

Final
Lead Impacted Soil Summary Report and
Sampling and Removal Action Workplan
NASA Research Park
Moffett Field, California

Prepared for

PAI/ISSi
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Harding ESE Project No. 54690 3.8

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DISTRIBUTION

1.0 INTRODUCTION

This Sampling and Removal Action Workplan (Workplan) has been prepared by Harding ESE, Inc. (Harding ESE) to address the lead-based paint (LBP) in soil issues at Parcels 1 through 6 of the National Aeronautics and Space Administrations (NASA) Research Park (NRP), Moffett Field, California (Site; Plate A1). NRP was formerly part of the Naval Air Station (NAS) Moffett Field and comprises the 213-acre area slated for redevelopment. For presentation purposes the NRP was divided into seven parcels for the *Environmental Baseline Surveys* (EBS; HLA, 2000, Harding ESE 2001a, b). The locations of the parcels are shown on Plate A2. Harding ESE conducted this assessment and prepared this report under contract to PAI/ISSi on behalf the NASA Ames Research Center.

1.1 Purposes of the Workplan

The purposes of this Workplan are to:

- 1) Summarize the previous LBP in soil data collected at the NRP (*CWMI, 1993, Weston, 1998, PAI/ISSi Team, 2001a and b, and 2002*),
- 2) Describe the additional soil sampling activities (*Initial Soil Lead Assessments*) for those buildings where the presence of LBP in the building materials is suspected or confirmed (*HLA, 2000, and Harding ESE 2001a and b*), and
- 3) Outline removal action activities in areas where the previous data has confirmed the presence of LBP in soil.

The Workplan describes the process and protocols to be utilized for the Initial Soil Lead Assessment, the remedial action of the soil at buildings with the confirmed presence of LBP, and for excavation post-grading confirmation soil sampling. The objective of the remedial action is to remove soil that contains lead exceeding the San Francisco Regional Water Quality Control Board (SFRWQCB) risk-based screening level (RBSL) and to confirm that this cleanup level is not exceeded after removal. Based on a residential land use scenario, the RBSL for lead in surface soils (< 3 meters (m) in depth) used for NRP is 200 milligrams per kilogram (mg/kg).

1.2 Background

Prior to 1933, the Moffett Field area was used for agriculture. The U.S. military continuously operated the Naval Air Station (NAS) Moffett Field from its date of commission in April 1933 as the Sunnyvale Naval Air Station until it was transferred to NASA on July 1, 1994. NAS Moffett Field's original mission was to serve as a base for the West Coast dirigibles of the lighter-than-air (LTA) program. The Navy continued to use the station as an air base until October 1935 when it was transferred to the Army Air Corps for use as a training base. During the Army's tenure, the National Advisory Committee for Aeronautics (NACA) established Ames Aeronautical Laboratory in December 1939 on land adjacent to the Navy at Moffett Field (in 1958, NASA was created and absorbed NACA; thus it became the NASA Ames Research Center).

In April 1942, the base was returned to the Navy and renamed Naval Air Station (NAS) Moffett Field. By 1950, Moffett Field was the largest naval air transport base on the West Coast and became the first all-weather air station. Jets first arrived in 1950 and included fighters. In 1953, the base became home to all Navy fixed-wing, land-based antisubmarine craft. A weapons department was formed on the base in 1954.

In February 1966, the base activated its high-speed refueling facilities, and in 1973, it became the headquarters of the Commander Patrol Wings, U.S. Pacific Fleet.

Between 1973 and 1994, NAS Moffett Field's mission involved support of antisubmarine warfare training and patrol squadrons. No heavy manufacturing or major aircraft maintenance was conducted during the last mission; mostly unit-and intermediate-level maintenance occurred.

The base was designated for closure as an active military base under the U.S. Department of Defense Base Realignment and Closure (BRAC) program. The base was transferred in July 1994 to NASA, except the military housing units and associated facilities, which were transferred to Onizuka Air Force Base.

Because the majority of the structures were constructed prior to 1978, evaluations for the presence of LBP were performed to assess Site conditions. An initial inspection and representative soil sampling around the buildings was conducted for NASA in 1993 by Chemical Waste Management, Inc. (*CWMI, 1993*) and a subsequent investigation was conducted by Roy F. Weston for the U.S. Environmental Protection Agency, Region IX (*Weston, 1998*).

NASA intends to redevelop the NRP with various public and private partners, as a collaborative research and educational campus. Previous investigations conducted at Moffett Field indicate that lead-impacted soil surrounding buildings is likely as a result of the age of the buildings within NRP and the historical use of lead-based paint.

The current *Draft Environmental Issues Management Plan* (EIMP; *EKI, 2001*) requires that initial soil assessment be conducted to evaluate whether the soil surrounding the buildings has been impacted by LBP, and that soils known to exceed the lead cleanup goal (i.e., the RBSL of 200 mg/kg) be remediated before the buildings are demolished. The EIMP also requires post-removal soil confirmation sampling to confirm lead levels are below the cleanup goal. The majority of the non-historic existing buildings will be demolished, and the surrounding areas regraded.

1.3 Organization of Report

The Workplan is organized as follows:

- Section 2.0 presents a summary description of the Site including location, Site geology and hydrogeology
- Section 3.0 presents the current and proposed future land use
- Section 4.0 presents a summary of the data from previous investigations
- Section 5.0 presents the workplan for the initial soil assessments and for the removal actions
- Section 6.0 includes the references
- The Appendixes include:
 - Appendix A; Sampling and Analysis Plan
 - Appendix B; Quality Assurance Project Plan.

2.0 SITE DESCRIPTION

2.1 Physical Description

This section describes the physical characteristics of the NRP and is summarized from the EBS documents (EBS; HLA, 2000, Harding ESE 2001a, b).

2.1.1 Location and Site Physiography

Moffett Field lies 35 miles south of San Francisco, 10 miles north of San Jose, and about 1 mile south of San Francisco Bay. The facility encompasses about 2,000 acres in Santa Clara County and borders the cities of Mountain View and Sunnyvale, California (Plate A1). To the north of Moffett Field are saltwater evaporation ponds and wetlands associated with San Francisco Bay; Stevens Creek lies to the west; U.S. Highway 101 runs along the southern perimeter; and Lockheed-Martin Aerospace facilities are located to the east. The existing Ames Campus and proposed Bayview areas are in the northwest portion of Moffett Field. The area south of U.S. 101 is and has been industrial and includes a group of companies located or formerly located in a 0.5 square-mile area bounded by East Middlefield Road, Ellis Street, Whisman Road, and U.S. 101 referred to as the MEW Superfund Site. These companies are cleaning up soil and groundwater contamination believed to originate within the MEW Superfund site that has also affected groundwater quality beneath the NRP.

The NASA Research Park Parcels (Plate A2) are in the southern portion of Moffett Field and comprise 213 acres. The Ames Campus and Bayview areas lie to the north and west of the NRP, U.S. 101 bounds the NRP to the south, and the runways and hangars of the Eastside Airfield lie to the east.

Moffett Field is located near the southern end of San Francisco Bay on nearly flat fluvial basin deposits. Elevations range from approximately 36 feet above mean sea level (msl) to 2 feet below msl. Because topographic relief is minimal, manmade structures are the most noticeable surface features and include buildings, aircraft hangars, roads, parking lots, runways, and landscaped areas.

The area north of Moffett Field was once tidal salt marshes and mud flats of San Francisco Bay. These marshes and mud flats have been eliminated or greatly altered by diking and filling. Currently, commercial saltwater evaporation ponds are present north of Moffett Field. A stormwater retention pond exists on lands of Midpeninsula Regional Open Space District and NASA Ames.

2.1.2 Geology/Hydrogeology

Moffett Field is located at the northern end of the Santa Clara Valley Basin, about 1-mile south of San Francisco Bay. The Santa Clara Valley Basin is a Pliocene-age, large, northwest-trending structural depression between the San Andreas and Hayward faults. The basin is bordered on the west by the Santa Cruz Mountains and on the east by the Diablo Range.

Regionally, the Santa Clara Valley contains up to 1,500 feet of interbedded alluvial, fluvial, and estuarine deposits. Locally, these sediments consist of varying combinations of clay, silt, sand, and gravel that represent interfingering of estuarine and fluvial depositional environments during the late Pleistocene and Holocene epochs. Surface geologic maps indicate that alluvial fan deposits extend toward the basin approximately to U.S. Highway 101, which forms the southern boundary of Moffett Field. Shallow deposits on Moffett Field are branching river and flood plain deposits. Estuarine deposits are found at the extreme northern end of Moffett Field.

Regionally, the Quaternary water-bearing deposits are divided into a deep, confined aquifer, and a shallow, unconfined aquifer based on the extent of a regional confining layer. The shallow aquifer (upper 250 feet) is subdivided into the A, B and C aquifer zones. The A aquifer extends from a depth of 5 to 65 feet below ground surface (bgs) at the western side of Moffett Field. The A aquifer is divided into the A1- and A2- aquifer zones by a discontinuous, low-permeability horizon (A1/A2 aquitard) located between 25 and 30 feet bgs. The aquifer consists of sands and gravels with gravel comprising 20 to 90 percent of the coarse material. In general, groundwater flow is toward San Francisco Bay (north) with a horizontal gradient of 0.004 to 0.005 feet per foot (ft/ft). Depth to groundwater ranges from 5 to 12 feet bgs.

A laterally extensive clay aquitard (B/C aquitard) effectively isolates the C aquifer (160 to 250 bgs) from the upper aquifers. The A/B aquitard may be locally discontinuous.

3.0 CURRENT AND PROPOSED FUTURE LAND USE

Currently, the NRP parcels are used as described below (*HLA, 2000a, Harding ESE, 2001b,c*):

- Parcel 1: Buildings are used by NASA for administration, research support, storage, or are vacant. Dormitories and administrative buildings associated with the Space Camp Operations are also present in the western portion of the parcel. Carnegie Mellon University is remodeling Buildings 17 and 23 for education use.
- Parcel 2: This parcel has buildings for base support services and recreation, and NASA administration, research support, and storage.
- Parcel 3: Hangar 1 is used for special services, including a museum of the former NAS Moffett Field, and the remainder of the buildings are vacant.
- Parcel 4: Buildings are used for office operations, air traffic control, or are vacant. The Computer History Museum is constructing a temporary museum and offices. A large portion of this parcel has been identified as a habitat area for burrowing owls, a California species of special concern, and will not be developed.
- Parcel 5: Buildings present onsite are currently used for office and training space, motor pool operations, storage, retail, recreation, or are vacant.

The planned reuse includes construction of a research and educational campus that may include buildings associated with research and development, education, general administration, dormitory-style housing and child care. The California Air & Space Center and Computer History Museum will attract visitors.

4.0 SUMMARY OF PREVIOUS INVESTIGATION FINDINGS

NASA conducted initial lead soil sampling in 1993 (*CWMI 1996*). Additional soil sampling was conducted in 1998 by the U.S. EPA Region IX (*Weston, 1998*).

The CWMI program included collection of surface soil samples from the perimeter of buildings that may have had exteriors painted with LBP. A total of 332 samples were collected within two feet of the buildings and within the upper 6 inches of surface soil. Samples were analyzed for total inorganic lead (TTLC) using EPA Method 6010. Samples with a TTLC of 50 mg/kg or greater were also analyzed for Soluble Lead (STLC) by EPA Method 6010.

The Weston samples were collected adjacent to the buildings or at the dripline where the CWMI results indicated high concentrations of lead, those with abundant painted surfaces, and those that were surrounded by soil. Buildings surrounded by paved surfaces were not sampled. Several locations required intensive sampling efforts with the collection of up to 5 samples. All samples (120 total) were analyzed for lead in the field using x-ray fluorescence (XRF) spectrometry. Twenty samples were submitted to a laboratory for confirmation analysis using EPA Method 6010.

The CWMI and Weston data were combined into a database and approximate sample locations were plotted on the NRP basemap (Plate A2). The site was then divided into 12 subareas for data presentation purposes. The data were screened using the 200 mg/kg RBSL and the locations with results above the screening values are shown by subarea on Plates 1 through 12.

The EBS documents (*HLA, 2000, Harding ESE 2001a, b*) provided a summary of the buildings that, based on the age of the structure or previous sampling, were assumed to contain lead, including the potential for LBP in soil.

Based on the analysis of the existing soil data and the EBS information, areas/buildings were recommended either for initial soil lead assessments or for remediation (Plates 13 through 36). The workplan describing these two actions is presented in Section 5.0.

5.0 WORKPLAN

5.1 Initial Soil Lead Assessments

On the basis of the review of the EBS data and the CWMI and Weston data, buildings/areas where lead-impacted soils are suspected were identified. On October 24, 2001, Harding ESE conducted a site visit to inspect these buildings/areas and to identify those that were surrounded by soil. Buildings/areas surrounded by paved surfaces were not included for initial soil lead assessments. The areas identified for initial soil lead assessments and the sampling locations are shown on Plates 14, 16, 18, 20, 23, 25, 28, 29, 32, 33, and 35. In addition, a building/area's previous use was also considered. For example, building 38 (Area 2, Parcel 1) is and has historically been tennis courts. Therefore, LBP impacts are not suspected and sampling is not recommended. These procedures are consistent with those outlined in the EIMP (*EKI 2001*).

5.1.1 Assessment Sampling

The initial soil assessment includes collecting a suite of composite samples in unpaved areas at the building corners, near suspect discharge points such as downspouts, and at regular intervals around the periphery of the building. The sampling grid will consist of six samples collected from a cell up to 30-feet long by 20-feet wide. All samples will be collected from 0 to 6 inches below the surface at the dripline or no more than 2-feet from the building wall if no dripline is apparent. A sample will be collected every 5-feet and the resulting six samples thoroughly mixed and composited in accordance with ASTM Standard D-6051-96 (*ASTM, 1996*). Sampling locations are shown on Plates 14, 16, 18, 20, 22, 23, 25, 28, 29, 32, 33, and 35 and are summarized as follows:

Area 2

Building 24 6 samples

Area 3

Building 943 6 samples

Area 4

Building 510 6 samples

Area 5

Building 29 8 samples (including two discrete samples at downspouts)

Area 6a

Building 64 6 samples

Area 6b

Building 3 72 samples

Area 7

Building 533 24 samples
Building 534 24 samples

Area 9

Building 113 24 samples

Area 11

Building 329 24 samples

Samples will be collected using a hand driven sampler equipped with a with a 6-inch-long stainless steel tube. If the ground surface is too hard to drive the sampler, samples will be collected with a stainless steel trowel and immediately transferred to the sample tubes. Sample tubes will be covered with Teflon-lined plastic caps, labeled, sealed, and stored in an insulated container with ice for transport under chain of custody procedures to a state-certified analytical laboratory for total lead analysis by EPA Test Method 6010. The sample will also be analyzed for soluble lead if the total lead concentration is greater than 50 mg/kg. A detailed discussion of sampling procedures and protocols is presented in the Sampling and Analysis Plan (Appendix A).

5.1.2 Reporting

The analytical results will be screened against the RBSL and additional areas requiring excavation identified. An addendum to this workplan will be prepared containing a description of soil sampling activities, the result of the laboratory analysis of the soil samples, and a figure for each building showing soil sample locations and results, and the required soil removal areas.

5.1.3 Quality Assurance

Quality Assurance/Quality Control (QA/QC) samples will also be collected. These samples will include duplicates and equipment blanks and will be collected at a minimum rate of one for every 15 samples. QA/QC procedures to be used by the laboratory will include; method blanks, duplicates, matrix spikes (MS) and laboratory control samples (LCS). A Quality Assurance Project Plan (QAPP) has been prepared for this project and is presented in Appendix B.

5.2 Soil Removal

On the basis of the soil sampling previously conducted by NASA and the US EPA, lead-impacted soil will be removed from those areas that exceed the RBSL. The areas are shown on Plates 13 through 27, 29 through 31, and 33 through 36, and include the approximate excavation limits. The excavations will be conducted by the development partner prior to building demolition. The procedures to be utilized for soil removal and confirmation sampling follow those in the EIMP (*EKI, 2001*). Following excavation and treatment, if necessary, disposal of lead-impacted soil excavated during Site development will be performed in accordance with applicable laws and regulations at permitted off-site facilities. NASA will dispose of the soil at the Navy's expense. Disposal characterization samples will be collected from bins or stockpiles in accordance with the needs of the disposal/treatment facility and to properly characterize the waste. NASA will sign the manifest as the generator of the waste.

Additional areas requiring soil removal, if any, will be indicated in the Addendum to this report, after the sampling and analysis described herein has been conducted.

5.2.1 Soil Excavation

Prior to instituting the remediation program, a Site-specific Health and Safety Plan and a Dust Prevention Plan will be prepared. The plans will detail measures required to protect onsite workers and the public from the potential hazards associated with the inhalation of dust impacted with lead. The plans will also include a contingency plan for emergencies and a hospital route map. Measures that will be taken to prevent generation of dust during construction activities will also be discussed.

Using a backhoe, shovel or other suitable equipment, the top three to six inches of lead impacted soil will be removed from those areas adjacent to the buildings where previous sampling results exceeded the 200 mg/kg cleanup goal. Excavation will continue outward approximately 10 feet in each direction from that sample location unless a patio, pavement, building or other material covering the ground surface is encountered first. Strip planting areas will only be excavated the width of the strip. Excavated soil will be loaded into bins as described below.

The proposed areas of excavation for each building are shown on Plates 13 through 27, 29 through 31, and 33 through 36. Estimated soil quantities to be removed are summarized below.

Area 1

Building 14	675 cubic feet (ft ³)
Building 25	700 ft ³
Building 34	200 ft ³
Building 37	100 ft ³
Building 67	350 ft ³

Area 2

Building 20	150 ft ³
Building 23	350 ft ³

Area 3

Building 26	250 ft ³
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Area 4

Building 10	600 ft ³
Building 16	350 ft ³
Building 76	600 ft ³
Building 567	200 ft ³

Area 5

Building 2	400 ft ³
Building 480	275 ft ³

Area 6a

Building 85	125 ft ³
Building 126	4,000 ft ³
Building 527	1,800 ft ³

Area 6b

Building 45	600 ft ³
Building 941	450 ft ³
Building 942	200 ft ³

Area 7

Building 50	300 ft ³
Building 153	1,000 ft ³
Building 543	1,000 ft ³

Area 9

Building 113	100 ft ³
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Area 10

Building 82	200 ft ³
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Area 11

Building 331	100 ft ³
Building 381	100 ft ³
Building 464	100 ft ³

After excavation, the lead impacted soil that has been removed will be sampled to evaluate disposal alternatives. NASA will then properly dispose of the excavated soil at the Navy's expense.

The soil removal equipment will be decontaminated prior to work at each soil removal location at each building. The equipment will be dry brushed to remove any excessive soil, and then rinsed using a soap and water solution. A final clean water rinse will be completed after the soap and water cleaning. Decon water will be collected in 55 gallon drums, labeled, and sampled to determine proper disposition.

Additional areas requiring excavation, if any, will be described in the Addendum to this report, after the sampling and analysis described herein has been conducted.

5.2.2 Confirmation Sampling

Upon completion of the removal of soil at each area, soil confirmation samples will be collected to confirm the remaining soil surface is below the lead RBSL. Samples will be collected using a hand driven sampler equipped with a with a 6-inch-long stainless steel tube. If the ground surface is too hard to drive the sampler, samples will be collected with a stainless steel trowel and immediately transferred to the sample tubes. Sample tubes will be covered with Teflon-lined plastic caps, labeled, sealed, and stored in an insulated container with ice for transport under chain of custody procedures to a state-certified analytical laboratory for total lead analysis by EPA Test Method 6010. Samples will be collected from the floor and excavation sidewalls for each excavation area. The samples will be a 6-point composite, properly homogenized and composited in accordance with the ASTM Standard D-6051-96. A detailed discussion of sampling procedures and protocols is presented in the Sampling and Analysis Plan (Appendix A).

The anticipated number of confirmation samples to be collected are summarized as follows:

Area 1

Building 14 12 samples
Building 25 6 samples
Building 34 6 samples
Building 37 12 samples
Building 67 6 samples

Area 2

Building 20 6 samples
Building 23 6 samples

Area 3

Building 26 6 samples

Area 4

Building 10 12 samples
Building 16 6 samples
Building 76 6 samples
Building 567 6 samples

Area 5

Building 2 6 samples
Building 480 6 samples

Area 6a

Building 85 12 samples
Building 126 42 samples
Building 527 12 samples

Area 6b

Building 45 18 samples
Building 941 12 samples
Building 942 6 samples

Area 7

Building 50 18 samples
Building 153 12 samples
Building 543 12 samples

Area 10

Building 82 6 samples

Area 11

Building 331 6 samples
Building 381 6 samples
Building 464 6 samples

After lead-impacted soils have been excavated and removed, soil excavation for site development can continue using the soil screening procedures described in the EIMP.

5.2.3 Soil Staging, Waste Characterization and Disposal

Excavated soil will be loaded into metal storage bins for staging and waste characterization sampling. One four-point composite soil sample will be collected from each bin. To collect the samples, at least 1-foot of surface soil will be removed and a clean stainless steel tube will be inserted into the exposed soil. This procedure will be repeated at four different locations in the bin. The soil from the tubes will be transferred into a stainless steel mixing bowl where it will be thoroughly mixed. Once mixed, one pre-cleaned eight-ounce glass jar with a Teflon-lined lid will be filled with the composite sample using a stainless steel spoon. The sample will be handled in the same manner as described above for the confirmation samples and delivered to the lab for testing.

Each bin sample will be tested for total lead. Soluble lead using Cal EPA's Soluble Threshold Limit Concentration (STLC) and federal Toxic Characteristics Leaching Procedure (TCLP) will also be analyzed if total lead results exceed 50 milligrams per kilogram (mg/kg). The STLC and TCLP threshold concentration is 5 milligrams per liter (mg/l). If the bin sample lead concentrations exceeds the TTLC, STLC, or TCLP, the soil will be classified as a hazardous waste, manifested, and transported to a state permitted Class I disposal facility.

5.2.4 Reporting

Upon completion of the excavation backfilling, a Removal Action Completion Report will be prepared documenting the removal action. This report will contain a description of soil removal and confirmation sampling procedures, a figure for each building showing soil removal area, previous soil sample locations, confirmation sample locations, and a table presenting the previous and confirmation sample results. Copies of the manifests documenting proper treatment and/or disposal of lead-impacted soil will also be included. The report will be prepared by NASA to document compliance with the soil management protocol presented in this workplan.

5.2.5 Decontamination Waste Disposal

Solids generated by decontamination procedures described above will be placed in the bins for testing and disposal with the excavated soils. Liquids stored in 55-gallon drums will be sampled and analyzed for the total lead. Depending on the analytical results, the liquids will be discharged to the sanitary sewer, pre-treated onsite and then discharged to the sanitary sewer, or transported offsite for treatment and disposal.

5.2.6 Quality Assurance

QA/QC samples will also be collected for both the confirmation sampling and disposal characterization activities. These samples will include duplicates and equipment blanks and will be collected at a minimum rate of one for every 15 samples. QA/QC procedures to be used by the laboratory will include;

method blanks, duplicates, matrix spikes (MS) and laboratory control samples (LCS). A Quality Assurance Project Plan (QAPP) as been prepared for this project and is presented in Appendix B.

5.2.7 Summary

A total of 200 soil samples will be collected for initial lead characterization.

Prior to building demolition, a total of 565 cubic yards of soil must be excavated.

After excavating, a total of 270 confirmation soil samples will be required to confirm that lead in the remaining soil is less then 200 mg/kg.

Additional initial soil samples, excavation, and confirmation soil samples, if any, will be described in the Addendum to this report after the sampling and analysis described herein is conducted.

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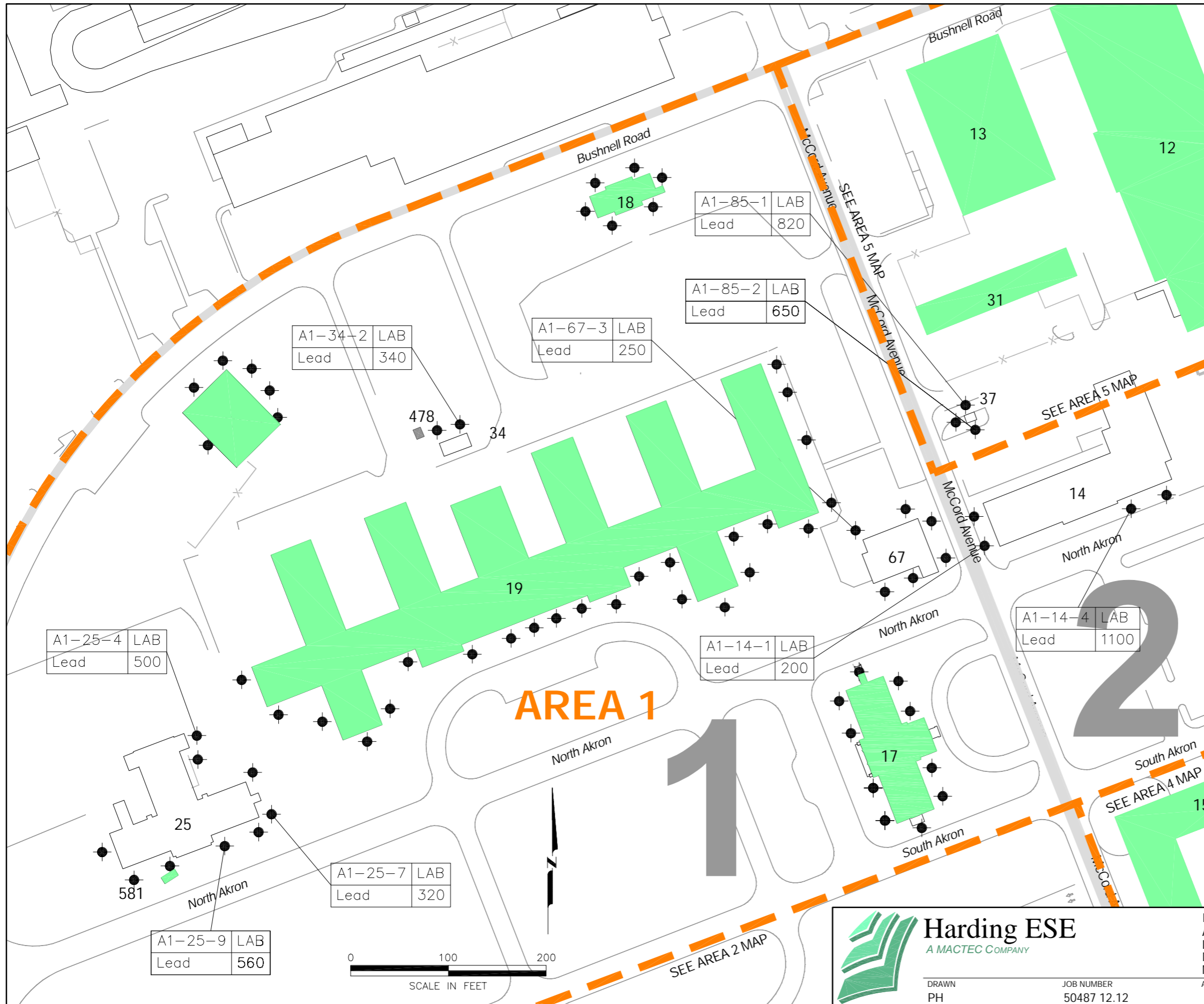
_____, 2002. *Closure Plan 8, Buildings 6, 76, 81, 460, 482, 509, 510, 527, 542, 567, 570*. February 2.

PRC Environmental Management, Inc. (PRC), 1994. *Base Realignment and Closure Cleanup Plan, Naval Air Station Moffett Field*. March.

Roy F. Weston (Weston), 1998. *Lead Based Paint Investigation Report for NAS Moffett Field*. Prepared for U.S. Environmental Protection Agency, Region IX, October.

Tetra Tech EM Inc. (Tetra Tech), 1998c. *Final Station-Wide Feasibility Study Report*. October 30.

PLATES



EXPLANATION

- Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
- Buildings requiring soil removal
- ▒ Buildings with potential for lead based paint (pre-1978 buildings not sampled)
- No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use (Note 1)

Station name (Note 2)
Sample Type (XRF/LAB)

A3-26-2	LAB
Lead	460

Concentration of lead (mg/kg)

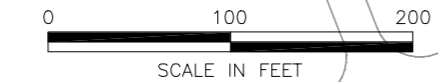
1 Parcel Number

— Parcel Boundary

- - - Area Boundary

NOTES: 1. Buildings surrounded by concrete were not included in sampling plan and are shown as green.

2. If the sample location symbol is present with no analytical results, the samples had lead less than 200 mg/kg.



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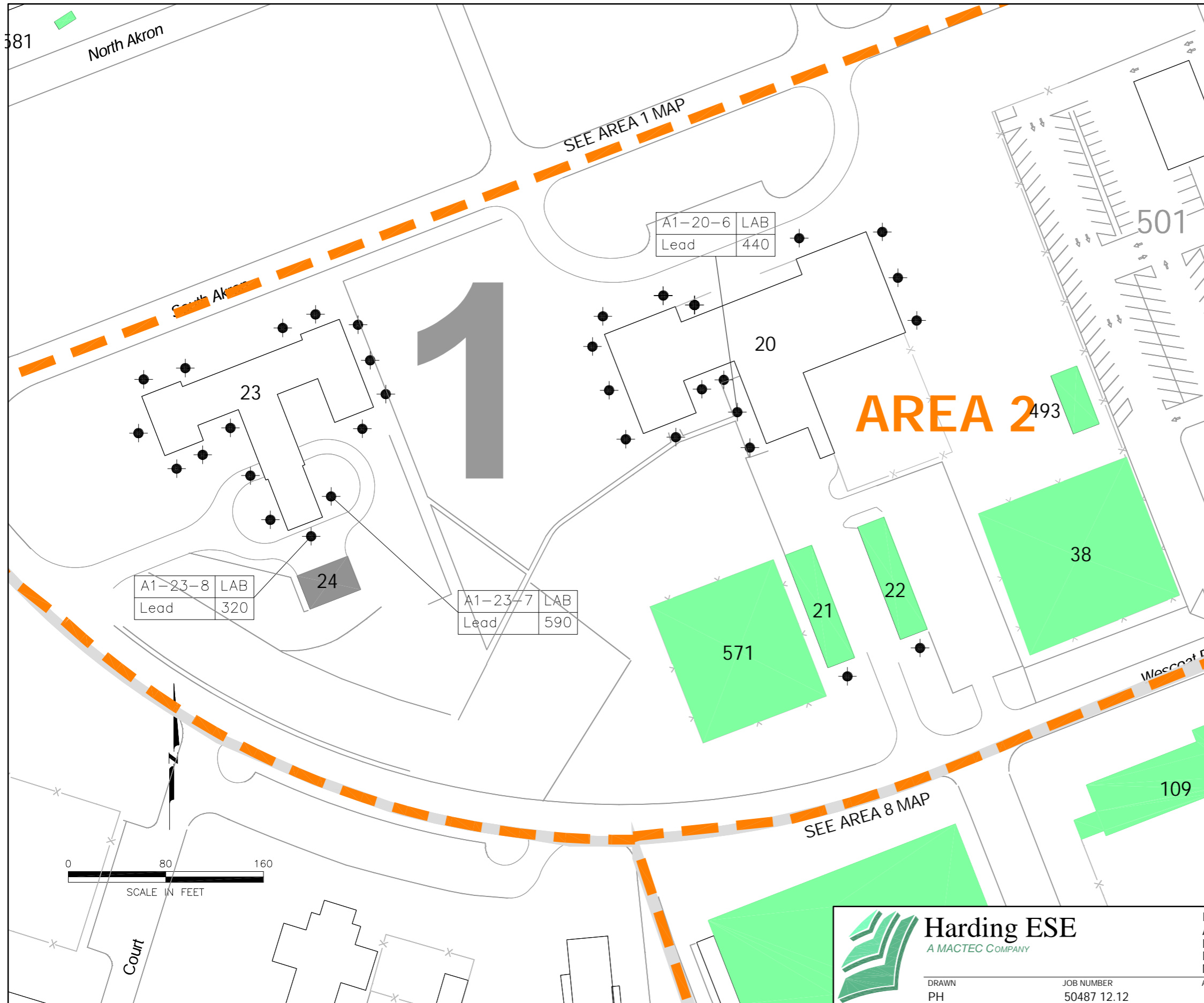
DRAWN: PH
JOB NUMBER: 50487 12.12

Lead Sample Results
Area 1 - Parcels 1, 2
Lead Sampling and Removal Action Plan
NASA Research Park
Moffett Field, California

APPROVED: _____ DATE: 9/01
REVISED DATE: _____

PLATE **1**

50487190.DWG 1.0
20020107.1202



EXPLANATION

- Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
- Buildings requiring soil removal
- Buildings with potential for lead based paint (pre-1978 buildings not sampled)
- No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use (Note 1)
- Station name (Note 2)
- Sample Type (XRF/LAB)
- Concentration of lead (mg/kg)
- Parcel Number
- Parcel Boundary
- Area Boundary

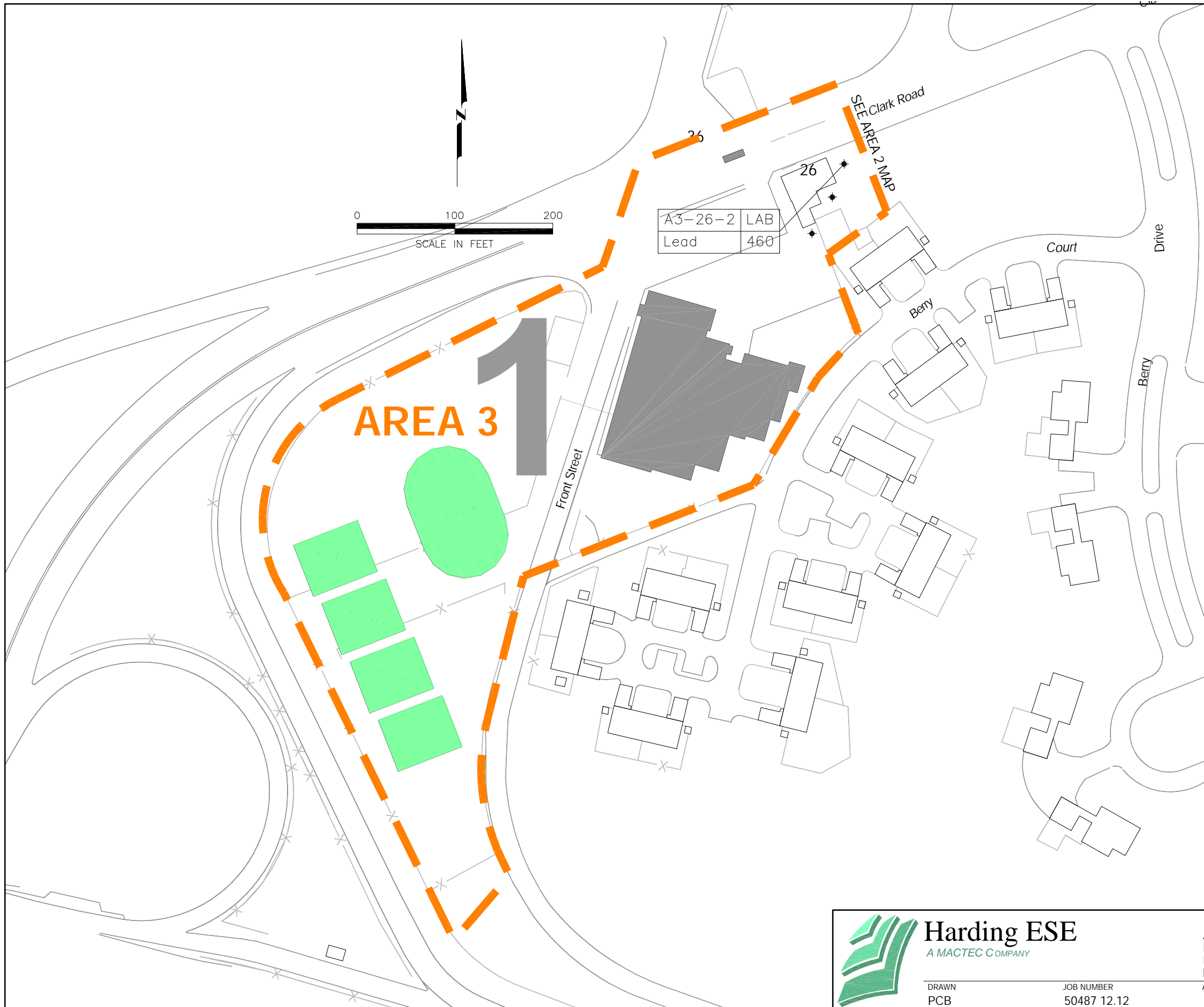
- NOTES: 1. Buildings surrounded by concrete were not included in sampling plan and are shown as green.
2. If the sample location symbol is present with no analytical results, the samples had lead less than 200 mg/kg.

50487192.DWG 1.0
2001101.1021


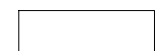

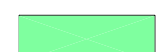
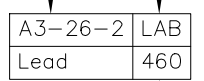



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DRAWN PH JOB NUMBER 50487 12.12 APPROVED DATE 9/01 REVISED DATE

Lead Sample Results
Area 2 - Parcel 1
Lead Sampling and Removal Action Work Plan
NASA Research Park
Moffett Field, California



EXPLANATION

-  Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
-  Buildings requiring soil removal
-  Buildings with potential for lead based paint (pre-1978 buildings not sampled)
-  No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use (Note 1)
-  Station name (Note 2)
Sample Type (XRF/LAB)
Concentration of lead (mg/kg)
-  Parcel Number
-  Parcel Boundary
-  Area Boundary

- NOTES: 1. Buildings surrounded by concrete were not included in sampling plan and are shown as green.
2. If the sample location symbol is present with no analytical results, the samples had lead less than 200 mg/kg.

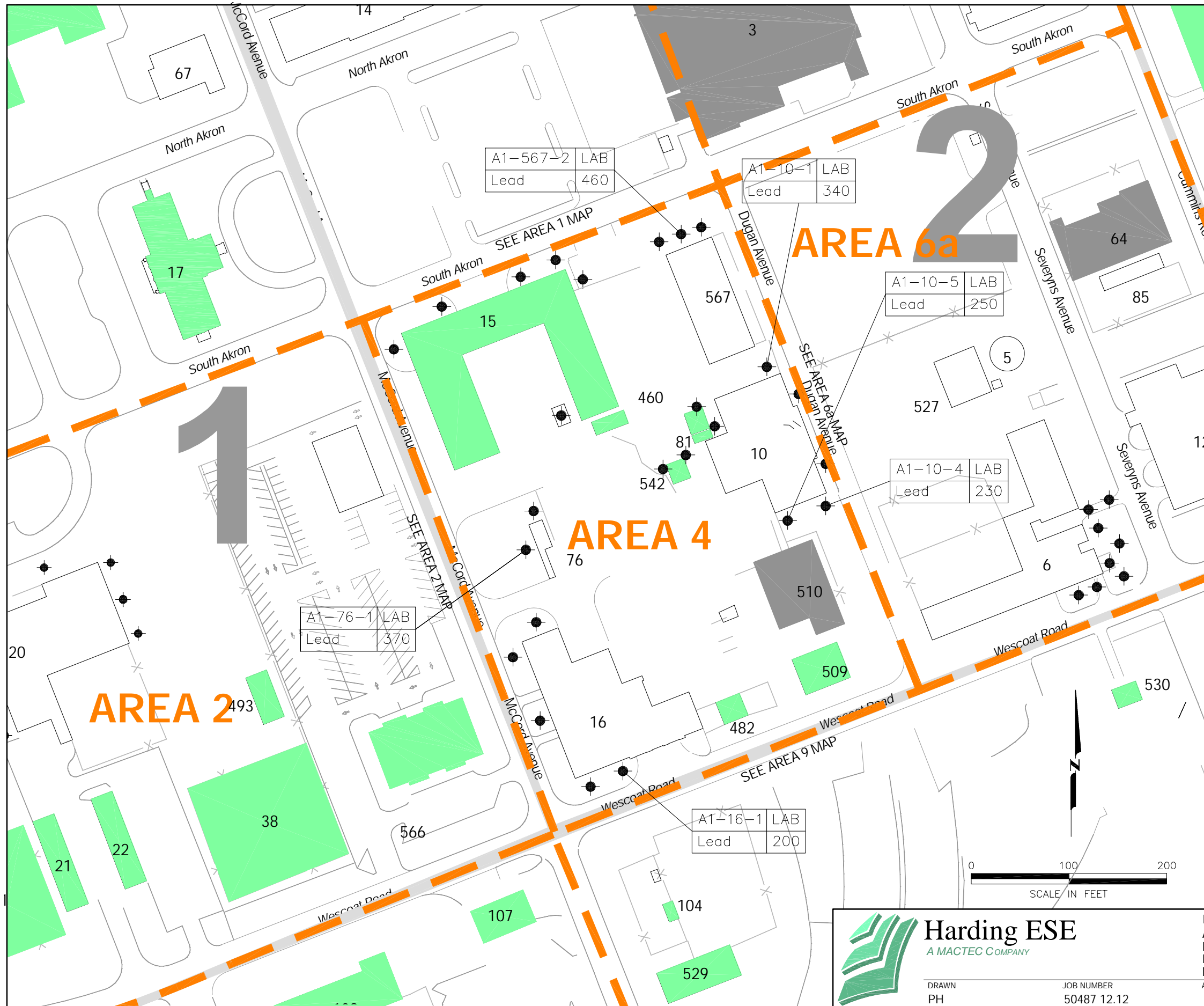
50487188.DWG 1.0
20020108:1445



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Lead Sample Results
Area 3 - Parcel 1
Lead Sampling and Removal Action Work Plan
NASA Research Park
Moffett Field, California

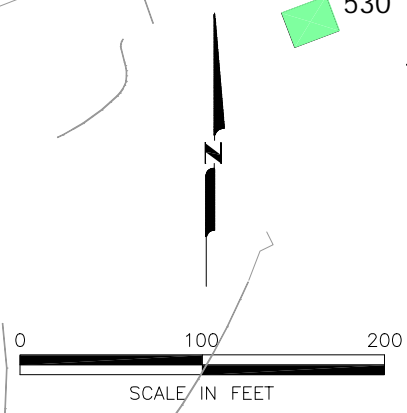
DRAWN PCB	JOB NUMBER 50487 12.12	APPROVED	DATE 9/01	REVISED DATE
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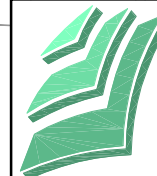


EXPLANATION

- Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
- Buildings requiring soil removal
- Buildings with potential for lead based paint (pre-1978 buildings not sampled)
- No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use (Note 1)
- Station name (Note 2)
Sample Type (XRF/LAB)
Concentration of lead (mg/kg)
- Parcel Number
- Parcel Boundary
- Area Boundary

- NOTES:
- Buildings surrounded by concrete were not included in sampling plan and are shown as green.
 - If the sample location symbol is present with no analytical results, the samples had lead less than 200 mg/kg.





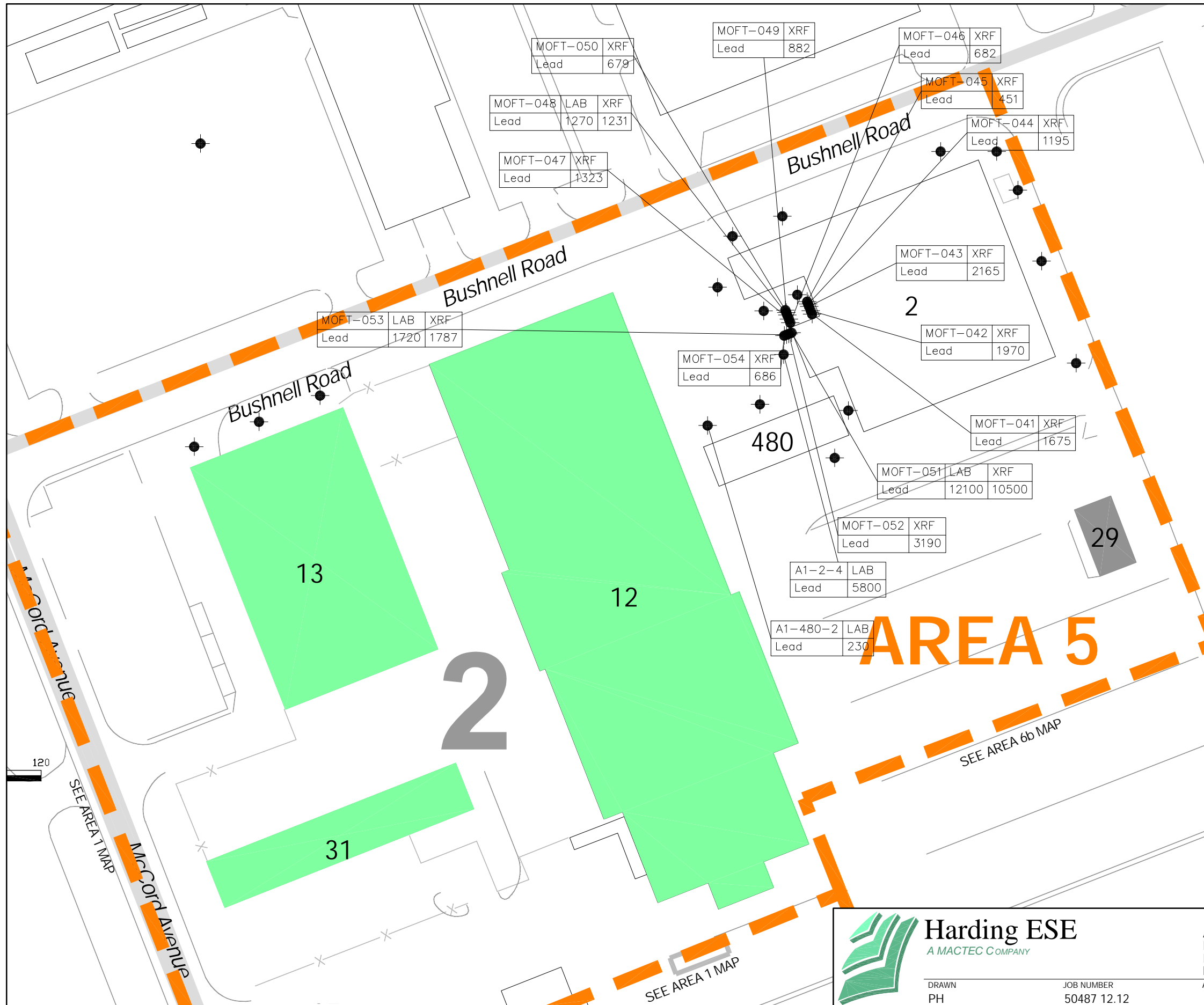
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A MACTEC COMPANY

Lead Sample Results
Area 4 - Parcel 2
Lead Sampling and Removal Action Work Plan
NASA Research Park
Moffett Field, California




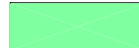


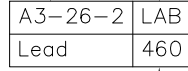
PLATE
4





DRAWN PH	JOB NUMBER 50487 12.12	APPROVED	DATE 9/01
			REVISED DATE

50487193.DWG 1.0
20020304.0838



EXPLANATION

-  Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
-  Buildings requiring soil removal
-  Buildings with potential for lead based paint (pre-1978 buildings not sampled)
-  No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use (Note 1)
-  Station name (Note 2)
-  Sample Type (XRF/LAB)
- 

A3-26-2	LAB
Lead	460
-  Concentration of lead (mg/kg)
-  Parcel Number
-  Parcel Boundary
-  Area Boundary

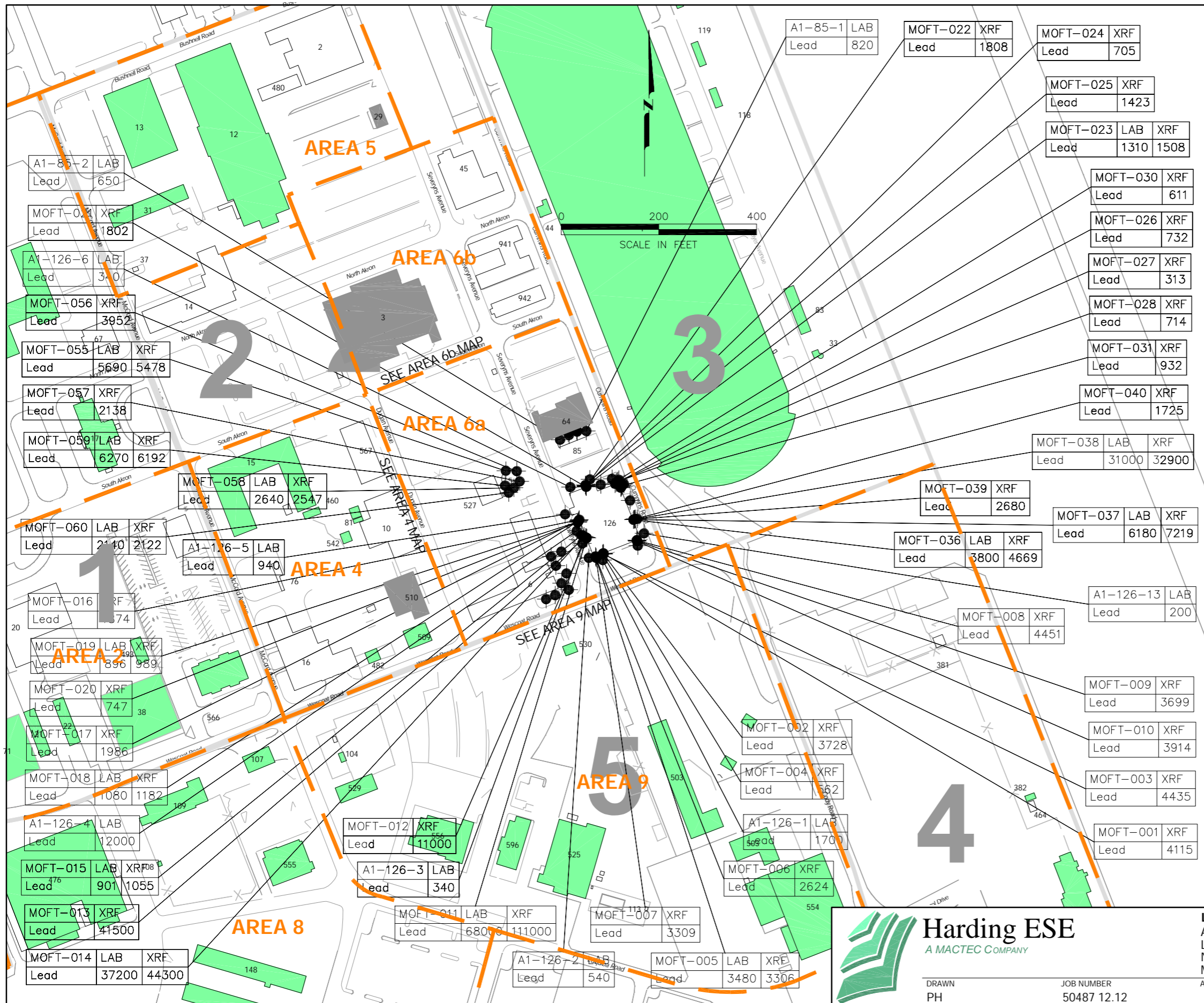
- NOTES: 1. Buildings surrounded by concrete were not included in sampling plan and are shown as green.
2. If the sample location symbol is present with no analytical results, the samples had lead less than 200 mg/kg.



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Lead Sample Results
Area 5 - Parcel 2
Lead Sampling and Removal Action Work Plan
NASA Research Park
Moffett Field, California

DRAWN PH	JOB NUMBER 50487 12.12	APPROVED	DATE 9/01	REVISED DATE
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EXPLANATION

- Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
- Buildings requiring soil removal
- Buildings with potential for lead based paint (pre-1978 buildings not sampled)
- No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use (Note 1)

Station name (Note 2)
Sample Type (XRF/LAB)
Concentration of lead (mg/kg)

1 Parcel Number

Parcel Boundary

Area Boundary

- NOTES:**
- Buildings surrounded by concrete were not included in sampling plan and are shown as green.
 - If the sample location symbol is present with no analytical results, the samples had lead less than 200 mg/kg.

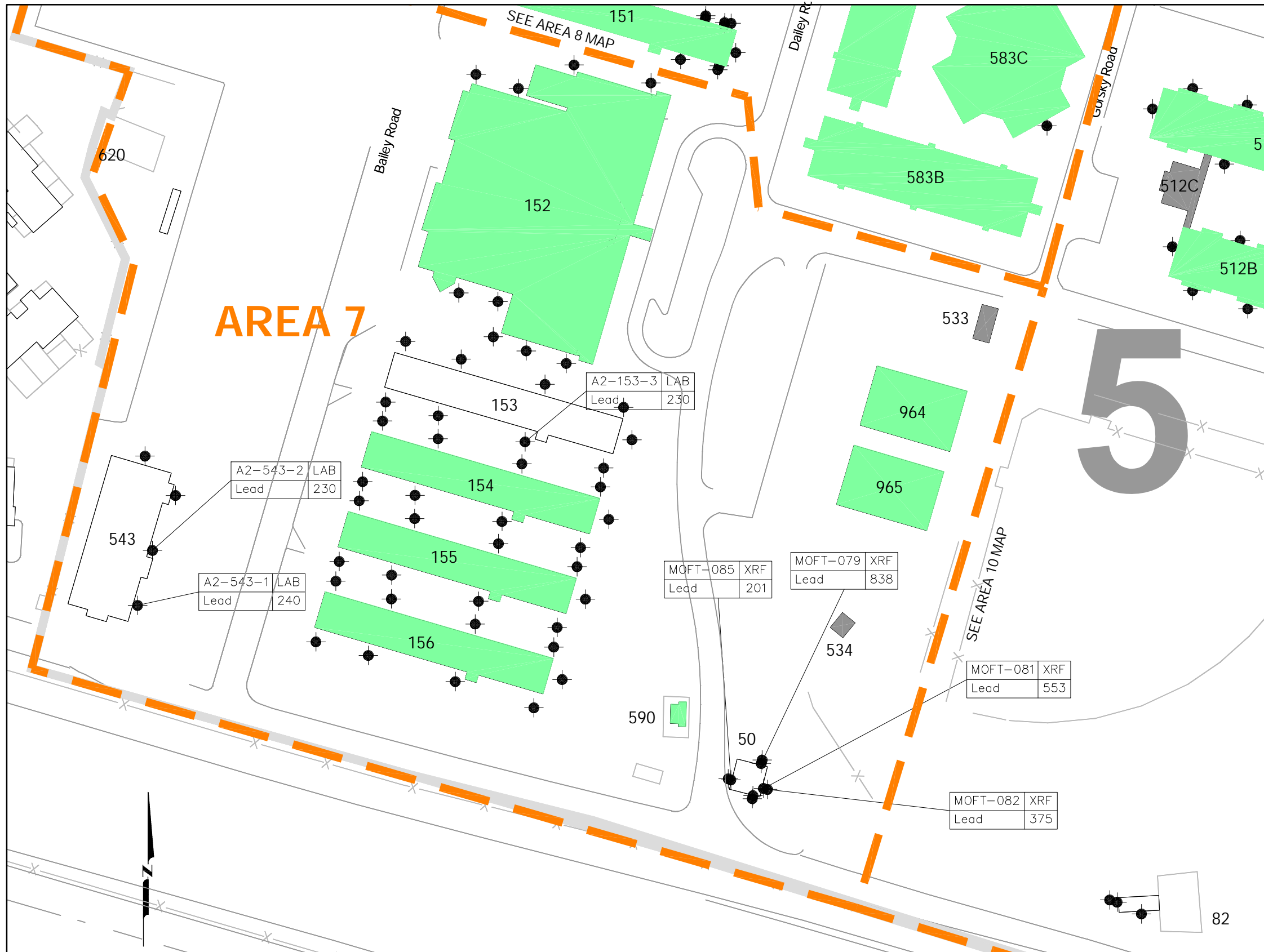
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Lead Sample Results
Area 6a - Parcel 2
Lead Sampling and Removal Action Work Plan
NASA Research Park
Moffett Field, California

PLATE **6a**

DRAWN PH JOB NUMBER 50487 12.12 APPROVED DATE 9/01 REVISED DATE

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20020304.0837



EXPLANATION

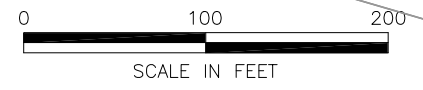
- Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
- Buildings requiring soil removal
- Buildings with potential for lead based paint (pre-1978 buildings not sampled)
- No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use (Note 1)

Station name (Note 2)
Sample Type (XRF/LAB)
Concentration of lead (mg/kg)

A3-26-2	LAB
Lead	460

Parcel Number
Parcel Boundary
Area Boundary

NOTES: 1. Buildings surrounded by concrete were not included in sampling plan and are shown as green.
2. If the sample location symbol is present with no analytical results, the samples had lead less than 200 mg/kg.

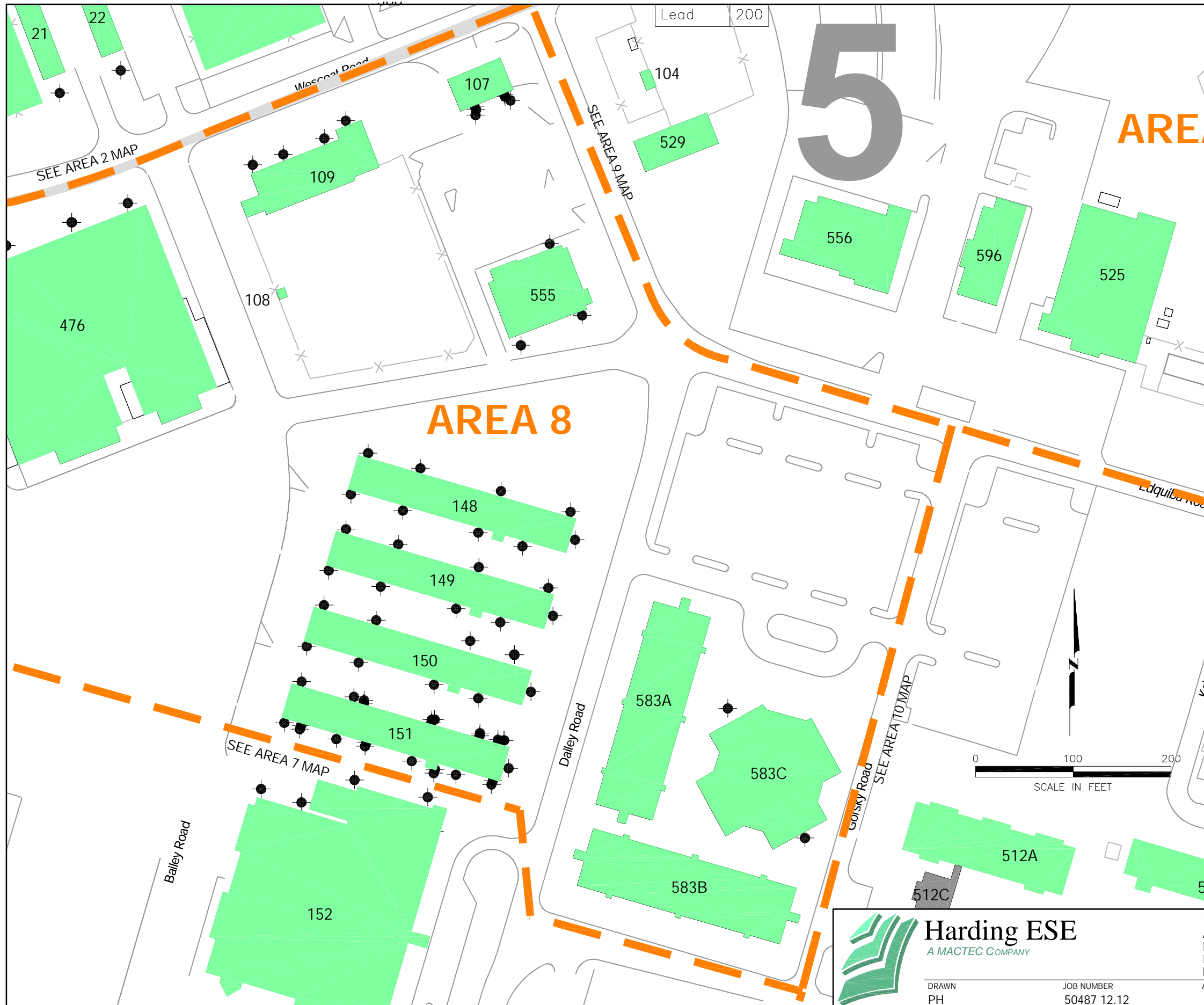


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Lead Sample Results
Area 7 - Parcel 5
Lead Sampling and Removal Action Work Plan
NASA Research Park
Moffett Field, California

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
CN	50487 12.12		9/01	

50487196.DWG 1.0
20020124.1219
PLATE
7



EXPLANATION

- Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
- Buildings requiring soil removal
- Buildings with potential for lead based paint (pre-1978 buildings not sampled)
- No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use (Note 1)
- Station name (Note 2)
 Sample Type (XRF/LAB)

A3-26-2	LAB
Lead	460

 Concentration of lead (mg/kg)
- Parcel Number
- Parcel Boundary
- Area Boundary

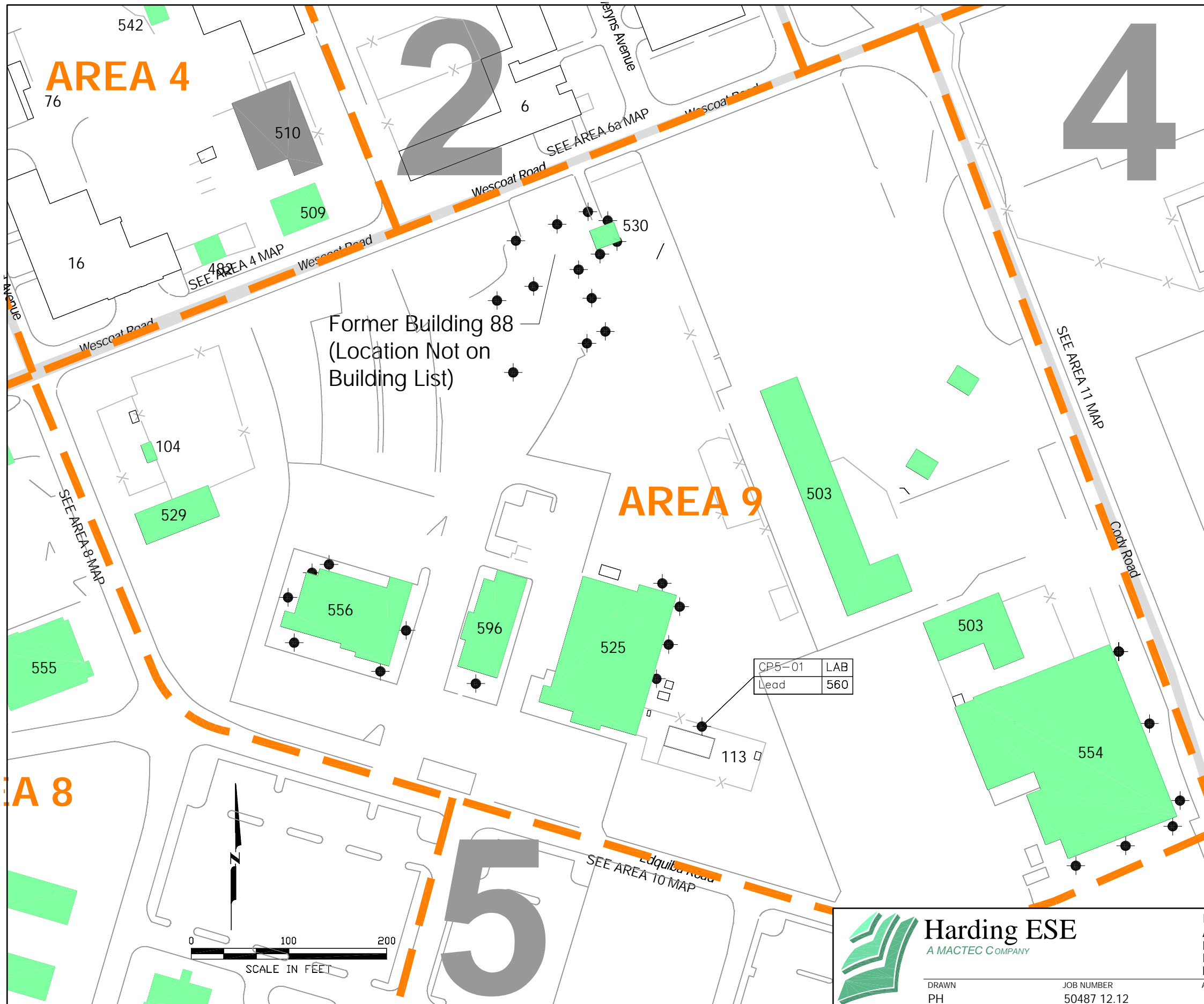
- NOTES: 1. Buildings surrounded by concrete were not included in sampling plan and are shown as green.
2. If the sample location symbol is present with no analytical results, the samples had lead less than 200 mg/kg.

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Lead Sample Results
 Area 8 - Parcel 5
 Lead Sampling and Removal Action Work Plan
 NASA Research Park
 Moffett Field, California

DRAWN PH	JOB NUMBER 50487 12.12	APPROVED	DATE 9/01	REVISED DATE
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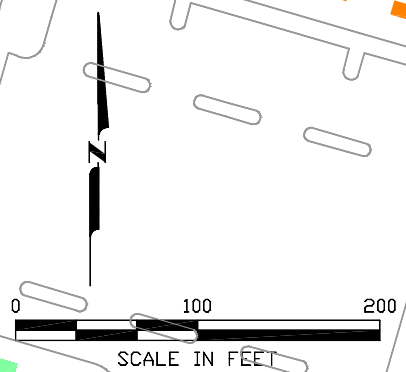
50487197.DWG 1.0
20020124.1233



EXPLANATION

- Sample locations (CWMI, 1993; Weston, 1998 PAI, 2001a), all locations approximate
- Buildings requiring soil removal
- Buildings with potential for lead based paint (pre-1978 buildings not sampled)
- No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use (Note 1)
- Station name (Note 2)
Sample Type (XRF/LAB)
Concentration of lead (mg/kg)
- Parcel Number
- Parcel Boundary
- Area Boundary

- NOTES: 1. Buildings surrounded by concrete were not included in sampling plan and are shown as green.
2. If the sample location symbol is present with no analytical results, the samples had lead less than 200 mg/kg.



CP5-01	LAB
Lead	560

A3-26-2	LAB
Lead	460



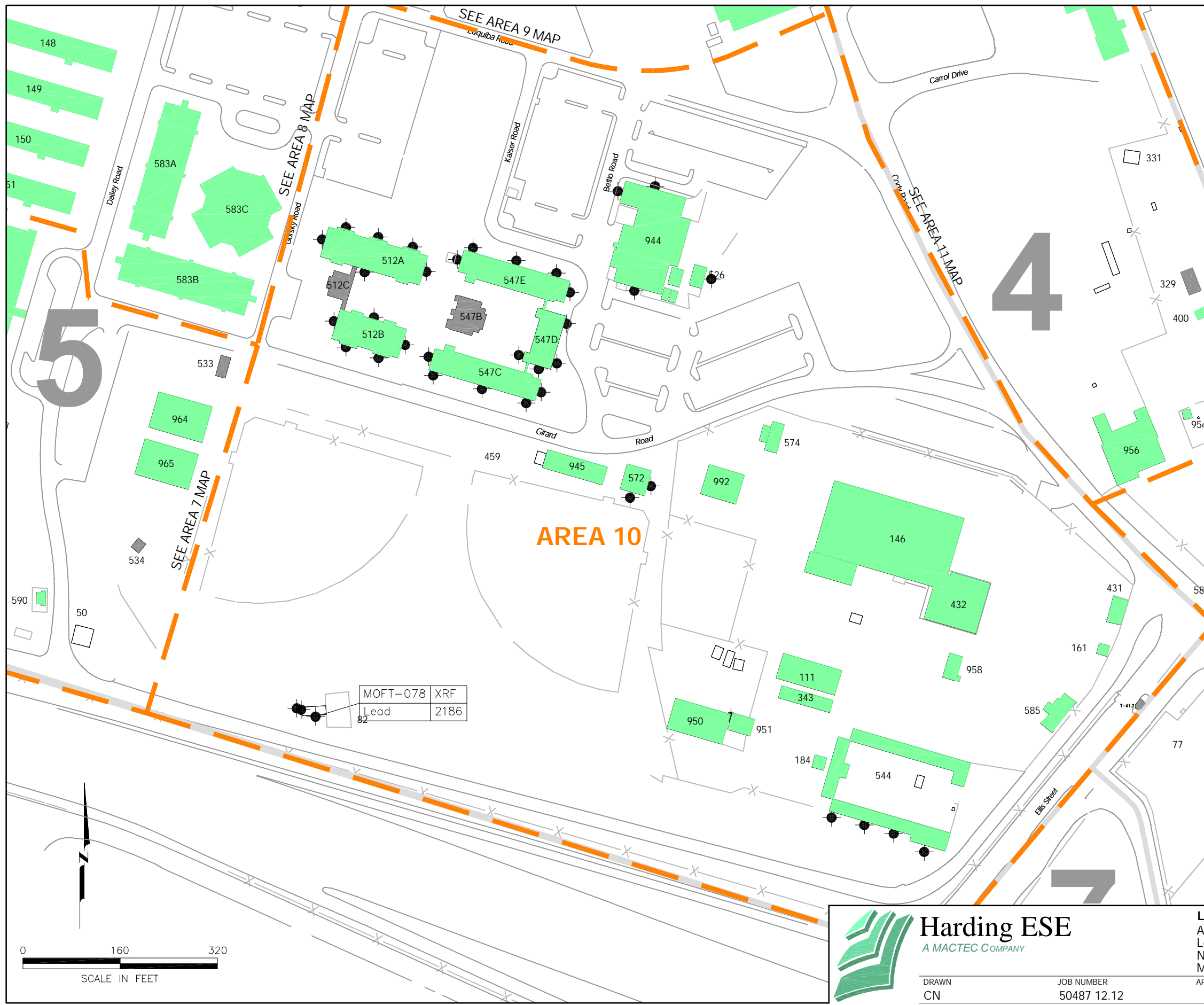
Lead Sample Results
 Area 9 - Parcel 5
 Lead Sampling and Removal Action Work Plan
 NASA Research Park
 Moffett Field, California

DRAWN PH	JOB NUMBER 50487 12.12	APPROVED	DATE 9/01	REVISED DATE
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20020304.0839

PLATE

9



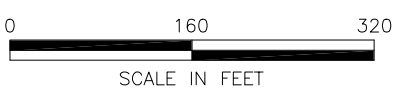
EXPLANATION

- Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
- Buildings requiring soil removal
- Buildings with potential for lead based paint (pre-1978 buildings not sampled)
- No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use (Note 1)
- Station name (Note 2)
- Sample Type (XRF/LAB)
- Concentration of lead (mg/kg)
- Parcel Number
- Parcel Boundary
- Area Boundary

NOTES: 1. Buildings surrounded by concrete were not included in sampling plan and are shown as green.
 2. If the sample location symbol is present with no analytical results, the samples had lead less than 200 mg/kg.

MOFT-078	XRF
Lead	2186

A3-26-2	LAB
Lead	460

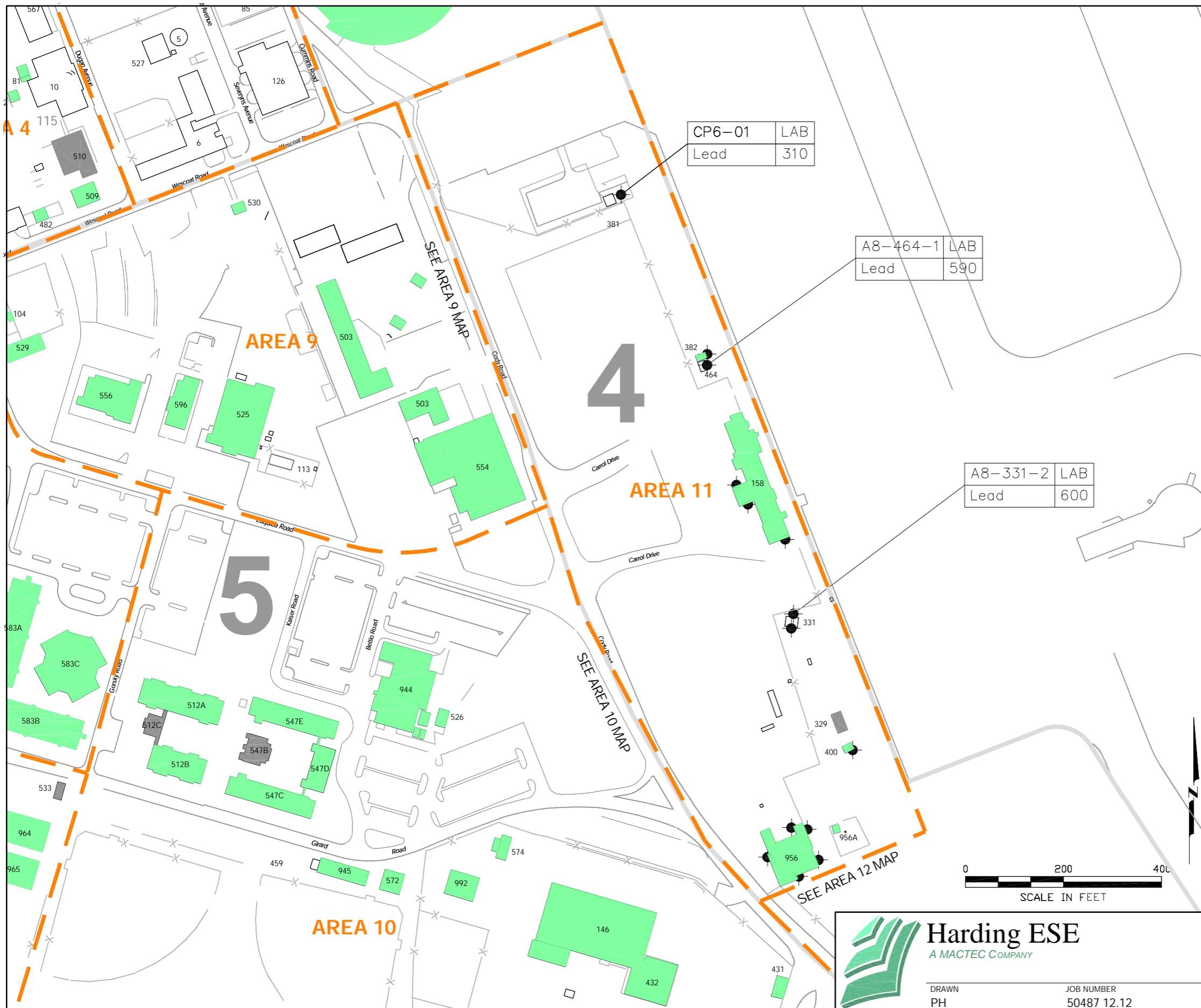


Lead Sample Results
 Area 10 - Parcel 5
 Lead Sampling and Removal Action Work Plan
 NASA Research Park
 Moffett Field, California

DRAWN CN	JOB NUMBER 50487 12.12	APPROVED	DATE 9/01	REVISED DATE
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50487194.DWG 1.0
 20020124.1232
 PLATE

10



CP6-01	LAB
Lead	310

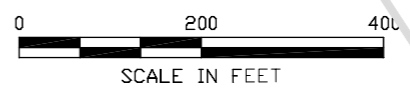
A8-464-1	LAB
Lead	590

A8-331-2	LAB
Lead	600

EXPLANATION

- Sample locations (CWMI, 1993; Weston, 1998 PAI,2001b), all locations approximate
- Buildings requiring soil removal
- Buildings with potential for lead based paint (pre-1978 buildings not sampled)
- No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use (Note 1)
- Station name (Note 2)
- Sample Type (XRF/LAB)
- Concentration of lead (mg/kg)
- Parcel Number
- Parcel Boundary
- Area Boundary

NOTES: 1. Buildings surrounded by concrete were not included in sampling plan and are shown as green.
 2. If the sample location symbol is present with no analytical results, the samples had lead less than 200 mg/kg.



6

AREA 12 454

A4-454-3

A4-454-2

A4-454-1

EXPLANATION



Sample locations (CWMI, 1993; Weston, 1998), all locations approximate



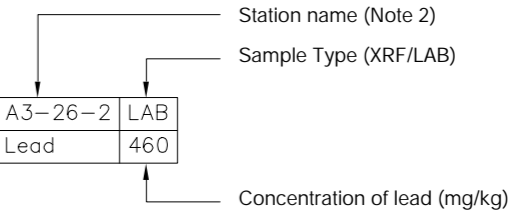
Buildings requiring soil removal



Buildings with potential for lead based paint (pre-1978 buildings not sampled)



No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use (Note 1)



1

Parcel Number

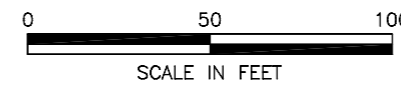


Parcel Boundary



Area Boundary

- NOTES: 1. Buildings surrounded by concrete were not included in sampling plan and are shown as green.
2. If the sample location symbol is present with no analytical results, the samples had lead less than 200 mg/kg.



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DRAWN
CN

JOB NUMBER
50487 12.12

APPROVED

DATE
9/01

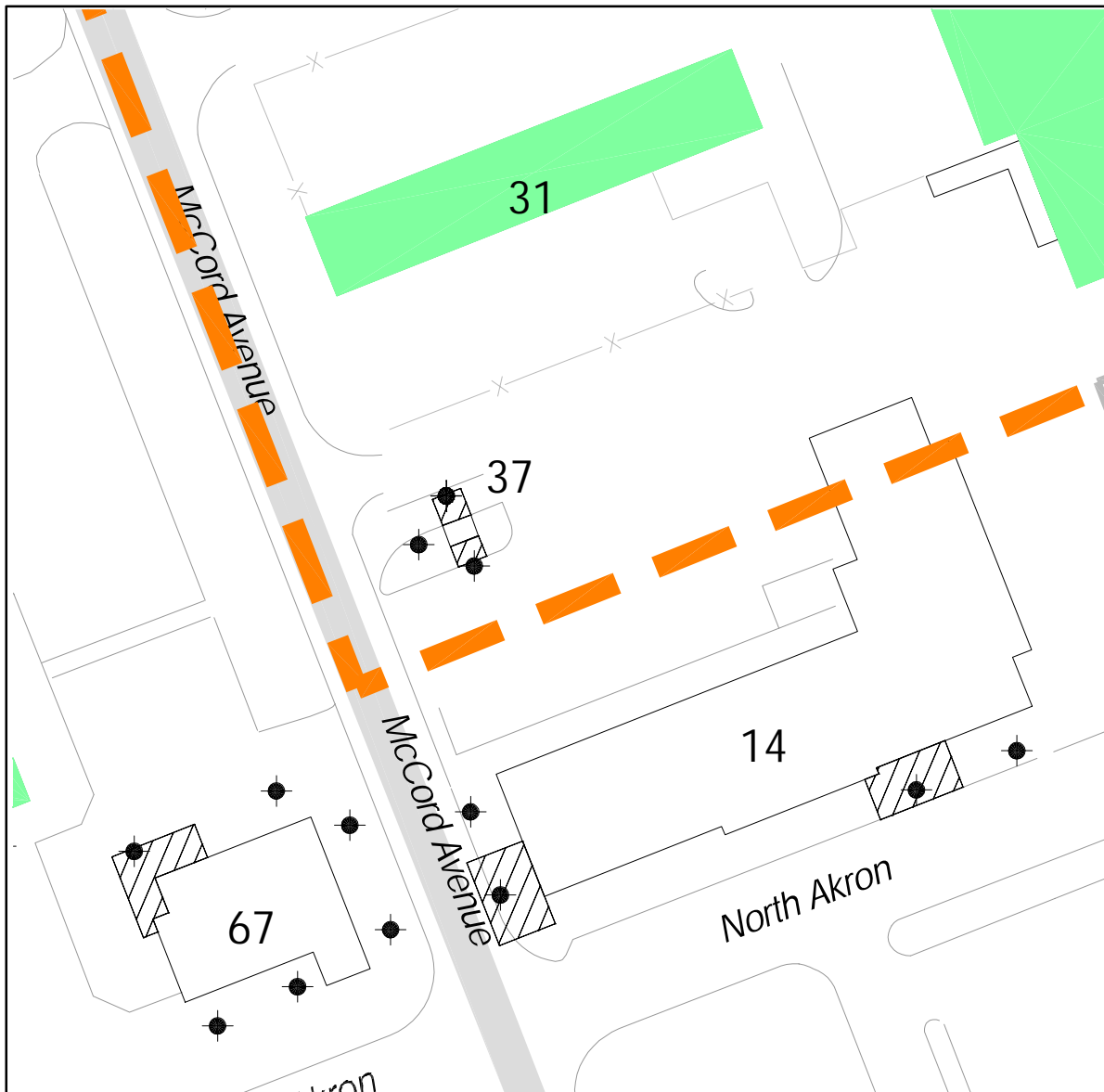
REVISED DATE



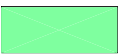



Lead Sample Results
Area 12 - Parcel 6
Lead Sampling and Removal Action Work and Plan
NASA Research Park
Moffett Field, California

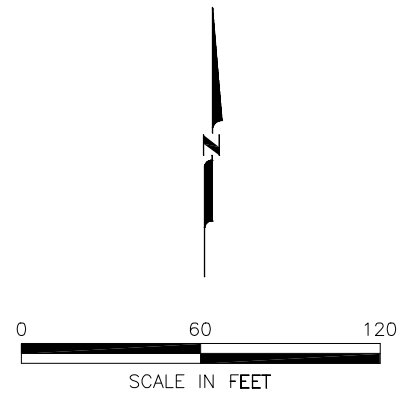
50487191.DWG
20020107.1252

PLATE

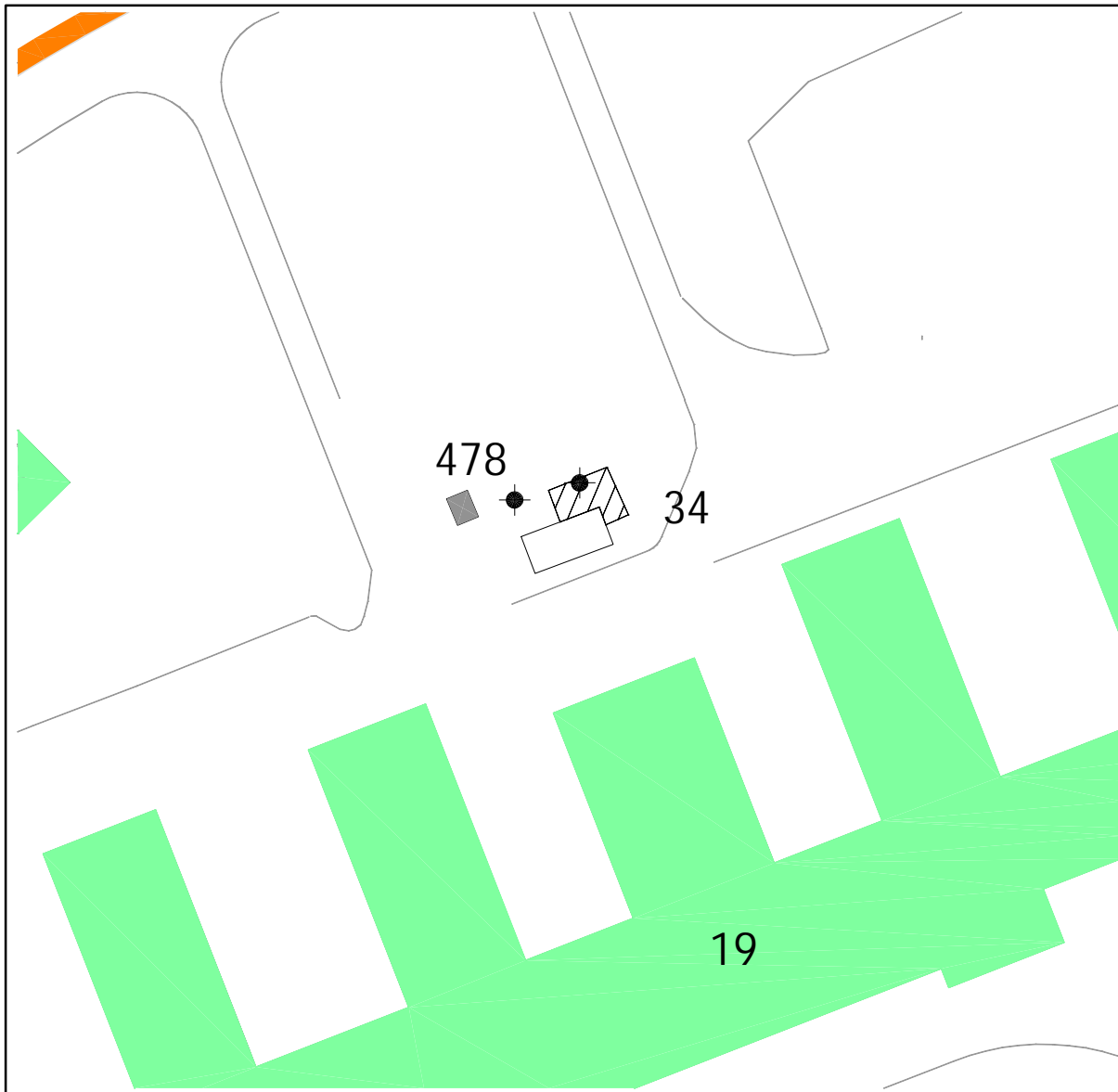
12






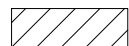


- EXPLANATION**
-  Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
 -  Buildings with potential for lead based paint (pre-1978 buildings not sampled)
 -  No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use.
 -  Approximate area to be excavated
 -  Parcel Boundary
 -  Area Boundary

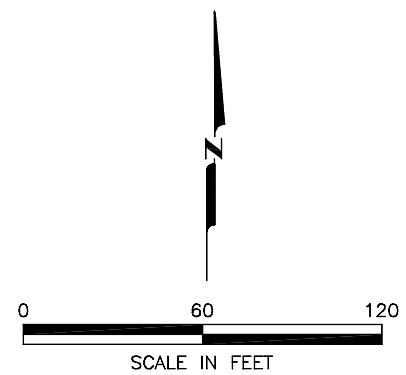


50487213.DWG
2002107.1311
1:0



EXPLANATION

-  Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
-  Buildings with potential for lead based paint (pre-1978 buildings not sampled)
-  No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use.
-  Approximate area to be excavated
-  Parcel Boundary
-  Area Boundary



50487214.DWG 1.0
2001105.1011



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A MACTEC COMPANY

Excavation/Sampling Plan
Buildings 34 and 478 (Area 1)
Lead Sampling and Removal Action Work Plan
NASA Research Park
Moffett Field, California

PLATE

14

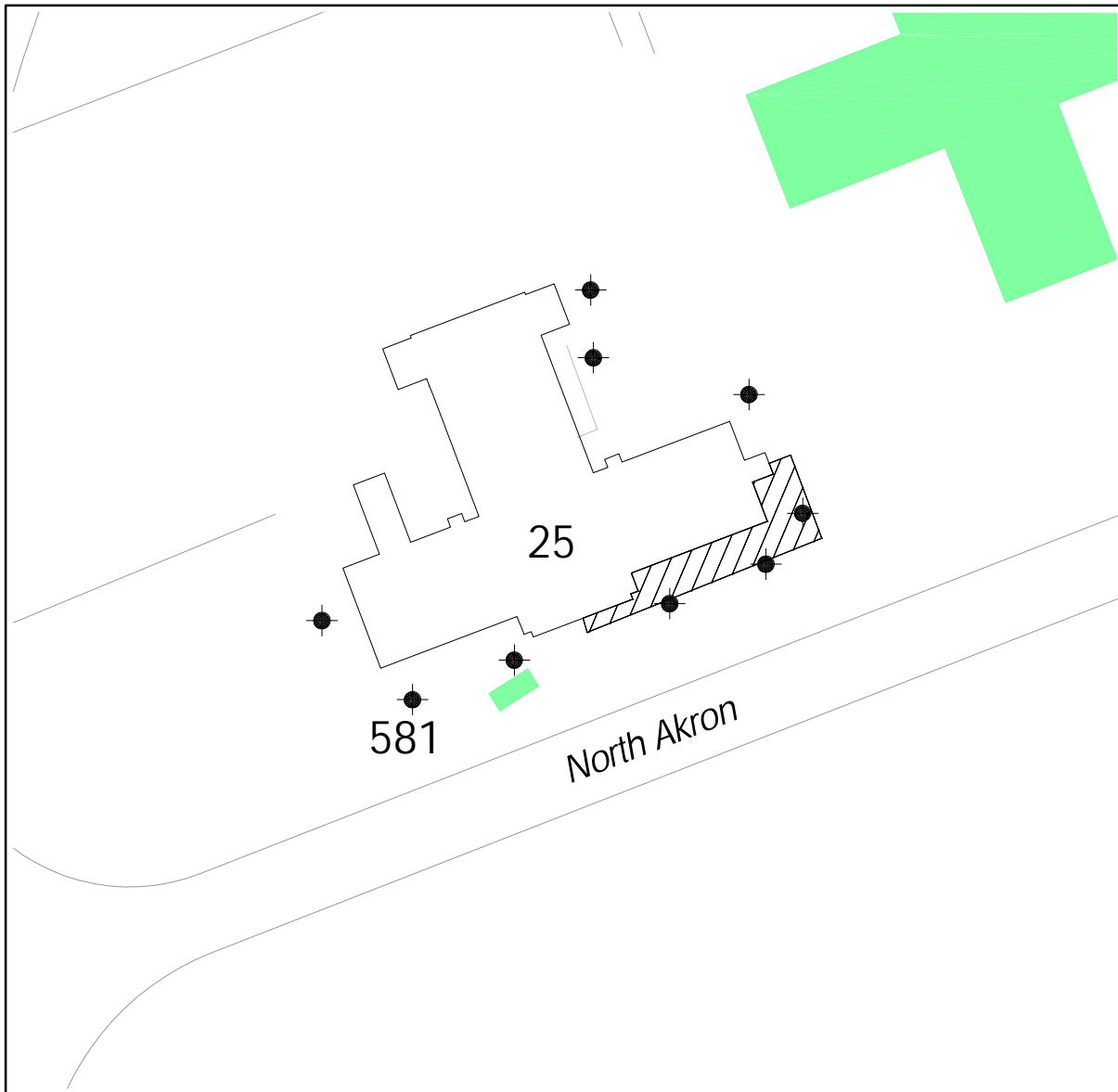
DRAWN
PH

JOB NUMBER
50487 12.12



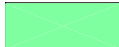
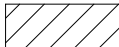


APPROVED

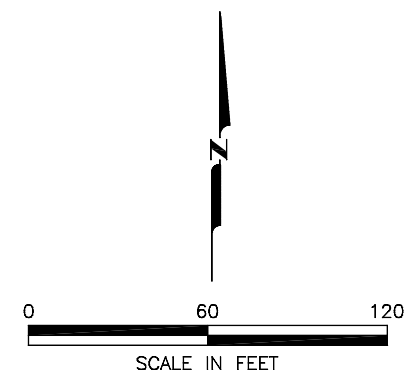
DATE
10/01

REVISED DATE

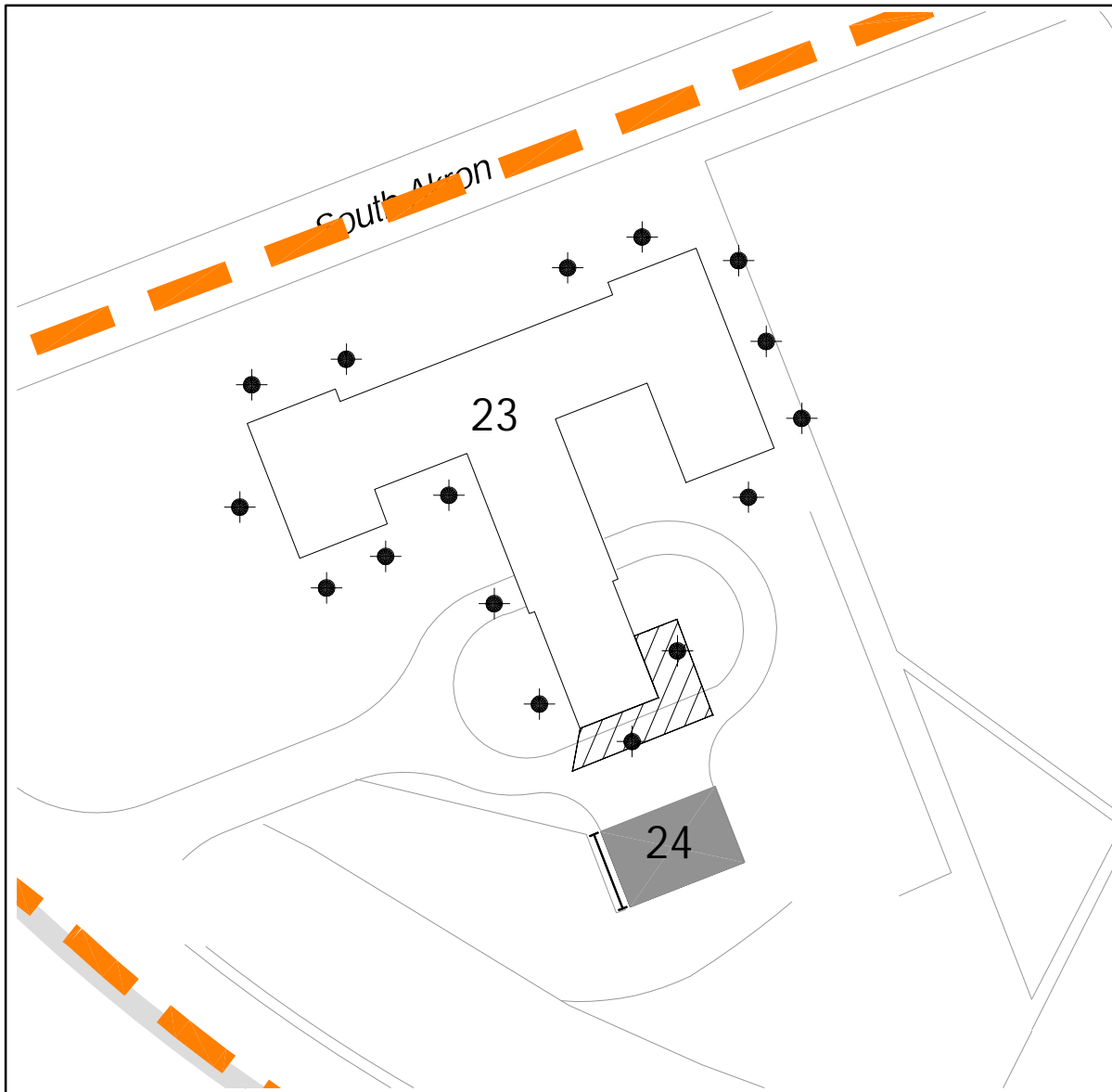


EXPLANATION



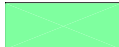
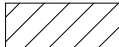



-  Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
-  Buildings with potential for lead based paint (pre-1978 buildings not sampled)
-  No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use.
-  Approximate area to be excavated
-  Parcel Boundary
-  Area Boundary

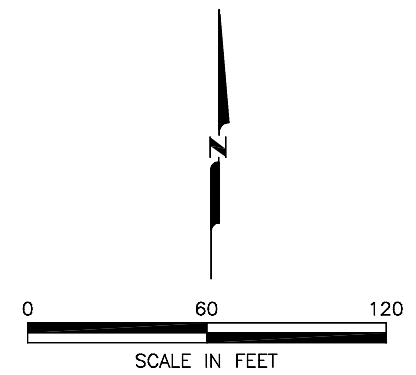


50487215.DWG
20020107.1324
1.0



EXPLANATION



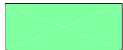
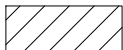


-  Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
-  Buildings with potential for lead based paint (pre-1978 buildings not sampled)
-  No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use.
-  Approximate area to be excavated
-  Sample Grid: Six samples to be collected within this cell and composited for analysis
-  Parcel Boundary
-  Area Boundary

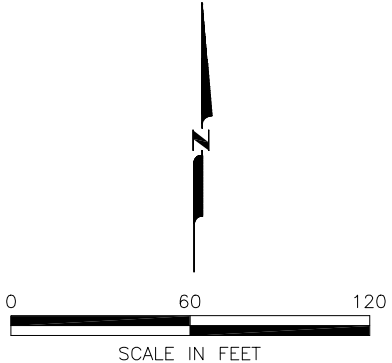


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20020107.1328

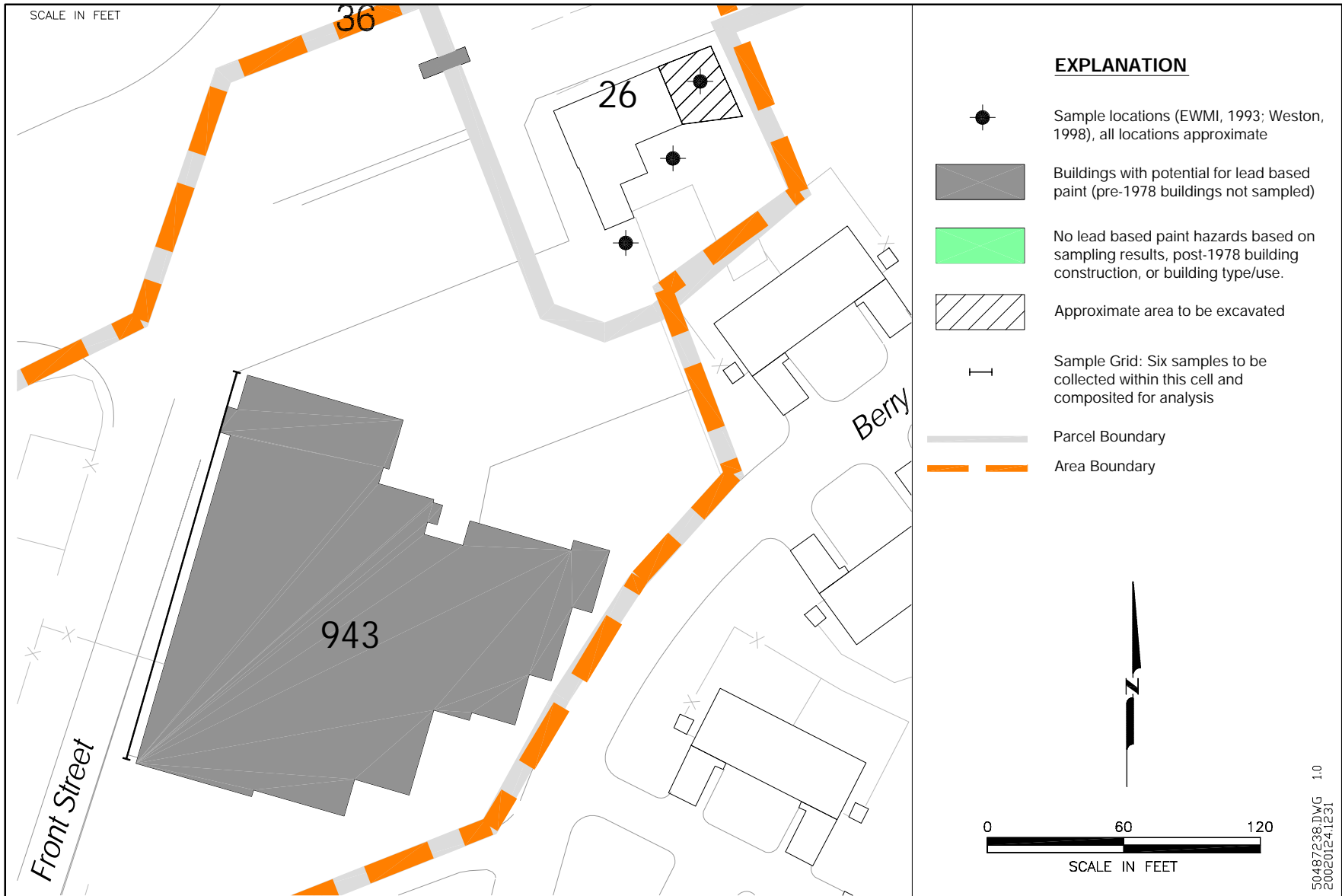


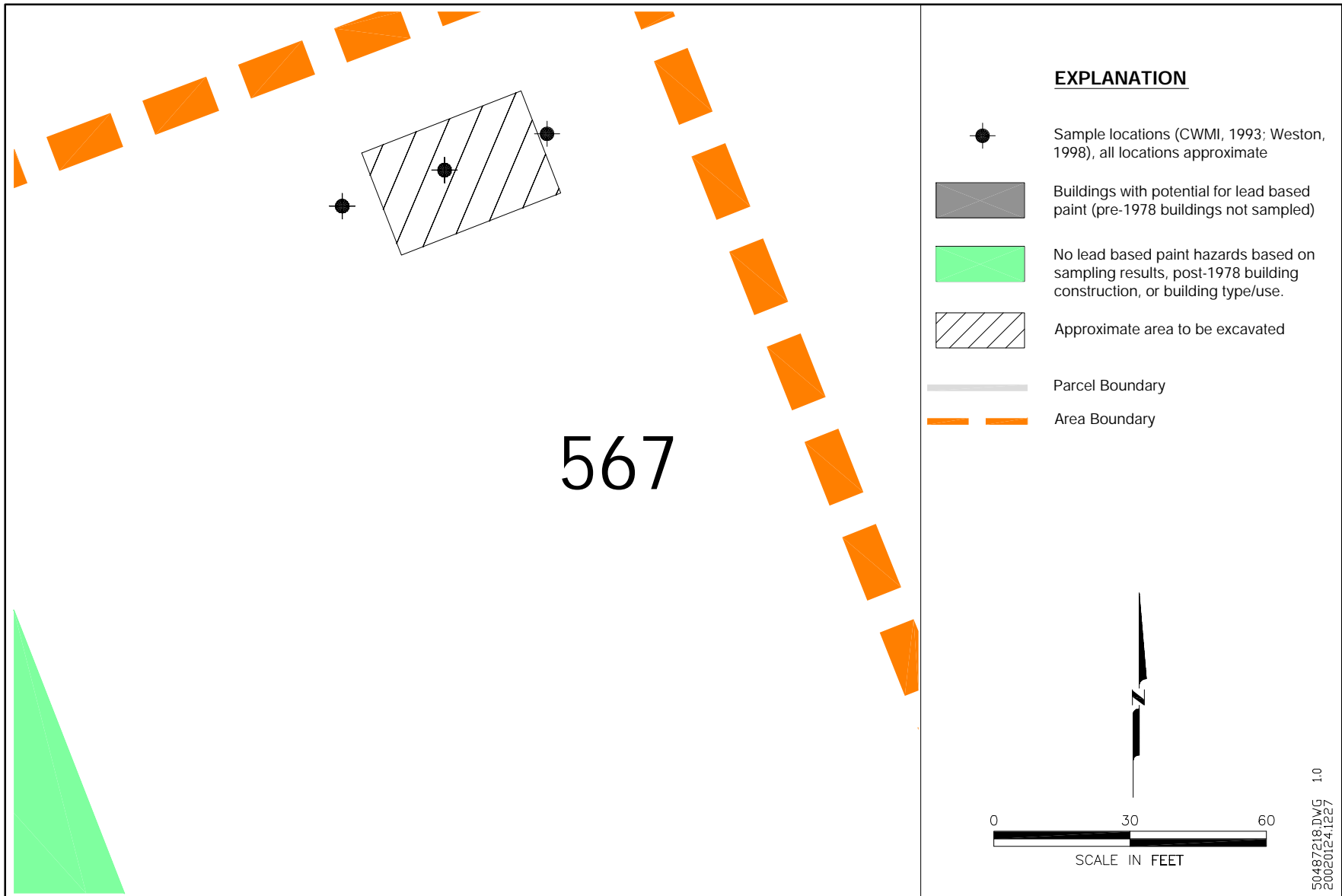
EXPLANATION

-  Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
-  Buildings with potential for lead based paint (pre-1978 buildings not sampled)
-  No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use.
-  Approximate area to be excavated
-  Parcel Boundary
-  Area Boundary





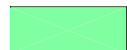




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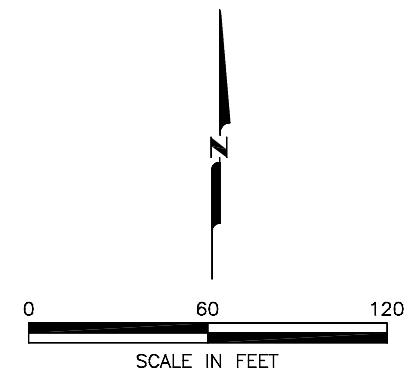




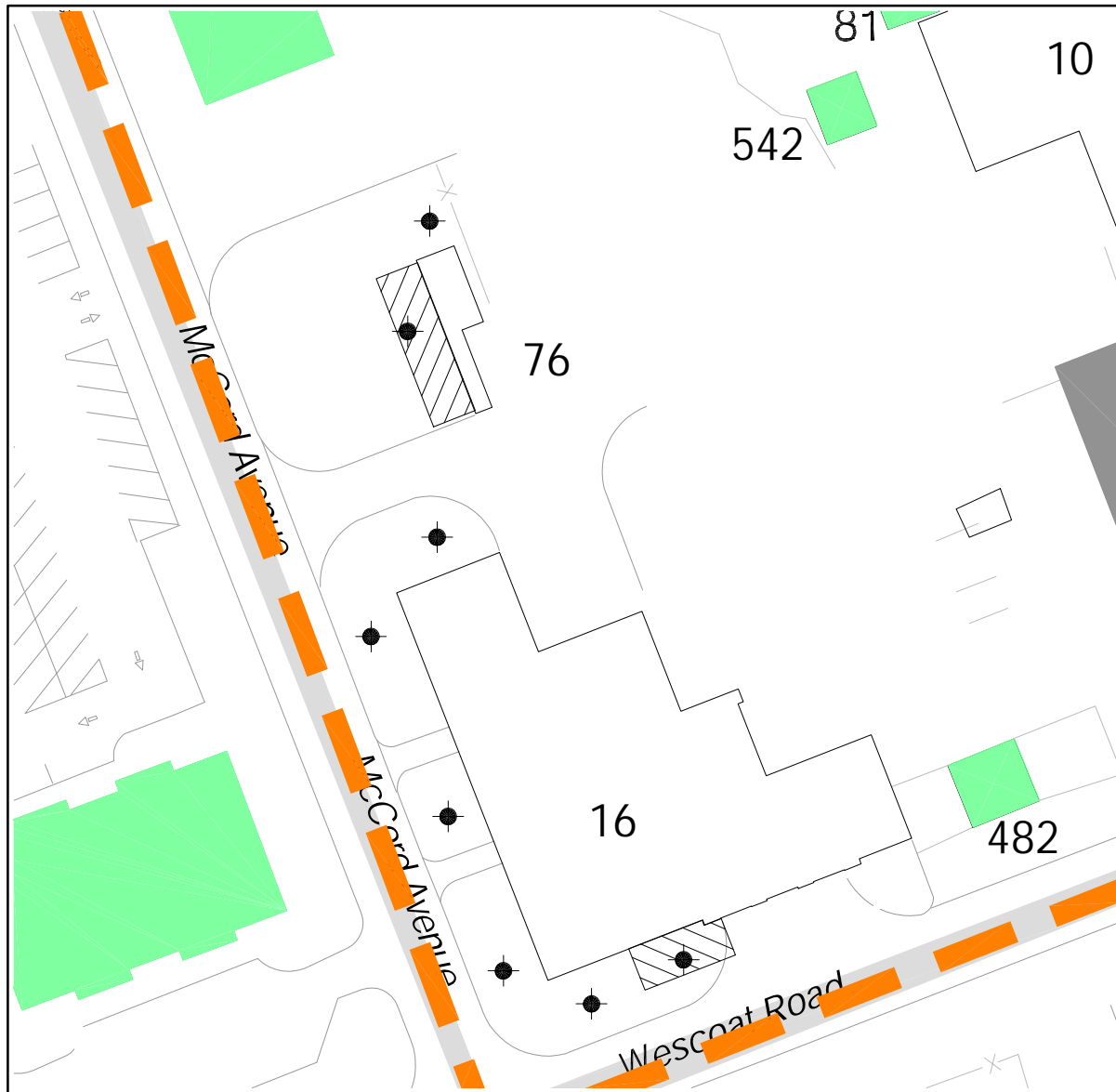




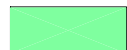



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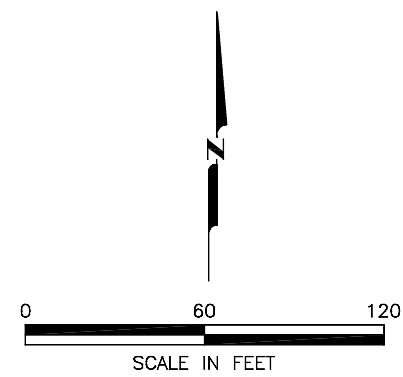
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-  Area Boundary



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 -  Parcel Boundary
 -  Area Boundary



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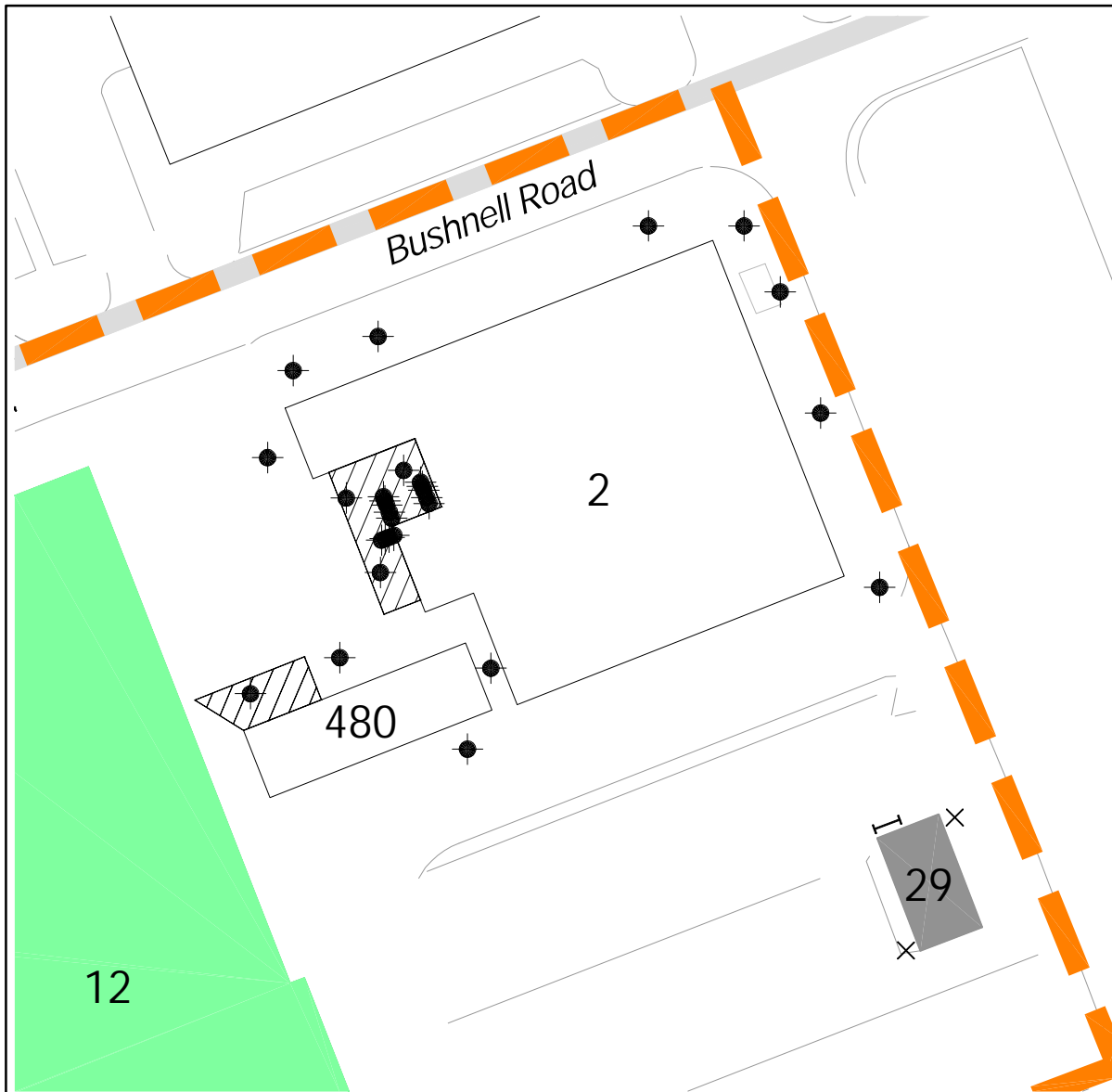


Excavation/Sampling Plan
 Buildings 16 and 76 (Area 4)
 Lead Sampling and Removal Action Work Plan
 NASA Research Park
 Moffett Field, California




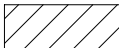




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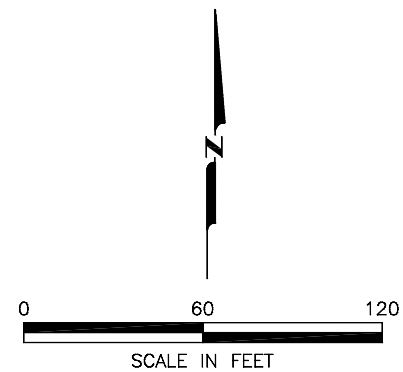
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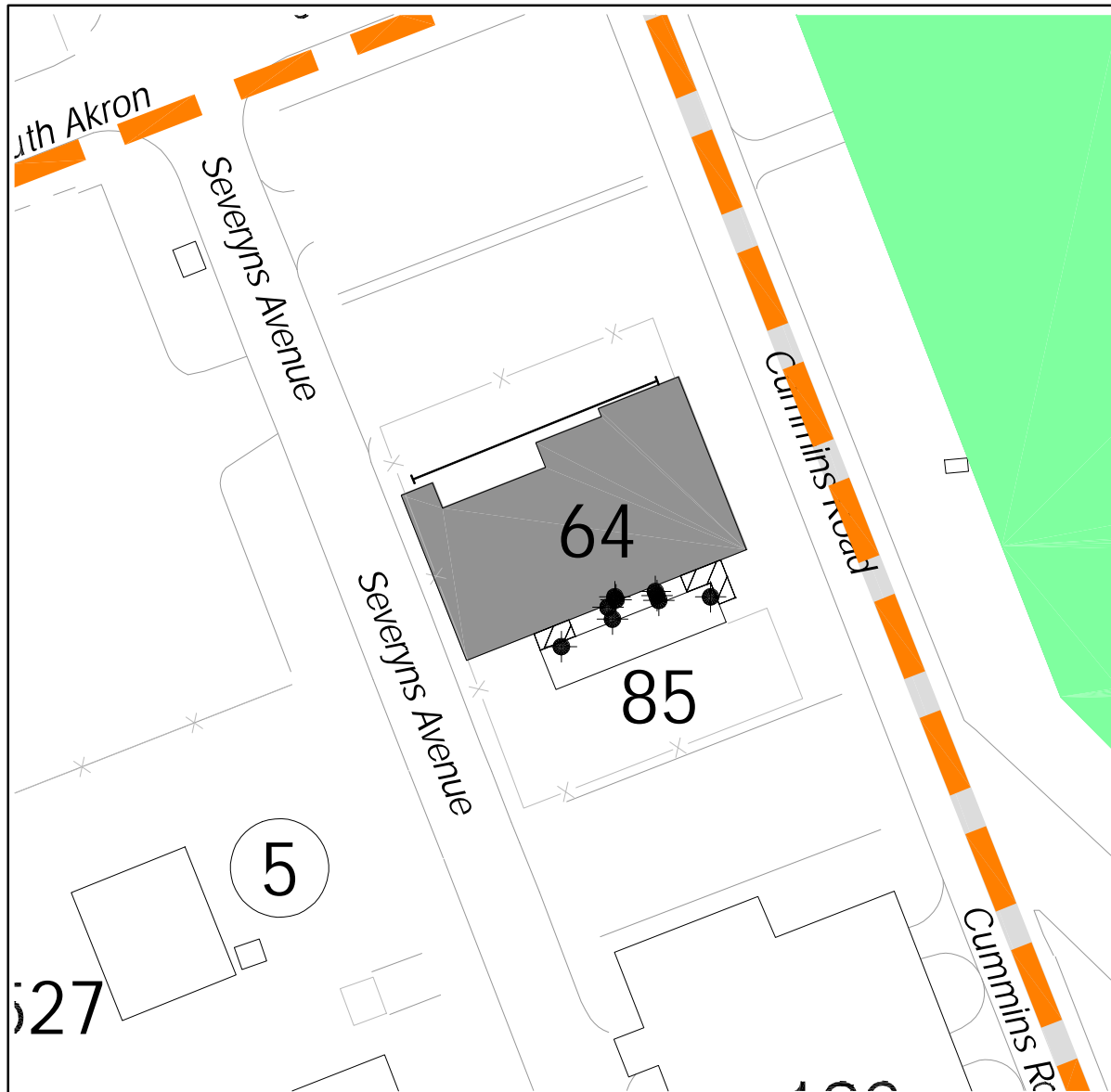





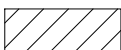



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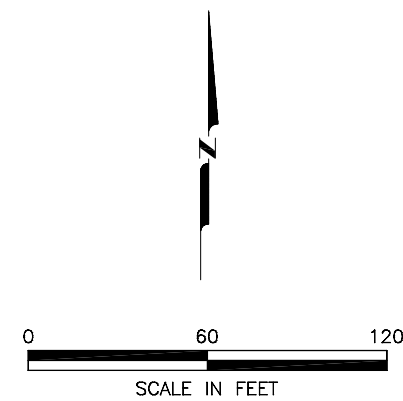
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-  Downspout Sample
-  Parcel Boundary
-  Area Boundary



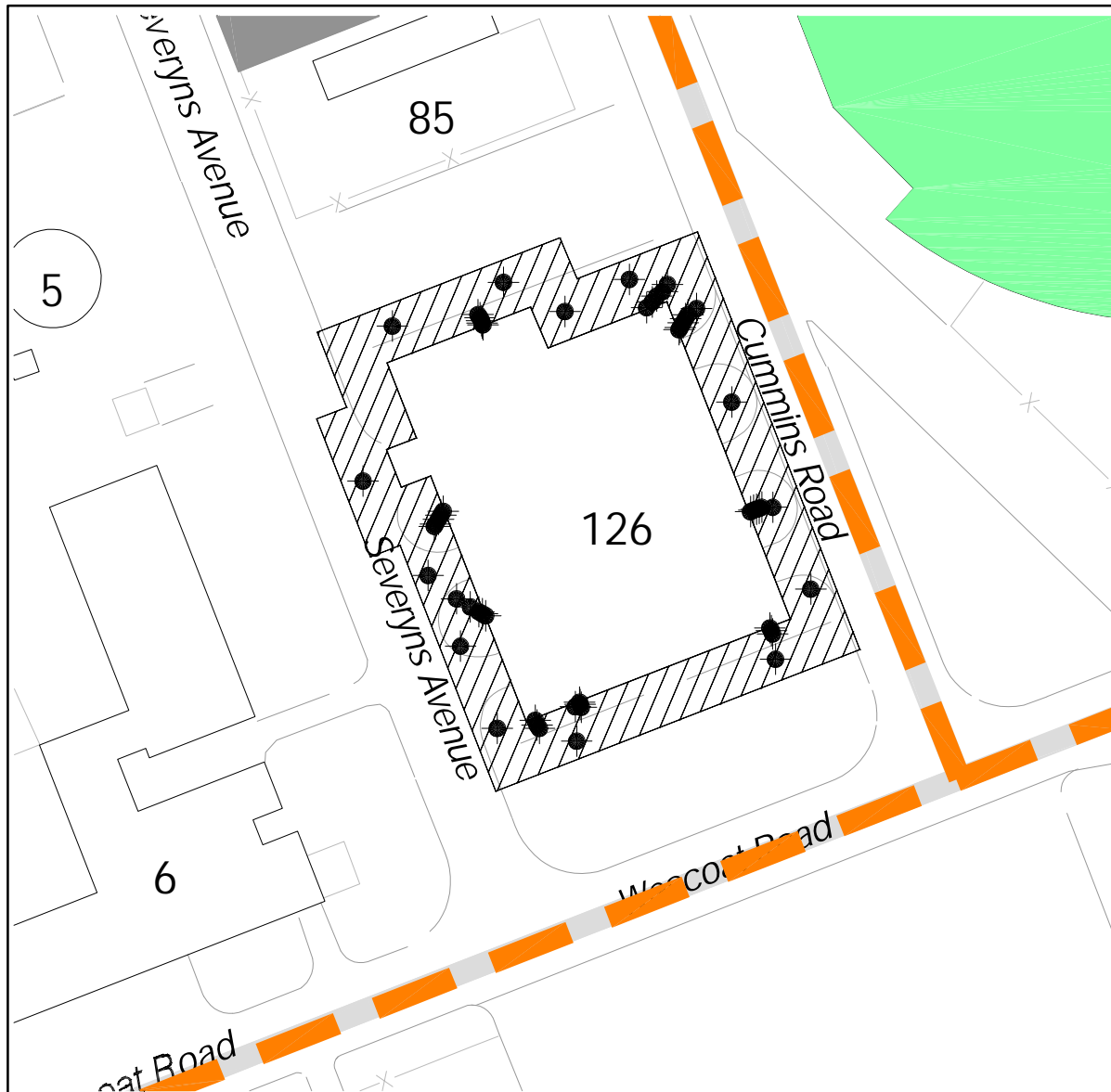
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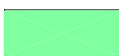
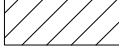


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 -  Parcel Boundary
 -  Area Boundary

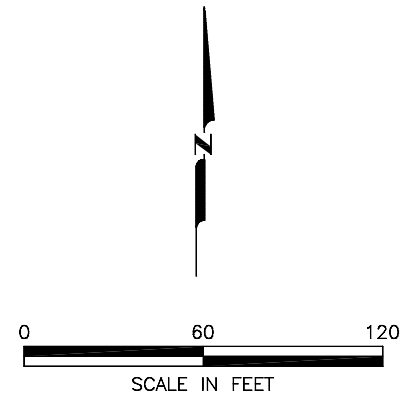


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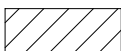


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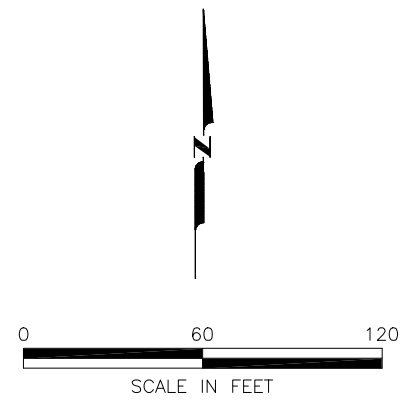
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-  Parcel Boundary
-  Area Boundary



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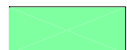



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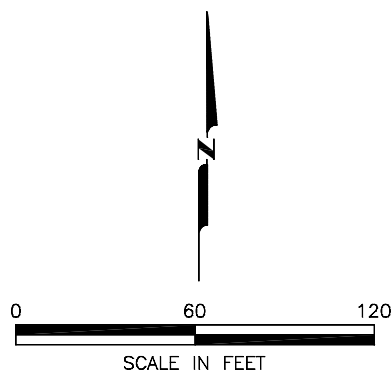


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-  Area Boundary



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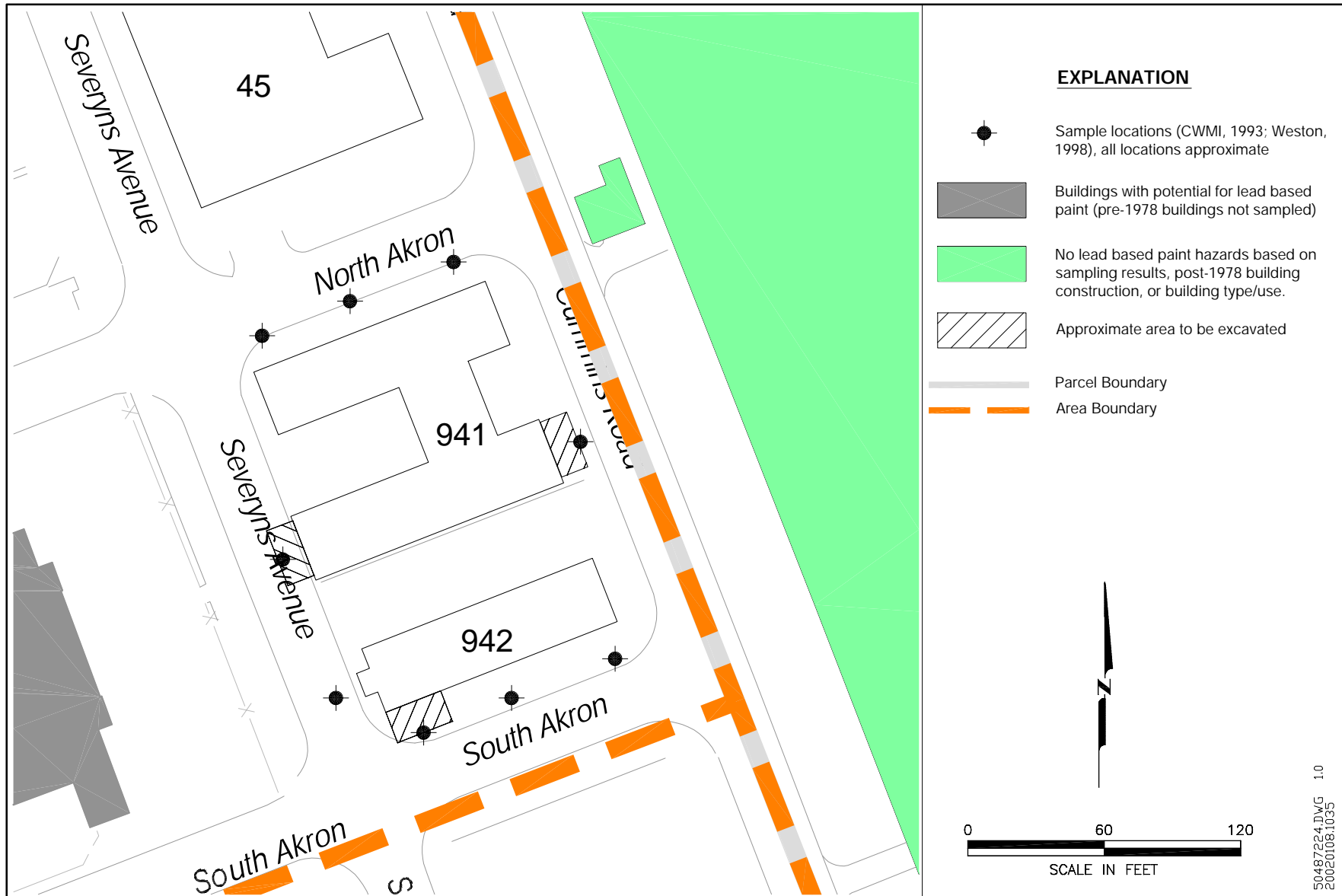


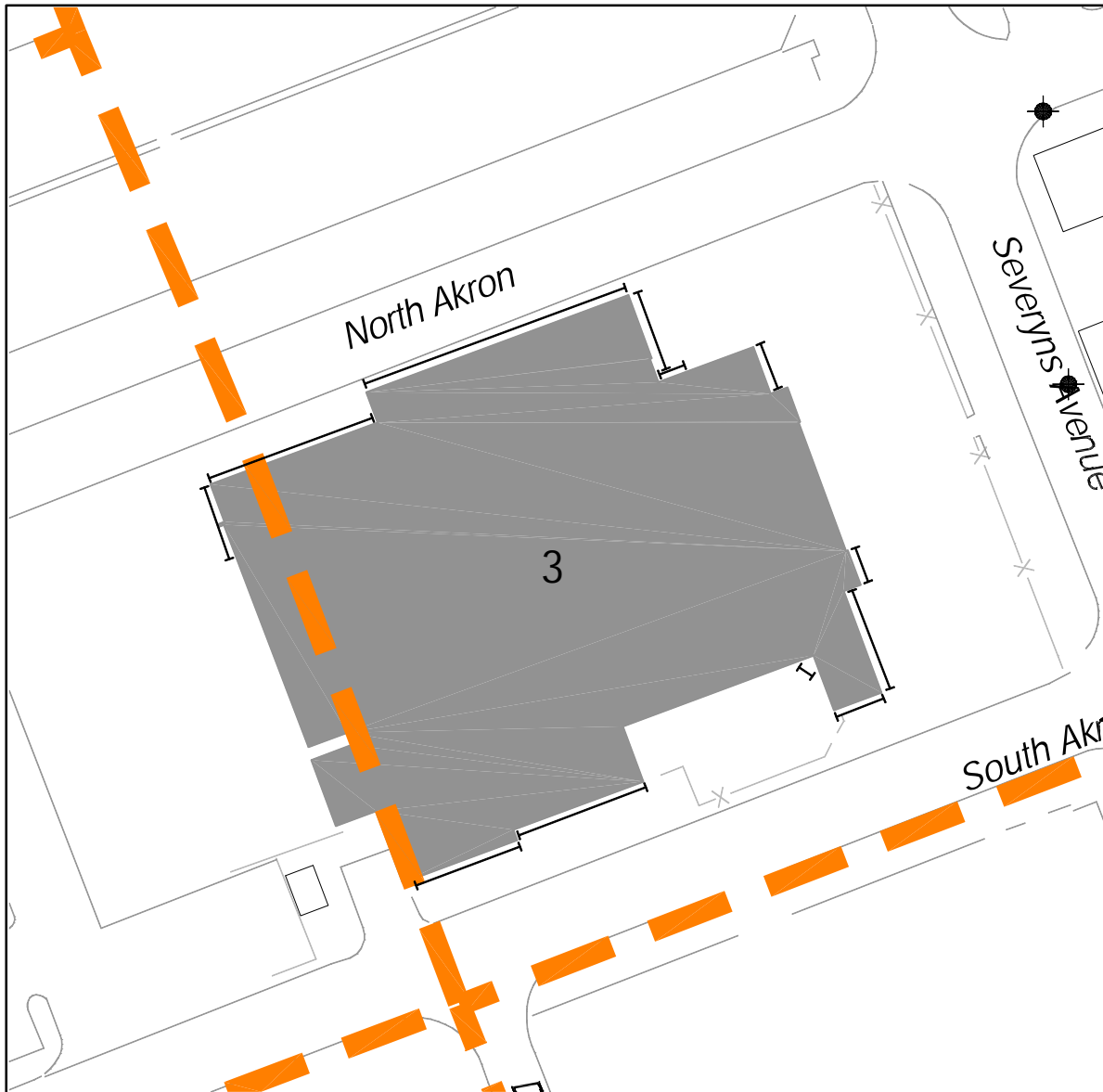
Excavation/Sampling Plan
 Building 45 (Area 6b)
 Lead Sampling and Removal Action Work Plan
 NASA Research Park
 Moffett Field, California

PLATE




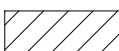



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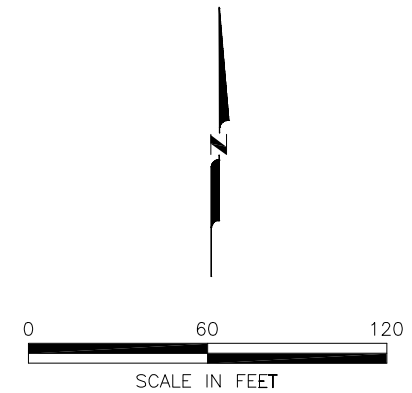
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EXPLANATION








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-  Area Boundary

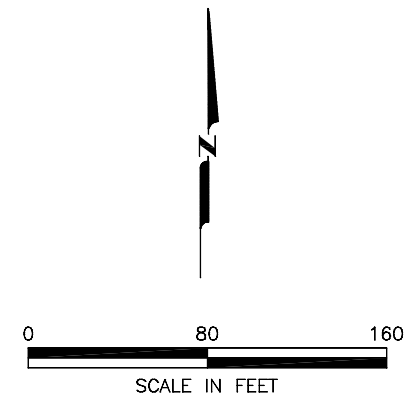


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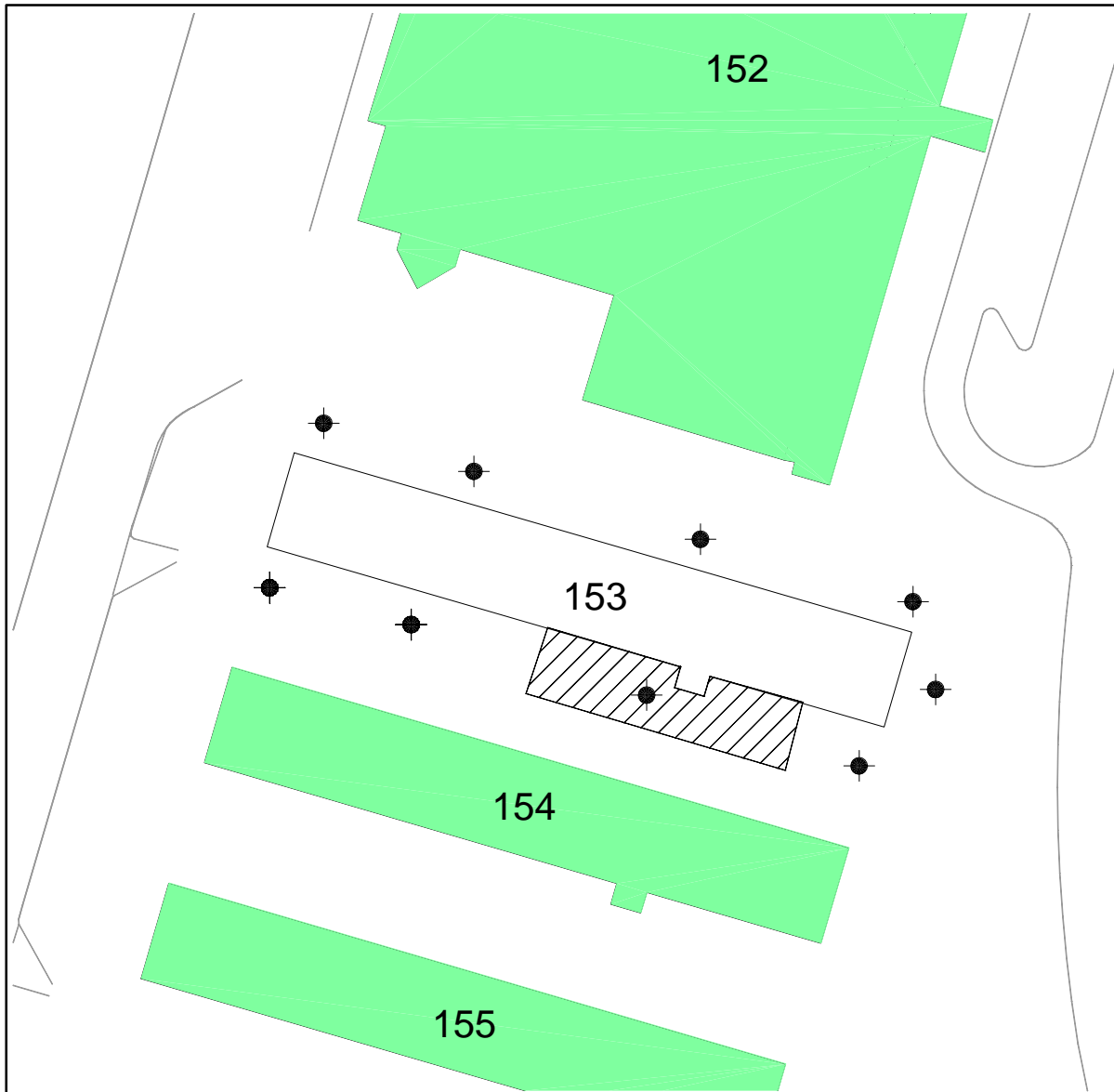


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-  Area Boundary

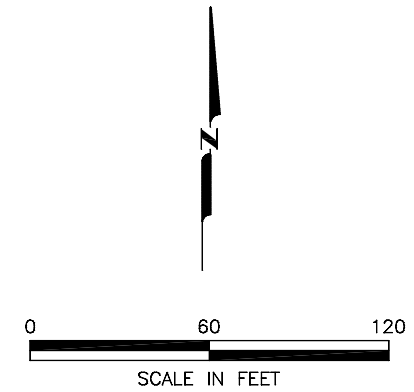


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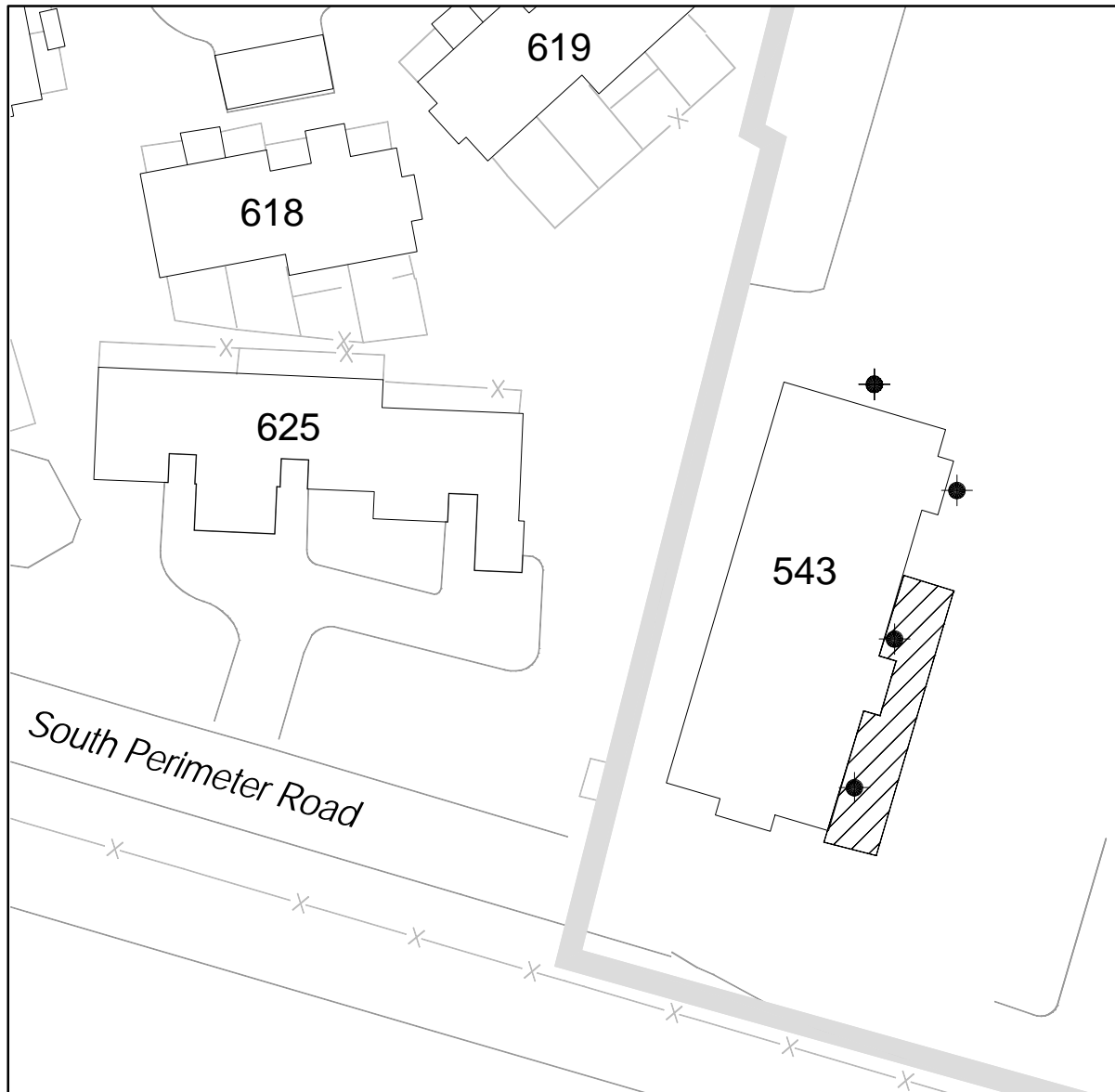


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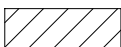


-  Sample locations (CWMI, 1993; Weston, 1998), all locations approximate
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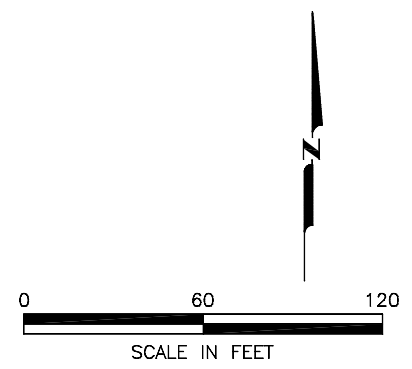


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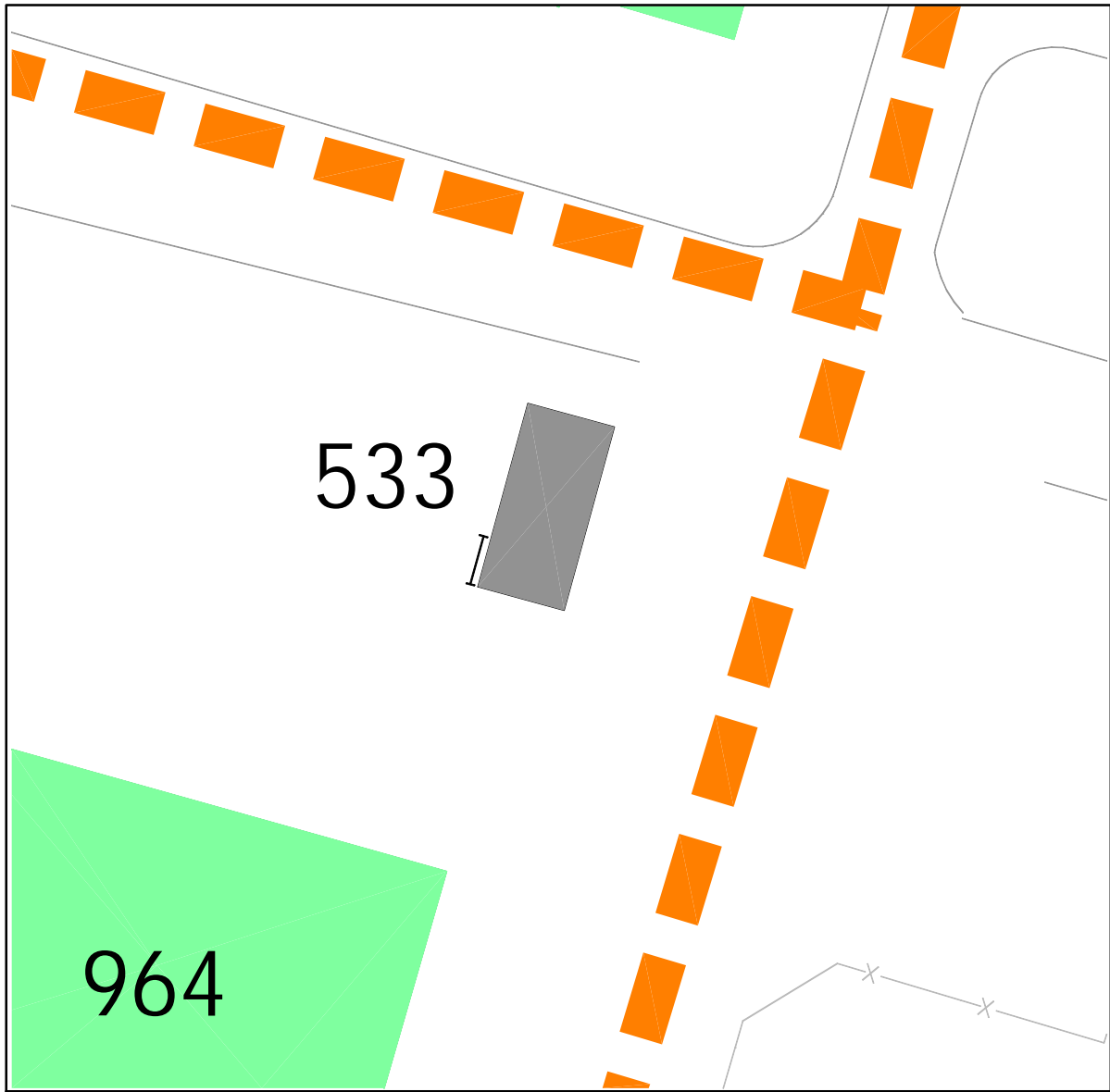


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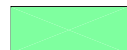




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-  Area Boundary

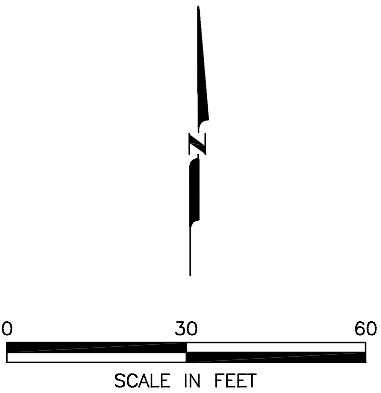


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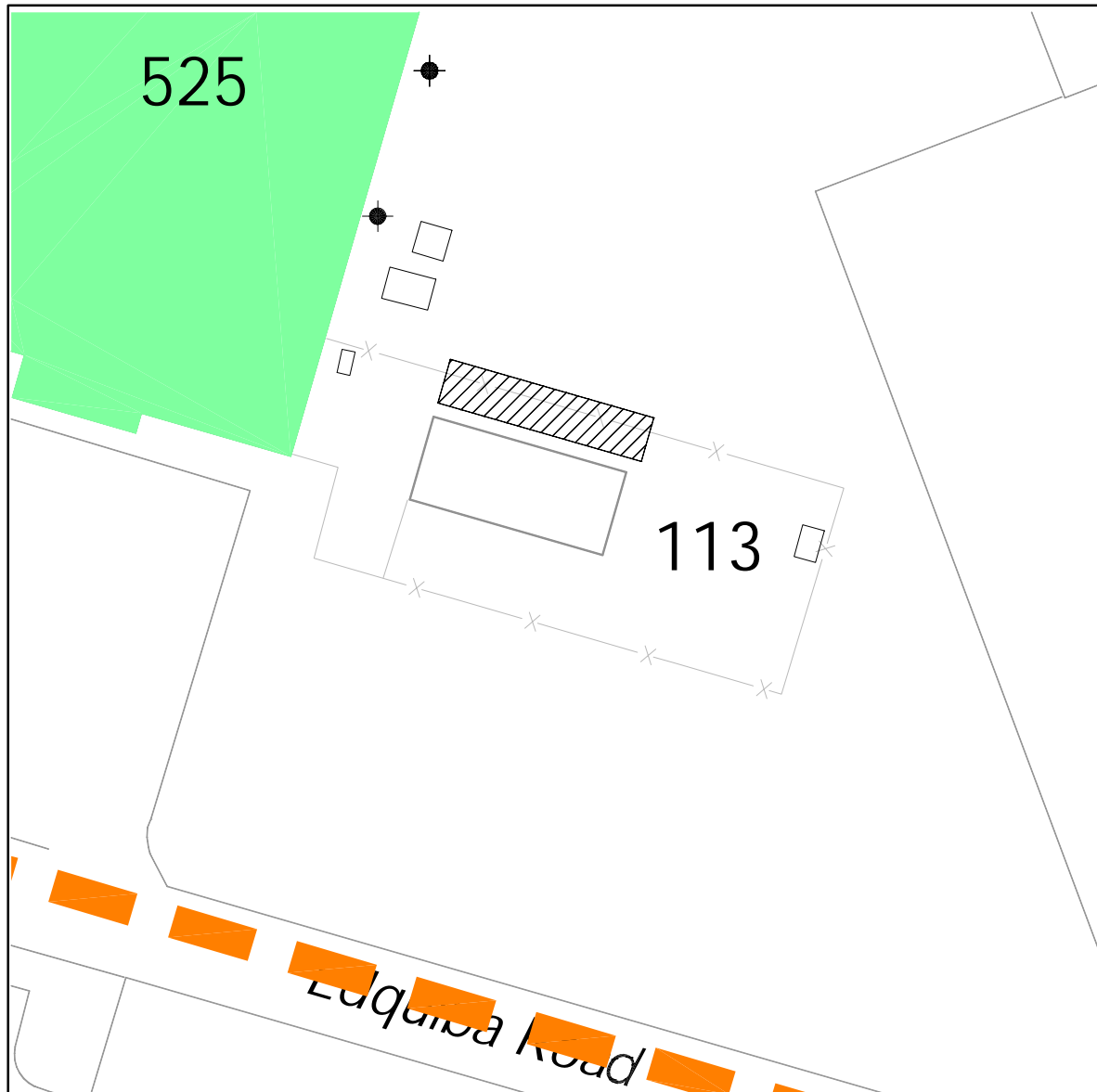


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-  Sample Grid: Six samples to be collected within this cell and composited for analysis
-  Parcel Boundary
-  Area Boundary

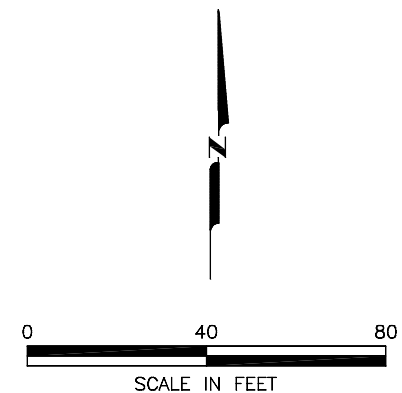


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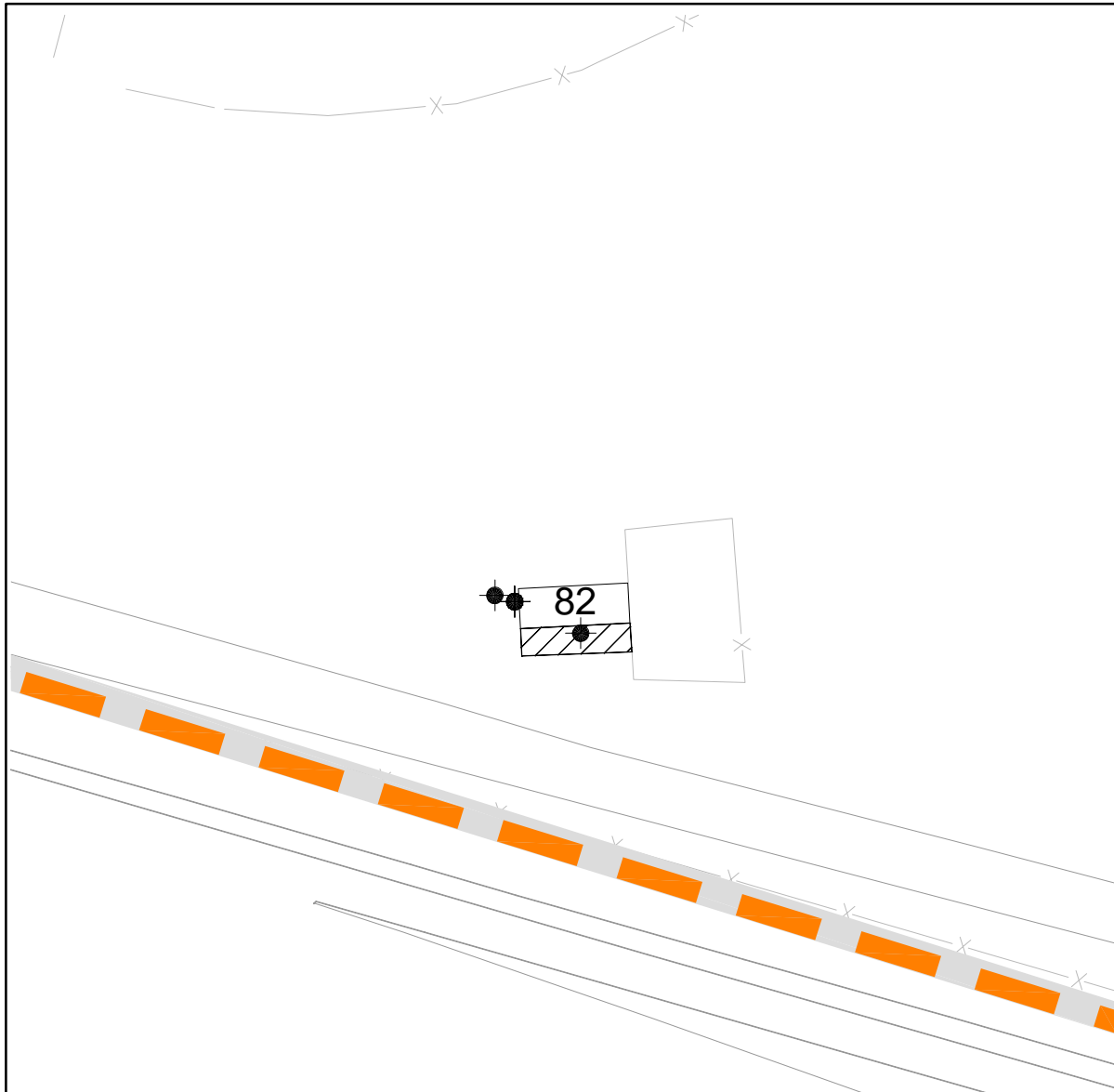


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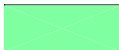



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-  Buildings with potential for lead based paint (pre-1978 buildings not sampled)
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-  Parcel Boundary
-  Area Boundary



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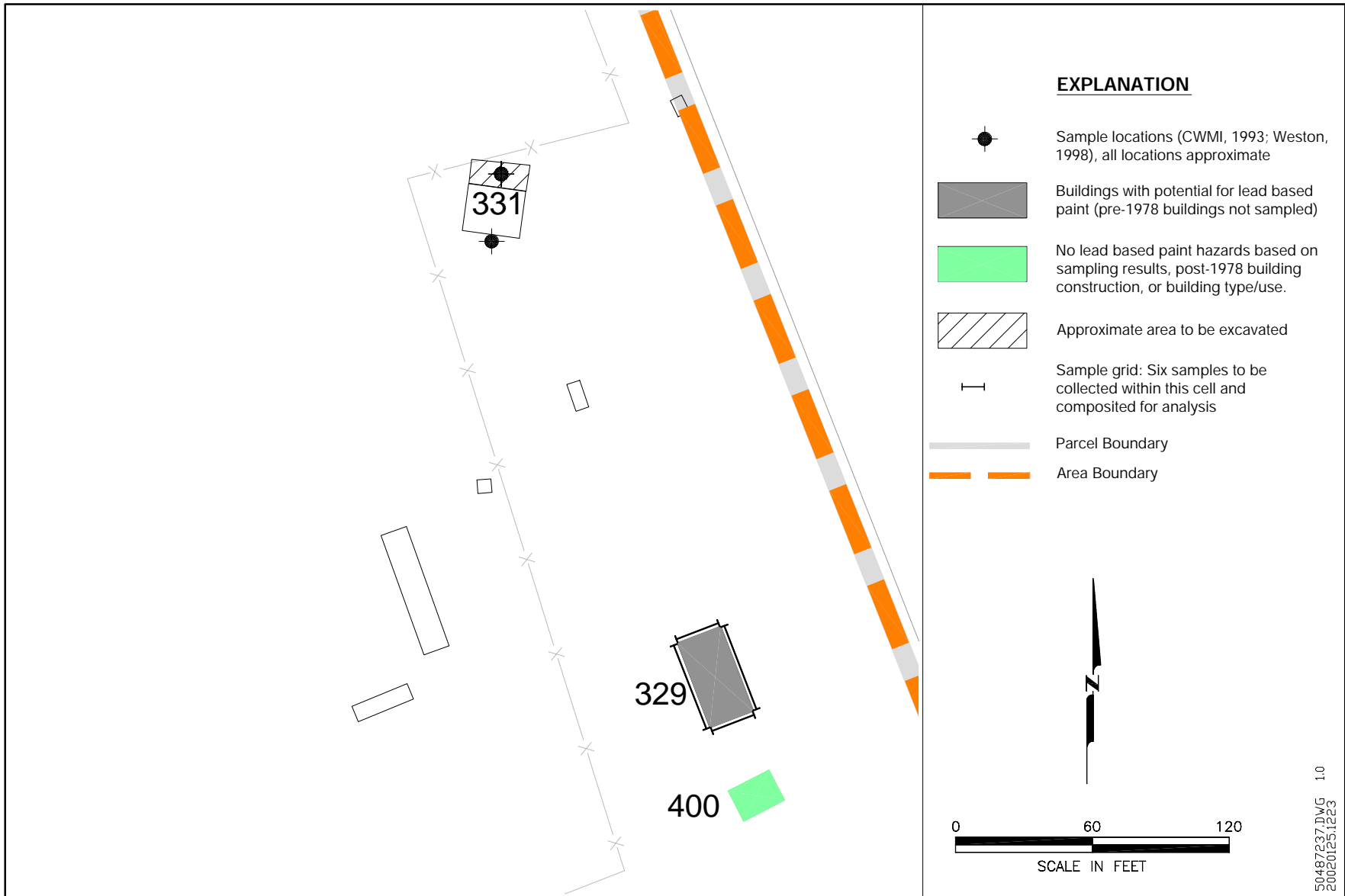


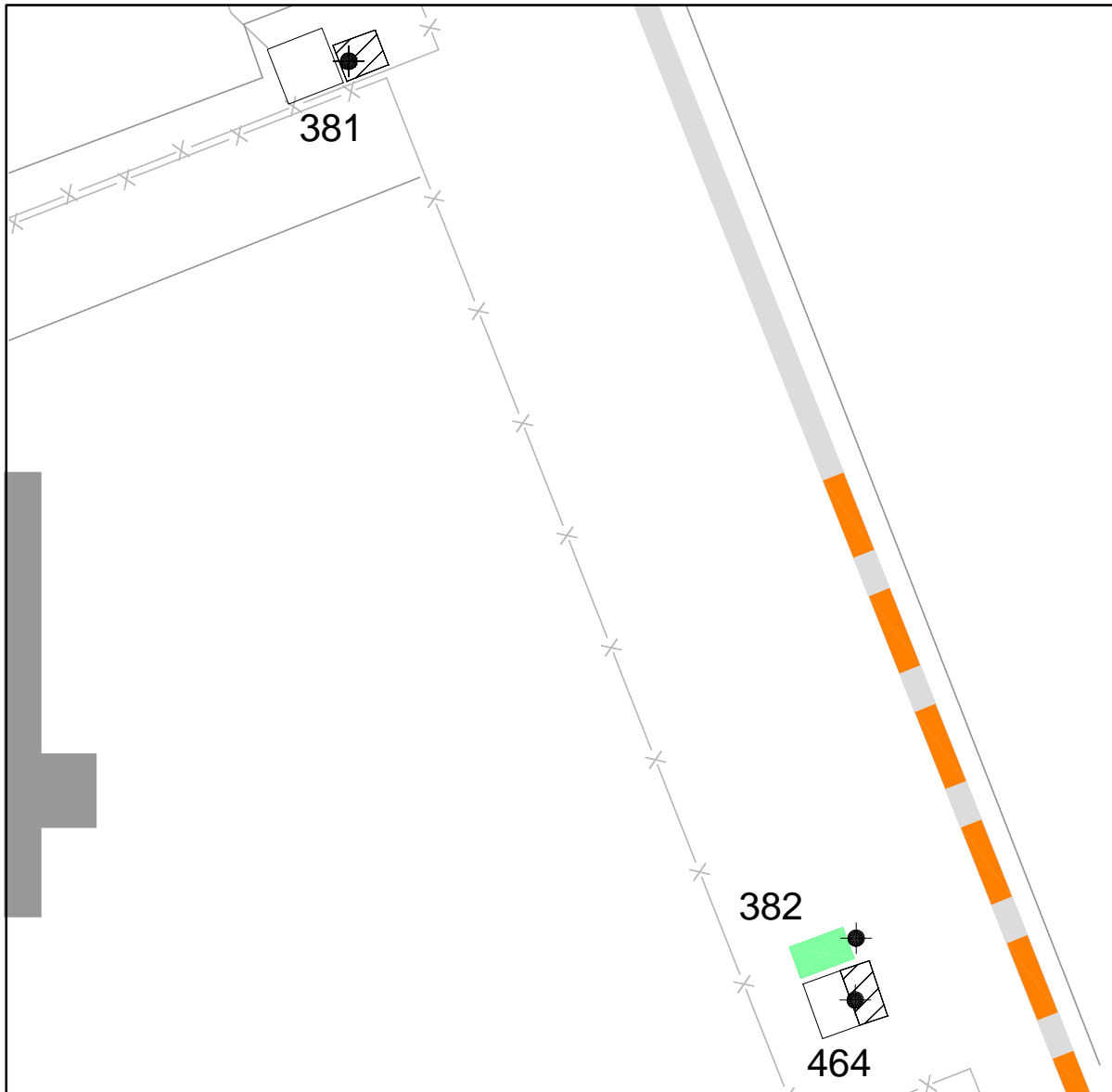
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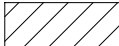




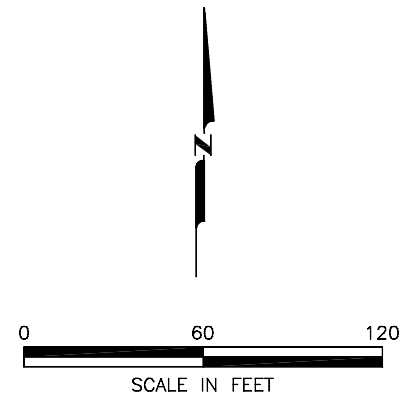
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-  No lead based paint hazards based on sampling results, post-1978 building construction, or building type/use.
-  Approximate area to be excavated
-  Parcel Boundary
-  Area Boundary



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APPENDIX A

SAMPLING AND ANALYSIS PLAN

CONTENTS

APPENDIX A

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APPENDIX A

SAMPLING AND ANALYSIS PLAN

The following is a Sampling and Analysis Plan (SAP) for the soil sampling and removal of lead-impacted soil at NRP in Moffett Field, California.

A1.0 Sample and Analysis Approach

An estimated 436 soil samples will be collected from the areas identified as suspect for LBP and for areas identified for removal, after lead-impacted soil has been removed. Section 5.1.1 summarizes the number of estimated samples for suspect LBP locations and Section 5.2.2 summarizes the estimated samples associated with confirmation sampling for lead-impacted soil removal. Composite samples will be submitted for laboratory analysis. Composite samples of the excavated soil will also be collected to properly characterize the soil for disposal. The following sections detail the sampling locations and sampling methods.

A2.0 Method Descriptions

Field methods are described in the following sections. All samples will be analyzed using a laboratory certified in the State of California.

A2.1 Sample Location Development

The goal is to collect a sufficient number of composite samples from each area previously identified with the potential to contain lead-impacted soil (initial soil lead assessments) and confirmation samples from areas identified for soil removal action after the excavation has occurred. For the initial soil lead assessments, the sampling grid will consist of six samples collected from a cell up to 30-feet long by 20-feet wide. All samples will be collected from 0 to 6 inches below the surface at the dripline or no more than 2-feet from the building wall if no dripline is apparent. A sample will be collected every 5-feet and the resulting six samples thoroughly mixed and composited in accordance with ASTM Standard D-6051-96 (*ASTM, 1996*). Confirmation sample locations will be selected on the basis of the size of the excavation, the location of previous exceedances, and the probable source of the lead.

A2.2 Sample Collection

All samples will be collected in accordance with the following procedures.

- Each sample cell will be measured and marked and the sample locations identified. In the case of confirmation samples, each excavation area will be measured and the confirmation sample locations will be measured and marked.
- A description of the sampling location will be recorded in the field logbook.
- Samples will be collected using a hand driven sampler equipped with a 6-inch long stainless steel tube. If the ground surface is too hard to drive the samplers, samples will be collected with a stainless steel trowel and immediately transferred to the sample tubes.

- Tubes will be covered with Teflon-lined plastic caps, labeled, sealed, and stored in an insulated sample container with ice, for transport under chain of custody control to a state certified laboratory.
- The samples will be thoroughly mixed and composited by the analytical laboratory in accordance with ASTM Standard D-6051-96 (*ASTM, 1996*).

A3.0 Equipment Decontamination

All sampling and field equipment will be cleaned and decontaminated in accordance with the approved regulatory protocols. Sufficient pre-cleaned equipment should be transported to the field to perform at least one day's work.

Decontamination and cleaning of all equipment will occur at a designated location at each building site. The designated area or decontamination pad will be constructed in an area known or believed to be free of surface contamination. The pad should not leak, and it should be constructed on a level, paved surface and should facilitate the removal of wastewater. This may be accomplished by either constructing the pad with one corner lower than the rest, or by creating a sump or pit in one corner or along one side. Any sump or pit should also be lined. The decontamination area could be established using visqueen.

All equipment used in measurements and sampling will be decontaminated before initial use and between samples by a potable water-detergent wash (with brush if necessary), followed by a potable water rinse, and a final deionized water rinse. This procedure will minimize the potential for cross-contamination between sampling locations. All wash and rinse water will be collected, sampled and properly disposed.

A4.0 Quality Assurance

Quality Assurance (QA) procedures, controls, and goals are discussed in detail in the project Quality Assurance Project Plan (QAPP; Appendix B). QA procedures assure validity of the sampling analyses and results.

A4.1 Quality Control Checks

Quality Control (QC) will be conducted in-house by the laboratory. Field personnel will also conduct QC checks and sampling. The QC samples include:

Field Samples

- Field duplicates
- Equipment blanks

These samples will be collected at a minimum rate of one for every 15 samples.

Laboratory Procedures

- Method blanks and duplicates
- Matrix spikes
- Laboratory Control Samples.

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

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APPENDIX B

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APPENDIX B

B1.0 Quality Assurance Project Plan

This Quality Assurance Project Plan (QAPP) describes the work activities to be performed during lead impacted soil sampling and removal activities associated with the NRP at Moffett Field, California. The goal of the sampling is to identify lead-impacted soil for removal actions and provide confirmation that the removal of all lead-impacted soil that exceeds the SFRWQCB RBSL of 200 mg/kg was performed.

B2.0 Quality Assurance

The general Quality Assurance/Quality Control (QA/QC) objective for this project is to ensure that data of known and acceptable quality are provided. In combination, QA/QC represent a set of procedures designed to produce analytical data of known and measurable quality. A useful distinction between QA and QC can be made as follows; QC represents the set of measurement procedures (spikes, blanks, replicates, calibration, etc.) used to provide overall evidence of the quality of a particular analytical batch; QA represents the set of procedures used to ensure that this evidence is available and used properly to evaluate and, if necessary, to quantify the data quality. The QA objectives of this project are to assess and document the precision, accuracy, representativeness, completeness, and comparability of all sampling and analyses performed. Criteria are established herein to ensure suitability for the intended use of data to be obtained during the work. The following discusses project-specific levels of effort for QA and data quality criteria.

B2.1 QA/QC Definitions

B2.1.1 Precision

Precision measures the reproducibility of measurements and methods, and is defined for qualitative data as a group of values' variability compared with its average value. To assess the precision of the measurement systems used in this project, field duplicates will be obtained and analyzed with the samples collected. Precision of laboratory analysis will be assessed by comparing the analytical results between laboratory duplicate results.

B2.1.2 Accuracy

Accuracy is the degree to which a given result agrees with the true value. Spiked sample results provide information needed to assess the accuracy of analyses. Specifically, MS percent recoveries (%R) are used to assess accuracy. Five percent of all samples analyzed are spiked with target chemicals for the MS. If the calculated %Rs are close to the known concentrations as defined within the limits set by each method, the reported sample concentrations are assumed to be accurate.

B2.1.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the total amount expected to be obtained under normal conditions. A 90% completeness figure is usually required for a particular analysis and overall project objective.

B2.1.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Careful choices and the use of appropriate methods in the field will ensure that samples are representative. Representativeness is primarily a professional subjective judgment about the collected data. Considerations for evaluating the representativeness of the data include: (1) the location and number of samples being collected, (2) the methods used to obtain environmental samples at the site, (3) the appropriateness of the analytical methods to the type of sample obtained, (4) environmental conditions at the time of sampling, and (5) results of replicate and duplicate samples.

B2.1.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another. Data will be calculated and reported in units consistent with those used by organizations reporting similar data to allow comparability of databases. Data will be reported in milligrams per kilograms (mg/kg) for soil samples, except the STLC and TCLP results, which will be reported in milligrams per liter (mg/L).

B3.0 Laboratory Data Quality Deliverables

Quality criteria are outlined here to ensure data obtained during projects are suitable for their intended use, and to meet established quality criteria goals. To acquire definitive data to meet the project QA objectives, the laboratory will supply QC information so the accuracy and precision of the data may be assessed.

B4.0 Field Procedures

All sampling activities will adhere to the SAP and as detailed below.

B4.1 Sample Documentation

This section discusses the standard operating procedures (SOPs) for sample identification, documentation, and custody. The purpose of this section is to ensure that sample quality is maintained during collection, transportation, and storage. Chain-of-custody requirements will comply with the standard SOPs. All sample documents will be completed legibly, in ink. Any corrections or revisions will be made by lining through the incorrect entry and by initialing the error.

Sample management documents must be carefully prepared so that sample tracking and disposition may be maintained and controlled. Sample identification documents include:

- Field logbooks
- Sample labels
- Chain-of-custody records
- Custody seals

B4.1.1 Chain-of-Custody

Official custody of samples must be maintained and documented from collection until analysis. The chain-of-custody procedures can provide an accurate record that can be used to trace the possession and handling of a sample. The laboratory will be notified before receipt of high-hazard samples and a notation will be made on the chain-of-custody form for such samples.

A sample is considered to be in an individual's custody if the following criteria are met:

- The sample is in physical possession
- It is within view after being in a person's possession
- It was in physical possession and then he/she secured it to prevent tampering
- It is placed in a secured area.

The field sampling team will be responsible for the care and custody of the collected samples until they are properly dispatched. The site manager or QA officer will review all field activities to ensure/confirm that proper custody procedures are followed during the field activities. The site manager will complete a chain-of-custody form to accompany each cooler shipped from the field to the laboratory. At a minimum, the following information will be recorded onto the chain-of-custody form by sampling personnel:

- The project number
- Sample identification number and location
- Signatures of any individuals with control over samples
- Date and time of collection
- Any preservatives used in the samples
- Additional comments that the sampling team deems necessary, (e.g., air-bill numbers, requesting faster turnaround time, etc.)
- The total number of sample containers and the required analysis.

B4.1.2 Field Logbooks

Sampling personnel will use bound, ruled, or gridded logbooks with numbered pages to maintain field records. The entries must be made with a permanent ink pen or marker. These logbooks will be a master reference for all site activities and accomplishments. The logbooks are dedicated and accountable documents, which will be properly maintained as part of the project files.

Information to be documented in field logbooks includes:

- All aspects of the sample collection and handling, as well as visual observations
- All sample collection equipment, field analytical equipment, and equipment used in the physical measurements

- All calculations, results, and calibration data for field sampling, field analytical and physical measurements
- Dates and times of activities or tasks performed in the field
- Weather conditions, as well as other site observations
- Names of personnel onsite
- Dates and times of all entries.

B4.1.3 Sample Labels and Custody Seals

Sample labels are preprinted, adhesive-backed, and designed so that removal would be evident. Labels should never be placed over previously recorded information. Labels will include site and sample identification number, collection time and date, sample matrix, preservation, the sampler's name, and the analytical parameters of interest.

B4.1.4 Sample Handling and Shipping

The shipping coolers in which the samples are packed must be properly sealed and accompanied by the chain-of-custody form. The original form accompanies the shipment in a resealable plastic bag attached to the lid of the cooler. Copies are to be distributed appropriately to the project manager. When transferring custody of the samples, individuals relinquishing and receiving must sign, date, and note the time on the form. All chain-of-custody forms will be returned to the contractor following receipt or as part of the data-reporting package.

The transportation and handling of samples will be accomplished in a manner that not only protects the integrity of the sample, but also prevents any detrimental effects due to the possible hazardous nature of the contents. Regulations for packaging, marking, labeling, and shipping of hazardous materials are promulgated by the U.S. Department of Transportation (DOT) in the Code of Federal Regulations, 49 CFR 171 through 177.

Samples must be packaged carefully to avoid breakage and/or cross-contamination and must be shipped to the laboratory at the proper preservation temperatures. The requirements outlined below will be followed.

B4.1.4.1 Sample Packaging Requirements

- All sample lids must stay with their original containers
- Sufficient quantities of packing materials will be placed in the cooler along with the ice to prevent the bottles from moving during shipment and to maintain the correct temperature.
- The sample bottles will be protected and placed in the cooler to ensure that they do not touch
- Environmental samples will be cooled to 4°C. Wet ice packaged in resealable plastic bags or blue ice will be used to cool samples during shipment. Ice will not be used as a substitute for packing materials

- Any remaining space in the cooler will be filled with an inert packing material. Under no circumstances should material such as sawdust, sand, etc., be used
- The chain-of-custody forms will be placed in a plastic bag and taped to the bottom of the cooler lid. Custody seals will be affixed to the sample cooler.

B4.1.4.2 Shipping Container Labeling Guidelines

- Use abbreviations only where specified
- The words “This End Up” or “This Side Up” should be clearly printed on the top of the outer package. Upward pointing arrows should be placed on the sides of the package. The words “Environmental Samples” should also be printed on the package.
- All samples and sample coolers will be packaged, shipped, labeled, and placarded (when applicable) in accordance with the appropriate DOT regulations.

Pre-cleaned sample containers will be provided by the laboratory.

B5.0 Sample Preservation and Holding Times

The required volume for lead analysis is 4 to 8 oz. of soil, collected in polyethylene or glass bottles. All samples must be cooled to 4°C after collection. The samples must be digested within 180 days of collection and analyzed with 180 days of digestion.

B6.0 Data Reduction, Validation and Reporting

The laboratory procedures for data reduction, validation, and reporting will be included in the selected laboratory QAPP. Data reduction, validation, and reporting by the laboratory will meet the criteria needed by the contractor for internal data validation. For this project, analytical procedures will be those specified by the analytical method employed. Data deliverables will be reported by the laboratory as defined in Section B3.0.

B7.0 Field Data Package

The field data package, including all field records and measurements obtained at the site by the contractor sampling personnel, will be reviewed for completeness and accuracy by conducting the following:

- A review of field data on water and soil/sediment sampling logs for completeness. Failure in this area may invalidate the data for litigation or regulatory purposes.
- A verification that sample rinsate blanks were properly prepared, identified, and analyzed. Failure in this area may compromise the analytical data package and result in some data being considered qualitative or invalid.
- A review of chain-of-custody forms for proper completion, signatures of field personnel and the laboratory sample custodian, and dates. Failure in this area may invalidate the data for litigation or regulatory purposes.

B7.1 Analytical Data Package

The analytical data deliverables, defined in Section B3.0 will be validated by the project chemist the validation steps will be performed by applying, where applicable, precision and accuracy statements for the analytical methods employed.

B7.2 Data Qualification

The data may be qualified by the project chemist during the evaluation of field and analytical data packages. As with the laboratory data validation, the qualification of data is based on specifically defined criteria. Samples are evaluated by matrix against the specific class criteria and qualified accordingly. Samples for which analytical data are unacceptable must be replaced by supplemental sampling, until data completeness goals for the sample matrix are met.

B7.3 Field and Laboratory Quality Control Checks

Internal checks used by the laboratory will be outlined in the analytical methods and in the laboratory's QAPP. The contractor will also conduct internal QC checks of sampling procedures and laboratory analyses. These checks will consist of the preparation and submittal of rinsate blanks, equipment rinsate blanks, and field duplicates for analysis; an evaluation of the field data package; and an evaluation of the laboratory analytical data package as described previously.

B7.3.1 Field Data Quality

Precision will be assessed by evaluating the results of duplicate samples, and accuracy will be assessed by evaluating the analyses of equipment rinsate blanks and laboratory matrix spikes.

B7.3.2 Analytical Data Quality

The laboratory will perform checks to verify the results are generated as defined by the method protocols. The laboratory checks will include verifying that all results and QC elements are properly measured, documented, and reported. The project chemist will validate the quality of the laboratory deliverables as described in Section B7.1. The method guidelines include analysis and evaluation of matrix spikes.

Matrix spike samples prepared by the laboratory are useful in assessing the accuracy of the analytical method. They can detect matrix effects in which other sample components interfere with the analysis of the contaminant of concern. The method of measuring analytical accuracy is percent recovery.

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