

**VOLUME 1**

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**INITIAL INVESTIGATION  
FINDINGS REPORT  
NEWHALL STREET RESIDENTIAL AREA  
HAMDEN, CONNECTICUT**

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**Prepared for:**

 **olin**  
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ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

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## **1.0 Background, Purpose and Scope**

### **1.1 REGULATORY STATUS**

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The Newhall Street study area, located in Hamden, Connecticut, (see Figure 1) is the subject of an Order by the Connecticut Department of Environmental Protection (CTDEP), which requires an investigation and remediation of the “site”.

The four parties cited by CTDEP in the Order include:

- Olin Corporation
- South Central Connecticut Regional Water Authority
- State of Connecticut Board of Education
- Town of Hamden, Connecticut

All four parties have requested a hearing on the Order. The parties are participating in the Hearing process and the hearings are scheduled to begin in late January. As a result, the Order is not currently in effect.

### **1.2 BACKGROUND**

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The United States Environmental Protection Agency (USEPA), CTDEP, and the Town of Hamden have conducted previous studies of the residential portions of the Newhall area. The principal scopes of work are summarized below.

USEPA conducted surficial soil sampling (0 – 6 in.) and analyses for lead, arsenic, mercury, semi-volatile organic compounds (SVOCs), and polycyclic aromatic hydrocarbons (PAHs) in April 2001 on 76 private properties in the Newhall Street Neighborhood Area. Of the approximately 422 samples collected, 34 contained lead concentrations greater than 1,200 mg/kg (the concentration used by USEPA to trigger an evaluation of the need for a time-critical response), 91 samples had lead concentrations between 500 and 1,200 mg/kg, and 297 samples had lead concentrations below the Connecticut Remediation Standard Regulations (RSR) limit of 500 mg/kg [Lockheed Martin/REAC for USEPA, Final Report. Site Investigation and Extent of Surface Soil

Contamination, Hamden Site, June 2001]. The soil data are presented in the REAC/USEPA report, but the sample locations have been withheld due to privacy agreements with the property owners.

From late November 2001 to early January 2002, USEPA conducted two separate removal actions where elevated concentrations of lead and arsenic and PAHs were detected. The “Rosem Removal Site” consists of five residences located on Morse Street, west of Newhall Street. The “Bryden and Morse Streets Removal Site” consists of eight residences located east of Newhall Street; five on Bryden Terrace, one on Winchester Avenue, one on Marlboro Street, and one on Morse Street (Sheet 1). Note that additional properties at 21 Marlboro St. and 127 Morse St. were removed from the project and have not been excavated (Hoyes, Summary Report, 2/8/02).

Because the USEPA removal actions were limited to the top 18 inches of soil, CTDEP sampled the bottoms of each excavation on the Rosem and Bryden/Morse Sites prior to the backfilling of the areas with clean soil. CTDEP also conducted supplemental surficial soil sampling of approximately 21 additional residential properties not previously tested by USEPA. The purpose of CTDEP’s investigation was to determine whether other properties within the Newhall area contain lead in surficial soils above the 1,200 mg/kg lead criterion employed by USEPA in establishing the extent of their removal actions. The specific sample locations of the supplemental soil investigation are not yet available.

In the course of investigating subsidence issues in the area, CTDEP drilled soil borings at nine properties and analyzed soil and groundwater samples for parameters of interest. Three of the borings were completed as groundwater monitoring wells. Sheet 1 shows the locations of the CTDEP’s subsidence investigation (conducted during February 2002 by GZA) and the locations of direct push soil borings that CTDEP conducted in the Newhall Street neighborhood rights-of-way during January – February 2001. Stratigraphic information from the boring logs for these two investigations are incorporated in this report.

The Town of Hamden has conducted a Phase I Environmental Site Assessment (ESA) of the Newhall area. Their report, prepared by Haley & Aldrich, Inc. (H&A) (January

2002), summarized historical record information and recent subsurface and analytical data. It included an investigation of the history of areas outside their Phase I Study Area.

The H&A Phase I ESA Report identified a study area comprising the Hamden Middle School, Rochford Field, and Rochford Field Annex and adjacent private parcels that encompass potential fill areas within contiguous historic wetlands or low-lying land. H&A included an interpretation of the extent of former wetlands/lowlands and watercourses apparent from 1934 aerial photographs.

H&A also reported in the “Findings and Conclusions” section of the Phase I ESA report that they “encountered evidence of areas of debris or ash-containing fill in the Newhall Neighborhood at locations outside the Phase I study area.” These areas include several blocks situated to the southwest and south of the areas discussed in the Phase I report. The H&A Phase I report indicated that there is little historical information and subsurface characterization of these areas. Previous investigations by others mostly have characterized shallow soil horizons. The analytical results indicate the presence of elevated concentrations of metals in the soil, principally arsenic and lead, and PAHs. Except for the recent CTDEP geotechnical investigation, groundwater quality and deeper soil horizons remained largely uncharacterized.

### **1.3 PURPOSE AND SCOPE**

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Based on the background information available at the time, the Initial Investigation Work Plan and subsequent correspondence with CTDEP (see Appendix A) defined a study area consisting of four parts (Sheet 1):

1. **The USEPA “Rosem Removal Site”.** This area of over 1 acre, includes the residential properties from 249 to 275 Morse Street adjacent to the Hamden Community Center and Hamden Middle School.
2. **The Eastern Area.** This area of approximately 21 acres is bounded by Newberry Street, Newhall Street, Marlboro Street, properties east of Winchester Avenue and south of Morse Street until Wadsworth Street, and those residential properties north of Bryden Terrace between Wadsworth Street and Winchester Avenue.
3. **The Southwest Satellite Area.** This area consists of three blocks totaling about 15 acres and is bounded by St. Mary Street on the west, Morse and Marlboro

Streets to the north, Shelton Avenue and Butler Street on the east, and Goodrich Street on the south.

4. **The Augur Street Area.** This area of approximately 6 acres is bounded by properties north of Augur Street, Newhall Street, Mill Rock Road Extension, and wetlands in Regional Water Authority property.

The purpose of this initial investigation was to determine the existence, nature, and extent of fill materials in these areas and to provide preliminary characterization of soil and groundwater quality. The investigation consisted of the following tasks:

- Review background information.
- Perform initial investigation (collection of samples of fill/soil and groundwater for laboratory analyses and logging of materials).
- Compile data from our investigation and any data collected by others.
- Submit Interim Data Report to CTDEP.
- Incorporate information into the Newhall Area Remedial Investigation database.

The Work Plan proposed a field investigation consisting of 70 borings. Because the investigation was conducted on numerous private properties with restricted physical access, the direct push drilling method was used to obtain soil and groundwater samples. The Work Plan proposed collecting a groundwater sample from approximately half of the direct push points (35) (see Appendix A).

This Findings Report presents the information obtained from the Initial Investigation of the Newhall Street Residential Study Area. It includes the direct push boring logs (Appendix B), photographs of soil/fill samples (Appendix C) and the laboratory analytical reports (Appendix D). The analytical data was compiled in a database that was used to generate the summary data tables in this report. These tables include comparisons of analyte concentrations to the numerical criteria in the 1996 Connecticut RSRs and to recent changes by CTDEP to the arsenic and lead criteria. Stratigraphic and groundwater elevation information from the Initial Investigation borings, as well as the GZA and CTDEP borings within the Initial Investigation Study Area was used to

determine the thickness and extent of fill materials (Sheet 2) and to generate cross-sections (Sheet 3). The distribution of analytes exceeding soil criteria is summarized on Sheet 4. Section 2 describes the specific scope as modified during the course of the investigation and Section 3 describes the findings.

## 2.0 Sampling and Analyses Plan

### 2.1 MEANS AND METHODS

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The investigation was performed in substantial accordance with the Work Plan dated March 2002 (Appendix A). A total of 80 direct-push borings were drilled in residential lots and public right-of-ways by Malcolm Pirnie's subcontractor Zebra Environmental Corporation (Zebra). The borings were advanced through any non-native fill material present and into native subsurface soils and were logged by a representative of Malcolm Pirnie. Completed boring logs are provided in Appendix B, and the boring locations are shown on the enclosed study area sampling plan (Sheet 1). Zebra drilled all direct-push borings between August 8 and August 27, 2002 using an all terrain vehicle (ATV)-mounted rig. The ATV-mounted direct-push unit was selected because of its compact size and light weight which facilitated access the drilling locations, many of which were not accessible with a conventional truck-mounted drilling rig. The small diameter borehole and compact rig resulted in minimal disturbance to the private properties. No significant quantity of investigation derived solid waste was generated during the conduct of this investigation. MPI staff directed and oversaw the direct-push investigation.

At 25 of the 80 boring locations, Malcolm Pirnie obtained groundwater grab samples for laboratory analyses. These locations are shown with a blue symbol on Sheet 1 and were selected based on the ability of the borehole to yield sufficient quantity of groundwater for analysis and to provide representative geographic coverage of the study area. The groundwater samples were collected using a Screen Point 15 (SP-15) groundwater sampler, which utilizes a screen with a standard slot size of 0.004 inches (0.1 mm) and has an exposed length of 41 inches. Depending on the yield and depth to groundwater, the samples were obtained either by submersible inertial lift pumping or surface pumping using a peristaltic pump with polyethylene tubing. All groundwater samples for metals analyses were field filtered through disposable 0.45 micron cartridge filters prior to containerization.

All boreholes were initially field located relative to recoverable features indicated on the study area base mapping. Subsequent to the direct push investigation, between October 3 and October 17, 2002, URS Corporation field surveyed the actual "as-built" locations of all boreholes. The location control was provided on NAD 83 and NGVD 88 as requested by the CTDEP. The topographic base map for the study area was developed from public record copies of the Town of Hamden Assessors Map revised April 2000. The locations indicated in this report for all Malcolm Pirnie boreholes conducted under this investigation reflect the surveyed location.

## **2.2 SAMPLING AND ANALYSES PLAN**

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At each boring location, Macro Core open samplers were used to collect continuous soil samples. These samples are open tube design and measure approximately 2" in diameter by 46" long. The samplers are fitted with a removable cutting shoe and clear acetate liner. Soil samples were collected in 4-foot depth intervals starting at surface grade. Soil cores were screened with a photo-ionization detector (PID) with an 11.7 ev lamp immediately upon opening the liner. The PID readings are provided on the boring logs in Appendix B. MPI field staff containerized all soil samples intended for laboratory analyses.

Soil samples were collected for analysis from each boring drilled, with the exception of borings M1004 and T1004, which were drilled primarily to visually determine the horizontal extent of the non-native material. Table 2 presents the soil/fill sampling and analysis plan for this initial investigation.

All soil/fill samples were analyzed for arsenic and lead. Surficial samples from approximately 0-3 inches below grade were collected at each boring, except those penetrating surficial asphalt pavement. In accordance with the Work Plan, samples that were deemed to be "predominantly fill material" were analyzed for the full suite of analytes proposed in the Work Plan and summarized below:

- Priority Pollutant Metals + Barium (antimony, arsenic, barium, beryllium, ~~cadmium, chromium, copper, lead, nickel~~, selenium, silver, thallium, and zinc)
- CT Extractable Total Petroleum Hydrocarbons
- ~~Volatile Organic Compounds~~
- ~~Semi-Volatile Organic Compounds~~
- ~~Pesticides and Poly-Chlorinated Biphenyls (except in Southwest Satellite Area and Morse Street Area)~~

In addition, based on the total metals concentrations detected, we selected a subset of samples for Synthetic Precipitate Leaching Procedure (SPLP) metals analyses. SPLP metals analyses were performed for the same list of metals as the original total metals samples (i.e. surficial samples were analyzed for SPLP arsenic and SPLP lead and fill samples were analyzed for SPLP priority pollutant metals + barium). A soil sample collected from the underlying native material at each sampling location was analyzed for arsenic and lead.

The groundwater samples were analyzed for the CTDEP Appendix II Landfill Leachate Parameters. This list is provided in the Work Plan in Appendix A. The metals analyses of the filtered groundwater are of the dissolved fraction. Severn Trent Laboratories, Inc. (STL) analyzed the soil and groundwater samples. Analytical laboratory data reports (exclusive of the quality control/quality assurance data package for compactness) and quality control/quality assurance (QA/QC) evaluation memorandums are provided in Appendix D.

### **2.3 MODIFICATIONS TO WORK PLAN**

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Additional minor modifications made to the Work Plan during the course of the field investigation are discussed below. All 70 boring locations proposed in the Work Plan were retained and drilled, approximately consistent with the originally specified locations subject to field conditions and access. As the investigation progressed and additional data became available, we drilled 10 additional borings outside of the initial study area in Blocks K, M, Q, and T.

In the Work Plan we proposed collecting groundwater samples from approximately half of the 70 proposed borings. Due to the deeper than expected groundwater table from prolonged drought and the low yield of the formation(s) in certain areas, it was not possible to obtain a sufficient quantity of groundwater from all of the desired locations. At some locations, due to the very low yield and turbid nature of the groundwater, it was not feasible to collect or filter an adequate sample for the proposed analyses within a realistic timeframe. Modifications to the field procedures to enhance groundwater sample recovery included the following:

- Overdrilling of the borehole by up to ten feet below the apparent water table to increase head on the sample screen in the borehole.
- Increasing the length of the sample screen from 18 inches to four feet to allow greater area for the groundwater to enter the sample tube.
- Using the peristaltic pump in preference to the inertial lift pump where feasible to decrease sampling duration.

With these modifications we were able to obtain groundwater samples from 25 of the 80 borings and maintain representative geographic coverage of the entire study area.

Other modifications were made based on actual field conditions encountered. A few borings were shifted and/or relocated to neighboring properties either because the property owner refused access or because of the presence of structures (garages, patios, etc.) preventing the drilling rig from accessing the proposed locations. However, the goals of the investigation were still achieved with the relocated borings. The actual drilling locations are shown on the Site Plan (Sheet 1).

Another modification to the Work Plan consisted of the 10 additional borings discussed above that established the limits of fill material where it extended outside the initial limits of study area.

The final modification to Work Plan is that, where appropriate, stratigraphic data generated from borings by CTDEP and GZA within the residential study area are incorporated into the findings discussions below.

## **2.4 ORGANIZATION OF ANALYTICAL DATABASE**

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The Work Plan for the residential areas proposed 70 soil borings within the study area identified as MPB-100 through MPB-169. Because several investigators were ultimately conducting concurrent investigations on adjoining parcels throughout the area, the CTDEP requested that the consultants' sample identification and environmental databases be consistent. This would facilitate the potential merging of the databases, developing a site-wide characterization from all available environmental data. Therefore, we devised a revised sample numbering scheme and database format. As a result, the Work Plan boring numbering system has been abandoned and a revised system implemented, now called station IDs. The basic approach was proposed to CTDEP in a memorandum by Andrew Danzig (MPI) dated July 30, 2002. The study area is now divided into geographic and environmental data Blocks A through T as shown on Sheet 1. All environmental samples obtained by Malcolm Pirnie carry sample or station IDs consistent with this numbering scheme. Table 1 correlates the location identifications from the Work Plan with those actually used during this investigation.

## 3.0 Findings

### 3.1 INTRODUCTION TO PRESENTATION OF FINDINGS

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We have divided the study area into five separate geographic areas for the purpose of presenting and discussing the findings. The five areas are listed below and are generally the same areas identified in the Work Plan with two exceptions. First, the "Eastern Area" as identified in the Work Plan has been subdivided into two areas, the *Newhall Street Area* and the *Bryden Terrace Area*. Second, the Auger Street Area was added to the study area as a result of a request from CTDEP to perform investigations within that area under the scope of this initial investigation.

- **Southwest Satellite Area** (Blocks H, J, K, L, & M) -- Bounded by Morse Street to the north, Goodrich Street to the south, St. Mary Street to the west, and Butler Street to the east.
- **Morse Street Area** (Block A) -- Bounded by the Hamden Middle School to the north, Morse Street to the south, the Hamden Community Center to the east, and 279 Morse Street to the west.
- **Newhall Street Area** (Blocks E, P, & Q) -- Bounded by Newbury Street to the north, Marlboro Street to the south, Newhall Street to the west, and Winchester Avenue to the east.
- **Bryden Terrace Area** (Blocks C, F, R, & S) -- Bounded by Mill Rock Park to the north, Winchester Avenue to the west, Wadsworth Street to the east, and Morse Street to the south.
- **Auger Street Area** (Block T) -- Bounded by Mill Rock Road Extension to the south, Newhall Street to the east, New Haven Water Company property to the west, and properties north of Auger Street to the north.

For each area we present a discussion of the physical nature and extent of the non-native fill material encountered and the analytical results of all soil/fill and groundwater samples analyzed as part of this investigation. For each area we prepared data tables summarizing the analytical data results for the soil and groundwater samples with highlighted concentrations shown for analytes exceeding any applicable regulatory criteria. For

clarity, the data tables include only those analytes where detections occurred in one or more samples. For the purposes of comparing the soil/fill analytical data, the criteria employed are those applicable criteria from the CTDEP *Remediation Standard Regulations* (RSR), specifically the Residential Direct Exposure Criteria (RDEC) and the GA/GAA groundwater classification Pollutant Mobility Criteria (GAPMC). The "published" RDEC for lead is 500 mg/Kg and the "published" GWPC for arsenic is 50 ug/L. In accordance with notification from CTDEP by email during the course of this investigation, the RDEC for lead is taken to be 400 mg/kg and the GWPC of arsenic is 10 ug/L, respectively. The new arsenic GWPC also changes the GAPMC for arsenic to 10 ug/L. It is our understanding that these changes are effective immediately as the CTDEP determined, pursuant to the RSRs, that these changes were necessary to protect public health and the environment.

For groundwater quality the applicable criteria from the RSR are the Groundwater Protection Criteria (GWPC), modified for arsenic as described above, and the Residential Groundwater Volatilization Criteria (RGWVC). The Surface Water Protection Criteria (SWPC) do not apply to the vast majority of the study area, except potentially the western boundary of the Auger Street area, as there is no adjacent surface water body receiving a groundwater discharge.

The large number of *semi-volatile organic compounds* (SVOCs) in the analytical protocol is divided into two categories to facilitate the discussion, compounds classed as polynuclear aromatic hydrocarbons (PAHs) and the remaining SVOCs. This maintains the use of the term PAH, which is familiar from reports of previous investigations within the general study area.

Sheet 2 shows the thickness and extent of the non-native material, Sheet 3 shows cross-sections cut through the study area, and Sheet 4 shows the locations and types of analytes that exceed RSR soil criteria. Figure 2 shows the approximate elevations of the water table at the locations where groundwater samples were collected. We did not attempt to contour the groundwater elevations because no permanent monitoring wells were installed. The depths to groundwater measured during the field investigation are

presumed to be non-equilibrium and elevations reported should be interpreted as “no greater than”. The groundwater elevations indicate a general gradient from northeast to southwest.

### **3.2 SOUTHWEST SATELLITE AREA**

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The Southwest Satellite Area lies principally within Blocks H, J, and L. Investigations within this section of the study area were expanded in accordance with provisions of the Work Plan to include portions of Blocks K (to the northeast), and M (to the east) based on preliminary findings.

Thirty-five borings were drilled within this section of the study area. The field investigation revealed three contiguous, elliptical filled depressions centered within the three principle blocks H, J, and L. These depressions were originally about 14 to 20 feet below the surrounding ground level and were apparently separated from each other by low rises, with lesser fill thickness, now coincident with Edwards Street and Shelton Avenue. The original depressions and material now found within them is geographically separate and distinct from the other low-lying areas within the overall study area.

The non-native material placed within this area consists generally of ash, slag, and cinders, with lesser amounts of peat, brick, coal, and clean fill. The clean fill contains much lower proportions of these materials and is composed mainly of a brown sand matrix. Its occurrence is not physically separable from the other materials and may be an artifact of the sampling program.

Several boring logs indicate the significant presence of brown to black sandy-appearing material as the principal component of the fill matrix. We should note that the initial classification and description of the non-native material did not attempt to differentiate the different types of fill encountered nor did it attempt to decipher the origin of the matrix material. Some large-scale layers of cinders and slag were observed, at times comprising the bulk of the matrix. The term "sand" is used in several boring log descriptions and was applied based on the size of the grains observed, not necessarily the

textural classification or inferred natural origin, which was not always apparent based on field observations.

Beneath and around the filled areas is a light brown to reddish brown natural sand layer containing minimal silt and gravel, typically covered by a surface layer approximately 0.25 to 1.5 foot thick of light brown to brown organic topsoil.

Tables 4 and 5 summarize the soil/fill sample analytical results. The concentrations are compared to the RDEC and the GAPMC. Concentrations exceeding criteria are highlighted.

### **Arsenic and Lead**

The arsenic and lead data are shown in Table 4. Arsenic and lead were analyzed for in a total of 93 samples, 29 of which were surficial fill/soil samples. Arsenic was detected in all 29 surficial samples at concentrations ranging from 2.12 mg/Kg to 35.5 mg/Kg and exceeds the RDEC of 10 mg/Kg in 4 of the 29 samples. Lead was detected in all 29 surficial samples at concentrations ranging from 64.2 mg/Kg to 761 mg/Kg and exceeds the RDEC of 400 mg/Kg in 11 of the 29 samples.

Eighteen of the twenty-nine surficial fill/soil samples were analyzed for SPLP arsenic and lead. SPLP arsenic was detected in 3 of the 18 surficial samples analyzed at concentrations ranging from 8.0 ug/L to 14.6 ug/L. Only the single highest concentration exceeds the GAPMC of 10 ug/L. SPLP lead was detected in 16 of the 18 surficial samples at concentrations ranging from 4.9 ug/L to 366 ug/L. SPLP lead concentrations exceed the GAPMC of 15 ug/L in 12 of 18 surficial samples analyzed.

Thirty samples of non-surficial fill were analyzed for arsenic and lead. Arsenic was detected in all 30 samples at concentrations ranging from 1.81 mg/Kg to 303 mg/Kg and exceeds the RDEC of 10 mg/Kg in 19 of the 30 samples analyzed. Note that the maximum arsenic concentration of 303 mg/Kg is an outlier, exceeding the next highest arsenic concentration by nearly a factor of 10. Lead was detected in all 30 non-surficial fill samples at concentrations ranging from 37.9 mg/Kg to 10,100 mg/Kg and exceeds the RDEC of 400 mg/Kg in 19 of the 30 samples.

Twenty-three of the thirty non-surficial fill samples were analyzed for SPLP arsenic and lead. SPLP arsenic was detected in only one sample (L1005S1 from 2-4 fbg) at a concentration of 15.9 ug/L, exceeding the GAPMC of 10 ug/L. The detection limits for SPLP arsenic exceed the GAPMC in three additional samples; however this analyte was not detected in these three samples. SPLP lead was detected in 16 of the 23 non-surficial fill samples at concentrations ranging from 3.9 ug/L to 2,920 ug/L. SPLP lead concentrations exceed the GAPMC of 15 ug/L in 9 of 23 samples.

Thirty-four samples of the underlying native soil were collected and analyzed for arsenic and lead. Arsenic was detected in 30 of the 34 samples at concentrations ranging from 0.783 mg/Kg to 6.09 mg/Kg, all of which are below the RDEC of 10 mg/Kg. Lead was detected in all 34 samples at concentrations ranging from 2.37 mg/Kg to 419 mg/Kg. Only this latter sample (J1003S4 from 10-12 fbg) exceeds the RDEC of 400 mg/Kg.

Eleven of the thirty-four underlying native soil samples were analyzed for SPLP arsenic and lead. SPLP arsenic was detected in only 1 of the 34 samples at a concentration of 19.1 ug/L, which exceeds the GAPMC of 10 ug/L. SPLP lead was detected in 3 of the 34 samples at concentrations ranging from 13.5 ug/L to 390 ug/L. Two of the three detected lead concentrations exceed the GAPMC of 15 ug/L.

## **Metals**

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All 14 metals analyzed for were detected in at least one non-surficial fill sample. Twenty-two out of twenty-seven samples from the non-surficial fill material contain at least one metal at a concentration exceeding the respective RDEC. The majority of arsenic and lead concentrations in samples collected from the fill material exceed the RDEC (19 of 30 for arsenic and 15 of 30 for lead). Aside from arsenic and lead, only two other metals were detected at concentrations exceeding the RDEC, copper and antimony, each of which exceed the RDEC in only one sample. In addition, the detection limits for two metals, beryllium and thallium, exceed the RDEC in one and two samples, respectively. Beryllium and thallium were below their detection levels in all samples analyzed.

## **SPLP Metals**

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In accordance with the Work Plan, we selected a subset of samples for SPLP metals analyses in addition to those performed for SPLP arsenic and lead alone, including all samples with at least one total metals concentration exceeding the RDEC. Twenty-three of the twenty-seven samples for which total metals analyses were run were analyzed by SPLP. Eleven of the fourteen metals analyzed by SPLP were detected. Three metals were non-detect in all samples (beryllium, silver, and thallium); however, the detection limits for thallium exceed the GAPMC of 5 ug/L in all samples analyzed. Of the 11 metals detected, 7 were detected at concentrations exceeding the GAPMC (antimony, arsenic, cadmium, lead, mercury, nickel, and zinc) in at least one sample.

Of the 23 samples, 13 have at least one metal at a concentration exceeding the GAPMC. Lead and nickel appear to be the most widespread, exceeding criteria in 9 of 23 and 8 of 23 samples, respectively. Antimony exceeds the GAPMC of 6 ug/L in 5 of 23 samples.

## **ETPH**

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ETPH was detected in all 27 samples analyzed at concentrations ranging from 21 mg/Kg to 11,000 mg/Kg. Thirteen of the twenty-seven samples analyzed have ETPH concentrations exceeding the RDEC of 500 mg/Kg. The maximum ETPH concentration detected was 11,000 mg/Kg and was detected at H1002S3 (from 8-10 fbg). Boring H1002 was drilled approximately 10 feet north of a garage and penetrated approximately 17 feet of fill material.

## **VOCs**

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Nineteen of the twenty-four VOCs analyzed for were detected. All VOC concentrations are well below their respective RDEC.

## **SVOCs**

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Ten of the seventeen SVOCs analyzed for were detected; however, none were detected at concentrations exceeding the RDEC. Sample H1004S2 (8-10 fbg) had to be diluted for analysis due to matrix interference. The detection limits for five SVOCs exceed the

RDEC in this sample so compliance with these criteria could not be confirmed quantitatively. These five SVOC were below the elevated detection limits in this sample.

### **PAHs**

All 17 PAHs were detected in at least one sample. Seven of the seventeen PAHs detected exceeded the RDEC in at least one sample. Of the 27 samples analyzed, 7 of the 27 contain at least one PAH at a concentration exceeding the RDEC.

### **Groundwater**

Nine groundwater samples were collected within the Southwest Satellite Area. The locations are shown in blue on Sheet 1. The analytical results for the groundwater samples are summarized in Table 6. Only one dissolved metal was detected above the GWPC in only one sample. Dissolved antimony was detected in sample J1006W1 at a concentration of 7.1 mg/L slightly exceeding the GWPC of 6 mg/L. All other dissolved metals concentrations are below the GWPC. The detection limits for dissolved thallium exceed the GWPC in all samples analyzed, so compliance with this metal could not be confirmed quantitatively.

Two VOCs and one SVOC were detected at concentrations exceeding the GWPC. Chloroform was detected in two samples L1008W1 and M1002W1 at concentrations of 12 ug/L and 20 ug/L, respectively. Both concentrations exceed the GWPC of 6 ug/L. The VOC 1,2-Dibromoethane (EDB) has a relatively low GWPC of 0.05 ug/L. The detection limits for this VOC (0.1 ug/L) exceed the GWPC, so compliance with this VOC could not be confirmed quantitatively. Bis(2-ethylhexyl)phthalate was also detected in sample L1008W1 at a concentration of 8 ug/L exceeding the GWPC of 2 ug/L. All VOC concentrations are below the RGWVC.

The pesticide concentrations are below their applicable criteria. Chlordane and dieldrin have detection limits exceeding their respective GWPC, so compliance with these compounds could not be quantitatively confirmed in all samples. The herbicide concentrations were below detection limits.

### **3.3 MORSE STREET AREA**

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The Morse Street Area (Block A) comprises the residential lots from 249-251 to 275 on the north side of Morse Street. Portion of individual properties within this area had previously been subject to a USEPA removal action addressing surficial soils up to 18 inches deep. Malcolm Pirnie drilled four borings in this section of the study area during this investigation.

The field investigation revealed two lobes of non-native fill material as shown on Sheet 2. These fill lobes include the footprints of the previous USEPA removal actions. Both lobes underlie at least the northern halves of the properties, but neither appears to extend as far south as Morse Street based on previous CTDEP borings drilled in the right-of way north of Morse Street. However, the fill extends north (outside of the study area) toward the Hamden Middle School property and east toward the Hamden Community Center.

Three of the four Malcolm Pirnie borings penetrated the non-native fill material, which is comprised primarily of sand, ash, slag, cinders, and peat. Boring A1001 drilled near the western boundary of this study area did not penetrate any fill material. Thus, the fill has been delineated to the west by boring A1001 and to the south by previous CTDEP borings in the right-of-way on the north side of Morse Street.

Beneath and around the fill areas is a light brown to reddish brown natural sand layer containing minimal silt and gravel typically covered by a surface layer approximately 0.25 to 1.5 foot thick of light brown to brown organic topsoil.

The following paragraphs detail the analytical findings from the soil and groundwater investigations within this section of the study area. Table 7 presents the soil/fill analytical data.

#### **Arsenic and Lead**

Eleven samples were analyzed for arsenic and lead, four of which were surficial samples. Arsenic was detected in all four surficial samples at concentrations ranging from 1.07 mg/Kg to 4.5 mg/Kg, all of which are below the RDEC of 10 mg/Kg. Lead was also

detected in all four surficial samples at concentrations ranging from 14.2 mg/Kg to 306 mg/Kg, all of which are below the RDEC of 400 mg/Kg. This latter lead concentration was collected from boring A1001, the only boring not penetrating fill.

The surficial sample from boring A1001, which contained the highest total lead concentration, was analyzed for SPLP arsenic and lead. The SPLP arsenic concentration was below the detection limit of 7 ug/L, and the SPLP lead concentration was 31.8 ug/L, exceeding the GAPMC of 15 ug/L.

Arsenic and lead were each detected in the three non-surficial fill samples analyzed. Arsenic concentrations range from 8.47 mg/Kg to 16.8 mg/Kg and exceed the RDEC in two of the three samples. Lead concentrations range from 319 mg/Kg to 2,210 mg/Kg and also exceed the RDEC in two of the three samples.

Each of the three non-surficial fill samples was analyzed for SPLP arsenic and lead. SPLP arsenic was detected in two of the three samples analyzed at concentrations ranging from 9.1 ug/L to 10.1 ug/L. Only this latter concentration marginally exceeds the GAPMC of 10 ug/L. SPLP lead was detected in all three samples analyzed at concentrations ranging from 15.6 ug/L to 116 ug/L, all of which exceed the GAPMC of 15 ug/L.

Four samples from the underlying native sand (one from each boring) were collected and analyzed for arsenic and lead. The arsenic concentrations range from 1.38 mg/Kg to 11.2 mg/Kg. Only this latter concentration exceeds the RDEC of 10 mg/Kg. Lead concentrations range from 3.72 mg/Kg to 143 mg/Kg and all are below the RDEC.

Two of the four samples from the underlying native sand were analyzed for SPLP arsenic and lead. SPLP arsenic and SPLP lead concentrations were below the detection limits in both samples analyzed.

## **Metals**

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Fourteen of the fifteen metals analyzed for were detected in at least one non-surficial fill sample. Four metals were detected at concentrations exceeding the RDEC. Arsenic and

lead, two of the metals that exceed the RDEC, were discussed above. Antimony was detected in all three samples at concentrations ranging from 1.73 mg/Kg to 47.6 mg/Kg. Two of the three antimony concentrations exceed the RDEC of 27 mg/Kg. Copper was detected in all three samples at concentrations ranging from 48.4 mg/Kg to 2,910 mg/Kg. This latter concentration exceeds the RDEC of 2,500 mg/Kg. All other metals concentrations are below their respective RDEC.

### **SPLP Metals**

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All three non-surficial fill samples were analyzed for SPLP metals. Nine of the fourteen SPLP metals were detected in at least one of the samples. Four SPLP metals were detected at concentrations exceeding their respective GAPMC. In addition to SPLP arsenic and lead, SPLP antimony was detected in one sample [A1003S2 (2-4 fb)] at a concentration of 6.7 ug/L, which exceeds the GAPMC of 6 ug/L. SPLP nickel was detected in all three samples at concentrations ranging from 4 ug/L to 113 ug/L, the latter exceeds the GAPMC of 100 ug/L. The detection limits for SPLP thallium exceed the GAPMC in all three samples, so compliance with this metal could not be quantitatively confirmed. Thallium was not detected in any of the three samples. All other SPLP metals concentrations are below their respective GAPMC.

### **ETPH**

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ETPH was detected in two of the three samples at concentrations of 320 mg/Kg and 12,000 mg/Kg. Only this latter concentration collected from sample A1004S2 (2-4 fb) exceeds the RDEC of 500 mg/Kg.

### **VOCs**

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Three of the 25 VOCs (acetone, benzene, and toluene) were detected in at least one fill sample. Acetone was the only VOC detected in all three samples at concentrations ranging from 56 ug/Kg to 300 ug/Kg, below the RDEC of 500,000 ug/Kg. All VOC concentrations are below their respective RDEC.

### **SVOCs**

Two of the seventeen SVOCs were detected in at least one fill sample [bis(2-ethylhexyl)phthalate and n-nitrosodiphenylamine]. Each was detected in only one sample. Detected concentrations are below the RDEC. The detection limit for bis(2-chloroethyl)ether exceeds the RDEC of 1,000 ug/Kg in one sample, A1004S2 (2-4 fbq), due to dilution of the original sample.

### **PAHs**

Thirteen of the seventeen PAHs were detected in at least one fill sample. Benzo(b)fluoranthene was detected in two of the three samples at concentrations of 160 ug/Kg and 1,400 ug/Kg. This latter concentration exceeds the RDEC of 1,000 ug/Kg. All other PAH concentrations are below the RDEC.

### **Groundwater**

Table 8 presents the groundwater data from the one sample collected within this section of the study area. Chloroform was detected at a concentration of 9 ug/L, exceeding the GWPC of 6 ug/L. All other VOC concentrations are below the RDEC and the GAPMC.

No SVOCs, PAHs, pesticides, or dissolved metals exceed the GWPC. The detection limit for thallium (16.1 ug/L) exceeds the GWPC of 5 ug/L, however thallium was not detected in the sample.

## **3.4 NEWHALL STREET AREA**

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The Newhall Street Area lies principally within Blocks E and P. This section of the study area was expanded in accordance with provisions of the Work Plan to include the western part of Block Q (to the south) based on preliminary findings.

We drilled 16 borings within this section of the study area. The field investigation revealed a filled, elongated depression trending north-south within the western half of this study area. This depression was originally up to 13 feet below the surrounding

ground level. This depression was filled with material consisting of interlayered or intermixed sand, gravel, ash, slag, cinders, and peat.

The extent of the non-native material placed within this section of the study area is shown on Sheet 2. The filled areas have been delineated by boring data to the east and south. The filled area is further bounded on the west by the Newhall Street ROW, previous CTDEP boring data showing substantial thinning of the fill (to 2 feet) within the Newhall Street ROW, and topographically by the house lots rising to the west beyond. The filled area extends to the north of the Newhall Street area, beneath and beyond Newberry Street, onto Rochford Field.

Fill is generally absent from the eastern half of this study area as shown on Sheet 2. Beneath and around the filled areas is a light brown to reddish brown natural sand layer containing minimal silt and gravel typically covered by a surface layer approximately 0.25 to 1.5 foot thick of light brown to brown organic topsoil.

At boring P1001 drilled in the right-of-way south of 461 Newhall Street, we encountered a layer of peat/decomposed wood approximately two feet thick. This is the only boring within this section of the study area that penetrated this material, although several borings were terminated at relatively shallow depths due to the absence of fill material. It is unclear whether this layer is a natural peat layer or a section of decomposed wood at the base of the fill.

Tables 9 and 10 summarize the analytical results from the soil/fill samples from this section of the study area.

### **Arsenic and Lead**

The arsenic and lead data are shown in Table 9. Sixteen surficial fill/soil samples were collected and analyzed for arsenic and lead. Arsenic was detected in all 16 samples at concentrations ranging from 2.13 mg/Kg to 27 mg/Kg and exceeds the RDEC of 10 mg/Kg in 4 of the 16 samples. Lead was detected in all 16 samples at concentrations ranging from 54.6 mg/Kg to 531 mg/Kg. Only this latter concentration of 531 mg/Kg exceeds the RDEC of 400 mg/Kg.

Ten surficial fill/soil samples were analyzed for SPLP arsenic and lead. SPLP arsenic was detected in 2 of the 10 samples at concentrations of 24.3 ug/L and 50.5 ug/L, both exceed the GAPMC of 10 ug/L. SPLP lead was detected in 9 of the 10 samples at concentrations ranging from 7.2 ug/L to 83.7 ug/L. Five of the ten SPLP lead concentrations exceed the GAPMC of 15 ug/L.

Nine non-surficial fill samples were collected and analyzed for arsenic and lead. Arsenic was detected in all nine samples at concentrations ranging from 7.47 mg/Kg to 54.2 mg/Kg. Eight of the nine arsenic concentrations exceed the RDEC of 10 mg/Kg. Lead was detected in all nine samples at concentrations ranging from 59.6 mg/Kg to 4,540 mg/Kg. Five of the nine lead concentrations exceed the RDEC of 400 mg/Kg.

Eight of the nine non-surficial fill samples were also analyzed for SPLP arsenic and lead. SPLP arsenic was detected in only one sample [P1001S3 (5-6 fbg)] at a concentration of 45.1 ug/L, exceeding the GAPMC of 10 ug/L. This sample was collected from the layer of the peat/decomposed wood discussed earlier. SPLP lead was detected in five of the eight samples at concentrations ranging from 5.5 ug/L to 299 ug/L. Three of the eight SPLP lead concentrations exceed the GAPMC of 15 ug/L.

Sixteen samples were collected from the underlying native soil and analyzed for arsenic and lead. Arsenic and lead were each detected in all 16 samples. Arsenic concentrations range from 0.921 mg/Kg to 2.23 mg/Kg and all are below the RDEC of 10 mg/Kg. Lead concentrations range from 3.2 mg/Kg to 23.7 mg/Kg and all are below the RDEC of 400 mg/Kg.

Three of the sixteen samples from the underlying native soil were analyzed for SPLP arsenic and lead. SPLP arsenic was detected in only one sample [P1003S2 (2-4 fbg)] at a concentration of 17.6 ug/L, which exceeds the GAPMC of 10 ug/L. SPLP lead was detected in two of the three samples at concentrations of 12.9 ug/L and 68.7 ug/L. This latter concentration exceeds the GAPMC of 15 ug/L.

## **Metals**

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Thirteen of the fourteen metals analyzed for (including lead and arsenic) were detected in at least one soil sample. Only thallium was below detection limits in all samples. Eight out of 9 samples from the fill material contain at least one metal at a concentration exceeding the RDEC. The majority of lead and arsenic samples collected from the fill material exceed the RDEC (8 of 9 for arsenic and 5 of 9 for lead). Aside from lead and arsenic, three other metals were detected at concentrations exceeding the RDEC; antimony, barium, and mercury. Antimony was detected above the RDEC of 27 mg/Kg in two samples, and barium and mercury exceed the RDEC in one sample each. In addition, the detection limits for thallium exceed the RDEC of 5.4 mg/Kg in one sample, however, the concentration was below detection limit.

## **SPLP Metals**

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Eight of the nine samples for which total metals analyses were performed were also analyzed for SPLP metals. Of the eight samples analyzed, three have at least one SPLP metal concentration exceeding the respective GAPMC (one from each block E, P, and Q). Sample P1001S3 (5-6 fbg) contains four SPLP metals exceeding their respective GAPMC (antimony, arsenic, lead, and mercury). This sample was composed mainly of peat/decomposed wood and was discussed briefly above. Except for this sample, lead is the only SPLP metal exceeding the GAPMC and did so in two of the remaining seven samples. The detection limits for thallium exceed the RDEC in all eight samples.

## **ETPH**

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ETPH was detected in all nine samples so analyzed. Two of the 9 concentrations exceed the RDEC of 500 mg/Kg. The maximum ETPH concentration detected was 3,100 mg/Kg from sample P1001S3 (5-6 fbg), the same sample containing the four SPLP metals above criteria discussed above.

## **VOCs**

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Four of the 24 VOCs analyzed for were detected (acetone, benzene, toluene, and carbon disulfide). All VOC concentrations are below their respective RDEC.

## **SVOCs**

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Six of the seventeen SVOCs were detected; however, none were detected at concentrations exceeding the RDEC. The detection limits for bis(2-ethylhexyl)phthalate exceed the RDEC in three samples. All concentrations were below the detection limits.

## **PAHs**

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All 17 PAHs were detected in at least one fill sample from this study area. Six of the seventeen PAHs detected were present at concentrations exceeding the RDEC. These include benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene, which were each detected above criteria in five of the nine samples analyzed. Two of the samples with exceeding concentrations, E1001S2 (2-4 fbg) and Q1001S2 (8-10 fbg), each contain six PAHs, including the three named above, at concentrations exceeding the RDEC.

## **Pesticides**

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Fifteen of the seventeen pesticides were detected. All pesticide concentrations are below their respective RDEC. Methoxychlor was the most widespread, being detected in seven of the nine samples analyzed. All detected methoxychlor concentrations are well below the RDEC of 340,000 ug/Kg.

## **PCBs**

---

Of the seven PCB arochlors analyzed for, two (arochlors 1254 and 1260) were detected. Three of the nine samples contain detectable concentrations of at least one arochlor. The total PCB concentrations are below the RDEC of 1,000 ug/Kg in all samples analyzed.

## **Groundwater**

---

Six groundwater samples were collected within the Newhall Street Area. The locations are shown in blue on Sheet 1. The analytical results for the groundwater samples are summarized in Table 11.

Of the six groundwater samples collected, three were from areas that had previously been filled. Only two groundwater samples (P1005W1 and Q1001W1) from areas where non-

native material had been placed, in the southern portion of the fill area had any analytes that exceeded the GWPC. Chloroform was detected above the GWPC in both samples. The SVOC bis(2-ethylhexyl)phthalate was detected above the GWPC in one sample P1005W1, and the PAH benzo(a)anthracene was detected above the GWPC in the other sample Q1001W1. Sample P1005W1 had to be diluted for analysis resulting in eight compounds with detection limits above their respective RDEC. Three of these compounds, the VOC EDB, the pesticide dieldrin, and thallium have detection limits above the RDEC in all samples analyzed. All herbicide concentrations are below detection limits.

### **3.5 BRYDEN TERRACE AREA**

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The Bryden Terrace area lies principally within Blocks C, F, R, and S. Some individual properties within this area had previously been subject to a USEPA removal action. Twenty-one borings were drilled in this section of the study area. The field investigation revealed that the majority of Blocks C and F are underlain by up to 11 feet of fill, reaching maximum thickness at CTDEP's previously drilled boring BT-124. The thickest area of fill encountered in the 21 Malcolm Pirnie borings was 8.5 feet thick at boring C1001 in the very northwest corner of this section of the study area. Four other borings (C1001, F1002, F1003, and F1008) penetrated approximately eight feet of fill. Based on the depths of fill encountered, the fill is generally thickest near the center of the Bryden Terrace Area and thins eastward toward Wadsworth Street, southwestward toward the intersection of Winchester Avenue and Morse Street, and southward toward Morse Street. The filled area is generally bounded on the southwest by Winchester Avenue, on the south by Morse Street and on the east by Wadsworth Street. The filled area extends beyond the study area to the north onto Mill Rock Park and across Winchester Avenue to the northwest onto Rochford Field.

The fill in this area is generally composed of brown to black sand with typically trace amounts of gravel, ash, coal ash, brick, glass, wood, cinders, ceramic, concrete, asphalt, etc. and is found at relatively shallow depths of approximately 0.5 fbg at several of the borings within Blocks C and F.

Blocks R and S, as well as the southwestern edge of Block F, are absent fill as shown on Sheet 2. Beneath and around the filled areas is a light brown to reddish brown natural sand layer containing little silt and gravel typically covered by a surface layer approximately 0.25 to 1 foot thick of light brown to brown organic topsoil. Boring S1002 penetrated a layer of gray to dark brown silt with trace organics and gravel at approximately 4 fbg. This material continued to the bottom of this boring at 8 fbg. This was the only boring south of Morse Street to penetrate this layer. However, several borings drilled within Blocks C and F penetrated a similar layer of black silt/clay and/or a layer of fine sand/silt of varying color (gray, light brown, brown, or black), which we believe to be former swamp deposits and are generally referred to as “fines” on the cross-sections.

The soil/fill analytical data for this area are presented in Tables 12 and 13.

### **Arsenic and Lead**

Twenty-three surficial fill/soil samples were collected and analyzed for arsenic and lead. Arsenic and lead were each detected in all 23 samples analyzed. Arsenic concentrations range from 2.01 mg/Kg to 33.1 mg/Kg. Only this latter concentration exceeds the RDEC of 10 mg/Kg. This sample was collected from boring F1002S1 near USEPA's previous removal activities. Lead concentrations range from 26.9 mg/Kg to 540 mg/Kg. Two of the twenty-three lead concentrations exceed the RDEC of 400 mg/Kg.

Twelve of the 23 surficial fill/soil samples were analyzed for SPLP arsenic and lead. SPLP arsenic was detected in 3 of the 12 samples at concentrations ranging from 8.9 ug/L to 59.6 ug/L. Two of the twelve samples analyzed for SPLP arsenic have concentrations exceeding the GAPMC of 10 ug/L. SPLP lead was detected in 11 of the 12 samples analyzed at concentrations ranging from 4.4 ug/L to 532 ug/L. Seven of the twelve samples analyzed for SPLP lead have concentrations exceeding the GAPMC of 15 ug/L.

Eighteen samples of non-surficial fill were collected and analyzed for arsenic and lead. Arsenic and lead were each detected in all 18 samples analyzed. Arsenic concentrations range from 1.89 mg/Kg to 219 mg/Kg and exceed the RDEC of 10 mg/Kg in 11 of 18

samples. Lead concentrations range from 7.53 mg/Kg to 2,840 mg/Kg and exceed the RDEC of 400 mg/Kg in 13 of 18 samples.

Fifteen of the non-surficial fill samples were analyzed for SPLP arsenic and lead. SPLP arsenic was detected in only 1 of the 15 samples [C1003S3 (6-8 fbg)] at a concentration of 167 ug/L, exceeding the GAPMC of 10 ug/L. SPLP lead was detected in 11 of the 15 samples analyzed at concentrations ranging from 3.6 ug/L to 36.6 ug/L. SPLP lead concentrations exceed the GAPMC of 15 ug/L in 5 of the 15 non-surficial fill samples analyzed.

Twenty-one samples of the underlying native soil were collected and analyzed for arsenic and lead. Arsenic and lead were each detected in all 23 samples analyzed. Arsenic concentrations range from 0.861 mg/Kg to 2.11 mg/Kg and all are below the RDEC of 10 mg/Kg. Lead concentrations range from 2.22 mg/Kg to 41.6 mg/Kg and all are below the RDEC of 400 mg/Kg.

Four of the twenty-one samples from the underlying native soil were analyzed for SPLP arsenic and lead. SPLP arsenic was detected in only one of the four samples [R1003S2 (2-4 fbg)] at a concentration of 17 ug/L, which exceeds the GAPMC of 10 ug/L. SPLP lead was detected in two of the four samples at concentrations of 4.8 ug/L and 36 ug/L. This latter concentration from sample F1004S3 (6-8 fbg) exceeds the GAPMC of 15 ug/L.

### **Metals**

Eighteen samples were analyzed for the full suite of metals. Thirteen of the fourteen metals (including arsenic and lead) were detected in at least one sample. Barium, chromium, copper, nickel, and zinc were each detected in all 18 fill samples analyzed. Aside from arsenic and lead, all metals concentrations in the fill samples are below their respective RDEC. The detection limits for thallium exceed the RDEC in four samples and for beryllium in one sample.

## **SPLP Metals**

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Fourteen of the eighteen fill samples were analyzed for SPLP metals. Nine of the fourteen SPLP metals were detected in at least one sample. SPLP barium and SPLP copper are the only metals detected in all 14 samples analyzed. Except for SPLP arsenic and lead discussed earlier, only SPLP antimony was detected at a concentration exceeding the GAPMC. SPLP antimony was detected at a concentration of 17.5 ug/L in sample F1002S3 (6-8 fbg). This concentration exceeds the GAPMC of 6 ug/L. This is the only sample in which SPLP antimony was detected. All other SPLP metals concentrations are below their respective GAPMC. The detection limits for SPLP thallium exceed the GAPMC in all 15 samples analyzed.

## **ETPH**

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ETPH was detected in 17 of the 18 samples analyzed at concentrations ranging from 34 mg/Kg to 9,000 mg/Kg. This maximum ETPH concentration was detected in sample F1005S2 (2-4 fbg). This sample also contains several PAHs and one SVOC at concentrations exceeding their respective RDEC. In all, 8 of the 18 ETPH concentrations exceed the RDEC of 500 mg/Kg.

## **VOCs**

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Ten of the twenty-five VOCs were detected in at least one of the 18 samples analyzed. All VOC concentrations are below the RDEC. Because of analytical interference, the laboratory had to dilute one sample, F1008S2 (2-4 fbg), and thus the detection limits for EDB and 1,2-dibromo-3-chloropropane exceed their respective RDEC.

## **SVOCs**

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Six of the seventeen SVOCs were detected in at least one sample. One SVOC, carbazole, was detected at a concentration exceeding the RDEC. Carbazole was detected in sample F1005S2 (2-4 fbg) at a concentration of 73,000 ug/Kg, exceeding the RDEC of 31,000 ug/Kg. This concentration is flagged with a "J" indicating that it is an estimated value below the reporting limit or a tentatively identified compound. Five of the eighteen samples contain at least one SVOC with a detection limit exceeding its respective RDEC.

Sample F1005S2 discussed above has six SVOCs with detection limits exceeding the RDEC.

### **PAHs**

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Sixteen of the seventeen PAHs analyzed for were detected. Eight of the seventeen were detected at concentrations exceeding the RDEC in at least one sample. Benzo(a)pyrene, benzo(a)anthracene, and benzo(b)fluoranthene are the most widespread, exceeding their respective RDEC in 12, 12, and 13 of 18 samples, respectively. Thirteen of 18 samples have at least one PAH concentration exceeding the RDEC. Table 13 shows generally similar proportions of exceeding concentrations in samples from blocks C and F.

### **Pesticides**

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Twelve of the seventeen pesticides analyzed for were detected in at least one sample. All detected pesticide concentrations are below the RDEC. Sample F1002S2 discussed earlier had to be diluted due to interference and six pesticides had detection limits exceeding their respective RDEC. These six pesticides were not detected in the sample.

### **PCBs**

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Two of the seven PCB arochlors were detected in at least one sample. Arochlor 1254 was detected in 4 of the 18 samples analyzed at concentrations ranging from 34 ug/Kg to 67 ug/Kg. Arochlor 1260 was detected in 13 of the 18 samples analyzed at concentrations ranging from 15 ug/Kg to 100 ug/Kg. Total PCB arochlor concentrations in all samples are below the RDEC of 1,000 ug/Kg. Sample F1002S2, which was diluted, has detection limits exceeding the RDEC in all seven arochlors analyzed.

### **Groundwater**

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Seven groundwater samples were collected within the Bryden Terrace Area. The locations are shown in blue on Sheet 1. The analytical results for the groundwater samples are summarized in Table 14.

Of the seven groundwater samples collected, five were from areas that had previously been filled (all groundwater samples from Blocks C and F). Only one of the 17 dissolved

metals was detected above the GWPC. Dissolved arsenic was detected in only one sample C1001W1 at a concentration of 12 ug/L. This concentration slightly exceeds the GWPC of 10 ug/L. All other detected dissolved metals concentrations are below their respective GWPC. The detection limits for thallium exceed the GWPC in all seven samples analyzed.

Only one VOC was detected at a concentration exceeding the GWPC. Chloroform was detected in sample C1006W1 at a concentration of 7 ug/L, which slightly exceeds the GWPC of 6 ug/L. All other VOC concentrations detected are below their respective GWPC.

Two of the nine SVOCs were detected in the groundwater, but only one [bis(2-ethylhexyl)phthalate] was detected at a concentration exceeding the GWPC. This SVOC was detected in all seven samples at concentrations ranging from 0.1 ug/L to 3 ug/L. Only the latter concentration of 3 ug/L detected in sample R1003W1 exceeds the GWPC of 2 ug/L. This sample is outside of the area of fill.

Four PAHs were detected at concentrations exceeding the RDEC. Two of the four exceed the GWPC in only one sample and both in sample F1005W1. Three samples contain at least one PAH at a concentration exceeding the GWPC. Each of these three samples is located in areas of fill within Blocks C and F. The detection limits for two PAHs in sample R1003W1 exceed their respective GWPC.

All detected pesticide concentrations are below the GWPC (where they exist). The detection limits for dieldrin exceed the GWPC in all six samples. All herbicide concentrations are below detection limits.

### **3.6 AUGER STREET AREA**

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The Auger Street Area occupies Block T and was added to the study area at the request of CTDEP. We drilled four borings within this section of the study area. CTDEP previously drilled six borings in this area and all boring locations are shown on Sheet 2.

The field investigation revealed a filled, elongated elliptical depression trending north south within the western portion of this study area. This depression was originally up to 8 feet below the surrounding ground level based on the CTDEP borings. Two Malcolm Pirnie borings, T1001 and T1002 penetrated fill up to 6.2 and 6.5 feet thick, respectively. The extent of the non-native material placed within this section of the study area is shown on Sheet 2 and has been delineated to the north by T1004, to the east by several CTDEP borings, and generally to the south by boring T1003. The western fill boundary has not been determined by boring data but is defined topographically and inferred to be generally consistent with the steep slope to the west where relief greatly exceeds the fill thickness encountered within the study area.

The non-native fill material encountered within this area is distinct from the fill material encountered within other sections of the study area. Two of the four Malcolm Pirnie borings penetrated fill material. The material encountered consists primarily of sand and gravel with only trace amounts of wood, concrete, brick, glass, and ash.

Beneath and around the filled areas is a brown to reddish brown natural layer of sand and gravel typically covered by a surface layer approximately 0.25 to 1.3 foot thick of brown organic topsoil.

The soil/fill analytical data for this section of the study area are presented in Table 15.

### **Arsenic and Lead**

At three of the four boring locations, surficial samples were collected and analyzed for arsenic and lead. Boring T1004 was drilled primarily to delineate the fill area. Lead and arsenic were detected in each of the three surficial samples. Surficial arsenic concentrations range from 2.3 mg/Kg to 5.38 mg/Kg, all of which are below the RDEC of 10 mg/Kg. Surficial lead concentrations range from 118 mg/Kg to 390 mg/Kg, all of which are below the RDEC of 400 mg/Kg.

Two of the three surficial samples were analyzed for SPLP arsenic and lead. SPLP arsenic concentrations were below the detection limits in both samples. SPLP lead was

detected in one of the two surficial samples at a concentration of 43.9 ug/L. This concentration detected in sample T1001S1 exceeds the GAPMC of 15 ug/L.

Two non-surficial fill samples were analyzed for arsenic and lead. Arsenic was detected in both samples at concentrations of 2.24 mg/Kg and 4.06 mg/Kg, both of which are below the RDEC of 10 mg/Kg. Lead was detected in both samples at concentrations of 70.7 mg/Kg and 281 mg/Kg, both of which are below the RDEC of 400 mg/Kg. Neither of the non-surficial fill samples were analyzed for SPLP arsenic and lead because all total arsenic and lead concentrations were below the RDEC.

Two samples of the underlying native soil were collected and analyzed for arsenic and lead. Arsenic was detected in both samples at concentrations of 1.73 mg/Kg and 1.8 mg/Kg, both of which are below the RDEC of 10 mg/Kg. Lead was detected in both samples at concentrations of 7.86 mg/Kg and 43.9 mg/Kg, both of which are below the RDEC of 400 mg/Kg.

Both of the underlying native soil samples were analyzed for SPLP arsenic and lead. All SPLP arsenic and SPLP lead concentrations are below detection limits.

### **Metals**

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One sample, T1002S2 (6-7 fbg) was analyzed for the full suite of metals. All concentrations are below the RDEC. This sample was not analyzed for SPLP metals.

### **ETPH**

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ETPH was detected at a concentration of 950 mg/Kg in the one non-surficial fill sample analyzed. This concentration exceeds the RDEC of 500 mg/Kg.

### **VOCs**

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Acetone was the only VOC detected in the sample. It was detected at a concentration of 190 ug/Kg, below the RDEC of 500,000 ug/Kg.

### **SVOCs**

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Five SVOCs were detected, and all concentrations are below the RDEC.

## **PAHs**

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All 17 PAHs were detected in the sample; however, 7 of the 17 PAH concentrations are flagged with a "J" indicating that the result is an estimated value below the reporting limit or a tentatively identified compound. Three of the seventeen PAHs [benzo(a)pyrene, benzo(a)anthracene, and benzo(b)fluoranthene] were detected at concentrations exceeding the RDEC of 1,000 ug/Kg.

## **Pesticides**

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Two pesticides were detected. 4,4-DDE and 4,4-DDT were detected at concentrations of 24 ug/Kg and 230 ug/Kg, respectively. Both detected concentrations are below the RDEC of 1,800 ug/kg.

## **PCBs**

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Two of the seven PCB arochlors were detected. Arochlor 1254 and arochlor 1260 were detected at concentrations of 25 ug/Kg and 21 ug/Kg, respectively. The total PCB concentration in this sample is 46 ug/Kg, well below the RDEC of 1,000 ug/Kg.

## **Groundwater**

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Two groundwater samples from this section of the study area were collected and analyzed. Boring T1001 penetrated fill material; however, the groundwater table was encountered at approximately 29 fbg. Boring T1003 did not penetrate any fill material, and the groundwater table was encountered at approximately 17.5 fbg.

All detected dissolved metals concentrations are below the GWPC. The detection limits for dissolved thallium exceed the GWPC in both samples analyzed.

All detected VOC, SVOC, PAH, and pesticide concentrations are below the GWPC. Aside from thallium mentioned above, the detection limits for one VOC (EDB) and one pesticide (dieldrin) exceed their respective GWPC. Neither compound was detected in either of the samples analyzed.

## **Appendix A – Work Plan and Correspondence**

## **Appendix B – Boring Logs**

## **Appendix C – Field Photos**

## **Appendix D – Laboratory Reports**