SITE INVESTIGATION REPORT
POTENTIAL SOIL IMPACT SURVEY

FOR THE

FORMER FIVE POINTS
OUTLYING FIELD (OLF)

Arlington, Texas

FOR THE

UNITED STATES ARMY CORPS OF ENGINEERS
FORT WORTH DISTRICT
P.O. BOX 17300
FORT WORTH, TEXAS 76102-0300

CONTRACT NO. DACA63-01-D-0013
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EXECUTIVE SUMMARY

The former Five Points Outlying Field (OLF) is a WWII-era Formerly Used Defense Site (FUDS) located in Arlington, Texas. The site was used as a practice landing strip and later converted into a practice bombing range, utilizing up to three different ordnance munitions for an unknown period of time. The site was closed, cleared of surface ordnance, and sold in 1956.

The site has since been developed into two residential housing communities, the Twin Parks Estates mobile home park (first developed in 1983) and South Ridge Hills (developed from 1998 to the present). Construction activities at both residential developments at the site have uncovered practice ordnance in surface soils and possibly to depths of up to six feet below ground surface (bgs).

The United States Army Corps of Engineers (USACE), Fort Worth District, in conjunction with the USACE Center of Expertise for Ordnance at Huntsville (CEHNC), has initiated an Engineering Evaluation/Cost Analysis (EE/CA) for the Five Points OLF site. This Site Investigation Report presents the results of the surface soil investigation phase of the on-going EE/CA.

The purpose of the surface soil investigation was to evaluate soil quality and compare the results to the risk-based protective concentration levels (PCLs) established under the Texas Risk Reduction Program (TRRP). The chemicals of concern (COCs) investigated at the site were selected based upon the known Department of Defense (DoD) uses of the site and the composition of the three potential munitions. These analytes include lead and zinc (metallic components of the bomb casings), white phosphorus (a smoking agent used as a spotting charge) and tetryl, 2,4,6-trinitrotoluene (TNT), and TNT degradation products (potentially used as detonation materials to expel spotting charges).

The site investigation was performed through surface soil sampling using direct push methods. The regions of the site with the highest probability of containing the COCs were identified as the center of the former practice range and the former surface water drainage areas. Sampling locations were subsequently identified in these two regions. A total of 144 near-surface (zero to two feet bgs) soil samples were collected to address potential surface exposure pathways. Twelve deeper soil samples (approximately six feet bgs) were collected to evaluate the potential for a release of COCs due to potential buried ordnance. The samples were sent to a USACE-validated laboratory and three USACE laboratories for chemical analysis.

The analytical results of all of the COCs were compared to their respective Tier I total combined exposure pathway PCLs for residential soils established by the Texas Commission on Environmental Quality (TCEQ) under TRRP. See Section 1.5 for an overview of TRRP. Lead and zinc levels were also compared to the Texas-Specific Background Levels, found in 30 Texas Administrative Code (TAC) 350.51, as these

metals are naturally occurring in soils [15 milligrams/kilogram (mg/kg) for lead, 30 mg/kg for zinc].

Results for all samples were either non-detect or below the TRRP PCLs. Tetryl, TNT and the TNT degradation products were not detected in any sample. The total lead and zinc concentrations across the site averaged below the background levels (lead site average of 12.97 mg/kg, zinc site average of 29.91 mg/kg). White phosphorus was detected in 18 of the 156 total samples, all of which were in the shallow soil interval. Of the 18 detections, only four were quantifiable above the method quantitation limit [location B40 at 0.63 micrograms/kilogram (µg/kg); location R05-2D at 2.47J µg/kg; location R05-2C at 0.58J µg/kg; and location R08-2A at 2.22 µg/kg], and all four were well below the residential soil PCL (510 µg/kg).

Additional soil sampling at the former Five Points OLF site is not recommended.

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ACRONYM LIST

APAR	Affected Property Assessment Report
ASTM	American Society for Testing and Materials
bgs	Below Ground Surface
CCBs	Continuing Calibration Blanks
CDQAR	Chemical Data Quality Assessment Review
CEHNC	Corps of Engineers Huntsville Engineering and Support Center
CEMVS	Corps of Engineers St. Louis District
CERCLA	Comprehensive Environmental Response Compensation & Liability Act
CESWF	Corps of Engineers Fort Worth District
COC	Chemical of Concern
CRREL	Cold Regions Research and Engineering Laboratory
DoD	(United States) Department of Defense
DQCR	Daily Quality Control Report
ECB	Environmental Chemistry Branch (Omaha)
EE/CA	Engineering Evaluation/Cost Analysis
EOD	Explosives and Ordnance Disposal
EPA	(United States) Environmental Protection Agency
ft.	Feet
FUDS	Formerly Used Defense Sites
GSA	General Services Administration
GPS	Global Positioning System
IDW	Investigation-Derived Waste
LCS	Laboratory Control Spike
LCSD	Laboratory Control Spike Duplicate
mg/kg	Milligrams/kilogram
µg/kg	Micrograms/kilogram
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NAS	Naval Air Station
NPL	National Priorities List

NWS	National Weather Service
OE	Ordnance and Explosives
OLF	Outlying Field
PCBs	Polychlorinated Biphenyls
PCLs	Protective Concentration Levels
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Differences
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
$^{Tot}Soil_{Comb}$	Total Exposure Pathway PCL for Soil
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TNT	2,4,6-Trinitrotoluene
TRRP	Texas Risk Reduction Program
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
UXO	Unexploded Ordnance
WES	Waterways Experimentation Station
WP	White Phosphorus

1.0 INTRODUCTION

1.1 Purpose

This preliminary site investigation relates to the surface soil study phase of the former Five Points Outlying Field (OLF) Engineering Evaluation/Cost Analysis (EE/CA). As part of the overall EE/CA, chemicals of concern (COCs) were designated based on the historical use of the OLF site. This historical search identified the ordnance used at the practice range.

The purpose of this preliminary investigation is to determine whether specific COCs that may have originated from prior Department of Defense (DoD) activities are present and potentially contributing to environmental impacts of surface soil at the former Five Points OLF site. To make this determination, data regarding the presence and/or the concentration of COCs including lead (Pb), zinc (Zn), white phosphorus (WP), tetryl and 2,4,6-trinitrotoluene (TNT), as well as its related transformation compounds, are needed.

Malcolm Pirnie, Inc., performed this preliminary investigation in late October and November 2002. Identification and removal of ordnance and explosives (OE) hazards are not part of this scope. However, ordnance avoidance is always a safety concern on former range sites. OE removal activities will be addressed under a separate phase of the EE/CA.

The former Five Points OLF is a Formerly Used Defense Site (FUDS) and since the FUDS program was created under the Superfund Amendments and Reauthorization Act (SARA) Act, this project is undertaken as a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) action. The CERCLA of 1980, as amended by the SARA on October 17, 1986, incorporates into the law the CERCLA compliance policy. Although the Five Points OLF site during this investigation is not a CERCLA Superfund project or a site on the National

Priority List (NPL), all investigation and reporting will meet CERCLA standards. For all non-NPL FUDS in Texas, the Texas Commission on Environmental Quality (TCEQ) will be the lead regulatory agency. Analytical results will be compared against the standards set forth in the Texas Risk Reduction Program (TRRP) adopted by the TCEQ.

1.2 Site Location

The 162.06-acre site known as the former Five Points OLF is located at the corner of Harris Road and Matlock Road, Arlington, Tarrant County, Texas, at latitude 32° 37' 26" and longitude 97° 07' 25" (Figure 1.1). A 35-acre portion of the former Five Points OLF was developed in the 1980s as a mobile home park under the name of Twin Parks Estates. The remainder of the original 162.06-acre tract used by the DoD is currently being developed as a new home subdivision known as South Ridge Hills.

1.3 Site History

The U.S. Government acquired 162.06 fee acres in 1940 as an outlying field for the Dallas Naval Air Station (Dallas NAS) at Grand Prairie, Texas (Huntsville Engineering and Support Center, 2002). Four runways were constructed at the site for naval air operations and were utilized for practice landings and takeoffs for several years (Figure 1.2). Records indicate that asphalt runways were used and no other physical structures were present at the site during past DoD operations (no fueling operations, electrical, maintenance, or other storage facilities were located at the site). At an unknown date, the site was converted to a practice bombing range.

Records indicate that the explosive ordnance used on this site was limited to MK 23 miniature Navy practice bombs, M38A2 practice bombs, and an unknown version of the M47 series practice chemical bomb. The MK 23 was a three-pound practice bomb with a metallic body composed mainly of lead and zinc, and was manufactured with a hollow interior to allow for placement of a shotgun shell and a black spotting powder to visually mark bomb strikes. The spotting powder was ejected from the bomb by shotgun shell discharge upon bomb impact with the ground. During WWII, M47 bomb casings were used as practice bombs if M38A2 practice bombs were unavailable. The M47 series practice chemical bombs were bombshell casings for chemical bombs that had failed pressure leak tests. The failed shell casings were used for practice bombs and were typically filled with sand or water with appropriate spotting charges. The M47 practice bombs could also have contained white phosphorus (a smoke producing agent), or powdered rust (a staining agent) as a spotting charge. The M38A2 practice bomb casing weighed approximately 16 pounds, and was typically filled with 80 pounds of sand, rust or water, and 3 pounds of black spotting powder, for a total ordnance weight of 100 pounds, similar to the weight of the live ordnance.

At an unknown date, the Navy declared the entire 162-acre site as excess and transferred the property to the General Services Administration (GSA) for disposal. Gordon and Pope Supply Company obtained the property from the GSA in July 1956 with the recommendation from the GSA that 17.5 acres of the former range be restricted to surface use only and stated that ordnance may be present anywhere on the property.

In September 1983, 35 acres of the former practice range were sold and developed as the Twin Parks Estates mobile home park (Figure 1.3). Development was halted in November 1983 upon the discovery of a practice bomb in the surface soil. The developer contracted the removal

of any remaining ordnance, leading to the removal of approximately 3,000 MK 23 practice bombs from the site. Some of these bombs were reportedly found to depths of up to six feet, suggesting that some leftover practice bombs may have been buried on-site.

In February 1998, personnel from the USACE Center of Expertise for Ordnance at Huntsville (CEHNC), visited the area to address some concerns pertaining to the remaining 127 acres of the former practice bombing range. At that time, the acreage was undeveloped, containing only mesquite, tall weeds, and grass. The CEHNC conducted a visual and magnetometer survey of the area without any intrusive investigations. Personnel located metal scrap on the surface, but none related to unexploded ordnance (UXO). Numerous metallic anomalies were detected, with the majority of them located near the former target center (with decreasing detection as the team moved away from the center). It was concluded that practice bombs could potentially remain in the site soils within the 127-acre region (USACE, 1998).

The remaining 127 acres of the site has been under development as a subdivision by KBHomes since 1998 (South Ridge Hills), with approximately 700 homes projected for construction (see Figures 1.4 and 1.5). In January 2000, the Corps of Engineers, St. Louis District (CEMVS), conducted a site visit, which was part of an Archive Search Report for the site. Open areas of the site were walked and no additional bombs were found. However, construction workers at the site indicated that practice bombs had been uncovered while digging in the area.

The USACE, Fort Worth District, in conjunction with the CEHNC, initiated an EE/CA in April 2002 for the Five Points OLF site. This Site Investigation Report presents the results of the surface soil investigation phase of the on-going EE/CA.

1.4 COC Selection

The COCs for this site investigation were selected based upon the known use of the site as a former practice bombing range, the composition of the three potential munitions, and consultation with the Environmental Protection Agency (EPA) and TCEQ personnel. These analytes include lead and zinc (metallic components of the bomb casings), white phosphorus (a smoking agent used as a spotting charge) and tetryl, TNT and TNT degradation products (potentially used as detonation materials to expel spotting charges). As the site did not contain infrastructure to support refueling, maintenance or electrical operations, constituents such as fuel hydrocarbons, chlorinated solvents, or polychlorinated biphenyls (PCBs) were not selected for analysis. Additionally, herbicides were eliminated as potential COCs following confirmation that the runways at the site were composed of asphalt and were not simply dirt runways. As there were no structures at the site, pesticides were also eliminated as potential COCs.

1.5 TRRP Regulatory Guidance

The Texas Risk Reduction Program (TRRP) Rule (30 TAC 350) and conforming rule changes were published in the *Texas Register* on September 17, 1999 and became effective on May 1, 2000. The TRRP was enacted to regulate the cleanup and management of hazardous waste and substances (i.e., COCs) which have been released into the environment, set reasonable response objectives that will protect human health and the environment, and preserve the active and productive use of land. The TRRP sets requirements for how to determine whether releases pose unacceptable risk to human health and the environment. Where applicable, the rule defines the requirements for what must be done to reduce the risk, prevent pollution, and protect the environment.

The initial step in the TRRP process is the performance of an assessment of environmental impacts at an affected property. This assessment includes characterization of soil and groundwater impacts of COCs and any other environmental media, as well as a description of the affected property's surface and subsurface conditions. Cleanup goals and requirements are established based upon the land use and size of the affected property. Performance of the affected property assessment also includes notification of owners of properties that were sampled or contain COCs.

The TRRP rule uses a tiered approach incorporating risk assessment techniques to establish procedures for calculating PCLs that are protective of human health and the environment. Each type of PCL focuses on a different potential exposure pathway. The method of exposure to humans from soil includes ingestion, inhalation of volatile emissions/particulates from soil and direct dermal contact. The PCL that is protective of all of these exposure pathways is known as the total combined soil PCL ($^{Tot}Soil_{Comb}$), and is the PCL in which the COCs in this investigation will be compared. There are also PCLs that provide the concentration limits for other exposure pathways including groundwater, subsurface soils, sediment, and surface water.

The TRRP provides three tiers for human health PCL determination: Tier I, Tier II and Tier III. Tier I is the simplest method for PCL selection as the TCEQ has tabulated these values based on land use (i.e., residential or commercial/industrial). Tier I values are calculated using generic parameter values in basic modeling equations, which generally results in the most stringent regulatory levels of the three tiers. Tier II allows assessors to use these same equations with site-specific parameter values. Tier III allows assessors to find models that are site-specific and use site-specific parameter values. Generally, determination of the PCLs starts with Tier I and progress to Tiers II or III only when warranted.

This site investigation will use Tier I to determine the PCLs for lead, zinc, white phosphorus, tetryl, TNT and TNT degradation products. Tier I is divided into two categories based on land use in the area of release: residential and commercial/industrial. These categories are, in turn, divided into two source area sizes: 0.5 acres and 30 acres. As the former Five Points OLF is currently a residential site, the Tier I residential total combined soil PCLs for a 30 acre site will be used. As TRRP defines surface soils in residential areas to be the interval from the surface to 15 feet below ground surface, only surface soils were sampled during this site investigation. The PCLs are listed in Table 3.1 of the analytical results section (Section 3.0).

TRRP reporting requirements include the preparation of an Affected Property Assessment Report (APAR) in the event that COCs are found at an affected property above the applicable PCLs. If remediation of a site is required, other reporting requirements can include the submission of a Response Action Plan highlighting the remediation or control strategies, a Response Action Effectiveness Report, a post-Response Action Care Report, and if the program is in the Voluntary Cleanup Program, conditional and final Certificates of Completion.

1.6 Geologic Setting

The Five Points OLF site is located in the Osage Plains section of the Central Lowland Province. Rocks of this section range from Cretaceous to Recent. The oldest strata are exposed in the western part of Tarrant County. Younger bedrock units are exposed in sequence toward the east. Alluvium and terrace deposits overlap the bedrock along streams and rivers.

The outstanding geologic event in the region was the encroachment of the Comanchean Sea. This early Cretaceous sea moved slowly northward from the Gulf of Mexico entirely covering Texas and extending north to the Arbuckle Uplift (in Oklahoma) before receding. After

a period of exposure and erosion, sediments from this period were covered by the less extensive sea of the Gulfian Epoch.

The predominant rock type that lies beneath Tarrant County and the Five Points OLF site is the Eagle Ford Group, part of the Gulf Series of the Cretaceous System (Nordstrom, 1982; Geological Atlas of Texas, 1988). This group, ranging in thickness of 150 to 300 feet, is composed predominantly of shale, sandstone, clay, marl, and limestone. The shale is bituminous and selenitic, with calcareous concretions and large septaria. The sandstone and sandy limestone in the upper and middle portions is platy, burrowed, and medium to dark gray in color. The hard limestone beds represent the base in counties south of the site.

The Comanchean series rocks of the Cretaceous System that lie beneath the Eagle Ford Group are divided into three major groups: the Trinity, the Fredericksburg, and the Washita Group. The Cretaceous System forms a thickening wedge extending southeast across the area into a structural feature known as the East Texas basin. Regional dip is east and southeast at rates of about 15 to 40 feet/mile (Nordstrom 1982).

1.7 Soils

The United States Department of Agriculture (USDA) has characterized the soils at the Five Points OLF as primarily Heiden clay (Ressel et al., 1981). The USDA description generally matches the observations made in the field during sampling. However, the site covers a large area and has a number of different soil types represented. The soils range from very shallow to deep over very short distances. The slopes range from level to 3%. For all the soils present, the risk of corrosion to uncoated steel is high and to concrete is low.

The shallow soils have a surface layer that can range from 5 to 12 inches deep. It consists of grayish-brown gravelly clay. These soils are well drained. The available water capacity is very low, permeability is moderately slow, and runoff is medium to rapid depending on the slope. The hazard of erosion due to water is slight to moderate.

The deep soils have profiles that differ greatly within small areas. The surface layer is generally about 12 inches thick. It is composed of dark grayish-brown clay. The "subsurface" layer, to a depth of 25 inches, is very dark gray clay. The subsoil, to a depth of 40 inches, is dark gray, light olive brown or yellowish-brown clay and silty clay. The stratum and substratum, to 70 inches, is composed of brownish yellow silty clay, or grayish-brown clay that may be mottled with olive yellow in small areas. The deep soils are well drained. The available water capacity is medium to high, permeability is very slow, surface runoff is medium, and the hazard of water erosion is moderate.

1.8 Hydrology

1.8.1 Ground Water

The Trinity Group of Cretaceous age is the largest and most prolific aquifer in the study area. The aquifer consists of the Antlers, Paluxy, and Twin Mountains Formations. The Antlers is a coalescence of the Paluxy and Twin Mountains. The Trinity Group aquifer ranges in thickness from 100 feet in the outcrop area to about 1200 feet near the down dip limit of fresh to slightly saline water. Artesian storage coefficients range from 0.0001 to 0.00025 and specific yields range from 15 to 25 percent in the outcrop (Nordstrom 1982).

1.8.2 Surface Water

There are no major rivers or streams at this site. Runoff from this location drains to the southeast portion of the site into an intermittent section of Bowman Branch. This branch flows easterly, becoming perennial, and eventually empties into Walnut Creek approximately 3.5 miles east southeast of the site. From this point, the flow heads to the east-northeast for approximately three miles until it drains into Mountain Creek, 1800 feet downstream of the John Penn Branch confluence. The flow then travels approximately five miles to the north-northeast before draining into Mountain Creek Lake.

1.9 Climate

The nearest source of long-record climatological data for this site is the Dallas-Fort Worth National Weather Service (NWS) office. This office is located approximately 15 miles north - northeast of Five Points OLF. Climatological data recorded at this office during the period 1948 – 1995 is given in Table 1.1. The Dallas-Fort Worth climate is humid subtropical with hot summers. It is also continental, characterized by a wide annual temperature range. Precipitation also varies considerably, ranging from less than 20 inches to more than 50 inches annually.

Throughout the year, rainfall occurs more frequently during the night. Usually, periods of rainy weather last for only a day or two, followed by several days with fair skies. A large part of the annual precipitation results from thunderstorm activity, with occasional heavy rainfall over brief periods of time. Thunderstorms occur throughout the year, but are most frequent in the spring. Hail falls on about two or three days a year, ordinarily with only slight and scattered damage. Windstorms occurring during thunderstorm activity are sometimes destructive. Wind

gusts for the area have reached a maximum of 72 knots, whereas the average maximum wind speed is 61 knots.

The highest temperatures of summer are associated with fair skies, westerly winds and low humidities. Characteristically, hot spells in summer are broken into three-to-five day periods by thunderstorm activity. There are only a few nights each summer when the low temperature exceeds 80 degrees Fahrenheit. Summer daytime temperatures frequently exceed 100 degrees Fahrenheit. Winters are mild, but cold fronts occur about three times each month and often are accompanied by sudden drops in temperature. Periods of extreme cold that occasionally occur are short-lived, so that even in January, mild weather occurs frequently. The average length of the warm season (freeze-free period) in the Dallas-Fort Worth Metroplex is about 249 days. The average last occurrence of 32 degrees Fahrenheit or below is in mid-March and the average first occurrence of 32 degrees Fahrenheit or below is in late November. During the period 1948 – 1995 at the Dallas-Fort Worth NWS office, the daily temperature extremes include a minimum of -1 degree Fahrenheit (in December 1989) and a maximum of 113 degrees Fahrenheit (in June 1980).

TABLE 1.1

CLIMATOLOGICAL DATA RECORDED AT THE
DALLAS-FT. WORTH, TEXAS, NATIONAL WEATHER SERVICE OFFICE

Month	Temperature		Precipitation	Wind	
	Average Minimum (°F)	Average Maximum (°F)	Average (inches)	Average Speed (knots)	Average Direction
January	34	54	1.9	11	S
February	38	60	2.2	11	S
March	45	68	2.6	13	S
April	55	76	3.8	13	S
May	63	83	5.0	12	S
June	71	92	2.9	11	S
July	75	96	2.2	10	S
August	74	96	2.0	9	S
September	67	88	3.0	10	S
October	56	79	3.5	10	S
November	45	66	2.2	11	S
December	37	58	1.9	10	S
YEARLY AVERAGE	55	76	33.3	11	S

Source: International Station Meteorological Climate Summary, September 1996.
Jointly produced by: Fleet Numerical Meteorology and Oceanography Detachment, National Climatic Data Center, and USAFETAC OL-A.

2.0 SAMPLING METHODOLOGY

2.1 Sampling Sites

Prior to the start of field activities, soils in two major regions within the former Five Points OLF were identified as being affected from prior practice bombing operations, and therefore had the highest probability of containing the COCs (lead, zinc, white phosphorus, tetryl, and TNT and its associated degradation products). These regions, the center of the former bombing target area and the original surface water drainage areas, were the focus of the sampling effort. Sampling sites were selected based on these highest probability regions. Additionally, some residents within the South Ridge Hills development requested that sampling be performed on their property, either due to suspected health problems, or from a desire to have the property tested in the event it was not initially selected as a sampling site.

The majority of the sampling sites were marked as "blue" sites. The so-called "blue" sites were those locations chosen for being in either the central target area or the drainage area (or both), or were requested by a resident who did not have a specific health concern. These sites were sampled at a single location on the residential property. The remaining sampling sites were marked as "red" sites, which were selected based upon resident requests due to suspected health concerns. Each red site had four shallow sampling locations within the property boundary, and had an additional deeper sampling location at one of the four sample locations.

In total, 84 blue and 12 red sites (total of 96 sampling sites and 144 sampling locations) within the Five Points OLF boundaries were selected for soil sample collection. Of the 96 sampling sites, 59 were located within the boundaries of the former bombing center (55 blue and 4 red sites), 39 were located within the drainage area (31 blue and 8 red sites) and two were

located in other locations outside of the high probability areas (both blue sites), as indicated on Figure 2.1. The field notes recorded during the site investigation are provided in Appendix B.

2.2 Site Layout

Layout of the sample boring locations at property locations for each of the sampling sites began on October 31, 2002. Initial layout activities consisted of placing a flagged stake with an identification number at each property identified as a sampling site. The flagged stake marked the proposed location of the boring point. Utility location companies were contacted and instructed to mark all utilities (cable, telephone, gas and electric) at all of the sites in which a stake was present. Multiple utility location requests were made, as some sampling sites were added throughout the field investigation. If a stake was placed over an area that was later identified as containing utilities in the surface soils, the stake was moved to a new location clear of utilities.

Following the initial layout activities, a boring location layout team visited each site for further investigation. The layout team consisted of one Malcolm Pirnie field technician and one USACE, Fort Worth District, explosives and ordnance disposal (EOD) specialist. The EOD specialist performed a magnetometer survey of the immediate area surrounding the flagged stake. If surface soil obstructions were detected, they were treated as if they were potential buried UXO. Surface soil obstructions detected by the magnetometer could include such items as buried nails, construction rebar, and, potentially, practice bombs. In these instances, the stake was pulled and moved to a new location free of obstructions. Using marking paint, a two-foot diameter circle was painted around the stake to denote the final boring location. No boring location was placed on impervious surfaces such as roads or driveways.

The Malcolm Pirnie field technician recorded the final boring location at each site using a Trimble Pro-XRS global positioning system (GPS). One point was recorded for each blue site, and four points were recorded for each red site. Note that shallow samples were collected from each of the four "red" points, with a deep sample being collected from only one of these locations. The sampling sites, the general location of each site (i.e., target center, drainage area, or outside), the dates and times of sample collection, and the site coordinates are presented in Table 2.1.

2.3 Sampling Procedures

The detailed sampling procedures for the Five Points OLF site investigation are outlined in Sampling and Analysis Plan (SAP) presented in the Site Investigation Work Plan (Malcolm Pirnie, 2002). The sampling procedures were designed to collect representative soil samples from locations determined to have highest probability of finding the COCs. Due to the small size of the practice bombs used at the site, the practice ordnance likely did not penetrate more than a few inches into the soil. Therefore, the COCs were determined to be most likely found at or near the surface.

TRRP defines surface soils as the interval between the surface and 15 feet below ground surface (bgs). Based on the conclusion that the COCs would most likely be found at or near the surface, it was determined that soil samples were to be collected at all sites from the native soil in the zero to two foot depth interval (0 to 24 inches) below the root mass (approximately 30 inches from the surface). Sampling soils at a deeper surface interval was also determined to be necessary based on the finding of approximately 3,000 practice bombs at depths of up to six feet bgs during the development of Twin Parks Estates in 1983. To address these concerns, deeper

interval soil samples were to be collected at the red sampling sites from five to six feet (60 to 72 inches) below the root mass.

Initial discussions with the residential developer at South Ridge Hills indicated that no off-site fill had been brought on site during construction activities and that the soil cut from the roadways had been used to grade the development. This would allow for the collection of soil samples immediately below the root zone, as initially designed. However, it was later determined that non-native fill had in fact been brought to the South Ridge Hills development and used to grade selected constructed residences. Off-site fill would not be representative of the soil that was present at the site during practice bombing operations, and therefore could not be collected as a sample for analysis. Approximately 36 of 132 borings were extended to reach native soils (see Appendix A).

TABLE 2.1

FIVE POINTS OLF SAMPLING SITES

Sample ID	Location	Date	Time	Northing[1] (meters)	Easting[1] (meters)
B01	Target	11/11/02	0845	3611181.45	676350.11
B02	Target	11/12/02	0830	3611160.80	676349.27
B03	Target	11/12/02	1050	3611133.46	676348.31
B04	Target	11/11/02	0930	3611050.24	676350.72
B04 (QA & QC)	Target	11/11/02	0930	3611050.24	676350.72
B05	Target	11/12/02	1620	3611005.29	676352.56
B06	Target	11/13/02	0900	3610973.63	676351.19
B07	Target	11/11/02	1120	3611206.44	676365.73
B08	Target	11/11/02	1050	3611173.39	676366.86
B09	Target	11/11/02	1040	3611138.92	676367.59
B10	Target	11/13/02	0950	3610968.23	676371.96
B11	Drainage	11/13/02	1630	3610889.69	676390.18
B12	Target	11/07/02	0850	3611228.26	676411.85
B13	Target	11/07/02	0910	3611204.11	676415.72
B14	Target	11/07/02	0925	3611167.96	676408.42
B15	Target	11/07/02	0935	3611102.72	676411.91
B16	Target	11/07/02	0945	3611071.45	676412.05
B17	Target	11/07/02	0955	3611038.28	676411.34
B18	Target	11/08/02	0900	3610960.90	676451.47
B19	Target	11/06/02	1415	3611237.30	676444.57
B20	Target	11/06/02	1215	3611197.28	676444.15
B21	Target	11/06/02	1150	3611168.36	676441.70
B22	Target	11/06/02	1135	3611104.54	676441.32
B23	Target	11/06/02	1120	3611060.33	676462.73
B24	Target	11/07/02	1005	3611043.26	676434.02
B25	Target	11/07/02	1020	3611038.65	676450.78
B26	Target	11/07/02	1500	3610971.54	676427.32
B26 (QA & QC)	Target	11/07/02	1500	3610971.54	676427.32
B27	Drainage	11/11/02	1330	3610890.82	676437.58
B28	Drainage	11/14/02	1500	3610887.23	676455.08
B28 (QA & QC)	Drainage	11/14/02	1500	3610887.23	676455.08
B29	Target	11/06/02	1400	3611227.18	676481.85
B30	Target	11/07/02	1320	3611194.94	676479.81
B30 (QA & QC)	Target	11/07/02	1320	3611194.94	676479.81
B31	Target	11/07/02	1350	3611152.25	676481.53
B32	Target	11/07/02	1405	3611119.60	676477.04
B33	Target	11/07/02	1420	3611090.07	676511.63
B34	Target	11/06/02	1040	3611080.42	676537.39
B35	Target	11/07/02	1435	3611033.75	676503.85
B36	Target	11/06/02	1100	3611046.77	676530.03
B37	Target	11/07/02	1105	3611020.92	676519.47
B38	Target	11/07/02	1030	3611028.08	676461.28
B39	Target	11/07/02	1050	3611015.15	676497.51
B40	Target	11/07/02	1120	3610968.78	676532.29
B41	Drainage	11/06/02	1550	3610948.21	676538.03
B42	Drainage	11/06/02	1610	3610917.32	676539.44
B43	Drainage	11/06/02	1615	3610890.40	676526.31
B44	Drainage	11/14/02	1550	3610877.76	676479.88
B45	Drainage	11/11/02	1410	3610869.61	676492.72
B46	Drainage	11/11/02	1440	3610847.46	676499.78
B47	Drainage	11/11/02	1450	3610825.03	676534.69
B48	Target	11/06/02	1455	3611232.25	676507.09
B49	Target	11/06/02	1510	3611159.03	676527.98
B50	Target	11/06/02	1530	3611128.85	676507.34
B51	Target	11/06/02	1020	3611097.00	676549.08
B52	Drainage	11/14/02	1610	3610843.39	676536.79
B53	Drainage	11/11/02	1520	3610832.78	676558.97
B53 (QA & QC)	Drainage	11/11/02	1520	3610832.78	676558.97

Sample ID	Location	Date	Time	Northing (meters)	Easting (meters)
B54	Drainage	11/08/02	1550	3610815.40	676550.62
B55	Target	11/06/02	0920	3611197.84	676582.02
B56	Target	11/06/02	0955	3611158.96	676574.61
B57	Target	11/08/02	1040	3611114.84	676575.04
B58	Target	11/08/02	1020	3611077.95	676555.78
B59	Target	11/08/02	1000	3611048.36	676543.99
B60	Target	11/15/02	1430	3611049.87	676610.76
B61	Target	11/08/02	0940	3611018.68	676539.80
B61 (QA & QC)	Target	11/08/02	0940	3611018.68	676539.80
B62	Target	11/15/02	1450	3611028.17	676608.61
B63	Target	11/08/02	0920	3610987.89	676544.31
B64	Target	11/08/02	0910	3610949.93	676550.41
B65	Drainage	11/14/02	1720	3610826.46	676568.41
B66	Target	11/08/02	1100	3611167.24	676589.23
B67	Target	11/08/02	1050	3611132.62	676589.64
B68	Target	11/15/02	1410	3611053.55	676622.27
B69	Drainage	11/18/02	1620	3610945.48	676618.59
B70	Drainage	11/11/02	1600	3610853.74	676608.99
B71	Drainage	11/08/02	1510	3610798.90	676607.85
B72	Drainage	11/08/02	1500	3610795.95	676635.02
B73	Drainage	11/08/02	1430	3610701.69	676701.94
B74	Drainage	11/08/02	1410	3610700.18	676733.71
B74 (QA & QC)	Drainage	11/08/02	1410	3610700.18	676733.71
B75	Drainage	11/08/02	1350	3610703.12	676776.79
B76	Drainage	11/18/02	1500	3610722.63	676637.86
B77	Drainage	11/18/02	1350	3610891.26	676405.03
B78	Drainage	11/18/02	1450	3610749.22	676681.96
B79	Drainage	11/18/02	1420	3610760.68	676680.83
B79 (QA & QC)	Drainage	11/18/02	1420	3610760.68	676680.83
B80	Drainage	11/18/02	1600	3610822.26	676596.57
B81	Other	11/15/02	0850	3610946.77	676243.12
B82	Other	11/13/02	0830	3611403.36	676246.68
B83	Target	11/14/02	0840	3611153.95	676367.66
B84	Drainage	11/18/02	1530	3610794.30	676659.60
R01-2A	Target	11/12/02	0920	3611145.88	676349.39
R01-2B	Target	11/12/02	0900	3611154.99	676350.83
R01-2C	Target	11/12/02	1020	3611149.18	676325.75
R01-2D	Target	11/12/02	1040	3611143.30	676325.07
R01-6A	Target	11/12/02	0940	3611145.88	676349.39
R02-2A	Target	11/12/02	1530	3611109.94	676367.40
R02-2B	Target	11/12/02	1120	3611106.65	676368.17
R02-2C	Target	11/12/02	1400	3611116.57	676397.06
R02-2D	Target	11/12/02	1350	3611111.83	676397.61
R02-6A	Target	11/12/02	1535	3611109.94	676367.40
R03-2A	Target	11/13/02	1010	3610989.64	676369.99
R03-2B	Target	11/13/02	1110	3610985.05	676369.03
R03-2C	Target	11/13/02	1150	3610993.37	676400.63
R03-2D	Target	11/13/02	1130	3610989.18	676400.55
R03-6A	Target	11/13/02	1040	3610989.64	676369.99
R04-2A*	Target	11/13/02	1350	3610988.36	676351.34
R04-2A2*	Target	11/15/02	0820	3610988.36	676351.34
R04-2B	Target	11/13/02	1510	3610986.56	676350.45
R04-2C	Target	11/13/02	1550	3610994.27	676325.07
R04-2D	Target	11/13/02	1530	3610989.06	676324.03
R04-6A	Target	11/13/02	1400	3610988.36	676351.34
R05-2A	Drainage	11/14/02	1200	3610943.74	676351.85
R05-2B	Drainage	11/14/02	1140	3610945.49	676344.64
R05-2C	Drainage	11/14/02	1430	3610920.69	676361.62
R05-2D	Drainage	11/14/02	1410	3610923.86	676364.20
R05-6A	Drainage	11/14/02	1230	3610943.74	676351.85
R06-2A	Drainage	11/15/02	0920	3610885.55	676465.66
R06-2B	Drainage	11/15/02	1000	3610894.31	676461.13
R06-2C	Drainage	11/15/02	1030	3610905.14	676468.47

Sample ID	Location	Date	Time	Northing (meters)	Easting (meters)
R06-2D	Drainage	11/15/02	1040	3610906.32	676481.33
R06-6A	Drainage	11/15/02	0950	3610885.55	676465.66
R07-2A	Drainage	11/19/02	1010	3610884.62	676618.56
R07-2B	Drainage	11/19/02	1100	3610889.53	676620.57
R07-2C	Drainage	11/19/02	1110	3610899.09	676602.58
R07-2D	Drainage	11/19/02	1140	3610890.84	676593.58
R07-6A	Drainage	11/19/02	1030	3610884.62	676618.56
R08-2A	Drainage	11/15/02	1110	3610852.33	676523.42
R08-2B	Drainage	11/15/02	1300	3610852.09	676525.07
R08-2C	Drainage	11/15/02	1340	3610875.22	676530.09
R08-2D	Drainage	11/15/02	1320	3610873.16	676536.20
R08-6A	Drainage	11/15/02	1130	3610852.33	676523.42
R09-2A	Drainage	11/18/02	0830	3610813.36	676434.90
R09-2B	Drainage	11/18/02	0930	3610808.48	676434.87
R09-2C	Drainage	11/18/02	0940	3610810.86	676411.29
R09-2D	Drainage	11/18/02	1000	3610819.03	676409.70
R09-6A	Drainage	11/18/02	0900	3610813.36	676434.90
R10-2A	Drainage	11/14/02	0910	3610949.84	676365.56
R10-2B	Drainage	11/14/02	1000	3610943.95	676380.41
R10-2C	Drainage	11/14/02	1040	3610932.74	676395.04
R10-2D	Drainage	11/14/02	1100	3610926.01	676382.27
R10-6A	Drainage	11/14/02	0930	3610949.84	676365.56
R11-2A	Drainage	11/18/02	1040	3610828.35	676435.77
R11-2A (QA & QC)	Drainage	11/18/02	1040	3610828.35	676435.77
R11-2B	Drainage	11/18/02	1010	3610825.14	676435.79
R11-2B (QA & QC)	Drainage	11/18/02	1010	3610825.14	676435.79
R11-2C	Drainage	11/18/02	1230	3610835.02	676409.31
R11-2C (QA & QC)	Drainage	11/18/02	1230	3610835.02	676409.31
R11-2D	Drainage	11/18/02	1150	3610827.53	676411.05
R11-2D (QA & QC)	Drainage	11/18/02	1150	3610827.53	676411.05
R11-6A	Drainage	11/18/02	1100	3610828.35	676435.77
R11-6A (QA & QC)	Drainage	11/18/02	1100	3610828.35	676435.77
R12-2A	Drainage	11/19/02	0810	3610721.63	676653.68
R12-2B	Drainage	11/19/02	0900	3610725.60	676663.80
R12-2C	Drainage	11/19/02	0950	3610754.39	676651.49
R12-2D	Drainage	11/19/02	0920	3610755.96	676662.25
R12-6A	Drainage	11/19/02	0830	3610721.63	676653.68

[1] *Sample location coordinates are given in Universal Transverse Mercator (UTM) units.*

**Sample R04-2A2 was a resample of R04-2A. R04-2A arrived at the laboratory with a temperature reading in exceedance of the acceptable range and was subsequently not tested for the target analytes.*

2.3.1 Shallow Surface Soil Sampling

Surface soil sampling began on November 6, 2002. The samples were collected using a direct push technology (DPT) rig operated by MagnaCore Drilling (a subcontractor to Malcolm Pirnie, Inc.). Two soil borings were performed within the marked circle at each location immediately adjacent to one another to a depth of two feet below the root zone and sampled. If fill materials (non-native soil) were encountered within the first two feet below the root zone, sampling continued to lower depths until sufficient native soil was collected. The fill material was easily identified; the material was composed of a fine, loose, light brown to beige sand, as compared to the native soil, which was a firm, dark-brown to black silty clay (see boring logs in Appendix A). The boring hole was checked for obstructions with the magnetometer at every two-foot interval beyond the initial boring depth.

Soil samples were collected with a 2-inch Macro-Core sampler lined with a clear acetate sampling tube. The sampling tube was removed from the sampling device, and the soil types were observed and recorded in a boring log at each location. Soil collected from the first boring was placed in a 16-ounch amber jar to be analyzed for lead, zinc and explosives. Field personnel manually extracted the soil samples from the sampling tube while wearing clean nitrile gloves. The soil sample collected from the second boring was collected for white phosphorus analysis. White phosphorus is sensitive to both oxygen and light; therefore, the sampling tube was sealed with wax on both ends (the soil was not removed from the tube or placed into a glass jar) and wrapped in black plastic to prevent photolysis or a reaction with oxygen.

All non-dedicated stainless steel sampling devices were decontaminated by washing with a phosphate-free detergent (Alconox) and American Society for Testing and Materials (ASTM)

Type II grade water and allowed to air dry between each new boring. Decontamination fluids and soil cuttings were containerized separately and stored on-site.

All borings were backfilled with bentonite up to 0.5 feet bgs, in accordance with TCEQ procedures. The remaining depth of the borehole was filled to the surface with fresh topsoil. All sampling activities were photographically recorded and are presented in Appendix D.

A total of 132 shallow soil field samples were collected (84 blue and 48 red samples). Triplicate split samples were collected at eight blue sites (8 quality assurance or QA samples and 8 quality control or QC samples) and one red site (4 QA and 4 QC samples). Five equipment rinsate samples were also collected. For metals and explosives analysis, each triplicate split sample was placed in a separate container for shipment to the analytical laboratory (i.e. one glass jar for the field sample, another for the QA sample, and another for the QC sample). To avoid reactions with oxygen and light, the tubes containing the white phosphorus triplicate split samples were not divided into separate containers, but rather were sent to the analytical laboratory as a single tube and later divided into field, QA and QC samples.

2.3.2 Deep Surface Soil Sampling

Deep interval surface soil samples were collected at all red sites to address the possibility that ordnance was buried in-place. At each of the twelve red sites, one of the shallow boring locations was continued to six feet below the root mass. Samples were collected from the five to six-foot depth interval (60-72 inches) using the procedures described in Section 2.3.1. The boring hole was swept with a magnetometer for every two feet of soil removed to avoid potential obstructions. A total of twelve deep interval surface field samples were collected (see Figure 2.2); one sample was a triplicate split.

2.3.3 Background Sampling

No background soil samples were collected during this sampling investigation. Analysis of the field samples indicated that lead and zinc soil concentrations were within the state-established background levels and did not exceed the TRRP Tier 1 total combined pathway PCLs for residential soil [500 milligrams/kilogram (mg/kg) for lead and 9,900 mg/kg for zinc].

2.4 Laboratory Analysis

At the end of each day of collection, the samples were shipped in coolers packed with ice to the appropriate USACE-validated laboratory. The labs were contacted the following day to confirm receipt of the sample cooler shipment. The field and QC samples for metals and explosives were shipped to the primary laboratory for analysis (Paragon Analytics, Fort Collins, Colorado). The QA samples for lead, zinc and explosives were sent to the USACE Environmental Chemistry Branch (ECB) Laboratory in Omaha, Nebraska, for analysis. The field, QC and QA samples for white phosphorus contained within the sealed sample tubes were sent to the USACE Waterways Experimentation Station (WES) for analysis. WES removed the soil from the sample tube and divided the soil sample under an anaerobic hood to prevent reactions with oxygen. WES kept the field and QC samples for analysis, and sent the QA samples to a separate USACE lab for analysis (Cold Regions Research and Engineering Lab, CRREL, Hanover, NH). The QA/QC split samples and equipment rinsate blanks were collected and analyzed to help determine analytical precision, comparability, and potential sample cross contamination, as described in the Quality Assurance Program Plan (QAPP), previously submitted with the site work plan.

All samples were analyzed in accordance with the most recently promulgated methods from the EPA publication, SW-846, "Test methods for Evaluating Solid Waste" (Revision 5, April 1998). Laboratory analyses were performed for total lead and zinc by EPA SW-846 method 6010; white phosphorus by EPA SW-846 method 7580; and tetryl, TNT and its transformation products by EPA SW-846 method 8330.

2.5 Investigation-Derived Waste

Investigation-derived wastes (IDW) were staged in properly labeled 55-gallon steel drums and secured in a locked staging area near the field trailer. Decontamination water was the only liquid IDW stored at the site. The soils that composed the IDW included fill material and excess soil from boring and sample collection. In addition, the soil samples sent to WES, CRREL and ECB will be returned to the site for disposal as IDW following the completion of sample analyses. All drummed IDW will be profiled and disposed of in accordance with local, state and federal regulations. The soil samples sent to Paragon Analytics were disposed of in accordance with that laboratory's waste disposal permit.

A water sample will be taken from the IDW drums for analytical testing and characterization of the water. The water drums will most likely be classified as a Class II non-hazardous waste, based on the analytical results. An appropriate waste hauler will transport the water drums to the proper off-site disposal facility, dependent on the classification of the liquid waste. The soil in the waste drums has been classified as a Class II, non-hazardous waste, based on the analytical results of the samples. A licensed waste hauler will pick up the soil IDW and transport the drums for disposal at an off-site facility.

3.0 ANALYTICAL RESULTS

3.1 Overview

The primary objective of this field investigation was to determine if COCs were present in the surface soil at the site (lead, zinc, white phosphorus, tetryl and TNT and its associated degradation products), and if present, to determine their respective concentrations. This section presents a summary of the analytical results of the soil sampling investigation.

The results of the lead and zinc analyses were compared against state background levels and TRRP residential soil PCLs (as indicated on Table 3.1). Analytical results for white phosphorus were compared against the TRRP residential soil PCL. Analytical results for explosives (tetryl, TNT and degradation products) were also compared to the TRRP residential soil PCLs; however, a "trigger" clause was added to supplement the Sampling and Analysis Plan for additional soil sampling to be performed at the site in the event any explosive compound was detected above the method detection limit during sample analysis.

TABLE 3.1

TEXAS-SPECIFIC BACKGROUND CONCENTRATION LEVELS[1] AND TRRP RESIDENTIAL SOIL PCLs

Analyte	Background (mg/kg)	TRRP $^{Tot}Soil_{Comb}$[2] (mg/kg)	Method Detection Limit (mg/kg)	Method Reporting Limit (mg/kg)
Lead	15	500	0.028	10
Zinc	30	9,900	0.0012	10
White Phosphorus	N/A[3]	0.51	0.00043	0.63[4]
Tetryl	N/A	37	0.0557	0.25
2,4,6-Trinitrotoluene (TNT)	N/A	17	0.0602	0.25
1,3,5-Trinitrobenzene	N/A	2,000	0.0624	0.25
Nitrobenzene	N/A	30	0.0464	0.25
1,3-Dinitrobenzene	N/A	6.3	0.0646	0.25
2,4-Dinitrotoluene (2,4-DNT)	N/A	6.9	0.0564	0.25
2,6-Dinitrotoluene (2,6-DNT)	N/A	6.9	0.0656	0.25
2-Amino-4,6-DNT	N/A	8.9	0.0634	0.25
4-Amino-2,6-DNT	N/A	9.3	0.0548	0.25
2-Nitrotoluene	N/A	280	0.0584	0.25
3-Nitrotoluene	N/A	270	0.0664	0.25
4-Nitrotoluene	N/A	270	0.0619	0.25
HMX	N/A	200	0.0551	0.25
RDX	N/A	25	0.0597	0.25

[1] *As defined by 30 TAC 350.51.*

[2] TRRP $^{Tot}Soil_{Comb}$ - *PCL for the total combined exposure pathway for residential soil, based on a 30-acre source.*

[3] N/A- *not applicable; no state background level established for these compounds.*

[4] *The reporting limit for the white phosphorus samples ranged from 0.57 to 0.68 mg/kg, depending on the percent moisture of each specific soil sample. Therefore, the reporting limit listed above for white phosphorus is an average reporting limit.*

Note: The method detection limit is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The method reporting limit is the lowest non-zero concentration standard in the laboratory's initial calibration curve, is based on the final volume of extract used by the laboratory, is corrected for percent moisture in soil samples, and is presented on a dry weight basis. Concentrations reported between these two limits are "J" qualified due to the loss of accuracy in that region.

3.2 Analytical Results

3.2.1 Metals (Lead and Zinc)

The analytical results for lead and zinc concentrations in the shallow interval soil samples are presented in Table 3.2. Figures 3.1 (lead) and 3.2 (zinc) show the geospatial distribution of these metals in the shallow samples at the Five Points OLF site.

While some individual samples collected from the shallow interval have lead and zinc concentrations that exceed the state background concentrations (11 and 46 samples, respectively), none of the samples have metal concentrations that exceed the residential soil PCLs (500 mg/kg and 9,900 mg/kg for lead and zinc, respectively) established under TRRP. The collective average of the shallow samples showed an average lead concentration of 13.04 mg/kg and an average zinc concentration of 29.23 mg/kg.

The analytical results for the deep samples (5-6 foot interval) are provided on Table 3.3 and Figures 3.3 (lead) and 3.4 (zinc). As was the case with the shallow samples, some deep soil samples exceed the state background levels for lead and zinc. Two of the deep interval samples were above state background levels for zinc, and seven samples exceeded background levels for lead. However, none of the 12 deep interval samples exceeded the TRRP residential soil PCLs for either metal. The collective average of the deep samples showed average lead and zinc concentrations of 12.2 mg/kg and 36.5 mg/kg, respectively.

A closer inspection of the data using averages from all of the sites indicates that the average concentrations are within the state background levels. The average metals concentration for all of the sampling sites (includes shallow and deep interval samples) was 12.97 mg/kg for lead and 29.91 for zinc, both of which are below state background levels of 15 mg/kg and 30 mg/kg, respectively.

TABLE 3.2

METALS CONCENTRATIONS – SHALLOW INTERVAL SAMPLES

Site	Sample ID	Location	Lead (mg/kg)	Zinc (mg/kg)
Texas-Specific Background Level:			**15**	**30**
TRRP Residential Soil PCL:			**500**	**9900**
B01	FP-B01-OT-2-01	Target	11	26
B02	FP-B02-OT-2-01	Target	13	25
B03	FP-B03-OT-2-01	Target	15	27
B04	FP-B04-OT-2-01	Target	9.8	32 J[1]
B05	FP-B05-OT-2-01	Target	12	61
B06	FP-B06-OT-2-01	Target	12	23
B07	FP-B07-OT-2-01	Target	15	28
B08	FP-B08-OT-2-01	Target	14	24
B09	FP-B09-OT-2-01	Target	11	18
B10	FP-B10-OT-2-01	Target	15	22
B11	FP-B11-OT-2-01	Drainage	12	19
B12	FP-B12-OT-2-01	Target	13	35
B13	FP-B13-OT-2-01	Target	13	29
B14	FP-B14-OT-2-01	Target	11	18
B15	FP-B15-OT-2-01	Target	12	26
B16	FP-B16-OT-2-01	Target	14	29
B17	FP-B17-OT-2-01	Target	25	27
B18	FP-B18-OT-2-01	Target	11	21
B19	FP-B19-OT-2-01	Target	14	30
B20	FP-B20-OT-2-01	Target	11	47
B21	FP-B21-OT-2-01	Target	13	26
B22	FP-B22-OT-2-01	Target	11	25
B23	FP-B23-OT-2-01	Target	14	30
B24	FP-B24-OT-2-01	Target	14	32
B25	FP-B25-OT-2-01	Target	14 J	28 J
B26	FP-B26-OT-2-01	Target	13	28
B27	FP-B27-OT-2-01	Drainage	9.6	19
B28	FP-B28-OT-2-01	Drainage	12 J	26 J
B29	FP-B29-OT-2-01	Target	13	25
B30	FP-B30-OT-2-01	Target	13	30
B31	FP-B31-OT-2-01	Target	12	23
B32	FP-B32-OT-2-01	Target	12	22
B33	FP-B33-OT-2-01	Target	15	28
B34	FP-B34-OT-2-01	Target	13	28
B35	FP-B35-OT-2-01	Target	13	32
B36	FP-B36-OT-2-01	Target	12	39
B37	FP-B37-OT-2-01	Target	17	34
B38	FP-B38-OT-2-01	Target	13 J	29 J

Site	Sample ID	Location	Lead (mg/kg)	Zinc (mg/kg)
Texas-Specific Background Level:			**15**	**30**
TRRP Residential Soil PCL:			**500**	**9900**
B39	FP-B39-OT-2-01	Target	14	28
B40	FP-B40-OT-2-01	Target	14	32
B41	FP-B41-OT-2-01	Drainage	14	38
B42	FP-B42-OT-2-01	Drainage	15	40
B43	FP-B43-OT-2-01	Drainage	17	37
B44	FP-B44-OT-2-01	Drainage	13 J	25 J
B45	FP-B45-OT-2-01	Drainage	12	25
B46	FP-B46-OT-2-01	Drainage	11	18
B47	FP-B47-OT-2-01	Drainage	9.8	16
B48	FP-B48-OT-2-01	Target	18	41
B49	FP-B49-OT-2-01	Target	16	26
B50	FP-B50-OT-2-01	Target	14	22
B51	FP-B51-OT-2-01	Target	12	37
B52	FP-B52-OT-2-01	Drainage	10	27
B53	FP-B53-OT-2-01	Drainage	13	31
B54	FP-B54-OT-2-01	Drainage	13	27
B55	FP-B55-OT-2-01	Target	13	45
B56	FP-B56-OT-2-01	Target	13	36
B57	FP-B57-OT-2-01	Target	13	35
B58	FP-B58-OT-2-01	Target	11	27
B59	FP-B59-OT-2-01	Target	13	31
B60	FP-B60-OT-2-01	Target	9.9 J	54
B61	FP-B61-OT-2-01	Target	12	30
B62	FP-B62-OT-2-01	Target	13 J	46
B63	FP-B63-OT-2-01	Target	12	30
B64	FP-B64-OT-2-01	Target	13	31
B65	FP-B65-OT-2-01	Drainage	15 J	33 J
B66	FP-B66-OT-2-01	Target	13	34
B67	FP-B67-OT-2-01	Target	13	31
B68	FP-B68-OT-2-01	Target	13 J	40
B69	FP-B69-OT-2-01	Drainage	12	44 J
B70	FP-B70-OT-2-01	Drainage	14	28
B71	FP-B71-OT-2-01	Drainage	13	27
B72	FP-B72-OT-2-01	Drainage	14	29
B73	FP-B73-OT-2-01	Drainage	14	35
B74	FP-B74-OT-2-01	Drainage	14	29
B75	FP-B75-OT-2-01	Drainage	12	33
B76	FP-B76-OT-2-01	Drainage	13	39
B77	FP-B77-OT-2-01	Drainage	11	20
B78	FP-B78-OT-2-01	Drainage	14	29
B79	FP-B79-OT-2-01	Drainage	13	34

Site		Sample ID	Location	Lead (mg/kg)	Zinc (mg/kg)
Texas-Specific Background Level:				**15**	**30**
TRRP Residential Soil PCL:				**500**	**9900**
B80		FP-B80-OT-2-01	Drainage	11	30 J
B81		FP-B81-OT-2-01	Other	9.6 J	21
B82		FP-B82-OT-2-01	Other	12	31
B83		FP-B83-OT-2-01	Target	15	22
B84		FP-B84-OT-2-01	Drainage	14	36 J
R01	2A	FP-R01-OT-2A-01	Target	14	28
	2B	FP-R01-OT-2B-01		19	26
	2C	FP-R01-OT-2C-01		18	28
	2D	FP-R01-OT-2D-01		15	29
R02	2A	FP-R02-OT-2A-01	Target	14	26
	2B	FP-R02-OT-2B-01		15	26
	2C	FP-R02-OT-2C-01		12	22
	2D	FP-R02-OT-2D-01		12	23
R03	2A	FP-R03-OT-2A-01	Target	9.5	21
	2B	FP-R03-OT-2B-01		12	28
	2C	FP-R03-OT-2C-01		14	21
	2D	FP-R03-OT-2D-01		13	21
R04	2A	FP-R04-OT-2A-01	Target	12 J	32
	2B	FP-R04-OT-2B-01		13	21
	2C	FP-R04-OT-2C-01		14	31
	2D	FP-R04-OT-2D-01		10	21
R05	2A	FP-R05-OT-2A-01	Drainage	6.5 J	53 J
	2B	FP-R05-OT-2B-01		11 J	18 J
	2C	FP-R05-OT-2C-01		16 J	27 J
	2D	FP-R05-OT-2D-01		14 J	29 J
R06	2A	FP-R06-OT-2A-01	Drainage	11 J	25
	2B	FP-R06-OT-2B-01		9.6 J	17
	2C	FP-R06-OT-2C-01		8.6 J	18
	2D	FP-R06-OT-2D-01		14 J	23
R07	2A	FP-R07-OT-2A-01	Drainage	12	29 J
	2B	FP-R07-OT-2B-01		14	33 J
	2C	FP-R07-OT-2C-01		10	27 J
	2D	FP-R07-OT-2D-01		17	40 J
R08	2A	FP-R08-OT-2A-01	Drainage	14 J	35
	2B	FP-R08-OT-2B-01		14 J	33
	2C	FP-R08-OT-2C-01		11 J	24
	2D	FP-R08-OT-2D-01		13 J	37
R09	2A	FP-R09-OT-2A-01	Drainage	11	27
	2B	FP-R09-OT-2B-01		15	24
	2C	FP-R09-OT-2C-01		10	24
	2D	FP-R09-OT-2D-01		14	24

Site		Sample ID	Location	Lead (mg/kg)	Zinc (mg/kg)
Texas-Specific Background Level:				**15**	**30**
TRRP Residential Soil PCL:				**500**	**9900**
R10	2A	FP-R10-OT-2A-01	Drainage	11 J	19 J
	2B	FP-R10-OT-2B-01		11 J	18 J
	2C	FP-R10-OT-2C-01		15 J	32 J
	2D	FP-R10-OT-2D-01		16 J	59 J
R11	2A	FP-R11-OT-2A-01	Drainage	13	27
	2B	FP-R11-OT-2B-01		18 J	23
	2C	FP-R11-OT-2C-01		13	20
	2D	FP-R11-OT-2D-01		15	33 J
R12	2A	FP-R12-OT-2A-01	Drainage	13	33 J
	2B	FP-R12-OT-2B-01		12	26 J
	2C	FP-R12-OT-2C-01		12	24 J
	2D	FP-R12-OT-2D-01		14	43 J

[1] *J qualifier indicates that the analyte concentration is estimated, as the data has been qualified during Data Validation.*

See Section 4.0 (Data Validation) for a detailed description of the data qualifiers.

TABLE 3.3

METALS CONCENTRATIONS – DEEP INTERVAL SAMPLES

Site	Sample ID	Location	Lead (mg/kg)	Zinc (mg/kg)
Texas-Specific Background Level:			**15**	**30**
TRRP Residential Soil PCL:			**500**	**9900**
R01	FP-R01-OT-6A-01	Target	11	34
R02	FP-R02-OT-6A-01	Target	12	27
R03	FP-R03-OT-6A-01	Target	20	24
R04	FP-R04-OT-6A-01	Target	7.1	25
R05	FP-R05-OT-6A-01	Drainage	11 J[1]	32 J
R06	FP-R06-OT-6A-01	Drainage	9.2 J	33
R07	FP-R07-OT-6A-01	Drainage	13	43 J
R08	FP-R08-OT-6A-01	Drainage	11 J	36
R09	FP-R09-OT-6A-01	Drainage	12	28
R10	FP-R10-OT-6A-01	Drainage	16 J	42 J
R11	FP-R11-OT-6A-01	Drainage	9.5	28
R12	FP-R12-OT-6A-01	Drainage	15	86 J

[1] *J qualifier indicates that the analyte concentration is estimated, as it has been qualified during Data Validation.*

See Section 4.0 (Data Validation) for a detailed description of the data qualifiers.

3.2.2 Explosives

The analytical results for tetryl, TNT and TNT degradation products in the shallow interval soil samples are presented in Table 3.4 and for the deep interval soil samples in Table 3.5. The results indicate that none of the explosives compounds were detected at concentrations above the method detection level in any soil sample, and therefore do not exceed the critical residential soil PCLs under TRRP. As none of the explosives compounds were detected in any samples, no figures are provided.

TABLE 3.4

EXPLOSIVES CONCENTRATIONS – SHALLOW INTERVAL SAMPLES

Site	Sample ID	Location	Tetryl	TNT	1,3,5-TNB	1,3-DNB	2,4-DNT	2,6-DNT	2-A-4,6-DNT	4-A-2,6-DNT	2-NT	3-NT	4-NT	HMX	RDX	Nitro-benzene
B01	FP-B01-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B02	FP-B02-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B03	FP-B03-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B04	FP-04-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B05	FP-B05-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B06	FP-B06-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B07	FP-B07-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B08	FP-B08-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B09	FP-B09-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B10	FP-B10-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B11	FP-B11-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B12	FP-B12-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B13	FP-B13-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B14	FP-B14-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B15	FP-B15-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B16	FP-B16-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B17	FP-B17-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B18	FP-B18-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B19	FP-B19-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B20	FP-B20-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B21	FP-B21-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B22	FP-B22-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B23	FP-B23-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B24	FP-B24-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B25	FP-B25-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B26	FP-B26-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25

Site	Sample ID	Location	Tetryl	TNT	1,3,5-TNB	1,3-DNB	2,4-DNT	2,6-DNT	2-A-4,6-DNT	4-A-2,6-DNT	2-NT	3-NT	4-NT	HMX	RDX	Nitro-benzene
B27	FP-B27-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B28	FP-B28-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B29	FP-B29-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B30	FP-B30-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B31	FP-B31-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B32	FP-B32-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B33	FP-B33-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B34	FP-B34-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B35	FP-B35-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B36	FP-B36-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B37	FP-B37-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B38	FP-B38-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B39	FP-B39-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B40	FP-B40-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B41	FP-B41-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B42	FP-B42-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B43	FP-B43-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B44	FP-B44-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B45	FP-B45-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B46	FP-B46-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B47	FP-B47-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B48	FP-B48-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B49	FP-B49-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B50	FP-B50-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B51	FP-B51-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B52	FP-B52-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B53	FP-B53-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B54	FP-B54-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B55	FP-B55-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B56	FP-B56-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B57	FP-B57-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25

Site	Sample ID	Location	Tetryl	TNT	1,3,5-TNB	1,3-DNB	2,4-DNT	2,6-DNT	2-A-4,6-DNT	4-A-2,6-DNT	2-NT	3-NT	4-NT	HMX	RDX	Nitro-benzene
B58	FP-B58-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B59	FP-B59-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B60	FP-B60-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B61	FP-B61-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B62	FP-B62-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B63	FP-B63-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B64	FP-B64-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B65	FP-B65-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B66	FP-B66-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B67	FP-B67-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B68	FP-B68-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B69	FP-B69-OT-2-01	Drainage	< 0.25UJ	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B70	FP-B70-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B71	FP-B71-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B72	FP-B72-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B73	FP-B73-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B74	FP-B74-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B75	FP-B75-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B76	FP-B76-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B77	FP-B77-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B78	FP-B78-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B79	FP-B79-OT-2-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B80	FP-B80-OT-2-01	Drainage	< 0.25UJ	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B81	FP-B81-OT-2-01	Other	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B82	FP-B82-OT-2-01	Other	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B83	FP-B83-OT-2-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
B84	FP-B84-OT-2-01	Drainage	< 0.25UJ	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R01-2A	FP-R01-OT-2A-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R01-2B	FP-R01-OT-2B-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R01-2C	FP-R01-OT-2C-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R01-2D	FP-R01-OT-2D-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25

Site	Sample ID	Location	Tetryl	TNT	1,3,5-TNB	1,3-DNB	2,4-DNT	2,6-DNT	2-A-4,6-DNT	4-A-2,6-DNT	2-NT	3-NT	4-NT	HMX	RDX	Nitro-benzene
R02-2A	FP-R02-OT-2A-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R02-2B	FP-R02-OT-2B-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R02-2C	FP-R02-OT-2C-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R02-2D	FP-R02-OT-2D-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R03-2A	FP-R03-OT-2A-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R03-2B	FP-R03-OT-2B-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R03-2C	FP-R03-OT-2C-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R03-2D	FP-R03-OT-2D-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R04-2A	FP-R04-OT-2A-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R04-2B	FP-R04-OT-2B-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R04-2C	FP-R04-OT-2C-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R04-2D	FP-R04-OT-2D-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R05-2A	FP-R05-OT-2A-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R05-2B	FP-R05-OT-2B-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R05-2C	FP-R05-OT-2C-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R05-2D	FP-R05-OT-2D-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R06-2A	FP-R06-OT-2A-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R06-2B	FP-R06-OT-2B-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R06-2C	FP-R06-OT-2C-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R06-2D	FP-R06-OT-2D-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R07-2A	FP-R07-OT-2A-01	Drainage	< 0.25UJ	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R07-2B	FP-R07-OT-2B-01		< 0.25UJ	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R07-2C	FP-R07-OT-2C-01		< 0.25UJ	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R07-2D	FP-R07-OT-2D-01		< 0.25UJ	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R08-2A	FP-R08-OT-2A-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R08-2B	FP-R08-OT-2B-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R08-2C	FP-R08-OT-2C-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R08-2D	FP-R08-OT-2D-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R09-2A	FP-R09-OT-2A-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R09-2B	FP-R09-OT-2B-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R09-2C	FP-R09-OT-2C-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R09-2D	FP-R09-OT-2D-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25

Site	Sample ID	Location	Tetryl	TNT	1,3,5-TNB	1,3-DNB	2,4-DNT	2,6-DNT	2-A-4,6-DNT	4-A-2,6-DNT	2-NT	3-NT	4-NT	HMX	RDX	Nitro-benzene
R10-2A	FP-R10-OT-2A-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R10-2B	FP-R10-OT-2B-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R10-2C	FP-R10-OT-2C-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R10-2D	FP-R10-OT-2D-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R11-2A	FP-R11-OT-2A-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R11-2B	FP-R11-OT-2B-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R11-2C	FP-R11-OT-2C-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R11-2D	FP-R11-OT-2D-01		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R12-2A	FP-R12-OT-2A-01	Drainage	< 0.25UJ	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R12-2B	FP-R12-OT-2B-01		< 0.25UJ	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R12-2C	FP-R12-OT-2C-01		< 0.25UJ	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R12-2D	FP-R12-OT-2D-01		< 0.25UJ	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25

UJ data qualifier indicates that the analyte was not detected, but the data has been qualified and should be considered an estimated value at the reporting limit.

Note: "<0.25" indicates that the sample result was below the method reporting limit (in mg/kg).

TNT – 2,4,6-trinitrotoluene
1,3,5-TNB – 1,3,5-trinitrobenzene
1,3-DNB – 1,3-dinitrobenzene
2,4-DNT – 2,4-dinitrotoluene
2,6-DNT – 2,6-dinitrotoluene
2-A-4,6-DNT – 2-amino-4,6-dinitrotoluene
4-A-2,6-DNT – 4-amino-2,6-dinitrotoluene
2-NT – 2-nitrotoluene (*ortho*-toluene)
3-NT – 3-nitrotoluene (*meta*-toluene)
4-NT – 4-nitrotoluene (*para*-toluene)
HMX – Cyclotetramethylenetetranitramine
RDX – Cyclotrimethylenetrinitramine

TABLE 3.5

EXPLOSIVES CONCENTRATIONS – DEEP INTERVAL SAMPLES

Site	Sample ID	Location	Tetryl	TNT	1,3,5-TNB	1,3-DNB	2,4-DNT	2,6-DNT	2-A-4,6-DNT	4-A-2,6-DNT	2-NT	3-NT	4-NT	HMX	RDX	Nitro-benzene
R01- 6A	FP-R01-OT-6A-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R02- 6A	FP-R02-OT-6A-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R03- 6A	FP-R03-OT-6A-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R04- 6A	FP-R04-OT-6A-01	Target	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R05- 6A	FP-R05-OT-6A-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R06- 6A	FP-R06-OT-6A-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R07- 6A	FP-R07-OT-6A-01	Drainage	< 0.25UJ	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R08- 6A	FP-R08-OT-6A-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R09- 6A	FP-R09-OT-6A-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R10- 6A	FP-R10-OT-6A-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R11- 6A	FP-R11-OT-6A-01	Drainage	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
R12- 6A	FP-R12-OT-6A-01	Drainage	< 0.25UJ	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25

UJ qualifier indicates that the analyte was not detected, but the data has been qualified and should be considered an estimated value at the reporting limit.

Note: "<0.25" indicates that the sample result was below the method reporting limit (in mg/kg).

TNT - 2,4,6-trinitrotoluene
1,3,5-TNB – 1,3,5-trinitrobenzene
1,3-DNB – 1,3-dinitrobenzene
2,4-DNT – 2,4-dinitrotoluene
2,6-DNT – 2,6-dinitrotoluene
2-A-4,6-DNT – 2-amino-4,6-dinitrotoluene
4-A-2,6-DNT – 4-amino-2,6-dinitrotoluene
2-NT – 2-nitrotoluene (*ortho*-toluene)
3-NT – 3-nitrotoluene (*meta*-toluene)
4-NT – 4-nitrotoluene (*para*-toluene)
HMX – Cyclotetramethylenetetranitramine
RDX – Cyclotrimethylenetrinitramine

3.2.3 White Phosphorus

The analytical results for white phosphorus concentrations in the shallow interval soil samples are presented in Table 3.6 and for the deep samples in Table 3.7 (note that the concentrations in these tables are provided in µg/kg for white phosphorus). White phosphorus was detected in 18 of the shallow soil samples; however, 14 of these reported values are estimated ("J" qualified), since the analyte was detected above the method detection limit but below the reporting limit, thereby preventing an accurate quantitation of the white phosphorus concentration (see footnote under Table 3.1). A full description of the qualified data is provided in Section 4.0 (Data Validation). White phosphorus was not detected in any of the deep interval samples. Measurable concentrations of white phosphorus (i.e., above the reporting limit) were detected in only four samples (B40 at 0.63 µg/kg; R05-2D at 2.47J µg/kg; R05-2C at 0.58J µg/kg; and R08-2A at 2.22 µg/kg). The highest concentration of white phosphorus detected (2.47J µg/kg) is over 200 times less than the TRRP residential soil PCL of 510 µg/kg. The locations of the sampling sites where a trace amount of residual white phosphorus was detected are indicated on Figure 3.5. Since the compound was not detected in any of the deep samples, no figure is provided for these locations. Again, none of the sample results exceeded the TRRP residential soil PCL.

TABLE 3.6

WHITE PHOSPHORUS CONCETRATIONS – SHALLOW INTERVAL SAMPLES

Site	Sample ID	Location	White Phosphorus (mg/kg)
TRRP Residential Soil PCL:			**510**
B01	FP-B01-WP-2-01	Target	<0.61 UJ
B02	FP-B02-WP-2-01	Target	<0.60
B03	FP-B03-WP-2-01	Target	<0.62
B04	FP-B04-WP-2-01	Target	<0.59 UJ
B05	FP-B05-WP-2-01	Target	<0.63
B06	FP-B06-WP-2-01	Target	<0.60 UJ
B07	FP-B07-WP-2-01	Target	<0.63 UJ
B08	FP-B08-WP-2-01	Target	<0.62 UJ
B09	FP-B09-WP-2-01	Target	<0.59 UJ
B10	FP-B10-WP-2-01	Target	<0.61 UJ
B11	FP-B11-WP-2-01	Drainage	<0.61 UJ
B12	FP-B12-WP-2-01	Target	0.24 J
B13	FP-B13-WP-2-01	Target	<0.62
B14	FP-B14-WP-2-01	Target	<0.63
B15	FP-B15-WP-2-01	Target	<0.61
B16	FP-B16-WP-2-01	Target	0.41 J
B17	FP-B17-WP-2-01	Target	0.50 J
B18	FP-B18-WP-2-01	Target	<0.58 UJ
B19	FP-B19-WP-2-01	Target	0.22 J
B20	FP-B20-WP-2-01	Target	<0.62
B21	FP-B21-WP-2-01	Target	<0.62
B22	FP-B22-WP-2-01	Target	<0.64
B23	FP-B23-WP-2-01	Target	<0.62
B24	FP-B24-WP-2-01	Target	0.24 J
B25	FP-B25-WP-2-01	Target	0.20 J
B26	FP-B26-WP-2-01	Target	<0.61
B27	FP-B27-WP-2-01	Drainage	<0.61 UJ
B28	FP-B28-WP-2-01	Drainage	<0.61 UJ
B29	FP-B29-WP-2-01	Target	0.33 J
B30	FP-B30-WP-2-01	Target	0.35 J
B31	FP-B31-WP-2-01	Target	0.42 J
B32	FP-B32-WP-2-01	Target	<0.61
B33	FP-B33-WP-2-01	Target	<0.61
B34	FP-B34-WP-2-01	Target	<0.63
B35	FP-B35-WP-2-01	Target	<0.62
B36	FP-B36-WP-2-01	Target	<0.64
B37	FP-B37-WP-2-01	Target	<0.61
B38	FP-B38-WP-2-01	Target	0.24 J
B39	FP-B39-WP-2-01	Target	<0.60

Site	Sample ID	Location	White Phosphorus (mg/kg)
TRRP Residential Soil PCL:			**510**
B40	FP-B40-WP-2-01	Target	0.63
B41	FP-B41-WP-2-01	Drainage	0.30 J
B42	FP-B42-WP-2-01	Drainage	<0.63
B43	FP-B43-WP-2-01	Drainage	<0.63
B44	FP-B44-WP-2-01	Drainage	<0.62 UJ
B45	FP-B45-WP-2-01	Drainage	<0.60 UJ
B46	FP-B46-WP-2-01	Drainage	<0.57 UJ
B47	FP-B47-WP-2-01	Drainage	<0.62 UJ
B48	FP-B48-WP-2-01	Target	<0.62
B49	FP-B49-WP-2-01	Target	<0.63
B50	FP-B50-WP-2-01	Target	<0.63
B51	FP-B51-WP-2-01	Target	<0.64
B52	FP-B52-WP-2-01	Drainage	<0.60 UJ
B53	FP-B53-WP-2-01	Drainage	<0.61 UJ
B54	FP-B54-WP-2-01	Drainage	<0.61 UJ
B55	FP-B55-WP-2-01	Target	<0.64
B56	FP-B56-WP-2-01	Target	<0.66
B57	FP-B57-WP-2-01	Target	<0.61 UJ
B58	FP-B58-WP-2-01	Target	<0.65 UJ
B59	FP-B59-WP-2-01	Target	<0.64 UJ
B60	FP-B60-WP-2-01	Target	<0.61
B61	FP-B61-WP-2-01	Target	<0.61 UJ
B62	FP-B62-WP-2-01	Target	<0.63
B63	FP-B63-WP-2-01	Target	<0.63 UJ
B64	FP-B64-WP-2-01	Target	<0.61 UJ
B65	FP-B65-WP-2-01	Drainage	<0.68 UJ
B66	FP-B66-WP-2-01	Target	<0.64 UJ
B67	FP-B67-WP-2-01	Target	<0.61 UJ
B68	FP-B68-WP-2-01	Target	<0.62
B69	FP-B69-WP-2-01	Drainage	<0.61
B70	FP-B70-WP-2-01	Drainage	<0.60 UJ
B71	FP-B71-WP-2-01	Drainage	<0.61 UJ
B72	FP-B72-WP-2-01	Drainage	<0.61 UJ
B73	FP-B73-WP-2-01	Drainage	<0.62 UJ
B74	FP-B74-WP-2-01	Drainage	<0.62 UJ
B75	FP-B75-WP-2-01	Drainage	<0.61 UJ
B76	FP-B76-WP-2-01	Drainage	<0.64
B77	FP-B77-WP-2-01	Drainage	<0.58
B78	FP-B78-WP-2-01	Drainage	<0.62
B79	FP-B79-WP-2-01	Drainage	<0.62
B80	FP-B80-WP-2-01	Drainage	<0.60
B81	FP-B81-WP-2-01	Other	<0.62

Site		Sample ID	Location	White Phosphorus (mg/kg)
TRRP Residential Soil PCL:				**510**
B82		FP-B82-WP-2-01	Other	<0.60 UJ
B83		FP-B83-WP-2-01	Target	<0.61 UJ
B84		FP-B84-WP-2-01	Drainage	<0.61
R01	2A	FP-R01-WP-2A-01	Target	<0.61
	2B	FP-R01-WP-2B-01		<0.62
	2C	FP-R01-WP-2C-01		<0.63
	2D	FP-R01-WP-2D-01		<0.61
R02	2A	FP-R02-WP-2A-01	Target	<0.60
	2B	FP-R02-WP-2B-01		<0.61
	2C	FP-R02-WP-2C-01		<0.60
	2D	FP-R02-WP-2D-01		<0.60
R03	2A	FP-R03-WP-2A-01	Target	<0.61 UJ
	2B	FP-R03-WP-2B-01		<0.60 UJ
	2C	FP-R03-WP-2C-01		<0.61 UJ
	2D	FP-R03-WP-2D-01		<0.61 UJ
R04	2A	FP-R04-WP-2A-01	Target	<0.62 UJ
	2B	FP-R04-WP-2B-01		<0.60 UJ
	2C	FP-R04-WP-2C-01		<0.60 UJ
	2D	FP-R04-WP-2D-01		<0.61 UJ
R05	2A	FP-R05-WP-2A-01	Drainage	<0.61 UJ
	2B	FP-R05-WP-2B-01		<0.61 UJ
	2C	FP-R05-WP-2C-01		0.58 J
	2D	FP-R05-WP-2D-01		2.47 J
R06	2A	FP-R06-WP-2A-01	Drainage	0.54 J
	2B	FP-R06-WP-2B-01		<0.60
	2C	FP-R06-WP-2C-01		<0.59
	2D	FP-R06-WP-2D-01		<0.60
R07	2A	FP-R07-WP-2A-01	Drainage	<0.61 UJ
	2B	FP-R07-WP-2B-01		<0.63 UJ
	2C	FP-R07-WP-2C-01		<0.62 UJ
	2D	FP-R07-WP-2D-01		<0.62 UJ
R08	2A	FP-R08-WP-2A-01	Drainage	2.22
	2B	FP-R08-WP-2B-01		<0.61
	2C	FP-R08-WP-2C-01		<0.61
	2D	FP-R08-WP-2D-01		0.37 J
R09	2A	FP-R09-WP-2A-01	Drainage	<0.60
	2B	FP-R09-WP-2B-01		<0.60
	2C	FP-R09-WP-2C-01		<0.59
	2D	FP-R09-WP-2D-01		<0.60

Site		Sample ID	Location	White Phosphorus (mg/kg)
TRRP Residential Soil PCL:				**510**
R10	2A	FP-R10-WP-2A-01	Drainage	<0.64 UJ
	2B	FP-R10-WP-2B-01		<0.59 UJ
	2C	FP-R10-WP-2C-01		0.45 J
	2D	FP-R10-WP-2D-01		<0.60 UJ
R11	2A	FP-R11-WP-2A-01	Drainage	<0.61
	2B	FP-R11-WP-2B-01		<0.60
	2C	FP-R11-WP-2C-01		<0.62
	2D	FP-R11-WP-2D-01		<0.62
R12	2A	FP-R12-WP-2A-01	Drainage	<0.66 UJ
	2B	FP-R12-WP-2B-01		<0.63 UJ
	2C	FP-R12-WP-2C-01		<0.63 UJ
	2D	FP-R12-WP-2D-01		<0.62 UJ

J qualifier indicates that the analyte concentration is estimated, as it was detected above the method detection limit but below the method reporting limit, or has been qualified during Data Validation.

UJ qualifier indicates that the analyte was not detected, but the data has been qualified and should be considered an estimated value at the reporting limit.

Note: See Section 4.0 (Data Validation) for a detailed description of the data qualifiers.

TABLE 3.7

WHITE PHOSPHORUS CONCENTRATIONS – DEEP INTERVAL SAMPLES

Site	Sample ID	Location	White Phosphorus (µg/kg)
TRRP Residential Soil PCL:			**510**
R01	FP-R01-WP-6A-01	Target	<0.62
R02	FP-R02-WP-6A-01	Target	<0.61
R03	FP-R03-WP-6A-01	Target	<0.60 UJ
R04	FP-R04-WP-6A-01	Target	<0.63 UJ
R05	FP-R05-WP-6A-01	Drainage	<0.64 UJ
R06	FP-R06-WP-6A-01	Drainage	<0.62
R07	FP-R07-WP-6A-01	Drainage	<0.63 UJ
R08	FP-R08-WP-6A-01	Drainage	<0.63
R09	FP-R09-WP-6A-01	Drainage	<0.60
R10	FP-R10-WP-6A-01	Drainage	<0.62 UJ
R11	FP-R11-WP-6A-01	Drainage	<0.62
R12	FP-R12-WP-6A-01	Drainage	<0.63 UJ

UJ qualifier indicates that the analyte was not detected, but the data has been qualified and should be considered an estimated value at the reporting limit.

Note: See Section 4.0 (Data Validation) for a detailed description of the data qualifiers.

4.0 DATA VALIDATION

4.1 Scope of Data Validation

Analytical data for the Former Five Points OLF was reviewed and validated in accordance with the procedures specified in the Quality Assurance Project Plan (QAPP, October 2002), the USEPA Functional Guidelines for Inorganic and Organic Data Validation, and quality assurance and control parameters set forth by the project analytical laboratories. Tables presenting qualified data, quality control/assurance triplicate samples, completeness analyses, and conclusions on data quality objectives are provided in Appendix C. The raw analytical data and summary tables, as supplied by the project laboratories, are provided in electronic format on a CD accompanying this site investigation report.

All sample results met the project completeness goals and are considered usable for project objectives. Several sample results were qualified based on the data validation (see Table 2 of Appendix C). The majority of qualified data were due to problems arising from the complex soil matrix (hard silty clay).

4.2 Project Description

A total of 144 soils samples were collected for metals (lead and zinc), explosives, and white phosphorus analyses. A complete list of all samples, with field IDs, laboratory IDs, and analyses is attached as Table 1 in Appendix C. The table below lists the analytical methods and the associated projects laboratories.

Parameter	Analytical Method	Laboratory	Role
Metals/ Explosives	6010/ 8330	Paragon Analytics, Inc.	Primary lab
		USACE Environmental Chemistry Branch, Omaha	QA lab
White Phosphorus	7580	USACE Waterways Experimental Station, Vicksburg	Primary lab
		USACE Cold Regions Research and Engineering Laboratory, New Hampshire	QA lab

4.3 Quality Control Activities

Malcolm Pirnie performed data validation activities by reviewing the following quality control parameters as contained in the Level III reports submitted by the project laboratories:

- Sample Preservation and Temperature Upon Laboratory Receipt
- Holding Times
- Method Blank Contamination
- Surrogate Recovery
- Laboratory Control Sample/Duplicate Recovery
- Matrix Spike/Duplicate Recovery
- Laboratory Duplicate
- QA/QC Triplicate Split Samples

Calibration data were not evaluated as part of this review. However, the calibration, continuing calibration, and raw data results are included in the report. Results that required data qualification are presented in Table 2 of Appendix C and described in the following sections.

4.3.1 Laboratory Quality Control

4.3.1.1 Data Qualifier Flags

Data qualifier flags are used by the laboratory and during data validation to notify the user of any possible uncertainty. Definitions of the most widely used data qualifiers in this assessment are:

U This flag indicates that an analyte was not detected above the method detection limit.

J This flag indicates an analyte has been positively identified; however, the result should be considered an estimated value and is still usable.

UJ This flag indicates that an analyte was not detected above the method detection limit; however, the reporting limit should be considered an estimated value, but the data is still usable.

R This flag indicates that the data has been qualified as rejected.

4.3.1.2 Sample Preservation and Temperature Upon Laboratory Receipt

Samples were received intact and at the correct temperature with the following exception:

- Sample FP-R04-OT-2A-01, collected 11/13/02, was received at Paragon at 7° C. Analyses for this sample were cancelled and another sample was collected at this sample location on 11/15/02. This resulted in no impact to the analytical results and did not result in data qualification.

4.3.1.3 Holding Times

Samples were extracted and analyzed within the holding time limits, with the following exception:

- The LCS associated with Method 8330 QC batch EX021126-7-1 had a low tetryl recovery (26 percent; acceptance limit is 45 percent). The entire analytical batch of samples was re-extracted two days past the recommended holding time. The re-extracted LCS had an acceptable tetryl recovery. The tetryl results for the original and re-extracted samples were all not detected above the reporting limit. The tetryl results were qualified "UJ" to indicate a potential low bias due to the low LCS recovery.

4.3.1.4 Blanks

Method blanks, continuing calibration blanks (CCBs), and equipment rinsate blanks were collected and analyzed at the appropriate frequencies. No target compounds were detected in the blanks with the following exceptions:

- Trace levels of lead and zinc were detected in several blank samples (method blanks, CCBs, and equipment rinsate blanks). In all cases, the blanks were associated with samples that had concentrations greater than ten times the metals concentrations detected in the blanks. These trace levels of lead and zinc did not result in any data qualification.

- Explosives were not detected in any blanks; however, equipment rinsate blanks FP-xxx-OT-x-04-1, collected 11/8/02, and FP-xxx-OT-x-01-4, collected on 11/15/02, had an anomalous peak in the sample chromatograms. These peaks did not match the retention time of any explosive analytes and were not present in any of the soil sample chromatograms. The peak appears to be a sampling artifact, probably related to the decontamination procedures (brush, buckets, soap residue, or rinse water), and did not result in any data qualification.

4.3.1.5 Surrogate Recovery

Surrogate recoveries for explosives analyses were all within acceptance limits.

4.3.1.6 Laboratory Control Sample/Duplicate Recovery and Relative Percent Difference

Laboratory control samples and laboratory control sample duplicates (LCS/LCSD) were performed at the required frequency and were within acceptance limits with the following exceptions:

- As described earlier, the LCS associated with explosives QC batch EX021126-7-1 had a low tetryl recovery (26 percent; acceptance limit is 45 percent). The entire analytical batch of samples was re-extracted two days past the recommended holding time. The re-extracted LCS had an acceptable tetryl recovery. The tetryl results for the original and re-extracted samples were all not detected above the reporting limit. The tetryl results were qualified "UJ" to indicate a potential low bias due to either low LCS recovery or the holding time exceedance.

- Non-project specific batch QC was performed for lead and zinc soils samples associated with QC batch 1P021119-2-1. The associated LCS and batch QC had acceptable recoveries; therefore, data validation was not required.

4.3.1.7 Matrix Spike/Matrix Spike Duplicate Recovery and Relative Percent Difference

Matrix spike and matrix spike duplicates (MS/MSD) were performed on project-specific samples at the required frequency. The percent recoveries and relative percent differences (RPDs) were within acceptance limits with the following exceptions:

- The zinc matrix spike recovery, laboratory duplicate RPD, and serial dilution RPD associated with sample FP-R12-OT-2A-01 were outside of acceptance limits. Zinc results for all samples associated with this QC batch (1P021122-2-1) were qualified "J" to indicate a potential bias.

- The white phosphorus MS/MSD associated with sample FP-B67-WP-2-01 were recovered outside of acceptance limits (23.8 percent and 35.8 percent; the lower limit is 50 percent). As stated in the laboratory corrective action form, there was insufficient sample matrix left to re-extract and re-analyze the QC sample set. A different sample (FP-B71-WP-2-01) from the analytical batch was re-analyzed as a MS/MSD and yielded acceptable recoveries (63.5 percent and 55.1 percent). Sample results associated with the low

MS/MSD recoveries were qualified "UJ" to indicate a potential low bias.

The white phosphorus MS/MSD recoveries were below acceptance limits for the following samples:

Sample ID	Percent Recovery (%)		
	MS	MSD	Control Limits
FP-B70-WP-2-01	12.1	26.3	50-130
FP-B28-WP-2-01	51.3	45.0	50-130
FP-R07-WP-2B-01	12.0	10.3	50-130
FP-B28-WP-2-01	30.1	27.0	50-130

The LCS associated with these analytical batches had acceptable recoveries. The low MS/MSD recoveries are most likely due to matrix effects. The white phosphorus results for the samples in these analytical batches that were non-detect were qualified "UJ" and the few samples that had detections were qualified "J", both qualifiers indicate a potential low bias.

4.3.1.8 Laboratory Duplicate Relative Percent Difference

Laboratory duplicates were performed on project-specific samples at the required frequency. The RPDs were within acceptance limits with the following exceptions:

- The lead RPD for the laboratory duplicate of sample FP-B83-OT-2-01 was outside of acceptance limits (28 percent; limit is 20 percent). The zinc RPD for the serial dilution of sample FP-B83-OT-2-01 was also above acceptance limits (12 percent; limit is 10 percent). The lead and zinc results for all samples associated with this QC batch were qualified "J" to indicate a low degree of precision possibly due to the heterogeneous nature of the soils. However, the sample results are considered in agreement since the difference in their results is less than two times the result.

- The lead RPD for the laboratory duplicate of sample FP-R04-OT-2A2-01 was outside of acceptance limits (24 percent; limit is 20 percent). The lead results for all samples associated with this QC batch were qualified "J" to indicate a low degree of precision possibly due to the heterogeneous nature of the soils. However, the sample results are still in agreement since the difference in their results is less than two times the result.

4.3.1.9 QA/QC Triplicate Samples

Thirteen field samples were submitted to the laboratories as QA/QC triplicate split samples. For lead, zinc, and explosives analyses, triplicate samples were collected in three separate aliquots; two were sent to the primary lab, and one was sent directly to the QA Lab. For white phosphorus analyses, one sample container was to be sent to the primary lab where it was to be split into three aliquots (field sample, field duplicate, and QA duplicate samples). The QA duplicate sample would then be sent to the QA lab for analysis. Due to miscommunication, white phosphorus samples were only split into two aliquots (analyzed as a field sample and QA duplicate).

The RPDs between field sample/field duplicate and field sample/QA duplicate are presented in Tables 3 and 4 in Appendix C, respectively. The RPDs calculated for field duplicates were compared to control limits presented in the QAPP. The field duplicate RPDs were within acceptance limits with the following exceptions:

Sample IDs	Analyte	Sample Result (mg/kg)	Field Duplicate Result (mg/kg)	RPD (%)
FP-B04-OT-2-(01/02)	Zinc	32	20	46
FP-R11-OT-2B-(01/02)	Lead	18	12	40
FP-R11-OT-2D-(01/02)	Zinc	33	24	32

The sample results from the three samples were qualified "J" to indicate a low degree of precision possibly due to the heterogeneous nature of the soils. Field duplicate RPDs calculated for QA duplicate samples were not evaluated against control limits but were reviewed qualitatively. Again, several QA results for lead and zinc yielded high RPDs, possibly indicating problems with sample heterogeneity.

4.4 Evaluation of Quality Control Parameters

The data quality for the sampling at the Former Five Points Outlying Fields has been measured and evaluated in terms of the following indicators:

- Precision
- Bias
- Representativeness
- Comparability
- Completeness
- Sensitivity

The following sections describe the data quality indicators and the quality level of this data.

4.4.1 Precision

Precision is a measure of the reproducibility of analyses under a given set of conditions. MS/MSD, LCS/LCSD, and laboratory duplicates are analyzed to determine analytical precision. Sampling precision is demonstrated through collection and analysis of field duplicates. Precision

is measured by calculating the RPD. There were only a few samples that were qualified because of LCS/LCSD or MS/MSD issues, thus indicating overall good precision for the project.

4.4.2 Bias

Bias refers to the systematic or persistent distortion of a measurement process that causes errors in one direction (above or below the true value or mean). Accuracy is a measure of closeness between an observed value and the 'true' value, but it does not differentiate between random error and systematic error (i.e., bias). Bias is impacted by errors introduced through the sampling process, handling, analytical procedures, and the sample matrix. Bias is evaluated by measuring the percent recovery for MS, MSD, LCS, LCSD, etc., samples and surrogate compounds for the respective analyses. Bias values are expressed in terms of percent recovery for each of the spiked components. Overall, there is little bias in the data with a few marginal exceptions involved with white phosphorus matrix spikes.

4.4.3 Representativeness

Representativeness is a qualitative parameter that evaluates the degree to which sample data accurately and precisely represent a characteristic of a population, a sampling point, or an environmental condition. Sample handling protocols (e.g., collection, storage, preservation, and transportation) have been established to ensure samples are representative of field conditions. The overall representativeness of the data seems to be good as indicated by the sample handling protocols.

4.4.4 Comparability

Comparability is a qualitative parameter that expresses the confidence with which one data set may be compared to another. This is a concern when current data are being integrated with historical data. A USACE Project Chemist will conduct a Chemical Data Quality Assessment Review (CDQAR), which will involve a comparison of the project laboratory results for the primary and QC samples to the results for the sample replicates analyzed by the QA laboratory.

4.4.5 Completeness

Completeness is a measure of the amount of valid data obtained compared to the total number of measurements planned. Completeness is evaluated qualitatively and quantitatively. The qualitative evaluation of completeness is determined as a function of the events contributing to the sampling event. This includes items such as samples arriving at the laboratory intact, properly preserved, and in sufficient quantity to perform the requested analyses.

Table 5 in Appendix C presents the percent completeness for metals, explosives, and white phosphorus analyses. The completeness goals for holding times (100%) and other QC parameters (90%) were met and/or exceeded for all analyses for the project.

4.4.6 Conclusion

Overall, the data were completed with quality assurance and control protocols met. None of the issues with LCS/LCSD and MS/MSD were significant. The data set is considered usable and meets or exceeds the criteria for the project data quality objectives as outlined in the QAPP (Malcolm Pirnie, November, 2002).

5.0 CONCLUSIONS

5.1 Summary of Field Investigation Results

The primary goal of this preliminary site investigation was to determine if there was a presence and/or concentration of certain COCs that may have been introduced to the former Five Points OLF site through prior DoD operations. The results of the investigation indicate that the COCs are either not present, present at background levels, or present in small quantities below PCLs at the site. As none of the COCs in this site investigation exceeded the PCLs established under TRRP, an APAR was not prepared.

None of the 14 explosives or explosives-derived compounds were detected in any of the samples collected. This result was expected, as TNT and its intermediate nitroaromatic degradation products are susceptible to biodegradation and irreversible sorption to soil matrices, and if released, could have naturally attenuated over the nearly five decades that have passed since bombing operations ceased. Also, black powder was the principal explosive source used in spotting charges at the site. Black powder does not contain TNT or its intermediate nitroaromatic degradation products.

The positive detection of white phosphorus, even at the trace levels found in the samples (< 2.5 µg/kg), indicates that the compound most likely originated from previous DoD activities at the site. White phosphorus has been and continues to be used as a smoking agent in practice ordnance, and the likelihood of a separate potential source contributing to its presence at this site is low, as it is a restricted material.

Previous studies performed by the USACE suggest that white phosphorus can persist in the environment, especially in wet, anaerobic sediments, since it requires oxygen to ignite (CREEL, 1995). This persistence can also be attributed to the formation of a layer of oxides

around the white phosphorus particles upon exposure to dry air, which slows or completely stops the oxidation reaction (CRREL, 1995). When exposed to moist air, a film of moisture envelops the remaining particles, also cutting off the oxidation reaction. The formation of these encased particles allows for the potential transport of white phosphorus by wind or surface water runoff. The climatological data presented in Section 1.9 indicates that the site received an annual average of 33.3 inches of rain over the 1948 to 1995 period, which could potentially contribute to the persistence and transport of white phosphorus at the site. However, despite its persistence, white phosphorus was quantifiable at only a few sampling sites, and the levels are well below the state-established residential soil PCL under TRRP.

Lead and zinc were selected as analytes for this investigation as they were primary metallic components of the bomb casings known to be used at the site during DoD operation. As stated previously, certain sampling sites contain lead or zinc or both metals above the state-established background concentrations for soil. However, the concentrations of both metals appear to fall within background levels when averaged across the site. Moreover, the TRRP PCL for either metal is not exceeded in any sample collected from the site. It can be concluded that the concentrations of lead and zinc at this site are typical of levels throughout Texas and, therefore, do not pose a significant health concern for the residents of South Ridge Hills and Twin Parks Estates.

5.2 Recommended Further Action

Soil sampling for this investigation was performed in the areas of the site identified as having the highest probability of containing the COCs (i.e., near the target center and surface drainage regions) originating from prior DoD activities. The COCs were either not detected at

all or detected at concentrations well below the PCLs established in Texas under TRRP, and indicates the absence of soil impacts related to prior DoD activities at the site. Therefore, it is unlikely that further sampling in the remaining peripheral areas of the site would yield higher concentrations of COCs than those detected in the central target and drainage areas, i.e., the areas with the highest probability of containing the COCs. It is recommended that no additional soil sampling is necessary to further assess potential DoD soil impacts.