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August 27, 2012

Alameda County Health Care Services Agency
Environmental Health Services
Environmental Protection
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502-6577

RECEIVED

7:56 am, Aug 28, 2012

Alameda County
Environmental Health

Re: **Chevron Facility No. 351645 (Former Unocal Service Station No. 1156)**
4276 MacArthur Boulevard, Oakland, California

ACEH Fuel Leak Case No. RO0000409
RWQCB Case No. 01-2474
GeoTracker Global ID T0600102279

I have reviewed the attached *Revised Work Plan for Vapor Intrusion Investigation and Risk Assessment*, dated August 27, 2012.

I agree with the information and recommendations presented in the referenced report. The information in this report is accurate to the best of my knowledge and all local Agency/Regional Board guidelines have been followed. This report was prepared by AECOM, upon whose assistance and advice I have relied.

This letter is submitted pursuant to the requirements of California Water Code Section 13257(b)(1) and the regulating implementation entitled Appendix A pertaining thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

Sincerely,

Roya Kambin
Project Manager

Attachment: *Revised Work Plan for Vapor Intrusion Investigation and Risk Assessment*

Environment

Prepared for:
Chevron, Inc.
San Ramon, California

Prepared by:
AECOM
Camarillo, California
August 27, 2012

REVISED

Work Plan for Vapor Intrusion Investigation and Risk Assessment

Former Unocal Station No. 1156
(Chevron Facility 351645)
4276 MacArthur Boulevard
Oakland, California

ACEH Case No. RO409
RWQCB Case No. 01-2474

AECOM Environment

Prepared for:
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Work Plan for Vapor Intrusion Investigation and Risk Assessment

Former Unocal Station No. 1156
(Chevron Facility 351645)
4276 MacArthur Boulevard
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ACEH Case No. RO409
RWQCB Case No. 01-2474

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Appendices

1.0 Introduction

On behalf of Chevron Environmental Management Company, for itself and as Attorney-in-Fact for Union Oil Company of California (hereinafter "EMC"), AECOM is pleased to submit this Work Plan for Vapor Intrusion Investigation and Risk Assessment. AECOM has prepared this work plan in association with Alameda County Environmental Health (ACEH) Case No. RO409, for Unocal Service Station No. 1156 (Chevron Site 351645), located at 4276 MacArthur Boulevard, Oakland, California (see Figure 1, Site Location Map).

1.1 Background and Objective

Elevated concentrations of petroleum hydrocarbons were previously detected in soil vapor along the northwest portion of the Unocal station site (Delta, 2009). AECOM has prepared this work plan to assess the potential for vapor intrusion to indoor air at the Oakland Veterinary Hospital (4258 MacArthur Boulevard), located adjacent to the northwest of the station site (see Figure 1 and Figure 2, Site Plan).

The investigation will focus on soil vapor sampling beneath the paved area adjacent to the Oakland Veterinary Hospital building. The assessment activities described in this work plan include the installation and sampling of two soil vapor wells (SV-1 and SV-2) and the evaluation of potential soil vapor inhalation risks using soil vapor concentration data.

The scope of work was developed using Chevron protocols and regulatory guidance documents, including the California Department of Toxic Substances Control (DTSC) *Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* (DTSC, 2011), the DTSC and Los Angeles RWQCB *Advisory – Active Soil Gas Investigation* (DTSC, 2012), and the American Petroleum Institute *Collecting and Interpreting Soil Gas Samples from the Vadose Zone: A Practical Strategy for Assessing the Subsurface Vapor-to-Indoor Air Migration Pathway at Petroleum Hydrocarbon Sites* (2005).

A work plan for additional site assessment activities, including investigation of the unknown vault located on the northwest side of the station building, will be submitted under separate cover.

1.2 Site Location and Description

The site is located in an urbanized area of Oakland at the base of the San Leandro Hills. The station site is located at the north corner of the intersection between MacArthur Boulevard and High Street in Oakland, and the Oakland Veterinary Hospital abuts the station site to the northwest. AECOM conducted an area reconnaissance and visited the Oakland Veterinary Hospital facility on March 15, 2012. A specific inspection of the station site was not conducted.

The site area consists of mixed commercial and residential development. A drug store is located beyond the veterinary facility to the northwest. Single-family dwellings border the station site to the northeast. An apartment building and commercial businesses (cleaners, tax service, pizza place, and sandwich shop) are present across High Street to the southeast. [Based on a review of the State Water Resources Control Board GeoTracker database, Chevron gasoline service station #93676 (4300 MacArthur Boulevard) was formerly located at this corner; case closed in 1999.] A vacant lot is located south of the station site at the south corner of the MacArthur Boulevard and High Street intersection. [The GeoTracker database indicates that an open leaking underground storage tank (LUST) case is located in the vicinity of this site – the former Roberts Tires facility, 4311-4333 MacArthur Boulevard.] A vacant lot is also located across MacArthur Boulevard to the southwest of the station site. [The GeoTracker database indicates Shell gasoline service station #13-5701 (4255 MacArthur Boulevard) was formerly located at this corner; case open.]

Based on site survey data (Morrow Surveying, 2008 and 2010), surface elevations at the site range from 179.42 feet above mean sea level (amsl) at MW-4B to 173.99 feet amsl at MW-2B. Observations during the area reconnaissance on March 15, 2012, further revealed that the elevation at the northeast site boundary is noticeably higher than at MW-4B. Additionally, the elevation at MW-5 is 169.67 feet amsl. MW-5 is located in the street in front of the Oakland Veterinary Hospital (adjacent to the northwest of the station site). To summarize, the southwest portion of the station site is at least 8 feet lower in elevation than the northeast portion; and the west corner is approximately 4 feet lower in elevation than the south corner.

1.3 History

A review of historical aerial photographs, city directories, and Sanborn fire insurance maps indicate that the site has been in use as a gasoline service station since at least 1950. The 1950 Sanborn map indicates that MacArthur Boulevard was formerly known as Hopkins. Earlier Sanborn maps indicate that dwellings were formerly present on site. Copies of the Sanborn maps are provided in Appendix B.

Historical information provided in previously prepared reports (Miller Brooks Environmental [MBE], 2005; ATC Associates, 2005; Delta, 2007a, 2007b, 2008a, 2009, 2010) indicates investigative activities have been conducted at the site from 1997 through 2010. The investigations have included the drilling of numerous soil borings, installation of 12 groundwater monitoring wells [four of which (MW-1 through MW-4) have been abandoned], and several soil vapor assessments.

The most recent investigative activities were conducted by Delta Consultants in 2010 and included soil vapor point sampling, soil vapor well installation and sampling, monitoring well abandonment and re-installation, soil and groundwater borings, and assessment of a previously unidentified underground vault/utility. The investigations were conducted to determine if a pathway existed between the former gasoline UST pit and MW-1, to adjust the effective screen interval of four on-site monitoring wells, and to assess the soil vapor intrusion risk to the Oakland Veterinary Hospital, located adjacent to the northwest of the station.

A total of eight sonic borings (SB-12 through SB-19) were sited along the northwest, northeast, and southeast portions of the station building; six soil vapor wells were installed along the northwest portion of the station; and the four on-site monitoring wells (MW-1 through MW-4) were abandoned and reinstalled with different screen intervals (MW-1B through MW-4B).

Groundwater samples were collected from SB-15, SB-16, SB-17, SB-18, and SB-19. SB-18, located between the unknown vault location and the former waste oil UST on the northwest side of the station building had the highest concentrations of petroleum hydrocarbons. SB-15, located near the current waste oil AST, on the northeast side of the station building, had the lowest concentrations.

Of the six vapor wells installed, extractable soil vapor samples were collected from only five – SVW-1, SVW-2, SVW-3, SVW-5, and SVW-6. [A soil vapor sample was not collected from SVW-4 due to water in the well.] The soil vapor wells that were sampled contained very high concentrations of petroleum hydrocarbons as gasoline (TPHg) up to 420,000,000 µg/m3 at SVW-6, benzene up to 1,100,000 µg/m3 at SVW-3, toluene up to 19,000 µg/m3 at SVW-2, ethylbenzene up to 610,000 µg/m3 at SVW-3, and total xylenes up to 820,000 µg/m3 at SVW-3. MTBE was not detected in the soil vapor analyses, though reporting limits were higher than Environmental Screening Level (ESL) values in many cases.

1.4 Geology/Hydrogeology

AECOM reviewed boring logs prepared by other consultants during previously completed subsurface investigations (Delta, 2007a, 2007b, 2008a, 2009, 2010). The boring logs indicate that soil types encountered beneath the site consist of unconsolidated deposits of sand and silt in a clay matrix, with some intermixed fine-to-medium-grained gravel. Clay is predominant in the upper lithology with sandy/silty clay and clayey sand units, between approximately 1 to 15 feet below grade surface (bgs). The clay unit is underlain by clay interbedded with sandy clay, clayey sand, silty sands, and some gravelly sandy clay units, observed to the maximum depth explored (50.5 feet bgs).

Based on a review of boring logs and groundwater monitoring data tables prepared by previous consultants (Delta, 2007b, 2008a, 2009, 2010; CRA, 2011), discontinuous confined and/or unconfined water bearing zones may exist within the stratified clay matrices. Soil boring logs depict groundwater being encountered first between 4 (SB-1) and 42 (SB-11) feet bgs. During monitoring well installations in 1999, groundwater was typically encountered at a depth of approximately 23.5 feet bgs (MW-1, MW-2, MW-3, MW-4). During well installations in 2001, groundwater was encountered at 6 and 5.5 feet bgs in MW-5 and MW-6, respectively. Groundwater was encountered at 15 feet bgs in MW-7 during installation in 2001.

During the most recent groundwater monitoring event, conducted on January 23, 2012 (first quarter), the static groundwater elevation ranged from 165.19 feet (MW-7) to 172.49 feet (MW-4B) amsl. The depth to water measurements during the first quarter 2012 ranged from 6.96 feet below ground surface (bgs) (MW-1B/MW-2B) to 1.98 feet bgs (MW-5). To note, the southwest portion of the station site is at least 8 feet lower in elevation than the northeast portion; and the west corner is approximately 4 feet lower in elevation than the south corner. The groundwater flow direction and gradient was interpreted to be to the southwest at 0.06 foot per foot (ft/ft). The predominant historical groundwater flow at the 76 service station has been to the west (with variations to the southwest) at an average gradient of approximately 0.05 ft/ft. These shallow depths to water are attributed to the pressure in the aquifer pushing water up through the well casing. While there may be some perched water in the area (as observed in some of the borings above), the deeper, confined aquifer is considered indicative of true groundwater elevation.

Varying groundwater-encounter depths are indicative of multiple water-bearing zones due to semi-impermeable, discontinuous clay layers identified in the soil boring logs. In addition, shallow static groundwater levels indicate a confined groundwater aquifer below 20 feet bgs under hydrostatic pressure. Previous well installations (MW-1 through MW-4) were screened across multiple confining layers, thus providing a conduit for deeper groundwater to saturate upper layers.

2.0 Proposed Scope of Work

AECOM proposes to conduct a soil vapor investigation at the Oakland Veterinary Hospital. The investigation will consist of installing and sampling two soil vapor wells (SV-1 and SV-2) through the paved area outside along the southeast side of the Oakland Veterinary Hospital building. The locations of the proposed sample locations are shown on Figure 2. At the property owner's request, no indoor air samples or sub-slab vapor samples inside the Veterinary Hospital building will be collected. In addition, no sub-slab vapor, indoor air, or outdoor ambient air samples will be collected at the station site as it is an active gasoline fueling facility.

AECOM will commence work upon receipt of regulatory acceptance of this work plan, and contingent upon successful completion of an access agreement with the Oakland Veterinary Hospital, the availability of subcontractors, and securing appropriate permits. A report will be prepared and submitted upon completion of the investigation.

2.1 Pre-Field Activities

Prior to installing and sampling the soil vapor probes, AECOM will perform an inspection of the veterinary facility property to determine the approximate locations of sewers, floor drains, joints in the floor slab, and utility lines beneath the paved areas. This inspection will also help to identify potential sources of cross-contamination and to mitigate health and safety risks. Based on previous requests, the property owner has indicated that there are no utility or as-built drawings available for the Oakland Veterinary Hospital building/site. AECOM will mark and identify the proposed probe locations and request an underground utility line clearance at least 48 hours in advance of any subsurface activities. In addition, AECOM will contract with a private utility line locating service to establish that there are no obstructions near the proposed probe areas.

AECOM will obtain all necessary well and encroachment permits from the appropriate Alameda County and City of Oakland agencies. AECOM will comply with the terms specified in the permits and will provide a minimum 72-hour notification to the agencies prior to mobilization. AECOM will contract with and schedule a State of California C-57-licensed and CEMC Loss Prevention System -trained drilling contractor to advance the boreholes and install the soil vapor wells.

2.2 Field Activities

Field activities will be performed under the supervision of a State of California Professional Engineer. At the commencement of field activities, AECOM will perform the following tasks:

- Conduct a tailgate safety meeting at the site.
- Review the contents of the Health and Safety Plan (HASP) and Job Loss Analysis (JLA) with all AECOM and subcontracted workers and review the requirements mandated by the Chevron Operational Excellence and Safety Program.
- Set up and demarcate an Exclusion Zone around the work area for each sample location to preclude access by anyone whose entry is unauthorized.
- AECOM will keep written documentation of field conditions during sampling and drilling. This will include, but not be limited to, weather conditions (e.g., temperature, wind direction, degree of cloud cover, etc.); and surface soil conditions (e.g., presence of standing water). AECOM

will maintain detailed field records of all activities, conditions, and sampling processes, including names of field personnel, dates and times, etc.

AECOM field activities will be conducted in accordance with the DTSC's vapor intrusion guidance (DTSC, 2011 and 2012).

2.2.1 Soil Vapor Well Installation and Construction

For each boring location, AECOM will follow CEMC protocol for confirmation that no subsurface utilities exist in the proposed boring location. Due to the potential impact of air knifing on the subsurface, the use of air knife for borehole clearance is not recommended for soil vapor well installation at shallow depths. A hand auger will be used for utility clearance and to advance each soil boring to at least 6 feet bgs. Subsurface utilities or obstructions identified during hand augering will require relocation with a new set of advancements free of obstructions.

CEMC protocols favor vapor wells installed at least 2 feet above the seasonally high water table. Historical depth to water data from groundwater monitoring wells associated with the Unocal station site indicate an average range of approximately 5.3 (MW-2) to 7.2 (MW-3) feet below the top of well casings in well MW-1 through MW-4 and MW-1B through MW-4B. However, boring log data indicates that the depth to first encountered water during installation of wells MW-1 through MW-4 (1999) and MW-1B through MW-4B (2010) was 23.5 feet bgs. Based on this data, the water-bearing zone is confined and under hydrostatic pressure. This condition is further evidenced by the fact that the MW-1B through MW-4B wells are screened only in the confined aquifer. Based on the boring log data, it is unlikely that groundwater would be encountered at less than 20 feet bgs. In the completed borings, the probes will be installed centered at just under 5 feet bgs. No probe will be installed shallower than 4.5 feet bgs or less than 2 feet above the water table.

Each well screen will be a 6-inch-long, 0.25-inch-diameter stainless-steel screen with a pore size of 0.0057 inch (0.14 millimeter). Screens will be connected to a length of 0.25-inch outside diameter (OD) nylon tubing to enable soil vapor sampling at the ground surface. Tubing will be capped at the surface with a Swagelok® valve installed in the closed position to allow equilibration of soil vapor concentrations. A 1-foot-thick Lonestar #2/12 sand pack will be placed from 3 inches above to 3 inches below each vapor probe screen. Above each sand pack, 1 foot of dry granular bentonite will be placed as a transitional seal. Ideally, ≥ 2 feet of semi-hydrated granular bentonite will be placed above the dry granular bentonite. The well will be capped by a concrete surface seal. A traffic-rated, bolt-down vault box will be installed slightly above surrounding grade and finished with a concrete apron to reduce the potential infiltration of surface water. The actual well dimensions will be determined in the field, based on the depth to water. Proposed well construction details are shown on Figure 3.

2.2.2 Soil Sampling Procedures

Soil samples will be collected from probe depths determined in the field. The samples will be collected using acetate sleeves capped with Teflon tape and rubber end caps. Borings will be logged consistent with the Unified Soil Classification System, in general accordance with American Society for Testing and Materials (ASTM) Method D2488-00, Visual and Manual Methods. Soil samples will be field-screened by conducting head space analysis with a photo-ionization detector/flame-ionization detector.

Soil samples will be preserved for physical and chemical analysis by sealing the sample liners with Teflon tape and plastic end caps and placing the samples in an ice chest for preservation pending delivery to the laboratory for analysis. Samples submitted for chemical analysis will be those corresponding to the probe depths (which will be determined based on the depth to groundwater on the day of probe installation). Chemical and physical testing is discussed in Section 3.0.

Correlation of the soil types encountered in prior soil borings suggest that the screens of vapor wells SV-1 and SV-2 will be located within fine-grained materials, specifically silt to silty clay.

Soil cuttings generated during well installation will be considered as investigation-derived waste, temporarily stored on site in United Nations (UN)-approved 55-gallon drums, and labeled as non-hazardous waste pending arrangements for transport and disposal. The soil will be transported by a licensed waste transporter to an appropriate disposal facility.

Decontamination water and any groundwater displaced by grouting procedures will be contained in UN-approved 55-gallon drums, labeled as non-hazardous waste, and temporarily stored at the Unocal station site pending arrangements for transport and disposal under applicable protocols.

2.2.3 Soil Vapor Probe Sampling Procedures

The proper collection of soil vapor samples is important in producing reliable concentration data. A number of factors are involved in ensuring the reliability of the data. Therefore, sampling procedures will follow those presented in DTSC vapor intrusion and soil vapor investigation guidance documents (DTSC, 2011 and 2012). Soil vapor sampling will not be conducted within 5 days of irrigation or measurable rainfall greater than 0.5 inch within a 24-hour period (DTSC, 2012). Sampling of all wells is expected to be completed within a one-day time period. The results of the initial sampling will be evaluated to determine if a second/seasonal sampling event is needed.

2.2.3.1 Equilibration Time

The installation of soil vapor sampling wells can introduce ambient air into the vadose zone. An equilibration time is required to account for these effects of soil vapor well installation that may adversely influence sample results. In accordance with DTSC guidelines (2012), and based on a combination of boring techniques, there will be a minimum 48-hour equilibration period between installation and sampling of soil vapor wells. This allows for equilibration of soil vapor concentrations following installation of the soil vapor monitoring wells. AECOM will sample the vapor wells no later than one week, after well construction is completed.

2.2.3.2 Sampling Equipment

The samples will be collected in a stainless steel, gas-tight, opaque Summa™ canister with a passivated, glass-lined internal surface, provided by the analytical laboratory. The canister will be certified clean by the laboratory. The canister will be field verified to have a vacuum of at least minus 25, and up to 29.9 inches mercury (Hg) before sampling. Canisters found to have insufficient vacuum will not be used.

All gauges and flow control manifolds will be connected by laboratory-supplied, chromatography-grade, stainless steel tubing, and dedicated flexible nylon or Teflon airtight tubing that has a low capacity for adsorbing volatile organic compounds. A sample train will be assembled using 0.25-inch OD nylon tubing for all vapor sampling. Swagelok® type connectors will be used for all connections between tubing and other sampling components.

The Summa® canister will be supplied under vacuum, and the vacuum contained in the canister will be used to draw the soil vapor to the surface. A three-way valve will be used to isolate the purging canister from a separate tube that is connected to the vapor sample canister. Figure 4 shows a typical equipment sample train for soil vapor sampling.

All samples will be collected in certified clean 1-liter Summa® canisters provided by the analytical laboratory and certified at 100 percent for use in human health risk assessment. Each canister will be field verified to have a vacuum of at least minus 25 inches mercury (Hg), and up to minus 29.9 inches Hg, before sampling. Canisters found to have insufficient vacuum will not be used.

2.2.3.3 Shut-in Testing

Prior to purging or sampling, a shut-in test will be conducted in general accordance with DTSC guidance (DTSC, 2012) to check for leaks in the above-ground sampling system. Sampling equipment will be thoroughly inspected to ensure tight fittings between all components and checked for leaks prior to sampling. Sample equipment consists of a sample train which is comprised of a purge pump, Summa™ canister with flow restrictor, and vacuum gauge. The purge pump will be used to evacuate the system to a minimum measured vacuum of about 100 inches of water. The test is conducted while the sampling canister is attached with its valve in the closed position. The vacuum gauge will be connected to the system with a “T”-fitting and observed for 10 minutes. If there is any observable loss of vacuum, the fittings will be adjusted until the vacuum in the sample train does not noticeably dissipate. After the shut-in test is validated, the sampling train will not be altered. The vacuum gauge will be calibrated and sensitive enough to indicate a water pressure change of 0.5 inches. The sample train will be considered to pass the shut-in test if constant vacuum pressure is maintained for the 10 minutes. If constant vacuum pressure is not maintained, the sample train will be repaired. If the sample train cannot be repaired to pass the shut-in test, no sample will be taken with that equipment.

2.2.3.4 Leak Testing

Leakage of atmospheric air into the sampling equipment during sampling can compromise sample integrity and dilute measured soil vapor hydrocarbon concentrations. Laboratory grade helium is the tracer gas that will be used to test for air leakage into the sampling system for the purpose of sample integrity verification. The leak testing will be conducted in general accordance with DTSC guidance (DTSC, 2012) on the use of a tracer gas. A clear plastic container will be used as the chamber or helium shroud and will have three ports of entry/exit. The chamber will then be placed over the well head or sub-slab sample point and sealed to ground surface by use of weather seal stripping or like material. Helium from a cylinder will be applied as necessary to the helium shroud (to maintain approximately 10% by volume) from one port and monitored from a helium detector that will be inserted at a second port. The final port will have nylon or Teflon® tubing exiting and will be connected to the vacuum pump for purging and leak testing. The portable helium detector will be used to measure the helium tracer gas concentration in the discharge containment bag (Tedlar bag) placed at the discharge end of the purge pump. Leakage in the sample train is indicated by the presence of helium in the discharge containment bag. When helium is detected, the sample train fittings will be tightened. This procedure will be repeated until no leaks are detected in the sample train. Helium will be applied as necessary to the shroud during both the purging and sampling procedures in order to maintain a relatively uniform, known concentration of gas for leak testing.

Helium concentrations measured from the helium detector during the sampling will be used to assess the amount of leakage, if any, during sampling. Lab analysis and field measurements will be used to estimate a leakage percentage. A sample will be considered valid and acceptable for risk evaluation if the concentrations of the tracer gas (helium) are 10% or less (CalEPA, 2005).

2.2.3.5 Purge Volume Test

Subsequent to the shut-in and leak testing, and prior to collecting a soil vapor sample, the sampling tubes will be purged using a battery-powered, flow-calibrated purge pump to ensure that the soil vapor samples collected will be representative of actual soil vapor concentrations. Field notes containing dimensions and specifications on the below-ground tubing length, inner diameter, and above ground sampling equipment will be used to calculate the purge volume. Per DTSC guidance, one purge volume includes the following volumes: the internal volume of tubing; the void space of the sand pack around the probe tip; and the void space of the dry bentonite in the annular space. The flow rate for purging will be the same as the flow rate used for subsequent sampling (less than <200 mL/min). Since the probes are being placed at just under 5 feet bgs, the default of three volumes will be purged before collecting each sample (DTSC, 2012). The purge test data (calculated purge volume, purging rate, and duration of purging) will be recorded on field data sheets for each soil vapor sampling point and the same purge rate will be used at a given probe/well for each sampling event.

2.2.3.6 Vacuum Flow Rate and Sample Intervals

After verifying that all connections between Summa® canister, flow controller, and sample train are tight, soil vapor sampling can commence. A 1-liter Summa® canister with a flow controller set to less than 200 mL/min, with nylon or Teflon tubing, will be connected to each vapor well. To minimize the potential for leakage, the soil vapor sampling rate will be kept at <200 milliliters per minute (mL/min) using a laboratory-supplied flow regulator. The initial and final vacuum, start and finish times, and estimated flow rate will be documented in the field notes. A low flow rate aids in obtaining a representative soil vapor sample and also reduces the possibility of leakage of ambient air into the sampling equipment. Vacuum measurements indicate the volume of soil vapor drawn for the sample.

The Summa® canister sample train will be equipped with a dedicated filter and flow controller to maintain the flow rate. The flow controller contains a critical orifice flow restrictor to maintain a constant flow rate of greater than 10 mL/min and less than 200 mL/min over a 30-minute period. The analytical laboratory, Air Toxics of Folsom, California, will supply the flow controller.

A vacuum gauge on the flow controller will be used to monitor sampling progress. In order to estimate each vapor well's ability to produce sufficient vapors for sample collection, vacuum measurements will be taken after equilibrium has been reached (i.e., no sooner than 30 minutes after well installation). The decreasing vacuum readings will be recorded over the course of 30 minutes after sampling begins. Final vacuum readings will be reported to the laboratory. If the vacuum has not decreased to below 10 inches Hg, or flow rates are found to be less than less than 10 mL/min, then the reporting limits for data from the sample will be increased due to a smaller than normal sample volume and, therefore, an increased dilution factor.

2.2.3.7 Sample Collection

Immediately following purging and leak-testing, the sample will be collected by opening the Summa™ canister valve to draw the soil vapor sample into the canister. The time and initial pressure will be recorded. As the canister fills, the pressure gauge on the flow controller is observed to ensure that the vacuum in the canister is decreasing over time. The sampling completion time should be approximately 30 minutes for the canister vacuum to decrease to minus 5 inches Hg. Low permeability soils characterized by low soil vapor flow rates may require sampling to cease before the canister vacuum has decreased to 5 inches Hg. The vacuum and flow rates will be kept at a minimum to limit enhanced volatilization of VOCs. Vacuum and flow rate readings will be obtained periodically to evaluate the fill rate of the Summa™ canisters. The laboratory will be instructed to set the flow controller to a rate greater than 10 mL/min and less than 200 mL/min. The valve will be closed when the Summa™ canister gauge measures approximately 5 inches of Hg vacuum. The final Summa™ canister vacuum will be measured in the field for each sample and upon receipt at the laboratory to evaluate sample integrity following shipment.

Helium will continue to be added as needed and monitored during sampling to minimize outside ambient air influences. New, unused disposable nitrile gloves will be used prior to the collection of each soil vapor sample.

2.3 Quality Control Samples

Quality control of soil vapor samples is accomplished through the collection of equipment blanks and field duplicates.

2.3.1 Duplicate Samples

One duplicate sample will be obtained for soil vapor sampling. AECOM proposes collecting the duplicate sample from SV-1. The duplicate sample will be obtained by using a splitter (such as a T-fitting) located between the flow controller and sample canisters with separate sample tubes connecting the splitter to two Summa™ canisters. The flow controller must be set such that the flow rate from the sampling probe is less than 200 mL/min, doubling the sample time required since two canisters are filled simultaneously.

2.3.2 Equipment Blanks

One equipment blank will be collected for each day of sampling just prior to sampling activities by collecting a sample of clean air or nitrogen through the probe materials before installation in the ground. Clean stainless steel, Nylon or Teflon tubing and a certified regulator will be used, in conjunction with a 100% QC level Summa canister. No Trip Blanks are necessary with the use of 100% certified Summa™ canisters. Analysis of the equipment blank can provide information on the cleanliness of new materials and/or the effectiveness of decontamination procedures used in the field.

3.0 Laboratory Analysis

Samples will be labeled following standard chain of custody (COC) protocols, including noting the final canister vacuums and the serial numbers of canisters and flow controllers. AECOM will document sampling activities, including sampling times, conditions, and any deviations in procedure on field sheets. Samples will be transported under COC protocols within 24 hours using ground transport to a State of California certified laboratory. Samples will NOT be chilled since contaminants may condense at low temperatures.

Soil samples will be submitted under COC protocol to a State of California-certified analytical laboratory and analyzed for TPHg using United States Environmental Protection Agency (USEPA) Method 8015M, and for BTEX using USEPA Method 8260B. Soil samples will also be submitted for physical analysis including fraction organic carbon, total porosity, dry bulk density (ASTM Method D2937), air and water-filled porosity, and grain size distribution (ASTM Method D422).

Soil vapor samples will be analyzed for TPHg, BTEX, methyl tertiary butyl ether, and naphthalene using USEPA Method (Modified) TO-15 APH Fractions (Sp)-Full list + Naph + APH. Samples will also be analyzed for oxygen, carbon dioxide, helium, nitrogen and methane by ASTM Method D1946 modified. Analytical results for this investigation will be reported in micrograms per cubic meter

4.0 Vapor Intrusion Modeling and Risk Evaluation

As discussed in Section 1.3, elevated concentrations of petroleum hydrocarbons were detected in soil vapor samples collected on September 8 and 9, 2010 (Delta, 2010) on the northwest side of the service station. There are existing single-family residences located to the east of the service station site. However, these are up-gradient and uphill from the service station. Existing soil vapor data on the service station site indicates diminishing soil vapor concentrations in this direction. Therefore, investigation of these residences is not warranted. The Oakland Veterinary Hospital is located on the property adjacent to, and down-gradient of, the service station site on the northwest side. AECOM proposes to evaluate the potential vapor intrusion pathway at the Oakland Veterinary Hospital building in accordance with California EPA and DTSC guidance (CalEPA, 2005, 2009 and DTSC, 2011).

AECOM proposes to evaluate the potential vapor intrusion pathway using a tiered or step-wise approach, in accordance with guidance documents from the CalEPA, SF RWQCB, and the USEPA, as referenced in this section. The initial evaluation step will compare the soil vapor results to conservative soil vapor screening levels. If compounds are detected at concentrations above soil vapor screening levels they will be identified as compounds of potential concern (COPCs). COPCs, if any, will be evaluated during a second step consisting of further vapor intrusion assessment using the USEPA Johnson and Ettinger Model (JE Model) adjusted for CalEPA recommended inputs and toxicity information (USEPA, 2004), and/or the BioVapor Model, released by the American Petroleum Institute (API) (API, 2010). Details of these sequential evaluations are provided in the following sections.

4.1 Step One: Screening Level Evaluation

COPCs will be selected by comparing the maximum detected soil vapor concentrations to the soil vapor screening levels, including the California Human Health Screening Levels (CHHSLs) (CalEPA, 2010 and DTSC, 2011) and Environmental Screening Levels (ESLs) (SF RWQCB, 2008). Compounds detected in soil vapor at concentrations greater than the screening levels will be identified as COPCs for further evaluation in Step Two. Compounds detected in soil vapor at concentrations below the screening levels will not be evaluated further. For compounds that are not detected, the maximum reporting detection limit for each compound will also be compared to the CHHSLs and ESLs for informational purposes. However, only detected compounds were selected for further evaluation of potential risk using indoor air modeling. Potential carcinogenic (cancer) risks and non-cancer hazards associated with the potential vapor intrusion pathway will be evaluated with respect to commercial land use scenarios (i.e., the current land use) and residential land use scenarios (i.e., hypothetical future land use).

CHHSLs and ESLs are conservative screening levels, for residential and commercial/industrial exposure scenarios, based on conservative modeling inputs. They are designed to be protective of human health and may be used to assess the need for further risk evaluation. CHHSLs are based on a target potential excess lifetime cancer risk (ELCR) of $1x10^{-6}$ and a target hazard quotient (HQ) of 1. ESLs are based on a target potential ELCR of $1x10^{-6}$ and a target HQ of 0.2. Soil vapor concentrations below these screening levels do not pose a human health risk of concern (CalEPA, 2005, SFRWQCB, 2008) and compounds present at these levels do not require further risk evaluation. Compounds detected in soil vapor at concentrations greater than the screening values are identified as COPCs for further evaluation.

4.2 Step Two: Modeling and Risk Analysis

For the COPCs identified in Step One, a vapor intrusion assessment will be performed using the USEPA JE Model (USEPA 2004). The model will be adjusted for CalEPA recommended inputs and toxicity information, and will be used to estimate the cumulative potential ELCR and non-cancer hazard index (HI) associated with COPC concentrations for a current/future on-site commercial worker and a hypothetical future on-site resident. Site-specific soil and building parameters will be used in the JE Model, where available. Site-specific building parameters including soil dry bulk density, soil total porosity and soil water-filled porosity (moisture content) will be used in the JE Model to calculate an effective diffusion coefficient and semi-site-specific volumetric flow rate of soil vapor potentially entering the building. Default input parameters, provided by DTSC (2011) and USEPA (2004), will be used where site-specific information was not available. The most current toxicity information available, as recommended by CalEPA (2012) and USEPA (2003), will be used.

Cumulative potential risk and total HI estimates will be compared to USEPA's target cancer risk range of $1x10^{-6}$ to $1x10^{-4}$ and target HI of 1 (USEPA, 1991). If the potential ELCR and HI are below or within the USEPA's target risk range or target HI, respectively, no further evaluation of the vapor intrusion pathway will be performed.

The JE model is widely considered to overestimate risks/hazards due to petroleum hydrocarbons. The major reason the model overestimates risk is that it does not account for biodegradation which can be significant in the shallow subsurface in the presence of oxygen. Therefore, if the JE model results indicate that there is a potential ELCR and/or HI above target levels, further evaluation may be conducted using the BioVapor Model (API, 2010). Site-specific soil and building parameters will be used in the model, where available. Model defaults will be used where site-specific information is not available.

If the potential ELCR and/or HI exceed the USEPA's target levels, then CEMC will work with the SF RWQCB to consider additional vapor intrusion investigation.

5.0 Data Reporting

AECOM will submit a soil vapor investigation report to the ACEH with analytical results and risk assessment findings, conclusions, and recommendations of the evaluation. The report will be prepared under the supervision of, and signed by, a State of California Professional Engineer or Geologist. AECOM will submit all required electronic files necessary to comply with ACEH and State of California GeoTracker requirements.

6.0 References

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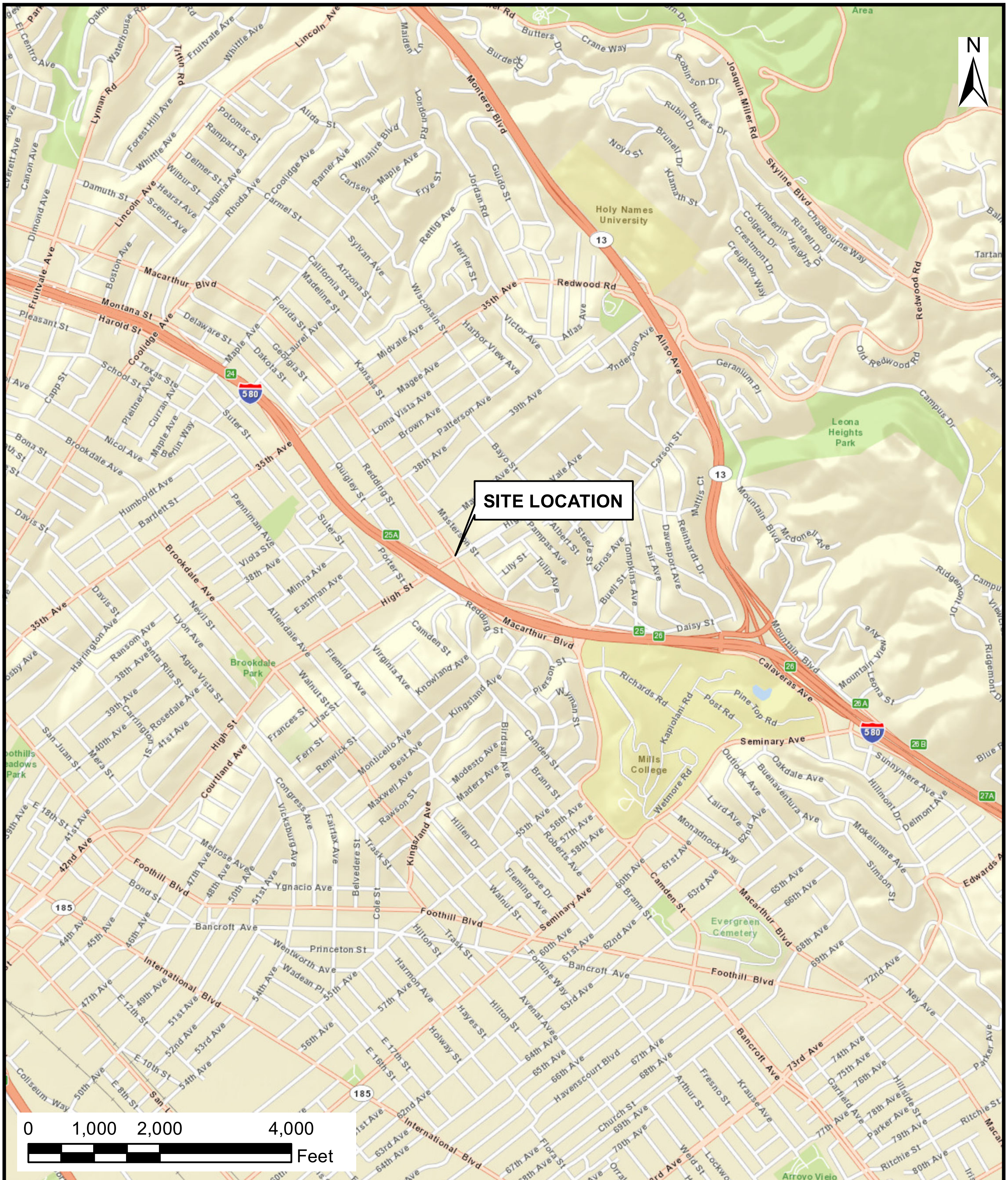
APPENDIX A – Figures



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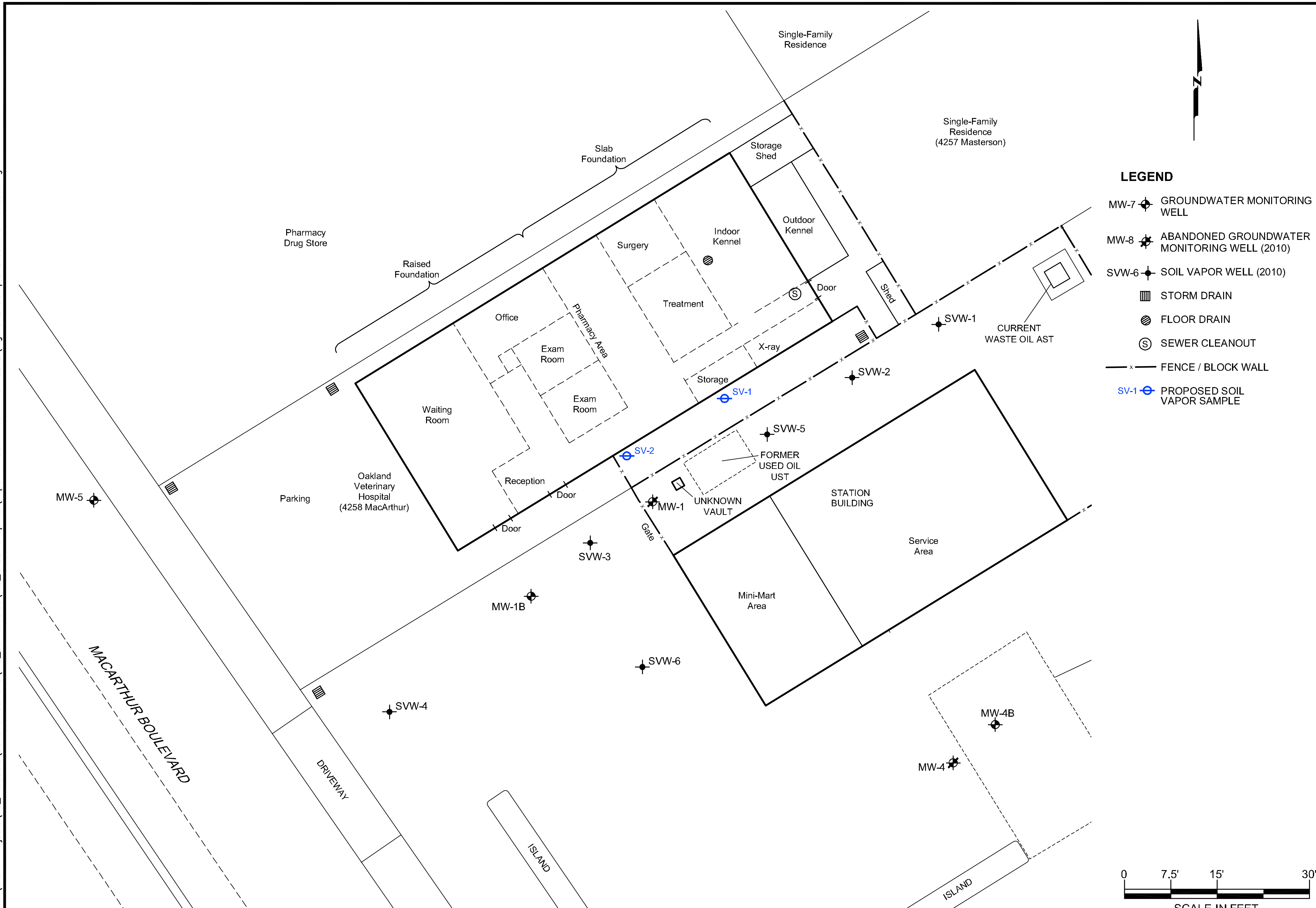
1220 AVENIDA ACASO
CAMARILLO, CALIFORNIA 93012
PHONE: 805.388.3775
FAX: 805.388.3577
WEB: HTTP://WWW.AECOM.COM

SITE LOCATION MAP

Chevron Site #351645 (76 Service Station #1156)
4276 MacArthur Boulevard
Oakland, California

FIGURE NUMBER:	1

DRAWN BY:	DATE:	PROJECT NUMBER:	SHEET NUMBER:
M. Scop	5/2/2012	60264254	1 of 1



Source:
Delta Consultants, Site Map with Historical Sampling Locations, Dated 06/26/2010
MW and SVW well locations from Morrow Surveying Land Surveyors, 8/24/2010

REVISIONS			
NO.:	DESCRIPTION:	DATE:	BY:

DESIGNED BY: X
DRAWN BY: M. Scop
CHECKED BY: X
APPROVED BY: B. Evans

AECOM

AECOM
1220 AVENIDA ACASO
CAMARILLO, CALIFORNIA 93012
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SITE PLAN WITH PROPOSED SOIL VAPOR SAMPLE LOCATIONS

Chevron Site #351645 (76 Service Station #1156)
4276 MacArthur Boulevard
Oakland, California

SCALE: 1" = 30'
DATE: 7/18/2012
PROJECT NUMBER: 60264254 - A10

FIGURE NUMBER: 2

SHEET NUMBER: X

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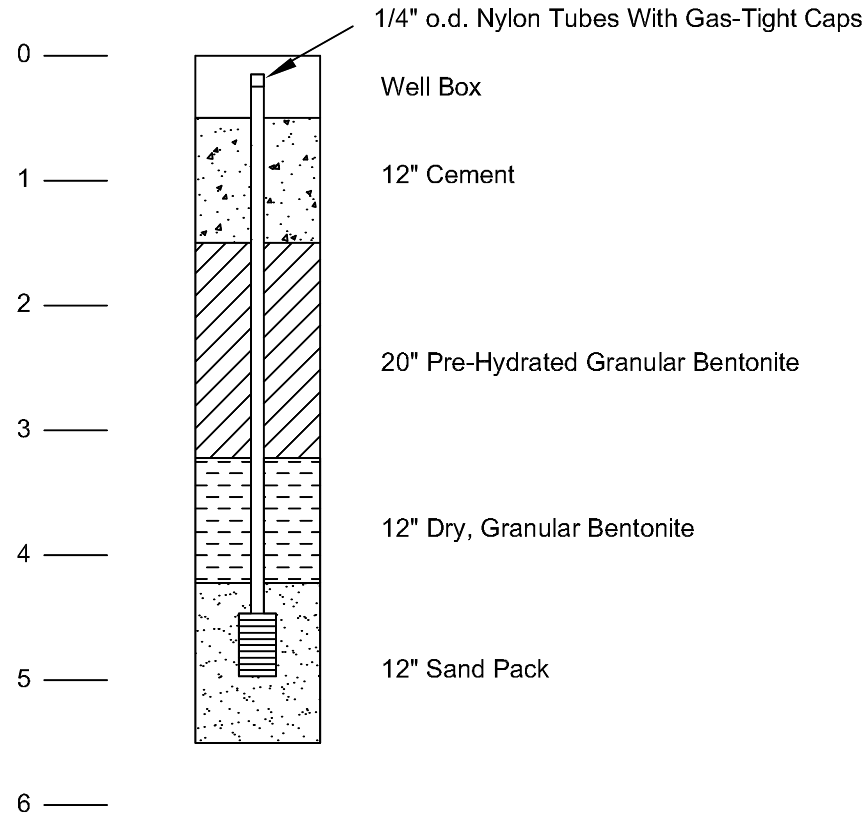

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PROPOSED SOIL VAPOR WELL CONSTRUCTION DIAGRAM

Chevron Site #351645 (76 Service Station #1156)
4276 MacArthur Boulevard
Oakland, California

FIGURE NUMBER:
3

DRAWN BY:	DATE:	PROJECT NUMBER:	SHEET NUMBER:
M. Scop	7/17/2012	60264254 - A10	X

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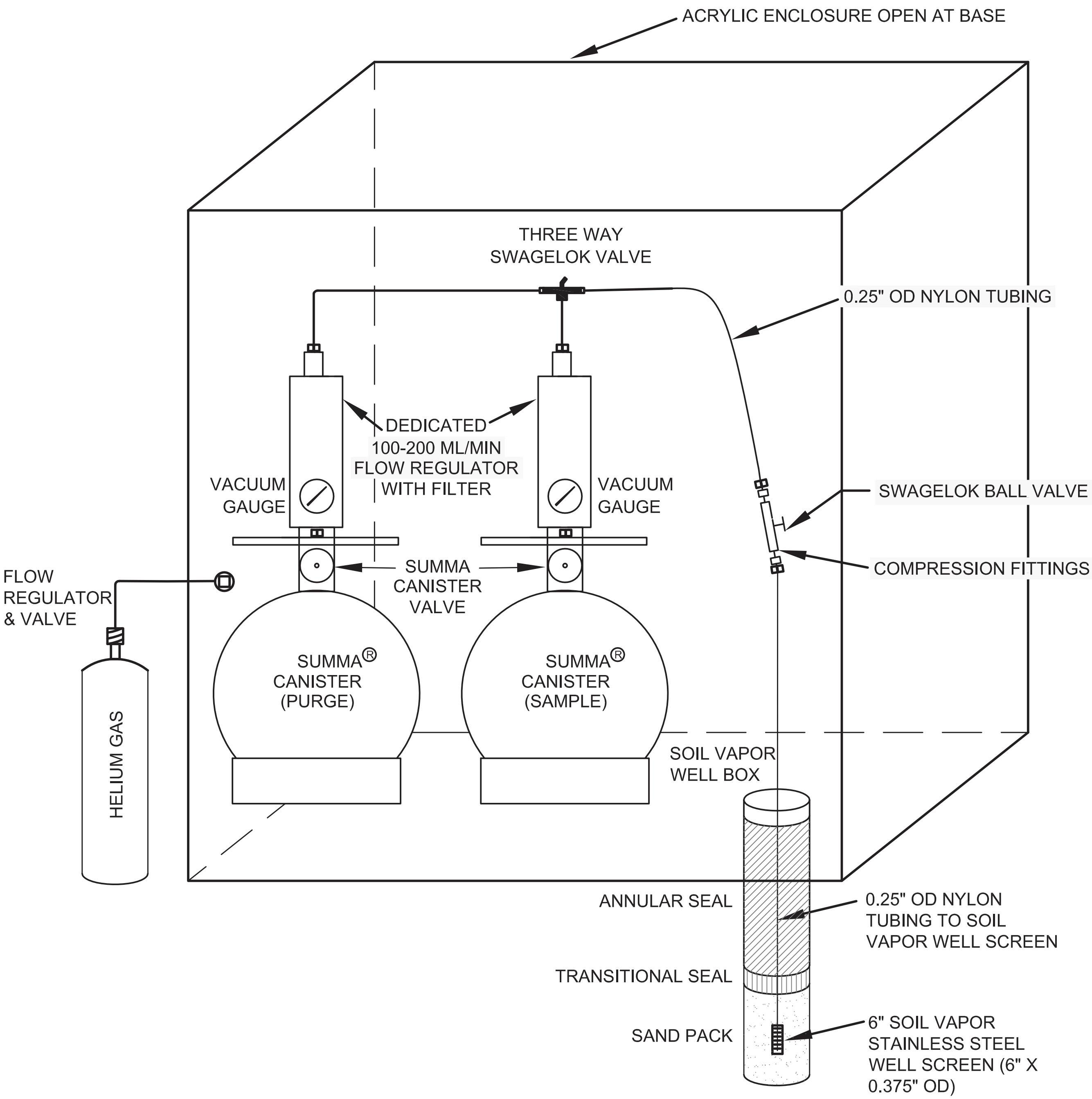

AECOM
10461 OLD PLACERVILLE ROAD SUITE 170
SACRAMENTO, CALIFORNIA 95827
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FAX: (916) 361-6401
WEB: HTTP://WWW.AECOM.COM

SOIL VAPOR SAMPLING APPARATUS

Chevron 351645 (Unocal #1156)
4276 MacArthur Boulevard
Oakland, California 94611

FIGURE NUMBER:
4

DRAWN BY:	DATE:	PROJECT NUMBER:	SHEET NUMBER:
JH	07/12/12	60264254	1

APPENDIX B – Sanborn Fire Insurance Maps

Former Unocal Site No. 1156
4276 Macarthur Boulevard
Oakland, CA 94619

Inquiry Number: 3283518.3
March 23, 2012

Certified Sanborn® Map Report

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
800.352.0050
www.edrnet.com

Certified Sanborn® Map Report

3/23/12

Site Name:
Former Unocal Site No. 1156
4276 Macarthur Boulevard
Oakland, CA 94619

EDR Inquiry # 3283518.3

Client Name:
AECOM
1220 Avenida Acaso
Camarillo, CA 93012

Contact: Brenda Evans

EDR® Environmental Data Resources Inc

The complete Sanborn Library collection has been searched by EDR, and fire insurance maps covering the target property location provided by AECOM were identified for the years listed below. The certified Sanborn Library search results in this report can be authenticated by visiting www.edrnet.com/sanborn and entering the certification number. Only Environmental Data Resources Inc. (EDR) is authorized to grant rights for commercial reproduction of maps by Sanborn Library LLC, the copyright holder for the collection.

Certified Sanborn Results:

Site Name: Former Unocal Site No. 1156
Address: 4276 Macarthur Boulevard
City, State, Zip: Oakland, CA 94619
Cross Street:
P.O. # NA
Project: 60249149-P10
Certification # 1CD0-4CEE-966F

Sanborn® Library search results
Certification # 1CD0-4CEE-966F

Maps Provided:

1969	1950
1968	1926
1966	1925
1965	1912
1957	
1952	

The Sanborn Library includes more than 1.2 million Sanborn fire insurance maps, which track historical property usage in approximately 12,000 American cities and towns. Collections searched:

- ✔ Library of Congress
- ✔ University Publications of America
- ✔ EDR Private Collection

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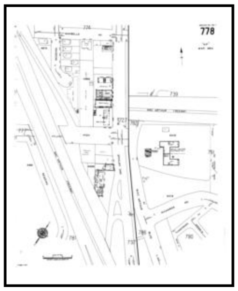
Sanborn Sheet Thumbnails

This Certified Sanborn Map Report is based upon the following Sanborn Fire Insurance map sheets.

1969 Source Sheets

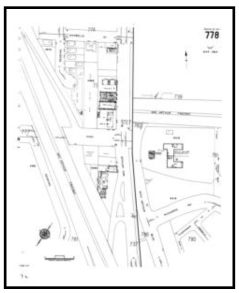
Volume 7, Sheet 727



Volume 7, Sheet 778

1968 Source Sheets

Volume 7, Sheet 727

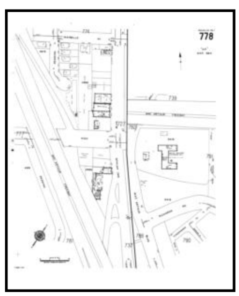


Volume 7, Sheet 778

1966 Source Sheets

Volume 7, Sheet 727

Volume 7, Sheet 774



Volume 7, Sheet 778

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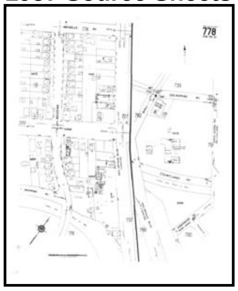
Volume 7, Sheet 778

Volume 7, Sheet 727

1957 Source Sheets



Volume 7, Sheet 778

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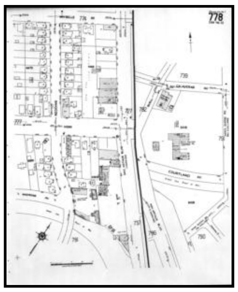


Volume 7, Sheet 727

Volume 7, Sheet 778

1950 Source Sheets

Volume 7, Sheet 727

Volume 5, Sheet 530

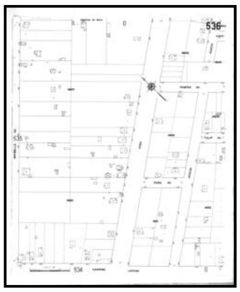
1926 Source Sheets

Volume 7, Sheet 727

1925 Source Sheets

Volume 5, Sheet 530

1912 Source Sheets



Volume 5, Sheet 534

Volume 5, Sheet 536

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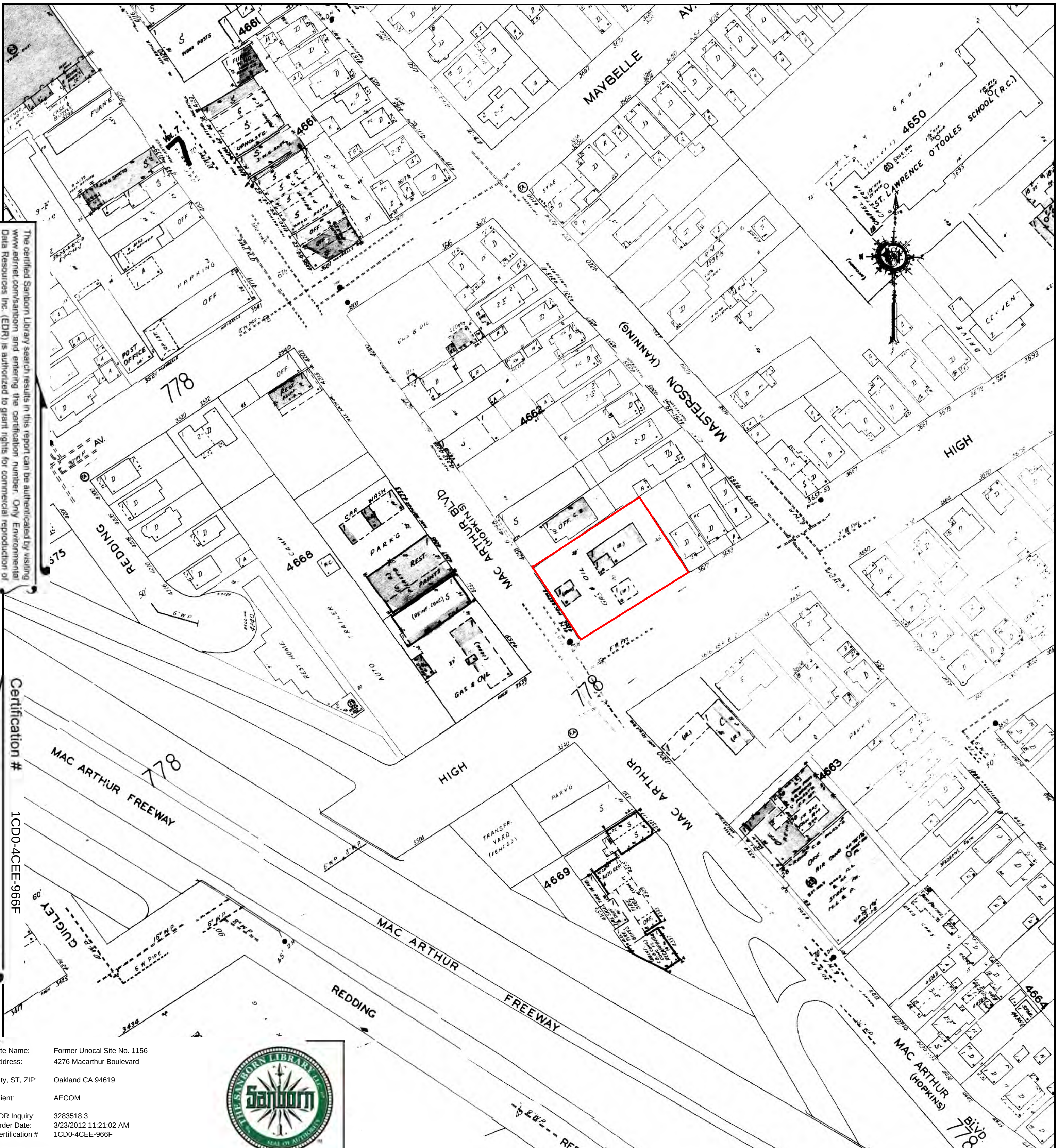

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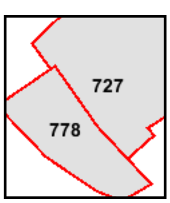

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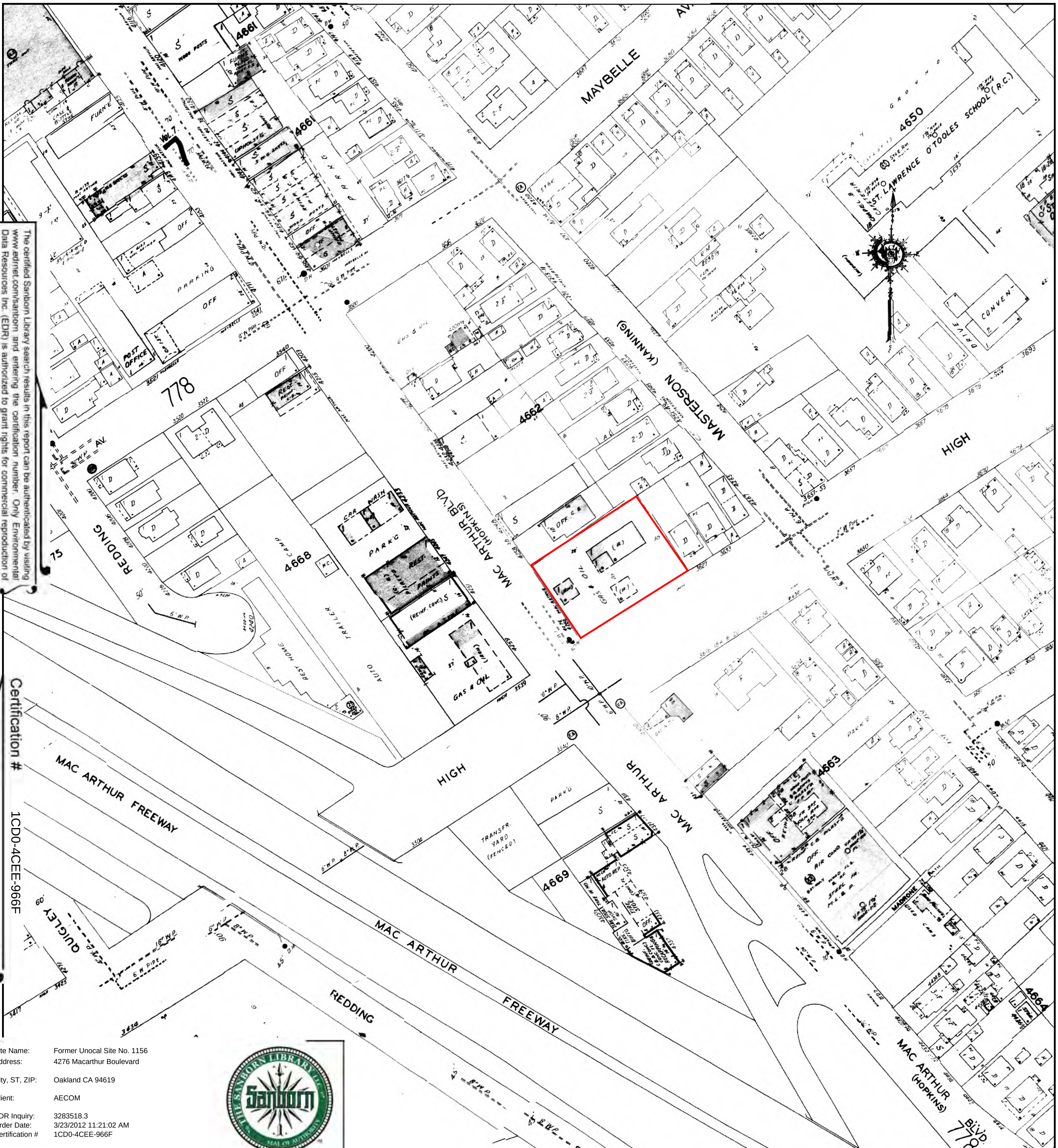

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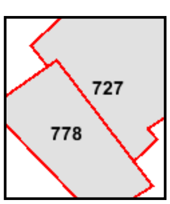

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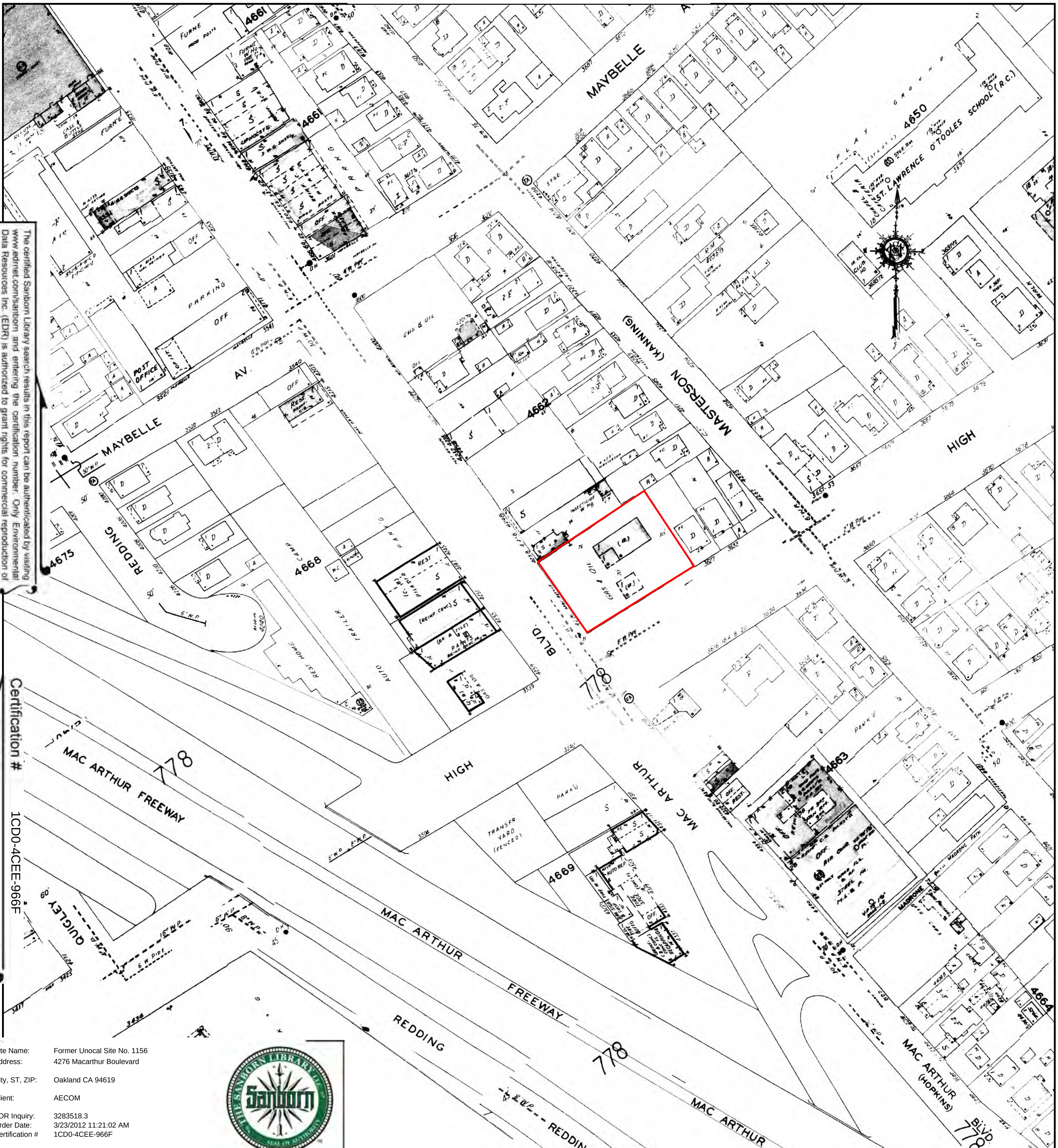

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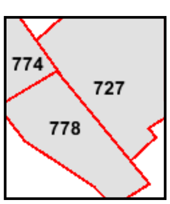

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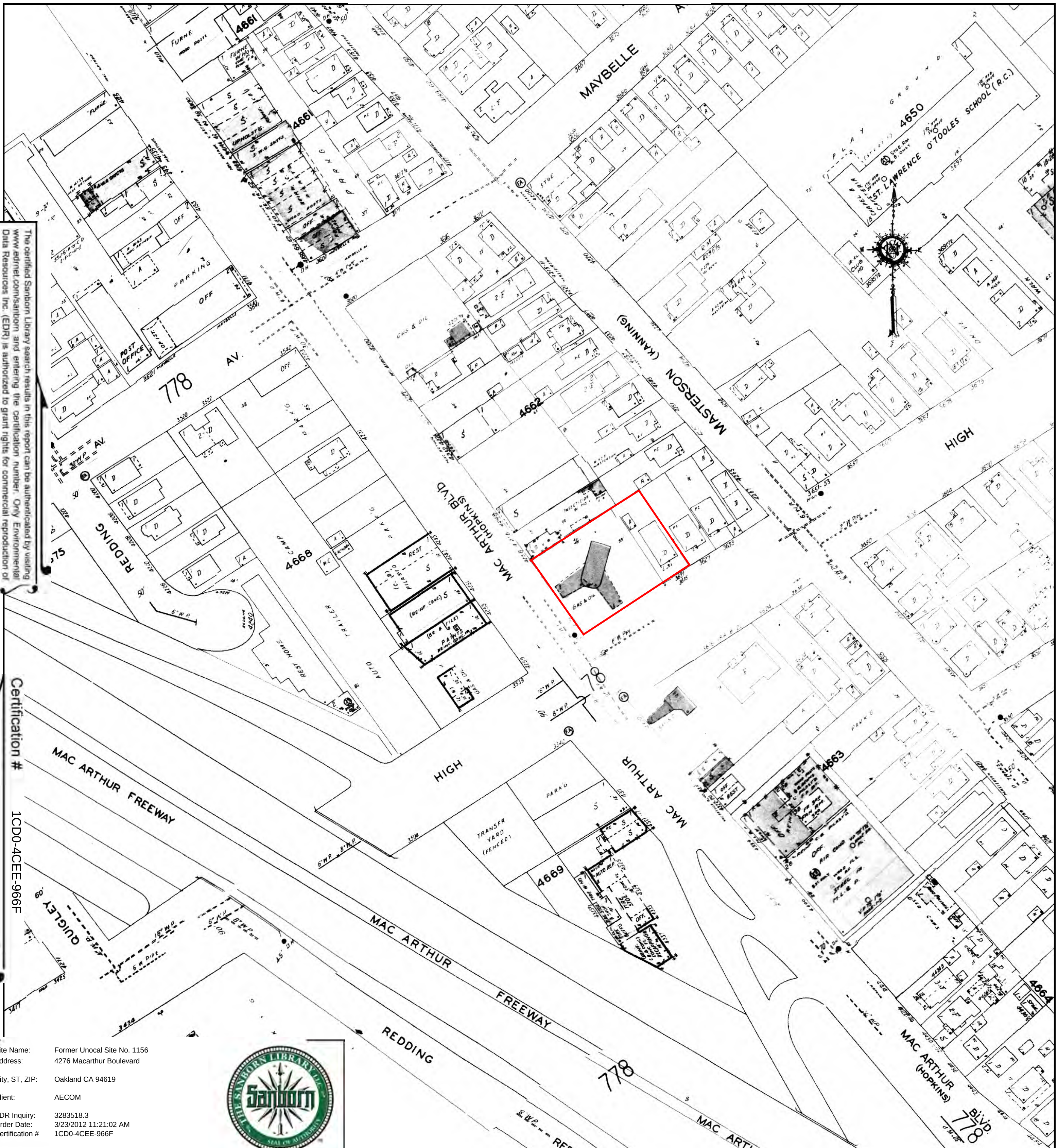

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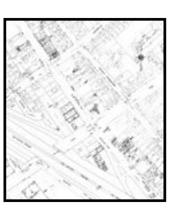

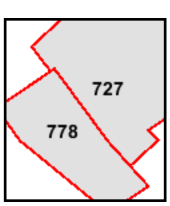

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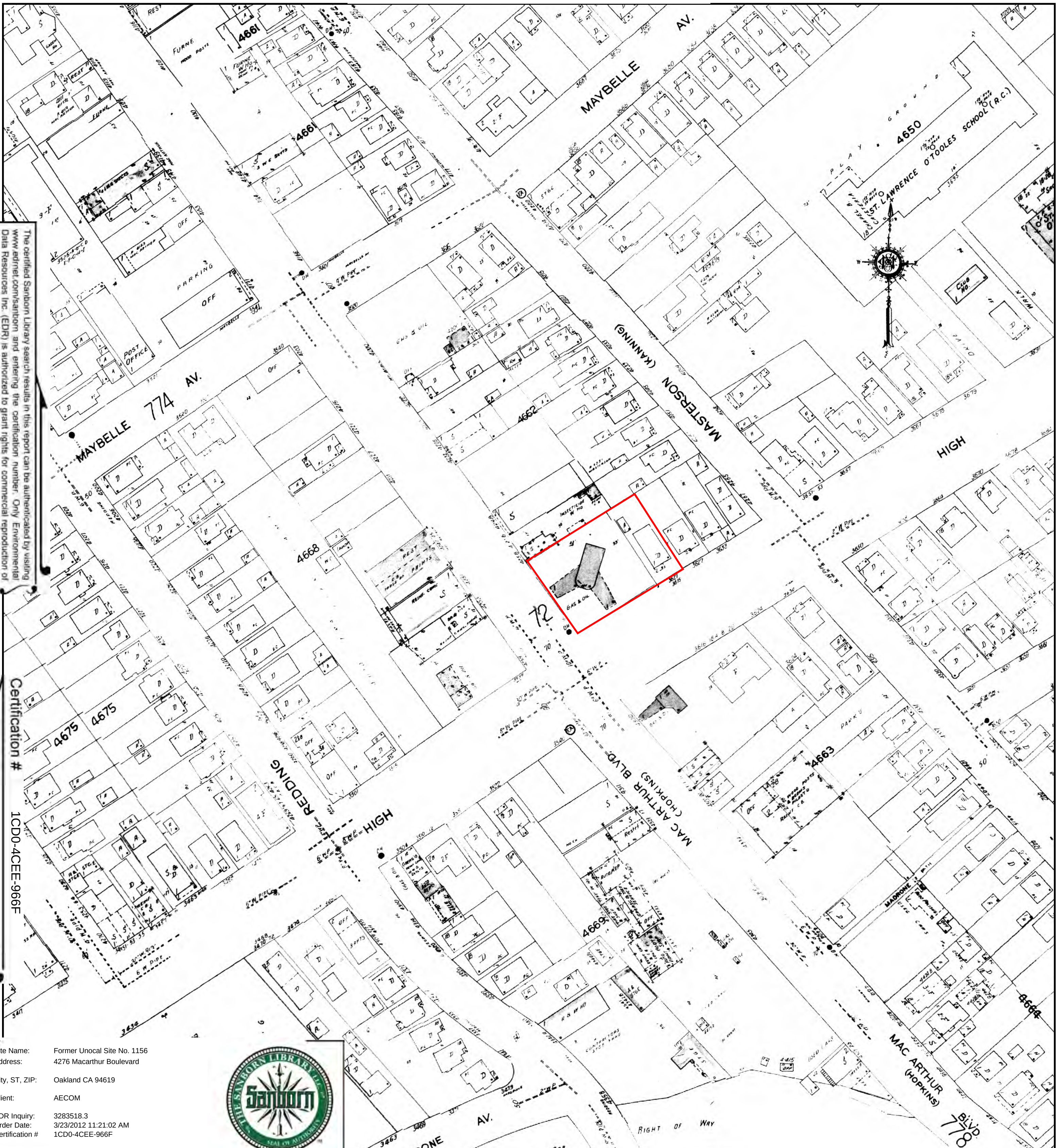

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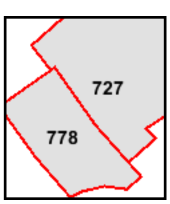

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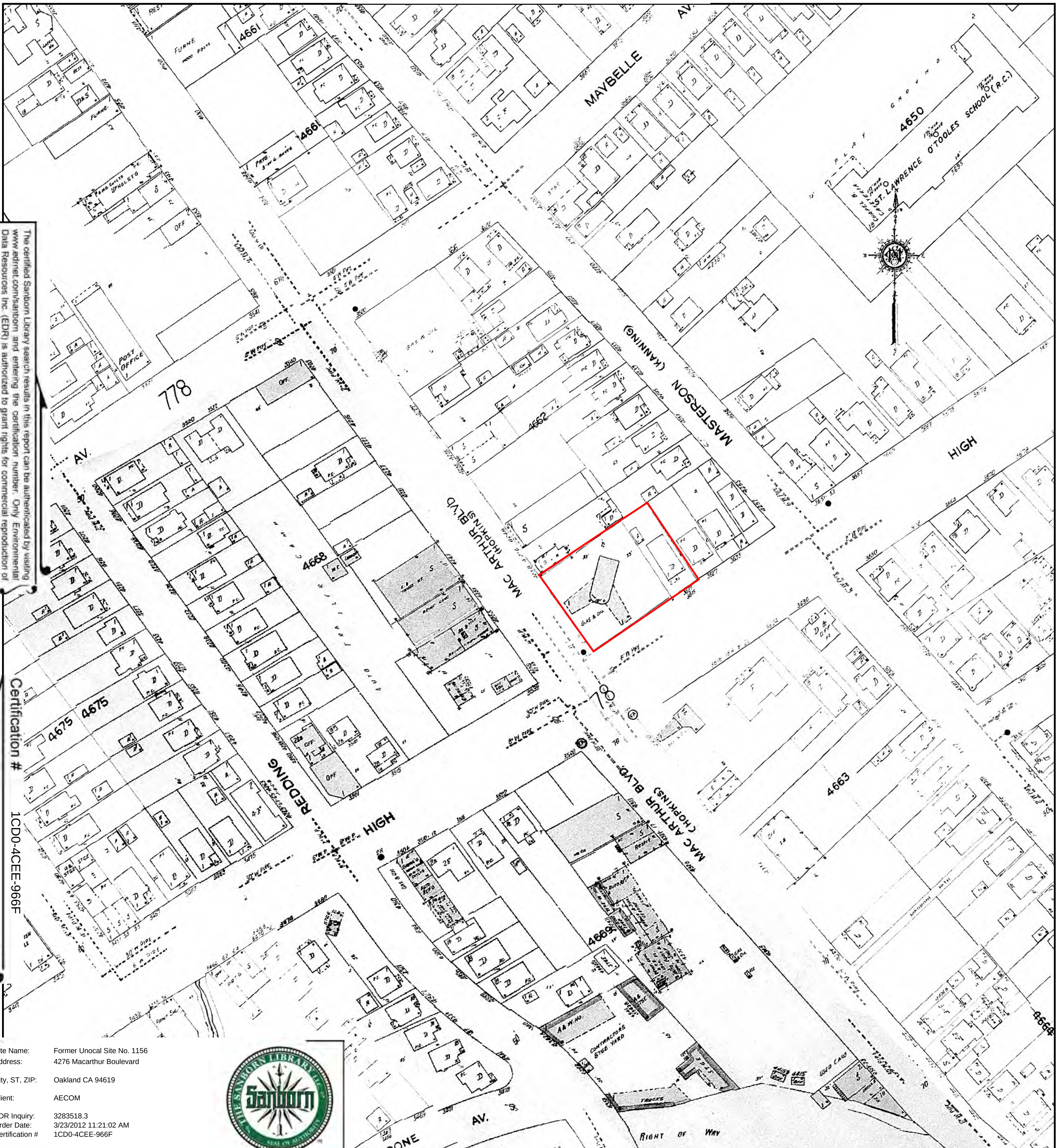

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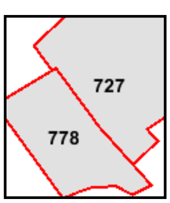

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Volume 7, Sheet 778

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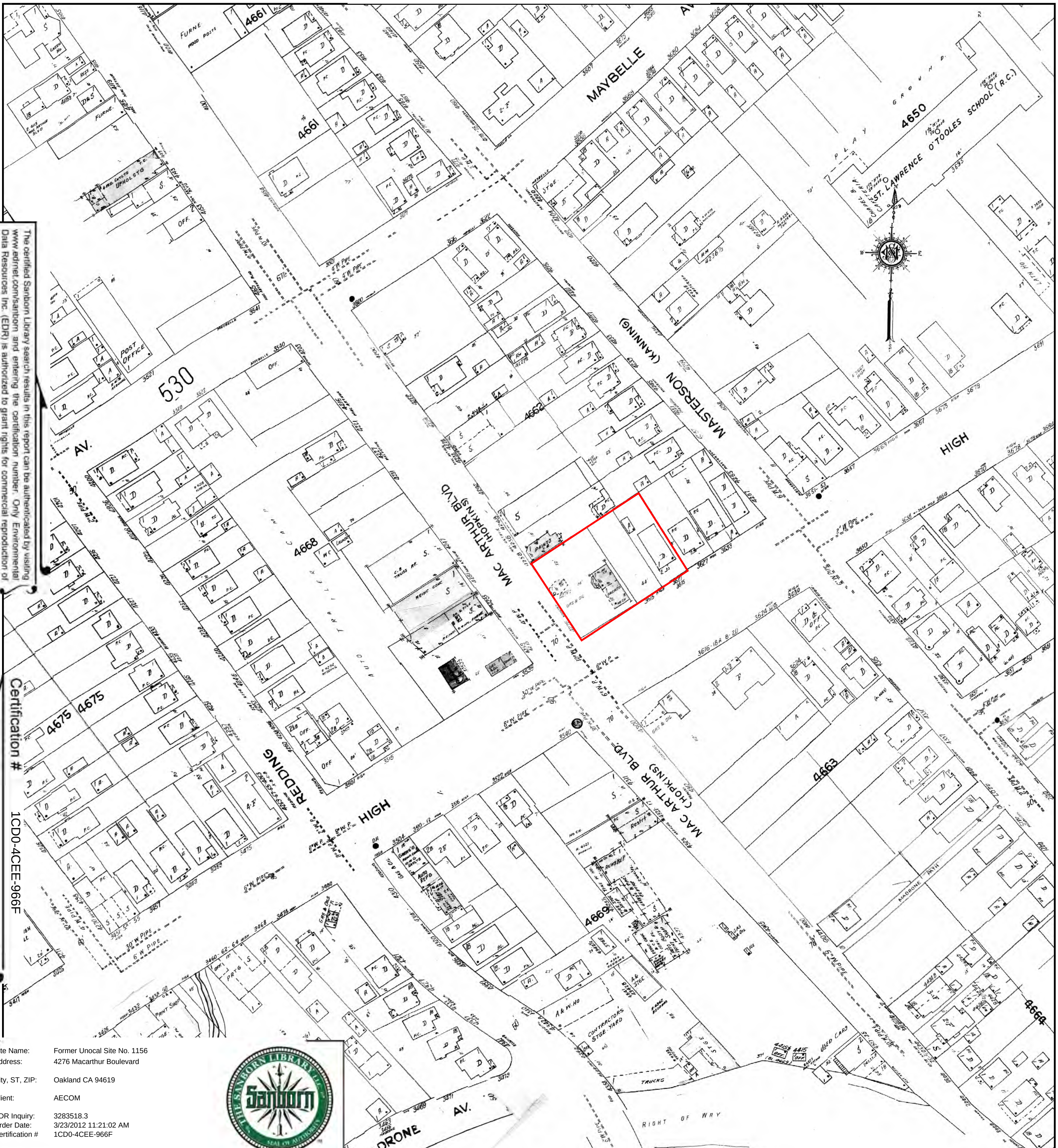

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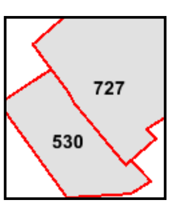

Volume 7, Sheet 727
Volume 5, Sheet 530

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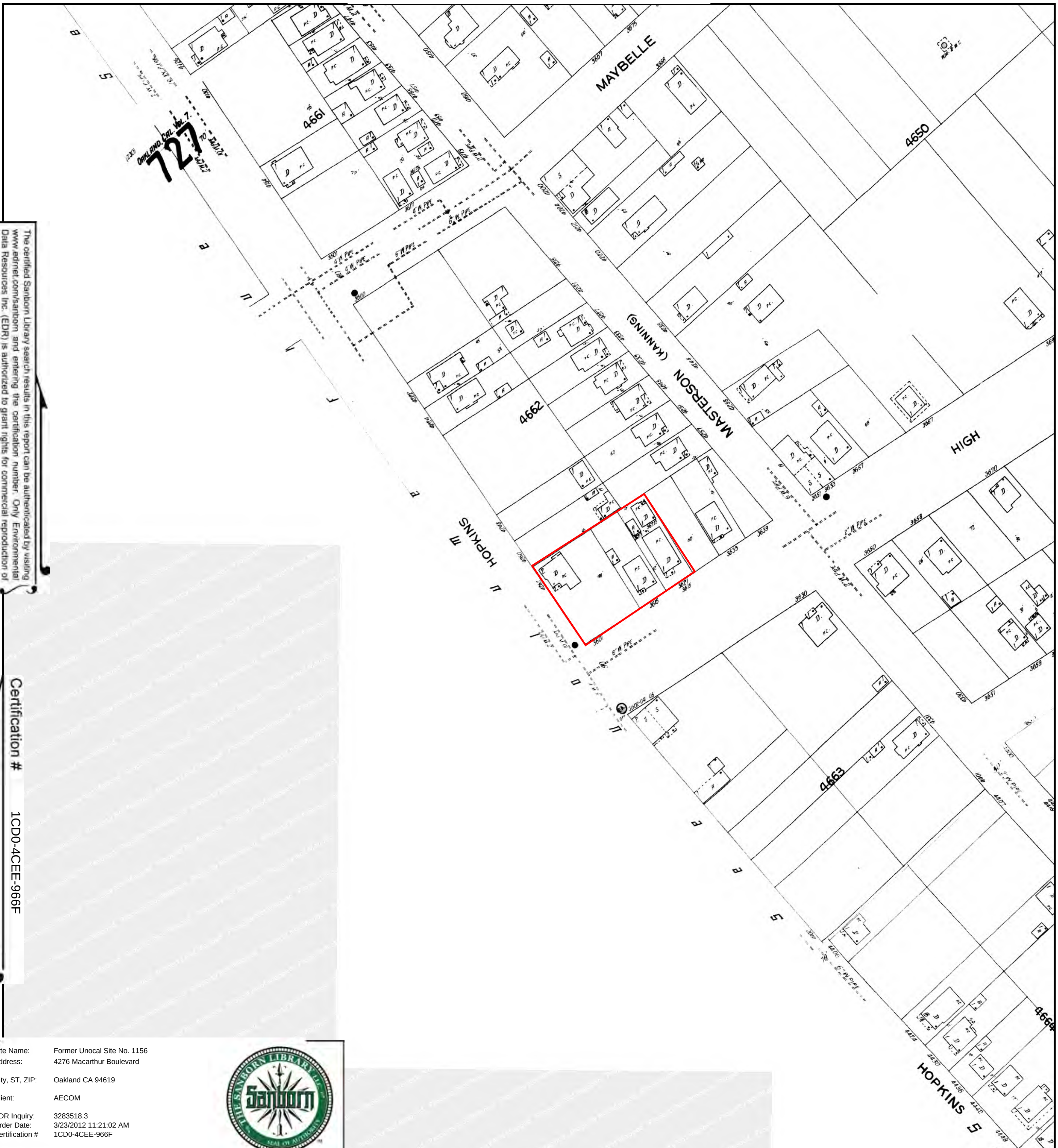
1926 Certified Sanborn Map



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Certification #

1CD0-4CEE-966F

Site Name:	Former Unocal Site No. 1156
Address:	4276 Macarthur Boulevard
City, ST, ZIP:	Oakland CA 94619
Client:	AECOM
EDR Inquiry:	3283518.3
Order Date:	3/23/2012 11:21:02 AM
Certification #	1CD0-4CEE-966F
Copyright:	1926

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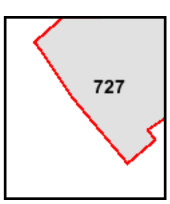

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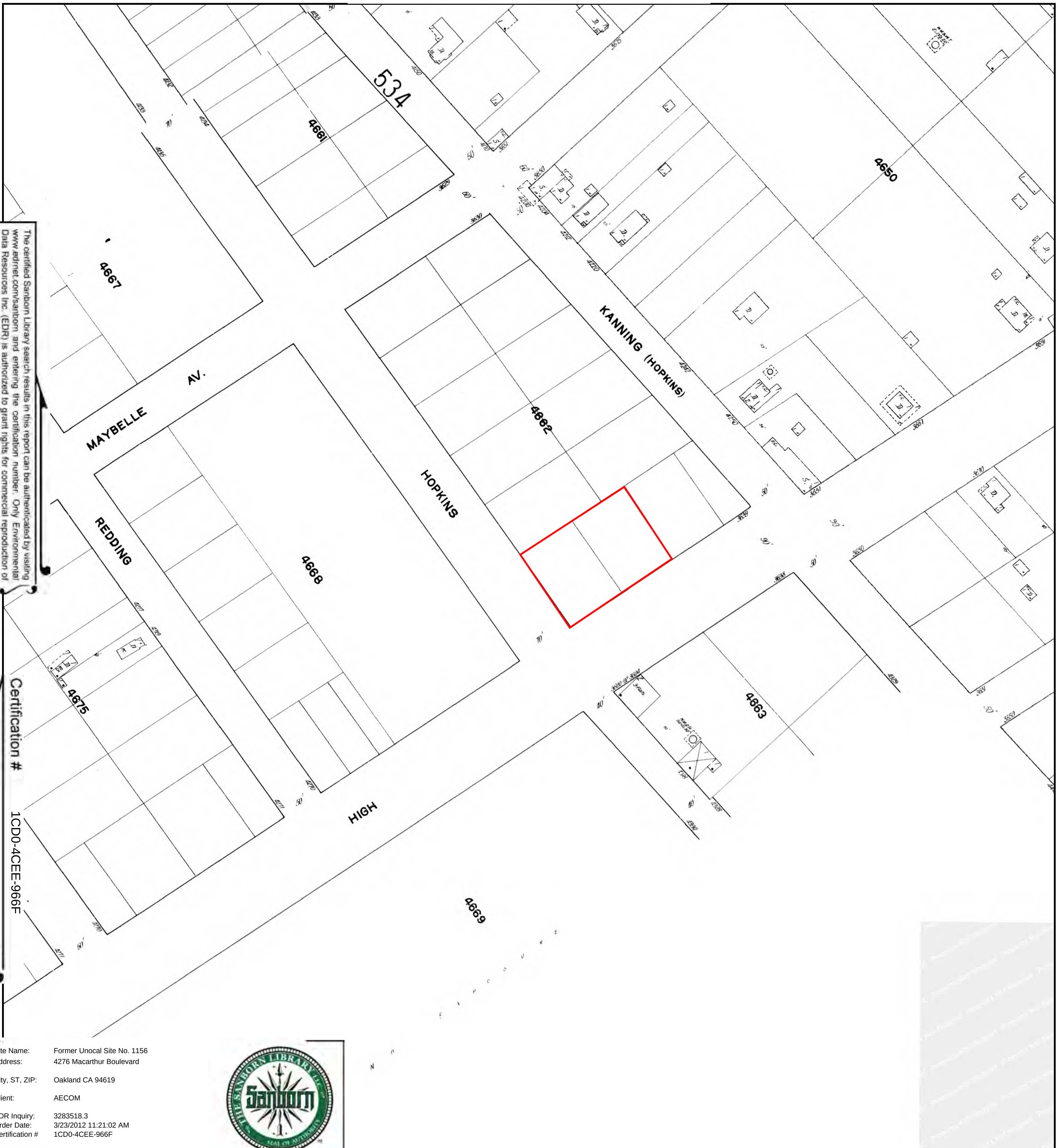
1912 Certified Sanborn Map



Certification # 1CD0-4CEE-966F

Site Name: Former Unocal Site No. 1156
Address: 4276 Macarthur Boulevard
City, ST, ZIP: Oakland CA 94619
Client: AECOM
EDR Inquiry: 3283518.3
Order Date: 3/23/2012 11:21:02 AM
Certification # 1CD0-4CEE-966F
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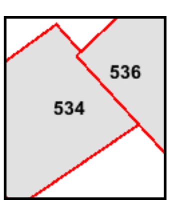

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