8.0 REMEDIAL INVESTIGATION FOR SITE 21- BUILDING 162 (SHIP FITTING AND ENGINE REPAIR)

This section describes the history and setting of Site 21 (Section 8.1), environmental investigations conducted at Site 21 (Section 8.2), the remedial investigation (RI) results (Section 8.3), and the RI conclusions and recommendations (Section 8.4). The RI results section addresses only soil at Site 21. This section does not address the groundwater located beneath Site 21, because this plume also lies beneath all of the other OU-2B sites, and thus it required a separate report section (see Section 9.0) to fully address OU-wide groundwater contaminants in terms of their nature and extent, fate and transport, and risks. Appendices E, F, and G, respectively, present the complete background comparison, human health risk assessment (HHRA), and ecological risk assessment (ERA) for OU-2B.

8.1 SITE 21 HISTORY AND SETTING

Site 21 is located in the eastern portion of Alameda Point south of West Seaplane Lagoon Street, west of Viking Street, north of corrective action area (CAA)-11A, and east of Seaplane Lagoon Road (see Figure 8-1). Site 21 measures about 7 acres, is irregularly shaped, and consists of Parcels 127, 135, 136, and 200, and Subparcel 155A. It is currently considered an intensively developed area consisting primarily of buildings, roads, and parking lots, and is bordered by intensively developed areas (see Figure 2-6). There is little vegetation at the site. Typical urban wildlife, such as the California ground squirrel, scrub jays, and American robins, have been observed in the intensively developed areas but to a lesser extent than in the landscaped/developed areas because less foraging habitat is available. Feral cats also are found in intensively developed areas (U.S. Department of the Navy [Navy] 1999).

Section 8.1.1 discusses the history of Site 21, including specific details about physical features and activities associated with hazardous waste generation or past disposal and storage practices, and Section 8.1.2 discusses future land use at Site 21.

8.1.1 History

Approximately 50 percent of Site 21 is covered with asphalt and concrete, and the rest of the site consists of buildings, roads, and parking lots. The northern portion of Site 21 is designated as part of CAA-3A and the southwestern corner as part of CAA-11A because of petroleum hydrocarbon contamination in groundwater at these locations. The main feature of Site 21 is Building 162, which was constructed in 1945 and operated as a ship and aircraft maintenance shop. Operations ceased in April 1997 (International Technology Corporation [IT] 2001a). Associated with Building 162 are oil-water separator (OWS)-162, Naval Air Station (NAS) generator accumulation point (GAP) 11, Naval Aviation Depot (NADEP) GAP 46, solid waste management unit (SWMU) 162, and underground storage tanks (UST) 162-1 and 162-2. Additional site features include Buildings 113 and 398, and former Building 349. Associated with Building 113 are NADEP GAP 76, NADEP GAP 77, and aboveground storage tank (AST) 113. Associated with Building 398 are Structure 470, NADEP GAP 44, NADEP GAP 45, Resource Conservation and Recovery Act (RCRA) Site M-07, and USTs 398-1 and 398-2.

Sitewide features include underground fuel lines, storm sewers, and open space. The history and description of each of these physical features summarized below was developed based on review of various reports and historical aerial photographs.

Building 162. Building 162, the ship and aircraft maintenance facility, occupies approximately 107,029 square feet (ft^2). Activities included the overhaul and repair of aircraft engines, ship fitting (Ship Intermediate Maintenance Activity), and building maintenance. Building 162 may have been used as a service station by the Navy exchange. The building is a wood structure with concrete floors. Multiple stains were visible on the concrete floor during the environmental baseline survey (EBS) investigation (ERM-West 1994). Permits were formerly issued for a spray booth, abrasive blasting, solvent use, solvent and chemical cleaning, an engine test stand, and an oven dryer. Chemical storage cabinets were located throughout the main floor. Hazardous wastes stored in drums included spent sand blasting abrasives, spent oil absorbents, oil-water mixtures, metals, caustics, plating solutions, and photographic solutions. Larger quantities of paint, petroleum products, halogenated and nonhalogenated organics, metals, and corrosives were stored in and around the building (ERM-West 1994). Alameda Reuse and Redevelopment Authority (ARRA) currently leases the building.

OWS-162. OWS-162 is located at the southeast corner of Building 162 (ERM-West 1994). A soil sample collected near this unit contained oil and grease at a concentration of 772 milligrams per kilogram (mg/kg). The site is being evaluated under CAA-11 as part of the TPH Program. No further action (NFA) for OWS-162 is recommended (Tetra Tech EM Inc. [Tetra Tech] 2003a). A Navy recommendation for NFA is included in Appendix I.

NAS GAP 11. NAS GAP 11 was a non-permitted RCRA area inside Building 162 consisting of a sump used to collect waste oils (IT 2001). This GAP was not included in the 1992 RCRA facility assessment (RFA). During a May 2002 visit inside Building 162, no definitive markings denoted the exact location of NAS GAP 11. The general area and surrounding areas were vacant, and no staining or corrosion was observed on the floors. NFA is recommended for NADEP GAP 11 (Tetra Tech 2003a). A Navy recommendation for NFA is included in SWMU Appendix (Appendix I).

NADEP GAP 46. NADEP GAP 46 is a non-permitted RCRA GAP. The GAP was located inside Building 162, the former ship and aircraft maintenance shop (Tetra Tech 2003a). Aerosol paint; 1,1,1-trichloroethane (TCA); lubrication oil; PD-680; and acetone were stored in this GAP (Tetra Tech 2003a). A Navy recommendation for NFA is included in Appendix I.

SWMU 162. SWMU 162 is a non-permitted RCRA GAP. Oil and 1,1,1-TCA were stored in this SWMU. The SWMU was located inside Building 162, the former ship and aircraft maintenance shop (Tetra Tech 2003a). A Navy recommendation for NFA is included in SWMU Appendix (Appendix I).

USTs 162-1 and 162-2. USTs 162-1 and 162-2 were associated with Building 162, the former ship and aircraft maintenance facility. The USTs were 100-gallon, steel diesel fuel tanks. Both tanks were removed in January 1995 with no over-excavation (Tetra Tech 2003a). The tanks

were observed to be in good condition upon removal. NFA is recommended (Tetra Tech 2003a). The USTs, collectively referred to as UST(R)-09, were integrated with the TPH program and are recommended for NFA.

Building 113. Building 113 was built some time between 1947 and 1957 and used to overhaul air conditioning parts and for welding, abrasive blasting, container repair, and as a paint shop. Permits were formerly issued for a spray booth and abrasive blasting. The 13,115-ft^2, concrete-floor building was also used for jet engine container overhaul. Chemicals including paints, resins, hydroxides, solvents, and cleaners were stored in cabinets in the paint room. Other chemicals stored in the building included penetrating oil, resin, silicone, sodium hydroxide, solvent stripper, phenol, and ethanolamine. A blast booth covered one-sixteenth of the building and was used for removing rust from containers. At the time of the Phase I EBS, a paint booth was located on the south side of the building, and paint and oil covered the entire floor area in this room (ERM-West 1994). The building has been vacant since May 2002.

NADEP GAP 76. NADEP GAP 76 is a non-permitted RCRA GAP. The GAP was associated with the former jet engine container overhaul shop in Building 113. Aerosol paint; rust remover; lacquer thinner; oil; enamel paint; and 1,1,1-TCA were stored in this GAP (Tetra Tech 2003a). During the Phase I EBS, PD680 dry cleaning solvent, naphtha (paper towels)-contaminated with JP-5 aviation fuel (including ethylbenzene), oil, and materials related to paint wastes were stored at this GAP (ERM-West 1994). A Navy recommendation for NFA is included in Appendix I.

NADEP GAP 77. NADEP GAP 77 is a non-permitted RCRA GAP. The GAP was associated with the southeastern corner of Building 113 and Shop 96215, the former jet engine container overhaul shop. Blasting grit was stored in this GAP (Tetra Tech 2003a). A Navy recommendation for NFA is included in Appendix I.

ASTs 113. AST 113 was located near the southeast corner of Building 113. The fiberglass AST supplied diesel fuel to Building 113. As of August of 2002, the tank had been removed. The only remaining component is a pipe that extends from Building 113 to the tank. The tank was integrated with the TPH Program and recommended for NFA in a report on the status of ASTs at Alameda Point, dated November 30, 2004 (Tetra Tech 2004).

Building 398. Building 398, the turbine accessories shop, was built in 1957 at the former location of an aluminum recovery smelting operation run by the Navy. The 31,900-ft^2, two-story, concrete-floor building was used as an aircraft engine testing facility and currently is leased by ARRA. Activities in the building included turbine engine testing, solvent cleaning and degreasing, use of miscellaneous chemicals, operation of a spray booth, storage of JP-5 in UST 398-1, abrasive blasting, operation of an electrical components shop, overhauling of pneumatic-hydraulic components, and repair of auxiliary power units. Solvent cleaner (PD-680); a 1,1,1-TCA recovery system; halogenated hydrocarbons; paint; grease; and chemical storage cabinets were observed in the building's cleaning room. The second floor starter and valve shops used and stored oil, grease, solvents, and paints. The auxiliary power unit used and stored acrylic lacquers, grease, acrylic paints, hydraulic fluids, dyes, and aerosols. Multiple stains from former spills are present in Building 398 in the cleaning room, control room, test cells (104,

109A, and 114 through 117), on the second floor, and outside in the UST area (ERM-West 1994). Chemicals formerly stored on the east side of the building at NADEP GAP 44 included fuel products, petroleum waste oil products, and halogenated and nonhalogenated organics (paint). Drums in this area were stored on pallets without secondary containment next to a storm drain (ERM-West 1994).

According to Ms. Luanne Tetrick, a former NADEP facilities manager, a drum storage area was formerly located on the west exterior side of Building 398. Solvents, oils, and various cleaners were stored in 55-gallon drums here, and drips occurred during transfer operations. According to Mr. Phillip Vercelli, an NADEP employee from 1945 to 1982, a smelting operation was previously located where Building 398 is currently located and scrap was cut up and smelted to recover aluminum (ERM-West 1994). The location of the smelting operation is confirmed by a 1947 aerial photograph where the smelting area is evident and the ground surrounding the area appears to be heavily stained (Pacific Aerial Surveys, various years). Mercury manometers were used in the building according to Mr. Lyn Stirewalt, a former NADEP employee. He reported that mercury was spilled on test stands and spills occurred often over a period of decades (ERM-West 1994).

Structure 470. Structure 470, an air vacuum pumping station, was built in 1961. The metal building has a concrete floor and houses a vacuum pump associated with Building 398. The 384-ft^2 structure was used for aircraft and engine overhaul. Materials associated with aircraft and engine overhaul and some nonhazardous materials were reportedly stored in this building (ERM-West 1994).

NADEP GAP 44. NADEP GAP 44 is a non-permitted RCRA area associated with Building 398 and Shop 96327, a former aircraft engine testing facility. Lubrication oil, JP-5, and M-114 solvent were stored at the GAP. NADEP GAP 44 consisted of three 500-gallon square containers (also known as "bowsers") located outside of Building 398 east of the northern wing. Chemicals formerly stored included lubrication oil, JP-5, and M-114 solvent.

NADEP GAP 45. NADEP GAP 45 is a non-permitted RCRA area associated with Building 398 and Shop 96327, a former aircraft engine testing facility. Aerosol paint, waste oil, filters, spent solvents, spent cleaning compounds, and used paper towels (with JP-5, hydraulic fluids and oil) were stored at the site (ERM-West 1994). NADEP GAP 45 consisted of 30- and 55-gallon drums atop a wooden pallet (removed using a forklift) located under a covered walkway of Building 398 inside the northwestern portion of the eastern wing. During a May 2002 site visit, a faded red and white rectangle on concrete outside of Building 398 was all that remained of NADEP GAP 45. The surrounding area was vacant. Minor staining was visible, most likely from outside elements (such as water and bird debris). An expansion joint was present in the concrete, but no stains were apparent within the joint. A Navy recommendation for NFA is included in Appendix I.

RCRA Site M-07. M-07 is a non-permitted RCRA site consisting of an inactive, portable, 15-gallon solvent distillation unit that likely was located in the northern portion of Building 398 in one of the engine test cells. PD-680, paint, thinner, and acetone were formerly stored at the

site (Tetra Tech 2003a). According to the RFA report, a RCRA facility investigation (RFI) was not recommended for RCRA Site M-07 because it was located inside and on a concrete floor (California Environmental Protection Agency Department of Toxic Substances Control [DTSC] 1992). During a May 2002 site visit, no definitive markings were left in Building 398 to denote the exact location of the site. Building tenants had reconditioned all Building 398 floors and remodeled the inside. According to one of the tenants, the floors were washed, stripped, and cleaned until any staining was removed. All cracks were repaired, and the floors were painted twice before sealing. A Navy recommendation for NFA is included in Appendix I.

USTs 398-1 and 398-2. USTs 398-1 and 398-2, referred to as area of concern (AOC) 398, are a RCRA Part B-listed site located in CAA 3A. USTs 398-1 and 398-2 are steel, 10,000-gallon tanks associated with Building 398. The USTs stored JP-5 (389-1) and JP-TS (398-2) from the time they were installed in 1969 until they were removed in April 1995. At the time of removal, the tanks were observed to be in good condition. No over-excavation was conducted; however, floating free product was detected during the removal of both USTs and during subsequent RI activities (Tetra Tech 2000d). The most recent data for the USTs will be evaluated using the TPH strategy (see Appendix H) to determine if an NFA closure report can be completed (Tetra Tech 2003c).

Former Building 349. Former Building 349 was built in 1948 and functioned as an aircraft overhaul, repair, and fuel system accessory building. The Phase I EBS investigation report indicates that the building was a 4,000-ft^2 Quonset hut with a concrete floor where solvents were used. Nonhalogenated organic lubricants and solvents were stored in drums and cabinets. During the Phase I EBS investigation, a hose was observed emerging from the building and draining directly into a storm drain. An oil-filled transformer was also observed adjacent to the south side of Building 349. Small stains led from the transformer platform to an adjacent storm drain (ERM-West 1994). Building 349 is present in a 1988 aerial photograph but is not present in a 1996 aerial photograph. All that remained of Building 349 in the 1996 photograph was a concrete pad, and staining was evident on the pad (Pacific Aerial Surveys, various years).

Fuel Lines. The fuel lines were located east of Seaplane Lagoon and were removed by IT in 1998 (Tetra Tech 2000d). The former fuel lines are located within CAA-3A, where studies to evaluate TPH are ongoing.

Storm Sewers. Multiple segments of storm sewers are present at Site 21. Figure 8-2 shows the location and condition of storm sewers at Site 21. Most are in sound condition, but actual or potential infiltration has been observed in limited segments at some of the lines. (Tetra Tech 2000b). The storm sewers from Site 21 flow to Outfalls G and H in Seaplane Lagoon. Storm sewer lines are considered to be possible preferential pathways for contaminants in groundwater, if they are below (or likely below) the groundwater table and exhibit sags in areas where they intersect a groundwater contaminant plume. The sags indicate areas where the storm sewer appears to have settled. They do not necessarily indicate breaks in the line where groundwater could infiltrate into the storm sewer.

One storm sewer line originates from between Buildings 398 and 470 in catch basin 3G-1C and flows north to manhole 3G-1. This line is likely below the groundwater table and is located within the OU-wide groundwater plume boundary. Another line runs parallel to the south side of Building 398, and most of this line is likely below the groundwater table and therefore likely located within the OU-wide groundwater plume. This line extends beyond the eastern boundary of Site 21 between manholes 2G-1 and 2G, then turns south and back to the site. A small line extends out of this line from catch basin 1GA. This line continues south and is likely below the groundwater table; therefore, the line is likely located within the OU-wide groundwater plume. This line eventually empties into Seaplane Lagoon from Outfall G.

Building 162 is connected to the storm sewer system by two lines. One line runs parallel to the north side of Building 162 and is likely above the groundwater table between its origination point west of manholes 2G-4 and 2G-3. The line continues northwest out of the site to manhole 2G-1. This section likely is below the groundwater table and therefore likely to be within the OU-wide groundwater plume. A line that originates east of Site 21 runs parallel to the south side of Building 162. Features of this line include manholes 5H, 4H, 3H, and 1H; OWS-162; and catch basins 4HA and 1-1H. The section of line between manholes 4H and 3H was considered a 'low-priority line' by the storm-sewer report for corrective action. The eastern portion of this line is below the groundwater table; no information is available for the section between manholes 3H and 1H. The section between manhole 1H to catch basin 1-1H is likely below the groundwater table.

Open Space. Approximately 50 percent of Site 21 is open space consisting of asphalt parking and storage areas, concrete storage aprons associated with buildings, and concrete paved areas near Seaplane Lagoon. The open space at Site 21 has had many historic uses. Historic aerial photographs of Site 21 indicate the following information. In 1947, the entire northern portion of the site was a smelting and storage area, and the pavement appeared heavily stained across the entire area. A parking lot covered the area where Building 113 is presently located. In 1957, the northeastern portion of the site appeared to be a storage area. A parking lot was located on the west side of Building 113. In 1969 the area east of Building 398 was a parking lot. Cars were parked along the west side of Building 113, and the area south of this building appeared to be a parking and storage area. Staining is evident just south of Building 162. In 1975, the area west of Building 398 was used to store drums, bins, and boxes, and no staining is apparent on the ground in the area. In 1988, the area east of Building 398 was a parking lot and drum and container storage area; no staining was evident. Drums and other storage materials were evident east of Building 113 and west of Building 162. In 1996, the area east of Building 398 was used for parking (Pacific Aerial Surveys, various years).

8.1.2 Future Land Use

According to the "NAS Alameda Community Reuse Plan," Site 21 is located in the Marina District (see Figure 2-2). The most likely reuses for Site 21 include residential and commercial or light industrial activities (EDAW, Inc. 1996).

The Marina District is planned to cover about 126 acres around the entire shoreline of the Seaplane Lagoon. The Navy used this reuse area primarily for deepwater ship and seaplane berthing, and equipment storage and repair. A proposed open space promenade extending from the Civic Core would open into a civic plaza as it meets the water's edge in the area. A hotel and conference center would be built on 4 acres. Civic uses, such as office space, a cultural arts center or theater, and recreational areas, could front the plaza. Housing in the area would be limited to the eastern shore of the Seaplane Lagoon and would provide opportunities for a mix of housing types and income levels. Housing could include artists' lofts, apartments for low- to moderate-income families, and townhouses consistent with Measure A and the City Charter (Navy 1999c).

8.2 ENVIRONMENTAL INVESTIGATIONS

This section describes each environmental investigation conducted at Site 21 under the Installation Restoration (IR) Program, which include investigations conducted under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the EBS, and the TPH Program. No data were collected under the RCRA Program. Tables 8-1 and 8-2 summarize the soil and soil gas and groundwater samples collected by investigation and the types of analyses conducted. Sampling locations are shown on Figures 8-3 and 8-4 and are categorized by investigation. Results for each of the investigations are summarized in Tables 8-3 through 8-16. The summaries are organized according to medium and analytical group and include the following information: (1) the number and percent of detections of chemicals; (2) the average, minimum, and maximum detected concentrations; (3) minimum and maximum detection limits for non-detected samples; and (4) whether the maximum detected concentrations or detection limits exceed Region 9 residential preliminary remediation goals (PRG) or California-modified PRGs (U.S. Environmental Protection Agency [EPA] 2002). PRGs and MCLs are provided in the tables for comparison purposes only.

The following subsections summarize investigations conducted at Site 3 under CERCLA, the EBS, and the TPH Program.

8.2.1 Comprehensive Environmental Response, Compensation, and Liability Act Investigations

Investigations conducted at Site 21 in conformance with CERCLA include the Phases 2B and 3 investigation, follow-on investigations in 1994 and 1998, supplemental RI data gap sampling, basewide groundwater monitoring, and a basewide polynuclear aromatic hydrocarbon (PAH) investigation. Each investigation is summarized below.

Phase 2B and 3 Investigations, 1991. In 1991, the initial RI was conducted at Site 21 as part of the Phase 2B and 3 investigation activities. During the Phase 2B and 3 investigation, the current Site 21 was part of Site 7, which included Buildings 459, 547, and 162. During subsequent investigations, Building 162 was separated from the other buildings and designated as Site 21. Sampling was conducted in accordance with the RI field sampling plan (FSP) sampling plan (Canonie 1989 and 1990). The primary objective of the investigation was to

determine if soil and groundwater were contaminated in areas identified as potential waste release sites (Canonie 1989 and 1990). Many potential waste release sites were first identified during: the initial assessment study conducted in 1983 (E&E 1983) and a confirmation study conducted in 1985 (Wahler Associates 1985). Other potential release sites are identified in the FSP (Canonie 1989 and 1990). The waste release areas were generally identified as buildings, tank locations, and other areas where activities could have contaminated soil and groundwater. As more information has become available through additional investigations, site boundaries were revised to encompass groundwater plumes.

The FSP identifies Building 162 as a potential waste release area currently located within the Site 21 boundary. The objective of Building 162 sampling activities was to characterize contamination from the service station previously located at Building 162. Prior to this investigation, no information was available regarding USTs at the service center from site visits, interviews with NAS Alameda personnel, or records (Canonie 1989 and 1990).

Two soil borings, B07B-01 and B07B-02, were advanced on the north side of Building 162, and a third boring, B07B-03, was advanced on the west side of the building (see Figure 8-3). Nine soil samples were collected from these soil borings. Surface samples were analyzed for semivolatile organic compounds (SVOC), TPH, pesticides, and metals (see Table 8-1). Subsurface samples were analyzed for the same constituents plus volatile organic compounds (VOC).

Monitoring well M07B-01 was installed in the soil boring located on the west side of building 162. Two groundwater samples were collected; one from M07B-01 and one from WA-8 (see Figure 8-3). The groundwater samples were analyzed for VOCs, SVOCs, TPH, metals, pesticides, total organic carbon (TOC), pH, and various anions (see Table 8-2).

According to the investigation summary for Site 21 (PRC Environmental Management, Inc. [PRC] and Montgomery Watson [MW] 1993), VOCs; acetone, carbon disulfide, methylene chloride, 1,2-DCE, and xylene were detected in soil at Site 21. Acetone was detected in all but one sample, methylene chloride was detected in 15 samples, and total 1,2-DCE and xylene were detected in one sample. PAH had several detections in native soils only at depths of 8 feet or more. Determination of whether levels of these contaminates were elevated was not made.

Follow-On Investigation, 1994. The purpose of this investigation was to fill data gaps from previous investigations by collecting additional chemical, geological, and hydrogeological data to further characterize the nature and extent of soil and groundwater contamination at Site 21. Field activities included cone penetrometer testing (CPT), direct-push groundwater sampling, soil sampling, monitoring well installation and sampling, and storm drain sediment sampling (PRC and MW 1995a).

The objective of the CPT sampling program was to evaluate lithology and hydrogeologic characteristics below 15 feet below ground surface (bgs) and to identify the second water-bearing zone (SWBZ). Two CPT points (CPT-S07B-01 and CPT-S07B-02) were tested at Site 21. No soil samples were collected during the CPT; however, two direct-push groundwater

samples (DHP-S07B-01 and DHP-S07B-02), one from each CPT location, were collected from the SWBZ (see Figure 8-3). The samples were analyzed for VOCs (including benzene, toluene, ethylbenzene, and xylenes [BTEX]), TPH, metals, and general chemical characteristics (including total dissolved solids, TOC, and chemical oxygen demand [COD]) (see Table 8-2).

Nine soil samples were collected from two soil borings (B07B-04 and B07B-05) and one monitoring well location (M11-06) to further evaluate the vertical nature and extent of contaminants in the area of the borings. Samples were collected from the surface and 2.5 and 5 feet bgs from each boring and monitoring well location. The soil samples were analyzed for VOCs (except surface samples), SVOCs, TPH, metals, and general chemistry (see Table 8-1). Soil samples from borings B07B-04 and B07B-05 also were analyzed for TOC, COD, and pesticides. In addition, a geotechnical sample was collected from 3.5 and 10 feet bgs at the monitoring well location.

One shallow monitoring well, M11-06, was installed at Site 21 (see Figure 8-3). A quarterly groundwater monitoring program was conducted from October 1994 to August 1995. Samples were collected each quarter from monitoring well M11-06 and analyzed for VOCs, SVOCs, ethylene dibromide, dissolved metals, cyanide, pesticides and PCBs, TPH, sulfide, and general chemistry parameters (see Table 8-2).

Two storm drain sediment samples, NPS-S7B-01 and NPS-S7B-02, were collected from Site 21. Sample NPS-S7B-01 was collected from the storm drain on the northeast side of Building 162, and sample NPS-S7B-02 was collected from the storm drain on the southeastern corner of Building 162. The samples were analyzed for VOCs, SVOCs, TPH, and metals (see Table 8-1).

According to the data summary report (PRC and MW, 1995) TPH as motor oil was detected in 13 of 33 soil samples from the northeast corner of Building 162. Samples from the northeast corner of 162 also had detections of TPH as gasoline and pesticides. Solvent-related VOCs were detected in four wells located along the west side of Building 162. TPH as motor oil was detected in all soil samples located in the SWBZ.

Storm Sewer Removal, 1997. This removal action was conducted to address elevated levels of organic and inorganic contaminants in the sediments and debris located within the storm sewer system. The Navy Public Works Center (PWC), using a vacuum, removed sediments and debris within the catch basins and manholes of the storm sewer system (Phase I of the removal action) and IT removed sediments and debris in the storm sewer system lines and associated manholes (Phase II of the removal action). Following the removal action, closed-circuit television was used to survey cleaned lines. Site-specific objectives of this removal action were to reduce the potential for sediments and debris in the storm sewer system, which contain elevated concentrations of VOCs, SVOCs, pesticides, heavy metals, and fuel-related hydrocarbons, from impacting nearby human populations, animals, the food chain, drinking water supplies, or sensitive ecosystems.

Site 21 contains storm sewer lines that are part of Subsystems G and H (see Figure 8-2). According to the storm sewer report, one storm sewer section (3H-4H) at Site 21 extended into a

BTEX plume and was in poor condition. Seven additional sections were characterized as non-priority lines in sound condition with a recommendation of NFA (Tetra Tech, 2000b).

Follow-On Investigation, 1998. The objectives of the 1998 investigation was to further characterize groundwater plumes, monitor solvent concentrations and plume movement, and further evaluate the source of solvents in the groundwater through quarterly groundwater sampling and a tidal influence study. Four quarters of groundwater monitoring were conducted during this investigation. Samples were collected each quarter from monitoring wells M07B-01 and M11-06 (see Figure 8-3). Samples collected were analyzed for VOCs and dissolved metals. In addition, samples collected during the first quarter were analyzed for TOC (Tetra Tech 1997c) (see Table 8-2).

To further evaluate the extent of chlorinated solvent plumes that covered multiple sites at OU-2B, several groundwater samples were collected using direct push techniques. A total of 32 groundwater samples were collected at depths ranging from 9.5 to 45 feet bgs from 9 locations within the Site 21 boundary (see Figure 8-3). See Tables 8-2 for a list of samples and analyses performed.

The tidal influence study was conducted over 24 hours and included 23 wells. Five wells were located in the southeast corner of Alameda Point, and one deep monitoring well (D11-01) was monitored at Site 11, which is adjacent to Site 21. D11-01 is screened in the SWBZ; the water elevation in this well changed by 1.1 feet during the 24-hour study. This monitoring well is located approximately 585 feet from the Seaplane Lagoon and had an estimated lag time for tidal response of 1 hour. Because Sites 21 and 11 are the same distance from Seaplane Lagoon and adjacent to each other, it is assumed that the SWBZ at Site 21 undergoes tidal fluctuations similar to those observed at Site 11.

According to the investigation summary (Tetra Tech 1997c) at Site 21, concentrations of one or more organic compounds exceeded their respective MCLs. Additionally, VOCs, trichloroethene (TCE), and vinyl chloride were detected in various concentrations much lower than the neighboring Site 4. The metals (arsenic, barium, cadmium, chromium, cobalt, lead, copper, manganese, mercury, molybdenum, nickel, selenium, vanadium, and zinc) were also detected (Tetra Tech 1997c).

Supplemental Remedial Investigation Data Gap Sampling, 2001. The specific objectives of data gap sampling at Site 11 were (1) delineation of chlorinated VOCs plumes in groundwater, (2) investigation of storm sewer pathways, and (3) soil gas sampling to support vapor intrusion modeling in the HHRA (Tetra Tech 2001b, 2002). As the data for OU-2B and Site 21 were evaluated, it became apparent that characterization of the lateral and vertical limits of the groundwater contamination plumes was insufficient. Subsequently, the Navy implemented the data gap sampling program in 2001 and 2002. The overall objectives of data gap sampling at Site 21 were to investigate (1) chlorinated VOCs in groundwater in the vicinity of Buildings 162 and 398, and (2) TPH in groundwater along the fuel line west of Building 162. To evaluate these plumes, 112 groundwater samples were collected from 5 to 50 feet bgs using direct-push techniques (see Figure 8-3). Five monitoring wells were also sampled. Groundwater

samples collected using direct-push techniques were analyzed for various chemicals including SVOCs, PAHs, VOCs, TPH, and dissolved gases (see Table 8-2). In addition, one soil sample (M07B-01) and four soil gas sample were collected (see Figure 8-3). See Table 8-1 for the analyses conducted.

Based on the report (Tetra Tech 2002), TPH contamination was detected along the fuel line west of Building 162, and the lateral and vertical boundaries of the VOC and TPH plumes have been defined, except at one location northwest of Site 21. One step out sample was recommended at this location. Because TPH plumes are commingled with the chlorinated VOCs, investigation under the CERCLA program was recommended.

During the storm sewer investigation, storm sewer bedding material samples were collected from locations S21-DGS-OF-G-GWI and S21-DGS-MH-6H-GWI to determine the potential infiltration of contaminated groundwater into the storm sewers and to evaluate the bedding material as a potential pathway. Sediment was sampled from two manholes (1G and 1H) associated with the storm sewer and analyzed for VOCs and TPH. Samples were analyzed at an on-site mobile laboratory. These chemical concentrations do not exceed ecological reference values (ERV); therefore, these particular pathways draining out through Outfall G and Outfall H were not evaluated further.

Basewide Investigation of Transformer Pads, 2001. The Navy conducted a basewide investigation to identify transformers with polychlorinated biphenyl (PCB) concentrations greater than 50 parts per million (ppm) for replacement. Wipe samples were collected around stained transformers, and no PCB contamination was detected in Site 21 that warranted further action (Innovative Technical Solutions, Inc. 2002).

Basewide Groundwater Monitoring, 2002. Two shallow monitoring wells (M11-06 and WA-8) at Site 21 were identified for sampling (see Figure 8-3). The wells were sampled quarterly for VOCs and TPH and semiannually for dissolved metals and general chemistry parameters (see Table 8-2). In addition, WA-8 was sampled semiannually for dissolved gases.

According to the groundwater monitoring report (Shaw Environmental & Infrastructure, Inc. [Shaw] 2003a), during four quarters of groundwater monitoring, concentrations of one or more chemicals exceeded their respective 2002 MCLs. These chemicals included trichloroethane (TCA) 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), vinyl chloride, 1,2-DCE (cis), 1,2-DCE (trans), 1,4-dichlorobenzene, benzene, and total petroleum hydrocarbons (TPH), aluminum, arsenic, selenium, lead, thallium, nickel and chromium (Shaw 2003a).

According to the data results for the summer investigation, VOCs and TPH constituents were present at levels exceeding MCLs in various locations in the first water-bearing zone (FWBZ). Aluminum and selenium, however, were detected in the FWBZ and SWBZ. Fall results indicated that TCE, DCE, cis-1,2-DCE, and vinyl chloride were detected in the upper zone of the Merritt Sand located west and downgradient of Building 360. Samples from the wells installed in the "upper sandy zone" along the eastern perimeter did not have VOC detections exceeding the MCLs. Winter results indicated that the distribution of TCE in the upper fine-grained zone of

the Merritt Sand is similar in distribution between the summer and winter investigations of 2002 (Shaw 2003a).

When compared to the winter data, TCE concentrations in various wells have fluctuated. Groundwater elevations from the wells show a general increase in groundwater elevations between the Winter 2002 and the Spring 2003 sampling events. Since the Fall 2002 event, 1,1-DCE concentrations vary in response to water level.

Basewide PAH Investigation, 2003. The objective of this investigation was to collect sufficient PAH data to calculate exposure point concentrations (EPCs) for risk assessments at CERCLA sites (Bechtel Environmental Inc. [Bechtel] 2003a). The historical PAH data collected at each CERCLA site were used to estimate the mean and standard deviation of benzo(a)pyrene (B(a)P) concentrations to determine the appropriate number of samples to collect at each site. At Site 21, 21 soil borings were advanced using direct-push sample methods (see Figure 8-3). Samples were collected separately from 0 to 0.5, 0.5 to 2, 2 to 4, and 4 feet to 8 feet bgs.

According to the technical memorandum (Bechtel 2003), PAHs (expressed as B[a]P equivalents) were detected at concentrations below the 2002 residential soil PRG of 62 micrograms per kilogram (µg/kg) in 83 percent of the samples, and concentrations were less than 620 µg/kg in 99 percent of the samples (Bechtel 2003b). Data quality was determined to be adequate.

8.2.2 Environmental Baseline Survey Investigations

Site 21 lies within Zone 17 and is comprised of Parcels 127, 135, 136, 200 and a portion of 155A (see Figure 8-1). As a part of the EBS, these parcels were investigated under the Phase 1, 2A, and 2B investigations and a storm water corridor study. An EBS is a fence-to-fence environmental survey of an installation to collect data and document current environmental conditions. Each EBS-related investigation is discussed below.

Phase 1. The primary objectives of this investigation were to identify Community Environmental Response Facilitation Act of 1992 (CERFA)-eligible parcels, and classify parcels into area types according to the Base Realignment and Closure (BRAC) Cleanup Plan Guidebook. Based on this evaluation, Parcels 127, 136, 200, and sub-parcel 155A were designated as BRAC Area Type 7, which is the "areas that are unevaluated or that require further action" (ERM-West 1994). Parcels classified in this category have data gaps that would require additional physical inspection, site history investigation, and/or sampling. Parcel 135 was designated as BRAC Area Type 6, which is the "areas of known contamination where required response actions have not yet been implemented" (ERM-West 1994). These areas contain contamination concentrations above action levels and required remedial systems have not been selected or implemented. Based on these BRAC designations, Site 21 was included in the next EBS, Phases 2A and 2B.

Phases 2A and 2B. Soil sampling was conducted at Parcel 127 in June 1995 to investigate three target areas (see Figure 8-4). Target area 1 included the central test cell area of

Building 398, target area 2 addressed the surface staining observed around NADEP GAP Sites 44 and 45 and target area 3 addressed the open space on the east side of Building 398 where possible staining was observed in aerial photographs. Soil sampling was conducted at Parcel 135 in June 1995 to investigate two areas of staining and NAS GAP Site 11 (a sump containing waste oils) located within Building 162. Soil sampling was conducted at Parcel 136 in June 1995 to investigate staining in the Shop Area and the Paint Booth located inside Building 113 and industrial sewer corridor sampling was conducted in December 1994 as part of the EBS Phase 2A. Soil sampling was not conducted at Parcel 200 or sub-Parcel 155A that lies within Site 21. In addition, no soil sampling was conducted at any of these sites during the Phase 2B or 2C and no groundwater sampling was conducted during the EBS at the Parcels associated with Site 21. Table 8-1 provides a complete list of samples collected and analyses performed.

The reported metal concentrations for all five Parcels surrounding Building162 and Building 398 were within the Alameda Point background concentrations and/or below the 1996 PRGs, except for arsenic. Arsenic was detected above its background concentration and 1996 PRG at three locations.

Multiple SVOCs and one VOC, chloroform, were detected at concentrations below 1996 PRGs. Based on the low concentrations of detected chemicals, no additional sampling is recommended.

Three surface and two subsurface soil samples were collected from Parcel 127, bordering the southeast corner of Building 398. TPH was not detected in the surface soil samples; however, it was detected as diesel and motor oil at three locations at low concentrations in soil samples.

Based on the low concentrations of detected analytes, no additional sampling is recommended.

Storm Sewer Investigation. Storm sewer corridor sampling was conducted from December 1994 through February 1995 at Parcel 135 as part of the EBS Phase 2A. Table 8-1 provides a complete list of samples collected and analyses performed, and Figure 8-4 shows the sample locations.

Multiple VOCs were detected around Building 398 in the storm sewer corridor at concentrations well below their 1996 PRGs. Oil and grease and TPH quantified as gasoline were detected in the storm sewer corridor at low concentrations. The reported metal concentrations for these parcels are within the Alameda Point background concentrations and below 1996 PRGs. Excluding B(a)P, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene, multiple SVOCs were detected in the storm sewer sample at Parcel 135 (Building 162) in concentrations below their 1996 PRGs. According to the data summary results, samples collected from Parcel 155A (railroad tracks) had detections of benzene above the 1996 PRG.

8.2.3 Total Petroleum Hydrocarbon Program Investigations

After Alameda Point was identified for closure in September 1993, the TPH Program was implemented to decommission all USTs. Under the TPH Program at Site 21, investigations were conducted near USTs 398-1 and 398-2 and at CAA 3A (Building 398) (see Figure 8-3). In January 1995, an investigation was conducted near USTs 398-1 and 398-2. TPH levels in groundwater samples collected directly east of USTs 398-1 and 398-2 indicated that floating product may be present. Chlorinated hydrocarbons including 1,1-DCA and TCE also were detected (ERM-West 1996). USTs 398-1 and 398-2 were removed in April 1995. Floating product was observed on the groundwater surface of the UST excavation (Navy PWC 1997). In September 1997, an investigation was conducted along the storm drains located east of the former USTs. The data indicate that a TPH plume intersects the storm drain; however, the storm drain pipeline is above the groundwater table (Moju1998).

In 1998, a UST and fuel line removal action was conducted at Site 21. Samples collected during removal are listed in Tables 8-1 and 8-2. Sample locations are provided on Figure 8-3.

Sampling was conducted at CAA 3A in 2000 during the data gap sampling investigation at the CAAs. One sampling location was sampled to assess the presence of floating free product. One soil boring was advanced to 10 feet bgs at location CA03-01 and a piezometer was installed and checked for floating product 24 hours after installation. No floating product was present in the sample, but the sample had a hydrocarbon odor and slight sheen (Tetra Tech 2001b).

Five sampling locations were sampled to assess the presence of chlorinated hydrocarbons in groundwater. Five groundwater samples were collected from sampling locations 398A-19, 398-MW1, 398-MW2, CA03-01, and CA11-20. Groundwater samples collected from wells 398-MW4 and 398-A19 had a slight solvent odor but no sheen. Groundwater samples collected from wells 398-MW1 and 398-MW2 did not have an odor or sheen (Tetra Tech 2001b).

There are no removal actions or pilot studies currently being conducted for TPH in Site 21.

8.2.4 Resource Conservation Recovery Act Investigations

A RFA was conducted at Alameda Point in 1992 to identify SWMUs and AOCs and to evaluate the need for and scope of an RFI. AOC 398, M-07, and NADEP GAPs 44, 45, 46, 76, and 77, and UST (R)-09 were identified during the RFA (DTSC 1992). An RFI was required for AOC 398.

A RFI for Alameda Point was implemented through the coordination of existing environmental programs, namely under CERCLA and the TPH Program, and as part of the EBS. The final EBS report summarizes many results from RFA- and RFI-related activities at Alameda Point (IT 2001a). NADEP GAPs 44, 45, 46, 76, and 77 were investigated during the Phase I EBS site inspection (IT 2001a) and an inspection in 2002 (Tetra Tech 2003a) (see Figure 8-1). DTSC recommended NFA for NADEP GAPs 46, 76, and 77 (DTSC 1999). Navy recommendations for

NFA at NADEP GAPs 46, 76, and 77 are included in Appendix I. AOC 398 was investigated under the TPH Program.

8.3 SITE 21 REMEDIAL INVESTIGATION RESULTS

The purpose of this section is to present the results of the investigations conducted at Site 21 in support of the CERCLA risk management process. Evaluations conducted at Site 21 included (1) a site-specific conceptual site model [CSM], (2) a data quality assessment, (3) a background comparison, (4) a nature and extent evaluation, (5) a fate and transport evaluation, (6) an HHRA, and (7) an ERA. Sections 8.3.1 through 8.3.7 summarize the results of these evaluations. Appendices E, F, and G, respectively, present the complete background comparison, HHRA, and ERA.

8.3.1 Site-Specific Conceptual Site Model

The CSM for Site 21 was used to support the nature and extent evaluations and risk assessments by identifying potential sources of contamination, media affected, exposure pathways, and future receptors. Figure 8-5 presents the CSM for Site 21.

Through environmental investigations and literature, physical features or activities at Site 21 that might have generated hazardous waste or released chemicals to the environment were identified. The following Site 21 physical features and activities (former and remaining) were identified as potential sources of contamination:

- Building 162 (ship and aircraft maintenance shop) – solvent cleaners, paint, solvent strippers, penetrating oils, resins, phenol, and ethanolamine
- Building 162 and NAS GAP 11 (hazardous waste storage) – a sump used to collect waste oils and a storage area for drums filled with cadmium and lead, sandblast wastes, and lead-based paint
- Building 162 and NADEP GAP 46 (hazardous waste storage – aerosol paint; 1,1,1-TCA; lubrication oil; PD-680; and acetone
- Building 162 and SWMU 162 (hazardous waste storage) –oil and 1, 1, 1-TCA
- Building 162 and OWS-162 (hazardous waste material handling)-managed oil-water mixtures
- Building 398 (turbine testing and accessories shop) – solvent cleaner (PD680); 1,1,1-TCA; hydrogenated hydrocarbons; paint; paint thinner; acetone; grease; hydraulic fluid; dyes; acrylic lacquers; and mercury
- Building 398 and NADEP GAP 44 (hazardous waste storage) – lubrication oil, JP-5, and M-114 solvent

- Building 398 and NADEP GAP 45 (hazardous waste storage) – aerosol paint, waste oil, filters, spent solvents, and spent cleaning compounds
- Building 113 (paint shop, abrasive blasting, and container repair) – paints, resins, hydroxides, solvents, solvent strippers, and cleaners
- Building 113 and NADEP GAP 76 (hazardous waste storage) – aerosol paints; rust remover; lacquer thinner; oil; enamel paint; and 1,1,1-TCA
- Building 113 and NADEP GAP 77 (hazardous waste storage) – blasting grit
- AST 113 (diesel fuel storage) - petroleum hydrocarbons
- USTs 162-1 and 162-2 (petroleum hydrocarbon storage) - petroleum hydrocarbons and lead
- USTs 398-1 and 398-2 (jet fuel storage) - petroleum hydrocarbons and lead
- Open space (aluminum smelter) – aluminum
- Placement of dredged fill material used to build the island – PAHs

Of these potential sources, Buildings 162, 398, and 113 and their associated sanitary sewer and fuel lines; NADEP GAP 44, and USTs 162-1, 162-2, 398-1, and 398-2 were identified as likely sources of soil and groundwater contamination at the site.

Exposure pathways and primary and secondary release mechanisms may include the following:

- Direct release of petroleum hydrocarbons (TPH and carbazole) to soil from OWSs, USTs, NADEP GAP 44, storm sewers, fuel lines, spills, or equipment testing and cleaning
- Direct release of metals (copper and lead) to soil from activities associated with Buildings 398, 162, and 113, NADEP GAP 44, USTs 162-1 and 162-2
- Placement of fill material that contained PAHs
- Secondary release from soil to air through volatilization or resuspension of particulates
- Secondary release from soil to homegrown produce
- Secondary release from soil to the food chain from plant uptake
- Secondary release from soil to groundwater through infiltration (see Section 9.0)

- Direct release to groundwater (see Section 9.0)

- Secondary release from storm sewers to surface water (see Section 9.0)

As Figure 8-2 shows, storm sewer lines at Site 21 were categorized as follows: (1) not below the groundwater table, (2) below the groundwater with no cracks or significant groundwater infiltration observed, or (3) below the groundwater table with cracks and significant groundwater infiltration observed (Tetra Tech 2000b). Lines in the third category are considered to provide a possible preferential pathway for contaminants in groundwater.

As the CSM for Site 21 shows (see Figure 8-5), residential, commercial/industrial, and construction worker receptors were identified as potential human receptors, and exposure pathways include ingestion, inhalation, and dermal contact with soil and groundwater and inhalation of ambient and indoor air. Direct contact with soil and the food chain also were identified as complete terrestrial ecological exposure pathways. In addition, exposure of marine ecological receptors to contaminants through groundwater discharged to the Seaplane Lagoon was identified as a complete ecological exposure pathway and is discussed in Section 9.0.

8.3.2 Data Quality Assessment

As discussed in Section 8.2.1, investigations were conducted at Site 21 under CERCLA, the EBS, and the TPH Program in order to identify and assess the extent of contamination in soil and groundwater and to determine risk. Data were collected over a period of approximately 10 years using a biased and phased sampling approach. Sampling focused on the objectives below.

- Determine if soil and groundwater were contaminated in areas identified as potential waste release sites including a former service station.

- Characterize groundwater plumes, monitoring chlorinated solvent concentrations and plume movement, and further evaluate the source of chlorinated solvents in the groundwater.

- Evaluate fill material and native sediments to determine if PAHs are present in soil and sediment.

Detection limits for some of the data used to evaluate Site 21 are elevated over the current residential PRGs (EPA 2002); these elevated detection limits are the consequence of one or more of the following circumstances: (1) the evolution of lower detection limits as technology improves, (2) the revision of PRGs over time (which are not always technologically feasible), (3) and matrix interference. The first two of these circumstances generally do not result in significantly elevated detection limits. However, matrix interferences sometimes cause significant elevations in the detection limits for a chemical contaminant; which leads to uncertainty as to whether that undetected compound could be present in significant concentrations at a site. Although some detection limits (sample quantitation limits [SQL]) were

elevated above 2002 PRGs, detection limits for non-detected chemicals were typically sufficiently low to permit identification of potential health risks.

Because detection limits for SVOCs in soil were elevated, the need for further sampling and analysis of soil may be necessary to confirm these chemicals are not present in site soil. Although soil data gaps were identified, it was determined that the types and numbers of samples collected at the site (see Figures 8-6 through 8-12) and the analyses conducted (see Tables 8-16 and 8-17) were sufficient to characterize the site and conduct risk assessments because data collection focused mainly on potential sources and was conducted in phases. The phased approach afforded stakeholders opportunities to provide feedback on the suitability or adequacy of the data to identify releases and complete the RI report. There is a low potential of any source at the site not being adequately evaluated or of recommending NFA if it poses a potential risk to human health or the environment.

Both definitive and screening-level data were generated. Screening data were considered appropriate for use in only nature and extent and fate and transport evaluations. See Section 3.4.2 for further detail regarding determining data quality and the use of definitive and screening-level data. In general, definitive quality data are consistent with EPA Analytical Level III, as specified in EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (1988a), and samples were analyzed in accordance with Contract Laboratory Program methods. Because laboratory detection limits for older PAH data were elevated and the 2003 PAH data were collected to replace older data, only PAH data from the 2003 sampling event were used in this RI.

Data generated during the environmental investigations that were considered to be of sufficient quality for use in the RI are presented in Appendix D. For this RI, groundwater is addressed OU-wide rather than by site; therefore, groundwater data from Site 21 and the other OU-2B sites are discussed in Section 9.0. Tables 8-16 and 8-17, summarize the CERCLA, EBS, and TPH investigation results for soil and soil gas. The summaries are organized according to analytical group and include the following information: (1) the number and percent of detections of chemicals; (2) the average, minimum, and maximum detected concentrations; (3) minimum and maximum detection limits for nondetected samples; and (4) whether the maximum detected concentrations or detection limits exceed Region 9 residential PRGs or California-modified PRGs (EPA 2002). PRGs and MCLs are provided in the tables for comparison purposes only.

8.3.2.1 Soil

At Site 11, soil samples collected under the environmental investigations were analyzed for VOCs, SVOCs, PAHs, TPH, pesticides, PCBs, metals, and general chemistry parameters (see Table 8-1). Of the samples collected and analyzed, 69 VOC and 48 SVOC results were considered acceptable for use in the RI. A total of 22 sample results for pesticides/PCBs and 57 sample results for metals were considered acceptable. From the additional PAH sampling conducted in 2003, a total of 84 sample results were considered acceptable for use in the RI. Because of raised detection limits, PAH data for soil samples collected during previous investigations were not evaluated.

Laboratory detection limits for some other chemicals in soil exceeded 2002 residential PRGs (EPA 2002) and are noted in Table 8-16. Detection limits for a few non-detected analytes were also elevated above residential PRGs (EPA 2002); however, a majority of the non-detected analytes had detection limits below PRGs. Therefore, detection limits were sufficiently low to permit identification of potential health risks, except for the following SVOCs for which detection limits exceeded the PRGs in more than 50 percent of the non-detected samples: bis(2-cholorethyl)ether, hexachlorobenzene, n-nitroso-di-n-propylamine, n-nitrosodimethylamine.

A subset of the soil data were selected for use in the risk assessments, as shown in the following table. Data were considered to be appropriate for use if they (1) are validated and (2) reflect current site conditions. Data for soils that are no longer present at the sites because of removal actions were not included, because they do not reflect the current conditions at the sites. Risk from TPH was assessed separately (see Appendix H).

Soil data for each site were aggregated in depth intervals of 0 to 2, 0 to 4, and 0 to 8 feet bgs. The depth intervals evaluate potential exposures associated with site use. The 0-to-2 and 0-to-8 foot bgs depth intervals evaluate potential human health exposures, and the 0- to 4-foot bgs depth interval evaluates potential ecological exposures. The total number of samples for each analytical group included in the data set for each depth interval is summarized in the table below.

SUMMARY OF SITE 21 SOIL DATA FOR RISK ASSESSMENT

Analytical Group	0 to 2 feet bgs	0 to 4 feet bgs	0 to 8 feet bgs
VOCs	2	27	41
SVOCs	12	34	41
PAHs	42	63	84
Pesticides/PCBs	5	11	15
Metals	12	30	39

Although minimal data were available for VOCs in soil from 0 to 2 feet bgs, this is not perceived as a data gap because the site is paved, and it is unlikely that VOCs spilled on the pavement would infiltrate into the ground. Instead they would be more likely to run into a storm drain or volatilize from the pavement. Data for 2 to 8 feet bgs are sufficient to capture the nature and extent and risk from VOCs at the site.

Pesticide and PCB data collected under the EBS investigations did not indicate widespread or elevated concentrations; therefore the presence of these compounds was not a focus of the RI investigations.

8.3.2.2 Groundwater

For this RI, groundwater is addressed OU-wide rather than by site; therefore, groundwater data from Site 21 and the other OU-2B sites are discussed in Section 9.0.

8.3.2.3 *Soil Gas*

Soil gas data were collected to evaluate risk in the HHRA from indoor air. At Site 21, 4 soil gas samples were collected at depths ranging from 0.5 to 4.0 feet bgs. Samples were collected near where maximum concentrations of VOCs in groundwater were detected at the following sample locations: S21-DGS-SG03, and S21-DGS-SG06 (See Table 8-1). Detection limits for some of the non-detected chemicals exceeded ambient air PRGs; however, SQLs were not set to meet these requirements.

8.3.3 Background

A background comparison was conducted for Site 21 by comparing a background data set with analytical results for metals in samples representative of the site. This comparison was used to determine which metals in soil are statistically similar to background and the concentrations could either be considered naturally occurring (background) or potentially resulting from historical site activities. The complete approach is presented in Appendix E and summarized in Section 3.4.3.

Based on a comparison of the Site 21 soil data with the background data set for the pink area (Figure 3-3), the following metals in soil at Site 21 are not attributed to background:

- Aluminum
- Arsenic
- Barium
- Beryllium
- Calcium
- Cobalt
- Copper
- Iron
- Lead
- Magnesium
- Manganese
- Nickel
- Vanadium
- Zinc

8.3.4 Nature and Extent

The main objectives of the nature and extent evaluation were to (1) present the types and concentrations of detected chemicals exceeding screening levels, (2) characterize the types and concentrations of chemicals that were used by the Navy, and (3) describe the spatial distribution and concentration patterns of all chemicals that demonstrate significant risk to human health or the environment (risk drivers). Risk drivers are defined by the risk assessments, which were conducted prior to this nature and extent evaluation, as those chemicals that pose a carcinogenic risk above 1E-06, an HI above 1, or pose potential risk to ecological receptors. Results of the nature and extent evaluation for Site 21 soil is presented below.

8.3.4.1 *Chemicals Exceeding Screening Levels*

The purpose of this evaluation is to provide an initial screening of chemical concentrations detected in soil at Site 21; it is not to quantify risk, which is estimated in the risk assessments. Concentrations of chemicals detected soil were compared to screening levels, which consisted of Region 9 residential or California-modified PRGs (EPA 2002) and 0.62 mg/kg for PAHs (expressed as B[a]P equivalents) that was established under agreements between the Navy and agencies (Navy 2001b).

Sampling locations for chemicals with concentrations exceeding screening levels are presented on Figures 8-13, 8-14, and 8-21. Chemicals are grouped by analytical group, and sampling locations with concentrations exceeding these screening levels are designated.

Chemicals in soil exceeding these screening levels are summarized in the embedded table below. The summary is organized according to analytical groups and includes the maximum detected concentrations and the number of detected concentrations exceeding the screening levels.

Chemicals in Site 21 Soil Exceeding Screening Levels

Analytical Group	Location of Maximum Detection	Maximum Detected Concentration	Screening Level	Number of Detected Concentrations Exceeding Screening Levels/Total Analyzed
VOCs (µg/kg)				
Benzene	398-10-ERM	620	600	1/69
Metals (mg/kg)				
Arsenic	127-002-005	20	0.39	38/44
Chromium	137-IW-001	291	210	1/48
Iron	127-002-005	46,800	23,000	6/44
Lead	B07B-05	416	150	1/57
PAHs (mg/kg)				
B(a)P equivalents	C3S021B009	121	0.62	2/84

No SVOCs, pesticides, and PCBs in Site 21 soil exceeded screening levels. The following conclusions were made for VOCs, metals, and PAHs that are elevated above screening levels in Site 21 soil.

The VOC benzene was elevated in one sample collected adjacent to a sanitary sewer line connected to Building 398 (see Figure 8-13). Benzene is most likely related to activities conducted at Building 398, the aircraft engine testing facility.

Concentrations of the metals arsenic, chromium, iron, and lead in Site 21 soil are elevated above screening levels. Elevated concentrations of arsenic appear to be uniformly distributed across the site and unrelated to storm sewers, buildings, or other site features, which suggests that these elevated arsenic concentrations may occur naturally (see Figure 8-14). Elevated levels of

chromium, iron, and lead were detected in a few confined areas. The single elevated concentration of chromium was detected in samples collected from along the southwestern side of Building 162 near manhole 3H. Elevated concentrations of iron were detected in samples collected from three areas, inside the eastern edge of Building 398, west of Building 162, and between former UST 113 and the southwestern side of Building 162. The single elevated concentration of lead was detected near former USTs 162-1 and 162-2, which are on the northeastern side of Building 162. Elevated levels of lead may be associated with historical use of lead-based paint and petroleum hydrocarbon use.

Elevated concentrations of PAHs, expressed as B(a)P equivalents, in Site 21 soil appear to be concentrated in surface soil within two areas, the northern border of the site and the western portion of the site (see Figure 8-21). Neither area is immediately adjacent to any building or site feature.

8.3.4.2 Characterizing Chemicals Used by the Navy

The purpose of this evaluation is to provide additional information to determine whether contamination hot spots or data gaps are present at the sites. This section focuses on chemicals detected in soil that were used historically at Site 21. Chemicals believed to have been used at Site 21 include petroleum hydrocarbons, metals (including mercury), and solvents and solvent strippers including PD-680, which contains tetrachloroethene, TCE, and benzene. Most of the chemicals detected across Site 21 are consistent with the historical activities that occurred at the site, which includes painting, paint stripping, sandblasting, jet engine maintenance and testing, equipment cleaning, and the use of petroleum products. Statistical summaries of all soil and soil gas results are presented in Tables 8-16 and 8-17.

Even though TPH is not a CERCLA contaminant, soil and groundwater were sampled at various locations across Site 21 for TPH, which includes all TPH-fractions (TPH as diesel, gasoline, jet fuel, or motor oil) and TPH-associated constituents (BTEX and lead). An evaluation of TPH in soil and groundwater at Site 21 was conducted based on the TPH strategy for Alameda Point (see Appendix H) to assess contamination and possible risk at the site. Analytical results for soil and groundwater samples associated with Site 21 were screened against site-specific preliminary remediation criteria to evaluate the potential risk to human health and ecological receptors from TPH-related constituents using guidance for low-risk fuel site closure (California Regional Water Quality Control Board 1996). On the basis of this evaluation, NFA is recommended for Site 21 soil and further action is recommended for Site 21 groundwater for TTPH and TPH-associated constituents. TPH impacted groundwater is addressed further in the OU-wide groundwater section (Section 9.0). TPH impacted soil is discussed below, and TPH sampling locations for soil are presented on Figure 8-12.

The following table lists the detected chemicals believed to be used at Site 21, the range of concentrations detected in soil at the site, detection frequency, and the sampling location of the maximum concentration detected. Figure 8-15 shows the locations of the samples with maximum concentrations.

Soil Analytical Results for Chemicals Believed to Have Been Used at Site 21

Chemical	Detection Frequency	Range of Concentrations	Sampling Location of Maximum Concentration	Sample Interval (feet bgs)
Pesticides (µg/kg)				
4,4'-DDD	1/22	12	B07B-05	0.5 – 1.5
4,4'-DDT	1/22	58	B07B-05	0.5 – 1.5
PCBs (µg/kg)				
Aroclor 1260	1/22	140	B07B-05	0.5 – 1.5
VOCs (µg/kg)				
Acetone	2/46	5 to 12	135-002-005	4 – 4.5
Benzene[1]	2/69	30 to 620	398-10-ERM	5
Toluene	3/69	3 to 11	136-001-001	3.5 – 4
TCE	1/49	5	135-002-005	4 – 4.5
Xylene (total)	7/66	2 to 390	398-10-ERM	5
Metals (mg/kg)				
Aluminum	43/44	3,410,000 to 21,600,000	M07B-01	8 – 9
Copper	44/47	5.4 to 148	127-002-005	1.5 – 2
Lead[1]	66/78	1.4 to 416	B07B-05	0.5 – 1
Mercury	6/47	0.16 to 2.6	127-002-005	1.5 – 2
Petroleum Hydrocarbons (mg/kg)				
TPH-diesel	14/77	2 to 430	398-W	7
TPH-gasoline	8/77	2.1 to 490	398-10-ERM	5
TPH-motor oil	30/70	22 to 6,900 mg/kg	030-S07-004	0 – 4.5

1 Exceeded screening levels in one or more samples. Other chemicals exceeded screening levels, but were not believed to be used at Site 21; these chemicals include arsenic, chromium, iron, and PAHs.

Additional sampling locations (126-003-008, 126-002-005, and 127-SN-002), not associated with Site 21, are located outside of the western boundary of the site (see Figure 8-3). Metals data associated with these sampling locations are presented in the table below.

	Sampling Locations (feet bgs)				
Sample Depth	**126-003-008**		**126-002-005**		**127-SN-002**
(Feet bgs)	0.5 - 1.5	3.0 - 4.0	0.0 - 0.5	0.5 - 1.0	6.0 - 6.5
Silver	1.3	1.4U	.55U	0.19	25U
Aluminum	6460	7600	NA	4230J	NA
Arsenic	3.5	6	6.3	1.8U	NA
Barium	39.8B	78.5	33.7	19.9	NA
Beryllium	0.31	.42B	0.55	.43	25U
Calcium	2970	4060	NA	2200	NA
Cadmium	.72B	.52U	0.93	.13	25U
Cobalt	4.8B	9.8B	8.1	5.2	NA
Chromium	30.3	49.4	.55U	5.9J	25U
Copper	11J	13.4J	44.1	13.1	28
Iron	14500	16900	NA	7990	NA

Sample Depth	Sampling Locations (feet bgs)				
	126-003-008		126-002-005		127-SN-002
(Feet bgs)	0.5 - 1.5	3.0 - 4.0	0.0 - 0.5	0.5 - 1.0	6.0 - 6.5
Mercury	.05U	.1	.11U	.17U	25
Potassium	808B	952	NA	642	NA
Magnesium	3680	5680	NA	2300	NA
Manganese	159	382	NA	137J	NA
Molybdenum	1.5U	1.6U	1.1U	2.2U	NA
Sodium	188	314	NA	143	NA
Nickel	23.3	64.5	1.7	20.6J	51
Lead	6.7	14	2.5	1.6J	25U
Antimony	.76UJ	.87J	3.3U	1.4UJ	25U
Selenium	.69B	.59U	2.8U	.76J	NA
Titanium	.11U	.11U	2.8U	6.4J	NA
Vanadium	26.4	26.2	40	15.5	NA
Zinc	31.3J	35J	54	21.5	31

Notes:

U negative values

J estimated

NA not analyzed

Most of the chemicals detected across Site 21 are consistent with the historical activities that occurred at Buildings 162, 398 and 113, including painting, paint stripping, sandblasting, jet engine maintenance and testing, equipment cleaning, and the use of petroleum products. There are four principal areas where chemicals appear to have been released to soil, (1) near USTs 398-1 and 398-2, (2) near the industrial waste treatment line located in the southern part of Building 162, (3) near USTs 162-1 and 162-2 and the fuel line located on the northeast corner of Building 162, (4) near Building 113, and (5) southwest corner of Building 398 along the storm sewer line (see Figure 8-7).

The maximum concentrations of benzene and xylene are located in soil near a sanitary sewer line to the northeast of USTs 398-1 and 398-2 at sampling location 398-10-ERM at a depth of 5 feet bgs. Benzene was only detected in 2 of 69 samples collected at the site and xylene was only detected in 7 of 66 samples collected at the site. In addition, the highest concentrations of copper and mercury are located in shallow soil at sampling location 127-002-005 near USTs 398-1 and 398-2. Benzene and xylene are likely the result of TPH contamination at the site.

Mercury was used within Building 162 in the repair of aircraft components; however; mercury concentrations are below the maximum background concentrations. Copper was also used at the site as a component in jet engine lubricant. Copper is generally detected at concentrations above the maximum background concentration in shallow soils beneath Buildings 398 and 113.

The maximum concentrations of TCE and acetone were detected at sampling location 135-002-005 from 4 to 4.5 feet bgs, which is located near the sanitary sewer treatment line in the southern part of Building 162. This is the only location where TCE was detected in soil (out of 49 samples) and acetone was only detected at one other location in soil (out of 46 samples). It is

likely that TCE and acetone were used in Buildings 162, 398, and 113 as degreasers and cleaners.

The maximum concentration of aluminum in soil was detected east of Building 162 in a sample collected during the installation of monitoring well M07B-01. This does not correspond to the area at Building 398 where aluminum smelting activities are known to occur.

4,4'-DDD, 4,4'-DDT, and Aroclor 1260 were detected in soil at sample location B07B-05 from 0.5 to 1.5 feet bgs, which is located near USTs 162-1 and 162-2 and the fuel line located on the northeast corner of Building 162. This is the only sampling location (out of 22 samples) where these compounds were detected. 4,4'-DDD and 4,4'-DDT are likely present at the site from general pesticide use. Aroclor 1260 is likely located at the site as the result of used oils containing PCBs being used for weed and dust control.

The maximum concentration of toluene was detected in a sample from sampling location 36-01-001 collected from 3.5 to 4 feet bgs below Building 113. Toluene detected in soil near Buildings 113 is likely the result of TPH contamination in soil.

The maximum concentration of lead was detected in a sample collected from surface soil near the southwest corner of Building 398 along the storm sewer line (sampling location 126-002-003 at 0.5 to 1 feet bgs). Lead detected in soil is likely the result of petroleum hydrocarbon and lead-based paint use.

Potential sources of TPH and TPH-associated constituents in soil include Building 162 (ship and aircraft maintenance shop), which includes GAPs 11 and 46, SWMU 162, and OWS 162; Building 398 (turbine testing and accessories shop), which includes GAPs 44 and 45; Building 113 (air conditioning repair and paint shop), which includes GAP 76; AST 113; and USTs 162-1, 162-2, 398-1, and 398-2 (diesel fuel tanks). The maximum concentration of total TPH in soil (28,900 mg/kg) was detected in a sample collected from 0 to 0.5 feet bgs (sampling location 126-001-001) inside Building 399 which is located northwest of the Site 21 boundary (see Figure 8-12). TPH concentrations range from 5.7 to 28,900 mg/kg. TPH related lead was detected in a sample from the southeastern portion of Site 21 (sampling location B07B-05) at a concentration of 416 mg/kg. TPH as diesel (1,900 mg/kg) was detected in one sample collected along the northwestern border of Site 21 (sampling location 126-001-001). TPH as gasoline was detected in samples from two sampling locations along the northwestern border of Site 21 (sampling locations 125-001-003 and 030-S07-072) at concentrations ranging from 1,300 to 2,000 mg/kg. TPH as motor oil was detected in samples collected from along the northwestern border (126-001-001) and in the southwestern portion of the site (030-S07-004) at concentrations ranging from 6,900 to 27,000 mg/kg.

8.3.4.3 Characterizing Risk Drivers

Following the evaluations of chemicals that exceeded screening levels and chemicals used by the Navy, a more detailed evaluation was conducted for those chemicals that pose potential

significant risk (risk drivers). Risk drivers were not limited to those chemicals used by the Navy; selection of risk drivers was defined by the HHRA and ERA (see Sections 3.4.6 and 3.4.7). Risk drivers are defined as those chemicals that pose a cancer risk above 1E-06, a hazard index (HI) above 1, or pose potential risk to ecological receptors. Background comparison results (see Section 3.4.3) were used to identify risk drivers attributed to background, and these drivers attributed to background were not evaluated further.

Based on the HHRA, arsenic, cadmium, carbazole, and iron in soil were identified as risk drivers. Based on the ERA, copper, lead, and PAHs in soil were identified as risk drivers. According to the background comparison, cadmium is attributed to background, so it is not evaluated further.

The discussions below focus on the nature and extent of arsenic, carbazole, copper, iron, lead, and PAHs in soil at Site 21. The evaluation of these contaminants primarily includes (1) site-specific figures to assess the spatial distribution and concentration patterns of the contaminants and (2) a review of the figures, data, and site hydrology to determine the boundaries of the contamination, the volume of the affected media, and identification, if possible, of the suspected source(s) of these chemicals. Table 8-18 summarizes the nature and extent evaluation.

Arsenic in Soil

Figure 8-16 shows the concentrations of arsenic in soil at Site 21. Arsenic was detected in 58 of 64 samples collected at various depths across the site. Detected concentrations ranged from 0.75 to 20 mg/kg. The maximum concentration of arsenic (20 mg/kg) was observed in a sample from soil boring location 127-002-005 at 1.5 to 2 feet bgs; however, this analytical result was qualified as estimated because of matrix spike recoveries that were outside the QC limits. In addition, a duplicate sample collected from the same boring from the same depth contained 13.9 mg/kg of arsenic. The maximum concentration observed in background soil was 15.60 mg/kg, which exceeds the nonestimated concentrations in soil samples collected from Site 21.

Although arsenic concentrations in soil exceeded background levels, no evidence exists that arsenic was used in site-related activities. The arsenic concentrations detected in soil at Site 21 are believed to be within background ranges typically seen in the San Francisco Bay Area (Tetra Tech 2003d); therefore, arsenic was attributed to background levels and will not be evaluated further.

Carbazole in Soil

Figure 8-17 shows the concentrations of carbazole in soil at Site 21. Carbazole was detected in 7 of 29 samples collected at various depths across the site. Detected concentrations ranged from 10 to 20,000 µg/kg. The maximum concentration of carbazole (20,000 µg/kg) was observed at sampling location 030-S07-04 at 0.0 to 4.5 feet bgs. Concentrations of carbazole detected at Site 21 were predominantly located in trench excavation samples taken during the removal of the

fuel line. TPH, SVOCs, and PAHs have also been detected in soil samples collected from the fuel line excavation.

Sample 136-001-001 is the exception, as carbazole was detected between 3.5 to 4.0 feet bgs from a soil boring at Building 113 (paint shop).

Carbazole is a SVOC that is classified as a PAH. It is produced during coal gasification and is commonly found in trace amounts in fuel. The presence of carbazole in soils is not unexpected given the known presence of PAHs in fill material, the known releases from the fuel lines, and underlying marsh crust at Site 21.

Copper in Soil

Figure 8-18 shows the concentrations of copper in soil at Site 21. Copper was detected in 64 of 68 samples collected at various depths across the site. Detected concentrations ranged from 4.3 to 148 mg/kg. The maximum concentration of copper (148 mg/kg) was observed at 127-002-005 at 1.5 to 2 feet bgs. In addition, a sample collected from this location from 3 to 3.5 contained 83.5 mg/kg of copper. Copper concentrations at sampling locations B07B-05, 136-002-002, and 127-002-006 also exceeded the maximum copper concentration in background soils of 49.1 mg/kg.

Copper concentrations exceeding the background soil concentration appear to be localized within surface soil in three areas: the jet engine test cell area in Building 398, below the southern portion of Building 113, and near USTs 162-1 and 162-2. Copper has been used at the site as a component in jet engine lubricant, and it is likely that jet engine lubricant was used in or near the locations where elevated concentrations of copper were detected in soil.

Iron in Soil

Figure 8-19 shows the concentrations of iron in soil at Site 21. Iron occurs naturally in soil, and background concentrations of soil in the pink background data set range from 4,500 to 27,900 mg/kg. The maximum detected concentration of iron at Site 11 (46,800 mg/kg) was detected between 1.5 and 2.0 feet bgs at sampling location 127-002-005, which is located below Building 398 (turbine accessories shop). Concentrations of iron elevated above the background screening level (27,900 mg/kg) were detected in three areas, inside the eastern edge of Building 98, west of Building 162, and between former UST 113 and the southwestern side of Building 162. Elevated concentrations were generally detected below the artificial fill

Iron appears to be uniformly distributed across the site and not exclusively related to storm sewers, buildings, or other site features, which suggests that iron occurs randomly across the site with no apparent source and may be naturally occurring.

Lead in Soil

Figure 8-20 shows the concentrations of lead in soil at Site 21. Lead was detected in 46 of 57 samples collected at various depths across the site. Detected concentrations ranged from 1.4 to 416 mg/kg. The maximum concentration of lead (416 mg/kg) was detected at B07B-05 at 0.5 to 1 feet bgs, which exceeded the background screening level of 165 mg/kg. The next highest concentration is 94.1 mg/kg at sampling location 030-S07-002.

The lead concentrations exceeding the maximum background lead concentration in soil appear to be localized within surface soil near the southwest corner of Building 398 along the storm sewer line and the northeast corner of Building 162 near USTs 162-1 and 162-2. Lead-containing petroleum hydrocarbons and lead-based paint have been used at the site and are the likely source.

PAHs in Soil

Figure 8-21 shows the concentrations of PAHs in soil expressed as B(a)P equivalents. PAHs were detected in 80 of 84 samples collected at various depths across the site. PAH concentrations at Site 21 are generally low; no samples at Site 21 exceeded the action criterion of 0.62 mg/kg for B(a)P.

The maximum PAH concentrations of 0.121 mg/kg, expressed as a B(a)P equivalent, was detected at sample location C3S021B009 between 0.0 to 0.5 feet bgs. The PAH concentrations do not appear to be related to the use patterns of Site 21 as a maintenance facility because the location of the maximum PAH concentration is outside the main work area of Building 162 in an area used for vehicle parking. PAHs at Site 21 likely are related to the fill history of the site (see Section 2.1.1) and appear to be confined to the surface immediately below the paved areas on the northwestern side of Building 162 and in one location in the southwestern portion of the site.

8.3.5 Fate and Transport

The objective of this evaluation is to determine whether the chemicals driving risk at Site 21 (1) ave migrated or degraded, (2) are being released from a continuing source of contamination, and (3) are likely to be transported through groundwater or other potential pathways. The evaluation of these contaminants primarily includes the following activities:

- Identifying soil sampling locations with the maximum concentrations of these contaminants
- Evaluating the effect of groundwater flow or other potential pathways on the distribution of the contaminants

The following sections present the fate and transport evaluation for each chemical driving risks to human and ecological receptors at Site 21, which are arsenic, carbazole, copper, iron, lead,

and PAHs. Because the site is currently paved, it is unlikely that sufficient soil would be exposed to transport chemicals in soil via wind. Therefore, this pathway is not evaluated.

8.3.5.1 Arsenic in Soil

Arsenic was detected in samples collected from across the site. The maximum concentration of arsenic of 20 mg/kg was observed at sampling location 127-002-005 at 1.5 to 2.0 feet bgs. This was the only sample at the site whose concentration exceeded the background screening level of 15.6 mg/kg, which is the maximum arsenic concentration observed in background soils. Sample location 127-002-005 was located in Building 398 (turbine accessories shop). A smelting operation was previously located where Building 398 is currently located and scrap was cut up and smelted to recover aluminum. Arsenic is relatively immobile under most soil conditions because it attaches strongly to organic material and minerals (Agency for Toxic Substances and Disease Registry [ATSDR] 2000). Arsenic is generally insoluble in water and particles that do dissolve in water typically bind to particulate matter and sediments. Because arsenic binds so strongly to suspended particles and sediments, it typically does not enter groundwater (ATSDR 2000).

8.3.5.2 Carbazole in Soil

Carbazole was detected in samples collected from excavations of the fuel line, which extended from east to west along the site. The maximum concentration of 20,000 µg/kg was detected in soil from 0.0 to 4.5 feet bgs at sampling location 030-S07-004. Carbazole is a SVOC compound produced during coal gasification and is commonly found in trace amounts in fuel. It is not subject to degradation processes and binds to organic matter in soil. In addition, Carbazole is insoluble in water and exhibits a low potential for migration (ATSDR 1995). Carbazole at Site 21 was likely removed during the fuel line removal project and does not pose a threat to groundwater at the site.

8.3.5.3 Copper in Soil

Copper was detected in samples collected from across the site. The maximum concentrations were detected in soil from 0 to 2 feet bgs immediately below Buildings 398 and 113 and in surface soil near USTs 162-1 and 162-2. Copper is relatively immobile under most soil conditions because it attaches strongly to organic material and minerals (ATSDR 2002). Copper that dissolves in water typically becomes rapidly bound to particles suspended in the water. Because copper binds so strongly to suspended particles and sediments, it typically does not enter groundwater (ATSDR 2002).

8.3.5.4 Iron in Soil

Iron in soil at Site 21 is distributed across the site, with elevated concentrations generally detected below the artificial fill. However, the maximum concentration of iron (46,800 mg/kg)

was detected between 1.5 and 2.0 feet bgs in the northeastern portion of the site, below Building 398 (sampling location 127-002-005).

Iron is a metal that is naturally occurring in soil. It is relatively immobile under most soil conditions because it readily forms oxides. Iron can migrate from soil to groundwater primarily under acidic and reducing conditions as solubility increases with decreasing pH (Lindsay 1979). The pH of soil samples collected at Site 21 ranged from 6.5 to 9.5. The geochemical conditions at Site 21 will tend to stabilize iron in soil and make it unlikely that iron will migrate to groundwater.

8.3.5.5 Lead in Soil

The maximum concentration of lead of 450 mg/kg was observed in a sample collected from sampling location 126-002-003 at 0.5 to 1 feet bgs. This and one other sample are the only samples at the site whose lead concentration exceeded the background screening level of 165 mg/kg, which is the maximum lead concentration observed in background soils.

Lead is relatively immobile under most soil conditions because it sorbs to organic matter and forms complexes with inorganic clays. Only acidic conditions and low sulfate concentrations could increase the mobility of significant quantities of lead in groundwater (Lindsay 1979). These conditions are not present at Site 21; the pH of soil samples collected at Site 21 ranged from 6.5 to 9.5.

8.3.5.6 PAHs in Soil

Low levels of PAHs in soil were detected across Site 21. The maximum PAH concentration expressed as B(a)P equivalent was detected in one sample from 0.0 to 0.5 feet bgs (C3S021B009) in an area outside of the main aircraft maintenance facility. Buildings and pavement at Site 21 have been present since the 1940s. PAHs may be related to the asphalt that covers much of the site or the material used to fill in the San Francisco Bay and construct Alameda Point.

PAHs are not subject to degradation processes and bind to organic matter in soil. In addition, they are mostly insoluble in water; therefore, they exhibit a low potential for migration (ATSDR 1995). The PAHs likely will remain in their present locations.

8.3.6 Human Health Risk Assessment

A site-specific HHRA was conducted for Site 21 as part of the RI to estimate potential human health risks associated with potential exposures to site-related chemicals during current and potential future uses of the site. Section 3.4.6 summarizes the approach used to conduct the HHRA. A summary of the HHRA results for soil at the site is presented below, and a summary of the OU-wide groundwater plume HHRA results are presented in Section 9.0. The following

sections discuss chemicals of potential concern (COPC), the exposure assessment, and the risk characterization for the HHRA. Appendix F presents the complete HHRA.

8.3.6.1 Chemicals of Potential Concern

Data for soil and soil gas samples collected within and around the site boundaries of Site 21 were used to conduct the HHRA for soil. Only chemicals in soil considered to be essential nutrients were excluded as COPCs. The essential human nutrients that were excluded are calcium, magnesium, potassium, and sodium. All other chemicals were retained for evaluation in the HHRA. Lead was selected as a COPC and was evaluated using the LeadSpread model (DTSC 2003).

8.3.6.2 Exposure Assessment

According to reuse plans for Alameda Point, residential, and commercial/industrial uses most likely apply to future exposures at Site 4 (EDAW 1996; Navy 1999c). These exposure scenarios, along with the construction worker exposure, were evaluated for the following soil pathways:

- **Residential** - incidental soil ingestion, dermal contact with soil, inhalation of particulates from soil (non-volatile), ingestion of homegrown produce, inhalation of vapors in ambient air, and inhalation of vapors in indoor air
- **Commercial/Industrial** - soil ingestion, dermal contact with soil, inhalation of particulates from soil (non-volatile), inhalation of vapors in ambient air, and inhalation of vapors in indoor air
- **Construction Worker** - soil ingestion, dermal contact with soil, inhalation of particulates from soil (non-volatile), and inhalation of vapors in ambient air

For all receptors, soil data were aggregated in depth intervals of 0 to 2 feet bgs (surface soil) and 0 to 8 feet bgs (subsurface soil). Exposure to subsurface soil was evaluated for future receptors in the event that subsurface soils are brought to the surface during redevelopment activities.

8.3.6.3 Risk Characterization

The potential for noncancer health effects is expressed as an HI. If the resulting HI is less than 1, it is assumed that there is no significant potential for noncarcinogenic health effects due to cumulative effects. If the total HI exceeds 1, a "segregation of hazard indices" analysis is conducted. In this analysis, chemicals that have similar target organs are grouped together, and an HI is calculated for each group. If the HI for a target organ exceeds 1, there is potential for noncancer health effects.

It is important to note that the noncancer HI is estimated differently than lifetime carcinogenic risk; specifically, a child's exposure is not cumulatively additive to the projected adult exposure.

Noncancer effects manifest over a specific time period, and once the exposure period is over, the hazard has also passed (that is, no latency is assumed). Therefore, because a child receptor has the highest potential risk, risk management decisions for chemicals with noncancer health effects are based on the HI for a child for the residential and recreational scenarios. The total HI that includes background chemicals is calculated for all scenarios, and an incremental HI (which does not include background) is also calculated for the child resident.

Unlike noncancer health effects, which assume that there is no significant potential for noncarcinogenic health effects if the HI is below 1, carcinogenic risks associated with exposure to chemicals classified as carcinogens are estimated as the incremental probability that an individual will develop cancer over a lifetime as a direct result of an exposure. Risk management decisions for chemicals with carcinogenic effects are based on lifetime or total risk; therefore, risks for adult and child receptors are summed to obtain a total carcinogenic risk. To aid in the interpretation of the results, EPA guidance presents a range of goals for residual carcinogenic risk, which is "an excess upper-bound lifetime cancer risk to an individual of between 1 in 1,000,000 to 1 in 10,000" or between 1.0E-06 and 1.0E-04. The range between 1E-06 and 1E-04 is referred to as the "risk management range."

The reasonable maximum exposure (RME) carcinogenic risks and noncancer HIs for soil at Site 21 are summarized below by scenario. See Section 9.0 for a summary of risk from the OU-wide groundwater plume. RME and CTE carcinogenic risks and noncancer HIs are presented in Table 8-19.

Soil

For the commercial/industrial and construction worker scenarios, the highest RME carcinogenic risk for surface soil is 1E-05 for the commercial/industrial worker, which is within the risk management range (see Table 8-19). The highest total RME HI is 1 for the construction worker, which is equal to the risk management HI of 1. No individual COPC exceeds a hazard quotient (HQ) of 1. The RME HI for the commercial/industrial worker is 0.3. Commercial/industrial worker risk drivers for surface and subsurface soil are presented in Tables 8-20 and 8-21.

The residential scenario is considered the most conservative estimate of risk. For surface soil, the carcinogenic risk is 1E-04 (see Table 8-19), which is within the risk management range. The noncancer HI for a child is 5, which is greater than HI of 1 (see Table 8-19). Carcinogenic and noncancer risk drivers for surface soil include the following (see Table 8-22):

- Arsenic
- Cadmium
- Iron

Soil risks are attributed primarily to arsenic. Arsenic and iron at Site 21 exceed background concentrations; iron concentrations are similar to iron concentrations in the background data set.

For the commercial/industrial and construction worker scenarios, the highest RME carcinogenic risk for subsurface soil is 4E-06 for the commercial/industrial worker, which is within the risk management range (see Table 8-19). The highest total RME HI is 1 for the construction worker, which is equal to the risk management HI of 1. No individual COPC exceeds an HQ of 1. The RME HI for the commercial/industrial worker is 0.2.

For subsurface soil, under the residential scenario, carcinogenic risk is 4E-05, which is within the risk management range. The HI for a child is 3, which is above 1. However, no individual HQ exceeds 1. Cancer risk drivers for subsurface soil include the following (see Table 8-23):

- Arsenic
- Carbazole

Soil risks from subsurface soils are attributed primarily to arsenic, which exceeds background concentrations.

Lead in Soil and Groundwater

Lead was selected as a COPC for Site 21 soil and OU-wide groundwater and was evaluated using LeadSpread. Lead in site soil and OU-wide groundwater is not attributed to background. The EPCs for lead are 37.0 and 132.0 mg/kg for surface and subsurface soil, respectively. For water ingestion, two EPC s were used: 7.38 micrograms per liter (µg/L) for the OU-wide groundwater plume, and 0.15 µg/L for East Bay Municipal Utilities District (EBMUD) drinking water.

For surface soil, the LeadSpread model predicts that the 95th percentile estimate of blood lead is 3.2 micrograms per deciliter (µg/dL) for a child ingesting Site 21 soil and OU-wide groundwater, and 2.2 µg/dL for a child ingesting Site 21 soil and EBMUD drinking water (see Appendix F). These values are below the comparison criterion of 10 µg/dL. Based on LeadSpread results, there is no appreciable risk to human health from ingestion of lead in Site 21 soil and groundwater. The 10 µg/dL child blood lead level equates to a soil concentration of 221 mg/kg when EBMUD is the drinking water source.

For subsurface soil, the LeadSpread model predicts that the 95th percentile estimate of blood lead is 5.8 µg/dL for a child ingesting Site 21 soil and OU-wide groundwater, and 4.8 µg/dL for a child ingesting Site 11 soil and EBMUD drinking water (see Appendix F). These values are below the comparison criterion of 10 µg/dL. Based on LeadSpread results, there is no appreciable risk to human health from ingestion of lead in Site 21 soil and groundwater. The 10 µg/dL child blood lead level equates to a soil concentration of 221 mg/kg when EBMUD is the drinking water source.

8.3.7 Ecological Risk Assessment

A site-specific ERA was conducted for Site 21 to estimate potential risks to ecological receptors. Section 3.4.7 summarizes the approach used to conduct the ERA. The following sections discuss chemicals of potential ecological concern (COPEC), the ERA problem formulation, and assessment results. Appendix G presents the complete ERA.

8.3.7.1 Chemicals of Potential Ecological Concern

Data for soil collected within and around the boundaries of Site 21 were used to conduct the ERA. Table 8-24 summarizes COPECs for soil from 0 to 4 feet bgs. Groundwater was evaluated for all OU-2B sites and is discussed separately in Section 9.0.

8.3.7.2 Problem Formulation

Currently, Site 21 does not contain ecological habitat capable of supporting significant wildlife; however, exposure pathways for terrestrial receptors were considered potentially complete to provide a conservative estimate of risk. The following complete soil exposure pathways were identified for Site 21:

- Direct exposure to soil
- Food chain exposure

Selected assessment and measurement endpoints include the following:

- Reproductive or physiological impacts to the California ground squirrel *(Citellus beecheyi)* as indicated by HQs developed based on both high (lowest observed adverse effect level [LOAEL]-based) and low (no observed adverse effect level (NOAEL)-based) toxicity reference values (TRVs)
- Reproductive or physiological impacts to the Alameda song sparrow *(Melospiza melodia pusillula)* as indicated by HQs developed based on both high (LOAEL-based) and low (NOAEL-based) TRVs
- Reproductive or physiological impacts to the American robin (*Turdus migratorius*) as indicated by HQs developed based on both high (LOAEL-based) and low (NOAEL-based) TRVs
- Reproductive or physiological impacts to the red-tailed hawk *(Buteo jamaicensis)* as indicated by HQs developed based on both high (LOAEL-based) and low (NOAEL-based) TRVs

8.3.7.3 Assessment Results

High and low TRVs were used to provide a bounding estimate of risk to each endpoint receptor. The high TRV represents an upper bounding limit, which is the lowest concentration at which adverse effects are known to occur. The low TRV represents the lower bounding limit, which is the highest concentration that an endpoint receptor can be exposed that does not result in adverse effects. If both HQ values for a chemical were below 1.0, then the ecological endpoint receptor is considered to be exposed to no potential risk from soil. Chemicals with one or both bounding limit HQs exceeding 1.0 were evaluated further based on background chemical concentrations, each chemical's frequency of detection and distribution at the site, the range of concentrations detected, and its absorption potential and toxicity to each ecological receptor. This type of analysis provides additional weight-of-evidence data to support risk management decisions for the sites. Assessment results for Site 21 soil for small mammal, passerine, and raptor populations are discussed below. Table 8-25 summarizes both high and low TRV HQ results for soil.

Small Mammal Populations

For small mammal populations, the California ground squirrel is the measurement endpoint receptor. The following soil COPECs had HQs above 1.0 (HQs shown in parentheses):

- Aluminum (131, 1310)
- Copper (2.8)
- Lead (3.4)
- Manganese (4.7)
- Vanadium (5.3)
- Zinc (4.2)

All other COPECs evaluated at Site 21 were determined to pose no significant risk, based on HQs of less than 1.0 for both the low and high TRVs.

Aluminum had an HQ above 1.0 for both the high and low TRV values. Aluminum was detected in all 12 samples collected at Site 21, with concentrations ranging from 3,940 to 21,600 mg/kg. Background concentrations ranged from 1,760 to 22,600 mg/kg. Based on these ranges of concentrations, aluminum concentrations appear to be naturally high in soils at Alameda Point; therefore, potential risks from aluminum at Site 21 to small mammals are not expected to exceed those posed by background levels.

Only the low TRV HQs for copper, lead, manganese, vanadium, and zinc were above 1.0. These COPECs were further evaluated using a weight-of-evidence approach as described above. After consideration of background concentrations at Alameda Point, the absorption potential of the chemical, the frequency of detection, bioconcentration factors (BCF) used in risk calculations, habitat available at the site, and the concentrations at Site 21, manganese, vanadium, and zinc were determined to pose no significant potential for risk to small mammals. Copper and lead pose a potential risk to small mammals.

Passerine Populations

For passerine populations, the Alameda song sparrow and American robin are the measurement endpoint receptors. The following soil COPECs had HQs above 1.0:

- Aluminum (sparrow – 1.2; robin – 3.8)
- Lead (sparrow – 91; robin – 315)

Literature data were not adequate to develop avian ERVs for the metals beryllium and cobalt or the SVOCs high molecular weight (HMW) PAHs and low molecular weight (LMW) PAHs. A qualitative evaluation was therefore conducted. All other COPECs evaluated at Site 21 were determined to pose no significant risk based on HQ values of less than 1.0 for both the low and high TRVs.

Only the low TRV HQs for aluminum and lead were above 1.0. After consideration of background concentrations at Alameda Point, the absorption potential of the chemical, the frequency of detection, BCFs used in risk calculations, habitat available at the site, and the concentrations at Site 21, aluminum and lead were determined to pose no significant potential for risk to passerines.

The qualitative evaluation of risk to passerines from exposure to beryllium, cobalt, HMW PAHs, and LMW PAHs involved assessing the weight-of-evidence parameters. Beryllium was detected at Site 21 in 10 of 12 samples collected at concentrations ranging from 0.87 to 2.5 mg/kg, and background concentrations ranged from 0.25 to 1.47 mg/kg. Cobalt was detected in all 12 samples collected at concentrations ranging from 2.9 to 21.1 mg/kg, and background concentrations ranged from 3.02 to 49.7 mg/kg. Based on these background concentrations, most of the doses of these metals to passerines is attributable to background concentrations. Very little information is available concerning the effects of beryllium and cobalt on avian species. Potential risks to passerines from these metals at Site 21 are not expected to exceed the risk posed by background concentrations of these chemicals.

HMW and LMW PAHs were detected at Site 21 at frequencies ranging from 11 to 95 percent out of a total of 63 samples collected. Calculated EPCs ranged from 0.005 to 0.045 mg/kg. PAHs can cause genotoxic, reproductive, and mutagenic effects; however, studies indicate that PAHs do not appear to bioaccumulate in mammals and birds (Eisler 1987). Given the relatively high frequency of detection, the risk posed to passerines from residual levels of HMW and LMW PAHs associated with Site 21 cannot be discounted.

Raptor Populations

For raptor populations, the red-tailed hawk is the measurement endpoint receptor. The following soil COPECs had HQs above 1.0:

- Aluminum (2.1, 20)
- DDT (1.2)
- Lead (732)
- Total PCBs (1.4)

Literature data were not adequate to develop avian ERVs for the metals beryllium and cobalt or the SVOCs HMW PAHs and LMW PAHs. A qualitative evaluation was therefore conducted. All other COPECs evaluated at Site 21 were determined to pose no significant risk, based on an HQ less than 1.0 for both the low and high TRVs.

Aluminum had an HQ above 1.0 for both the high and low TRV values. Aluminum was detected in all 12 samples collected at Site 21 at concentrations ranging from 3,940 to 21,600 mg/kg. Background concentrations ranged from 1,760 to 22,600 mg/kg. Based on these ranges of concentrations, aluminum concentrations appear to be naturally high in soils at Alameda Point; therefore, potential risks from aluminum at Site 21 to raptors are not expected to exceed those posed by background levels.

Only the low TRV HQs for lead, DDTt, and total PCBs for the red-tailed were above 1.0. The lead low TRV HQ may be driven by the overly conservative low TRV value; the alternate low TRV HQ calculated for the red-tailed hawk was 2.0. Based on this information, lead at Site 21 poses a potential risk to raptors.

The low TRV HQs for DDTt and total PCBs were 1.23 and 1.36, respectively. Aroclor 1260, DDD and DDT were detected in only 1 of 10 samples collected from Site 21 at concentrations of 0.14 mg/kg, 0.012 mg/kg, and 0.058 mg/kg, respectively. PCBs and chlorinated pesticides can cause adverse effects in birds. These HQs for raptors were conservatively calculated assuming that 100 percent of the organism's diet came from Site 21, which is only 7 acres. Raptors, such as the red-tailed hawk, can have extensive foraging ranges, up to 200 acres. Based on the low frequency of detection and the low HQ value (only slightly above 1.0), the risk to raptors from residual levels of DDD, DDT, and total PCBs at Site 21 is expected to be low.

The qualitative evaluation of risk to raptors from exposure to beryllium, cobalt, HMW PAHs, and LMW PAHs involved assessing the weight-of-evidence parameters. As discussed above for passerines, the potential risks posed to raptors from beryllium and cobalt at Site 21 are not expected to exceed the risk posed from background concentrations of these chemicals.

Impacts to raptors from HMW PAHs and LMW PAHs could not be discounted because of the lack of information concerning long-term impacts of multiple PAHs to raptors at the site.

8.4 SITE 21 CONCLUSIONS AND RECOMMENDATIONS

This section summarizes conclusions and recommendations regarding the nature and extent of chemicals at Site 21 are the risk posed by those chemicals. The contents of this section are based on (1) the site-specific CSM, (2) data quality assessment, (3) background comparison, (4) nature and extent evaluations, (5) fate and transport evaluation, (6) the HHRA, and (7) the ERA.

8.4.1 Nature and Extent Conclusions

Most of the chemicals detected across Site 21 are consistent with the historical activities that occurred at Buildings 162, 398 and 113, including painting, paint stripping, sandblasting, jet engine maintenance and testing, equipment cleaning, and the use of petroleum products. There are five principal areas where chemicals appear to have been released to soil, (1) near USTs 398-1 and 398-2, (2) near the industrial waste treatment line located in the southern part of Building 162, (3) near USTs 162-1 and 162-2 and the fuel line located on the northeast corner of Building 162, (4) near Building 113, and (5) southwest corner of Building 398 along the storm sewer line (see Figure 8-7).

The maximum concentrations of benzene and xylene are located in soil near an industrial waste treatment line to the south of USTs 398-1 and 398-2 at a depth of 5 feet bgs. Benzene was only detected in 2 of 71 samples collected at the site, and xylene was only detected in 7 of 68 samples collected at the site. Benzene and xylene are likely the result of TPH contamination at the site.

Copper and mercury also are located in shallow soil near USTs 398-1 and 398-2. Mercury was used within Building 162 in the repair of aircraft components; however; mercury concentrations are below the maximum background concentration. Copper was also used at the site as a component in jet engine lubricant.

The maximum concentrations of TCE and acetone were detected near the industrial waste treatment line in the southern part of Building 162. This is the only location where TCE was detected in soil (out of 51 samples) and acetone was only detected at one other location in soil (out of 46 samples). It is likely that TCE and acetone were used in Buildings 162, 398, and 113 as degreasers and cleaners.

The maximum concentration of aluminum in soil was detected east of Building 162 in a sample collected during the installation of monitoring well M07B-01. This does not correspond to the area at Building 398 where aluminum smelting activities are known to occur.

DDD, DDT, and Aroclor 1260 were detected in soil at sample location B07B-05 from 0.5 to 1.5 feet bgs, which is located near USTs 162-1 and 162-2 and the fuel line located on the northeast corner of Building 162. This is only sampling location (out of 22 samples) where these compounds were detected. DDD and DDT likely are present at the site from general pesticide use. Aroclor 1260 is likely located at the site as the result of used oils containing PCBs being used for weed and dust control.

The maximum concentration of toluene was detected from 3.5 to 4 feet bgs below Building 113. Toluene detected in soil near Buildings 113 398 is likely the result of TPH contamination in soil.

The maximum concentration of lead was detected in samples collected from surface soil near the southwest corner of Building 398 along the storm sewer line (sampling location 126-002-003 at

0.5 to 1 feet bgs). Lead detected in soil is likely the result of petroleum hydrocarbon and lead-based paint use at the site.

PAHs were detected at a maximum B(a)P equivalent concentration of 0.172 mg/kg, which is less than the screening level of 0.62 mg/kg.

Although arsenic concentrations in soil exceeded the background screening level, no evidence exists that arsenic was used in site-related activities. Arsenic concentrations detected in soil are within background ranges typically seen in the San Francisco Bay Area (Tetra Tech 2003d); therefore, arsenic is attributed to background.

Copper concentrations exceeding the maximum background screening level appear to be localized within surface soil in three areas: the jet engine test cell area in Building 398, the paint booth in Building 113, and near UST 162-1.

Concentrations of iron elevated above the background screening level were detected in samples collected from three areas, inside the eastern edge of Building 398, west of Building 162, and between former UST 113 and the southwestern side of Building 162, with the maximum concentration detected below Building 398 (turbine accessories shop). Elevated concentrations were generally detected below the artificial fill. Iron appears to be uniformly distributed across the site and not exclusively related to storm sewers, buildings, or other site features, which suggests that iron occurs randomly across the site with no apparent source and may be naturally occurring.

Lead in two soil samples at the site exceeded the background screening level. Lead appears to be localized within surface soil near the southwest corner of Building 398 along the storm sewer line and the northeast corner of Building 162 near USTs 162-1 and 162-2. Lead-containing petroleum hydrocarbons and lead-based paint have been used at the site and are the likely source.

8.4.2 Risk Assessment Conclusions

The following sections discuss HHRA and ERA results from the evaluation of risk from chemicals detected in soil and the lead groundwater plume at Site 21. Risk assessment results for the OU-wide groundwater plume are presented in Section 9.0.

Although numerous chemicals were detected at the site, some of these chemicals do not pose significant risk as defined by the risk assessments. Based on the HHRA, arsenic, cadmium, carbazole, and iron lead in soil were identified as risk drivers. Based on the ERA, copper, lead, and PAHs in soil were identified as risk drivers. According to the background comparison, cadmium is attributed to background.

8.4.2.1 Human Health Risk Assessment Conclusions

According to reuse plans for Alameda Point, residential and commercial/industrial exposures are the most likely future exposures at Site 21 (EDAW 1996; Navy 1999c). Human health risk was evaluated for residential and commercial/industrial exposures, along with construction worker exposure. HHRA results for soil are summarized below.

Soil

For the commercial/industrial and construction worker scenarios, the most conservative RME carcinogenic risks for Site 21 soil are within the risk management range. The most conservative RME noncancer HI for soil is 1, equal to the risk management HI of 1.

The residential scenario is considered the most conservative estimate of risk. For surface and subsurface soil, RME carcinogenic risks are within the risk management range. The surface and subsurface soil noncancer HIs for a child are 5 and 3, respectively.

Residential soil risks are primarily attributed to arsenic. Based on the background comparison, arsenic is attributed to background.

Lead in Soil and Groundwater

Lead was selected as a COPC for Site 21 soil and groundwater and was evaluated using LeadSpread. Lead in site soil and OU-wide groundwater is not attributed to background. For both surface and subsurface soils, child blood lead levels are below the comparison criterion of 10 µg/dL. Based on LeadSpread results, there is no appreciable risk to human health from ingestion of lead in Site 21 soil and groundwater.

8.4.2.2 Ecological Risk Assessment Conclusions

A site-specific ERA was conducted for Site 21 to estimate potential risks to the environment. Currently, Site 21 does not contain ecological habitat capable of supporting significant wildlife; however, exposure pathways for terrestrial receptors were considered potentially complete to provide a conservative estimate of risk.

Assessment endpoint receptors include small mammals, passerines, and raptors. Copper and lead in soil were identified as posing potential risk to small mammals. PAHs in soil were identified as posing potential risk to passerines and raptors and lead was identified as posing a potential risk to raptors.

8.4.3 Recommendations

Based on the data and risks discussed previously, soil at Site 21 is recommended for further evaluation in a feasibility study (FS), as defined under CERCLA, to address risks to residential receptors under the unrestricted reuse scenario. Arsenic, carbazole, and iron are identified as chemicals of concern (COC) for soil. In addition, because detection limits for non-detected SVOCs in soil were elevated, the need for further sampling and analysis of soil may be necessary to confirm these chemicals are not present in site soil.

Cadmium was also identified as risk driver for soil but is not recommended as a COC for further evaluation in the FS because this metal is attributed to background.

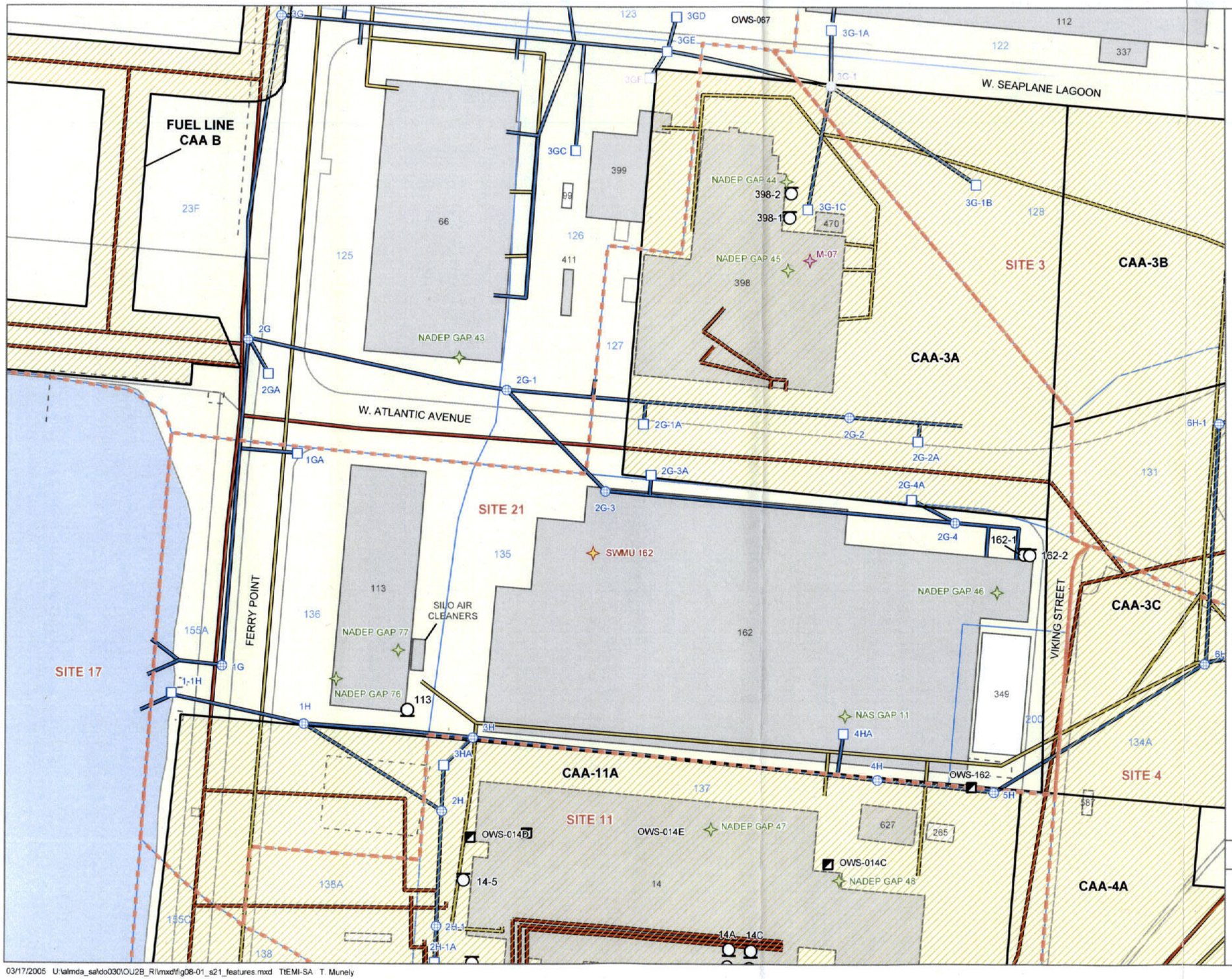
Although chemicals were identified that could pose a risk to ecological receptors, there is little likelihood the site will be used for ecological habitat. Therefore, the risks identified for ecological receptors are overestimated. No action is recommended for chemicals based on potential risk to ecological receptors.

An evaluation of TPH in soil and groundwater also was conducted based on the TPH Strategy for Alameda Point. On the basis of this evaluation, NFA is recommended for Site 21 soil and further action is recommended for Site 21 groundwater for TTPH and TPH-associated constituents. TPH impacted groundwater is addressed further in the OU-wide groundwater section (Section 9.0).

FIGURES

FINAL OPERABLE UNIT 2B
REMEDIAL INVESTIGATION REPORT
SITES 3, 4, 11, AND 21

DATED 05 AUGUST 2005



ABOVEGROUND STORAGE TANK (AST)
- Present
- Removed

UNDERGROUND STORAGE TANK (UST)
- Present
- Removed
- RCRA UNIT
- GENERATOR ACCUMULATION POINT (GAP)
- SOLID WASTE MANAGEMENT UNIT (SWMU)
- CATCH BASIN
- MANHOLE
- OIL-WATER SEPARATOR (OWS)
- FENCE
- FUEL LINE
- SANITARY SEWER LINE
- STORM SEWER LINE
- CORRECTIVE ACTION AREA (CAA)
- CERCLA SITE BOUNDARY
- ENVIRONMENTAL BASELINE SURVEY (EBS) PARCEL BOUNDARY AND NUMBER
- LAND COVER
- WATER

BUILDING
- Present
- Removed

Notes:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
GAP = Generator accumulation point
NADEP = Naval Aviation Depot Alameda
NAS = Naval Air Station
RCRA = Resource Conservation and Recovery Act
SWMU = Solid Waste Management Unit

40 0 40 80 Feet

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FIGURE 8-1
SITE 21 FEATURES

Operable Unit 2B
Remedial Investigation Report

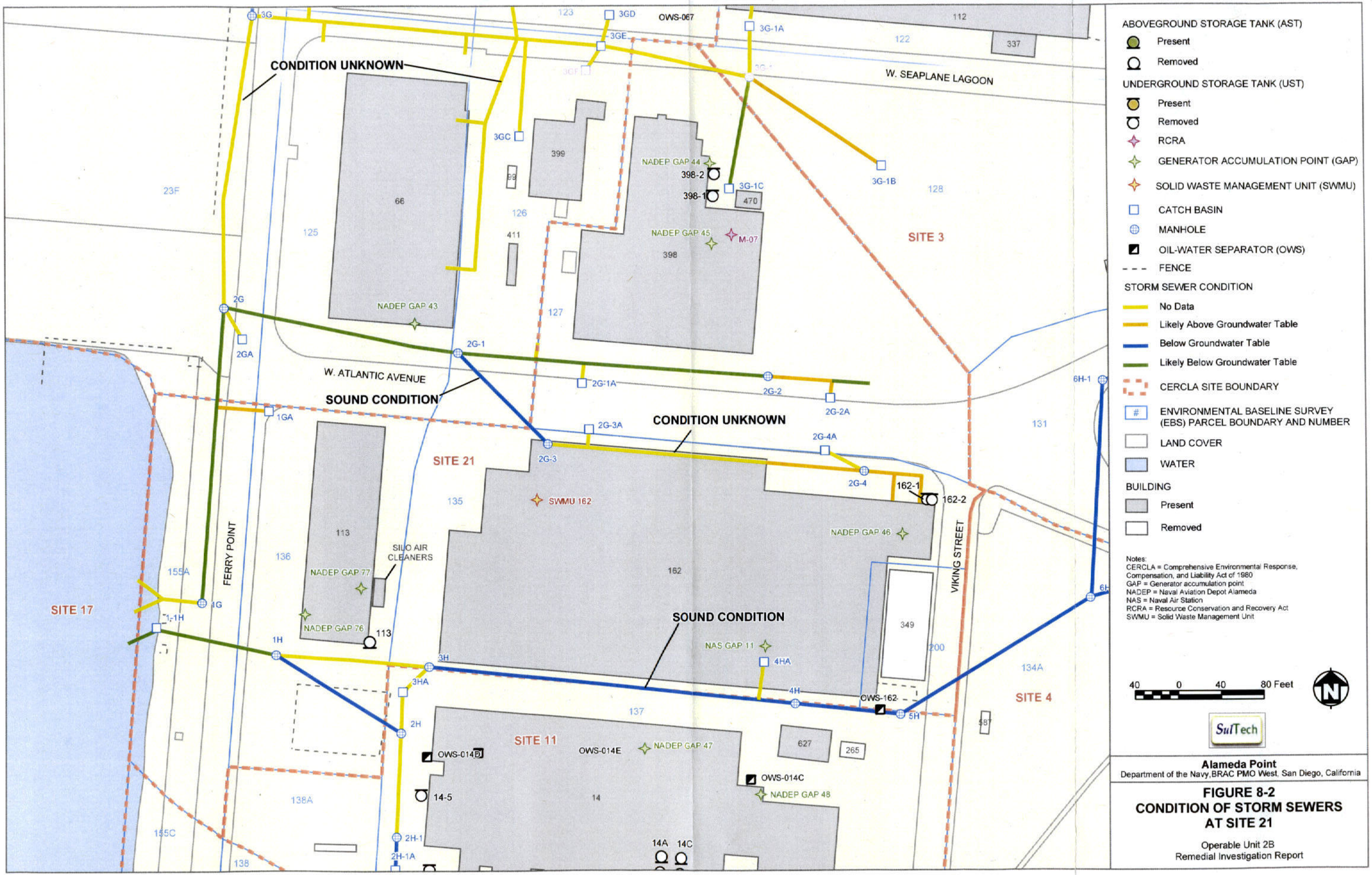

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FIGURE 8-2
CONDITION OF STORM SEWERS AT SITE 21

Operable Unit 2B
Remedial Investigation Report

03/17/2005 U:\almda_sa\do030\OU2B_RI\mxd\fig08-02_s21_sewer_cond.mxd TtEMI-SA T. Munley

SAMPLING LOCATION
- Direct-Push
- Excavation
- Manhole Storm Drain
- Monitoring Well
- Piezometer
- Soil Boring
- Storm Drain Outlet
- Soil Gas

SAMPLING INVESTIGATION
- Phase 2B & 3, 1991
- SCS Investigation 1991
- Follow-on Investigation, 1994
- Follow-on Investigation, 1998
- Supplemental RI Data Gap Sampling, 2001
- Basewide Groundwater Monitoring, 2002
- Total Petroleum Hydrocarbon Program
- Polynuclear aromatic hydrocarbon investigation of 2003

ABOVEGROUND STORAGE TANK (AST)
- Present
- Removed

UNDERGROUND STORAGE TANK (UST)
- Present
- Removed
- RCRA UNIT
- GENERATOR ACCUMULATION POINT (GAP)
- SOLID WASTE MANAGEMENT UNIT (SWMU)
- CATCH BASIN
- MANHOLE
- OIL-WATER SEPARATOR (OWS)
- FENCE
- FUEL LINE
- SANITARY SEWER LINE
- STORM SEWER LINE
- CERCLA SITE BOUNDARY
- ENVIRONMENTAL BASELINE SURVEY (EBS) PARCEL BOUNDARY AND NUMBER
- LAND COVER
- WATER

BUILDING
- Present
- Removed

Notes:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
GAP = Generator accumulation point
NADEP = Naval Aviation Depot Alameda
NAS = Naval Air Station
RCRA = Resource Conservation and Recovery Act
RI = Remedial Investigation
SWMU = Solid Waste Management Unit
TPH = Total Petroleum Hydrocarbon

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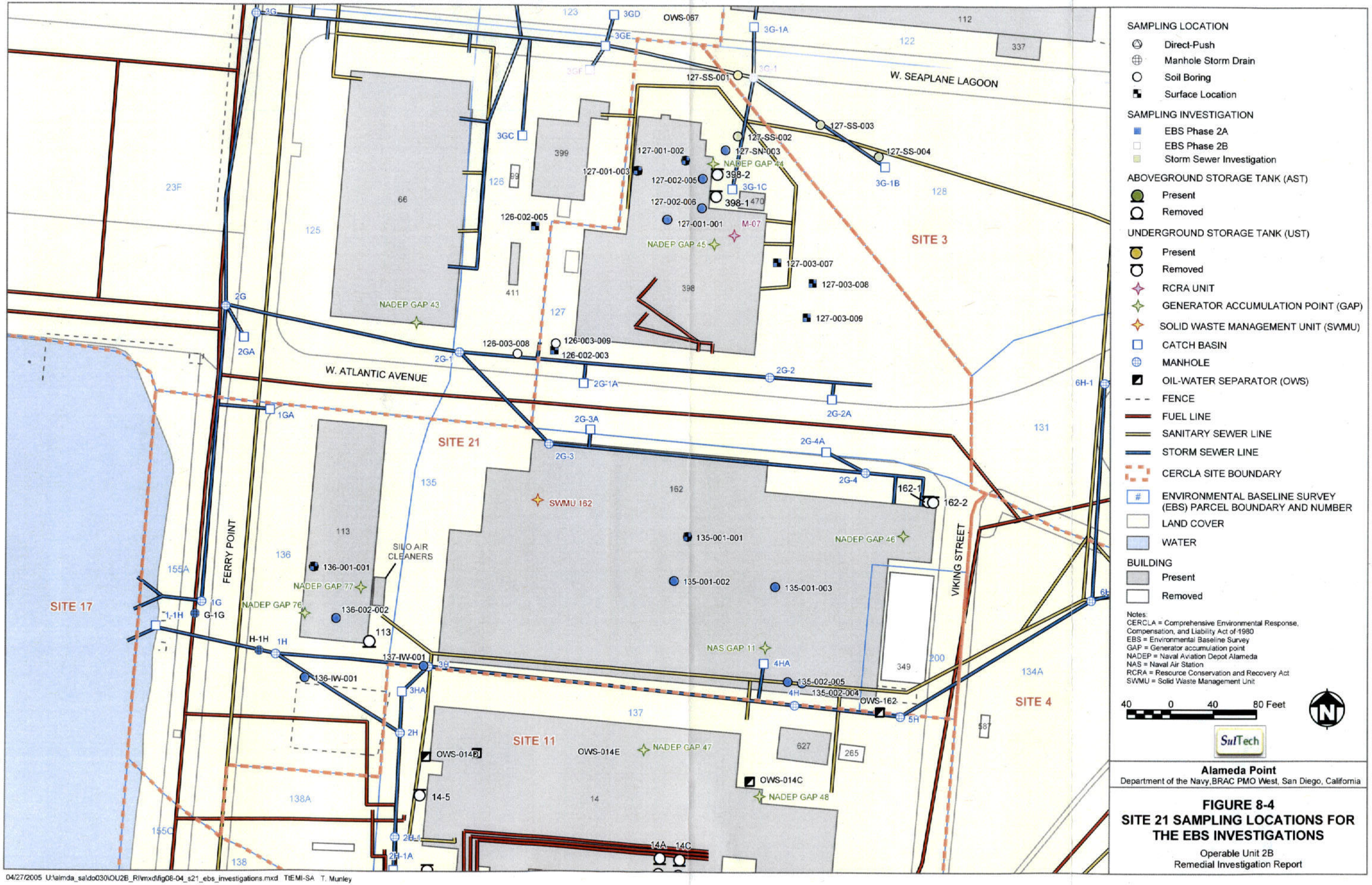
FIGURE 8-3
SITE 21 SAMPLING LOCATIONS FOR THE CERCLA AND TPH INVESTIGATIONS

Operable Unit 2B
Remedial Investigation Report

40 0 40 80 Feet

2004-03-31 U:\almda_sa\do030\OU2B_RI\mxd\fig08-03_s21_cercla_investigations.mxd TtEMI-SA K. Johnson



SAMPLING LOCATION
- Direct-Push
- Manhole Storm Drain
- Soil Boring
- Surface Location

SAMPLING INVESTIGATION
- EBS Phase 2A
- EBS Phase 2B
- Storm Sewer Investigation

ABOVEGROUND STORAGE TANK (AST)
- Present
- Removed

UNDERGROUND STORAGE TANK (UST)
- Present
- Removed
- RCRA UNIT
- GENERATOR ACCUMULATION POINT (GAP)
- SOLID WASTE MANAGEMENT UNIT (SWMU)
- CATCH BASIN
- MANHOLE
- OIL-WATER SEPARATOR (OWS)
- FENCE
- FUEL LINE
- SANITARY SEWER LINE
- STORM SEWER LINE
- CERCLA SITE BOUNDARY
- # ENVIRONMENTAL BASELINE SURVEY (EBS) PARCEL BOUNDARY AND NUMBER
- LAND COVER
- WATER

BUILDING
- Present
- Removed

Notes:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
EBS = Environmental Baseline Survey
GAP = Generator accumulation point
NADEP = Naval Aviation Depot Alameda
NAS = Naval Air Station
RCRA = Resource Conservation and Recovery Act
SWMU = Solid Waste Management Unit

40 0 40 80 Feet

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FIGURE 8-4
SITE 21 SAMPLING LOCATIONS FOR THE EBS INVESTIGATIONS

Operable Unit 2B
Remedial Investigation Report

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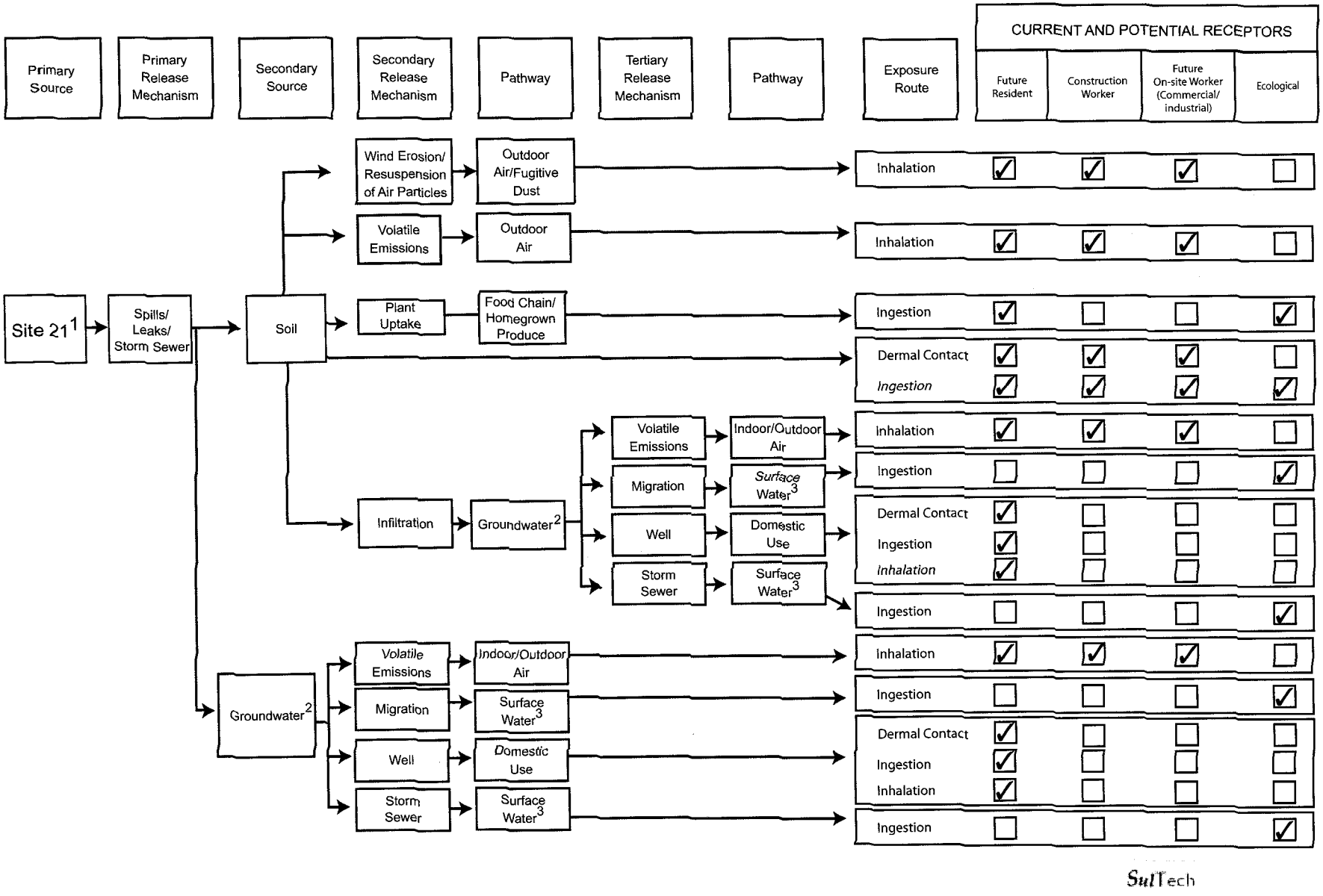

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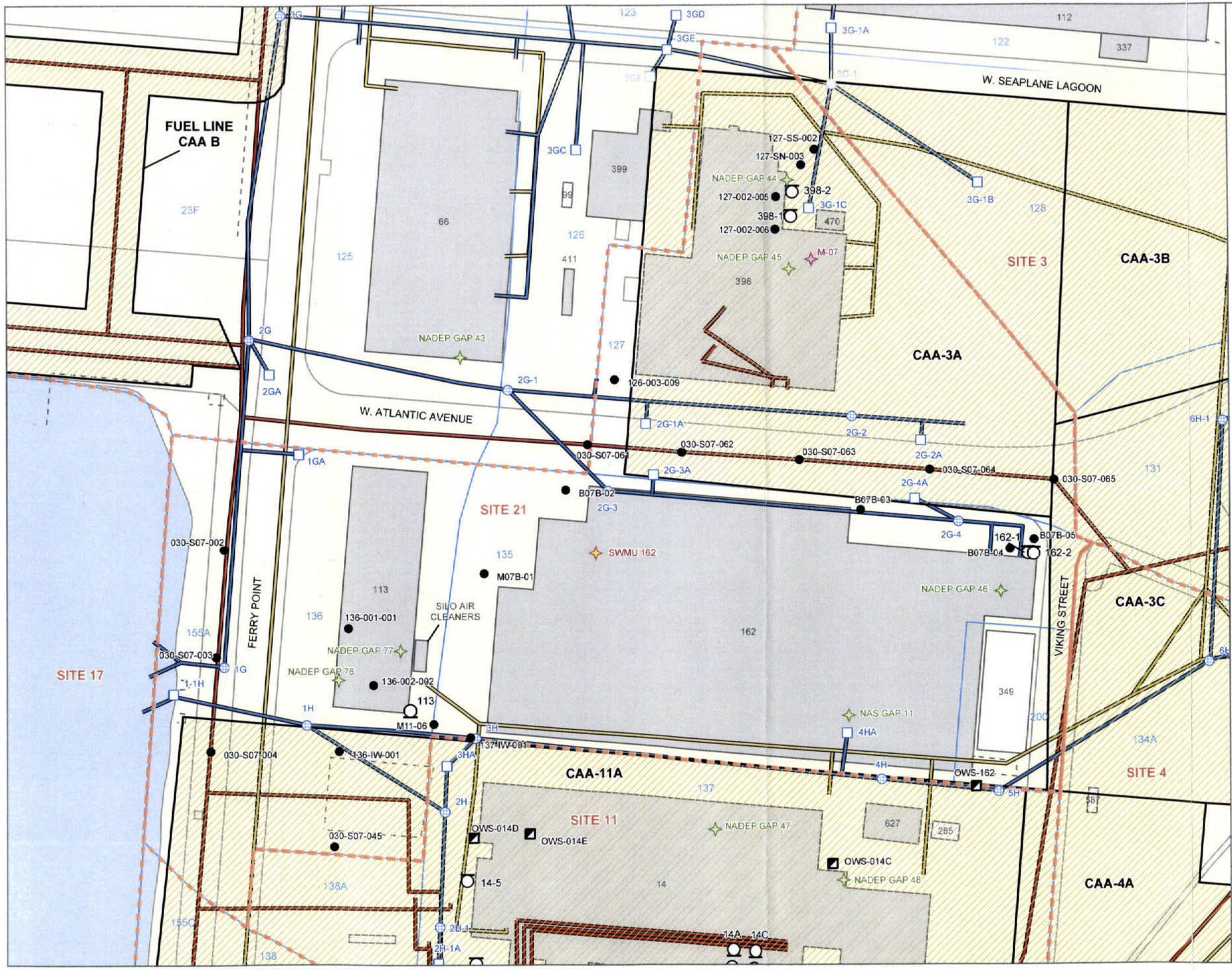
FIGURE 8-5
SITE 21 CONCEPTUAL SITE MODEL
Operable Unit 2B
Remedial Investigation Report

1 Buildings 162, 398, and 113 and OWS-162; USTs 162-1, 162-2, 398-1, and 398-2; and their associated sanitary sewer and fuel lines
2 *OU-wide plume*
3 Seaplane Lagoon

☑ Potentially complete pathway, exposure quantified



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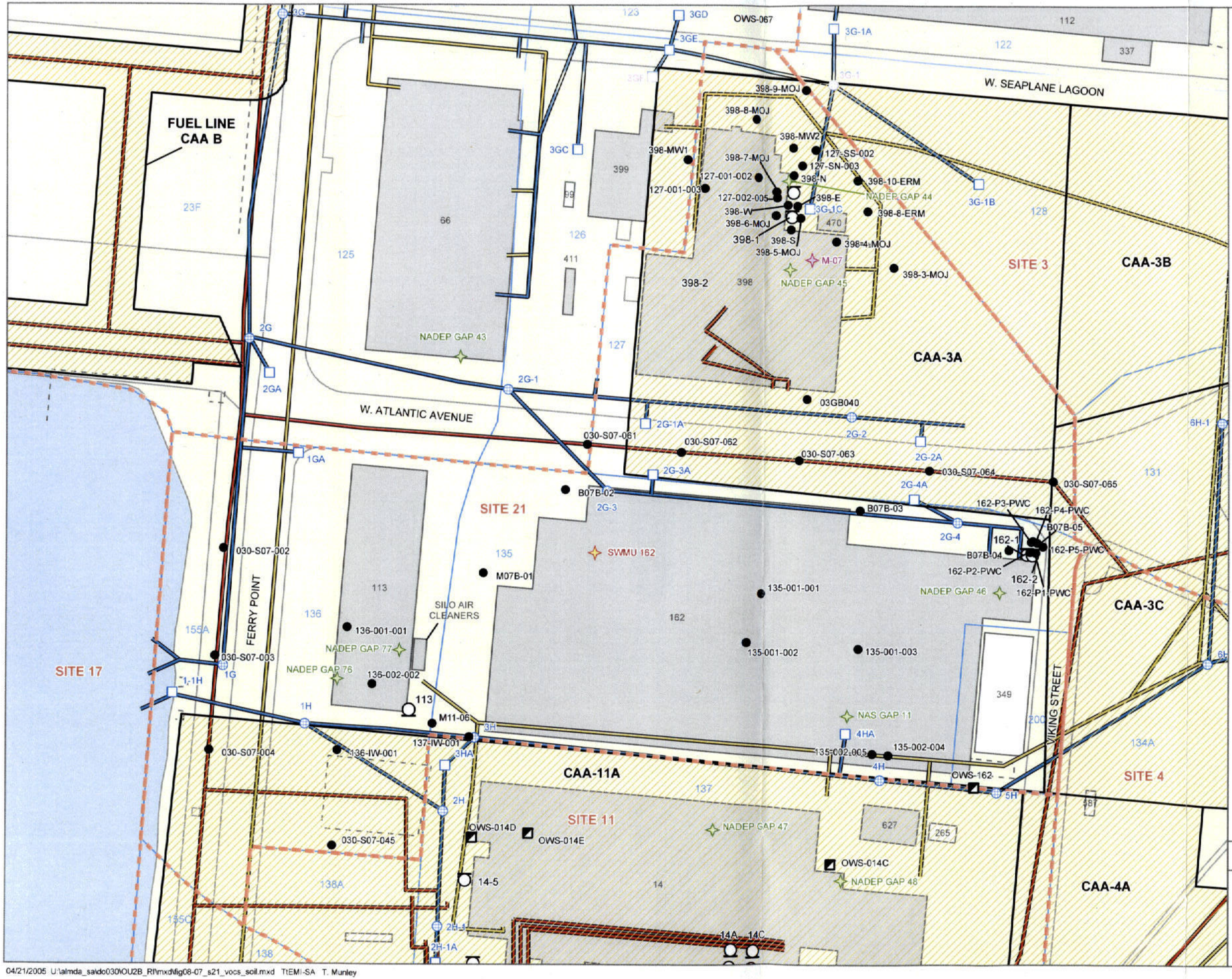

SAMPLING LOCATION
- Location analyzed for VOCs in soil

ABOVEGROUND STORAGE TANK (AST)
- Present
- Removed

UNDERGROUND STORAGE TANK (UST)
- Present
- Removed
- RCRA UNIT
- GENERATOR ACCUMULATION POINT (GAP)
- SOLID WASTE MANAGEMENT UNIT (SWMU)
- CATCH BASIN
- MANHOLE
- OIL-WATER SEPARATOR (OWS)
- FENCE
- FUEL LINE
- SANITARY SEWER LINE
- STORM SEWER LINE
- CORRECTIVE ACTION AREA (CAA)
- CERCLA SITE BOUNDARY
- # ENVIRONMENTAL BASELINE SURVEY (EBS) PARCEL BOUNDARY AND NUMBER
- LAND COVER
- WATER

BUILDING
- Present
- Removed

Notes:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
GAP = Generator accumulation point
NADEP = Naval Aviation Depot Alameda
NAS = Naval Air Station
RCRA = Resource Conservation and Recovery Act
SWMU = Solid Waste Management Unit

40 0 40 80 Feet

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FIGURE 8-7
SITE 21 SAMPLING LOCATIONS FOR VOCs IN SOIL

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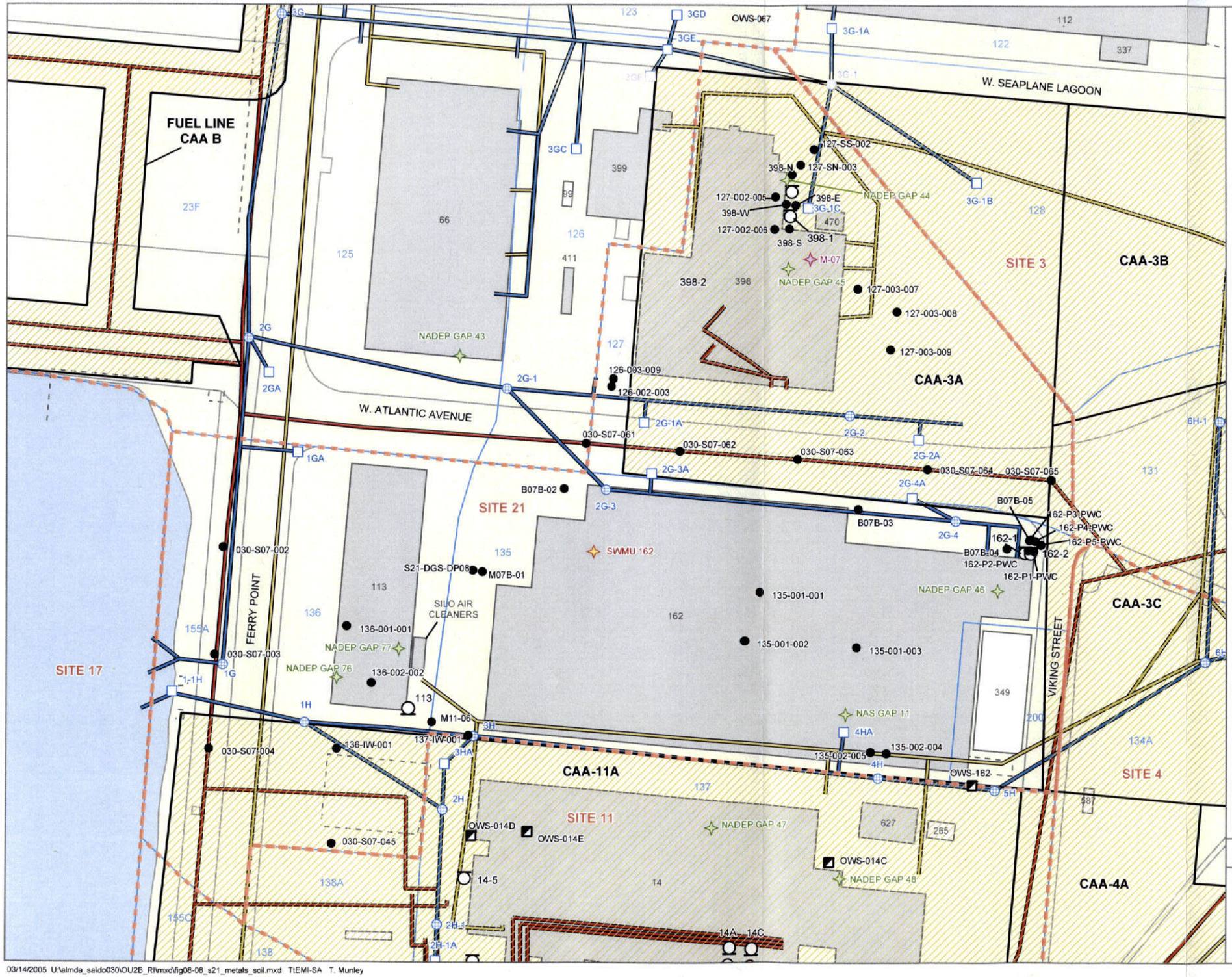

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FIGURE 8-8
SITE 21 SAMPLING LOCATIONS FOR METALS IN SOIL
Operable Unit 2B
Remedial Investigation Report

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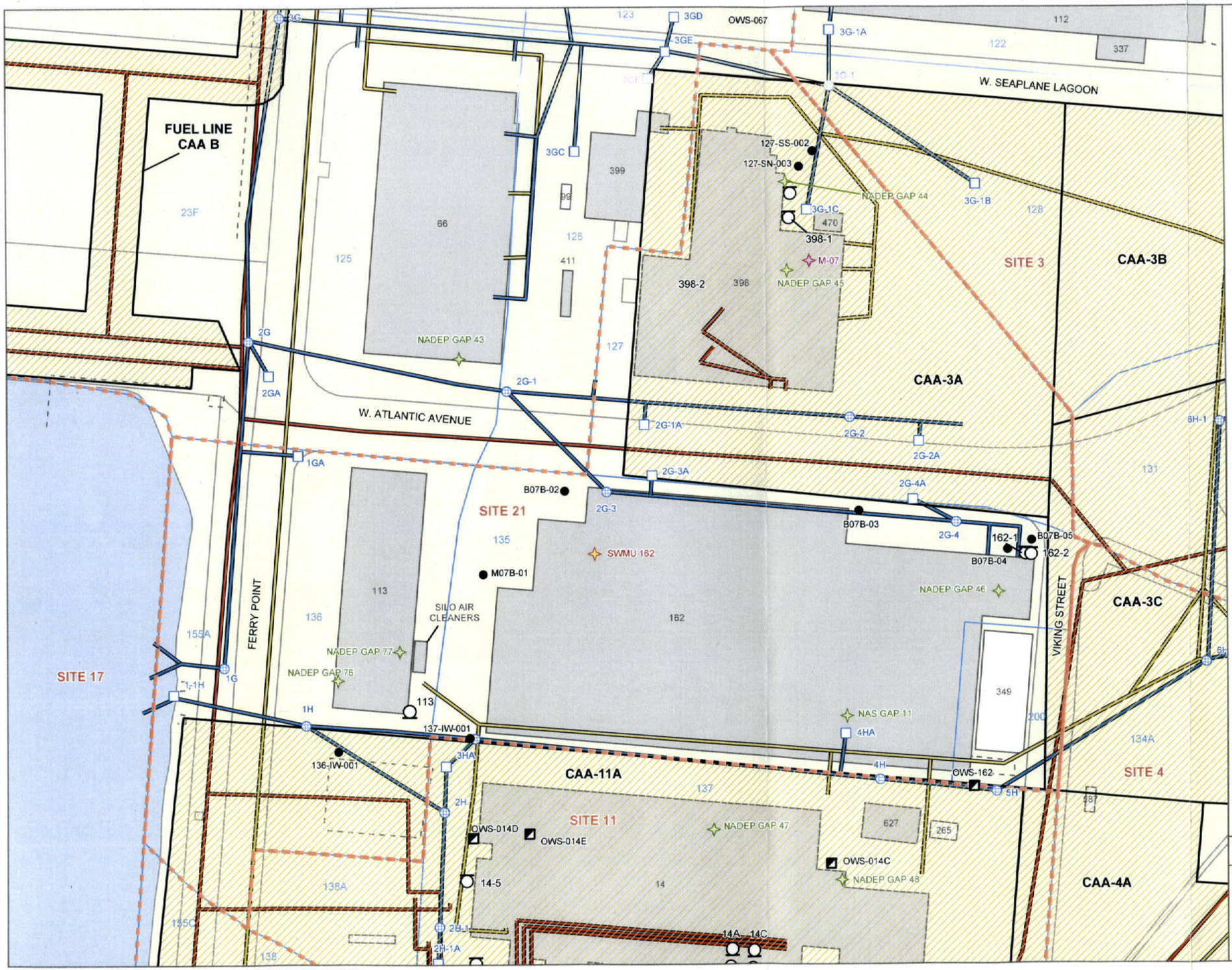

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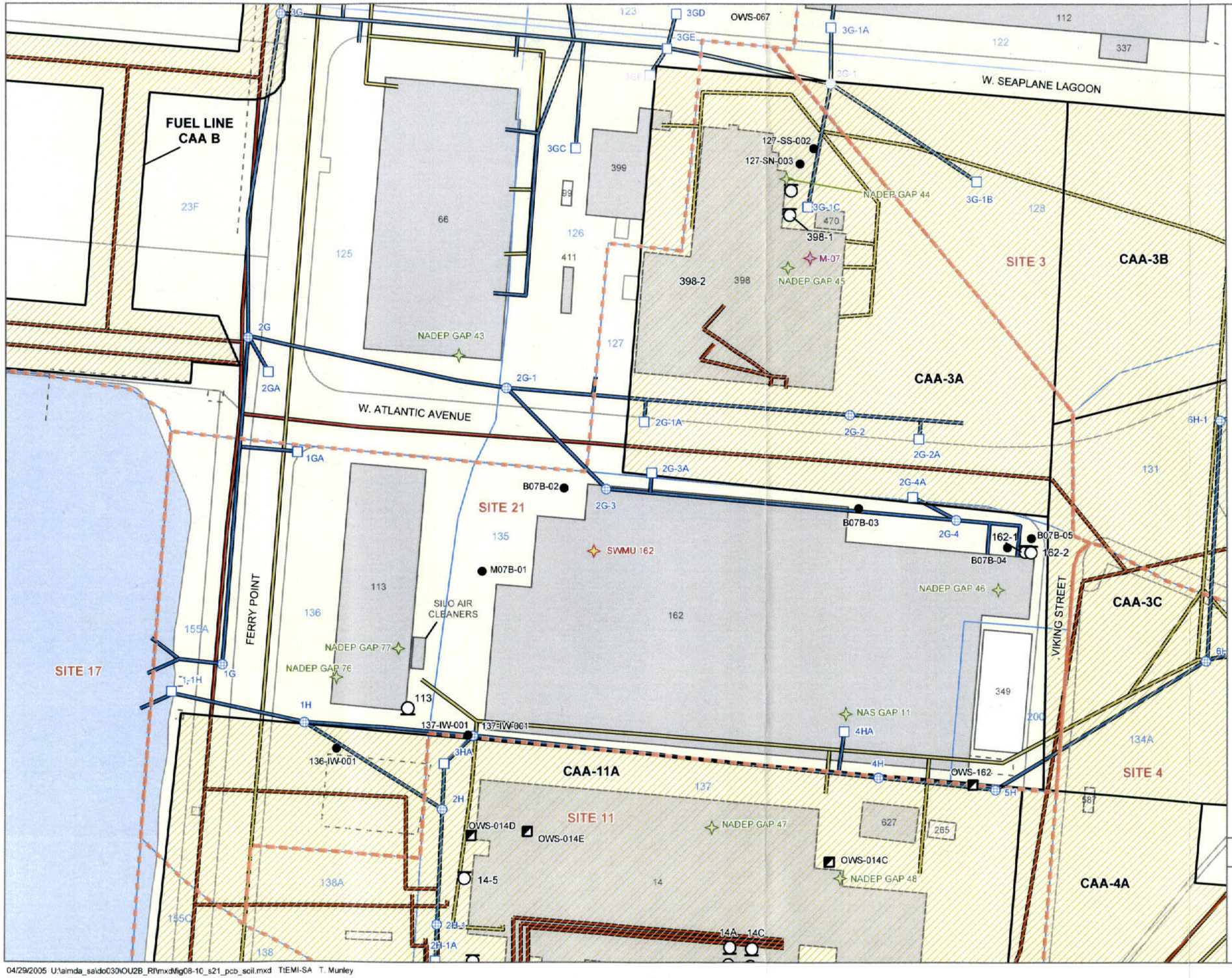

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FIGURE 8-10
SITE 21 SAMPLING LOCATIONS FOR PCBs IN SOIL
Operable Unit 2B
Remedial Investigation Report

04/29/2005 U:\alameda_sa\do030\OU2B_RI\mxd\fig08-10_s21_pcb_soil.mxd TtEMI-SA T. Munley

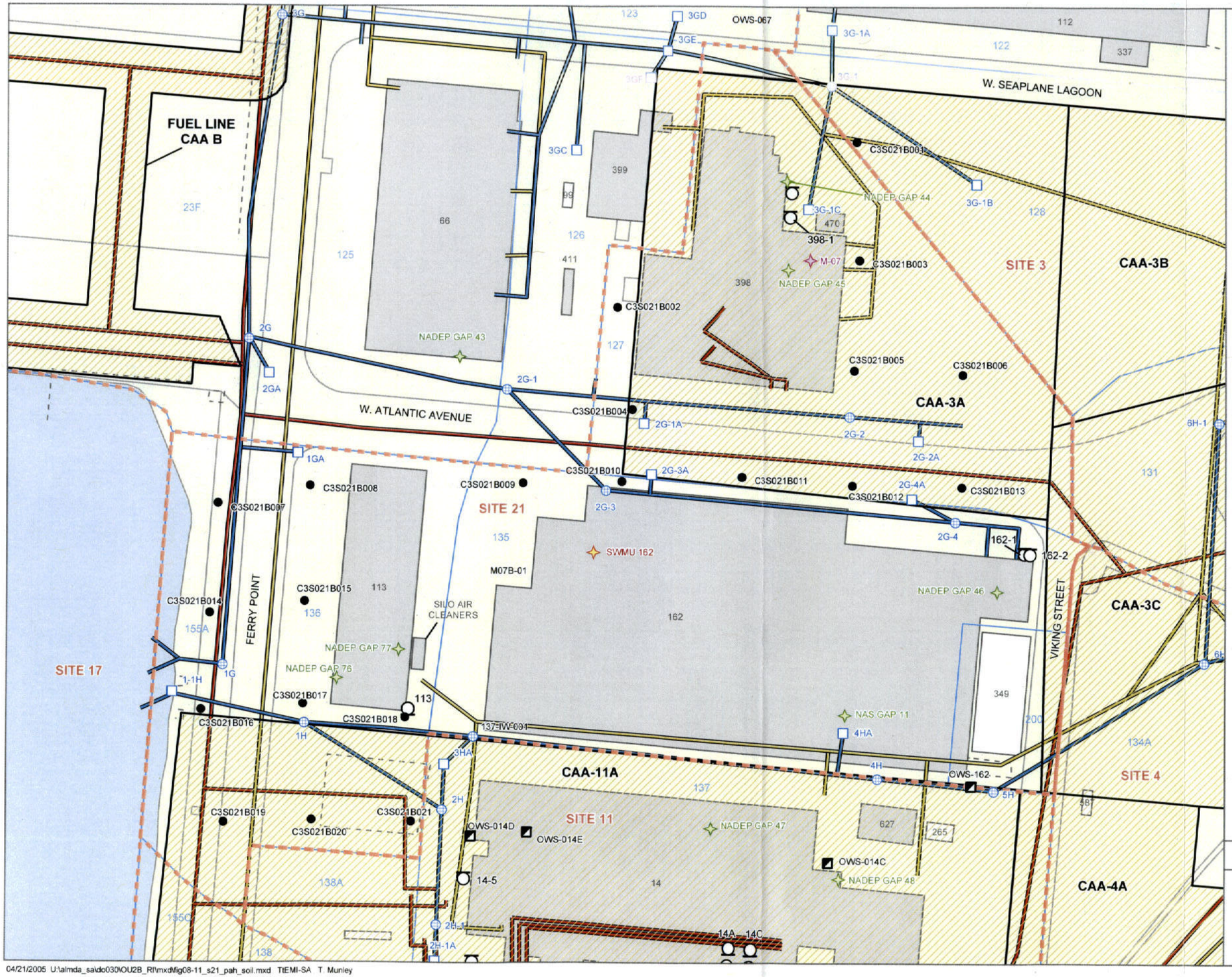

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FIGURE 8-11
SITE 21 SAMPLING LOCATIONS FOR PAHs IN SOIL
Operable Unit 2B
Remedial Investigation Report

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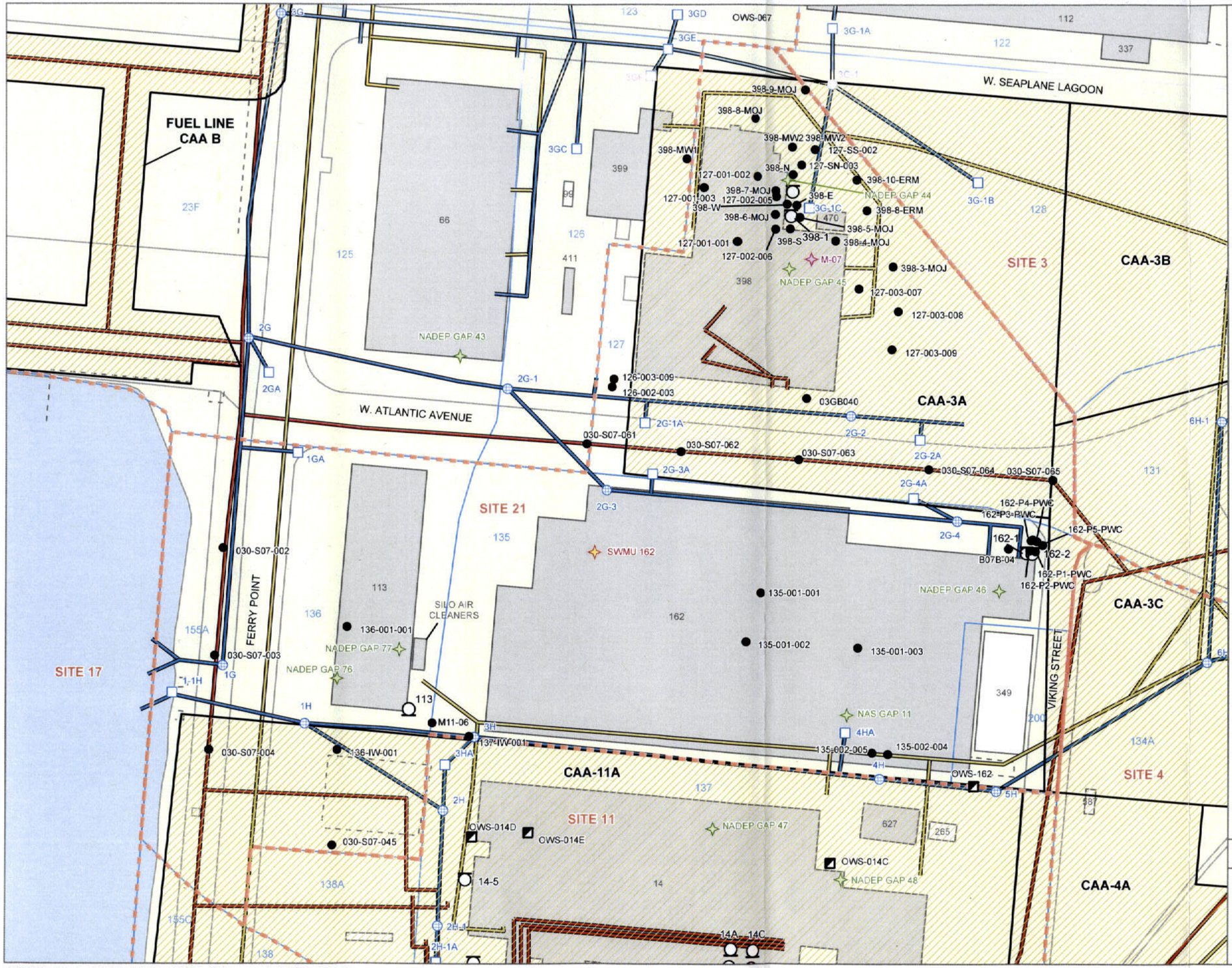

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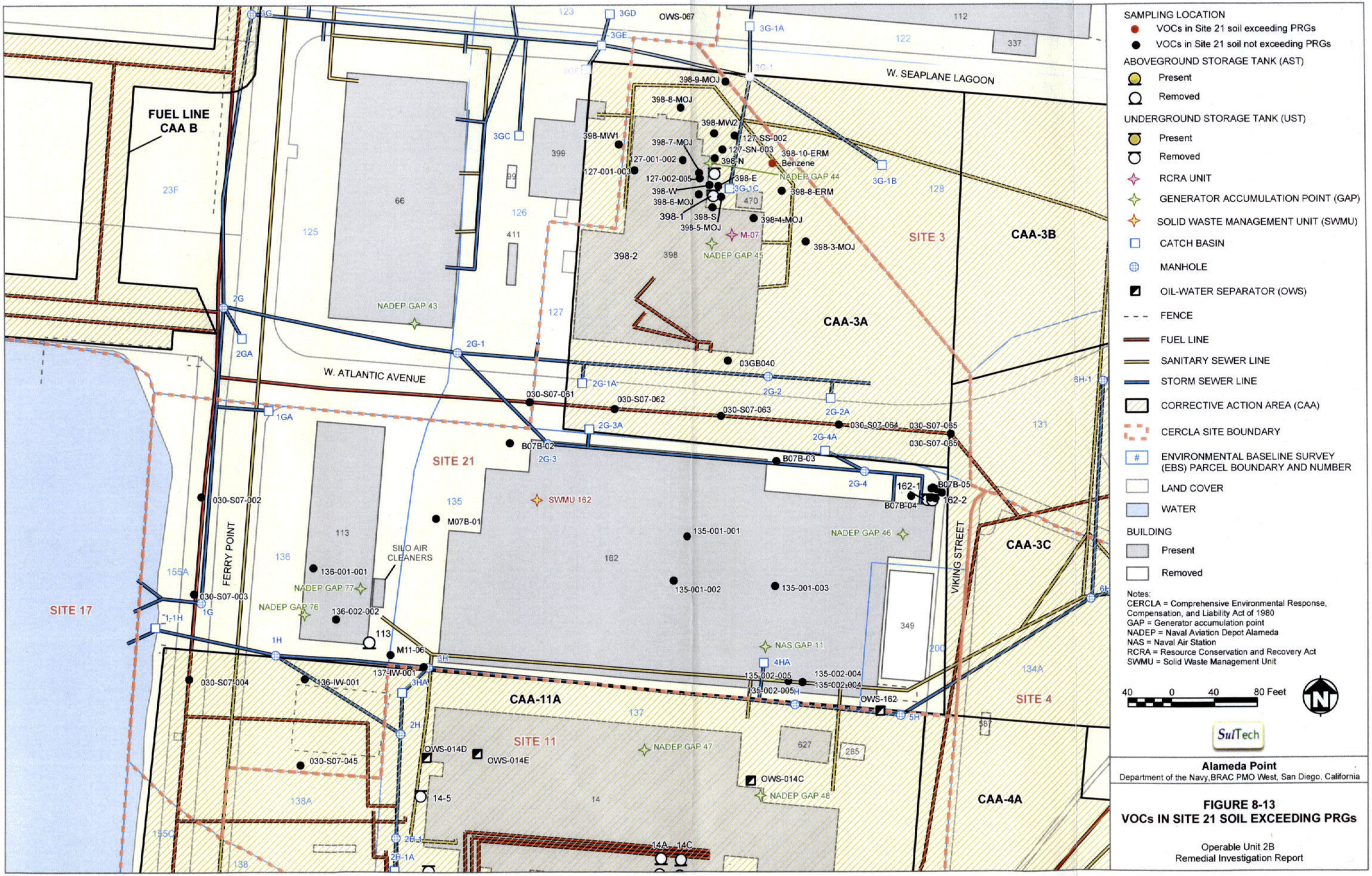

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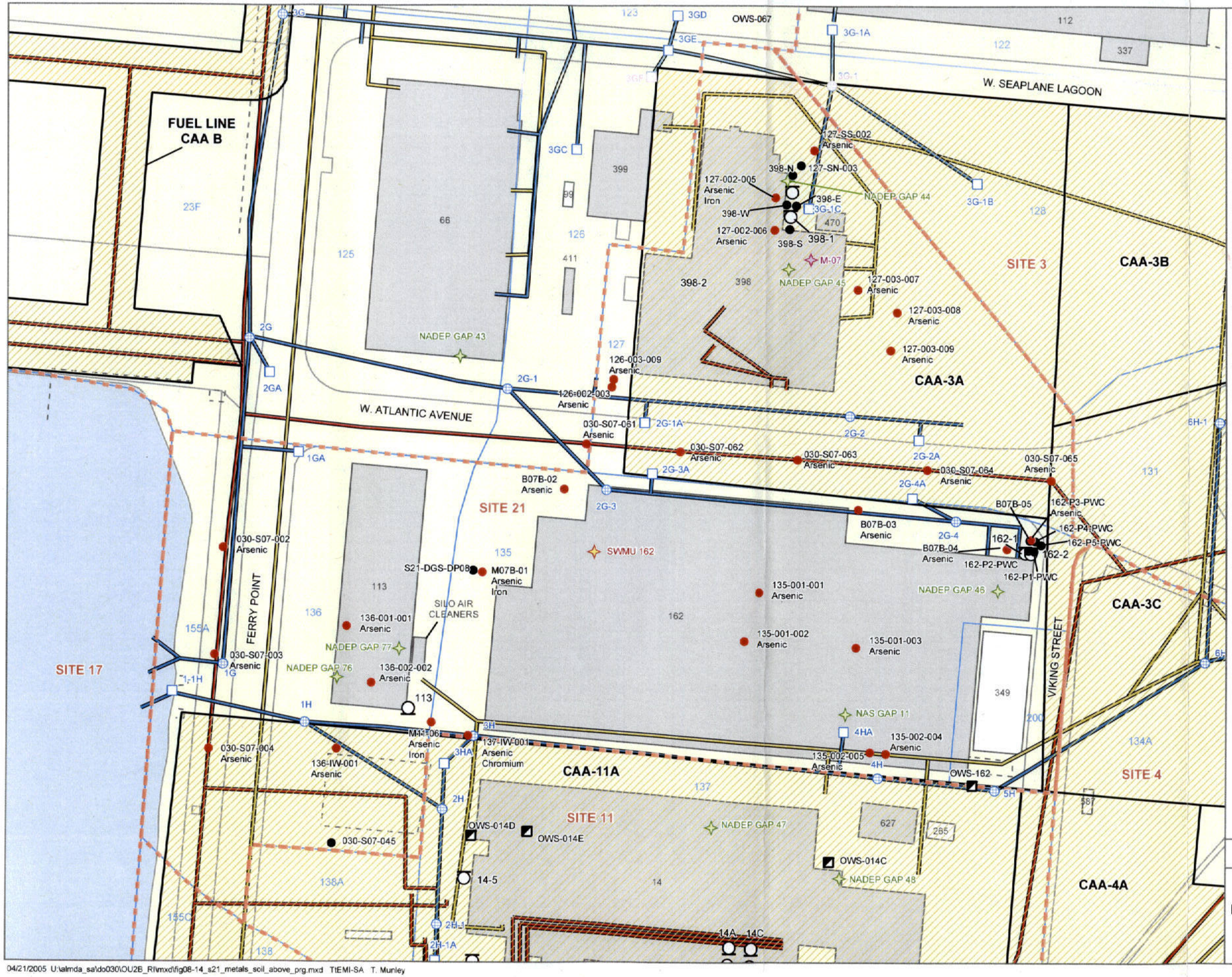

SAMPLING LOCATION
- Metals in Site 21 soil exceeding PRGs
- Metals in Site 21 soil not exceeding PRGs

ABOVEGROUND STORAGE TANK (AST)
- Present
- Removed

UNDERGROUND STORAGE TANK (UST)
- Present
- Removed
- RCRA UNIT
- GENERATOR ACCUMULATION POINT (GAP)
- SOLID WASTE MANAGEMENT UNIT (SWMU)
- CATCH BASIN
- MANHOLE
- OIL-WATER SEPARATOR (OWS)
- FENCE
- FUEL LINE
- SANITARY SEWER LINE
- STORM SEWER LINE
- CORRECTIVE ACTION AREA (CAA)
- CERCLA SITE BOUNDARY
- # ENVIRONMENTAL BASELINE SURVEY (EBS) PARCEL BOUNDARY AND NUMBER
- LAND COVER
- WATER

BUILDING
- Present
- Removed

Notes:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
GAP = Generator accumulation point
NADEP = Naval Aviation Depot Alameda
NAS = Naval Air Station
RCRA = Resource Conservation and Recovery Act
SWMU = Solid Waste Management Unit

40 0 40 80 Feet

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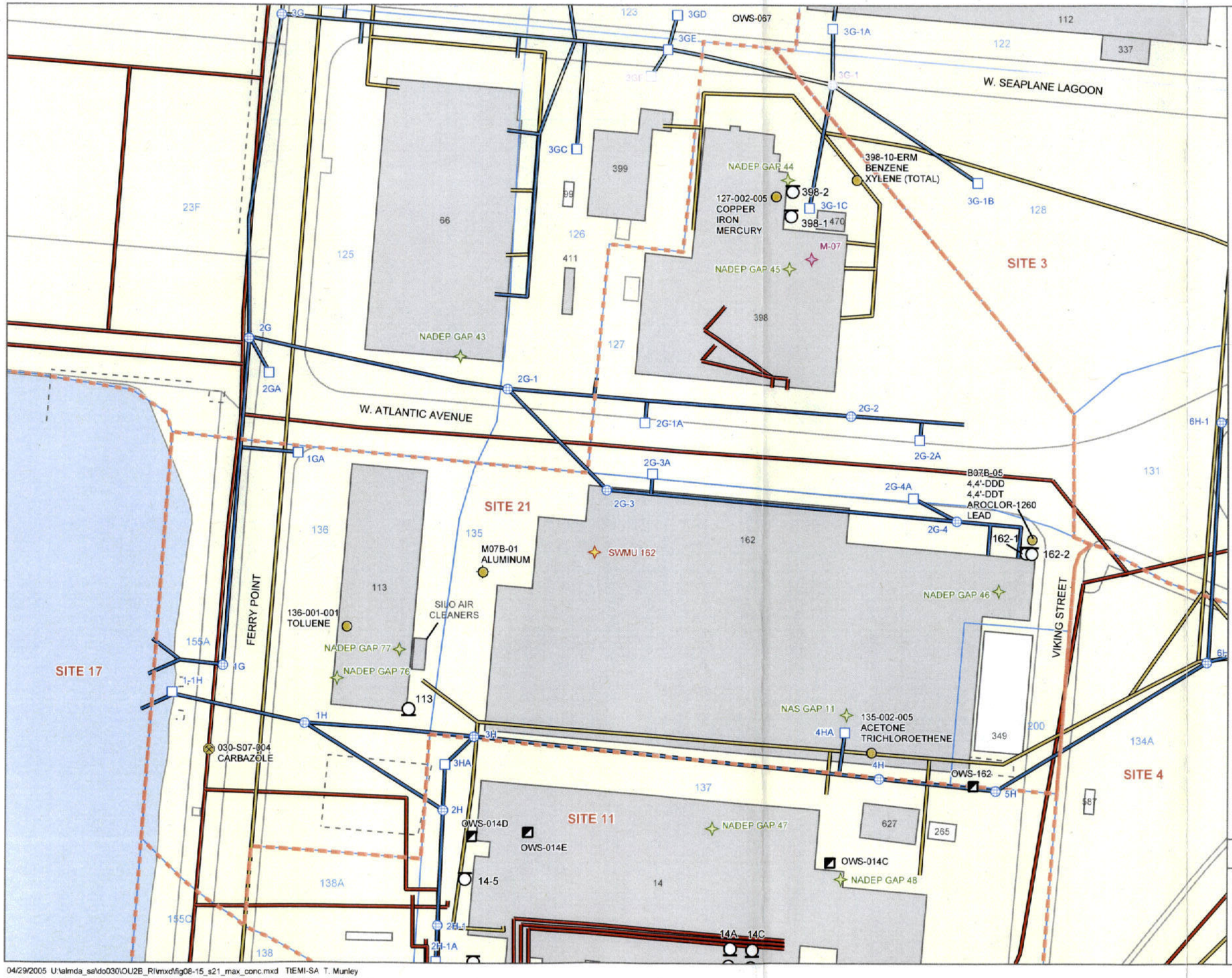
FIGURE 8-14
METALS IN SITE 21 SOIL EXCEEDING PRGs

Operable Unit 2B
Remedial Investigation Report

04/21/2005 U:\almda_sa\do030\OU2B_RI\mxd\fig08-14_s21_metals_soil_above_prg.mxd TtEMI-SA T. Munley



SAMPLING LOCATION
- Excavation
- Soil Boring
- Surface Location

ABOVEGROUND STORAGE TANK (AST)
- Present
- Removed

UNDERGROUND STORAGE TANK (UST)
- Present
- Removed
- RCRA UNIT
- GENERATOR ACCUMULATION POINT (GAP)
- SOLID WASTE MANAGEMENT UNIT (SWMU)
- CATCH BASIN
- MANHOLE
- OIL-WATER SEPARATOR (OWS)
- FENCE
- FUEL LINE
- SANITARY SEWER LINE
- STORM SEWER LINE
- CERCLA SITE BOUNDARY
- # ENVIRONMENTAL BASELINE SURVEY (EBS) PARCEL BOUNDARY AND NUMBER
- LAND COVER
- WATER

BUILDING
- Present
- Removed

Notes:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
GAP = Generator accumulation point
NADEP = Naval Aviation Depot Alameda
NAS = Naval Air Station
RCRA = Resource Conservation and Recovery Act
SWMU = Solid Waste Management Unit

N

40 0 40 80 Feet

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FIGURE 8-15
MAXIMUM CONCENTRATIONS IN SOIL OF CHEMICALS USED AT SITE 21

Operable Unit 2B
Remedial Investigation Report

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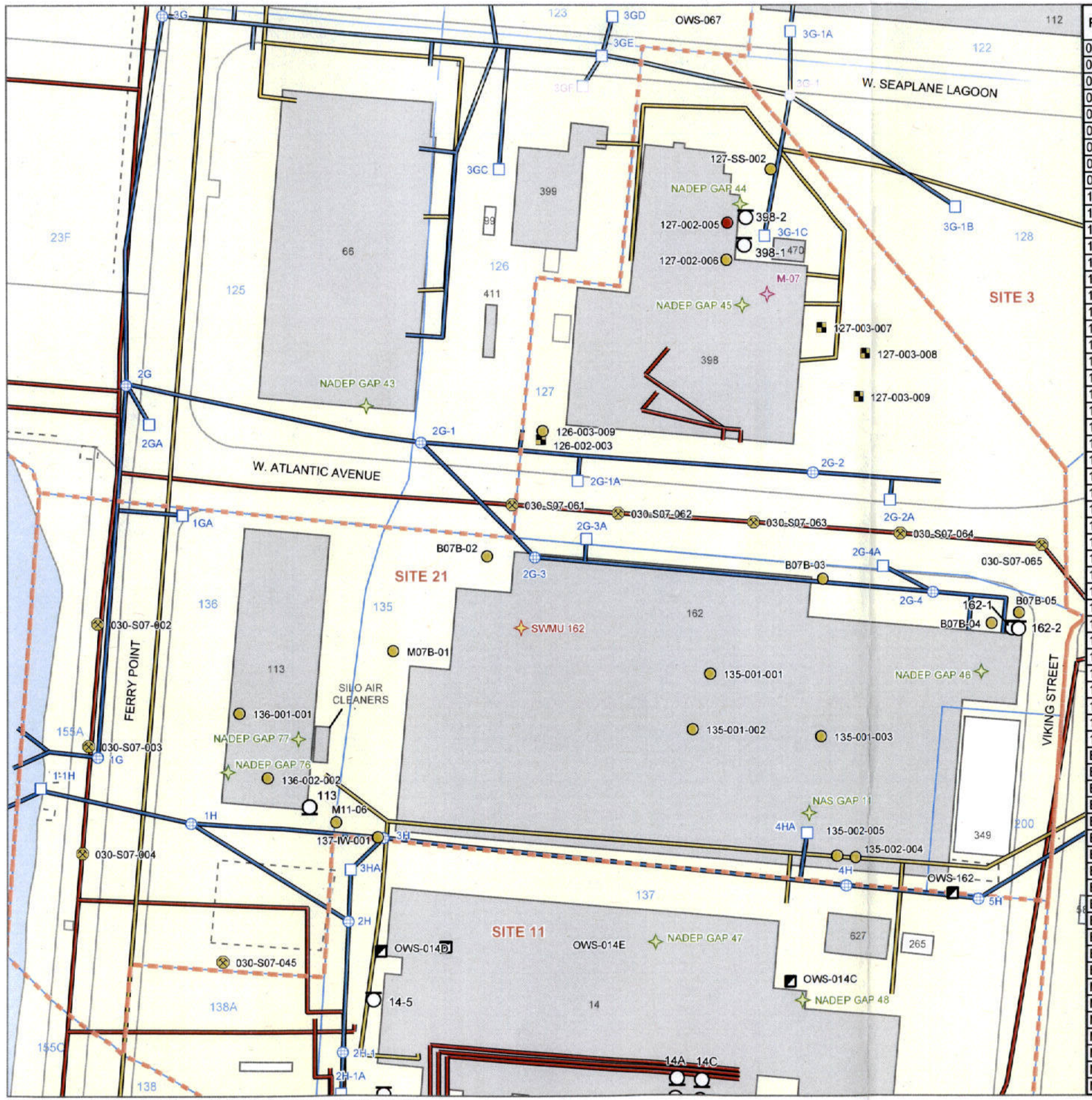

Point Name	Sample Depth (feet)	Concentration[1] (mg/kg)	Qualifier
030-S07-002	0 - 4.5	2.1	J
030-S07-003	0 - 4.5	2.2	J
030-S07-004	0 - 4.5	2.1	J
030-S07-045	0 - 6	3.7	UJ
030-S07-061	0 - 5.5	2.3	J
030-S07-062	0 - 6	3.9	
030-S07-063	0 - 5.5	3.4	J
030-S07-064	0 - 5.5	2.6	
030-S07-065	0 - 5.5	2.6	J
126-002-003	0.5 - 1	5.5	
126-003-009	0.5 - 1.5	3	
126-003-009	3 - 4	2.5	
127-002-005	1.5 - 2	**20**	J
127-002-005	1.5 - 2	13.9	
127-002-005	3 - 3.5	11.6	J
127-002-005	3 - 3.5	11.3	
127-002-006	2 - 2.5	12.9	
127-003-007	0.5 - 1	1.7	
127-003-008	0.5 - 1	2.9	
127-003-009	0.5 - 1	1.2	U
127-003-009	0.5 - 1	1.3	
127-SS-002	3 - 4.5	1.6	
135-001-001	0.5 - 1	1.8	
135-001-001	2.5 - 3	2	
135-001-002	1 - 1.5	1.6	
135-001-002	3 - 3	1.8	
135-001-003	1 - 1.5	1.6	B
135-001-003	1 - 1.5	1.4	
135-001-003	4 - 4.5	1.2	B
135-001-003	4 - 4.5	1.3	
135-002-004	4 - 4.5	0.92	
135-002-005	4 - 4.5	2.1	B
135-002-005	4 - 4.5	2	
136-001-001	0.5 - 1	1.2	B
136-001-001	0.5 - 1	1.6	
136-001-001	3.5 - 4	0.84	U
136-001-001	3.5 - 4	1.6	
136-002-002	0.5 - 1.5	0.84	U
136-002-002	0.5 - 1.5	0.75	
136-002-002	4 - 5	2.8	J
136-002-002	4 - 5	1.5	
136-IW-001	4.5 - 5	2.1	
137-IW-001	8 - 9	2.8	
B07B-02	0.5 - 1.5	2.34	J
B07B-02	3.5 - 5	6.66	J
B07B-02	11 - 12.5	6.34	J
B07B-02	14 - 14.5	3.14	J
B07B-03	0.5 - 1	2.33	J
B07B-03	2 - 3.5	2.51	J
B07B-03	11 - 12.5	2.2	J
B07B-03	15.5 - 16.5	5.4	J
B07B-04	0.5 - 1.5	4	
B07B-04	2.5 - 3.5	2.7	
B07B-04	5 - 5.5	3.4	
B07B-05	0.5 - 1.5	5.8	
B07B-05	2.5 - 3.5	3.1	
B07B-05	5 - 6	1.8	J
M07B-01	1 - 1.5	3.04	J
M07B-01	3.5 - 5	2.25	J
M07B-01	8 - 9	6.93	J
M07B-01	14 - 15	2.88	J
M11-06	0.5 - 1.5	2.3	UJ
M11-06	2.5 - 3.5	1.8	UJ
M11-06	5 - 6	8.8	

SAMPLING LOCATION
Red = Exceeds Screening Level[2]

- Excavation
- Soil Boring
- Surface Location

ABOVEGROUND STORAGE TANK (AST)

- Present
- Removed

UNDERGROUND STORAGE TANK (UST)

- Present
- Removed
- RCRA UNIT
- GENERATOR ACCUMULATION POINT (GAP)
- SOLID WASTE MANAGEMENT UNIT (SWMU)
- CATCH BASIN
- MANHOLE
- OIL-WATER SEPARATOR (OWS)
- FENCE
- FUEL LINE
- SANITARY SEWER LINE
- STORM SEWER LINE
- CERCLA SITE BOUNDARY
- # ENVIRONMENTAL BASELINE SURVEY (EBS) PARCEL BOUNDARY AND NUMBER
- LAND COVER
- WATER

BUILDING

- Present
- Removed

Notes:
B = Compound detected in an associate blank as well as the sample
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
GAP = Generator accumulation point
J = Estimated
mg/kg = Milligrams per kilogram
NADEP = Naval Aviation Depot Alameda
NAS = Naval Air Station
RCRA = Resource Conservation and Recovery Act
SWMU = Solid Waste Management Unit
U = Not detected

[1]Bold denotes "exceeds screening level."
[2]Screening level based on maximum ambient concentration of 15.6 mg/kg.

40 0 40 80 Feet

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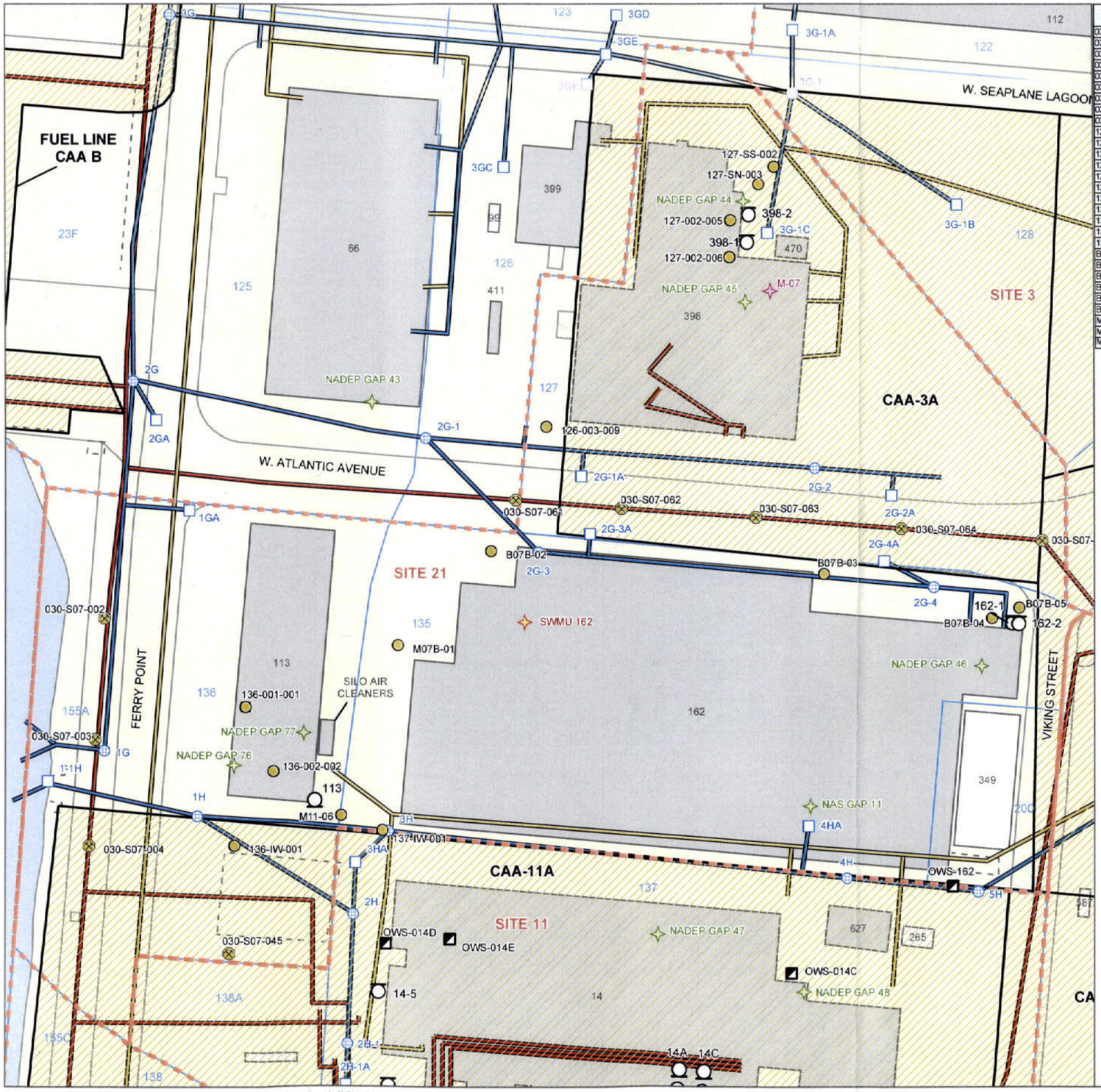
FIGURE 8-16
SITE 21
CONCENTRATIONS OF ARSENIC IN SOIL

Operable Unit 2B
Remedial Investigation Report

03/30/2005 U:\almda_sa\do030\OU2B_RI\mxd\fig08-16_s21_soil_arsenic.mxd TtEMI-SA T. Munley



Point Name	Sample Depth (feet)	Concentration (µg/kg)	Qualifier
030-S07-002	0.0-4.5	36	U
030-S07-003	0.0-4.5	75	U
030-S07-004	0.0-4.5	20000	
030-S07-045	0.0-6.0	330	U
030-S07-061	0.0-5.5	10	J
030-S07-062	0.0-6.0	140	J
030-S07-063	0.0-5.5	58	J
030-S07-064	0.0-5.5	22	J
030-S07-065	0.0-5.5	1100	J
126-003-009	0.5-1.5	340	U
126-003-009	3.0-4.0	380	U
127-002-005	1.5-2.0	380	U
127-002-005	3.0-3.5	380	U
127-SS-002	3.5-4.5	350	U
127-SN-003	5.0-5.5	380	U
136-001-001	0.5-1.0	340	U
136-001-001	3.5-4.0	34	J
136-002-002	4.0-5.0	370	U
136-IW-001	4.5-5.0	360	U
137-IW-001	8.0-9.0	390	U
B07B-05	0.5-1.5	1100	U
B07B-05	2.5-3.5	330	U
B07B-05	5.0-6.0	380	U
B07B-04	0.5-1.5	340	U
B07B-04	2.5-3.5	340	U
B07B-04	5.0-5.5	390	U
M11-06	0.5-1.5	340	U
M11-06	2.5-3.5	340	U
M11-06	5.0-8.0	380	U

SAMPLING LOCATION
- Excavation
- Soil Boring
- Surface Location

ABOVEGROUND STORAGE TANK (AST)
- Present
- Removed

UNDERGROUND STORAGE TANK (UST)
- Present
- Removed
- RCRA UNIT
- GENERATOR ACCUMULATION POINT (GAP)
- SOLID WASTE MANAGEMENT UNIT (SWMU)
- CATCH BASIN
- MANHOLE
- OIL-WATER SEPARATOR (OWS)
- FENCE
- FUEL LINE
- SANITARY SEWER LINE
- STORM SEWER LINE
- CORRECTIVE ACTION AREA (CAA)
- CERCLA SITE BOUNDARY
- # ENVIRONMENTAL BASELINE SURVEY (EBS) PARCEL BOUNDARY AND NUMBER
- LAND COVER
- WATER

BUILDING
- Present
- Removed

Notes:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
GAP = Generator accumulation point
NADEP = Naval Aviation Depot Alameda
NAS = Naval Air Station
RCRA = Resource Conservation and Recovery Act
SWMU = Solid Waste Management Unit

40 0 40 80 Feet

N

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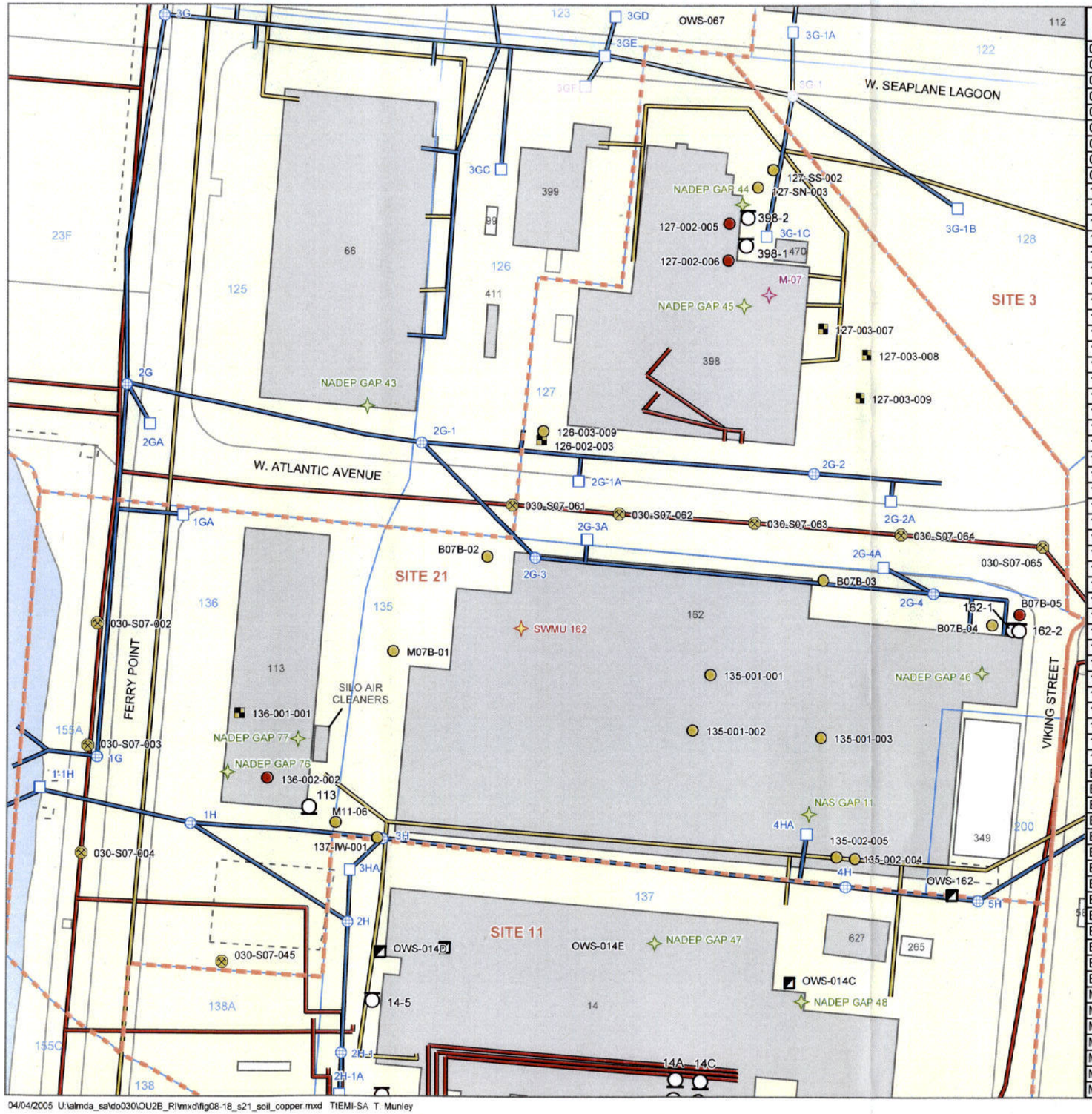
FIGURE 8-17
SITE 21 CONCENTRATIONS OF CARBAZOLE IN SOIL
Operable Unit 2B
Remedial Investigation Report

04/04/2005 U:\alameda_sa\do030\OU2B_RI\mxd\fig08-17_s21_carbazole_soil.mxd TtEMI-SA T. Munley



Point Name	Sample Depth (feet)	Concentration[1] (mg/kg)	Qualifier
030-S07-002	0 - 4.5	5.8	J
030-S07-003	0 - 4.5	7.6	J
030-S07-004	0 - 4.5	13.6	J
030-S07-045	0 - 6	12.7	UJ
030-S07-061	0 - 5.5	12.1	
030-S07-062	0 - 6	12.5	
030-S07-063	0 - 5.5	10.9	
030-S07-064	0 - 5.5	11.4	
030-S07-065	0 - 5.5	12.8	
126-002-003	0.5 - 1	47	
126-003-009	0.5 - 1.5	9.5	J
126-003-009	3 - 4	6.8	J
127-002-005	1.5 - 2	**148**	*J
127-002-005	1.5 - 2	**111**	
127-002-005	3 - 3.5	**83.5**	*J
127-002-005	3 - 3.5	**107**	
127-002-006	2 - 2.5	**112**	
127-003-007	0.5 - 1	10.2	
127-003-008	0.5 - 1	17.4	
127-003-009	0.5 - 1	9.2	*J
127-003-009	0.5 - 1	12.2	
127-SN-003	5 - 5.5	42	
127-SS-002	3 - 4.5	4.6	
135-001-001	0.5 - 1	7.5	
135-001-001	2.5 - 3	25	
135-001-002	1 - 1.5	21	
135-001-002	3 - 3	12	
135-001-003	1 - 1.5	17.2	NJ
135-001-003	1 - 1.5	8.8	
135-001-003	4 - 4.5	6.3	NJ
135-001-003	4 - 4.5	5.2	
135-002-004	4 - 4.5	12	
135-002-005	4 - 4.5	19	
135-002-005	4 - 4.5	20.7	
136-001-001	0.5 - 1	32.4	
136-001-001	0.5 - 1	27	
136-001-001	3.5 - 4	7.6	
136-001-001	3.5 - 4	19	
136-002-002	0.5 - 1.5	**67.2**	
136-002-002	0.5 - 1.5	**68**	
136-002-002	4 - 5	7.8	
136-002-002	4 - 5	4.3	
136-IW-001	4.5 - 5	16.4	EJ
136-IW-001	4.5 - 5	25	U
137-IW-001	8 - 9	14.6	EJ
137-IW-001	8 - 9	25	U
B07B-02	0.5 - 1.5	49.1	
B07B-02	3.5 - 5	15.4	
B07B-02	11 - 12.5	11.5	
B07B-02	14 - 14.5	16.2	
B07B-03	0.5 - 1	16.7	
B07B-03	2 - 3.5	10.9	
B07B-03	11 - 12.5	7.23	
B07B-03	15.5 - 16.5	8.36	
B07B-04	0.5 - 1.5	16.8	
B07B-04	2.5 - 3.5	6.7	
B07B-04	5 - 5.5	8.5	
B07B-05	0.5 - 1.5	**71.4**	
B07B-05	2.5 - 3.5	9.4	
B07B-05	5 - 6	6.2	
M07B-01	1 - 1.5	24.7	
M07B-01	3.5 - 5	6.33	
M07B-01	8 - 9	32.5	
M07B-01	14 - 15	10.6	
M11-06	0.5 - 1.5	27.7	
M11-06	2.5 - 3.5	5.4	
M11-06	5 - 6	28.9	

SAMPLING LOCATION
Red = Exceeds Screening Level[2]

- Excavation
- Soil Boring
- Surface Location

ABOVEGROUND STORAGE TANK (AST)

- Present
- Removed

UNDERGROUND STORAGE TANK (UST)

- Present
- Removed
- RCRA UNIT
- GENERATOR ACCUMULATION POINT (GAP)
- SOLID WASTE MANAGEMENT UNIT (SWMU)
- CATCH BASIN
- MANHOLE
- OIL-WATER SEPARATOR (OWS)
- FENCE
- FUEL LINE
- SANITARY SEWER LINE
- STORM SEWER LINE
- CERCLA SITE BOUNDARY
- ENVIRONMENTAL BASELINE SURVEY (EBS) PARCEL BOUNDARY AND NUMBER
- LAND COVER
- WATER

BUILDING

- Present
- Removed

Notes:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
E = Compound concentration exceeds the (GC/MS) calibration range.
GAP = Generator accumulation point
J = Estimated
mg/kg = Milligrams per kilogram
N = Estimated due to matrix spike recoveries out of QC limits
NADEP = Naval Aviation Depot Alameda
NAS = Naval Air Station
RCRA = Resource Conservation and Recovery Act
SWMU = Solid Waste Management Unit
U = Not detected
* = Duplicate sample analysis not within control limits.

[1]Bold denotes "exceeds screening level."
[2]Screening level based on maximum ambient concentration of 49.1 mg/kg.

40 0 40 80 Feet

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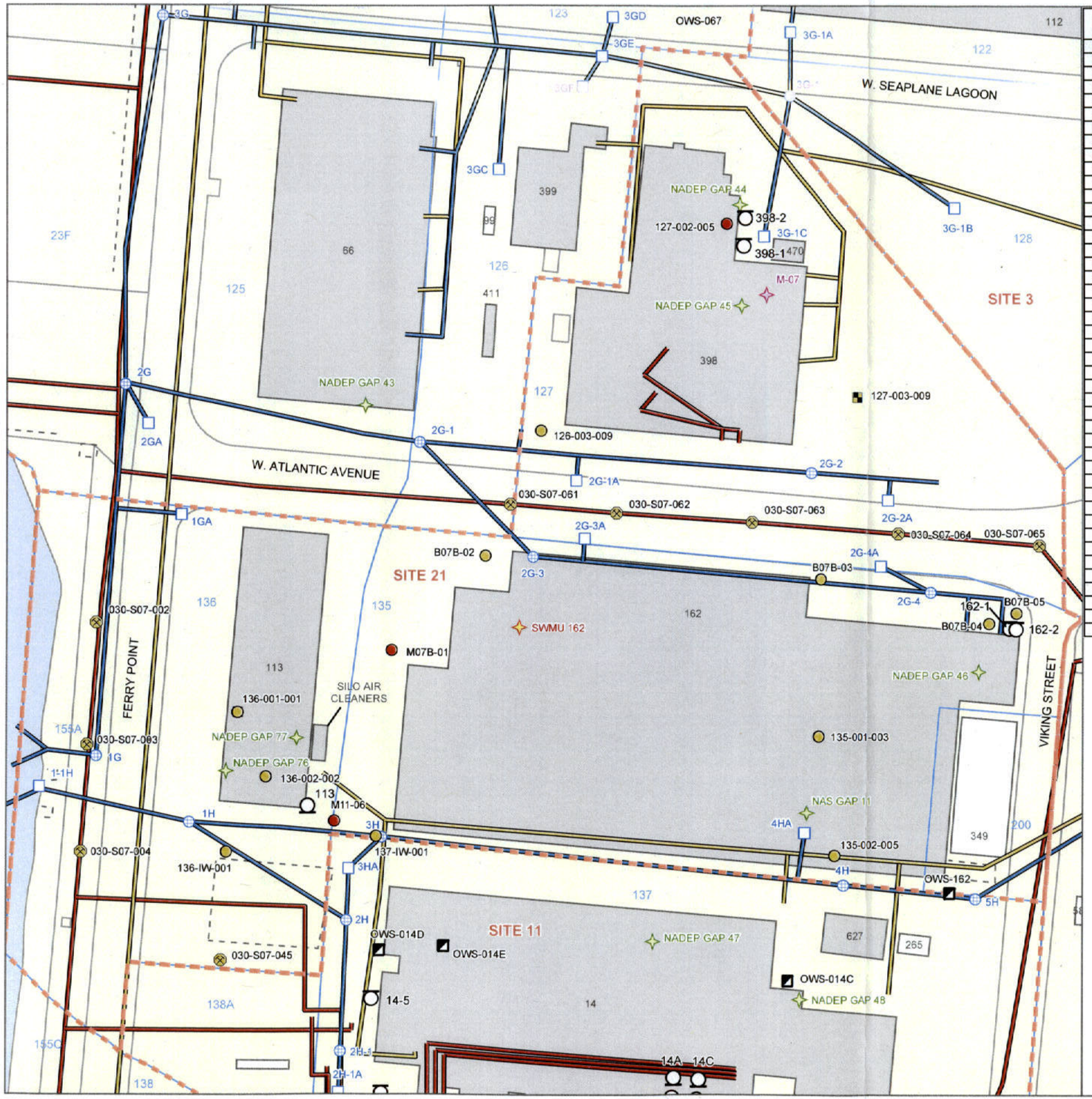
Department of the Navy,BRAC PMO West, San Diego, California

FIGURE 8-18
SITE 21
CONCENTRATIONS OF COPPER IN SOIL

Operable Unit 2B
Remedial Investigation Report

04/04/2005 U:\almda_sa\do030\OU2B_RI\mxd\fig08-18_s21_soil_copper.mxd TIEMI-SA T. Munley



Point Name	Sample Depth (feet)	Concentration (mg/kg)[1]	Qualifier
030-S07-002	0.0-4.5	8,820	
030-S07-003	0.0-4.5	12,400	
030-S07-004	0.0-4.5	12,700	
030-S07-045	0.0-6.0	16,500	UJ
030-S07-061	0.0-5.5	16,400	
030-S07-062	0.0-6.0	17,400	
030-S07-063	0.0-5.5	20,900	
030-S07-064	0.0-5.5	18,400	
030-S07-065	0.0-5.5	14,000	
126-003-009	0.5-1.5	11,300	
126-003-009	3.0-4.0	8,960	
127-002-005	1.5-2.0	**46,800**	J
127-002-005	3.0-3.5	**28,800**	J
127-003-009	0.5-1.0	11,500	J
135-001-003	1.0-1.5	7,590	J
135-001-003	4.0-4.5	6,080	J
135-002-005	4.0-4.5	17,900	J
136-001-001	0.5-1.0	12,400	J
136-001-001	3.5-4.0	9,930	J
136-002-002	0.5-1.5	16,500	J
136-002-002	4.0-5.0	7,610	J
136-IW-001	4.5-5.0	9,770	
137-IW-001	8.0-9.0	11,000	
B07B-02	0.5-1.5	17,700	J
B07B-02	11.0-12.5	9,730	J
B07B-02	14.0-14.5	16,900	J
B07B-02	3.5-5.0	18,800	J
B07B-03	0.5-1.0	13,800	J
B07B-03	11.0-12.5	10,400	J
B07B-03	15.5-16.5	14,500	J
B07B-03	2.0-3.5	12,400	J
B07B-04	0.5-1.5	14,200	
B07B-04	2.5-3.5	9,260	
B07B-04	5.0-5.5	12,100	
B07B-05	0.5-1.5	17,900	
B07B-05	2.5-3.5	11,500	
B07B-05	5.0-6.0	9,280	
M07B-01	1.0-1.5	24,800	J
M07B-01	14.0-15.0	15,400	J
M07B-01	3.5-5.0	10,200	J
M07B-01	8.0-9.0	**30,600**	J
M11-06	0.5-1.5	**34,100**	
M11-06	2.5-3.5	7,280	
M11-06	5.0-6.0	**31,300**	

SAMPLING LOCATION
Red = Exceeds Screening Level[2]

- Excavation
- Soil Boring
- Surface Location

ABOVEGROUND STORAGE TANK (AST)

- Present
- Removed

UNDERGROUND STORAGE TANK (UST)

- Present
- Removed
- RCRA UNIT
- GENERATOR ACCUMULATION POINT (GAP)
- SOLID WASTE MANAGEMENT UNIT (SWMU)
- CATCH BASIN
- MANHOLE
- OIL-WATER SEPARATOR (OWS)
- FENCE
- FUEL LINE
- SANITARY SEWER LINE
- STORM SEWER LINE
- CERCLA SITE BOUNDARY
- ENVIRONMENTAL BASELINE SURVEY (EBS) PARCEL BOUNDARY AND NUMBER
- LAND COVER
- WATER

BUILDING

- Present
- Removed

Notes:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
E = Compound concentration exceeds the (GC/MS) calibration range.
GAP = Generator accumulation point
J = Estimated
mg/kg = Milligrams per kilogram
N = Estimated due to matrix spike recoveries out of QC limits
NADEP = Naval Aviation Depot Alameda
NAS = Naval Air Station
RCRA = Resource Conservation and Recovery Act
SWMU = Solid Waste Management Unit
U = Not detected
* = Duplicate sample analysis not within control limits.

[1]Bold denotes "exceeds screening level."
[2]Screening level based on maximum ambient concentration of 27,900 mg/kg.

40 0 40 80 Feet

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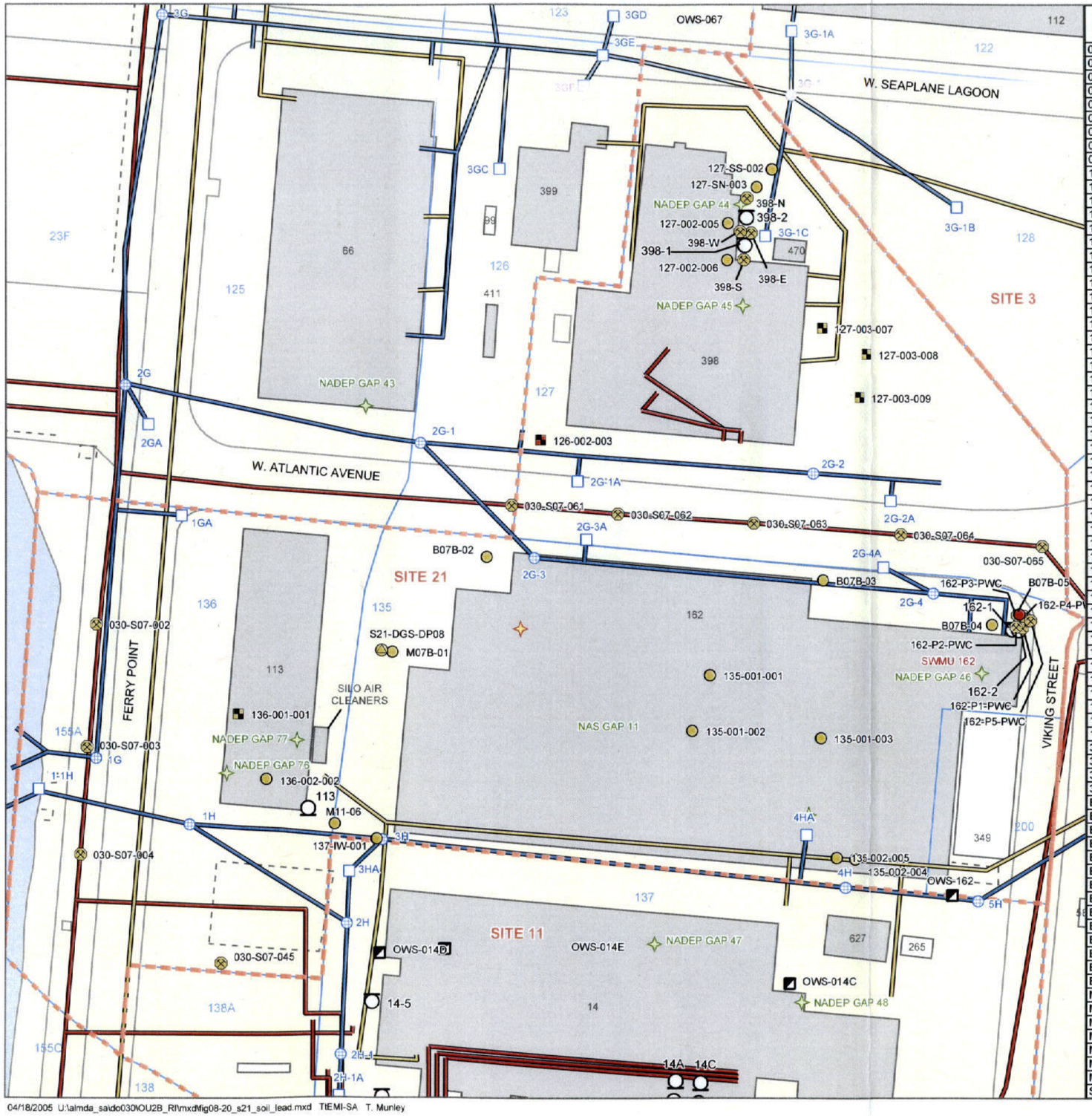
FIGURE 8-19
SITE 21
CONCENTRATIONS OF IRON IN SOIL

Operable Unit 2B
Remedial Investigation Report

04/18/2005 U:\almda_sa\do030\OU2B_RI\mxd\fig08-19_s21_soil_iron.mxd TtEMI-SA T. Munley



Point Name	Sample Depth (feet)	Concentration[1] (mg/kg)	Qualifier
030-S07-002	0 - 4.5	94.1	J
030-S07-003	0 - 4.5	25.3	J
030-S07-004	0 - 4.5	29.2	J
030-S07-045	0 - 6	7.4	UJ
030-S07-061	0 - 5.5	4.9	J
030-S07-062	0 - 6	6.9	J
030-S07-063	0 - 5.5	37.5	J
030-S07-064	0 - 5.5	10.7	J
030-S07-065	0 - 5.5	12.3	J
126-002-003	0.5 - 1	**450**	
126-003-009	0.5 - 1.5	3.4	
126-003-009	3 - 4	2	
127-002-005	1.5 - 2	24	
127-002-005	1.5 - 2	17.9	
127-002-005	3 - 3.5	21.5	
127-002-005	3 - 3.5	14.7	
127-002-006	2 - 2.5	20.2	
127-003-007	0.5 - 1	3.1	
127-003-008	0.5 - 1	3.3	
127-003-009	0.5 - 1	10.6	
127-003-009	0.5 - 1	5	
127-SN-003	5 - 5.5	25	U
127-SS-002	3 - 4.5	2.1	
135-001-001	0.5 - 1	17	
135-001-001	2.5 - 3	7.8	
135-001-002	1 - 1.5	19	
135-001-002	3 - 3	8.4	
135-001-003	1 - 1.5	30.9	
135-001-003	1 - 1.5	24	
135-001-003	4 - 4.5	2.3	
135-001-003	4 - 4.5	1.9	
135-002-004	4 - 4.5	2.2	
135-002-005	4 - 4.5	15.7	*J
135-002-005	4 - 4.5	8.8	
136-001-001	0.5 - 1	3.2	*J
136-001-001	0.5 - 1	6.7	
136-001-001	3.5 - 4	2.1	*J
136-001-001	3.5 - 4	3.3	
136-002-002	0.5 - 1.5	1.4	*J
136-002-002	0.5 - 1.5	2.2	
136-002-002	4 - 5	1.8	*J
136-002-002	4 - 5	2	
136-IW-001	4.5 - 5	7.7	
136-IW-001	4.5 - 5	25	U
137-IW-001	8 - 9	6.2	
137-IW-001	8 - 9	25	U
162-P1-PWC	3.5 -	11	
162-P2-PWC	3.5 -	32	
162-P3-PWC	3.5 -	31	
162-P4-PWC	3.5 -	53	
162-P5-PWC	3.5 -	5	U
398-E	7 -	0	U
398-N	7 -	0	U
398-S	7 -	0	U
398-W	7 -	0	U
B07B-02	0.5 - 1.5	70.7	
B07B-02	3.5 - 5	7.84	J
B07B-02	11 - 12.5	21.7	J
B07B-02	14 - 14.5	3.46	J
B07B-03	0.5 - 1	44.1	
B07B-03	2 - 3.5	5.3	J
B07B-03	11 - 12.5	12.7	J
B07B-03	15.5 - 16.5	3.71	J
B07B-04	0.5 - 1.5	29.2	
B07B-04	2.5 - 3.5	2.3	UJ
B07B-04	5 - 5.5	3.6	
B07B-05	0.5 - 1.5	**416**	
B07B-05	2.5 - 3.5	4.2	
B07B-05	5 - 6	9.3	
M07B-01	1 - 1.5	8.97	J
M07B-01	3.5 - 5	2.86	J
M07B-01	8 - 9	32.2	
M07B-01	14 - 15	3.96	J
M11-06	0.5 - 1.5	7.9	
M11-06	2.5 - 3.5	2.4	UJ
M11-06	5 - 6	8	
S21-DGS-DP0	9 - 9.5	42	

SAMPLING LOCATION
Red = Exceeds Screening Level[2]

- Direct-Push
- Excavation
- Soil Boring
- Surface Location

ABOVEGROUND STORAGE TANK (AST)

- Present
- Removed

UNDERGROUND STORAGE TANK (UST)

- Present
- Removed
- GENERATOR ACCUMULATION POINT (GAP)
- SOLID WASTE MANAGEMENT UNIT (SWMU)
- CATCH BASIN
- MANHOLE
- OIL-WATER SEPARATOR (OWS)
- FENCE
- FUEL LINE
- SANITARY SEWER LINE
- STORM SEWER LINE
- CERCLA SITE BOUNDARY
- ENVIRONMENTAL BASELINE SURVEY (EBS) PARCEL BOUNDARY AND NUMBER
- LAND COVER
- WATER

BUILDING

- Present
- Removed

Notes:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
GAP = Generator accumulation point
J = Estimated
mg/kg = Milligrams per kilogram
NADEP = Naval Aviation Depot Alameda
NAS = Naval Air Station
SWMU = Solid Waste Management Unit
U = Not detected
* = Duplicate sample analysis not within control limits

[1]Bold denotes "exceeds screening level."
[2]Screening level based on maximum ambient concentration of 165 mg/kg.

40 0 40 80 Feet

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Alameda Point
Department of the Navy,BRAC PMO West, San Diego, California

FIGURE 8-20
SITE 21
CONCENTRATIONS OF LEAD IN SOIL

Operable Unit 2B
Remedial Investigation Report

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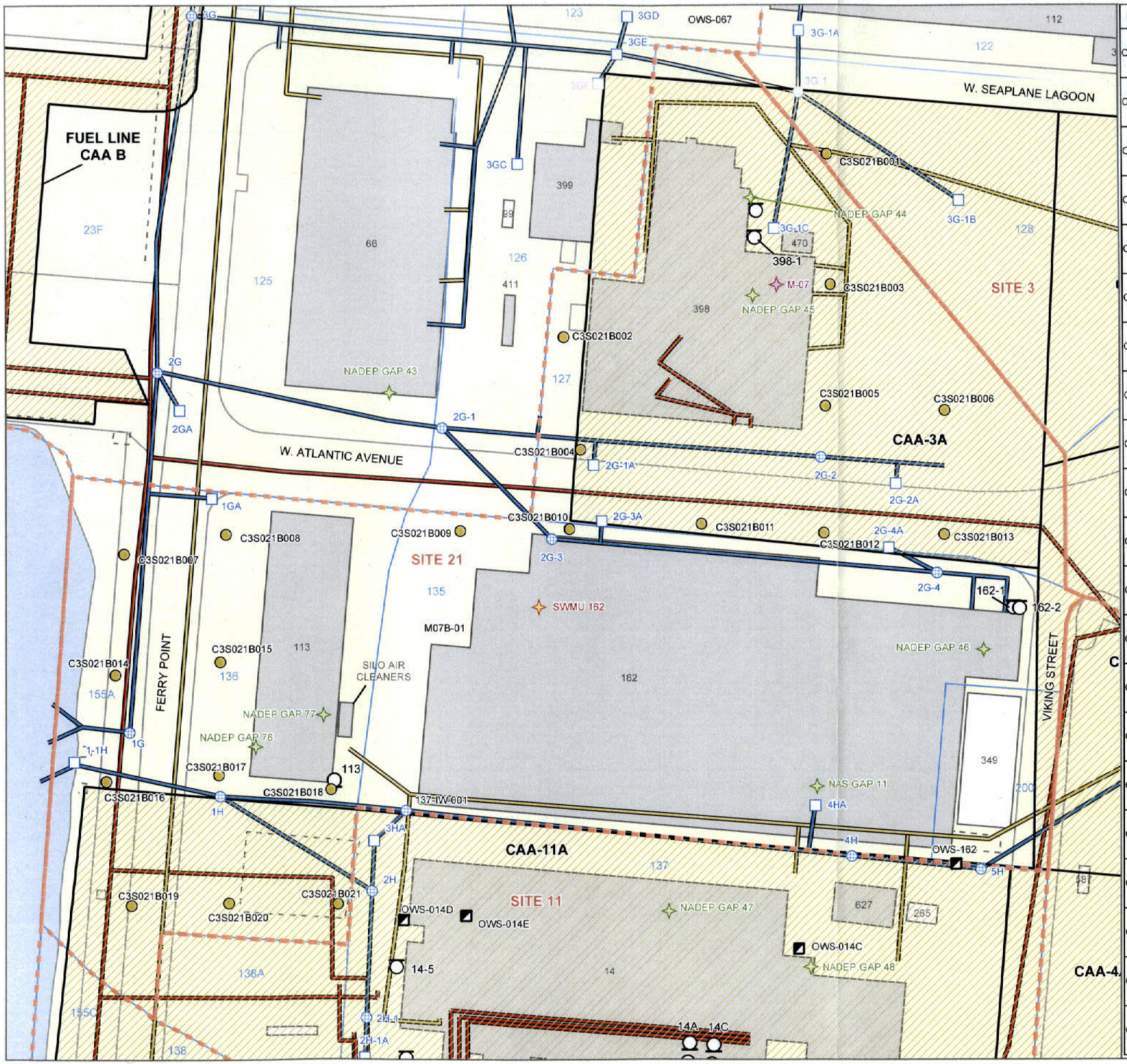

Point Name	Sample Depth (feet)	B(a)P EQ mg/kg
C3S021B001	0.0-0.5	0.0013806
	0.5-2.0	0.003236
	2.0-4.0	0.0006361
	4.0-8.0	0.006379
C3S021B002	0.0-0.5	0.019593
	0.5-2.0	0.0031548
	2.0-4.0	0.003795
	4.0-8.0	0.006061
C3S021B003	0.0-0.5	0.06235
	0.5-2.0	0.0000883
	2.0-4.0	0.0015712
	4.0-8.0	0.003566
C3S021B004	0.0-0.5	0.02556
	0.5-2.0	0.02809
	2.0-4.0	0.09454
	4.0-8.0	0.014272
C3S021B005	0.0-0.5	0.002872
	0.5-2.0	0.0017022
	2.0-4.0	0.0011479
	4.0-8.0	0.02627
C3S021B006	0.0-0.5	0.0023306
	0.5-2.0	0.00263
	2.0-4.0	0.003977
	4.0-8.0	0.005402
C3S021B007	0.0-0.5	0.030125
	0.5-2.0	0.009723
	2.0-4.0	0.0025203
	4.0-8.0	0.01641
C3S021B008	0.0-0.5	0.00000493
	0.5-2.0	0.00001619
	2.0-4.0	0.000071189
	4.0-8.0	0.00014137
C3S021B009	0.0-0.5	0.12104
	0.5-2.0	0.009667
	2.0-4.0	0.01228
	4.0-8.0	0.0009133
C3S021B010	0.0-0.5	0.003399
	0.5-2.0	0.01679
	2.0-4.0	0.0008121
	4.0-8.0	0.013182
C3S021B011	0.0-0.5	ND
	0.5-2.0	0.00000265
	2.0-4.0	0.000000239
	4.0-8.0	0.000005104
C3S021B012	0.0-0.5	0.000017677
	0.5-2.0	0.00000246
	2.0-4.0	0.00000021
	4.0-8.0	0.000009727
C3S021B013	0.0-0.5	0.000018543
	0.5-2.0	0.00000859
	2.0-4.0	ND
	4.0-8.0	0.00000215
C3S021B014	0.0-0.5	0.01413
	0.5-2.0	0.0016232
	2.0-4.0	0.0005713
	4.0-8.0	0.02799
C3S021B015	0.0-0.5	0.00000392
	0.5-2.0	ND
	2.0-4.0	0.00000208
	4.0-8.0	0.00017188
C3S021B016	0.0-0.5	0.000021
	0.5-2.0	0.00579
	2.0-4.0	0.0008811
	4.0-8.0	0.011103
C3S021B017	0.0-0.5	0.003735
	0.5-2.0	0.11105
	2.0-4.0	0.002163
	4.0-8.0	0.01599
C3S021B018	0.0-0.5	0.004049
	0.5-2.0	0.0012995
	2.0-4.0	0.0000385
	4.0-8.0	0.001498
C3S021B019	0.0-0.5	0.08984
	0.5-2.0	0.0252
	2.0-4.0	0.0002331
	4.0-8.0	0.003138
C3S021B020	0.0-0.5	0.025982
	0.5-2.0	ND
	2.0-4.0	ND
	4.0-8.0	0.006349
C3S021B021	0.0-0.5	0.03743
	0.5-2.0	0.0000606
	2.0-4.0	0.0000017
	4.0-8.0	0.011227

SAMPLING LOCATION
- Soil Boring

ABOVEGROUND STORAGE TANK (AST)
- Present
- Removed

UNDERGROUND STORAGE TANK (UST)
- Present
- Removed
- RCRA UNIT
- GENERATOR ACCUMULATION POINT (GAP)
- SOLID WASTE MANAGEMENT UNIT (SWMU)
- CATCH BASIN
- MANHOLE
- OIL-WATER SEPARATOR (OWS)
- FENCE
- FUEL LINE
- SANITARY SEWER LINE
- STORM SEWER LINE
- CORRECTIVE ACTION AREA (CAA)
- CERCLA SITE BOUNDARY
- ENVIRONMENTAL BASELINE SURVEY (EBS) PARCEL BOUNDARY AND NUMBER
- LAND COVER
- WATER

BUILDING
- Present
- Removed

Notes:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
GAP = Generator accumulation point
NADEP = Naval Aviation Depot Alameda
NAS = Naval Air Station
RCRA = Resource Conservation and Recovery Act
SWMU = Solid Waste Management Unit

Action level is 0.62 mg/kg

40 0 40 80 Feet

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FIGURE 8-21
SITE 21 CONCENTRATIONS OF PAHs (EXPRESSED AS BENZO(a)PYRENE EQUIVALENTS)

Operable Unit 2B
Remedial Investigation Report

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