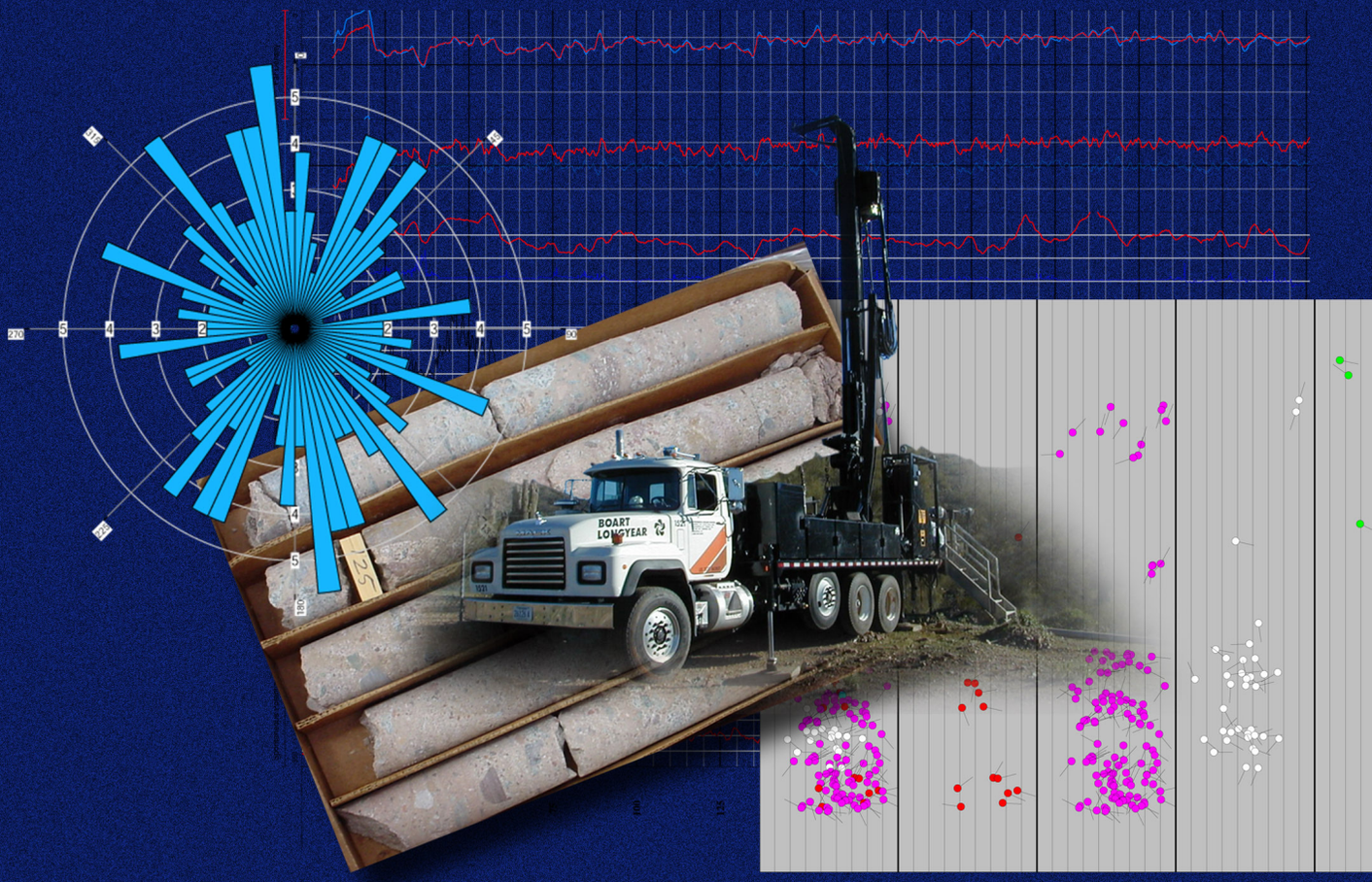
Remedial Investigation Summary Report

Universal Propulsion Co. Inc.



August 2011

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1. Introduction

This Remedial Investigation (RI) Summary Report (report) provides an overview of the soil, soil vapor, and groundwater investigation activities conducted at the former Universal Propulsion Company, Inc. (UPCO) facility (site) in Phoenix, Arizona. The purpose of the RI activities was to identify and delineate contaminants of potential concern (COPCs) that may have been released into the soil and/or groundwater as a result of past operational activities. This report serves as an executive summary to the Final RI Report submitted in June 2011 (ARCADIS, 2011). As such, specific details regarding site history, site investigation activities, site conceptual model development, and conclusions are summarized in the Final RI Report.

1.1. Site Description

The former UPCO facility is located at 25401 North Central Avenue in Phoenix, Arizona, near the intersection of Central Avenue and Happy Valley Road (Figure 1). The site is within the southeast quarter, Section 5, Township 4 North, Range 3 East of the Union Hills 7.5' United States Geologic Survey (USGS) quadrangle. The former UPCO facility was situated on approximately 160 acres of land leased from the State of Arizona and was initially constructed in 1972. The western, southern, and eastern boundaries of the property are undeveloped land owned by the State of Arizona. Residential properties are to the north along Yearling Road. The former operational areas of the facility are surrounded by a security fence and primary access is limited to a gate along Happy Valley Road.

The facility consisted of various manufacturing, storage, and administrative buildings/structures which were separated into seven operational areas. These areas of the site are illustrated on Figure 2 and include: A-Complex, B-Complex, C-Complex, D-Complex, E-Complex (Storage Magazine Area), F-Complex, and the Open Burn Unit (New Burn Area).

1.2. Site History

UPCO, a Delaware corporation, is the successor to the original Universal Propulsion Co., a California Corporation, incorporated in 1959. UPCO began operations at its current Arizona facility in 1972. UPCO became part of Goodrich Corporation in 1998. The UPCO operations were transferred to a facility in Fairfield, California in the fourth

quarter of 2009. Demolition of the UPCO facility occurred throughout 2009 and was completed in January 2010.

1.3. Facility Operations

The former UPCO facility primarily produced components for crew escape systems for military aircraft. Component products such as gas generators, rocket motors, cartridge actuated devices (CADs), propellant actuated devices (PADs), and electronic explosive devices (EEDs) were also developed and manufactured at the facility.

The facility included several separate operational areas for manufacturing, assembling, testing and storing energetic materials (Figure 2). The A-Complex Area consisted of buildings associated with the administrative and management functions. The B-Complex Area consisted of various buildings/structures used primarily for ejection seat, EED, CAD, and PAD assemblies. The C-Complex Area consisted of various buildings/structures used for manufacturing of castable propellants including material weigh-out, oxidizer grinding, propellant mixing and casting.

The D-Complex Area was located in the northwest portion of the facility and consisted of various buildings/structures used primarily for device testing, as well as the waterbore process. There were three specific areas of focus within the D-Complex which included the Old Burn Area, the Thermal Treatment Unit (TTU), and Waterbore Area. The Old Burn Area was located in the northern portion of the D-Complex and used to burn off-specification energetic materials and devices. Open burning of waste materials occurred in the Old Burn Area during the 1970s and early 1980s, until open burn operations were moved to the Open Burn Unit (OBU) in the New Burn Area. The TTU was located south of the D-Complex fence line and was used to burn off-specification solid propellant materials. Since at least 1983, a high-pressure water spray wand operation had been used to remove solid propellant and binders from rocket motor tubes so that the tubes could be reused. This process was referred to as the waterbore operation. The Waterbore Area, where waterbore operation was performed, was located at the southern end of the D-Complex within the fence line. The E-Complex, also referred to as the Storage Magazine Area (SMA), consisted of portable prefabricated metal (Conex-type) containers used for the storage of energetic materials and devices used at the facility.

The F-Complex Area consisted of various buildings/structures used for manufacturing of powder-based energetic formulations, assembly operations and quality assurance/quality control (QA/QC) testing. Historically it was also used for manufacturing of castable and extruded propellant, manufacturing of large rocket motors, lining of rocket motor tubes,

liner drying, tool pull, propellant mixing, propellant casting, and propellant curing, and weigh-out of oxidizers, binders, and fuel powders.

The OBU was operated in the New Burn Area, located south of the C-Complex near the south central property boundary. Open burning of waste/off-specification solid propellant materials were performed in this area since 1980.

Utilities available at the facility at the time of operation included electrical power and communications; however, municipal services were not available in the area; therefore, the facility relied on a production well and septic systems.

1.4. Regional Setting

1.4.1. Regional Geology

The Site is located within the Basin and Range physiographic province of Arizona. The UPCO facility is located between and within the southern flanks of the Union Hills, a northwest trending bedrock mountain range, and the northern margin of the West Salt River Valley within the Union Hills USGS 7.5' Quadrangle. The surface geology of the site can be grouped into two categories, Tertiary/Quaternary sedimentary strata (Sedimentary Unit), and Precambrian basement rock of various lithologies. The surface deposits (upper two feet) of the Sedimentary Unit are generally poorly consolidated and poorly sorted, with particle sizes ranging from clay to boulder. Locally, desert pavement is observed in undisturbed areas of the site and caliche is found in the upper few feet of the soil horizon as observed at bank cuts of entrenched washes in the area. Surface bedrock surrounds the leased property on the north, east, and south boundaries in somewhat of a crescent shape.

1.4.2. Regional Hydrogeology

The regional hydrogeology encompasses two significant hydrogeologic units. They include the Sedimentary Unit within the West Salt River Valley Basin, and the Proterozoic bedrock which comprises the Union Hills and underlies the alluvial deposits.

The West Salt River Valley Basin is comprised of valley-fill deposits divided based on lithologic characteristics. In descending order from the land surface, the water-bearing units include the upper alluvial unit (UAU), the middle fine-grained unit (MAU), and the lower alluvial unit (LAU). The primary water bearing unit in the West Salt River Valley Sub-basin is the UAU. A direct correlation between the typical hydrogeologic units of the Salt River Valley (e.g. UAU, MAU, and LAU) and those underlying the UPCO facility has not been made.

Depths to groundwater vary within the UAU temporally and with location. On a regional scale, the groundwater flow direction near the UPCO facility appears to be from the northeast to the southwest away from the Union Hills (Rascona, 2003). The bedrock units, which underlie the basin sediments and comprises the Union Hills, may contain usable amounts of groundwater where they are significantly fractured or faulted (Anderson, 1995).

2. Study Area Investigation

2.1. Soil Investigation Summary

Initial RI soil characterization activities were conducted between July 2004 and August 2005 and supplemental soil characterization was performed between February and March 2008. The soil investigation activities included the sampling and analysis of soil samples at each of the following operational areas: B-Complex, C-Complex, D-Complex (Waterbore Area, Thermal Treatment Unit, and Old Burn Area), E-Complex (Storage Magazine Area), F-Complex, and Open Burn Unit (New Burn Area).

The area by area investigations were focused on the suspected or known releases of COPCs. The soil boring and sampling activities were intended to provide sufficient data to vertically and horizontally characterize surface and subsurface soils that may contain COPCs above the applicable screening levels. Surface and subsurface borings advanced during the 2004 and 2005 investigation activities provided initial sample results to characterize the nature, magnitude, and extent of COPCs in soil. Supplemental surface and subsurface borings advanced in 2004, 2005 and 2008 provided additional characterization data for the horizontal and vertical delineation of COPCs in soil relative to horizontal and vertical characterization targets, respectively.

Soil samples collected during the RI investigations were submitted to an Arizona state-certified laboratory and analyzed for one or more of the following constituents: perchlorate, metals, nitrate, cyanide, SVOCs, acetate, sodium azide, dioxins, high explosives, and pH.

2.1.1. Area Investigations

The sample locations, depths, and analyses were identified based on area operations, potential or known historic releases, and data gaps from previous assessments/investigations. The soil investigation included the collection of the following samples:

- B-Complex Area - 117 soil samples were collected from 39 surface or subsurface soil boring locations
- C-Complex Area - 98 soil samples were collected from 22 surface or subsurface soil boring locations

- Old Burn Area - 112 soil samples were collected from 51 surface or subsurface soil boring locations
- TTU Area - 104 soil samples were collected from 30 surface or subsurface soil boring locations
- Waterbore Area - 155 soil samples were collected from 15 surface or subsurface soil boring locations
- SMA - 61 soil samples were collected from 27 surface or subsurface soil boring locations
- F-Complex Area - 71 soil samples were collected from 22 surface or subsurface soil boring locations
- New Burn Area 147 soil samples were collected from 47 surface or subsurface soil boring locations

2.1.2. COPCs - Soil

Soil samples collected during the RI activities indicated that perchlorate and select metals (arsenic and lead) were detected at concentrations above the characterization targets. The elevated arsenic and lead concentrations detected in soil were limited to surface and near surface samples collected at the Old Burn Area, the New Burn Area, and one location along the wash behind the B-Complex. The highest arsenic concentration detected in soil was 15 mg/kg at the New Burn Area and the highest lead concentration detected in soil was 4,800 mg/kg at the Old Burn Area.

During the initial and supplemental soil investigations, perchlorate was detected above the characterization targets within each operational area investigated. The highest concentrations were detected in the Waterbore Area, C-Complex and the New Burn Area. The highest concentration detected in soil at the C-Complex was 330 mg/kg, in a surface soil sample (at boring CC-SB08). The highest perchlorate concentration detected in a subsurface soil sample at the C-Complex is 83 mg/kg at 20 feet bgs.

The highest perchlorate concentration detected in soil at the New Burn Area was 150 mg/kg. This was detected in surface soil at the former burn pad, which was subsequently removed. After the limited soil removal activities, performed as part of the RCRA closure of the OBU, the highest perchlorate concentration remaining in soil at the New Burn Area is 61 mg/kg, at 5 feet bgs.

The highest perchlorate concentration detected in soil at the Waterbore Area was 369 mg/kg, at 20 feet bgs during historical RFI activities. At two borings drilled beneath the former evaporation ponds during RI activities, perchlorate was detected at elevated

concentrations in each soil sample collected at WB-SB06, to a depth of 175 feet bgs, and in 7 of 13 samples collected at WB-SB07, to a depth of 70 feet bgs.

2.1.3. Remedial Goals in Soil

Once COPCs in soil were identified, remedial goals were established based on Arizona soil remediation level (SRLs) or groundwater protection levels (GPLs), whichever was more stringent. Arizona Residential SRLs have been established for arsenic, lead, and perchlorate concentrations in soil that are protective of direct contact with potential human receptors in a residential scenario. ADEQ has also developed minimum groundwater protection levels (GPLs) for arsenic and lead to be protective of migration to groundwater, and potential exposure to human receptors via drinking water ingestion. ADEQ has not developed a minimum GPL for perchlorate; however, due to perchlorate's solubility and mobility and potential for migration to groundwater, a site-specific GPL was developed for perchlorate using a batch test leaching method (BTLM) model, approved by ADEQ.

The minimum GPL for arsenic and lead is 290 mg/kg, which is less stringent for arsenic but more stringent than the SRL for lead. Therefore, the Arizona residential SRL of 10 mg/kg for arsenic and the minimum GPL of 290 mg/kg for lead have been identified as remedial goals in soil at the Site. The site-specific GPL calculated for the UPCO facility for perchlorate in soil is 16 mg/kg. Since this concentration is more stringent than the Arizona residential SRL of 55 mg/kg, the remedial goal for perchlorate in soil at the Site is the GPL of 16 mg/kg.

2.1.4. Source Delineation – Soil

2.1.4.1. Perchlorate

Perchlorate has been detected at concentrations above the remedial goal of 16 mg/kg in the Waterbore Area, C-Complex, and New Burn Area. The elevated perchlorate concentrations in soil at the Waterbore Area are limited to the soil beneath the former evaporation ponds where wastewater from the water wand operation was discharged. Perchlorate was detected above the remedial goal of 16 mg/kg in 18 subsurface soil samples collected from three borings in the vicinity of the former evaporations ponds (Figure 3). In the boring drilled directly beneath the former ponds, perchlorate detections above 16 mg/kg extend vertically to 175 feet bgs, at bedrock.

Perchlorate detections above the remedial goal of 16 mg/kg in the C-Complex are limited to five samples collected from five different locations: two surface soil locations and three subsurface soil locations at depths ranging from 10 to 20 feet bgs. These elevated perchlorate concentrations include one subsurface sample, 20 feet bgs, to the north of

Building C-1, one surface sample to the south of Building C-1, one subsurface soil location, 20 feet bgs, located between Buildings C-1 and C-2, one subsurface soil sample, 10 feet bgs, east of Building C-2, and one surface soil location outside of Building C-4 (Figure 4).

The impacted surface soil at the New Burn Area, beneath the former burn pad, was removed during RCRA closure activities. The remaining elevated perchlorate concentrations observed in the New Burn Area were limited to 11 subsurface soil samples collected from eight locations beneath and adjacent to the former OBU burn pad, at depths ranging from 5 to 20 feet bgs (Figure 5).

2.1.4.2. Metals

Elevated lead concentrations above the remedial goal of 290 mg/kg were detected in the Old Burn Area and the New Burn Area. The elevated lead concentration detected in the New Burn Area was limited to one surface soil sample located in the vicinity of the former OBU burn pad. The impacted soil in the New Burn Area was removed during RCRA closure activities; therefore, lead is not a contaminant of concern at the New Burn Area. The only area with elevated lead concentrations in soil is the Old Burn Area at nine surface to near surface (one foot bgs) locations in the vicinity of the former treatment unit (Figure 6).

Arsenic was detected above the remedial goal of 10 mg/kg in soil at a few locations within the Old Burn Area, F-Complex, B-Complex and the New Burn Area. The elevated arsenic concentration detected in the New Burn Area was limited to one surface soil sample located beneath the former OBU burn pad. The impacted soil was removed during RCRA closure activities. The arsenic impacted soil in the B-Complex is limited to one surface location in the wash that borders the west and north side of the operational area. The arsenic impacted soil in the F-Complex is limited to one location, 20 feet bgs, off the southwest corner of Building F-1. The arsenic impact at the Old Burn Area is limited to one near surface location (one foot bgs) to the northwest of the former burn area.

2.2. Soil Gas Investigation Summary

Initial soil gas investigation activities were conducted between July 2004 and August 2005 and supplemental soil gas characterization was performed between February and March 2008. The soil gas investigation activities included the sampling and analysis of soil gas samples at each of the following operational areas: B-Complex, C-Complex, D-Complex (Waterbore Area and Old Burn Area), F-Complex, and Open Burn Unit (New Burn Area).

The area investigations were focused on locations where solvents were managed, stored, or used and/or potentially released to the surrounding soil (e.g., septic leach fields). Therefore, some of the areas investigated for potential soil impacts were not investigated for soil gas impacts (e.g., the TTU area). The soil gas sampling activities were intended to provide sufficient data to assess for the presence or absence of VOCs in soil vapor and identify primary COPCs.

2.2.1. Area Investigations

The sample location, sample depth, and COPCs were identified based on historical operations, potential historical releases, and data gaps from previous assessments/investigations. The soil gas investigation included the collection of the following samples:

- B-Complex Area - 80 soil gas samples were collected from 41 subsurface soil borings.
- B-Complex Area – eight sets of soil gas samples from a soil vapor monitoring well (SVMW-1) consisting of a series of four nested soil gas monitoring screens installed at 190-200 feet bgs, 140-150 feet bgs, 90-100 feet bgs, and 30-40 feet bgs, respectively.
- C-Complex Area - 13 soil vapor samples were collected from 8 subsurface soil borings.
- Old Burn Area - four soil vapor samples were collected from three subsurface soil borings.
- Waterbore Area - two soil gas samples were collected from one boring.
- F-Complex - 34 soil vapor samples were collected from 13 subsurface soil borings.
- New Burn Area - nine soil vapor samples were collected from three subsurface soil borings

2.2.2. COPCs - Soil Gas

Soil gas sampling identified several VOCs that are present at low concentrations in the soil gas beneath operational areas where solvent usage and/or management has occurred, namely B-Complex, C-Complex, F-Complex, and the Old Burn Area. Based on frequency of detection, magnitude of concentration, historic usage, and detection in groundwater samples, 1,1-DCE, acetone and MEK were identified as the COPCs in soil gas that warranted evaluation.

2.2.3. Remedial Goals in Soil Gas

The results of the RI activities have lead to the identification of COPCs in soil gas. There are two potential migration pathways for the COPCs in soil gas that may pose an exposure risk to human receptors. One pathway involves vertical migration downward, dissolution in groundwater, and ingestion; while the other involves vertical migration upward, vapor intrusion into buildings (current or future) and inhalation. Based on the vertical profile of VOC concentrations in soil gas at the suspected source area in B-Complex (collected at SVMW-1), the majority of the VOC mass is approximately 100 feet bgs and is not impacting the groundwater which is located approximately 210 feet bgs. The collection of a grab sample from the groundwater during drilling/installation of SVMW-1 confirmed that 1-1,DCE was not present in the groundwater beneath where SWMU 5 had been located. VOCs in soil gas will continue to be monitored at SVMW-1 to assess if migration to groundwater has the potential to become a pathway of concern in the future.

Potential indoor air exposure risks due to VOCs in soil gas at the Site were evaluated using the Johnson & Ettinger (J&E) Vapor Intrusion Model. Using the EPA's on-line J&E screening tool, soil gas concentrations protective of indoor air were calculated to be 26,900 ppbv for 1,1-DCE, 65,440 ppbv for acetone, and 194,200 ppbv for MEK, assuming a depth to contamination of 10 feet bgs and using default parameters for building design. These concentrations have been established as the remedial goals for 1,1-DCE, acetone, and MEK in soil gas.

2.2.4. Source Delineation – Soil Gas

VOCs present in soil vapor appear to be limited primarily to the B-Complex, C-Complex and F-Complex, which are also the operational areas historically with the highest solvent usage. 1,1-DCE and acetone are the primary VOC impacts to the B-Complex soil vapor. VOCs were detected in soil gas samples collected throughout the B-Complex at various depths; however, the highest concentrations were detected beneath SWMU 5, which was a former solvent storage shed. VOC impacts to soil vapor extend to the water table at SWMU 5 based on soil gas sampling during the B-Complex site investigation and the installation of a nested soil vapor monitoring well. The highest 1,1-DCE and acetone concentrations were measured in a sample collected approximately 100 feet bgs. These concentrations are below the remedial goals for 1,1-DCE and acetone in soil vapor.

The VOC impacts in the C-Complex appear to be limited to acetone which was detected in soil vapor beneath Building C-2 and the former laboratory trailer, Building C-11. Vertical migration beneath Building C-2 appears to be limited to approximately 40 feet bgs. Vertical migration of VOCs in soil vapor beneath the former laboratory trailer

appears to extend at least 80 feet bgs. VOC concentrations in soil vapor beneath the C-Complex were below the remedial goals.

The VOC impacts in the F-Complex appear to be limited to MEK and acetone which were detected in soil vapor beneath Building F-1 and F-10. Vertical migration beneath Building F-1 appears to extend at least 100 feet bgs. Vertical migration of VOCs in soil vapor beneath Building F-10 appears to extend at least 60 feet bgs. Further vertical delineation of VOC impacts at Buildings F-1 and F-10 were not completed due to access issues for the drill rig and the lack of an aquifer water quality standard for acetone. VOC concentrations in soil vapor beneath the F-Complex were below the remedial goals.

2.3. Hydrogeologic Investigation

A hydrogeologic investigation was conducted between December 2003 and April 2011 at and near the UPCO facility. The hydrogeologic investigation included:

- The installation of monitor wells (MW-1 through MW-19) to assess the prevailing hydrogeologic conditions in the vicinity of the UPCO facility.
- Collection of core samples from four monitor well locations (MW-5, MW-6, MW-9, and MW-13) to assess the subsurface geology.
- Collection of geophysical logs from the open boreholes at most of the monitor well locations to assess the subsurface geology.
- Recording of groundwater elevations from the monitor wells, using a combination of manual depth to water measurement and pressure data downloaded from dedicated transducers installed in select wells to assess groundwater conditions.
- Collection of quarterly groundwater samples from monitor wells to assess groundwater quality beneath the facility.
- Analysis of the surface drainage pattern in the vicinity of the site.
- Collection of semi-annual samples from private off-site domestic wells north of the UPCO facility along Yearling Road.

2.3.1. Monitor Well Installation and Sampling

Between 2004 and 2011, 19 groundwater monitor wells were installed at on-site and off-site locations to assess groundwater quality, groundwater flow direction, and subsurface geology in the vicinity of the UPCO facility. The locations of the UPCO facility on site and off site monitor wells are shown in Figure 7.

Groundwater samples have been collected from the 19 monitor wells and production well PW-1, on a quarterly basis since August 2004. Zonal grab samples from groundwater were also collected during drilling of MW-12, MW-13, MW-14, MW-18, and SVMW-1.

2.3.2. Private Domestic Wells

Private residential wells have been sampled on a semi-annual basis from November 2004 to the present. Private wells at fourteen residences have been sampled one or more times during this period, depending on access and resident approval. Perchlorate was not detected in the samples collected between November 2004 and May 2006 above the detection limit of 2 µg/L. Beginning in November 2006, samples collected from the private wells were analyzed for perchlorate by both EPA Method 314 and EPA Method 332. Since November 2006, perchlorate has been detected in two samples analyzed by EPA Method 314 , 2.2 µg/L and 2.4 µg/L. Perchlorate has been detected at concentrations ranging from 0.00089 µg/L to 3.1 µg/L in samples analyzed by EPA Method 332.

2.3.3. COPCs - Groundwater

Routine groundwater monitoring at the UPCO facility indicated two contaminants in groundwater that have historically been detected at concentrations above the characterization targets: perchlorate and 1,1-DCE. These have been identified as the COPCs in groundwater for the Site.

During the April 2011 sampling event, perchlorate was detected in groundwater collected at five monitor wells (MW-1, MW-2, MW-5, MW-6, and MW-19) at concentrations above the characterization target.

Only samples collected from production well PW-1 have contained concentrations of 1,1-DCE near or above the AWQS of 7 µg/L. The highest 1,1-DCE concentration detected at PW-1 was 7.5 µg/L in September 2004. 1,1 DCE has not been detected in PW-1 above the AWQS since 2004 and was detected at a concentration of 5 µg/L during Second Quarter 2011 monitoring.

2.3.4. Remedial Goals in Groundwater

2.3.4.1. Perchlorate

The RCRA permit for the Site, issued on June 30, 2011, specified the Arizona Department of Health Services (ADHS) health based guidance level (HBGL) of 14 µg/L for perchlorate in groundwater that was protective of ingestion in a residential exposure scenario. Therefore, the HBGL of 14 µg/L has subsequently been established as the remedial goal for perchlorate in groundwater at the Site.

2.3.4.2. 1,1-DCE

The remedial goal established for 1,1-DCE in groundwater at the Site is the aquifer water quality standard (AWQS) of 7 µg/L.

2.3.5. Source Delineation – Groundwater

2.3.5.1. Perchlorate

During the remedial investigation activities conducted since 2004, perchlorate has been detected in groundwater at concentrations above the remedial goal of 14 µg/L in samples collected at monitor wells MW-1, MW-2, MW-5, MW-6, MW-13, and MW-19. Elevated perchlorate concentrations at MW-1 and MW-2 may be attributed to historical waterbore operations, propellant production in the C-Complex, waste propellant burning in the New Burn Area, and/or a combination of these sources. The elevated perchlorate concentrations in MW-6 are considered to be potentially attributed to historic release(s) at F-Complex via surface drainage and infiltration from a wash on the west side of the facility.

Figure 8 shows the inferred extent of perchlorate concentrations in groundwater above the remedial goal.

2.3.5.2. 1,1-DCE

Groundwater collected from the facility production well, PW-1, has historically contained low concentrations of 1,1-DCE, potentially attributed to historic solvent release in the B-Complex. The 1,1-DCE concentration has not exceeded the remedial goal of 7 µg/L since 2004.

3. Physical Characteristics of Study Area

The following section provides a summary of the physical characteristics (geologic and hydrogeologic) observed during the RI related activities.

3.1. Subsurface Geology

Twenty borehole logs within the study area were collected or reviewed as part of the RI of the UPCO facility. Similar to the surface geology, two major geologic units are observed in the borehole logs, a Sedimentary Unit and a Bedrock Unit.

3.1.1. Sedimentary Unit

The Sedimentary Unit is observed in each of the 20 boreholes, overlies the Bedrock Unit, and ranges in thickness from a few feet (i.e. MW-4) to greater than 300 feet (i.e. MW-6 and MW-10). The unit as a whole is moderately to well-cemented with calcium carbonate; however, unconsolidated non-cemented layers are observed within the core samples at MW-5, MW-6, MW-9, and MW-13; and near the surface. Comparison of borehole logs within the Sedimentary Unit shows that the local geology is fairly uniform (e.g., sand and gravel); however, distinct stratigraphic horizons, such as a clay layer, have not been correlated from one borehole to the next.

3.1.2. Bedrock Unit

The Bedrock Unit is observed in 17 of the 20 boreholes, is covered by the Sedimentary Unit, and ranges in depth across the site. The bedrock surface is irregular; however, depth to bedrock generally increases to the southwest. The unit consists of highly fractured and weathered metamorphic rock as well as fractured granitic rock (e.g. granite, grano-diorite, and diorite).

3.1.3. Geologic Structure

As described previously, the surface contact between the Sedimentary Unit and the Bedrock unit is considered a nonconformity. Visual observation of the drill cuttings, especially well preserved core cuttings, indicate that the Bedrock Unit and well cemented sections of the Sedimentary Unit are fractured. Extensive zones of fractures with displacement surfaces may represent significant faults within the study area.

Geophysical surveys were performed in boreholes MW-3 through MW-14, and MW-16 through MW-18, and the private well installed at 18 E. Yearling. Fracture analyses were

performed where bedrock was observed, which included monitor wells MW-3, MW-4, MW-5, MW-8, MW-9, MW-11, MW-12, MW-13, MW-14, MW-16 and MW-18. The fractures do not appear to have a site wide preferential orientation and do not appear to be dependent on the type of bedrock (greenstone vs. granitic). Locally, the fractures do exhibit some preferred orientations.

Rock quality designation (RQD) analysis was performed on the bedrock core recovered from the pilot boreholes for MW-5, MW-9, and MW-13. In general, most of the RQD data from the three boreholes falls within the "poor" to "very poor" rock quality range. This is consistent with the interpretation of the bedrock as fractured to highly fractured.

3.2. Subsurface Hydrogeology

3.2.1. Hydrogeologic Structure

Based on analysis of site geology and available hydrogeologic information, groundwater underlying the site occurs within two distinct zones, separated by one or possibly several associated subsurface geologic structures. Monitor wells completed in bedrock at the Site (MW-1, MW-2, MW-3, MW-4, MW-5, MW-8, MW-9, MW-11, MW-12, MW-13, MW-14, MW-15, MW-16, MW-18 and MW-19) exhibit groundwater elevations 30 to 40 feet lower than wells (MW-6, MW-7, MW-10, and MW-17) completed in the consolidated Sedimentary Unit west of the Site..

3.2.2. Groundwater Characteristics

Hydrogeophysical logging (HPL) activities were conducted in the borehole for monitor well MW-14 to identify water bearing zones, and quantify the flow rates under ambient and dynamic (pumping) conditions. A short duration aquifer testing was also conducted at monitor well MW-14 to estimate hydraulic parameters. In general, the HPL activities and the pumping test results indicate that the aquifer has a low hydraulic conductivity and low transmissivity.

3.2.3. Groundwater Flow

It is believed that up until the mid to late 1980s or early 1990s, groundwater flow was generally to the south-southwest, out of the CSM study area, away from the mountain front. Currently, groundwater in the central and southeast portion of the site still appears to follow a generally south and southwest flow pattern (Figure 9). The horizontal groundwater gradient in the central and southeast portion of the site is relatively flat. More recently, groundwater flow direction in the northern portion of the CSM study area has been observed to be more north-northwest between monitor wells, MW-3, MW-4, MW-14, and MW-15, and the private wells along Yearling. This is based on data

obtained from the private wells and observed steeper rates of water level decline in wells MW-3, MW-4, MW-14, and MW-15. This condition is likely the result of an induced gradient due to the combined effective pumping of the multiple private wells in the lower yielding bedrock unit to the north. Horizontal groundwater gradients are steeper between the central and northern portions of the site and appear to be increasing over time due to the higher rates of water level decline, observed in well MW-3, MW-4, MW-14 and MW-15.

The general groundwater flow direction between monitor wells MW-6, MW-7 and MW-10 constructed in the Sedimentary Unit appears to be south to south easterly and between monitor wells MW-6 and MW-17 appears to be northerly based on current groundwater elevations (Figure 9).

Vertical groundwater gradients have been observed at shallow/deep bedrock monitor well sets, including MW-1/MW-12, MW-15/MW-14, MW-19/MW-13 and MW-3/MW-16. A downward vertical gradient has been observed in the south central portion of the site and in the northwest portion of the site while an upward vertical gradient has been observed in the north central portion of the site and the east central side of the site.

A review of groundwater level data collected from the transducers indicates that the groundwater elevations in the private wells are generally lower today than at the nearest site wells, MW-14 and MW-15. A general declining water level trend has been observed in the private wells over a period of the last 15 to 20 years. At the time of construction of these private wells, the water level elevations were reported to be much higher in most cases. Some of the private well owners have resorted to drilling deeper wells as water levels have continued to decline. Hydrographs for the private wells show steep pumping level drawdowns ranging from 10 to 50 plus feet below static levels, especially during the on-cycles which may correlate with cumulative peak periods of use. However, this steep drawdown has not been observed in nearest site wells, showing at a minimum that the short term pumping related drawdown does not extend very far. Wells MW-14 and MW-15 show steeper water level declines when compared to other onsite wells suggesting that the overall lowered water table to the north is propagating south onto the site.

Groundwater velocities are generally expected to be low in the central portion of the site where horizontal groundwater gradients are relatively low. However, groundwater velocities area expected to be higher and possibly increasing in the northern portion of the site where horizontal gradients are steeper and have been increasing over time.

3.2.4. Surface Drainage Analysis

The primary drainage orientation is in a northeast to southwest direction away from the Union Hills. The dominant recharge mechanism for the aquifer system beneath the site is considered to be mountain-front recharge. Faults may play an important role in regulating flow paths in mountain blocks and are believed to act as both hydraulic conduits and barriers (Wilson and Guan, 2004).

4. Summary and Conclusions

4.1. Summary

UPCO has conducted a comprehensive series of soil, soil gas and groundwater investigations to assess the nature, magnitude, and extent of potential releases associated with historical operations at the Site. Contaminants were detected in soil, soil gas and groundwater at concentrations above characterization targets, requiring further evaluation and establishment of remedial goals.

Three COPCs have been identified in soil at concentrations above the remedial goals: perchlorate, lead and arsenic. The highest concentrations of perchlorate in soil at the former UPCO facility, and the deepest vertical extent of elevated perchlorate concentrations in soil (to 175 feet bgs), were observed in the Waterbore Area. There were also some elevated perchlorate concentrations in soil detected in the C-Complex and the New Burn Area, at depths ranging from 0 to 20 feet bgs. Lead concentrations in soil appear to be attributed to historic burning of waste propellants in the former open burning areas: Old Burn Area and New Burn Area. The elevated lead detected in surface soil at the New Burn Area was removed during the OBU closure activities. Observed arsenic concentrations in soil are considered consistent with naturally occurring conditions.

VOCs were detected in soil gas samples collected in B-Complex, C-Complex, F-Complex, and Old Burn Area. The suspected source of the VOC detections is historic solvent and adhesive use in these areas. 1,1-DCE, acetone and MEK have been identified as the COPCs in soil vapor based on frequency of detection, magnitude of concentration, historic usage, and detection in groundwater samples. The largest VOC impacts to soil vapor were observed in the B-Complex. The VOC concentrations detected in B-Complex do not appear to be impacting groundwater above characterization targets, based on groundwater monitoring data obtained at wells in the vicinity of the B-Complex (MW-1, MW-2, MW-6, MW-7, MW-10, MW-12, and PW-1) as well as the grab groundwater sample collected beneath the suspected source area in B-Complex, SWMU 5. Screening level J&E modeling also suggests that vapor intrusion is not of concern.

Perchlorate and 1,1-DCE are the two COPCs identified in groundwater. Historic groundwater sampling detected 1,1-DCE in the production well, PW-1, at a concentrations above the remedial goal of 7 µg/L in 2004. 1,1-DCE has not been detected

above the laboratory reporting limit in the other site monitoring wells. The concentration of 1,1-DCE in PW-1 has declined below the remedial goal since 2004.

4.2. Conclusions

Perchlorate is currently detected in five site monitor wells, MW-1, MW-2, MW-5, MW-6 and MW-19, at concentrations above the remedial goal. Detections of perchlorate in monitor wells MW-5 and MW-19 appear to be attributed to historic waterbore operations. The detections in MW-1 and MW-2 are thought to be attributed either to historic waterbore operations, propellant production in the C-Complex and/or burning of waste propellant at the New Burn Area.

As discussed in Section 5.2, the Waterbore Area is suspected to have contributed the most perchlorate mass to the groundwater beneath the site. Perchlorate mass contributions to groundwater from the C-Complex and New Burn Area are considered to be smaller in comparison to the Waterbore Area since the elevated perchlorate concentrations in soil at these areas are lower and the hydraulic driver to transport perchlorate to the groundwater is limited to infiltration from precipitation.

The perchlorate detections in MW-6, which is installed in Sedimentary Unit to the west of an apparent subsurface geologic structure, may be attributed to recharge of impacted surface water (from historic F-Complex operations) in the wash along the west side of the Site.

The results of the investigations suggest that the characterization of soil, soil gas, and groundwater at the Site are complete. Soil with COPC concentrations above the remedial goals will be evaluated during the Corrective Measures Study to determine the appropriate actions needed to address potential risks to human health. VOC concentrations in soil gas are below the remedial goals for the Site.

The concentrations of 1,1-DCE in PW-1 have declined below the remedial goal since 2004.

Perchlorate concentrations detected in groundwater during the remedial investigation period (2004 to 2011) have remained relatively stable and current perchlorate detections are limited to four shallow bedrock wells and one shallow sedimentary unit well. The current monitoring network is designed to monitor potential perchlorate migration in each direction as described in the following paragraphs.

Elevated perchlorate concentrations in the shallow bedrock wells MW-1, MW-2, MW-5, and MW-19 are delineated by MW-3, MW-15, and MW-4 to the north, the grab sample collected during drilling at SVMW-1 and the inferred subsurface geologic structure to the west, MW-11 to the east, and MW-8, MW-9, and MW-18 to the south. Potential vertical migration of perchlorate impacts in monitor wells MW-1 and MW-2 are currently delineated by MW-12 and PW-1.

Potential vertical migration of perchlorate impacts at the Waterbore Area are delineated by MW-13 at the Waterbore Area, MW-12 to the south, MW-14 and MW-16 to the north, and PW-1 to the west. The elevated perchlorate concentration initially observed at MW-13 was attributed to well installation activities. This is supported by the zonal sample collected at the bottom of the borehole, prior to well installation, and the current perchlorate concentration of 7 ug/L, which are both below the remedial goal of 14 µg/L.

Elevated perchlorate concentrations in the shallow Sedimentary Unit at MW-6 are delineated by the inferred subsurface geologic structure to the east and monitor wells MW-7, MW-10, and MW-17 to the south, southwest, and northwest, respectively.

5. References

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Universal Propulsion Company
Remedial Investigation Summary Report

Figures

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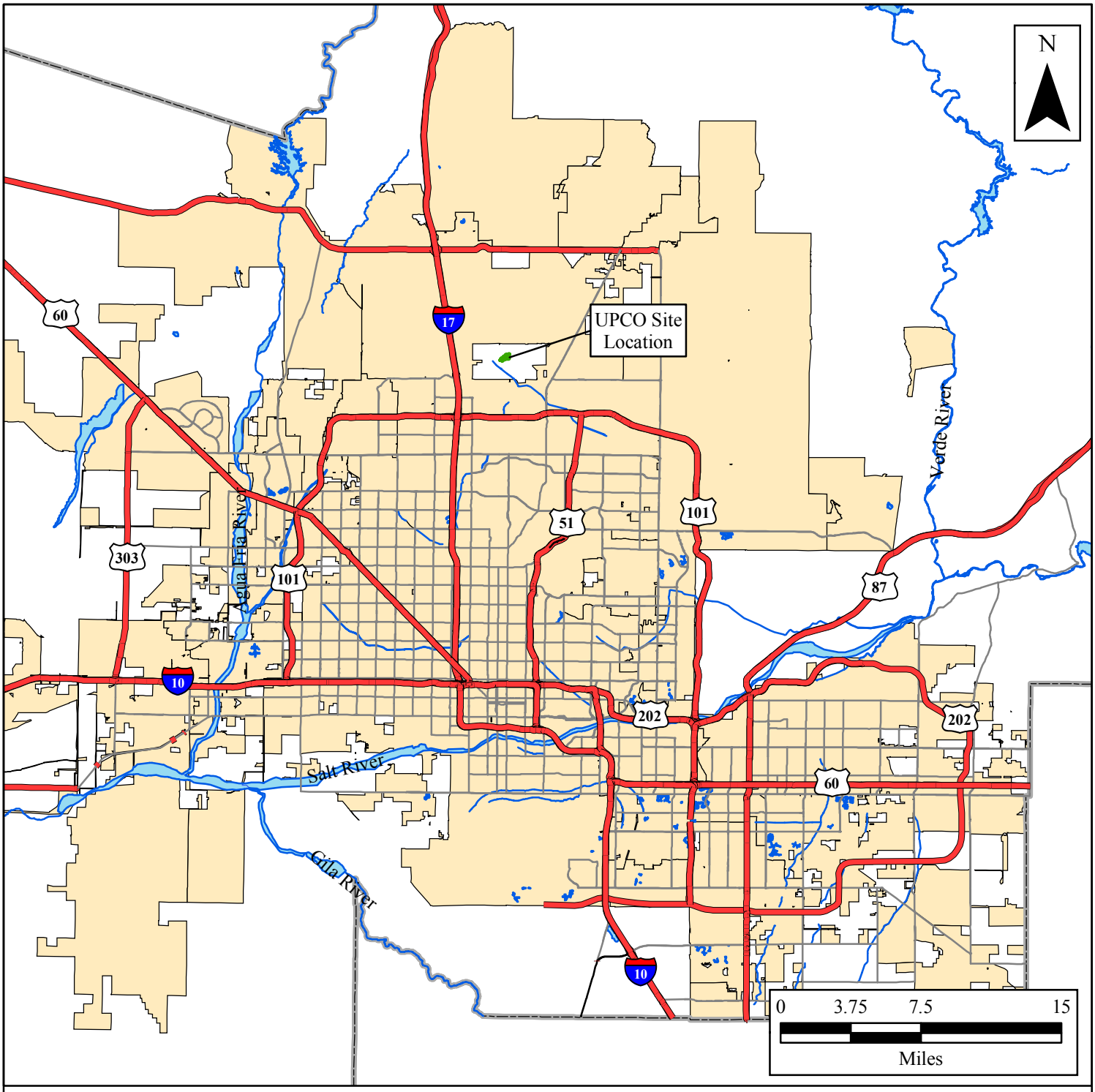

Legend

- Site Location
- Primary Roads
- Highways, Freeways
- Rivers
- County Boundaries
- Lakes
- City Master Planning Area Boundaries

Source: City boundaries from Maricopa Association of Governments, 2005. Other data from Teleatlas, Oct. 2003.

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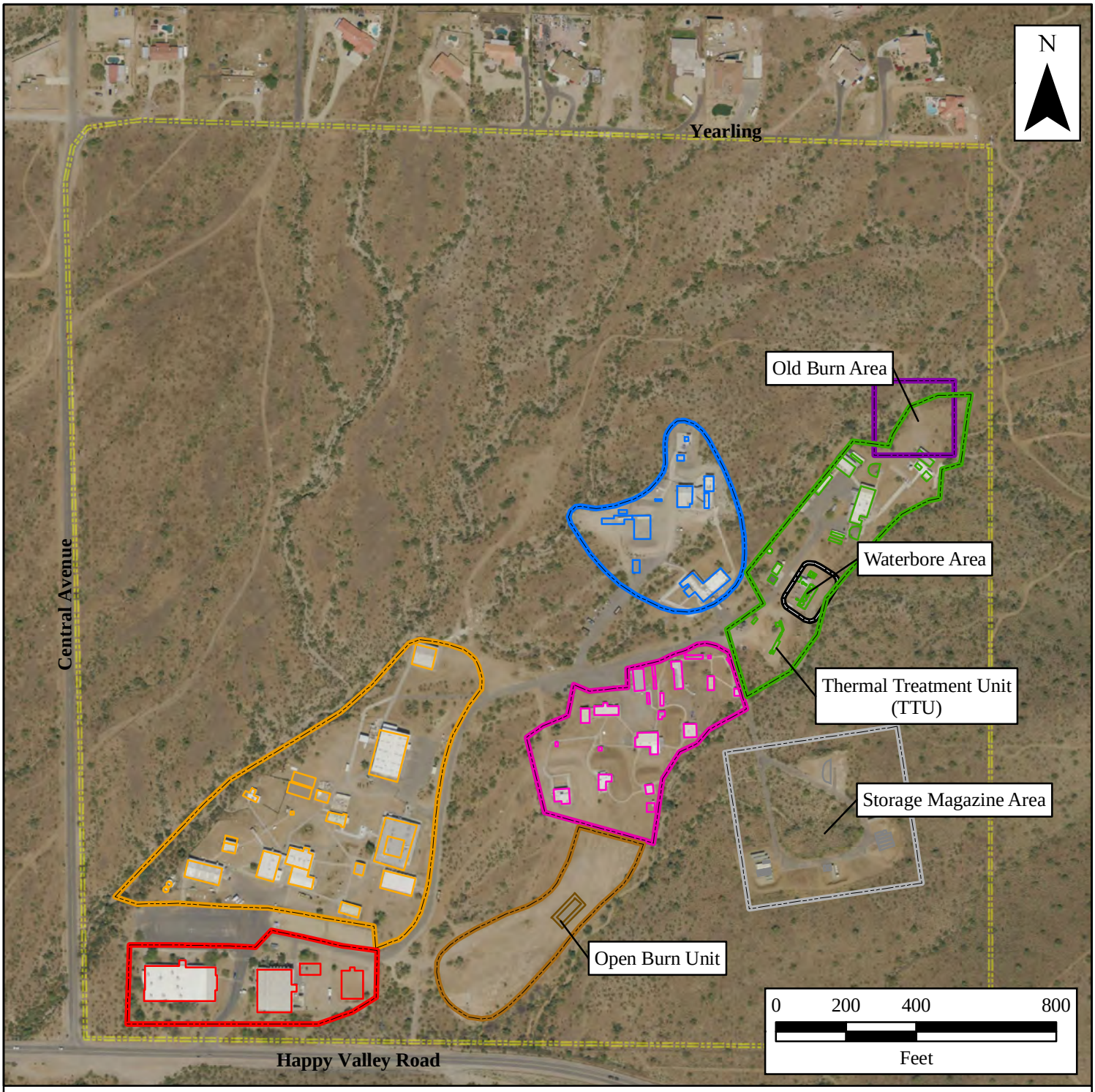
Site Location Map
Remedial Investigation
Summary Report
Universal Propulsion Company, Inc.

August 2011 | **Figure 1**

\\phoenix\Projects\3994003\GIS\Projects_MXD\RI_Summary_report\August_11\Figure 01 Site location.mxd



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Legend

- Lease Property Boundary
- A-Complex
- B-Complex
- C-Complex
- D-Complex
- E-Complex
- F-Complex
- New Burn Area

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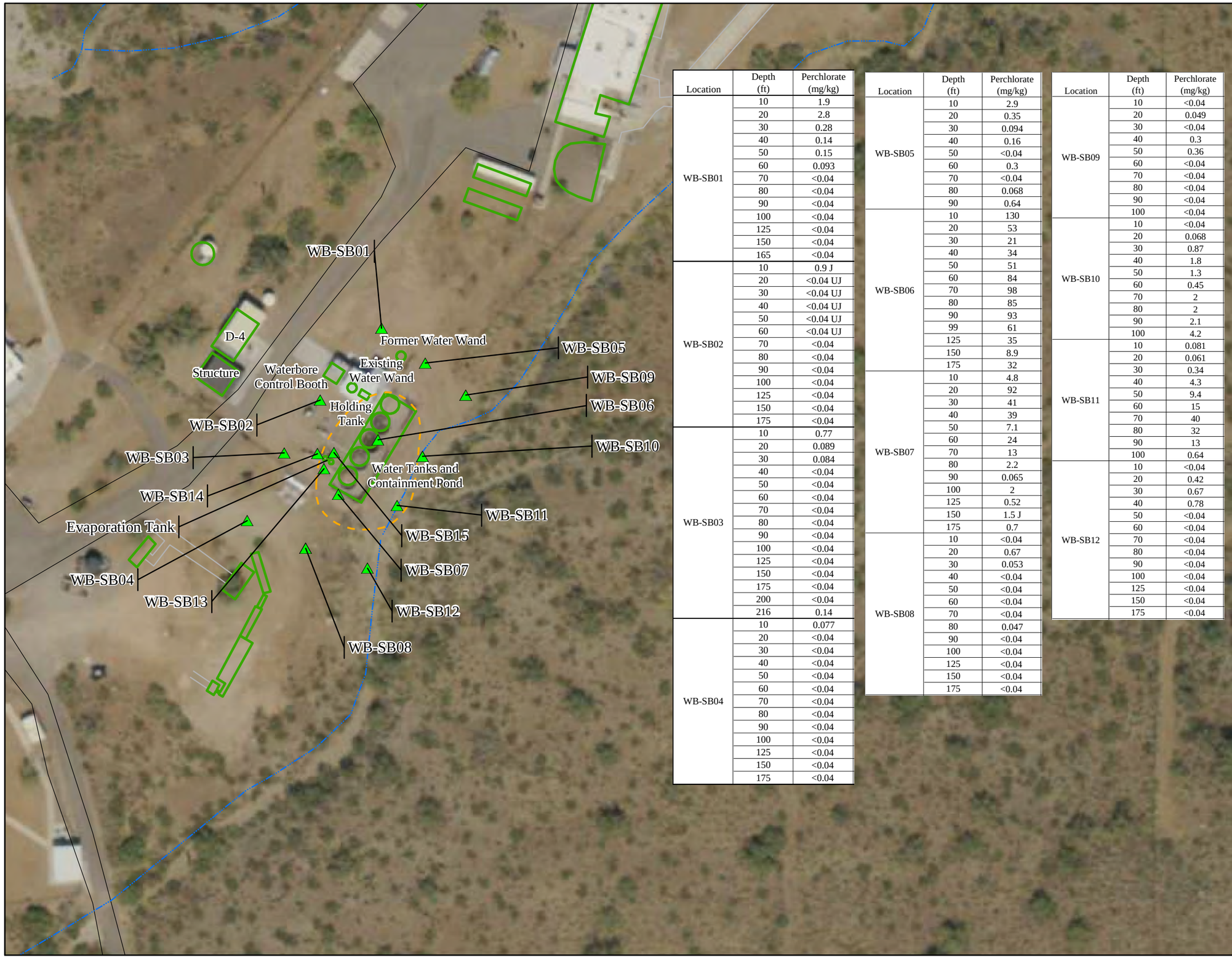
Facility Operational Areas
Remedial Investigation
Summary Report
Universal Propulsion Company, Inc.

August 2011 | **Figure 2**

\\phoenix\Projects\3994003\GIS\Projects_MXD\RI_Summary_report\August_11\Figure 02 Site operational areas.mxd



Location	Depth (ft)	Perchlorate (mg/kg)
WB-SB01	10	1.9
	20	2.8
	30	0.28
	40	0.14
	50	0.15
	60	0.093
	70	<0.04
	80	<0.04
	90	<0.04
	100	<0.04
	125	<0.04
	150	<0.04
	165	<0.04
WB-SB02	10	0.9 J
	20	<0.04 UJ
	30	<0.04 UJ
	40	<0.04 UJ
	50	<0.04 UJ
	60	<0.04 UJ
	70	<0.04
	80	<0.04
	90	<0.04
	100	<0.04
	125	<0.04
	150	<0.04
	175	<0.04
WB-SB03	10	0.77
	20	0.089
	30	0.084
	40	<0.04
	50	<0.04
	60	<0.04
	70	<0.04
	80	<0.04
	90	<0.04
	100	<0.04
	125	<0.04
	150	<0.04
	175	<0.04
	200	<0.04
	216	0.14
WB-SB04	10	0.077
	20	<0.04
	30	<0.04
	40	<0.04
	50	<0.04
	60	<0.04
	70	<0.04
	80	<0.04
	90	<0.04
	100	<0.04
	125	<0.04
	150	<0.04
	175	<0.04

Location	Depth (ft)	Perchlorate (mg/kg)
WB-SB05	10	2.9
	20	0.35
	30	0.094
	40	0.16
	50	<0.04
	60	0.3
	70	<0.04
	80	0.068
	90	0.64
WB-SB06	10	130
	20	53
	30	21
	40	34
	50	51
	60	84
	70	98
	80	85
	90	93
	99	61
	125	35
	150	8.9
	175	32
WB-SB07	10	4.8
	20	92
	30	41
	40	39
	50	7.1
	60	24
	70	13
	80	2.2
	90	0.065
	100	2
	125	0.52
	150	1.5 J
	175	0.7
WB-SB08	10	<0.04
	20	0.67
	30	0.053
	40	<0.04
	50	<0.04
	60	<0.04
	70	<0.04
	80	0.047
	90	<0.04
	100	<0.04
	125	<0.04
	150	<0.04
	175	<0.04

Location	Depth (ft)	Perchlorate (mg/kg)
WB-SB09	10	<0.04
	20	0.049
	30	<0.04
	40	0.3
	50	0.36
	60	<0.04
	70	<0.04
	80	<0.04
	90	<0.04
	100	<0.04
WB-SB10	10	<0.04
	20	0.068
	30	0.87
	40	1.8
	50	1.3
	60	0.45
	70	2
	80	2
	90	2.1
	100	4.2
WB-SB11	10	0.081
	20	0.061
	30	0.34
	40	4.3
	50	9.4
	60	15
	70	40
	80	32
	90	13
	100	0.64
WB-SB12	10	<0.04
	20	0.42
	30	0.67
	40	0.78
	50	<0.04
	60	<0.04
	70	<0.04
	80	<0.04
	90	<0.04
	100	<0.04
	125	<0.04
	150	<0.04
	175	<0.04

Legend

- Waterbore Soil Data
- D-Complex Site Facilities
- Sidewalk or Paved Area
- Ephemeral Wash
- Paved Road
- Inferred Perchlorate Contour of 16 mg/kg GPL

mg/kg = milligram per kilogram

< = Analyte not reported above the listed laboratory detection limit

ft = feet below ground surface

J = Analyte was positively identified; however, the result should be considered an estimate

UJ = The listed laboratory detection limit is considered an estimate

Note: Soil Boring WB-SB13 through WB-SB15 were not analyzed for perchlorate

N

0 60 120

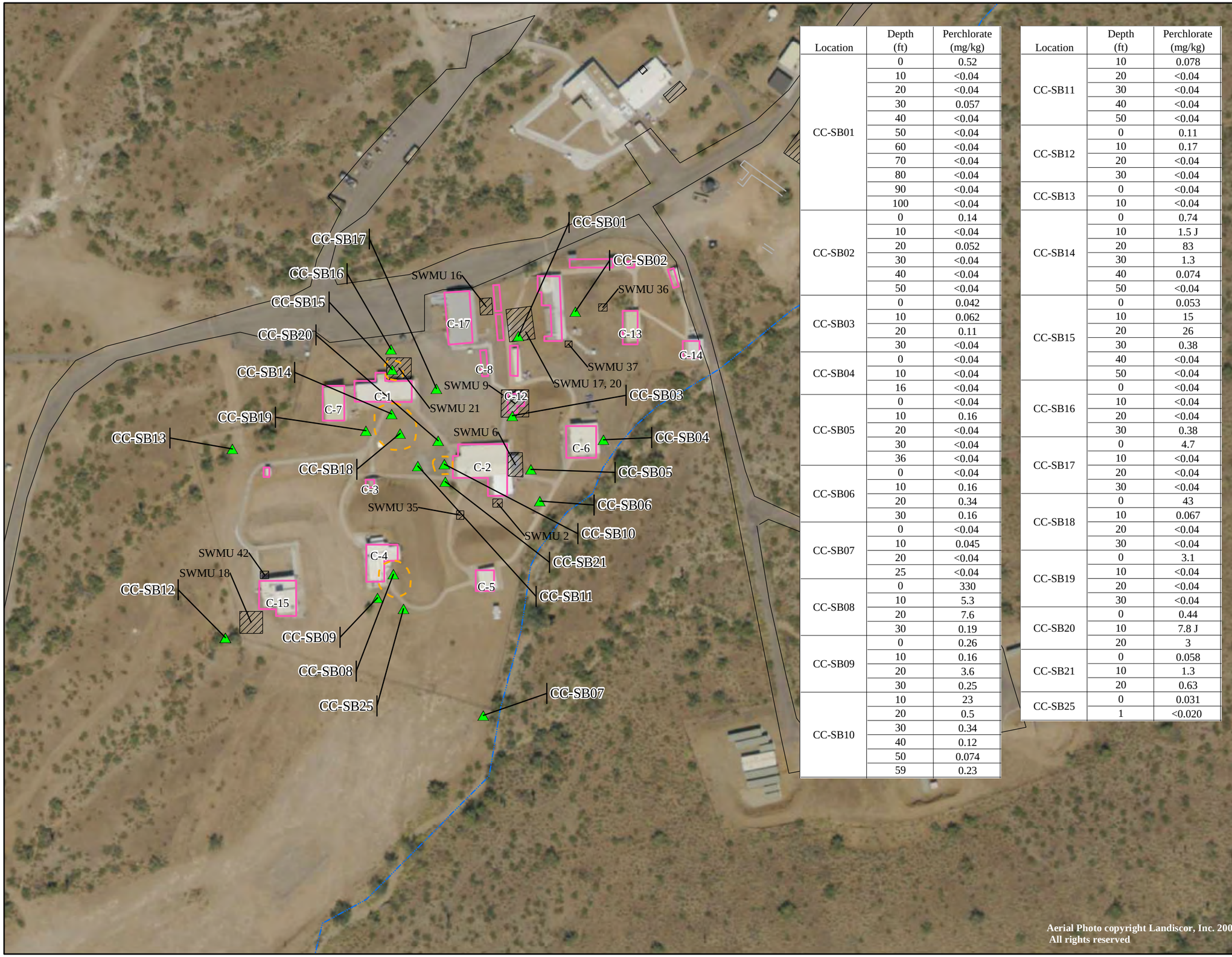
Feet

ARCADIS

Waterbore Area
Perchlorate Concentration in Soil Above Remedial Goal
Remedial Investigation
Summary Report
Universal Propulsion Company, Inc.

August 2011 | **Figure 3**

\\phoenix\Projects\3994003\GIS\Projects_MXD\RI_Summary_report\August_11\Figure 03 WB Perchlorate Concentration in Soil Above Remedial Goal.mxd



Location	Depth (ft)	Perchlorate (mg/kg)
CC-SB01	0	0.52
	10	<0.04
	20	<0.04
	30	0.057
	40	<0.04
	50	<0.04
	60	<0.04
	70	<0.04
	80	<0.04
	90	<0.04
	100	<0.04
CC-SB02	0	0.14
	10	<0.04
	20	0.052
	30	<0.04
	40	<0.04
	50	<0.04
CC-SB03	0	0.042
	10	0.062
	20	0.11
	30	<0.04
CC-SB04	0	<0.04
	10	<0.04
	16	<0.04
CC-SB05	0	<0.04
	10	0.16
	20	<0.04
	30	<0.04
	36	<0.04
CC-SB06	0	<0.04
	10	0.16
	20	0.34
	30	0.16
CC-SB07	0	<0.04
	10	0.045
	20	<0.04
	25	<0.04
CC-SB08	0	330
	10	5.3
	20	7.6
	30	0.19
CC-SB09	0	0.26
	10	0.16
	20	3.6
	30	0.25
CC-SB10	10	23
	20	0.5
	30	0.34
	40	0.12
	50	0.074
	59	0.23

Location	Depth (ft)	Perchlorate (mg/kg)
CC-SB11	10	0.078
	20	<0.04
	30	<0.04
	40	<0.04
	50	<0.04
CC-SB12	0	0.11
	10	0.17
	20	<0.04
	30	<0.04
CC-SB13	0	<0.04
	10	<0.04
CC-SB14	0	0.74
	10	1.5 J
	20	83
	30	1.3
	40	0.074
	50	<0.04
CC-SB15	0	0.053
	10	15
	20	26
	30	0.38
	40	<0.04
	50	<0.04
CC-SB16	0	<0.04
	10	<0.04
	20	<0.04
	30	0.38
CC-SB17	0	4.7
	10	<0.04
	20	<0.04
	30	<0.04
CC-SB18	0	43
	10	0.067
	20	<0.04
	30	<0.04
CC-SB19	0	3.1
	10	<0.04
	20	<0.04
	30	<0.04
CC-SB20	0	0.44
	10	7.8 J
	20	3
CC-SB21	0	0.058
	10	1.3
	20	0.63
CC-SB25	0	0.031
	1	<0.020

Legend

- C-Complex Soil Data
- C-Complex Site Facilities
- Sidewalk or Paved Area
- Ephemeral Wash
- Paved Road
- SWMUs
- Inferred Perchlorate Contour of 16 mg/kg GPL

mg/kg = milligram per kilogram

< = Analyte not reported above the listed laboratory detection limit

J = Analyte was positively identified; however, the result should be considered an estimate

ft = feet below ground surface

SWMUs = Solid Waste Management Units

N

0 50 100 150 200

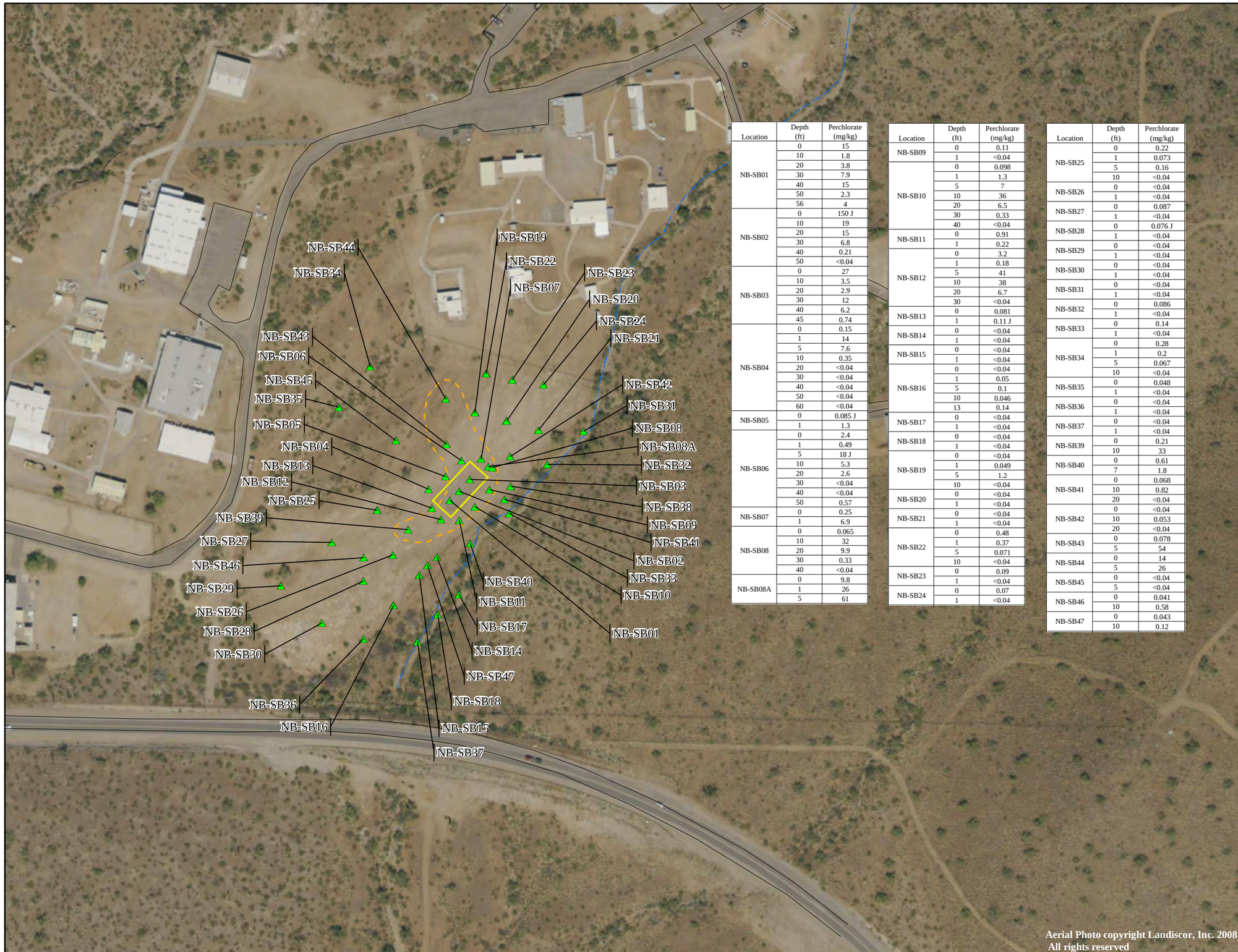
Feet

ARCADIS

C-Complex
Perchlorate Concentration in Soil
Above Remedial Goal
Remedial Investigation
Summary Report
Universal Propulsion Company, Inc.

August 2011 | **Figure 4**

\\phoenix\Projects\3994003\GIS\Projects_MXD\RI_Summary_report\August_11\Figure 04 C-Complex Perchlorate Concentration in Soil Above Remedial Goal.mxd



Location	Depth (ft)	Perchlorate (mg/kg)
NB-SB01	0	15
	10	1.8
	20	3.8
	30	7.9
	40	15
	50	2.3
	56	4
NB-SB02	0	150 J
	10	19
	20	15
	30	6.8
	40	0.21
	50	<0.04
NB-SB03	0	27
	10	3.5
	20	2.9
	30	12
	40	6.2
	45	0.74
NB-SB04	0	0.15
	1	14
	5	7.6
	10	0.35
	20	<0.04
	30	<0.04
	40	<0.04
	50	<0.04
	60	<0.04
NB-SB05	0	0.085 J
	1	1.3
NB-SB06	0	2.4
	1	0.49
	5	18 J
	10	5.3
	20	2.6
	30	<0.04
	40	<0.04
	50	0.57
NB-SB07	0	0.25
	1	6.9
NB-SB08	0	0.065
	10	32
	20	9.9
	30	0.33
	40	<0.04
NB-SB08A	0	9.8
	1	26
	5	61

Location	Depth (ft)	Perchlorate (mg/kg)
NB-SB09	0	0.11
	1	<0.04
NB-SB10	0	0.098
	1	1.3
	5	7
	10	36
	20	6.5
	30	0.33
	40	<0.04
NB-SB11	0	0.91
	1	0.22
NB-SB12	0	3.2
	1	0.18
	5	41
	10	38
	20	6.7
	30	<0.04
NB-SB13	0	0.081
	1	0.11 J
NB-SB14	0	<0.04
	1	<0.04
NB-SB15	0	<0.04
	1	<0.04
NB-SB16	0	<0.04
	1	0.05
	5	0.1
	10	0.046
	13	0.14
NB-SB17	0	<0.04
	1	<0.04
NB-SB18	0	<0.04
	1	<0.04
NB-SB19	0	<0.04
	1	0.049
	5	1.2
	10	<0.04
NB-SB20	0	<0.04
	1	<0.04
NB-SB21	0	<0.04
	1	<0.04
NB-SB22	0	0.48
	1	0.37
	5	0.071
	10	<0.04
NB-SB23	0	0.09
	1	<0.04
NB-SB24	0	0.07
	1	<0.04

Location	Depth (ft)	Perchlorate (mg/kg)
NB-SB25	0	0.22
	1	0.073
	5	0.16
	10	<0.04
NB-SB26	0	<0.04
	1	<0.04
NB-SB27	0	0.087
	1	<0.04
NB-SB28	0	0.076 J
	1	<0.04
NB-SB29	0	<0.04
	1	<0.04
NB-SB30	0	<0.04
	1	<0.04
NB-SB31	0	<0.04
	1	<0.04
NB-SB32	0	0.086
	1	<0.04
NB-SB33	0	0.14
	1	<0.04
NB-SB34	0	0.28
	1	0.2
	5	0.067
	10	<0.04
NB-SB35	0	0.048
	1	<0.04
NB-SB36	0	<0.04
	1	<0.04
NB-SB37	0	<0.04
	1	<0.04
NB-SB39	0	0.21
	10	33
NB-SB40	0	0.61
	7	1.8
NB-SB41	0	0.068
	10	0.82
	20	<0.04
NB-SB42	0	<0.04
	10	0.053
	20	<0.04
NB-SB43	0	0.078
	5	54
NB-SB44	0	14
	5	26
NB-SB45	0	<0.04
	5	<0.04
NB-SB46	0	0.041
	10	0.58
NB-SB47	0	0.043
	10	0.12

Legend

New Burn Soil Data

Building

Former Open Burn Unit

Sidewalk or Paved Area

Ephemeral Wash

Paved Road

Inferred Perchlorate Contour of 16 mg/kg GPL

mg/kg = milligram per kilogram

< = Analyte not reported above the listed laboratory detection limit

ft = feet below ground surface

J = Analyte was positively identified; however, the result should be considered an estimate

Note: Soil samples collected at NB-SB38 were not analyzed for perchlorate

N

0 50 100 150 200

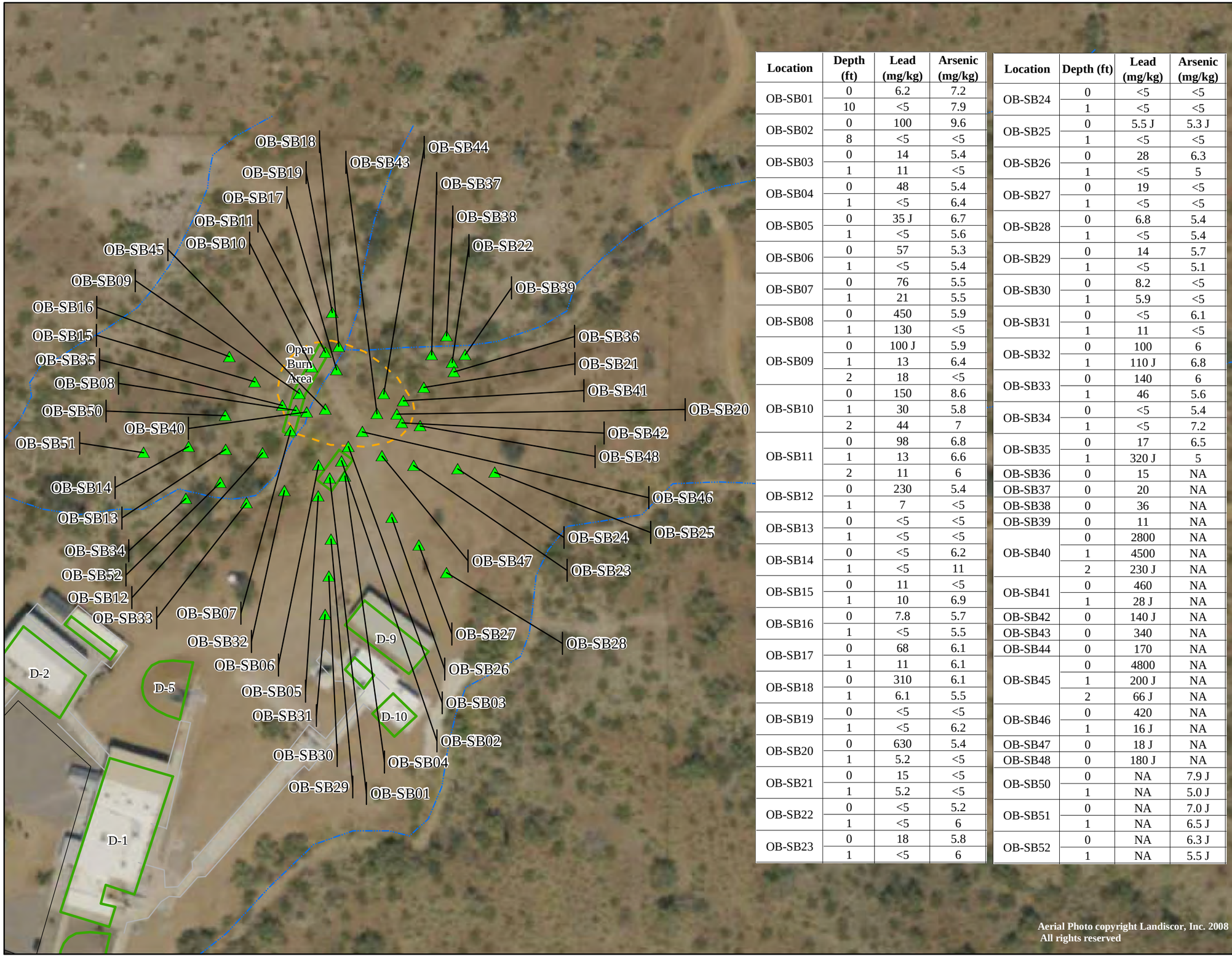
Feet

ARCADIS

New Burn Area
Perchlorate Concentration in Soil Above Remedial Goal
Remedial Investigation
Summary Report
Universal Propulsion Company, Inc.

August 2011 | **Figure 5**

\\phoenix\Projects\3994003\GIS\Projects_MXD\RI_Summary_report\August_11\Figure 05 Perchlorate Concentration in Soil Above Remedial Goal.mxd



Location	Depth (ft)	Lead (mg/kg)	Arsenic (mg/kg)
OB-SB01	0	6.2	7.2
	10	<5	7.9
OB-SB02	0	100	9.6
	8	<5	<5
OB-SB03	0	14	5.4
	1	11	<5
OB-SB04	0	48	5.4
	1	<5	6.4
OB-SB05	0	35 J	6.7
	1	<5	5.6
OB-SB06	0	57	5.3
	1	<5	5.4
OB-SB07	0	76	5.5
	1	21	5.5
OB-SB08	0	450	5.9
	1	130	<5
OB-SB09	0	100 J	5.9
	1	13	6.4
	2	18	<5
OB-SB10	0	150	8.6
	1	30	5.8
	2	44	7
OB-SB11	0	98	6.8
	1	13	6.6
	2	11	6
OB-SB12	0	230	5.4
	1	7	<5
OB-SB13	0	<5	<5
	1	<5	<5
OB-SB14	0	<5	6.2
	1	<5	11
OB-SB15	0	11	<5
	1	10	6.9
OB-SB16	0	7.8	5.7
	1	<5	5.5
OB-SB17	0	68	6.1
	1	11	6.1
OB-SB18	0	310	6.1
	1	6.1	5.5
OB-SB19	0	<5	<5
	1	<5	6.2
OB-SB20	0	630	5.4
	1	5.2	<5
OB-SB21	0	15	<5
	1	5.2	<5
OB-SB22	0	<5	5.2
	1	<5	6
OB-SB23	0	18	5.8
	1	<5	6

Location	Depth (ft)	Lead (mg/kg)	Arsenic (mg/kg)
OB-SB24	0	<5	<5
	1	<5	<5
OB-SB25	0	5.5 J	5.3 J
	1	<5	<5
OB-SB26	0	28	6.3
	1	<5	5
OB-SB27	0	19	<5
	1	<5	<5
OB-SB28	0	6.8	5.4
	1	<5	5.4
OB-SB29	0	14	5.7
	1	<5	5.1
OB-SB30	0	8.2	<5
	1	5.9	<5
OB-SB31	0	<5	6.1
	1	11	<5
OB-SB32	0	100	6
	1	110 J	6.8
OB-SB33	0	140	6
	1	46	5.6
OB-SB34	0	<5	5.4
	1	<5	7.2
OB-SB35	0	17	6.5
	1	320 J	5
OB-SB36	0	15	NA
OB-SB37	0	20	NA
OB-SB38	0	36	NA
OB-SB39	0	11	NA
OB-SB40	0	2800	NA
	1	4500	NA
	2	230 J	NA
OB-SB41	0	460	NA
	1	28 J	NA
OB-SB42	0	140 J	NA
OB-SB43	0	340	NA
OB-SB44	0	170	NA
OB-SB45	0	4800	NA
	1	200 J	NA
	2	66 J	NA
OB-SB46	0	420	NA
	1	16 J	NA
OB-SB47	0	18 J	NA
OB-SB48	0	180 J	NA
OB-SB50	0	NA	7.9 J
	1	NA	5.0 J
OB-SB51	0	NA	7.0 J
	1	NA	6.5 J
OB-SB52	0	NA	6.3 J
	1	NA	5.5 J

Legend

- Old Burn Area Soil Data
- D-Complex Site Facilities
- Sidewalk or Paved Area
- Ephemeral Wash
- Paved Road
- Inferred Lead Contour of 290 mg/kg GPL

mg/kg = milligram per kilogram

< = Analyte not reported above the listed laboratory detection limit

ft = feet below ground surface

J = Analyte was positively identified; however, the result should be considered an estimate

N

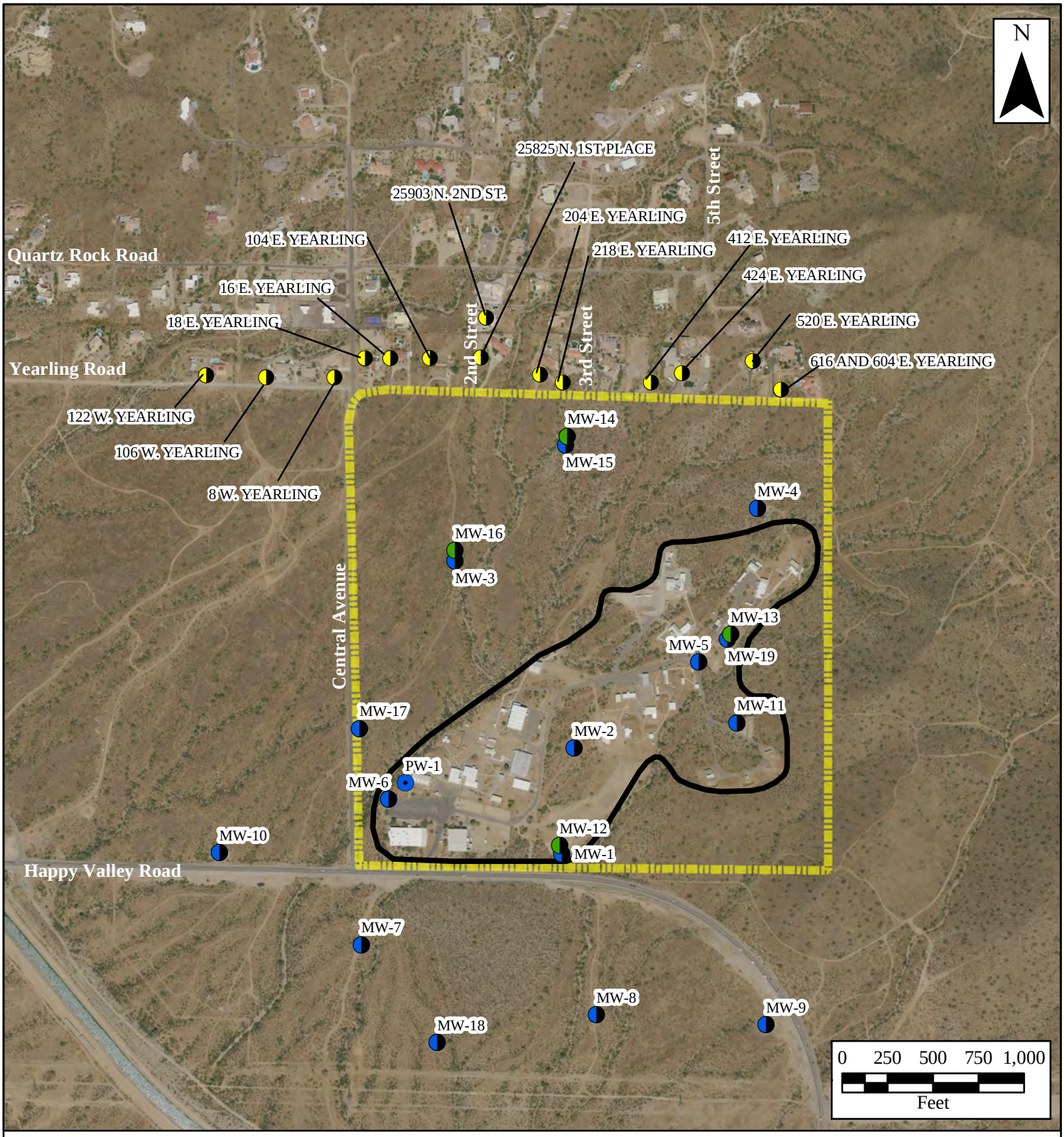
0 60 120
Feet

ARCADIS

Old Burn Area
Lead Concentration in Soil
Above Remedial Goal
Remedial Investigation
Summary Report
Universal Propulsion Company, Inc.

August 2011 | **Figure 6**

\\phoenix\Projects\3994003\GIS\Projects_MXD\RI_Summary_report\August_11\Figure 06 Old burn lead concentration in soil above remedial goal.mxd



Legend

- Deep Well
- Monitor Well
- Production Well
- Private Wells
- Lease Property Boundary
- Operational Areas

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Groundwater Monitoring Network
Remedial Investigation
Summary Report
Universal Propulsion Company, Inc.

August 2011 | **Figure 7**

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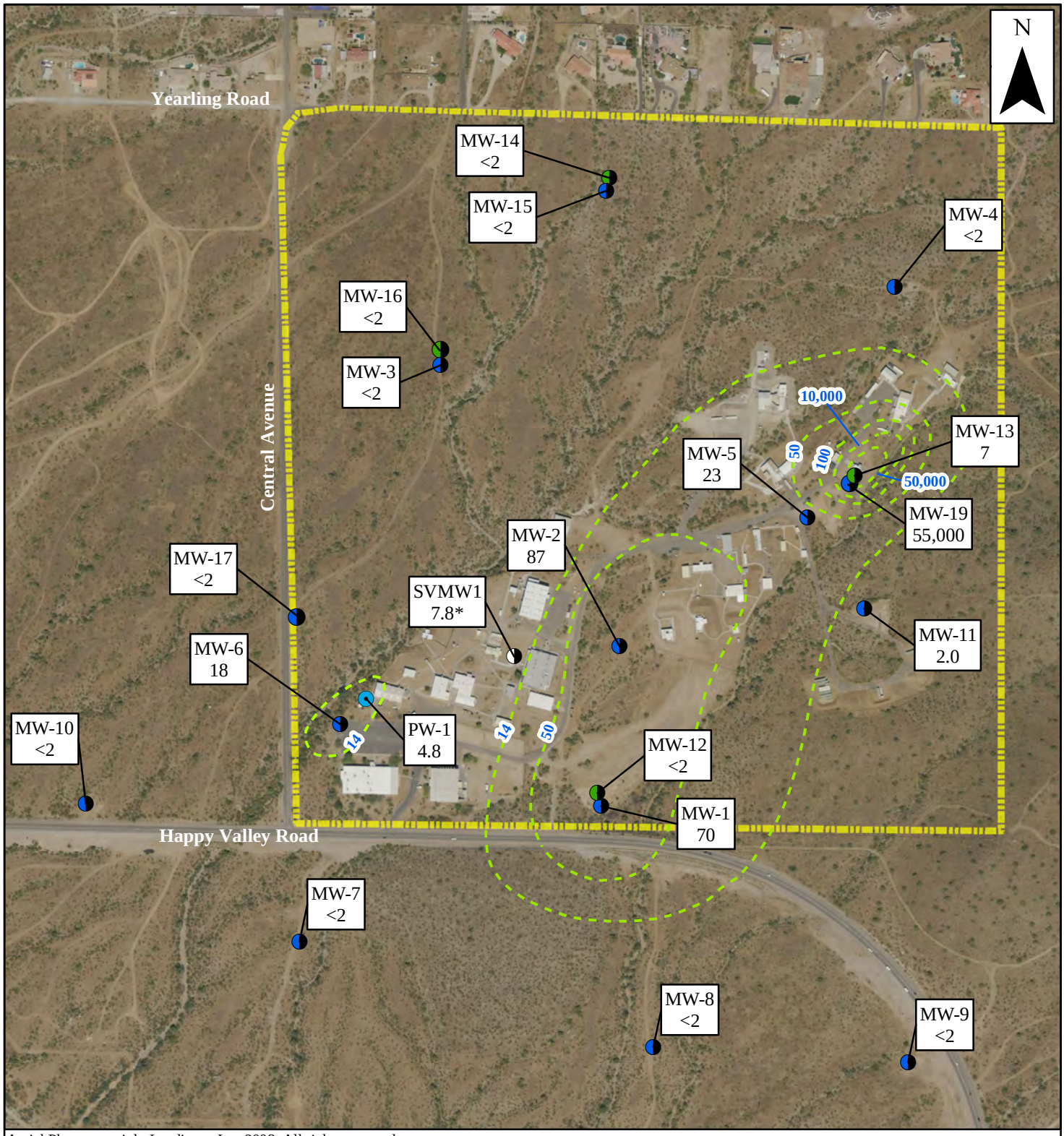
\\phoenix\Projects\3994003\GIS\Projects_MXD\RI_Summary_report\August_11\Figure 07 Groundwater Monitoring Network.mxd



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Legend

- Deep Well
- Monitor Well
- Production Well
- Soil Vapor Well
- Lease Property Boundary
- Inferred Perchlorate Contours

MW-1 Well ID
70 Perchlorate Concentration (µg/L)
* Shallow Groundwater Grab Sample

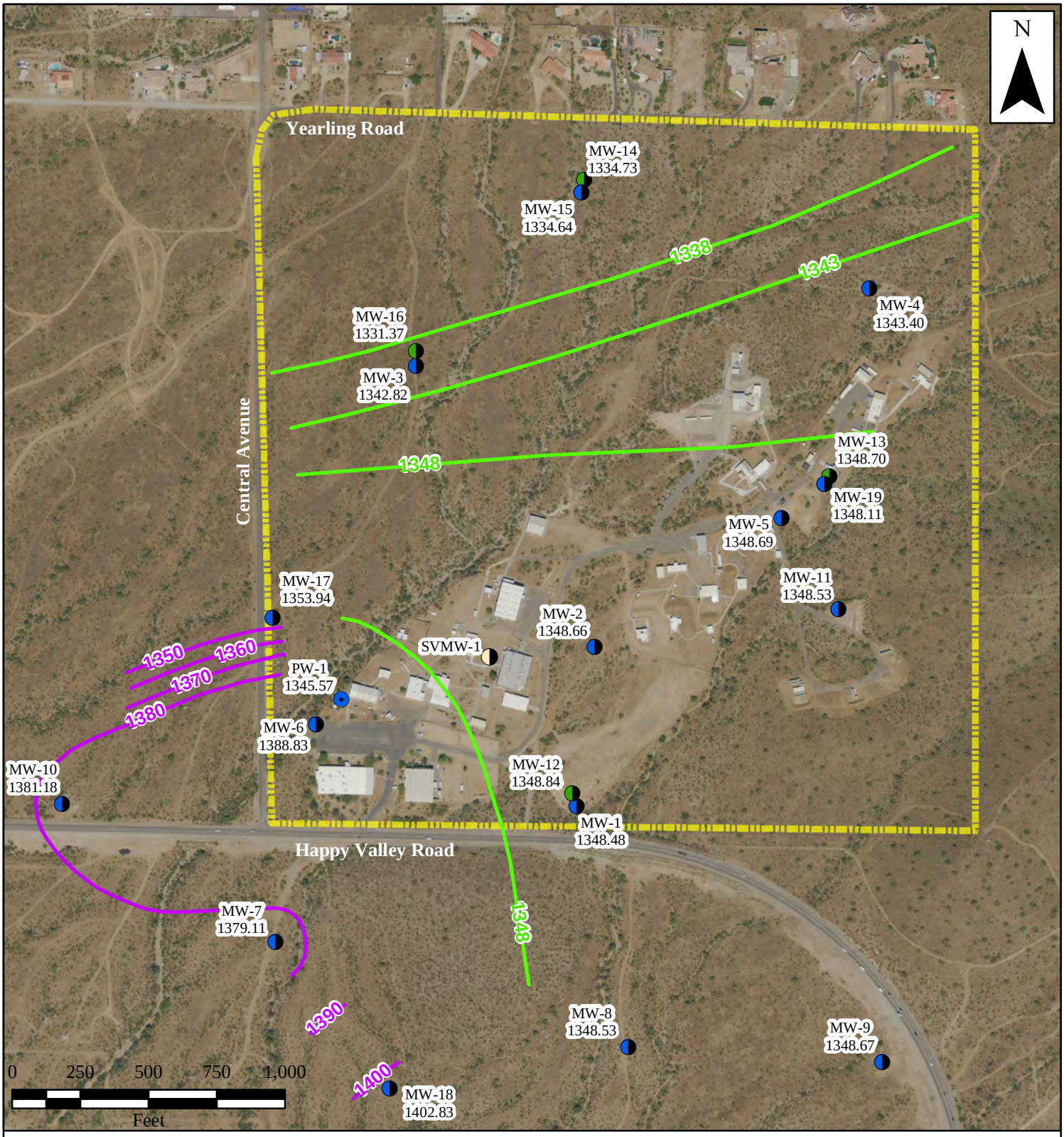
0 250 500
Feet

ARCADIS

Perchlorate Concentration in Groundwater Above Remediation Goal
Remedial Investigation Summary Report
Universal Propulsion Company, Inc.

August 2011 | **Figure 8**

M:\3994003\GIS\Projects_MXD\RI_Summary_report\August_11\Figure 08 Perchlorate Concentration Contour in GW.mxd



Legend

- Deep Monitor Well
- Monitor Well
- Production Well
- Soil Vapor Monitor Well

MW-1 — Well ID
1349.38 — Groundwater Elevation (ft amsl)

Lease Property Boundary

Sedimentary Unit Groundwater Elevations (10 foot contours)

Shallow Bedrock Unit Groundwater Elevation (5 foot contours)

Notes:
The deep bedrock was not contoured due to not enough data points.
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ARCADIS

Second Quarter
Groundwater Elevation
May 27, 2011
Remedial Investigation
Summary Report
Universal Propulsion Company, Inc.

August 2011 | **Figure 9**

Universal Propulsion Company
Remedial Investigation Summary Report

Appendix A
Electronic Copy

3994003