft Division Lakehurst (NAWCADLKE), due to a reorganization within the Department of the Navy. In January 1994, the NAWCADLKE was renamed the Naval Air Engineering Station (NAES), due to continued reorganization within the Department of the Navy.

Currently, NAES's mission is to support programs of technology development, engineering, developmental evaluation and verification, systems integration, limited manufacturing, procurement, integrated logistic support management, and fleet engineering support for Aircraft-Platform Interface (API) systems. This includes terminal guidance, recovery, handling, propulsion support, avionics support, servicing and maintenance, aircraft/weapons/ship compatibility, and takeoff. The Station provides, operates, and maintains product evaluation and verification sites, aviation and other facilities, and support services (including development of equipment and instrumentation) for API systems and other Department of Defense programs. The Station also provides facilities and support services for tenant activities and units as designed by appropriate authority.

NAES and its tenant activities now occupy more than 300 buildings, built between 1919 and 1996, totaling over 2,845,000 square feet. The command also operates and maintains: two 5,000-foot long runways, a 12,000-foot long test runway, one-mile long jet car test track, four one and one-quarter mile long jet car test tracks, a parachute jump circle, a 79-acre golf course, and a 3,500-acre conservation area.

In the past, the various operations and activities at the Station required the use, handling, storage and occasionally the on-site disposal of hazardous substances. During the operational period of the facility, there have been documented, reported or suspected releases of these substances into the environment.

2.0 SITE HISTORY

Areas I and J are located along the southern boundary of NAES in the west central portion of the Station (Figures 2 and 3). The NAES property boundary forms the southern border of Area 1. Areas I and J are largely developed and include various Navy testing facilities, including a steam plant, catapult launching facilities and a runway arrested landing site (RALS) facility (Figures 4-6). The catapult runway traverses Areas I and J and Taxiway No. 4 parallels the southern NAES property line in the eastern portion of the Area. Groundwater flow in Areas I and J is in a generally east to southeast direction toward the facility boundary (Figure 7).

Since the facilities in Areas I and J were constructed in 1958, they have been used for the testing of aircraft launching and recovery activities. Past releases of liquid wastes associated with these testing activities resulted in the contamination of groundwater at these Areas. Potential sources of groundwater contamination east of the catapult and taxiway include past releases of wastewater from the catapult test facility, past releases of liquid wastes at the catapult test facility storage area, past releases associated with testing of catapult equipment, and former launching/recovery activities on Taxiway No. 4. This contamination occurred during the 1960's and early 1970's. Potential sources of the contaminant plume south of the runway include past releases of wastewater from the RALS facility, former activities at the jet blast deflector site, and former runway launching/recovery activities. The sources of groundwater contamination are believed to be the result of releases that

occurred in the past and no longer exist. The Remedial Investigation section of this report summarizes the potential past contaminant sources.

The primary contaminants present in groundwater at Areas I and J and downgradient, off-base locations are chlorinated volatile organic compounds (VOCs) including cis-1,2-dichloroethene, 1,1dichloroethene, 1,1-dichloroethane, 1,1,1-trichloroethane, trichloroethene and tetrachloroethene. The groundwater contamination appears to occur in two discrete areas (Figure 8). One zone extends along the base boundary east of Taxiway No. 4 and the other area is to the south of the catapult runway. At the former area, detectable levels of VOCs appear to occur in a plume extending approximately 5,000 feet beyond the NAES boundary. In the latter area, the contaminant plume extends approximately 4,400 feet downgradient from the facility boundary, The impacted off-base property is undeveloped and currently there are no approved plans for future development of this area. Upgradient of this area, lower levels (< 10 ppb) of contamination extend to the area near the RALS facility. Vertically, the contamination extends 70 feet below the groundwater table with the largest amount of contamination in the zone from 30 to 50 feet below the groundwater table.

There are currently five supply wells in use in Areas I and J (Figure 4). NAES well no. 32 and well no. 45 are located in Area I. These wells are 1583 ft. and 1567 ft. deep, respectively. They were placed in the deeper Potomac-Raritan-Magothy aquifer due to the high quantity of water needed for aircraft catapult testing activities conducted in the area. The water from these wells is used for both potable and testing purposes. Due to the depth of these wells, they are not impacted by the groundwater contamination in the area. NAES well no. 16 is also located in Area I. This well is 52 feet deep. This well is only used for fire protection. NAES well no. 23 and well no. 41 are located in Area J. These wells are 60 ft. and 75 ft. deep, respectively. The water from these wells is used for bathroom toilets and sinks and jet blast deflector testing. Sampling of these wells did not show any VOC levels. However, as a precaution, signs are posted at sinks in the area to prevent the ingestion of this water.

2.1 INITIAL INVESTIGATIONS

As part of the DOD Installation Restoration Program and the Navy Assessment and Control of Installation Pollutants (NACIP) program, an initial Assessment Study was conducted in 1983 to identify and assess sites posing a potential threat to human health or the environment due to contamination from past hazardous materials operations.

Based on information from historical records, aerial photographs, field inspections, and personnel interviews, the study identified a total of 44 potentially contaminated sites. An additional site, Bomarc, was also investigated by NAES. The Bomarc Site is the responsibility of the U.S. Air Force and is located on Fort Dix adjacent to the western portion of NAES. A Remedial Investigation (RI) was recommended to confirm or deny the existence of the suspected contamination and to quantify the extent of any problems that may exist. Following further review of available data by Navy personnel, it was decided that 42 of the 44 sites should be included in the Remedial Investigation. Two potentially contaminated sites, an ordnance site (Site 41) and an Advanced Underground Storage Facility (Site 43), were deleted from the Remedial Investigation because they had already been addressed through previous investigations or standard removal procedures.

In 1987, NAES was designated as a National Priorities List (NPL) or Superfund site under the federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

2.2 REMEDIAL INVESTIGATIONS

Remedial Investigations revealed the existence of an extensive groundwater contaminant plume in Areas I and J and downgradient off-base locations. The main contaminants of the plume are chlorinated volatile organic compounds (VOCs). The chlorinated VOC groundwater contaminant plume in Areas I and J encompasses portions of Sites 3, 6, 7, 22, 24, 25, areas along Taxiway No. 4, the catapult and runway area, and the off-base area to the east. Areas I and J contain a wide range of potential contaminant sources generally related to past facility activities and possible associated releases. Reported or potential contaminant sources at these sites that may have contributed to the plume are summarized below:

AREA	SITE	REPORTED OR POTENTIAL CONTAMINANT SOURCES
J	3	Past releases of contaminated waste water into the adjacent drainage swale (Figure 6)
I	6	Contaminated sediment present in the holding ponds and drainage swales (Figure 5)
I	7	Potential disposal of various liquid wastes at the Catapult Test Facility Storage Area (Figures 5)
J	22	Former activities at the Jet Blast Deflector which may have resulted in the release of fuels or other liquid wastes into the ground (Figure 6)
I	24	Testing of catapult equipment and associated releases of various liquid wastes (Figure 5)

- A gravel and blacktop area in which catapult testing also occurred, located approximately 450 feet to the south/southeast of the catapult runway, and south of Site 24 (Figure 5)
- An area to the southwest of Building 453 and Site 25, in which the steam-cleaning of various equipment reportedly occurred (Figure 5)
- An area located adjacent to (on both the southeast and northwest sides of) Taxiway No. 4, approximately 3,450 feet northeast of Site 6, in which catapult testing also occurred (Figure 4)
- The area surrounding the Conservation Rod and Gun Club (Building 525), located to the immediate northwest of Taxiway No. 4 where it was reported that various liquid wastes may have been disposed of around the building, which was formerly used for storage (Figure 4)

Investigations at some of these sites were initiated in 1982 by NAES with the installation of a series of groundwater monitoring wells, which were monitored on a regular basis for the presence of fuel product. Additional investigations conducted at these sites include:

Phase I Remedial Investigation (RI)(1985-1986) - Additional monitoring wells were installed and groundwater samples were collected from all new and existing wells for comprehensive chemical analyses. The Phase I groundwater analytical results for Areas I and J are contained in the Phase I Remedial Investigation Report, dated April 1987, which is available for review in the Station's Administrative Record.

A visual inspection of Areas I and J was conducted to locate possible source areas.

Soil Gas and Groundwater Screening Survey (May - June 1988) - A soil gas and groundwater screening survey was conducted at and downgradient from several sites in Area I and J to determine possible source areas. On the basis of the data, additional investigations were recommended.

Phase II Remedial Investigation (1988) - Additional monitoring wells were installed and two rounds of samples were collected from all new and existing wells for comprehensive chemical analyses. The Phase II groundwater analytical results for Areas I and J are contained in the Phase II Remedial Investigation Report, dated July 1990, which is available for review in the Station's Administrative Record.

As part of the Phase II investigation, soil sampling was conducted at Sites 3, 6, 7, 22, 24, and 25 and sediment sampling was conducted at Sites 3, 6, and 25 to determinethe extent of contamination identified in the Phase I Remedial Investigation and the Soil Gas and Groundwater Screening Survey. Soil, sediment, and surface water at these Sites are addressed in other RODs as indicatedin the Introduction/Background section of this report.

Phase III Remedial Investigation (1991-1992) - A Hydropunch is a sampling device that allows a groundwater sample to be obtained without the installation of a well. Analysis of groundwater, using the Hydropunch, at 39 locations allowed samples to be collected and analyzed at different depths of the plume (approximately 10, 30, 50, 70 feet below groundwater). The Hydropunch was used throughout the potential source areas and downgradient (including off-base locations) to determine boththe horizontal and vertical extent of detected groundwater contamination.
Monitoring wells were then installed,at key locations, throughout and downgradient of the plume in order to monitor groundwater quality, monitor plume migration and define the downgradient extent of the plume. The Phase III groundwater analytical results for Areas I and J are contained in the Phase III Remedial Investigation Report dated October 1992 which is available for review in the Station's Administrative Record.

As part of the Phase III investigation, additional soil sampling was conducted at Sites 7 and 24 and sediment sampling was conducted at Sites 3, 6, and 25 to further define the extent of contamination at these areas. Soil, sediment and surface water at these Sites are addressed in other RODs as indicated in the Introduction/Background section of this report.

Soil Screening Survey (April 1992) - During the Spring of 1992, additional investigations were conducted in Areas I and J to determine if any additional sources of groundwater contamination could

be found. The areas of investigation were chosen based on reports of past activities at NAES, past sampling results and possible source locations based on the plume location as defined by the remedial investigations. Nine areas were investigated. Within each of the areas of investigation, several soil borings were drilled to depths of three to four feet below ground surface. The soil and bore holes were monitored with an HNu photoionization detector (PID). Of the nine areas, three required further investigation due to high readings on the PID. These areas were 1) along the NAWC south boundary road by well cluster IL, IM and IN; 2) an area south of Clubhouse Road and 3) Site 24.

Further investigations conducted were: 1) NAWC South Boundary Road by well cluster IL, IM and IN: This area required further investigation due to a PID reading of 40 ppm at a depth of four feet in one of several borings. Two samples were taken in May 1992 and analyzed at a laboratory for total petroleum hydrocarbons (TPHC) and VOC. No contamination was detected. 2) South of Clubhouse Road: This area required further investigation due to readings of 15 ppm on the PID at a depth of 2 feet in three of the borings at the site. Samples were taken in May 1992 and laboratory analyzed for TPHC and VOC. No contamination was found. 3) Site 24: During investigations, a localized area of the site appeared to be contaminated with a petroleum product to a depth of approximately three feet. Screening with the PID showed levels of 300 to 400 ppm in three borings. In May 1992, samples were taken at these locations and laboratory tested for TPHC, VOC and base neutrals. All samples were below NJDEP impact to groundwater and both residential and non-residential direct contact soil cleanup criteria. At these areas, the PID readings were not confirmed by laboratory analysis possibly due to the detection of methane or other organic compounds that are not included as part of the VOC results.

Aquifer Characterization Investigation in Areas I and J (October 1992) - The objective of this investigation was to develop data that could be used to design a groundwater remedial system capable of capturing and treating the contaminated groundwater as discussed in the previous section. A preliminary two-dimensional groundwater flow model was developed based on the results of this study. The model provided a representation of the conditions at Areas I and J and was used to develop a conceptual recovery system design.

A long-term (72 hour) pumping test was conducted on a recovery well located in Area I and J. This pumping test was conducted to determine site-specific aquifer characteristics. This data was used to generate different pumping scenarios based on the recovery of plumes of different contaminant concentrations (>50ppb, >10 ppb, >1 ppb). The pump test was performed 22-26 October 1992 and a remedial modeling report was submitted to the Navy on 16 February 1993.

Within the study area, there are wetlands that may be impacted as a result of groundwater pumping. As part of the aquifer characterization report, drawdown projections were estimated for the preliminary groundwater recovery scenarios.

The results of the report, concerning plurne capture and impact to wetlands, were used to develop preliminary alternatives for plume recovery. It was recornmended that a three-dimensional model be developed and used to design a recovery system.

Groundwater, Sediment and Surface Water Sampling - Area I and J (February 1993) - Sediment and surface water samples were taken at six location in the North Ruckles Branch, Black Branch and Manapaqua Brook. These samples were taken at locations where the plume appears to discharge at or

near the surface water bodies (Figure 9). These samples were taken to confirm if the plume is discharging into the downgradient surface water bodies. All the monitoring wells and supply wells in the area were sampled to provide a comprehensive set of well sampling data. The results indicated the presence of low levels of volatile organic compounds in the North Ruckles Branch and Black Branch sediment, downgradient of the plume. These levels will be used as a baseline for comparison of future results. No volatile contaminants were detected in surface water samples. Of the fifty-nine monitoring wells sampled, forty-three of the wells had non-detectable levels of volatile organic contamination.
No volatile organic contamination was detected in supply wells tested. The results for this round of sampling are contained in the Groundwater, Sediment and Surface Water Sampling and Analysis Report - Areas I and J dated July 1993.

Pre-Design Groundwater Remedial Investigation - Areas I and J (April 1994) - A three-part investigation was conducted between July 1993 and February 1994. The objective of the study was to obtain the necessary data for the design of a system to remediate volatile organic compounds (VOCs) in groundwater at Areas I and J and downgradient, off-base locations. The investigation consisted of the following three studies: 1) Groundwater Modeling Study; 2) Wetland Impact Study; and 3) Recharge Basin Study.

The groundwater modeling study consisted of the setup and calibration of a three-dimensional groundwater flow and contaminant transport model, which was used to predict the fate and transport of the VOC plume under existing natural conditions and various remedial alternatives. The remedial alternatives considered in the modeling were based on the principle of pump-and-treat to achieve hydraulic control, containment, and withdrawal of the plume. The goal of the modeling was to identify a groundwater recovery/recharge scheme that would allow an optimal remediation of the plume. An optimal scheme was considered to achieve hydraulic containment of elevated chlorinated VOCs and at the same time minimize the groundwater recovery and treatment time, the number of recovery wells, the groundwater recovery rate, and the adverse impact to area wetlands. The model indicated that the impact of contaminant degradation is the most important attenuation mechanism for the plume. The effect of pumping was insignificant when compared to the mass loss due to degradation.

A primary concern associated with the implementation of a groundwater recovery and treatment system in and downgradient of Areas I and J is the potential for reduction of wetlands within the drawdown zone. Wetland reduction could result in a loss of habitat for several locally occurring, rare and protected wetland plant species and reduce habitat for wetland dependent animal species. A study was conducted to evaluate the effects to groundwater-driven wetlands resulting from drawdown associated with different groundwater recovery/recharge schemes. The results were used as a basis for the selection of the final remedial scheme. Wetland losses for the pumping scenarios varied from 87 acres to 113 acres. The wetland loss compared to the various pumping scenarios and wetland loss calculations can be found in the Pre-design Groundwater Remedial Investigation Report for Areas I and J.

A recharge basin study was conducted to identify and select an area suitable for a recharge basin system capable of accepting treated water. The best area for recharge was identified based on field investigations. A pilot recharge basin test was conducted in this area to determine design parameters for the design of a full-scale system.

The results of this study can be found in the Pre-design Groundwater Remedial Investigation Report for Areas I and J dated April 1994 which is available for review in the Station's Administrative Record.

Groundwater Natural Restoration Study - Areas I and J (May 1999) - As a result of the uncertainty regarding the long-term effectiveness of a groundwater recovery, treatment and recharge system, and the concern regarding the potentially significant loss of wetlands, natural attenuation was designated as the preferred interim alternative for Areas I and J groundwater. This interim action was presented to the public on September 14, 1994 and a Record of Decision for a Natural Restoration Study was signed on January 5, 1995. Subsequently, a three year study was initiated in 1996 to verify the existence and evaluate the effectiveness of the natural attenuation process in degrading the VOC plume in Areas I and J and downgradient, off-base locations.

The study consisted of groundwater monitoring for VOCs and parameters indicative of contaminant degradation activity, geostatistical analysis, and groundwater modeling. A monitoring well network of 85 wells located throughout and downgradient of the area of groundwater contamination was sampled for VOCs on a semi-annual basis. This sampling was intended to monitor plume migration, monitor the downgradient line of compliance wells, and verify the horizontal and vertical extent of the plume. The current downgradient line of compliance wells are the following: JS, JT, LS, LU, JW, JJ, IS, IT, IQ, and ME. Quarterly sampling of 14 wells for VOCs was also conducted to identify and evaluate spatial and temporal trends and correlation between analytical parameters that are indicative of natural restoration. In-situ measurements of temperature, dissolved oxygen, dissolved iron, oxidation reduction potential, electrical conductivity, pH, and turbidity were conducted during the quarterly and semi-annual sampling events to assess if conditions are favorable to promote degradation and quantify indicators of degradation activity. Groundwater samples were also collected from 12 wells chosen to allow both spatial and vertical characterization of the impacted aquifer and surrounding uncontaminated zones. The following parameters which are indicative of contaminant degradation activity were collected: dissolved oxygen, pH, oxidation reduction potential, specific conductivity, temperature, dissolved organic carbon, alkalinity, VOCs, carbon dioxide, hydrogen sulfide, ethane, ethene, methane, chloride, dissolved oxygen, nitrate/nitrite, iron (II), sulfate, ammonia, phosphate, and metals. Four soil samples were collected from the saturated zone to characterize the subsurface soil conditions and demonstrate the presence of a diverse microbial population in the subsurface. Soil samples were analyzed for: grain size, total organic carbon, total kjeldahl nitrogen, nitrite, nitrate, ammonia, total phosphate, metals, bacterial populations by phospholipid analysis, and VOCs. Geostatistical analysis of the data was conducted to evaluate the levels of uncertainty within the data collected, provide recommendations for improving data quality, evaluate correlation among parameters that influence rates of degradation, and identify, evaluate, and quantify trends that are indicative of dechlorination. Modelingwas conducted using the Modflow groundwater flow model and MT3D contaminant transport model.

The study used three lines of evidence to document the presence of natural restoration processes and quantify its impact on the chlorinated VOC plume in Areas I and J and downgradient, off-base locations. The first line of evidence requires that contaminant loss or transformation in the field be documented. This is accomplished through analysis for chlorinated VOC parent compounds, transformation intermediates, and end products in groundwaterthrough specialized sampling and periodic monitoring of the plume. The data gathered was used to calculate decay rates of contaminants over both time and space and to monitor changes in the contaminant mass contained

within the plume. The second line of evidence requires that the distribution of electron donors and acceptors and/or alteration of groundwater chemistry be consistent with intrinsic biodegradation processes. This is accomplished by analyzing for electron donors and acceptors in groundwater. Of particular concern was the delineation of aerobic and anaerobic zones within the plume. This dictates the type of biological degradation taking place within those zones. The third line of evidence requires direct microbial evidence that indigenous bacteria are capable of mediating the contaminant transformations observed. This evidence is well established through numerous laboratory and field studies for the biological transformnations of chlorinated VOCs.

A report, which presented the results of the first year of the study, was issued in December 1997 (Brown and Root Environmental). The preliminary results of the Natural Restoration Study indicated that natural restoration processes, primarily in the form of intrinsic biodegradation, were active within the contaminant plume. The preliminary results of the groundwater contaminant fate and transport modeling indicated that the plume would be reduced naturally to levels below ARARs in approximately 60 years.

Modifications based on the first year of the study included changing the wells sampled quarterly to wells that lie along common groundwater flow paths in order to refine attenuation and mass reduction rate estimates. The low flow sampling protocol was implemented to obtain more accurate sampling results. The semi-annual sampling program was revised to eliminate the sampling of 40 wells, only wells that were important tothe natural restoration study continued to be sampled. Additional work conducted as a result of the first year of the study included installation of staff gauges in area streams and ponds and conducting flowmeter and slug tests to improve the modeling data. The modeling effort was upgraded through the use of the biologically reactive multispecies transport model RT3D. With this more advanced model, transport of individual contaminants, as opposed to transport of total VOCs, can be simulated.

The final Natural Restoration Study report was issued in May 1999 (Tetra Tech NUS). The results of the study indicated that natural restoration processes, primarily in the form of intrinsic biodegradation, are active within the contaminant plume. The presence of intrinsic biodegradation is supported by: widespread distribution of chlorinated VOC dehalogenation products, the presence of anaerobic conditions near contaminant source areas, and oxidation of lightly chlorinated VOCs by aerobic bacteria. Groundwater flow and contaminant transport modeling supports natural restoration as a viable remedial strategy for Areas I and J groundwater. Groundwater flow and contaminant transport modeling based on the information developed during the Natural Restoration Study predicts that all contaminant concentrations will meet ARARs by the year 2042.

The Natural Restoration Study for Areas I and J groundwater is available for review in the Station's Administrative Record.

Summary

The results of the above investigations have revealed that the primary contaminants present in groundwater are chlorinated volatile organic compounds. The chlorinated compounds most commonly detected include cis- 1,2-dichloroethene, 1,1-dichloroethene, 1,1-dichloroethane, 1,1,1trichloroethane, trichloroethene and tetrachloroethene.Table 1 provides a summary of all VOCs that were detected in and downgradient of Areas I and J above ARARs.

Benzene, toluene, ethylbenzene and xylene (BTEX) were detected at a few locations and, with one exception, at low concentrations. BTEX in a shallow sample collected at one off-base location is believed to be attributable to an unidentified minor off-base petroleum release and not related to activities at NAES.

Based on the results of groundwater sampling, contamination appears to occur at low levels at and downgradient of the RALS facility. This was probably the result of past releases of contaminated wastewater into the drainage swale at Site 3 and, to a lesser extent, the former activities at the Jet Blast Deflector which may have resulted in the releases of liquid wastes (Figure 6).

The area of higher contamination to the south of the catapult runway appears to be the result of catapult testing which occurred on a gravel and blacktop area located approximately 450 feet to the south/southeast of the catapult runway and south of Site 24 (Figure 5).

The area of contamination which extends off-base, to the east of the catapult area, appears to emanate from the area where steam-cleaning of various equipment reportedly occurred, to the southwest of building 453 and Site 25. Contamination could also be from the area adjacent to Taxiway No. 4 in which catapult testing also-occurred and possibly from the area surrounding the Conservation Club, where it was reported that liquid wastes may have been disposed (Figures 4 and 5).

Previous actions have addressed the potential source areas, so that no further impact to groundwater is expected from them. These actions are summarized in the Introduction/Background section of this report.

Based on the results of the Remedial Investigation, the Navy originally proposed a groundwater recovery, treatment and recharge system as the preferred remedial alternative. However, in 1993 and 1994, a Groundwater Modeling Study, Wetland Impact Study and Recharge Basin Study were conducted to select and design the optimum groundwater extraction scheme capable of remediating the aquifer, while minimizing the adverse impact on wetlands. The results of these studies indicated that the effects of pumping would be insignificant compared to the reduction of contaminants resulting from natural attenuation and that groundwater recovery could result in the loss of 87 acres of wetlands.

As a result of those studies, an interim Record of Decision for Areas I and J groundwater (November 30, 1994) designated natural attenuation as the preferred remedial alternative. As part of the interim decision for Areas I and J groundwater, it was determined that NAES would evaluate the effects of natural restoration for a period of three years. If this study determined that natural restoration would be effective, this alternative would then become the final alternative for Areas I and J groundwater.

A three year study was conducted between 1996 and 1999 to verify the existence and evaluate the effectiveness of the natural attenuation process in degrading the VOC plume in Areas I and J and downgradient, off-base locations. The Natural Attenuation Study demonstrated that natural restoration processes, primarily in the form of intrinsic biodegradation, are active within the contaminant plume. Groundwater flow and contaminant transport modeling, conducted as part of the study, predicts that natural restoration will reduce all contaminant concentrations to meet ARARs in 44 years (2042). The study recommends that natural restoration be selected as the final alternative for the remediation of groundwater contamination in Areas I and J, and downgradient

off-base locations. The 3 Year Groundwater Natural Restoration Study report for Areas I and J Groundwater, dated May 1999, is available in the Administrative Record for NAES.

Table 1
Areas I and J
Highest Detected Concentration of Volatile Organic Compounds Which Exceeded Federal and/or State Groundwater Cleanup Standards
(as of August 1998)

Contaminant	Result (ug/l)	Sample Location	Sample Round	Federal MCL (ug/l)	State PQL (ug/l)
Benzene	4.55	HPI-21	RI Phase III (Nov. 1991)	5	1
Bromodichloromethane	1.32	NC	Mar. 1998	-	1
Bromoform	3.6	LK	Sept. 1996	-	0.8
Chlorodibromomethane	1.75	NC	Mar. 1998	-	1
Chloroform	2.9	LC	May 1998	100	1
1,2-dichloroethane	3.02	LK	Sept. 1996	-	2
1,1-dichloroethene	12.3	LF	May 1996	7	2
cis-1,2-dichloroethene	513.73	LK	Aug. 1998	70	2
trans-1,2-dichloroethene	8.57	MC	Feb. 1996	70	2
Ethylbenzene	7.5	HPI-21	RI Phase III (Nov. 1991)	700	5
methylene chloride	440 J	DH	RI Phase II (Sept 1988)	5	2
1,1,2,2-tetrachloromethane	2.01	LK	Sept. 1996	-	1
Tetrachloroethene	233	LK	May 1996	5	1
Toluene	24.1 J	HPI-21	RI Phase III (Nov. 1991)	1000	5
1,1,1-trichloroethane	139	LK	May 1996	200	1
Trichloroethene	291	LK	May 1996	5	1
vinyl chloride	33	DI	Feb. 1993	2	2
m&p-xylenes	35.8 J	HPI-21	RI Phase III (Nov. 1991)	10,000	2
o-xylenes	19.3 J	HPI-21	RI Phase III (Nov. 1991)	10,000	1

J - Quantitation is approximate due to limitations identified during data validation
MCL -Maximum Contaminant Levels
PQL - Practical Quantitation Levels

Primary Maximum Contaminant Levels (MCLs) are Federally enforceable contaminant levels allowable in public drinking water supplies. They have been established from health-based data by EPA's Office of Drinking Water and are described in the National Primary Drinking Water Regulations (40 CFR 141) established under the authority of the Safe Drinking Water Act. MCLs are periodically revised as more information becomes available. When MCLs are not available, proposed MCLs were used as the comparison criteria for some analytes.

On 13 January 1993, the revised N.J.A.C. 7:9-6 which includes the Groundwater Quality Criteria was signed. The criteria establish the groundwater classifications for the Pinelands, including Class I-PL (Preservation Area) and Class I-PL (Protection Area). The actual groundwater criteria are the natural quality and background quality, respectively (N.J.A.C. 7:9-6.7). However, for some constituents natural quality is often much lower than can be measured in a laboratory, therefore, some measurable criteria are necessary to determine compliance. Practical Quantitation Levels (PQLs) are the lowest concentration of a constituent that can be reliably achieved among laboratories within specified limits of precision and accuracy during routine laboratory operating conditions. PQLs will be used to determine compliance with groundwater quality criteria for Class I-PL groundwater.

3.0 HIGHLIGHTS OF THE COMMUNITY PARTICIPATION

The 2nd Draft Proposed plan for areas I and J groundwaterwas issued to interested parties on May 3, 1999. On May 3 and 4, 1999, a newspaper notification inviting public comment on the Proposed Plan appeared in The Ocean County Observer and The Asbury Park Press. The comment period was held from May 3, 1999 through July 23, 1999. The newspaper notification also identified the Ocean County Library as the location of the Administrative Record.

A Public Meeting was held on May 19, 1999 at the Manchester Branch of the Ocean County Library from 6:00 to 7:00 p.m. At this meeting, representatives from the Navy, EPA and NJDEP were available to answer questions concerning Areas I and J groundwater and the preferred alternative. The attendance list is provided in this Record of Decision as Appendix A. Comments received and responses provided during the public meeting are included inthe Responsiveness Summary, which is part of this Record of Decision.

During the public comment period several written comments were received pertaining to Areas I and J groundwater. Written comments and responses are included in the Responsiveness Summary, which is part of this Record of Decision.

On May 18, 1999, the EPA submitted additional written comments to the Proposed Plan for Areas I and J groundwater. The Proposed Plan was revised to include these comments. A copy of the final Proposed Plan for Areas I and J groundwater, dated June 11, 1999, has been placed in the Administrative Record for NAES located at the Ocean County Library, Toms River NJ.

This decision document presents the selected alternative (i.e., natural restoration with long-term monitoring and co-metabolism) for Areas I and J groundwater, chosen in accordance with CERCLA, as amended by SARA and, to the extent practicable, the National Contingency Plan (NCP). The decision for Areas I and J groundwater is based on the information contained in the Administrative Record, which is available for public review at the Ocean County Library, 10 1 Washington Street, Toms River, New Jersey.

4.0 SCOPE AND ROLE OF RESPONSE ACTION

There are 44 sites at NAES and one additional "off-site" site that were investigated for potential remediation. This document is intended to propose the final alternative to address groundwater contamination at Areas I and J. It does not address other areas at NAES, orsites other than those in Areas I and J at which groundwater contamination has been detected. Other sites, as well as potential soil, sediment, and surface water contamination in Areas I and J have been addressed as separate remedial actions.

Studies conducted at and downgradient of Areas I and J have shown that the groundwater in this area has been contaminated with chlorinated volatile organic compounds as a result of past releases of liquid wastes associated with testing and maintenance activities. This contamination occurred during the 1960's and early 1970's. The sources of groundwater contamination are believed to be the result of releases that occurred in the past and no longer exist. Other actions as follows have addressed these potential sources, so that no further impact to groundwater is expected from them.

At Sites 3 and 6, located within Areas I and J, contaminated sediment was removed in June of 1993 for treatment via on site recycling. Post removal sampling indicated no evidence of any significant contamination remaining at Sites 3 and 6. No unacceptable risks to human health or the environment exist at these Sites. No potential impact to groundwater exists at these Sites. Therefore, ndurther action is necessary for Sites 3 and 6. The Record of Decision (ROD) for contaminated sediment removal at Sites 3 and 6 is dated September 14, 1993. No additional soil or sediment contamination has been identified which could have been a source of the groundwater contamination in Areas I and J.

The results of environmental investigations conducted at Sites 7, 22, 24, and 25, located in Areas I and J, showed no evidence of any significant contamination. No unacceptable risks to human health or the environment exist at these Sites. No potential impact to groundwater exists at these Sites. Therefore, no action is necessary for Sites 7, 22, 24, and 25, The ROD that documented no further action at Sites 7, 22, 24, and 25 was issued on September 14, 1993.

The Records of Decision for Sites 3, 6, 7, 22, 24, and 25 and other referenced documents used in the preparation of this document are available for review in the facility's Administrative Record located in the Ocean County Library in Toms River, NJ.

5.0 SUMMARY OF SITE RISKS

In April 1992, an overall endangerment assessment for NAES was conducted. The objective of this Endangerment Assessment (EA) was to assess the potential current and future human health risks and potential environmental impacts posed by contaminated soils, groundwater, sediment, and surface water at NAES. The specific objectives of the EA were to:

- Apply appropriate human health EA and ecological assessment (ECA) methodologies to fulfill the U.S. Environmental Protection Agency's (EPA) requirement to conduct such assessments.

- Identify the NAES sites that should be targeted to undergo a remedial alternatives evaluation to control or reduce contamination, based on the quantitative human health EA results and the semiquantitative ECA results.
- Identify prudent target remedial objectives such as: (1) source control and monitoring, (2) chemical and media-specific cleanup goals, and (3) other objectives, if applicable, for those sites estimated to require a remedial alternatives evaluation (i.e., sites posing current or future risks or posing unacceptable ecological impacts).

Based on available information, NAES was considered to be a potential public health concern because of the risk to human health caused by the possibility of exposure to hazardous substances via contaminated groundwater, soil, sediment, and surface water.

5.1 Areas I and J Endangerment Assessment Summary (Groundwater)

This is a summary of the Endangerment Assessment (EA) addendum findings for groundwater in Areas I and J and downgradient off-base locations. The assessment of this site was conducted using all available data generated during the remedial investigation (RI). This risk summary is limited to groundwater, the only media addressed in this FS. All other media associated with these areas are addressed in separate documents. This summary will discuss (1) the chemicals identified by the EA

addendum as contaminants of concern (COCs), (2) the land use assumptions upon which estimates of potential human exposure to site contaminants are based, (3) the quantitative estimates of carcinogenic risk and noncarcinogenic hazard, and (4) a summary interpretation of the EA findings with regard to need for site remediation.

5.2 Contaminants of Concern

For groundwater COCs were determined to be the following chlorinated aliphatic hydrocarbons: 1,2dichloroethene, 1,1,1 -trichloroethane, trichloroethene, tetrachloroethene, c is-1,2-dichloroethene, chloroform and vinyl chloride.

5.3 Land Use and Exposure Assumptions

Four different scenarios representing current and potential future land uses were evaluated to assess applicability to the site. Evaluated scenarios included military, light industrial, construction and residential land uses. For each of these scenarios, human exposure is effected by mechanisms that include direct contact, inhalation and ingestion.

Based on current land use conditions within Areas I and J, a light industrial land use scenario was quantified for direct exposure to contaminated groundwater via incidental ingestion. This scenario was selected because it represents a conservative land use scenario that can reasonably be expected at these Areas. In addition, because the groundwater contamination plume in these Areas extends beyond the NAES boundary, in the direction of off-site populations, a residential land use scenario was also quantified for potential future land use conditions.

Military and construction land uses were not evaluated for Areas I and J. These scenarios would indicate a lower risk than those scenarios that were selected as -most representative of the current and potential future land use conditions.

5.4 Human Health Risk and Hazard Findings

For groundwater the results of the EA for the current light industrial land use scenario at Areas I and J indicate that hazards resulting from noncarcinogens; are not elevated for any chemical above EPA's hazard index criteria value of 1.0. The hazard index values ranged from a minimum of 1.77 x 10^{-3} for chloroform to a maximum of 1.67 x 10^{-1} for cis-1,2-dichloroethene. The overall area hazard represented by the hazard quotient, or sum of the chemical-specific hazard indices, was also below a value of 1.0. The overall hazard quotient estimated for groundwater is 3.2 x 10^{1}. Carcinogenic risk estimates for groundwater at Areas I and J are within EPA's acceptable risk range of 10^{-6} to 1 $0^{-4}$and exceed NJDEP's acceptable risk of 10^{-6}. The risk estimates ranged from a minimum of 3.86 x 10^{-8} for chloroform to a maximum of 1.53 x 10^{-4} for vinyl chloride. The overall area groundwater risk represented by the sum of the chemical-specific risk estimates is 1.66 x 10^{-4}. This number exceeds the NJDEP acceptable carcinogenic risk of one-in-one million. The EPA acceptable risk range is one-in-one million to one-in-ten thousand, and the excess lifetime cancer risk estimated for exposure to vinyl chloride is at the upper bound of this risk range. The risk range should be carefully considered in risk management decisions.

The results of the EA for the potential future residential land use scenario at Areas I and J indicate that hazards resulting from noncarcinogens are elevated above EPA's hazard index criteria value of 1.0. The hazard index values ranged from a minimum of 4.96 x 10^{-3} for chloroform to a maximum of 1.36 for 1,1-dichloroethane. The overall hazard quotient, or sum of the chemical-specific hazard indices

estimated for groundwater is 2.02. Carcinogenic risk estimates for groundwater at Areas I and J are exceed the EPA's acceptable risk range of 10^{-6} to 10^{-4} and NJDEP's acceptable risk of 10^{-6} . The risk estimates ranged from a minimum of 5.36×10^{-6} for chloroform to a maximum of 1.09×10^{-3} for vinyl chloride. The overall area groundwater risk represented by the sum of the chemical-specific risk estimates is 1.21×10^{-3}.

5.5 Ecological Assessment

As part of the Endangerment Assessment, a Baseline Ecological Evaluation (BEE) was conducted to obtain a description of the ecosystems at NAES. The objective of the BEE was:

- To identify contaminants at each site that are of ecological concern.
- To identify whether sensitive ecological receptors are present or may have been present at the contaminated site
- To identify potential exposure pathways to sensitive ecological receptors that exist or may have existed
- To determine whether or not sensitive ecological receptors are being or potentially may be adversely impacted by contaminants.

Areas I and J and downgradient, off-base areas contain several surface water bodies. The Black Branch, North Ruckles Branch and Manapaqua Brook exist in this Area. Cranberry bogs are located to the northeast of Areas I and J. Several large wetland areas cover a majority of Areas I and J. Wetlands border the Black Branch and Ruckles Branch located in the west and south sections of the site. Wetlands also exist upgradient of the northern plume within the NAES property. This wetland area is the largest single wetland area on base.

The BEE contains information obtained from a comprehensive endangered species study conducted in 1988. This study indicates that wetlands in Area I and J contain an endangered amphibian and several endangered plants.

The Pine Barrens treefrog is a State endangered species. It inhabits low areas with standing acid water (pH from 4.2 to 5.2) in pitch pine lowlands, pine oak (majority pine) and oak pine (majority oak) stands, white cedar swamps and bogs, and red maple swamps of the pinelands. The treefrog must have acid water plus proper conditions of humidity and plant cover for breeding. Inimical factors for the treefrog are habitat destruction, particularly from draining wetlands.

The Barratt's sedge is a threatened Pinelands plant. It can be found growing in areas of pitch pine lowlands. It is a wetlands species occurring in swales and the margins of bogs and Atlantic white cedar swamps. Inimical factors include succession of habitat due to wetland disturbances and degradation.

The pale beaked rush is a rare species that can be found in sedge and grass bogs and seepage areas adjacent to stream corridors. This plant is vulnerable to wetland disturbance.

The slender nut rush is a listed pinelands protected plant. This plant lives in moist to sandy pine barren thickets, swales, and depressions. Inimical factors include succession of wetlands.

The two-flowered bladderwort is a state-endangered plant. Its habitat is open water of ponds and streams, also boggy or sandy shores. This plant is possibly vulnerable to disturbances of wetland habitat.

Based on the BEE, an ecological concern at Area I and J is that wetlands may be adversely effected by pumping of the hydraulically linked aquifer. To evaluate the impact of pumping on surface water bodies, it is necessary to estimate the projected drawdown within the upper few feet of the water table aquifer at the location of these surface water bodies.

A Wetland Impact Study was conducted as part of the Pre-Design Groundwater Remedial Investigation. This study was conducted to evaluate the effects to area wetlands resulting from drawdown associated with different groundwater recovery schemes. First groundwater was modeled using Modflow™ to calculate draw-down under the different schemes. The drawdown data was then used in the computer-based Geographical Information System (GIS) software package ArcInfo™ to predict the resulting areal loss of wetlands. Three groundwater recovery scenarios were selected for wetland loss determination. The estimated wetland loss for these scenarios varied from 87 to 113 acres. In addition, the results suggested that populations of obligated wetland plants may decline in the drawdown area.

Another ecological issue of concern is that the wetlands and surface water of the Manapaqua Brook, Black Branch and North Ruckles; Branch may be receiving very low levels of chlorinated organics. Sampling of sediment and surface water at off-base locations where the Area I and J groundwater contaminant plume appears to discharge into the streams has been performed at the locations indicated in Figure 9. Analysis of these samples indicated levels of 1,1 -dichloroethane and 1,2-dichloroethene in North Ruckles, Branch sediment, at the base boundary (SED-2). Levels of these compounds were also detected in a hydropunch sample (taken 50 feet below the groundwater table) and at the deep well sample taken adjacent to the stream at this location. 1,2-dichloroethene was detected in sediment (SED-3) in the North Ruckles Branch east of the base boundary. A hydropunch sample (taken 70 feet below the groundwater table) adjacent to the stream also indicated similar levels of this contaminant. Two sediment samples (SED-5, SED-6) taken in the Black Branch downgradient of the northern plume indicated levels of chloroform. Chloroform was also detected in well and hydropunch samples taken adjacent to the stream in these areas. Sediment taken from the Manapaqua Brook did not reveal any contamination. No volatile contaminants were detected in surface water samples taken.

The results of these samples indicate that the aquifer appears to be hydraulically linked to the downgradient surface water bodies. This observation can be supported by the results of similarly screened wells located on the opposite side of the streams which do not indicate similar levels of contamination.

The surface water is not likely to reveal any contamination due to the already low levels of volatile compounds present at the downgradient edge of the plume and the subsequent dilution as groundwater discharges to the flowing stream. Therefore, it is highly unlikely that any significant impacts to wetlands or surface water would result from this exposure route.

5.6 Endangerment Assessment Summary

In summary, the results of the EA indicate that contaminants present in groundwater at Areas I and J may pose a concern relative to current, and potential future, exposed populations.

The effects of contaminant reduction on groundwater risk and hazard reduction were evaluated. For the potential future residential land use scenario presented, a reduction of the maximum total contaminant concentrations to or below 50 ug/l (ppb) would reduce the hazard quotient for groundwater, below the acceptable level of 1.0. For the light industrial land use scenario, the hazard quotient is below the acceptable level of 1.0 for existing conditions.

For the light industrial land use scenario, to reduce the overall carcinogenic groundwater risk below 1×10^{-6} (the EPA's point of departure for acceptable risk and the NJDEP's acceptable risk), maximum total VOC concentrations would need to be reduced to a concentration on the order of 25 ug/l (ppb). For the light industrial land use scenario, to reduce the overall groundwater risk to within the EPA acceptable risk range of 10^{-4} to 10^{-6} maximum total VOC concentrations would need to be reduced to a concentration at or below 50 ug/l (ppb).

For the potential future residential land use scenario, to reduce the overall carcinogenic groundwater risk, to within the EPA acceptable risk range of 10^{-4} to 10^{-6} maximum total VOC concentrations would need to be reduced to a level at or below 50 ug/l (ppb).

The results of the EA should not be considered a characterization of absolute risks posed to human health or the environment. Rather, risk and hazard index values estimated in the EA should be used to identify potential sources of risks at NAES, with resultant consideration of sites for remedial action.

6.0 SUMMARY OF REMEDIAL ALTERNATIVES

Under CERCLA, the alternative selected must be protective of human health and the environment, in accordance with statutory requirements and cost effective. Permanent solutions to contamination are to be achieved wherever possible. The remedial alternatives considered for the site are summarized below.

The following is a summary of technologies that were considered and their applicability to Areas I and J groundwater.

Natural Restoration

Natural restoration is the reduction of contaminant concentrations and/or mitigation of contaminant migration due to naturally occurring processes. These processes occur without direct human intervention and can be physical, chemical, or biological in nature. Physical processes include dispersion, dilution, retardation, and volatilization. Physical processes can reduce contaminant concentrations in groundwater, but do not transform or destroy the compounds. Chemical and biological attenuation processes transform the contaminants. For chlorinated VOCs, biological processes are the most important. The term intrinsic biodegradation is used when the attenuation processes are biological. Intrinsic biodegradation processes include anaerobic reductive dehalogenation and aerobic and anaerobic oxidation. Reductive dehalogenation is marked by the step-wise removal of chlorine atoms from VOC molecules by anaerobic bacteria. Where oxygen is present, chlorinated VOCs can be oxidized by aerobic bacteria, resulting in breakdown to carbon

dioxide, chlorine, and water. There is also a second type of oxidation process which occurs under anaerobic conditions. Like aerobic oxidation, the end products of anaerobic oxidation are carbon dioxide, chlorine, and water.

Natural restoration is considered to be a viable remedial option when natural attenuation processes are sufficient to mitigate risk to human health and the environment. This occurs when groundwater contaminant concentrations are reduced to below regulatory standards before potential exposure pathways are completed.

An extensive three year natural restoration study for Areas I and J groundwater demonstrated that natural restoration processes, primarily in the form of intrinsic biodegradation, are active within the contaminant plume. Groundwater flow and contaminant transport modeling, conducted as part of the study, predicts that natural restoration will reduce all contaminant concentrations to meet ARARs in 44 years (2042). The study recommends that natural restoration be selected as the final alternative for the remediation of groundwater contamination in Areas I and J, and downgradient off-base locations.

Co-metabolism

Co-metabolism is a process in which microorganisms growing on one compound produce an enzyme that chemically transforms another compound on which they cannot grow. In particular, microorganisms that degrade methane (methanotrophic bacteria) have been found to produce enzymes that can initiate the oxidation of a variety of carbon compounds. As a groundwater remediation method, water containing dissolved primary substrate (e.g. methane, propane, butane) and oxygen is injected into groundwater to support the co-metabolic breakdown of targeted organic contaminants. The addition of methane or methanol supports methanotrophic activity, which has been demonstrated effective to degrade chlorinated solvents, such as vinyl chloride and TCE, by co-metabolism. Although propane and butane are used to stimulate a different class of microorganisms, not methanotrophs, they have been used successfully for supporting co-metabolism of TCE. Since TCE is only one of several of the chlorinated compounds present in Areas I and J, the effect the substrates have on the degradation of other chlorinated compounds will be investigated as part of a co-metabolic demonstration to be conducted for Areas I and J. The primary target contaminants for co-metabolism are chlorinated solvents.

Enhanced Bioremediation

Bioremediation is a process in which indigenous or inoculated micro-organisms (i.e., fungi, bacteria, and other microbes) degrade (metabolize) organic contaminants found in soil and/or groundwater. This process attempts to accelerate the natural biodegradation process by providing nutrients, electron donors, and competent degrading microorganisms that may otherwise be limiting the rapid conversion of contamination organics to innocuous end products. The rate of bioremediation of organic contaminants by microbes is enhanced by increasing the concentration of electron donors and nutrients in groundwater.

This technology was considered for treatment of the higher area of groundwater contamination in Areas I and J. This technology is considered applicable to address the higher area of contamination in Areas I and J groundwater. The groundwater natural restotation study has indicated that the microorganisms necessary for natural restoration are present. This technology could be investigated should co-metabolism fail to be effective.

Air Sparging

Air sparging is an in-situ technology in which air is injected through a contaminated aquifer. Injected air traverses horizontally and vertically in channels through the soil column, creating an underground stripper that removes contaminants by volatilization. This injected air helps to flush (bubble) the contaminants up into the unsaturated zone where a vapor extraction system is usually implemented in conjunction with air sparging to remove the generated vapor phase contamination. This technology is designed to operate at high flow rates to maintain increased contact between groundwater and soil and strip more ground water by sparging.

Factors that may limit the applicability and effectiveness of air sparging to treat Areas I and J groundwater include:

- Air sparging does not destroy contamination but transfers the contaminants to another media.
- The depth of contamination in Areas I and J may limit the use of this technology.

This technology was considered for treatment of the higher area of groundwater contamination in Areas I and J. This technology may be applicable to address the higher area of groundwater contamination in Areas I and J, however, enhancements to natural restoration are considered to provide more advantages and less limitations.

Pump and Treat

This technology would involve the pumping of groundwater to a treatment facility for treatment by physical and/or chemical methods.

Extensive groundwater studies and modeling conducted for Areas I and J indicated that, even for conservative degradation rates, the effects of pumping would be relatively minor when compared to the reduction of contamination by natural restoration. As the degradation rates were increased to more probable values, the beneficial effect of pumping diminished until it was negligible compared to the effects of natural restoration. The model indicated that the time to achieve ARARs; through pumping did not offer an advantage over the time to reach ARARs through natural restoration. However, the use of pump and treat may be a viable option for containment of the higher area of contamination in the event that co-metabolism. is deemed ineffective at preventing contaminants from being added to the body of the plume.

Factors that may limit the applicability and effectiveness of pumping and treatment of groundwater in Areas I and J include:

- Pump and treat does not destroy contamination but transfers the contaminants to another media.
- Residual saturation of the contaminant in the soil pores cannot be removed by groundwater pumping.
- The impact of a pumping well in Areas I and J would be limited.

Therefore, the use of pumping to recover area groundwater may fail to capture/contain the contamination.

- Pump and treat may have a negative impact on area wetlands and associated threatened and endangered species.
- The significant amount of power required to operate a pump and treatment facility would contribute to contamination of the environment.
- The cost of constructing and operating pumping and treatment systems is high.

7.0 THE SELECTED ALTERNATIVE

The selected alternative to address groundwater in and downgradient of Areas I and J is natural restoration with long-term monitoring and co-metabolism to treat the higher area of contamination. If natural restoration and co-metabolism are not effective, air sparging will be implemented as a contingency remedy.

The three-year natural restoration study conducted for Areas I and J groundwater has established and documented the presence of natural attenuation processes. Based on these results, natural restoration has been selected as the final alternative to address groundwater in these areas. The groundwater in Areas I and J and downgradient, off-base locations will continue to be monitored until cleanup levels are met.

Co-metabolic biostimulation will be used at the higher area of groundwater contamination within the northern plume to enhance degradation and prevent the addition of contaminants to the main body of the plume. A pilot system is being implemented to demonstrate the effectiveness of co-metabolism. The system installed at Areas I and J will inject oxygen and co-substrates into the zone of groundwater contamination. The distribution and dilution of injected co-substrates will be monitored through bi-weekly sampling of treatment area monitoring wells. The specifics of the co-metabolic biostimulation demonstration and associated monitoring can be found in the Technology Demonstration Work Plan dated May 25, 1999 which is available for review in the Administrative Record for NAES.

The pilot system will be expanded if the pilot test is successful and the data indicates that it would be appropriate. Changes in the injected substrate concentrations and dissolved oxygen concentrations will be performed to determine and maintain optimal system performance. Modifications to the system may be made based on future monitoring. The pilot demonstration is scheduled to begin operation in July 1999. The expected duration of the pilot demonstration is fourteen months. This pilot system is being adopted as a component of the remedy for this site.

If natural attenuation and co-metabolism, are not effective, air sparging, if demonstrated to be effective, will be implemented as a contingency remedy. The effectiveness of natural attenuation and co-metabolism will be determined by the TRC upon review of future data to be collected as part of the selected alternative.

The main objectives of the selected remedial action are to:

- Use co-metabolism to treat the higher area of groundwater contamination.
- Allow natural restoration to reduce the remaining groundwater contamination to levels that are protective of human health and the environment and comply with ARARs.
- Monitor the migration of the contaminated groundwater plume to ensure protection of human health and the environment.

To meet these objectives, groundwater quality at 48 selected existing and 4 new wells, to be installed as part of this alternative, will be monitored to determine the progress of natural restoration, determine the effectiveness of co-metabolism, verify the vertical and horizontal extent of the plume, monitor the migration of the plume, if any, and monitor the line of compliance. The frequency of natural restoration monitoring will initially be semi-annually and will be modified as deemed necessary by the Navy in consultation with the TRC to meet the objectives.

The line of compliance is a series of wells used to define the downgradient extent of the plume. The current line of compliance wells are the following (JS, JT, LS, LU, JW, JJ, IS, IT, IQ, and ME) (see Figure 3). This remedial action will be designed so that ARARs will be met at the downgradient line of compliance. If a sampling result from a line of compliance well exceeds ARARs, the well will be resampled. If the well continues to show levels above ARARs, a decision will be made by the Navy in consultation with the TRC to install additional wells or conduct other actions as deemed necessary to protect human health and the environment.

Groundwater samples will be analyzed for VOCs. Physical parameters (temperature, dissolved oxygen, dissolved iron, oxidation-reduction potential, electrical conductivity, and pH) which would indicate a change in the natural restoration activity in the Area will be collected as part of the groundwater quality sampling. If these parameters indicate that the natural restoration and co-metabolic processes previously identified are not effectively occurring, air sparging, if demonstrated to be effective, will be implemented as a contingency remedy.

The existing groundwater flow and contaminant transport model will be updated every 5 years to include additional groundwater quality data and updated natural restoration rates to provide a more accurate prediction of the contaminant reduction and time required to meet ARARs.

The estimated cost of the selected remedy is $290,000 per year for natural restoration/groundwater quality monitoring, modeling, and reporting and an additional $240,000 per year for operation, maintenance, power, monitoring, and reporting of a co-metabolic treatment system. The estimated cost to install a sparge system to treat the higher area of contamination is $120,000 with an additional cost of $160,000 per year for operation, maintenance, power, monitoring, and reporting. Additional costs for institutional controls, if necessary, range from $2,000 for signs to restrict water usage to $560,000 to close and abandon on site shallow supply wells and hookup the water systems to existing on-site deep wells.

As part of this remedial action, the NJDEP has indicated that it will establish a Classification Exception Area (CEA) for Areas I and J and associated downgradient, off-base locations because the Ground Water Quality Standards are exceeded (N.J.A.C. 7:9-6.6(a)). The CEA is an institutional control component of the remedy. In addition, pursuant to N.J.A.C. 7:9-6.6(d), NJDEP is obligated to restrict or require the restriction of potable groundwater uses within any CEA where there is or will be an exceedance of the Primary Drinking Water Standards (N.J.A.C. 7:10). Therefore, when contaminant concentrations in a CEA exceed Maximum Contaminant Levels (MCLs), and designated aquifer use based on classification includes potable use, NJDEP will identify the CEA as a Well Restriction Area (WRA). The WRA functions as the institutional control by which potable use restriction can be effected. The CEA boundaries will include both the current and projected future extent of the plume. The CEA will include the vertical boundaries as defined by the affected formations, as well as the horizontal extent. The CEA will also include the

groundwater contaminants to which the exception applies. The downgradient line of compliance wells will be used to address the requirements discussed above. As part of the selected remedial action, additional controls will be established as deemed necessary by the Navy in consultation with the TRC to protect human health or the environment. Controls could include the closing and abandoning of shallow supply wells in Areas I and J with hookup of systems to deep supply wells in the area.

Natural resource injuries will be evaluated and addressed as part of this remedy.

As part of the selected alternative, the results of continued natural restoration, co-metabolic treatment, and groundwater quality monitoring will be provided at regularly scheduled TRC meetings. The co-metabolic treatment will be evaluated and a decision will be made by the TRC to continue with co-metabolic treatment or implement the contingency remedy. Five-year review reports will be provided to the regulatory agencies. These five-year reviews will include a summary of the progress of natural restoration, groundwater quality results, and an updated groundwater contaminant transport model to provide updated predictions future contaminant migration and time to meet ARARs. These reports will be provided to the regulatory agencies and placed in the Administrative Record for NAES.

8.0 RESPONSIVENESS SUMMARY

The purpose of this responsiveness summary is to review public response to the Proposed Plan for Areas I and J groundwater. It also documents the Navy's consideration of comments during the decision making process and provides answers to any comments raised during the public comment period.

The responsiveness summary for Areas I and J groundwater is divided into the following sections:

OVERVIEW - This section briefly describes the remedial alternative recommended in the Proposed Plan and any impacts on the Proposed Plan due to public comment.

BACKGROUND ON COMMUNITY INVOLVEMENT - This section describes community relations activities conducted with respect to the area of concern.

SUMMARY OF MAJOR QUESTIONS AND COMMENTS - This section summarizes verbal and written comments received during the public meeting and public comment period.

8.1 OVERVIEW

Areas I and J are located at the NAES in Ocean County, Lakehurst, New Jersey. This responsiveness summary addresses public response to the Proposed Plan, proposing natural restoration with long term monitoring and co-metabolism to treat the higher area of contamination.

The Proposed Plan and other supporting information are available for public review at the information repository located at the Ocean County Library, 101 Washington Street, Toms River, New Jersey.

8.2 BACKGROUND ON COMMUNITY INVOLVEMENT

This section provides a brief history of community participation in the investigation and interim remedial planning activities conducted for Areas I and J. Throughout the investigation period, the EPA and NJDEP have been reviewing work plans and reports and have been providing comments and recommendations which are incorporated into the appropriate documents. A Technical Review Committee (TRC), consisting of representatives of the Navy, the EPA, the NJDEP, the Ocean County Board of Health, the New Jersey Pinelands Commission, other agencies and communities surrounding NAES was formed and has been holding periodic meetings to maintain open lines of communication and to inform all parties of current activities.

Prior to public release of site-specific documents, NAES's public relations staff compiled a list of local public officials who demonstrated or were expected to have an interest in the investigation. Local environmental interest groups were also identified and included on this list. The list is attached as Appendix B to this Record of Decision. On May 3 and 4, 1999, a newspaper notification inviting public comment on the Proposed Plan appeared in The Ocean County Observer and The Asbury Park Press. The public notice summarized the Proposed Plan and the preferred alternative. The announcement also identified the time and location of a Public Meeting and specified a public comment period, and the address to which written comments could be sent. As a result of comments from the EPA, the comment period was extended to July 23, 1999. The newspaper notification also identified the Ocean County Library as the location of the Administrative Record.

A Public Meeting was held on May 19, 1999, from 6:00 p.m. to 7:00 p.m. at the Manchester Branch of the Ocean County Library. At this meeting, representatives from the Navy, EPA and NJDEP were available to answer questions concerning Areas I and J groundwater and the preferred alternative. NAES representatives present included: CAPT Stephen Himes, Executive Officer; Lucy Bottomley, Supervisory Environmental Engineer; and Environmental Branch personnel: Dorothy Peterson, Greg Bury, Ray Hahn, Bob Previte, Michael Figura, and Larry Lemig; and Larry Lyford, Public Affairs Officer. Mr. Paul Ingrisano, represented the EPA's Federal Facility Section; Mr. Kevin Schick represented the NJDEPs Bureau of Environmental Evaluation and Risk Assessment and Ms. Linda Welkorn represented the NJDEP's Bureau of Groundwater Pollution Abatement. The complete attendance list is provided in Appendix A.

8.3 SUMMAR Y OF MAJOR QUESTIONS AND COMMENTS

Written Comments

On May 25, 1999, the Navy met with the EPA to discuss the Proposed Plan. At this meeting it was decided to incorporate co-metabolism. into the Proposed Plan for the area and add air sparging as a contingency remedy to be implemented if co-metabolic treatment is ineffective. The final Proposed Plan dated June 11, 1999 and notice of the extended comment period were mailed to all interested parties on June 21, 1999. A copy of the Final Proposed Plan for Areas I and J groundwater has been placed in the Administrative Record for NAES located at the Ocean County Library, Toms River NJ.

On July 20, 1999, the NJDEP submitted additional written comments to the Proposed Plan for Areas I and J groundwater. The NJDEP finds the selected alternative in the Final Proposed Plan to

be acceptable. However, the NJDEP believes that the co-metabolic biostimulation demonstration should have been completed before being stipulated as part of the final remedy for the groundwater in Areas I and J. The NJDEP indicated that the Pinelands Commission shares their opinion.

Bench scale studies of co-metabolic biostimulation conducted by Environment, Inc. have shown this technology to be effective at degrading chlorinated solvents. If the TRC determines that co-metabolism is not effective at treating the higher areas of contamination, air sparging, if demonstrated to be effective, will be implemented as a contingency remedy.

During the public comment period from May 3, 1999 through July 23, 1999, written comments to the 2nd Draft Final Proposed Plan (May 3, 1999) were received from the law firm of Connell, Foley and Geiser representing Heritage Minerals, Inc. A summary of the comments and responses is provided as follows.

Comment No. 1
Connell, Foley and Geiser indicated that they did not have adequate time to fully evaluate the report and requested an additional 60-day comment period.

Response
The Proposed Plan, dated 3 May 1999, that was mailed to Heritage Minerals, Inc. as part of our community notification program was labeled as a second draft final, pending final comments by the EPA, Region 11. Once the Navy gained concurrence from the EPA and NJDEP, the final Proposed Plan dated June 11, 1999 and notice that extended the comment period to July 23, 1999 were mailed to all interested parties on June 21, 1999. This extension has been deemed adequate for concerned parties to review and comment on the Final Proposed Plan.

Comment No. 2
Connell, Foley and Geiser states that the Proposed Plan is objectionable in that it prohibits utilization of the property owned by Heritage Minerals, Inc. until the year 2042 without directly proposing a firm and definite plan for groundwater remediation or for the provision of an alternate water source.

Response
The Proposed Plan outlines the remedial action to address groundwater contamination in and downgradient of Areas I and J. The Proposed Plan does not preclude utilization of the property owned by Heritage Minerals, Inc. The plan includes a firm and definite remedy to address groundwater contamination. The selected remedy to address groundwater in and downgradient of Areas I and J is natural restoration with long-term monitoring and co-metabolism to treat the higher area of contamination. If natural restoration and co-metabolism are not effective, air sparging will be implemented as a contingency remedy. The addition of co-metabolism (and air sparging if needed) will further reduce the time for groundwater remediation. Should groundwater contamination from Areas I and J migrate beyond the CEA, the Navy in consultation with the TRC will take appropriate action to protect human health and the environment.

Comment No. 3
Connell, Foley and Geiser requested all details with respect to the $3,000,000 estimate contained on page 27 of the 2nd Draft Final Proposed Plan for Areas I and J groundwater. Details requested

include how the estimate was calculated and the time period that would be involved in implementing such an alternative.

Response
The second draft final Proposed Plan included an estimate for providing an alternative source of potable water based on the event that contaminated groundwater migrated to the existing off-base wells. Subsequent versions of the Proposed Plan deleted the language as it was determined through extensive computer modeling that the plume would not reach these wells. It has become unnecessary to include contingencies for future groundwater use because this will be addressed by the NJDEP through the Classification Exception Area to be established for Areas I and J. Should groundwater contamination from Areas I and J migrate beyond the CEA, the Navy in consultation with the TRC will take appropriate action to protect human health and the environment.

Comment No. 4
Connell, Foley and Geiser requested copies of correspondence from the NJDEP and the Pinelands Commission, which indicate that those agencies have approved the remediation plan. They also requested copies of correspondence from the EPA evaluating the Final Proposed Plan.

Response
Copies of correspondence with the EPA, NJDEP, and Pinelands Commission concerning the Proposed Plan for Areas I and J groundwater are placed in the Station's Administrative Record which is available for public review at the Ocean County Library, 101 Washington Street, Toms River, New Jersey.

Comment No. 5
Connell, Foley and Geiser requested a copy of the classification exception area (CEA) application the Navy submitted to the NJDEP.

Response
A copy of the CEA application is available for public review and copying at the Station's Administrative Record located at the Ocean County Library, 101 Washington Street, Toms River, New Jersey.

Comment No. 6
Connell, Foley and Geiser stated that they were confused by the statement that the proposed plan outlines a remedial action to address the groundwater contamination in and downgradient of Areas I and J. Rather, the proposed plan seems to leave the groundwater contamination in place in the hope that it will naturally remediate over the next half century.

Response
Natural restoration is a recognized means of achieving remediation objectives that may be appropriate for specific, well-documented site circumstances where its use meets the applicable statutory and regulatory requirements. EPA guidance concerning the use of monitored natural attenuation at Superfund sites can be downloaded from http://www.epa.gov/swerust1/directiv/d9200417.htm.

Natural restoration is considered to be a viable remedial option when natural attenuation processes are sufficient to mitigate risk to human health and the environment. An extensive three year natural restoration study for Areas I and J groundwater demonstrated that natural restoration processes are capable of reducing contaminant concentrations to below regulatory standards before potential exposure pathways are completed. To treat the higher areas of groundwater contamination, co-metabolism (with a contingency for air sparging) has been included as part of the selected remedy.

Comment No. 7
Connell, Foley and Geiser requested an explanation as to why the $3,000,000 estimate contained in the 2nd draft of the final proposed plan was deleted and what alternative relief is proposed by the Navy.

Response
The second draft final Proposed Plan included an estimate for providing an alternative source of potable water based on the event that contaminated groundwater migrated to the existing off-base wells. Subsequent versions of the Proposed Plan deleted the language as it was determined through extensive computer modeling that the plume would not reach these wells. No potable wells exist within the proposed classification exception area (CEA). The proposed CEA includes the existing and projected extent of contamination. Since the Navy does not expect contamination to reach existing wells, no alternative relief is being proposed at this time. Should groundwater contamination from Areas I and J migrate beyond the CEA, the Navy in consultation with the TRC will take appropriate action to protect human health and the environment.

Comment No. 8
Connell, Foley and Geiser requested an explanation as to why it has become unnecessary to include a contingency for future groundwater use as this will be addressed by the NJDEP through the classification exception area to be established. On what basis is it assumed by the Navy that NJDEP will address contingencies for future groundwater use in the classification exception area to be established by NJDEP?

Response
A notification regarding the proposed classification exception (CEA) was mailed to Heritage Minerals, Inc. on July 1, 1999. The letter indicated that a CEA is required pursuant to the State's Groundwater Quality Standards, NJAC 7:9-6, whenever an approved remedy will not meet constituent standards for the term of the remediation. The CEA is the State's method of ensuring that the uses of the aquifer are restricted until standards are achieved. When necessary, the State will designate the area as a Well Restriction Area (WRA). The State ordinarily will not prohibit installation of wells in WRAs, but identify any special installation and construction requirements through the well permit program administered by the Bureau of Water Allocation. The CEA puts institutional controls in place to protect human health until standards are achieved. Should groundwater contamination from Areas I and J migrate beyond the CEA, the Navy in consultation with the TRC will take appropriate action to protect human health and the environment.

During the public comment period from May 3, 1999 through June 21, 1999, written comments to the 2nd Draft Final Plan (May 3, 1999) were received from the law firm of Kline and Gast, P.A. representing Jeffrey's Branch Cranbury, LLC. A summary of the comments and responses is provided as follows.

Comment No. 1
Kline and Gast, P.A. indicated that, from the exhibits contained in the Proposed Plan, they were unable to determine how near the groundwater contamination comes to their clients' reservoir, cranberry bogs, and adjacent woodlands located to the northeast of Areas I and J.

Response
The groundwater flow direction in Areas I and J is to the southeast (see Figure 7). The Jeffrey's Branch Cranbury, LLC property is located to the northeast of Areas I and J. There is no indication that the groundwater contamination in Areas I and J has migrated or will migrate to the Jeffrey's Branch Cranbury, LLC property.

Comment No. 2
Kline and Gast, P.A. states that it is futile to wait for natural restoration, and aggressive steps must be taken to eradicate the groundwater pollution and to insure their clients' ability to safely conduct their farming operation.

Response
The groundwater flow direction in Areas I and J is to the southeast (see Figure 7). The Jeffrey's Branch Cranbury, LLC property is located to the northeast of Areas I and J. There is no indication that the groundwater contamination in Areas I and J will prevent Jeffrey's Branch Cranbury from safely conducting their farming operation. The Final Proposed Plan and Record of Decision for Areas I and J groundwater outline the remedial action to address groundwater contamination in and downgradient of Areas I and J. The selected alternative to address groundwater in and downgradient of Areas I and J is natural restoration with long-term monitoring and co-metabolism to treat the higher area of contamination. If natural restoration and co-metabolism. are not effective, air sparging will be implemented as a contingency remedy.

As part of this remedial action, the NJDEP has indicated that it will establish a Classification Exception Area (CEA) for Areas I and J and associated downgradient, off-base locations. The CEA will be used to establish permitted uses for groundwater in and downgradient of Areas I and J.

Public Meeting Comments
The following is a summary of questions and comments received at the Public Meeting held on May 19, 1999. A complete transcript of the Public Meeting is provided in the Administrative Record at the Ocean County Library, Toms River, NJ.

Comment No. 1
Fred Seeber from the Ocean County Health Department asked if the potential impacts to area water sources were investigated for the 44 year period that natural restoration would take to remediate the groundwater contamination in Areas I and J.

Response
As part of the three year natural restoration study conducted for Areas I and J groundwater, extensive computer modeling was conducted to predict the extent of plume migration. Based on the current understanding of contaminant migration and degradation, predictive model simulations show that contaminant concentrations will decrease steadily due to natural restoration processes.

The extent of the plume may initially increase marginally, followed by a more rapid decrease after the residual contaminant sources are fully depleted. The modeling did not indicate that the groundwater contamination would reach any existing water sources.

As part of the selected alternative, groundwater quality at 52 wells will be monitored to determine the progress of natural restoration, determine the effectiveness of co-metabolism, verify the vertical and horizontal extent of the plume, monitor the migration of the plume, if any, and monitor the line of compliance. The line of compliance is a series of wells used to define the downgradient extent of the plume. This remedial action is designed so that cleanup standards will not be exceeded beyond the CEA.

As part of the selected alternative the existing groundwater flow and contaminant transport model will be updated every 5 years to include additional groundwater quality data and updated natural restoration rates to provide a more accurate prediction of the contaminant reduction and time required to meet cleanup standards.

Comment No. 2
Fred Seeber from the Ocean County Health Department asked if the Borough of Lakehurst was replacing their existing supply wells with deeper wells and if these wells would pump from a different aquifer.

Response
The Borough of Lakehurst is in the process of installing a 600 ft. deep supply well in the Englishtown Formation Aquifer. It is expected that this well will be able to meet the water needs of the Borough. The existing supply wells will be used as a backup.

Comment No. 3
Fred Seeber from the Ocean County Health Department asked for the depth of groundwater contamination.

Response
Vertically the contamination extends to 70 feet below the groundwater table with the largest amount of contamination in the zone from 30 to 50 feet below the groundwater table.

Comment No. 4
Theresa Lettman of the Pinelands Preservation Alliance asked for the depth of the Lakehurst municipal wells.

Response
Currently, the Borough of Lakehurst has 7 shallow municipal wells, which range in depth from 35 ft. to 80 ft. These wells are being replaced by a 600 ft. deep supply well.

Comment No. 5
Theresa Lettman of the Pinelands Preservation Alliance asked for the year that groundwater in Areas I and J would meet cleanup standards through natural restoration. She also asked for the year that groundwater in Areas I and J would meet cleanup standards through pumping and treatment.

Response
Modeling conducted as part of the three year natural restoration study for Areas I and J groundwater predicts that all contaminant levels will be reduced to cleanup standards by the year 2042. The addition of co-metabolism (and air sparging if needed) will reduce this timeframe for cleanup.

As part of the pre-design groundwater remedial investigation conducted for Areas I and J, a three-dimensional contaminant fate and transport model was used to evaluate various groundwater recovery alternatives. The model predicted that under the optimal pumping scheme it would take 40-70 years (2034 - 2064 (model run in 1996)) to remediate the plume to meet cleanup standards.

Comment No. 6
Theresa Lettman of the Pinelands Preservation Alliance asked when the NJDEP will establish the classification exception area (CEA) for Areas I and J groundwater.

Response
An application to establish a classification exception area (CEA) for Areas I and J groundwater was submitted to the NJDEP on 20 January 1999. The CEA will be established by the NJDEP upon review and approval of the application.

Comment No. 7
Tim Andreucci of WOBM asked how nature is taking part in the cleanup of Areas I and J groundwater.

Response
Natural restoration is the reduction of contaminant concentrations and/or mitigation of contaminant migration due to naturally occurring processes. These processes occur without direct human intervention and can be physical, chemical, or biological in nature. Physical processes include dispersion, dilution, retardation, and volatilization. Physical processes can reduce contaminant concentrations in groundwater, but do not transform or destroy the compounds. Chemical and biological attenuation processes transform the contaminants. For chlorinated VOCs, biological processes are the most important. The term intrinsic biodegradation is used when the attenuation processes are biological.

An extensive three year natural restoration study for Areas I and J groundwater demonstrated that natural restoration processes, primarily in the form of intrinsic biodegradation, are active within the contaminant plume. The study recommends that natural restoration be selected as the final alternative for the rernediation of groundwater contamination in Areas I and J, and downgradient off-base locations.

Comment No. 8
Tim Andreucci of WOBM asked what are the resulting compounds from the natural breakdown of the contaminants in Areas I and J groundwater.

Response
Natural restoration results in non-toxic end products. An extensive three year natural restoration study for Areas I and J groundwater demonstrated that natural restoration processes, primarily in the

form of intrinsic biodegradation, are active within the contaminant plume. Intrinsic biodegradation processes include anaerobic reductive dehalogenation and aerobic and anaerobic oxidation. Reductive dehalogenation is marked by the step wise removal of chlorine atoms from VOC molecules by anaerobic bacteria. Reductive dehalogenation processes reduce chlorinated compounds to ethene. Where oxygen is present, chlorinated VOCs can be oxidized by aerobic bacteria, resulting in breakdown to carbon dioxide, chlorine, and water. There is also a second type of oxidation process which occurs under anaerobic conditions. Like aerobic oxidation, the end products of anaerobic oxidation are carbon dioxide, chlorine, and water.

Comment No. 9
Tim Andreucci of WOBM asked how the progress of natural restoration is going to be checked over time.

Response
Groundwater quality at 48 selected existing and 4 new wells, to be installed as part of this alternative, will be monitored to determine the progress of natural restoration, determine the effectiveness of co-metabolism, verify the vertical and horizontal extent of the plume, monitor the migration of the plume, if any, and monitor the line of compliance. The frequency of monitoring will initially be semi-annually and will be modified as deemed necessary by the Navy in consultation with the Technical Review Committee.

As part of the selected alternative, the results of continued natural restoration, co-metabolic treatment, and groundwater quality monitoring will be provided at regularly scheduled TRC meetings. Five-year review reports will be provided to the regulatory agencies. These five-year reviews will include a summary of the progress of natural restoration, groundwater quality results, and an updated groundwater contaminant transport model to provide updated predictions future contaminant migration and time to meet ARARs. These reports will be provided to the regulatory agencies and placed in the Administrative Record for NAES.

Comment No. 10
Tim Andreucci of WOBM asked if the Areas I and J plume will impact any drinking water sources.

Response
As part of the three year natural restoration study conducted for Areas I and J groundwater, extensive computer modeling was conducted to predict the extent of plume migration. The modeling did not indicate that the groundwater contamination would reach any existing drinking water sources.

Comment No. 11
Tim Andreucci of WOBM asked how long it would take for groundwater to meet cleanup standards.

Response
Modeling conducted as part of the three year natural restoration study for Areas I and J groundwater predicts that all contaminant levels will be reduced to meet cleanup standards by the year 2042. The addition of co-metabolism (and air sparging if needed) will reduce this timeframe for cleanup.

Comment No. 12
Tim Andreucci of WOBM asked for a description of the pump and treat method.

Response
Pump and treat technology would involve the pumping of groundwater from recovery wells to a treatment facility for treatment by physical and/or chemical methods.

Extensive groundwater studies and modeling conducted for Areas I and J indicated that, even for conservative degradation rates, the effects of pumping would be relatively minor when compared to the reduction of contamination by natural restoration. As the degradation rates were increased to more probable values, the beneficial effect of pumping diminished until it was negligible compared to the effects of natural restoration. The model indicated that the time to achieve cleanup standards through pumping did not offer an advantage over the time to reach cleanup standards through natural restoration. The model also indicated that pumping could result in the loss of at least 87 acres of wetlands.

Comment No. 13
Tim Andreucci of WOBM asked for the advantages of natural restoration. He also asked if the use of natural restoration would save money in the long run.

Response
Natural restoration is less detrimental to the environment than construction and operation of a treatment system.

- Natural restoration reduces contamination to non-toxic compounds. Pump and treat systems do not destroy contamination but transfers the contaminants to another media.
- A wetland study conducted as part of the Pre-Design Remedial Investigation (April 1994) indicated that even minimal pumping could result in the loss of 87 acres of wetlands.
- Treatment system construction and operation may negatively impact area forest lands, wetlands, and associated threatened and endangered species.
- The significant amount of power required to operate a treatment facility contributes to contamination of the environment.

The cost associated with natural restoration is much less than that for other treatment alternatives.

- The associated cost for the initial three year Natural Restoration Study was less than 1 million dollars. Continued costs to implement natural restoration is estimated to be approximately $290,000 per year.
- The estimated cost for construction of a groundwater pumping and treatment system was estimated to be $5,000,000 with a yearly operations cost of $700,000.

Comment No. 14
Tim Andreucci of WOBM asked how Areas I and J were used and what caused the groundwater contamination.

Response
Areas I and J are largely developed and include various Navy testing facilities, including a steam plant, catapult launching facilities and a runway arrested landing site (RALS) facility. The catapult runway

traverses Areas I and J and Taxiway No. 4 parallels the southern NAES property line in the eastern portion of the Area.

Since the facilities, in Areas I and J were constructed in 1958, they have been used for the testing of aircraft launching and recovery activities. Past releases of liquid wastes associated with these testing activities resulted in the contamination of groundwater at these Areas. Potential sources of groundwater contamination east of the catapult and taxiway include past releases of wastewater from the catapult test facility, past releases of liquid wastes at the catapult test facility storage area, past releases associated with testing of catapult equipment, and former launching/recovery activities on Taxiway No. 4. This contamination occurred during the 1960's and early 1970's. Potential sources of the contaminant plume south of the runway include past releases of wastewater from the RALS facility, former activities at the jet blast deflector site, and former runway launching/recovery activities. The sources of groundwater contamination are the result of releases that occurred in the past and no longer exist.

Comment No. 15
Tim Andreucci of WOBM asked if Areas I and J were still used for the same activities.

Response
Areas I and J are still used for the testing of aircraft launching and recovery activities. However, actions have been taken to ensure no further impact to groundwater. The introduction/background section of the final Proposed Plan addresses the waste management practices implemented so that there is no further impact to groundwater in Areas I and J.

Comment No. 16
Tim Andreucci of WOBM asked how the public would be able to keep up with what is being done for Areas I and J groundwater.

Response
The Station has an information repository at the Ocean County Library, Adult Services Department, Toms River, NJ. Copies of documents and correspondence concerning Areas I and J are available to the public for review and copying.

The Station holds a Restoration Advisory Board (RAB) meeting to discuss the status of our cleanup actions. RAB meetings are held on the second Wednesday of every other month at 5:30 p.m. in the Manchester Library. The next RAB is scheduled for July 14, 1999.

Comment No. 17
Tim Andreucci of WOBM asked if wells will be checked periodically to make sure the selected remedy is effective.

Response
Groundwater quality at 48 selected existing and 4 new wells, to be installed as part of this alternative, will be monitored to determine the progress of natural restoration, determine the effectiveness of co-metabolism, verify the vertical and horizontal extent of the plume, monitor the migration of the plume, if any, and monitor the line of compliance. The frequency of monitoring

will initially be semi-annually and will be modified as deemed necessary by the Navy in consultation with the TRC.

As part of the selected alternative, the results of continued natural restoration, co-metabolic treatment, and groundwater quality monitoring will be provided at regularly scheduled TRC meetings. Five-year review reports will be provided to the regulatory agencies. These five-year reviews will include a summary of the progress of natural restoration, groundwater quality results, and an updated groundwater contaminant transport model to provide updated predictions future contaminant migration and time to meet ARARs. These reports will be provided to the regulatory agencies and placed in the Administrative Record for NAES.

Comment No. 18
Tim Andreucci of WOBM asked if the Areas I and J plume has moved in the last three years.

Response
During the natural restoration study conducted over the past three years, the levels of contamination in groundwater have fluctuated, however, no significant migration of contamination has been observed.

As part of the three year natural restoration study conducted for Areas I and J groundwater, extensive computer modeling was conducted to predict the extent of plume migration. The model indicated that the extent of the plume may initially increase marginally, followed by a more rapid decrease after the residual contaminant sources are fully depleted.

Comment No. 19
Tim Andreucci of WOBM asked if the action for Areas I and J groundwater would help Lakehurst be removed from the National Priorities List (Superfund).

Response
Upon completion of this Record of Decision for Areas I and J groundwater, all sites at the Naval Air Engineering Station will have been addressed.

Comment No. 20
Tim Andreucci of WOBM asked how many sites have been addressed at NAES, Lakehurst.

Response
There were 44 potentially contaminated "sites" and one additional adjacent "off-site" site that have been investigated and addressed at NAES.