Section : 01.04
Site 20903-5640 (White Oak)
Doc. #: 0003
00020

N60921.AR.000053
NSWC WHITE OAK
5090.3a

INFORMATION ASSESSMENT REPORT
SITES 2, 3, AND 4
Naval Surface Warfare Center, White Oak

LOCKWOOD, ANDREWS AND NEWNAM

MAY 1996

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1

1.0 FORMER APPLE ORCHARD LANDFILL 3
- 1.1 Site Description 3
- 1.2 RCRA Facility Assessment 3
- 1.3 RI Report 4
- 1.4 Design Verification Report 4
- 1.5 Environmental Baseline Survey 5
- 1.6 Scope Reformulation and Issues Letter 5
- 1.7 Discussion 6
- 1.8 Data Gaps 6
- 1.9 Conclusions 7

2.0 FORMER PISTOL RANGE LANDFILL 8
- 2.1 Site Description 8
- 2.2 RCRA Facility Assessment 8
- 2.3 RI Report 8
- 2.4 Design Verification Report 10
- 2.5 Environmental Baseline Survey 10
- 2.6 Scope Reformulation and Issues Letter 10
- 2.7 Discussion 11
- 2.8 Data Gaps 12
- 2.9 Conclusions 12

3.0 FORMER CHEMICAL BURIAL SITE 14
- 3.1 Site Description 14
- 3.2 RCRA Facility Assessment 14
- 3.3 RI Report 14
- 3.4 Design Verification Report 15
- 3.5 Environmental Baseline Survey 16
- 3.6 Discussion 16
- 3.7 Data Gaps 17
- 3.8 Conclusions 17

ATTACHMENTS

- A Questions regarding Apple Orchard Landfill 18
- B Questions regarding Pistol Range Landfill 19
- C Questions regarding Chemical Burial Site 20

EXECUTIVE SUMMARY

This report compares and evaluates the results of previous environmental assessments and investigations of three units at the Naval Surface Warfare Center, White Oak (NSWCWO) near Silver Springs, Maryland. These units, the Apple Orchard Landfill, the Pistol Range Landfill and the Chemical Burial Site were the site of disposal of various chemical wastes including solvents, acids, metals and PCB-contaminated oils from the mid 1940s to the early 1980s. A RCRA Facility Assessment (RFA), Remedial Investigation (RI)/Feasibility Study (FS), Design Verification Report (DV), and an Environmental Baseline Survey (EBS) have been carried out for this facility to date. In addition, a Scope Reformulation and Issues Letter with recommendations for two of these sites has been submitted.

The Apple Orchard Landfill was an unlined landfill and open disposal area covering 4.3 acres, parts of which overly a streambed, where solid and liquid wastes were disposed. It is estimated to contain 75,000 cubic yards of fill. The area of 4.3 acres cited in the Design Verification Report by Brown & Root Environmental in 1995 is an increase over the earlier estimate of 0.8 acre by Malcolm Pirnie in 1991. Metals, PCBs, and halogenated organics have been found in the surface and subsurface sediments of the streambed downgradient of the landfill. Surface and groundwater was also contaminated with halogenated organics, TCE and some heavy metals. It is not clear from previous reports the direction of groundwater movement or the extent of groundwater contamination, and aquifer parameters have not been estimated. The extent of the landfill boundaries has not been determined, nor has the lateral extent of PCB contamination. A conclusive assessment of vertical and lateral extent of both groundwater and sediment contamination is still needed, as well as a determination of aquifer parameters and groundwater gradient. Although the DV ignores the question of groundwater remediation, the groundwater contamination clearly must be addressed in the ultimate remediation strategy.

The Pistol Range Landfill was an unlined, uncontrolled 1.1 acre facility constructed over a streambed for the disposal of various liquid and solid hazardous wastes. It may also contain unexploded ordnance. The estimated volume of the landfill is 20,000 cubic yards. Halogenated organics and heavy metals were found in surface water and sediments. The groundwater is contaminated with heavy metals and volatile organics including TCE. The RFA and the RI disagree on the direction of groundwater movement at the site, and aquifer parameters have not been determined. The vertical and horizontal extent of soil and groundwater contamination is not yet known and must be established to design a remediation plan. Groundwater remediation should be included in the final plan, as well as removal or containment of the contaminant source.

The Chemical Burial Site consists of four burial pits on a 1.1 acre site where liquid and solid wastes including transformers containing PCBs were disposed. Some of the wastes may have been disposed in drums. Heavy metals and volatile organics including TCE and

vinyl chloride have been found in the groundwater. Metals and some volatile and semi-volatile organics have been found in soil samples, although the organic analysis was plagued by analytical problems, and many of the results are invalidated or are estimates. PCBs have also been detected in some soil samples. There is some uncertainty about the subsurface characteristics and the extent of the confining layers beneath the site, i.e., whether there is one aquifer or two separate ones. The vertical and horizontal extent of groundwater contamination must be established, and the lateral extent of the soil contamination should be determined. Groundwater remediation as well as containment or removal of the source contamination should be a part of the future remediation plans.

1.0 FORMER APPLE ORCHARD LANDFILL

The Former Apple Orchard Landfill was identified as a Solid Waste Management Unit (SWMU) in the early 1980s. This site is known as SMWU #1 under the RCRA program and Installation Restoration (IR) site No. 2 in the Navy's installation restoration program. The following subsections summarize the results of the various studies, compare the results noting any discrepancies, and identify the data gaps required to make intelligent, informed decisions regarding appropriate response actions.

1.1 Site Description

The Apple Orchard Landfill is comprised of several disposal areas with an acreage of 4.3. This acreage was updated in 1995 from Malcolm Pirnie's 1991 estimate of 0.8 acres. The landfill lies south of Perimeter Road, approximately half a mile south of the northwest facility boundary. The landfill was operated as both an open disposal area and an unlined landfill. Both solid and liquid wastes were disposed in the unit, and not all of the liquids were containerized. In addition, one of the disposal areas is located over a perennial stream bed, and an estimated 25 vertical feet of waste or fill material has been disposed in that area. The unit was operated between 1948 and 1982, but when the RCRA Facility Assessment (RFA) was conducted in 1986, evidence of recent solid waste disposal was found. The estimated volume is 75,000 cubic yards.

An estimated 500 gallons of PCB contaminated oils were disposed in the SWMU prior to 1970. Other wastes include miscellaneous solvents, paint residues, acids, chemicals, and lubricating oils.

1.2 RCRA Facility Assessment

Sampling was conducted in both 1986 and 1989 as part of the RCRA Facility Assessment. In 1986 sampling occurred along the streambed which is mostly downgradient from the landfill. No groundwater elevations or contours were given in the document, but the groundwater flow direction appears to be from the landfill toward the stream in a southeasterly direction. Sediments were sampled at both 1 foot and 8 foot depths. Both surface water and groundwater were sampled. The analytical program did not appear to be chemical specific; in general screening methods were used to identify the presence of contamination. Several metals, including cadmium, chromium, and lead, were detected in the sediments to a depth of 8 feet. PCBs, ranging from below detection limits to 1.8 ppm were detected in subsurface sediments. PCBs were detected as high as 4.5 ppm in the surface sediments. Total Halogenated Organics or TOX concentrations ranged from 10 to 300 ppm in the sediments. The surface water and groundwater also had TOX. PCBs were analyzed in the groundwater samples, but the levels were below detection limits.

In 1989 cadmium and chromium were identified in the groundwater as well as copper and mercury. PCBs were again found in the stream sediments. Samples were collected within the landfill itself, and several semi-volatile compounds and PCBs were identified. The attachment showing the sampling locations and analytical results was missing from the review copy of the RFA.

1.3 Remedial Investigation Report

The Remedial Investigation was conducted in two phases. The first phase occurred between January 1989 and April 1990, and Phase II occurred between August 1990 and October 1992. Sediments, surface soils, surface water, and groundwater were sampled during the RI, and it appears that there were some QA/QC problems with the data.

In addition to PCBs, chromium, copper, lead and zinc were detected in the sediments along the stream and the surface soils. The PCB concentrations appear to be at approximately the same level as the 1986 samples, and they ranged from 24 to 8700 ug/kg. The highest chromium concentration was 45 mg/kg, and the highest lead concentration was 101 mg/kg. Semivolatile compounds were detected in the surface soils but not the sediment samples. Laboratory contaminants including acetone and methylene chloride were also detected. In spite of the additional sediment sampling, it was still unknown how far downstream the limits of PCB contamination extended.

An oily sheen was observed on the surface water collected from the stream, and natural habitat indicators show a marked decrease in water quality downstream of the landfill. TCE was found in the surface water samples.

The RI stated that groundwater flows in an east-southeasterly direction toward the center of the facility. The report also states that the leachate is migrating toward the stream which lies southeast of the landfill. The consultant proposes that the metals within the leachate are migrating in a radial direction because metals were detected in the assumed upgradient well. Both metals and TCE were detected in the groundwater beneath and downgradient from the site. Chromium (147 ug/L) and lead (235 ug/L) were detected above MCLs in the groundwater. Mercury could also be a concern, but the laboratory results were invalidated in all but one sample. Cadmium has increased in the downgradient well between 1984 and 1990. Despite these levels, the consultant believed that the PCB found in the surface soils and sediments was the chemical of concern that could impact human health and the environment.

1.4 Design Verification Report

The Design Verification (DV) Report estimated that the tributary within the landfill contained 240 cubic yards of PCB contaminated wastes. The estimated landfill area is 4.3

acres. The DV report identified data gaps with respect to limits of waste disposal and the limits of PCB contamination.

Three groundwater monitor wells were installed in 1995 as part of the Confirmation Study/Verification Phase Project. In addition, four surface water samples and ten sediment samples were collected and analyzed. A ground penetrating radar (GPR) study was also conducted, but the results were inconclusive. Seven test trenches were dug along the north and east perimeter of the landfill to define the limits of waste placement. Fill material was identified in each of the trenches.

Surface soil samples were collected between the landfill and the streambed and analyzed for PCBs. However, most of the results are based on field screening kits, not laboratory analysis. The field kit results estimated that several of the samples contained PCBs between 0.4 and 4.0 ppm. Sediment samples collected along the stream also indicated the presence of PCBs. The areas of highest PCB concentrations are along the northwest face of the landfill, downgradient of the alleged PCB storage tank area.

Although groundwater level readings were taken from eight existing monitor wells in March 1995, gradients were not calculated, and flow direction was not established. There is a 30 foot range in the groundwater elevations, and it is possible that the wells are screened within different strata of the aquifer. In any event, groundwater levels approach 6 feet below the ground surface at their shallowest, indicating that the majority of the 25 feet of fill material lies within the saturated zone.

1.5 Environmental Baseline Survey

Very little is mentioned about the former Apple Orchard Landfill in the Environmental Baseline Survey (EBS). The EBS describes the Installation Restoration Program in general, and a table summarizes the status of each site. For site number 2, the report mentions that the Remedial Investigation/Feasibility Study phase and the Design Verification phase have been completed. A second table indicates that metals, VOCs, PCBs, and PAHs have been detected and which media have been impacted. It does not quantify the extent of the impact. A third table states that the preferred remedial alternative for surface soil and buried material is source removal and a synthetic or soil cap over the landfill. It recommends excavation of PCB-containing sediments.

1.6 Scope Reformulation and Issues Letter

In the Scope Reformulation and Issues Letter, Brown & Root Environmental recommends adding the non-hazardous contents of the Site 3 landfill to the Site 2 landfill and screening to separate any hazardous or explosive waste. The hazardous waste would then be disposed offsite, and the explosives would be dealt with either on- or off-site in an unspecified manner. The consultant cites as the primary advantage of this strategy savings on post-closure care and and removal of a possible contaminant source at Site 3. The letter

acknowledges that groundwater monitoring and possibly remediation would still be required at that site, but does not address the issue of documented subsurface and groundwater contamination at Site 2.

1.7 Discussion

The RCRA Facility Assessment, Remedial Investigation Report, Design Verification Report, and the Environmental Baseline Survey were compared to identify data gaps, discrepancies, the need for additional information, and recommended actions. There appears to be some question regarding groundwater flow and direction. The RCRA facility assessment states that groundwater flows in a southeasterly direction, while the RI report states that groundwater flows to the east-southeast. This report later postulates that metals are migrating in a radial direction. The design verification report opted not to evaluate their data regarding flow direction and gradients, a fairly unusual procedure.

The RI report (Section 2.7.1.1) indicates that PCBs are the contaminants of greatest concern in the stream sediments, as the concentration exceeded the RCRA Corrective Action level for that chemical. The EBS report, however, states that PCBs have had only "minimal" impact on stream sediments. The EBS report does concur with the RI/FS recommendation of on-site thermal treatment for the affected sediments. The DV report recommends off-site treatment of sediments due to the estimated quantity of 240 cubic yards. The Scope Reformulation letter recommends consolidation of wastes between Sites 2 and 3. As the White Oak facility is not yet operating under a RCRA Part B permit, this is not a legally feasible alternative.

The extent of groundwater contamination has not been fully defined. The monitor wells sampled in the RI phase all have metals concentrations greater than MCLs. Although three wells were installed during the DV phase, there is no indication that they were sampled. Also, the FS recommends a groundwater extraction system with carbon adsorption, but groundwater is not discussed in the DV conclusions and recommendations section. The EBS does not mention groundwater remediation although it does mention that metals and TOX concentrations are "elevated".

1.8 Data Gaps

Very limited data is available regarding the vertical and horizontal extent of contamination as well as the constituents of concern. Groundwater flow patterns have not been established, so it is difficult to predict plume migration. The depth of the shallow aquifer has not been defined, and it is unknown whether or not contaminants have migrated downward into the next saturated zone. Aquifer characteristics have not been determined, so velocities cannot be calculated, nor groundwater remediation scenarios simulated. As mentioned in the previous section, the contaminant plume has not been identified. All of the groundwater wells need to be sampled, and then the need for additional monitor wells evaluated.

Much of the analytical data used for delineation of the PCB contamination in the DV report comes from test kits, not laboratory analysis. Also, sediment samples should be collected both upstream and downstream until detection limits are reached. It is not clear from the DV report how the contaminant volumes were calculated. The RI showed PCB contamination as deep as 8 feet whereas the DV investigation only collected surface samples.

1.9 Conclusions

The Apple Orchard Landfill was essentially an at-grade, unlined disposal area that took advantage of natural terrain to fill low-lying areas (e.g., the stream). As a result, much of the waste could lie within the saturated zone and is subject to transport through the groundwater and the stream itself. As much of the shallow soils beneath the site consist of sand, silt, and/or loam (Soil Survey Report, U.S. Naval Ordnance Laboratory), the contaminant transport is accelerated by the high porosity soils.

The existing groundwater wells should be sampled for RCRA metals, volatiles, semi-volatiles, PCBs/pesticides, and TOX. Groundwater elevations should also be measured at that time, and initial velocities and gradients should be computed. After the analytical results have been evaluated, drill more monitor wells to define the extent of contamination within the groundwater. During this phase, conduct a pump test to determine aquifer characteristics that can be used in the design of a groundwater remediation system.

Review aerial photographs to determine the extent of the landfill boundaries (this should be available from the EBS). Then collect more samples beyond the limits of waste and analyze them for PCBs and indicator chemicals from the metals, volatiles, and semi-volatiles groups. The contaminant volume proposed in the DV should be verified, especially if new data points are collected.

Although a RCRA cap has been proposed for this SWMU, it does not address the groundwater issues at the site. A cap is only one portion of a containment option; the source must also be contained to prevent horizontal migration. Remedial options such as pump and treat, bioremediation, and containment technologies should be evaluated before making a decision regarding the site.

2.0 FORMER PISTOL RANGE LANDFILL

The Former Pistol Range Landfill was identified as a Solid Waste Management Unit (SWMU) in the early 1980s. This site is known as SMWU #2 under the RCRA program and Installation Restoration (IR) site No. 3 in the Navy's installation restoration program. The following subsections summarize the results of the various studies, compare the results noting any discrepancies, and identify the data gaps required to make intelligent, informed decisions regarding appropriate response actions.

2.1 Site Description

The Pistol Range Landfill was partially constructed over a perennial tributary of Paint Branch Creek between Dahlgren Road and the northern facility boundary. It covers approximately 1.1 acres and contains an estimated 20,000 cubic yards. The landfill is located west of the pistol range, hence the name. Approximately 30 vertical feet of fill material has been disposed within the tributary over the years. Like the Apple Orchard Landfill, the Pistol Range Landfill was an unlined, uncontrolled disposal area for a variety of solid and hazardous wastes. The unit was operated between the late 1940s to the mid 1970s; exact dates of operation are unknown. An estimated 8,000 gallons of solvents and oils were disposed within the landfill over a 30 year period. A number of drums, large shell casings, torpedoes, and other unidentifiable metallic objects have been observed within the landfill. In addition to solvents and oils, sodium nitrate has also been disposed there. The possibility exists that unexploded ordinance materials still lie within the landfill.

2.2 RCRA Facility Assessment

Sampling was conducted in 1986 and 1989 as part of the RCRA facility investigation. In 1986 sampling occurred along the tributary of Paint Branch Creek. Although no groundwater elevations were included in the assessment report, the flow direction is shown to be from the landfill toward the tributary, essentially in a southerly direction. Several surface water samples were collected that had TOX concentrations ranging from 18 to 136 ppb. Sediment samples contained TOX ranging from <10 to 150 ppm. Chromium was identified in all of the sediment samples, and lead, nickel and zinc were also found to be above background levels.

In 1989 samples were again collected although it is not clear if sediments or sediments and surface water were the sample media. Metals including chromium, lead, copper, mercury, and cadmium were detected. Some volatile and semi-volatile compounds were also detected, but specific constituents were not mentioned in the report, and the appropriate attachment was missing from the review copy of the RFA.

2.3 Remedial Investigation Report

As previously mentioned, the Remedial investigation was conducted in two phases.

Phase I occurred between January 1989 and April 1990, and Phase II occurred between August 1990 and October 1992. A soil gas survey was conducted as well as groundwater, sediment, and soil sampling.

It appears that the landfill leachate has migrated into the shallow groundwater, but the consultant does not think that the leachate is migrating into the stream. A number of metals were detected in the groundwater including cadmium, chromium, lead, and zinc. The maximum chromium concentration was 259 ug/L, and the maximum lead concentration was 91 ug/L. A number of organics were also detected, and the risk assessment indicated that the following compounds were at concentrations significant enough to warrant health concerns: TCE, chloroform, and 1,2-DCE. The dissolved metals plume is larger than the dissolved organics plume, so the consultant hypothesized that the metals plume was the older of the two.

The RI report indicated that groundwater flow is toward the west except in the immediate vicinity of the stream; then groundwater flows to the south. The report states that leachate migration is to the south-southwest. However, the dissolved organics plume has migrated west of the stream, but the report says that the stream has not been impacted. The consultant hypothesizes that a second source is located west of the former landfill.

The groundwater table is located approximately 7 to 8 feet below the ground surface (in fractured bedrock) for all seven monitor wells. This elevation is approximately the same as the stream. The RI report states that a former sand and gravel quarry lies 500 feet north of the landfill, and it could also affect local hydraulic gradients. Two slug tests were also conducted for this aquifer, and the estimated velocity is 0.018 feet per day or 6.4 feet per year.

A soil gas survey was conducted at and around the landfill, and volatile organic compounds (VOCs) were found within the landfill as well as west and east of the landfill (3 ppm) and south of Dahlgren Road (0.6 to 15 ppm). Sediment samples were collected along the stream, and the benthos population was also sampled. Mercury and occasionally other metals were found above action levels at the time of the investigation. Surficial soils along the landfill face, immediately east of the stream or culvert, do appear to have a metals impact. The maximum chromium concentration was 83 mg/kg, and the maximum copper concentration was 2530 mg/kg. Lead was found as high as 1460 mg/kg, and the highest zinc level was 7300 mg/kg. Low levels of semivolatile compounds were found in two of the samples. Surface water samples collected from the culvert showed low levels of lead (up to 31.4 ug/L), zinc (14.5 to 28.3 ug/L), and copper (3.8 to 7.5 ug/L).

The FS recommended the construction of a 40,000 square foot cap for affected areas and the construction and installation of a groundwater pump and treat system.

2.4 Design Verification Report

The DV report estimated that the Pistol Range Landfill covered 1.1 acres. During the DV investigation, an electromagnetic survey and subsurface trenching were conducted to determine the eastern boundary (i.e., along the stream side) of the landfill. In addition, one boring was completed within the landfill to determine the depth of waste on the western face of the landfill.

The results of the EM survey indicated that the fill material does not extend beyond Perimeter Road on the west. Seven test trenches were excavated along Perimeter Road as well as the eastern face of the landfill, and several fuses were unearthed. The landfill boring was unsuccessful at determining the depth of waste on the western face, as there was too much debris.

Water level readings were recorded in March 1995. However, gradients were not calculated, and flow directions were not established. Groundwater elevations range from 6 to 11 feet below the ground surface.

The DV recommended that site remediation consist of capping the landfill. It also suggests that due to potentially explosive materials that the stream may need to be relocated as well as several existing rights of way. No mention is made of groundwater remediation.

2.5 Environmental Baseline Survey

Very little is mentioned about the former Pistol Range Landfill in the Environmental Baseline Survey (EBS). The EBS describes the Installation Restoration Program in general, and a table summarizes the status of each site. For site number 3, the report mentions that the Remedial Investigation/Feasibility Study phase and the Design Verification phase have been completed. A second table indicates that metals and VOCs have been detected and which media have been impacted. It does not quantify the extent of the impact. A third table states that the preferred remedial alternative for surface soil and buried material is a synthetic or soil cap over the landfill. It recommends a pump and treat scenario (activated carbon) for the groundwater.

2.6. Scope Reformulation and Issues Letter

In the Scope Reformulation and Issues Letter, Brown & Root Environmental recommends moving the non-hazardous contents of the Site 3 landfill to the Site 2 landfill and screening to separate any hazardous or explosive waste. The hazardous waste would then be disposed offsite, and the explosives would be dealt with either on- or off-site in an unspecified manner. The consultant cites as the primary advantage of this strategy savings on post-closure care and and removal of a possible contaminant source at Site 3. The letter acknowledges that groundwater monitoring and possibly remediation would still be required at

that site. However, Site 3 would not be restored to its natural condition unless all contaminated soil and sediment were treated or removed and the groundwater remediated.

2.7 Discussion

The RCRA Facility Assessment, Remedial Investigation Report, Design Verification Report, and the Environmental Baseline Survey were compared to identify data gaps, discrepancies, the need for additional information, and recommended actions. There appears to be some question regarding groundwater flow and direction. The RCRA facility assessment states that groundwater flows in a southerly direction, while the RI report states that groundwater flows to the west in general and toward the south in the vicinity of the stream. The RI report states that leachate migration is to the south-southwest, but the dissolved organic plume has also migrated west of the stream. The design verification report opted not to evaluate their data regarding flow direction and gradients, a fairly unusual procedure.

The RI report shows that the shallow groundwater has been impacted by both metals and organics that have migrated into the saturated zone. Several of these constituents, including chromium, lead, and TCE, were found above MCLs, and the risk assessment suggested that there could be health risks from the ingestion of groundwater. While the RI states that leachate has migrated from the landfill into the shallow aquifer, it suggests that there is not enough evidence to state that the leachate is migrating into the stream. However, there is no explanation or conclusions drawn as to why dissolved metals above action levels were found in the surface water samples collected from the stream nor why metals were found above action levels in soil/sediment samples collected along the eastern bank of the stream.

While the RI does conclude that there has been a groundwater impact, and this is mentioned in the DV report, the DV report completely ignores groundwater issues. No sampling of wells is conducted, nor is there any mention of groundwater remediation in the conclusions and recommendations chapter. As previously mentioned, groundwater extraction and carbon adsorption were recommended in the Feasibility Study and in the Environmental Baseline Survey. Although groundwater elevation data was collected, it was not evaluated.

It appears that some amount of unexploded ordnance material has been disposed in the landfill. This issue has not been fully explored in the documents reviewed for this report.

The Scope Reformulation letter recommends consolidating wastes from the Site 3 landfill to the Site 2 landfill. One of the advantages cited is source removal. It is true that the source would be removed fro Site 3, but the waste would still remain on the property at a different location. Also, as the White Oak facility is not operating under a RCRA Part B permit, this is not a legally feasible alternative.

2.8 Data Gaps

Very limited data is available regarding the vertical and horizontal extent of contamination. The constituents of concern have been identified in the groundwater, but the sampling data is over 5 years old at this point in time. The extent of contamination has not been delineated, and the plume has most likely spread since the last samples were collected and analyzed. The metals appear to be migrating in a different direction than the organics. Groundwater flow patterns have not been adequately defined, so it is difficult to predict plume migration. For example, one report has the plume migrating south, while another report has the plume migrating to the west. The depth of the shallow aquifer has not been defined, and it is unknown whether or not contaminants have migrated downward into the next saturated zone. While slug tests were conducted, pump tests are necessary to further refine the parameters required to design a groundwater extraction system.

Data from the RI suggests that the leachate could be migrating into the stream. Additional samples from surface water and soils within the stream bed could establish whether or not this is indeed the case. Previous groundwater measurements indicate that the groundwater table is at the approximate level of the stream bed. This, too, should be verified.

2.9 Conclusions

The Pistol Range Landfill was essentially an at-grade, unlined disposal area that took advantage of natural terrain to fill low-lying areas (e.g., the stream). As a result, much of the waste could lie within the saturated zone and is subject to transport through the groundwater and the stream itself. As much of the shallow soils beneath the site consist of sand, silt, and/or loam (Soil Survey Report, U.S. Naval Ordnance Laboratory and RCRA Facility Assessment Report), the contaminant transport is accelerated by the high porosity soils.

The existing groundwater wells should be sampled for RCRA metals, volatiles, semi-volatiles, PCBs/Pesticides, and TOX. Groundwater elevations should also be measured at that time, and initial velocities and gradients should be computed and compared to previous data. After the analytical results have been evaluated, drill more monitor wells to define the extent of contamination within the groundwater, as neither upgradient nor downgradient conditions have been confidently established. During this phase, conduct a pump test to determine aquifer characteristics that can be used in the design of a groundwater remediation system.

The electromagnetic survey defined the boundary of waste disposal, but the depth of waste has not been defined on the west side of the landfill. Due to the amount of debris in the landfill, it may not be possible to do this prior to remedial action. However, sediment and surface water samples can and should be collected from the stream to verify whether or not contaminant migration has occurred from the landfill.

Although a RCRA cap has been proposed for this SWMU, it does not address the groundwater issues at the site. A cap is only one portion of a containment option; the source

must also be contained to prevent horizontal migration. Remedial options such as pump and treat, bioremediation, and containment technologies should be evaluated before making a decision regarding the site.

3.0 FORMER CHEMICAL BURIAL SITE

The Former Chemical Burial Site was identified as a Solid Waste Management Unit (SWMU) in the early 1980s. This site is known as SWMU #4 under the RCRA program and Installation Restoration (IR) site No. 4 in the Navy's installation restoration program. The following subsections summarize the results of the various studies, compare the results noting any discrepancies, and identify the data gaps required to make intelligent, informed decisions regarding appropriate response actions.

3.1 Site Description

The former Chemical Burial Site consists of 4 burial pits or areas within a 1.1 acre site. Both liquid and solid wastes including transformers were disposed here between the mid 1950s and the mid 1970s. It has been reported that one of the burial pits, measuring 100 feet by 15 feet by 20 feet, was used for the one-time disposal of 5 and 55 gallon drums of miscellaneous chemicals. It is estimated that 600 cubic feet of chemicals have been disposed here. Potential wastes include acids, explosives, kerosene, solvents, tank bottom sludges, and miscellaneous chemicals. Also, PCBs may have leaked from the disposed transformers. The Chemical Burial Site is located south of Perimeter Road, approximately 400 yards northeast of Site 3. Unlike the other two landfills, there is no perennial stream in the immediate vicinity of the site.

3.2 RCRA Facility Assessment

Sampling was conducted in both 1986 and 1989 as part of the RCRA Facility Assessment. Monitor wells were sampled and analyzed for metals, TOC, TOX, conductivity, oil and grease, nitroaromatics and volatile organic compounds (VOCs). A number of metals including chromium, lead, copper, and nickel were above action levels. For example, chromium ranged from 123 to 870 ug/L, and lead ranged from 58 to 1400 ug/L. Toluene was detected in three wells during the 1986 sampling event but not in 1989. Vinyl chloride was detected once (19 ug/L) in 1986. Monitor wells north and southwest of the pit contained constituents above action levels. The monitor well southeast of the SWMU did not have metals and organics above action levels. PCBs, polynuclear aromatic hydrocarbons, thallium and arsenic were reportedly detected in downgradient soil borings in 1986, but these results were not included in the summary analysis.

3.3 Remedial Investigation Report

The Remedial Investigation was conducted in two phases. Phase I occurred between January 1989 and April 1990, and Phase II occurred between August 1990 and October 1992. A ground penetrating radar (GPR) survey was conducted as well as the collection of soil samples, a soil gas survey, and groundwater sampling.

The GPR survey delineated the boundaries of the four disposal pits, and a number of anomalies appear to be rocks or drums. Readings of 0 to 40 ppm were obtained from the soil gas survey. Several soil samples were analyzed for VOCs, but the sample results were generally invalidated due to laboratory QA/QC problems. However, the consultant believed that the pyrene concentrations were legitimate.

The groundwater hydrology and hydrogeology beneath the landfill is rather complex. The consultant conducted a pump test, but the results were variable due to heterogeneities within the subsurface. The depth to the water table varies from 28 to 58 feet. An aquitard was encountered at 44 feet. Later in the text, it was proposed that clay layers between 20 and 25 feet were retarding the vertical migration of the contaminants. There is a flow divide beneath the landfill so that some groundwater flow is to the south-southeast while some groundwater flows west toward the unnamed tributary discussed in Section 2.0. The average aquifer thickness is 21 feet, and the estimated hydraulic gradient is 1.4 percent.

The maximum metals concentrations were obtained from the shallowest well at the site. For example, the copper concentration was 1150 ug/L, and the lead level was at 96 ug/L. Zinc was found at 5310 ug/L. Mercury was included in the metals analysis, but due to laboratory QA/QC problems, the results had to be invalidated. Four wells had TCE concentrations ranging from 160 to 1000 ug/L in 1989. These wells ranged from 90 to 650 ug/L TCE in 1991. Low levels of vinyl chloride were detected during Phase II of the RI. Other VOCs found above MCLs included 1,2-DCE, 1,1,2,2 tetrachloroethene, methylene chloride, benzene and chloroform. However, the methylene chloride and chloroform could be laboratory contaminants. The TCE was most likely released from three of the disposal areas which combined to form one plume. The TCE plume appears to be migrating south. The consultant assumed that the retardation factor for TCE is 1, and that the plume is migrating an estimated 0.92 feet per day. However, the plume migration is actually much slower than this, and the dissolved metals are migrating at a different velocity.

The Feasibility Study recommended that approximately 5200 cubic yards of waste be excavated and thermally treated. A pump and treat system was recommended for groundwater.

3.4 Design Verification Report

An electromagnetic (EM) survey and subsurface sampling were conducted as part of the DV phase in 1995. The survey verified the presence of the four disposal pits identified during the RI as well as the suspected drum locations. Six borings were drilled within the waste areas, and 14 borings were drilled in the immediate vicinity of the landfill. Nine additional borings were installed during Phase II. High levels of aluminum (980 to 13,600 mg/kg) were detected in all of the soil samples. Arsenic was also detected in all samples. Barium and zinc were detected in over half the samples. Chromium was detected in all of the samples but one. Volatile and semivolatile organics were found at elevated levels in some samples. Many volatile and semi-volatile concentrations were either below practical

quantitation limits or invalidated due to matrix interference or blank contamination. Field kits were used for PCBs in several areas, and elevated levels were found in three samples. The results were below detection limits (0.4 ppm) in all others. Field test results were compared with laboratory analyses and were in agreement except for two false positives for concentrations greater than 4 mg/L.

Groundwater water level readings were recorded in March 1995. However, gradients were not calculated, and flow directions were not established. Groundwater elevations ranged from 6.5 to 63 feet below the ground surface, indicating that wells have been drilled in two different strata. Also, two of the wells were dry at the time the levels were measured.

The DV report states "limited subsurface waste and soil contamination at Site 4...was similar in nature but less extensive than that previously identified in the Remedial Investigation". Excavation and disposal of waste and contaminated soil is the recommended remedial action. Future groundwater remediation is alluded to but not specifically recommended.

3.5 Environmental Baseline Survey

Very little is mentioned about the Chemical Burial Site in the Environmental Baseline Survey (EBS). The EBS describes the Installation Restoration Program in general, and a table summarizes the status of each site. For site number 4, the report mentions that the Remedial Investigation/Feasibility Study phase and the Design Verification phase have been completed. A second table indicates that metals, TOC, and TOX concentrations are elevated in groundwater. However, there are neither ranges nor definitions as to what qualifies as minimal or elevated concentrations. A third table states that the preferred remedial alternative is a pump and treat scenario (activated carbon) for the groundwater. Although nothing is mentioned regarding soils or sediments, excavation and on-site thermal treatment of soils is recommended.

3.6 Discussion

The RCRA Facility Assessment, Remedial Investigation Report, Design Verification Report, and the Environmental Baseline Survey were compared to identify data gaps, discrepancies, and recommended actions. The RFA reports groundwater contamination at levels above MCLs for TCE, cadmium, chromium and lead, as does the RI. The RI reports levels above MCLs for other volatile organics as well, and for mercury concentrations measured in the Phase I investigation. Mercury analyses for the Phase II groundwater samples were rejected during the data evaluation. Phase II of the RI found copper and some volatile organics in surface soils at levels above acceptable background concentrations. The RFA mentions but does not include data for soil contamination at the site. The DV did not attempt to verify site hydrogeology or groundwater contamination. Its results indicate contamination of soil with VOCs, metals, and PCBs as did the previous reports.

3.7 Data Gaps

None of the foregoing work fully defines the horizontal extent of soil contamination nor does it define the vertical or horizontal extent of groundwater contamination. The plume needs to be defined to MCLs for the purpose of future remediation design. Installation of more downgradient wells will be necessary.

There is some uncertainty as to the hydrogeology of the subsurface at this unit. The RI mentions a clayey confining layer at 20 ft and a confining layer of saprolite at 44 ft. It is unclear whether there are two distinct aquifers or if the upper layer represents discontinuities within a single aquifer.

The usefulness of the analytical results of the RI are diminished by the laboratory's QA/QC problems. The results for a considerable number of samples had to be rejected due to contamination of the blanks or failure to recover a spike.

With better delineation of the contamination and more reliable analytical results, it should be possible to quantify the volume of contaminated soil and groundwater.

3.8 Conclusions

The Chemical Burial Site has released volatile and semi-volatile organic and heavy metal contaminants into the groundwater beneath the burial pits at levels above MCLs. The surface soils in the vicinity are also contaminated at levels higher than acceptable background levels. More data is needed to quantify the extent of contamination and estimate volumes of contaminated soil and groundwater.

More groundwater monitoring wells should be installed and sampled to quantify the extent of groundwater contamination. Additional soil sampling will be necessary to determine the volumes of soil requiring remediation.

Aquifer parameters have been previously determined from pumping tests and will be useful in designing a groundwater remediation scenario. Groundwater elevations should be measured and compared to previous data.

Removal of the contaminant source at this site is essential to prevent further release of contaminants into the groundwater. Remediation of the contaminated groundwater with respect to both metals and volatile organics will also be necessary to protect human health and the environment.

ATTACHMENT A

Questions Regarding Apple Orchard Landfill

1. What is the vertical and horizontal extent of groundwater contamination?
2. What are the aquifer parameters?
3. What is the direction of groundwater flow?
4. What are the groundwater elevations?
5. What are the landfill boundaries?
6. What is the volume of contaminated sediment and soil?

ATTACHMENT B

Questions Regarding Pistol Range Landfill

1. What is the vertical and horizontal extent of groundwater contamination?
2. What are the aquifer parameters?
3. What is the direction of groundwater flow?
4. What are the groundwater elevations?
5. What is the depth of waste on the west side of the landfill?
6. Is there a second source or organic contamination west of the former landfill?
7. What is the extent of soil, sediment and surface water contamination?

ATTACHMENT C

Questions Regarding Chemical Burial Site

1. What is the vertical and horizontal extent of groundwater contamination?
2. Are there two contaminated aquifers or one?
3. What are the groundwater elevations?
4. What is the extent of soil contamination?