APPENDIX A

PUBLIC COMMENTS IN RESPONSE TO THE NOTICE OF PREPARATION

Department of Planning & Development

SENT VIA U.S. MAIL and EMAIL

Raphael Breines
Senior Planner
Physical & Environmental Planning
University of California, Berkeley
300 A&E Building
Berkeley, CA 94720
email – rbreines@berkeley.edu

Subject: Response to Notice of Preparation of a Draft Supplemental Environmental Impact Report for the Upper Hearst Development for the Goldman School of Public Policy (GSPP) and Minor Amendment to the 2020 Long Range Development Plan (LRDP)

Dear Raphael Breines,

We appreciate the opportunity to submit comments on the Notice of Preparation (NOP) for the GSPP project and the amendment to the 2020 Long Range Development Plan and we look forward to continued collaboration on next steps.

The NOP addresses two issues: 1) changes to the 2020 LRDP land use plan to accommodate the proposed GSPP project[1] and 2) an increase in current and foreseeable campus population levels above those analyzed in the 2020 LRDP Environmental Impact Report.

In 2005, UC Berkeley released the 2020 Long Range Development Plan and accompanying EIR to establish a framework for the University's land use and capital investments through the year 2020. Also in 2005, UC Berkeley and the City of Berkeley entered into an agreement, valid through spring 2021, regarding planning and development in Berkeley, which includes an annual payment from the University to the City of Berkeley to mitigate the University's impacts on City services, infrastructure, and other aspects of community quality of life.

As you know, the University's student enrollment far exceeds the figures identified in the LRDP and EIR. The City appreciates that the University is taking tangible steps to address the growth in the student population through its strategy to significantly increase the number of beds for students over the next 10 years and beyond. In addition to housing, the growing campus population also has impacts on a range of City services, including traffic and parking

[1] The GSPP project was reviewed as a courtesy by the City's Landmarks Preservation Commission (LPC) on September 6, 2018; comments from that meeting will be forwarded to you under separate cover.

management, public safety, public health, solid waste management and stormwater. At the same time, we are appreciative of the many ways that the University brings benefits to the city.

The amendment to the LRDP is a good opportunity for the City and University to work together to ensure that the impacts of the growing campus population are accounted for and mitigated. Under CEQA, these impacts must be addressed and, if necessary, mitigated in the Supplemental EIR. The City is in the process of collecting and analyzing data that can illustrate the benefits and impacts of the growth of the campus community, and we look forward to sharing that information as part of this supplemental EIR process.

As the University has expressed, the City and the University have a shared interest in continuing to make Berkeley a desirable place to work, live, play, and study. The City's public safety, parks, transit, commercial areas, and rich arts and cultural scene are a major attraction to students, faculty, and staff. The City and the University have always worked closely together to ensure that City services and University programs remain in balance. We look forward to working with you on the planning and environmental review process for this project as well.

Thank you for the opportunity to engage on these important issues with you and for your continued collaboration.

Sincerely,

Timothy Burroughs
Director, Department of Planning & Development

cc: Vini Bhargava, Director, Physical and Environmental Planning

September 14, 2018

Mr. Raphael Breines
Senior Planner
Physical and Environmental Planning
University of California, Berkeley

via email: rbreines@berkeley.edu

Dear Mr. Breines:

This letter responds to the University of California's Notice of Preparation for the Upper Hearst Development for the Goldman School of Public Policy Project, dated August 15, 2018.

As you know, the proposed project was presented to both the Landmarks Preservation Commission and the City of Berkeley Design Review Committee earlier this year.

At its September regular meeting the Berkeley Landmarks Preservation Commission discussed the Upper Hearst project. The Commission (seven members present) unanimously resolved that a letter should be sent to the University expressing a number of concerns about the Upper Hearst Project.

We note in introduction that the Landmarks Preservation Commission does not object to the creation of new academic facilities facing Hearst Avenue, or multi-unit campus-related housing on this block. Both are appropriate uses.

However, the project as proposed is too physically massive and inappropriately designed for this site.

The decision to perch a huge new residential building atop a three story existing parking structure is especially problematic. A housing structure alone or combined housing / academic building might work for this neighborhood context, with suitable modifications to massing and exterior character. The housing-atop-parking parti does not work well.

Unless significantly modified, the project will do serious, perhaps irreparable, harm to one of Berkeley's most architecturally and culturally important neighborhoods, an area with national architectural and historic significance containing a dense concentration of well documented and recognized historic structures.

The Draft Supplemental EIR should propose and evaluate modifications to the project or alternative projects that would mitigate the negative impacts on the neighborhood and on individual adjacent and nearby historic resources. This must not be a sham review in which inherently infeasible alternatives are proposed then automatically rejected, but a serious discussion of practical alternatives. At least one alternative should examine a project with the complete removal of the parking structure, and one should consider a reduction in the program size of the GSPP addition or the shifting of more of the GSPP addition building away from the adjacent historic structures.

The Northside neighborhood surrounding the Upper Hearst "site" is at the historical center of one of Berkeley's most distinctive and important architectural districts.

City Landmarks, National Register sites, SHRI properties and other recognized and documented historic resources abound in the immediate vicinity and on the project block. The project location is adjacent or within a few hundred feet of buildings designed by Ernest Coxhead, Bakewell and Brown, John Galen Howard, and Bernard Maybeck.

The first home Maybeck designed in Berkeley was done for Charles Keeler who became the most prominent exponent of "building with nature"; it is just up Ridge Road. Other regionally important homes very close to the project site include Weltevreden (the former Volney Moody House, and the current Tellefson Hall) and Allanoke (designed by Ernest Coxhead). Clyne Court, Howard's superbly successful essay in shingle style multi-family apartment sits adjacent to the project and could be a model for sensitively designed housing on this block.

Founders' Rock, the location where the Berkeley campus was both "consecrated for learning" in 1860 and where the name, Berkeley, was inspired in 1866, lies directly cross the street. "Annie's Oak", a re-planted oak tree at a site famous in Berkeley history where the original ancient tree was saved from cutting by Mrs. Annie Maybeck, is a block away.

The saving of the original tree on this site was a leading example of the influential advocacy of Berkeley's Hillside Club which called for buildings to integrate and harmonize with the natural environment. The proposed Upper Hearst project is an vivid example of the opposite.

The surviving buildings and 19th / early 20th century context of the neighborhood are given added importance by the fact that the 1923 Berkeley Fire, which destroyed some 600 homes in North Berkeley, obliterated much of Berkeley's original "brown shingle" and Arts & Crafts heritage. On the Northside, only a few scattered structures and a small triangle of developed blocks did not burn, giving the remaining pre-1923 buildings additional significance as rare survivors. The Upper Hearst site is in the midst of that triangle of survivors and on the same block with two of the most important of them.

Our concerns focus on these issues:

- the University and its consultants appear to have undertaken no study of, and seem to be largely unaware of, the special historical and architectural significance of this site and its neighborhood, including the history described above. The project architect stated at the Design Review Committee that he had been given no materials on the neighborhood history or context by the University and had not sought out any historical research materials on his own before preparing a design. The University appears to have conducted a design competition for the project without any reference to the historic character of the immediate environs and the broader neighborhood;
- This complacently a-historical attitude displayed by the design team and University representatives at LPC and Design Review Committee meetings is discouraging and worrisome;
- the proposed structures in the project are too massive for their sites, rising several stories (including parking levels) above street level. The structures will overwhelm both the adjacent landmark buildings and the overall neighborhood;
- the linear massing of the new buildings crowds the street and gives no relief from the appearance of a solid, unrelieved, wall of construction inconsistent with a fine-grained neighborhood containing along its edge a mix of residential and institutional structures;
- the program for the project—in terms of both the size of the residential building, and the square footage projected for the Goldman School addition—is quite possibly too large for this site, especially with the retention of the large and bulky corner parking structure;
- the relentlessly modernist exterior of the proposed buildings, including the colors, materials, and detailing, present an "anywhere" and bland modern architectural character that entirely ignores the neighborhood context. The buildings as designed display no sensitively to their surroundings and no sense of a "contemporary / compatible" design approach that would harmonize with the neighborhood.

We urge the University to consult at least the following written historic resources in the CEQA process to provide an accurate and informed historical foundation for planning and design on this site. No accurate and meaningful environmental review of cultural resources can be credibly undertaken without thorough study of, and reference to, these documents to set and understand the cultural and architectural context of this neighborhood.

The materials that should be consulted include, but are not limited to:

- Berkeley Landmarks (Susan Cerny)
- The Architectural Guide: University of California, Berkeley (Harvey Helfand)
- Northside (Susan Cerny)
- 41 Berkeley Walking Tours (Susan Cerny, editor)
- Berkeley Rocks (Jonathan Chester and David Weinstein)
- The Simple Home (Charles Keeler)
- The University's own previous Historic Structures Reports and similar evaluations, and related Cultural Resources sections of CEQA studies researched and written by architectural historians for Cloyne Court, the Graduate School of Public Policy Complex (including the Beta Theta Pi Fraternity), the Foothill dormitory complex, the Naval Architecture Building (now Blum Hall), and Stern Hall.
- Online articles posted on the BerkeleyHeritage.com website dealing with buildings in the immediate neighborhood and vicinity, and/or notable architects who worked there. This would include, but not be limited to, articles and essays regarding Cloyne Court, Charles Keeler and Bernard Maybeck, the Beta Theta Pi fraternity, Bakewell and Brown, Ernest Coxhead, and the Bennington Apartments.

City of Berkeley Planning staff can also supply copies of the landmark applications and designations and SHRI listings for the several officially designated City Landmarks and other historic resources in the vicinity.

In conclusion, we would like to note that in the 1950s and 1960s the University thoughtlessly destroyed much of what remained of the Northside neighborhood, buying and demolishing homes (including a number of large student group quarters), and inserting awkwardly sited and poorly designed structures such as Etcheverry Hall, and two massive parking structures north of Hearst Avenue.

On the Upper Hearst site the University demolished the original Newman Hall (Roman Catholic Student Center) which was one of Berkeley's most handsome and admired institutional buildings outside the campus, and left the land as an unimproved surface parking lot for decades.

In the 1980s and 1990s the University did undertake what could be considered some "repair" to the neighborhood fabric by building a relatively modestly scaled and architecturally compatible addition to the Public Policy School, and constructing the Foothill Housing complex which, although quite large, did break its massing into several buildings and stepped elevations and employed a number of exterior materials reflecting the neighborhood character including wooden shingles, unpeeled redwood logs, and green, shingled, roofs.

(We note that to give the appearance of a shingled structure, the shingles used for roof and walls need not be wooden. Saying that wood cannot be used as an exterior element on the proposed Upper Hearst buildings is not an insurmountable barrier to creating an exterior that appears to have a wooden, Arts & Crafts, character.)

The University has now inexplicably retrenched from those days and seems intent on constructing another out of character and context design assault on this enduring, but still fragile, district of Berkeley history. We ask the campus reverse this approach and plan instead a appropriately scaled, massed, and designed project for this block.

The Commission anticipates discussing and commenting on the Draft Supplemental EIR when it is released. Because of public noticing requirements for meeting agendas, we ask that the release of the Draft Supplemental be scheduled so the Commission may routinely place it on a regular meeting agenda (first Thursday of the month) for review in a timely manner, and also retain at least two weeks following the Commission meeting to prepare and submit comments if the Commission so desires.

Sincerely,

Steven Finacom
Chair
Berkeley Landmarks Preservation Commission

cc:

Fatema Crane, City of Berkeley Planning and Development

EAST BAY
MUNICIPAL UTILITY DISTRICT

September 7, 2018

Raphael Breines, Senior Planner
Physical & Environmental Planning
University of California, Berkeley
300 A&E Building
Berkeley, CA 94720-1382

Re: Notice of Preparation of a Draft Supplemental Environmental Impact Report – Upper Hearst Development for the Goldman School of Public Policy and Minor Amendment to the 2020 Long Range Development Plan, Berkeley

Dear Mr. Breines:

East Bay Municipal Utility District (EBMUD) appreciates the opportunity to comment on the Notice of Preparation of a Draft Supplemental Environmental Impact Report for the Upper Hearst Development for the Goldman School of Public Policy and Minor Amendment to the 2020 Long Range Development Plan (Project) for the University of California, Berkeley (U.C. Berkeley) located in the City of Berkeley. EBMUD has the following comments.

WATER SERVICE

On January 29, 2004, EBMUD provided a written response to U.C. Berkeley for a Water Supply Assessment (WSA) for the U.C. Berkeley 2020 Long Range Development Plan which is attached for your reference. If the proposed Project exceeds the water use and land uses in the approved 2020 Long Range Development Plan WSA, a revised WSA pursuant to Section 15155 of the California Environmental Quality Act Guidelines and Section 10910-10915 of the California Water Code may be required. Please submit a written request to EBMUD to review the Project changes to determine if a revised WSA is required. Preparation of the revised WSA will require U.C. Berkeley to submit data and estimates of future water demands for the Project area to EBMUD. Please be aware that the revised WSA can take up to 90 days to complete from the day the request was received.

EBMUD's Santa Barbara Regulator and Summit Pressure Zones, with service elevation ranges of 400 to 500 feet and 500 to 700 feet, respectively, will serve the proposed Project. Effective January 1, 2018, water service for new multi-unit structures shall be individually metered or sub-metered in compliance with State Senate Bill 7 (SB-7). SB-7 encourages conservation of water in multi-family residential and mixed-use multi-family and commercial buildings through metering infrastructure for each dwelling unit, including appropriate water billing safeguards for both tenants and landlords. EBMUD water services shall be conditioned for all development projects that are subject to SB-7 requirements and will be released only after the Project sponsor has satisfied all requirements and provided evidence of conformance with SB-7. In addition, structures on a single parcel require separate water services. When the development plans are finalized, U.C. Berkeley should contact EBMUD's New Business Office and request a water service estimate to determine costs and conditions for providing water service to the proposed Project. Engineering and installation of water services require substantial lead time, which should be provided for in U.C. Berkeley's development schedule.

WASTEWATER SERVICE

EBMUD's Main Wastewater Treatment Plant (MWWTP) and interceptor system are anticipated to have adequate dry weather capacity to accommodate the proposed wastewater flows from this Project and to treat such flows provided that the wastewater generated by the Project meets the requirements of the EBMUD Wastewater Control Ordinance. However, wet weather flows are a concern. The East Bay regional wastewater collection system experiences exceptionally high peak flows during storms due to excessive infiltration and inflow (I/I) that enters the system through cracks and misconnections in both public and private sewer lines. EBMUD has historically operated three Wet Weather Facilities (WWFs) to provide primary treatment and disinfection for peak wet weather flows that exceed the treatment capacity of the MWWTP. Due to reinterpretation of applicable law, EBMUD's National Pollutant Discharge Elimination System (NPDES) permit now prohibits discharges from EBMUD's WWFs. Additionally, the seven wastewater collection system agencies that discharge to the EBMUD wastewater interceptor system ("Satellite Agencies") hold NPDES permits that prohibit them from causing or contributing to WWF discharges. These NPDES permits have removed the regulatory coverage the East Bay wastewater agencies once relied upon to manage peak wet weather flows.

A federal consent decree, negotiated among EBMUD, the Satellite Agencies, the Environmental Protection Agency (EPA), the State Water Resources Control Board (SWRCB), and the Regional Water Quality Control Board (RWQCB), requires EBMUD and the Satellite Agencies to eliminate WWF discharges by 2036. To meet this requirement, actions will need to be taken over time to reduce I/I in the system. The consent decree requires EBMUD to continue implementation of its Regional Private Sewer Lateral Ordinance (www.eastbaypsl.com), construct various improvements to its interceptor system, and identify key areas of inflow and rapid infiltration over a 22-year period. Over the same time period, the consent decree requires the Satellite Agencies to perform I/I reduction work including sewer main rehabilitation and elimination of inflow sources. EBMUD and the Satellite Agencies must jointly demonstrate at specified intervals that this work has resulted in a sufficient, pre-determined level of reduction in WWF discharges. If sufficient I/I reductions are not achieved, additional investment into the region's wastewater infrastructure would be required, which may result in significant financial implications for East Bay residents.

To ensure that the proposed Project contributes to these legally required I/I reductions, U.C. Berkeley should comply with EBMUD's Regional Private Sewer Lateral Ordinance. Additionally, it would be prudent for U.C. Berkeley to require the following mitigation measures for the proposed Project: (1) replace or rehabilitate any existing sanitary sewer collection systems, including sewer lateral lines to ensure that such systems and lines are free from defects or, alternatively, disconnected from the sanitary sewer system, and (2) ensure any new wastewater collection systems, including sewer lateral lines, for the Project are constructed to prevent I/I to the maximum extent feasible while meeting all requirements contained in the Regional Private Sewer Lateral Ordinance and applicable municipal codes or Satellite Agency ordinances.

WATER CONSERVATION

The proposed Project presents an opportunity to incorporate water conservation measures. EBMUD requests that U.C. Berkeley comply with Assembly Bill 325, "Model Water Efficient Landscape Ordinance," (Division 2, Title 23, California Code of Regulations, Chapter 2.7, Sections 490 through 495) for the proposed Project. U.C. Berkeley should be aware that Section 31 of EBMUD's Water Service Regulations requires that water service shall not be furnished for new or expanded service unless all the applicable water-efficiency measures described in the regulation are installed at the Project sponsor's expense.

If you have any questions concerning this response, please contact Timothy R. McGowan, Senior Civil Engineer, Major Facilities Planning Section at (510) 287-1981.

Sincerely,

FOR

David J. Rehnstrom
Manager of Water Distribution Planning

DJR:KKN:dks
sb18_157.doc

Attachment: Letter to U.C. Berkeley from EBMUD dated January 29, 2004

EAST BAY
MUNICIPAL UTILITY DISTRICT

January 29, 2004

Jennifer Lawrence, Senior Planner
Environmental and Long Range Planning Office
University of California, Berkeley
300 A & E Building, #1382
Berkeley, CA 94607-4249

Dear Ms. Lawrence:

Re: Water Supply Assessment – University of California, Berkeley 2020 Long Range Development Plan

This letter responds to your request of October 22, 2003 for water agency consultation concerning the University of California, Berkeley (U.C. Berkeley) 2020 Long Range Development Plan (Enclosure 1). The East Bay Municipal Utility District (EBMUD) appreciates the opportunity to provide this response.

Pursuant to Sections 10910-10915 (SB-610) of the California Water Code, the project meets the threshold requirement for an assessment of water supply availability based on the amount of water this project would require, which would be greater than the amount of water required by a 500 dwelling unit project. Because this project is not a residential subdivision, Government Code Section 66473.7 (SB-221) does not apply.

Please note that this assessment addresses the issue of water supply only and is not a guarantee of service, and future water service is subject to rates and regulations in effect at the time.

Project Demand

The water demands for the U.C. Berkeley 2020 Long Range Development Plan project area are accounted for in EBMUD's water demand projections as published in EBMUD's 2000 Urban Water Management Plan (UWMP/Enclosure 2). EBMUD's water demand projections account for anticipated future water demands within EBMUD's service boundaries and for variations in demand-attributed changes in development patterns. The current water demand for the existing land uses in the U.C. Berkeley 2020 Long Range Development Plan project area is about 100,000 gallons per day (gpd). The projected demand, based on the projected water consumption by EBMUD for the project area, is estimated to be about 400,000 gpd, which is consistent with EBMUD's demand projections which indicate densification of these types of land uses.

Project Area

The U.C. Berkeley 2020 Long Range Development Plan project area is located in Berkeley and Oakland. The project area consists of approximately 1,400 acres that include the intensively developed Campus Park, the Hill Campus, and areas adjacent to the Campus Park. The Lawrence Berkeley National Laboratory is under Federal jurisdiction and therefore outside the scope of the U.C. Berkeley 2020 Long Range Development Plan.

The project under consideration includes the U.C. Berkeley 2020 Long Range Development Plan (program level analysis) and the Chang-Lin Tien Center for East Asian Studies (project level analysis). The 2020 Long Range Development Plan includes development of residential, classroom and laboratory space. Residential development will consist of 2,500 student housing bed units and 200 faculty/staff units. Approximately 1,540,000 square feet of general campus space and 660,000 square feet of laboratory space will also be constructed under the 2020 Long Range Development Plan. The Tien Center consists of two buildings totaling 103,500 square feet.

EBMUD Water Demand Projections

The water consumption of EBMUD customers has remained relatively level in recent years in spite of population and account growth. Between 1987 and the present, consumption has ranged from a high of approximately 220 million gallons per day (mgd) in 1987 to a low of 170 mgd in 1989. Based on extensive forecasting in EBMUD's Water Supply Management Program (WSMP) and recent land use based demand forecasting, the WSMP forecast 2020 water demand of 277 mgd can be reduced to 229 mgd with successful water recycling and conservation programs that are in place. The U.C. Berkeley 2020 Long Range Development Plan will not change the EBMUD 2020 demand projection.

EBMUD Water Supply and Water Rights

EBMUD has water rights and facilities to divert up to a maximum of 325 mgd from the Mokelumne River, subject to the availability of Mokelumne River runoff and the prior water rights of other users. EBMUD's position in the hierarchy of Mokelumne River water users is determined by a variety of agreements between Mokelumne River water right holders, the appropriative water rights permits and licenses that have been issued by the State, pre-1914 rights, and riparian rights. Conditions that restrict EBMUD's ability to use its 325 mgd entitlement include:

- Upstream water use by prior right holders.
- Downstream water use by riparian and senior appropriators and other downstream obligations, including protection of public trust resources.

- Drought, or less than normal rainfall for more than a year.
- Emergency outage.

During periods of drought, runoff from the Mokelumne River is insufficient to supply the 325 mgd entitlement. EBMUD studies indicate that, with its current water supply and the water demands expected in 2020, deficiencies in supply of up to 67 percent could occur during droughts.

EBMUD UWMP

The UWMP, adopted by the Board of Directors in Resolution No. 33242-01, includes planning level analyses at the County- and EBMUD-wide levels for existing and projected water demand. A summary of EBMUD's demand and supply projections in five-year increments is provided in a table (Enclosure 3) from the UWMP. The data reflects the latest actual and forecast values.

EBMUD's evaluation of water supply availability accounts for the diversions of both upstream and downstream water right holders and fishery releases. Fishery releases are based on the requirements of a 1998 Joint Settlement Agreement (JSA) between EBMUD and State and Federal wildlife agencies. The JSA requires EBMUD to make minimum flow releases from its reservoirs to the lower Mokelumne River to benefit the fishery. As this water is released downriver, it is, therefore, not available for use by EBMUD's customers.

The available supply shown in the table (Enclosure 3) in years 1, 2 and 3 of a multiple-year drought was determined by EBMUD's hydrologic model with the following assumptions:

- EBMUD Drought Planning Sequence is used for 1976, 1977, and 1978.
- Total system storage is depleted by the end of the third year of the drought.
- The diversions by Amador and Calaveras Counties upstream of Pardee Reservoir increase over time.
- Releases are made to meet the requirements of senior downstream water right holders and fishery releases are made according to the JSA.

As discussed under the Drought Management Program section in Chapter 3 of the UWMP, EBMUD's system storage generally allows it to continue serving its customers during dry-year events. EBMUD imposes rationing based on the projected storage at the end of September. By imposing rationing in the first dry year of potential drought, EBMUD attempts to minimize rationing in subsequent years if a drought persists while continuing to meet its current and subsequent-year fishery flow release requirements and obligations to downstream agencies. Table 3-1 in the UWMP summarizes the guidelines for consumer water reduction goals, based on system storage.

In the table (Enclosure 3), "Single Dry" year (or Year 1 of "Multiple Dry Years") is determined to be a year that EBMUD would implement Drought Management Program elements at the "moderate" stage with the goal of achieving between 0 to 15 percent reduction in customer demand. Year 2 of Multiple Dry Years is determined to be a year that EBMUD would implement Drought Management Program elements at the "severe" stage with the goal of achieving between 15 to 25 percent reduction in customer demand. In Year 3 of the multiple-year drought, deficiencies from about 48 percent in year 2005 to about 67 percent in year 2020 are forecast to occur. Therefore, a supplemental supply is needed, which is defined by EBMUD as the additional amount of water necessary to limit customer deficiency to 25 percent in a multiple-year drought while continuing to meet the requirements of senior downstream water right holders and the provisions of the 1998 JSA.

Supplemental Water Supply and Demand Management

The goals of meeting projected water needs and increased water reliability rely on three components: supplemental supply, water conservation, and recycled water.

Chapter 2 of the UWMP describes EBMUD's supplemental water supply project alternatives to meet its long-term water demand. To address the need for a supplemental water supply during droughts, EBMUD signed a contract in 1970 with the Federal government for a supplemental supply from the Central Valley Project (CVP). In 2001, EBMUD certified the environmental documentation amending its CVP contract 14-06-200-5183A, reducing EBMUD's contract from 150,000 acre-feet (AF)/year to an annual entitlement not to exceed 133,000 AF. In 2002, EBMUD signed a Memorandum of Agreement with the City of Sacramento, the County of Sacramento, and the U.S. Bureau of Reclamation to study a joint regional water project on the Sacramento River near Freeport. The Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) of the Freeport Regional Water Project identifies several regulatory permits and approvals required for the implementation of the project alternatives. These are listed in Table 2-6 of the Freeport Regional Water Project Draft EIR/EIS, July 2003.

Chapter 2 of the UWMP also describes other supplemental water projects, including the development of groundwater storage within EBMUD's service area. EBMUD is studying the environmental impacts of these proposed projects. Specific capital outlay and financing information for these projects are included in EBMUD's FY02-03 Budget and Five-Year Plan. The Freeport project would also allow for a future groundwater conjunctive use component and, along with the proposed local groundwater projects, emergency interties, and planned water recycling and conservation efforts, would ensure a reliable water supply to meet projected demands for current and future EBMUD customers within the current service area. Without a supplemental water supply source, continued conservation efforts and further use of recycled water, deficiencies in supply are projected as noted above.

The U.C. Berkeley 2020 Long Range Development Plan presents an opportunity to incorporate many water conservation measures. U.C. Berkeley should include in its conditions of approval for the implementation of the 2020 Long Range Development Plan that the project complies with Division 2, Title 231 California Code of Regulations, Chapter 2.7, Sections 490 through 495 (AB325), and with EBMUD water service regulations in force at the time the application is made. EBMUD staff would appreciate the opportunity to meet with U.C. Berkeley's staff to discuss water conservation programs and best management practices applicable to the project area. A key objective of this discussion will be to explore timely opportunities to expand conservation via early consideration of EBMUD's conservation programs and best management practices applicable to the project.

EBMUD's Policy 73 requires "...that customers...use non-potable water for non-domestic purposes when it is of adequate quality and quantity, available at reasonable cost, not detrimental to public health and not injurious to plant life, fish and wildlife" to offset demand on EBMUD's limited potable water supply. U.C. Berkeley has been identified as a potential customer for EBMUD's Satellite Recycled Water Treatment Facility Project. A study is currently underway to evaluate the feasibility of constructing a small satellite recycled water treatment facility to serve a large customer within the EBMUD wastewater service area, and the U.C. Berkeley campus is one of the large customers under consideration. EBMUD staff will continue to work with U.C. Berkeley as the study proceeds and will coordinate with U.C. Berkeley regarding the installation of dual plumbing systems where feasible.

The project sponsor should contact David J. Rehnstrom, Senior Civil Engineer, at (510) 287-1365 for further information.

Sincerely,

WILLIAM R. KIRKPATRICK
Manager of Water Distribution Planning Division

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sb04_001b.doc

Enclosures: 1. Letter of Request for Water Supply Assessment dated October 23, 2003
2. EBMUD's 2000 Urban Water Management Plan Area
3. EBMUD's Projected Demand and Available Supply Table

cc: Board of Directors w/o Enclosure 2

Enclosure 1

UNIVERSITY OF CALIFORNIA, BERKELEY

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO | SANTA BARBARA • SANTA CRUZ

CAPITAL PROJECTS
PHYSICAL AND ENVIRONMENTAL PLANNING
300 A & E BUILDING, # 1382

BERKELEY, CALIFORNIA 94720-1382

October 22, 2003

William R. Kirkpatrick
Manager of Water Distribution Planning
East Bay Municipal Utility District
375 Eleventh Street
Oakland, CA 94607-4249

WATER DISTRIBUTION
OCT 23 2003
PLANNING DIVISION

SUBJECT: Request for a Water Supply Assessment for the 2020 Long Range Development Plan pursuant to Section 10910 of the state Water Code and Section 15083.5, California Environmental Quality Act Guidelines

Dear Mr. Kirkpatrick:

This letter is to formally request that East Bay Municipal Utilities District undertake a water supply assessment (WSA) for UC Berkeley's proposed 2020 Long Range Development Plan (LRDP) pursuant to Section 10910 of the state Water Code and Section 15083.5 of the California Environmental Quality Act Guidelines using information on projected water demand provided in the attachment.

A Notice of Preparation (NOP) for this project was circulated for 30 days beginning August 29, 2003 (ref. *Initial Study Checklist and Notice of Preparation for UC Berkeley 2020 Long Range Development Plan and Chang-Lin Tien Center for East Asian Studies*, dated August 29, 2003). The University received a comment letter from EBMUD dated September 29, 2003 in response to the NOP which states that there was not enough information to assess future water demand. It is our hope that the supplemental information provided with this letter will make it possible to prepare a WSA on behalf of the 2020 LRDP.

As described in the NOP, the new development proposed in the 2020 LRDP – to be analyzed in the EIR – is a maximum of:

- 2,200,000 gross square feet (gsf) of campus academic and support space (including 660,000 gsf identified specifically as laboratory space)
- 2,500 student housing beds
- 200 units of staff/faculty housing

A maximum annual water demand projection was calculated for the 2020 LRDP by applying historical campus water usage to the proposed additional square footage and housing. The campus estimates an additional water demand of 404,000 gpd associated with the plan. Please refer to the attached worksheet for calculations and details.

Please call Billi Romain at (510) 643-4404 if there is any additional information you need to complete the Water Supply Assessment for the 2020 LRDP.

Sincerely,

Jennifer Lawrence

Jennifer Lawrence, Principal Planner
Environmental and Long Range Planning

Enclosure 3

PROJECTED DEMAND AND AVAILABLE SUPPLY
EAST BAY MUNICIPAL UTILITY DISTRICT

(million gallons per day - mgd)

	2000	2005	2010	2015	2020
Customer Demand[1]	230	242	257	267	277
Adjusted for Conservation[2]	(8)	(14)	(20)	(27)	(34)
Adjusted for Recycled Water[3]	(6)	(9)	(11)	(12)	(14)
Planning Level of Demand	216	219	226	228	229
Available Supply & Need for Supplemental Supply					
Normal Year	>216	>219	>226	>228	>229
Supplemental Supply Need	*0*	*0*	*0*	*0*	*0*
Single Dry Year (Multiple Dry Years - Year 1) Moderate Stage (approximately 7% deficiency)[4]	200	203	210	212	213
Supplemental Supply Need	*0*	*0*	*0*	*0*	*0*
Multiple Dry Years - Year 2 Severe Stage (approximately 25% deficiency)[4]	162	164	169	171	172
Supplemental Supply Need	*0*	*0*	*0*	*0*	*0*
Multiple Dry Years - Year 3					
Available Supply	125	114	95	84	77
Deficiency	42%	48%	58%	63%	67%
Supplemental Supply Need[5] (to limit deficiency to 25%)	*87*	*102*	*128*	*142*	*154*

1. *Demand taken from the 2000 Demand Study.*
2. *Conservation water savings goals from the WCMP 1999 Annual Report, 2 mgd in 1999 and 34 mgd for year 2020, linearly interpolated into five-year increments.*
3. *Chapter 5 of UWMP.*
   Note: Conservation and Reclamation savings reported are those attributed to programs which are a part of the 1993 WSMP. Reference Chapter 6 of UWMP.
4. *Drought conditions per Table 3-1, UWMP.*
5. *The supplemental supply need is calculated from modeling studies and is the amount of water needed to limit customer deficiency to 25 percent and to implement all provisions of the 1998 Joint Settlement Agreement.*

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Email: Lippelaw@sonic.net

September 14, 2018

Raphael Breines
Senior Planner
Physical & Environmental Planning
University of California, Berkeley
300 A&E Building, Berkeley, CA 94720-1382
Email: rbreines@berkeley.edu

Re: Scoping Comments: Upper Hearst Project CEQA Review

Dear Mr. Breines:

I write on behalf of Save Berkeley's Neighborhoods to submit scoping comments on the August 15, 2018, Notice of Preparation of a Draft Supplemental Environmental Impact Report for the Upper Hearst Development for the Goldman School of Public Policy and Minor Amendment to the 2020 Long Range Development Plan.

As you may know, Save Berkeley's Neighborhoods is the plaintiff in a pending lawsuit, entitled *Save Berkeley's Neighborhoods v. The Regents of the University of California*, Alameda County Superior Court Case No. RG18902751. A copy of the Petition for Writ of Mandate and Complaint for Declaratory Relief is attached for your reference.

Plaintiffs allege in this lawsuit that the Regents have failed to comply with their legal duty to evaluate the environmental impacts of increases in student enrollment that have occurred since the Regents certification of the EIR for the 2020 Long Range Development Plan (2020 LRDP) and that exceed enrollment increases disclosed in that EIR. The Petition for Writ of Mandate and Complaint for Declaratory Relief allege:

- In 2005, UCB adopted a Long Range Development Plan (2020 LRDP) to achieve a number of objectives through the year 2020, including stabilizing enrollment. In or about 2005, UCB certified a Final Environmental Impact Report for the 2020 LRDP (2005 EIR) pursuant to CEQA. The 2020 LRDP and 2005 EIR projected that by 2020 student enrollment at UCB would increase by 1,650 students above the 2001-02 two-semester average. The 2020 LRDP and 2005 EIR also projected that by 2020 UCB would add 2,500 beds for students.

- On October 30, 2017, UCB responded to the City of Berkeley's request for information regarding enrollment increases. This response shows the actual increase in student enrollment above the 2001-02 two-semester average for the most recent two-semester period (i.e., Spring 2017 and Fall 2017) is 8,302 students. This increase represents a five-fold increase compared to the 1,650 enrollment increase projected in the 2020 LRDP and 2005 EIR. The response also shows UCB has built fewer than 1,000 beds.

- The increase in student enrollment over and above the 1,650 additional students projected by the 2020 LRDP and included in the 2005 EIR's environmental impact analysis (hereinafter the "excess increase in student enrollment") has caused and continues to cause significant adverse environmental impacts that were not analyzed in the 2005 EIR. Plaintiff is informed and believes and on that basis alleges that these impacts include, without limitation, increased use of off-campus housing for and by UCB students, leading to increases in off-campus noise and trash; displacement of tenants resulting in more homeless individuals living on public streets and in local parks; increases in the number of UCB students who are homeless; increases in traffic and transportation related congestion and safety risks; and increased burdens on the City of Berkeley's public safety services, including police, fire, ambulance, and Emergency Medical Technician services.

- Respondents have had and continue to have a legal obligation to analyze the environmental effects of the excess increase in student enrollment pursuant to CEQA, including, without limitation, by preparing and certifying an Environmental Impact Report to assess the significance of impacts caused by the extraordinary increase in enrollment and to identify and adopt mitigation measures to reduce these significant impacts.

UCB's announced intention to combine in a single EIR the environmental review of the Upper Hearst capital improvement project and excess increases in enrollment presents number of legal and practical difficulties that can and should be avoided by separating them into two different EIRs.

UC's enrollment increases are a "CEQA project" in their own right as shown by Education Code section 67504 and Public Resources Code section 21080.9. Education Code section 67504 provides that "The Legislature further finds and declares that the expansion of campus enrollment and facilities may negatively affect the surrounding environment. Consistent with the requirements of the California Environmental Quality Act (CEQA), it is the intent of the Legislature that the University of California sufficiently mitigate significant off-campus impacts related to campus growth and development." Public Resources Code section 21080.9 requires that the University of California, Berkeley (UCB) "consider the environmental impact of academic and enrollment plans" pursuant to CEQA and "that any such plans shall become effective for a campus ... only after the environmental effects of those plans have been analyzed" as required by CEQA.

Even without these statutes, UC's enrollment increases are a CEQA project because they are "an activity directly undertaken by any public agency" "which has a potential for resulting in either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment" as provided in CEQA Guideline section 15378.

There is no intrinsic relationship between the two projects that suggest greater efficiencies or other benefits from the combination. To the contrary, there are key "structural" problems caused by combining environmental review of these two distinct CEQA projects in the same EIR: causation, baseline, and timeline.

Causation. The Upper Hearst project is not the cause of increases in enrollment to date and will not be the cause of a portion of future increases. Absent this causal link, it is not clear how a CEQA/EIR process for Upper Hearst project will impose on UC a CEQA-based legal obligation to adopt mitigation to reduce impacts caused by general excess enrollment increases.

Baseline. Any EIR for excess increases in enrollment since adoption of the 2020 LRDP must use 2004 enrollment as its baseline.

Timeline. The CEQA process for the Upper Hearst EIR has no particular deadline, while preparation and certification of an EIR for excess enrollment increases is long overdue and now critically time-sensitive. Therefore, the EIR for excess enrollment increases should not be yoked to the EIR for a major capital project that may face unknown and potentially protracted delays.

Whether combined or stand-alone, the EIR for excess enrollment increases must evaluate impacts of this project on increased use of off-campus housing for and by UCB students, leading to increases in off-campus noise and trash; displacement of tenants resulting in more homeless individuals living on public streets and in local parks; increases in the number of UCB students who are homeless; increases in traffic and transportation related congestion and safety risks; and increased burdens on the City of Berkeley's public safety services, including police, fire, ambulance, and Emergency Medical Technician services.

The EIR should pay particular attention to whether increases in student enrollment at UC Berkeley since 2005 may have had or may in the future have a significant effect on the local environment as a result of increases in off-campus student housing and increasing the ratio between housing demand and housing supply in the City of Berkeley since 2005. This analysis should be based on data regarding residential rental demand by market segment, particularly student housing demand characteristics; data regarding residential rental supply trends and planned and proposed projects in the relevant market area.

Thank you for your attention to this matter.

Very Truly Yours,

Tom Lippe

Thomas N. Lippe

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Attorney for Plaintiff: Save Berkeley's Neighborhoods

ENDORSED
FILED
ALAMEDA COUNTY

APR 27 2018

CLERK OF THE SUPERIOR COURT
By CURTIYAH GANTER
Deputy

IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA

IN AND FOR THE COUNTY OF ALAMEDA

SAVE BERKELEY'S NEIGHBORHOODS, a California nonprofit public benefit corporation;

Plaintiff,

vs.

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA; JANET NAPOLITANO, in her capacity as President of the University of California; CAROL T. CHRIST, in her capacity as Chancellor of the University of California, Berkeley; and DOES 1 through 20,

Respondents and Defendants.

Case No. RG18902751

PETITION FOR WRIT OF MANDATE AND COMPLAINT FOR DECLARATORY RELIEF

[CALIFORNIA ENVIRONMENTAL QUALITY ACT]

Plaintiff Save Berkeley's Neighborhoods alleges:

1. Education Code section 67504 provides that "The Legislature further finds and declares that the expansion of campus enrollment and facilities may negatively affect the surrounding environment. Consistent with the requirements of the California Environmental Quality Act (CEQA), it is the intent of the Legislature that the University of California sufficiently mitigate significant off-campus impacts related to campus growth and development."

2. Public Resources Code section 21080.9 requires that the University of California, Berkeley (UCB) "consider the environmental impact of academic and enrollment plans" pursuant to CEQA and "that any such plans shall become effective for a campus ... only after the environmental effects of those plans have been analyzed" as required by CEQA.

3. In 2005, UCB adopted a Long Range Development Plan (2020 LRDP) to achieve a number of objectives through the year 2020, including stabilizing enrollment. In or about 2005, UCB certified a Final Environmental Impact Report for the 2020 LRDP (2005 EIR) pursuant to CEQA. The 2020 LRDP and 2005 EIR projected that by 2020 student enrollment at UCB would increase by 1,650 students above the 2001-02 two-semester average. The 2020 LRDP and 2005 EIR also projected that by 2020 UCB would add 2,500 beds for students.

4. On October 30, 2017, UCB responded to the City of Berkeley's request for information regarding enrollment increases. This response shows the actual increase in student enrollment above the 2001-02 two-semester average for the most recent two-semester period (i.e., Spring 2017 and Fall 2017) is 8,302 students. This increase represents a five-fold increase compared to the 1,650 enrollment increase projected in the 2020 LRDP and 2005 EIR. The response also shows UCB has built fewer than 1,000 beds.

5. The increase in student enrollment over and above the 1,650 additional students projected by the

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2020 LRDP and included in the 2005 EIR's environmental impact analysis (hereinafter the "excess increase in student enrollment") has caused and continues to cause significant adverse environmental impacts that were not analyzed in the 2005 EIR. Plaintiff is informed and believes and on that basis alleges that these impacts include, without limitation, increased use of off-campus housing for and by UCB students, leading to increases in off-campus noise and trash; displacement of tenants resulting in more homeless individuals living on public streets and in local parks; increases in the number of UCB students who are homeless; increases in traffic and transportation related congestion and safety risks; and increased burdens on the City of Berkeley's public safety services, including police, fire, ambulance, and Emergency Medical Technician services.

6. Respondents have had and continue to have a legal obligation to analyze the environmental effects of the excess increase in student enrollment pursuant to CEQA, including, without limitation, by preparing and certifying an Environmental Impact Report to assess the significance of impacts caused by the extraordinary increase in enrollment and to identify and adopt mitigation measures to reduce these significant impacts.

Parties

7. Plaintiff SAVE BERKELEY'S NEIGHBORHOODS (Plaintiff) is a California nonprofit public benefit corporation formed to provide education and advocacy to improve quality of life, protect the environment and implement best planning practices. Plaintiff's founders, members, and directors live in the area affected by the excess increase in student enrollment, have suffered and will continue to suffer injury from adverse environmental impacts caused by the excess increase in student enrollment if the legal violations alleged in this Petition and Complaint are not remedied. Plaintiff was formed and brings this action to represent and advocate the beneficial interests of its founders, members, and directors in obtaining relief from these legal violations and to improve quality of life, protect the

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environment and implement best planning practices in connection UCB's increases in student enrollment.

8. Respondent and Defendant THE REGENTS OF THE UNIVERSITY OF CALIFORNIA (hereinafter "Regents") is a public trust corporation and state agency established pursuant to the California Constitution vested with administering the University of California including the management and disposition of property of the University and the lead agency for the 2020 LRDP under CEQA, and is thus responsible for analyzing, disclosing, and mitigating the environmental impacts of the 2020 LRDP and the excess increase in student enrollment.

9. Respondent and Defendant JANET NAPOLITANO is the President of the University of California and is named herein solely in this capacity. Regents Policy 8103 delegates to the President of the University the Regents' authority for budget or design for capital projects consistent with approved Long Range Development Plans and minor Long Range Development Plan amendments.

10. Respondent and Defendant CAROL T. CHRIST is the Chancellor of the University of California, Berkeley, and named herein solely in this capacity.

11. Respondents and Defendants Regents, Janet Napolitano, and Carol T. Christ are hereinafter collectively referred to as "Respondents."

12. Plaintiff does not know the true names and capacities of Respondents and Defendants fictitiously named herein as DOES 1 through 20, inclusive. Plaintiff is informed and believes, and thereon alleges, that such fictitiously named Respondents and Defendants are responsible in some manner for the acts or omissions complained of or pending herein. Plaintiff will amend this Petition to allege the fictitiously named Respondents' and Defendants' true names and capacities when ascertained.

Notice Requirements

13. In accordance with Public Resources Code section 21167.5, Plaintiff served Respondents with

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written notice of commencement of this action on April 12, 2018. The Notice of Commencement of Action and Proof of Service are attached hereto as Exhibit 1.

14. In accordance with Public Resources Code section 21167.7 and Code of Civil Procedure section 388, Plaintiff has provided a copy of this pleading to the Attorney General's office. (See Exhibit 2.)

Jurisdiction and Venue

15. Plaintiff brings this action as a Petition for Writ of Mandate pursuant to Code of Civil Procedure sections 1085, 1088.5, and 1094.5, and Public Resources Code sections 21168 and 21168.5; and as a Complaint for Declaratory relief pursuant to Code of Civil Procedure section 1060. The Court has jurisdiction over these claims.

16. Venue is proper in Alameda County under Code of Civil Procedure section 394, subdivision (a), because UCB and Respondents are situated therein.

Standing

17. Plaintiff and, to the extent applicable, its members are beneficially interested in Respondents' full compliance with CEQA. Respondents owed a mandatory duty to comply with CEQA with respect to the 2020 LRDP and the excess increase in student enrollment. Plaintiff has the right to enforce the mandatory duties that CEQA imposes on Respondents.

Exhaustion of Administrative Remedies

18. UCB provides no administrative remedy for the legal claims or grounds of noncompliance with CEQA alleged in this Petition and Complaint and Plaintiff had no opportunity to raise the grounds of noncompliance alleged in this Petition and Complaint in any UCB administrative proceeding.

Private Attorney General Doctrine

19. Plaintiff brings this action as a private attorney general pursuant to Code of Civil Procedure section 1021.5, and any other applicable legal theory, to enforce important rights affecting the public

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interest.

20. Issuance of the relief requested in this Petition and Complaint will confer a significant benefit on a large class of persons by ensuring that Respondents analyze and disclose the environmental impact of the excess increase in student enrollment.

21. Issuance of the relief requested in this Petition will result in the enforcement of important rights affecting the public interest. By compelling Respondents to complete adequate environmental review of the excess increase in student enrollment under CEQA, Plaintiff will vindicate the public's important CEQA rights to public disclosure regarding and public participation in government decisions that affect the environment.

22. The necessity and financial burden of enforcement are such as to make an award of attorney's fees appropriate in this proceeding because the transgressor is the agency whose duty it is to enforce the laws at issue in this proceeding.

First Cause of Action
(Violation of CEQA: Pub. Resources Code, § 21000 et seq.)

23. Plaintiff hereby realleges and incorporates the preceding paragraphs of this Petition and Complaint as though set forth herein in full.

24. Respondents prejudicially abused their discretion in violation of CEQA pursuant to Public Resources Code sections 21168 and 21168.5 and Code of Civil Procedure sections 1085 and 1094.5 by failing to analyze the excess increase in student enrollment pursuant to CEQA, including, without limitation, by failing to prepare and certify an Environmental Impact Report to assess the significance of impacts caused by the excess increase in student enrollment and to identify and adopt mitigation measures to reduce these significant impacts.

25. Plaintiff has no other plain, speedy, and adequate remedy in the ordinary course of law and will

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suffer irreparable injury unless this Court issues the relief requested in this Petition.

Second Cause of Action
(Declaratory Relief: Code Civ. Proc., § 1060)

26. Plaintiff hereby realleges and incorporates the preceding paragraphs of this Petition and Complaint as though set forth herein in full.

27. Plaintiff seeks a judicial determination and declaration that Respondents violated CEQA by failing to analyze the excess increase in student enrollment pursuant to CEQA.

28. An actual controversy has arisen and now exists between Plaintiff and Respondents. Plaintiff contends that Respondents violated CEQA by failing to analyze the excess increase in student enrollment pursuant to CEQA. Plaintiff is informed and believes, and based thereon alleges, that Respondents dispute these contentions.

Prayer for Relief

WHEREFORE, Plaintiff prays for the following relief:

1. For a writ of mandate compelling Respondents to conduct environmental review of the excess increase in student enrollment pursuant to CEQA including, without limitation, by preparing and certifying an Environmental Impact Report to assess the significance of impacts caused by the excess increase in student enrollment and to identify and adopt mitigation measures to reduce these significant impacts.

2. For a declaration that Respondents have failed to comply with CEQA because it has failed to conduct environmental review of the excess increase in student enrollment, including, without limitation, by failing to prepare and certify an Environmental Impact Report to assess the significance of impacts caused by the excess increase in student enrollment and to identify and adopt mitigation measures to reduce these significant impacts.

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3. For an order retaining the Court's jurisdiction over this matter until Respondents comply with the peremptory writ;

4. For an order compelling Respondents to pay Plaintiff's costs of suit;

5. For an order compelling Respondents to pay Plaintiff's reasonable attorneys fees related to these proceedings pursuant to Code of Civil Procedure section 1021.5; and

6. For such other relief as the Court may deem proper.

DATED: April 27, 2018

LAW OFFICES OF THOMAS N. LIPPE, APC

Thomas N. Lippe
Attorney for Plaintiff Save Berkeley's Neighborhoods

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<u>VERIFICATION</u>

Save Berkeley's Neighborhoods v. The Regents of the University of California, Alameda County Superior Court, Case No. (to be determined)

I, Phillip Bokovoy, declare that:

1. I am a founder and member of the Board of Directors of Plaintiff Save Berkeley's Neighborhoods and its President. I am authorized by Save Berkeley's Neighborhoods to execute this verification.

2. I have read the foregoing Verified Petition for Writ of Mandate and know the contents thereof; the factual allegations therein are true of my own knowledge, except as to those matters which are therein stated upon information or belief, and as to those matters I believe them to be true.

I declare under penalty of perjury, under the laws of the State of California, that the foregoing is true and correct. Executed on April 27, 2018 at San Francisco, California.

Phillip Bokovoy, President, Save Berkeley's Neighborhoods

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EXHIBIT 1

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April 12, 2018

By email: chancellor@berkeley.edu
Chancellor Carol T. Christ
University of California, Berkeley
c/o Jenny Hanson
Executive Assistant to the Chancellor
Office of the Chancellor
200 California Hall, #1500
Berkeley, CA 94720-1500

By email: regentsoffice@ucop.edu
Regents of the University of California
c/o Anne Shaw
Office of the Secretary and Chief of Staff to the Regents
1111 Franklin St.,12th floor
Oakland, CA 94607

Re: Notice of Intent to Sue Regarding Inadequate CEQA Review of UC Berkeley's 2020 Long Range Development Plan.

Dear Chancellor Christ and Regents of the University of California:

This office represents Save Berkeley's Neighborhoods with respect to the University of California at Berkeley's legal obligations to conduct environmental review of the 2020 Long Range Development Plan (2020 LRDP) in compliance with the California Environmental Quality Act (CEQA).

One of the 2020 LRDP's objectives is to stabilize enrollment. (2020 LRDP, Environmental Impact Report (2004 EIR), p. 3.1-10.) The 2004 EIR evaluated an increase in enrollment of 1,650 students above the 2001-02 two-semester average. (2004 EIR , p. 3.1-14.) The University's October 30, 2017, response to the City of Berkeley's request for information regarding enrollment increases shows an actual increase of 8.302 enrolled students above the 2001-02 two-semester average for the most recent two-semester period (i.e., Spring 2017 and Fall 2017). (Exhibit 1.) This represents a five-fold increase compared to the 2004 EIR's projection of a 1,650 student increase in enrollment.

This change in the project renders the 2004 EIR informationally defective because the EIR does not assess the impact of the actual increase in enrollment, which is orders of magnitude higher than the 1,650-student increase projected in the 2004 EIR. As a result, the University must prepare a supplemental or subsequent EIR to assess the significance of impacts caused by this extraordinary increase in enrollment and to identify and adopt mitigation measures to reduce these significant impacts.

This letter provides notice pursuant to Public Resources Code section 21167.5 that on or before April 20, 2018, Save Berkeley's Neighborhoods intends to file a lawsuit challenging the University's adoption of the 2020 LRDP on grounds the adoption does not comply with CEQA.

Save Berkeley's Neighborhoods is willing to discuss settling this dispute without the need for litigation. At a minimum, any such settlement must include: (1) an enforceable agreement by the University to prepare and certify a new EIR to assess the impacts of the 2020 LRDP as its project description has changed to reflect the increases in enrollment shown in the University's October 30, 2017, response to the City's request for information; (2) the new EIR must use the same environmental baseline used in the 2004 EIR; and (3) tolling the statute of limitations so that Save Berkeley's Neighborhoods is not forced to file its lawsuit to protect against the statute of limitations.

Thank you for your attention to this matter.

Very Truly Yours,

Tom Lippe

Thomas N. Lippe

cc:
David M. Robinson, Interim Chief Campus Counsel
By email: dmrobinson@berkeley.edu

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UNIVERSITY OF CALIFORNIA, BERKELEY

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA BARBARA • SANTA CRUZ

BERKELEY, CALIFORNIA 94720-1382

CAPITAL STRATEGIES
PHYSICAL AND ENVIRONMENTAL PLANNING
A&E Bldg. (MC 1382)

30 October 2017

Mayor Jesse Arreguin
City of Berkeley
2180 Milvia Street
Fifth Floor
Berkeley, California 94704

[Transmitted via email]

Mayor Arreguin:

My office has compiled the attached data in response to your request for information sent to former Chancellor Dirks' office on May 25, 2017. We have organized responses using the item numbers indicated in your letter. The data provided in the attachment is the current available information as of October 2017 and based on our understanding of your request.

Please contact Ruben Lizardo (rlizardo@berkeley.edu) if you have questions or would like clarification on the information that has been provided.

Sincerely,

Emily Marthinsen

Emily Marthinsen
Assistant Vice Chancellor/Campus Architect
Physical & Environmental Planning | Capital Strategies

CC: R Lizardo, R Parikh, S Viducich, A Machamer, S Wilmot

EXHIBIT 1

ATTACHMENT 1. UC RESPONSE TO DATA REQUEST

1. **Registered Student Headcount - Source: CalAnswers Student Census, UC Berkeley Office of Planning and Analysis, Accessed 10.04.2017**

Academic Term	Total Undergraduates	Total Graduate Students	Off-campus Undergraduates	Off-campus Graduate Programs
Fall (F) 05	23,482	10,076	381	668
Spring (S) 06	22,643	9,571	384	674
F06	23,863	10,070	357	713
S07	23,351	9,592	384	732
F07	24,636	10,317	359	752
S08	24,032	9,809	395	766
F08	25,151	10,258	325	743
S09	24,448	9,735	405	758
F09	25,530	10,393	331	757
S10	25,061	9,854	421	773
F10	25,540	10,298	369	777
S11	24,969	9,789	498	762
F11	25,885	10,257	342	782
S12	25,277	9,764	529	788
F12	25,774	10,125	334	789
S13	25,181	9,610	463	800
F13	25,951	10,253	327	881
S14	25,473	9,834	426	954
F14	27,126	10,455	296	1111
S15	25,903	10,065	424	1118
F15	27,496	10,708	335	1243
S16	26,094	10,279	466	1252
F16	29,310	10,863	650	1424
S17	27,784	10,510	425	1480
F17	30,574	11,336	560	1536

Note: Columns indicated total number of students include all registered students, including those enrolled in off-campus programs such as online graduate degree programs, the Education Abroad Program, Global Edge (European Study Abroad), and Freshman in San Francisco. The students enrolled in these off-campus programs are tallied in the "off-campus" columns.

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Attorney for Plaintiff: Save Berkeley's Neighborhoods

IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA

IN AND FOR THE COUNTY OF ALAMEDA

SAVE BERKELEY'S NEIGHBORHOODS, a California nonprofit public benefit corporation; Plaintiff, vs. THE REGENTS OF THE UNIVERSITY OF CALIFORNIA; JANET NAPOLITANO, in her capacity as President of the University of California; CAROL T. CHRIST, in her capacity as Chancellor of the University of California, Berkeley; and DOES 1 through 20, Respondents and Defendants.	Case No. **PROOF OF SERVICE** **[CALIFORNIA ENVIRONMENTAL QUALITY ACT]**

PROOF OF SERVICE

I am a citizen of the United States, employed in the City and County of San Francisco, California. My business address is 201 Mission Street, 12th Floor, San Francisco, CA 94105. I am over the age of 18 years and not a party to the above entitled action. On April 12, 2018, I served the following document on the parties below, as designated:

- **Re: Notice of Intent to Sue Regarding Inadequate CEQA Review of UC Berkeley's 2020 Long Range Development Plan**

MANNER OF SERVICE
(check all that apply)

[ ]	By Mail:	In the ordinary course of business, I caused each such envelope to be placed in the custody of the United States Postal Service, with postage thereon fully prepaid in a sealed envelope.
[ ]	By Personal Service:	I personally delivered each such envelope to the office of the address on the date last written below.
[ ]	By Overnight FedEx:	I caused such envelope to be placed in a box or other facility regularly maintained by the express service carrier or delivered to an authorized courier or driver authorized by the express service carrier to receive documents, in an envelope or package designated by the express service carrier with delivery fees paid or provided for.
[x]	By E-mail:	I caused such document to be served via electronic mail equipment transmission (E-mail) on the parties as designated on the attached service list by transmitting a true copy to the following E-mail addresses listed under each addressee below.
[ ]	By Personal Delivery by Courier:	I caused each such envelope to be delivered to an authorized courier or driver, in an envelope or package addressed to the addressee below.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct. Executed on April 12, 2018, in the City and County of San Francisco, California

Kelly Marie

Kelly Marie Perry

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Thomas N. Lippe
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Tel: 415-777-5604
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SERVICE LIST

By email: chancellor@berkeley.edu
Chancellor Carol T. Christ
University of California, Berkeley
c/o Jenny Hanson
Executive Assistant to the Chancellor
Office of the Chancellor
200 California Hall, #1500
Berkeley, CA 94720-1500

By email: regentsoffice@ucop.edu
Regents of the University of California
c/o Anne Shaw
Office of the Secretary and Chief of Staff to the Regents
1111 Franklin St.,12th floor
Oakland, CA 94607

By email: dmrobinson@berkeley.edu
David M. Robinson, Interim Chief Campus Counsel

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EXHIBIT 2

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Attorney for Plaintiff: Save Berkeley's Neighborhoods

IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA

IN AND FOR THE COUNTY OF ALAMEDA

SAVE BERKELEY'S NEIGHBORHOODS, a California nonprofit public benefit corporation; Plaintiff, vs. THE REGENTS OF THE UNIVERSITY OF CALIFORNIA; JANET NAPOLITANO, in her capacity as President of the University of California; CAROL T. CHRIST, in her capacity as Chancellor of the University of California, Berkeley; and DOES 1 through 20, Respondents and Defendants.	Case No. **PROOF OF SERVICE** **[CALIFORNIA ENVIRONMENTAL QUALITY ACT]**

PROOF OF SERVICE

I am a citizen of the United States, employed in the City and County of San Francisco, California. My business address is 201 Mission Street, 12th Floor, San Francisco, CA 94105. I am over the age of 18 years and not a party to the above entitled action. On April 27, 2018, I served the following document on the parties below, as designated:

- **PETITION FOR WRIT OF MANDATE AND COMPLAINT FOR DECLARATORY RELIEF**

MANNER OF SERVICE
(check all that apply)

[x]	By Mail:	In the ordinary course of business, I caused each such envelope to be placed in the custody of the United States Postal Service, with postage thereon fully prepaid in a sealed envelope.
[ ]	By Personal Service:	I personally delivered each such envelope to the office of the address on the date last written below.
[ ]	By Overnight FedEx:	I caused such envelope to be placed in a box or other facility regularly maintained by the express service carrier or delivered to an authorized courier or driver authorized by the express service carrier to receive documents, in an envelope or package designated by the express service carrier with delivery fees paid or provided for.
[ ]	By E-mail:	I caused such document to be served via electronic mail equipment transmission (E-mail) on the parties as designated on the attached service list by transmitting a true copy to the following E-mail addresses listed under each addressee below.
[ ]	By Personal Delivery by Courier:	I caused each such envelope to be delivered to an authorized courier or driver, in an envelope or package addressed to the addressee below.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct. Executed on April 27, 2018, in the City and County of San Francisco, California

Kelly Marie

Kelly Marie Perry

Law Offices of
Thomas N. Lippe
201 Mission St. 12th Floor
San Francisco, CA 94105
Tel: 415-777-5604
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SERVICE LIST

Hon. Xavier Becerra
Attorney General
State of California
Office of the Attorney General
1300 I Street
Sacramento, CA 95814

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STATE OF CALIFORNIA Edmund G. Brown Jr., Governor

NATIVE AMERICAN HERITAGE COMMISSION
Cultural and Environmental Department
1550 Harbor Blvd., Suite 100
West Sacramento, CA 95691
Phone (916) 373-3710
Email: nahc@nahc.ca.gov
Website: http://www.nahc.ca.gov
Twitter: @CA_NAHC

August 31, 2018

Raphael Breines, Senior Planner
University of California, Berkeley

VIA Email to: rbreines@berkeley.edu

RE: SCH# 2003082131 Upper Hearst Development for the Goldman School of Public Policy and Minor Amendment to the 2020 Long Range Development Plan, Alameda County

Dear Mr. Breines:

The Native American Heritage Commission (NAHC) has received the Notice of Preparation (NOP), Draft Environmental Impact Report (DEIR) or Early Consultation for the project referenced above. The California Environmental Quality Act (CEQA) (Pub. Resources Code §21000 et seq.), specifically Public Resources Code §21084.1, states that a project that may cause a substantial adverse change in the significance of a historical resource, is a project that may have a significant effect on the environment. (Pub. Resources Code § 21084.1; Cal. Code Regs., tit.14, §15064.5 (b) (CEQA Guidelines §15064.5 (b)). If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, an Environmental Impact Report (EIR) shall be prepared. (Pub. Resources Code §21080 (d); Cal. Code Regs., tit. 14, § 5064 subd.(a)(1) (CEQA Guidelines §15064 (a)(1)). In order to determine whether a project will cause a substantial adverse change in the significance of a historical resource, a lead agency will need to determine whether there are historical resources within the area of potential effect (APE).

CEQA was amended significantly in 2014. Assembly Bill 52 (Gatto, Chapter 532, Statutes of 2014) (AB 52) amended CEQA to create a separate category of cultural resources, "tribal cultural resources" (Pub. Resources Code §21074) and provides that a project with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment. (Pub. Resources Code §21084.2). Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource. (Pub. Resources Code §21084.3 (a)). **AB 52 applies to any project for which a notice of preparation, a notice of negative declaration, or a mitigated negative declaration is filed on or after July 1, 2015.** If your project involves the adoption of or amendment to a general plan or a specific plan, or the designation or proposed designation of open space, on or after March 1, 2005, it may also be subject to Senate Bill 18 (Burton, Chapter 905, Statutes of 2004) (SB 18). **Both SB 18 and AB 52 have tribal consultation requirements**. If your project is also subject to the federal National Environmental Policy Act (42 U.S.C. § 4321 et seq.) (NEPA), the tribal consultation requirements of Section 106 of the National Historic Preservation Act of 1966 (154 U.S.C. 300101, 36 C.F.R. §800 et seq.) may also apply.

The NAHC recommends consultation with California Native American tribes that are traditionally and culturally affiliated with the geographic area of your proposed project as early as possible in order to avoid inadvertent discoveries of Native American human remains and best protect tribal cultural resources. Below is a brief summary of portions of AB 52 and SB 18 as well as the NAHC's recommendations for conducting cultural resources assessments.

Consult your legal counsel about compliance with AB 52 and SB 18 as well as compliance with any other applicable laws.

AB 52

AB 52 has added to CEQA the additional requirements listed below, along with many other requirements:

1. Fourteen Day Period to Provide Notice of Completion of an Application/Decision to Undertake a Project: Within fourteen (14) days of determining that an application for a project is complete or of a decision by a public agency to undertake a project, a lead agency shall provide formal notification to a designated contact of, or tribal representative of, traditionally and culturally affiliated California Native American tribes that have requested notice, to be accomplished by at least one written notice that includes:
   a. A brief description of the project.
   b. The lead agency contact information.
   c. Notification that the California Native American tribe has 30 days to request consultation. (Pub. Resources Code §21080.3.1 (d)).
   d. A "California Native American tribe" is defined as a Native American tribe located in California that is on the contact list maintained by the NAHC for the purposes of Chapter 905 of Statutes of 2004 (SB 18). (Pub. Resources Code §21073).

2. Begin Consultation Within 30 Days of Receiving a Tribe's Request for Consultation and Before Releasing a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report: A lead agency shall begin the consultation process within 30 days of receiving a request for consultation from a California Native American tribe that is traditionally and culturally affiliated with the geographic area of the proposed project. (Pub. Resources Code §21080.3.1, subds. (d) and (e)) and prior to the release of a negative declaration, mitigated negative declaration or Environmental Impact Report. (Pub. Resources Code §21080.3.1(b)).
   a. For purposes of AB 52, "consultation shall have the same meaning as provided in Gov. Code §65352.4 (SB 18). (Pub. Resources Code §21080.3.1 (b)).

3. Mandatory Topics of Consultation If Requested by a Tribe: The following topics of consultation, if a tribe requests to discuss them, are mandatory topics of consultation:
   a. Alternatives to the project.
   b. Recommended mitigation measures.
   c. Significant effects. (Pub. Resources Code §21080.3.2 (a)).

4. Discretionary Topics of Consultation: The following topics are discretionary topics of consultation:
   a. Type of environmental review necessary.
   b. Significance of the tribal cultural resources.
   c. Significance of the project's impacts on tribal cultural resources.
   d. If necessary, project alternatives or appropriate measures for preservation or mitigation that the tribe may recommend to the lead agency. (Pub. Resources Code §21080.3.2 (a)).

5. Confidentiality of Information Submitted by a Tribe During the Environmental Review Process: With some exceptions, any information, including but not limited to, the location, description, and use of tribal cultural resources submitted by a California Native American tribe during the environmental review process shall not be included in the environmental document or otherwise disclosed by the lead agency or any other public agency to the public, consistent with Government Code §6254 (r) and §6254.10. Any information submitted by a California Native American tribe during the consultation or environmental review process shall be published in a confidential appendix to the environmental document unless the tribe that provided the information consents, in writing, to the disclosure of some or all of the information to the public. (Pub. Resources Code §21082.3 (c)(1)).

6. Discussion of Impacts to Tribal Cultural Resources in the Environmental Document: If a project may have a significant impact on a tribal cultural resource, the lead agency's environmental document shall discuss both of the following:
   a. Whether the proposed project has a significant impact on an identified tribal cultural resource.
   b. Whether feasible alternatives or mitigation measures, including those measures that may be agreed to pursuant to Public Resources Code §21082.3, subdivision (a), avoid or substantially lessen the impact on the identified tribal cultural resource. (Pub. Resources Code §21082.3 (b)).

7. Conclusion of Consultation: Consultation with a tribe shall be considered concluded when either of the following occurs:
    a. The parties agree to measures to mitigate or avoid a significant effect, if a significant effect exists, on a tribal cultural resource; or
    b. A party, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached. (Pub. Resources Code §21080.3.2 (b)).

8. Recommending Mitigation Measures Agreed Upon in Consultation in the Environmental Document: Any mitigation measures agreed upon in the consultation conducted pursuant to Public Resources Code §21080.3.2 shall be recommended for inclusion in the environmental document and in an adopted mitigation monitoring and reporting program, if determined to avoid or lessen the impact pursuant to Public Resources Code §21082.3, subdivision (b), paragraph 2, and shall be fully enforceable. (Pub. Resources Code §21082.3 (a)).

9. Required Consideration of Feasible Mitigation: If mitigation measures recommended by the staff of the lead agency as a result of the consultation process are not included in the environmental document or if there are no agreed upon mitigation measures at the conclusion of consultation, or if consultation does not occur, and if substantial evidence demonstrates that a project will cause a significant effect to a tribal cultural resource, the lead agency shall consider feasible mitigation pursuant to Public Resources Code §21084.3 (b). (Pub. Resources Code §21082.3 (e)).

10. Examples of Mitigation Measures That, If Feasible, May Be Considered to Avoid or Minimize Significant Adverse Impacts to Tribal Cultural Resources:
    a. Avoidance and preservation of the resources in place, including, but not limited to:
        i. Planning and construction to avoid the resources and protect the cultural and natural context.
        ii. Planning greenspace, parks, or other open space, to incorporate the resources with culturally appropriate protection and management criteria.
    b. Treating the resource with culturally appropriate dignity, taking into account the tribal cultural values and meaning of the resource, including, but not limited to, the following:
        i. Protecting the cultural character and integrity of the resource.
        ii. Protecting the traditional use of the resource.
        iii. Protecting the confidentiality of the resource.
    c. Permanent conservation easements or other interests in real property, with culturally appropriate management criteria for the purposes of preserving or utilizing the resources or places.
    d. Protecting the resource. (Pub. Resource Code §21084.3 (b)).
    e. Please note that a federally recognized California Native American tribe or a non-federally recognized California Native American tribe that is on the contact list maintained by the NAHC to protect a California prehistoric, archaeological, cultural, spiritual, or ceremonial place may acquire and hold conservation easements if the conservation easement is voluntarily conveyed. (Civ. Code §815.3 (c)).
    f. Please note that it is the policy of the state that Native American remains and associated grave artifacts shall be repatriated. (Pub. Resources Code §5097.991).

11. Prerequisites for Certifying an Environmental Impact Report or Adopting a Mitigated Negative Declaration or Negative Declaration with a Significant Impact on an Identified Tribal Cultural Resource: An Environmental Impact Report may not be certified, nor may a mitigated negative declaration or a negative declaration be adopted unless one of the following occurs:
    a. The consultation process between the tribes and the lead agency has occurred as provided in Public Resources Code §21080.3.1 and §21080.3.2 and concluded pursuant to Public Resources Code §21080.3.2.
    b. The tribe that requested consultation failed to provide comments to the lead agency or otherwise failed to engage in the consultation process.
    c. The lead agency provided notice of the project to the tribe in compliance with Public Resources Code §21080.3.1 (d) and the tribe failed to request consultation within 30 days. (Pub. Resources Code §21082.3 (d)).

The NAHC's PowerPoint presentation titled, "Tribal Consultation Under AB 52: Requirements and Best Practices" may be found online at: http://nahc.ca.gov/wp-content/uploads/2015/10/AB52TribalConsultation_CalEPAPDF.pdf

SB 18

SB 18 applies to local governments and requires local governments to contact, provide notice to, refer plans to, and consult with tribes prior to the adoption or amendment of a general plan or a specific plan, or the designation of open space. (Gov. Code §65352.3). Local governments should consult the Governor's Office of Planning and Research's "Tribal Consultation Guidelines," which can be found online at: https://www.opr.ca.gov/docs/09_14_05_Updated_Guidelines_922.pdf

Some of SB 18's provisions include:

1. Tribal Consultation: If a local government considers a proposal to adopt or amend a general plan or a specific plan, or to designate open space it is required to contact the appropriate tribes identified by the NAHC by requesting a "Tribal Consultation List." If a tribe, once contacted, requests consultation the local government must consult with the tribe on the plan proposal. **A tribe has 90 days from the date of receipt of notification to request consultation unless a shorter timeframe has been agreed to by the tribe.** (Gov. Code §65352.3 (a)(2)).
2. No Statutory Time Limit on SB 18 Tribal Consultation. There is no statutory time limit on SB 18 tribal consultation.
3. Confidentiality: Consistent with the guidelines developed and adopted by the Office of Planning and Research pursuant to Gov. Code §65040.2, the city or county shall protect the confidentiality of the information concerning the specific identity, location, character, and use of places, features and objects described in Public Resources Code §5097.9 and §5097.993 that are within the city's or county's jurisdiction. (Gov. Code §65352.3 (b)).
4. Conclusion of SB 18 Tribal Consultation: Consultation should be concluded at the point in which:
    a. The parties to the consultation come to a mutual agreement concerning the appropriate measures for preservation or mitigation; or
    b. Either the local government or the tribe, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached concerning the appropriate measures of preservation or mitigation. (Tribal Consultation Guidelines, Governor's Office of Planning and Research (2005) at p. 18).

Agencies should be aware that neither AB 52 nor SB 18 precludes agencies from initiating tribal consultation with tribes that are traditionally and culturally affiliated with their jurisdictions before the timeframes provided in AB 52 and SB 18. For that reason, we urge you to continue to request Native American Tribal Contact Lists and "Sacred Lands File" searches from the NAHC. The request forms can be found online at: http://nahc.ca.gov/resources/forms/

NAHC Recommendations for Cultural Resources Assessments

To adequately assess the existence and significance of tribal cultural resources and plan for avoidance, preservation in place, or barring both, mitigation of project-related impacts to tribal cultural resources, the NAHC recommends the following actions:

1. Contact the appropriate regional California Historical Research Information System (CHRIS) Center (http://ohp.parks.ca.gov/?page_id=1068) for an archaeological records search. The records search will determine:
    a. If part or all of the APE has been previously surveyed for cultural resources.
    b. If any known cultural resources have already been recorded on or adjacent to the APE.
    c. If the probability is low, moderate, or high that cultural resources are located in the APE.
    d. If a survey is required to determine whether previously unrecorded cultural resources are present.

2. If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
    a. The final report containing site forms, site significance, and mitigation measures should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum and not be made available for public disclosure.
    b. The final written report should be submitted within 3 months after work has been completed to the appropriate regional CHRIS center.

3. Contact the NAHC for:
   a. A Sacred Lands File search. Remember that tribes do not always record their sacred sites in the Sacred Lands File, nor are they required to do so. A Sacred Lands File search is not a substitute for consultation with tribes that are traditionally and culturally affiliated with the geographic area of the project's APE.
   b. A Native American Tribal Consultation List of appropriate tribes for consultation concerning the project site and to assist in planning for avoidance, preservation in place, or, failing both, mitigation measures.

4. Remember that the lack of surface evidence of archaeological resources (including tribal cultural resources) does not preclude their subsurface existence.
   a. Lead agencies should include in their mitigation and monitoring reporting program plan provisions for the identification and evaluation of inadvertently discovered archaeological resources per Cal. Code Regs., tit. 14, §15064.5(f) (CEQA Guidelines §15064.5(f)). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American with knowledge of cultural resources should monitor all ground-disturbing activities.
   b. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the disposition of recovered cultural items that are not burial associated in consultation with culturally affiliated Native Americans.
   c. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the treatment and disposition of inadvertently discovered Native American human remains. Health and Safety Code §7050.5, Public Resources Code §5097.98, and Cal. Code Regs., tit. 14, §15064.5, subdivisions (d) and (e) (CEQA Guidelines §15064.5, subds. (d) and (e)) address the processes to be followed in the event of an inadvertent discovery of any Native American human remains and associated grave goods in a location other than a dedicated cemetery.

If you have any questions or need additional information, please contact me at my email address: Frank.Lienert@nahc.ca.gov.

Sincerely,

for

Frank Lienert
Associate Governmental Program Analyst

cc: State Clearinghouse

APPENDIX B

DRAFT MINOR LRDP TEXT AMENDMENT

UC Berkeley 2020 Long Range Development Plan

3.1.14 CITY ENVIRONS FRAMEWORK

PLAN EVERY NEW PROJECT TO RESPECT AND ENHANCE THE CHARACTER, LIVABILITY, AND CULTURAL VITALITY OF OUR CITY ENVIRONS.

….

PROJECT DESIGN

UC Berkeley serves the entire state of California, and thus has a mission that can not always be met entirely within the parameters of municipal policy. In the City Environs, however, the objectives of UC Berkeley must be informed by the plans and policies of neighboring cities, to respect and enhance their character and livability through new university investment.

POLICY: USE MUNICIPAL PLANS AND POLICIES TO INFORM THE DESIGN OF FUTURE CAPITAL PROJECTS IN THE CITY ENVIRONS.
USE THE SOUTHSIDE PLAN AS A GUIDE TO THE DESIGN OF FUTURE CAPITAL PROJECTS IN THE SOUTHSIDE.
PREPARE PROJECT SPECIFIC DESIGN GUIDELINES FOR EACH MAJOR NEW PROJECT.

ADJACENT BLOCKS
City of Berkeley land use regulations for the Adjacent Blocks in place as of July 2003, particularly the height and density provisions of the zoning ordinance, reflect a strong preference toward residential and mixed-use projects. However, in order to meet the demands for program space created by enrollment growth and by ongoing growth in research, sites on the Adjacent Blocks must provide adequate capacity to accommodate these demands, in order to maintain UC Berkeley as the compact, interactive campus described in **Campus Land Use.**

While maximizing the capacity of limited campus lands may be the rule, a rare exception may be made to continue to support excellence, as in the Cal Aquatics Center example. The Cal Aquatics Center would provide needed training facilities for UC Berkeley's outstanding athletes in a low density single use facility in the Adjacent Blocks [*paragraph reflects changes adopted in 2013*].

Major capital projects would be reviewed at each stage of design by the UC Berkeley Design Review Committee, based on project specific design guidelines informed by the provisions of the Berkeley General Plan and other relevant city plans and policies. The university would make informational presentations of all major projects on the Adjacent Blocks to the City of Berkeley Planning Commission and, if relevant, the City of Berkeley Landmarks Commission for comment prior to schematic design review by the UC Berkeley Design Review Committee.

Projects on the Adjacent Blocks within the area of the Southside Plan would as a general rule use the Southside Plan as a guide to project design, as described below.

SOUTHSIDE
The university owns roughly 45% of the land in the Southside, and students comprise over 80% of Southside residents. For both reasons, the Southside has always been the area of Berkeley where a positive, shared city-campus vision is most urgently required, and the lack of such a vision most acutely felt.

In 1997 the City of Berkeley and UC Berkeley signed a Memorandum of Understanding, which states 'the city and the university will jointly participate in the preparation of a Southside Plan ... the campus will acknowledge the Plan as the guide for campus developments in the Southside area'. The city and university have since collaborated on a draft Southside Plan, which as of March 2004 was being finalized for formal city adoption.

View original document at https://capitalstrategies.berkeley.edu/2020LRDP
See page numbered 49 in original

Given the mixed-use character of the Southside and the constant influx of new student residents, it is important to remember the Southside is, first and foremost, a place where people live. While the Southside Plan recognizes there are many areas within the Southside suitable for new non-residential projects, it also recognizes such projects must be planned to enhance the quality of life for all Southside residents.

Assuming no further substantive changes are made by the city prior to adoption, the university should as a general rule use the Southside Plan as its guide for the location and design of future projects in the Southside, as envisioned in the Memorandum of Understanding.

As of 2013, the Southside Plan has been adopted by the City of Berkeley and is the university's guide for the location and design of projects in the Southside. A rare exception may be made, however, to continue to support excellence, as in the Cal Aquatics Center example. The Cal Aquatics Center would provide needed training facilities for UC Berkeley's outstanding athletes in a low density single use facility in an area of the Adjacent Blocks subject to the Southside Plan [*paragraph reflects changes adopted in 2013*].

Major capital projects would be reviewed at each stage of design by the UC Berkeley Design Review Committee, informed by the provisions of the Southside Plan. The university would make informational presentations of all major projects within the Southside Plan area to the City of Berkeley Planning Commission and, if relevant, the City of Berkeley Landmarks Commission for comment prior to schematic design review by the UC Berkeley Design Review Committee.

…

2020 LRDP HOUSING ZONE

The housing objectives for the 2020 LRDP require that all new lower division undergraduate housing be located within a mile of the center of the Campus Park, defined as Doe Library, and all other student housing either within this radius or within one block of a transit line providing trips to Doe Library in under 20 minutes. In the 2020 LRDP, this Housing Zone is defined to exclude those areas with residential designations of under 40 units per acre in a municipal general plan as of July 2003.

The definition of the Housing Zone not only serves the objectives of improving student access to the intellectual and cultural life of the campus and minimizing vehicle trips, it also aligns with our goal to concentrate new housing development along transit routes. While future university housing projects must have adequate density to support reasonable rents, they should also be designed to respect and enhance the character and livability of the cities in which they are located. Therefore, to the extent feasible university housing projects in the Housing Zone should not have a greater number of stories nor have setback dimensions less than could be permitted for a project under the relevant city zoning ordinance as of July 2003. A rare exception may be made, however, to continue to support excellence, as in the Upper Hearst Development for the Goldman School of Public Policy, which would expand the Housing Zone to include high density housing at a site designated in the municipal general plan for medium density development. The Upper Hearst Project would provide needed student, staff and faculty housing at a University-owned site on Hearst Avenue, contiguous with other University-owned sites, while also providing the funding needed to develop new program space for the Goldman School of Public Policy, consistently rated one of the top public policy schools in the nation.

Major capital projects would be reviewed at each stage of design by the UC Berkeley Design Review Committee, based on project specific design guidelines informed by the provisions of the relevant city general plan and other relevant city plans and policies. The university would make informational presentations of all major projects in the Housing Zone to the relevant city planning commission and landmarks commission for comment prior to schematic design review by the UC Berkeley Design Review Committee.

View original document at https://capitalstrategies.berkeley.edu/2020LRDP
See page numbered 49 in original

APPENDIX C

AIR QUALITY MODELING RESULTS

Upper Hearst Development

Alameda County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
University/College (4Yr)	91.00	Employee	0.25	64,226.19	0
University/College (4Yr)	860.00	Student	0.25	158,065.82	0
Apartments Mid Rise	150.00	Dwelling Unit	0.50	150,000.00	429

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	63
Climate Zone	5			**Operational Year**	2023
Utility Company	Pacific Gas & Electric Company				
CO2 Intensity (lb/MWhr)	641.35	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - Per site plans one acre project site. Students = 397 academic classrooms + 450 academic event space + 13 residential amenity space

Construction Phase - Client provided phases and schedule

Trips and VMT -

Demolition - per applicant supplied information. 7,000 cy = 3,300 sf

Grading - Per applicant supplied information 13,000 cy export

Vehicle Trips - Zero trips, project would not increase trips compared to existing conditions.

Woodstoves - No fireplaces per site plans

Construction Off-road Equipment Mitigation -

Table Name	Column Name	Default Value	New Value
tblFireplaces	FireplaceDayYear	11.14	0.00
tblFireplaces	FireplaceHourDay	3.50	0.00
tblFireplaces	FireplaceWoodMass	228.80	0.00
tblFireplaces	NumberGas	22.50	0.00
tblFireplaces	NumberNoFireplace	6.00	0.00
tblFireplaces	NumberWood	25.50	0.00
tblGrading	AcresOfGrading	0.75	1.00
tblGrading	MaterialExported	0.00	13,000.00
tblLandUse	LotAcreage	1.47	0.25
tblLandUse	LotAcreage	3.63	0.25
tblLandUse	LotAcreage	3.95	0.50
tblTripsAndVMT	HaulingTripNumber	15.00	0.00
tblTripsAndVMT	HaulingTripNumber	1,625.00	0.00
tblVehicleTrips	ST_TR	6.39	0.00
tblVehicleTrips	ST_TR	3.12	0.00
tblVehicleTrips	ST_TR	1.30	0.00
tblVehicleTrips	SU_TR	5.86	0.00
tblVehicleTrips	WD_TR	6.65	0.00
tblVehicleTrips	WD_TR	8.96	0.00
tblVehicleTrips	WD_TR	1.71	0.00
tblWoodstoves	NumberCatalytic	3.00	0.00
tblWoodstoves	NumberNoncatalytic	3.00	0.00
tblWoodstoves	WoodstoveDayYear	14.12	0.00
tblWoodstoves	WoodstoveWoodMass	582.40	0.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2019	0.1386	1.3793	0.8562	1.4700e-003	0.1656	0.0750	0.2406	0.0570	0.0699	0.1269	0.0000	131.1696	131.1696	0.0336	0.0000	132.0083
2020	0.3340	2.6065	2.1764	5.6400e-003	0.3990	0.1047	0.5037	0.1390	0.1001	0.2390	0.0000	498.8580	498.8580	0.0577	0.0000	500.3005
2021	0.1084	0.8436	0.8397	2.1000e-003	0.0713	0.0327	0.1040	0.0193	0.0313	0.0505	0.0000	185.6246	185.6246	0.0221	0.0000	186.1770
Maximum	**0.3340**	**2.6065**	**2.1764**	**5.6400e-003**	**0.3990**	**0.1047**	**0.5037**	**0.1390**	**0.1001**	**0.2390**	**0.0000**	**498.8580**	**498.8580**	**0.0577**	**0.0000**	**500.3005**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2019	0.1386	1.3793	0.8562	1.4700e-003	0.1656	0.0750	0.2406	0.0570	0.0699	0.1269	0.0000	131.1694	131.1694	0.0336	0.0000	132.0082
2020	0.3340	2.6065	2.1764	5.6400e-003	0.3990	0.1047	0.5037	0.1390	0.1001	0.2390	0.0000	498.8578	498.8578	0.0577	0.0000	500.3003
2021	0.1084	0.8436	0.8397	2.1000e-003	0.0713	0.0327	0.1040	0.0193	0.0313	0.0505	0.0000	185.6245	185.6245	0.0221	0.0000	186.1769
Maximum	**0.3340**	**2.6065**	**2.1764**	**5.6400e-003**	**0.3990**	**0.1047**	**0.5037**	**0.1390**	**0.1001**	**0.2390**	**0.0000**	**498.8578**	**498.8578**	**0.0577**	**0.0000**	**500.3003**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
1	7-1-2019	9-30-2019	0.8232	0.8232
2	10-1-2019	12-31-2019	0.6887	0.6887
3	1-1-2020	3-31-2020	0.5298	0.5298
4	4-1-2020	6-30-2020	0.7878	0.7878
5	7-1-2020	9-30-2020	0.7792	0.7792
6	10-1-2020	12-31-2020	0.8034	0.8034
7	1-1-2021	3-31-2021	0.7191	0.7191
8	4-1-2021	6-30-2021	0.2454	0.2454
		Highest	0.8232	0.8232

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	1.7099	0.0129	1.1228	6.0000e-005		6.2000e-003	6.2000e-003		6.2000e-003	6.2000e-003	0.0000	1.8363	1.8363	1.7900e-003	0.0000	1.8812
Energy	0.0481	0.4330	0.3387	2.6200e-003		0.0332	0.0332		0.0332	0.0332	0.0000	1,320.7092	1,320.7092	0.0473	0.0166	1,326.8468
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	60.6436	0.0000	60.6436	3.5839	0.0000	150.2418
Water						0.0000	0.0000		0.0000	0.0000	3.9221	29.8576	33.7797	0.4042	9.7900e-003	46.8022
Total	**1.7579**	**0.4459**	**1.4615**	**2.6800e-003**	**0.0000**	**0.0394**	**0.0394**	**0.0000**	**0.0394**	**0.0394**	**64.5656**	**1,352.4032**	**1,416.9688**	**4.0372**	**0.0264**	**1,525.7720**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	1.7099	0.0129	1.1228	6.0000e-005		6.2000e-003	6.2000e-003		6.2000e-003	6.2000e-003	0.0000	1.8363	1.8363	1.7900e-003	0.0000	1.8812
Energy	0.0481	0.4330	0.3387	2.6200e-003		0.0332	0.0332		0.0332	0.0332	0.0000	1,320.709 2	1,320.709 2	0.0473	0.0166	1,326.846 8
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	60.6436	0.0000	60.6436	3.5839	0.0000	150.2418
Water						0.0000	0.0000		0.0000	0.0000	3.9221	29.8576	33.7797	0.4042	9.7900e-003	46.8022
Total	**1.7579**	**0.4459**	**1.4615**	**2.6800e-003**	**0.0000**	**0.0394**	**0.0394**	**0.0000**	**0.0394**	**0.0394**	**64.5656**	**1,352.403 2**	**1,416.968 8**	**4.0372**	**0.0264**	**1,525.772 0**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demo, Concrete	Demolition	7/1/2019	11/11/2019	5	10	
2	Earthwork, grading	Grading	11/12/2019	3/27/2020	5	2	
3	Framing, mechanical, electrical plumbing	Building Construction	3/30/2020	8/28/2020	5	100	
4	Exterior and interior finishes	Building Construction	8/31/2020	4/12/2021	5	100	
5	Sidewalks	Paving	4/13/2021	5/31/2021	5	5	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

<u>OffRoad Equipment</u>

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demo, Concrete	Concrete/Industrial Saws	1	8.00	81	0.73
Demo, Concrete	Rubber Tired Dozers	1	8.00	247	0.40
Demo, Concrete	Tractors/Loaders/Backhoes	3	8.00	97	0.37
Earthwork, grading	Graders	1	6.00	187	0.41
Earthwork, grading	Rubber Tired Dozers	1	6.00	247	0.40
Earthwork, grading	Tractors/Loaders/Backhoes	1	7.00	97	0.37
Framing, mechanical, electrical plumbing	Cranes	1	6.00	231	0.29
Framing, mechanical, electrical plumbing	Forklifts	1	6.00	89	0.20
Framing, mechanical, electrical plumbing	Generator Sets	1	8.00	84	0.74
Framing, mechanical, electrical plumbing	Tractors/Loaders/Backhoes	1	6.00	97	0.37
Framing, mechanical, electrical plumbing	Welders	3	8.00	46	0.45
Exterior and interior finishes	Cranes	1	6.00	231	0.29
Exterior and interior finishes	Forklifts	1	6.00	89	0.20
Exterior and interior finishes	Generator Sets	1	8.00	84	0.74
Exterior and interior finishes	Tractors/Loaders/Backhoes	1	6.00	97	0.37
Exterior and interior finishes	Welders	3	8.00	46	0.45
Sidewalks	Cement and Mortar Mixers	1	6.00	9	0.56
Sidewalks	Pavers	1	6.00	130	0.42
Sidewalks	Paving Equipment	1	8.00	132	0.36
Sidewalks	Rollers	1	7.00	80	0.38
Sidewalks	Tractors/Loaders/Backhoes	1	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demo, Concrete	5	13.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Earthwork, grading	3	8.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Framing, mechanical, electrical plumbing	7	201.00	52.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Exterior and interior finishes	7	201.00	52.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Sidewalks	5	13.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Demo, Concrete - 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0156	0.0000	0.0156	2.3600e-003	0.0000	2.3600e-003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1102	1.0884	0.7149	1.1600e-003		0.0617	0.0617		0.0577	0.0577	0.0000	102.7972	102.7972	0.0262	0.0000	103.4516
Total	**0.1102**	**1.0884**	**0.7149**	**1.1600e-003**	**0.0156**	**0.0617**	**0.0773**	**2.3600e-003**	**0.0577**	**0.0600**	**0.0000**	**102.7972**	**102.7972**	**0.0262**	**0.0000**	**103.4516**

3.2 Demo, Concrete - 2019

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	2.3600e-003	1.8000e-003	0.0182	5.0000e-005	4.9300e-003	4.0000e-005	4.9700e-003	1.3100e-003	3.0000e-005	1.3400e-003	0.0000	4.5258	4.5258	1.3000e-004	0.0000	4.5291
Total	**2.3600e-003**	**1.8000e-003**	**0.0182**	**5.0000e-005**	**4.9300e-003**	**4.0000e-005**	**4.9700e-003**	**1.3100e-003**	**3.0000e-005**	**1.3400e-003**	**0.0000**	**4.5258**	**4.5258**	**1.3000e-004**	**0.0000**	**4.5291**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0156	0.0000	0.0156	2.3600e-003	0.0000	2.3600e-003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1102	1.0884	0.7149	1.1600e-003		0.0617	0.0617		0.0577	0.0577	0.0000	102.7971	102.7971	0.0262	0.0000	103.4515
Total	**0.1102**	**1.0884**	**0.7149**	**1.1600e-003**	**0.0156**	**0.0617**	**0.0773**	**2.3600e-003**	**0.0577**	**0.0600**	**0.0000**	**102.7971**	**102.7971**	**0.0262**	**0.0000**	**103.4515**

3.2 Demo, Concrete - 2019

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	2.3600e-003	1.8000e-003	0.0182	5.0000e-005	4.9300e-003	4.0000e-005	4.9700e-003	1.3100e-003	3.0000e-005	1.3400e-003	0.0000	4.5258	4.5258	1.3000e-004	0.0000	4.5291
Total	**2.3600e-003**	**1.8000e-003**	**0.0182**	**5.0000e-005**	**4.9300e-003**	**4.0000e-005**	**4.9700e-003**	**1.3100e-003**	**3.0000e-005**	**1.3400e-003**	**0.0000**	**4.5258**	**4.5258**	**1.3000e-004**	**0.0000**	**4.5291**

3.3 Earthwork, grading - 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.1439	0.0000	0.1439	0.0530	0.0000	0.0530	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0256	0.2886	0.1189	2.5000e-004		0.0133	0.0133		0.0122	0.0122	0.0000	22.8021	22.8021	7.2100e-003	0.0000	22.9825
Total	**0.0256**	**0.2886**	**0.1189**	**2.5000e-004**	**0.1439**	**0.0133**	**0.1572**	**0.0530**	**0.0122**	**0.0652**	**0.0000**	**22.8021**	**22.8021**	**7.2100e-003**	**0.0000**	**22.9825**

3.3 Earthwork, grading - 2019

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.5000e-004	4.2000e-004	4.2000e-003	1.0000e-005	1.1400e-003	1.0000e-005	1.1500e-003	3.0000e-004	1.0000e-005	3.1000e-004	0.0000	1.0444	1.0444	3.0000e-005	0.0000	1.0452
Total	**5.5000e-004**	**4.2000e-004**	**4.2000e-003**	**1.0000e-005**	**1.1400e-003**	**1.0000e-005**	**1.1500e-003**	**3.0000e-004**	**1.0000e-005**	**3.1000e-004**	**0.0000**	**1.0444**	**1.0444**	**3.0000e-005**	**0.0000**	**1.0452**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.1439	0.0000	0.1439	0.0530	0.0000	0.0530	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0256	0.2886	0.1189	2.5000e-004		0.0133	0.0133		0.0122	0.0122	0.0000	22.8021	22.8021	7.2100e-003	0.0000	22.9825
Total	**0.0256**	**0.2886**	**0.1189**	**2.5000e-004**	**0.1439**	**0.0133**	**0.1572**	**0.0530**	**0.0122**	**0.0652**	**0.0000**	**22.8021**	**22.8021**	**7.2100e-003**	**0.0000**	**22.9825**

3.3 Earthwork, grading - 2019

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.5000e-004	4.2000e-004	4.2000e-003	1.0000e-005	1.1400e-003	1.0000e-005	1.1500e-003	3.0000e-004	1.0000e-005	3.1000e-004	0.0000	1.0444	1.0444	3.0000e-005	0.0000	1.0452
Total	**5.5000e-004**	**4.2000e-004**	**4.2000e-003**	**1.0000e-005**	**1.1400e-003**	**1.0000e-005**	**1.1500e-003**	**3.0000e-004**	**1.0000e-005**	**3.1000e-004**	**0.0000**	**1.0444**	**1.0444**	**3.0000e-005**	**0.0000**	**1.0452**

3.3 Earthwork, grading - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.2049	0.0000	0.2049	0.0866	0.0000	0.0866	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0425	0.4752	0.2033	4.4000e-004		0.0216	0.0216		0.0198	0.0198	0.0000	39.0272	39.0272	0.0126	0.0000	39.3428
Total	**0.0425**	**0.4752**	**0.2033**	**4.4000e-004**	**0.2049**	**0.0216**	**0.2265**	**0.0866**	**0.0198**	**0.1064**	**0.0000**	**39.0272**	**39.0272**	**0.0126**	**0.0000**	**39.3428**

3.3 Earthwork, grading - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	8.7000e-004	6.4000e-004	6.5900e-003	2.0000e-005	1.9900e-003	1.0000e-005	2.0100e-003	5.3000e-004	1.0000e-005	5.4000e-004	0.0000	1.7712	1.7712	5.0000e-005	0.0000	1.7723
Total	**8.7000e-004**	**6.4000e-004**	**6.5900e-003**	**2.0000e-005**	**1.9900e-003**	**1.0000e-005**	**2.0100e-003**	**5.3000e-004**	**1.0000e-005**	**5.4000e-004**	**0.0000**	**1.7712**	**1.7712**	**5.0000e-005**	**0.0000**	**1.7723**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.2049	0.0000	0.2049	0.0866	0.0000	0.0866	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0425	0.4752	0.2033	4.4000e-004		0.0216	0.0216		0.0198	0.0198	0.0000	39.0272	39.0272	0.0126	0.0000	39.3427
Total	**0.0425**	**0.4752**	**0.2033**	**4.4000e-004**	**0.2049**	**0.0216**	**0.2265**	**0.0866**	**0.0198**	**0.1064**	**0.0000**	**39.0272**	**39.0272**	**0.0126**	**0.0000**	**39.3427**

3.3 Earthwork, grading - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	8.7000e-004	6.4000e-004	6.5900e-003	2.0000e-005	1.9900e-003	1.0000e-005	2.0100e-003	5.3000e-004	1.0000e-005	5.4000e-004	0.0000	1.7712	1.7712	5.0000e-005	0.0000	1.7723
Total	**8.7000e-004**	**6.4000e-004**	**6.5900e-003**	**2.0000e-005**	**1.9900e-003**	**1.0000e-005**	**2.0100e-003**	**5.3000e-004**	**1.0000e-005**	**5.4000e-004**	**0.0000**	**1.7712**	**1.7712**	**5.0000e-005**	**0.0000**	**1.7723**

3.4 Framing, mechanical, electrical plumbing - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1117	0.8134	0.7253	1.2100e-003		0.0438	0.0438		0.0423	0.0423	0.0000	99.8482	99.8482	0.0185	0.0000	100.3116
Total	**0.1117**	**0.8134**	**0.7253**	**1.2100e-003**		**0.0438**	**0.0438**		**0.0423**	**0.0423**	**0.0000**	**99.8482**	**99.8482**	**0.0185**	**0.0000**	**100.3116**

3.4 Framing, mechanical, electrical plumbing - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0107	0.3362	0.0724	7.9000e-004	0.0188	1.5600e-003	0.0203	5.4300e-003	1.4900e-003	6.9300e-003	0.0000	75.6500	75.6500	4.3500e-003	0.0000	75.7587
Worker	0.0382	0.0282	0.2892	8.6000e-004	0.0874	6.1000e-004	0.0880	0.0233	5.6000e-004	0.0238	0.0000	77.7007	77.7007	2.0100e-003	0.0000	77.7508
Total	**0.0490**	**0.3644**	**0.3617**	**1.6500e-003**	**0.1062**	**2.1700e-003**	**0.1084**	**0.0287**	**2.0500e-003**	**0.0307**	**0.0000**	**153.3506**	**153.3506**	**6.3600e-003**	**0.0000**	**153.5095**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1117	0.8134	0.7253	1.2100e-003		0.0438	0.0438		0.0423	0.0423	0.0000	99.8481	99.8481	0.0185	0.0000	100.3114
Total	**0.1117**	**0.8134**	**0.7253**	**1.2100e-003**		**0.0438**	**0.0438**		**0.0423**	**0.0423**	**0.0000**	**99.8481**	**99.8481**	**0.0185**	**0.0000**	**100.3114**

3.4 Framing, mechanical, electrical plumbing - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0107	0.3362	0.0724	7.9000e-004	0.0188	1.5600e-003	0.0203	5.4300e-003	1.4900e-003	6.9300e-003	0.0000	75.6500	75.6500	4.3500e-003	0.0000	75.7587
Worker	0.0382	0.0282	0.2892	8.6000e-004	0.0874	6.1000e-004	0.0880	0.0233	5.6000e-004	0.0238	0.0000	77.7007	77.7007	2.0100e-003	0.0000	77.7508
Total	**0.0490**	**0.3644**	**0.3617**	**1.6500e-003**	**0.1062**	**2.1700e-003**	**0.1084**	**0.0287**	**2.0500e-003**	**0.0307**	**0.0000**	**153.3506**	**153.3506**	**6.3600e-003**	**0.0000**	**153.5095**

3.5 Exterior and interior finishes - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0904	0.6581	0.5869	9.8000e-004		0.0354	0.0354		0.0342	0.0342	0.0000	80.7863	80.7863	0.0150	0.0000	81.1612
Total	**0.0904**	**0.6581**	**0.5869**	**9.8000e-004**		**0.0354**	**0.0354**		**0.0342**	**0.0342**	**0.0000**	**80.7863**	**80.7863**	**0.0150**	**0.0000**	**81.1612**

3.5 Exterior and interior finishes - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	8.6900e-003	0.2720	0.0586	6.4000e-004	0.0152	1.2600e-003	0.0165	4.4000e-003	1.2100e-003	5.6000e-003	0.0000	61.2077	61.2077	3.5200e-003	0.0000	61.2957
Worker	0.0309	0.0228	0.2340	7.0000e-004	0.0707	4.9000e-004	0.0712	0.0188	4.5000e-004	0.0193	0.0000	62.8669	62.8669	1.6200e-003	0.0000	62.9075
Total	**0.0396**	**0.2948**	**0.2926**	**1.3400e-003**	**0.0859**	**1.7500e-003**	**0.0877**	**0.0232**	**1.6600e-003**	**0.0249**	**0.0000**	**124.0746**	**124.0746**	**5.1400e-003**	**0.0000**	**124.2032**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0904	0.6581	0.5869	9.8000e-004		0.0354	0.0354		0.0342	0.0342	0.0000	80.7862	80.7862	0.0150	0.0000	81.1611
Total	**0.0904**	**0.6581**	**0.5869**	**9.8000e-004**		**0.0354**	**0.0354**		**0.0342**	**0.0342**	**0.0000**	**80.7862**	**80.7862**	**0.0150**	**0.0000**	**81.1611**

3.5 Exterior and interior finishes - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	8.6900e-003	0.2720	0.0586	6.4000e-004	0.0152	1.2600e-003	0.0165	4.4000e-003	1.2100e-003	5.6000e-003	0.0000	61.2077	61.2077	3.5200e-003	0.0000	61.2957
Worker	0.0309	0.0228	0.2340	7.0000e-004	0.0707	4.9000e-004	0.0712	0.0188	4.5000e-004	0.0193	0.0000	62.8669	62.8669	1.6200e-003	0.0000	62.9075
Total	**0.0396**	**0.2948**	**0.2926**	**1.3400e-003**	**0.0859**	**1.7500e-003**	**0.0877**	**0.0232**	**1.6600e-003**	**0.0249**	**0.0000**	**124.0746**	**124.0746**	**5.1400e-003**	**0.0000**	**124.2032**

3.5 Exterior and interior finishes - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0653	0.4909	0.4644	7.9000e-004		0.0246	0.0246		0.0238	0.0238	0.0000	65.3571	65.3571	0.0117	0.0000	65.6488
Total	**0.0653**	**0.4909**	**0.4644**	**7.9000e-004**		**0.0246**	**0.0246**		**0.0238**	**0.0238**	**0.0000**	**65.3571**	**65.3571**	**0.0117**	**0.0000**	**65.6488**

3.5 Exterior and interior finishes - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	5.7900e-003	0.2002	0.0424	5.1000e-004	0.0123	4.2000e-004	0.0127	3.5600e-003	4.0000e-004	3.9600e-003	0.0000	49.0409	49.0409	2.6900e-003	0.0000	49.1082
Worker	0.0231	0.0165	0.1725	5.4000e-004	0.0572	3.8000e-004	0.0576	0.0152	3.5000e-004	0.0156	0.0000	49.0943	49.0943	1.1700e-003	0.0000	49.1236
Total	**0.0289**	**0.2167**	**0.2149**	**1.0500e-003**	**0.0695**	**8.0000e-004**	**0.0703**	**0.0188**	**7.5000e-004**	**0.0195**	**0.0000**	**98.1352**	**98.1352**	**3.8600e-003**	**0.0000**	**98.2319**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0653	0.4909	0.4644	7.9000e-004		0.0246	0.0246		0.0238	0.0238	0.0000	65.3571	65.3571	0.0117	0.0000	65.6488
Total	**0.0653**	**0.4909**	**0.4644**	**7.9000e-004**		**0.0246**	**0.0246**		**0.0238**	**0.0238**	**0.0000**	**65.3571**	**65.3571**	**0.0117**	**0.0000**	**65.6488**

3.5 Exterior and interior finishes - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	5.7900e-003	0.2002	0.0424	5.1000e-004	0.0123	4.2000e-004	0.0127	3.5600e-003	4.0000e-004	3.9600e-003	0.0000	49.0409	49.0409	2.6900e-003	0.0000	49.1082
Worker	0.0231	0.0165	0.1725	5.4000e-004	0.0572	3.8000e-004	0.0576	0.0152	3.5000e-004	0.0156	0.0000	49.0943	49.0943	1.1700e-003	0.0000	49.1236
Total	**0.0289**	**0.2167**	**0.2149**	**1.0500e-003**	**0.0695**	**8.0000e-004**	**0.0703**	**0.0188**	**7.5000e-004**	**0.0195**	**0.0000**	**98.1352**	**98.1352**	**3.8600e-003**	**0.0000**	**98.2319**

3.6 Sidewalks - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0135	0.1355	0.1550	2.4000e-004		7.2700e-003	7.2700e-003		6.7000e-003	6.7000e-003	0.0000	20.5887	20.5887	6.5300e-003	0.0000	20.7519
Paving	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0135**	**0.1355**	**0.1550**	**2.4000e-004**		**7.2700e-003**	**7.2700e-003**		**6.7000e-003**	**6.7000e-003**	**0.0000**	**20.5887**	**20.5887**	**6.5300e-003**	**0.0000**	**20.7519**

3.6 Sidewalks - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	7.3000e-004	5.2000e-004	5.4200e-003	2.0000e-005	1.8000e-003	1.0000e-005	1.8100e-003	4.8000e-004	1.0000e-005	4.9000e-004	0.0000	1.5435	1.5435	4.0000e-005	0.0000	1.5445
Total	**7.3000e-004**	**5.2000e-004**	**5.4200e-003**	**2.0000e-005**	**1.8000e-003**	**1.0000e-005**	**1.8100e-003**	**4.8000e-004**	**1.0000e-005**	**4.9000e-004**	**0.0000**	**1.5435**	**1.5435**	**4.0000e-005**	**0.0000**	**1.5445**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0135	0.1355	0.1550	2.4000e-004		7.2700e-003	7.2700e-003		6.7000e-003	6.7000e-003	0.0000	20.5887	20.5887	6.5300e-003	0.0000	20.7519
Paving	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0135**	**0.1355**	**0.1550**	**2.4000e-004**		**7.2700e-003**	**7.2700e-003**		**6.7000e-003**	**6.7000e-003**	**0.0000**	**20.5887**	**20.5887**	**6.5300e-003**	**0.0000**	**20.7519**

3.6 Sidewalks - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	7.3000e-004	5.2000e-004	5.4200e-003	2.0000e-005	1.8000e-003	1.0000e-005	1.8100e-003	4.8000e-004	1.0000e-005	4.9000e-004	0.0000	1.5435	1.5435	4.0000e-005	0.0000	1.5445
Total	**7.3000e-004**	**5.2000e-004**	**5.4200e-003**	**2.0000e-005**	**1.8000e-003**	**1.0000e-005**	**1.8100e-003**	**4.8000e-004**	**1.0000e-005**	**4.9000e-004**	**0.0000**	**1.5435**	**1.5435**	**4.0000e-005**	**0.0000**	**1.5445**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Apartments Mid Rise	0.00	0.00	0.00		
University/College (4Yr)	0.00	0.00	0.00		
University/College (4Yr)	0.00	0.00	0.00		
University/College (4Yr)	0.00	0.00	0.00		
University/College (4Yr)	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Apartments Mid Rise	10.80	4.80	5.70	31.00	15.00	54.00	86	11	3
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Apartments Mid Rise	0.561348	0.038614	0.190285	0.107199	0.015389	0.005180	0.024554	0.046236	0.002209	0.002456	0.005491	0.000334	0.000704
University/College (4Yr)	0.561348	0.038614	0.190285	0.107199	0.015389	0.005180	0.024554	0.046236	0.002209	0.002456	0.005491	0.000334	0.000704

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	845.1336	845.1336	0.0382	7.9100e-003	848.4450
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	845.1336	845.1336	0.0382	7.9100e-003	848.4450
NaturalGas Mitigated	0.0481	0.4330	0.3387	2.6200e-003		0.0332	0.0332		0.0332	0.0332	0.0000	475.5757	475.5757	9.1200e-003	8.7200e-003	478.4018
NaturalGas Unmitigated	0.0481	0.4330	0.3387	2.6200e-003		0.0332	0.0332		0.0332	0.0332	0.0000	475.5757	475.5757	9.1200e-003	8.7200e-003	478.4018

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Apartments Mid Rise	1.30956e+006	7.0600e-003	0.0603	0.0257	3.9000e-004		4.8800e-003	4.8800e-003		4.8800e-003	4.8800e-003	0.0000	69.8834	69.8834	1.3400e-003	1.2800e-003	70.2986
University/College (4Yr)	2.19654e+006	0.0118	0.1077	0.0905	6.5000e-004		8.1800e-003	8.1800e-003		8.1800e-003	8.1800e-003	0.0000	117.2155	117.2155	2.2500e-003	2.1500e-003	117.9121
University/College (4Yr)	5.40585e+006	0.0292	0.2650	0.2226	1.5900e-003		0.0201	0.0201		0.0201	0.0201	0.0000	288.4768	288.4768	5.5300e-003	5.2900e-003	290.1911
Total		**0.0481**	**0.4330**	**0.3387**	**2.6300e-003**		**0.0332**	**0.0332**		**0.0332**	**0.0332**	**0.0000**	**475.5757**	**475.5757**	**9.1200e-003**	**8.7200e-003**	**478.4018**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Apartments Mid Rise	1.30956e+006	7.0600e-003	0.0603	0.0257	3.9000e-004		4.8800e-003	4.8800e-003		4.8800e-003	4.8800e-003	0.0000	69.8834	69.8834	1.3400e-003	1.2800e-003	70.2986
University/College (4Yr)	2.19654e+006	0.0118	0.1077	0.0905	6.5000e-004		8.1800e-003	8.1800e-003		8.1800e-003	8.1800e-003	0.0000	117.2155	117.2155	2.2500e-003	2.1500e-003	117.9121
University/College (4Yr)	5.40585e+006	0.0292	0.2650	0.2226	1.5900e-003		0.0201	0.0201		0.0201	0.0201	0.0000	288.4768	288.4768	5.5300e-003	5.2900e-003	290.1911
Total		**0.0481**	**0.4330**	**0.3387**	**2.6300e-003**		**0.0332**	**0.0332**		**0.0332**	**0.0332**	**0.0000**	**475.5757**	**475.5757**	**9.1200e-003**	**8.7200e-003**	**478.4018**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Apartments Mid Rise	633299	184.2338	8.3300e-003	1.7200e-003	184.9557
University/College (4Yr)	1.61543e +006	469.9479	0.0213	4.4000e-003	471.7893
University/College (4Yr)	656392	190.9519	8.6300e-003	1.7900e-003	191.7001
Total		**845.1336**	**0.0382**	**7.9100e-003**	**848.4450**

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Apartments Mid Rise	633299	184.2338	8.3300e-003	1.7200e-003	184.9557
University/College (4Yr)	1.61543e +006	469.9479	0.0213	4.4000e-003	471.7893
University/College (4Yr)	656392	190.9519	8.6300e-003	1.7900e-003	191.7001
Total		**845.1336**	**0.0382**	**7.9100e-003**	**848.4450**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	1.7099	0.0129	1.1228	6.0000e-005		6.2000e-003	6.2000e-003		6.2000e-003	6.2000e-003	0.0000	1.8363	1.8363	1.7900e-003	0.0000	1.8812
Unmitigated	1.7099	0.0129	1.1228	6.0000e-005		6.2000e-003	6.2000e-003		6.2000e-003	6.2000e-003	0.0000	1.8363	1.8363	1.7900e-003	0.0000	1.8812

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.2215					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	1.4540					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0344	0.0129	1.1228	6.0000e-005		6.2000e-003	6.2000e-003		6.2000e-003	6.2000e-003	0.0000	1.8363	1.8363	1.7900e-003	0.0000	1.8812
Total	**1.7099**	**0.0129**	**1.1228**	**6.0000e-005**		**6.2000e-003**	**6.2000e-003**		**6.2000e-003**	**6.2000e-003**	**0.0000**	**1.8363**	**1.8363**	**1.7900e-003**	**0.0000**	**1.8812**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.2215					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	1.4540					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0344	0.0129	1.1228	6.0000e-005		6.2000e-003	6.2000e-003		6.2000e-003	6.2000e-003	0.0000	1.8363	1.8363	1.7900e-003	0.0000	1.8812
Total	**1.7099**	**0.0129**	**1.1228**	**6.0000e-005**		**6.2000e-003**	**6.2000e-003**		**6.2000e-003**	**6.2000e-003**	**0.0000**	**1.8363**	**1.8363**	**1.7900e-003**	**0.0000**	**1.8812**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	33.7797	0.4042	9.7900e-003	46.8022
Unmitigated	33.7797	0.4042	9.7900e-003	46.8022

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Apartments Mid Rise	9.7731 / 6.1613	24.7580	0.3194	7.7200e-003	35.0451
University/College (4Yr)	0.748186 / 1.17024	2.6066	0.0245	6.0000e-004	3.3970
University/College (4Yr)	1.84135 / 2.88005	6.4151	0.0603	1.4700e-003	8.3602
Total		**33.7797**	**0.4042**	**9.7900e-003**	**46.8022**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Apartments Mid Rise	9.7731 / 6.1613	24.7580	0.3194	7.7200e-003	35.0451
University/College (4Yr)	0.748186 / 1.17024	2.6066	0.0245	6.0000e-004	3.3970
University/College (4Yr)	1.84135 / 2.88005	6.4151	0.0603	1.4700e-003	8.3602
Total		**33.7797**	**0.4042**	**9.7900e-003**	**46.8022**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	60.6436	3.5839	0.0000	150.2418
Unmitigated	60.6436	3.5839	0.0000	150.2418

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Apartments Mid Rise	69	14.0064	0.8278	0.0000	34.7002
University/College (4Yr)	156.95	31.8594	1.8828	0.0000	78.9304
University/College (4Yr)	72.8	14.7777	0.8733	0.0000	36.6112
Total		**60.6436**	**3.5839**	**0.0000**	**150.2418**

8.2 Waste by Land Use

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Apartments Mid Rise	69	14.0064	0.8278	0.0000	34.7002
University/College (4Yr)	156.95	31.8594	1.8828	0.0000	78.9304
University/College (4Yr)	72.8	14.7777	0.8733	0.0000	36.6112
Total		**60.6436**	**3.5839**	**0.0000**	**150.2418**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

Upper Hearst Development

Alameda County, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
University/College (4Yr)	91.00	Employee	0.25	64,226.19	0
University/College (4Yr)	860.00	Student	0.25	158,065.82	0
Apartments Mid Rise	150.00	Dwelling Unit	0.50	150,000.00	429

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	63
Climate Zone	5			**Operational Year**	2023
Utility Company	Pacific Gas & Electric Company				
CO2 Intensity (lb/MWhr)	641.35	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - Per site plans one acre project site. Students = 397 academic classrooms + 450 academic event space + 13 residential amenity space

Construction Phase - Client provided phases and schedule

Trips and VMT -

Demolition - per applicant supplied information. 7,000 cy = 3,300 sf

Grading - Per applicant supplied information 13,000 cy export

Vehicle Trips - Zero trips, project would not increase trips compared to existing conditions.

Woodstoves - No fireplaces per site plans

Construction Off-road Equipment Mitigation -

Table Name	Column Name	Default Value	New Value
tblFireplaces	FireplaceDayYear	11.14	0.00
tblFireplaces	FireplaceHourDay	3.50	0.00
tblFireplaces	FireplaceWoodMass	228.80	0.00
tblFireplaces	NumberGas	22.50	0.00
tblFireplaces	NumberNoFireplace	6.00	0.00
tblFireplaces	NumberWood	25.50	0.00
tblGrading	AcresOfGrading	0.75	1.00
tblGrading	MaterialExported	0.00	13,000.00
tblLandUse	LotAcreage	1.47	0.25
tblLandUse	LotAcreage	3.63	0.25
tblLandUse	LotAcreage	3.95	0.50
tblTripsAndVMT	HaulingTripNumber	15.00	0.00
tblTripsAndVMT	HaulingTripNumber	1,625.00	0.00
tblVehicleTrips	ST_TR	6.39	0.00
tblVehicleTrips	ST_TR	3.12	0.00
tblVehicleTrips	ST_TR	1.30	0.00
tblVehicleTrips	SU_TR	5.86	0.00
tblVehicleTrips	WD_TR	6.65	0.00
tblVehicleTrips	WD_TR	8.96	0.00
tblVehicleTrips	WD_TR	1.71	0.00
tblWoodstoves	NumberCatalytic	3.00	0.00
tblWoodstoves	NumberNoncatalytic	3.00	0.00
tblWoodstoves	WoodstoveDayYear	14.12	0.00
tblWoodstoves	WoodstoveWoodMass	582.40	0.00

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2019	2.3470	22.7082	15.3064	0.0252	5.8476	1.2870	6.5845	2.6687	1.2024	3.3466	0.0000	2,472.7783	2,472.7783	0.6043	0.0000	2,487.8851
2020	2.9571	21.2838	20.1491	0.0534	5.8476	0.8351	6.5324	2.6687	0.8059	3.2987	0.0000	5,214.1254	5,214.1254	0.4980	0.0000	5,226.5745
2021	2.6488	19.5476	19.2298	0.0527	2.0035	0.7065	2.7100	0.5394	0.6816	1.2210	0.0000	5,141.2210	5,141.2210	0.4747	0.0000	5,153.0876
Maximum	**2.9571**	**22.7082**	**20.1491**	**0.0534**	**5.8476**	**1.2870**	**6.5845**	**2.6687**	**1.2024**	**3.3466**	**0.0000**	**5,214.1254**	**5,214.1254**	**0.6043**	**0.0000**	**5,226.5745**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2019	2.3470	22.7082	15.3064	0.0252	5.8476	1.2870	6.5845	2.6687	1.2024	3.3466	0.0000	2,472.7783	2,472.7783	0.6043	0.0000	2,487.8851
2020	2.9571	21.2838	20.1491	0.0534	5.8476	0.8351	6.5324	2.6687	0.8059	3.2987	0.0000	5,214.1254	5,214.1254	0.4980	0.0000	5,226.5745
2021	2.6488	19.5476	19.2298	0.0527	2.0035	0.7065	2.7100	0.5394	0.6816	1.2210	0.0000	5,141.2210	5,141.2210	0.4747	0.0000	5,153.0876
Maximum	**2.9571**	**22.7082**	**20.1491**	**0.0534**	**5.8476**	**1.2870**	**6.5845**	**2.6687**	**1.2024**	**3.3466**	**0.0000**	**5,214.1254**	**5,214.1254**	**0.6043**	**0.0000**	**5,226.5745**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	9.5627	0.1436	12.4750	6.6000e-004		0.0689	0.0689		0.0689	0.0689	0.0000	22.4910	22.4910	0.0220	0.0000	23.0403
Energy	0.2633	2.3727	1.8560	0.0144		0.1819	0.1819		0.1819	0.1819		2,872.5064	2,872.5064	0.0551	0.0527	2,889.5763
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**9.8260**	**2.5162**	**14.3310**	**0.0150**	**0.0000**	**0.2508**	**0.2508**	**0.0000**	**0.2508**	**0.2508**	**0.0000**	**2,894.9974**	**2,894.9974**	**0.0770**	**0.0527**	**2,912.6166**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	9.5627	0.1436	12.4750	6.6000e-004		0.0689	0.0689		0.0689	0.0689	0.0000	22.4910	22.4910	0.0220	0.0000	23.0403
Energy	0.2633	2.3727	1.8560	0.0144		0.1819	0.1819		0.1819	0.1819		2,872.5064	2,872.5064	0.0551	0.0527	2,889.5763
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**9.8260**	**2.5162**	**14.3310**	**0.0150**	**0.0000**	**0.2508**	**0.2508**	**0.0000**	**0.2508**	**0.2508**	**0.0000**	**2,894.9974**	**2,894.9974**	**0.0770**	**0.0527**	**2,912.6166**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demo, Concrete	Demolition	7/1/2019	11/11/2019	5	10	
2	Earthwork, grading	Grading	11/12/2019	3/27/2020	5	2	
3	Framing, mechanical, electrical plumbing	Building Construction	3/30/2020	8/28/2020	5	100	
4	Exterior and interior finishes	Building Construction	8/31/2020	4/12/2021	5	100	
5	Sidewalks	Paving	4/13/2021	5/31/2021	5	5	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demo, Concrete	Concrete/Industrial Saws	1	8.00	81	0.73
Demo, Concrete	Rubber Tired Dozers	1	8.00	247	0.40
Demo, Concrete	Tractors/Loaders/Backhoes	3	8.00	97	0.37
Earthwork, grading	Graders	1	6.00	187	0.41
Earthwork, grading	Rubber Tired Dozers	1	6.00	247	0.40
Earthwork, grading	Tractors/Loaders/Backhoes	1	7.00	97	0.37
Framing, mechanical, electrical plumbing	Cranes	1	6.00	231	0.29
Framing, mechanical, electrical plumbing	Forklifts	1	6.00	89	0.20
Framing, mechanical, electrical plumbing	Generator Sets	1	8.00	84	0.74
Framing, mechanical, electrical plumbing	Tractors/Loaders/Backhoes	1	6.00	97	0.37
Framing, mechanical, electrical plumbing	Welders	3	8.00	46	0.45
Exterior and interior finishes	Cranes	1	6.00	231	0.29
Exterior and interior finishes	Forklifts	1	6.00	89	0.20
Exterior and interior finishes	Generator Sets	1	8.00	84	0.74
Exterior and interior finishes	Tractors/Loaders/Backhoes	1	6.00	97	0.37
Exterior and interior finishes	Welders	3	8.00	46	0.45
Sidewalks	Cement and Mortar Mixers	1	6.00	9	0.56
Sidewalks	Pavers	1	6.00	130	0.42
Sidewalks	Paving Equipment	1	8.00	132	0.36
Sidewalks	Rollers	1	7.00	80	0.38
Sidewalks	Tractors/Loaders/Backhoes	1	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demo, Concrete	5	13.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Earthwork, grading	3	8.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Framing, mechanical, electrical plumbing	7	201.00	52.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Exterior and interior finishes	7	201.00	52.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Sidewalks	5	13.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Demo, Concrete - 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.3248	0.0000	0.3248	0.0492	0.0000	0.0492			0.0000			0.0000
Off-Road	2.2950	22.6751	14.8943	0.0241		1.2863	1.2863		1.2017	1.2017		2,360.7198	2,360.7198	0.6011		2,375.7475
Total	**2.2950**	**22.6751**	**14.8943**	**0.0241**	**0.3248**	**1.2863**	**1.6111**	**0.0492**	**1.2017**	**1.2509**		**2,360.7198**	**2,360.7198**	**0.6011**		**2,375.7475**

3.2 Demo, Concrete - 2019

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0520	0.0331	0.4121	1.1300e-003	0.1068	7.3000e-004	0.1075	0.0283	6.8000e-004	0.0290		112.0586	112.0586	3.1600e-003		112.1376
Total	**0.0520**	**0.0331**	**0.4121**	**1.1300e-003**	**0.1068**	**7.3000e-004**	**0.1075**	**0.0283**	**6.8000e-004**	**0.0290**		**112.0586**	**112.0586**	**3.1600e-003**		**112.1376**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.3248	0.0000	0.3248	0.0492	0.0000	0.0492			0.0000			0.0000
Off-Road	2.2950	22.6751	14.8943	0.0241		1.2863	1.2863		1.2017	1.2017	0.0000	2,360.7197	2,360.7197	0.6011		2,375.7475
Total	**2.2950**	**22.6751**	**14.8943**	**0.0241**	**0.3248**	**1.2863**	**1.6111**	**0.0492**	**1.2017**	**1.2509**	**0.0000**	**2,360.7197**	**2,360.7197**	**0.6011**		**2,375.7475**

3.2 Demo, Concrete - 2019

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0520	0.0331	0.4121	1.1300e-003	0.1068	7.3000e-004	0.1075	0.0283	6.8000e-004	0.0290		112.0586	112.0586	3.1600e-003		112.1376
Total	**0.0520**	**0.0331**	**0.4121**	**1.1300e-003**	**0.1068**	**7.3000e-004**	**0.1075**	**0.0283**	**6.8000e-004**	**0.0290**		**112.0586**	**112.0586**	**3.1600e-003**		**112.1376**

3.3 Earthwork, grading - 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					5.7819	0.0000	5.7819	2.6512	0.0000	2.6512			0.0000			0.0000
Off-Road	1.4197	16.0357	6.6065	0.0141		0.7365	0.7365		0.6775	0.6775		1,396.3909	1,396.3909	0.4418		1,407.4359
Total	**1.4197**	**16.0357**	**6.6065**	**0.0141**	**5.7819**	**0.7365**	**6.5184**	**2.6512**	**0.6775**	**3.3288**		**1,396.3909**	**1,396.3909**	**0.4418**		**1,407.4359**

3.3 Earthwork, grading - 2019

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0320	0.0204	0.2536	6.9000e-004	0.0657	4.5000e-004	0.0662	0.0174	4.2000e-004	0.0179		68.9591	68.9591	1.9500e-003		69.0078
Total	**0.0320**	**0.0204**	**0.2536**	**6.9000e-004**	**0.0657**	**4.5000e-004**	**0.0662**	**0.0174**	**4.2000e-004**	**0.0179**		**68.9591**	**68.9591**	**1.9500e-003**		**69.0078**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					5.7819	0.0000	5.7819	2.6512	0.0000	2.6512			0.0000			0.0000
Off-Road	1.4197	16.0357	6.6065	0.0141		0.7365	0.7365		0.6775	0.6775	0.0000	1,396.3909	1,396.3909	0.4418		1,407.4359
Total	**1.4197**	**16.0357**	**6.6065**	**0.0141**	**5.7819**	**0.7365**	**6.5184**	**2.6512**	**0.6775**	**3.3288**	**0.0000**	**1,396.3909**	**1,396.3909**	**0.4418**		**1,407.4359**

3.3 Earthwork, grading - 2019

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0320	0.0204	0.2536	6.9000e-004	0.0657	4.5000e-004	0.0662	0.0174	4.2000e-004	0.0179		68.9591	68.9591	1.9500e-003		69.0078
Total	**0.0320**	**0.0204**	**0.2536**	**6.9000e-004**	**0.0657**	**4.5000e-004**	**0.0662**	**0.0174**	**4.2000e-004**	**0.0179**		**68.9591**	**68.9591**	**1.9500e-003**		**69.0078**

3.3 Earthwork, grading - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					5.7819	0.0000	5.7819	2.6512	0.0000	2.6512			0.0000			0.0000
Off-Road	1.3498	15.0854	6.4543	0.0141		0.6844	0.6844		0.6296	0.6296		1,365.718 3	1,365.718 3	0.4417		1,376.760 9
Total	**1.3498**	**15.0854**	**6.4543**	**0.0141**	**5.7819**	**0.6844**	**6.4663**	**2.6512**	**0.6296**	**3.2809**		**1,365.718 3**	**1,365.718 3**	**0.4417**		**1,376.760 9**

3.3 Earthwork, grading - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0293	0.0180	0.2282	6.7000e-004	0.0657	4.4000e-004	0.0662	0.0174	4.0000e-004	0.0178		66.8289	66.8289	1.7100e-003		66.8718
Total	**0.0293**	**0.0180**	**0.2282**	**6.7000e-004**	**0.0657**	**4.4000e-004**	**0.0662**	**0.0174**	**4.0000e-004**	**0.0178**		**66.8289**	**66.8289**	**1.7100e-003**		**66.8718**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					5.7819	0.0000	5.7819	2.6512	0.0000	2.6512			0.0000			0.0000
Off-Road	1.3498	15.0854	6.4543	0.0141		0.6844	0.6844		0.6296	0.6296	0.0000	1,365.7183	1,365.7183	0.4417		1,376.7609
Total	**1.3498**	**15.0854**	**6.4543**	**0.0141**	**5.7819**	**0.6844**	**6.4663**	**2.6512**	**0.6296**	**3.2809**	**0.0000**	**1,365.7183**	**1,365.7183**	**0.4417**		**1,376.7609**

3.3 Earthwork, grading - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0293	0.0180	0.2282	6.7000e-004	0.0657	4.4000e-004	0.0662	0.0174	4.0000e-004	0.0178		66.8289	66.8289	1.7100e-003		66.8718
Total	**0.0293**	**0.0180**	**0.2282**	**6.7000e-004**	**0.0657**	**4.4000e-004**	**0.0662**	**0.0174**	**4.0000e-004**	**0.0178**		**66.8289**	**66.8289**	**1.7100e-003**		**66.8718**

3.4 Framing, mechanical, electrical plumbing - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	2.0305	14.7882	13.1881	0.0220		0.7960	0.7960		0.7688	0.7688		2,001.159 5	2,001.159 5	0.3715		2,010.446 7
Total	**2.0305**	**14.7882**	**13.1881**	**0.0220**		**0.7960**	**0.7960**		**0.7688**	**0.7688**		**2,001.159 5**	**2,001.159 5**	**0.3715**		**2,010.446 7**

3.4 Framing, mechanical, electrical plumbing - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1913	6.0430	1.2272	0.0145	0.3523	0.0282	0.3805	0.1015	0.0270	0.1284		1,533.888 9	1,533.888 9	0.0835		1,535.975 0
Worker	0.7354	0.4525	5.7338	0.0169	1.6512	0.0110	1.6622	0.4380	0.0102	0.4481		1,679.077 0	1,679.077 0	0.0430		1,680.152 8
Total	**0.9266**	**6.4955**	**6.9610**	**0.0314**	**2.0035**	**0.0392**	**2.0427**	**0.5394**	**0.0371**	**0.5765**		**3,212.965 9**	**3,212.965 9**	**0.1265**		**3,216.127 8**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	2.0305	14.7882	13.1881	0.0220		0.7960	0.7960		0.7688	0.7688	0.0000	2,001.159 5	2,001.159 5	0.3715		2,010.446 7
Total	**2.0305**	**14.7882**	**13.1881**	**0.0220**		**0.7960**	**0.7960**		**0.7688**	**0.7688**	**0.0000**	**2,001.159 5**	**2,001.159 5**	**0.3715**		**2,010.446 7**

3.4 Framing, mechanical, electrical plumbing - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1913	6.0430	1.2272	0.0145	0.3523	0.0282	0.3805	0.1015	0.0270	0.1284		1,533.888 9	1,533.888 9	0.0835		1,535.975 0
Worker	0.7354	0.4525	5.7338	0.0169	1.6512	0.0110	1.6622	0.4380	0.0102	0.4481		1,679.077 0	1,679.077 0	0.0430		1,680.152 8
Total	**0.9266**	**6.4955**	**6.9610**	**0.0314**	**2.0035**	**0.0392**	**2.0427**	**0.5394**	**0.0371**	**0.5765**		**3,212.965 9**	**3,212.965 9**	**0.1265**		**3,216.127 8**

3.5 Exterior and interior finishes - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	2.0305	14.7882	13.1881	0.0220		0.7960	0.7960		0.7688	0.7688		2,001.159 5	2,001.159 5	0.3715		2,010.446 7
Total	**2.0305**	**14.7882**	**13.1881**	**0.0220**		**0.7960**	**0.7960**		**0.7688**	**0.7688**		**2,001.159 5**	**2,001.159 5**	**0.3715**		**2,010.446 7**

3.5 Exterior and interior finishes - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1913	6.0430	1.2272	0.0145	0.3523	0.0282	0.3805	0.1015	0.0270	0.1284		1,533.888 9	1,533.888 9	0.0835		1,535.975 0
Worker	0.7354	0.4525	5.7338	0.0169	1.6512	0.0110	1.6622	0.4380	0.0102	0.4481		1,679.077 0	1,679.077 0	0.0430		1,680.152 8
Total	**0.9266**	**6.4955**	**6.9610**	**0.0314**	**2.0035**	**0.0392**	**2.0427**	**0.5394**	**0.0371**	**0.5765**		**3,212.965 9**	**3,212.965 9**	**0.1265**		**3,216.127 8**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	2.0305	14.7882	13.1881	0.0220		0.7960	0.7960		0.7688	0.7688	0.0000	2,001.159 5	2,001.159 5	0.3715		2,010.446 7
Total	**2.0305**	**14.7882**	**13.1881**	**0.0220**		**0.7960**	**0.7960**		**0.7688**	**0.7688**	**0.0000**	**2,001.159 5**	**2,001.159 5**	**0.3715**		**2,010.446 7**

3.5 Exterior and interior finishes - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1913	6.0430	1.2272	0.0145	0.3523	0.0282	0.3805	0.1015	0.0270	0.1284		1,533.8889	1,533.8889	0.0835		1,535.9750
Worker	0.7354	0.4525	5.7338	0.0169	1.6512	0.0110	1.6622	0.4380	0.0102	0.4481		1,679.0770	1,679.0770	0.0430		1,680.1528
Total	**0.9266**	**6.4955**	**6.9610**	**0.0314**	**2.0035**	**0.0392**	**2.0427**	**0.5394**	**0.0371**	**0.5765**		**3,212.9659**	**3,212.9659**	**0.1265**		**3,216.1278**

3.5 Exterior and interior finishes - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.8125	13.6361	12.8994	0.0221		0.6843	0.6843		0.6608	0.6608		2,001.2200	2,001.2200	0.3573		2,010.1517
Total	**1.8125**	**13.6361**	**12.8994**	**0.0221**		**0.6843**	**0.6843**		**0.6608**	**0.6608**		**2,001.2200**	**2,001.2200**	**0.3573**		**2,010.1517**

3.5 Exterior and interior finishes - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1573	5.5078	1.0945	0.0144	0.3523	0.0115	0.3638	0.1015	0.0110	0.1124		1,519.182 2	1,519.182 2	0.0789		1,521.154 7
Worker	0.6790	0.4037	5.2360	0.0163	1.6512	0.0107	1.6619	0.4380	9.8400e-003	0.4478		1,620.818 8	1,620.818 8	0.0385		1,621.781 2
Total	**0.8363**	**5.9115**	**6.3305**	**0.0307**	**2.0035**	**0.0221**	**2.0256**	**0.5394**	**0.0208**	**0.5602**		**3,140.001 0**	**3,140.001 0**	**0.1174**		**3,142.935 9**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.8125	13.6361	12.8994	0.0221		0.6843	0.6843		0.6608	0.6608	0.0000	2,001.220 0	2,001.220 0	0.3573		2,010.151 7
Total	**1.8125**	**13.6361**	**12.8994**	**0.0221**		**0.6843**	**0.6843**		**0.6608**	**0.6608**	**0.0000**	**2,001.220 0**	**2,001.220 0**	**0.3573**		**2,010.151 7**

3.5 Exterior and interior finishes - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1573	5.5078	1.0945	0.0144	0.3523	0.0115	0.3638	0.1015	0.0110	0.1124		1,519.182 2	1,519.182 2	0.0789		1,521.154 7
Worker	0.6790	0.4037	5.2360	0.0163	1.6512	0.0107	1.6619	0.4380	9.8400e-003	0.4478		1,620.818 8	1,620.818 8	0.0385		1,621.781 2
Total	**0.8363**	**5.9115**	**6.3305**	**0.0307**	**2.0035**	**0.0221**	**2.0256**	**0.5394**	**0.0208**	**0.5602**		**3,140.001 0**	**3,140.001 0**	**0.1174**		**3,142.935 9**

3.6 Sidewalks - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.7739	7.7422	8.8569	0.0135		0.4153	0.4153		0.3830	0.3830		1,296.866 4	1,296.866 4	0.4111		1,307.144 2
Paving	0.0000					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Total	**0.7739**	**7.7422**	**8.8569**	**0.0135**		**0.4153**	**0.4153**		**0.3830**	**0.3830**		**1,296.866 4**	**1,296.866 4**	**0.4111**		**1,307.144 2**

3.6 Sidewalks - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0439	0.0261	0.3386	1.0500e-003	0.1068	6.9000e-004	0.1075	0.0283	6.4000e-004	0.0290		104.8291	104.8291	2.4900e-003		104.8913
Total	**0.0439**	**0.0261**	**0.3386**	**1.0500e-003**	**0.1068**	**6.9000e-004**	**0.1075**	**0.0283**	**6.4000e-004**	**0.0290**		**104.8291**	**104.8291**	**2.4900e-003**		**104.8913**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.7739	7.7422	8.8569	0.0135		0.4153	0.4153		0.3830	0.3830	0.0000	1,296.8664	1,296.8664	0.4111		1,307.1442
Paving	0.0000					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Total	**0.7739**	**7.7422**	**8.8569**	**0.0135**		**0.4153**	**0.4153**		**0.3830**	**0.3830**	**0.0000**	**1,296.8664**	**1,296.8664**	**0.4111**		**1,307.1442**

3.6 Sidewalks - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0439	0.0261	0.3386	1.0500e-003	0.1068	6.9000e-004	0.1075	0.0283	6.4000e-004	0.0290		104.8291	104.8291	2.4900e-003		104.8913
Total	**0.0439**	**0.0261**	**0.3386**	**1.0500e-003**	**0.1068**	**6.9000e-004**	**0.1075**	**0.0283**	**6.4000e-004**	**0.0290**		**104.8291**	**104.8291**	**2.4900e-003**		**104.8913**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Apartments Mid Rise	0.00	0.00	0.00		
University/College (4Yr)	0.00	0.00	0.00		
University/College (4Yr)	0.00	0.00	0.00		
University/College (4Yr)	0.00	0.00	0.00		
University/College (4Yr)	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Apartments Mid Rise	10.80	4.80	5.70	31.00	15.00	54.00	86	11	3
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Apartments Mid Rise	0.561348	0.038614	0.190285	0.107199	0.015389	0.005180	0.024554	0.046236	0.002209	0.002456	0.005491	0.000334	0.000704
University/College (4Yr)	0.561348	0.038614	0.190285	0.107199	0.015389	0.005180	0.024554	0.046236	0.002209	0.002456	0.005491	0.000334	0.000704

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	0.2633	2.3727	1.8560	0.0144		0.1819	0.1819		0.1819	0.1819		2,872.506 4	2,872.506 4	0.0551	0.0527	2,889.576 3
NaturalGas Unmitigated	0.2633	2.3727	1.8560	0.0144		0.1819	0.1819		0.1819	0.1819		2,872.506 4	2,872.506 4	0.0551	0.0527	2,889.576 3

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Apartments Mid Rise	3587.85	0.0387	0.3306	0.1407	2.1100e-003		0.0267	0.0267		0.0267	0.0267		422.0998	422.0998	8.0900e-003	7.7400e-003	424.6081
University/College (4Yr)	14810.6	0.1597	1.4520	1.2197	8.7100e-003		0.1104	0.1104		0.1104	0.1104		1,742.4177	1,742.4177	0.0334	0.0319	1,752.7721
University/College (4Yr)	6017.91	0.0649	0.5900	0.4956	3.5400e-003		0.0448	0.0448		0.0448	0.0448		707.9889	707.9889	0.0136	0.0130	712.1962
Total		**0.2633**	**2.3726**	**1.8560**	**0.0144**		**0.1819**	**0.1819**		**0.1819**	**0.1819**		**2,872.5064**	**2,872.5064**	**0.0551**	**0.0527**	**2,889.5763**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Apartments Mid Rise	3.58785	0.0387	0.3306	0.1407	2.1100e-003		0.0267	0.0267		0.0267	0.0267		422.0998	422.0998	8.0900e-003	7.7400e-003	424.6081
University/College (4Yr)	14.8106	0.1597	1.4520	1.2197	8.7100e-003		0.1104	0.1104		0.1104	0.1104		1,742.4177	1,742.4177	0.0334	0.0319	1,752.7721
University/College (4Yr)	6.01791	0.0649	0.5900	0.4956	3.5400e-003		0.0448	0.0448		0.0448	0.0448		707.9889	707.9889	0.0136	0.0130	712.1962
Total		**0.2633**	**2.3726**	**1.8560**	**0.0144**		**0.1819**	**0.1819**		**0.1819**	**0.1819**		**2,872.5064**	**2,872.5064**	**0.0551**	**0.0527**	**2,889.5763**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	9.5627	0.1436	12.4750	6.6000e-004		0.0689	0.0689		0.0689	0.0689	0.0000	22.4910	22.4910	0.0220	0.0000	23.0403
Unmitigated	9.5627	0.1436	12.4750	6.6000e-004		0.0689	0.0689		0.0689	0.0689	0.0000	22.4910	22.4910	0.0220	0.0000	23.0403

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	1.2137					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	7.9671					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.3819	0.1436	12.4750	6.6000e-004		0.0689	0.0689		0.0689	0.0689		22.4910	22.4910	0.0220		23.0403
Total	**9.5627**	**0.1436**	**12.4750**	**6.6000e-004**		**0.0689**	**0.0689**		**0.0689**	**0.0689**	**0.0000**	**22.4910**	**22.4910**	**0.0220**	**0.0000**	**23.0403**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	1.2137					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	7.9671					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.3819	0.1436	12.4750	6.6000e-004		0.0689	0.0689		0.0689	0.0689		22.4910	22.4910	0.0220		23.0403
Total	**9.5627**	**0.1436**	**12.4750**	**6.6000e-004**		**0.0689**	**0.0689**		**0.0689**	**0.0689**	**0.0000**	**22.4910**	**22.4910**	**0.0220**	**0.0000**	**23.0403**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

Upper Hearst Development

Alameda County, Winter

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
University/College (4Yr)	91.00	Employee	0.25	64,226.19	0
University/College (4Yr)	860.00	Student	0.25	158,065.82	0
Apartments Mid Rise	150.00	Dwelling Unit	0.50	150,000.00	429

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	63
Climate Zone	5			**Operational Year**	2023
Utility Company	Pacific Gas & Electric Company				
CO2 Intensity (lb/MWhr)	641.35	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - Per site plans one acre project site. Students = 397 academic classrooms + 450 academic event space + 13 residential amenity space

Construction Phase - Client provided phases and schedule

Trips and VMT -

Demolition - per applicant supplied information. 7,000 cy = 3,300 sf

Grading - Per applicant supplied information 13,000 cy export

Vehicle Trips - Zero trips, project would not increase trips compared to existing conditions.

Woodstoves - No fireplaces per site plans

Construction Off-road Equipment Mitigation -

Table Name	Column Name	Default Value	New Value
tblFireplaces	FireplaceDayYear	11.14	0.00
tblFireplaces	FireplaceHourDay	3.50	0.00
tblFireplaces	FireplaceWoodMass	228.80	0.00
tblFireplaces	NumberGas	22.50	0.00
tblFireplaces	NumberNoFireplace	6.00	0.00
tblFireplaces	NumberWood	25.50	0.00
tblGrading	AcresOfGrading	0.75	1.00
tblGrading	MaterialExported	0.00	13,000.00
tblLandUse	LotAcreage	1.47	0.25
tblLandUse	LotAcreage	3.63	0.25
tblLandUse	LotAcreage	3.95	0.50
tblTripsAndVMT	HaulingTripNumber	15.00	0.00
tblTripsAndVMT	HaulingTripNumber	1,625.00	0.00
tblVehicleTrips	ST_TR	6.39	0.00
tblVehicleTrips	ST_TR	3.12	0.00
tblVehicleTrips	ST_TR	1.30	0.00
tblVehicleTrips	SU_TR	5.86	0.00
tblVehicleTrips	WD_TR	6.65	0.00
tblVehicleTrips	WD_TR	8.96	0.00
tblVehicleTrips	WD_TR	1.71	0.00
tblWoodstoves	NumberCatalytic	3.00	0.00
tblWoodstoves	NumberNoncatalytic	3.00	0.00
tblWoodstoves	WoodstoveDayYear	14.12	0.00
tblWoodstoves	WoodstoveWoodMass	582.40	0.00

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2019	2.3493	22.7162	15.2853	0.0251	5.8476	1.2870	6.5845	2.6687	1.2024	3.3466	0.0000	2,463.8424	2,463.8424	0.6041	0.0000	2,478.9446
2020	2.9986	21.4531	20.0230	0.0517	5.8476	0.8356	6.5324	2.6687	0.8064	3.2987	0.0000	5,038.0014	5,038.0014	0.5038	0.0000	5,050.5962
2021	2.6873	19.6862	19.0998	0.0510	2.0035	0.7068	2.7103	0.5394	0.6819	1.2214	0.0000	4,970.1097	4,970.1097	0.4803	0.0000	4,982.1172
Maximum	**2.9986**	**22.7162**	**20.0230**	**0.0517**	**5.8476**	**1.2870**	**6.5845**	**2.6687**	**1.2024**	**3.3466**	**0.0000**	**5,038.0014**	**5,038.0014**	**0.6041**	**0.0000**	**5,050.5962**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2019	2.3493	22.7162	15.2853	0.0251	5.8476	1.2870	6.5845	2.6687	1.2024	3.3466	0.0000	2,463.8424	2,463.8424	0.6041	0.0000	2,478.9446
2020	2.9986	21.4531	20.0230	0.0517	5.8476	0.8356	6.5324	2.6687	0.8064	3.2987	0.0000	5,038.0014	5,038.0014	0.5038	0.0000	5,050.5962
2021	2.6873	19.6862	19.0998	0.0510	2.0035	0.7068	2.7103	0.5394	0.6819	1.2214	0.0000	4,970.1097	4,970.1097	0.4803	0.0000	4,982.1172
Maximum	**2.9986**	**22.7162**	**20.0230**	**0.0517**	**5.8476**	**1.2870**	**6.5845**	**2.6687**	**1.2024**	**3.3466**	**0.0000**	**5,038.0014**	**5,038.0014**	**0.6041**	**0.0000**	**5,050.5962**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	9.5627	0.1436	12.4750	6.6000e-004		0.0689	0.0689		0.0689	0.0689	0.0000	22.4910	22.4910	0.0220	0.0000	23.0403
Energy	0.2633	2.3727	1.8560	0.0144		0.1819	0.1819		0.1819	0.1819		2,872.5064	2,872.5064	0.0551	0.0527	2,889.5763
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**9.8260**	**2.5162**	**14.3310**	**0.0150**	**0.0000**	**0.2508**	**0.2508**	**0.0000**	**0.2508**	**0.2508**	**0.0000**	**2,894.9974**	**2,894.9974**	**0.0770**	**0.0527**	**2,912.6166**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	9.5627	0.1436	12.4750	6.6000e-004		0.0689	0.0689		0.0689	0.0689	0.0000	22.4910	22.4910	0.0220	0.0000	23.0403
Energy	0.2633	2.3727	1.8560	0.0144		0.1819	0.1819		0.1819	0.1819		2,872.5064	2,872.5064	0.0551	0.0527	2,889.5763
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**9.8260**	**2.5162**	**14.3310**	**0.0150**	**0.0000**	**0.2508**	**0.2508**	**0.0000**	**0.2508**	**0.2508**	**0.0000**	**2,894.9974**	**2,894.9974**	**0.0770**	**0.0527**	**2,912.6166**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demo, Concrete	Demolition	7/1/2019	11/11/2019	5	10	
2	Earthwork, grading	Grading	11/12/2019	3/27/2020	5	2	
3	Framing, mechanical, electrical plumbing	Building Construction	3/30/2020	8/28/2020	5	100	
4	Exterior and interior finishes	Building Construction	8/31/2020	4/12/2021	5	100	
5	Sidewalks	Paving	4/13/2021	5/31/2021	5	5	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demo, Concrete	Concrete/Industrial Saws	1	8.00	81	0.73
Demo, Concrete	Rubber Tired Dozers	1	8.00	247	0.40
Demo, Concrete	Tractors/Loaders/Backhoes	3	8.00	97	0.37
Earthwork, grading	Graders	1	6.00	187	0.41
Earthwork, grading	Rubber Tired Dozers	1	6.00	247	0.40
Earthwork, grading	Tractors/Loaders/Backhoes	1	7.00	97	0.37
Framing, mechanical, electrical plumbing	Cranes	1	6.00	231	0.29
Framing, mechanical, electrical plumbing	Forklifts	1	6.00	89	0.20
Framing, mechanical, electrical plumbing	Generator Sets	1	8.00	84	0.74
Framing, mechanical, electrical plumbing	Tractors/Loaders/Backhoes	1	6.00	97	0.37
Framing, mechanical, electrical plumbing	Welders	3	8.00	46	0.45
Exterior and interior finishes	Cranes	1	6.00	231	0.29
Exterior and interior finishes	Forklifts	1	6.00	89	0.20
Exterior and interior finishes	Generator Sets	1	8.00	84	0.74
Exterior and interior finishes	Tractors/Loaders/Backhoes	1	6.00	97	0.37
Exterior and interior finishes	Welders	3	8.00	46	0.45
Sidewalks	Cement and Mortar Mixers	1	6.00	9	0.56
Sidewalks	Pavers	1	6.00	130	0.42
Sidewalks	Paving Equipment	1	8.00	132	0.36
Sidewalks	Rollers	1	7.00	80	0.38
Sidewalks	Tractors/Loaders/Backhoes	1	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demo, Concrete	5	13.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Earthwork, grading	3	8.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Framing, mechanical, electrical plumbing	7	201.00	52.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Exterior and interior finishes	7	201.00	52.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Sidewalks	5	13.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Demo, Concrete - 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.3248	0.0000	0.3248	0.0492	0.0000	0.0492			0.0000			0.0000
Off-Road	2.2950	22.6751	14.8943	0.0241		1.2863	1.2863		1.2017	1.2017		2,360.7198	2,360.7198	0.6011		2,375.7475
Total	**2.2950**	**22.6751**	**14.8943**	**0.0241**	**0.3248**	**1.2863**	**1.6111**	**0.0492**	**1.2017**	**1.2509**		**2,360.7198**	**2,360.7198**	**0.6011**		**2,375.7475**

3.2 Demo, Concrete - 2019

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0543	0.0412	0.3910	1.0400e-003	0.1068	7.3000e-004	0.1075	0.0283	6.8000e-004	0.0290		103.1226	103.1226	2.9800e-003		103.1972
Total	**0.0543**	**0.0412**	**0.3910**	**1.0400e-003**	**0.1068**	**7.3000e-004**	**0.1075**	**0.0283**	**6.8000e-004**	**0.0290**		**103.1226**	**103.1226**	**2.9800e-003**		**103.1972**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.3248	0.0000	0.3248	0.0492	0.0000	0.0492			0.0000			0.0000
Off-Road	2.2950	22.6751	14.8943	0.0241		1.2863	1.2863		1.2017	1.2017	0.0000	2,360.7197	2,360.7197	0.6011		2,375.7475
Total	**2.2950**	**22.6751**	**14.8943**	**0.0241**	**0.3248**	**1.2863**	**1.6111**	**0.0492**	**1.2017**	**1.2509**	**0.0000**	**2,360.7197**	**2,360.7197**	**0.6011**		**2,375.7475**

3.2 Demo, Concrete - 2019

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0543	0.0412	0.3910	1.0400e-003	0.1068	7.3000e-004	0.1075	0.0283	6.8000e-004	0.0290		103.1226	103.1226	2.9800e-003		103.1972
Total	**0.0543**	**0.0412**	**0.3910**	**1.0400e-003**	**0.1068**	**7.3000e-004**	**0.1075**	**0.0283**	**6.8000e-004**	**0.0290**		**103.1226**	**103.1226**	**2.9800e-003**		**103.1972**

3.3 Earthwork, grading - 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					5.7819	0.0000	5.7819	2.6512	0.0000	2.6512			0.0000			0.0000
Off-Road	1.4197	16.0357	6.6065	0.0141		0.7365	0.7365		0.6775	0.6775		1,396.3909	1,396.3909	0.4418		1,407.4359
Total	**1.4197**	**16.0357**	**6.6065**	**0.0141**	**5.7819**	**0.7365**	**6.5184**	**2.6512**	**0.6775**	**3.3288**		**1,396.3909**	**1,396.3909**	**0.4418**		**1,407.4359**

3.3 Earthwork, grading - 2019

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0334	0.0253	0.2406	6.4000e-004	0.0657	4.5000e-004	0.0662	0.0174	4.2000e-004	0.0179		63.4601	63.4601	1.8300e-003		63.5060
Total	**0.0334**	**0.0253**	**0.2406**	**6.4000e-004**	**0.0657**	**4.5000e-004**	**0.0662**	**0.0174**	**4.2000e-004**	**0.0179**		**63.4601**	**63.4601**	**1.8300e-003**		**63.5060**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					5.7819	0.0000	5.7819	2.6512	0.0000	2.6512			0.0000			0.0000
Off-Road	1.4197	16.0357	6.6065	0.0141		0.7365	0.7365		0.6775	0.6775	0.0000	1,396.3909	1,396.3909	0.4418		1,407.4359
Total	**1.4197**	**16.0357**	**6.6065**	**0.0141**	**5.7819**	**0.7365**	**6.5184**	**2.6512**	**0.6775**	**3.3288**	**0.0000**	**1,396.3909**	**1,396.3909**	**0.4418**		**1,407.4359**

3.3 Earthwork, grading - 2019

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0334	0.0253	0.2406	6.4000e-004	0.0657	4.5000e-004	0.0662	0.0174	4.2000e-004	0.0179		63.4601	63.4601	1.8300e-003		63.5060
Total	**0.0334**	**0.0253**	**0.2406**	**6.4000e-004**	**0.0657**	**4.5000e-004**	**0.0662**	**0.0174**	**4.2000e-004**	**0.0179**		**63.4601**	**63.4601**	**1.8300e-003**		**63.5060**

3.3 Earthwork, grading - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					5.7819	0.0000	5.7819	2.6512	0.0000	2.6512			0.0000			0.0000
Off-Road	1.3498	15.0854	6.4543	0.0141		0.6844	0.6844		0.6296	0.6296		1,365.7183	1,365.7183	0.4417		1,376.7609
Total	**1.3498**	**15.0854**	**6.4543**	**0.0141**	**5.7819**	**0.6844**	**6.4663**	**2.6512**	**0.6296**	**3.2809**		**1,365.7183**	**1,365.7183**	**0.4417**		**1,376.7609**

3.3 Earthwork, grading - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0305	0.0224	0.2155	6.2000e-004	0.0657	4.4000e-004	0.0662	0.0174	4.0000e-004	0.0178		61.4967	61.4967	1.6100e-003		61.5368
Total	**0.0305**	**0.0224**	**0.2155**	**6.2000e-004**	**0.0657**	**4.4000e-004**	**0.0662**	**0.0174**	**4.0000e-004**	**0.0178**		**61.4967**	**61.4967**	**1.6100e-003**		**61.5368**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					5.7819	0.0000	5.7819	2.6512	0.0000	2.6512			0.0000			0.0000
Off-Road	1.3498	15.0854	6.4543	0.0141		0.6844	0.6844		0.6296	0.6296	0.0000	1,365.7183	1,365.7183	0.4417		1,376.7609
Total	**1.3498**	**15.0854**	**6.4543**	**0.0141**	**5.7819**	**0.6844**	**6.4663**	**2.6512**	**0.6296**	**3.2809**	**0.0000**	**1,365.7183**	**1,365.7183**	**0.4417**		**1,376.7609**

3.3 Earthwork, grading - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0305	0.0224	0.2155	6.2000e-004	0.0657	4.4000e-004	0.0662	0.0174	4.0000e-004	0.0178		61.4967	61.4967	1.6100e-003		61.5368
Total	**0.0305**	**0.0224**	**0.2155**	**6.2000e-004**	**0.0657**	**4.4000e-004**	**0.0662**	**0.0174**	**4.0000e-004**	**0.0178**		**61.4967**	**61.4967**	**1.6100e-003**		**61.5368**

3.4 Framing, mechanical, electrical plumbing - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	2.0305	14.7882	13.1881	0.0220		0.7960	0.7960		0.7688	0.7688		2,001.1595	2,001.1595	0.3715		2,010.4467
Total	**2.0305**	**14.7882**	**13.1881**	**0.0220**		**0.7960**	**0.7960**		**0.7688**	**0.7688**		**2,001.1595**	**2,001.1595**	**0.3715**		**2,010.4467**

3.4 Framing, mechanical, electrical plumbing - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.2011	6.1022	1.4208	0.0141	0.3523	0.0286	0.3809	0.1015	0.0274	0.1288		1,491.737 9	1,491.737 9	0.0920		1,494.037 2
Worker	0.7670	0.5627	5.4141	0.0155	1.6512	0.0110	1.6622	0.4380	0.0102	0.4481		1,545.104 1	1,545.104 1	0.0403		1,546.112 3
Total	**0.9681**	**6.6649**	**6.8349**	**0.0297**	**2.0035**	**0.0396**	**2.0431**	**0.5394**	**0.0375**	**0.5770**		**3,036.842 0**	**3,036.842 0**	**0.1323**		**3,040.149 5**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	2.0305	14.7882	13.1881	0.0220		0.7960	0.7960		0.7688	0.7688	0.0000	2,001.159 5	2,001.159 5	0.3715		2,010.446 7
Total	**2.0305**	**14.7882**	**13.1881**	**0.0220**		**0.7960**	**0.7960**		**0.7688**	**0.7688**	**0.0000**	**2,001.159 5**	**2,001.159 5**	**0.3715**		**2,010.446 7**

3.4 Framing, mechanical, electrical plumbing - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.2011	6.1022	1.4208	0.0141	0.3523	0.0286	0.3809	0.1015	0.0274	0.1288		1,491.737 9	1,491.737 9	0.0920		1,494.037 2
Worker	0.7670	0.5627	5.4141	0.0155	1.6512	0.0110	1.6622	0.4380	0.0102	0.4481		1,545.104 1	1,545.104 1	0.0403		1,546.112 3
Total	**0.9681**	**6.6649**	**6.8349**	**0.0297**	**2.0035**	**0.0396**	**2.0431**	**0.5394**	**0.0375**	**0.5770**		**3,036.842 0**	**3,036.842 0**	**0.1323**		**3,040.149 5**

3.5 Exterior and interior finishes - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	2.0305	14.7882	13.1881	0.0220		0.7960	0.7960		0.7688	0.7688		2,001.159 5	2,001.159 5	0.3715		2,010.446 7
Total	**2.0305**	**14.7882**	**13.1881**	**0.0220**		**0.7960**	**0.7960**		**0.7688**	**0.7688**		**2,001.159 5**	**2,001.159 5**	**0.3715**		**2,010.446 7**

3.5 Exterior and interior finishes - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.2011	6.1022	1.4208	0.0141	0.3523	0.0286	0.3809	0.1015	0.0274	0.1288		1,491.737 9	1,491.737 9	0.0920		1,494.037 2
Worker	0.7670	0.5627	5.4141	0.0155	1.6512	0.0110	1.6622	0.4380	0.0102	0.4481		1,545.104 1	1,545.104 1	0.0403		1,546.112 3
Total	**0.9681**	**6.6649**	**6.8349**	**0.0297**	**2.0035**	**0.0396**	**2.0431**	**0.5394**	**0.0375**	**0.5770**		**3,036.842 0**	**3,036.842 0**	**0.1323**		**3,040.149 5**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	2.0305	14.7882	13.1881	0.0220		0.7960	0.7960		0.7688	0.7688	0.0000	2,001.159 5	2,001.159 5	0.3715		2,010.446 7
Total	**2.0305**	**14.7882**	**13.1881**	**0.0220**		**0.7960**	**0.7960**		**0.7688**	**0.7688**	**0.0000**	**2,001.159 5**	**2,001.159 5**	**0.3715**		**2,010.446 7**

3.5 Exterior and interior finishes - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.2011	6.1022	1.4208	0.0141	0.3523	0.0286	0.3809	0.1015	0.0274	0.1288		1,491.737 9	1,491.737 9	0.0920		1,494.037 2
Worker	0.7670	0.5627	5.4141	0.0155	1.6512	0.0110	1.6622	0.4380	0.0102	0.4481		1,545.104 1	1,545.104 1	0.0403		1,546.112 3
Total	**0.9681**	**6.6649**	**6.8349**	**0.0297**	**2.0035**	**0.0396**	**2.0431**	**0.5394**	**0.0375**	**0.5770**		**3,036.842 0**	**3,036.842 0**	**0.1323**		**3,040.149 5**

3.5 Exterior and interior finishes - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.8125	13.6361	12.8994	0.0221		0.6843	0.6843		0.6608	0.6608		2,001.220 0	2,001.220 0	0.3573		2,010.151 7
Total	**1.8125**	**13.6361**	**12.8994**	**0.0221**		**0.6843**	**0.6843**		**0.6608**	**0.6608**		**2,001.220 0**	**2,001.220 0**	**0.3573**		**2,010.151 7**

3.5 Exterior and interior finishes - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1664	5.5483	1.2740	0.0140	0.3523	0.0118	0.3642	0.1015	0.0113	0.1127		1,477.385 5	1,477.385 5	0.0871		1,479.561 8
Worker	0.7084	0.5019	4.9264	0.0150	1.6512	0.0107	1.6619	0.4380	9.8400e-003	0.4478		1,491.504 1	1,491.504 1	0.0360		1,492.403 7
Total	**0.8748**	**6.0502**	**6.2004**	**0.0290**	**2.0035**	**0.0225**	**2.0260**	**0.5394**	**0.0211**	**0.5606**		**2,968.889 7**	**2,968.889 7**	**0.1230**		**2,971.965 5**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.8125	13.6361	12.8994	0.0221		0.6843	0.6843		0.6608	0.6608	0.0000	2,001.220 0	2,001.220 0	0.3573		2,010.151 7
Total	**1.8125**	**13.6361**	**12.8994**	**0.0221**		**0.6843**	**0.6843**		**0.6608**	**0.6608**	**0.0000**	**2,001.220 0**	**2,001.220 0**	**0.3573**		**2,010.151 7**

3.5 Exterior and interior finishes - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1664	5.5483	1.2740	0.0140	0.3523	0.0118	0.3642	0.1015	0.0113	0.1127		1,477.3855	1,477.3855	0.0871		1,479.5618
Worker	0.7084	0.5019	4.9264	0.0150	1.6512	0.0107	1.6619	0.4380	9.8400e-003	0.4478		1,491.5041	1,491.5041	0.0360		1,492.4037
Total	**0.8748**	**6.0502**	**6.2004**	**0.0290**	**2.0035**	**0.0225**	**2.0260**	**0.5394**	**0.0211**	**0.5606**		**2,968.8897**	**2,968.8897**	**0.1230**		**2,971.9655**

3.6 Sidewalks - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.7739	7.7422	8.8569	0.0135		0.4153	0.4153		0.3830	0.3830		1,296.8664	1,296.8664	0.4111		1,307.1442
Paving	0.0000					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Total	**0.7739**	**7.7422**	**8.8569**	**0.0135**		**0.4153**	**0.4153**		**0.3830**	**0.3830**		**1,296.8664**	**1,296.8664**	**0.4111**		**1,307.1442**

3.6 Sidewalks - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0458	0.0325	0.3186	9.7000e-004	0.1068	6.9000e-004	0.1075	0.0283	6.4000e-004	0.0290		96.4654	96.4654	2.3300e-003		96.5236
Total	**0.0458**	**0.0325**	**0.3186**	**9.7000e-004**	**0.1068**	**6.9000e-004**	**0.1075**	**0.0283**	**6.4000e-004**	**0.0290**		**96.4654**	**96.4654**	**2.3300e-003**		**96.5236**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.7739	7.7422	8.8569	0.0135		0.4153	0.4153		0.3830	0.3830	0.0000	1,296.8664	1,296.8664	0.4111		1,307.1442
Paving	0.0000					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Total	**0.7739**	**7.7422**	**8.8569**	**0.0135**		**0.4153**	**0.4153**		**0.3830**	**0.3830**	**0.0000**	**1,296.8664**	**1,296.8664**	**0.4111**		**1,307.1442**

3.6 Sidewalks - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0458	0.0325	0.3186	9.7000e-004	0.1068	6.9000e-004	0.1075	0.0283	6.4000e-004	0.0290		96.4654	96.4654	2.3300e-003		96.5236
Total	**0.0458**	**0.0325**	**0.3186**	**9.7000e-004**	**0.1068**	**6.9000e-004**	**0.1075**	**0.0283**	**6.4000e-004**	**0.0290**		**96.4654**	**96.4654**	**2.3300e-003**		**96.5236**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Apartments Mid Rise	0.00	0.00	0.00		
University/College (4Yr)	0.00	0.00	0.00		
University/College (4Yr)	0.00	0.00	0.00		
University/College (4Yr)	0.00	0.00	0.00		
University/College (4Yr)	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Apartments Mid Rise	10.80	4.80	5.70	31.00	15.00	54.00	86	11	3
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0
University/College (4Yr)	9.50	7.30	7.30	6.40	88.60	5.00	91	9	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Apartments Mid Rise	0.561348	0.038614	0.190285	0.107199	0.015389	0.005180	0.024554	0.046236	0.002209	0.002456	0.005491	0.000334	0.000704
University/College (4Yr)	0.561348	0.038614	0.190285	0.107199	0.015389	0.005180	0.024554	0.046236	0.002209	0.002456	0.005491	0.000334	0.000704

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	0.2633	2.3727	1.8560	0.0144		0.1819	0.1819		0.1819	0.1819		2,872.5064	2,872.5064	0.0551	0.0527	2,889.5763
NaturalGas Unmitigated	0.2633	2.3727	1.8560	0.0144		0.1819	0.1819		0.1819	0.1819		2,872.5064	2,872.5064	0.0551	0.0527	2,889.5763

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Apartments Mid Rise	3587.85	0.0387	0.3306	0.1407	2.1100e-003		0.0267	0.0267		0.0267	0.0267		422.0998	422.0998	8.0900e-003	7.7400e-003	424.6081
University/College (4Yr)	14810.6	0.1597	1.4520	1.2197	8.7100e-003		0.1104	0.1104		0.1104	0.1104		1,742.4177	1,742.4177	0.0334	0.0319	1,752.7721
University/College (4Yr)	6017.91	0.0649	0.5900	0.4956	3.5400e-003		0.0448	0.0448		0.0448	0.0448		707.9889	707.9889	0.0136	0.0130	712.1962
Total		**0.2633**	**2.3726**	**1.8560**	**0.0144**		**0.1819**	**0.1819**		**0.1819**	**0.1819**		**2,872.5064**	**2,872.5064**	**0.0551**	**0.0527**	**2,889.5763**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Apartments Mid Rise	3.58785	0.0387	0.3306	0.1407	2.1100e-003		0.0267	0.0267		0.0267	0.0267		422.0998	422.0998	8.0900e-003	7.7400e-003	424.6081
University/College (4Yr)	14.8106	0.1597	1.4520	1.2197	8.7100e-003		0.1104	0.1104		0.1104	0.1104		1,742.4177	1,742.4177	0.0334	0.0319	1,752.7721
University/College (4Yr)	6.01791	0.0649	0.5900	0.4956	3.5400e-003		0.0448	0.0448		0.0448	0.0448		707.9889	707.9889	0.0136	0.0130	712.1962
Total		**0.2633**	**2.3726**	**1.8560**	**0.0144**		**0.1819**	**0.1819**		**0.1819**	**0.1819**		**2,872.5064**	**2,872.5064**	**0.0551**	**0.0527**	**2,889.5763**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	9.5627	0.1436	12.4750	6.6000e-004		0.0689	0.0689		0.0689	0.0689	0.0000	22.4910	22.4910	0.0220	0.0000	23.0403
Unmitigated	9.5627	0.1436	12.4750	6.6000e-004		0.0689	0.0689		0.0689	0.0689	0.0000	22.4910	22.4910	0.0220	0.0000	23.0403

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	1.2137					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	7.9671					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.3819	0.1436	12.4750	6.6000e-004		0.0689	0.0689		0.0689	0.0689		22.4910	22.4910	0.0220		23.0403
Total	**9.5627**	**0.1436**	**12.4750**	**6.6000e-004**		**0.0689**	**0.0689**		**0.0689**	**0.0689**	**0.0000**	**22.4910**	**22.4910**	**0.0220**	**0.0000**	**23.0403**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	1.2137					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	7.9671					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Hearth	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.3819	0.1436	12.4750	6.6000e-004		0.0689	0.0689		0.0689	0.0689		22.4910	22.4910	0.0220		23.0403
Total	**9.5627**	**0.1436**	**12.4750**	**6.6000e-004**		**0.0689**	**0.0689**		**0.0689**	**0.0689**	**0.0000**	**22.4910**	**22.4910**	**0.0220**	**0.0000**	**23.0403**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

APPENDIX D

GEOTECHNICAL INVESTIGATION

12 October 2018

Mr. Charlie MacDonald
ACC OP Development LLC
12700 Hill Country Boulevard, Suite T-200
Austin, Texas 78738

Subject: Addendum to Geotechnical Investigation Report
Fault Rupture Hazard at Goldman School of Public Policy
Hearst Avenue Academic Housing
Summary of Geologic Review
University of California, Berkeley
Langan Project No.: 731706301

Dear Mr. MacDonald:

Langan is pleased to present this addendum to our geotechnical investigation report, dated 13 February 2018. This letter report addresses the fault rupture hazard for the proposed Goldman School of Public Policy (GSPP) Hearst Avenue Academic Housing site. The project site occupies a reverse L-shaped lot at the northwest corner of Hearst Avenue and La Loma Avenue at the University of California, Berkeley (University) campus (Figure 1, Site Location Map). The site is bound by Ridge Road to the north, La Loma Avenue to the east, Hearst Avenue to the south, a four-story student housing building (Cloyne Court Co-op) and existing GSPP facilities to the west. The southern portion of the site is currently occupied by the four-level Upper Hearst parking structure, which is accessed by concrete entrance ramps along La Loma and Hearst Avenues. The northern portion of the site is currently occupied by an asphalt parking lot which is accessed via Ridge Road to the north.

We understand the proposed development includes demolition of the upper portion of the existing Upper Hearst parking structure, and the construction of a new five story residential units, classrooms and assembly space above the existing parking structure. New construction in the vicinity of the existing asphalt parking lot includes two below grade parking levels and six levels of above grade construction with classrooms and faculty offices. The existing and new buildings are proposed to be structurally connected. Excavations will be approximately 25 feet below grade at the intersection of La Loma Avenue and Ridge Road, with lowest finished grade at approximate Elevation 380 feet[1], based on schematic drawings provided by SCB, the project architect. We understand retaining walls and new stairs will be built off of Hearst Avenue to provide access between the existing and the planned GSPP structures.

1 Elevations in this report refer to the City of Berkeley Datum, which corresponds to approximately 3.17 feet below Mean Sea Level (MSL), or the National Geodetic Vertical Datum of 1929 (NGVD 29), and 0.95 feet above the UC Berkeley Datum.

SCOPE OF SERVICES

Our scope of services included performing a desk study to address the potential for active faulting through the project site, which included thorough research and review of:

- Available published and unpublished reports, including Alquist-Priolo and other nearby paleoseismic studies;
- fault creep data from nearby alignment arrays;
- local and regional seismicity data from the Northern California Earthquake Data Center (NCEDC) to evaluate previous and recent seismic and microseismic activity in the area;
- high resolution LiDAR data accessed from the publically available Open Topography website;
- published and unpublished geologic and fault maps;
- stereo-paired aerial photographs to observe evidence of fault-related geomorphology historical land use and urbanization;
- geotechnical reports of existing improvements in the area, as available.

We also reviewed samples and subsurface data obtained during our geotechnical investigation (2017). To supplement our desk review, we retained the services of Lettis Consultants International (LCI) to perform a Fault Displacement Hazard Analysis (FDHA) for the project site. the purpose of our desk study was to evaluate if available data and studies present firm conclusions and indications regarding the presence or absence of active faulting through the project site.

This addendum presents recommendations for seismic design for the proposed structures. Unless explicitly discussed in this letter, the conclusions and recommendations presented in our 13 February report remain unchanged. The project site and associated subsurface exploration points completed for our geotechnical investigation are shown on Figure 2.

The building was in schematic design, building loads had not been finalized, and the fault study was ongoing when the geotechnical investigation report was published. Because there are still a number of undetermined details for the structural design, the purpose of this addendum is to provide seismic design recommendations for the project team; we will provide additional addenda with recommendations in the future as needed.

REGIONAL AND SITE GEOLOGY

The project site is located on the western flanks of the Berkeley Hills, within the of the Coast Ranges geomorphic province of California. The province is generally characterized by northwest-southeast trending valleys, ridges, and mountain chains. The structural grain or fabric of the Coast Ranges parallel the northwest-striking San Andreas fault zone and associated system of faults, including the Hayward fault system to the east. The Hayward fault is characterized as a predominately right-lateral, strike slip fault; the fault zone is comprised of highly deformed rocks, ranging between two and 10 kilometers wide. The terrain along the west side of the Hayward fault is largely supported by a series of sedimentary, igneous, and metamorphic rocks collectively known as the Franciscan Complex of late Jurassic to early Cretaceous (164 to 100 million years ago). The Franciscan Complex basement rocks lay in faulted contact with unmetamorphosed rocks of the Coast Range ophiolite and Great Valley sequence (Graymer, Jones and Brabb, 1995). Locally, the project site is mapped as underlain by silica-carbonate rocks (Figure 3, Regional Geologic Map). Depending on the location, all of the rock types are blanketed by thick sequences of various surficial deposits, including alluvium, colluvium, mass-wasting deposits, and more recently, artificial fill.

The northeastern half of the site is mapped within an Earthquake Zone of Required Investigation for the Hayward fault (Figure 4, Zones of Required Investigation), as zoned by the California Geological Survey. Locally, the zone is established around two mapped Alquist-Priolo (A-P) fault traces, which are depicted on Figure 5. According to the 2006 USGS Fault and Fold Database, the closest trace of the Hayward fault is mapped approximately 530 feet to the northeast site, trending N032W. A second, subparallel trace is mapped approximately 725 feet to the northeast of the project site, trending N035W. Multiple other traces have been mapped by consultants that have performed fault studies in the area, including a shear zone (referenced as the Louderback Shear Zone (LSZ)) associated with the Louderback fault mapped directly through the site, with a projection of N036W. The LSZ is characterized as a 200-foot wide zone of sheared rock and colluvium, originally identified in the Lawson Adit by Louderback (1939); the location and alignment of the Adit are shown on Figure 2. The Louderback trace through the site is not considered to be an active fault, and portions of the LSZ fall outside of the A-P boundary. The Louderback is not a zoned A-P fault. However, Mr. James Lienkaemper formerly of the USGS, indicated evidence for Holocene activity on the Louderback (pers. comm., 2017).

SUBSURFACE CONDITIONS

As part of our geotechnical investigation (Langan 2018), three exploratory borings (designated LB-1 through LB-3) were advanced to depths of between 51 and 65 feet below the existing ground surface (bgs). These borings were drilled in the existing asphalt parking lot to the north of the GSPP parking structure. Boring B-3 was continuously cored starting at a depth of 52 feet. Downhole seismic shear wave velocities were measured in LB-3. Exploratory boring logs are presented in Appendix A.

Two geophysical surveys were also completed across the parking lot consisting of two seismic refraction (SR) and Multi-Channel Analysis of Surface Waves (MASW) lines, designated Line #1 and Line #2, respectively. The results of the geophysical surveys are presented in Appendix B.

Three test pits were excavated adjacent to existing footings of buildings adjacent to the proposed development. The test pit logs are also included in Appendix A.

The ground surface of the site slopes down to the southwest, with ground surface elevations at the parking lot between about 405 feet at the northeastern corner and 390 feet at the southwestern corner of the site, and site grades along Hearst Avenue at the western edge of the parking garage of about 370 feet. To the north, east, south, and west of the site are Ridge Road, La Loma Avenue, Hearst Avenue, and Cloyne Court Co-op and the current GSPP building, respectively. Based on information from the test pits, the adjacent Cloyne Court Co-op and the adjacent GSPP academic building are founded on shallow footings bearing on sand, sandy clay, and silty sand fill over native clayey soil.

The northeast portion of the site is generally underlain by up to nine feet of heterogeneous fill, consisting mainly of stiff to hard clay and sandy clay, and very dense gravel and clayey gravel. The fill, in general, has a moderate to high expansion potential and is underlain by approximately 30 to 40 feet of undifferentiated colluvial materials/surficial deposits, composed of interbedded stiff to hard clay, and sandy clay with medium to very dense clayey sands and silty sands. Colluvial materials were encountered under the fill, underlain by fault gouge, brecciated sandstone and shale, and serpentinite. The brecciated bedrock materials were encountered approximately 30 to 50 feet below the parking lot surface. We interpret the gouge and brecciated bedrock materials to be associated with the mapped LSZ.

Because rotary wash drilling method was used, the depth to groundwater was not observed during our investigation.

Based on our preliminary interpretation of the seismic refraction profiles, we noted at least three prominent velocity contrasts, indicating possible discontinuities at depth (Plate 2, Appendix B). SR Line #1 shows contrast in velocity contours, at 6,000 ft/sec (starting approximately STA 20+00 in from the SW end of the profile) and continuing to 9,000 ft/sec. The contrast in contours indicates the higher velocity materials, interpreted as bedrock, as up to the northeast and lower velocity materials down to the southwest. There is no disruption noted below the 9,000 ft/sec contour within the discontinuity alignment. The contours above also indicate minor downdrop, but appear to be more associated with the southwestern dipping site gradients. Another larger contrast in velocity occurs at the 10,000 ft/sec contour at approximately STA 82+00, which is interpreted as bedrock up to the northeast. The discontinuity tapers out at the 8,000 ft/sec contour, and appears to die out within the bedrock. In Line #2, a discontinuity is visible at approximately STA 43+00, with the 5,000 ft/sec contour dipping vertically to the northeast. The disruption in the velocity contours generally correspond with the Louderback fault trace, as mapped by Lennert and Curtis. The overlying 4,000 ft/sec contour appears undisturbed.

Our interpretations of subsurface conditions, including those interpreted from the SR profiles, are depicted in Figures 6 through 8, Geologic Cross Sections A-A' through C-C'. The interpreted conditions in SR Line #1 are projected onto Geologic Cross Section B-B' (Figure 7), and those in SR Line #2 are projected onto Geologic Cross Section A-A' (Figure 6).

PREVIOUS INVESTIGATIONS AND BACKGROUND

As indicated above, the purpose of our desk study was to evaluate if available data and studies present firm conclusions and indications regarding the presence or absence of active faulting through the project site. This study was performed to generally satisfy requirements of the A-P Act. Subsurface data obtained during our geotechnical investigation and the results of a probabilistic fault displacement hazard analysis (PFDHA) and deterministic fault displacement hazard analysis (DFDHA) performed by our subconsultant Lettis Consultants International (LCI) were used to supplement our study. This study supersedes our preliminary interpretations and conclusions regarding faulting through the project site.

Our scope of services for this task included reviewing: historical maps, stereo-paired historical aerial photographs, available geologic data, and geotechnical and geologic investigation reports completed by others in the vicinity. We also contacted Mr. Lienkaemper retired USGS seismologist, and other consultants who had previously done work in the area to discuss their observations and interpretations of anomalous features that were observed either during their exploratory trench logging or previous construction activities.

Based on our review of aerial photos and historical Sanborn maps, the existing asphalt parking lot was formerly the site of Newman Hall and a rectory, both of which were constructed sometime between 1903 and 1911, and demolished between 1959 and 1969. Newman Hall was underlain by a basement, which is visible in the 1969 aerial photos following the building's demolition. The basement appears to have been backfilled between 1969 and 1973, and used as a parking lot to present day. The existing University parking garage at the corner of Hearst and La Loma Streets was previously occupied by College Hall dormitory, which was demolished around 1938. The existing parking structure and Ridge Road access driveway were fully constructed in their current configuration by 1973.

Summaries of consultant reports that were particularly instructive and their findings are presented below. Project sites, fault traces and fault trenches from the reports referenced below are all depicted on Figure 2:

1. *Fault Hazard Study, Berkeley Campus, University of California, prepared by Lennert and Associates, dated 12 June 1980*; This study was prepared to determine the potential for and extent of surface rupture through the UC Berkeley campus. This study is frequently referenced in subsequent consultant reports (referenced as Lennert and Curtis), and is only included for thoroughness. Lennert and Curtis identified the Hayward fault passing approximately 500 feet to the northeast of the GSPP project site. The Louderback fault

was mapped through the UC Berkeley campus at an orientation that differs from the alignment mapped by later consultants. The fault is mapped as extending east of the Greek theater, trending approximately N050W, and extending through the northeast corner of the GSPP project site. The Lennert and Curtis Louderback fault trace was also characterized as a major feature, dipping steeply to the west, with a well-developed gouge zone and large vertical offsets in bedrock. Although the fault was identified as a major feature, Lennert and Curtis concluded that the fault is inactive. The Louderback fault trace was identified through seismic refraction data; no ground truth was established through subsurface excavations.

2. *Geologic and Fault Hazard Investigation, Proposed Student Housing, University of California*, prepared by Harding Lawson Associates, dated 13 October, 1986; Harding Lawson Associates (HLA) performed a preliminary study that included document review, exploratory borings and eight fault trenches totaling 1075 linear feet. Their study was performed as the initial phase of geotechnical investigations for the Foothill Housing project, consisting of two sites: Hillside and La Loma Ridge. The La Loma Ridge site is across the street to the northeast of the GSPP project site. Three fault trenches designated Trenches A, B and C were excavated for the La Loma Ridge site, and five trenches were excavated as part of Hillside site (D,E,F,G and H). The Hillside and La Loma Ridge housing sites and fault trench locations are depicted on Figure 2. HLA identified the Hayward fault in Trench H, which was excavated to the southeast of the La Loma Ridge site. La Loma Ridge trenches and borings encountered relatively uniform colluvial soils. No bedrock was exposed, but no vertical discontinuities suggestive of faulting were observed in the colluvium. HLA concluded that absence of continuous clay-filled vertical fractures of faults in colluvial material indicated that no active faulting is present at the La Loma Ridge site. HLA sited the active trace of the Hayward fault, and provided preliminary setbacks for the Hillside site.

3. *Geologic and Fault Hazard Investigation, Phase II, Foothill Student Housing, University of California, Berkeley, California,* prepared by Harding Lawson and Associates, dated 12 January 1988; HLA performed a Phase II investigation that included additional research, mapping, 14 borings, and 14 fault trenches totaling 1435 linear feet. The trenches excavated as part of their Phase II investigation were designated as Trenches I through V. The trenches were excavated to observe evidence of active faulting from the Hayward fault and any subsidiary faults, primarily the Louderback fault. Trenches were also excavated across the previously mapped Lennert and Curtis trace of the Louderback fault.

   Hayward Fault- Trenches I, J, K, M, N, O, P, Q, S, T, U and V were excavated in the vicinity of the Hillside housing site, where the Hayward fault was previously mapped and encountered in HLA's Phase I Trench H. Trenches I, K, M, N, P and S exposed what were interpreted to be indicators of active Hayward fault traces. HLA also observed non fault-related features in their trenches, including tension cracks and slip planes, attributed to deep-seated landslide movement.

HLA concluded that two subparallel traces extend through the Hillside site, with the traces up to 160 feet apart. However, it was concluded that no active fault traces extend under Stern Hall, and that the adjacent proposed student housing additions do not contain active fault traces. HLA recommended that structures for human occupancy not be built over the identified, active traces or in between them. Setbacks between 20 feet to 50 feet were used to site buildings away from the identified fault traces.

The Hayward fault, as mapped by HLA, is roughly coincident with Lennert and Curtis's 1980 trace, approximately 500 feet to the northeast of the GSPP project site.

<u>Louderback Fault</u>- Trenches L, W, X and Y were excavated to explore for subsidiary faulting to the Hayward fault, and were excavated across the Louderback trace. To the northwest of Stern Hall, the Louderback was exposed in trenches W and Z. In the vicinity of the La Loma Ridge site, the fault was exposed in Trench L. Trenches L and Y were excavated at the southwest corner of the La Loma Ridge site.

HLA mapped the Louderback fault as a shear zone approximately 200 feet wide. Based on review of historical data, fault studies by others, aerial photos, analysis of topographic features, and observations made in their exploratory fault trenches, HLA concluded that the LSZ is not active, and structures can be placed over it. However, HLA indicated that the shear zone contains vertical separations representing planes of weakness that could experience displacement during a large seismic event, and estimated that lateral displacement at the ground surface above the shear zone would be less than two feet during a maximum probable earthquake, either due to subsidiary faulting or secondary ground deformation. HLA recommended that the buildings constructed over the shear zone be engineered to accommodate the anticipated displacements. HLA did not encounter the Louderback trace, as mapped by Lennert and Curtis, in their fault trenches.

A summary of the fault trench logs and trench descriptions by HLA are included in Appendix B. No age-dating was completed as part of their investigation.

4. <u>*Supplemental Fault Hazard Investigation, "Louderback Trace", Foothill Student Housing Project, University of California, Berkeley, California*, prepared by Harding Lawson Associates, dated 22 June 1988</u>. In addition to extensive document review, HLA performed a supplemental investigation of the Louderback fault to further evaluate the potential for active faulting across the shear zone. HLA geologists observed and documented the conditions of various urban facilities that cross the Louderback to

observe evidence for distress and/or offset. They also performed geologic mapping of accessible portions of the Lawson Adit, and compared their observations to those of previous mapping efforts by others within the Adit.

Two new fault trenches were excavated across the fault, and Trench L was re-excavated and widened at Hearst Avenue and Gayley. Excavated trenches across Louderback ranged between 32 and 120 feet in length, totaling 438 linear feet. Trenches were observed by Jim Lienkaemper of the USGS, California Division of Mines and Geology personnel, geologists from Geomatrix, Dames & Moore, and independent geologic consultants Charles Purcell and Dr. Roy Shlemon. Various other consultants and university personnel were also present to observe the exposed trench walls and document the conditions.

The trench logs indicate numerous shear planes in bedrock and old colluvium; colluviual units were differentiated into younger colluvium (Qyl) and older colluvium (Qocl). Age dating techniques for B soil horizon in Trench Z were performed, and it was determined that young colluvium in the trenches is no older than mid-Holocene. Older colluvium was estimated to be approximately 100,000 years old or older. No shears were observed extending into overlying younger colluvium. Sheared materials observed Trenches R and L were correlated with sheared material observed in Lawson Adit. All trenches encountered sheared bedrock and old colluvium, and some unit continuity was found between trenches. Slickensided surfaces were rarely observed on shears in the trenches, and could not be correlated between trenches or across the same trench. None of the shear planes exposed in trenches were observed to extend up into overlying soil deposits.

HLA again trenched across the Louderback trace mapped by Lennert and Curtis, and did not encounter a fault trace. No throughgoing fault structure was encountered in the exploratory fault trenches. HLA also did not observe evidence of ground cracking that would suggest fault creep on the Louderback fault. Through their observations in the Adit, they concurred with previous conclusions that the Louderback fault is inactive, and that the Louderback "trace" is actually a zone of sheared materials at least 200 feet wide, consisting of a complex zone of thin, numerous discontinuous shears that curve off in various directions, but generally striking to the northwest and dipping moderately to the northeast. The direction of slip of the ancient fault features observed within bedrock exposed in the trenches was interpreted to be near vertical and reverse movement. HLA interpreted the shears as representing a complex system of inactive thrust faults, toes of landslides, or some combination thereof. This movement was interpreted to be associated with ancient folding and compressional uplift of the Berkeley Hills. HLA maintained that active faulting is restricted to the Hayward fault, 450 feet east of the LSZ.

5. *Surface Fault Rupture Hazard Evaluation, Proposed Haas School Executive Education Building, University of California, Berkeley, Berkeley, California,* prepared by William

Lettis & Associates (WLA), dated November 2007. William Lettis & Associates excavated a trench across the Louderback trace (T-1, Figure 2), and determined that the trace is inactive. However the WLA Louderback trace is placed east of the Greek Theatre and mapped as extending through the La Loma Ridge site, but does not cross the project site.

6. *Review of Ground Cracks- Building B Hillside Site, Foothill Housing Project, University of California, Berkeley, California,* prepared by Geomatrix, dated 5 July 1989.
   During construction of Building B of the Hillside site, ground cracks were encountered in a cut slope above the Building B footprint. The cracks were documented as open, closely spaced and parallel generally striking to northeast, with dips between of 45 to 80 degrees to southeast (into the hillside). None were observed to cross-cut overlying soil horizons, and none were traced to the ground surface. Earth materials were also observed to be laterally continuous on either side of the ground cracks, with no offset. The cracks were within the projection of two trenches that were previously excavated during the HLA Phase II investigation; however, the cracks were not encountered in those trenches, indicating fracture discontinuity along trend between the cut slope and the trench locations. Geomatrix concluded that the ground cracks are not indicative of repeated, lateral and /or vertical fault displacement, but instead may be associated with deformation or shearing associated with surface faulting along the active Hayward fault trace upslope and to the east.

   Geologic Evaluation- Fracture Pattern, Building B, Foothill Housing Project, Berkeley, California, prepared by Kleinfelder, dated 9 October 1990. Kleinfelder provided observations and conclusions to supplement those made by Geomatrix and Patrick Williams, Lawrence Livermore Berkeley Laboratory. Their comments were provided in response to a report submitted to the University by Williams, in which he interpreted the ground cracks as secondary faults with possible Holocene displacement. Kleinfelder concluded that, based on the irregular pattern and orientation of the cracks, including lack of vertical continuity to the ground surface or with depth, the cracks were the result of tension cracks due to intense ground shaking. Kleinfelder disputed Williams' interpretation of the cracks to indicate subsidiary faulting, primarily by citing lack of displacement along the fractures. No changes were made to the mapped active Hayward fault alignment.

7. *Observation of Ground Cracks, Building B Hillside Site, Foothill Student Housing Project, University of California,* prepared by Geomatrix, dated 3 August 1990. Geomatrix prepared a follow-up summary letter to their initial July 1989 Letter (reference #5) The letter documented additional cracks observed in field at the base of exposed foundation excavations for the Hillside Building B site, which were examined by Geomatrix, Kleinfelder and HLA geologists. The cracks were documented to be northwest trending features, dipping approximately 34 to 41 degrees to the northeast. The cracks exhibited horizontal slickenside-like features along their planes. However, within the same area,

similar sub-horizontal features were observed with differing orientations, some orthogonal to the primary fracture planes. It was determined that slickensides were a result of shrink/swell within the clay infilling the fractures. Fractures of varying orientations, striking both northeast and northwest, dipping to north and south, were documented; however, none extended into the base of an overlying B horizon or organic soil layers. The weathering profile was not disrupted along the soil/colluvium contact, and no differences or offsets were noted in the stratigraphic profiles across fracture planes.

The documented observations are inconclusive with respect to the cause and origin of the cracks; Geomatrix could not verify whether the fractures were of tectonic or non-tectonic origin. Geomatrix concluded that the features are not definite indicators of tectonic activity, but noted down to the east dip-slip movement. It was determined that no significant, recurrent displacements have occurred across the fractures, and that the fractures may be due to ground failure from strong seismic ground shaking, slope instability, or localized shearing of earth materials within proximity to rupturing along the active trace during a seismic event.

Geomatrix estimated that future displacements along the active Hayward fault would be up to three feet laterally, and 1 foot vertically; smaller displacements on the order of one foot or less is considered likely along secondary features.

8. *Personal communication, James (Jim) Lienkaemper (USGS, retired), various dates*: Lienkaemper indicated that, during the trench excavations along the Hayward for the Harding Lawson 1988 trenches, he observed what he interpreted to be evidence for Holocene movement on the Louderback trace in a trench between two wings of Stern Hall, Trench Z (Figure 2). The feature was a young fissure-fill that he interpreted to be of Holocene-age. Lienkaemper also interpreted 2007 LiDAR imagery as showing geomorphic support for an uphill-facing fault scarp, parallel to the main Hayward fault trace. He also noted that, in other trenches, there was little to no Holocene soil cover, and minimal Pleistocene-age colluvium. He emphasized that he observed Holocene offset in Trench Z. Lienkaemper did not get a sense of displacement or dip-slip direction, but interpreted the Louderback to likely be a splay structure, and not a compressional or extensional step-over feature.

9. *Hayward Fault Trace, Parking Structure "H", University of California, Berkeley*, prepared by Woodward-Clyde & Associates (WCA), dated 10 November 1970. Observations made during the construction of the existing parking structure indicate that a well-developed fault trace intersects the northeast corner of the parking structure. The geologist of record interpreted the trace as a "probably active trace of the Hayward fault", but determined that the design of the new parking garage) (now existing) was adequate, and the possibility of rupture along this trace in a future earthquake was remote. Instead, rupture would be limited to the main trace to the east. No study was conducted to supplement their conclusions.

DISCUSSION

Through our document review, we determined that an extensive amount of work had been performed around the campus and project vicinity that identifies well-constrained, active traces of the Hayward fault to the east of the project site, and no active faulting within the immediate vicinity of our project site. The LSZ was also extensively investigated in the 1980's by HLA, who determined that there was a potential for secondary, coseismic deformation or offset on the Louderback fault, the extent of which was never fully determined. Two well-defined fault traces were encountered by WCA during construction of the existing parking structure, which were interpreted at the time to be probable active traces of the Hayward fault. This conclusion was based on observations made during excavations for the garage, and no fault study was done. In our opinion, the faults encountered by Woodward Clyde were likely faults associated with the LSZ and not active traces of the Hayward fault.

With respect to the HLA studies, we find some merit in Lienkaemper's observations that there was little to no Holocene-age earth materials exposed in the trenches across the Louderback fault to fully eliminate the potential for rupture or shearing into overlying, Holocene-age materials. Trench L, which was excavated at the southwest corner of the La Loma Ridge site (Figure 2), encountered the Louderback fault trace at the southwest end of the trench. The contact of the fault with overlying earth materials appear to be somewhat infilled by what was interpreted as old colluvium or weathered in place bedrock. The fault was in direct contact in places with artificial fill, and no young alluvium was observed in between.

Just south of Trench W, Trench Y encountered fault gouge at the southwestern end of the trench; the gouge appears to have been truncated by landslide deposits. Trench X encountered a shear zone with a possible fault; fill was logged directly over the sheared material, but the fault was not traced the ground surface. To the south in Trench W, a shear zone was encountered extending up to the ground surface at the western end of the trench, with fill over residual soil to the northeast. HLA mapped the western half of the trench as within the LSZ.

In Trench Z East, a shear zone encountered does not disrupt an A-horizon within young colluvium. The A-horizon was also undisturbed in Trench Z West. Lienkaemper documented what he interpreted as Holocene infill within a fissure in Trench Z. However, this was not documented in the HLA trench, and no offset or evidence for Holocene activity was documented by the other parties present at the time, including CGS geologists. The trench log suggests that this is fissure fill directly above the shear zone, and colluvium thickens across the shear zone above it.

Based on the data reviewed during our desk study, we concluded that excavating a fault trench for the purpose of evaluating Holocene activity would not be feasible due to removal of Holocene-age overburden during previous grading activities associated with construction of Newman Hall, adjacent rectory (both since demolished), as well as the existing parking structure. Site grades have been reduced to construct the existing parking structure and associated driveways, and significant amounts of fill were placed to fill in the former basement of Newman Hall. To date, we have not encountered reports nor other information disputing HLA's conclusion regarding the potential for secondary, coseismic faulting or deformation across the LSZ during a large seismic event on the Hayward fault. Consequently, our study focused on quantifying potential displacements of the Louderback fault and associated shear zone, and possible adverse impacts on the proposed site development.

LCI was engaged to perform PFDHA and DFDHA and quantify potential fault displacement of the LSZ under various probabilistic and deterministic scenarios (Attachment D- LCI, 2018). LCI performed a probabilistic and deterministic hazard analysis to quantify fault displacement hazard at the project site from secondary faulting or secondary deformation (e.g., localized slip or distributed shear on previously unrecognized faults or tectonic shears) resulting from a large earthquake on northern segment of the Hayward fault. The actively creeping, principal strand of the Northern Hayward fault is well constrained and is approximately 160 to 250 m east of the project site. Consequently, principal fault displacement from the Hayward fault rupture is not considered a hazard for the project site.

CONCLUSIONS

With respect to the potential for surface fault rupture from the Hayward fault, we believe that there is sufficient coverage from fault trenches to the south of the project site that collectively shadow the GSPP project from all inferred projections of the active Hayward fault.

Ground cracking observed at the Hillside site indicate ground cracking at depth in area, away from active faulting. To the best of our knowledge, ground cracks were not encountered at the La Loma Ridge site. A stiff grid of spread footings was ultimately recommended by HLA to support the La Loma buildings.

The Langan borings at the project site encountered sheared, laterally discontinuous materials in all borings. Previous exploration performed at the site by WCA encountered similar conditions in their borings. We also observed discontinuities within the seismic refraction profiles; these are only interpreted as discontinuities at this point, as there is not sufficient ground truth to confirm their presence. Based on our preliminary review of reports and geologic data available to us, we conclude that the active traces of the Hayward fault have been sufficiently identified as located away from the project site, and do not pose a surface fault rupture hazard to the proposed improvements. Although the WCA (1970) report indicated that a "probably active" trace of the Hayward extends through the project site, we conclude that the trace they observed was actually a fault within the LSZ.

With respect to the LSZ, we conclude that the shear zone does extend through the project site, as currently mapped, but the majority of data available strongly supports faults within the LSZ as not Holocene active; however, some of them have ruptured in the late Quaternary. With the exception of one reference, the assembled trench data, analysis and conclusions developed by other consultants for projects in the vicinity generally demonstrate the absence of Holocene-age fault related features from the Louderback fault.

Below are the results of the PFDHA and DFDHA performed by LCI (2018):

PFDHA results

Average Return Period (years)	Net Displacement (inches)
1,000	Negligible
2,500	Negligible
5,000	0.5
10,000	2.5

Summarized from Table 5-1 in LCI report (2018)

DFDHA

Percentile	Corresponding Average Return Period (years)	Displacement
16th	12,500	1 inch
50th (median)	25,000	4 inches
84th	100,000	11 inches

Summarized from Table 5-2 in LCI report (2018)

We understand the project is designed for the Risk-Targeted Maximum Considered Earthquake (MCE_R) and Design Earthquake DE as defined in ASCE 7-10, respectively. The MCE_R level of shaking is the lesser of probabilistic seismic hazard analysis (PSHA) for 2 percent probability of exceedance in 50 years or 84th percentile of the deterministic on the governing fault. For the project site, MCE_R is governed by the 84th percentile deterministic spectrum, which corresponds to a magnitude 7.2 on the Hayward fault (URS/Pacific, 2015). This deterministic spectrum is approximately equivalent to a PSHA having a 1,000 year return period. Based on the results of Table 5-1 in the LCI report (Attachment D, pg. 30), fault displacements for a 1,000 year return event are negligible. Therefore, we conclude that, based on the results of the LCI (2018) study, fault rupture for a 1,000 year return event will have negligible impact on the proposed development.

In our opinion, the proposed structure can be constructed and the existing structure can be retrofitted if designed to accommodate the estimated deformations across the shear zone consistent with the governing level of ground shaking.

Seismic Site Class

The closest active fault to the site is the Hayward fault, approximately 0.2 kilometer away. Probabilistic and deterministic seismic hazard analyses and corresponding acceleration time series were previously developed for the UC Berkeley campus by others (URS/Pacific, 2009, 2015) for rock and thin soil site conditions. URS/Pacific (2015) recommends that sites be classified as one of five different profiles defined as: 1) 10 to 35 feet of soil, 2) 36 to 75 feet of soil, 3) 76 to 150 feet of soil, 4) Rock, 5) Rock – Shear Zone. In our 13 February report, we preliminarily recommended classifying the site as Category 3 (76 to 150 feet of soil). Upon further evaluation of the shear wave velocity profiles and consultation with LCI and the design team, we recommend that the site should be classified as Category 5 (Rock – Shear Zone). In addition, seismic design parameters in accordance with the provisions of 2016 CBC/ASCE 7-10, as presented in the geotechnical report, should be used as appropriate.

If you have additional questions, please do not hesitate to contact us.

Sincerely yours,
Langan Engineering and Environmental Services, Inc.

Marina Mascorro, PG, CEG
Senior Project Geologist

Cary Ronan, PE, GE
Associate

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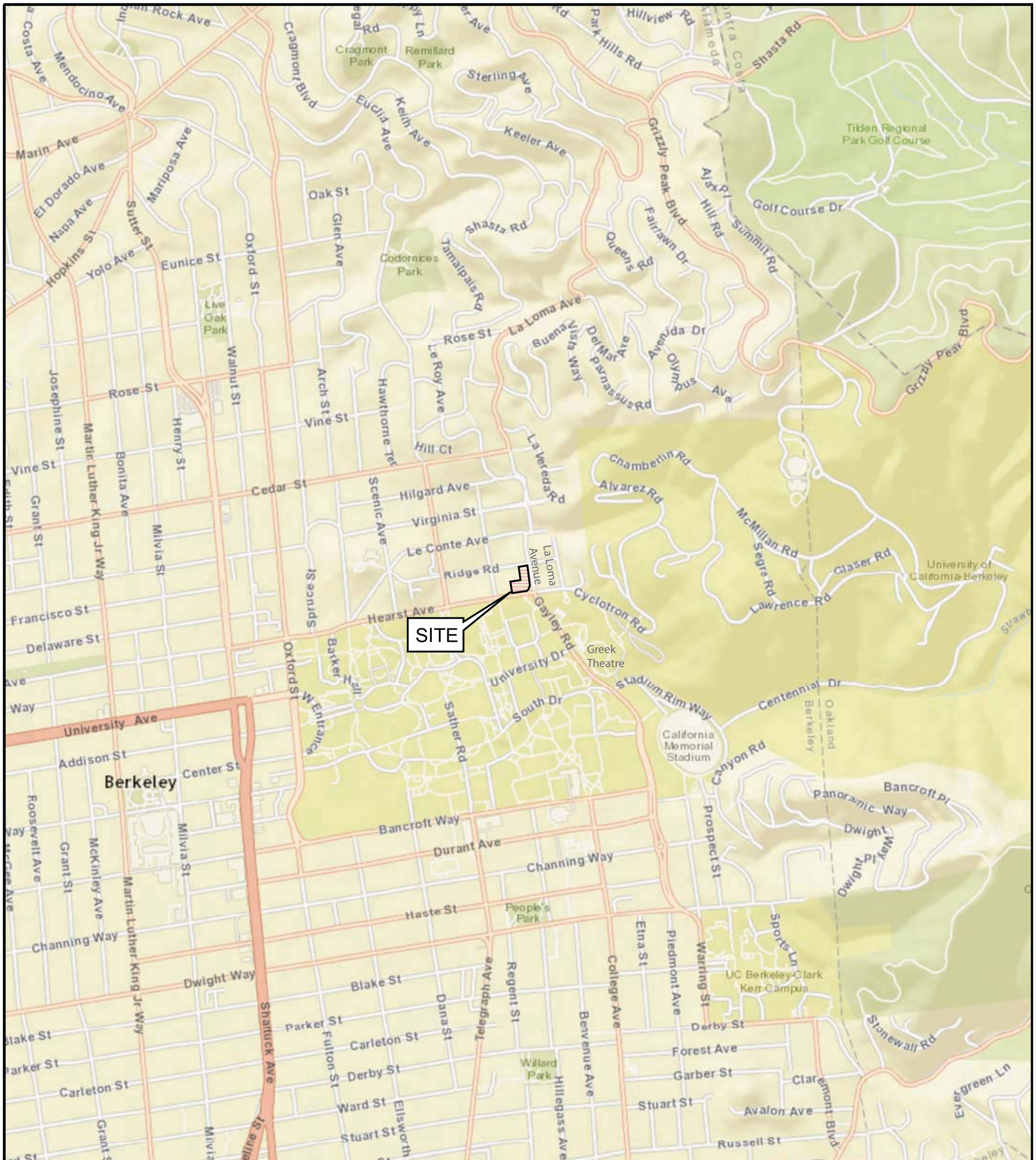
Attachments:

Figure 1: Site Location Map
Figure 2A: Site Plan- Regional
Figure 2B: Site Plan- Detailed
Figure 3: Regional Geologic Map
Figure 4: Map Showing Zones of Required Investigation
Figure 5: Mapped Alquist-Priolo Fault Traces
Figure 6: Geologic Cross Section A-A'
Figure 7: Geologic Cross Section B-B'
Figure 8: Geologic Cross Section C-C'

Appendix A: Langan Boring Logs
Appendix B: Norcal Geophysical Surveys
Appendix C: HLA Fault Trench Logs and Descriptions
Appendix D: LCI, 2018, Fault Displacement Hazard Analysis (Report)
Appendix E: CPTs
Appendix F: Test Pits

FIGURES



NOTES:

World street basemap is provided through Langan's Esri ArcGIS software licensing and ArcGIS online.
Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN.

0 1,000 2,000
Feet

N W E S

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

LANGAN

SITE LOCATION MAP

Date 10/08/18	Project No. 731706301	Figure 1

Reference: Nearmap aerial imagery, dated 03/09/17.

EXPLANATION

- Langan project site boundary
- AP Zone, West boundary
- Mapped active Hayward fault, Harding Lawson Associates, 1988
- Updated active Hayward fault, USGS fault and fold database, 2006
- Mapped Louderback fault, Lennert and Currtis, 1980
- Faults (solid where certain, dashed where approximate, dotted where concealed), Alan Kropp & Associates, 2016
- Louderback trace, Lettis, 2007
- Hayward fault active trace, Lettis, 2007
- Fault trace, Woodward Clyde & Associates, 1970
- Mapped Louderback Shear Zone, Harding Lawson Associates, 1986 & 1988
- Fault trenches, Harding Lawson Associates, 1986 and 1988
- Approximate location of seismic refraction line, Langan, September 2017'
- Foothill Housing Project - La Loma Ridge Site
- Foothill Housing Project - Hillside Site
- Lawson Adit
- Approximate location of boring, September 2017
- Approximate location of test pit, September 2017
- Test borings from 1986, Harding Lawson Associates, 1986
- Test borings from 1987, Harding Lawson Associates, 1988
- 300 Average groundwater elevation (ft, NGVD*)
- Test borings, Mactec, 2003
- Test borings, Dames & Moore,1989
- Test borings, Woodward-Clyde-Sherard & Associates, 1968
- Test borings, Rutherford & Chekene, 1998
- A A' Idealized geologic cross section
- Extent of Figure 2B

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

SITE PLAN - REGIONAL

Date 10/08/18	Project No. 731706301	Figure 2A

LANGAN

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Reference: © 2017 Microsoft Corporation, Bing

EXPLANATION

- LB-1 — Approximate location of boring by Langan, September 2017
- TP-1 — Approximate location of test pit by Langan, September 2017
- CPT-1 — Approximate location of cone penetration test by Langan, December 2017
- DPT-1 — Approximate location of dynamic penetration test by Langan, December 2017
- WC-1 — Approximate location of boring by Woodward Clyde & Associates, 1969
- WC-11 — Approximate location of boring by Woodward Clyde & Associates, 1959
- Project limits
- Line #1 — Approximate location of seismic refraction line, September 2017
- Fault trenches, Harding Lawson Associates, 1986 and 1988
- Fault trace, Woodward Clyde and Associates, 1970
- A A' — Idealized subsurface profile location, see Figure 2A for full extent

0 60 Feet

Approximate scale

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
San Francisco, California

SITE PLAN - DETAILED

Date 06/05/18	Project No. 731706301	Figure 2B

LANGAN

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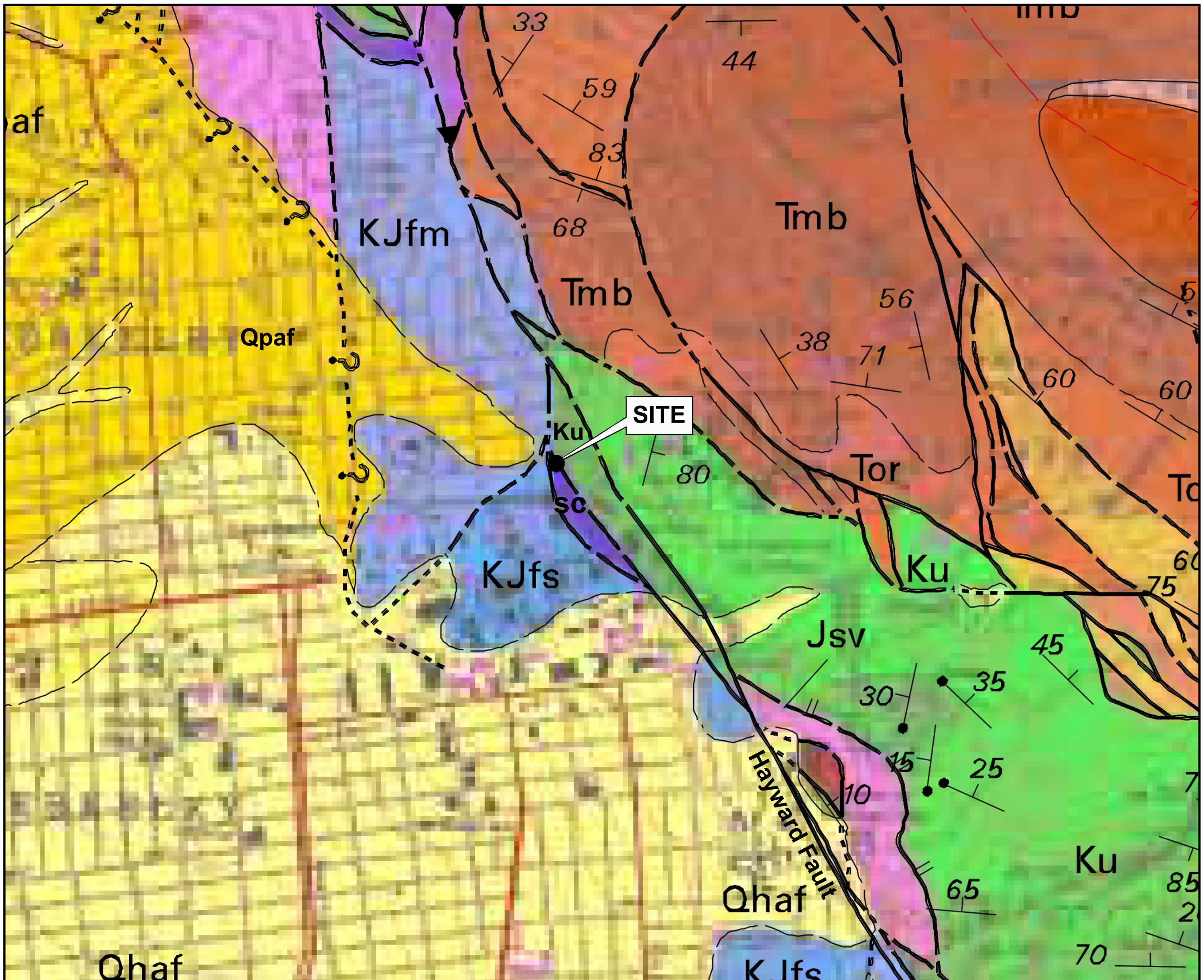

Reference: Geologic Map and Map Database of the Oakland Metropolitan Area, Alameda, Contra Costa, and San Francisco Counties, California, By R.W. Graymer, 2000.

EXPLANATION

Qpaf	Alluvial fan and fluvial deposits (Pleistocene)
Ku	Unnamed sedimentary rocks (Late Cretaceous, Turonian and Cemonanion)
sc	Silica carbonate rock
KJfs	Franciscan complex sandstone, undivided (Late Cretaceous (?) and Late Jurassic)
KJfm	Franciscan complex, melange (Cretaceous Late Jurassic), includes mapped locally: Graywacke and meta-graywacke blocks)

— —. . . .	Geologic contact: dashed where approximate and dotted where concealed
- - -?- - -?- - -	Fault, uncertain
▼ ▼ ▼	Thrust or reverse fault, dashed where inferred, dotted where conceald
35	Strike and dip of bedding
25	Strike and dip of bedding, top indicator observed

0 2000 Feet

Approximate scale

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
San Francisco, California

LANGAN

REGIONAL GEOLOGIC MAP

Date 10/08/18	Project No. 731706301	Figure 3

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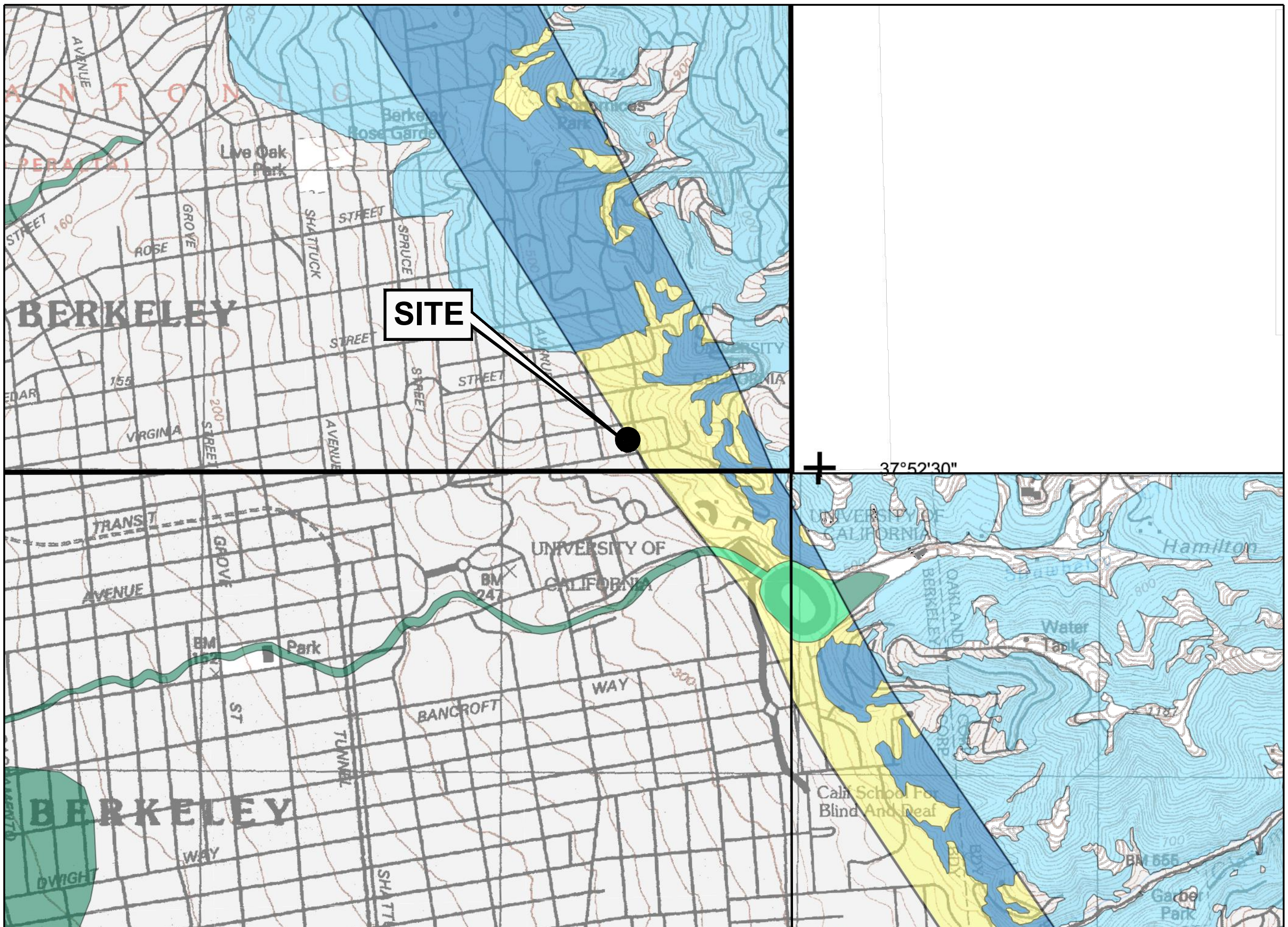

Reference: Earthquake Zones of Required Investigation; Richmond, Oakland West, and Oakland East 7.5-minute Quadrangles; California Geological Survey, undated.

EXPLANATION

ALQUIST-PRIOLO EARTHQUAKE FAULT ZONES

Earthquake Fault Zones
Zone boundaries are delineated by straight-line segments; the boundaries define the zone encompassing active faults that constitute a potential hazard to structures from surface faulting or fault creep such that avoidance as described in Public Resources Code Section 2621.5(a) would be required.

SEISMIC HAZARD ZONES

Liquefaction Zones
Areas where historical occurrence of liquefaction, or local geological, geotechnical and ground water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslide Zones
Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

OVERLAPPING ALQUIST-PRIOLO AND SEISMIC HAZARD ZONES

Overlap of Earthquake Fault Zone and Earthquake-Induced Landslide Zone
Areas that are covered by both Earthquake Fault Zone and Earthquake-Induced Landslide Zone.

0 2000 Feet
Approximate scale

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

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EARTHQUAKE ZONES OF REQUIRED INVESTIGATION

Date 10/08/18	Project No. 731706301	Figure 4

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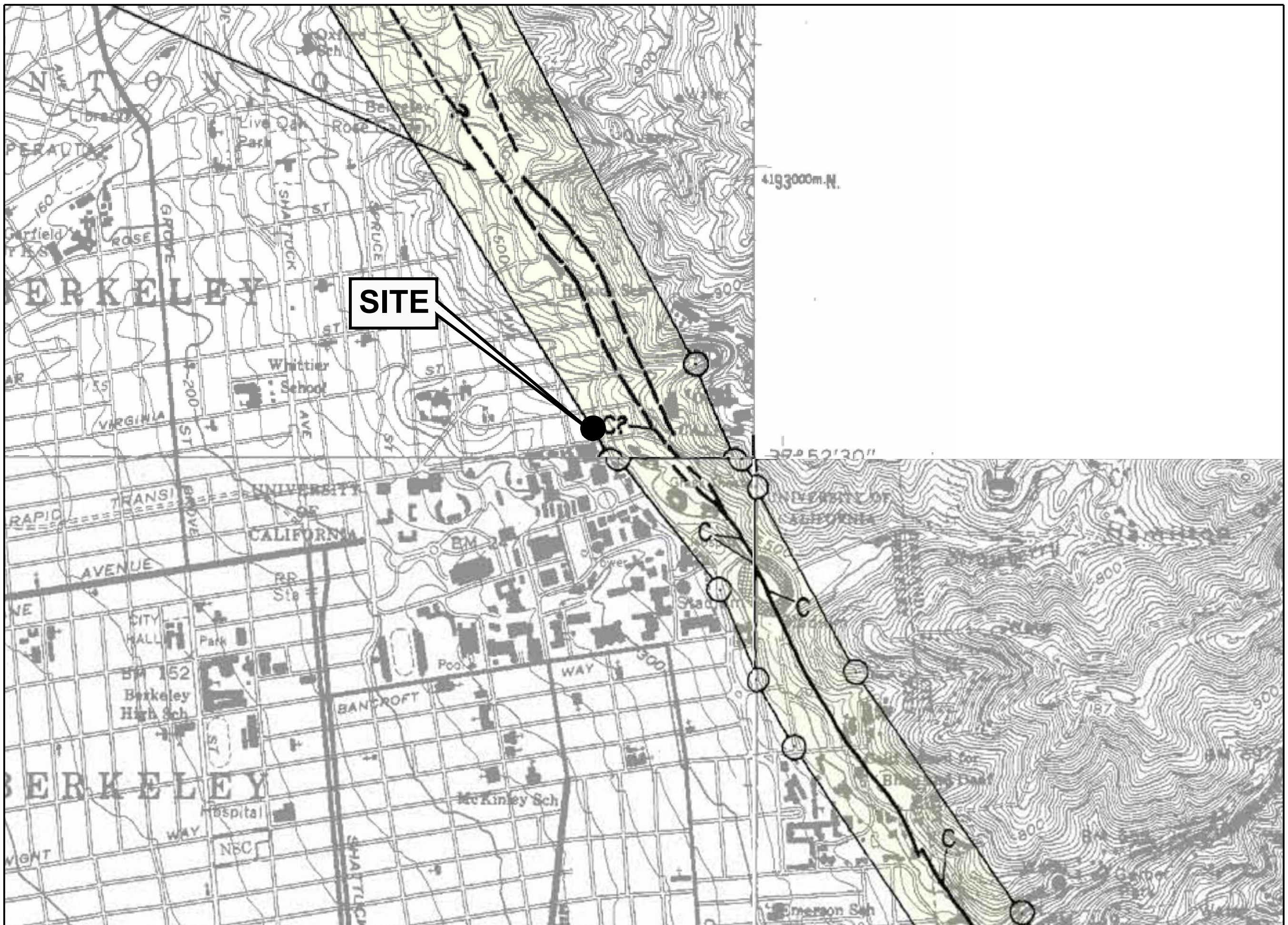

Reference: State of California Special Studies Zone, Richmond, Oakland East, and Oakland West, by James Davis, dated January 1, 1982.

EXPLANATION

Potentially Active Faults

1906 C

Faults considered to have been active during Holocene time and to have a relatively high potential for surface rupture; solid line where accurately located, long dash where approximately located, short dash where inferred, dotted where concealed; query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by creep or possible creep.

Special Studies Zone Boundaries

These are delineated as straight-line segments that connect encircled turning points so as to define special studies zone segments.

Seaward projection of zone boundary.

0 2000 Feet

Approximate scale

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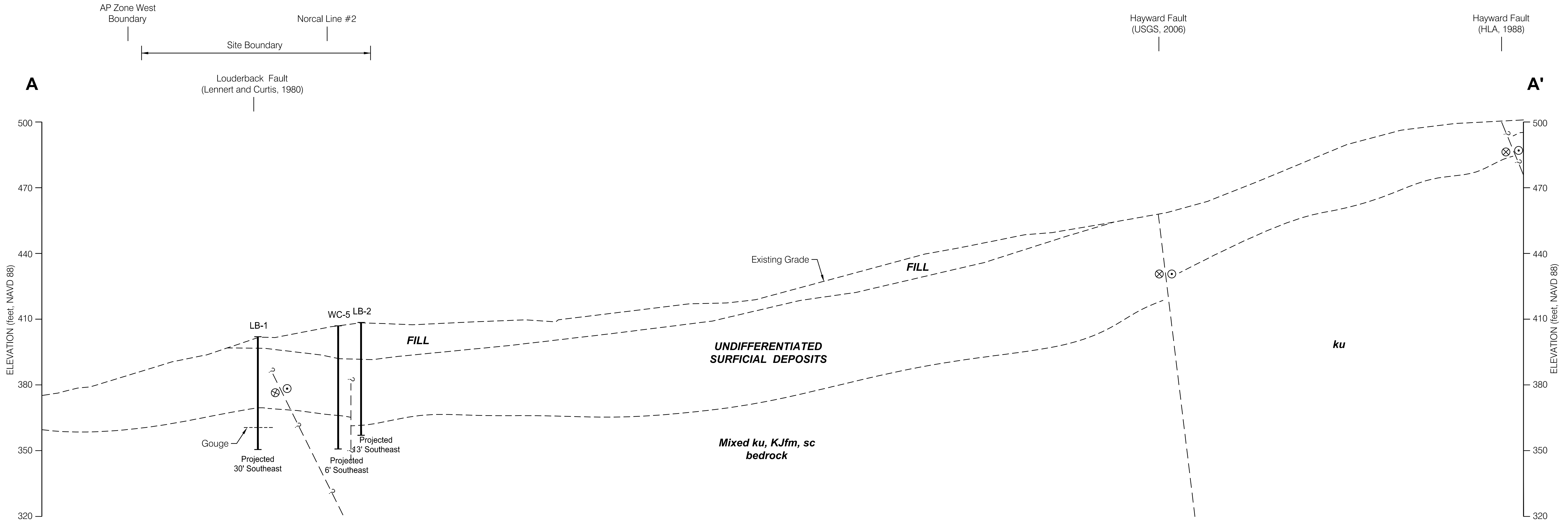
UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

LANGAN

MAPPED ALQUIST-PRIOLO FAULT TRACES

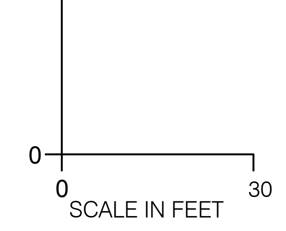
Date 10/08/18 | Project No. 731706301 | Figure 5



EXPLANATION

— — — —	Geologic contact, dashed where approximate, queried where inferred
—?— — —	Fault, dashed where inferred, queried where uncertain
⊗⊙	Away/toward
ku	Undivided Great Valley Complex rocks
KJfm	Franciscan Complex Serpentinite Melange
sc	Silica - carbonate rock
FILL	Artificial/man-made fill

Notes:
1. The above profile represents a generalized soil cross section interpreted from widely spaced borings. Soil deposits may vary in type, strength, and other important properties between points of exploration.
2. Boring B-1 and B-2 by Langan, 2017
3. North American Vertical Datum of 1988.
4. Topo based on USGS Richmond 7.5-minute Quadrangle, 2012.



UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

IDEALIZED SUBSURFACE PROFILE A-A'

Date 05/15/18	Project No. 731706301	Figure 6

LANGAN

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EXPLANATION

- Geologic contact, dashed where approximate, queried where inferred
- Fault, dashed where inferred, queried where uncertain
- Shear
- Away/toward

ku	Undivided Great Valley Complex rocks
KJfm	Franciscan Complex Serpentinite Melange
sc	Silica - carbonate rock
FILL	Artificial/man-made fill

Notes:
1. The above profile represents a generalized soil cross section interpreted from widely spaced borings. Soil deposits may vary in type, strength, and other important properties between points of exploration.
2. Borings 10, 11, 14, and G-26 by Harding Lawson Associates, 1986 and 1988.
3. HLA-B and HLA-C fault trenches by Harding Lawson Associates, 1988.
4. Boring B-3 by Langan, 2017
5. North American Vertical Datum of 1988.
6. Topo based on USGS Richmond 7.5-minute Quadrangle, 2012.

30
0
0 30
SCALE IN FEET

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

IDEALIZED SUBSURFACE PROFILE B-B'

Date 05/15/18	Project No. 731706301	Figure 7

LANGAN

EXPLANATION

Geologic contact, dashed where approximate, queried where inferred	**ku** Undivided Great Valley Complex rocks
Fault, dashed where inferred, queried where uncertain	**KJfm** Franciscan Complex Serpentinite Melange
Shear	**sc** Silica - carbonate rock
Away/toward	***FILL*** Artificial/man-made fill

Notes:
1. The above profile represents a generalized soil cross section interpreted from widely spaced borings. Soil deposits may vary in type, strength, and other important properties between points of exploration.
2. Borings G-27, G-28, and G-29 by Harding Lawson Associates, 1988.
3. HLA-L fault trench by Harding Lawson Associates, 1988.
4. North American Vertical Datum of 1988.
5. Topo based on USGS Richmond 7.5-minute Quadrangle, 2012.

30

0

0 30

SCALE IN FEET

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

IDEALIZED SUBSURFACE PROFILE C-C'

Date 05/15/18	Project No. 731706301	Figure 8

LANGAN

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APPENDIX A

Langan Boring Logs

PROJECT: **UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING**
Berkeley, California

Log of Boring B-1

Boring location:	See Site Plan, Figure 2		
Date started:	9/15/17	Date finished:	9/15/17
Drilling method:	Rotary Wash		
Hammer weight/drop:	140 lbs./30 inches	Hammer type:	Automatic
Samplers:	Sprague & Henwood (S&H), Standard Penetration Test (SPT)		

Logged by: H. Sok

MATERIAL DESCRIPTION — Ground Surface Elevation: 402 feet[2]

LABORATORY TEST DATA

DEPTH (feet)	Sampler Type	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0					3.5 inches asphalt concrete (AC)						
					6 inches aggregate base (AB)						
1–2	GRAB			CL	SANDY CLAY with GRAVEL (CL) brown, moist, fine to coarse sand, fine to coarse subangular gravel (FILL)						
5–6	S&H	12, 20, 31	36	CL	SANDY CLAY (CL) yellow-brown, hard, fine- to medium-grained sand, trace angular, fractured, oxidized gravel	PP		4,500		12.1	123
8	SPT	10, 18, 22	48	SC	CLAYEY SAND with GRAVEL (SC) orange-brown, dense, moist, fine- to coarse-grained, fine oxidized sandstone gravel, chaotic structure; Particle Size Analysis, see Appendix F				34.8	13.8	
10–11	SPT	13, 13, 13	31	SC	wet, increased crushed gravel					13.2	
16				CL	SANDY CLAY (CL) yellow to yellow-brown, very stiff, wet, fine-grained, trace coarse fractured angular fine to coarse gravel, black decomposing organics						
20–21	SPT	6, 10, 11	25	CL							
30											

FILL (approx. 0.8–4.5 ft); UNDIFFERENTIATED SURFICIAL DEPOSITS (approx. 4.5–30 ft)

LANGAN

Project No.: 731706301 Figure: A-1a

PROJECT: **UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING**
Berkeley, California

Log of Boring B-1

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31	SPT		8 16 30	55	CL	CLAY with GRAVEL (CL) gray, hard, with fine subangular to subrounded shale gravel, abraded with polished surfaces				27.5	15.9	
32 33 34 35 36 37 38 39						SILTSTONE dark gray to black, moderately fractured, low hardness, friable, moderately to deeply weathered						
40 41 42 43 44	SPT		14 18 25	52		GOUGE yellow-brown to gray, hard, with fine subangular shale and meta-sandstone gravel, lack of internal shearing in clay matrix, polished surfaces on gravel LL = 43, PI = 24, see Appendix F					12.0	
45 46 47 48 49	SPT		10 21 29	60		occasional fine carbonate inclusions						
50 51	SPT		20 26 28	65		gray to green-gray						
52 53 54 55 56 57 58 59 60												

Boring terminated at a depth of 51.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater obscure by drilling method.
PP = pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.7 and 1.2, respectively to account for sampler type and hammer energy.

[2] Elevations based on the City of Berkeley Datum and the Parking Structure "H" Topo drawing by David J. Russell, Land Surveyor, dated 03/69, by the Universtiy of California.

LANGAN

Project No.: 731706301

Figure: A-1b

PROJECT: **UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING**
Berkeley, California

Log of Boring B-2

Boring location: See Site Plan, Figure 2	Logged by: H. Sok
Date started: 9/15/17	Date finished: 9/15/17
Drilling method: Rotary Wash	
Hammer weight/drop: 140 lbs./30 inches	Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)	

DEPTH (feet)	Sampler Type	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION (Ground Surface Elevation: 408.5 feet[2])	Unit	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0					2 inches asphalt concrete (AC)							
0–1					7 inches aggregate base (AB)							
1–3				CL	CLAY with SAND (CL) brown, very stiff, moist, fine sand, trace fine gravel, oxidized	FILL						
3	S&H	6 12 12	17	CL	LL = 43, PI = 25, see Appendix F	FILL	PP		>4,500		14.2	118
6	S&H	6 9 11	14	CL	grades sandy, brown to dark brown with white calcium carbonate and yellow brown mottling, stiff, oxidized fine sandstone gravel	FILL	PP		4,250	62.3	18.3	109
8	S&H	11 12 12	17	CL	brown with light brown mottling, very stiff, fine to coarse sand, trace silt	FILL	PP		4,500			
9–10				GP	GRAVEL (GP) very dense	FILL						
10.5	SPT	7 50/ 5.5"	60/ 5.5"	CL	SANDY CLAY (CL) brown to yellow-brown, hard, wet, fine sand, trace gravel, chaotic structure	FILL						
12.5–15.5				GL	CLAY with GRAVEL (CL) gray to yellow-brown, medium dense to dense, wet, subangular, coarse	FILL						
15				GL	Particle Size Analysis, see Appendix F	FILL				52.9	15.9	
16	SPT	8 12 13	30	CL	SANDY CLAY (CL) yellow-brown to gray-brown, very stiff, hard, wet, trace fine subangular to subrounded gravel, trace oxidation staining on gravel	UNDIFFERENTIATED SURFICIAL DEPOSITS						
21	S&H	6 12 6	13	CL	yellow-brown with gray-brown mottling, stiff, trace dark brown spots, with deeply weathered fine sandstone gravel, occasional black staining Triaxial Test, see Appendix F	UNDIFFERENTIATED SURFICIAL DEPOSITS	PP TxUU	 2,000	>4,500 3,440		20.0	108
26	S&H	13 18 22	28	CL	very stiff, fine to coarse sand, trace fine subangular gravel, faint oxidation staining Consolidation Test, see Appendix F	UNDIFFERENTIATED SURFICIAL DEPOSITS	PP		3,250		17.5	110
30.5	SPT		20	CL		UNDIFFERENTIATED SURFICIAL DEPOSITS						

LANGAN

Project No.: 731706301
Figure: A-2a

PROJECT: UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

Log of Boring B-2

DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31	SPT		8 13 15	20	CL	SANDY CLAY (CL) (continued) yellow-brown, fine angular to subangular siltstone gravel, faint oxidation staining, slightly chaotic structure						
33					SC	CLAYEY SAND (SC) yellow-brown, medium dense, wet						
35–36	SPT		12 18 18	20		increased gravel, coarse, up to 1 inch in diameter, increased structure, transitioning to residual soil				31.1	13.0	
40–41	SPT		12 18 20	46		residual soil, dense						
45–46	SPT		11 12 14	31		SILTSTONE dark gray, intensely fractrured, low hardness, friable, deeply weathered						
48.5						GOUGE yellow-brown to gray-brown, hard, siltstone/shale in clay matrix, abraded, polished surfaces						
50–51	SPT		11 18 28	55								
55–56	SPT		16 13 21	41								
56.5						SERPENTINITE MELANGE intensely fractured, low hardness, weak , deeply weathered						
60–61	SPT		11 18 32	60								

UNDIFFERENTIATED SURFICIAL DEPOSITS (31 to 48.5 feet)

Boring terminated at a depth of 51.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater obscure by drilling method.
PP = pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.7 and 1.2, respectively to account for sampler type and hammer energy.
[2] Elevations based on the City of Berkeley Datum and the Parking Structure "H" Topo drawing by David J. Russell, Land Surveyor, dated 03/69, by the Universtiy of California.

LANGAN

Project No.: 731706301
Figure: A-2b

TEST GEOTECH LOG 731706301.GPJ TR.GDT 12/5/17

PROJECT: **UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING**
Berkeley, California

Log of Boring B-3

Boring location: See Site Plan, Figure 2

Logged by: H. Sok

Date started: 9/14/17 Date finished: 9/14/17

Drilling method: Rotary Wash

Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic

Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

LABORATORY TEST DATA

DEPTH (feet)	SAMPLES: Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION (Ground Surface Elevation: 398.5 feet[2])		Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0						4 inches asphalt concrete (AC)	FILL						
1–2					CL	CLAY with SAND and GRAVEL (CL) dark brown							
3–4	S&H		6 16 14	21	CL	brown to yellow-brown, very stiff, moist, fine sand, coarse gravel		PP		>4,500			
5–6	S&H		7 7 5	8	CL	yellow-brown with black and brown-red mottling, medium stiff to stiff, scattered organics		PP		3,400		17.2	111
7					CL	wet							
7.5–9	SPT		50/ 2"	60/ 2"	GC	CLAYEY GRAVEL (GC) gray-brown, very dense, wet, dark brown-gray subrounded volcanic rock fragments							
9–12	S&H		4 7 13	14	CL	CLAY with SAND (CL) yellow-brown with gray-brown mottling, stiff, wet, fine to coarse sand, trace fine gravel LL = 45, PI = 28, see Appendix F fine subangular silica-carbonate gravel, fragments of silty sandstone, gray gouge seams		PP		4,250		24.4	100
12.5–14					GC	CLAYEY GRAVEL (GC) fractured rock							
14–18.5	S&H		12 32 29	43	SC	CLAYEY SAND with GRAVEL (SC) yellow-brown with dark brown mottling, dense, wet, fine- to coarse-grained, rock fragments highly fractured into fine to coarse gravel, black decomposed organic seams, scattered subrounded fine to coarse gravel, highly oxidized throughout, chaotic structure Particle Size Analysis, see Appendix F	UNDIFFERENTIATED SURFICIAL DEPOSITS	PP		4,500	47.1	25.0	101
18.5–22	S&H		13 13 22	25	CL	CLAY with GRAVEL (CL) yellow-brown with gray-brown mottling, very stiff, fine sand, trace coarse sand, abundant red decomposed sandstone clasts with oxidation staining Consolidation Test, see Appendix F		PP		4,250		19.2	109
25–27	S&H		11 19 37	39	CL	hard, trace coarse gravel, highly oxidized and decomposed sandstone fragments		PP		4,500			
26.5					CL			TxUU	2,300	5,270		16.5	114
27					CL	Triaxial Test, see Appendix F							
28–30					CL								

LANGAN

Project No.: 731706301

Figure: A-3a

DEPTH (feet)	Run Number	Sample Type	SPT N-Value[1]	Recovery, %	RQD, %	Drilling Rate (min/ft)	LITHOLOGY	MATERIAL DESCRIPTION	Dip, Degrees	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31			39				CL	SANDY CLAY with GRAVEL (CL) yellow, hard, coarse sand, trace coarse gravel up to 1 inch in length PP (Su >4,500 psf)				
33–38			25 55				CL	CLAY with SAND (CL) gray and dark brown, very stiff, wet, coarse sand, trace fine gravel PP (Su > 4,500 psf) yellow-brown to red-black serpentinite fragments, fine rounded to subangular gravel, decomposed red sandstone and fresh black meta shale Triaxial Test, see Appendix F (Su = 2,960 psf) red-brown, hard			16.6	115
39–41	1		60/ 3"	87.5	0	22	GP	CLAYEY GRAVEL (GP) yellow-brown to gray with hard, strong black meta sandstone, dense, wet				
42	2			87.5	0	5.5						
43							CL	CLAY with SAND (CL) yellow-brown, coarse sand				
44–51								SHALE MELANGE yellow-brown to gray, moderately fractured, moderately hard, weak, deeply weathered				
52–56	3			80	0	2.5		BRECCIA yellow to yellow-brown with orange oxidation staining, low hardness, friable, deeply weathered, variable grain size and composition set in soft and plastic clayey matrix, variable sand content in matrix				
57–60	4			24	0	2.4		decreased structure and decreased matrix, strong orange oxidation staining, graywacke sandstone inclusion, moderately hard to hard, strong, oxidized pockets				

UNDIFFERENTIATED SURFICIAL DEPOSITS (31–43 ft)

PROJECT: UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING Berkeley, California	Log of Boring B-3 PAGE 3 OF 3

DEPTH (feet)	SAMPLES Run Number	Sample Type	SPT N-Value[1]	Recovery, %	RQD, %	Drilling Rate (min/ft)	LITHOLOGY	MATERIAL DESCRIPTION	Dip, Degrees	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
61								BRECCIA (continued)				
62	5			0	0	3.2		no recovery				
63												
64	6		88/ 8"	50	0	20		gray, moderately hard, moderately strong to strong, little weathered calcite deposits along surfaces				
65												
66												
67												
68												
69												
70												
71												
72												
73												
74												
75												
76												
77												
78												
79												
80												
81												
82												
83												
84												
85												
86												
87												
88												
89												
90												

Boring terminated at a depth of 65.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater obscure by drilling method.
PP = pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.7 and 1.2, respectively to account for sampler type and hammer energy.
[2] Elevations based on the City of Berkeley Datum and the Parking Structure "H" Topo drawing by David J. Russell, Land Surveyor, dated 03/69, by the Universtiy of California.

LANGAN

Project No.: 731706301 | Figure: A-3c

40.2 40.9

Run 1: 40.2 to 41 feet (segment from 40.2 to 40.9 feet)

41 41.6

Run 2: 41 to 43 feet (segment from 41 to 41.6 feet)

41.4 42.2

Run 2: 41 to 43 feet (segment from 41.4 to 42.2 feet)

42.1 42.75

Run 2: 41 to 43 feet (segment from 42.1 to 42.75 feet)

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING Berkeley, California	**BORING B-3 PHOTOS**
LANGAN	Date 03/01/17 | Project No. 731706301 | Figure A-3d

52 52.5

Run 3: 52 to 56 feet (segment from 52 to 52.5 feet)

52.2 53.15

Run 3: 52 feet to 56 feet (segment from 52.2 to 53.15 feet)

53.2 54.3

Run 3: 52 to 56 feet (segment from 53.2 to 54.3 feet)

54.2 55.2

Run 3: 52 to 56 feet (segment from 54.2 to 55.2 feet)

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING Berkeley, California	**BORING B-3 PHOTOS**
LANGAN	Date 03/01/17 | Project No. 731706301 | Figure A-3e

\\langan.com\data\SFO\data3\731706301\Project Data\CAD\01\2D-DesignFiles\Geotechnical\731706301-B-GI0101.dwg 12/05/17

56 56.7

Run 4: 56 to 61 feet (segment from 56 to 56.7 feet)

56.35 57.2

Run 4: 56 to 61 feet (segment from 56.35 to 57.2 feet)

Run 5: 61 to 63.5 (no recovery)

63.5 64

Run 6: 63.5 to 64 feet

\\langan.com\data\SFO\data3\731706301\Project Data\CAD\01\2D-DesignFiles\Geotechnical\731706301-B-GI0101.dwg 12/05/17

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

LANGAN

BORING B-3 PHOTOS

Date 03/01/17	Project No. 731706301	Figure A-3f

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions		Symbols	Typical Names
Coarse-Grained Soils (more than half of soil > no. 200 sieve size	**Gravels** (More than half of coarse fraction > no. 4 sieve size)	**GW**	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (More than half of coarse fraction < no. 4 sieve size)	**SW**	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly-graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
Fine -Grained Soils (more than half of soil < no. 200 sieve size)	**Silts and Clays** LL = < 50	**ML**	Inorganic silts and clayey silts of low plasticity, sandy silts, gravelly silts
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	Silts and Clays LL = > 50	**MH**	Inorganic silts of high plasticity
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic silts and clays of high plasticity
Highly Organic Soils		**PT**	Peat and other highly organic soils

GRAIN SIZE CHART

Classification	Range of Grain Sizes: U.S. Standard Sieve Size	Range of Grain Sizes: Grain Size in Millimeters
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel	3" to No. 4	76.2 to 4.76
coarse	3" to 3/4"	76.2 to 19.1
fine	3/4" to No. 4	19.1 to 4.76
Sand	No. 4 to No. 200	4.76 to 0.075
coarse	No. 4 to No. 10	4.76 to 2.00
medium	No. 10 to No. 40	2.00 to 0.420
fine	No. 40 to No. 200	0.420 to 0.075
Silt and Clay	Below No. 200	Below 0.075

▽ Unstabilized groundwater level

▼ Stabilized groundwater level

SAMPLE DESIGNATIONS/SYMBOLS

Sample taken with Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter. Darkened area indicates soil recovered

Classification sample taken with Standard Penetration Test sampler

Undisturbed sample taken with thin-walled tube

Disturbed sample

Sampling attempted with no recovery

Core sample

Analytical laboratory sample

Sample taken with Direct Push or Drive sampler

SAMPLER TYPE

- C — Core barrel
- CA — California split-barrel sampler with 2.5-inch outside diameter and a 1.93-inch inside diameter
- D&M — Dames & Moore piston sampler using 2.5-inch outside diameter, thin-walled tube
- O — Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube
- PT — Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube
- S&H — Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter
- SPT — Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.5-inch inside diameter
- ST — Shelby Tube (3.0-inch outside diameter, thin-walled tube) advanced with hydraulic pressure

I FRACTURING

Intensity	Size of Pieces in Feet
Very little fractured	Greater than 4.0
Occasionally fractured	1.0 to 4.0
Moderately fractured	0.5 to 1.0
Closely fractured	0.1 to 0.5
Intensely fractured	0.05 to 0.1
Crushed	Less than 0.05

II HARDNESS

1. **Soft** - reserved for plastic material alone.
2. **Low hardness** - can be gouged deeply or carved easily with a knife blade.
3. **Moderately hard** - can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away.
4. **Hard** - can be scratched with difficulty; scratch produced a little powder and is often faintly visible.
5. **Very hard** - cannot be scratched with knife blade; leaves a metallic streak.

III STRENGTH

1. **Plastic** or very low strength.
2. **Friable** - crumbles easily by rubbing with fingers.
3. **Weak** - an unfractured specimen of such material will crumble under light hammer blows.
4. **Moderately strong** - specimen will withstand a few heavy hammer blows before breaking.
5. **Strong** - specimen will withstand a few heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.
6. **Very strong** - specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

IV WEATHERING - The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation, and freezing and thawing.

D. Deep - moderate to complete mineral decomposition; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.

M. Moderate - slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected. Moderate to occasionally intense discoloration. Moderately coated fractures.

L. Little - no megascopic decomposition of minerals; little of no effect on normal cementation. Slight and intermittent, or localized discoloration. Few stains on fracture surfaces.

F. Fresh - unaffected by weathering agents. No disintegration of discoloration. Fractures usually less numerous than joints.

ADDITIONAL COMMENTS:

V CONSOLIDATION OF SEDIMENTARY ROCKS: usually determined from unweathered samples. Largely dependent on cementation.

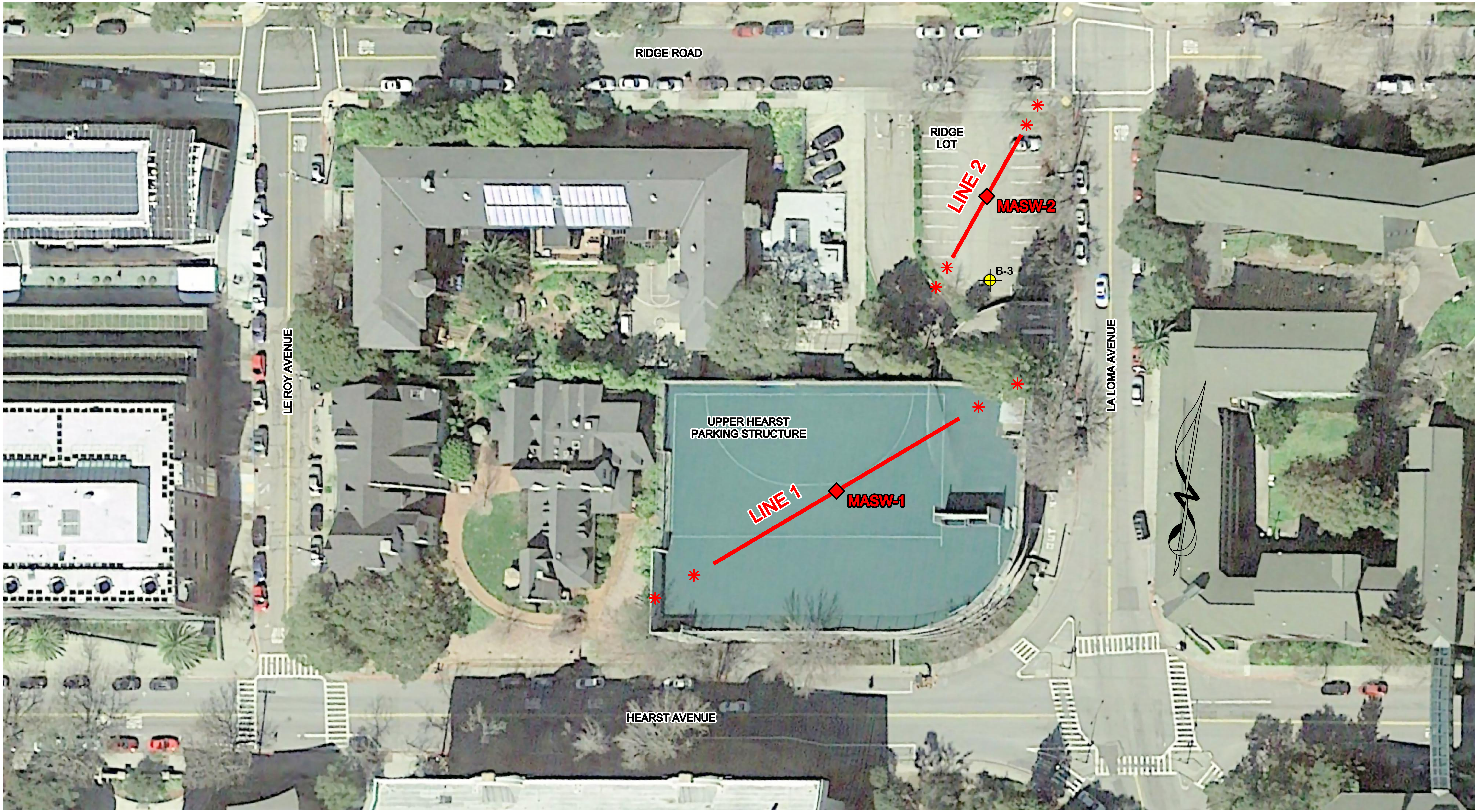
U = unconsolidated
P = poorly consolidated
M = moderately consolidated
W = well consolidated

VI BEDDING OF SEDIMENTARY ROCKS

Splitting Property	Thickness	Stratification
Massive	Greater than 4.0 ft.	very thick-bedded
Blocky	2.0 to 4.0 ft.	thick bedded
Slabby	0.2 to 2.0 ft.	thin bedded
Flaggy	0.05 to 0.2 ft.	very thin-bedded
Shaly or platy	0.01 to 0.05 ft.	laminated
Papery	less than 0.01	thinly laminated

APPENDIX B

Norcal Geophysical Surveys



LEGEND

(red line)	SEISMIC REFRACTION LINE
(red diamond)	MASW SOUNDING LOCATION
(red asterisk)	MASW SHOT POINT
(yellow circled cross)	DOWNHOLE SEISMIC BOREHOLE

SCALE

0 25 50 100

(1 inch = 50 feet)

NORCAL GEOPHYSICAL CONSULTANTS INC.
A Terracon COMPANY

321A BLODGETT STREET
COTATI, CA 94931
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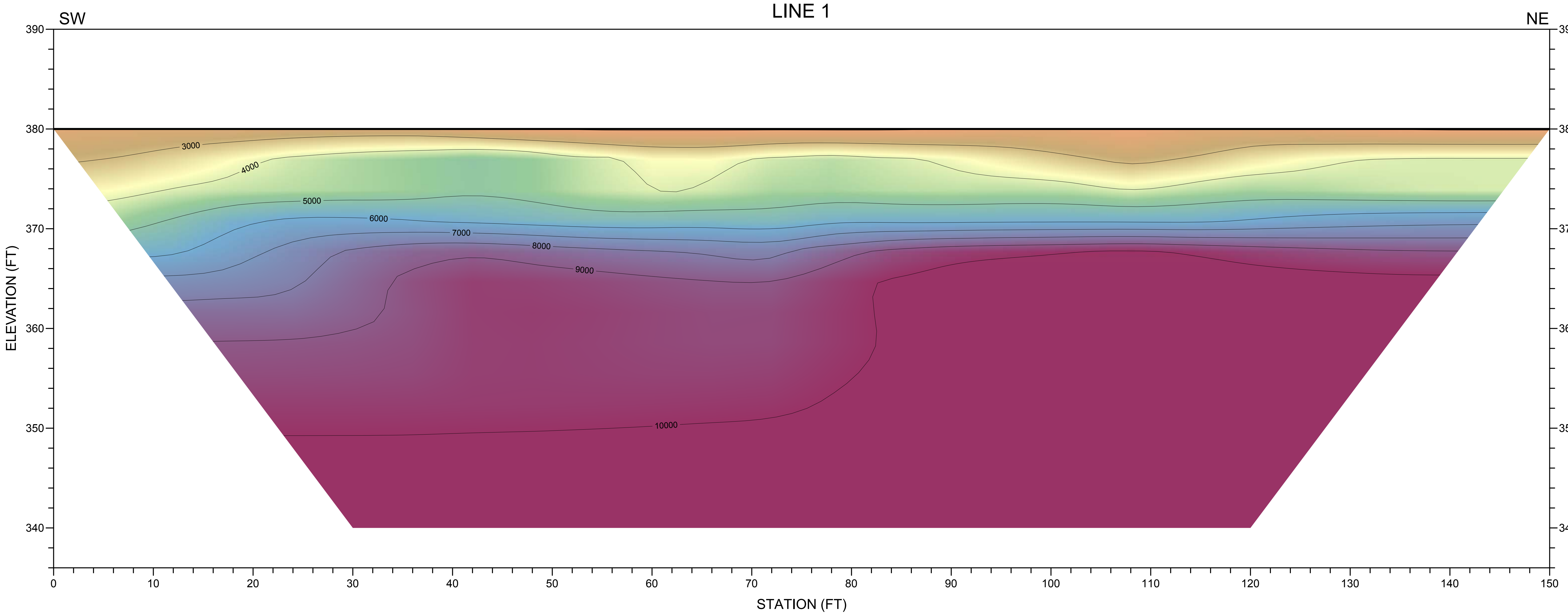
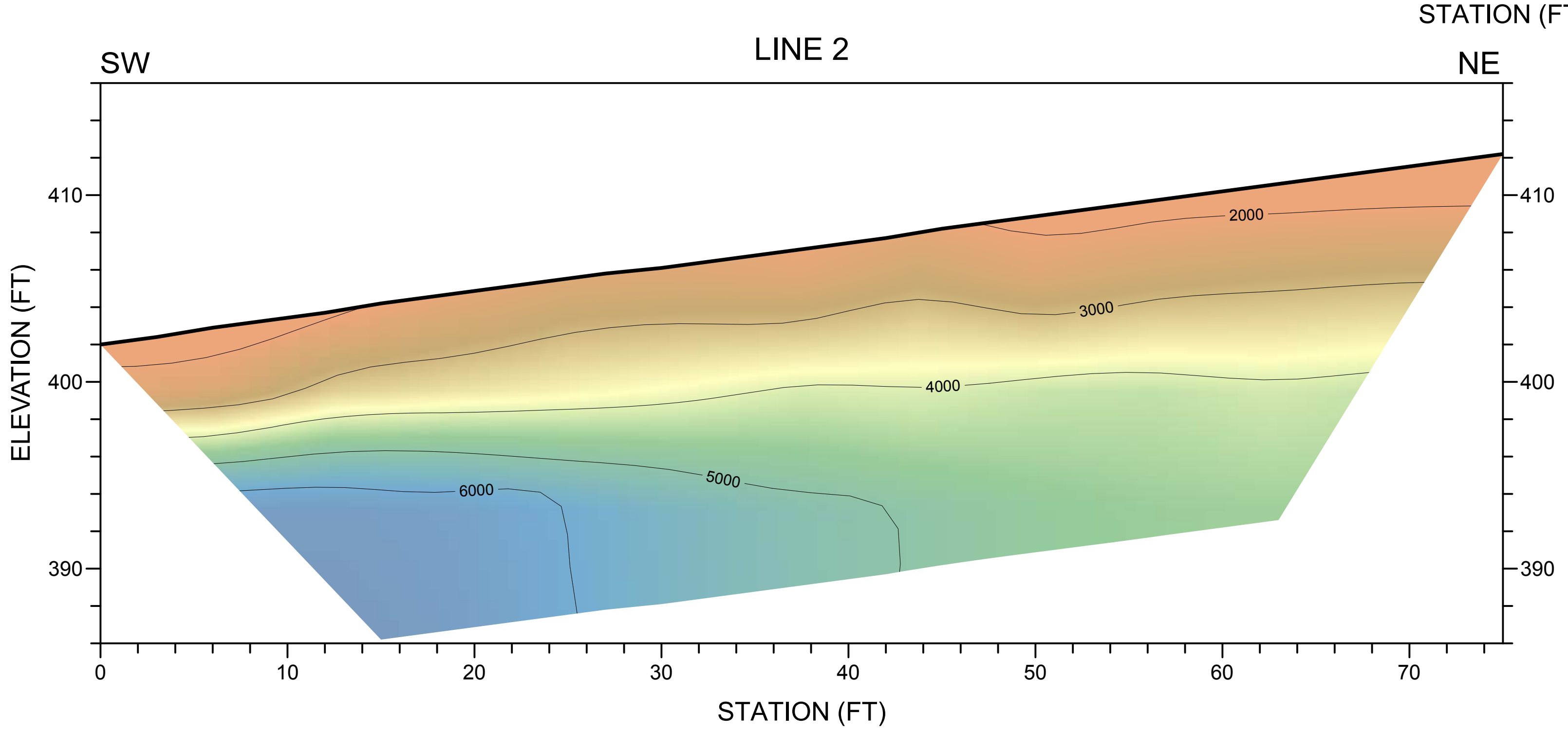
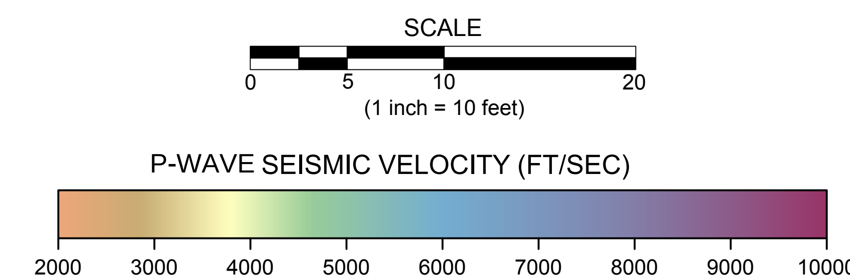
REGISTERED GEOPHYSICIST
WILLIAM J. HENRICH
No. 893
STATE OF CALIFORNIA

SITE LOCATION MAP
HEARST-LA LOMA PARKING FACILITIES
SURFACE & DOWNHOLE SEISMIC SURVEY

LOCATION: BERKELEY, CALIFORNIA		
CLIENT: LANGAN		
JOB #. NS175052	DATE: OCTOBER 2017	PLATE 1
DRAWN BY: G.RANDALL	APPROVED BY: WJH	
10/16/2017		







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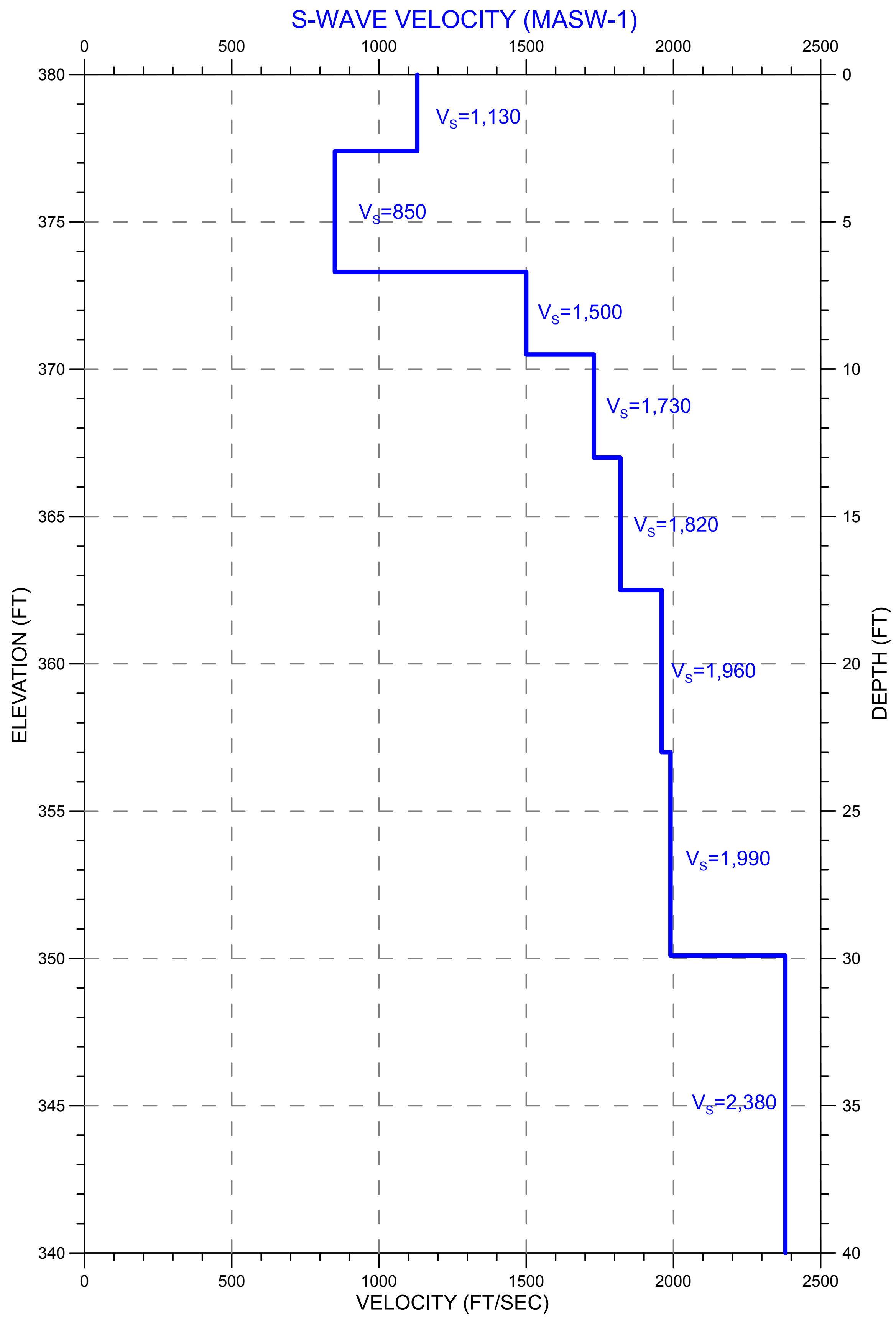
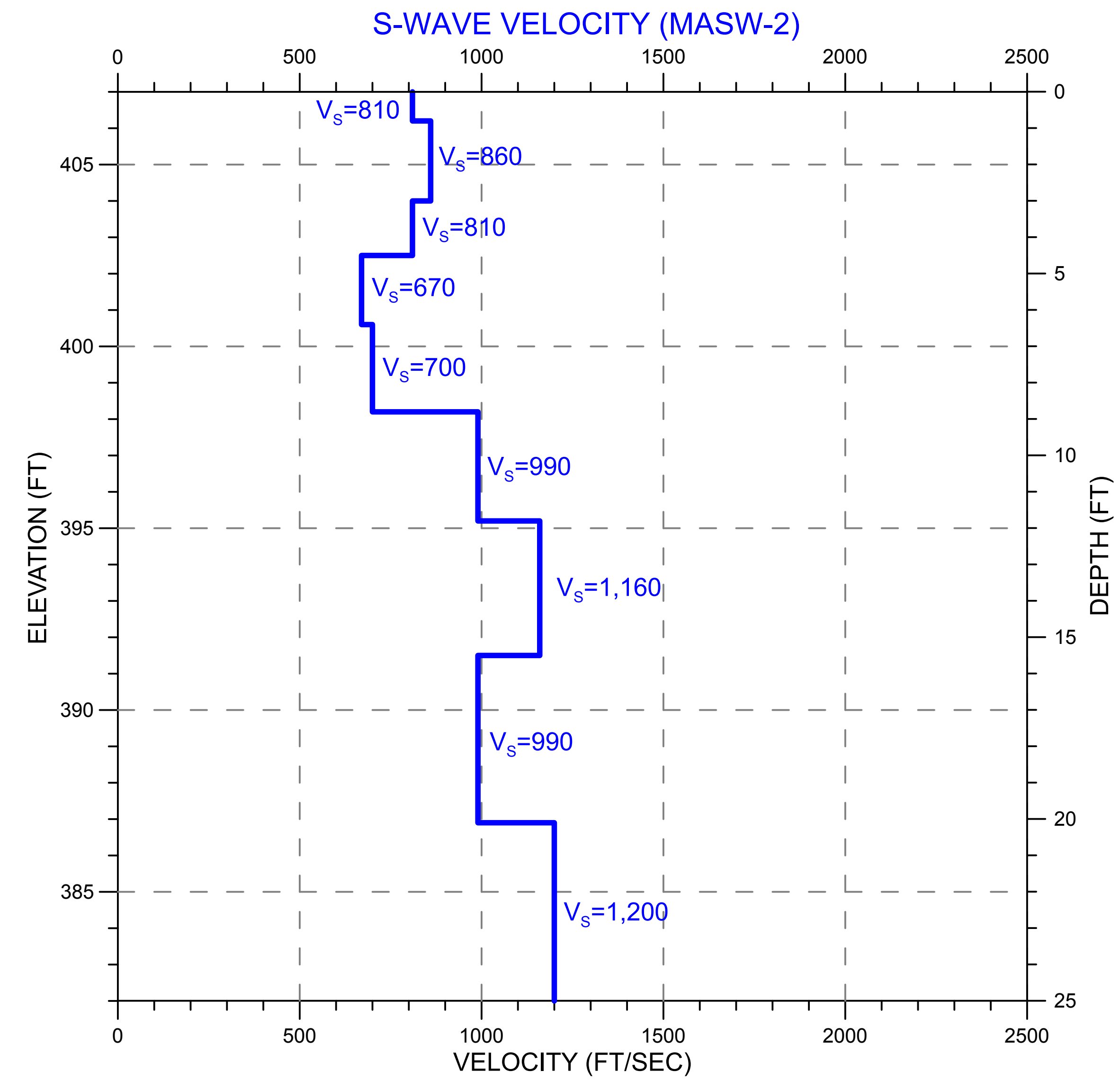
SEISMIC REFRACTION PROFILES LINES 1 & 2 HEARST-LA LOMA PARKING FACILITIES

LOCATION: BERKELEY, CALIFORNIA	
CLIENT: LANGAN	
JOB #: NS175052	DATE: OCTOBER 2017
DRAWN BY: G.RANDALL	APPROVED BY: WJH

10/16/2017

PLATE 2





LEGEND	
	S-WAVE VELOCITY (MASW)

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REGISTERED GEOPHYSICIST
WILLIAM J. HENRICH
No. 893
STATE OF CALIFORNIA

MASW 1D S-WAVE VELOCITY SOUNDINGS
MASW 1 & MASW 2
HEARST-LA LOMA PARKING FACILITIES

LOCATION: BERKELEY, CALIFORNIA
CLIENT: LANGAN

JOB #: NS175052	DATE: OCTOBER 2017	PLATE
DRAWN BY: G.RANDALL	APPROVED BY: WJH	3

William J. Henrich 10/16/2017

NORCAL GEOPHYSICAL CONSULTANTS INC.
A Terracon COMPANY

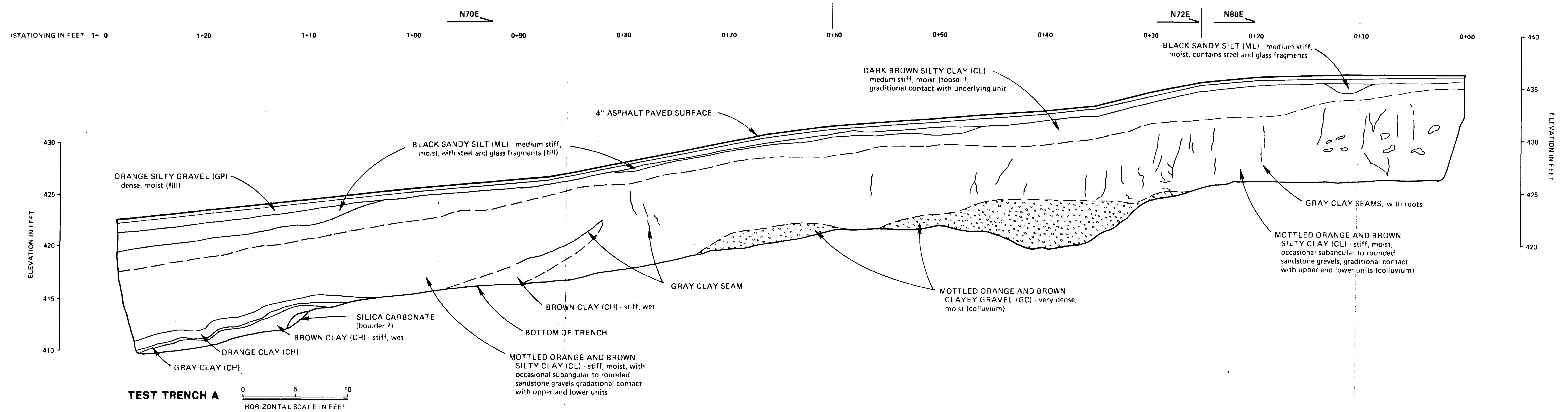
Table 1: Borehole B-3, P- and S-wave Velocity Table

METRIC UNITS DEPTHS & INTERVAL VELOCITIES					IMPERIAL UNITS DEPTHS AND INTERVAL VELOCITIES						
Depth	VsLeft	VsRight	VsAvg	Vp	Depth	VsLeft	VsRight	VsAvg	Vp	VsAvg-3pt	Vp -3pt
Meters	M/sec.	M/sec.	M/sec.	M/sec.	Feet	Ft./sec.	Ft./sec.	Ft./sec.	Ft./sec.	Ft./sec.	Ft./sec.
3.65	296	298	297	1799	11.96	971	976	974	5867		
4.27	305	309	307	1852	14.02	1000	1013	1006	6039	958	5790
4.35	268	277	272	1676	14.26	879	908	893	5465	1013	5793
4.89	342	352	347	1802	16.06	1124	1155	1139	5875	1036	5623
4.91	318	338	328	1695	16.12	1043	1108	1076	5527	1052	5777
5.49	284	289	287	1818	18.00	932	948	940	5929	985	5610
5.50	282	291	286	1648	18.03	925	954	939	5375	986	5797
6.09	327	331	329	1866	19.98	1072	1086	1079	6086	1033	5750
6.13	338	321	329	1775	20.10	1108	1052	1080	5789	1065	5990
6.72	313	318	315	1869	22.06	1025	1045	1035	6095	1058	5825
6.80	325	321	323	1714	22.31	1065	1052	1058	5590	1033	5927
7.01	303	311	307	1869	23.01	994	1019	1007	6095	1084	5848
7.11	355	368	362	1796	23.34	1166	1206	1186	5858	1103	5955
7.25	338	342	340	1813	23.79	1108	1124	1116	5911	1145	5911
7.27	357	333	345	1829	23.84	1172	1094	1133	5965	1127	5990
7.33	350	341	345	1869	24.04	1149	1117	1133	6095	1134	6027
7.55	350	342	346	1846	24.78	1150	1124	1137	6020	1142	6067
7.61	357	347	352	1866	24.96	1172	1139	1155	6086	1107	6018
7.88	321	306	313	1824	25.84	1052	1004	1028	5947	1082	6024
7.93	342	305	324	1852	26.03	1124	1000	1062	6039	1066	5933
7.96	341	334	338	1783	26.13	1120	1097	1109	5814	1141	5892
8.23	382	382	382	1786	27.00	1252	1252	1252	5823	1232	5855
8.54	403	410	407	1818	28.01	1323	1345	1334	5929	1312	5994
8.57	419	403	411	1911	28.12	1375	1323	1349	6231	1348	6104
8.85	413	417	415	1887	29.04	1356	1367	1361	6153	1382	6153
9.13	431	444	437	1863	29.94	1414	1456	1435	6076	1393	6127
9.16	424	418	421	1887	30.04	1390	1373	1381	6153	1413	6071
9.44	446	420	433	1835	30.98	1465	1379	1422	5983	1423	5983
9.76	446	446	446	1783	32.01	1465	1465	1465	5814	1404	5945
9.76	408	401	404	1852	32.02	1337	1316	1327	6039	1430	5945
10.10	463	450	457	1835	33.15	1519	1478	1498	5983	1458	5981
10.38	467	476	472	1815	34.04	1533	1562	1548	5920	1383	6019

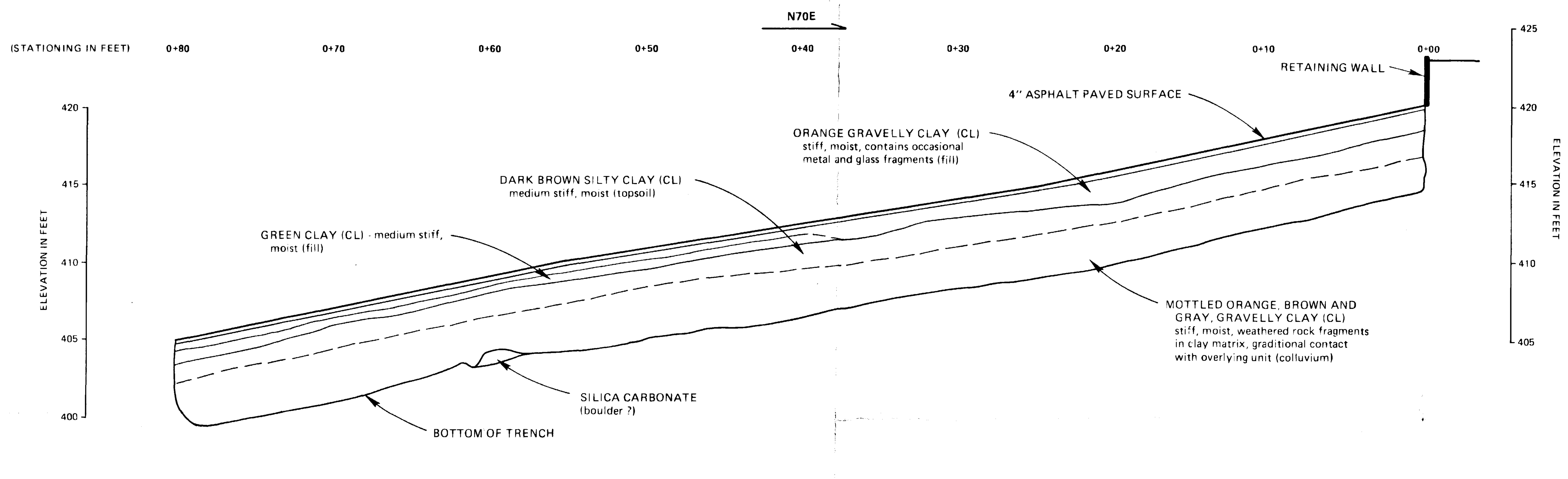
10.39	338	335	336	1887	34.08	1108	1099	1103	6153	1372	6072
10.67	452	441	447	1884	35.02	1485	1445	1465	6143	1310	6022
10.96	413	417	415	1770	35.96	1356	1367	1361	5772	1366	5960
11.00	379	397	388	1829	36.10	1243	1302	1272	5965	1373	5803
11.30	459	446	453	1739	37.07	1505	1465	1485	5671	1284	5930
11.58	326	341	333	1887	38.00	1070	1118	1094	6153	1373	5973
11.64	472	467	469	1869	38.18	1548	1533	1540	6095	1334	6041
11.91	424	410	417	1802	39.09	1390	1345	1367	5875	1324	5979
12.20	328	321	324	1829	40.03	1075	1052	1063	5965	1278	5902
12.22	427	427	427	1799	40.09	1402	1402	1402	5867	1328	5957
12.50	459	467	463	1852	41.02	1505	1533	1519	6039	1559	5930
12.51	521	549	535	1805	41.06	1709	1803	1756	5884	1616	5972
12.79	482	477	479	1838	41.95	1580	1565	1572	5992	1588	5972
12.82	437	439	438	1852	42.07	1433	1439	1436	6039	1514	6084
13.12	476	459	467	1908	43.03	1562	1505	1534	6221	1493	6118
13.12	461	459	460	1869	43.05	1512	1505	1508	6095	1500	6279
13.41	446	442	444	2000	44.01	1465	1452	1458	6522	1505	6424
13.41	467	476	472	2041	44.01	1533	1562	1548	6655	1478	6545
13.70	431	439	435	1980	44.96	1414	1439	1427	6457	1476	6523
13.73	446	441	443	1980	45.06	1465	1445	1455	6457	1497	6523
14.03	495	485	490	2041	46.04	1624	1593	1608	6655	1512	6523
14.05	443	455	449	1980	46.09	1454	1494	1474	6457	1541	6612
14.34	476	463	470	2062	47.05	1562	1519	1541	6724	1580	6612
14.34	532	521	526	2041	47.05	1745	1709	1727	6655	1662	6724
14.63	538	510	524	2083	48.01	1764	1674	1719	6794	1704	6724
14.64	505	510	508	2062	48.03	1657	1674	1665	6724	1729	6818
14.96	546	552	549	2128	49.07	1793	1813	1803	6938	1811	6917
14.97	602	595	599	2174	49.10	1976	1953	1965	7089	1892	6984
15.24	588	575	581	2124	50.01	1930	1886	1908	6926	1862	6984
15.25	515	529	522	2128	50.04	1691	1736	1714	6938	1737	6959
15.45	483	485	484	2151	50.70	1585	1593	1589	7013	1744	6959
15.47	581	595	588	2124	50.75	1907	1953	1930	6926		

APPENDIX C

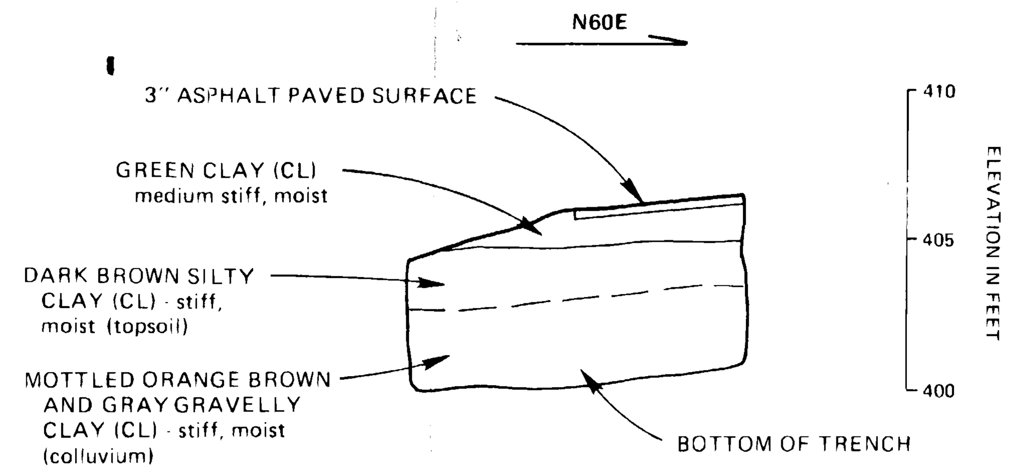
HLA Fault Trench Logs and Descriptions



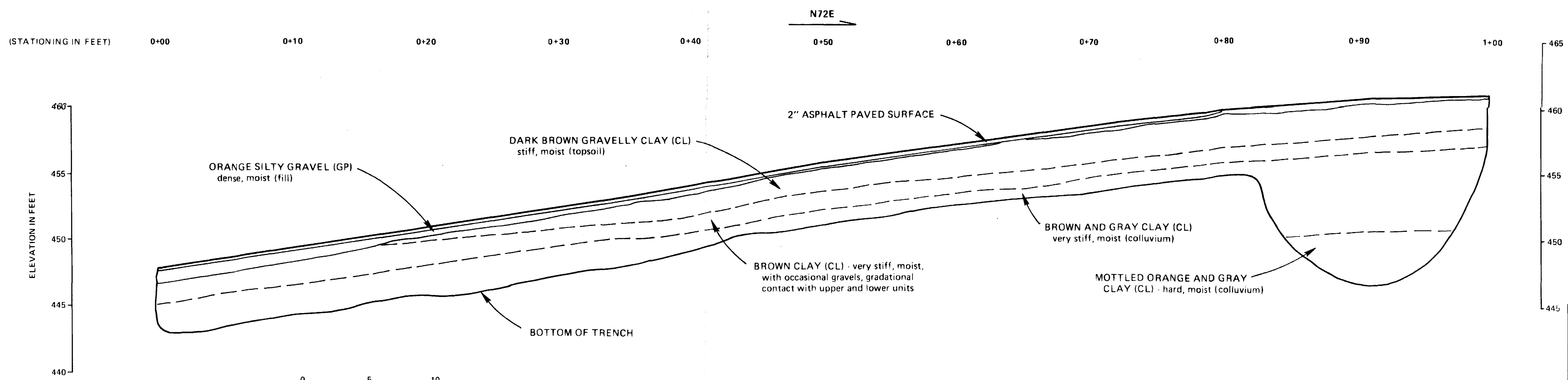
TEST TRENCH A



TEST TRENCH B



TEST TRENCH C



TEST TRENCH D

HLA Harding Lawson Associates
Engineers, Geologists & Geophysicists

Log of Test Trenches A, B, C, D
La Loma-Ridge
Student Housing Project
University of California
Berkeley, California

PLATE **22**

DRAWN	JOB NUMBER	APPROVED	DATE
PM	2313,057.01	SK	10/86
REVISED	DATE	REVISED	DATE

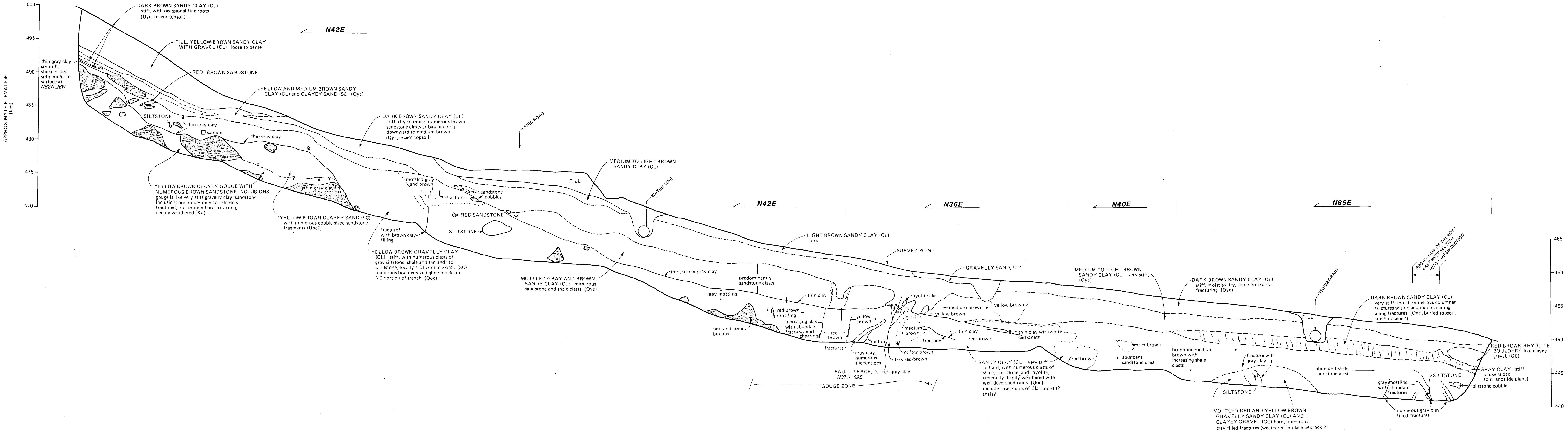
HLA Harding Lawson Associates
Engineers, Geologists & Geophysicists

Log of Trenches E, F, G, H
Hillside Site
Student Housing Project
University of California
Berkeley, California

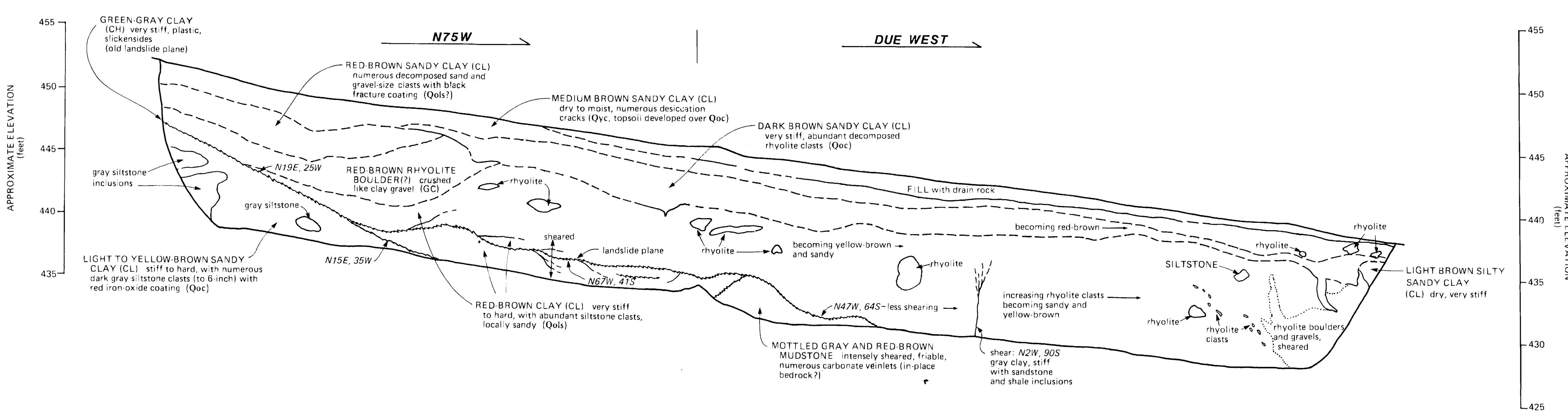
PLATE 21

DRAWN	JOB NUMBER	APPROVED	DATE
PM	2313,057.01		10/86
REVISED	DATE	REVISED	DATE

TRENCH I
NE-SW SECTION
1" = 5'



TRENCH I
EAST-WEST SECTION
1" = 5'



EXPLANATION

SOIL UNITS

Fill — Typically sandy and clayey soils of variable consistency

Qyc — Younger Colluvium – Typically medium stiff to stiff sandy and gravelly clays with sandstone and mudstone clasts, including topsoil and slope deposits.

Qols — Older Landslide Deposits – Composed of older colluvial materials underlain by slide planes.

Qoc — Older Colluvium – Generally stiff to hard sandy and gravelly clays with sandstone, mudstone, shale, rhyolite, andesite, basalt, greenstone, and chert clasts exhibiting a high degree of weathering.

BEDROCK UNITS

Ku — Undifferentiated sedimentary rocks including sandstone, mudstone, and shale

SYMBOLS

— — ?— Contact, dashed where approximate, queried where uncertain

- -?- Fault plane, dashed where approximate, queried where uncertain

.... Approximate limit of soil property within a specific unit, such as color, moisture, texture

Thin shear, typically filled with gray clay

□ Carbon sample location

Harding Lawson Associates
Engineers and Geoscientists

Log of Trench I
Foothill Housing Project
U.C. Berkeley
Berkeley, California

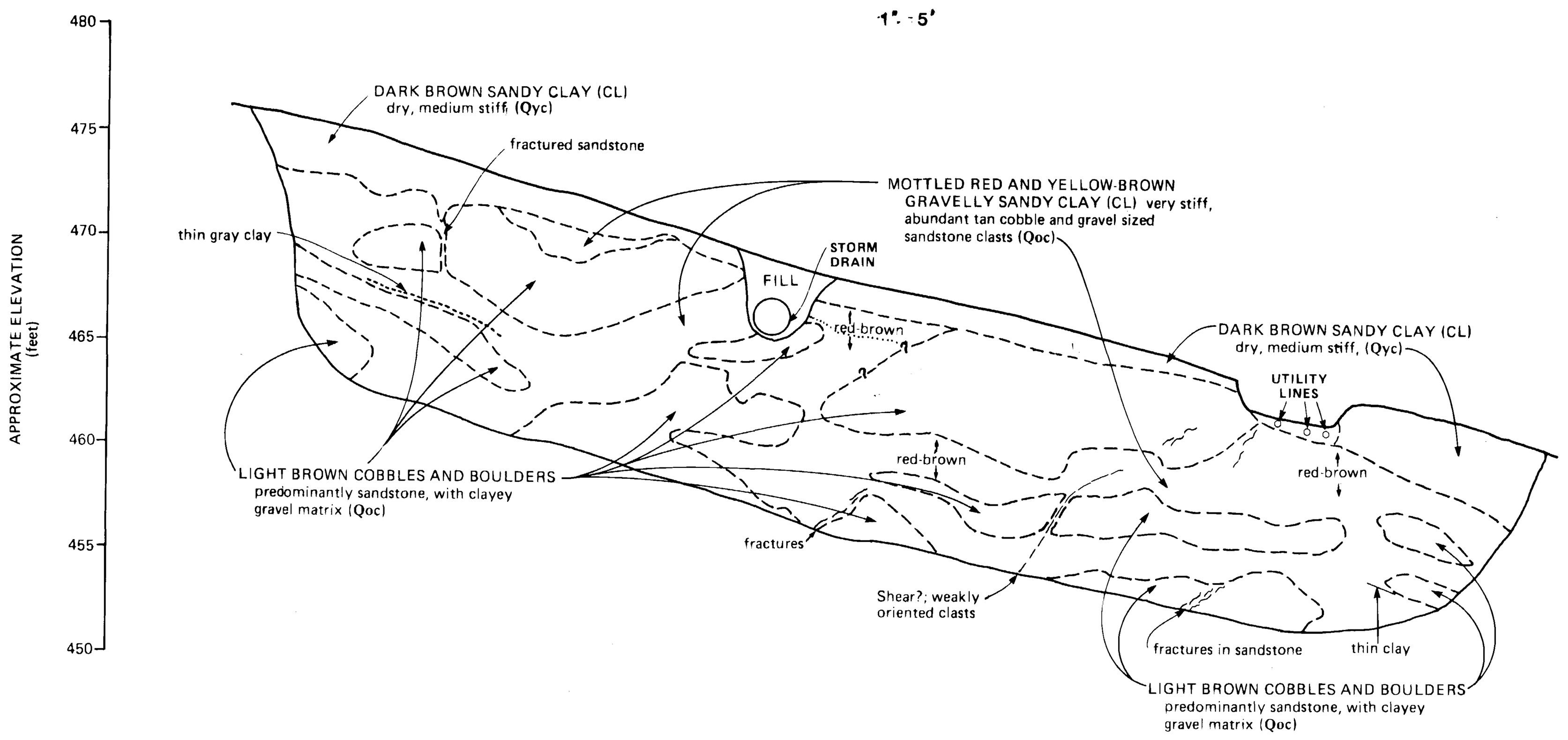
PLATE **6**

DRAWN	JOB NUMBER	APPROVED	DATE
RHC	18,360,001.01		12/86
REVISED	DATE	REVISED	DATE

TRENCH J

N52E

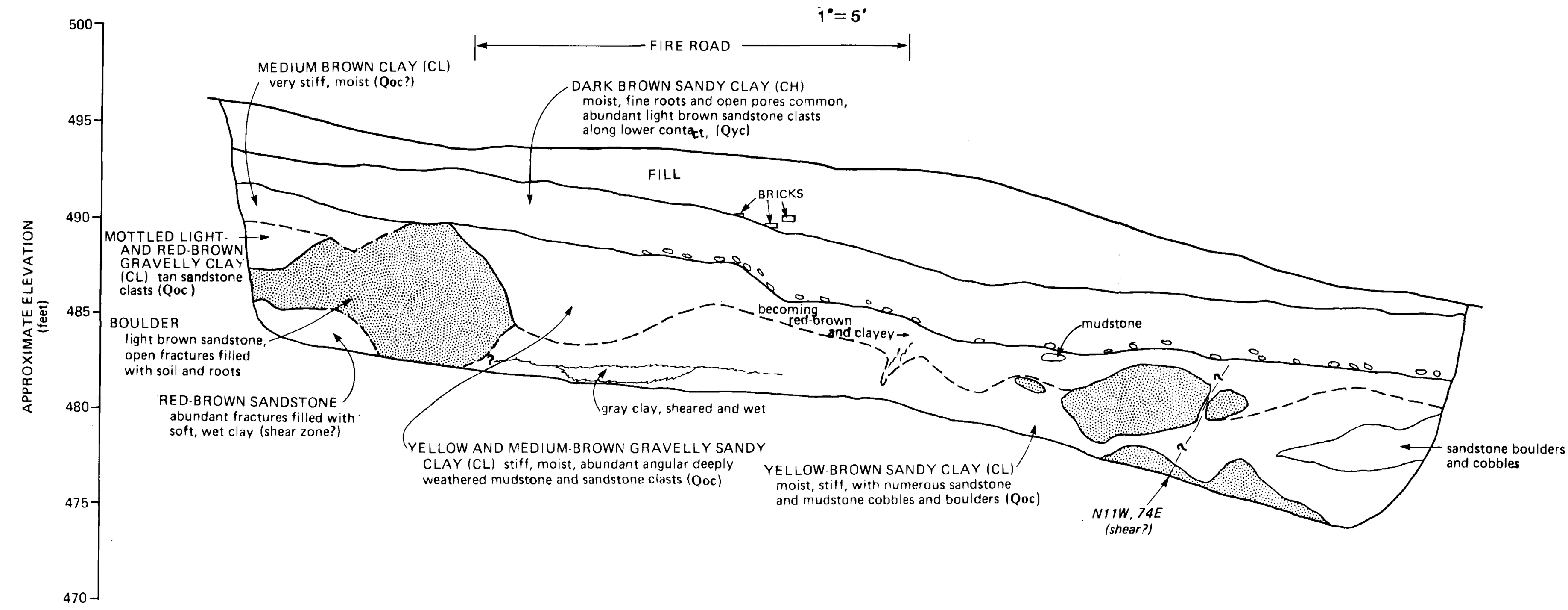
1" = 5'



TRENCH K

N75E

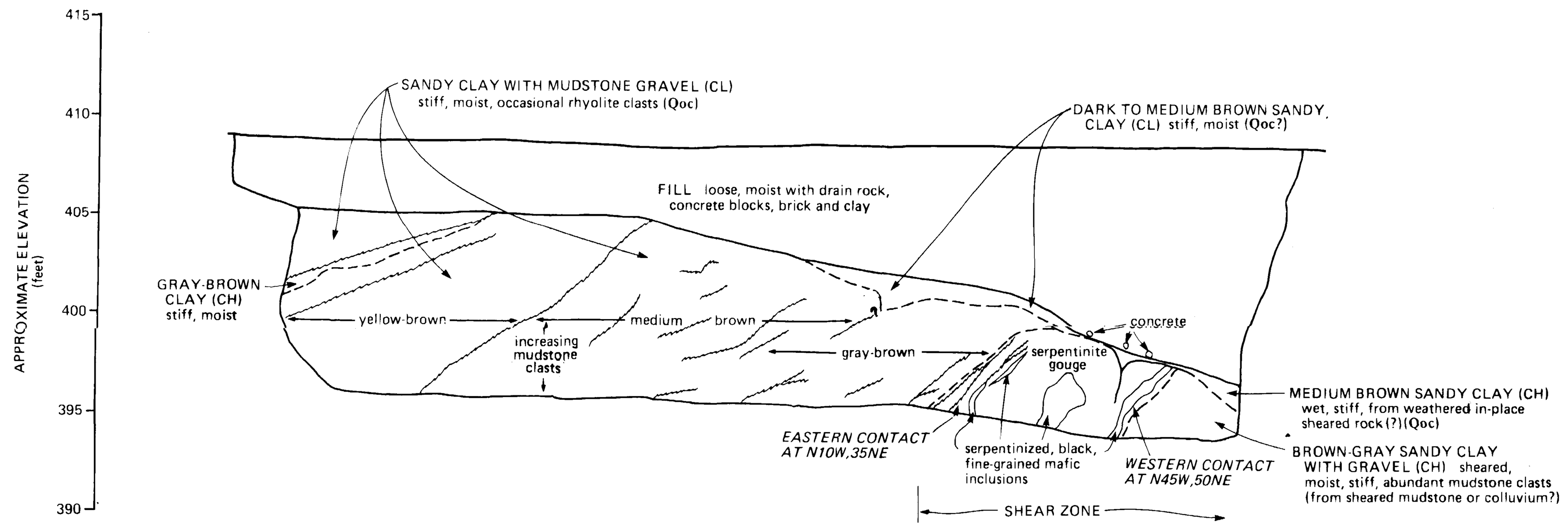
1" = 5'



TRENCH L

N50E

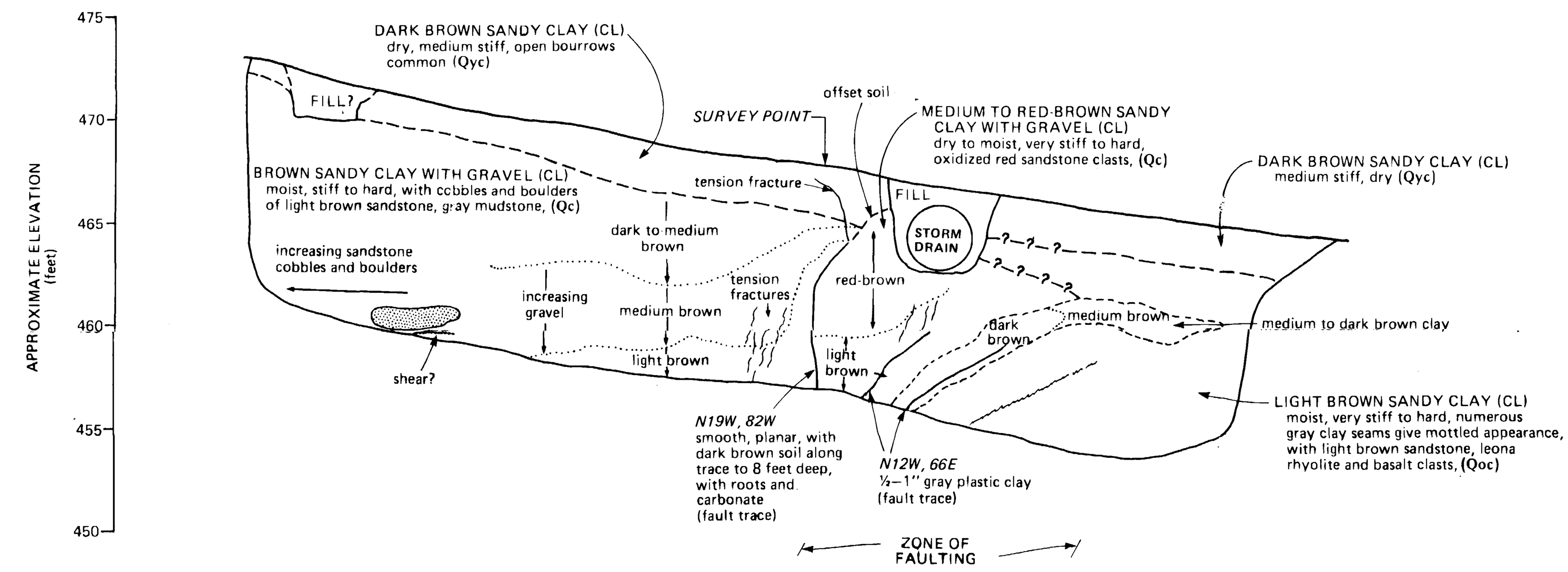
1" = 5'



TRENCH M

N67E

1" = 5'



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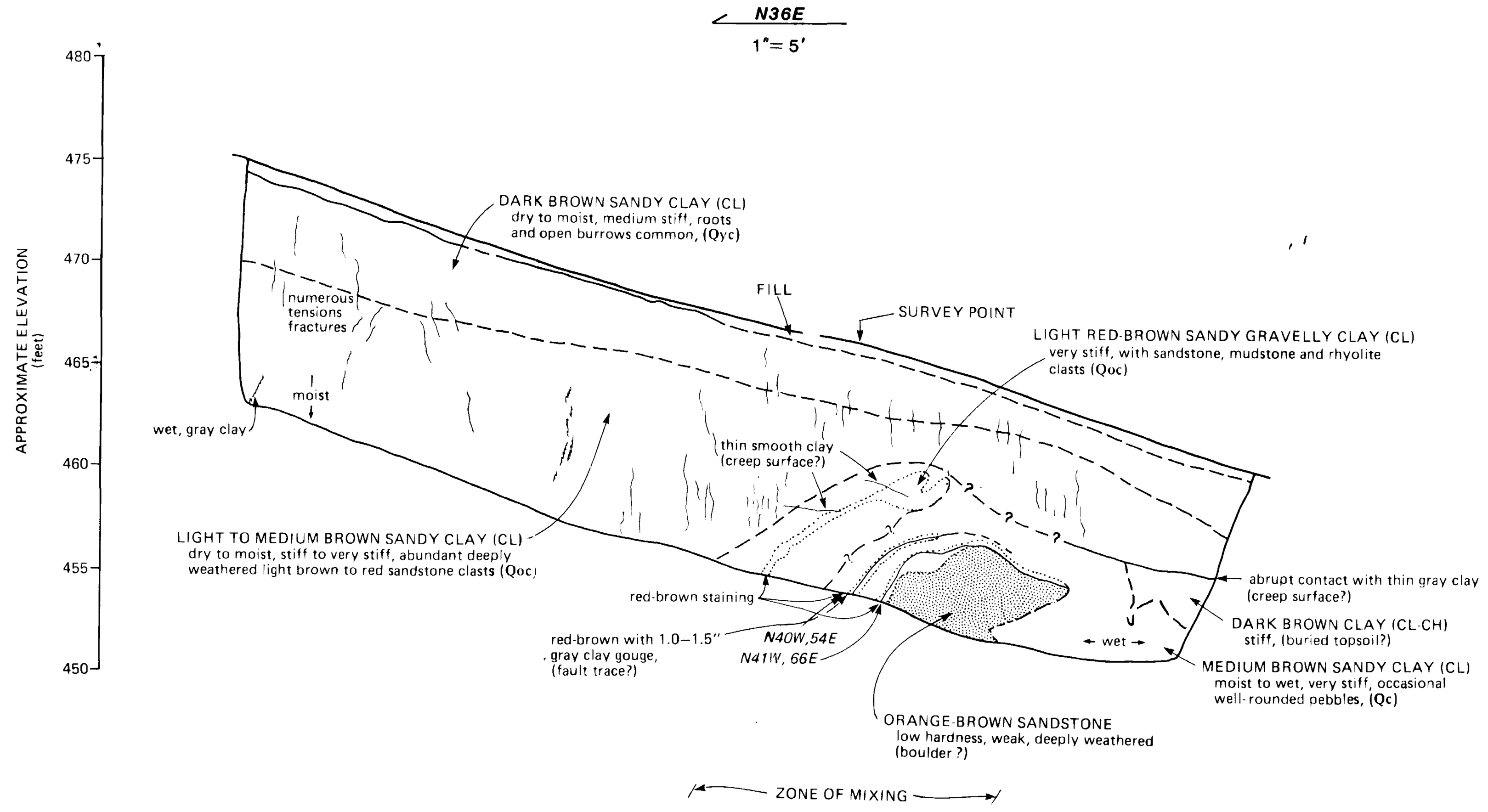

TRENCH O

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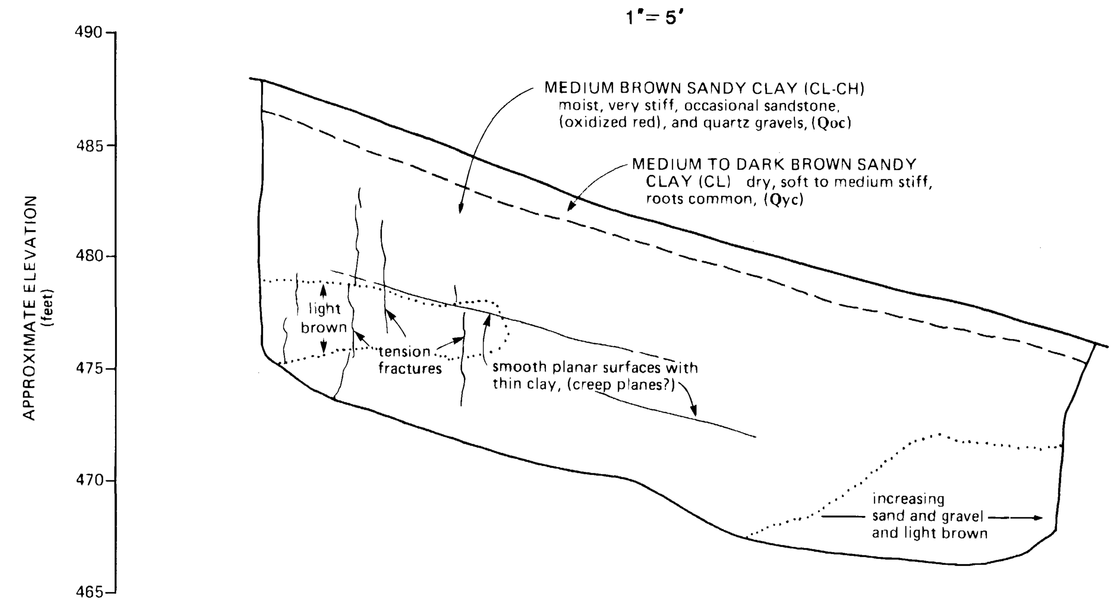

TRENCH P

N53E

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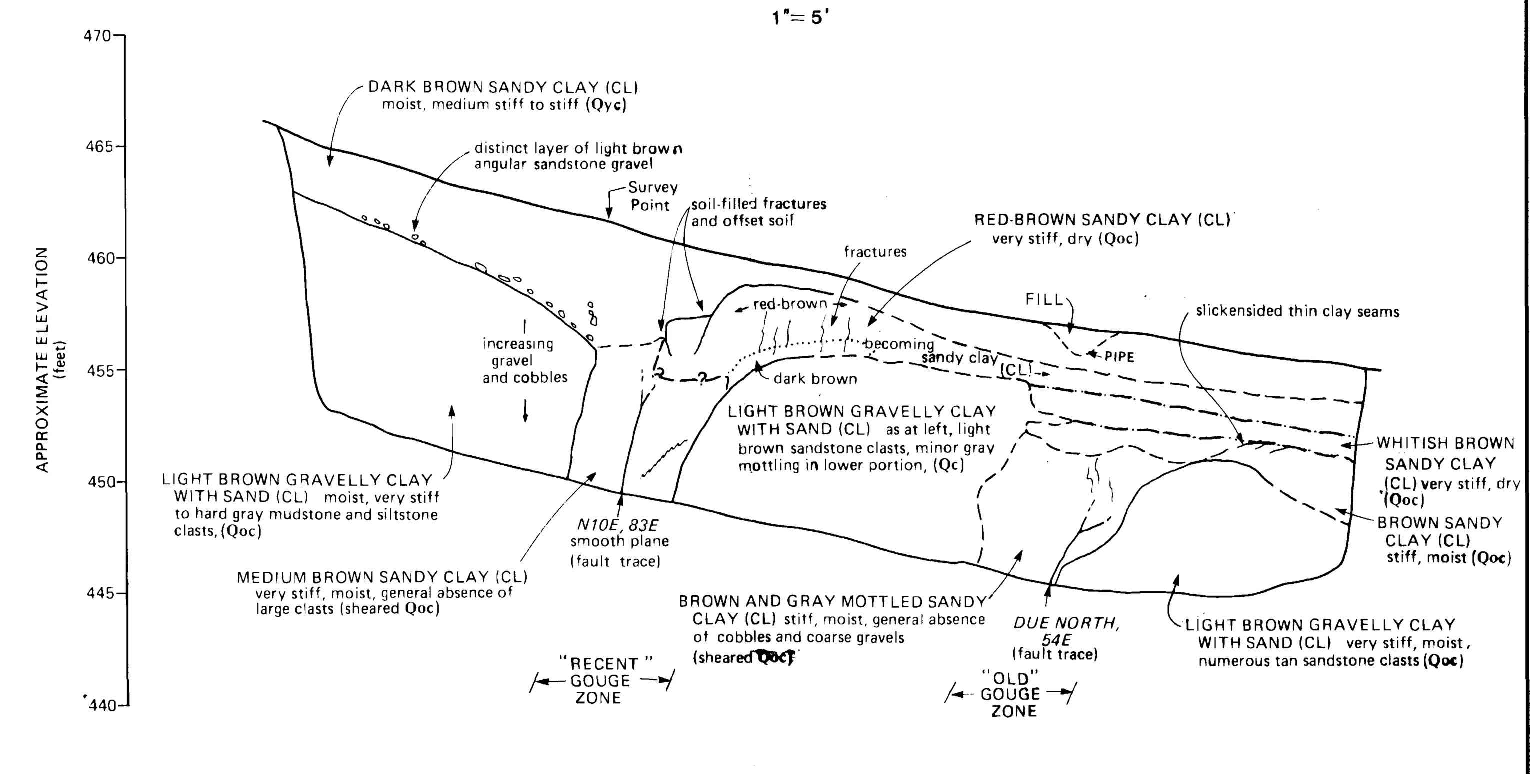


SOIL UNITS

Fill	Typically sandy and clayey soils of variable consistency
Qyc	Younger Colluvium — Typically medium stiff to stiff sandy and gravelly clays with sandstone and mudstone clasts, including topsoil and slope deposits.
Qols	Older Landslide Deposits — Composed of older colluvial materials underlain by slide planes.
Qoc	Older Colluvium — Generally stiff to hard sandy and gravelly clays with sandstone, mudstone, shale, rhyolite, andesite, basalt, greenstone, and chert clasts exhibiting a high degree of weathering.

BEDROCK UNITS

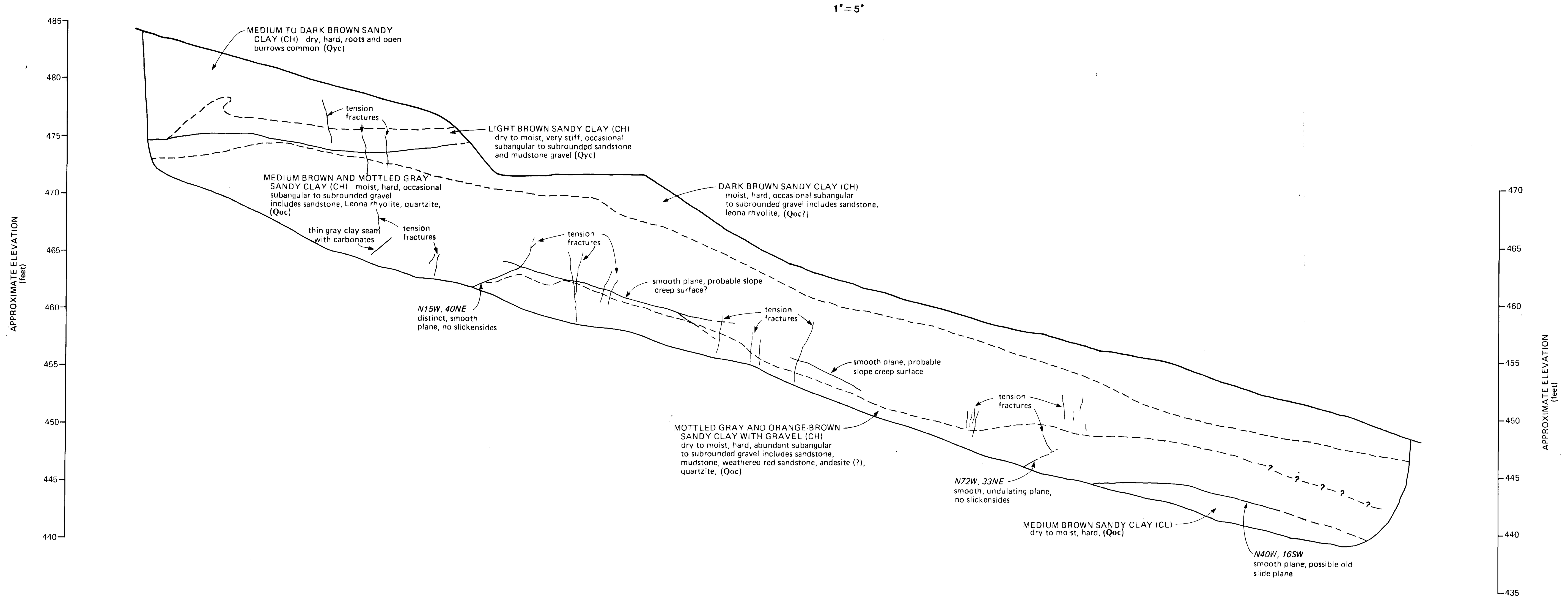
Ku	Undifferentiated sedimentary rocks including sandstone, mudstone, and shale

SYMBOLS

- Contact, dashed where approximate, queried where uncertain
- Fault plane, dashed where approximate, queried where uncertain
- Approximate limit of soil property within a specific unit, such as color, moisture, texture
- Thin shear, typically filled with gray clay
- Carbon sample location

HLA Harding Lawson Associates Engineers, Geologists & Geophysicists	**Log of Trenches J through P** Foothill Housing Project U.C. Berkeley Berkeley, California
PLATE	7
DRAWN NB	JOB NUMBER 18,360,001.01
APPROVED	DATE 12/86
REVISED	DATE

TRENCH Q



EXPLANATION

SOIL UNITS

Fill	Typically ~~sandy and clayey soils~~ of variable consistency
Qyc	Younger Colluvium – Typically medium stiff to stiff sandy and gravelly clays with sandstone and mudstone clasts, including topsoil and slope deposits.
Qols	Older Landslide Deposits – Composed of older colluvial materials underlain by slide planes.
Qoc	Older Colluvium – Generally stiff to hard sandy and gravelly clays with sandstone, mudstone, shale, rhyolite, andesite, basalt, greenstone, and chert clasts exhibiting a high degree of weathering.

BEDROCK UNITS

Ku	Undifferentiated sedimentary rocks including sandstone, mudstone, and shale

SYMBOLS

Contact, dashed where approximate, queried where uncertain

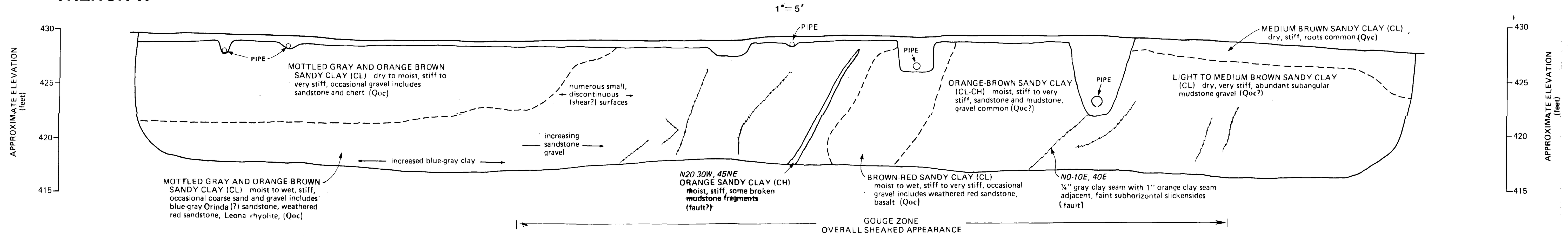
Fault plane, dashed where approximate, queried where uncertain

Approximate limit of soil property within a specific unit, such as color, moisture, texture

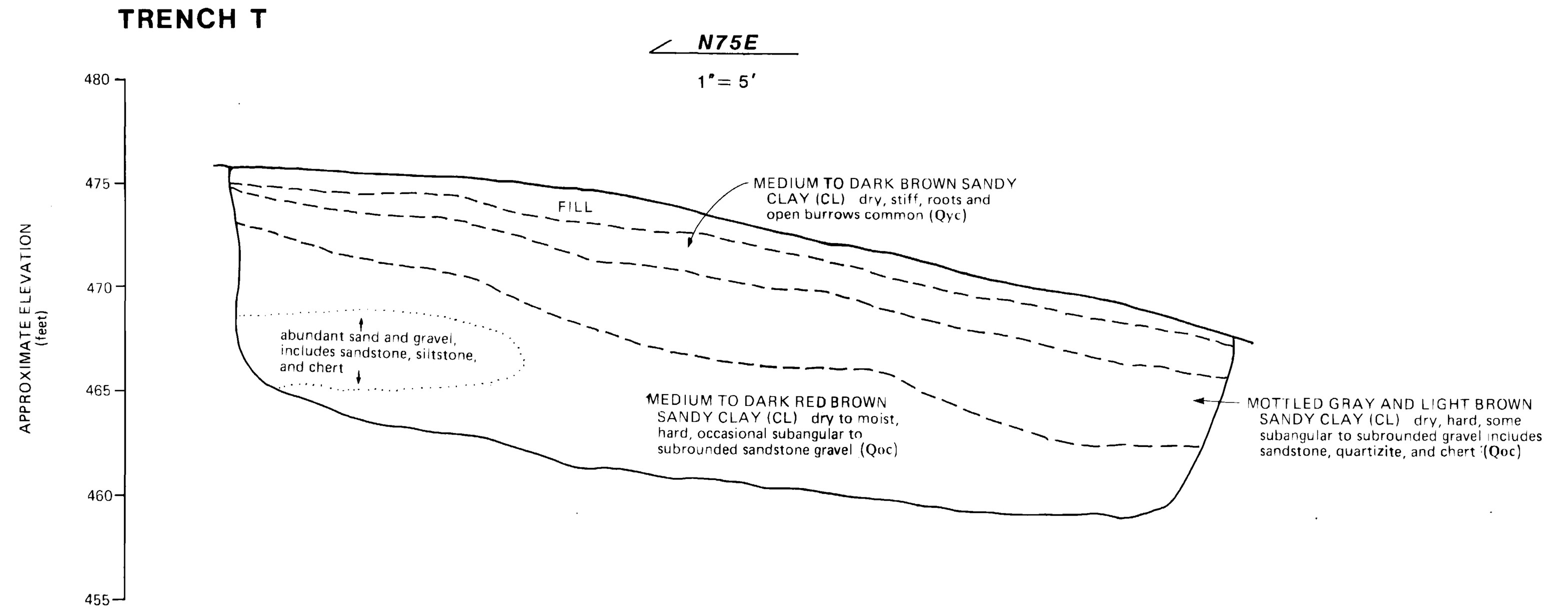
Thin shear, typically filled with gray clay

Carbon sample location

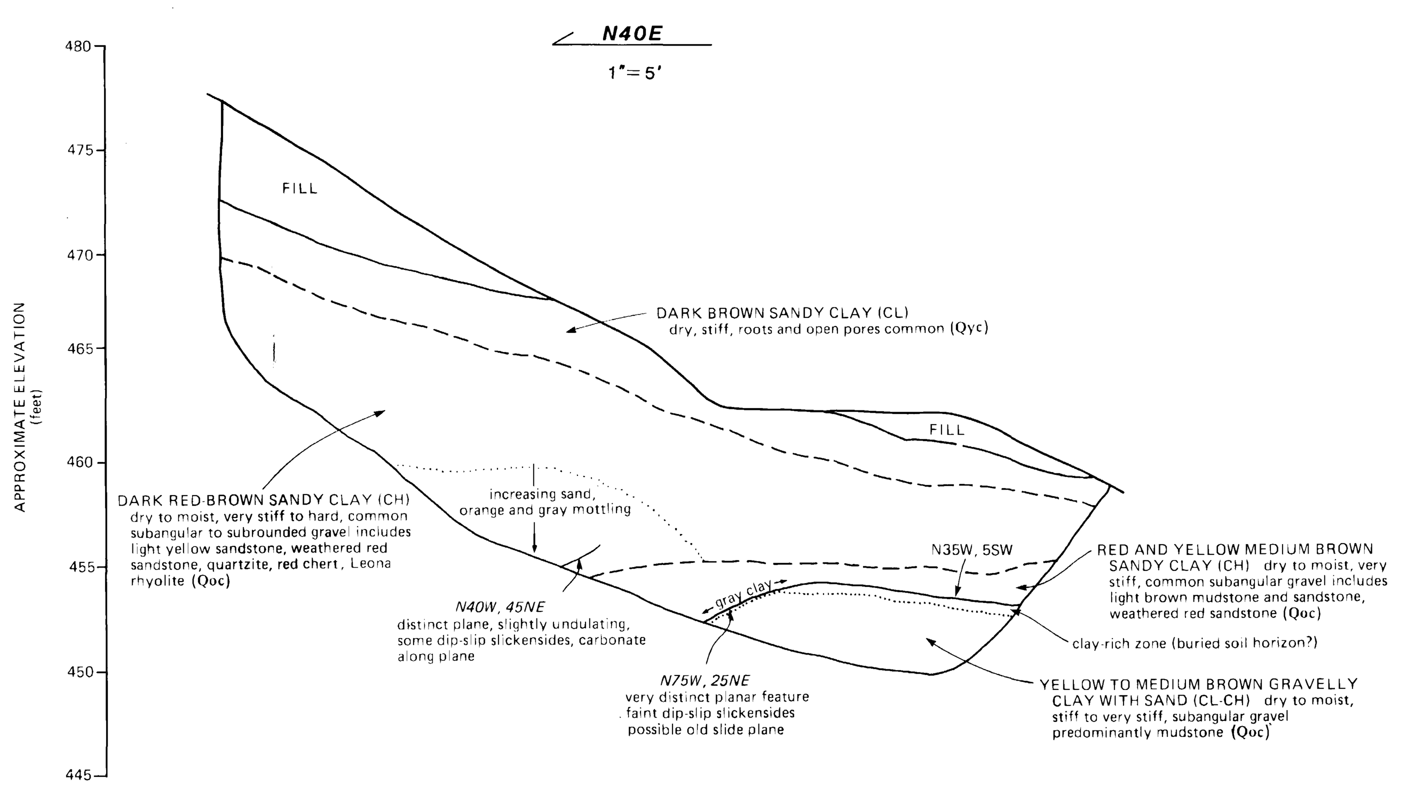
TRENCH R



TRENCH T



TRENCH V



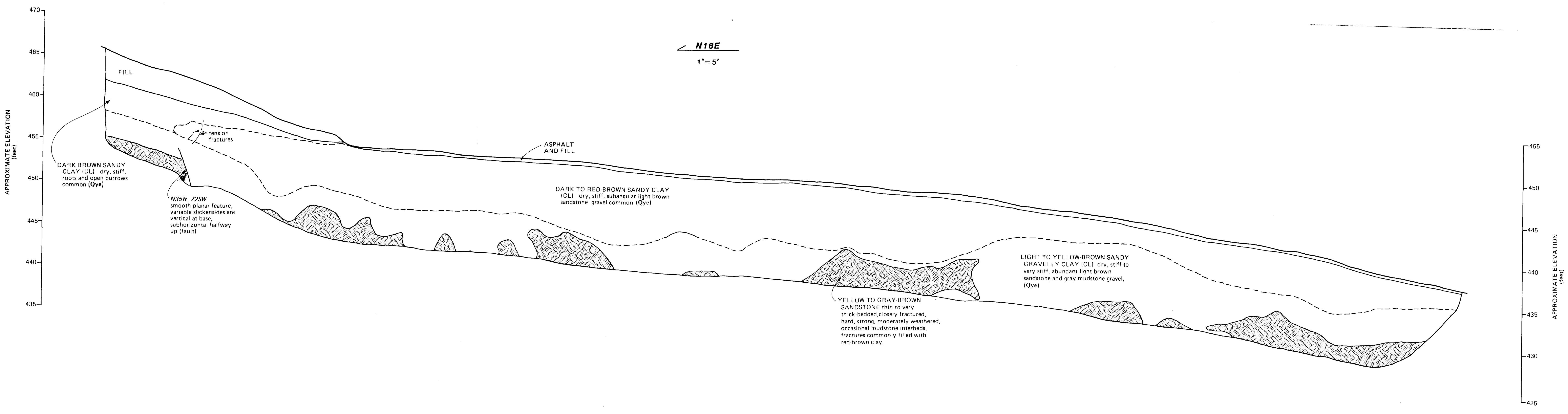
HLA **Harding Lawson Associates**
Engineers and Geoscientists

Log of Trenches Q, R, T & V
Foothill Housing Project
U.C. Berkeley
Berkeley, California

PLATE **8**

DRAWN	JOB NUMBER	APPROVED	DATE
RHC	18,360,001.01		12/86
REVISED	DATE	REVISED	DATE

TRENCH S



EXPLANATION

SOIL UNITS

Fill — Typically sandy and clayey soils of variable consistency

Qyc — Younger Colluvium – Typically medium stiff to stiff sandy and gravelly clays with sandstone and mudstone clasts, including topsoil and slope deposits.

Qols — Older Landslide Deposits – Composed of older colluvial materials underlain by slide planes.

Qoc — Older Colluvium – Generally stiff to hard sandy and gravelly clays with sandstone, mudstone, shale, rhyolite, andesite, basalt, greenstone, and chert clasts exhibiting a high degree of weathering.

BEDROCK UNITS

Ku — Undifferentiated sedimentary rocks including sandstone, mudstone, and shale

SYMBOLS

Contact, dashed where approximate, queried where uncertain

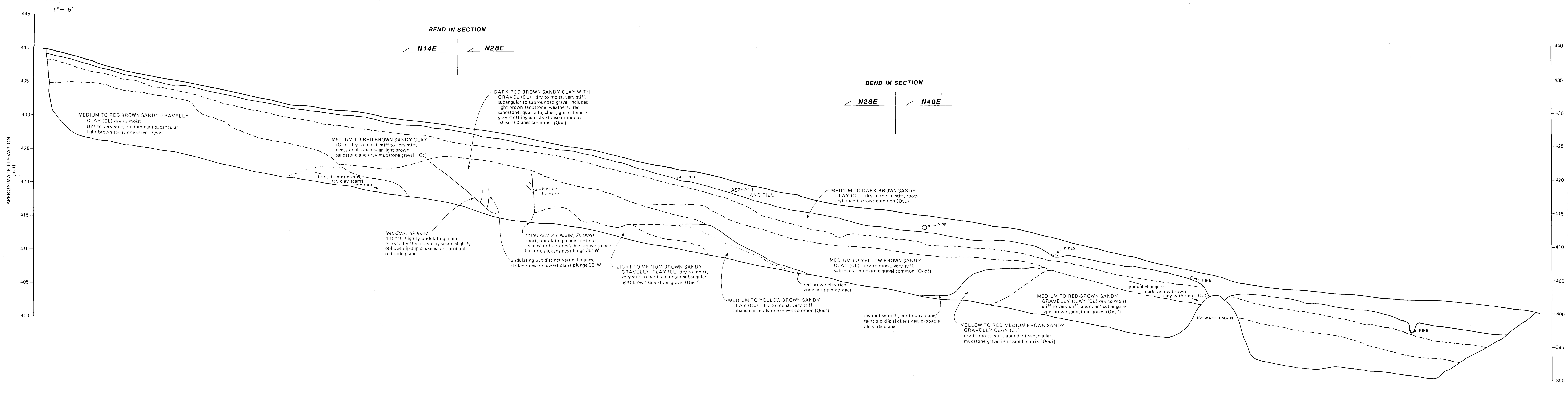
Fault plane, dashed where approximate, queried where uncertain

Approximate limit of soil property within a specific unit, such as color, moisture, texture

Thin shear, typically filled with gray clay

Carbon sample location

TRENCH U

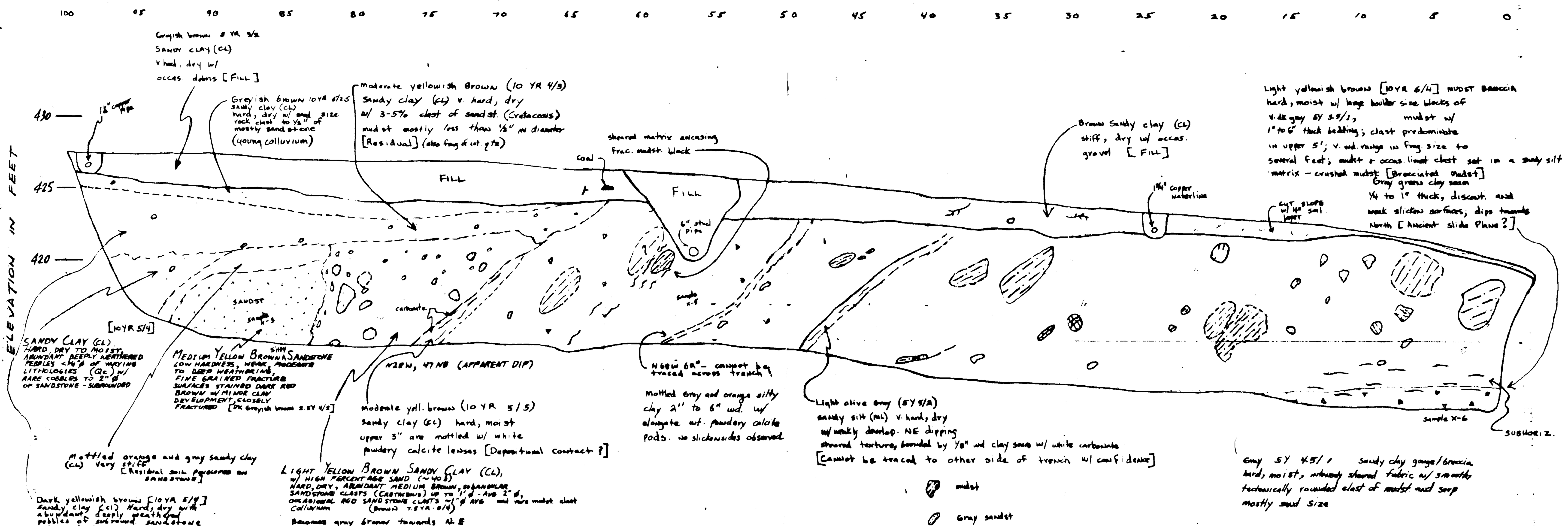


Harding Lawson Associates
Engineers and Geoscientists

Log of Trenches S & U
Foothill Housing Project
U.C. Berkeley
Berkeley, California

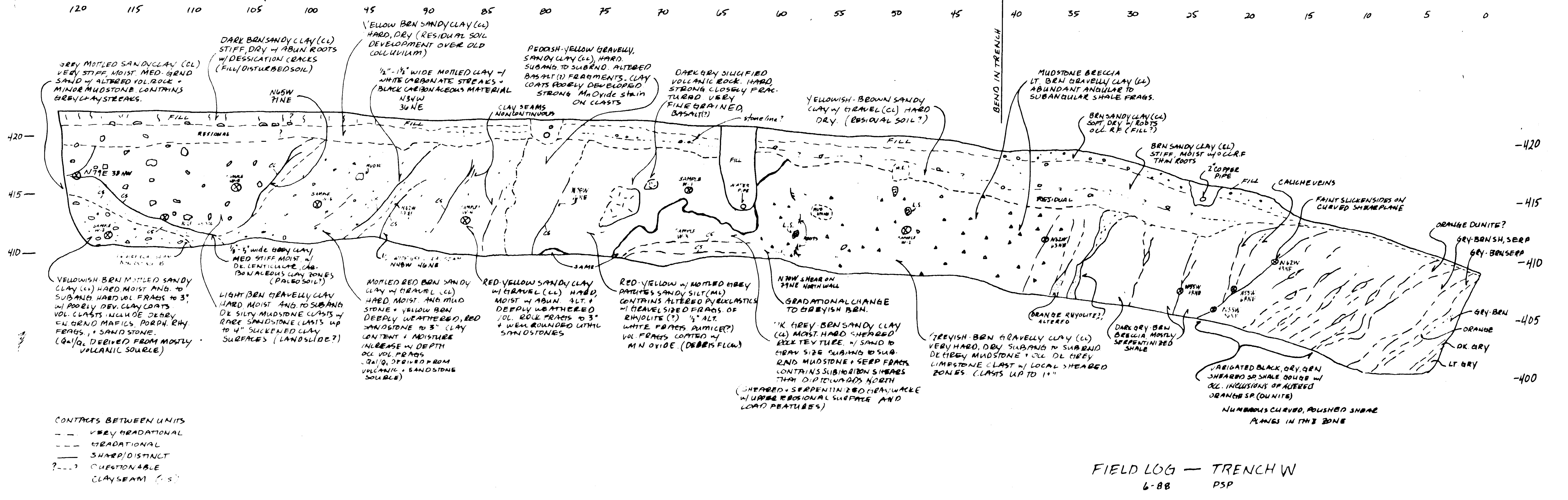
PLATE **9**

DRAWN	JOB NUMBER	APPROVED	DATE
NB	18,360,001.01		12/86
REVISED	DATE	REVISED	DATE

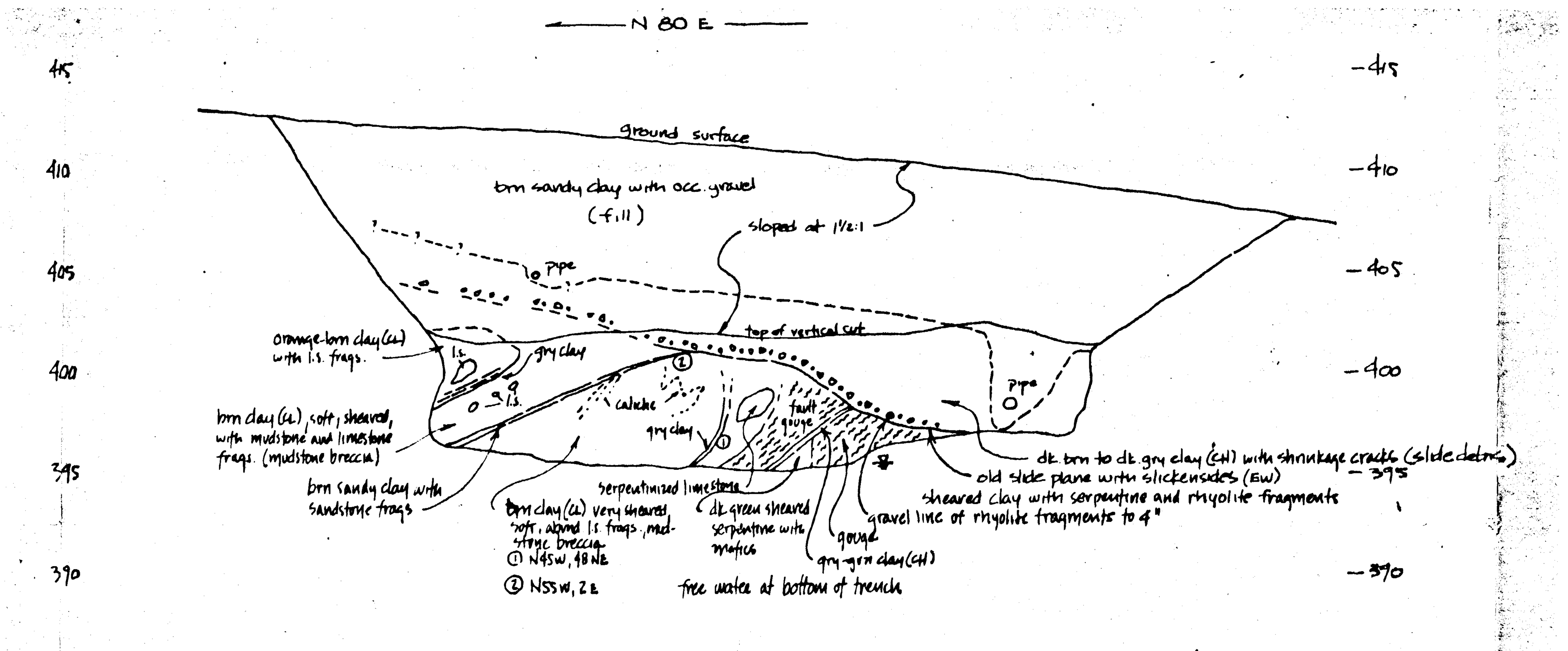


TRENCH X
FIELD LOG

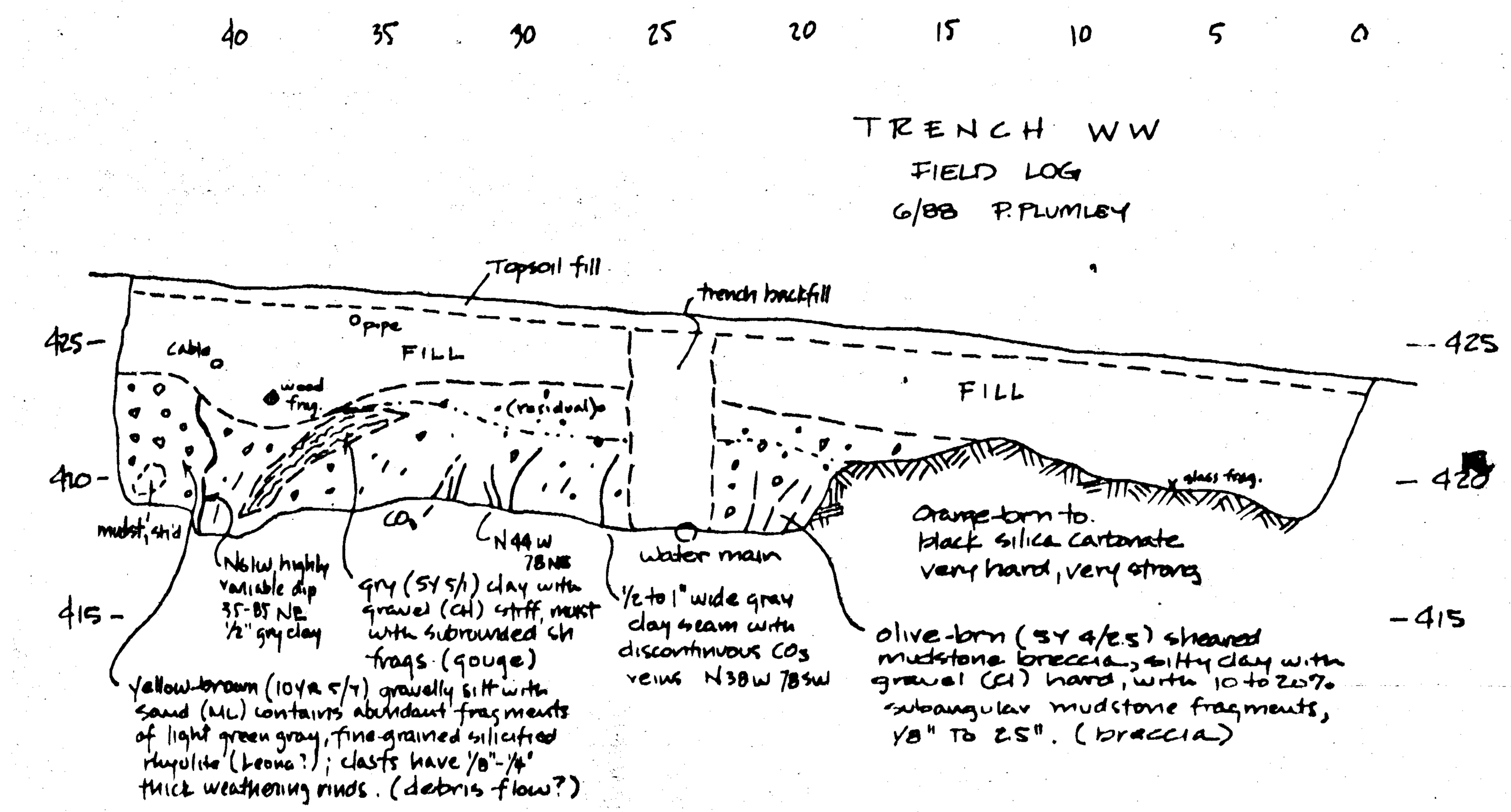
TRENCH W



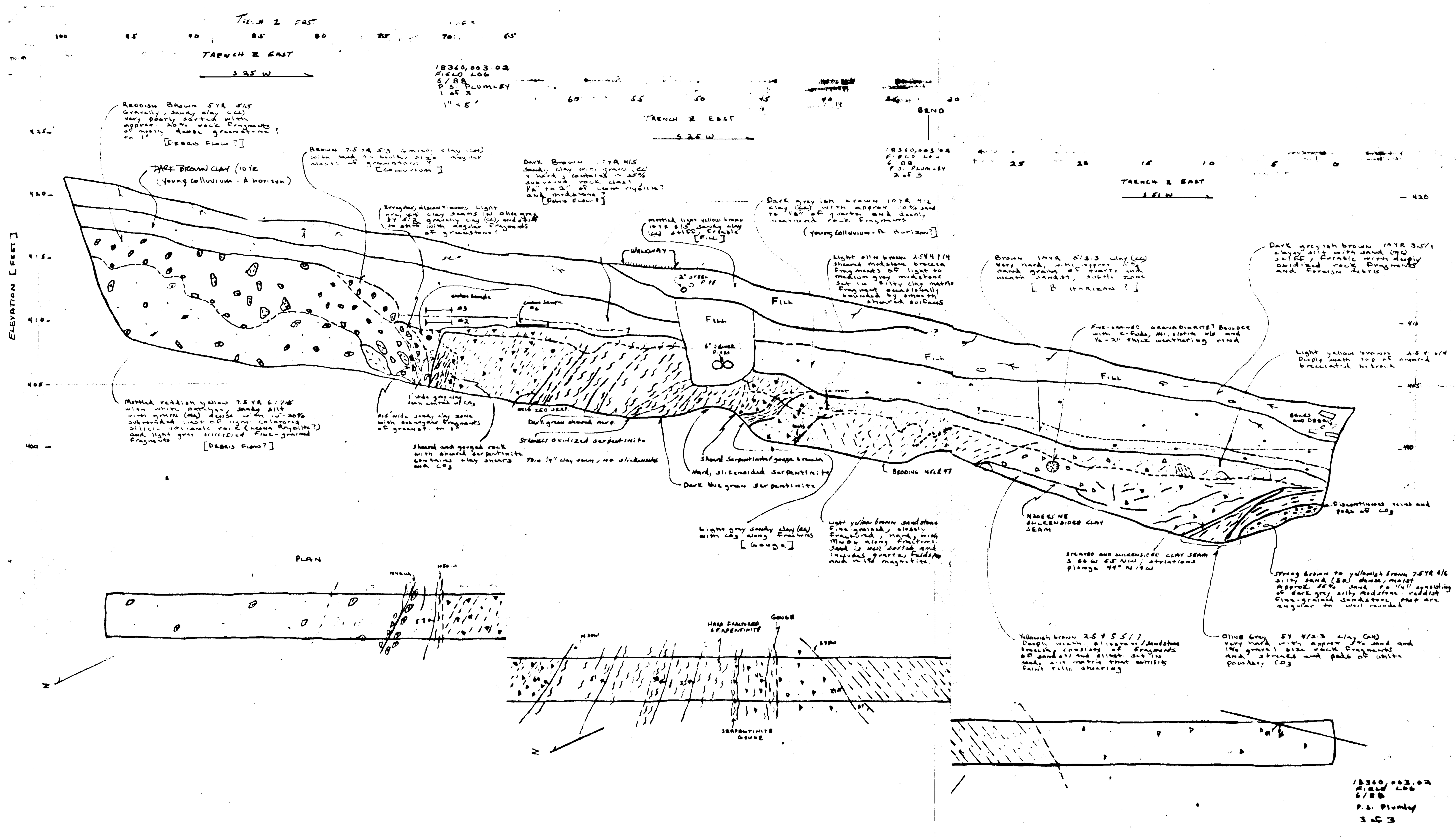
FIELD LOG — TRENCH W
6-88 PSP

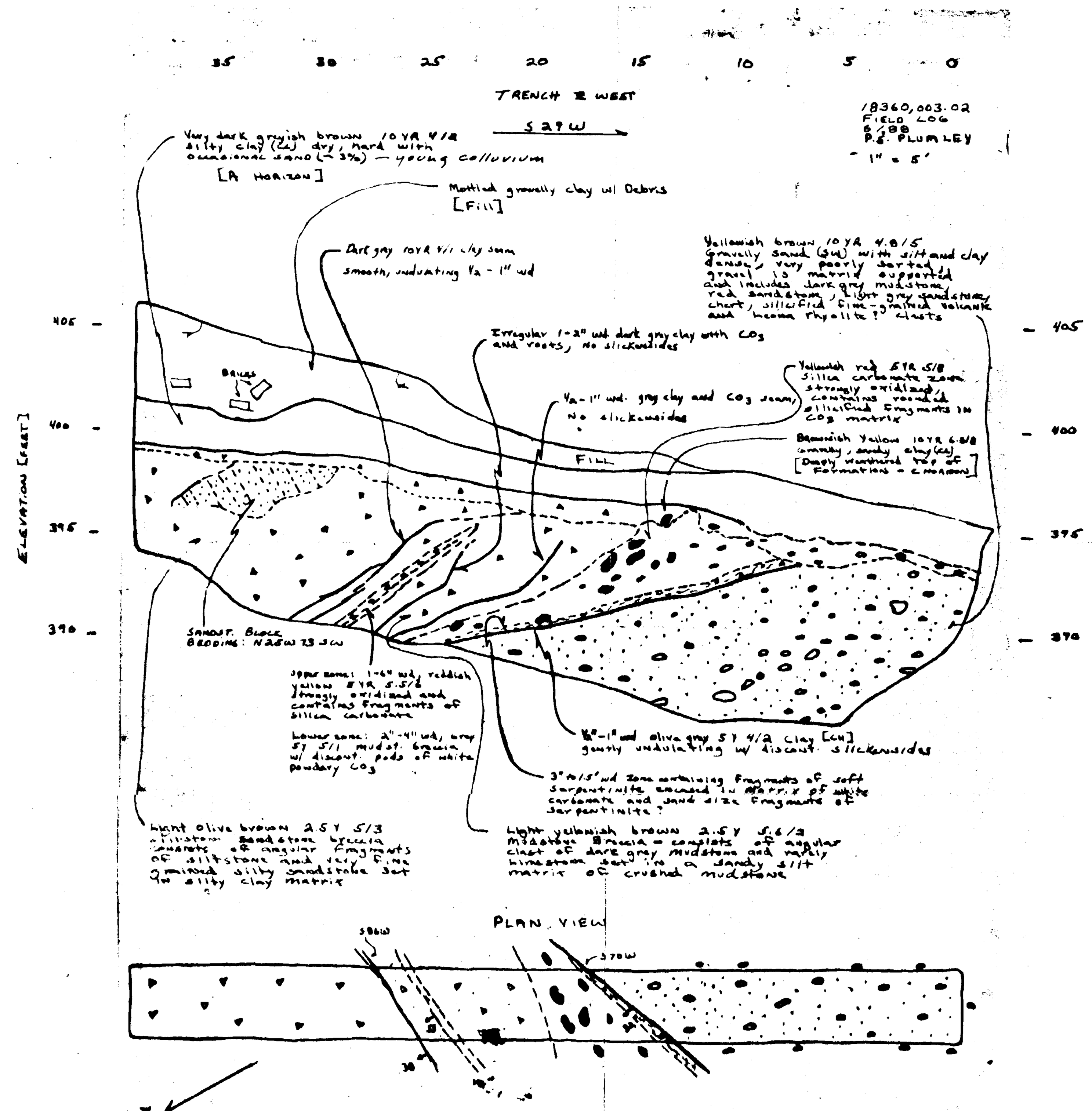


FIELD LOG – TRENCH Y
6-9-88 MNB



TRENCH WW
FIELD LOG
6/88 P. PLUMLEY





Harding Lawson Associates Engineers and Geoscientists	LOG OF TRENCHES X, W, Y, WW, Z EAST AND Z WEST FOOTHILL HOUSING PROJECT- UCB BERKELEY, CALIFORNIA
PLATE	3
JOB NUMBER	18,360,001.01
APPROVED	Kotay
DATE	6/88

APPENDIX D

LCI, 2018, Probabilistic Fault Displacement Hazard Analysis – for the Louderback Shear Zone

LCI
EARTH SCIENCE CONSULTANTS

Lettis Consultants International, Inc.
1981 N. Broadway, Suite 330
Walnut Creek, CA 94596
(925) 482-0360; fax (925) 482-0361

LETTER OF TRANSMITTAL

Date: October 8, 2018

Recipient: Ms. Marina Mascorro, PG, CEG
Langan Engineering and Environmental Services
555 Montgomery Street, Suite 1300
San Francisco, CA, 94111
Email: mmascorro@langan.com

SUBJECT: **Transmittal of Rev. 0 Report, "Fault Displacement Hazard Analysis for the Proposed Goldman School of Public Policy and Hearst Avenue Academic Housing Site, Berkeley, California"**

Contents: Adobe Acrobat PDF file of report.

Dear Ms. Mascorro,

Attached please find our report on fault displacement hazards for the Proposed Goldman School of Public Policy and Hearst Avenue Academic Housing site in Berkeley, California. This final (Rev.0) version addresses comments received from Langan (by Ms. Kate Krug) on October 5th on an earlier draft.

Thanks very much for the opportunity to work with you on this interesting project.

Respectfully,

CERTIFIED ENGINEERING GEOLOGIST
JOHN N. BALDWIN
EXP. 04/19
NO. 2167
JNB
STATE OF CALIFORNIA

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Lettis Consultants International, Inc.

Fault Displacement Hazard Analysis for the Proposed Goldman School of Public Policy and Hearst Avenue Academic Housing Site, Berkeley, California

LCI Project No. 1729

Prepared for:
Langan Engineering and Environmental Services, Inc.
555 Montgomery St., Suite 1300
San Francisco, CA 94111

Prepared by:
Lettis Consultants International, Inc.
1981 N Broadway, Suite 330
Walnut Creek, CA 94596

October 8, 2018
Rev. 0

Lettis Consultants International, Inc.

Table of Contents

LISTS OF TABLES AND FIGURES

Tables

Figures

1.0 INTRODUCTION

Lettis Consultants International, Inc. (LCI) performed a probabilistic fault displacement hazard analysis (PFDHA) and deterministic fault displacement hazard analysis (DFDHA) for the proposed Goldman School of Public Policy building and Hearst Avenue Academic Housing building (GSPP-HAAH; site), Berkeley, California. The fault displacement hazard characterization is intended to provide initial estimates on the annual probability and amount of coseismic secondary fault displacement expected on the Louderback shear zone (LSZ) beneath the site in support of seismic design of the proposed buildings.

On the basis of information provided by Langan, we understand that the proposed development includes: (1) demolition of the western and upper portions of the existing Upper Hearst parking structure at the corner of Hearst Avenue and La Loma Avenue, Berkeley, California, (2) construction of a new 4-story building with classrooms and assembly space to the west of the remaining parking structure, (3) an addition of 5 stories of residential space above the remaining parking structure, and (4) and construction of a classroom and faculty office building at the existing surface parking lot to the north of the Hearst parking structure that will consist of two below-grade and six above grade parking levels, respectively.

As shown in Figure 1-1, the northeastern half of the proposed building site is mapped within the State of California Alquist-Priolo Earthquake Fault Zone (A-P Zone) of the Hayward fault (California Geological Survey [CGS], 2001). The closest mapped active Hayward fault trace shown on the A-P map is located approximately 530 ft (160 m) to the northeast of the site (Figure 1-2). The CGS defines an active fault as one that has ruptured in the past approximately 11,000 years. Within the A-P zone are multiple other bedrock fault traces mapped by researchers and consultants, including the approximately 200-ft (61-m)-wide, northwest-trending LSZ that strikes subparallel to the active Hayward fault (Harding Lawson Associates [HLA], 1988a). The LSZ investigated in the early and late 1980's by a number of consultants and researchers, including the CGS (Smith, 1980a, 1980b), is not considered to be active by the State of California and is not depicted on the current State A-P map (Figure 1-1). More recently, however, Lienkaemper (2008) depicts a single fault trace within the broader LSZ as Holocene active. Lienkaemper (2008) shows the fault trace as 600- to 700-ft (183- to 213-m)-long and terminating at or near the intersection of Hearst Avenue and La Loma Avenue directly southeast of the site. Along a simple northwest projection from this termination point, the fault trace would intersect the northeast corner of the proposed GSPP (Figure 1-2). Review of historical consultant reports for the site shows the existence of two fault traces intersecting the northeastern part of the site that lie along projection with the Lienkaemper (2008) fault trace (Woodward-Clyde & Associates [WCA], 1970). Exposures logged during the construction of the present-day parking structure show that the western fault trace juxtaposes late Quaternary alluvium of Blackberry Creek on the west against Jurassic serpentinite on the east (WCA, 1970), which is generally consistent with the geologic units of Graymer et al. (2006) (Figure 1-3). Most of the remainder of the site lies within the projection of the broader (200-ft [61-m]-wide) LSZ as originally identified and described within the Lawson Adit, located approximately 315 ft (96 m) to the south (Louderback, 1939).

Fault exploration studies performed in the 1980's for the Foothill Student Housing Complex—located directly east-southeast of the site—evaluated the LSZ (Figure 1-2). These earlier studies concluded that the LSZ is inactive based on the interpretation of multiple trenches (several of which [trenches L, X, and Y] are near the intersection of Hearst and La Loma Avenues) and limited soil and age-dating analysis. Some of the trenches (e.g., trench Z-East) confirmed the presence of displaced late Quaternary alluvium and colluvium, but the consultants and soil-dating experts interpreted the faulting to be pre-Holocene in age. These observations of displaced Quaternary alluvium are consistent with consultant interpretations of the shear zone(s) in the western portion of the Lawson Adit, where shear planes were documented as terminating below gravels of presumed Quaternary age or older (HLA, 1988a).

Although the LSZ was interpreted to be inactive, the previous consultants performing the 1980's studies recommended that buildings built across the LSZ be designed to withstand secondary fault displacement (HLA, 1988b). Secondary displacement of up to 2 ft (0.6 m) was estimated in these reports, with the displacement being triggered sympathetically by a large earthquake on the Hayward fault. This secondary displacement amount was estimated based on an assumed MCE Hayward fault displacement of 10 ft, and Bonilla (1970) finding that displacement on secondary faults could be up to 20% of the main fault displacement. Information on how the 2 ft (0.6 m) of displacement was considered in the final design of the various student residential facilities was not provided in the documents available for review by Langan (2018).

The reviewed consultant reports and Lienkaemper (2008) indicate it is highly probable that quaternary faulting has occurred beneath the proposed site, and this faulting may be in a favorable orientation and location to accommodate secondary displacement (either as localized fault slip or as distributed shear) during future large Hayward fault earthquakes. Because the fault traces identified by WCA (1970) are on projection with the Lienkaemper (2008) trace that is interpreted as active, it is prudent to consider the possibility of secondary fault rupture across the site, either as a single fault trace or broad zone up to 200 ft (61 m) wide. The lack of Holocene material in the project area and the Lienkaemper (2008) interpretation of an active fault trace to the southeast results in uncertainty in the activity of the LSZ across the project site. Because of this remaining uncertainty on the shear zone's activity, as well as how the LSZ connects with the Hayward fault, and, what coseismic displacement may occur, further evaluation of the potential for secondary fault displacement at the proposed GSPP-HAAH site is warranted. To address these questions, Langan subcontracted LCI to perform a PFDHA and DFDHA for the proposed building site.

1.1 Scope of Work

Based on the available information compiled and reviewed, and our extensive experience conducting fault studies within the Hayward fault zone at U.C. Berkeley, LCI has developed the following scope of work for the GSPP-HAAH:

- Task 1.0 – Review existing data. Includes review and compilation of existing geologic and geotechnical site information, field reconnaissance, and interviews with previous investigators of the LSZ.
- Task 2.0 – Characterization of the LSZ as a potential rupture source based on existing information. Since no trenching is proposed, the technical approach relies on existing campus-wide information to develop the fault characterization data.
- Task 3.0 – Perform probabilistic and deterministic fault displacement hazard analysis
- Task 4.0 – Reporting
- Task 5.0 – Meetings/Presentations of Preliminary Findings

The PFDHA/DFDHA was conducted by Lettis Consultants International, Inc. (LCI) under contract with Langan and under the project management of Mr. John Baldwin (C.E.G.). The report was prepared by LCI geologists Dr. Stephen Thompson and Ms. Nora Lewandowski, and reviewed by Mr. John Baldwin. LCI engineer Dr. Arash Zandieh performed the hazard calculations. Figures were prepared by Ms. Åse Mitchell of LCI. The Rev. 0 version of the report incorporates comments from Langan on an earlier draft that were received October 5th.

1.2 Technical Approach

The first phase of our technical approach included review of existing data, primarily compiled by Langan (2018), and interviews with community experts (Section 2.1) and analysis of the location, geometry, and activity of the LSZ (Section 2.2). The primary data sources used were consultant reports that included subsurface exploration (boreholes, trenching, and logging of a building foundation excavation) of the LSZ and the GSPP-HAAH project site. Also critical to characterizing the LSZ were interviews conducted with previous investigators of the LSZ. These investigators were present in the 1980's when trenching was completed across the LSZ; and the interviews provided context for previous characterizations of the LSZ, specifically regarding its activity. The data review and analysis and information obtained from interviews with experts helped to characterize the LSZ as a potential rupture source in the PFDHA and DFDHA.

The second phase of our technical approach included the PFDHA and DFDHA for the GSPP-HAAH project site (Sections 3.0 through 6.0). The PFDHA methodology selected for the project site follows the "earthquake approach" (Youngs et al., 2003; Petersen et al., 2011) and takes advantage of the abundant geologic and paleoseismic data on the Hayward fault zone in the area of the UCB campus (Langan, 2018), as well as the recently performed PSHA study for the UC Berkeley campus by AECOM (2015). As the proposed site has been extensively modified, direct estimation of the activity of the LSZ beneath the site and, if active, per-event displacements, are not possible. In the PFDHA, displacement hazard results are focused on the criteria used for estimating design ground motions because no building code specifications exist for seismic design of fault displacement hazard. To help assess whether the displacements determined from the PFDHA and whether applying design criteria for ground shaking is reasonable, we also performed a DFDHA. The DFDHA was completed assuming an MCE on the Hayward fault. The PFDHA and DFDHA results and characterization of the LSZ are also used to provide information on the displacement distribution, orientation, and rake at the project site, which may aid in engineering assessments.

2.0 CHARACTERIZATION OF THE LOUDERBACK SHEAR ZONE

Significant work on the LSZ was performed in the 1970's and 1980's by multiple consultants and researchers who collectively interpreted the shear zone as inactive. Very little information has been collected since then to further characterize the LSZ. The shear zone intersects a highly urbanized area consisting of roads, buildings, utilities and landscaped areas. This study, therefore, relies on existing trench and map data collected previously to help estimate the annual probability and amount of coseismic secondary fault displacement beneath the project site. For this study we compiled and reviewed existing geologic information (Section 2.1) and used this information to help constrain the location and activity of the shear zone (Section 2.2). Please see Langan (2018) for a comprehensive review of existing site and local geologic information on the LSZ. The following is a summary of key components that help guide the PFDHA and DFDHA.

2.1 Data Compilation and Review

We reviewed existing publications, consultant reports, and maps that describe or include the LSZ and/or project site to help parameterize the PFDHA and DFHDA. Table 2-1 summarizes key reports used to develop the fault characterization. As previously noted, the northeastern part of the project site lies within the State A-P Zone for the Hayward fault, with the closest mapped trace of the Hayward fault lying approximately 530 ft (162 m) to the northeast of the site (Figure 1-1). The State A-P Zone map does not reference the LSZ, the focus of this study.

The LSZ is located approximately 350 ft (107 m) southwest of the Hayward fault (Figure 1-2). Multiple authors have had different interpretations on the location, activity, and width of faulting of the LSZ, but all have mapped the Louderback as generally northwest-striking and trending subparallel to the Hayward fault. The shear zone was first documented by Louderback (1939) in the Lawson Adit, and was subsequently included in maps by Radbruch-Hall (1974), Lennert and Curtis (1980), and Lienkaemper (2008) as a single trace, and WCA (1970) and HLA (1988a, 1988b) as multiple traces or a zone. Of these interpretations, Lienkaemper (2008) identifies a fault trace within the Louderback shear zone as Holocene active; all others either state the Louderback shear zone is inactive or do not comment on or define its activity. The LSZ is not shown on the present-day A-P map (CGS, 2001).

Table 2-1. Key Reports and Publications Used in the Louderback Shear Zone Characterization.

Author, Year	Type of Report	Key Purpose/Applicability of Work
Woodward-Clyde & Associates, 1969	Consulting Report	Geotechnical investigation at southern part of the project site (Parking Structure H). Includes borehole logs, laboratory testing data, and blow counts for nine exploratory boreholes completed in 1969, and logs for six boreholes completed in 1959. Boreholes were completed in location of Parking Structure H, as well as the northeastern part of the project site.
Woodward-Clyde & Associates, 1970	Consulting Report	Supplement to the Geotechnical Investigation for Parking Structure H. Study includes map and logged excavation face showing two fault traces observed during foundation excavation. Fault displaces Quaternary alluvium and is described as an active trace of the Hayward fault, though no definition of active is provided.
Harding Lawson Associates, 1986	Consulting Report	Geologic and Fault Hazard Investigation, Phase I, for Proposed Student Housing. Study included a total of 15 boreholes at three sites (Hillside, La Loma Ridge, and Bowles Hall Addition), and multiple trenches (trenches A through D at La Loma Ridge and trenches E through H at Hillside). La Loma Ridge is located directly east of the project site (Figure 1-2).
Harding Lawson Associates, 1988a	Consulting Report	Supplemental Fault Hazard Investigation on the Louderback for the Foothill Student Housing Project. Study included five boreholes, six trenches (all of which intersect the LSZ), logging of the western portion of the Lawson Adit, and a pedologic assessment of the soil ages. Study concluded that the LSZ is inactive. Study reviewed by members of the CGS (Jeff Howard, Glenn Borchardt, and Robert Snyder).

Author, Year	Type of Report	Key Purpose/Applicability of Work
Harding Lawson Associates, 1988b	Consulting Report	Geologic and Fault Hazard Investigation, Phase II, Foothill Student Housing. Study included 36 boreholes and 14 trenches (trenches I through V). Trenches L and R intersect the LSZ and exhibit evidence of faulting, however there was insufficient Holocene cover to constrain the age of fault activity.
Lienkaemper, 2008	USGS Map and Digital Database	Digital database of recently active traces of the Hayward fault. Database shows LSZ as a single trace that approximately corresponds to the eastern boundary of the HLA mapping of the shear zone. The database also includes the Lawson Adit, HLA trenches, and interpreted age of offset in the adit and each trench. With the exception of Trench Z-East, all other trenches and the adit are interpreted as having faulted Pliocene or Pleistocene sediments. Trench Z-East (which Lienkaemper combines with Trench Z-West in the database), offset is shown to be Holocene in age based on radiocarbon (14C) dating.
Langan, 2018	Consulting Report	Compilation of previously collected subsurface data, various interpretations of fault traces related to the LSZ, newly collected borehole and geophysical data on the project site. Identify sheared Franciscan melange bedrock beneath the site.

The primary sources of subsurface information used to characterize the LSZ for this project include borehole and trench data provided in HLA (1986, 1988a, 1988b), as well as borehole and foundation excavation documents described in WCA (1969,1970). These data sources provide information on the local subsurface geologic conditions and locations of fault traces or zones of bedrock shearing. Langan (2018) summarized the HLA (1986, 1988a, 1988b) trench findings in detail, and utilized borehole and trench data to construct three preliminary geologic cross sections through the project site. We reviewed the HLA (1986, 1988a, 1988b) trench logs and reports, and where information on fault orientation (strike and dip) and kinematics (slickensides) of the LSZ was available, it was compiled in tabular format. This information can be used to evaluate the displacement distribution, orientation, and rake (vertical to horizontal) of coseismic secondary faulting at the project site (Section 6.0). Langan (2018) also provided a description of development history of the project site based on historical aerial photography, architectural plans, and Sanborn maps. This information was used to provide context for the boring data collected by WCA (1969) and the level of modification of the site topography.

We also contacted several experts from the geosciences community who are familiar with the LSZ and were present when subsurface explorations were completed on the shear zone in the mid-late 1980's. The purpose of these interviews was to gain more context for the 1980's interpretations on the LSZ and activity. Table 2-2 lists the community experts contacted for this study and summary notes from each correspondence.

Table 2-2. Community Experts Contacted as Part of this Study[1].

Contact Name	Position and Agency/Company	Date	Correspondence Detail
Dr. Roy Shlemon	Principal Geologist Roy J. Shlemon & Associates	07/24/2018	Dr. Shlemon visited the 1988 HLA trenches across the LSZ and provided a report to HLA on his qualitative assessment of the age of soils observed in the HLA trenches. This report has not been made available to LCI. During our phone conversation, he stated that he remembered a consensus opinion in 1988 that the LSZ is inactive. Dr. Shlemon did not recall speaking to Mr. James Lienkaemper at the time of the trench review, nor was he aware of Mr. Lienkaemper's alternative interpretation of activity of the LSZ (i.e., active).
Mr. James Lienkaemper	Retired Paleoseismologist USGS	08/01/2018	Mr. Lienkaemper visited the HLA trenches in 1987 and 1988 and interpreted the LSZ as active based on observations of possibly young fissure-fill material in HLA (1988a) Trench Z-East, and an inferred uphill-facing escarpment noted in 2007 LiDAR data. The escarpment coincides with the approximate location of Trench Z-East. In our email correspondence, Mr. Lienkaemper stated that he did not perform a formal review of the HLA trenches and did not recall discussing his interpretations with HLA geologists. It is important to note that the inferred

Contact Name	Position and Agency/Company	Date	Correspondence Detail
			escarpment could be a cultural feature (sidewalk or landscaping). Mr. Lienkaemper did not compare the LiDAR features to pre-development topographic maps.
Glenn Borchardt	Principal Soil Scientist Soil Tectonics	08/02/2018	Dr. Borchardt formally reviewed the 1988 HLA trenches while working for the California Division of Mines and Geology. During our phone conversation, Dr. Borchardt recalled there was no compelling evidence to suggest that the LSZ was an active through-going fault, but stated that it was possible. Dr. Borchardt also stated that even if the fissure-fill in Trench Z-East was Holocene in age as Lienkaemper interpreted, he did not see evidence to support connecting this fissure fill to a larger and longer fault structure. Other CGS employees that reviewed the HLA trenches with Dr. Borchardt include Jeff Howard and Robert Snyder.

Notes:

[1]Mr. Steve Korbay, engineering geologist with HLA during the HLA (1988a, 1988b) trenching of the LSZ, was also contacted for this study. At the time of report writing, Mr. Korbay had not responded to requests by LCI for an interview.

2.2 Analysis of the Location and Activity of Louderback Shear Zone

In this section, subsurface data collected by HLA (1986, 1988a, 1988b) southeast of the project site and data by WCA (1969, 1970) within the project site, are used to characterize the location and activity of the LSZ.

Harding Lawson Associates (1968, 1988a, 1988b)

As summarized in Langan (2018), HLA mapped the LSZ as a complex ≥ 200 ft (61 m) wide zone of faulting that generally strikes northwest and dips northeast (HLA, 1988a, 1988b; Figure 1-2). Interpretations on the broad width of faulting were based primarily on the logging of the western 255 ft (78 m) of the Lawson Adit and eight HLA trenches (HLA, 1988a, 1988b). HLA (1988a, 1988b) delineated the LSZ across the eastern U.C. Berkeley campus based on faulted

Mesozoic bedrock and Quaternary colluvium and thin clay seams (HLA, 1988a, 1988b). The thin clay seams and bedrock shears were discontinuous and generally could not be connected from trench to trench, or from wall to wall within the same trench. HLA (1988a, 1988b) show the shears as terminating below the younger (Holocene) colluvial soils, and the juxtaposition of three main units at the fault zone: Pleistocene colluvium/alluvium, early Cretaceous and/or late Jurassic mudstone breccia, and Jurassic serpentinite. Additionally, in locations that were not covered in shotcrete or timbers in the Lawson Adit, HLA (1988a) logged massive greywacke sandstone, fault gouge, and Quaternary alluvium.

Based on the documentation in HLA (1988a, 1988b) and our interviews with community experts, including former CGS geologists, who reviewed the HLA trenches, the near consensus opinion at the time of trenching was that the LSZ was inactive. James Lienkaemper, who visited the HLA trenches but did not provide a formal review to HLA (1998a, 1988b), apparently was the only individual to interpret the shear zone in Trench Z-East as active (Table 2-2). Mr. Lienkaemper interpreted a fissure-fill in Trench Z-East as Holocene in age, and later used 2007 LiDAR data to interpret an east-facing scarp coincident with the approximate location of the fault in Trench Z-East. The interpretation of fissure-fill and absence of thick deposits of Holocene material across the LSZ were the primary reasons for delineating the shears exposed in trenches of HLA (1988a) as Holocene and uncertain in age. Mr. Lienkaemper stated that he did not recall discussing his interpretations of Trench Z-East with HLA geologists (Table 2-2). Although HLA (1988a) concluded that the LSZ is inactive, trench logs generally show a very thin layer or absence of young Holocene-age colluvium, precluding definitive interpretations on fault activity. Mapping performed by HLA (1988a) shows the LSZ projecting northwest into the central part of the project site. The northwest termination of the shear zone appears to be arbitrary and likely based on the northern limit of the mapping. HLA did not perform any subsurface explorations within the project site (Figure 1-2).

Woodward-Clyde & Associates (1969, 1970)

WCA (1969, 1970) performed several geotechnical investigations prior to construction of Parking Structure H that included 17 borings[1] and logging of the foundation excavation (Figure 2-1). The borehole and excavation logs are evaluated herein for information on the local subsurface conditions to help characterize the location, geometry, and activity of the LSZ across the project site.

[1] WCA (1970) stated that eight borings were completed in 1959, however the logs for presumably boring 10 and 17 are absent from their report and the locations are not shown on their site plan.

Subsurface Site Conditions

Across a large portion of the project site, WCA (1969) interpret sandy clay fill and estimate up to 7 ft (2 m) of fill in the southwest corner of the site. In some locations, the fill is underlain by several feet of “old topsoil”; this topsoil may be Holocene in age, though WCA (1969) do not provide an age interpretation for the material. Stiff to very stiff silty or sandy clay that contained variable amounts of coarse sand to medium gravel size rock fragments is observed below the topsoil; in some locations, this clay is observed directly below the ground surface or asphalt (Figure 2-2). WCA (1969) interpret the clay as a residual soil or heavily weathered bedrock, though much of the material is likely Quaternary alluvium associated with an inferred paleochannel of Blackberry or Strawberry Creeks. In general, fill and presumed Holocene and Pleistocene material was either highly variable or described inconsistently between WCA (1969) boring logs across the project site, making it difficult to distinguish Holocene material with high confidence or certainty. We considered blow counts and color of units noted in the borehole logs in an attempt to assess the age of deposits across the project site. In general, within the Quaternary units, blow counts and reddening of the units increase with depth, which suggest an increasing age of the material with depth. This information alone is not detailed enough to confidently asses the Pleistocene-Holocene boundary.

The Quaternary colluvium and alluvium ranges from 6 to > 40 feet in thickness, and is underlain by Mesozoic Franciscan complex rocks of shale and greywacke sandstone, the majority of which are weathered, fractured, and jointed. The Langan (2018) boreholes are consistent with the WCA (1969) boreholes, with undifferentiated surficial deposits interpreted to be > 25 feet thick and underlain by Franciscan complex rocks. The depth to bedrock is variable across the site and in most of the WCA (1969) borings below the “planned foundation level” (i.e., elevation of 372 feet, as described in WCA [1969]), however shallow bedrock is observed in borings from the central part of the site near La Loma Avenue. In boring 4, for example, sheared shale is encountered at an elevation of 384 feet[2], 6 ft (1.8 m) below the ground surface (Figures 2-1 and 2-2). This shale in turn is described as underlain by very stiff sandy silty clay (presumably Quaternary alluvium or colluvium) at approximately 30 ft (9.1 m) below ground surface. Shallow bedrock is also observed in the nearby boring 14 (Figure 2-1), though bedrock is not underlain by Quaternary material in this boring.

These units were later observed during the foundation excavation for Parking Structure H, where a fault juxtaposing Quaternary alluvium on the west against Mesozoic sheared and

[2] Elevation datum is City of Berkeley.

serpentinized shale and sandstone on the east, was observed in the northeast corner of the excavation (Figures 2-1 and 2-3). Similar to available boring logs, WCA (1970) do not distinguish between Holocene and Pleistocene alluvium in the parking lot exposure. The fault observed in the excavation is described further in the next section.

Fault Location and Geometry

During the foundation excavation for Parking Structure H, WCA (1970) document a well-developed curvilinear fault zone in the northeast corner of the parking structure that coincides with the shallow bedrock encountered in borings 4 and 14 (Figure 2-1). The faulting is generally on strike with the LSZ as defined by HLA (1988a, 1988b) and Lienkaemper (2008). WCA (1970) show two fault traces: a western, main trace, and an eastern, secondary trace (Figure 2-2). The main trace exhibits a variable dip along approximately 60 ft (18 m) long exposure, ranging from 50 degrees southwest to vertical. No dip information is provided for the secondary eastern trace. Additionally, the secondary trace is not shown in the WCA (1970) interpretation of the excavation (Figure 2-3). The secondary trace is proximal to the WCA (1969) boring 4, where bedrock was underlain by presumed Quaternary alluvium or colluvium.

The presence of other fault traces in the project area is uncertain. The logging performed by WCA (1970) of the excavation face at the northeast corner of Parking Structure H may suggest that they were present during the excavation of the entire parking structure foundation area and did not observe any other faults in addition to the two shown in Figure 2-1. This is not explicitly stated in their report, however. Unlike borings 4 and 14 where bedrock is shallow, in all other borings located in the Parking Structure H footprint, bedrock was logged either near or below the base of the foundation footing. This suggests that if faulting was encountered elsewhere during the foundation excavation, it would have occurred in offset Quaternary units. If such faults exist, these faults may be more likely missed during mapping and/or may indicate less cumulative displacement compared to the main trace mapped by WCA (1970). Therefore, given the available data, other secondary faulting cannot be precluded elsewhere in the project site.

Recency of Activity

WCA (1970) state that the main trace encountered at the site displaced units “very nearly to the ground surface” and describe the fault as active. No definition of “active faulting” is provided, however, WCA (1970) characterize the observed fault zone part of the active Hayward fault. Identifying active trace(s) of the Hayward fault across the UCB campus at this time was in its infancy as noted by present-day mapping that shows the closest mapped active Hayward fault trace is approximately 530 ft (162 m) east of the site. The WCA (1970) interpretation of the observed fault trace(s) as being part of the Hayward fault preceded Radbruch-Hall (1974) which initially defined the Louderback fault trace east of the site.

In an effort to better evaluate the presence of faulted Holocene material in the WCA (1970) excavation, we evaluated historical topographic maps, construction documents and borehole data. Prior to the foundation excavation activities, WCA (1969) estimated the deepest excavation for the parking structure foundation would be to an elevation of 372 feet, or as much as 25 ft (8.6 m) below the adjacent Hearst and La Loma Avenues. This depth of excavation is generally consistent with the building plans for the parking structure, with the exception of the foundation footing that extends to elevations of 363 to 365.25 feet, depending on location (see Sheets S-6 and S-7, Anshen & Allen Architects, 1970). The logged excavation is approximately 19 ft (5.8 m) high, with the base and top of the excavation at elevations of approximately 370 and 389 feet, respectively (Figures 2-1 and 2-3). East of the interpreted excavation face, La Loma Avenue is at an elevation of approximately 397 feet. These relations suggest as much as 8 ft (2.4 m) of material may have been missing at the time fault exposure was logged. The value of 8 ft (2.4 m) assumes generally flat-lying or gently west-sloping topography across the site. This likely underestimates the variable topography in the site area given the Berkeley Hills and proximity of the site to Blackberry Creek (Figure 1-1). The majority of the shallow surficial deposits likely were removed during the construction of College Hall between 1903 and 1911. Collectively, based on the planned excavation depths for the original parking structure, description of presumed Quaternary deposits in the boring logs, and estimated amount of material removed for the multiple site excavations, it is highly likely that much of the Holocene deposits and “residual soil” have been stripped from the site. The removal of the Holocene deposits prevents further refinement on the age of faulting across the project site. In summary, the fault zone exposure provides an apparent ≥ 19 ft (5.8 m) of vertical separation across the LSZ in the Quaternary (Figure 2-3).

2.3 Summary of Louderback Shear Zone Characterization

We reviewed existing publications, consultant reports, and maps, and interviewed community experts to parameterize the LSZ for the PFDHA and DFDHA. Although mapped by some authors as a single fault trace (e.g., Lienkaemper, 2008), subsurface explorations performed by HLA (1986, 1988a, 1988b) including trenching and logging of the Lawson Adit support characterizing the LSZ as a complex ≥ 200 ft (61 m) wide northwest striking zone of faulting that generally dips northeast. Southeast of the project site, HLA (1988a, 1988b) define the zone based on faulted Mesozoic bedrock (early Cretaceous and/or late Jurassic mudstone breccia and Jurassic serpentinite) and Pleistocene alluvium and colluvium and thin clay seams. The northern extent of their interpreted shear zone is located near the center of the project site (Figure 1-2). This termination is likely based on the northern limit of their mapping and is otherwise arbitrary. At the project site, WCA (1970) defined the LSZ by a similar geologic contact of Quaternary alluvium juxtaposed against Mesozoic sheared and serpentinized shale and sandstone. WCA (1970) mapped two fault traces towards the center of the project site near La Loma Avenue, a western main trace, and an eastern secondary trace (Figure 2-1). However, given uncertainties in the scope of WCA's (1970) analysis, secondary faulting cannot be precluded elsewhere in the project site.

With the exception of Lienkaemper (2008; personal communication), all publications, reports, and community experts interviewed defined the LSZ as inactive, though offsetting late Quaternary deposits. WCA (1970) stated that the fault traces observed during the foundation excavation of Parking Structure H were active, though no definition of active was provided. The existing descriptions from the WCA (1969) borehole logs and WCA (1970) excavation log are inadequate for assessing the Pleistocene-Holocene boundary across the project site and therefore cannot help refine the age of LSZ faulting beyond late Quaternary. Additionally, we interpret that most if not all Holocene material had been removed from the project site at the location of the WCA (1970) excavation face at the time of their interpretation. Because of the uncertainties on the location, width, and activity of faulting within the project site, we performed the PFDHA and DFDHA described in Sections 3.0 through 6.0.

3.0 FAULT DISPLACEMENT HAZARD ANALYSIS METHODOLOGY

The probabilistic fault displacement hazard analysis (PFDHA) methodology implemented in this study follows Youngs et al. (2003) and Petersen et al. (2011), which are based on the more common probabilistic seismic hazard analysis (PSHA) of Cornell (1968). Instead of estimating the annual rate of exceeding a specified earthquake ground motion at a site, PFDHA estimates the annual rate of earthquake-induced displacement D exceeds a specified level, d, at a site x,y of site dimension z (geographic and geometric definitions are shown in Figure 3-1). The time-independent rate of exceedance, $\lambda_{xyz}(D > d)$, is computed as:

$$\lambda_{xyz}(D > d) = \alpha(M_{min}) \int_M f_M(m) \int_S f_{S|M}(s|m) \times \int_{R_p} f_{R_p}(r_p)\, P_{xy}[D > d|m, s, r_p, z]\, dr_p\, ds\, dm \qquad (3\text{-}1)$$

where $\alpha(M_{min})$ is the rate of all earthquakes on the fault of interest above a minimum magnitude M_{min}, $f_M(m)$ is the probability density function (PDF) of earthquake magnitudes M (from M_{min}, to a maximum earthquake the fault can produce), and $f_{S|M}(s|m)$ is a PDF of (magnitude-dependent) earthquake rupture locations on the fault source, as measured by the distance S from the end of the fault source to the end of the rupture. These initial terms in (2-1) are exactly comparable to fault source characterization that is required for a PSHA, whereby the location and rate of earthquakes are defined for each seismic source. Additional terms in (2-1) that are specific to PFDHA include a PDF describing the *across* strike rupture location uncertainty, $f_{R_p}(r_p)$, where R_p refers to the perpendicular distance from the site to the principal fault rupture, and a conditional probability of displacement exceedance term (a fault displacement attenuation relation), $P_{xy}[D > d|m, s, r_p, z]$. This displacement attenuation relation itself may consist of three separate terms, as follows:

$$P_{xy}[D > d|m, s, r_p, z] = P[sr \neq 0|m] P_{xy}[d \neq 0|s, z, r_p, sr \neq 0] \times P_{xy}[D \geq d|m, s, r_p, d \neq 0]. \qquad (3\text{-}2)$$

The first term, $P[sr \neq 0|m]$, is the conditional probability that some amount of surface rupture occurs as a result of an earthquake of magnitude m. Whereas in PSHA all earthquakes are presumed to cause some amplitude of vibratory ground motion, in PFDHA not all earthquakes rupture to the surface (or near-surface). Examples of this include the 1994 moment magnitude (M_W) 6.7 Northridge, California earthquake on the Northridge blind thrust (Yeats and Huftile, 1995), and the 2010 M_W 7.0 Haiti earthquake adjacent to the strike-slip Enriquillo fault zone

(Prentice et al., 2010). The second term, $P_{xy}[d \neq 0|s, z, r_p, sr \neq 0]$, is the conditional probability that some amount of surface rupture occurs at the site x,y, given the location of the principal rupture relative to the site (s, z, r_p) and an earthquake that produces some surface rupture. The third and final term in (3-2) is the conditional probability of displacement exceedance at the site of interest, where displacement is expressed as a PDF that is dependent on m, s (represented in Petersen et al. (2011) by the ratio l/L as show in Figure 3-1), and r_p.

The functional forms and/or parameter values of the PDFs and conditional probabilities changes based on the style of faulting (strike-slip, normal, or reverse), and the location and size of the site xyz relative to the principal fault trace. If the site straddles the principal fault (and $r_p \sim 0$), the site is subjected to a principal displacement hazard as well as distributed deformation adjacent to the principal rupture. If the site of interest is away from the principal fault ($r_p > z$), the hazard is from secondary (also called "distributed") fault displacement only. In rare cases, typically associated with reverse faulting environments, the permanent ground deformation hazard is not discrete surface-fault rupture but rather abrupt tilting or warping, such as in the production of fold scarps (Streig et al., 2007; ANSI/ANS 2.30-2015). Figures 3-2 and 3-3 show examples of historic strike-slip surface-fault ruptures from Petersen et al. (2011), and the separate hazards of principal, secondary, and distributed deformation.

For this study, the proposed GSPP-HAAH site is located within a zone of suspected secondary or distributed deformation hazard, at a distance of approximately 160–250 m from the primary strand of the Hayward fault which represents the principal rupture source (Figures 1-1 and 3-4). Thus, the hazard of concern is that of secondary fault displacement (e.g., slip on the fault observed by WCA (1970) in the excavation for the parking structure) or distributed fault displacement (e.g., localized slip or distributed shear on previously unrecognized faults or tectonic shears beneath the proposed GSSP and HAAH structures). Hazard is calculated for three points each representing the center point for an approximately 50 m × 50 m cell (Figure 3-4 and Table 3-1). The proposed GSSP facility is represented by the western point, and the proposed HAAH facility is represented by the two eastern points. The 50 m cell dimension slightly overestimates the precise area of the project facilities, but this difference is not meaningful for the hazard results given the overall uncertainties in the analysis. Table 3-1 lists the longitude and latitude (x and y), cell dimension (z), and distance to the principal fault source from the center points (r_p).

Table 3-1. Locations for Hazard Calculation.

Point Name	Longitude (x), Decimal Degrees WGS84	Latitude (y), Decimal Degrees WGS84	Cell Dimension (z)	Distance from Center Point to Principal Hayward Fault (r_p)
GSSP	-122.25756	37.87573	50 m	220 m
HAAH North	-122.25725	37.87625	50 m	170 m
HAAH South	-122.25725	37.87577	50 m	190 m

The PFDHA hazard formulation in (3-1) and (3-2) was calculated for the three points with parameters in Table 3-1 in LCI's software code TDISE. Alternative parameter values are captured in logic trees that describe the fault source characterization and the fault displacement prediction equations (Section 4). The results are shown graphically in hazard curves of annual probability (or rate or frequency) of exceedance versus net displacement amplitude (Section 5).

In most cases, the hazard curves are applicable for estimating exceedance probabilities of net ground surface amplitudes under "natural" conditions (e.g., natural soil profiles without built structures). In order to make the hazard more useful for consideration of its potential impact on the built environment, and for consideration of how to design or model a structure to withstand displacement, additional information may be needed such as the following:

- displacement orientation (strike and dip of displacements),
- displacement direction (horizontal and vertical components of slip), and
- displacement localization (knife-edge dislocation or distributed shear across a zone).

These parameters are defined in Section 6.

4.0 PFDHA LOGIC TREE

The PFDHA logic trees for the UCB GSPP and HAAH project are presented in Figures 4-1 (for fault source characterization) and 4-2 (for fault displacement prediction model). As stated above, the location of the project is approximately 160 to 250 m from the primary trace of the Hayward fault, and thus the hazard at the site is from secondary, or distributed, fault displacement rather than principal fault displacement.

4.1 Logic Tree Primer

The logic trees consist of nodes and branches that collectively provide the information needed to calculate hazard and capture hazard uncertainty. Nodes are organized in columns in Figures 4-1 and 4-2. Each node represents a model element that is required either to justify the calculation methodology or to parameterize the model. Nodes in Figure 4-1 are named with the initials SC for source characterization, and are numbered sequentially from node SC 1 to SC 11. Nodes in Figure 4-2 are named with the initials DM for displacement model, and are numbered sequentially from node DM 1 to DM 7. The following chapter subsections are organized to follow these nodes.

Branches are organized as one or more rows under each node in Figures 4-1 and 4-2. Branch values represent inputs that are required to implement the model. There are two types of branching structures represented in the logic trees. Branches that are connected by vertical lines (e.g., Figure 4-1, node SC 3) represent relationships whereby multiple values are required to fully describe the model. The one instance in this project where there are such aleatory branching relationships involves the segmentation model for earthquake ruptures on the Hayward fault zone source. Here, the various branch combinations each represent a complete description of how the Hayward fault zone—consisting of separate, non-overlapping Southern Hayward, Northern Hayward, and Rodgers Creek fault segments—rupture as separate segment ruptures or as multi-segment ruptures. Because the study site is located adjacent to the Northern Hayward fault segment, only rupture sources that include the Northern Hayward segment are included in the analysis (Figure 4-3). For example, the “Three Segment” rupture scenario defined under node SC 2 is followed by three aleatory branches that define the three separate rupture segments under node SC 3 (Figure 4-1). Entries of “N/A” (for not applicable) follow the Rodgers Creek and Southern Hayward branches under node SC 4 because the displacement hazard from separate ruptures on those fault segments do not impact the study site. Conversely, a maximum rupture length value of 35 km is provided under node SC 4 for the Northern Hayward branch, and alternative values and weights are provided under nodes SC 5 to SC 11 that are applicable to complete the source description for the Northern Hayward rupture segment branch.

Logic tree branches connected by inclined lines that come together at a dot represent alternative parameters with an "or" relationship. In these cases, branch values represent alternative possible correct values, with the correct value being uncertain but, theoretically, knowable. In these cases, the likelihood that each alternative value represents the correct value is represented by a branch weight, which is listed as a number in square brackets beneath each branch line, with each number less than or equal to one. The branch weights are subject to the requirement that all alternative branch weights sum to unity. These alternatives represent epistemic, or model, uncertainty for parameters that are considered to be ultimately knowable given the collection of enough information.

Each pathway through the logic trees in Figures 4-1 and 4-2 represents a complete and permissible set of model parameter inputs, and a hazard curve can be calculated to represent that pathway. The likelihood that the particular pathway and its resulting hazard curve are correct is indicated by the combined weight of epistemic branch values following that path. The mean hazard curve is calculated as the weighted sum of hazard for every possible pathway through the logic tree.

4.2 Source Characterization Logic Tree

The source characterization logic tree for this study is based on the seismic source characterization developed for the 2015 update to the site-specific seismic hazard analysis for the UCB campus (URS, 2015). The source characterization required for the PFDHA is limited to a single source—the Hayward-Rodgers Creek fault source—and to the subset of ruptures occurring on the Northern Hayward fault segment (Figures 4-1 and 4-3). The URS (2015) characterization of the Hayward fault source is a modification of the fault source characterization developed for the community earthquake rupture forecasts developed by the 2002 Working Group for California Earthquake Probabilities (WGCEP, 2003) and by the 2007 WGCEP, published as the second Uniform California Earthquake Rupture Forecast (UCERF 2; WGCEP, 2008).

The source characterization logic tree provides parameters needed to implement the first parts of equation (3-1) with the following exception. The conditional probability of principal rupture occurring adjacent to the site, represented by $\int_S f_{S|M}(s|m)\,ds$, is solved in the hazard code numerically by placing ruptures on the fault source plane based on magnitude and simple magnitude-area scaling (similar to PSHA codes). For the other terms of the equation—namely the rate of earthquakes and the magnitude PDF on the fault source—the source characterization is defined by fault location and source geometry (nodes SC 1 to SC 5), the earthquake magnitude distribution (nodes SC 6 to SC 8), and the earthquake recurrence rate (nodes SC 9 to SC 11).

4.2.1 Fault source geometry

The fault source geometry model is defined in nodes SC 1 to SC 5 (Figure 4-1). Node SC 1 identifies the Hayward-Rodgers Creek fault source, which is shown in Figure 4-3, and notes that the seismogenic probability (i.e., the degree of belief that the source is capable of generating damaging earthquakes) is 1.0. Node SC 2 describes rupture scenarios for the fault source that are presented as epistemic alternatives for the portions of the fault source that host the largest earthquake ruptures. Node SC 3 identifies the rupture segments or segment combinations that make up the rupture scenarios. As SC 3 provides a definition for the logic tree branches in SC 2, the branches in SC 3 do not have weights. The highest weighted logic tree branches under SC 2 are for the three segment rupture scenario [0.5], which proposes that the Rodgers Creek fault and the Northern and Southern Hayward fault segments rupture separately, and the two segment rupture scenario whereby the Northern and Southern Hayward fault segments rupture together and the Rodgers Creek fault ruptures separately [0.3]. The least weight [0.05] is given to rupture sources that propose the entire Hayward-Rodgers Creek fault source ruptures together or that earthquakes up to M_W 6.9 rupture in "floating" earthquakes up and down the fault source without regard to the proposed fault or fault segment boundaries.

Node SC 4 defines the lengths of the rupture sources. As the model does not include uncertainty in the endpoints of the rupture segments, the maximum rupture length branch values have corresponding weights of [1.0]. As stated in Section 4.1, the PFDHA is only concerned with ruptures that include the Northern Hayward fault segment, as that segment is located adjacent to the project site (Figure 4-3). Any rupture segment or segment combination that does not include the Northern Hayward fault segment is not included in the calculation, and this is indicated by a "N/A" (not applicable) branch entry.

Node SC 5 defines the maximum rupture width for the fault source. For all cases, an identical logic tree structure of 14 km, 12 km, and 10 km values with [0.3], [0.4], and [0.3] weights, respectively is assigned. These values approximately represent the 90th, 50th, and 10th percentile uncertainty values for maximum rupture width, as defined by depth of microseismicity and geodetic modeling. As the Hayward fault dip is steeply dipping to sub-vertical, we do not consider separately fault source dip and maximum depth of the seismogenic crust.

4.2.2 Fault source magnitude distribution

The earthquake magnitude distribution for the Northern Hayward fault source is defined by nodes SC 6, SC 7, and SC 8 (Figure 4-1). The basic approach for assessing the magnitude distribution for the sources is to consider the maximum rupture dimensions of a rupture source, and apply empirical scaling relations between moment magnitude and maximum rupture area (the product of maximum rupture length *L* and maximum rupture width *W*, from nodes SC 4 and SC 5, respectively) or earthquake magnitude and rupture length. Because the Hayward fault creeps, and thus a portion of the fault area slips by stable sliding rather than stick-slip earthquake rupture, the common magnitude-area scaling relations are adjusted to account for a reduction in fault area that is expected to release significant seismic moment (Bakun, 2003). The seismogenic scale factor, *R*, is approximately defined as the ratio of the fault area expected to release full seismic moment to the total fault area. The effective rupture area, *A'*, equal to $L \times W \times R$, is then used in empirical magnitude-rupture area relations (e.g., Wells and Coppersmith, 1994; Hanks and Bakun, 2008). Node SC 6 provides best-estimate values of *R* for the different rupture sources, with the *R* values shown in 4-1 representing an average of estimated values from the recent UCERF 3 study (Field et al., 2013) and from Lienkaemper et al. (2014).

Node SC 7 describes the earthquake magnitude PDF, or the relative frequency distribution of earthquakes sizes from a minimum cutoff magnitude (M_W 5.0 used in this study) to a maximum magnitude (Mmax). Following URS (2015), two PDFs are considered. The higher weighted branch alternative with a weight of [0.7] is the characteristic earthquake magnitude PDF from Youngs and Coppersmith (1985). This model is implemented with a boxcar distribution 0.5 magnitude units wide, centered on a mean "characteristic" magnitude (Mchar) provided under Node SC 8. Approximately 10 percent of the seismic moment rate of the fault source is accommodated through lower earthquake magnitudes (between the minimum magnitude and the lower edge of the boxcar) that follow an exponential magnitude-frequency distribution. The lower weighted branch with [0.3] weight is the maximum magnitude PDF of Wesnousky et al. (1983). The implementation of this model is a truncated normal distribution, centered on Mchar, with a standard deviation of 0.125 magnitude units and truncations at ± 2 standard deviations (yielding a total width of 0.5 magnitude units centered on Mchar).

The Mchar values needed to anchor the magnitude PDFs are provided in node SC 8. These alternative branch values and weights are based on the effective rupture areas of the fault sources (the product of nodes SC 4, 5, and 6) and a weighted combination of three empirical magnitude-scaling relations used by URS (2015) (Hanks and Bakun, 2008 [0.2], Shaw, 2009 [0.4], and Ellsworth, 2003 [0.4]). The center branch Mchar value under node SC 8 (with a weight of [0.6]) represents the weighted average of the effective rupture areas and empirical scaling relations, and the high and low branch Mchar values (with weights of [0.2]) represent the center values ± 0.3 magnitude units that represent the range of branch combinations plus an additional 0.1 magnitude unit that accounts for additional uncertainty in *R*. The aleatory magnitude distribution in the magnitude PDFs account for additional epistemic and aleatory uncertainty in earthquake magnitude given the maximum rupture dimensions for the Northern Hayward fault source.

4.2.3 Fault source recurrence rate

The estimated mean recurrence rate of moderate to large earthquakes on the rupture sources is needed to complete the fault source characterization. Node SC 9 defines the recurrence approach, with alternatives for using fault slip rate (node SC 10) (and moment balancing) or using mean recurrence intervals for surface-rupturing earthquakes estimated from paleoseismic data (node SC 11). Only the rupture source that consists of the single-segment Northern Hayward fault has the branch option for direct mean recurrence interval estimates (Figure 4-1). The reader is directed to URS (2015) for the basis of the recurrence intervals selected in the logic tree. In all other cases, mean recurrence is calculated from the fault slip rate and moment balancing.

Node SC 10 provides estimates of fault slip rate for the Northern Hayward fault. The logic tree branch values of 9, 11, and 7 with weights of [0.6], [0.2], and [0.2] represent the estimated geologic slip rates for the fault at the mean and approximately 95% confidence interval. For the recurrence rate calculation, moment balancing is performed such that the seismic moment rate for the fault source is balanced by the magnitude-frequency distribution of earthquakes generated for the fault source. The *R* factor that was used to adjust the characteristic earthquake magnitudes is also used in the moment balancing to make sure rates of earthquakes on the defined fault source are appropriate.

4.3 Fault Displacement Prediction Model Logic Tree

The fault displacement prediction model provides information to solve the later terms in equation (3-1) and the expanded terms in equation (3-2). A simplification to (3-1) that is used in this analysis is to recognize that the location of the main, creeping Hayward fault that is the locus of principal faulting is well defined adjacent to the project location (Figure 3-4), and treat R_p as a constant.

The remaining terms are those in (3-2) and the logic tree to characterize uncertainties in these terms is presented in Figure 4-2. The first node in the displacement model, node DM 1, shows that the analysis is based on the displacement prediction model of Petersen et al. (2011), which was developed for strike-slip faults and relies on several California earthquakes and other, global earthquakes on relatively similar strike-slip faults as the Hayward fault (with the notable exception that none of the faults are known to creep at levels comparable to the Hayward fault).

The progression of the displacement prediction model logic tree follows the order of terms in (3-2), and includes the following:

- conditional probability of surface rupture, $P[sr \neq 0|m]$, (node DM 2);
- conditional probability of displacement (in this case, secondary or distributed deformation) at the site, $P_{xy}[d \neq 0|s, z, r_p, sr \neq 0]$, (nodes DM 3 and DM 4); and
- the displacement exceedance PDF (in this case, for secondary or distributed deformation), $P_{xy}\left[D \geq d \middle| m, s, r_p, d \neq 0\right]$, (nodes DM 5 and DM 6).

4.3.1 Conditional probability of surface rupture

The first term, $P[sr \neq 0|m]$, is the conditional probability that some amount of surface rupture occurs as a result of an earthquake of magnitude m (Section 3.0). Logic tree node DM 2 shows the implementation of this conditional probability.

The conditional probability of surface rupture is typically based on global empirical observations of earthquakes of varying magnitudes that have or have not produced surface rupture. As the outcome of surface rupture is binary (an earthquake either ruptures the surface or it does not), the probability can be represented through a logistic regression of the form:

$$P[sr \neq 0|m] = \frac{e^{a+bm}}{1+e^{a+bm}} \tag{4-1}$$

The logic tree shows two branch alternatives. The first branch, with a weight of [0.4], is the parameterization of the *a* and *b* constants developed by Wells and Coppersmith (1993) as presented in Youngs et al. (2003) (Table 4-1). This regression was developed from 276 worldwide earthquakes of various slip types, and it predicts that an earthquake of M_W 6.0 has a 45% chance of rupturing the surface, 70% for M_W 6.5, and 87% for M_W 7.0. The second branch, with a weight of [0.6], is shown as “Modified from Takao et al. (2015).” The basis for this branch comes from Takao et al. (2015), who used the same functional form as (4-1) and fit *a* and *b* parameters using 107 inland crustal earthquakes in Japan of mostly reverse and strike-slip styles of faulting. They found a much steeper curve than the global Wells and Coppersmith (1993) data, with an only 7% probability of surface rupture from M_W 6.0, but a 91% probability from M_W 7.0 earthquakes. This result strongly suggests that regionalization is an important consideration for this conditional probability, and that the global average condition may not be an accurate, or best, model to use for any single site in particular.

Table 4-1. Logistic Regression Coefficients for the Conditional Probability of Surface Fault Rupture.

Reference and Data Set	Weight	a	b	P[sr≠0], M_W =6.0	P[sr≠0], M_W =6.5	P[sr≠0], M_W =7.0
Wells and Coppersmith (1993), 276 worldwide earthquakes, all slip types	[0.4]	-12.51	2.053	0.45	0.70	0.87
Takao et al. (2015), 107 crustal earthquakes in Japan, strike-slip and reverse	--	-32.03	4.90	0.07	0.46	0.91
Modified from Takao et al. (2015) for application to the Hayward fault (this study)	[0.6]	-30	5.2	0.77	0.98	1.0

Based on the relatively thin seismogenic crust and creeping nature of the Hayward fault, and given the paleoseismic evidence on the southern and northern Hayward faults for repeated surface-fault ruptures over the past few thousand years (e.g., Lienkaemper and Williams, 2007), and given that surface-fault rupture has occurred historically on Bay Area faults for magnitudes as low as M_W 5.8 (e.g., 1980 M_W 5.8 Greenville fault earthquake; also 1984 M_W 6.2 Morgan Hill earthquake on the Central Calaveras fault, and 2014 M_W 6.0 Napa earthquake on the West Napa fault), we consider the probability of surface rupture (or at least accelerated fault creep at the surface) given magnitude to be much greater for the Hayward fault than the global average or from the Japan dataset. We keep the steep slope from the Takao et al. (2015) relationship, but modify the *a* and *b* values such that the probability of surface rupture is almost a certainty for earthquakes greater than or equal to M_W 6.5, and the probability of a M_W 6.0 on the Hayward generating surface rupture is greater than about 75% (Table 4-1). This modified from Takao et al. (2015) parameterization is not given a weight higher than [0.6] because it is not based on carefully considered data, but rather is defined on the more qualitative basis described above.

4.3.2 Conditional probability of distributed deformation at the site

The second term in equation (3-2), $P_{xy}[d \neq 0|s, z, r_p, sr \neq 0]$, is the conditional probability that some amount of surface displacement occurs at the study site (x,y) of site dimension z given principal rupture adjacent to the site (represented by s) and an earthquake that produces surface rupture ($sr \neq 0$). Logic tree node DM 3 shows that the conditional probabilities developed by Petersen et al. (2011) are used for the median model, and node DM 4 shows that uncertainty in the probabilities is treated epistemically, with branch alternatives for 90th, 50th, and 10th percentile probabilities.

The Petersen et al. (2011) empirical model was developed using data from several well-documented strike-slip earthquakes that documented both principal and distributed displacement (e.g., Figures 3-2 and 3-3). This probability (*P*) is represented through a regression of the form:

$$\ln(P) = a(z)\ln(r_p) + b(z) \tag{4-2}$$

where $a(z)$ and $b(z)$ are regression coefficients (dependent on cell size z) and r_p is the perpendicular distance from the site of interest to the primary rupture (Petersen et al., 2011, their Equation 20). Petersen et al. (2011) consider this model to be valid for values of r_p between approximately 200 m and 2.5 km. For distances less than 200 m, Petersen et al. (2011) provide fixed mean probabilities at interval distances based on interpolation. Because the distances considered in this study are in the range of $170 \leq r_p \leq 220$ (Table 3-1), we use the published linear interpolation points of Petersen et al. (2011) for 100 m and 200 m for z = 50 m, and derive an additional interpolation point for r_p = 300 m based on the distributed rupture dataset provided with Petersen et al. (2011) as an electronic supplement. From those data, we also confirmed the published interpolation probabilities for the 100 m and 200 m distances.

Node DM-4 presents the uncertainty in the median model for the probability of distributed deformation at the site of interest. Evaluation of the electronic supplement dataset provided in Petersen et al (2011) shows that the probability of displacement at a site off of the principal rupture varies greatly from earthquake rupture to earthquake rupture. Thus, the average of the earthquakes examined by Petersen et al. (2011) does not necessarily represent the average condition for any individual fault. It is unclear whether the probability of distributed displacement at the GSPP and HAAH sites should be less than, about equal to, or greater than the dataset average. An argument that the probabilities should be less than the dataset average is that the Northern Hayward fault is locally relatively straight and does not show much structural complexity along its creeping trace (e.g., Figure 1-1). This simplicity and the creeping behavior may tend to minimize off-fault displacement during large earthquakes, and concentrate the strain at the ground surface along the creeping trace. An argument that the probabilities of off-fault displacement at the project sites may be higher than the dataset average is that we know a late Quaternary fault underlies a portion of the site (Figures 1-2, 1-3, and 3-4), and the Louderback shear zone probably underlies the entire study site. In contrast, the Petersen et al. (2011) dataset and methodology to estimate off-fault rupture probabilities does not restrict its examination to only those areas with pre-existing faulting, and thus many of the areas around the historic ruptures that go into the conditional probability analysis are likely areas that are unfaulted. Because of the uncertainty in how to center the conditional probability of distributed rupture for the project site, we center the probabilities on the dataset average (the 50th percentile), and adopt a 3-point uncertainty distribution with branches representing the 90th and 10th percentile probabilities from the Petersen et al. (2011) dataset and the calculated sample standard deviations derived from the data (Figure 4-2). The weighting scheme of [0.3], [0.4], [0.3] for the 90th, 50th, and 10th percentile values follows the recommended 3-point approximation for a continuous uncertainty distribution by Keefer and Bodily (1983) for cases where the tails of the distribution are poorly defined. The probability levels, values and weights for the linear interpolation points used in the analysis are provided in Table 4-2.

Table 4-2. Linear Interpolation Points for the Conditional Probability of Distributed Deformation for the 50 m × 50 m Cell Size from Analysis of Data in Petersen et al. (2011).

Probability	Linear Interpolation Probabilities $P(r_p)$			Branch Weight
	P(100 m)	P(200 m)	P(300 m)	
90th Percentile	0.0804	0.0505	0.0425	[0.3]
50th Percentile	0.0482	0.0262	0.0203	[0.4]
10th Percentile	0.0160	0.0018	0.0001	[0.3]

4.3.3 Displacement exceedance PDF for distributed deformation

The displacement exceedance model for distributed deformation, $P_{xy}\left[D \geq d \middle| m, s, r_p, d \neq 0\right]$, is described under nodes DM 5 and DM 6 in the displacement model logic tree (Figure 4-2). Node DM 5 contains two alternative models from Petersen et al. (2011); both models are fit to a set of strike-slip earthquake data between approximately 20 m and 3 km from the principal rupture (Petersen et al., 2011). The first branch, with a weight of [0.3], is for a functional form that solves for distributed displacement *d* as a function of m and r_p. From equation 18 of Petersen et al. (2011), it is:

$$\ln(d) = 1.4016m - 0.1671\ln(r_p) - 6.7991 + 1.1193\varepsilon \quad (4\text{-}3)$$

where *d* is in centimeters and r_p is in meters. The regression standard deviation of 1.1193 is multiplied by the standard normal distribution function, ε, to represent event to event variability.

The second branch under node DM 5 uses an alternative functional form that solves for normalized *d* over the average displacement of the rupture, D_{ave} , as a function of r_p:

$$\ln\left({}^{d}/_{D_{ave}}\right) = -0.1826 \ln(r_p) - 1.5471 + 1.1388\varepsilon \quad (4\text{-}4)$$

This second branch is given a higher weight of [0.7] due to the greater flexibility of the model to explore uncertainty of distributed displacement amplitudes (through node DM 6). For both (4-3) and (4-4), the natural log standard deviations are used to capture aleatory variability in distributed displacement.

Node DM 6 explores equations to derive the average principal fault displacement as a function of magnitude, $D_{ave}(m)$, to provide the input required for implementing (4-4). Three branch alternatives are considered that explore epistemic uncertainty in average principal displacement for the Northern Hayward fault (Figure 4-2). The branch alternatives are based on the published equation of Wells and Coppersmith (1994) constrained by global data of strike-slip ruptures. This equation has the form:

$$\log_{10} D_{ave} = bm + a + \tau\varepsilon \quad (4\text{-}5)$$

with τ representing the published standard deviation of the regression and ε representing the standard normal distribution. Best fit *a* and *b* values are listed in Table 4-3 as are the values for ε and τ. The upper (90th percentile) and lower (10th percentile) branches each are weighted [0.3] and the central (50th percentile) branch has a weight of [0.4] following Keefer and Bodily (1983).

Table 4-3. Parameters used for Average Principal Fault Displacement Estimations Based on Wells and Coppersmith (1994).

Probability	Parameters for $\log_{10} D_{ave} = bm + a + \tau\varepsilon$				Branch Weight
	b	***a***	τ	ε	
90th Percentile	0.90	-5.96	0.28	+1.28	[0.3]
50th Percentile	0.90	-6.32	0.28	0	[0.4]
10th Percentile	0.90	-6.68	0.28	-1.28	[0.3]

4.4 Deterministic Hazard Analysis

In addition to the PFDHA, a deterministic hazard analysis was performed in order to understand the median and higher and lower standard deviation displacements that may be expected from a maximum credible earthquake (MCE) comparable to that selected for deterministic ground motions. Following URS (2015), an MCE of M_W 7.0 on the Hayward fault was selected as the scenario earthquake. The scenario deterministic case for fault displacement hazard implicitly assumes that this earthquake causes surface rupture within the site of interest, and thus the conditional probabilities defined under nodes DM 2 to DM 4 are not applied. The displacement hazard and its uncertainty is estimated following the same equations and weights under nodes DM 5 and DM 6 in Figure 4-2, with r_p values based on Table 3-1. The alternative branches and aleatory variabilities in equations (4-3) and (4-4) allow for assessment of the median (50th), 84th, and other percentile deterministic displacements to be calculated.

5.0 HAZARD RESULTS

Probabilistic and deterministic hazard results presented in this section represent net displacement hazard for the project site. The specific characteristics of the net displacement, including orientation, distribution, horizontal and vertical components, and coseismic slip versus afterslip, are discussed in Section 6.0. The probabilistic results are based on the full PFDHA logic trees shown in Figures 4-1 and 4-2, and were calculated using LCI's hazard code TDISE. The deterministic results are based on a specific set of conditions from the logic trees as described in Section 5.4. The hazard results are presented in four types of figures, as follows:

- Hazard curves showing total hazard for each of the three center points (representing hazard within an approximately 50 m cell dimension) shown in Figure 3-4, as well as a summed mean hazard curve showing the hazard from the combined HAAH-North and HAAH-South cells;
- Hazard fractiles for one center point (representing HAAH-North) showing total epistemic uncertainty in the results captured in the logic trees;
- Hazard curves for one center point (representing HAAH-North) showing weighted hazard contribution by rupture scenario, and conditional (unweighted) hazard curves by rupture scenario to examine the contribution to hazard uncertainty due to the fault source model;
- A deterministic exceedance curve, showing both the mean deterministic exceedance and conditional (unweighted) exceedance curves to examine the contribution to uncertainty from the fault displacement prediction equation.

5.1 Mean Hazard

The mean hazard results of the PFDHA for the three hazard center points are presented in terms of mean annual frequency of exceedance (MAFE; in units of per year) as a function of net displacement amplitude in units of centimeters (panel a) and inches (panel b) (Figure 5-1). The mean, or "total" displacement hazard is the sum of all paths through the logic tree, with each path multiplied by its weight. The MAFE is the reciprocal of the average return period. Figure 5-1 also shows the mean total displacement hazard for the sum of the two center points representing the HAAH (HAAH-North + HAAH-South). As stated in Section 3-4, the 50 m cell dimensions are slightly greater than the physical footprints of the proposed structures they are intended to represent, but this difference is not meaningful compared to the overall uncertainties in the calculation. The individual HAAH point hazard curves and the combined north and south HAAH point hazard curves are an additional representation of probabilistic fault displacement hazard uncertainty for the proposed project site.

The mean hazard curves all fall entirely below the 10^{-3} yr^{-1} MAFE hazard level, indicating that mean hazard is negligible at the 1,000 yr average return period (Figure 5-1). The hazard curves for each 50 m cell center point all fall below the 2×10^{-4} yr^{-1} MAFE, or 5,000 yr average return period as well. The sum of the two HAAH center points, which approximates the hazard of fault displacement beneath the entire proposed HAAH facility, flattens at approximately 2.5×10^{-4} yr^{-1} MAFE, or 4,000 yr average return period. For a displacement amplitude of 1 inch (~2.5 cm), the corresponding mean return periods (rounded to the nearest 1,000 yr) range from 6,000 yr (for the sum of the two HAAH points) to 14,000 yr (for the GSPP). This basic result reflects the very low probabilistic hazard of fault displacement compared to other probabilistic seismic hazard levels commonly considered for buildings. Table 5-1 shows the hazard results (at net displacement in inches) at various MAFEs between 10^{-3} and 10^{-4} yr^{-1} (1,000 and 10,000 yr average return periods).

Table 5-1. PFDHA Results for the GSPP and HAAH at Selected Hazard Levels.

Hazard Level		Net Displacement (inches)[1]			
Mean Annual Exceedance Frequency (yr^{-1})	Average Return Period (yr)	GSPP	HAAH-North	HAAH-South	HAAH-Combined
1×10^{-3} yr^{-1}	1,000	--	--	--	--
4×10^{-4} yr^{-1}	2,500	--	--	--	--
2×10^{-4} yr^{-1}	5,000	--	--	--	0.5
1×10^{-4} yr^{-1}	10,000	<0.1	0.6	0.3	2.5

Note

(1) Dashed line indicates case where hazard curve lies entirely below the specified hazard level, and hazard is considered to be "negligible."

5.2 Hazard Fractiles

As the field of PFDHA is relatively new, it is important to consider the uncertainty in the mean hazard curves. Figure 5-2 shows the hazard fractiles for the HAAH-North point, which represents the closest point to the principal Hayward fault source and highest of the 50 m cell points. The figure shows the mean hazard curve (black dashed line) along with hazard fractiles in colored, solid lines at the 5th, 15th, 50th (median), 85th, and 95th percentiles. These fractile curves indicate the range of possibly correct hazard curves given the epistemic (or model) uncertainties in the logic trees. The 95th fractile, as an example, represents the hazard curve that would be exceeded only 5 percent of the time for all possible paths (scaled by weight) through the logic tree. The 50th (or median) fractile represents a hazard curve that would be exceeded for about half of the possible paths through the logic tree. The weighted mean hazard curve falls between the median and 85th fractile hazard curves, as is common.

The hazard fractiles show that, even at the 95th fractile, the mean hazard is lower than the 10^{-3} yr^{-1} hazard level for the HAAH-North point. At the 4×10^{-4} yr^{-1} hazard level (2,500 yr average return period), the 95th fractile shows a displacement amplitude of only 0.2 cm (about 0.08 inches) (Figure 5-2). This result suggests that the mean hazard results showing negligible hazard at the 10^{-3} hazard level are robust even given the considerable epistemic uncertainties in the logic tree model.

5.3 Hazard Sensitivity to Hayward Fault Source Characterization

Figure 5-3 provides to ways to examine how different concepts of large earthquakes on the Hayward fault source affect the PFDHA results at the GSSP and HAAH sites. Similar to the hazard fractiles, Figure 5-3 shows hazard for the HAAH-North center point only, as results for this point are representative for the entire project area. Panel (a) shows the total hazard curve (dashed black line) and the weighted contribution to the total hazard from each rupture scenario (logic tree node SC 2; Figure 4-1). Reflecting the highest weight for the “Three Segments” [0.5] and “Two Segments (Version B)” [0.3] branches, the blue and purple solid lines show a much greater contribution to the total hazard than the other three branches. The highest weighted “Three Segments” branch, which models earthquakes on the Northern Hayward fault as coming from repeated smaller magnitude, single-segment ruptures, has the largest contribution at the smaller amplitudes (reflecting both the highest weight and a more frequent occurrence), but has a lower contribution to total hazard at amplitudes above 10 cm. Above 10 cm, the hazard is dominated by the “Two-Segment” scenario that models earthquakes on the Northern Hayward fault as coming from repeated earthquakes on a combined Southern + Northern Hayward fault source (Figure 4-3) that are a larger magnitude (and thus larger corresponding displacement, on average) than the single-segment rupture scenario.

Panel (b) of Figure 5-3 shows conditional hazard curves, or unweighted curves. Conditional hazard curves reflect the hazard curves under the sensitivity condition that the particular logic-tree branch is given full weight of [1.0], and the other branches have zero weight. The plot shows that all rupture scenarios except the “Two Segment (Version A)” scenario give very similar rates of earthquakes involving the Northern Hayward fault (as seen by the narrow grouping of curves a the lowest displacement amplitudes). The “Two Segment (Version A)” earthquake scenario, in which the Northern Hayward fault segment and the Rodgers Creek fault rupture together and the Southern Hayward fault segment ruptures independently (Figures 4-1 and 4-3) results in a lower mean rate of earthquakes that the others. This sensitivity shows that the low hazard results for the GSPP and HAAH sites are robust and independent of the assumption made on how large earthquakes are released on the Northern Hayward fault segment.

5.4 Deterministic Displacement Hazard

The deterministic displacement hazard for the project site is shown as a plot of exceedance probability versus net displacement, with displacement amplitude in inches (Figure 5-4). As described in Section 4.4, the deterministic analysis is based on an MCE M_W 7.0 earthquake on the entire Hayward fault source (Northern + Southern fault segments), similar to the scenario earthquake selected for deterministic ground motion analysis (URS, 2015). In the deterministic analysis, displacement hazard is estimated based on assuming that the scenario earthquake ruptures beneath the site, and the amplitude of displacement is captured by weighted uncertainties in the secondary displacement exceedance model (nodes DM 5 and DM 6 in Figure 4-2). Each displacement exceedance equation includes an aleatory term that describes event-to-event natural variability in amplitude (Section 4.3.3, equations 4-3 and 4-4). Figure 4-5 shows the weighted mean displacement exceedance curve (solid black line) and conditional exceedance curves (dashed lines) for each of the four branch combination alternatives for predicting displacement at the project site given the occurrence of the M_W 7.0 scenario earthquake. As the r_p distance in (4-3) and (4-4) is a very weak predictor of displacement amplitude, the exceedance curves in Figure 5-4 applies to the entire site. The plot shows that, especially at the median exceedance probability, the selection of functional form of the displacement prediction model (i.e., node DM 5 in Figure 4-2) has very little effect on hazard estimation. When considering uncertainties in the average displacement (D_{ave}) of the entire rupture given magnitude, however, as explored in node DM 6, uncertainty in the median displacement is on the order of a factor of two (Figure 5-4).

Deterministic net displacement exceedance values at the median (50th percentile), 16th percentile, and 84th percentile are listed in Table 5-2 and indicated on Figure 5-4 as dashed horizontal lines. These values, or other percentile values, range from 1 to 11 inches with a median value of 4 inches, and may be used by the project in the event the project desires to consider displacement hazard and its possible impact on the project from a scenario—rather than probabilistic—perspective.

Table 5-2. Deterministic Displacement Hazard Results for the GSPP and HAAH Sites at Selected Percentiles.

Hazard Level		Mean Net Displacement Hazard (inches)
Percentile	Corresponding Average Return Period[1] (yr)	
16th	12,500	1
50th (median)	25,000	4
84th	100,000	11

Note

(1) Corresponding average return periods are for a PFDHA calculated for a generic 50 m cell within the project area (e.g., hazard curves for single points in Figure 5-1). Return periods are rounded to the nearest 500 yr for the 16th percentile and to the nearest 1,000 yr for the median and 84th percentile levels.

Although 50th and 84th percentile deterministic values are commonly considered in PSHA, we show the 16th percentile deterministic values as well. We do so to reflect the results of both the PFDHA and the geological analysis in Section 2 that suggest the activity of the Louderback shear zone (and the potential for fault rupture at the GSPP and HAAH sites) is low, and therefore evaluating the performance of the proposed facilities for displacement amplitudes less than the median may be justifiable.

6.0 DISPLACEMENT CHARACTERISTICS

A practical goal of the fault displacement hazard analysis is to provide guidance for engineering assessments of the possible performance impacts of fault displacement hazard. If the project decides to consider non-negligible fault displacement in a performance evaluation or in structural design, we provide summary information to help guide an understanding of how earthquake-related net displacements beneath the project site, with amounts and probabilities of exceedance based on the deterministic and PFHDA results in Section 5, may be distributed beneath the structures, how the slips may be oriented, and what the likely horizontal and vertical slip components would be. In addition, we discuss the uncertainty related to the timing of the displacement, and whether it may occur entirely as coseismic displacement or as a combination of coseismic slip and afterslip. Displacement characteristics based on the geologic assessment are summarized in Table 6-1.

Localization or distribution of displacement and orientation

The net displacement hazards estimated in Section 5 may be either localized on a single slip plane or distributed across a broad shear zone beneath the project facility. This broad uncertainty is due to the incomplete knowledge of geologic conditions directly beneath the site. The late Pleistocene fault beneath the proposed HAAH as documented by WCA (1970) and shown in Figures 2-1, 2-3, and 3-4 is a clear potential source for secondary displacement to localize, but the net displacements may also manifest as distributed shear or localized slip across other portions of the facility.

The likely orientation of the displacement is sub-parallel to the principal Hayward fault trace to sub-parallel to fault strands within the Louderback shear zone documented by HLA (1988) and others (Figure 1-2). Displacements on steeply dipping planes striking approximately N40°W, but possibly between N15°W and N55°W are most probable (Table 6-1).

Slip direction and horizontal and vertical slip components

Secondary fault displacement or distributed shear beneath the GSPP and HAAH structures is likely to be in a direction sub-parallel to the slip on the principal Hayward fault, with the possibility that the secondary displacements may accommodate a greater ratio of vertical displacement due to slip partitioning. Our preferred interpretation, based on the HLA (1988) trenches and geologic relationship of the WCA (1970) exposure, is that the slip will occur as right-lateral strike slip with an east-side up vertical component (Table 6-1). Although east-side up is considered most likely, we cannot preclude west-side up vertical components. The relative components of vertical and horizontal slip are similarly uncertain, but we recommend that two end-members be considered in analysis based on an evaluation of distributed displacements from strike-slip earthquakes in Petersen et al. (2011): First, a strike-slip scenario where horizontal slip is equal to the net displacements from Section 5, and vertical slip is negligible. The second end-member is an oblique slip case (with a rake of about 50°) where vertical slip is a maximum of 0.75 times the net displacement, and the horizontal slip component is 0.66 times the net displacement (Table 6-1). The Petersen et al. (2011) dataset suggest that, although steeper rakes are observed, they are relatively rare compared to rakes less than about 50°.

Table 6-1. Characteristics of Possible Secondary (or Distributed) Displacements beneath the GSPP and HAAH Sites.

Characteristic	**Notes**
Localization	May be localized as secondary fault displacement (e.g., on an existing fault like the one documented by WCA (1970) under Parking Structure H) or as distributed shear beneath the entire structural footprint.
Orientation	Subparallel to Louderback shear zone faults or principal Hayward fault; consider N40°W (preferred); N15°W to N55°W (range) for strike; subvertical to steeply east or west dipping.
Slip direction	Right-lateral strike-slip with an east-side up vertical component is most likely; west-side up vertical component possible but less likely
Vertical and horizontal amounts	Consider end-member "strike-slip" and "oblique" possibilities. Strike-slip case: Horizontal = 1.0*net displacement; Vertical = 0 Oblique case: Max vertical = 0.75*net displacement; Horizontal = 0.66*net.
Timing of displacement	Slip will probably be a combination of coseismic slip and post-seismic afterslip; afterslip likely would be power-law exponential decay in hours/days/weeks following the earthquake as per Aagaard et al. (2012).

Timing of displacement

Due to the creeping behavior of the Northern Hayward fault, surface-fault rupture following a large earthquake is expected to occur by a combination of coseismic slip and post-seismic afterslip (Aagaard et al., 2012). Examination of earthquake afterslip following several historical California earthquakes suggests that displacement follows a power-law decay with slip occurring weeks to months following the earthquake. Although it is uncertain whether distributed or secondary displacement follows a similar coseismic-afterslip pattern as principal faulting, we consider it most likely that the timing of secondary or distributed slip beneath the GSPP and HAAH would be some combination of coseismic slip (during strong ground shaking) and post-seismic afterslip (after shaking and decaying in the hours to weeks following the earthquake) (Table 6-1).

7.0 CONCLUSIONS

This evaluation included a review of information on the Louderback shear zone and a displacement hazard analysis for the proposed GSPP and HAAH facilities in Berkeley, California. The review of geological and geotechnical information suggests that the Louderback shear zone identified previously to the southeast extends beneath the GSPP and HAAH sites, and in at least one location (beneath the proposed HAAH) a late Quaternary fault underlies the site. Based on review of reports and discussions with experts, the preponderance of evidence is that faults within the Louderback shear zone are not Holocene active, but several of them have moved in the late Quaternary and there is still uncertainty regarding the potential for secondary displacement within the shear zone during future, large earthquakes on the adjacent Northern Hayward fault. A probabilistic and deterministic hazard analysis explores the fault displacement hazard to the GSPP and HAAH project sites. The hazard comes from secondary faulting or distributed tectonic deformation resulting from a large earthquake on Northern Hayward fault. The actively creeping, principal strand of the Northern Hayward fault is well located approximately 160 to 250 m east of the project site, and thus principal fault displacement hazard is not considered applicable for the project sites.

The PFDHA shows that the fault displacement hazard low for the project sites compared to hazard levels commonly considered for seismic loads in building design. There is a negligible displacement hazard to the GSPP and HAAH facilities at hazard levels corresponding to average return periods of 1,000 and 2,500 years, and the hazard corresponding to a 10,000 yr average return period is less than an inch for any given 50 m × 50 m cell location beneath the proposed project, and is on the order of 2.5 inches for the entire HAAH facility footprint (Table 5-1). Examination of hazard fractiles and a sensitivity to Hayward fault rupture scenarios suggest that the low hazard result—especially at the 1,000 and 2,500 yr average return periods—is robust.

The deterministic displacement hazard analysis, which explores the amount of displacement that may be expected beneath the GSPP or HAAH facilities given a scenario M_W 7.0 Hayward fault earthquake that does produce rupture beneath the project site, suggests a median displacement may be on the order of 4 inches, and displacements of 1 to 11 inches are possible at the 16th to 84th percentile levels, respectively (Table 5-2). The average return periods from the PFDHA corresponding to these amplitudes are between 12,500 yr (for the 1 inch displacement hazard at the 16th percentile) to 100,000 yr (for the 11 inch displacement at the 84th percentile). These long average return periods are qualitatively consistent with the geological assessments of the Louderback shear zone, which suggest that rupture probably last occurred prior to about 11,000 years ago.

If the project wishes to consider fault displacement hazard in the design or performance evaluation of the proposed structures, displacement characteristics are provided in Section 6. These characteristics include the estimated localization, displacement orientation and direction, relative amounts of horizontal and vertical displacement, and the expected timing of displacement (as a combination of coseismic slip and post-seismic afterslip). These parameters may be developed further if necessary for the project.

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8.0 REFERENCES

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Figures

EXPLANATION

- Project site
- Creek; solid where visible, dotted where underground (modified from Sowers et al., 2010)
- A-P zone boundary (CGS, 2001)
- Fault; solid where certain, dashed where approximate (CGS, 2001)

N W E S

0 200 400 ft

0 100 200 m

Map projection and scale: NAD 1983 UTM Zone 10N, 1:4,000

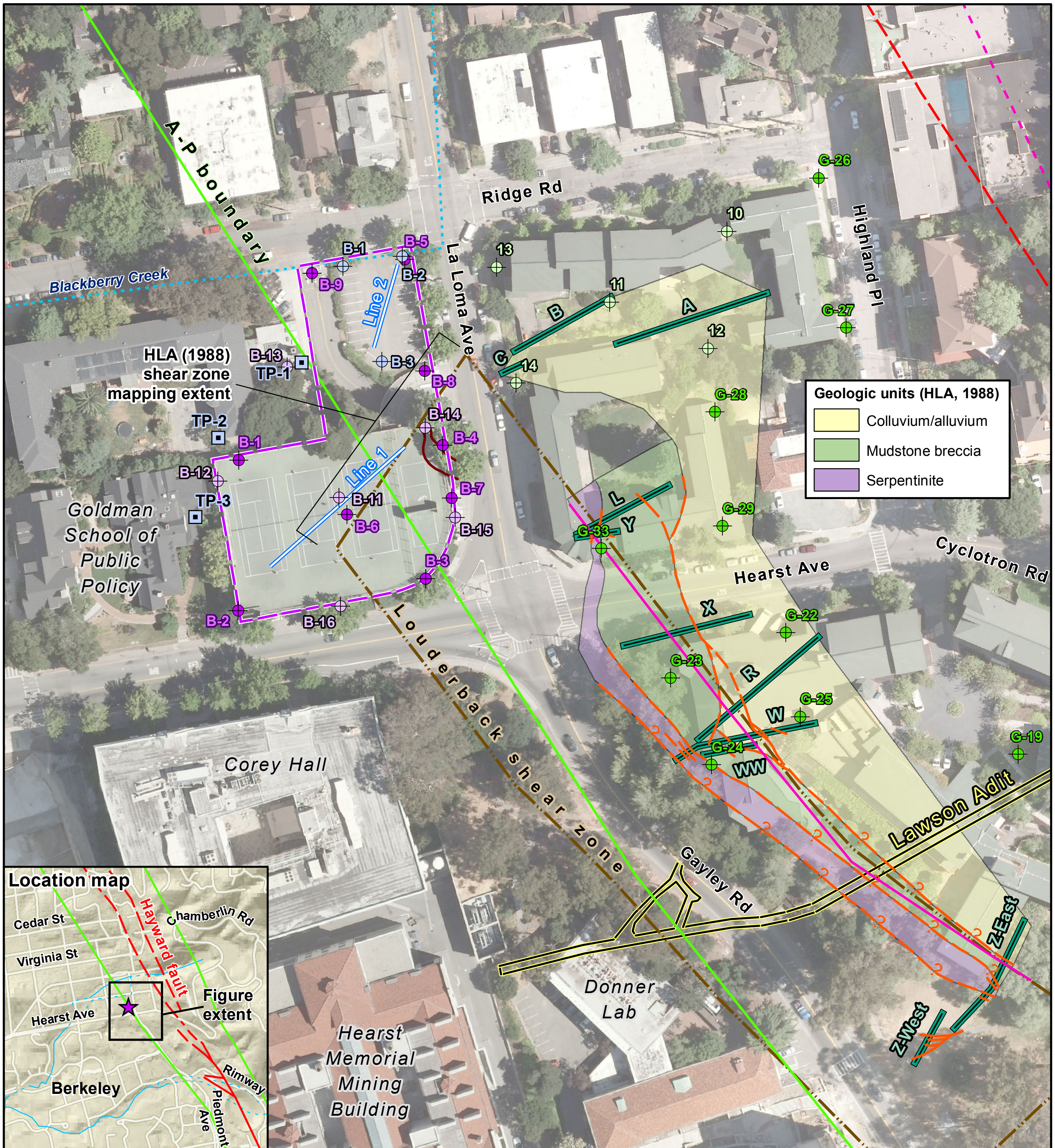
Building Site Location Map of the GSPP-HAAH

UCB LANGAN GSPP-HAAH PROJECT

Lettis Consultants International, Inc. | Figure **1-1**

Sources:
Aerial imagery from USGS (2009)
0.5 m hillshaded DEM from Earthscope (2007)
10 m hillshaded DEM from USGS NED (2013)

File path: S:\1729\Figures\Figure_1-1.mxd; Date: 10/08/2018; User: ase, LCI; Rev.1



EXPLANATION

Project site

Creek; solid where visible, dotted where underground (modified from Sowers et al., 2010)

Exploration data:

- Test pit (Langan, 2017)
- Boring (Langan, 2017)
- Boring (HLA, 1986)
- Boring (HLA, 1988)
- Boring (WCA, 1959)
- Boring (WCA, 1969)
- Trench (HLA, 1988)
- Lawson Adit
- Seismic line (Langan, 2017)

Fault data:

- Fault; solid where certain, dashed where approximate (Lienkaemper, 2006)
- Fault; solid where certain, dashed where approximate (CGS, 2001)
- ? Fault; solid where certain, dashed where approximate, queried where uncertain (HLA, 1988)
- Fault (WCA, 1970)
- A-P zone boundary (CGS, 2001)
- Louderback shear zone (HLA, 1988)

Notes:
- HLA - Harding Lawson Associates
- WCA - Woodward-Clyde & Associates
- Geologic unit mapping extent based on HLA (1986, 1988) trench observations.

Sources:
- Aerial imagery from USGS (2009)
- 10 m hillshaded DEM from USGS NED (2013)

N S W E

0 100 200 ft

0 50 100 m

Map projection and scale: NAD 1983 UTM Zone 10N, 1:1,500

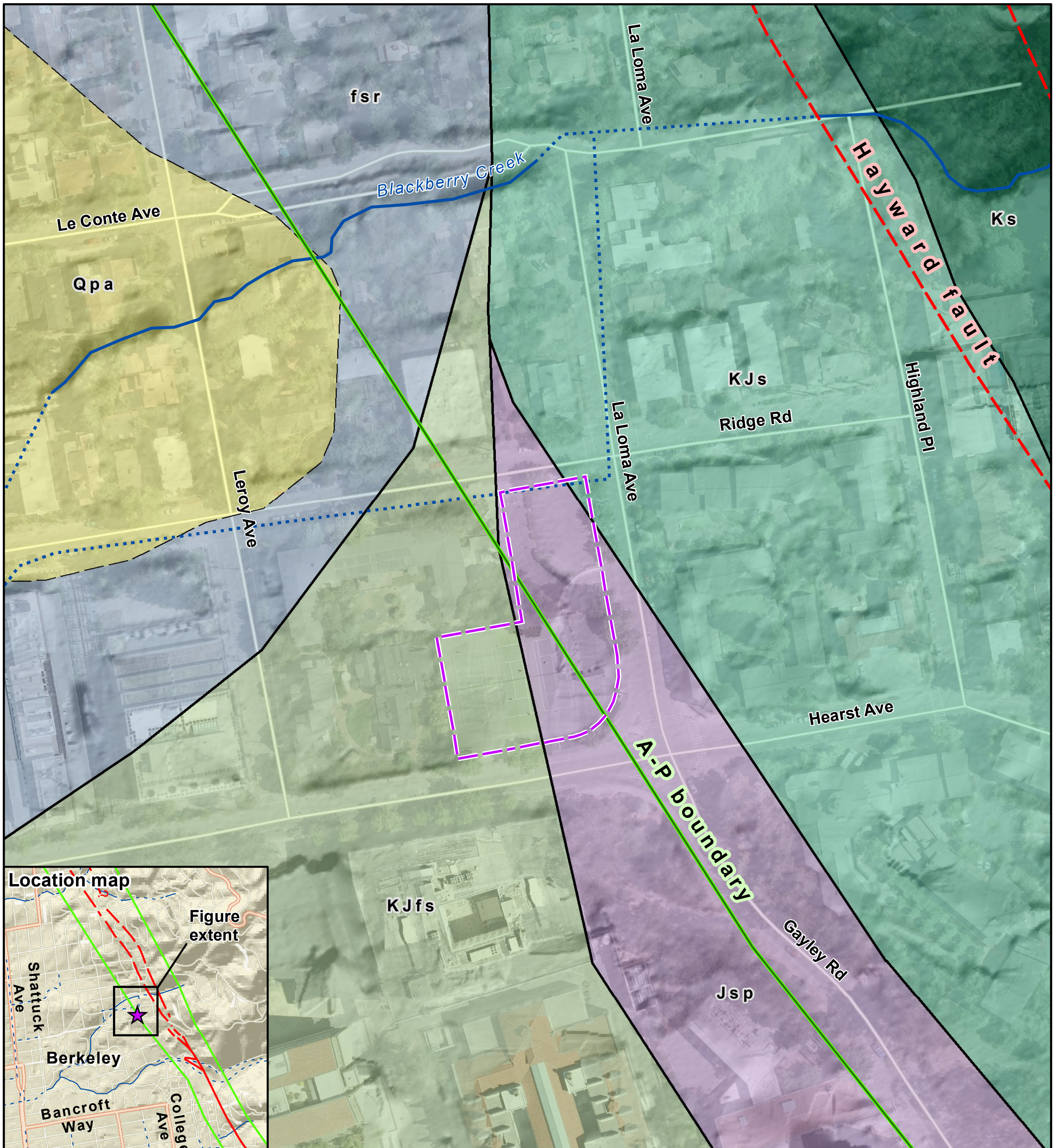
Locations of Subsurface Investigations Across the Louderback Shear Zone

UCB LANGAN GSPP-HAAH PROJECT

LCI Lettis Consultants International, Inc.

Figure **1-2**

File path: S:\1729\Figures\Figure_1-2.mxd; Date: 10/08/2018; User: ase, LCI; Rev.1



EXPLANATION

Project site

Creek; solid where visible, dotted where underground (modified from Sowers et al., 2010)

Fault data

A-P zone boundary (CGS, 2001)

Fault; solid where certain, dashed where approximate (CGS, 2001)

Fault (Graymer et al., 2006)

Geologic Units (Graymer et al., 2006)

Geologic contact

Qpa - Alluvium (Pleistocene)

fsr - Franciscan Complex mélange (Eocene, Paleocene, Cretaceous)

Ks - Great Valley complex sedimentary rocks (Cretaceous)

KJs - Great Valley complex sedimentary rocks (Cretaceous, Jurassic)

KJfs - Franciscan Complex sedimentary rocks (Cretaceous, Jurassic)

Jsp - serpentinite (Jurassic)

Sources:
Aerial imagery from USGS (2009)
0.5 m hillshaded DEM from Earthscope (2007)
10 m hillshaded DEM from USGS NED (2013)

N W E S

0 100 200 ft

0 50 100 m

Map projection and scale: NAD 1983 UTM Zone 10N, 1:2,000

Geologic Map of the GSPP-HAAH Building Site Area

UCB LANGAN GSPP-HAAH PROJECT

LCI Lettis Consultants International, Inc.

Figure **1-3**

File path: S:\1729\Figures\Figure_1-3.mxd; Date: 10/08/2018; User: ase, LCI; Rev.1

(a) Project Site

(b) Location of WCA (1970) Foundation Excavation Mapping

EXPLANATION

- Project site
- Parking structure H
- Creek; solid where visible, dotted where underground (modified from Sowers et al., 2010)

Exploration data:

- Test pit (Langan, 2017)
- Boring (WCA, 1959)
- Cross section (WCA, 1970)
- Boring (Langan, 2017)
- Boring (WCA, 1969)
- Seismic line (Langan, 2017)
- Boring (HLA, 1986)

Fault data:

- Fault (WCA, 1970)
- Louderback shear zone (HLA, 1988)
- A-P zone boundary (CGS, 2001)

Notes:
See Figure 2-3 for cross section details
HLA - Harding Lawson Associates
WCA - Woodward-Clyde & Associates

Sources:
Aerial imagery from USGS (2009)
Panel (b) topo basemaps from WCA (1970)

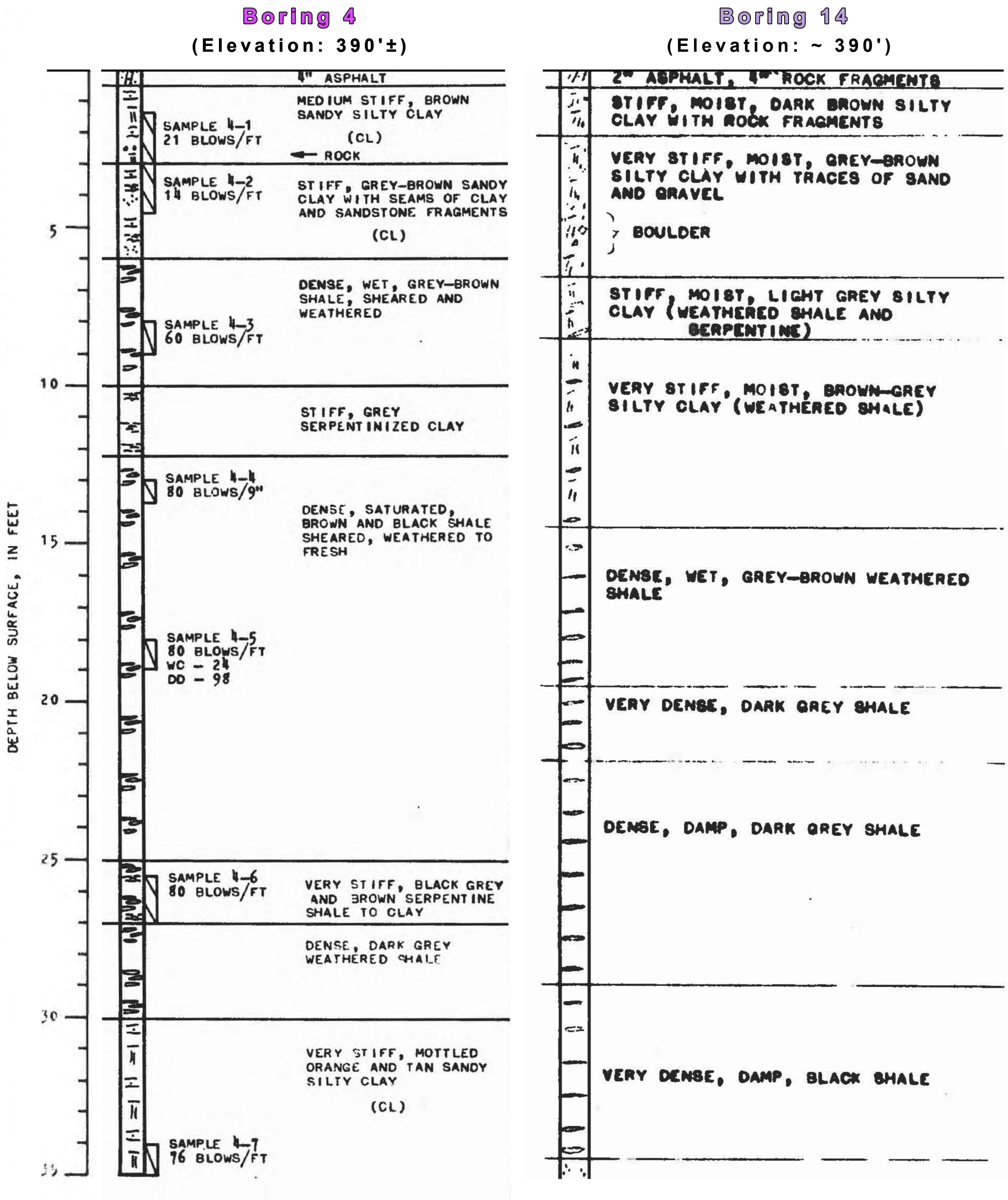
Map projection: NAD 1983 UTM Zone 10N

Fault Traces Mapped by Woodward-Clyde & Associates (1970) in Parking Structure H Foundation Excavation

UCB LANGAN GSPP-HAAH PROJECT

Lettis Consultants International, Inc. | Figure **2-1**

File path: S:\1729\Figures\Figure_2-1.mxd; Date: 10/08/2018; User: ase, LCI; Rev.1



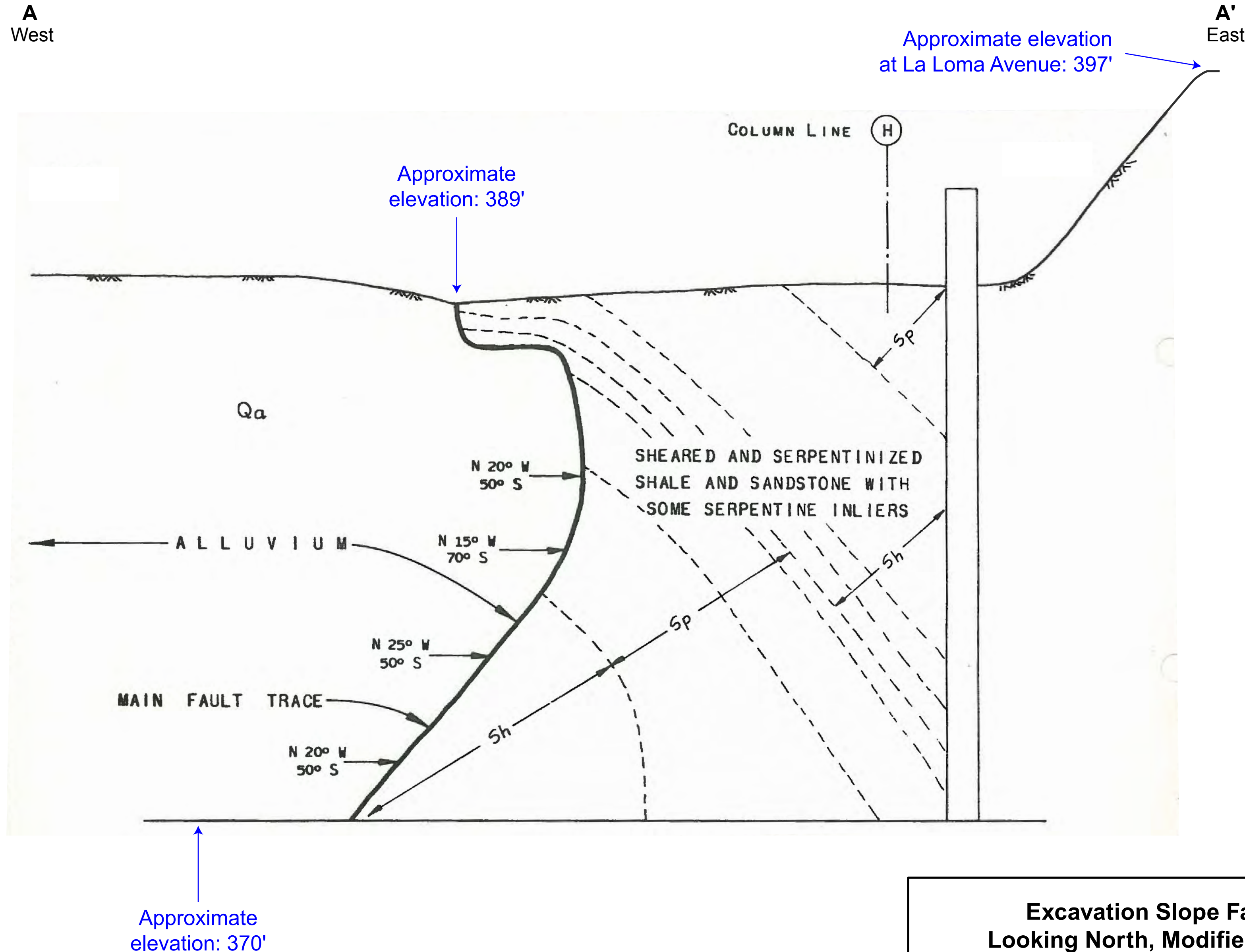
Notes:
- See Figure 1-2 for location of borings.
- Boring 14 continues an additional 28' until bottom of hole.
- Elevation of Boring 14 was not provided in the log and was estimated from a 1969 topographic survey of the project site.

Logs of Boring 4 and Boring 14 from Woodward-Clyde & Associates (1969)

UCB LANGAN GSPP-HAAH PROJECT

Lettis Consultants International, Inc. | Figure 2-2

File path: S:\1729\Figures\Figure_2-2.ai; Date: 08/15/2018; User: Åse, LCI; Rev.1

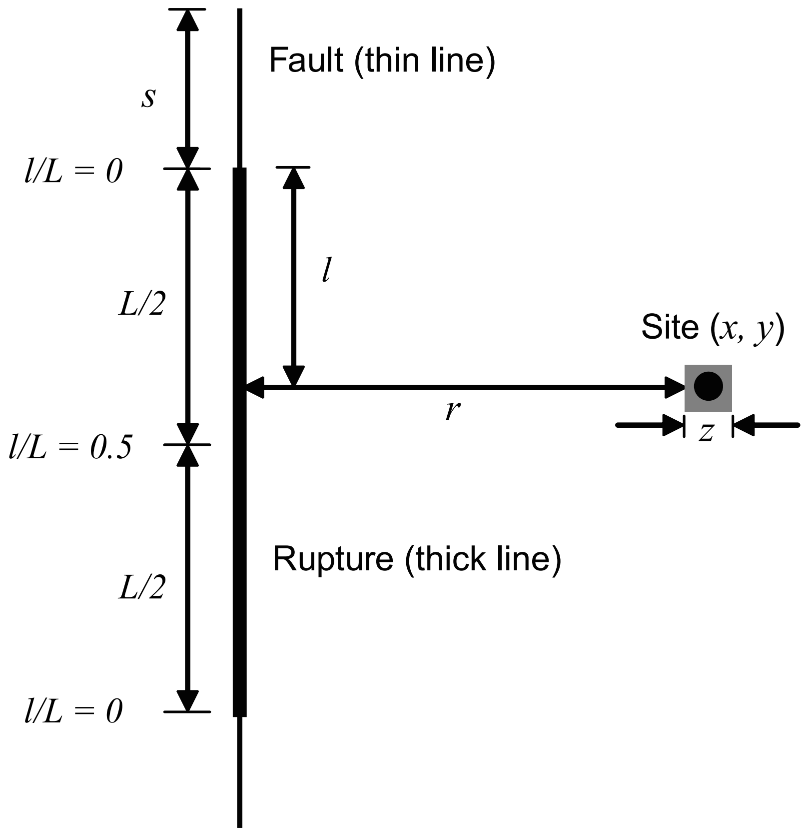


Notes:
- Approximate scale: 1 in. = 3 ft.
- See Figure 2-1 for cross section location
- Reconstruction suggests approximately 8 ft of material has been removed above the existing exposure which suggests near-surface Holocene material is likely absent.

Excavation Slope Face Looking North, Modified from Woodward-Clyde & Associates (1970)

UCB LANGAN GSPP-HAAH PROJECT

Lettis Consultants International, Inc. | Figure **2-3**



Variables used in the fault-displacement hazard analysis:

x,y	Site coordinates
z	Dimension of the site area considered for probability of fault rupture
r	Distance from the site to the mapped fault trace
l	Distance from the nearest point on the rupture to the closest end of the rupture
L	Total Rupture Length
s	Distance from the end of the rupture to the end of the fault

Definition of PFDHA Variables, Earthquake Magnitude Approach (After Petersen et al., 2011)

UCB LANGAN GSPP-HAAH PROJECT

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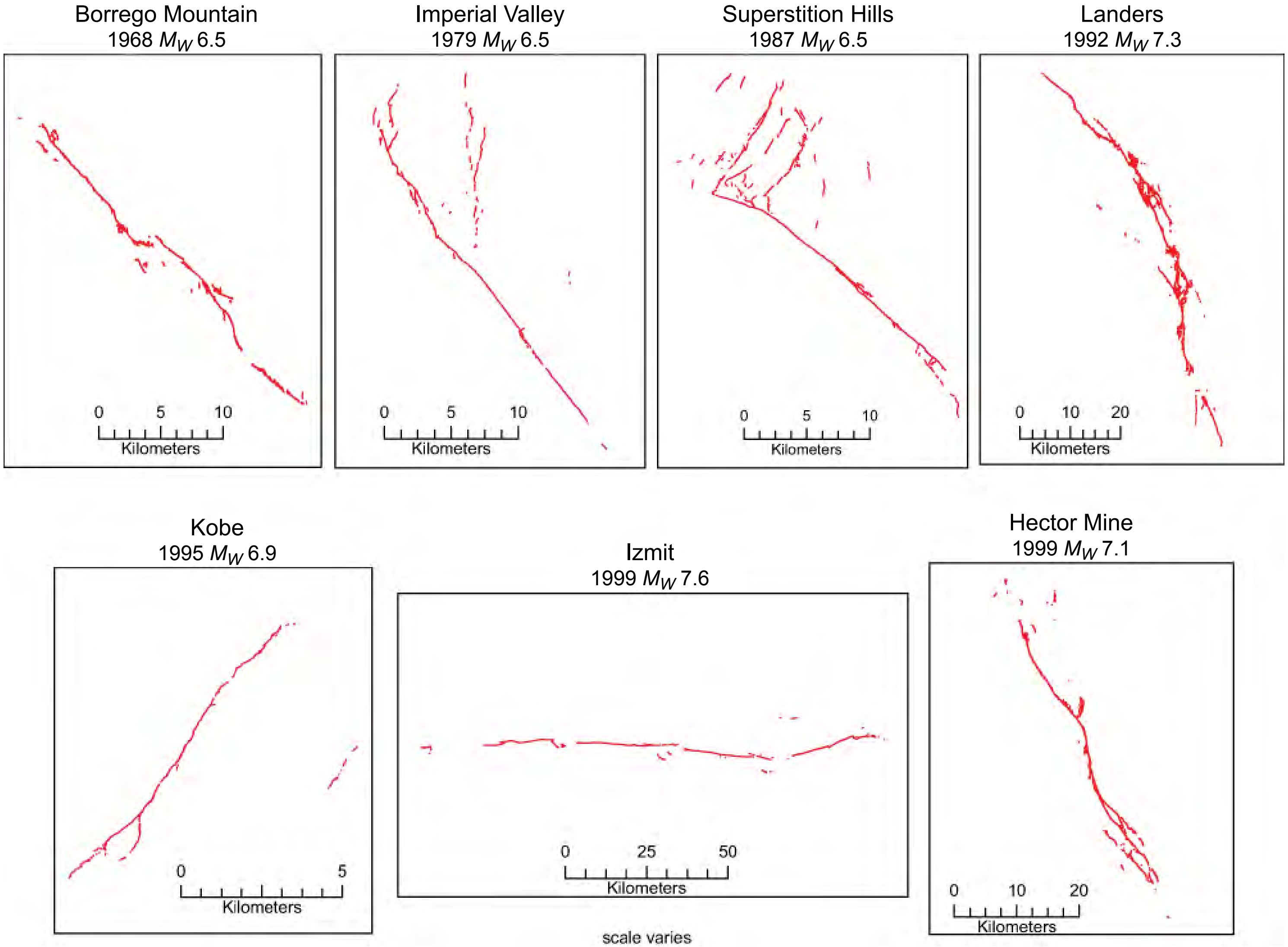
Figure **3-1**

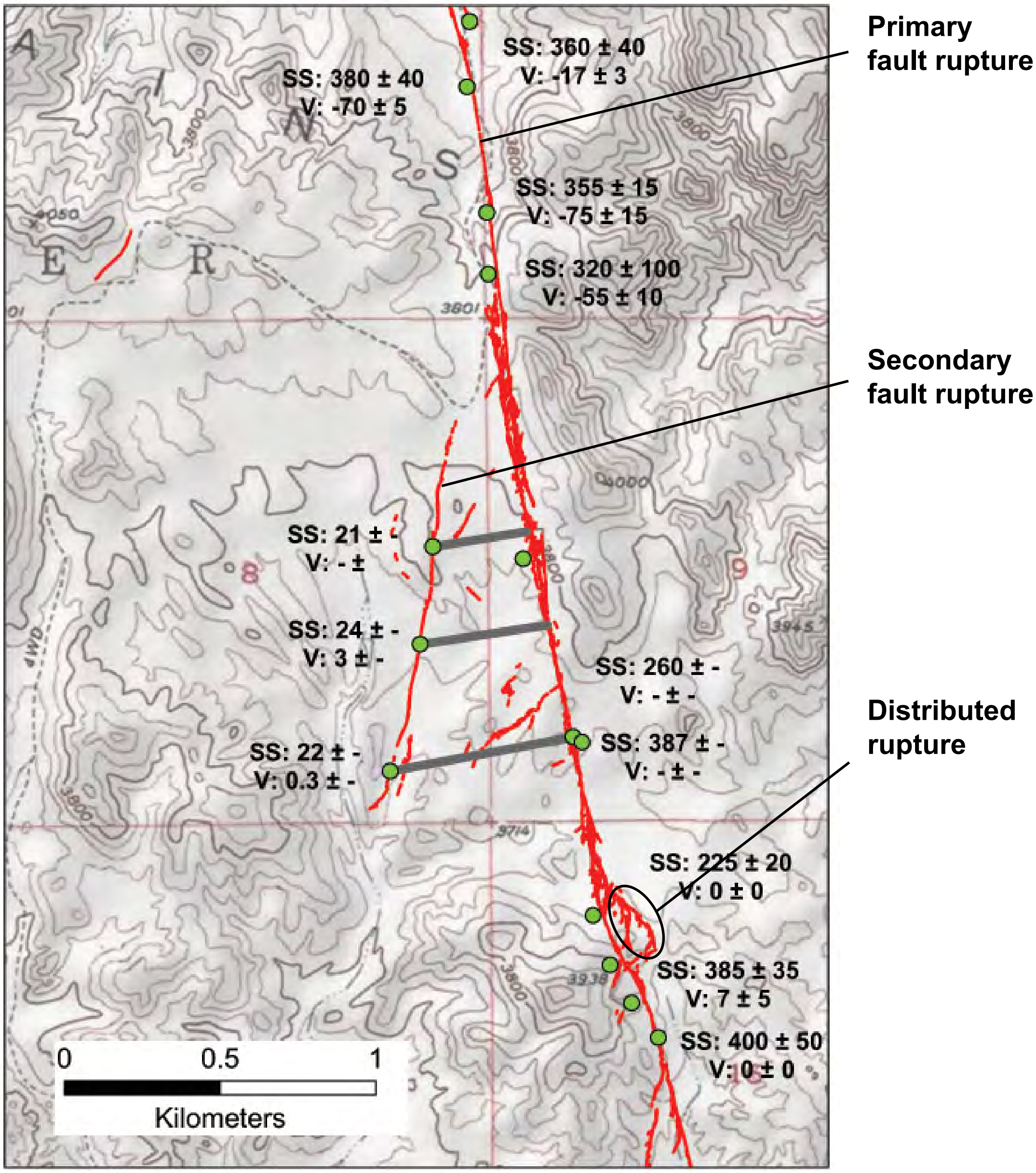
File path: S:\1729\Figures\Figure_3-1.ai; Date: 08/16/2018; User: Åse, LCI; Rev.1



Examples of Historic Strike-Slip Surface Ruptures (After Petersen et al., 2011)

UCB LANGAN GSPP-HAAH PROJECT

Lettis Consultants International, Inc. | Figure **3-2**



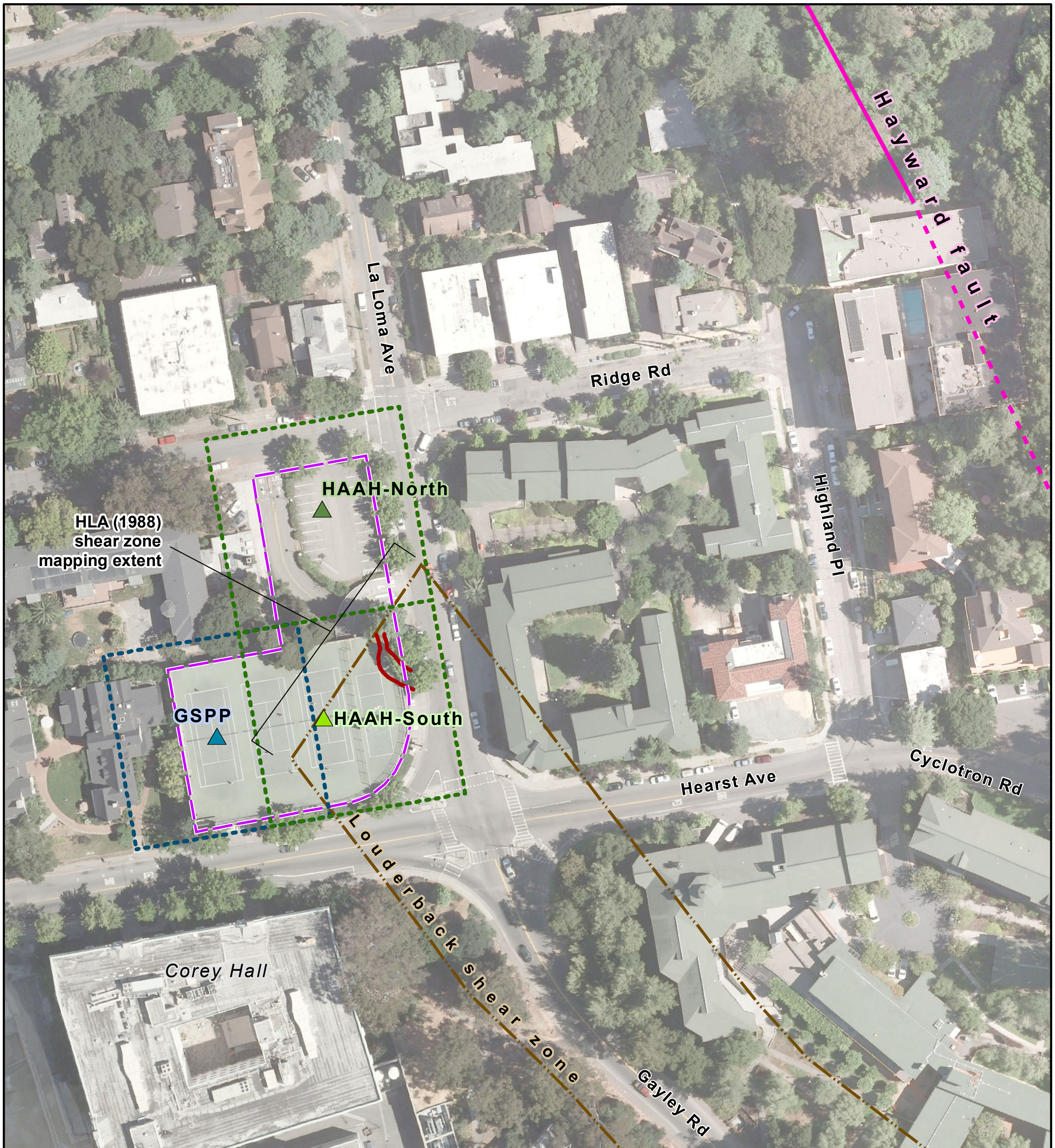
EXPLANATION

SS:	Lateral component of slip in centimeters
V:	Vertical component of slip in centimeters
●	Slip measurements
▬	Distance from secondary rupture to primary rupture

Example of Primary, Secondary, and Distributed Fault Rupture, Hector Mine Earthquake (After Petersen et al., 2011)

UCB LANGAN GSPP-HAAH PROJECT

Lettis Consultants International, Inc. | Figure **3-3**



EXPLANATION

Project site

Fault data:

Principal Hayward fault; solid where certain, dashed where approximate (Lienkaemper, 2006)

Fault (WCA, 1970)

Louderback shear zone (HLA, 1988)

Hazard location center point:

GSPP

HAAH-North

HAAH-South

Hazard cells (50 m x 50 m):

GSPP

HAAH

Notes:
GSPP - Goldman School of Public Policy
HAAH - Hearst Avenue Academic Housing

Sources:
Aerial imagery from USGS (2009)

0 100 200 ft

0 50 100 m

Map projection and scale: NAD 1983 UTM Zone 10N, 1:1,500

Hazard Calculation Point and 50 m Cell Locations

UCB LANGAN GSPP-HAAH PROJECT

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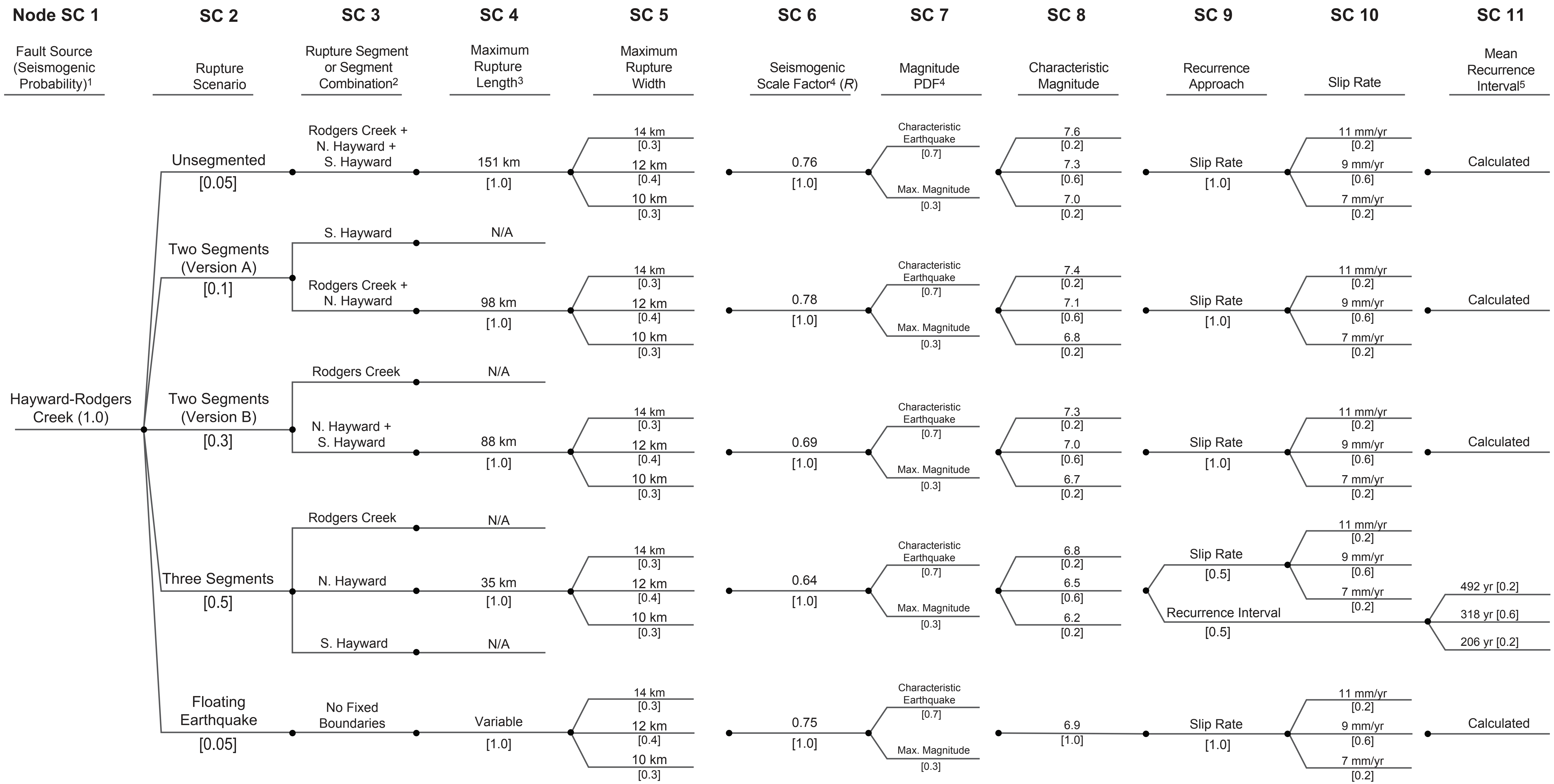
Figure **3-4**

File path: S:\1729\Figures\Figure_3-4.mxd; Date: 10/08/2018; User: ase, LCI; Rev.1



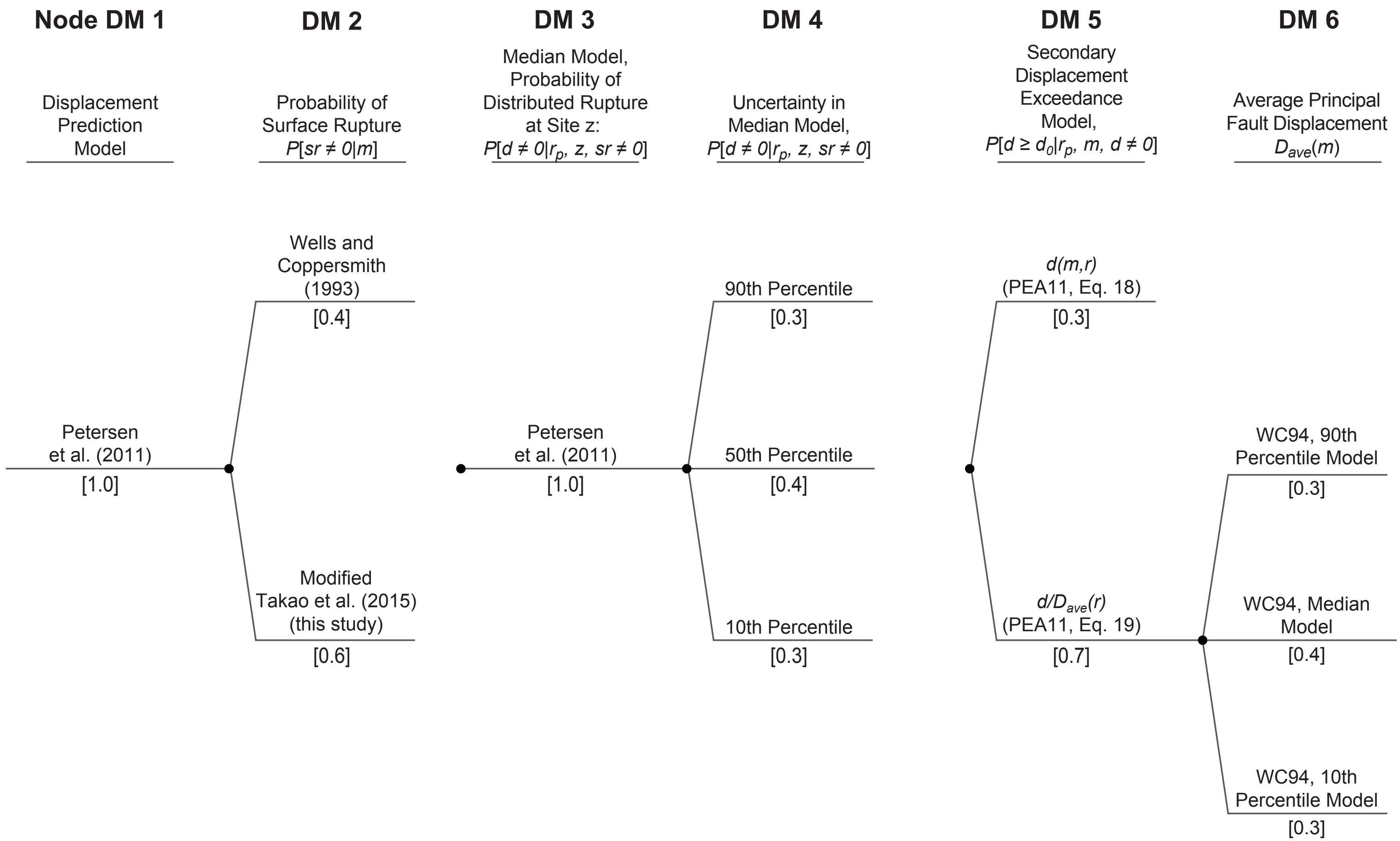
Notes:
1. Fault source characterization based on URS (2015).
2. Figure 4-3 shows locations of fault segments used to construct the rupture sources.
3. For rupture sources that do not involve the Northern Hayward segment, “N/A” (not applicable) is listed to indicate it is not part of the hazard assessment.
4. See text for explanation.
5. Mean recurrence rates (inverse of recurrence intervals) are calculated using moment balancing when fault slip rate is the approach. Slip rates are multiplied by the R value in the moment balancing.

Source Characterization Logic Tree for Northern Hayward Fault

UCB LANGAN GSPP-HAAH PROJECT

Lettis Consultants International, Inc. | Figure **4-1**

File path: S:\1729\Figures\FIGURE_4-1.ai; Date: 08/15/2018; User:Steve, LCI; Rev.1



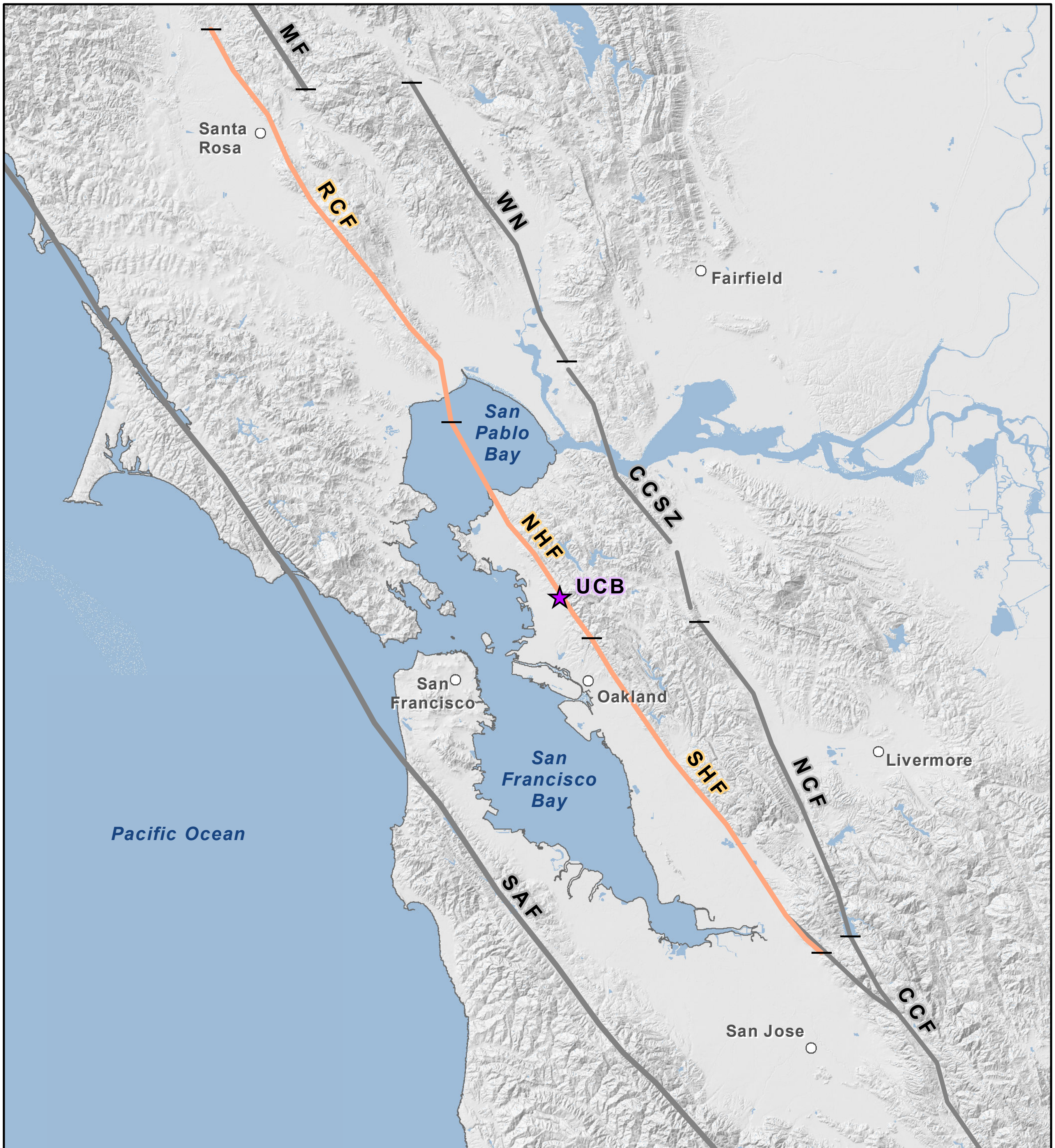
Notes:
- PEA11 = Petersen et al. (2011)
- WC94 = Wells and Coppersmith (1994)

Displacement Prediction Model Logic Tree

UCB LANGAN GSPP-HAAH PROJECT

Lettis Consultants International, Inc. | Figure **4-2**

File path: S:\1729\Figures\fIGURE_4-2.ai; Date: 08/16/2018; User:Steve, LCI; Rev.1



EXPLANATION:

Project Site

Fault segment:
NHF - Northern Hayward fault
RCF - Rodgers Creek fault
SHF - Southern Hayward fault

Selected other fault sources:
CCF - Central Calaveras fault
CCSZ - Contra Costa shear zone
MF - Maacama fault
NCF - Northern Calaveras fault
SAF - San Andreas fault
WN - West Napa fault

Sources:
Faults modified from WGCEP (2008)
30 m hillshaded DEM from DFG (2002)

N 0 5 10 20 mi
0 10 20 40 km

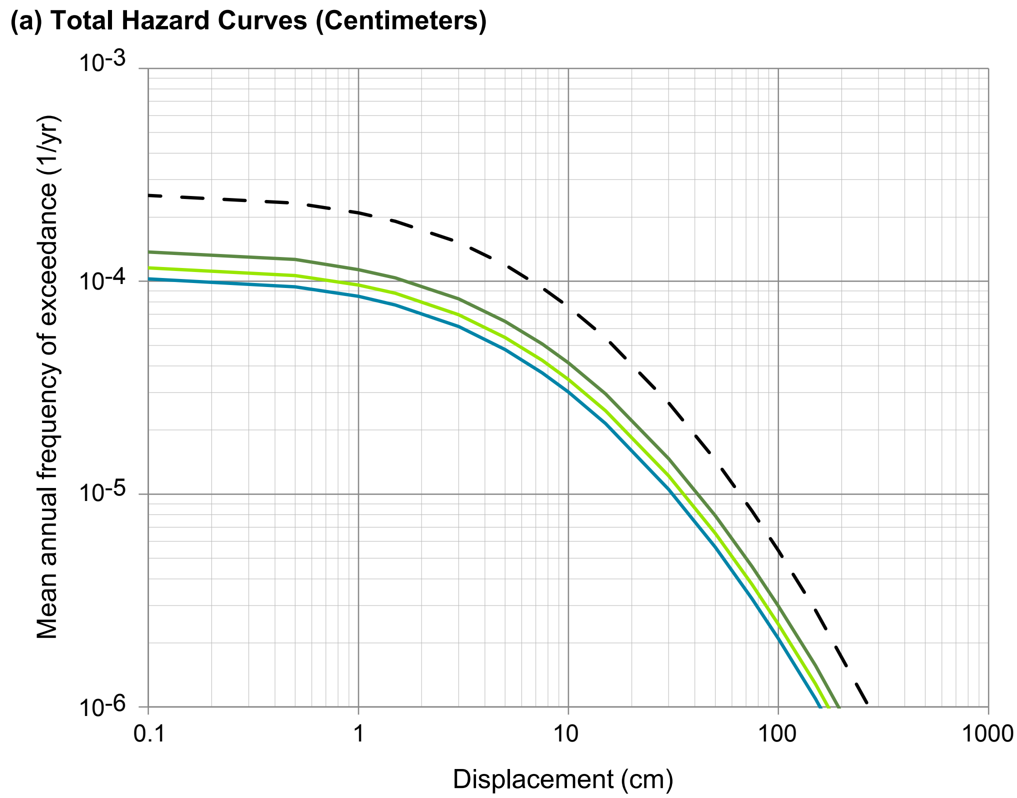
Map projection and scale: NAD 1983 UTM Zone 10N, 1:800,000

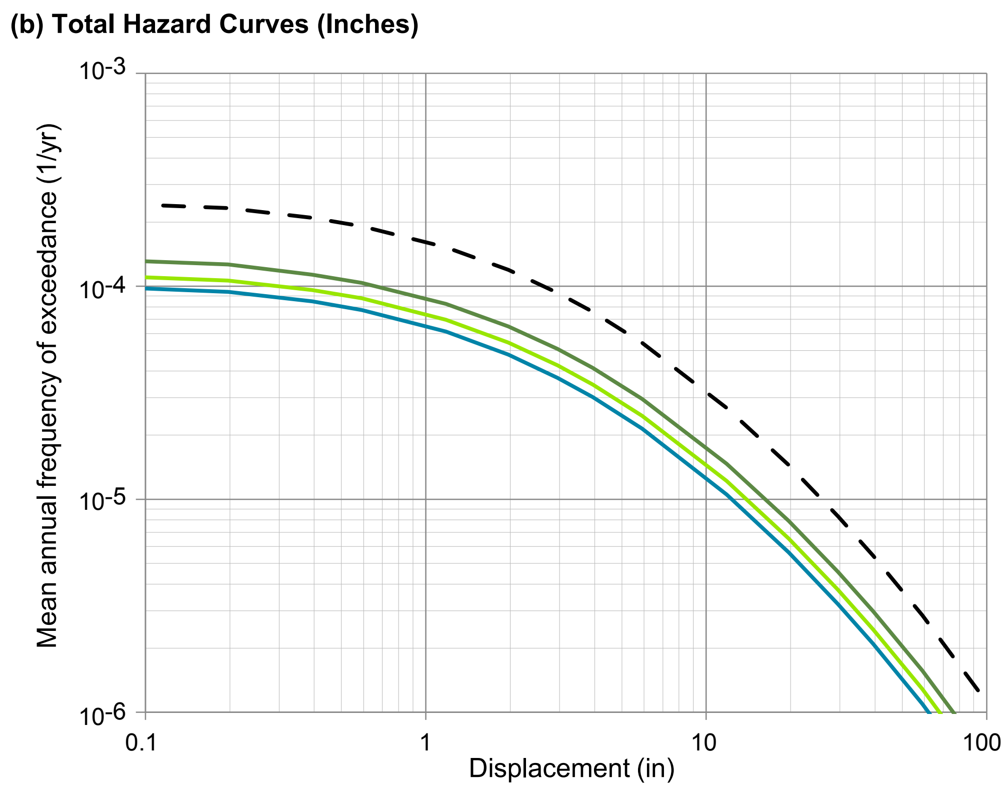
Hayward-Rodgers Creek Fault Source

UCB LANGAN GSPP-HAAH PROJECT

Lettis Consultants International, Inc. | Figure **4-3**

File path: S:\1729\Figures\Figure_4-3.mxd; Date: 10/08/2018; User: ase, LCI; Rev.1





EXPLANATION

- GSPP
- HAAH-North
- HAAH-South
- HAAH-Sum

Notes:
- Figure 3-4 shows location of 50 m cells and center points

Total Displacement Hazard Curves for the GSPP, HAAH-North, and HAAH-South 50 m Cells, and Summed HAAH Cells in (a) Centimeters and (b) Inches

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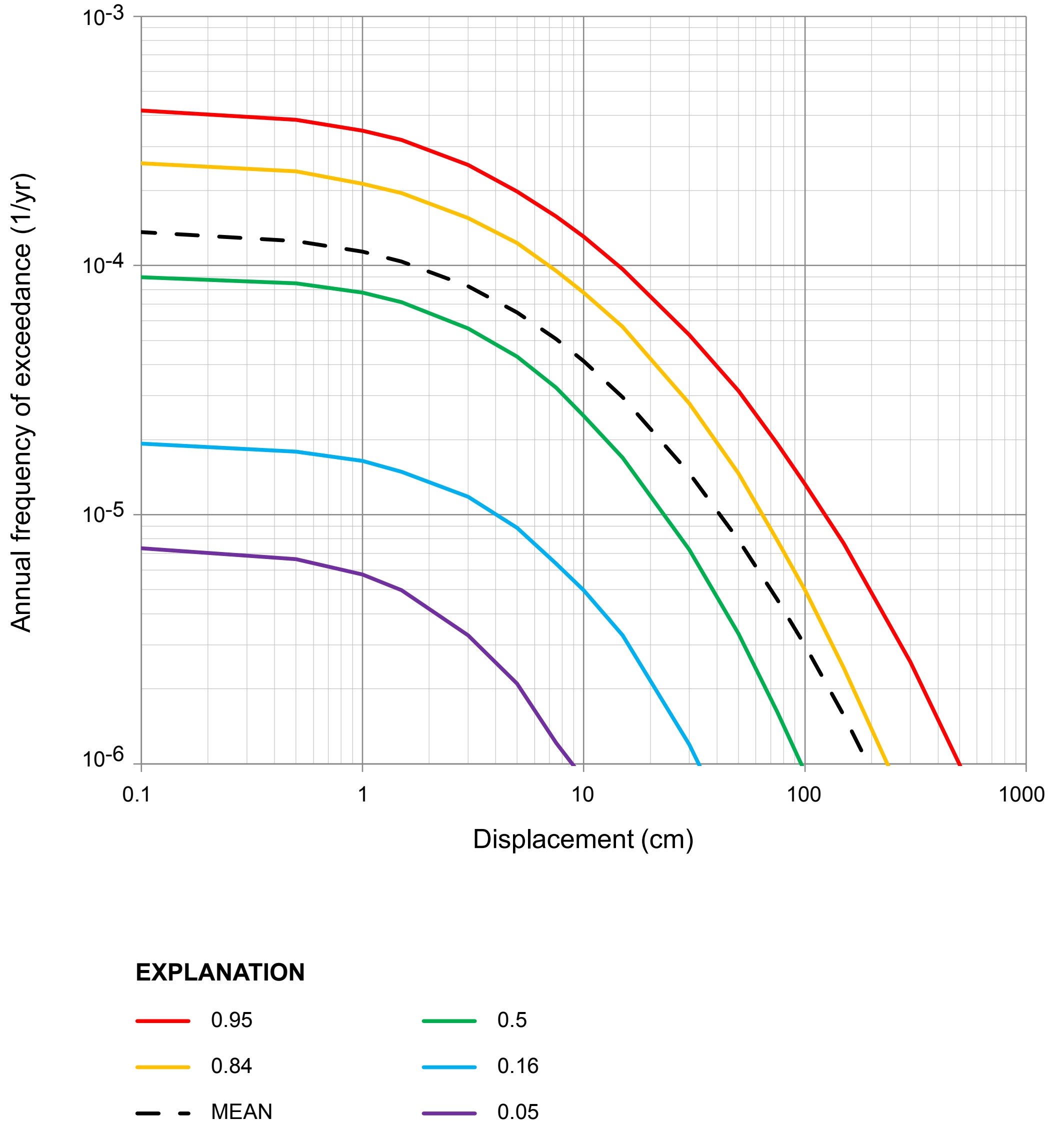
Figure **5-1**

File path: S:\1729\Figures\Figures\Figure_5-1.ai; Date: 08/17/2018; User: S. Thompson, LCI; Rev.1



File path: S:\1729\Figures\Figures\Figure_5-2.ai; Date: 08/17/2018; User: S. Thompson, LCI; Rev.1

Notes:
- Figure 3-4 shows location of 50 m cells and center points.

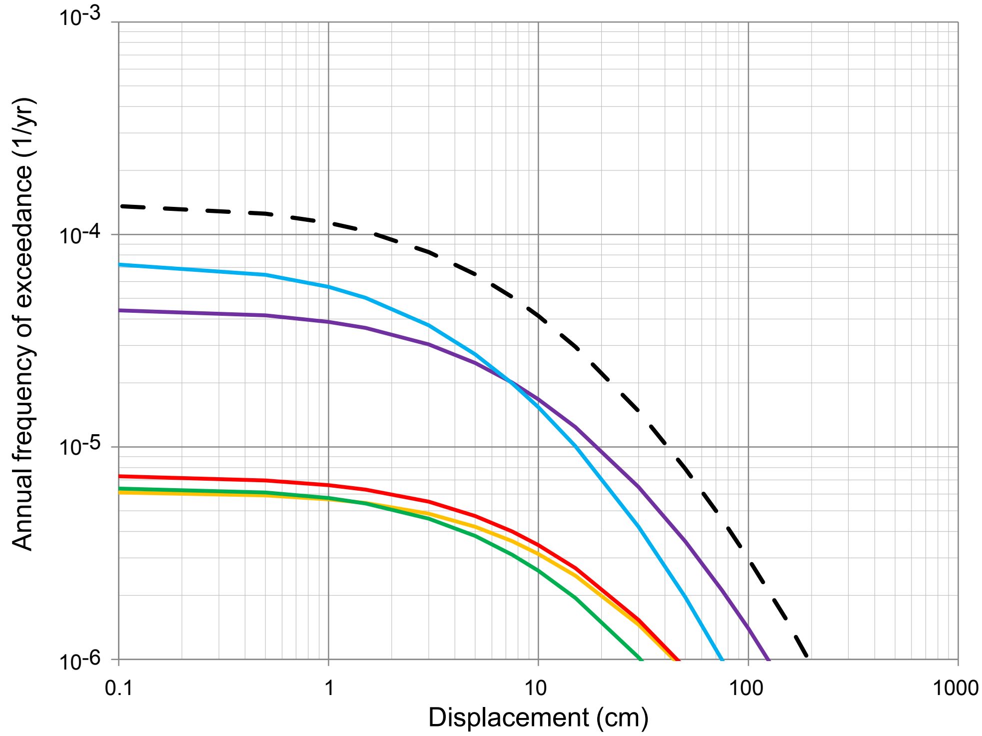
Mean and Fractile Hazard Curves for the HAAH-North 50 m Cell in Centimeters

UCB LANGAN GSPP-HAAH PROJECT

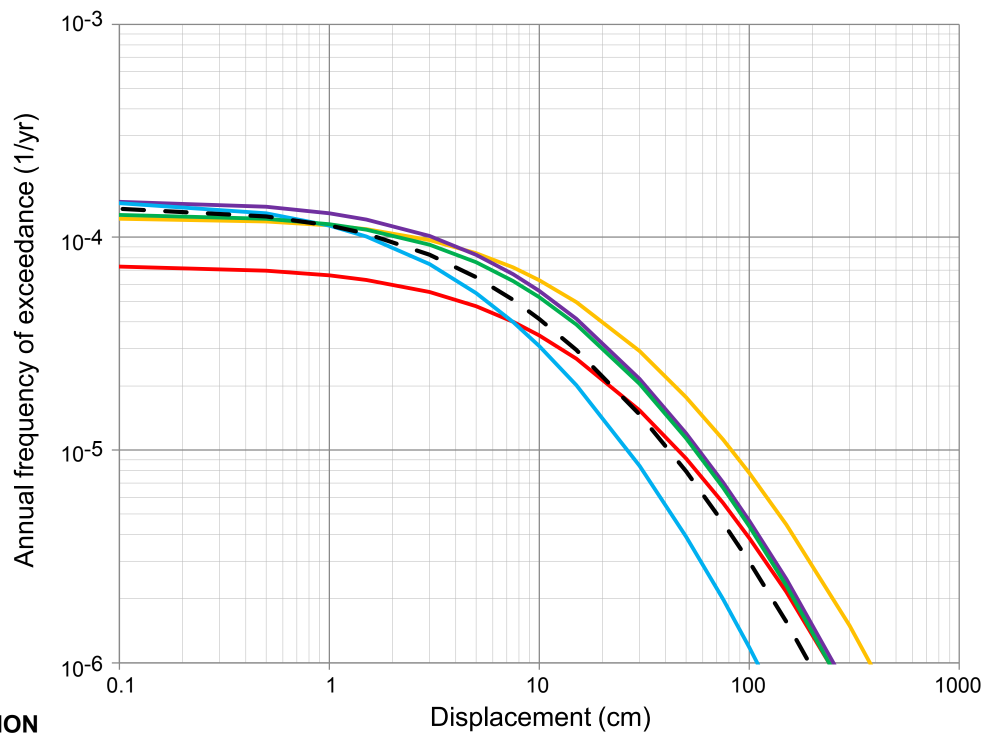
Lettis Consultants International

Figure **5-2**

(a) Weighted Contribution by Rupture Scenario (Centimeters)



(b) Conditional (Unweighted) Hazard Curves by Rupture Scenario (Centimeters)



EXPLANATION

- Unsegmented
- Two Segments (Version A)
- Two Segments (Version B)
- Three Segments
- Floating Earthquakes
- Total Hazard

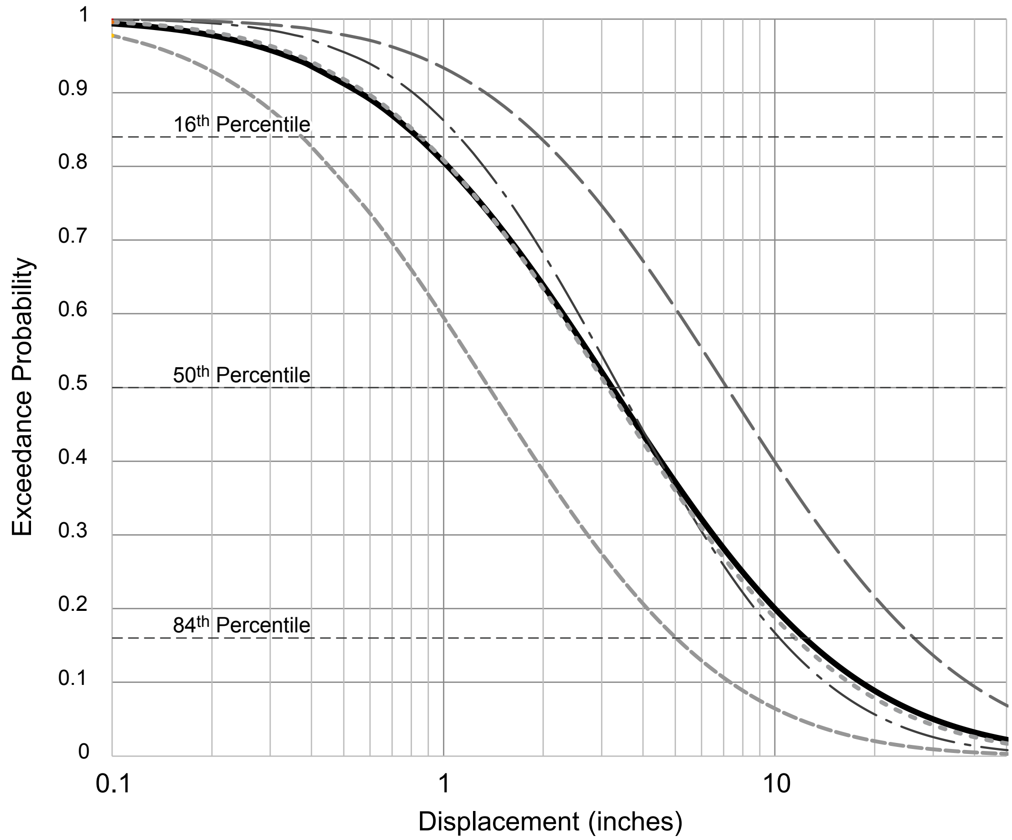
Notes:
- Figure 3-4 shows location of 50 m cells and center points.
- Figure 4-1 shows source characterization logic tree with rupture scenarios.

Contribution to Hazard by Rupture Scenario to HAAH-North 50 m Cell Showing (a) Weighted Contribution, and (b) Conditional (Unweighted) Hazard Curves

UCB LANGAN GSPP-HAAH PROJECT

Lettis Consultants International | Figure **5-3**

File path: S:\1729\Figures\Figures\Figure_5-3.ai; Date: 08/17/2018; User: S. Thompson, LCI; Rev.1



EXPLANATION

Weighted mean

f(m,r)

f(d/D$_{ave}$,r), 90%D$_{ave}$

f(d/D$_{ave}$,r), 50%D$_{ave}$

f(d/D$_{ave}$,r), 10%D$_{ave}$

Notes:
1. Mean deterministic hazard exceedance curve is applicable to the GSPP and HAAH sites. See text for applicability.
2. Conditional (unweighted) exceedance curves show uncertainty in displacement prediction equations. See Figure 4-2, nodes DM 5 and DM 6.

Mean Deterministic Hazard Exceedance Curve and Conditional (Unweighted) Exceedance Curves in Inches

UCB LANGAN GSPP-HAAH PROJECT

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Figure **5-4**

File path: S:\1729\Figures\Figure_5-4.ai; Date: 08/20/2018; User: S. Thompson, LCI; Rev.1

APPENDIX E

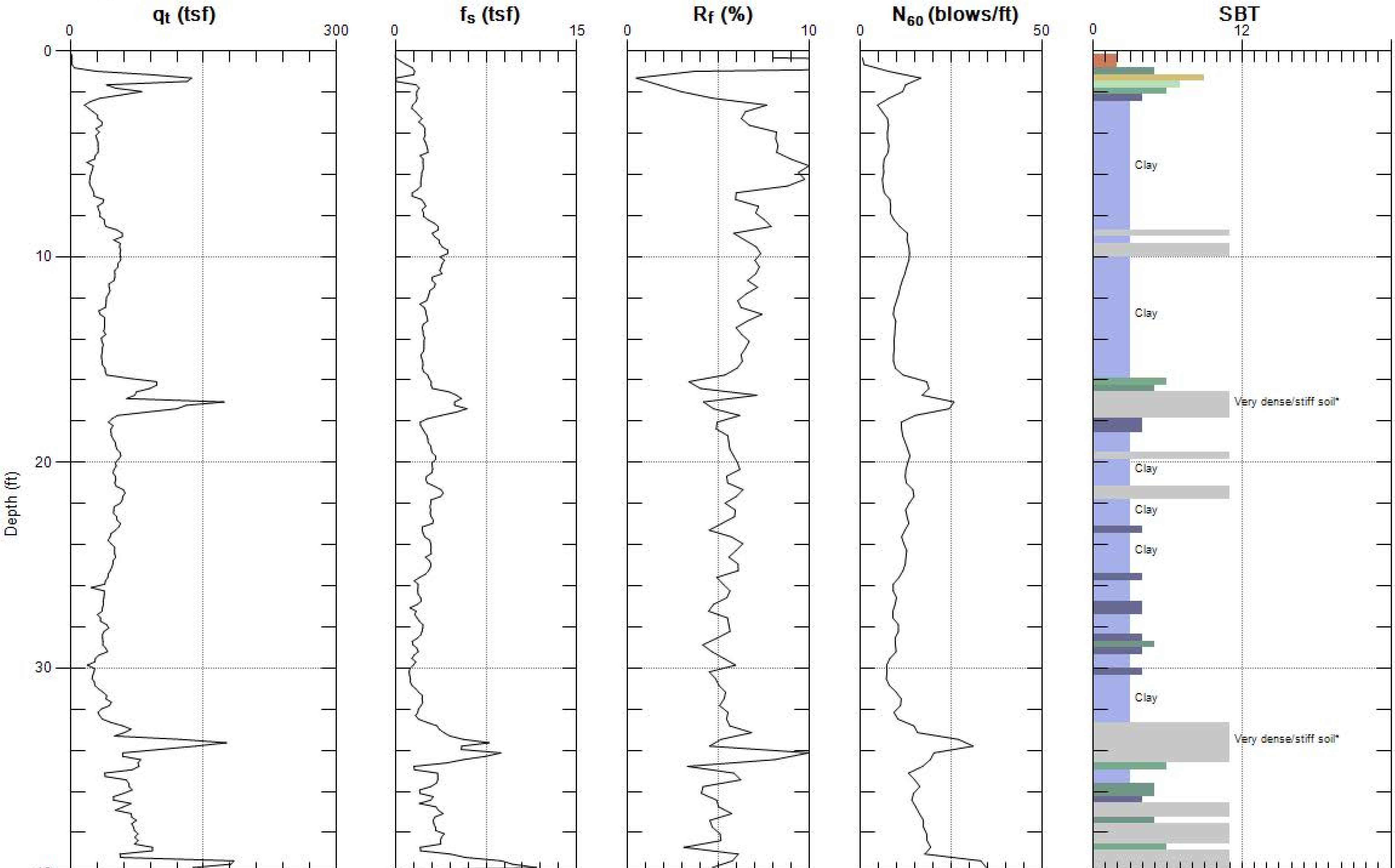
CPTs

LANGAN

GREGG **LANGAN**

Site: UPR. HEARST PARKING Engineer: S.BOUDREAU

Sounding: CPT-01 Date: 12/21/17 09:55



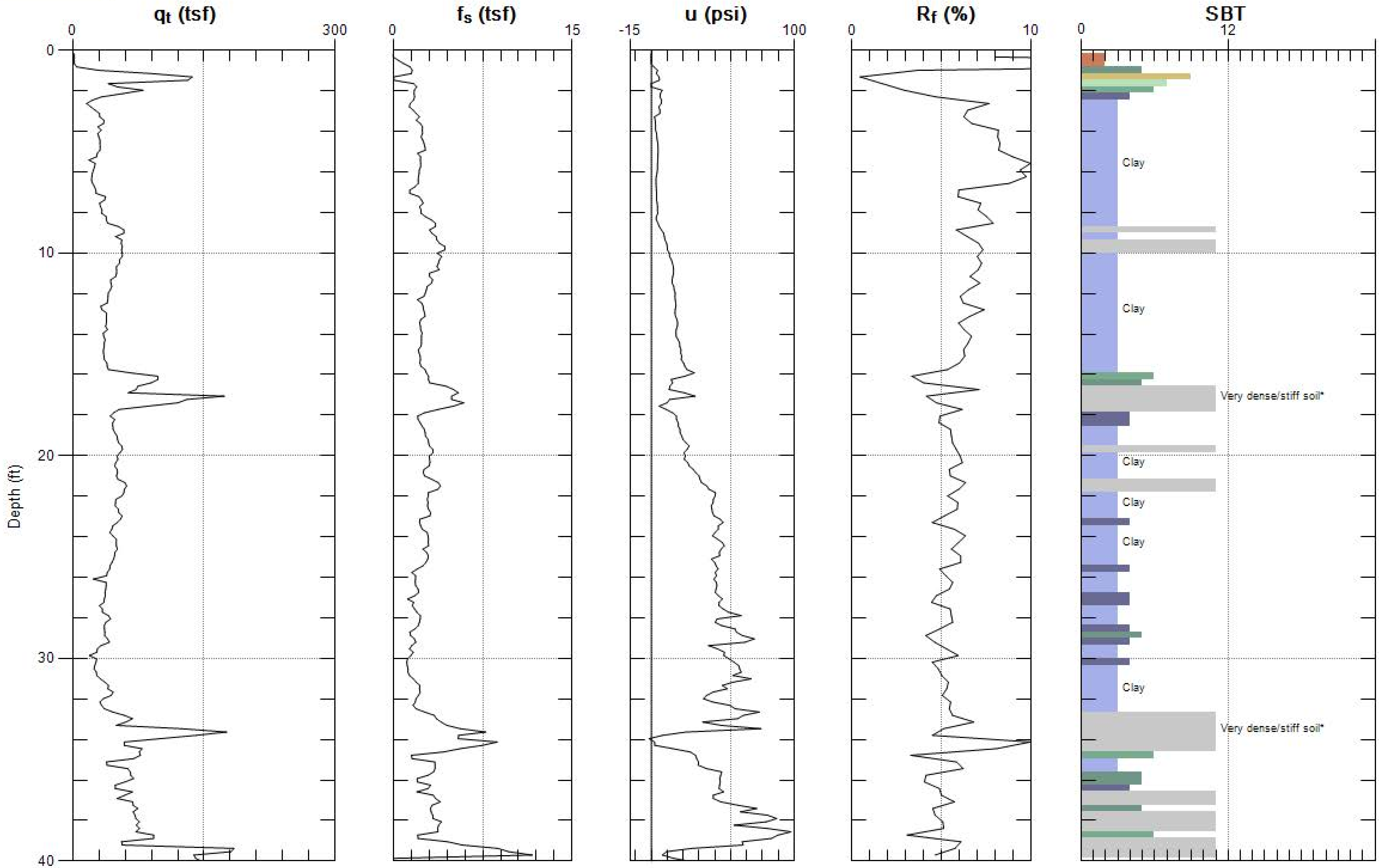
Max. Depth: 40.026 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG LANGAN

Site: UPR. HEARST PARKING Engineer: S.BOUDREAU

Sounding: CPT-01 Date: 12/21/17 09:55



Max. Depth: 40.026 (ft)
Avg. Interval: 0.328 (ft)

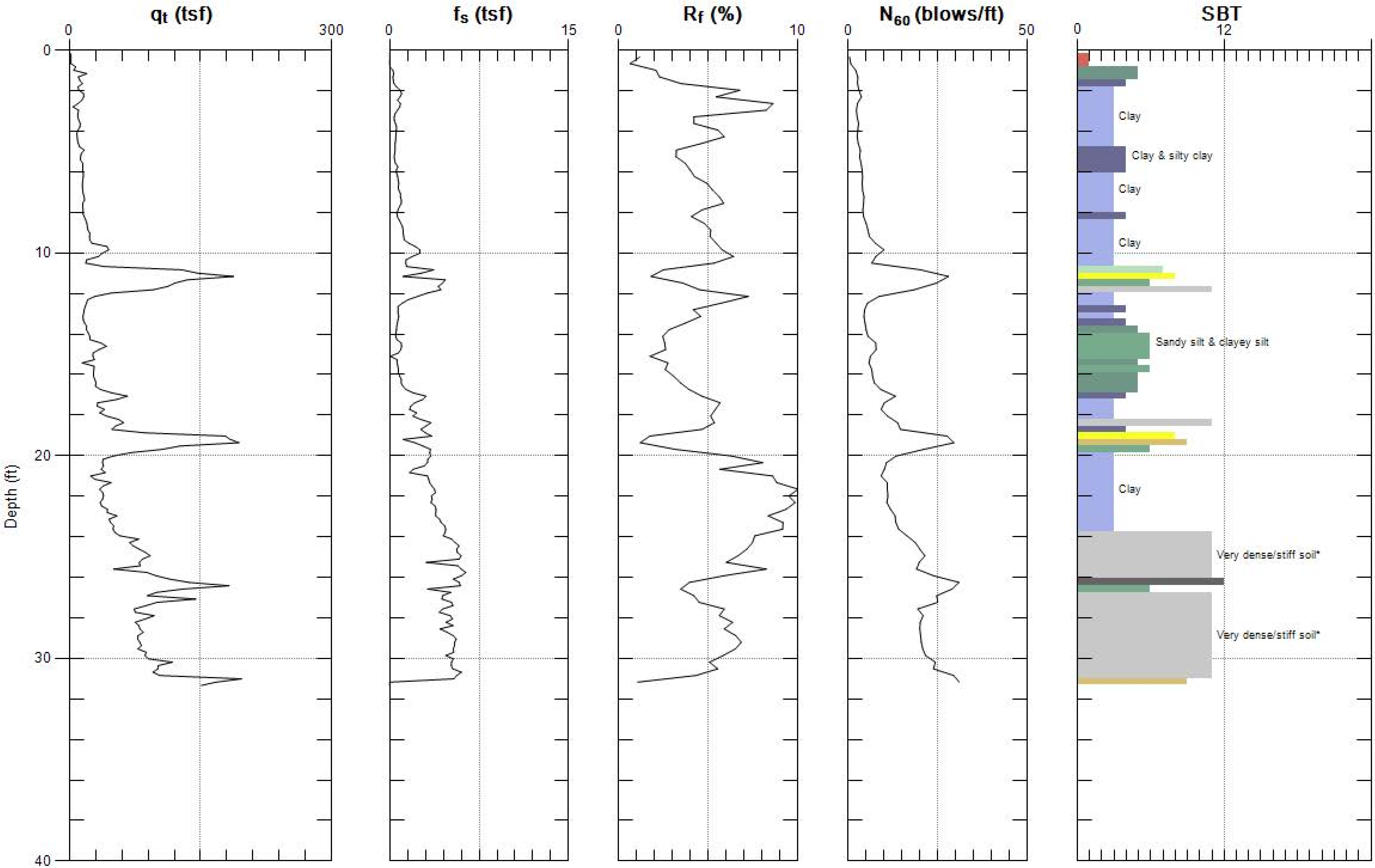
SBT: Soil Behavior Type (Robertson 1990)

GREGG

LANGAN

Site: UPR. HEARST PARKING **Engineer: S.BOUDREAU**

Sounding: CPT-02 **Date: 12/21/17 11:57**



Max. Depth: 31.332 (ft)
Avg. Interval: 0.328 (ft)

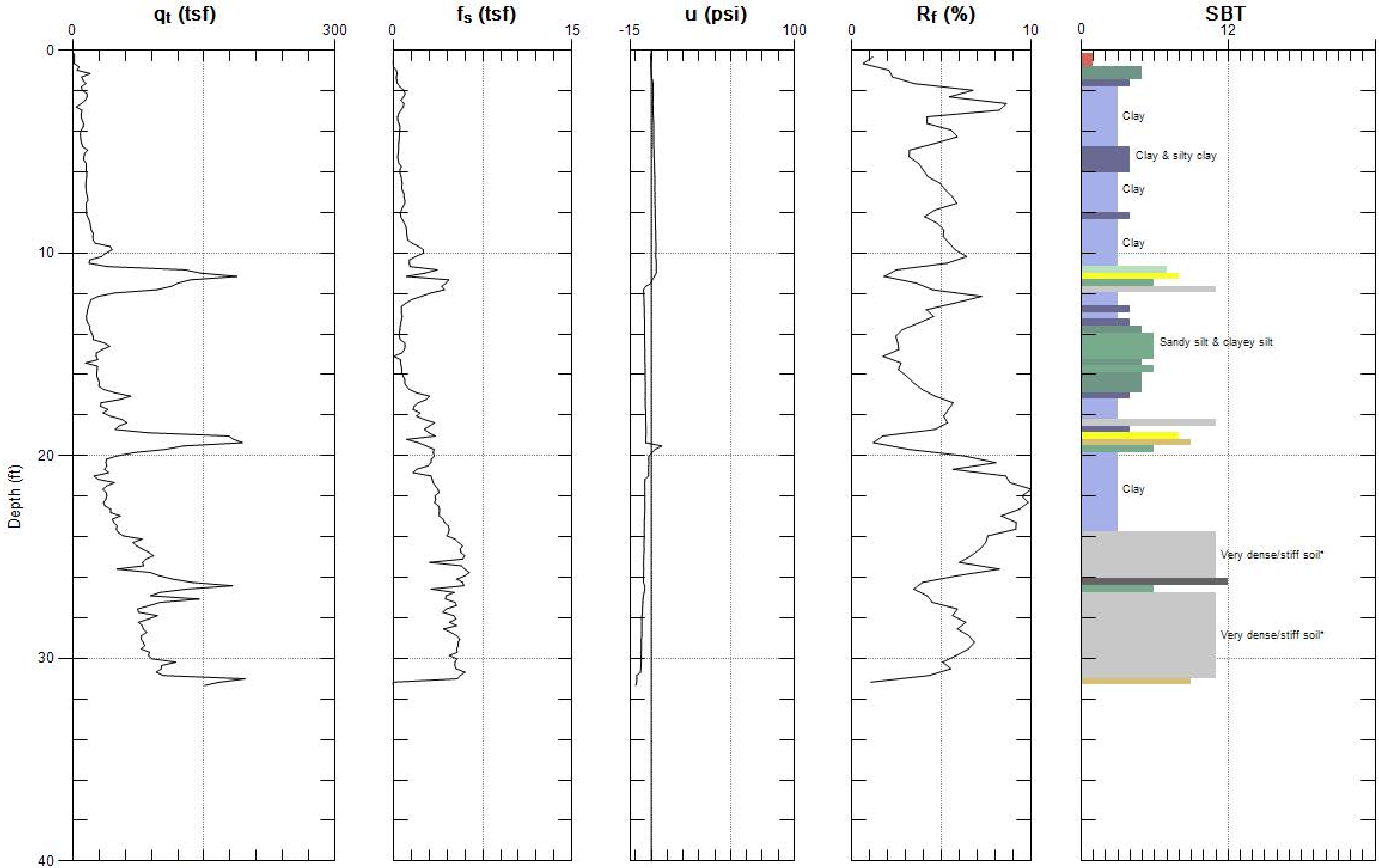
SBT: Soil Behavior Type (Robertson 1990)

GREGG

LANGAN

Site: UPR. HEARST PARKING Engineer: S.BOUDREAU

Sounding: CPT-02 Date: 12/21/17 11:57



Max. Depth: 31.332 (ft)
Avg. Interval: 0.328 (ft)

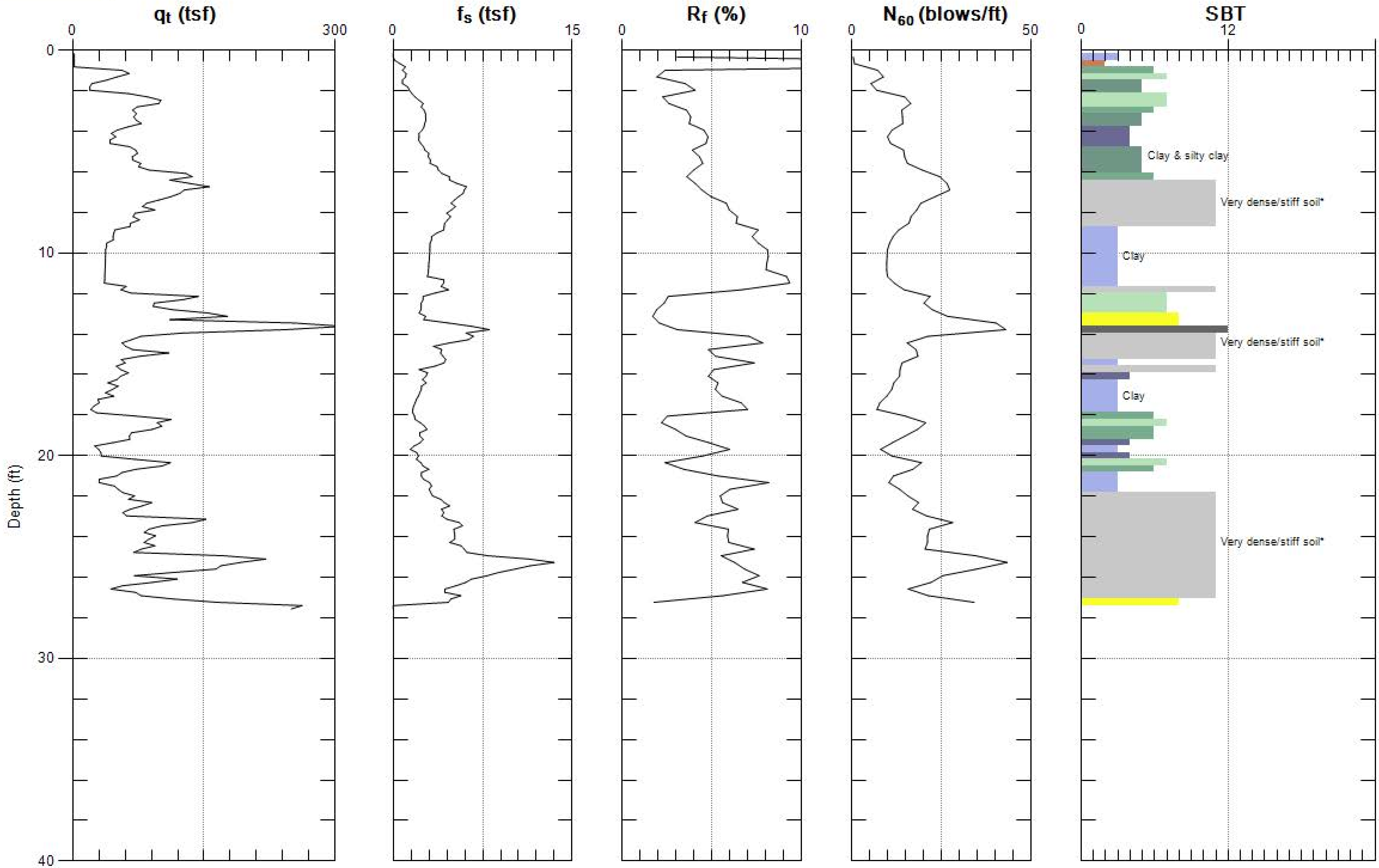
SBT: Soil Behavior Type (Robertson 1990)

GREGG

LANGAN

Site: UPR. HEARST PARKING Engineer: S.BOUDREAU

Sounding: CPT-03 Date: 12/21/17 10:58



Max. Depth: 27.559 (ft)
Avg. Interval: 0.328 (ft)

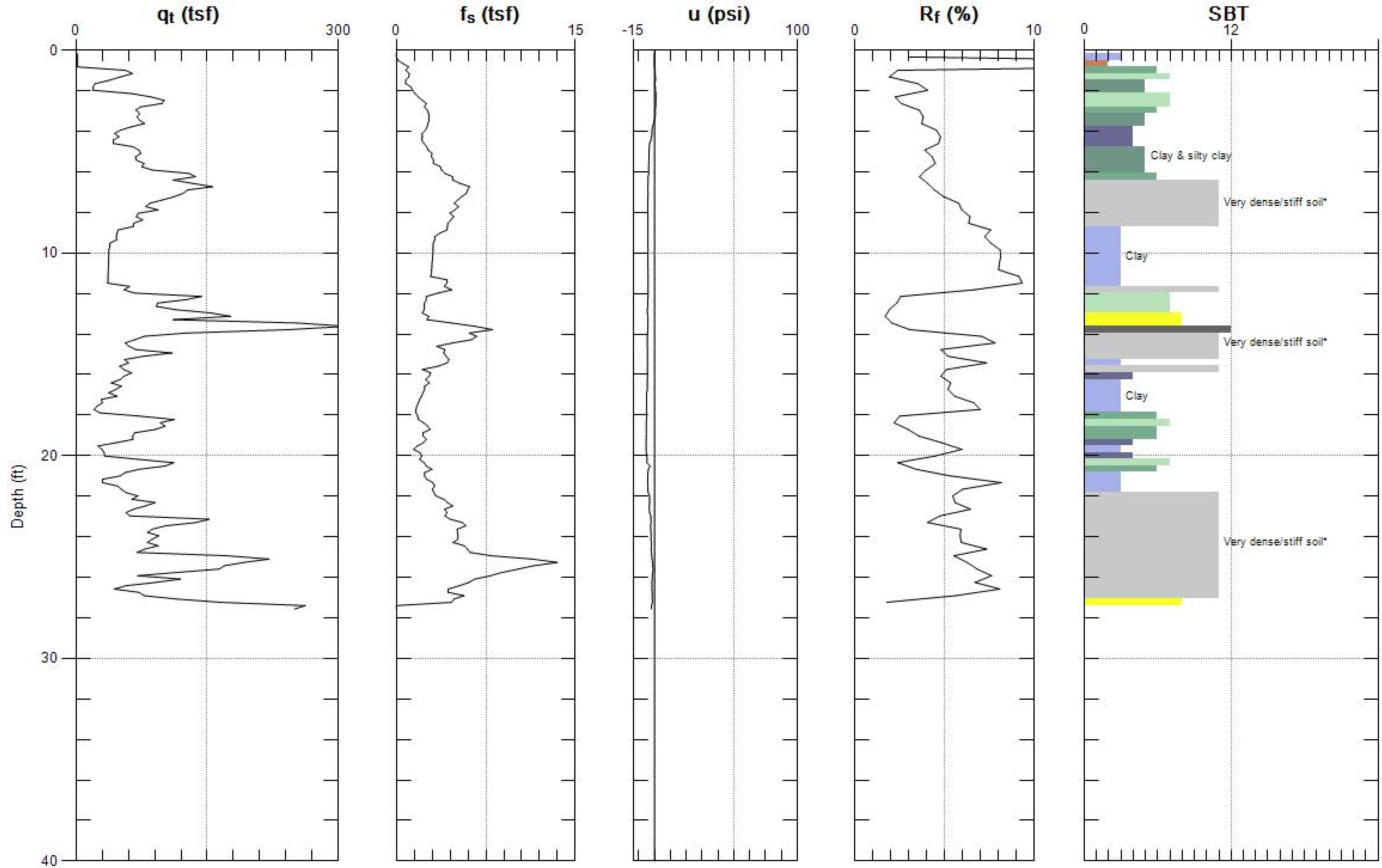
SBT: Soil Behavior Type (Robertson 1990)

GREGG

LANGAN

Site: UPR. HEARST PARKING Engineer: S.BOUDREAU

Sounding: CPT-03 Date: 12/21/17 10:58



Max. Depth: 27.559 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Cone Penetration Testing Procedure (CPT)

Gregg Drilling carries out all Cone Penetration Tests (CPT) using an integrated electronic cone system, *Figure CPT*.

The cone takes measurements of tip resistance (q_c), sleeve resistance (f_s), and penetration pore water pressure (u_2). Measurements are taken at either 2.5 or 5 cm intervals during penetration to provide a nearly continuous profile. CPT data reduction and basic interpretation is performed in real time facilitating on-site decision making. The above mentioned parameters are stored electronically for further analysis and reference. All CPT soundings are performed in accordance with revised ASTM standards (D 5778-12).

The 5mm thick porous plastic filter element is located directly behind the cone tip in the u_2 location. A new saturated filter element is used on each sounding to measure both penetration pore pressures as well as measurements during a dissipation test (*PPDT*). Prior to each test, the filter element is fully saturated with oil under vacuum pressure to improve accuracy.

When the sounding is completed, the test hole is backfilled according to client specifications. If grouting is used, the procedure generally consists of pushing a hollow tremie pipe with a "knock out" plug to the termination depth of the CPT hole. Grout is then pumped under pressure as the tremie pipe is pulled from the hole. Disruption or further contamination to the site is therefore minimized.

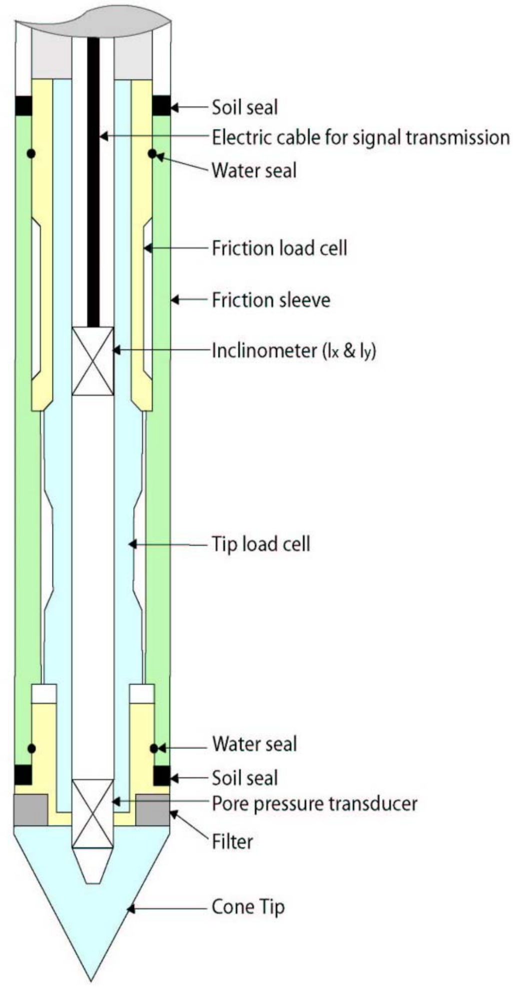


Figure CPT

Gregg 15cm^2 Standard Cone Specifications

Dimensions	
Cone base area	15 cm^2
Sleeve surface area	225 cm^2
Cone net area ratio	0.80
Specifications	
Cone load cell	
Full scale range	180 kN (20 tons)
Overload capacity	150%
Full scale tip stress	120 MPa (1,200 tsf)
Repeatability	120 kPa (1.2 tsf)
Sleeve load cell	
Full scale range	31 kN (3.5 tons)
Overload capacity	150%
Full scale sleeve stress	1,400 kPa (15 tsf)
Repeatability	1.4 kPa (0.015 tsf)
Pore pressure transducer	
Full scale range	7,000 kPa (1,000 psi)
Overload capacity	150%
Repeatability	7 kPa (1 psi)

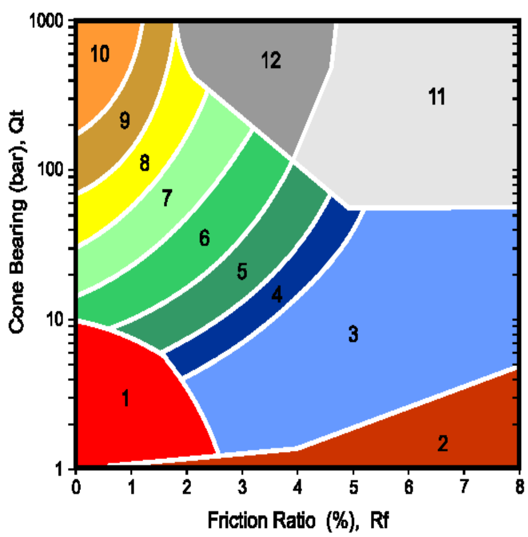
Note: The repeatability during field use will depend somewhat on ground conditions, abrasion, maintenance and zero load stability.

Cone Penetration Test Data & Interpretation

The Cone Penetration Test (CPT) data collected are presented in graphical and electronic form in the report. The plots include interpreted Soil Behavior Type (SBT) based on the charts described by Robertson (1990). Typical plots display SBT based on the non-normalized charts of Robertson et al (1986). For CPT soundings deeper than 30m, we recommend the use of the normalized charts of Robertson (1990) which can be displayed as SBTn, upon request. The report also includes spreadsheet output of computer calculations of basic interpretation in terms of SBT and SBTn and various geotechnical parameters using current published correlations based on the comprehensive review by Lunne, Robertson and Powell (1997), as well as recent updates by Professor Robertson (Guide to Cone Penetration Testing, 2015). The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg Drilling & Testing Inc. does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software. Some interpretation methods require input of the groundwater level to calculate vertical effective stress. An estimate of the in-situ groundwater level has been made based on field observations and/or CPT results, but should be verified by the user.

A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface.

Note that it is not always possible to clearly identify a soil type based solely on q_t, f_s, and u_2. In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the correct soil behavior type.



ZONE		SBT
1		Sensitive, fine grained
2		Organic materials
3		Clay
4		Silty clay to clay
5		Clayey silt to silty clay
6		Sandy silt to clayey silt
7		Silty sand to sandy silt
8		Sand to silty sand
9		Sand
10		Gravely sand to sand
11		Very stiff fine grained*
12		Sand to clayey sand*

*over consolidated or cemented

Figure SBT (After Robertson et al., 1986) – Note: Colors may vary slightly compared to plots

Cone Penetration Test (CPT) Interpretation

Gregg uses a proprietary CPT interpretation and plotting software. The software takes the CPT data and performs basic interpretation in terms of soil behavior type (SBT) and various geotechnical parameters using current published empirical correlations based on the comprehensive review by Lunne, Robertson and Powell (1997). The interpretation is presented in tabular format using MS Excel. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software.

The following provides a summary of the methods used for the interpretation. Many of the empirical correlations to estimate geotechnical parameters have constants that have a range of values depending on soil type, geologic origin and other factors. The software uses 'default' values that have been selected to provide, in general, conservatively low estimates of the various geotechnical parameters.

Input:

1 Units for display (Imperial or metric) (atm. pressure, p_a = 0.96 tsf or 0.1 MPa)
2 Depth interval to average results (ft or m). Data are collected at either 0.02 or 0.05m and can be averaged every 1, 3 or 5 intervals.
3 Elevation of ground surface (ft or m)
4 Depth to water table, z_w (ft or m) – input required
5 Net area ratio for cone, a (default to 0.80)
6 Relative Density constant, C_{Dr} (default to 350)
7 Young's modulus number for sands, α (default to 5)
8 Small strain shear modulus number
   a. for sands, S_G (default to 180 for SBT_n 5, 6, 7)
   b. for clays, C_G (default to 50 for SBT_n 1, 2, 3 & 4)
9 Undrained shear strength cone factor for clays, N_{kt} (default to 15)
10 Over Consolidation ratio number, k_{ocr} (default to 0.3)
11 Unit weight of water, (default to γ_w = 62.4 lb/ft^3 or 9.81 kN/m^3)

Column

1 Depth, z, (m) – CPT data is collected in meters
2 Depth (ft)
3 Cone resistance, q_c (tsf or MPa)
4 Sleeve resistance, f_s (tsf or MPa)
5 Penetration pore pressure, u (psi or MPa), measured behind the cone (i.e. u_2)
6 Other – any additional data
7 Total cone resistance, q_t (tsf or MPa) $q_t = q_c + u\,(1-a)$

8	Friction Ratio, R_f (%)	$R_f = (f_s/q_t) \times 100\%$
9	Soil Behavior Type (non-normalized), SBT	see note
10	Unit weight, γ (pcf or kN/m^3)	based on SBT, see note
11	Total overburden stress, σ_v (tsf)	$\sigma_{vo} = \sigma\, z$
12	In-situ pore pressure, u_o (tsf)	$u_o = \gamma_w (z - z_w)$
13	Effective overburden stress, σ'_{vo} (tsf)	$\sigma'_{vo} = \sigma_{vo} - u_o$
14	Normalized cone resistance, Q_{t1}	$Q_{t1} = (q_t - \sigma_{vo}) / \sigma'_{vo}$
15	Normalized friction ratio, F_r (%)	$F_r = f_s / (q_t - \sigma_{vo}) \times 100\%$
16	Normalized Pore Pressure ratio, B_q	$B_q = u - u_o / (q_t - \sigma_{vo})$
17	Soil Behavior Type (normalized), SBT_n	see note
18	SBT_n Index, I_c	see note
19	Normalized Cone resistance, Q_{tn} (n varies with I_c)	see note
20	Estimated permeability, k_{SBT} (cm/sec or ft/sec)	see note
21	Equivalent SPT N_{60}, blows/ft	see note
22	Equivalent SPT $(N_1)_{60}$ blows/ft	see note
23	Estimated Relative Density, D_r, (%)	see note
24	Estimated Friction Angle, ϕ', (degrees)	see note
25	Estimated Young's modulus, E_s (tsf)	see note
26	Estimated small strain Shear modulus, Go (tsf)	see note
27	Estimated Undrained shear strength, s_u (tsf)	see note
28	Estimated Undrained strength ratio	s_u/σ_v'
29	Estimated Over Consolidation ratio, OCR	see note

Notes:

1 Soil Behavior Type (non-normalized), SBT (Lunne et al., 1997 and table below)

2 Unit weight, γ either constant at 119 pcf or based on Non-normalized SBT (Lunne et al., 1997 and table below)

3 Soil Behavior Type (Normalized), SBT_n Lunne et al. (1997)

4 SBT_n Index, I_c $I_c = ((3.47 - \log Q_{t1})^2 + (\log F_r + 1.22)^2)^{0.5}$

5 Normalized Cone resistance, Q_{tn} (n varies with Ic)

$Q_{tn} = ((q_t - \sigma_{vo})/pa)\,(pa/(\sigma'_{vo})^n$ and recalculate I_c, then iterate:

When $I_c < 1.64$, n = 0.5 (clean sand)
When $I_c > 3.30$, n = 1.0 (clays)
When $1.64 < I_c < 3.30$, $n = (I_c - 1.64)0.3 + 0.5$
Iterate until the change in n, $\Delta n < 0.01$

6 Estimated permeability, k_{SBT} based on Normalized SBT_n (Lunne et al., 1997 and table below)

7 Equivalent SPT N_{60}, blows/ft Lunne et al. (1997)

$$\frac{(q_t/p_a)}{N_{60}} = 8.5\left(1 - \frac{I_c}{4.6}\right)$$

8 Equivalent SPT $(N_1)_{60}$ blows/ft $(N_1)_{60} = N_{60}\, C_N,$
where $C_N = (pa/\sigma'_{vo})^{0.5}$

9 Relative Density, D_r, (%) $D_r^2 = Q_{tn} / C_{Dr}$
Only SBT_n *5, 6, 7 & 8* *Show 'N/A' in zones 1, 2, 3, 4 & 9*

10 Friction Angle, ϕ', (degrees) $\tan\phi' = \frac{1}{2.68}\left[\log\left(\frac{q_c}{\sigma'_{vo}}\right) + 0.29\right]$

Only SBT_n *5, 6, 7 & 8* *Show'N/A' in zones 1, 2, 3, 4 & 9*

11 Young's modulus, E_s $E_s = \alpha\, q_t$
Only SBT_n *5, 6, 7 & 8* *Show 'N/A' in zones 1, 2, 3, 4 & 9*

12 Small strain shear modulus, Go
a. $G_o = S_G\,(q_t\ \sigma'_{vo}\ pa)^{1/3}$ *For* SBT_n *5, 6, 7*
b. $G_o = C_G\, q_t$ *For* SBT_n *1, 2, 3& 4*
Show 'N/A' in zones 8 & 9

13 Undrained shear strength, s_u $s_u = (q_t - \sigma_{vo}) / N_{kt}$
Only SBT_n *1, 2, 3, 4 & 9* *Show 'N/A' in zones 5, 6, 7 & 8*

14 Over Consolidation ratio, OCR $OCR = k_{ocr}\, Q_{t1}$
Only SBT_n *1, 2, 3, 4 & 9* *Show 'N/A' in zones 5, 6, 7 & 8*

The following updated and simplified SBT descriptions have been used in the software:

SBT Zones		**SBT_n Zones**	
1	sensitive fine grained	1	sensitive fine grained
2	organic soil	2	organic soil
3	clay	3	clay
4	clay & silty clay	4	clay & silty clay
5	clay & silty clay		
6	sandy silt & clayey silt		

7	silty sand & sandy silt	5	silty sand & sandy silt
8	sand & silty sand	6	sand & silty sand
9	sand		
10	sand	7	sand
11	very dense/stiff soil*	8	very dense/stiff soil*
12	very dense/stiff soil*	9	very dense/stiff soil*

*heavily overconsolidated and/or cemented

Track when soils fall with zones of same description and print that description (i.e. if soils fall only within SBT zones 4 & 5, print 'clays & silty clays')

Estimated Permeability (see Lunne et al., 1997)

SBT_n	Permeability (ft/sec)	(m/sec)
1	$3x\ 10^{-8}$	$1x\ 10^{-8}$
2	$3x\ 10^{-7}$	$1x\ 10^{-7}$
3	$1x\ 10^{-9}$	$3x\ 10^{-10}$
4	$3x\ 10^{-8}$	$1x\ 10^{-8}$
5	$3x\ 10^{-6}$	$1x\ 10^{-6}$
6	$3x\ 10^{-4}$	$1x\ 10^{-4}$
7	$3x\ 10^{-2}$	$1x\ 10^{-2}$
8	$3x\ 10^{-6}$	$1x\ 10^{-6}$
9	$1x\ 10^{-8}$	$3x\ 10^{-9}$

Estimated Unit Weight (see Lunne et al., 1997)

SBT	Approximate Unit Weight (lb/ft^3)	(kN/m^3)
1	111.4	17.5
2	79.6	12.5
3	111.4	17.5
4	114.6	18.0
5	114.6	18.0
6	114.6	18.0
7	117.8	18.5
8	120.9	19.0
9	124.1	19.5
10	127.3	20.0
11	130.5	20.5
12	120.9	19.0

Pore Pressure Dissipation Tests (PPDT)

Pore Pressure Dissipation Tests (PPDT's) conducted at various intervals can be used to measure equilibrium water pressure (at the time of the CPT). If conditions are hydrostatic, the equilibrium water pressure can be used to determine the approximate depth of the ground water table. A PPDT is conducted when penetration is halted at specific intervals determined by the field representative. The variation of the penetration pore pressure (*u*) with time is measured behind the tip of the cone and recorded.

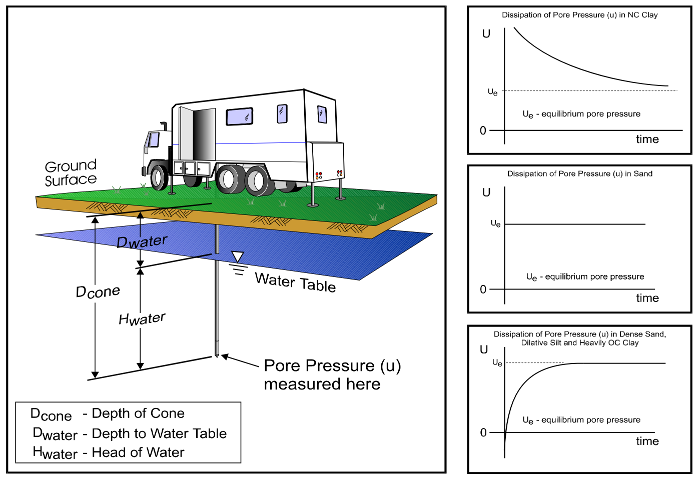
Pore pressure dissipation data can be interpreted to provide estimates of:

- Equilibrium piezometric pressure
- Phreatic Surface
- In situ horizontal coefficient of consolidation (c_h)
- In situ horizontal coefficient of permeability (k_h)

In order to correctly interpret the equilibrium piezometric pressure and/or the phreatic surface, the pore pressure must be monitored until it reaches equilibrium, *Figure PPDT*. This time is commonly referred to as t_{100}, the point at which 100% of the excess pore pressure has dissipated.

A complete reference on pore pressure dissipation tests is presented by Robertson et al. 1992 and Lunne et al. 1997.

A summary of the pore pressure dissipation tests are summarized in Table 1.



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

Useful Conversion Factors: 1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

Figure PPDT

APPENDIX F

Test Pits

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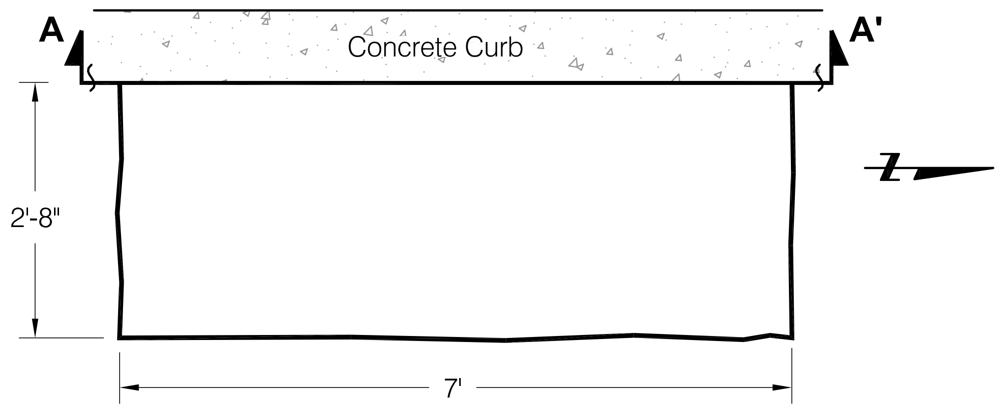
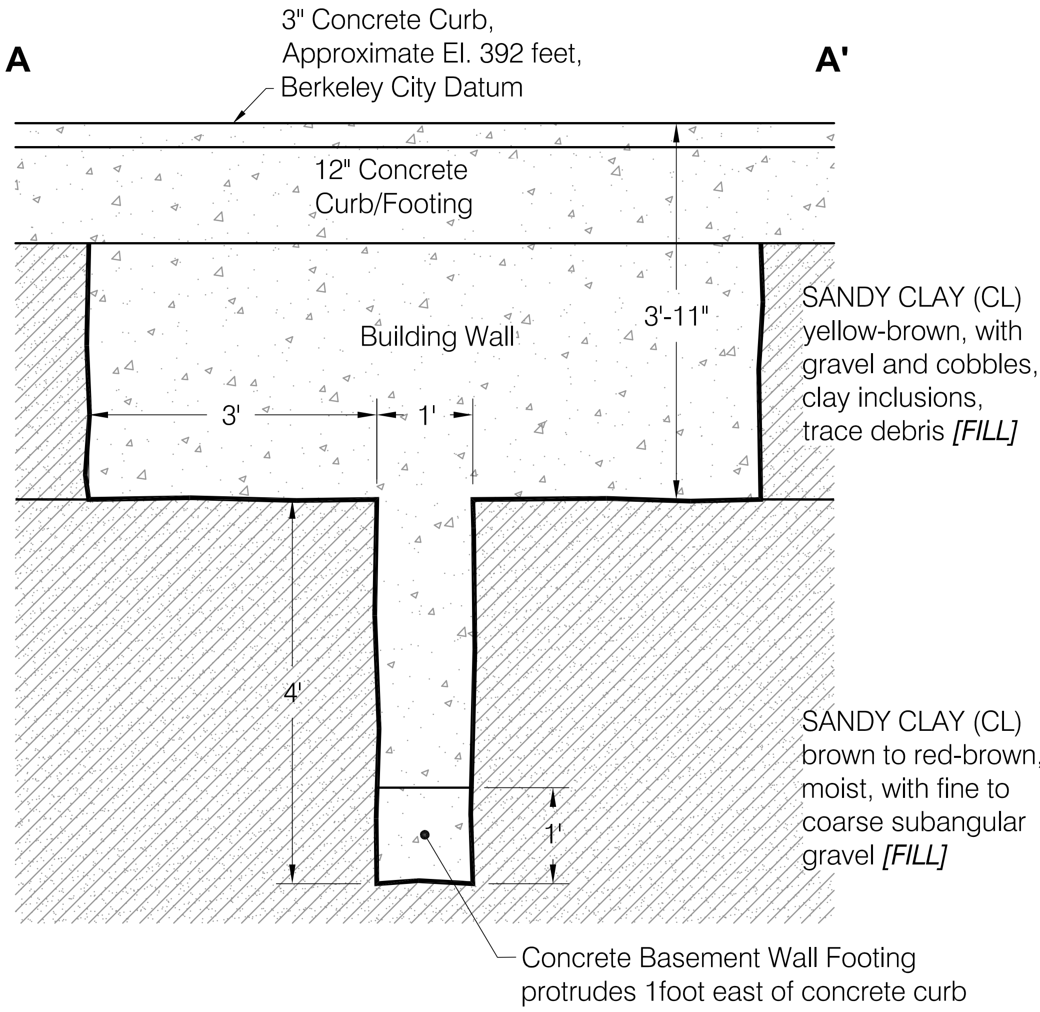
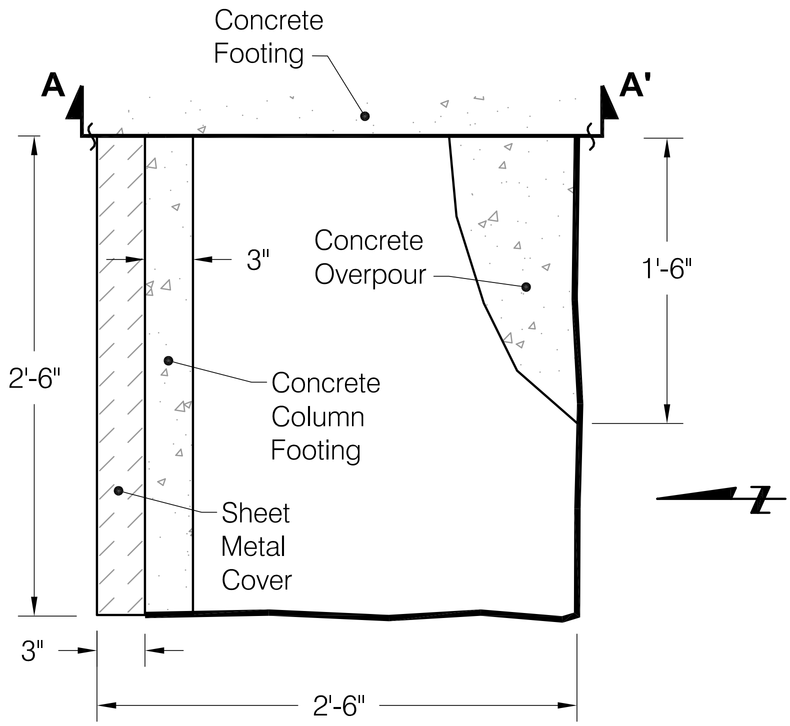


PLAN VIEW

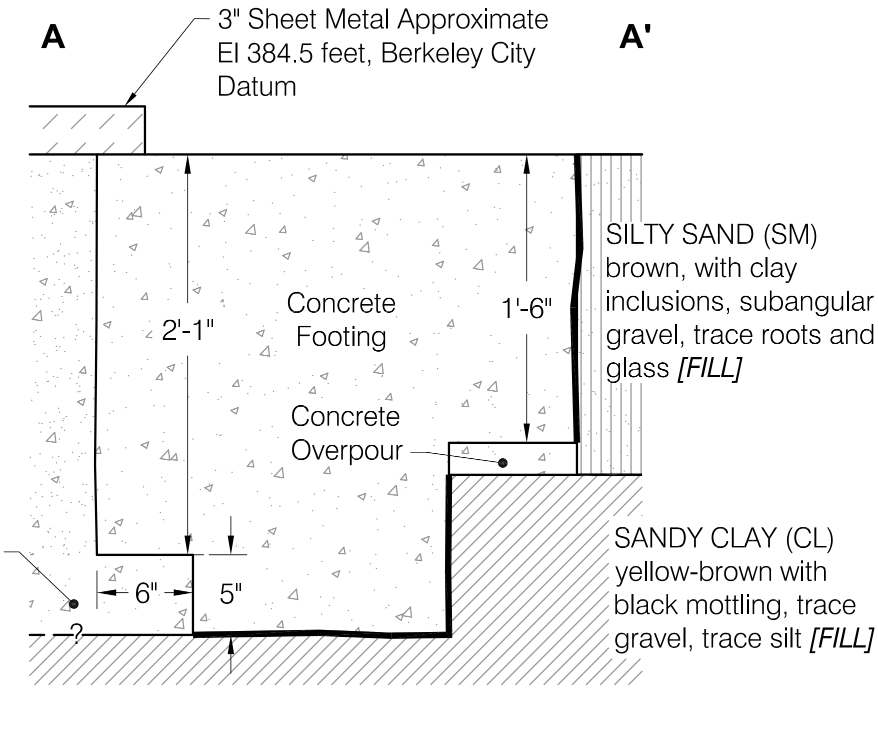


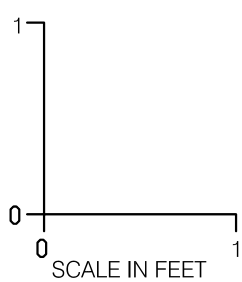
ELEVATION A - A'

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING Berkeley, California	**LOG OF TEST PIT TP-1**
LANGAN	Date 09/25/17 | Project No. 731706301 | Figure C-1



PLAN VIEW





ELEVATION A - A'

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

LANGAN

LOG OF TEST PIT TP-2

Date 09/25/17	Project No. 731706301	Figure C-2

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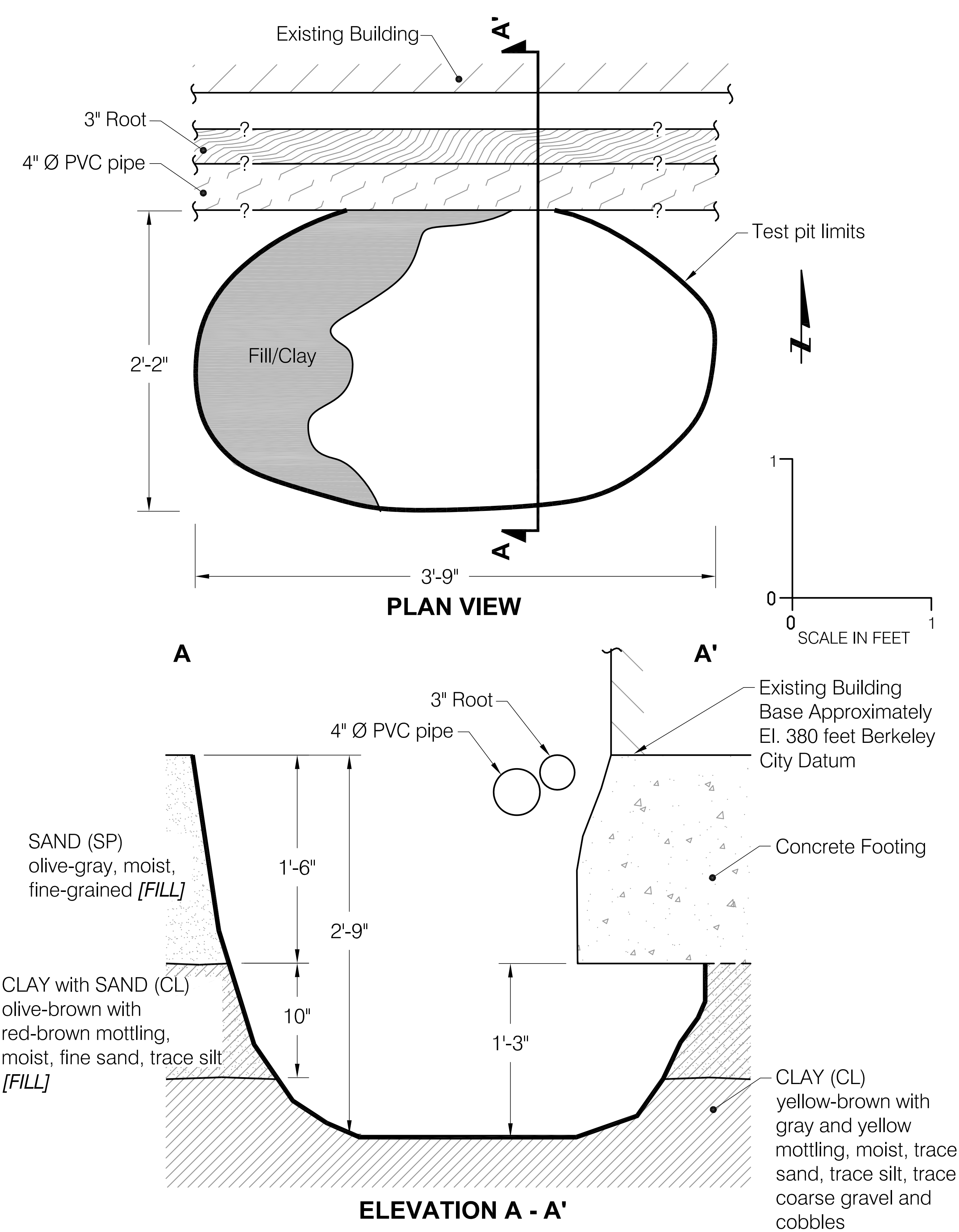

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

LANGAN

LOG OF TEST PIT TP-3

Date 09/25/17	Project No. 731706301	Figure C-3

GEOTECHNICAL INVESTIGATION, PRELIMINARY ENVIRONMENTAL SITE CHARACTERIZATION, AND FAULT STUDY

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING

Berkeley, California

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Cary E. Ronan, PE, GE
Associate

13 February 2018
731706301

LANGAN

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GEOTECHNICAL INVESTIGATION, PRELIMINARY ENVIRONMENTAL SITE CHARACTERIZATION, AND FAULT STUDY UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING Berkeley, California

1.0 INTRODUCTION

This report presents the results of the geotechnical investigation, preliminary environmental site characterization (ESC), and fault study performed by Langan Engineering and Environmental Services, Inc. (Langan) for the proposed new student housing development at the Goldman School of Public Policy (GSPP) and Hearst Avenue Academic Housing site. The site is at the corner of Hearst Avenue and La Loma Avenue at the University of California, Berkeley (University) campus. The location of the site is shown on Figure 1.

The site is L-shaped and approximately one acre in size. As shown on Figure 2, the southern portion of the site is occupied by the four-level Upper Hearst parking structure, and the northern portion of the site is occupied by an at-grade asphalt-paved parking lot with concrete entrance ramps to the west and southeast that lead to the below-grade portions of the structure. The site is bound by Ridge Road to the north; La Loma Avenue to the east; Hearst Avenue to the south; and a four-story student housing building (Cloyne Court Co-op) and the current GSPP building to the west. The northeastern half of the site is within a state-designated Alquist-Priolo Earthquake Fault Zone.

We understand the proposed development includes demolition of the upper portion of the existing Upper Hearst parking structure, construction of a new 5-story GSPP building with classrooms and assembly space, and addition of 5 stories of residential space above the remaining parking structure. The proposed development will also extend to the surface parking lot to the north of the parking structure. This portion of the development will include two below-grade parking levels (approximately 25 feet below grade at the intersection of La Loma Avenue and Ridge Road, at approximate Elevation 380 feet[1] (based on schematic

[1] Elevations in this report refer to the City of Berkeley Datum, which corresponds to approximately 3.17 feet below Mean Sea Level (MSL), or the National Geodetic Vertical Datum of 1929 (NGVD 29), and 0.95 feet above the UC Berkeley Datum.

drawings provided by the architect) and six levels of above-grade construction with classrooms and faculty offices. We understand retaining walls and new stairs will be built off of Hearst Avenue to provide access between the existing and the planned GSPP structures.

2.0 SCOPE OF SERVICES

The geotechnical portion of our scope of services, outlined in our proposal dated 22 September 2017, consisted of exploring the subsurface conditions at the site and performing laboratory tests and engineering analyses to develop conclusions and recommendations regarding:

- soil, rock, and groundwater conditions at the site
- adjacent building foundation conditions at test pit locations
- appropriate foundation type(s)
- design criteria for the recommended appropriate foundation type(s), including values for vertical (compression and uplift) and lateral capacities
- estimated foundation settlements
- site preparation, including grading, demolition and stripping
- fill quality and compaction criteria
- slab-on-grade subgrade preparation
- retaining and below-grade wall design criteria
- excavations, temporary slopes, and shoring design criteria, if needed
- moisture proofing for slabs-on-grade and site drainage
- utility trench backfill
- soil corrosivity
- site seismicity and geologic conditions
- seismic hazards, including ground rupture, liquefaction, lateral spreading, and differential compaction
- seismic design criteria in accordance with 2016 California Building Code (CBC)
- construction considerations.

The geologic portion of our scope of services, also outlined in our proposal dated 22 September 2017, consists of a desk study of local and regional data; the results of which are summarized herein.

The environmental portion of our scope of services, also outlined in our proposal dated 22 September 2017, consists of completing a Phase I environmental site assessment (ESA) and a preliminary ESC. The results of the Phase I ESA and the preliminary ESC are presented in Section 7.6.

The preliminary ESC scope consists of collecting shallow soil samples during the geotechnical field investigation; analyzing the soil samples for various non-metal and metal chemical parameters; and describing the soil sampling procedures, analytical results, and our general opinion regarding the presence of hazardous and/or contaminated materials beneath the site.

3.0 FIELD EXPLORATION

Our field exploration included: 1) drilling three borings, designated B-1 through B-3, including rock coring, 2) performing downhole seismic shear wave velocity readings in the deepest boring (B-3) and a geophysical seismic refraction survey consisting of two seismic lines, designated Line #1 and Line #2, 3) excavating three test pits, designated TP-1 through TP-3 adjacent to neighboring structures to investigate foundation conditions, 4) performing three dynamic penetrometer tests (DPTs), and 5) performing three cone penetrometer tests (CPTs). The approximate locations of the borings, seismic lines, test pits, DPTs, and CPTs are presented on Figure 2. Details of each aspect of our field exploration are outlined in the remainder of this section.

3.1 Borings

The borings were drilled on 14 and 15 September 2017 by Pitcher Drilling Co. of East Palo Alto, California (Pitcher) using a truck-mounted drill rig equipped with rotary wash drilling equipment. The borings were advanced to depths of between 51 and 65 feet below the existing ground surface (bgs). Prior to performing our field investigation we coordinated with the University and Cloyne Court Co-op, notified Underground Service Alert, and retained a private underground utility locating service to check that locations of exploration points were clear of existing utilities. Drilling permits from the City of Berkeley were not required because the property is owned by the University.

During drilling, our field representatives logged the borings and obtained representative samples of the soil encountered for classification and laboratory testing. The boring logs are presented in Appendix A on Figures A-1 through A-3. Photographs of rock core collected are presented on Figures A-3d through A-3f. The soil and rock encountered in the borings were classified in accordance with the soil and rock classification systems presented on Figures A-4 and A-5.

Soil samples were obtained during drilling using the following sampler types:

- Standard penetration test (SPT) split-barrel sampler with a 2.0-inch-outside diameter and a 1.5-inch-inside diameter, without liners
- Sprague and Henwood (S&H) split-barrel sampler with a 3.0-inch-outside diameter and a 2.5-inch-inside diameter lined with brass or stainless steel tubes with an inside diameter of 2.43 inches
- HQ-3 Core barrel rock coring system.

The SPT and S&H samplers were driven with an automatic-safety hammer. The hammer was 140 pounds and dropped 30 inches to cause a hammer blow on the sampler. The samplers were driven up to 18 inches and the hammer blows required to drive the sampler every six inches of penetration were recorded and are presented on the boring logs. A "blow count" is defined as the number of hammer blows per six inches of penetration or 50 blows for six inches or less of penetration. The driving of samplers was discontinued if the observed (recorded) blow count was 50 for six inches or less of penetration. The blow counts required to drive the S&H and SPT samplers were converted to approximate SPT N-values using factors of 0.7 and 1.2, respectively, to account for sampler type and hammer energy and are shown on the boring logs. The blow counts used for this conversion were: 1) the last two blow counts if the sampler was driven more than 12 inches, 2) the last one blow count if the sampler was driven more than six inches but less than 12 inches, and 3) the only blow count if the sampler was driven six inches or less.

The HQ-3 coring system was used to obtain core samples in rock.

Upon completion of the borings, the boreholes were backfilled with cement grout. Soil cuttings from the borings were placed into 55-gallon drums, which were transported off-site for proper testing and disposal by Pitcher.

3.2 In-Situ Seismic Downhole and Refraction Studies

To measure the in-situ shear wave velocity of the subsurface materials, Norcal Geophysical Consultants, Inc. of Cotati, California (Norcal) performed suspension P-S velocity logging to a depth of approximately 50 feet bgs in Boring B-3. The suspension P-S velocity logging system uses a 7-meter probe, containing a source and two receivers spaced one meter apart, suspended by a cable. The armored 4- or 7-conductor cable serves both to support the probe and to convey data to and from a recording/control device on the surface. The probe is lowered into the borehole to a specified depth (a rotary encoder on a winch measures probe depth), where the source generates a pressure wave in the borehole fluid. The pressure wave is converted to seismic waves (P and S) at the borehole wall. Along the wall at each receiver location, the P and S waves are converted back to pressure waves in the fluid and received by the geophones, which send the data to the recorder on the surface. The elapsed time between arrivals of the waves at the receivers is used to determine the average velocity of a one-meter-high column of soil around the borehole.

Norcal also performed two seismic refraction lines at the site to characterize variations in the P- and S-wave velocities of the material in the upper 40 to 70 feet of the subsurface along both lines. The seismic refraction surveys are useful in estimating the depth to the rock surface, the strength of rock, and the rippability (excavatability) characteristics of the rock. Multi-Channel Analysis of Surface Waves (MASW) techniques were used to obtain the seismic readings: 24 geophones spaced 6-ft apart with shot points located 12-ft and 36-ft off each end of the seismic lines were be used. A 16-pound sledge hammer striking a metal plate placed on the ground surface was used to generate the seismic energy. All seismic data was recorded on a 24-channel Geometrics seismic system. Color coded P-wave velocity profiles, and 1-D S-wave velocity graphs of P- and S-wave velocities with depth at the center point of the respective geophone arrays are included in Appendix B.

3.3 Test Pits

Three test pits were excavated by A&B Construction of Berkeley, California on 14 and 15 September 2017 in order to expose the bottom of footings at adjacent buildings. The locations of the test pits are shown on Figure 2, and the test pit logs are included in Appendix C. Test Pit TP-1 was in a concrete-covered area and required saw cutting of the concrete. The sides of the test pits did not require any shoring during excavation and did not encounter groundwater. Our field representative logged the foundation and soil conditions exposed in each test pit before the pits were backfilled with the spoils from excavation in relatively thin lifts and mechanically tamped/compacted. Concrete was patched at TP-1 to match the adjacent slab thickness.

3.4 Dynamic Penetrometer Tests

We performed three dynamic penetrometer tests (DPTs) from the ground floor of the existing garage on 22 December 2017. The locations of the DPTs are shown on Figure 2, and the DPT logs are included in Appendix D. The DPTs were performed to depths between 3-1/2 and 6-1/2 feet below the ground floor slab. A DPT consists of driving a 1.4-inch-diameter, cone-tipped probe into the ground with a hand-held 35-pound safety hammer falling approximately 15 inches. The blows required to drive the rods and cone into the soil were recorded at 10 centimeter (approximately four-inch) intervals and were converted to SPT N-values, for use in our engineering studies. After the completion of each DPT, our field representatives used a hand auger below the ground floor slab to collect grab samples for field and office classification and laboratory testing. Upon completion of each DPT and hand auger, the void was filled with cement grout and the garage floor slab was patched at each location to match the adjacent slab thickness.

3.5 Cone Penetration Tests

In addition to the DPTs, three portable cone penetration tests (CPTs) were performed from the ground floor of the existing garage by Gregg Drilling and Testing, Inc. of Martinez, California on 22 December 2017. The CPTs were performed by hydraulically pushing a 1.7-inch-diameter cone-tipped probe into the ground using a limited access ramset rig. The cone on the end of the probe is equipped to measure tip resistance, and the sleeve behind the cone tip measures frictional resistance. Electrical strain gauges within the cone measure soil parameters continuously for the entire depth advanced. Penetration data is transferred to a computer and processed to provide engineering information, such as the type of soil encountered and its approximate strength characteristics. Upon completion of each CPT, the hole was backfilled with cement grout and the garage floor slab was patched at each location to match the adjacent slab thickness. The CPT results are presented as Appendix E.

4.0 LABORATORY TESTING

The geotechnical soil samples recovered from the field exploration programs were re-examined in the office for soil classification, and representative samples were selected for laboratory testing. The laboratory testing program was designed to correlate and evaluate engineering properties of the soil at the site. Samples were tested to measure moisture content, dry density, fines content, particle size, strength, compressibility, plasticity (Atterberg limits), and corrosivity. Results of all but the corrosivity laboratory tests are included on the boring logs and in Appendix F. The corrosivity results and a brief evaluation are presented in Section 7.5 and Appendix G.

In the field, the environmental soil samples were sealed with Teflon and plastic caps, labeled, and placed on ice in a cooler for delivery to McCampbell Analytical, a State of California certified analytical laboratory based in Pittsburg, California, under chain of custody procedures. A total of six soil samples were submitted for some or all of the following chemical analyses:

- Total petroleum hydrocarbons (TPH) as gasoline (TPHg), diesel (TPHd), and motor oil (TPHmo) by EPA Method 8021/8015;
- Polychlorinated biphenyls (PCBs) by EPA Method 8082;
- Volatile organic compounds (VOCs) by EPA Method 8260;
- Polynuclear aromatics (PNAs) and polyaromatic hydrocarbons (PAHs) by EPA Method 8270C-SIM;
- Semi-volatile organic compounds (SVOCs) by EPA Method 8270;
- California assessment manual (CAM) 17 metals by EPA Method 6020; and
- Asbestos by California Air Resource Board (CARB) Method 435.

The soil analytical results from the site's preliminary ESC are discussed in Section 7.6. Copies of the certified analytical reports are provided in Appendix H.

5.0 SITE AND SUBSURFACE CONDITIONS

The site is occupied by the four-level Upper Hearst parking structure, which is supported on shallow, spread footings[2], and an at-grade asphalt-paved parking lot. The ground surface of the site slopes down to the southwest, with ground surface elevations at the parking lot between about 405 feet at the northeastern corner and 390 feet at the southwestern corner of the site, and site grades along Hearst Avenue at the western edge of the parking garage of about

[2] Per as-built "Parking Garage H" drawings for the University of California, Berkeley by David J. Russell, dated March 1969.

370 feet. To the north, east, south, and west of the site are Ridge Road, La Loma Avenue, Hearst Avenue, and Cloyne Court Co-op and the current GSPP building, respectively. Based on information obtained in the test pits, the adjacent Cloyne Court Co-op and the adjacent GSPP academic building are founded on shallow footings bearing on sand, sandy clay, and silty sand fill over native clayey soil.

The parking lot on Ridge Road is generally underlain by up to nine feet of heterogeneous fill, consisting mainly of stiff to hard clay and sandy clay, and very dense gravel and clayey gravel. The fill, in general, has a moderate to high expansion potential and is underlain by approximately 30 to 40 feet of undifferentiated colluvial materials/surficial deposits, composed of interbedded stiff to hard clay, and sandy clay with medium to very dense clayey sands and silty sands. Colluvial materials are underlain by fault gouge, brecciated sandstone and shale, and serpentinite, which were encountered at approximately 30 to 50 feet below the parking lot surface. We interpret the gouge and brecciated bedrock materials to be associated with the mapped Louderback shear zone. The existing concrete garage slab along Hearst Avenue is underlain by approximately 6 inches of gravel fill over hard clay, sandy clay, and clay with gravel.

Depth to groundwater in the site vicinity is expected to range from approximately 10 to 40 feet bgs; however, it was not observed during our borings due to the rotary wash drilling fluids obscuring the groundwater level. The inferred groundwater gradient is to the southwest, which corresponds to the site's topography. We anticipate the groundwater varies seasonally. On the basis of the available groundwater information from past investigations in the vicinity of the site and to account for the gradient across the site and seasonal fluctuations, we judge that a design groundwater level of Elevation 370 feet, which corresponds to approximately 20 to 35 feet bgs at the existing parking lot or approximately 1 to 3 feet bgs at the existing garage entrance on Hearst Avenue, is appropriate. A pore pressure dissipation test performed in CPT-2 indicates that the groundwater is approximately 4 feet bgs at the CPT-2 location; this is consistent with the design groundwater level of Elevation 370 feet.

6.0 REGIONAL SEISMICITY AND FAULTING

The major active faults in the area are the Total Hayward, Total Hayward-Rodgers Creek, Mount Diablo, Calaveras, Green Valley, Rodgers Creek, and San Andreas faults. These and other faults of the region are shown on Figure 3. For each of the active faults within about 50 kilometers (km) of the site, the distance from the site and estimated mean characteristic

Moment magnitude[3] [2007 Working Group on California Earthquake Probabilities (WGCEP) (2008) and Cao et al. (2003)] are summarized in Table 1.

TABLE 1
Regional Faults and Seismicity

Fault Segment	Approx. Distance from fault (km)	Direction from Site	Mean Characteristic Moment Magnitude
Total Hayward	0.2	Northeast	7.0
Total Hayward-Rodgers Creek	0.2	Northeast	7.3
Mount Diablo Thrust	19	East	6.7
Green Valley Connected	22	East	6.8
Total Calaveras	23	East	7.0
Rodgers Creek	28	Northwest	7.1
N. San Andreas - Peninsula	29	West	7.2
N. San Andreas (1906 event)	29	West	8.1
N. San Andreas - North Coast	30	West	7.5
West Napa	32	North	6.7
San Gregorio Connected	34	West	7.5
Greenville Connected	37	East	7.0
Great Valley 5, Pittsburg Kirby Hills	39	East	6.7
Monte Vista-Shannon	49	South	6.5
Point Reyes	51	West	6.9

Figure 3 also shows the earthquake epicenters for events with magnitude greater than 5.0 from January 1800 through August 2014. Since 1800, four major earthquakes have been recorded on the San Andreas fault. In 1836 an earthquake with an estimated maximum intensity of VII on the Modified Mercalli (MM) scale (Figure 4) occurred east of Monterey Bay on the San Andreas fault (Toppozada and Borchardt 1998). The estimated Moment magnitude, $M_{w,}$ for this earthquake is about 6.25. In 1838, an earthquake occurred with an estimated intensity of about VIII-IX (MM), corresponding to a M_w of about 7.5. The San Francisco Earthquake of 1906

[3] Moment magnitude is an energy-based scale and provides a physically meaningful measure of the size of a faulting event. Moment magnitude is directly related to average slip and fault rupture area.

caused the most significant damage in the history of the Bay Area in terms of loss of lives and property damage. This earthquake created a surface rupture along the San Andreas fault from Shelter Cove to San Juan Bautista approximately 470 kilometers in length. It had a maximum intensity of XI (MM), a M_w of about 7.9, and was felt 560 kilometers away in Oregon, Nevada, and Los Angeles. The Loma Prieta Earthquake occurred on 17 October 1989, in the Santa Cruz Mountains with a M_w of 6.9, approximately 99 km from the site.

In 1868 an earthquake with an estimated maximum intensity of X on the MM scale occurred on the southern segment (between San Leandro and Fremont) of the Hayward fault. The estimated M_w for the earthquake is 7.0. In 1861, an earthquake of unknown magnitude (probably a M_w of about 6.5) was reported on the Calaveras fault. The most recent significant earthquake on this fault was the 1984 Morgan Hill earthquake ($M_w = 6.2$).

The most recent earthquake to affect the Bay Area occurred on 24 August 2014 and was located on the West Napa fault with a M_W of 6.0, approximately 39 km from the site.

The 2014 Working Group for California Earthquake Probabilities (WGCEP) at the U.S. Geologic Survey (USGS) predicted a 72 percent chance of a magnitude 6.7 or greater earthquake occurring in the San Francisco Bay Area in 30 years (Fields et al. 2015). More specific estimates of the probabilities for different faults in the Bay Area are presented in Table 2.

TABLE 2

WGCEP (2015) Estimates of 30-Year Probability (2014 to 2043) of a Magnitude 6.7 or Greater Earthquake

Fault	Probability (percent)
Hayward-Rodgers Creek	31
N. San Andreas	21
Calaveras	7
San Gregorio	6
Concord-Green Valley	3
Greenville	3
Mount Diablo Thrust	1

7.0 DISCUSSION AND CONCLUSIONS

From a geotechnical standpoint, we conclude the proposed new 5- to 6-story GSPP classroom and residential development can be constructed as planned provided the geotechnical recommendations presented in this report are incorporated in the project plans and specifications and are implemented during construction. The primary geotechnical concerns for the project are the presence of expansive soil, selecting appropriate foundation and temporary shoring types to support the building and excavation loads, constructing near fault traces and on shear zone material, and constructing near existing adjacent buildings. Our conclusions regarding seismic hazards, the most appropriate foundation and shoring type(s), settlement, and other geotechnical issues are presented in this section.

7.1 Seismic Hazards

During a major earthquake on one of the nearby faults, strong to very strong shaking is expected to occur at the site. Strong shaking during an earthquake can result in ground failure such as that associated with soil liquefaction,[4] lateral spreading,[5] and cyclic densification[6]. We used the results of the borings and our understanding of the site geology to evaluate the potential for these phenomena to occur at the site. The results of our evaluation are presented in the following sections.

The California Geological Survey (CGS)[7] has prepared a map titled *Earthquake Zones of Required Investigation, Richmond Quadrangle* (undated), released 10 April 2017. This map was prepared in accordance with the Seismic Hazards Mapping Act of 1990 and Alquist-Priolo (AP) Earthquake Fault Zoning Act, and shows both seismic hazard and AP zones. The northeastern half of the project site is mapped within an earthquake zone of required investigation.

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4 Liquefaction is a transformation of soil from a solid to a liquefied state during which saturated soil temporarily loses strength resulting from the buildup of excess pore water pressure, especially during earthquake-induced cyclic loading. Soil susceptible to liquefaction includes loose to medium dense sand and gravel, low-plasticity silt, and some low-plasticity clay deposits.

5 Lateral spreading is a phenomenon in which surficial soil displaces along a shear zone that has formed within an underlying liquefied layer. Upon reaching mobilization, the surficial blocks are transported downslope or in the direction of a free face by earthquake and gravitational forces.

6 Cyclic densification is a phenomenon in which non-saturated, cohesionless soil is compacted by earthquake vibrations, causing differential settlement.

7 Formerly the California Division of Mines and Geology.

7.1.1 Fault Rupture

Historically, ground surface ruptures closely follow the traces of geologically young faults. The northeastern half of the site is located within an Earthquake Fault Zone, as defined by the Alquist-Priolo Earthquake Fault Zoning Act (Figure 5). The Louderback shear zone is mapped as extending through the project site. A number of fault investigations have been completed on the UC Berkeley Campus, and within the vicinity of the site, to determine whether the Louderback is Holocene-active. As part of our fault evaluation, we have contacted Jim Lienkaemper of the USGS, discussed the Louderback fault with other consultants who have evaluated fault activity on the various fault traces extending through the UC Berkeley campus and vicinity, and reviewed the following fault studies:

- Harding Lawson Associates, Geologic and Fault Hazard Investigation, Proposed Student Housing, University of California, Berkeley, California, 13 November 1986;
- Harding Lawson Associates, Geologic and Fault Hazard Investigation, Phase II, Foothill Student Housing, University of California, Berkeley, California, 12 January, 1988;
- Harding Lawson Associates Supplemental Fault Hazard Investigation, "Louderback Trace", Foothill Student Housing Project, University of California, Berkeley, California, 22 June 1988;
- Kleinfelder, 1990, Geologic Evaluation – Fracture Pattern, Building B, Foothill Housing Project, Berkeley, California, consultant report;
- GTC "Fault Investigation, West Trace of the Hayward Fault, Bowles Hall Renovation Project, University of California, Berkeley, California." 6 August 1992;
- William Lettis & Associates, Inc., Revised Draft Report, Fault Displacement Hazard Study, Bowles Hall, Berkeley, California, 3 January 2008;
- Alan Kropp & Associates, Initial Geotechnical/Geological Assessment Joint Chemistry and Engineering Building, University of California- Berkeley, 21 June 2016.

We have also reviewed numerous, older AP reports that were on file with the California Geological Survey[8]. According to Harding Lawson & Associates (HLA) (1988) and GTC (1992) reports, studies by George Louderback in 1939 concluded that the Hayward fault is split into

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[8] A complete list of reports reviewed is included in the references.

two traces in the vicinity of the Greek Theater. One trace is west of the colonnade (near Gayley Road) and the other trace is east of the seating Greek Theater seating bowl. Subsequent studies, including those referenced above, have identified the western "active" trace of the Hayward fault to be east of the Greek Theater seating bowl (HLA 1988). Furthermore, Louderback also indicated that the westernmost trace (subsequently named the Louderback trace) had not moved in "a very long time" (GTC 1992). HLA evaluated the La Loma Ridge housing site, across the street from the project site, and determined that no active faults pass through the site. In their study, HLA referenced a 1939 study by Louderback, which included observations made in the Lawson Adit, located approximately 215 feet to the south of the intersection of La Loma and Hearst Ave (southeast corner of the site). Louderback observed that Holocene-age alluvial gravels were not offset in the vicinity of the mapped fault trace. HLA confirmed the lack of offset in its own supplemental study on the Louderback fault (HLA 1988).

We understand that a report prepared by William Lettis & Associates in 2007 for the Haas School Executive Business Building presented a detailed discussion summarizing the various traces of the Hayward fault and the conclusions from previous studies. They also concluded that the Louderback trace in the vicinity of the Greek Theater stage area shows no evidence of recent faulting and is inactive. We have not reviewed this report to date, but are in the process of acquiring it to verify this conclusion.

Kropp (2016) completed a preliminary geotechnical and geological assessment for a proposed new Joint Chemistry and Engineering Building in the existing location of Donner Laboratory Building, approximately 360 feet south of the project site. Kropp concluded that no active faults extend through this location, and that the nearest active trace of the Hayward fault is approximately 150 feet to the northeast. However, we have not confirmed that there is an active fault trace in this location as stated in Kropp's report. Kropp also concludes that the Louderback fault is inactive.

Our review of fault investigations and geologic analysis is ongoing. We have recently acquired information that suggests potential Holocene offset on the Louderback fault in the vicinity of Stern Hall, and are in the process of pursuing additional information from the USGS regarding this interpretation. Based on the distance of the project site from the nearest active trace of Hayward fault and review of fault investigations in the area, our preliminary assessment to date is that most evidence seems to suggest that the Louderback fault is inactive. We are still reviewing reports and discussing fault observations with the USGS and other consultants who have evaluated the Louderback. Our final conclusions and supporting figures will be included in an addendum to this report.

7.1.2 Liquefaction and Associated Hazards

Liquefaction is a phenomenon in which saturated soil temporarily loses strength from the build-up of excess pore water pressure, especially during earthquake-induced cyclic loading. Flow failure, lateral spreading, differential settlement, loss of bearing strength, ground fissures, and sand boils are evidence of excess pore pressure generation and liquefaction. We evaluated the potential for liquefaction to occur at the site in accordance with Special Publication 117A, *Guidelines for Evaluating and Mitigating Seismic Hazards Zones in California*, dated 11 September 2008.

In general, the site subsurface material consists of relatively dense granular soil and stiff cohesive soil such that we conclude, in general, the site subsurface material has sufficient relative density and/or cohesion to resist liquefaction. Accordingly, we judge the potential for liquefaction to occur at the site is low. Because the potential for liquefaction is low, we conclude that the potential for seismic hazards associated with liquefaction, such as sand boils, are also low.

7.1.3 Lateral Spreading

Lateral spreading is a phenomenon in which a surficial soil displaces along a shear zone that has formed within an underlying liquefied layer. The surficial blocks are transported downslope or in the direction of a free face, such as a channel, by earthquake and gravitational forces. Lateral spreading is generally the most pervasive and damaging type of liquefaction-induced ground failure generated by earthquakes.

Because the potential for liquefaction at the site is low, we conclude, likewise, the potential of lateral spreading at the site is low.

7.1.4 Seismic Densification

Seismic densification, also referred to as cyclic densification, of non-saturated cohesionless soil (sand and silt above the groundwater table) caused by earthquake vibrations may result in settlement. Because of the cohesion and relative density of the soil encountered above the groundwater table, we conclude the potential for cyclic densification and resulting ground settlement is low.

7.2 Expansive Soil

Laboratory test results indicate the fill soil and gouge material have moderate to high expansion potential. Expansive soil is subject to high volume changes during seasonal fluctuations in moisture content. These volume changes can cause cracking of foundations and floor slabs. Therefore, foundations and slabs should be designed and constructed to resist the effects of the expansive soil. These effects can be mitigated by moisture conditioning the expansive soil and providing non-expansive engineered fill below slabs and supporting foundations founded on fill soils.

7.3 Foundations and Settlement

We conclude the proposed new portion of the building can be supported on a mat foundation and the improvements to the existing structure can be supported on the existing spread footings. Previous experience with similar soil types indicates exterior concrete slabs-on-grade should perform satisfactorily if they are supported on a layer of select fill at least 12 inches thick.

We conclude the new building can be supported on a shallow mat foundation on native material and the improvements to the existing structure can be supported on the existing spread footings. Design recommendations for a mat foundation are presented in Section 8.2. We expect that at the new building foundation subgrade (assumed to be about 15 to 30 feet below the existing parking lot ground surface), colluvial materials, composed of interbedded stiff to hard clay and sandy clay with medium to very dense clayey sand and silty sand, will be present. We expect gouge, brecciated bedrock materials and serpentinite below the colluvial materials, at approximately 30 to 50 feet below the parking lot surface, corresponding to approximately 10 to 25 feet below the basement finished floor. It is unlikely that any sandstone and shale or other bedrock unit that could be encountered in excavations is laterally continuous, and should not be relied upon for support. We anticipate settlement under the existing garage structure is substantially complete. We anticipate additional loads from the proposed improvements to the structure could produce settlement on the order of ½ inch. We estimate immediate settlement of the soil below the new building may be on the order of 1 inch. These settlement estimates are based on preliminary loads provided by the structural engineer[9] and foundations designed in

[9] The building is in schematic design and building loads have not yet been finalized.

accordance with the recommendations provided in Section 8.2. More detailed estimates of settlement based on final building loads will be provided in an addendum to this report, if necessary.

7.4 Construction Considerations

Construction of the new building will require an excavation of up to about 25 feet below existing parking lot grades. We anticipate the soil beneath the site can be excavated with conventional equipment; however, remnants of former buildings, concrete foundations, slabs, walls, etc. should be expected to be encountered. During excavation for the proposed below-grade levels, shoring will be required to laterally restrain the sides of the excavation and limit the movement of adjacent improvements, such as public streets and sidewalks, and adjacent structures.

We judge the most economical shoring system for the project would consist of soldier piles, timber lagging, and tiebacks. Internal braces may be required if there are obstructions precluding use of tiebacks or if extending them beyond property lines is not permitted.

For a soldier beam and lagging system, steel soldier piles are placed in predrilled holes and backfilled with lean and/or full-strength concrete. Wood lagging would be placed between the soldier beams as the excavation proceeds. Drilling of the holes for the soldier piles will likely require casing and/or the use of drilling mud to prevent caving of the sand and gravel layers. The shoring system and adjacent improvements should be monitored for movements throughout the excavation until the street-level slab is cast.

Where the proposed excavation extends deeper than the foundations of adjacent buildings, underpinning should be provided to support the adjacent building loads (or the shoring and basement walls should be designed to accommodate surcharge pressures from adjacent building loads). Underpinning could consist of hand-excavated piers that extend at least two feet below the planned bottom of excavation. Underpinning piers are usually about 30- by 48-inches in plan and are shored using pressure-treated lagging. The piers are reinforced with steel and are filled with concrete; the pier should be pre-loaded by jacking against the foundation, and the top of the pier dry-packed to fit tightly with the base of the underpinned foundation. The piers should act in end bearing in the strata below the bottom of the proposed excavation. Alternatively, slant-drilled piles could be used as underpinning.

7.5 Groundwater and Dewatering

Groundwater levels measured on site and in nearby investigations indicate that the depth to groundwater varies across the site (10 to 40 feet below existing ground surface at the parking lot and less than 5 feet below existing ground floor slab level at the garage). Depending on the time of year excavations are made, and due to perched water, water could be encountered during excavation and be present at the bottom of excavations. As a result, the contractor should be prepared to control groundwater when making excavations.

7.6 Soil Corrosivity

CERCO Analytical of Concord, California evaluated the corrosivity of the site fill by testing two composite samples obtained from depths of 3.5 feet from Boring B-2 and 1 to 4 feet from DPT-1. Corrosion potential was determined based on the nominal resistivity measurement (100 percent saturation), chloride ion concentration, sulfate ion concentration, pH, and redox potential.

The test results indicate the samples tested are "corrosive." Test results and brief evaluations describing the corrosion characteristics and corrosion protection recommendations are included in Appendix G.

7.7 Phase I ESA and Preliminary Environmental Site Characterization Results

The Phase I ESA, completed and report dated 15 November 2017, did not identify any recognized environmental conditions directly or indirectly associated with the site. Results of the preliminary ESC are as follows.

Soil analytical results for parameters other than metals are summarized in Analytical Summary Table 1 and were compared to both the San Francisco Bay Area Regional Water Quality Control Board (RWQCB) Tier 1 environmental screening levels (ESLs) summary table (RWQCB, February 2016 [Rev. 3]) and construction worker direct exposure ESLs for any soil type at any depth for any land use (RWQCB, Table S-1, February 2016 [Rev. 3]). TPHg was detected above the laboratory reporting limit (1.0 milligram per kilogram (mg/kg)) in one of the six samples analyzed at a concentration of 1.4 mg/kg. TPHd was detected above the laboratory reporting limit (1.0 mg/kg) in four of the six samples analyzed at concentrations ranging from 2.5 mg/kg to 210 mg/kg. TPHmo was detected above the laboratory reporting limit in five of the six samples analyzed at concentrations ranging from 8.6 mg/kg to 4,300 mg/kg. None of the TPH concentrations detected in the six samples analyzed exceed the established ESLs.

A trace concentration of 1,2,4-trimethylbenzene, a VOC, was detected in one of the four samples analyzed, at a concentration of 0.0075 mg/kg. There are no established ESLs for 1,2,4-trimethylbenzene.

Trace to low-level concentrations of PNAs and PAHs were detected in one of the two samples analyzed. Benzo(a)pyrene and benzo(b)fluoranthene (both PAHs/PNAs) were detected at concentrations of 0.083 mg/kg and 0.24 mg/kg, respectively which exceed the established Tier 1 ESLs of 0.016 mg/kg and 0.16 mg/kg, respectively. However, the detected concentrations of benzo(a)pyrene and benzo(b)fluoranthene do not exceed the established construction worker direct exposure ESLs of 1.6 mg/kg and 16 mg/kg, respectively.

Trace to low-level concentrations of SVOCs were detected in one of the three samples analyzed. Bis(2-chloroisopropyl)ether, dibenzo(a,h)anthracene, and naphthalene were detected at concentrations of 0.015 mg/kg, 0.064 mg/kg, and 0.028 mg/kg, respectively. The detected concentrations of bis(2-chloroisopropyl)ether and dibenzo(a,h)anthracene exceed the established Tier 1 ESLs of 0.0039 mg/kg and 0.016 mg/kg, respectively. However, the detected concentrations of bis(2-chloroisopropyl)ether and dibenzo(a,h)anthracene do not exceed the established construction worker direct exposure ESLs of 220 mg/kg and 1.6 mg/kg, respectively.

No PCBs or asbestos were detected at or above method reporting limits in the sample analyzed.

Soil analytical results for metal parameters are summarized in Analytical Summary Table 2, and were compared to the total threshold limit concentration (TTLC) and background concentrations of metals in Bay Area soils. All detected metals concentrations were within normal[10] background ranges found in the western United States, specifically the Bay Area.

10 "Background concentration ranges of metals in Bay Area soils, Appendix A, Table A-2 from Environmental Resources Management. Feasibility Study, Hookston Station, Pleasant Hill, California. July 2006.

8.0 RECOMMENDATIONS

Recommendations for site preparation, foundation design, excavation and shoring, tiebacks, underpinning, below-grade walls, floor slabs, retaining walls, construction monitoring, seismic design, and preliminary ESC are presented in this section of the report.

8.1 Earthwork

This section presents earthwork recommendations for site preparation and grading.

8.1.1 Site Preparation

Grading operations should commence after demolition and removal of the existing pavements, foundations, slabs, and underground utilities within the development area. Following demolition, all areas to receive improvements should be stripped of vegetation and organic topsoil. The pavement material, including asphalt, may be segregated from organic topsoil and used as compacted fill, provided it meets the fill requirements presented in Section 8.1.3. The stripped organic soil can be stockpiled for later use in landscaped areas, if approved by the architect; organic topsoil should not be used as compacted fill.

Where utilities that are removed extend off site, they should be capped or plugged with grout at the property line. It may be feasible to abandon utilities in-place by filling them with grout, provided they will not interfere with future utilities or affect building foundations. The utility lines should be addressed on a case-by-case basis.

8.1.2 Subgrade Preparation

The soil exposed at the bottom of foundation excavations and floor slab-on-grade areas should be cleared of loose material and should be non-yielding. We recommend at least 12 inches of non-expansive engineered fill be placed beneath proposed exterior concrete flatwork, including patio slabs and sidewalks; the fill should extend at least two feet beyond the slab edges. The upper 12 inches of soil in exterior slab areas should be moisture-conditioned to at least three percent above optimum moisture content and compacted to between 88 and 93 percent relative compaction.

If the subgrade is disturbed during utility or foundation construction, it should be re-rolled and moisture conditioned prior to flatwork or slab construction.

8.1.3 Engineered Fill Placement and Compaction

Excavated on-site soil may be suitable for reuse as engineered fill or backfill provided it meets the following requirements:

- is free of organic material
- contains no rocks or lumps larger than three inches in greatest dimension
- has a low expansion potential (defined by a liquid limit of less than 40 and a plasticity index lower than 12)
- is non-corrosive and non-hazardous
- is confirmed as environmentally acceptable by Langan

In addition, engineered fill should contain at least 20 percent fines (particles passing the No. 200 sieve) to reduce the potential for surface water to infiltrate beneath slabs. Engineered fill should be placed in lifts not exceeding eight inches in loose thickness and compacted to at least 90 percent relative compaction. During construction, we should check that the on-site and any proposed import material are suitable for use as fill. In lieu of soil fill, lean concrete or controlled density fill (CDF) may be used.

Langan should approve all sources of imported fill at least three days before use at the site. The grading contractor should provide analytical test results or other suitable environmental documentation indicating the imported fill is free of hazardous materials at least three days before use at the site. If data are not available, up to two weeks should be allowed to perform, review, and approve analytical testing on the proposed import material. A bulk sample of approved fill should be provided to Langan at least three working days before use at the site so a compaction curve can be prepared.

8.1.4 Utilities and Utility Trenches

Excavations in soil for utility trenches can be made with conventional earth-moving equipment. Backfill for utility trenches and other excavations is also considered fill, and should be compacted according to the recommendations presented in Section 8.1.3. If imported clean sand or gravel is used as backfill, however, it should be compacted to at least 95 percent relative compaction. Jetting of trench backfill should not be permitted. Special care should be taken when backfilling utility trenches in pavement areas. Poor compaction may cause excessive settlements, resulting in damage to the pavement section.

Utility trenches should be excavated at least four inches below the bottom of pipes or conduits and have clearances of at least four inches on both sides. To provide uniform support, pipes or conduits should be bedded on a minimum of four inches of sand or fine gravel. After pipes and conduits are tested, inspected (if required), and approved, they should be covered to a depth of six inches with sand or fine gravel, which should then be mechanically tamped.

Where utility trenches backfilled with sand or gravel enter the building, an impermeable plug consisting of native clay or lean concrete, at least five feet in length, should be installed at the building line. Further, where sand- or gravel-backfilled trenches cross planter areas and pass below asphalt or concrete pavements, a similar plug should be placed at the edge of the pavement. The purpose of these plugs is to reduce the potential for water to become trapped in trenches beneath the building or pavements. This trapped water can cause heaving of soils beneath slabs and softening of subgrade soil beneath pavements.

8.2 Mat Foundation

The new portion of the building should be supported on a mat bearing on firm soil, which we anticipate to be native colluvial material over gouge, brecciated bedrock materials and serpentinite.

A mat foundation bearing on this material may be designed for a preliminary allowable bearing pressure of 4,500 psf for dead loads, 6,800 psf for dead plus live loads, and 9,100 psf for total design forces, i.e. including wind and/or seismic load. Mat foundations should be embedded at least 24 inches below lowest adjacent soil subgrade.

Lateral loads can be resisted by a combination of passive pressures on the vertical faces of the foundations and friction along the bases of the foundations. We recommend passive resistance be calculated using a uniform pressure of 2,000 psf. The upper foot of soil should be ignored unless it is confined by slabs or pavement. Frictional resistance should be computed using a base friction coefficient of 0.25. These values include a factor of safety of 1.5, and may be used in combination without reduction.

Weak soil or non-engineered fill encountered in the bottom of foundation excavations should be excavated and replaced with engineered fill or lean concrete. The bottoms and sides of the foundation excavations should be wetted following excavation and maintained in a moist condition until concrete is placed. We should check foundation excavations prior to placement of reinforcing steel. Foundation excavations should be free of standing water, debris, and disturbed materials prior to placing concrete. Positive surface drainage should be provided around the building to direct surface water away from the foundations. In addition, roof downspouts should be discharged into controlled drainage facilities to keep the water away from the foundations.

Further detailed recommendations and geotechnical design parameters to be used to support structural design of the new building atop the existing parking garage footings are underway in conjunction with continued structural design, as it evolves. These recommendations will be provided in addenda to this report, as appropriate.

8.3 Excavation, Temporary Slopes, and Shoring

Langan is in the process of developing final shoring pressures for the excavation which will be provided in an addendum to this report. Tied-back soldier piles and lagging shoring should be designed to resist these pressures. However, for preliminary design, we recommend using an apparent pressure of 30H, where H is the height of the wall, for tied-back and internally braced shoring. The shoring designer should evaluate the required penetration depth of the soldier piles. The soldier piles should have sufficient axial capacity to support the vertical load acting on the piles, if any. Temporary slopes should not be steeper than 1.5:1 (horizontal to vertical) for slopes up to 15 feet in height. Slopes higher than 15 feet should be analyzed.

8.4 Tiebacks

Tiebacks should derive their load-carrying capacity from the soil behind an imaginary line sloping upward from a point H/5 feet away from the bottom of the excavation at an angle 60 degrees from horizontal, where H is the wall height in feet.

Allowable capacities of the tiebacks will depend on the installation method, hole diameter, grout pressure, and workmanship. For estimating purposes, we recommend using a skin friction value of 500 psf tiebacks with for gravity placed grout or 1,000 psf for pressure-grouted tiebacks within the bond length, with a minimum bond length of 15 feet. The stressing (unbonded) length should be at least 15 feet for steel strands and 10 feet for steel bars. These values include a safety factor of approximately 1.5. A Klemm-type rig (double cased hole) should be used to drill the shafts and the tiebacks should be equipped with post-grout tubes.

Determining the length of tieback required to resist the earth pressures presented above should be the contractor's responsibility. The computed bond length should be confirmed by a testing program under our observation. Testing procedures should follow those described in Section 8.5 for tieback testing.

If any tiebacks fail to meet the testing requirements, additional tiebacks should be added to compensate for the deficiency as required by the shoring designer. Additionally, the tiebacks should be checked 24 hours after initial prestressing to check that stress relaxation has not occurred. The bottom of the excavation should not extend more than two feet below a row of unsecured tiebacks.

8.5 Tieback Testing

We should observe tieback testing. The first two production tiebacks and two percent of the remaining tiebacks should be performance-tested to at least 1.25 times the design load. The remaining tiebacks should be confirmed by proof tests also to at least 1.25 times the design load.

The movement of each tieback should be monitored with a free-standing, tripod-mounted dial gauge during performance and proof testing. The performance test is used to verify the capacity and the load-deformation behavior of the tiebacks. It is also used to separate and identify the causes of tieback movement, and to check that the designed unbonded length has been established. In the performance test, the load is applied to the tieback in several cycles of incremental loading and unloading. During the test, the tieback load and movement are measured. The maximum test load should be held for a minimum of 10 minutes, with readings taken at 0, 1, 3, 6, and 10 minutes. If the difference between the 1- and 10-minute readings is less than 0.04 inch during the loading, the test is discontinued. If the difference is more than 0.04 inch, the holding period is extended by 50 minutes to 60 minutes, and the movements should be recorded at 15, 20, 25, 30, 45, and 60 minutes.

A proof test is a test used to measure the total movement of the tieback during one cycle of incremental loading. The maximum test load should be held for a minimum of 10 minutes, with readings taken at 0, 1, 2, 3, 6, and 10 minutes. If the difference between the 1- and 10-minute readings is less than 0.04 inch, the test is discontinued. If the difference is more than 0.04 inch, the holding period is extended by 50 minutes to 60 minutes, and the movements should be recorded at 15, 20, 25, 30, 45, and 60 minutes.

We should evaluate the tieback test results and determine whether the tiebacks are acceptable. A performance- or proof-tested tieback with a ten-minute hold is acceptable if the tieback carries the maximum test load with less than 0.04 inch movement between one and 10 minutes, and total movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

A performance- or proof-tested tieback with a 60-minute hold is acceptable if the tieback carries the maximum test load with less than 0.08 inch movement between six and 60 minutes, and total movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

Tiebacks that failed to meet the first criterion will be assigned a reduced capacity. If the total movement of the tiebacks at the maximum test load does not exceed 80 percent of the theoretical elastic elongation of the unbonded length, the contractor should replace the tiebacks.

8.6 Underpinning Design

Underpinning piers might be required to support the loads of adjacent structures during construction of the proposed basement levels. Piers should bottom at least two feet below the bottom of the excavation. We recommend underpinning piers be designed using preliminary allowable bearing pressures of 3,000 psf for dead loads, 4,500 psf for dead plus live loads, and 6,000 psf for total design forces, i.e. including wind and/or seismic load, provided native material is exposed at the base of the piers.

The piers should be designed to resist at-rest soil pressures. Because expansive soil is present at the site, we recommend an equivalent fluid unit weight of 75 pcf be used to determine the lateral earth pressure against the pier. Lateral earth pressures may be resisted by tiebacks and passive resistance against the portion of the pier extending below the excavation. We recommend passive resistance below the bottom of the excavation be calculated using a uniform pressure of 2,000 psf. This value includes a factor of safety of about 1.5 and assumes the groundwater level is a minimum of 3 feet below the bottom of the underpinning pier.

The bottom of the piers should be free of standing water, debris, and disturbed materials prior to placing concrete. We should check the excavations prior to placement of reinforcing steel to confirm the exposed soil is suitable to support the design bearing pressures. If loose or soft soil or undesirable material is encountered, it should be removed and the overexcavation backfilled with lean or structural concrete to the bottom of the pier.

If slant-drilled piles are used as underpinning, to compute the embedment depth of the piles, we recommend using an allowable skin friction of 500 psf below the bottom of the excavation.

8.7 Below-Grade Wall Design

To protect against moisture migration, basement walls should be waterproofed and water stops should be placed at all construction joints. We recommend all below-grade and retaining walls be designed to resist lateral pressures imposed by the adjacent soil and vehicles. Lateral earth pressures on basement walls will depend partially on the restraint at the top of the walls. Accordingly, walls should be designed for the equivalent fluid weights (triangular distribution) presented in Table 3.

Table 3 presents the active, at-rest, and total pressures (active plus seismic pressure increment) for soil with level backfill for drained conditions. We used the procedures outlined in Sitar et al. (2012) to compute the seismic active pressure. The more critical condition of either at-rest pressure or active pressure plus a seismic increment (total pressure) should be checked.

TABLE 3
Below-Grade Wall Design

Retained Material	Static Conditions		Seismic Conditions	
	Unrestrained Walls Active Condition (pcf)	Restrained Walls At-Rest Condition (pcf)	Total (Active Plus Seismic Increment) (pcf)	
			DE	MCE_R
Soil Above the Groundwater Level, Drained	75	75	75	90

Notes:

1. The more critical condition of either at-rest pressure (static condition) or active pressure plus a seismic pressure increment (seismic condition) should be checked.
2. DE = Design Earthquake
3. MCE_R = Rick Targeted Maximum Considered Earthquake
5. Structural engineer to determine appropriate load combinations for design of below grade walls.

Surcharge loads from traffic and the foundations of adjacent structures should be included in the wall design. If surcharge loads occur above an imaginary 30-degree line (from the horizontal) projected up from the bottom of a retaining wall, a surcharge pressure should be included in the wall design. If this condition exists, we should be consulted to estimate the added pressure on a case-by-case basis. Where truck traffic will pass within 10 feet of retaining walls, temporary traffic loads should be considered in the design of the walls. Traffic loads may be modeled by a uniform pressure of 100 pounds per square foot applied in the upper 10 feet of the walls.

The recommended design pressures assume the walls will be properly backdrained above the design groundwater level to prevent the buildup of hydrostatic pressure. One acceptable method for backdraining walls is to place a prefabricated drainage panel against the backside of the newly cast wall. If temporary shoring is used, the panel may be placed directly on the shoring prior to casting the wall. The panel should extend down to a perforated PVC collector pipe or an equivalent "flat" pipe (such as AdvanEdge) at the base of the wall or shoring. The PVC pipe should be bedded on and covered by at least 4 inches of Class 2 permeable material (per Caltrans Standard Specifications) or drain rock, and the aggregate material should be surrounded by filter fabric (Mirafi 140NC or equivalent). We should check the manufacturer's specifications regarding the proposed prefabricated drainage panel material to confirm it is appropriate for its intended use. The pipe should be connected to a suitable discharge point. If a flat pipe surrounded by a filter fabric is used, it is not necessary to surround it with rock. The closed pipe should be sloped to drain to a suitable outlet. If water is collected in a sump, a pumping system may be required to carry the water to the storm drain system. In lieu of a backdrain system for outside retaining walls, weep holes could be used. We recommend at least one row of weep holes be installed and they be spaced at no more than 5 feet on-center.

If placed, wall backfill should be compacted to at least 95 percent relative compaction using light compaction equipment. If heavy equipment is used, the wall should be appropriately designed to withstand loads exerted by the equipment and/or temporarily braced.

8.8 Floor Slabs

Moisture is likely to condense on the underside of the floor slabs, even though they may be above the design groundwater level. Consequently a moisture barrier should be installed beneath new slabs, including mat foundation slabs, if movement of water vapor through the slabs is not acceptable. A typical moisture barrier consists of a capillary moisture break and a water vapor retarder.

A capillary moisture break consists of at least four inches of clean, free-draining gravel or crushed rock. The vapor retarder should meet the requirements for Class C vapor retarders stated in the current ASTM E1745. The vapor retarder should be placed in accordance with the requirements of the current ASTM E1643. These requirements include overlapping seams by six inches, taping seams, and sealing penetrations in the vapor retarder. The particle size of the gravel/crushed rock should meet the gradation requirements presented in Table 4.

TABLE 4

Gradation Requirements for Capillary Moisture Break

Sieve Size	Percentage Passing Sieve
Gravel or Crushed Rock	
1 inch	90 – 100
3/4 inch	30 – 100
1/2 inch	5 – 25
3/8 inch	0 – 6

Concrete mixes with high water/cement (w/c) ratios result in excess water in the concrete, which increases the cure time and results in excessive vapor transmission through the slab. Therefore, concrete for the floor slab should have a low w/c ratio - less than 0.45. If necessary, workability should be increased by adding plasticizers. In addition, the slab should be properly cured. Before the floor covering is placed, the contractor should check that the concrete surface moisture emission levels (if emission testing is required) meet the manufacturer's requirements.

8.9 Site Retaining Walls

We understand site design may include cantilever retaining walls supported on shallow footings or cantilever soldier-pile-and-lagging walls. Cantilever walls should be designed in accordance with below-grade wall design recommendations presented in Section 8.7. Because of the pervious nature of wood lagging, no additional drainage would be required behind a soldier-pile-and-lagging wall provided impervious facing is not installed against the front of the wall. During placement of backfill behind retaining walls, the walls should be braced, or hand compaction equipment should be used, to prevent surcharges on walls.

Retaining walls may be supported on shallow, spread or continuous footings bearing on firm soil, which we anticipate to be fill or colluvial material over gouge, brecciated bedrock materials and serpentinite. Our recommendation is that footings bearing on this material be designed for an allowable bearing pressure of 3,000 psf for dead plus live loads; this value may be increased by 1/3 for total loads, including wind and seismic.

To reduce the potential for movement of the footings due to shrink and swell of the expansive clay, we recommend that the bottom of the footings should be embedded at least 36 inches below the lowest adjacent soil subgrade and should be at least 18 inches wide. Proposed footings adjacent to utility trenches or other footings should bear below an imaginary 1.5:1 (horizontal to vertical) plane projected upward from the bottom edge of the utility trench or adjacent footings.

Lateral loads can be resisted by a combination of passive pressures on the vertical faces of the foundations and friction along the bases of the foundations. We recommend passive resistance be calculated using a uniform pressure of 1,500 psf. The upper foot of soil should be ignored unless it is confined by slabs or pavement. Frictional resistance should be computed using a base friction coefficient of 0.25. These values include a factor of safety of 1.5, and may be used in combination without reduction.

For a soldier-beam-and-lagging wall, lateral forces may be resisted by passive earth pressures against the embedded vertical faces of the soldier beams. We recommend passive resistance be calculated using a uniform pressure of 1,500 psf. The passive pressure may be applied over three pier diameters or the spacing between soldier beams, whichever is less. In addition, the upper foot of soil below the finished subgrade level should be ignored for passive resistance unless it is confined by a slab.

Weak soil or non-engineered fill encountered in the bottom of foundation excavations should be removed and replaced with engineered fill or lean concrete. The bottoms and sides of the foundation excavations should be wetted following excavation and maintained in a moist condition until concrete is placed. We should check foundation excavations prior to placement of reinforcing steel. Foundation excavations should be free of standing water, debris, and disturbed materials prior to placing concrete.

8.10 Construction Monitoring

The conditions of existing buildings and other improvements within 100 feet of the site should be photographed and surveyed prior to the start of construction and monitored periodically during construction.

To monitor ground movements, groundwater levels, and shoring movements, we recommend installing survey points on the adjacent buildings and streets that are within 100 feet of the site. In addition, survey points should be installed at the tops of the shoring walls at 20-foot-spacing. The survey points should be read regularly and the results should be submitted to us in a timely manner for review. For estimating purposes, assume that the survey points will be read as follows:

- Prior to any shoring work at the site
- After installing soldier piles
- Weekly during excavation work
- After the excavation reaches the planned excavation level
- Every two weeks until the street-level floor slab is constructed

8.11 Seismic Design

The closest active fault to the site is the Hayward Fault, which is about 0.2 kilometer away. Probabilistic and deterministic seismic hazard analyses and acceleration time histories were previously performed for the UC Berkeley campus by others (URS/Pacific, 2009, 2015) for rock and thin soil site conditions. In the 2015 report, they recommend that sites be classified as one of five different profiles defined as: 1) 10 to 35 feet of soil, 2) 36 to 75 feet of soil, 3) 76 to 150 feet of soil, 4) Rock, 5) Rock – Shear Zone. On the basis of the results of our geotechnical investigation and a review of nearby data and the 2015 URS/Pacific Engineering & Analysis report; our conclusion is that the site should be classified as Category 3 (76 to 150 feet of soil). Any changes to the recommended site class based on discussions with the project structural engineer will be provided in addenda to this report, as appropriate.

In addition, seismic design parameters are presented for the subject site below, in accordance with the provisions of 2016 CBC/ASCE 7-10:

- Site Class C
- Risk Targeted Maximum Considered Earthquake (MCE_R) S_S and S_1 of 2.473g and 1.027g, respectively.
- Site Coefficients F_A and F_V of 1.0 and 1.3, respectively
- MCE_R spectral response acceleration parameters at short periods, S_{MS}, and at one-second period, S_{M1}, of 2.473g and 1.336g, respectively.
- Design Earthquake (DE) spectral response acceleration parameters at short period, S_{DS}, and at one-second period, S_{D1}, of 1.649g and 0.890g, respectively.

8.12 Preliminary Environmental Site Characterization

The soil analytical results from this preliminary ESC are presented in Analytical Summary Tables 1 and 2, and copies of the certified analytical reports are provided in Appendix H. As previously summarized in Section 7.6, low level contamination from petroleum hydrocarbons, VOCs, PAHs/PNAs, and SVOCs were detected in the site's shallow subsurface. However, no hazardous material was detected. Based on the analytical results, if the disturbance, removal, and/or off-site disposal of the site's shallow subsurface soil material is required, the material will likely be classified as Class II non-hazardous or unrestrictive waste, depending on the criteria of the accepting facility criteria.

The presence of these compounds poses minimal soil management and health and safety (H&S) issues to be addressed as part of the site development activities. The soil management objectives for the site are to minimize exposure of construction workers at the site, nearby residents and/or pedestrians, and future users of the site, to constituents in soil and groundwater.

Based on the limited area of the site and the characterization of soil that has been completed, it is anticipated that soil excavated during the construction activities will be directly loaded into trucks for off-site disposal; if necessary, other means for disposal of soils include use of bins for containing soil prior to transport and off-site disposal. If needed, additional soil samples will be tested for analysis typically required by regulated landfills.

If soil stockpiling of suspected contaminated soil is to be performed, the excavation contractor shall establish appropriate soil stockpile locations on the site to properly segregate, cover, control dust, profile, and manage the excavated soil. At a minimum, stockpiled soils should be placed on top of one layer of 10-mil polyethylene sheeting (or equivalent), such as Visqueen. When stockpiled soil is not actively being handled, top sheeting should be adequately secured so that all surface areas are covered.

If needed, chemical testing of any stockpiled soil will be performed to profile the soil for disposal. Soil profiling criteria depends on the proposed landfill location or off-site receiving facility. These procedures should be established by the excavation contractor and coordinated with the proposed landfills prior to initiating soil excavation. Langan should be provided documentation from the excavation contractor that the soils from the site to the proposed acceptance facilities have been approved. Typical soil profiling requirements for landfills are one four-point composite sample per 250 - 500 cubic yards to be disposed.

9.0 FUTURE GEOTECHNICAL SERVICES

As the structural design is advanced, we anticipate on-going discussions and coordination with the design team. Further, detailed geotechnical design recommendations will be presented in addenda to this report, as necessary. During final design we should be retained to consult with the design team as geotechnical questions arise. Prior to construction, we should review the project plans and specifications to check their conformance with the intent of our recommendations. During construction, we should observe site preparation, shoring and underpinning, testing of tiebacks, installation and testing of building and retaining wall foundations, slab and pavement subgrade preparation, placement and compaction of fill, and grading. These observations will allow us to compare the actual with the anticipated soil conditions and to check that the contractors' work conforms to the geotechnical aspects of the plans and recommendations.

10.0 LIMITATIONS

The conclusions and recommendations provided in this report result from our interpretation of the geotechnical conditions existing at the site inferred from a limited number of exploration points as well as architectural and structural information provided by the architect. Actual subsurface conditions could vary. Recommendations provided are dependent upon one another and no recommendation should be followed independent of the others. Any proposed changes in structures, depths of excavation, or their locations should be brought to Langan's attention as soon as possible so that we can determine whether such changes affect our recommendations. Information on subsurface strata and groundwater levels shown on the logs represent conditions encountered only at the locations indicated and at the time of investigation. If different conditions are encountered during construction, they should immediately be brought to Langan's attention for evaluation, as they may affect our recommendations.

This report has been prepared to assist the Owner, architect, and structural engineer in the design process and is only applicable to the design of the specific project identified. The information in this report cannot be utilized or depended on by engineers or contractors who are involved in evaluations or designs of facilities on adjacent properties which are beyond the limits of that which is the specific subject of this report.

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TABLES

Analytical Summary Table 1
Soil Analytical Results - Non-Metals
UC Berkeley - Goldman School of Public Policy
and Hearst Avenue Academic Housing
Berkeley, Ca

Sample ID	Sample depth (feet)	Date Sampled	TPHg	TPHd	TPHmo	PCBs	VOC	All Other VOCs	PAHs/PNAs													All Other PAHs/PNAs	SVOCs			All Other SVOCs	Asbestos
							1,2,4-Trimethyl-benzene		Anthracene	Benzo (a) anthracene	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (g,h,i) perylene	Benzo (k) fluoranthene	Chrysene	Fluoranthene	Indeno (1,2,3-cd) pyrene	1-Methyl-naphthalene	2-Methyl-naphthalene	Phenanthrene	Pyrene		Bis (2-chloro-isopropyl) ether	Dibenzo (a,h) anthracene	Naphthalene		
			(mg/kg)																								(%)
B-1-2.0	2	9/15/17	1.4	210	4,300	ND	0.0075	ND	0.055	0.12	**0.083**	**0.24**	0.14	0.061	0.45	0.54	0.059	0.023	0.034	0.55	0.57	ND	**0.015**	**0.064**	0.028	ND	--
B-1-5.5	5.5	9/15/17	< 1.0	< 1.0	< 5.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-2-3.0	3	9/15/17	< 1.0	3.5	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.25
B-2-5.5	5.5	9/15/17	< 1.0	< 1.0	8.6	--	< 0.0050	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.25	< 0.25	< 0.25	ND	--
B-3-3.0	3	9/15/17	< 1.0	3.6	24	ND	< 0.0050	ND	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	ND	< 0.25	< 0.25	< 0.25	ND	--
B-3-5.5	5.5	9/15/17	< 1.0	2.5	12	--	< 0.0050	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.25	< 0.25	< 0.25	ND	--
Tier 1 ESL			100	230	5,100	0.25	--	Various	2.8	0.16	0.016	0.16	2.5	1.6	3.8	60	0.16	--	0.25	11	85	Various	0.0039	0.016	0.033	Various	--
Direct Exposure ESL			2,800	880	32,000	5.6	--	Various	50,000	16	1.6	16	--	150	1,500	6,700	16	--	670	--	5,000	Various	220	1.6	350	Various	--

Notes:
mg/kg - Milligrams per kilogram
% - Percentage
TPHg - Total petroleum hydrocarbons as gasoline
TPHd - Total petroleum hydrocarbons as diesel
TPHmo - Total petroleum hydrocarbons as motor oil
PCBs - Polychlorinated biphenyls
VOCs - Volatile organic compounds
PAHs/PNAs - Polycyclicaromatic hydrocarbons / polynuclear aromatics
SVOCs - Semi-volatile organic compounds
< 1.0 - Analyte was not detected above the laboratory reporting limit (1.0 mg/kg)
Bold indicates exceedance of Tier 1 ESL.
ND - Not detected at or above the laboratory reporting limit(s)
-- Sample not analyzed or criteria not established
ESL - Environmental screening level(s)
Various - ESLs, where established, vary for each of the multiple compounds analyzed
Tier 1 ESL - San Francisco Bay Regional Water Quality Control Board's Environmental Screening Levels - *Tier 1 Soil.* February 2016 [Rev. 3]
Direct Exposure ESL - San Francisco Bay Regional Water Quality Control Board's Environmental Screening Levels - Direct Exposure Human Health Risk Levels for Any Land Use/Any depth Soil Exposure (Table S-1) for Construction Workers. February 2016 [Rev. 3]

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Analytical Summary Table 2
Soil Analytical Results - Metals
UC Berkeley - Golman School of Public Policy
and Hearst Avenue Academic Housing
Berkeley, Ca

Sample ID	Sample Depth (feet)	Date Sampled	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
			(mg/kg)																
B-1-2.0	2	9/15/17	1.3	3.8	120	< 0.50	< 0.25	30	11	120	9.3	0.13	< 0.50	53	< 0.50	< 0.50	< 0.50	34	110
B-1-5.5	5.5	9/15/17	0.92	10	140	0.60	< 0.25	40	12	47	8.6	< 0.050	0.69	47	< 0.50	< 0.50	< 0.50	70	77
B-2-3.0	3	9/15/17	0.95	9.0	150	0.53	< 0.25	52	11	39	41	0.21	0.66	57	< 0.50	< 0.50	< 0.50	54	94
B-2-5.5	5.5	9/15/17	0.78	8.1	160	0.54	< 0.25	35	11	37	16	0.098	0.64	41	< 0.50	< 0.50	< 0.50	59	68
B-3-3.0	3	9/15/17	0.81	7.8	150	< 0.50	< 0.25	49	14	41	26	0.13	0.61	72	< 0.50	< 0.50	< 0.50	62	88
B-3-5.5	5.5	9/15/17	0.86	9.7	140	< 0.50	< 0.25	36	8.6	33	38	0.072	0.75	27	< 0.50	< 0.50	< 0.50	57	53
Background [Metal] in Bay Area Soils*			1.5-7.1	1.2-31	41-411	0.29-1.1	0.27-3.3	10-142	6.5-25.5	5.4-100	4.8-65	0.07-0.6	0.33-11.4	16-144	< 0.25-7	0.2-2.2	< 0.25-42.5	22-90	33-282
Hazardous Waste Criteria																			
TTLC		(mg/kg)	500	500	10,000	75	100	2,500	8,000	2,500	1,000	20	3,500	2,000	100	500	700	2,400	5,000
STLC		(mg/L)	15	5	100	0.75	1	--	80	25	--	0.2	350	--	1	5	7	24	250
TCLP		(mg/L)	--	5	100	--	1	--	--	--	--	0.2	--	--	1	5	--	--	--

Notes:
mg/kg - Milligrams per kilogram
mg/L - Milligrams per liter
< 0.50 - Analyte was not detected at or above the laboratory reporting limit (0.50 mg/kg)
-- Criteria not established
TTLC - California Total Threshold Limit Concentration - State hazardous waste criterion
STLC - California Soluble Threshold Limit Concentration
TCLP - Federal Toxicity Characteristic Leaching Procedure
*Background concentration ranges of metals in Bay Area soils, Appendix A, Table A-2 from Environmental Resources Management. Feasibility Study, Hookston Station, Pleasant Hill, California. July 2006

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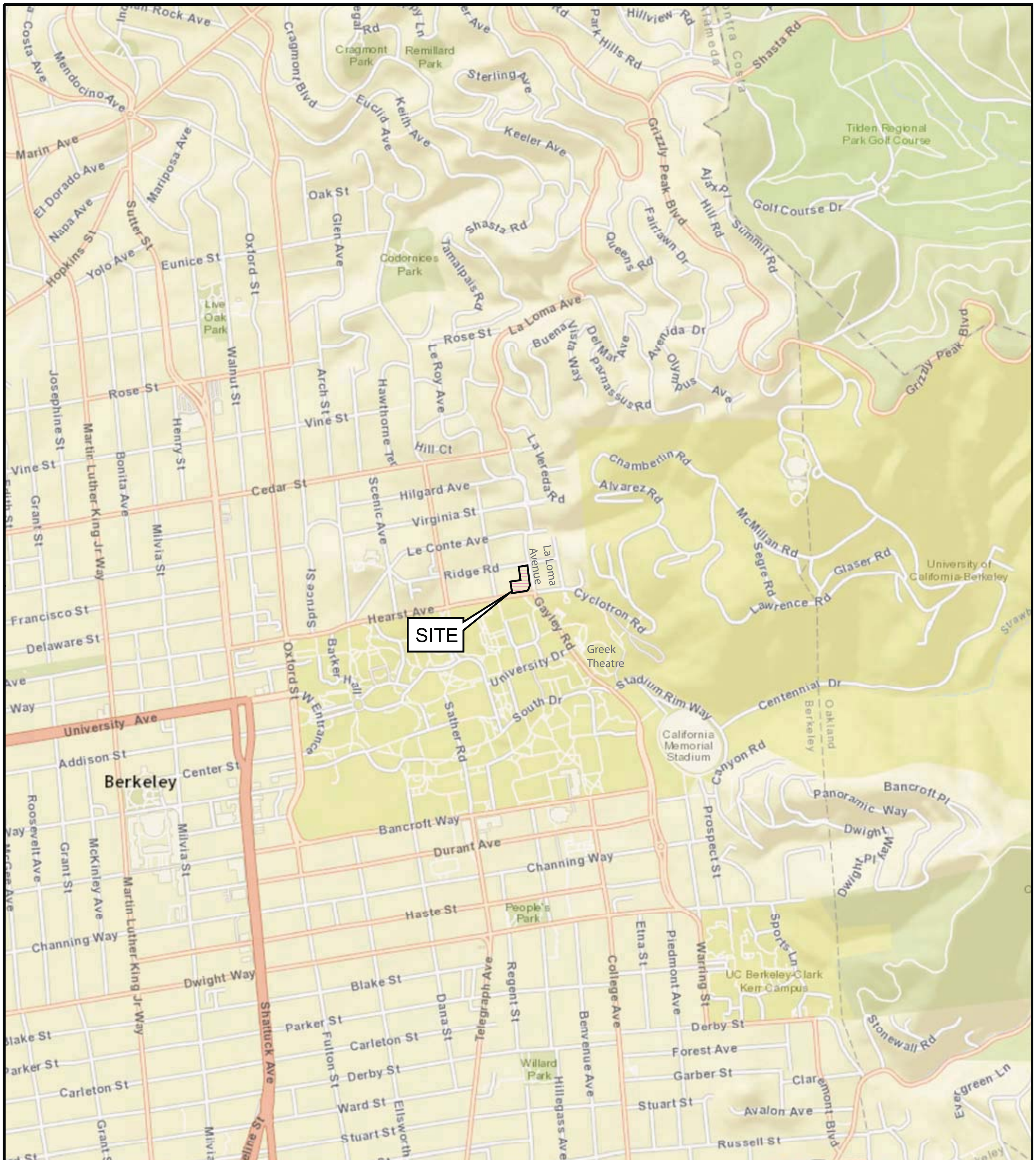
FIGURES



NOTES:

World street basemap is provided through Langan's Esri ArcGIS software licensing and ArcGIS online.
Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN.

0 1,000 2,000
Feet

N W E S

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

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SITE LOCATION MAP

Date 09/14/17	Project No. 731706301	Figure 1

EXPLANATION

B-1 — Approximate location of boring by Langan, September 2017

TP-1 — Approximate location of test pit by Langan, September 2017

CPT-1 — Approximate location of cone penetration test by Langan, December 2017

DPT-1 — Approximate location of dynamic penetration test by Langan, December 2017

Project limits

Line #1 — Approximate location of seismic refraction line, September 2017

0 60 Feet

Approximate scale

Reference: © 2017 Microsoft Corporation, Bing

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SITE PLAN

Date 01/18/18	Project No. 731706301	Figure 2

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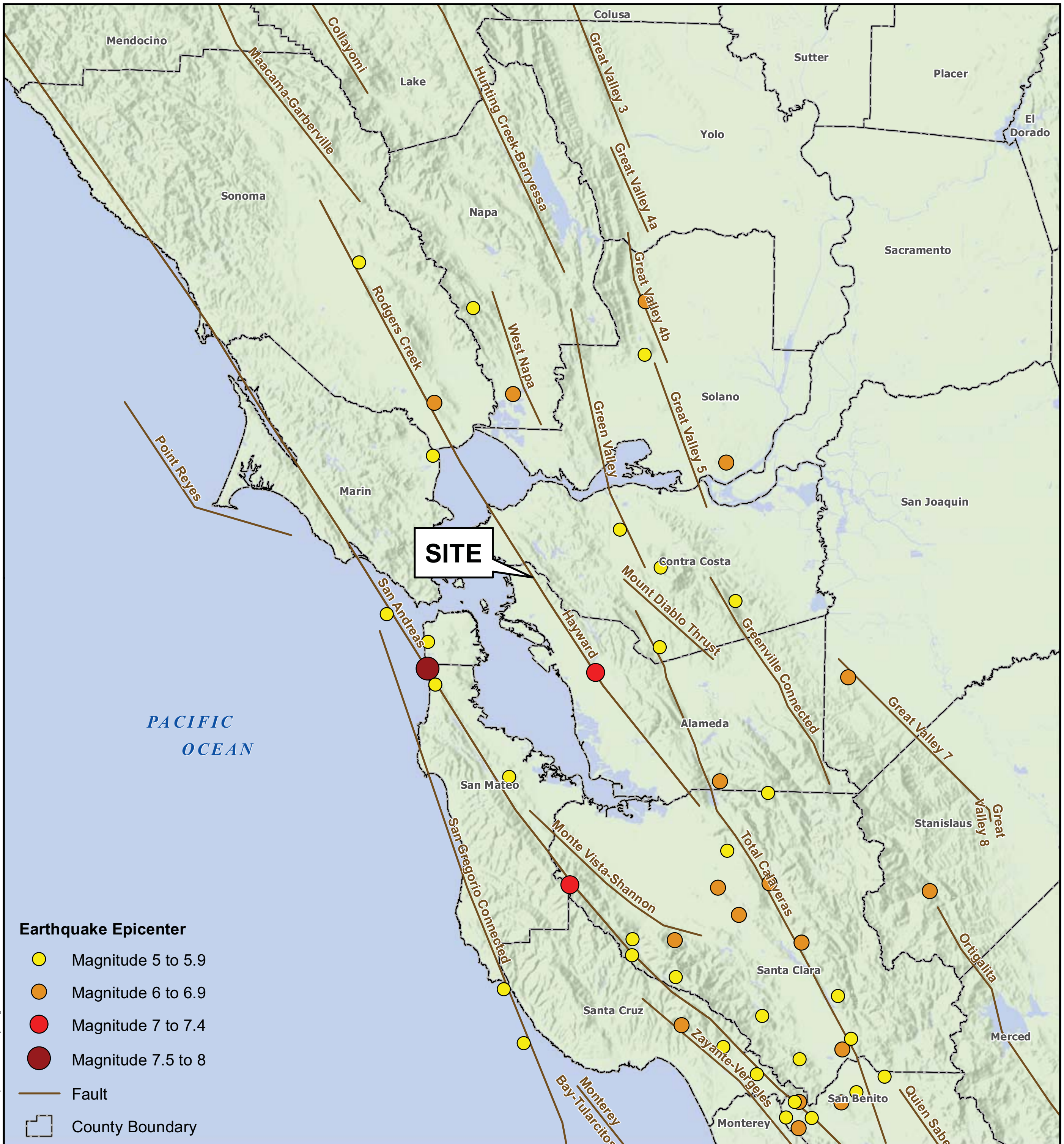

Notes:

1. Quaternary fault data displayed are based on a generalized version of U.S Geological Survey (USGS) Quaternary Fault and fold database, 2010. For cartographic purposes only.
2. The Earthquake Epicenter (Magnitude) data is provided by the USGS and is current through 08/26/2014.
3. Basemap hillshade and County boundaries provided by USGS and California Department of Transportation.
4. Map displayed in California State Coordinate System, California (Teale) Albers, North American Datum of 1983 (NAD83), Meters.

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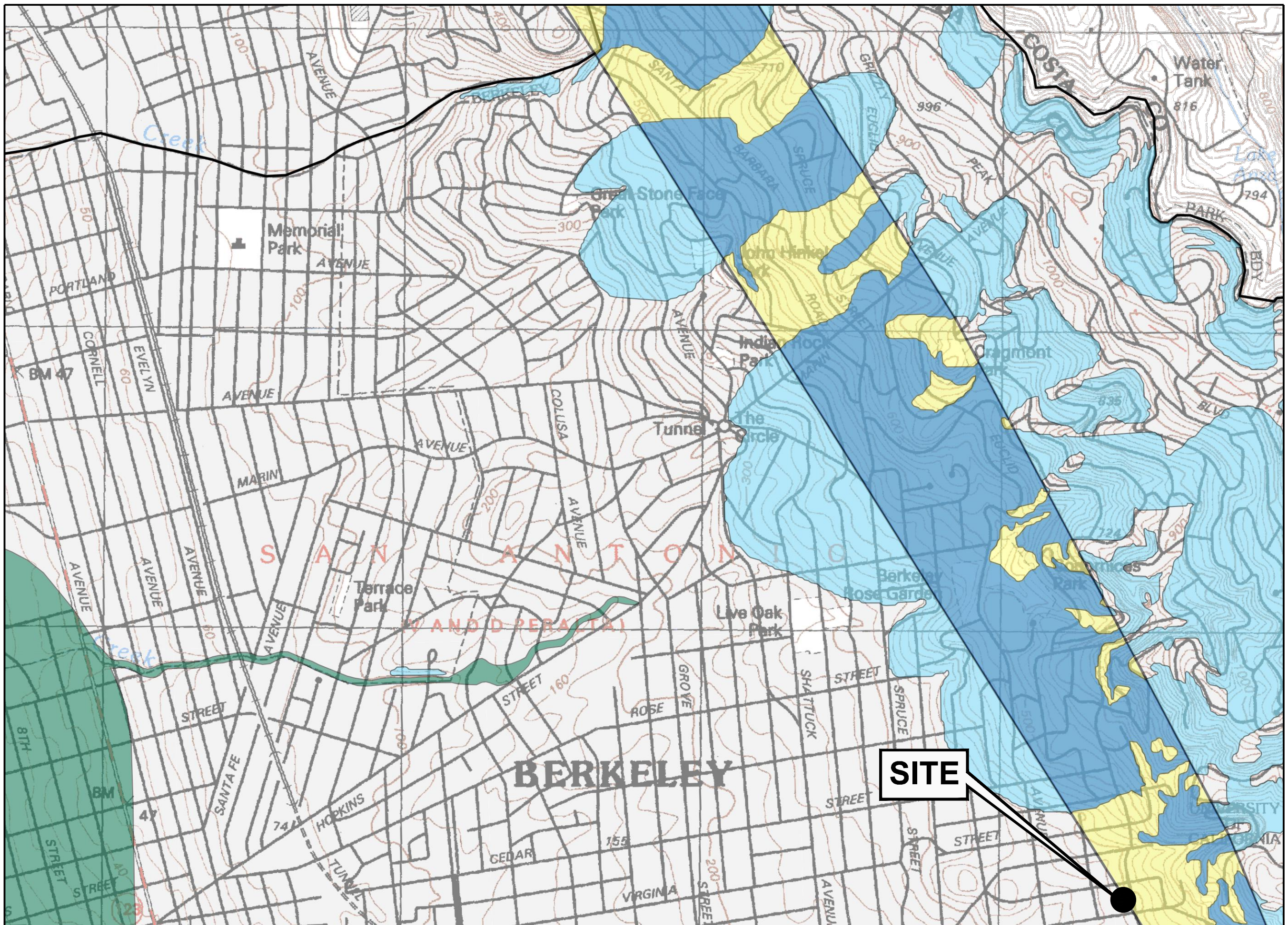
MAP OF MAJOR FAULTS AND EARTHQUAKE EPICENTERS IN THE SAN FRANCISCO BAY AREA

Date 10/19/2017	Project No. 731706301	Figure 3

\\langan.com\data\SFO\data3\731706301\Project Data\ArcGIS\MXD\Geotech_Figures\Fault Map.mxd User: Cyoung

I	**Not felt by people, except under especially favorable circumstances. However, dizziness or nausea may be experienced.** Sometimes birds and animals are uneasy or disturbed. Trees, structures, liquids, bodies of water may sway gently, and doors may swing very slowly.
II	**Felt indoors by a few people, especially on upper floors of multi-story buildings, and by sensitive or nervous persons.** As in Grade I, birds and animals are disturbed, and trees, structures, liquids and bodies of water may sway. Hanging objects swing, especially if they are delicately suspended.
III	**Felt indoors by several people, usually as a rapid vibration that may not be recognized as an earthquake at first. Vibration is similar to that of a light, or lightly loaded trucks, or heavy trucks some distance away. Duration may be estimated in some cases.** Movements may be appreciable on upper levels of tall structures. Standing motor cars may rock slightly.
IV	**Felt indoors by many, outdoors by a few. Awakens a few individuals, particularly light sleepers, but frightens no one except those apprehensive from previous experience. Vibration like that due to passing of heavy, or heavily loaded trucks. Sensation like a heavy body striking building, or the falling of heavy objects inside.** Dishes, windows and doors rattle; glassware and crockery clink and clash. Walls and house frames creak, especially if intensity is in the upper range of this grade. Hanging objects often swing. Liquids in open vessels are disturbed slightly. Stationary automobiles rock noticeably.
V	**Felt indoors by practically everyone, outdoors by most people. Direction can often be estimated by those outdoors. Awakens many, or most sleepers. Frightens a few people, with slight excitement; some persons run outdoors.** Buildings tremble throughout. Dishes and glassware break to some extent. Windows crack in some cases, but not generally. Vases and small or unstable objects overturn in many instances, and a few fall. Hanging objects and doors swing generally or considerably. Pictures knock against walls, or swing out of place. Doors and shutters open or close abruptly. Pendulum clocks stop, or run fast or slow. Small objects move, and furnishings may shift to a slight extent. Small amounts of liquids spill from well-filled open containers. Trees and bushes shake slightly.
VI	**Felt by everyone, indoors and outdoors. Awakens all sleepers. Frightens many people; general excitement, and some persons run outdoors.** Persons move unsteadily. Trees and bushes shake slightly to moderately. Liquids are set in strong motion. Small bells in churches and schools ring. Poorly built buildings may be damaged. Plaster falls in small amounts. Other plaster cracks somewhat. Many dishes and glasses, and a few windows break. Knickknacks, books and pictures fall. Furniture overturns in many instances. Heavy furnishings move.
VII	**Frightens everyone. General alarm, and everyone runs outdoors.** People find it difficult to stand. Persons driving cars notice shaking. Trees and bushes shake moderately to strongly. Waves form on ponds, lakes and streams. Water is muddied. Gravel or sand stream banks cave in. Large church bells ring. Suspended objects quiver. Damage is negligible in buildings of good design and construction; slight to moderate in well-built ordinary buildings; considerable in poorly built or badly designed buildings, adobe houses, old walls (especially where laid up without mortar), spires, etc. Plaster and some stucco fall. Many windows and some furniture break. Loosened brickwork and tiles shake down. Weak chimneys break at the roofline. Cornices fall from towers and high buildings. Bricks and stones are dislodged. Heavy furniture overturns. Concrete irrigation ditches are considerably damaged.
VIII	**General fright, and alarm approaches panic.** Persons driving cars are disturbed. Trees shake strongly, and branches and trunks break off (especially palm trees). Sand and mud erupts in small amounts. Flow of springs and wells is temporarily and sometimes permanently changed. Dry wells renew flow. Temperatures of spring and well waters varies. Damage slight in brick structures built especially to withstand earthquakes; considerable in ordinary substantial buildings, with some partial collapse; heavy in some wooden houses, with some tumbling down. Panel walls break away in frame structures. Decayed pilings break off. Walls fall. Solid stone walls crack and break seriously. Wet grounds and steep slopes crack to some extent. Chimneys, columns, monuments and factory stacks and towers twist and fall. Very heavy furniture moves conspicuously or overturns.
IX	**Panic is general.** Ground cracks conspicuously. Damage is considerable in masonry structures built especially to withstand earthquakes; great in other masonry buildings - some collapse in large part. Some wood frame houses built especially to withstand earthquakes are thrown out of plumb, others are shifted wholly off foundations. Reservoirs are seriously damaged and underground pipes sometimes break.
X	**Panic is general.** Ground, especially when loose and wet, cracks up to widths of several inches; fissures up to a yard in width run parallel to canal and stream banks. Landsliding is considerable from river banks and steep coasts. Sand and mud shifts horizontally on beaches and flat land. Water level changes in wells. Water is thrown on banks of canals, lakes, rivers, etc. Dams, dikes, embankments are seriously damaged. Well-built wooden structures and bridges are severely damaged, and some collapse. Dangerous cracks develop in excellent brick walls. Most masonry and frame structures, and their foundations are destroyed. Railroad rails bend slightly. Pipe lines buried in earth tear apart or are crushed endwise. Open cracks and broad wavy folds open in cement pavements and asphalt road surfaces.
XI	**Panic is general.** Disturbances in ground are many and widespread, varying with the ground material. Broad fissures, earth slumps, and land slips develop in soft, wet ground. Water charged with sand and mud is ejected in large amounts. Sea waves of significant magnitude may develop. Damage is severe to wood frame structures, especially near shock centers, great to dams, dikes and embankments, even at long distances. Few if any masonry structures remain standing. Supporting piers or pillars of large, well-built bridges are wrecked. Wooden bridges that "give" are less affected. Railroad rails bend greatly and some thrust endwise. Pipe lines buried in earth are put completely out of service.
XII	**Panic is general.** Damage is total, and practically all works of construction are damaged greatly or destroyed. Disturbances in the ground are great and varied, and numerous shearing cracks develop. Landslides, rock falls, and slumps in river banks are numerous and extensive. Large rock masses are wrenched loose and torn off. Fault slips develop in firm rock, and horizontal and vertical offset displacements are notable. Water channels, both surface and underground, are disturbed and modified greatly. Lakes are dammed, new waterfalls are produced, rivers are deflected, etc. Surface waves are seen on ground surfaces. Lines of sight and level are distorted. Objects are thrown upward into the air.



Reference:Earthquake Fault Zones and Seismic Harzard Zones, Richmond 7.5 minute Quadrangle by John G. Parrish, PHD. dated 01/01/82 and 02/14/03 respectively.

EXPLANATION

ALQUIST-PRIOLO EARTHQUAKE FAULT ZONES

Earthquake Fault Zones
Zone boundaries are delineated by straight-line segments; the boundaries define the zone encompassing active faults that constitute a potential hazard to structures from surface faulting or fault creep such that avoidance as described in Public Resources Code Section 2621.5(a) would be required.

SEISMIC HAZARD ZONES

Liquefaction Zones
Areas where historical occurrence of liquefaction, or local geological, geotechnical and ground water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslide Zones
Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

OVERLAPPING ALQUIST-PRIOLO AND SEISMIC HAZARD ZONES

Overlap of Earthquake Fault Zone and Earthquake-Induced Landslide Zone
Areas that are covered by both Earthquake Fault Zone and Earthquake-Induced Landslide Zone.

0 2000 Feet

Approximate scale

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REGIONAL ALQUIST-PRIOLO EARTHQUAKE FAULT ZONE MAP

Date 12/20/17	Project No. 731706301	Figure 5

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APPENDIX A

LOGS OF BORINGS

PROJECT: **UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING**
Berkeley, California

Log of Boring B-1

Boring location: See Site Plan, Figure 2	Logged by: H. Sok
Date started: 9/15/17	Date finished: 9/15/17
Drilling method: Rotary Wash	
Hammer weight/drop: 140 lbs./30 inches	Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)	

Ground Surface Elevation: 402 feet[2]

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION		LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0–0.3						3.5 inches asphalt concrete (AC)							
0.3–0.8						6 inches aggregate base (AB)	FILL						
1–2	GRAB				CL	SANDY CLAY with GRAVEL (CL) brown, moist, fine to coarse sand, fine to coarse subangular gravel	FILL						
5–6	S&H		12 20 31	36	CL	SANDY CLAY (CL) yellow-brown, hard, fine- to medium-grained sand, trace angular, fractured, oxidized gravel	UNDIFFERENTIATED SURFICIAL DEPOSITS	PP		4,500		12.1	123
8	SPT		10 18 22	48	SC	CLAYEY SAND with GRAVEL (SC) orange-brown, dense, moist, fine- to coarse-grained, fine oxidized sandstone gravel, chaotic structure Particle Size Analysis, see Appendix F	UNDIFFERENTIATED SURFICIAL DEPOSITS				34.8	13.8	
10–11	SPT		13 13 13	31	SC	wet, increased crushed gravel	UNDIFFERENTIATED SURFICIAL DEPOSITS					13.2	
15.5–30					CL	SANDY CLAY (CL) yellow to yellow-brown, very stiff, wet, fine-grained, trace coarse fractured angular fine to coarse gravel, black decomposing organics	UNDIFFERENTIATED SURFICIAL DEPOSITS						
20–21	SPT		6 10 11	25	CL		UNDIFFERENTIATED SURFICIAL DEPOSITS						

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Project No.: 731706301

Figure: A-1a

PROJECT: **UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING**
Berkeley, California

Log of Boring B-1

DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31	SPT		8 16 30	55	CL	CLAY with GRAVEL (CL) gray, hard, with fine subangular to subrounded shale gravel, abraded with polished surfaces				27.5	15.9	
32–39						SILTSTONE dark gray to black, moderately fractured, low hardness, friable, moderately to deeply weathered						
40–41	SPT		14 18 25	52		GOUGE yellow-brown to gray, hard, with fine subangular shale and meta-sandstone gravel, lack of internal shearing in clay matrix, polished surfaces on gravel LL = 43, PI = 24, see Appendix F					12.0	
45–46	SPT		10 21 29	60		occasional fine carbonate inclusions						
50–51	SPT		20 26 28	65		gray to green-gray						
52–60												

Boring terminated at a depth of 51.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater obscure by drilling method.
PP = pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.7 and 1.2, respectively to account for sampler type and hammer energy.
[2] Elevations based on the City of Berkeley Datum and the Parking Structure "H" Topo drawing by David J. Russell, Land Surveyor, dated 03/69, by the Universtiy of California.

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Project No.: 731706301
Figure: A-1b

PROJECT: **UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING**
Berkeley, California

Log of Boring B-2

Boring location: See Site Plan, Figure 2	Logged by: H. Sok
Date started: 9/15/17	Date finished: 9/15/17
Drilling method: Rotary Wash	
Hammer weight/drop: 140 lbs./30 inches	Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)	

DEPTH (feet)	SAMPLES: Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION — Ground Surface Elevation: 408.5 feet[2]		LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						2 inches asphalt concrete (AC)							
1						7 inches aggregate base (AB)	FILL						
2–4	S&H		6 12 12	17	CL	CLAY with SAND (CL) brown, very stiff, moist, fine sand, trace fine gravel, oxidized LL = 43, PI = 25, see Appendix F	FILL	PP		>4,500		14.2	118
5–6	S&H		6 9 11	14	CL	grades sandy, brown to dark brown with white calcium carbonate and yellow brown mottling, stiff, oxidized fine sandstone gravel	FILL	PP		4,250	62.3	18.3	109
7–9	S&H		11 12 12	17	CL	brown with light brown mottling, very stiff, fine to coarse sand, trace silt	FILL	PP		4,500			
9–10					GP	GRAVEL (GP) very dense	FILL						
10–12	SPT		7 50/ 5.5"	60/ 5.5"	CL	SANDY CLAY (CL) brown to yellow-brown, hard, wet, fine sand, trace gravel, chaotic structure	FILL						
12–15					GL	CLAY with GRAVEL (CL) gray to yellow-brown, medium dense to dense, wet, subangular, coarse	FILL						
15	SPT		8 12 13	30	GL	Particle Size Analysis, see Appendix F	FILL				52.9	15.9	
16–19					CL	SANDY CLAY (CL) yellow-brown to gray-brown, very stiff, hard, wet, trace fine subangular to subrounded gravel, trace oxidation staining on gravel	UNDIFFERENTIATED SURFICIAL DEPOSITS						
20–22	S&H		6 12 6	13	CL	yellow-brown with gray-brown mottling, stiff, trace dark brown spots, with deeply weathered fine sandstone gravel, occasional black staining Triaxial Test, see Appendix F	UNDIFFERENTIATED SURFICIAL DEPOSITS	PP TxUU	 2,000	>4,500 3,440		 20.0	 108
23–24					CL		UNDIFFERENTIATED SURFICIAL DEPOSITS						
25–27	S&H		13 18 22	28	CL	very stiff, fine to coarse sand, trace fine subangular gravel, faint oxidation staining Consolidation Test, see Appendix F	UNDIFFERENTIATED SURFICIAL DEPOSITS	PP		3,250		17.5	110
28–29					CL		UNDIFFERENTIATED SURFICIAL DEPOSITS						
30–31	SPT			20	CL		UNDIFFERENTIATED SURFICIAL DEPOSITS						

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Project No.: 731706301 | Figure: A-2a

Log of Boring B-2

PROJECT: UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
	SPT		8 13 15	20	CL	SANDY CLAY (CL) (continued) yellow-brown, fine angular to subangular siltstone gravel, faint oxidation staining, slightly chaotic structure						
32												
33					SC	CLAYEY SAND (SC) yellow-brown, medium dense, wet						
34												
35												
36	SPT		12 18 18	20		increased gravel, coarse, up to 1 inch in diameter, increased structure, transitioning to residual soil				31.1	13.0	
37												
38												
39												
40												
41	SPT		12 18 20	46		residual soil, dense						
42												
43												
44												
45												
46	SPT		11 12 14	31		SILTSTONE dark gray, intensely fractrured, low hardness, friable, deeply weathered						
47												
48												
49						GOUGE yellow-brown to gray-brown, hard, siltstone/shale in clay matrix, abraded, polished surfaces						
50												
51	SPT		11 18 28	55								
52												
53												
54												
55												
56	SPT		16 13 21	41								
57						SERPENTINITE MELANGE intensely fractured, low hardness, weak , deeply weathered						
58												
59												
60												
61	SPT		11 18 32	60								
62												

UNDIFFERENTIATED SURFICIAL DEPOSITS

Boring terminated at a depth of 51.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater obscure by drilling method.
PP = pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.7 and 1.2, respectively to account for sampler type and hammer energy.
[2] Elevations based on the City of Berkeley Datum and the Parking Structure "H" Topo drawing by David J. Russell, Land Surveyor, dated 03/69, by the Universtiy of California.

LANGAN

Project No.: 731706301
Figure: A-2b

TEST GEOTECH LOG 731706301.GPJ TR.GDT 12/5/17

Log of Boring B-3

Boring location: See Site Plan, Figure 2

Logged by: H. Sok

Date started: 9/14/17 | Date finished: 9/14/17

Drilling method: Rotary Wash

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic

Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

DEPTH (feet)	Sampler Type	Blows/6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION (Ground Surface Elevation: 398.5 feet[2])	Unit	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0					4 inches asphalt concrete (AC)	FILL						
1–2				CL	CLAY with SAND and GRAVEL (CL) dark brown							
3	S&H	6 16 14	21		brown to yellow-brown, very stiff, moist, fine sand, coarse gravel		PP		>4,500			
6	S&H	7 7 5	8		yellow-brown with black and brown-red mottling, medium stiff to stiff, scattered organics		PP		3,400		17.2	111
7					wet							
8	SPT	50/ 2"	60/ 2"	GC	CLAYEY GRAVEL (GC) gray-brown, very dense, wet, dark brown-gray subrounded volcanic rock fragments							
11	S&H	4 7 13	14	CL	CLAY with SAND (CL) yellow-brown with gray-brown mottling, stiff, wet, fine to coarse sand, trace fine gravel LL = 45, PI = 28, see Appendix F fine subangular silica-carbonate gravel, fragments of silty sandstone, gray gouge seams		PP		4,250		24.4	100
13				GC	CLAYEY GRAVEL (GC) fractured rock							
16	S&H	12 32 29	43	SC	CLAYEY SAND with GRAVEL (SC) yellow-brown with dark brown mottling, dense, wet, fine- to coarse-grained, rock fragments highly fractured into fine to coarse gravel, black decomposed organic seams, scattered subrounded fine to coarse gravel, highly oxidized throughout, chaotic structure Particle Size Analysis, see Appendix F	UNDIFFERENTIATED SURFICIAL DEPOSITS	PP		4,500	47.1	25.0	101
21	S&H	13 13 22	25	CL	CLAY with GRAVEL (CL) yellow-brown with gray-brown mottling, very stiff, fine sand, trace coarse sand, abundant red decomposed sandstone clasts with oxidation staining Consolidation Test, see Appendix F		PP		4,250			
21.5											19.2	109
26	S&H	11 19 37	39		hard, trace coarse gravel, highly oxidized and decomposed sandstone fragments		PP		4,500			
26.5							TxUU	2,300	5,270		16.5	114
27					Triaxial Test, see Appendix F							
30												

TEST GEOTECH LOG 731706301.GPJ TR.GDT 12/5/17

DEPTH (feet)	Run Number	Sample Type	SPT N-Value[1]	Recovery, %	RQD, %	Drilling Rate (min/ft)	LITHOLOGY	MATERIAL DESCRIPTION	Dip, Degrees	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31			39				CL	SANDY CLAY with GRAVEL (CL) yellow, hard, coarse sand, trace coarse gravel up to 1 inch in length PP (Su >4,500 psf)				
32												
33							CL	CLAY with SAND (CL) gray and dark brown, very stiff, wet, coarse sand, trace fine gravel				
34												
35								PP (Su > 4,500 psf)				
36			25					yellow-brown to red-black serpentinite fragments, fine rounded to subangular gravel, decomposed red sandstone and fresh black meta shale			16.6	115
37			55					Triaxial Test, see Appendix F (Su = 2,960 psf)				
38								red-brown, hard				
39							GP	CLAYEY GRAVEL (GP) yellow-brown to gray with hard, strong black meta sandstone, dense, wet				
40			60/ 3"									
41	1			87.5	0	22						
42	2			87.5	0	5.5						
43							CL	CLAY with SAND (CL) yellow-brown, coarse sand				
44								SHALE MELANGE yellow-brown to gray, moderately fractured, moderately hard, weak, deeply weathered				
45												
46												
47												
48												
49												
50												
51												
52								BRECCIA yellow to yellow-brown with orange oxidation staining, low hardness, friable, deeply weathered, variable grain size and composition set in soft and plastic clayey matrix, variable sand content in matrix				
53												
54	3			80	0	2.5						
55												
56												
57								decreased structure and decreased matrix, strong orange oxidation staining, graywacke sandstone inclusion, moderately hard to hard, strong, oxidized pockets				
58	4			24	0	2.4						
59												
60												

UNDIFFERENTIATED SURFICIAL DEPOSITS (approx. 30 to 43 feet)

PROJECT:	UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING Berkeley, California						

Log of Boring B-3

DEPTH (feet)	Run Number	Sample Type	SPT N-Value[1]	Recovery, %	RQD, %	Drilling Rate (min/ft)	MATERIAL DESCRIPTION	Dip, Degrees	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
							BRECCIA (continued)				
61							no recovery				
62	5			0	0	3.2					
63											
64	6		88/ 8"	50	0	20	gray, moderately hard, moderately strong to strong, little weathered calcite deposits along surfaces				
65											
66											
67											
68											
69											
70											
71											
72											
73											
74											
75											
76											
77											
78											
79											
80											
81											
82											
83											
84											
85											
86											
87											
88											
89											
90											

Boring terminated at a depth of 65.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater obscure by drilling method.
PP = pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.7 and 1.2, respectively to account for sampler type and hammer energy.
[2] Elevations based on the City of Berkeley Datum and the Parking Structure "H" Topo drawing by David J. Russell, Land Surveyor, dated 03/69, by the Universtiy of California.

LANGAN

Project No.: 731706301

Figure: A-3c

40.2 — 40.9

Run 1: 40.2 to 41 feet (segment from 40.2 to 40.9 feet)

41 — 41.6

Run 2: 41 to 43 feet (segment from 41 to 41.6 feet)

41.4 — 42.2

Run 2: 41 to 43 feet (segment from 41.4 to 42.2 feet)

42.1 — 42.75

Run 2: 41 to 43 feet (segment from 42.1 to 42.75 feet)

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

LANGAN

BORING B-3 PHOTOS

Date 03/01/17	Project No. 731706301	Figure A-3d

\\langan.com\data\SFO\data3\731706301\Project Data\CAD\01\2D-DesignFiles\Geotechnical\731706301-B-GI0101.dwg 12/04/17

52 52.5

Run 3: 52 to 56 feet (segment from 52 to 52.5 feet)

52.2 53.15

Run 3: 52 feet to 56 feet (segment from 52.2 to 53.15 feet)

53.2 54.3

Run 3: 52 to 56 feet (segment from 53.2 to 54.3 feet)

54.2 55.2

Run 3: 52 to 56 feet (segment from 54.2 to 55.2 feet)

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

LANGAN

BORING B-3 PHOTOS

Date 03/01/17	Project No. 731706301	Figure A-3e

56 56.7

Run 4: 56 to 61 feet (segment from 56 to 56.7 feet)

56.35 57.2

Run 4: 56 to 61 feet (segment from 56.35 to 57.2 feet)

Run 5: 61 to 63.5 (no recovery)

63.5 64

Run 6: 63.5 to 64 feet

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

LANGAN

BORING B-3 PHOTOS

Date 03/01/17	Project No. 731706301	Figure A-3f

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions		Symbols	Typical Names
Coarse-Grained Soils (more than half of soil > no. 200 sieve size	**Gravels** (More than half of coarse fraction > no. 4 sieve size)	**GW**	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (More than half of coarse fraction < no. 4 sieve size)	**SW**	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly-graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
Fine -Grained Soils (more than half of soil < no. 200 sieve size)	**Silts and Clays** LL = < 50	**ML**	Inorganic silts and clayey silts of low plasticity, sandy silts, gravelly silts
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	Silts and Clays LL = > 50	**MH**	Inorganic silts of high plasticity
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic silts and clays of high plasticity
Highly Organic Soils		**PT**	Peat and other highly organic soils

GRAIN SIZE CHART

Classification	Range of Grain Sizes: U.S. Standard Sieve Size	Range of Grain Sizes: Grain Size in Millimeters
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel	3" to No. 4	76.2 to 4.76
coarse	3" to 3/4"	76.2 to 19.1
fine	3/4" to No. 4	19.1 to 4.76
Sand	No. 4 to No. 200	4.76 to 0.075
coarse	No. 4 to No. 10	4.76 to 2.00
medium	No. 10 to No. 40	2.00 to 0.420
fine	No. 40 to No. 200	0.420 to 0.075
Silt and Clay	Below No. 200	Below 0.075

▽ Unstabilized groundwater level

▼ Stabilized groundwater level

SAMPLE DESIGNATIONS/SYMBOLS

- Sample taken with Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter. Darkened area indicates soil recovered
- Classification sample taken with Standard Penetration Test sampler
- Undisturbed sample taken with thin-walled tube
- Disturbed sample
- Sampling attempted with no recovery
- Core sample
- Analytical laboratory sample
- Sample taken with Direct Push or Drive sampler

SAMPLER TYPE

C	Core barrel
CA	California split-barrel sampler with 2.5-inch outside diameter and a 1.93-inch inside diameter
D&M	Dames & Moore piston sampler using 2.5-inch outside diameter, thin-walled tube
O	Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube
PT	Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube
S&H	Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter
SPT	Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.5-inch inside diameter
ST	Shelby Tube (3.0-inch outside diameter, thin-walled tube) advanced with hydraulic pressure

I FRACTURING

Intensity	Size of Pieces in Feet
Very little fractured	Greater than 4.0
Occasionally fractured	1.0 to 4.0
Moderately fractured	0.5 to 1.0
Closely fractured	0.1 to 0.5
Intensely fractured	0.05 to 0.1
Crushed	Less than 0.05

II HARDNESS

1. **Soft** - reserved for plastic material alone.
2. **Low hardness** - can be gouged deeply or carved easily with a knife blade.
3. **Moderately hard** - can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away.
4. **Hard** - can be scratched with difficulty; scratch produced a little powder and is often faintly visible.
5. **Very hard** - cannot be scratched with knife blade; leaves a metallic streak.

III STRENGTH

1. **Plastic** or very low strength.
2. **Friable** - crumbles easily by rubbing with fingers.
3. **Weak** - an unfractured specimen of such material will crumble under light hammer blows.
4. **Moderately strong** - specimen will withstand a few heavy hammer blows before breaking.
5. **Strong** - specimen will withstand a few heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.
6. **Very strong** - specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

IV WEATHERING - The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation, and freezing and thawing.

D. Deep - moderate to complete mineral decomposition; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.
M. Moderate - slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected. Moderate to occasionally intense discoloration. Moderately coated fractures.
L. Little - no megascopic decomposition of minerals; little of no effect on normal cementation. Slight and intermittent, or localized discoloration. Few stains on fracture surfaces.
F. Fresh - unaffected by weathering agents. No disintegration of discoloration. Fractures usually less numerous than joints.

ADDITIONAL COMMENTS:

V CONSOLIDATION OF SEDIMENTARY ROCKS: usually determined from unweathered samples. Largely dependent on cementation.

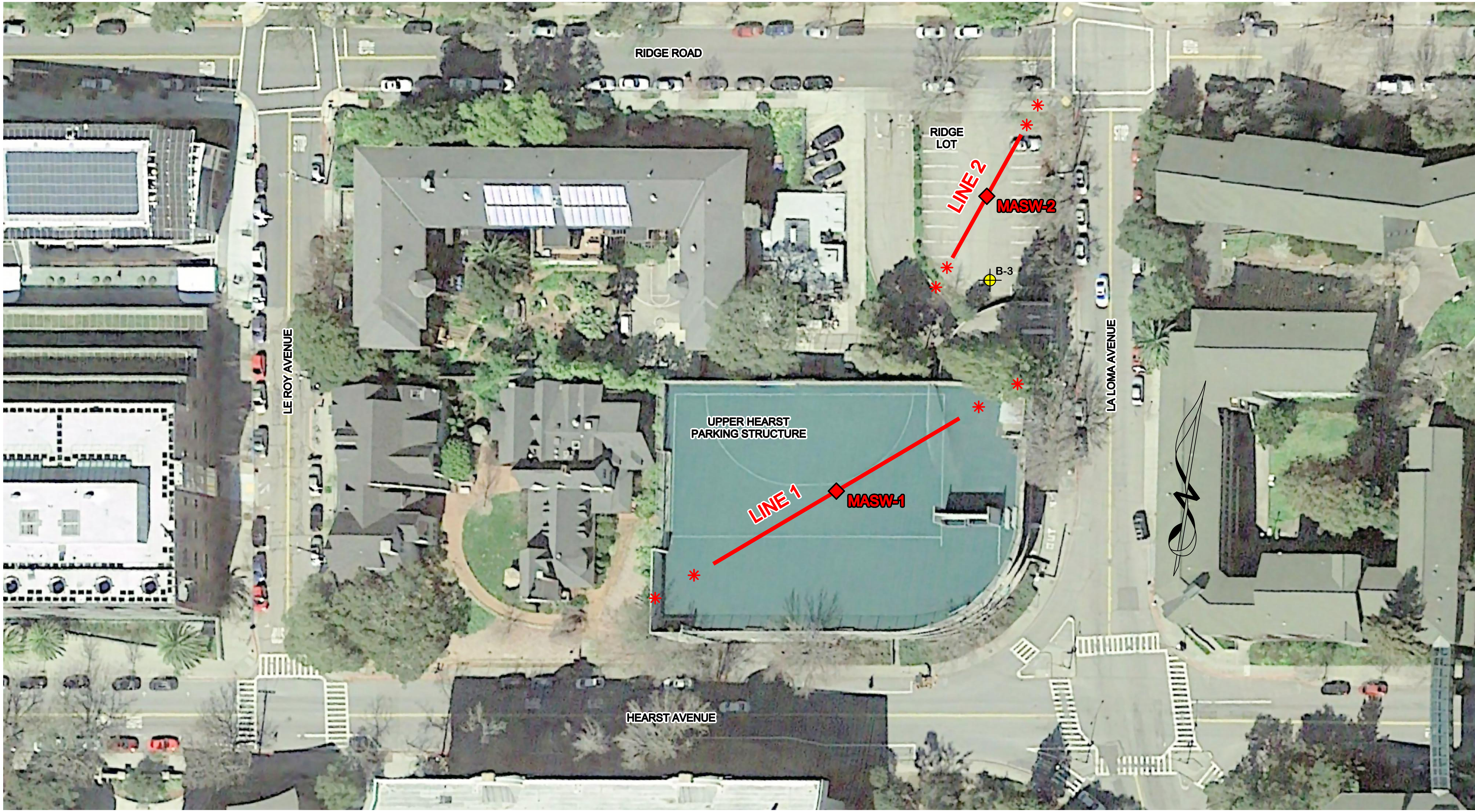
U = unconsolidated
P = poorly consolidated
M = moderately consolidated
W = well consolidated

VI BEDDING OF SEDIMENTARY ROCKS

Splitting Property	Thickness	Stratification
Massive	Greater than 4.0 ft.	very thick-bedded
Blocky	2.0 to 4.0 ft.	thick bedded
Slabby	0.2 to 2.0 ft.	thin bedded
Flaggy	0.05 to 0.2 ft.	very thin-bedded
Shaly or platy	0.01 to 0.05 ft.	laminated
Papery	less than 0.01	thinly laminated

APPENDIX B

GEOPHYSICAL TEST RESULTS



LEGEND

(red line)	SEISMIC REFRACTION LINE
(red diamond)	MASW SOUNDING LOCATION
(red asterisk)	MASW SHOT POINT
(yellow circle with cross)	DOWNHOLE SEISMIC BOREHOLE

SCALE

0 25 50 100

(1 inch = 50 feet)

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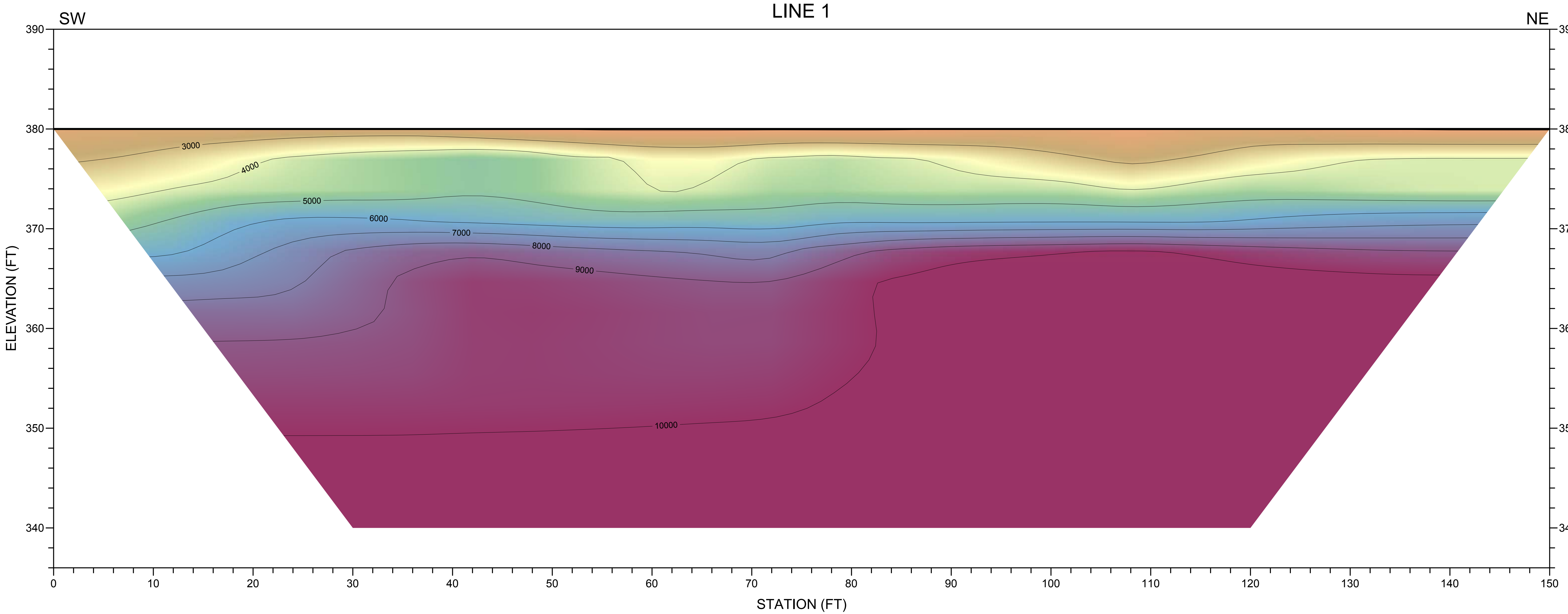
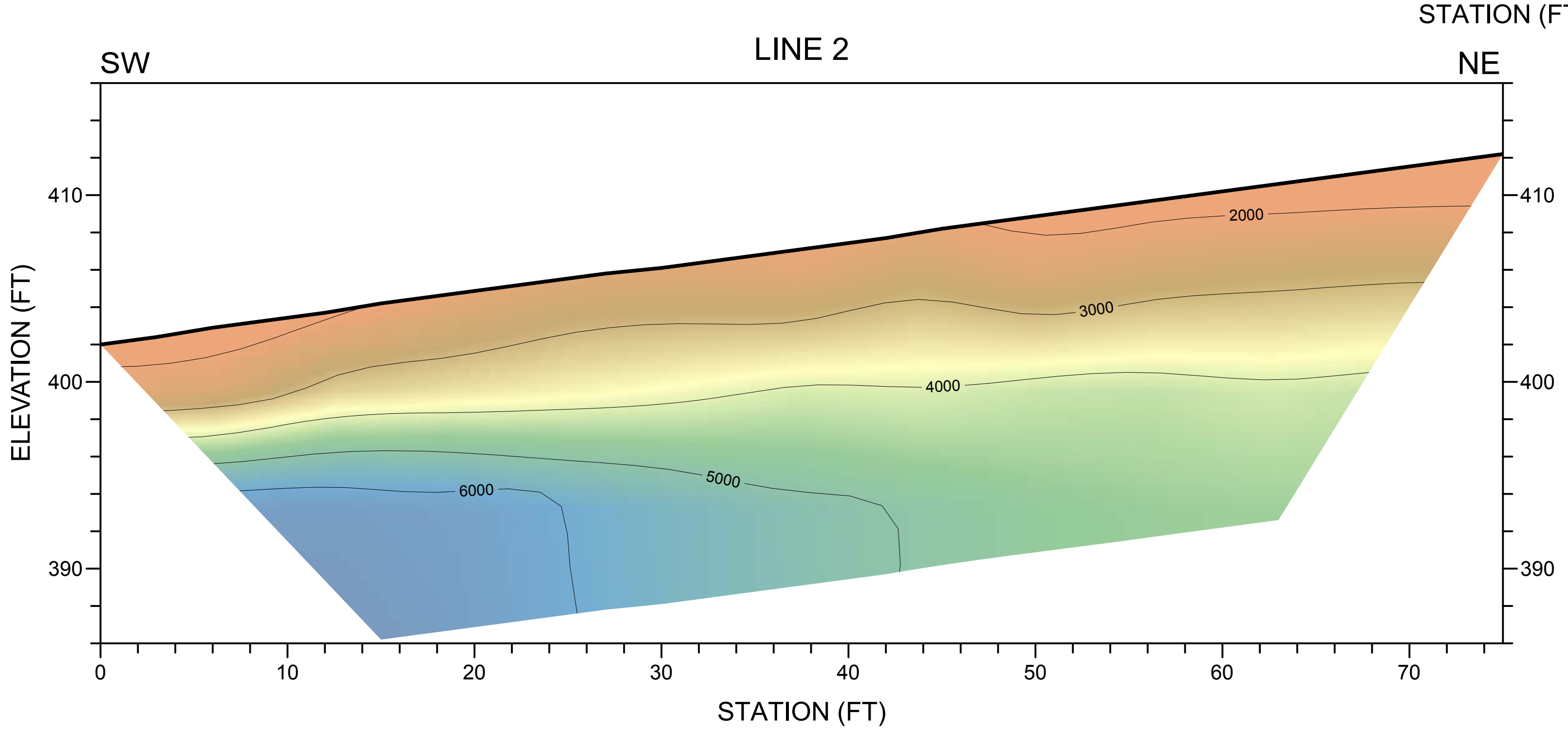
REGISTERED GEOPHYSICIST
WILLIAM J. HENRICH
No. 893
STATE OF CALIFORNIA

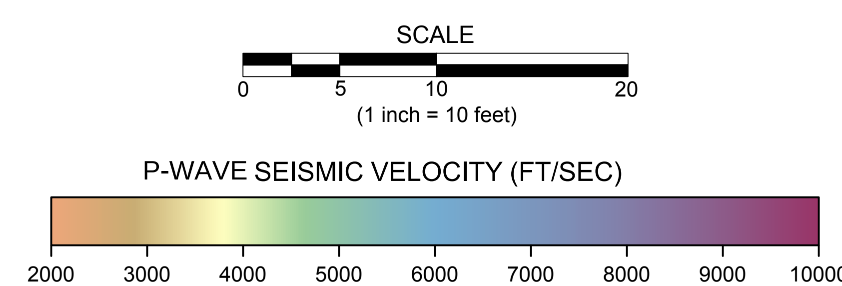
SITE LOCATION MAP
HEARST-LA LOMA PARKING FACILITIES
SURFACE & DOWNHOLE SEISMIC SURVEY

LOCATION: BERKELEY, CALIFORNIA		
CLIENT: LANGAN		
JOB #. NS175052	DATE: OCTOBER 2017	PLATE
DRAWN BY: G.RANDALL	APPROVED BY: WJH	1

10/16/2017







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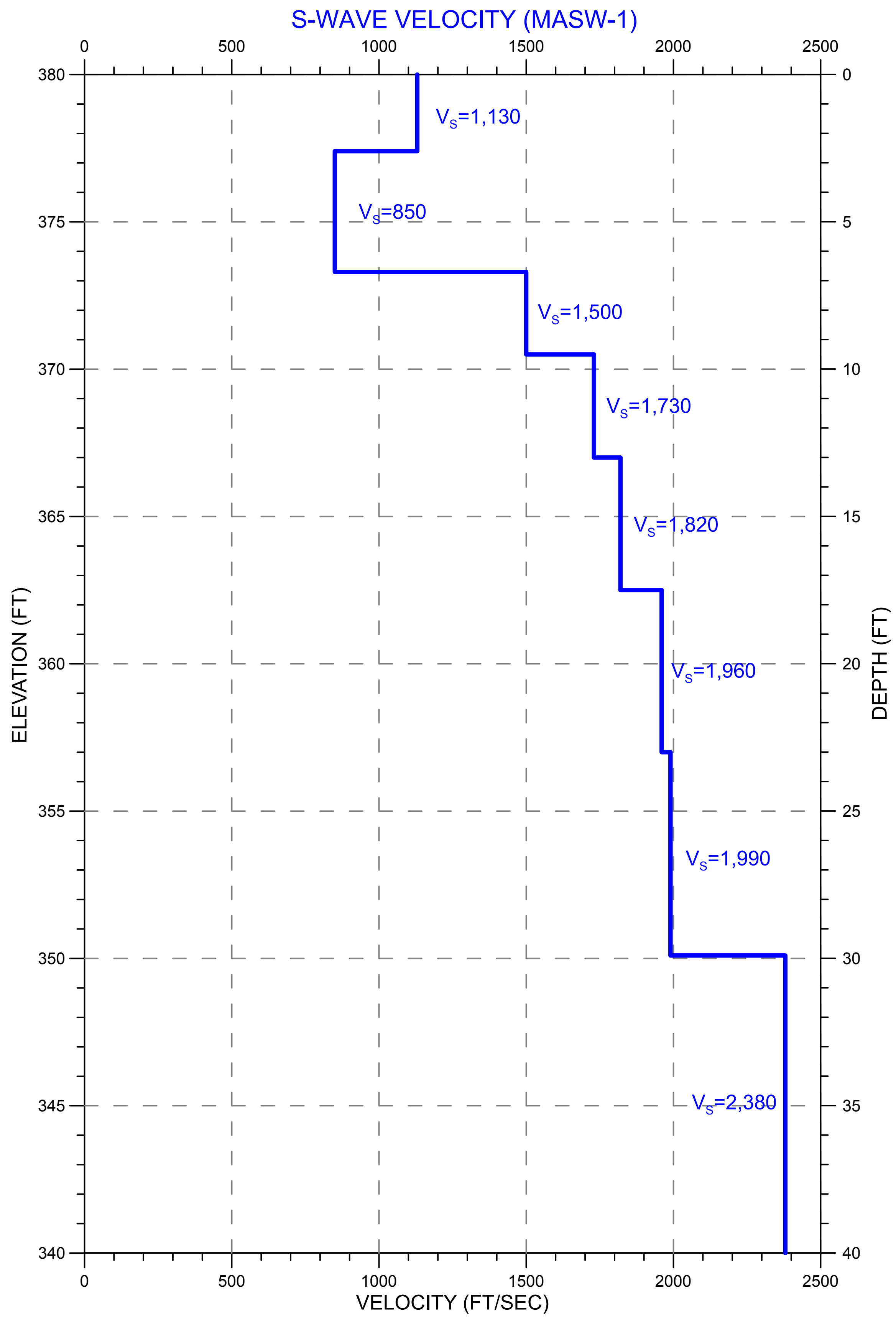
STATE OF CALIFORNIA

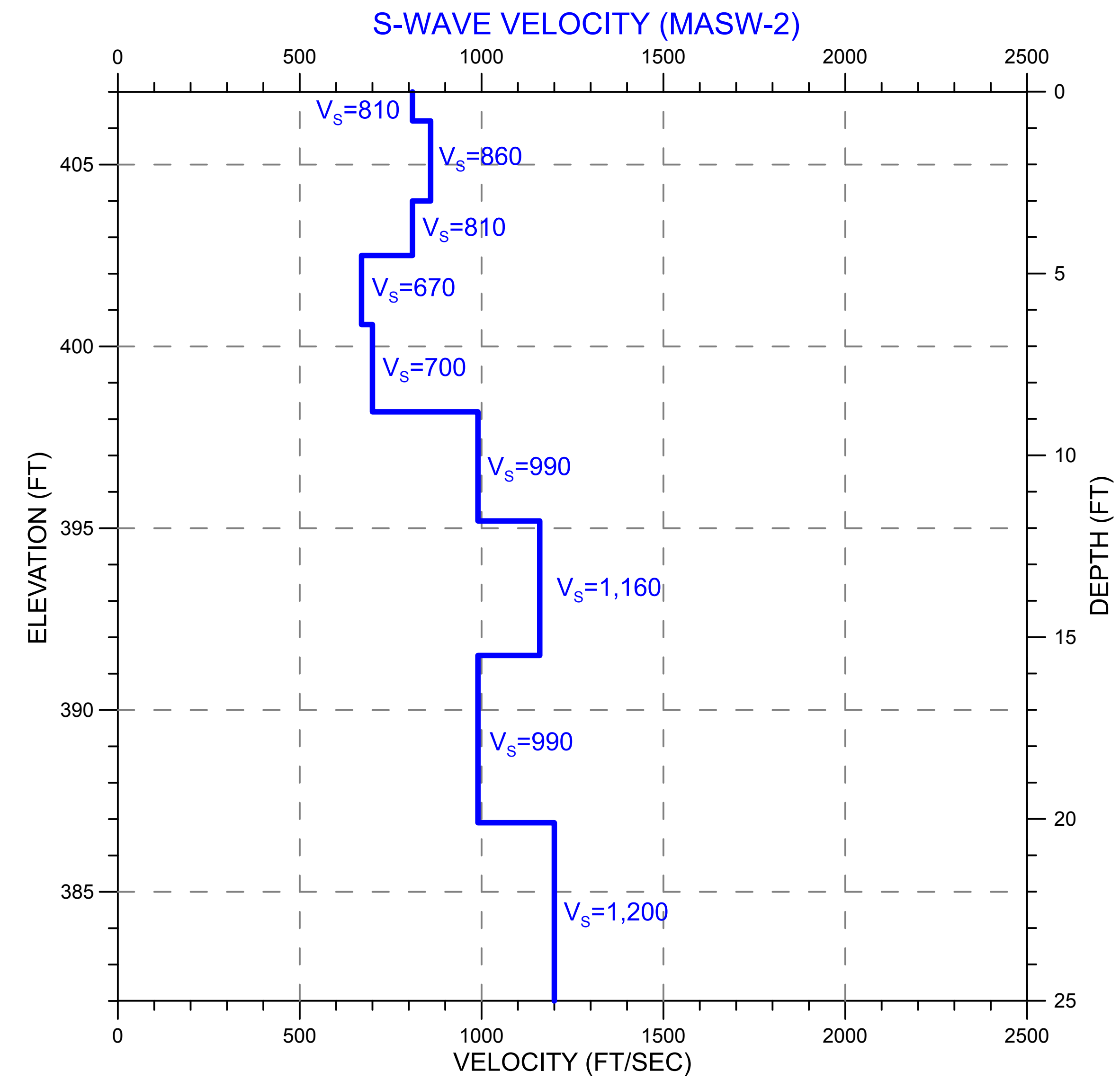
SEISMIC REFRACTION PROFILES
LINES 1 & 2
HEARST-LA LOMA PARKING FACILITIES

LOCATION: BERKELEY, CALIFORNIA	
CLIENT: LANGAN	
JOB #: NS175052	DATE: OCTOBER 2017
DRAWN BY: G.RANDALL	APPROVED BY: WJH

10/16/2017

PLATE
2





LEGEND	
(blue line)	S-WAVE VELOCITY (MASW)

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No. 893
STATE OF CALIFORNIA

MASW 1D S-WAVE VELOCITY SOUNDINGS
MASW 1 & MASW 2
HEARST-LA LOMA PARKING FACILITIES

LOCATION: BERKELEY, CALIFORNIA	
CLIENT: LANGAN	
JOB #: NS175052	DATE: OCTOBER 2017
DRAWN BY: G.RANDALL	APPROVED BY: WJH
William J. Henrich 10/16/2017	

PLATE
3

NORCAL GEOPHYSICAL CONSULTANTS INC.
A Terracon COMPANY

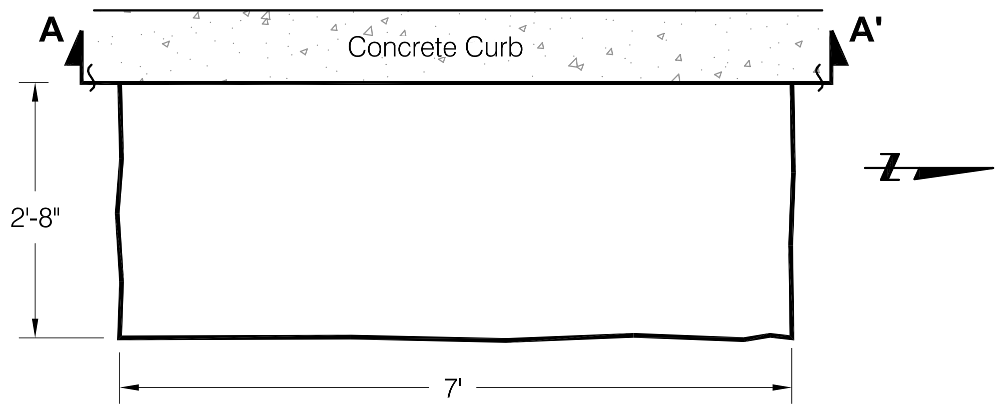
Table 1: Borehole B-3, P- and S-wave Velocity Table

METRIC UNITS DEPTHS & INTERVAL VELOCITIES					IMPERIAL UNITS DEPTHS AND INTERVAL VELOCITIES						
Depth	VsLeft	VsRight	VsAvg	Vp	Depth	VsLeft	VsRight	VsAvg	Vp	VsAvg-3pt	Vp -3pt
Meters	M/sec.	M/sec.	M/sec.	M/sec.	Feet	Ft./sec.	Ft./sec.	Ft./sec.	Ft./sec.	Ft./sec.	Ft./sec.
3.65	296	298	297	1799	11.96	971	976	974	5867		
4.27	305	309	307	1852	14.02	1000	1013	1006	6039	958	5790
4.35	268	277	272	1676	14.26	879	908	893	5465	1013	5793
4.89	342	352	347	1802	16.06	1124	1155	1139	5875	1036	5623
4.91	318	338	328	1695	16.12	1043	1108	1076	5527	1052	5777
5.49	284	289	287	1818	18.00	932	948	940	5929	985	5610
5.50	282	291	286	1648	18.03	925	954	939	5375	986	5797
6.09	327	331	329	1866	19.98	1072	1086	1079	6086	1033	5750
6.13	338	321	329	1775	20.10	1108	1052	1080	5789	1065	5990
6.72	313	318	315	1869	22.06	1025	1045	1035	6095	1058	5825
6.80	325	321	323	1714	22.31	1065	1052	1058	5590	1033	5927
7.01	303	311	307	1869	23.01	994	1019	1007	6095	1084	5848
7.11	355	368	362	1796	23.34	1166	1206	1186	5858	1103	5955
7.25	338	342	340	1813	23.79	1108	1124	1116	5911	1145	5911
7.27	357	333	345	1829	23.84	1172	1094	1133	5965	1127	5990
7.33	350	341	345	1869	24.04	1149	1117	1133	6095	1134	6027
7.55	350	342	346	1846	24.78	1150	1124	1137	6020	1142	6067
7.61	357	347	352	1866	24.96	1172	1139	1155	6086	1107	6018
7.88	321	306	313	1824	25.84	1052	1004	1028	5947	1082	6024
7.93	342	305	324	1852	26.03	1124	1000	1062	6039	1066	5933
7.96	341	334	338	1783	26.13	1120	1097	1109	5814	1141	5892
8.23	382	382	382	1786	27.00	1252	1252	1252	5823	1232	5855
8.54	403	410	407	1818	28.01	1323	1345	1334	5929	1312	5994
8.57	419	403	411	1911	28.12	1375	1323	1349	6231	1348	6104
8.85	413	417	415	1887	29.04	1356	1367	1361	6153	1382	6153
9.13	431	444	437	1863	29.94	1414	1456	1435	6076	1393	6127
9.16	424	418	421	1887	30.04	1390	1373	1381	6153	1413	6071
9.44	446	420	433	1835	30.98	1465	1379	1422	5983	1423	5983
9.76	446	446	446	1783	32.01	1465	1465	1465	5814	1404	5945
9.76	408	401	404	1852	32.02	1337	1316	1327	6039	1430	5945
10.10	463	450	457	1835	33.15	1519	1478	1498	5983	1458	5981
10.38	467	476	472	1815	34.04	1533	1562	1548	5920	1383	6019

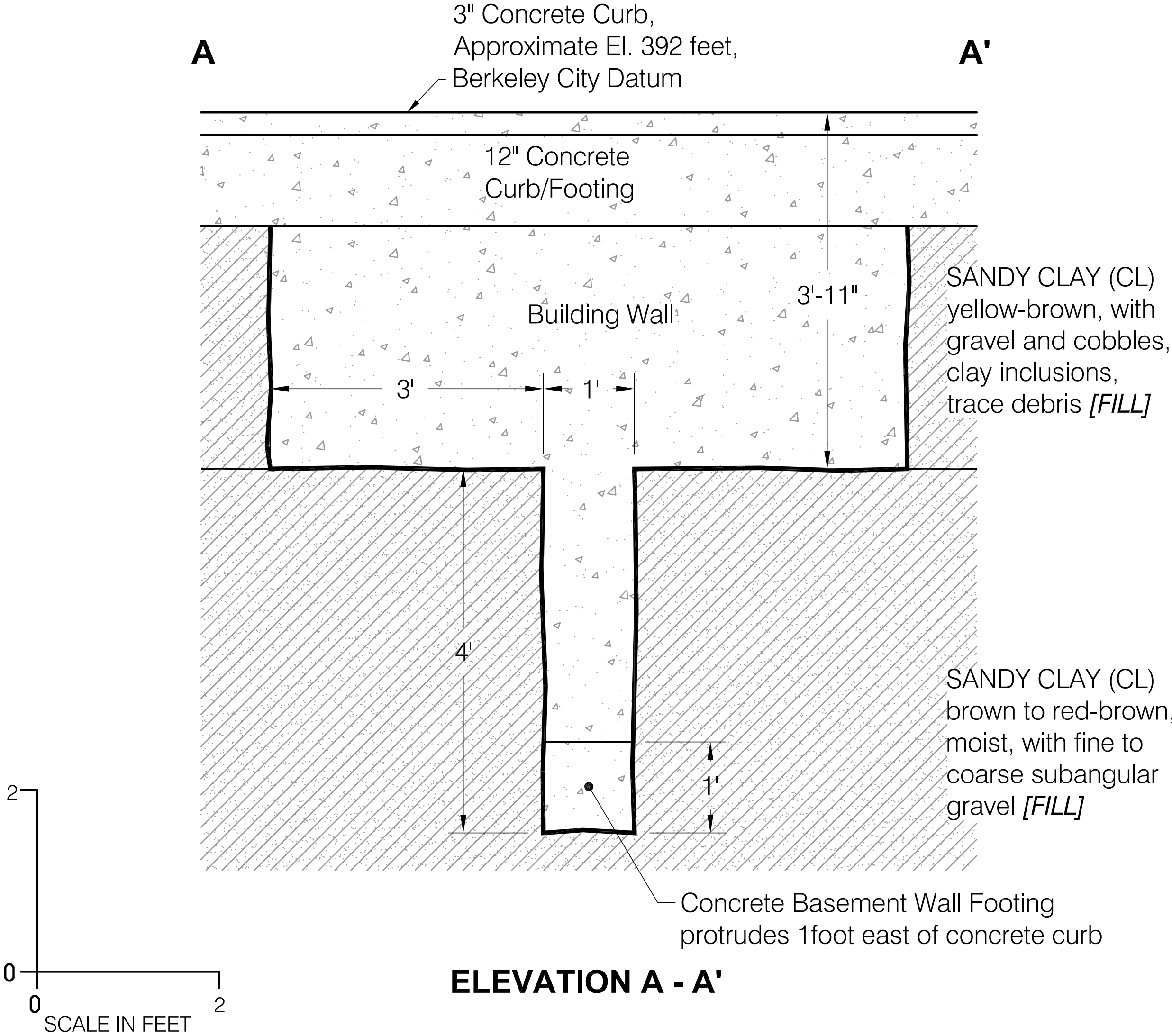
10.39	338	335	336	1887	34.08	1108	1099	1103	6153	1372	6072
10.67	452	441	447	1884	35.02	1485	1445	1465	6143	1310	6022
10.96	413	417	415	1770	35.96	1356	1367	1361	5772	1366	5960
11.00	379	397	388	1829	36.10	1243	1302	1272	5965	1373	5803
11.30	459	446	453	1739	37.07	1505	1465	1485	5671	1284	5930
11.58	326	341	333	1887	38.00	1070	1118	1094	6153	1373	5973
11.64	472	467	469	1869	38.18	1548	1533	1540	6095	1334	6041
11.91	424	410	417	1802	39.09	1390	1345	1367	5875	1324	5979
12.20	328	321	324	1829	40.03	1075	1052	1063	5965	1278	5902
12.22	427	427	427	1799	40.09	1402	1402	1402	5867	1328	5957
12.50	459	467	463	1852	41.02	1505	1533	1519	6039	1559	5930
12.51	521	549	535	1805	41.06	1709	1803	1756	5884	1616	5972
12.79	482	477	479	1838	41.95	1580	1565	1572	5992	1588	5972
12.82	437	439	438	1852	42.07	1433	1439	1436	6039	1514	6084
13.12	476	459	467	1908	43.03	1562	1505	1534	6221	1493	6118
13.12	461	459	460	1869	43.05	1512	1505	1508	6095	1500	6279
13.41	446	442	444	2000	44.01	1465	1452	1458	6522	1505	6424
13.41	467	476	472	2041	44.01	1533	1562	1548	6655	1478	6545
13.70	431	439	435	1980	44.96	1414	1439	1427	6457	1476	6523
13.73	446	441	443	1980	45.06	1465	1445	1455	6457	1497	6523
14.03	495	485	490	2041	46.04	1624	1593	1608	6655	1512	6523
14.05	443	455	449	1980	46.09	1454	1494	1474	6457	1541	6612
14.34	476	463	470	2062	47.05	1562	1519	1541	6724	1580	6612
14.34	532	521	526	2041	47.05	1745	1709	1727	6655	1662	6724
14.63	538	510	524	2083	48.01	1764	1674	1719	6794	1704	6724
14.64	505	510	508	2062	48.03	1657	1674	1665	6724	1729	6818
14.96	546	552	549	2128	49.07	1793	1813	1803	6938	1811	6917
14.97	602	595	599	2174	49.10	1976	1953	1965	7089	1892	6984
15.24	588	575	581	2124	50.01	1930	1886	1908	6926	1862	6984
15.25	515	529	522	2128	50.04	1691	1736	1714	6938	1737	6959
15.45	483	485	484	2151	50.70	1585	1593	1589	7013	1744	6959
15.47	581	595	588	2124	50.75	1907	1953	1930	6926		

APPENDIX C

LOGS OF TEST PITS



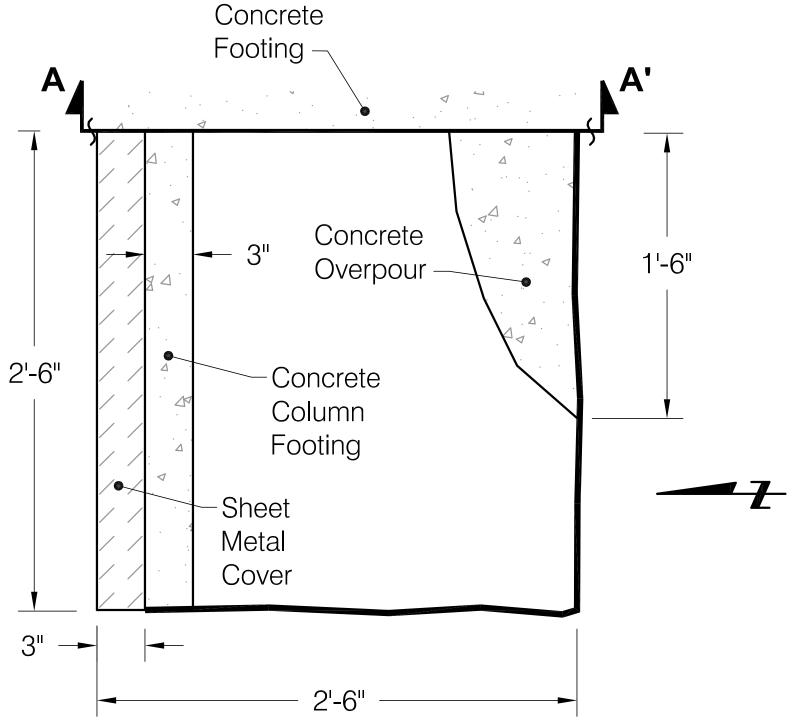
PLAN VIEW



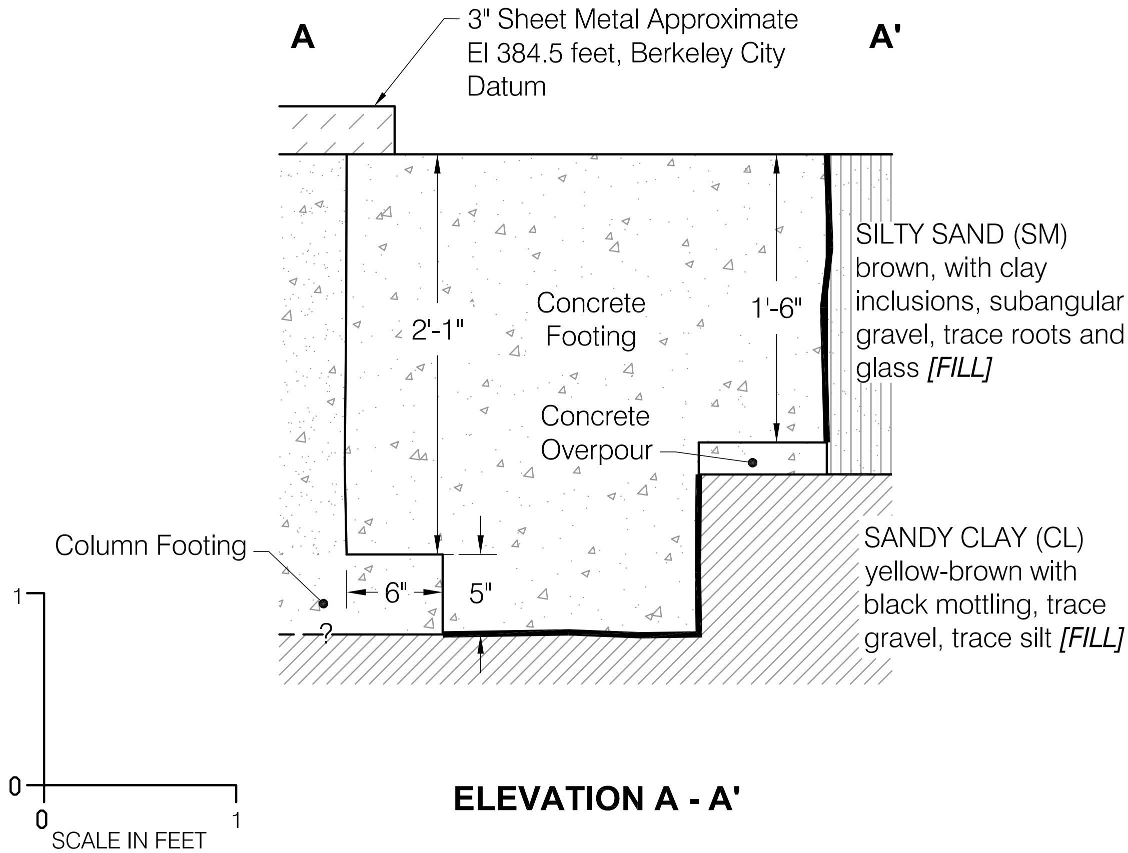
ELEVATION A - A'

\\langan.com\data\SFO\data3\731706301\Project Data\CAD\01\2D-DesignFiles\Geotechnical\731706301-B-XS0101.dwg 12/21/17

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING Berkeley, California	**LOG OF TEST PIT TP-1**
LANGAN	Date 09/25/17 | Project No. 731706301 | Figure C-1



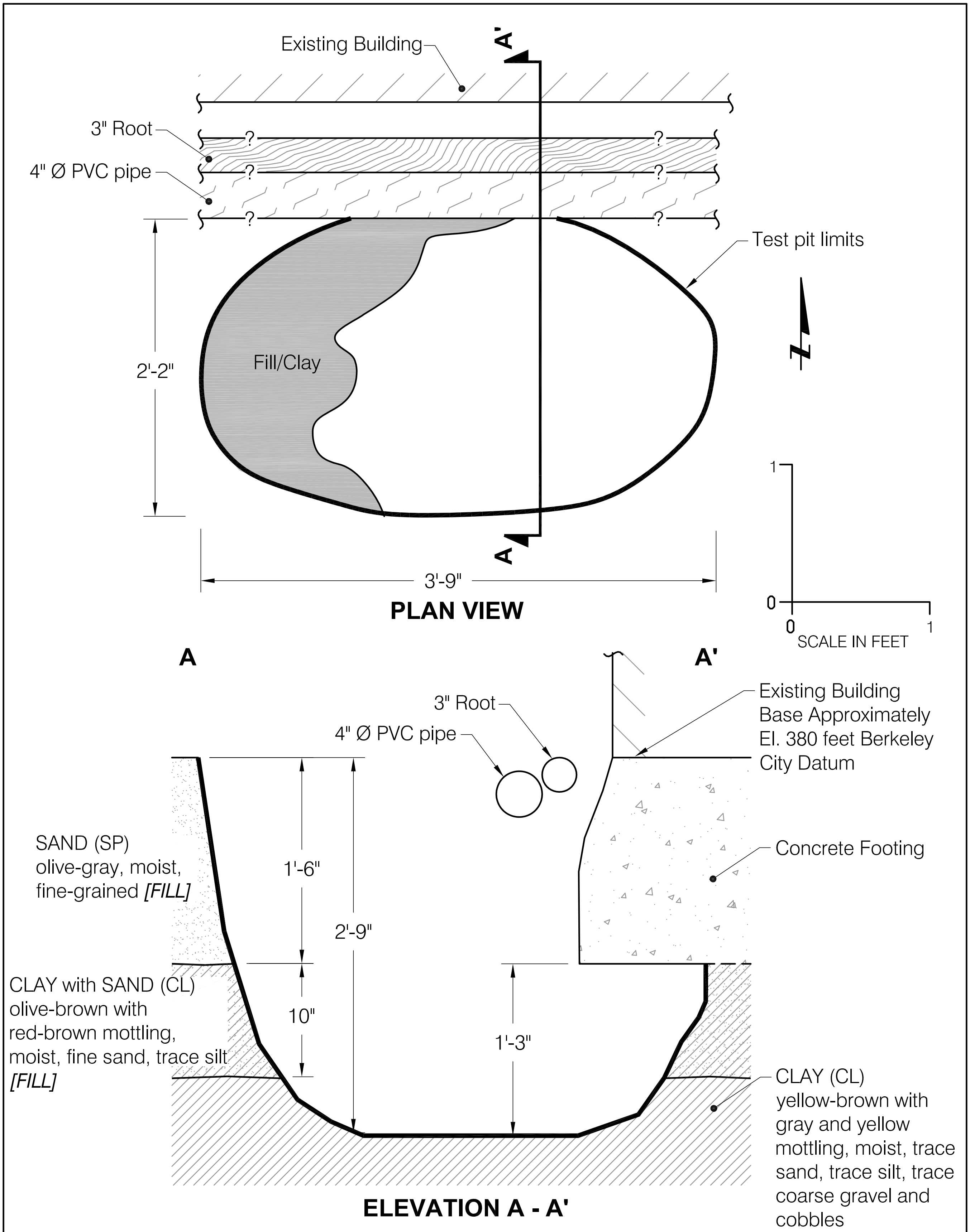
PLAN VIEW



ELEVATION A - A'

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING Berkeley, California	**LOG OF TEST PIT** **TP-2**
LANGAN	Date 09/25/17 | Project No. 731706301 | Figure C-2

\\langan.com\data\SFO\data3\731706301\Project Data\CAD\01\2D-DesignFiles\Geotechnical\731706301-B-XS0101.dwg 12/21/17



UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING
Berkeley, California

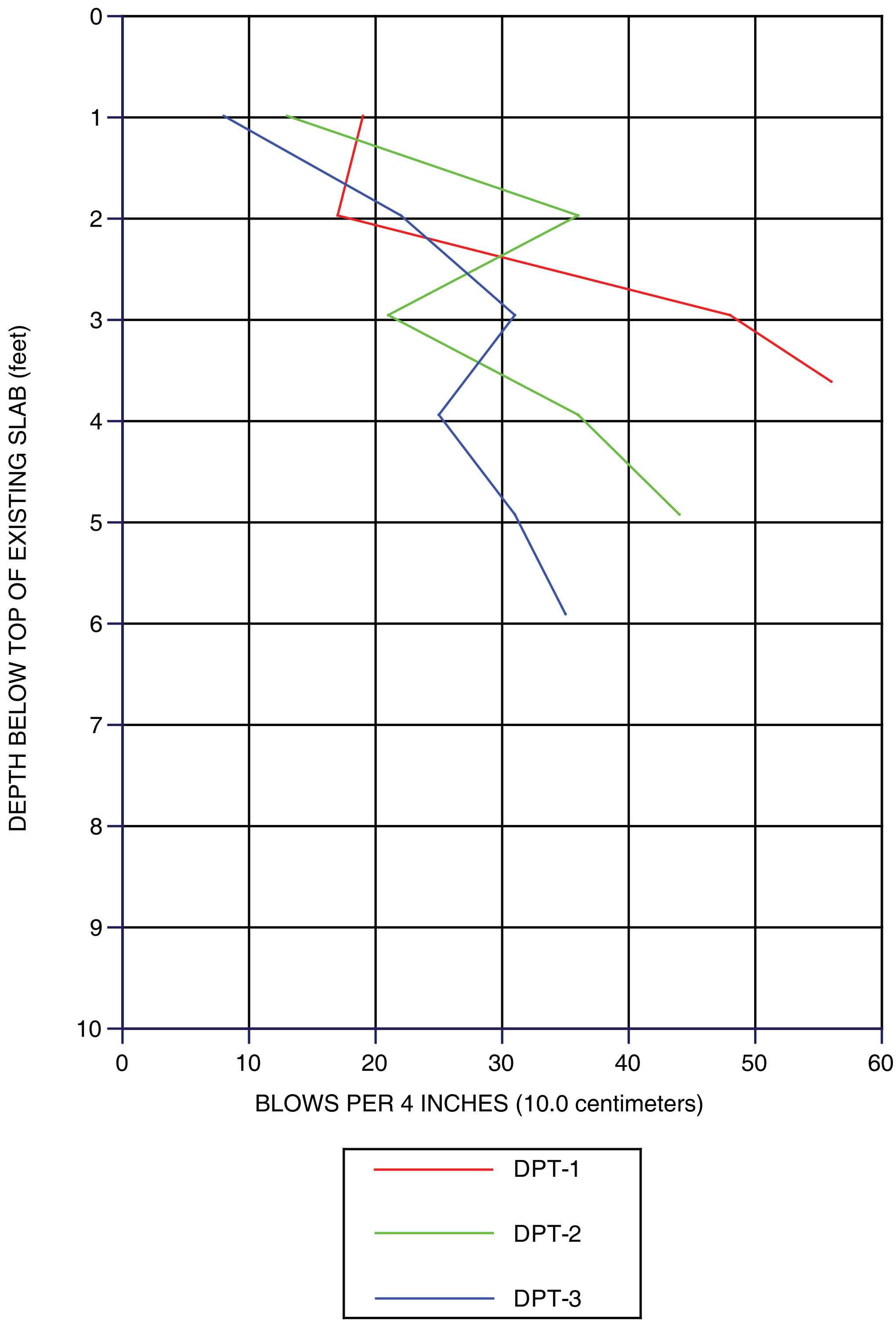
LANGAN

LOG OF TEST PIT TP-3

Date 09/25/17	Project No. 731706301	Figure C-3

APPENDIX D

DYNAMIC PENETROMETER TESTS



Notes:

1. Depth of zero feet on graph corresponds to top of existing ground surface.

UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING Berkeley, California	**DYNAMIC PENETROMETER TESTS DPT-1 TO DPT-3**
LANGAN	Date 01/19/18 | Project No. 731706301 | Figure D-1

PROJECT: **UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING**
Berkeley, California

Log of Boring DPT-1

Boring location: See Site Plan, Figure 2

Logged by: C. Leege

Date started: 12/22/17 Date finished: 12/22/17

Drilling method: Hand Auger

Hammer weight/drop: NA Hammer type: NA

Samplers: Hand Auger

DEPTH (feet)	Sampler Type	Sample	Blows/6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						5 inches concrete						
1				19	GP	GRAVEL (GP) gray, medium dense, moist, coarse, subangular to angular						
2	BULK	X		17								
3				48	CL	SANDY CLAY (CL) gray to yellow-brown, hard, moist, fine to coarse-grained sand, with some fine to coarse subangular gravel up to 1.5 inches in diameter						
				56								
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
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Boring terminated at a depth of 4 feet below ground surface.
Boring backfilled with cuttings.
Groundwater not encountered during drilling.
SPT N values (blows per foot) were converted from Dynamic Penetration Test (DPT) blow counts (blows per 10cm) using the Dutch Formula.

[1] Elevations based on the City of Berkeley Datum and the Parking Structure "H" Topo drawing by David J. Russell, Land Surveyor, dated 03/69, by the Universtiy of California.

LANGAN

Project No.: 731706301 Figure: D-2

TEST GEOTECH LOG 731706301 EDIT PDF #.GPJ TR.GDT 2/8/18

PROJECT: UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING Berkeley, California	Log of Boring DPT-2 PAGE 1 OF 1

Boring location: See Site Plan, Figure 2	Logged by: C. Leege
Date started: 12/22/17 / Date finished: 12/22/17	
Drilling method: Hand Auger	
Hammer weight/drop: NA / Hammer type: NA	
Samplers: Hand Auger	

DEPTH (feet)	SAMPLES: Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						7 inches concrete						
1				13	GP	GRAVEL (GP) gray, medium dense, coarse, angular						
2	BULK	☒		36	CL-CH	CLAY (CL/CH) olive-gray with red-brown and dark brown mottling, moist, very stiff, with some fine gravel LL = 50, PI = 31, see Appendix F					18.5	
3				21								
4	BULK	☒		36	CL	SANDY CLAY (CL) red-brown, hard, moist, some fine to coarse subangular to angular gravel Partical Size Analysis, see Appendix F				59.0	18.3	
5				44								
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
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Boring terminated at a depth of 5.3 feet below ground surface.
Boring backfilled with cuttings.
Groundwater not encountered during drilling.
SPT N values (blows per foot) were converted from Dynamic Penetration Test (DPT) blow counts (blows per 10cm) using the Dutch Formula.

[1] Elevations based on the City of Berkeley Datum and the Parking Structure "H" Topo drawing by David J. Russell, Land Surveyor, dated 03/69, by the Universtiy of California.

LANGAN

Project No.: 731706301 | Figure: D-3

TEST GEOTECH LOG 731706301 EDIT PDF #.GPJ TR.GDT 2/8/18

PROJECT: **UC BERKELEY GOLDMAN SCHOOL OF PUBLIC POLICY AND HEARST AVENUE ACADEMIC HOUSING**
Berkeley, California

Log of Boring DPT-3

Boring location:	See Site Plan, Figure 2	Logged by:	C. Leege
Date started:	12/22/17	Date finished:	12/22/17
Drilling method:	Hand Auger		
Hammer weight/drop:	NA	Hammer type:	NA
Samplers:	Hand Auger		

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						6 inches concrete						
1	BULK	X		8	GP	GRAVEL (GP) gray, medium dense to dense, moist, fine to coarse, some medium to coarse sand, trace clay						
2				22								
3	BULK	X		31	CL	SANDY CLAY (CL) yellow-brown, very stiff, moist, fine sand				64.4	16.5	
4				25								
5	BULK	X		31	CL-CH	CLAY with SAND (CL/CH) red-brown, hard, moist, trace fine gravel LL = 50, PI = 32, see Appendix F					17.6	
6				35								
7–30												

Boring terminated at a depth of 5 feet below ground surface.
Boring backfilled with cuttings.
Groundwater not encountered during drilling.
SPT N values (blows per foot) were converted from Dynamic Penetration Test (DPT) blow counts (blows per 10cm) using the Dutch Formula.

[1] Elevations based on the City of Berkeley Datum and the Parking Structure "H" Topo drawing by David J. Russell, Land Surveyor, dated 03/69, by the Universtiy of California.

LANGAN

Project No.: 731706301 | Figure: D-4

APPENDIX E

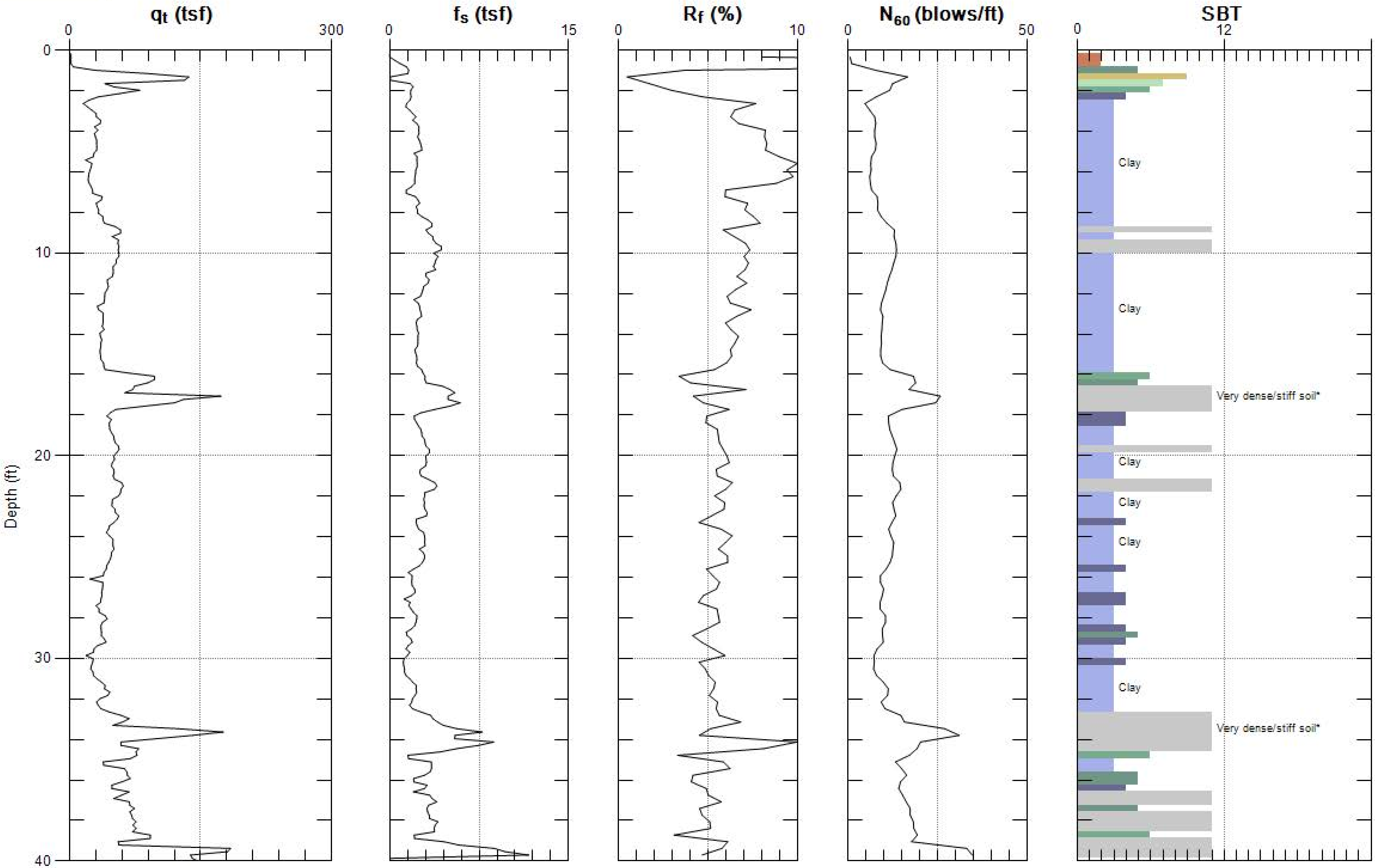
CONE PENETRATION TESTS

GREGG

LANGAN

Site: UPR. HEARST PARKING Engineer: S.BOUDREAU

Sounding: CPT-01 Date: 12/21/17 09:55



Max. Depth: 40.026 (ft)
Avg. Interval: 0.328 (ft)

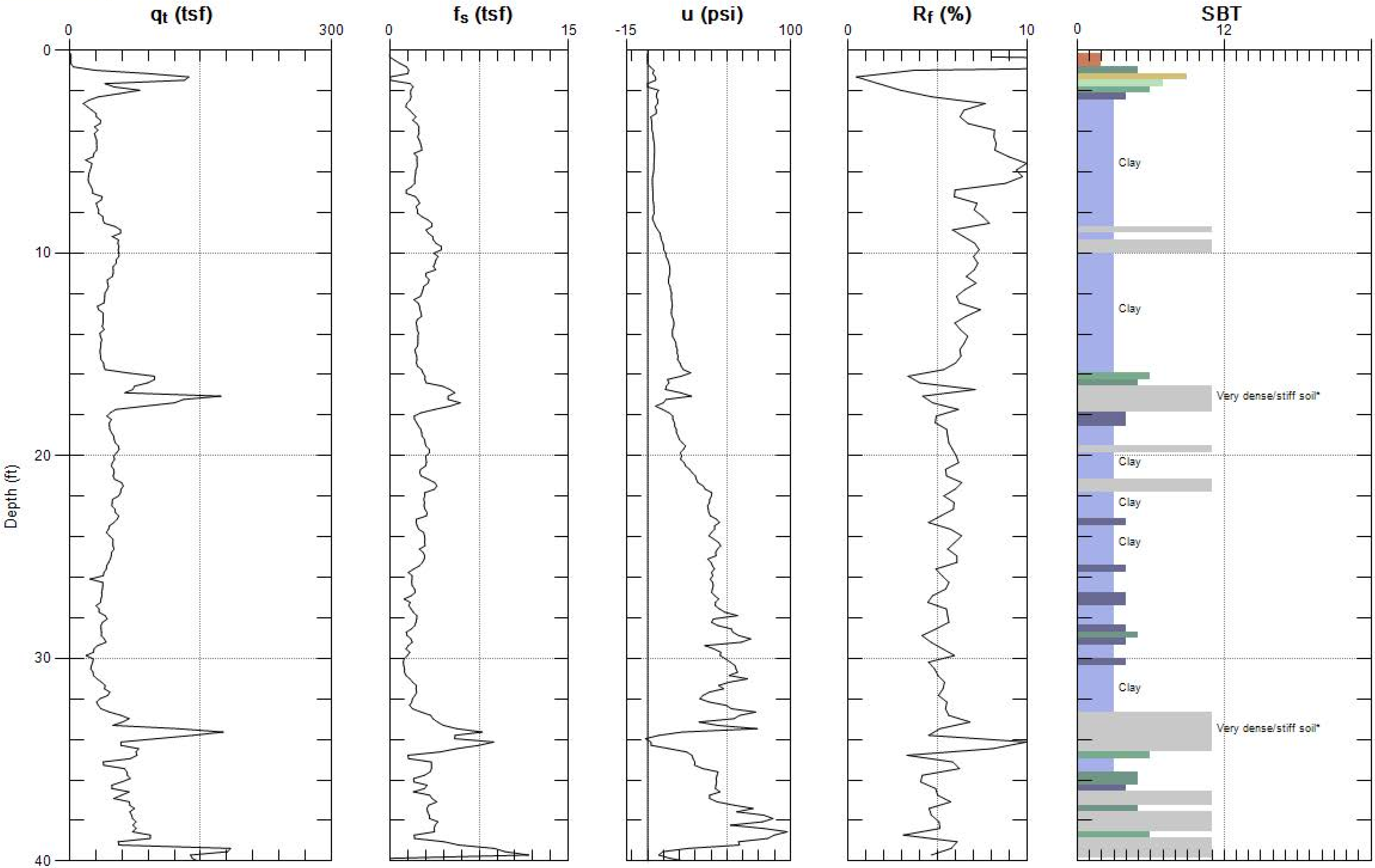
SBT: Soil Behavior Type (Robertson 1990)

GREGG

LANGAN

Site: UPR. HEARST PARKING Engineer: S.BOUDREAU

Sounding: CPT-01 Date: 12/21/17 09:55



Max. Depth: 40.026 (ft)
Avg. Interval: 0.328 (ft)

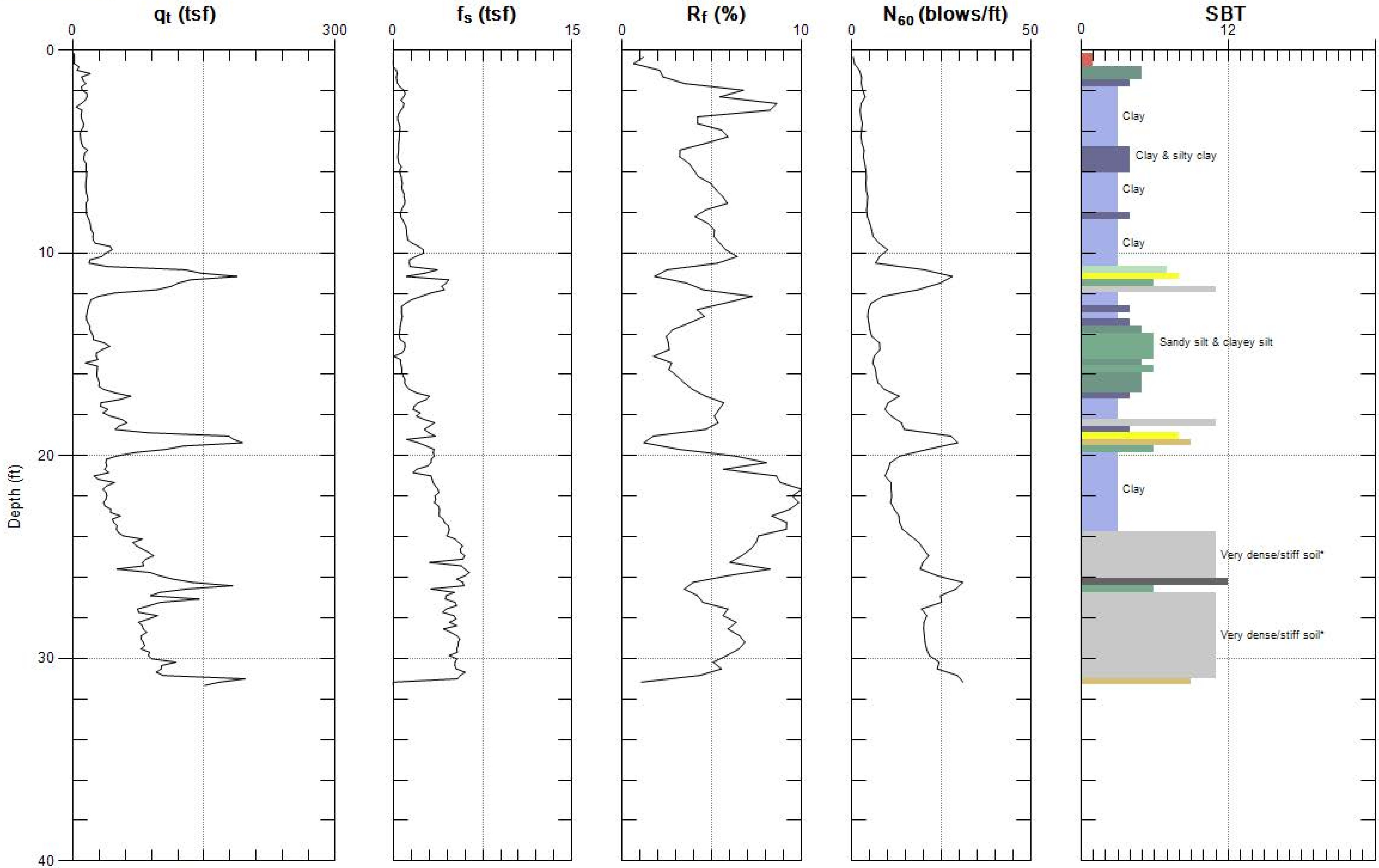
SBT: Soil Behavior Type (Robertson 1990)

GREGG

LANGAN

Site: UPR. HEARST PARKING
Sounding: CPT-02

Engineer: S.BOUDREAU
Date: 12/21/17 11:57

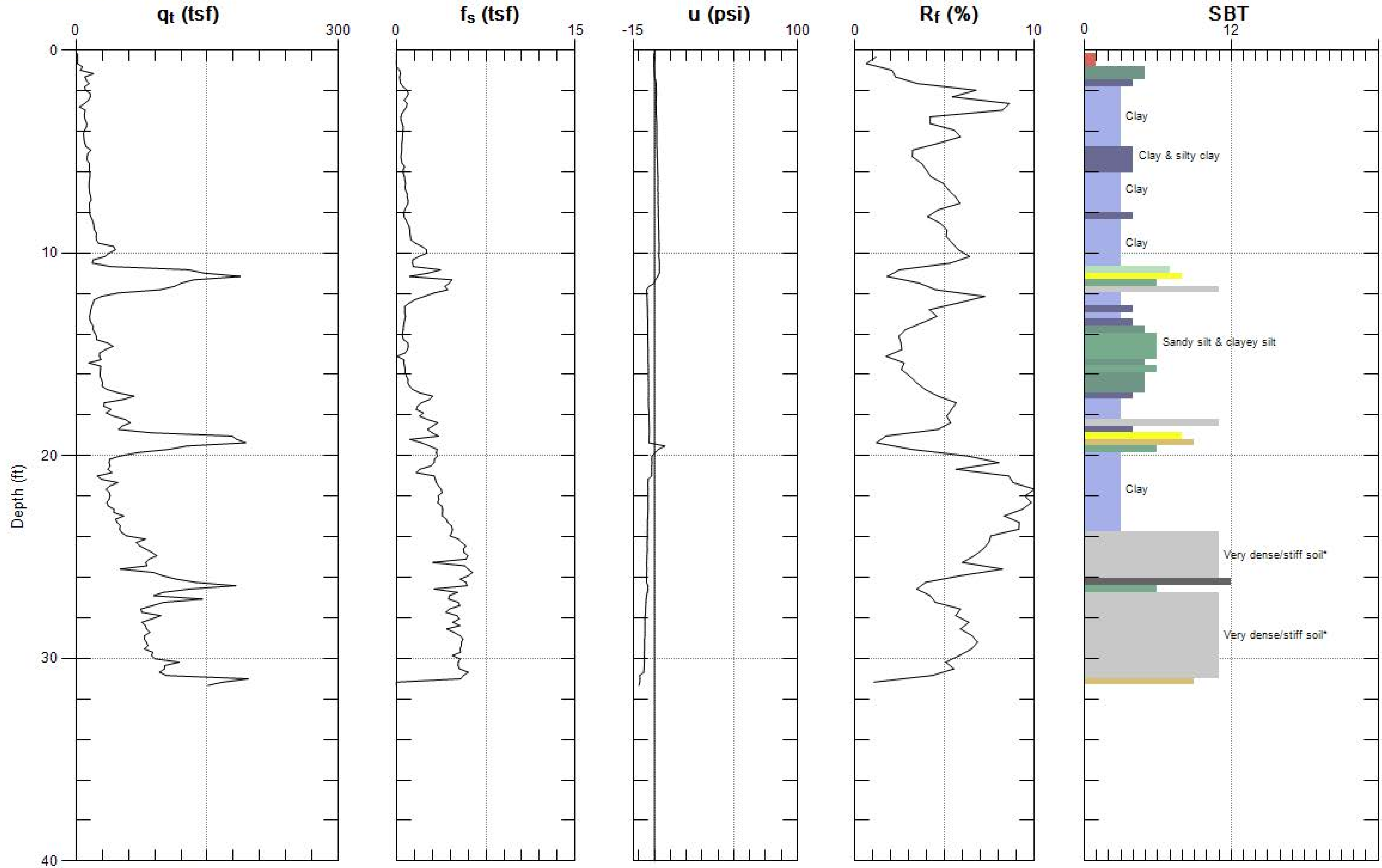


Max. Depth: 31.332 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

LANGAN

Site: UPR. HEARST PARKING
Engineer: S.BOUDREAU
Sounding: CPT-02
Date: 12/21/17 11:57



Max. Depth: 31.332 (ft)
Avg. Interval: 0.328 (ft)

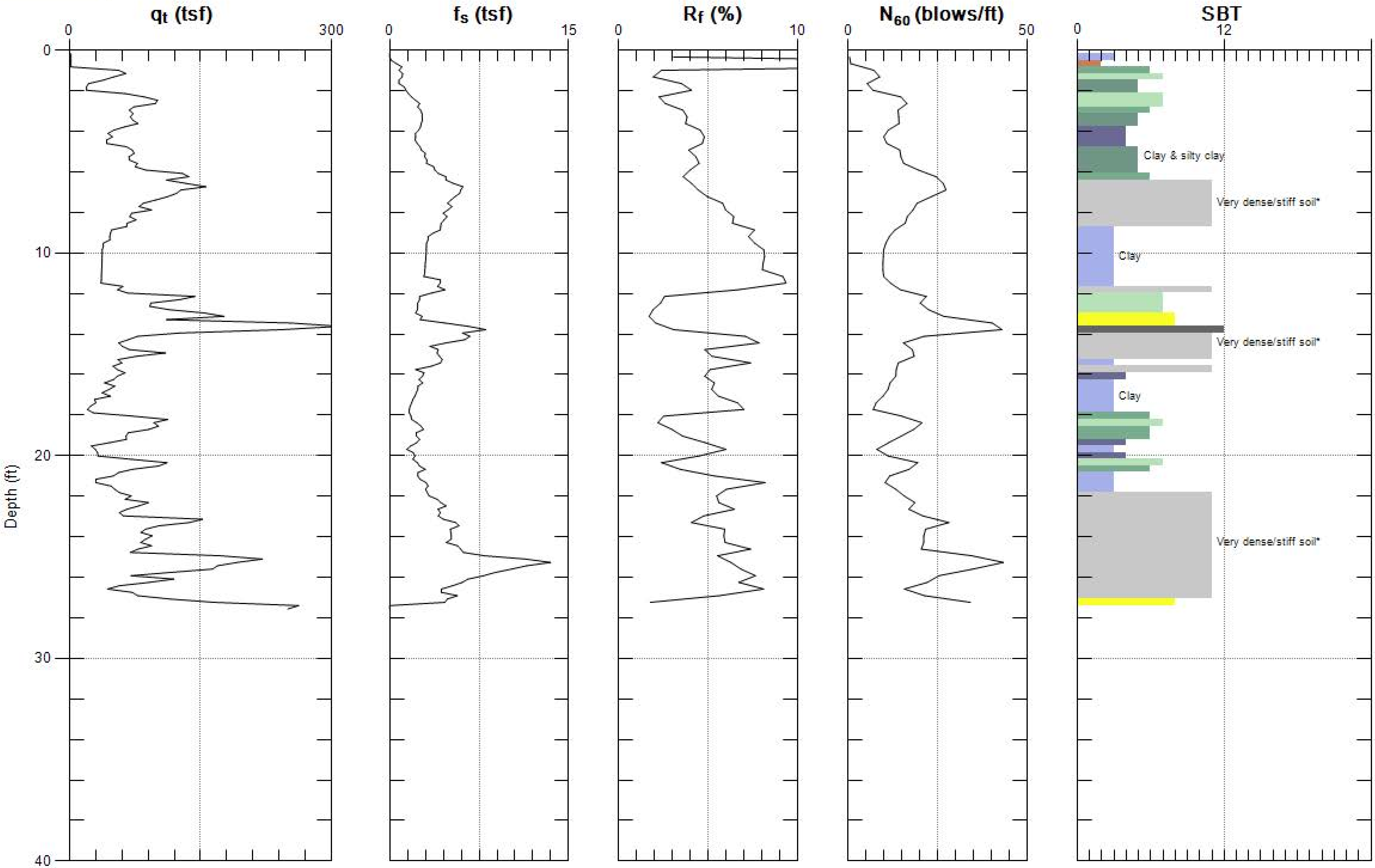
SBT: Soil Behavior Type (Robertson 1990)

GREGG

LANGAN

Site: UPR. HEARST PARKING Engineer: S.BOUDREAU

Sounding: CPT-03 Date: 12/21/17 10:58



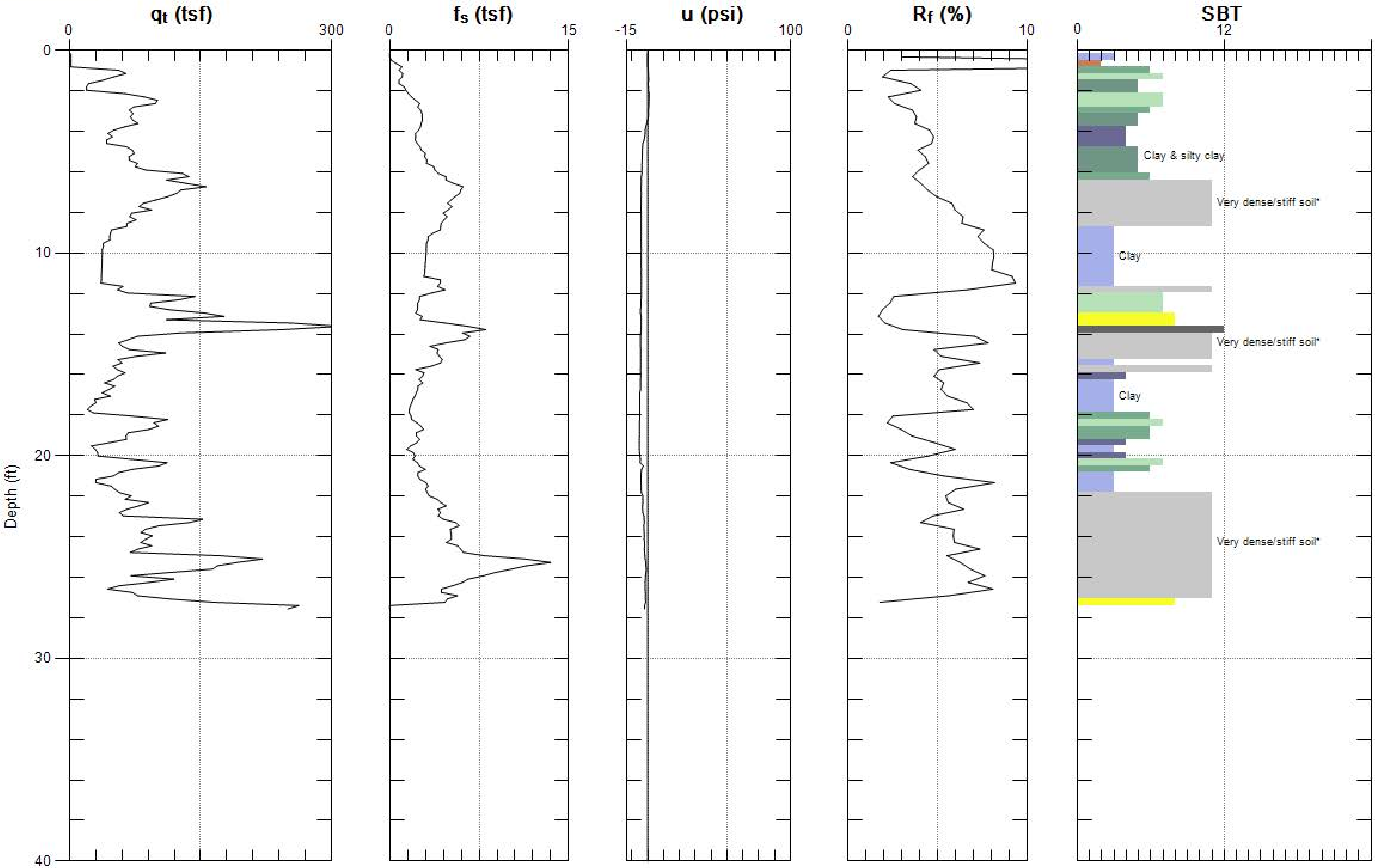
Max. Depth: 27.559 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **LANGAN**

Site: UPR. HEARST PARKING | Engineer: S.BOUDREAU

Sounding: CPT-03 | Date: 12/21/17 10:58



Max. Depth: 27.559 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Cone Penetration Testing Procedure (CPT)

Gregg Drilling carries out all Cone Penetration Tests (CPT) using an integrated electronic cone system, *Figure CPT*.

The cone takes measurements of tip resistance (q_c), sleeve resistance (f_s), and penetration pore water pressure (u_2). Measurements are taken at either 2.5 or 5 cm intervals during penetration to provide a nearly continuous profile. CPT data reduction and basic interpretation is performed in real time facilitating on-site decision making. The above mentioned parameters are stored electronically for further analysis and reference. All CPT soundings are performed in accordance with revised ASTM standards (D 5778-12).

The 5mm thick porous plastic filter element is located directly behind the cone tip in the u_2 location. A new saturated filter element is used on each sounding to measure both penetration pore pressures as well as measurements during a dissipation test (*PPDT*). Prior to each test, the filter element is fully saturated with oil under vacuum pressure to improve accuracy.

When the sounding is completed, the test hole is backfilled according to client specifications. If grouting is used, the procedure generally consists of pushing a hollow tremie pipe with a "knock out" plug to the termination depth of the CPT hole. Grout is then pumped under pressure as the tremie pipe is pulled from the hole. Disruption or further contamination to the site is therefore minimized.

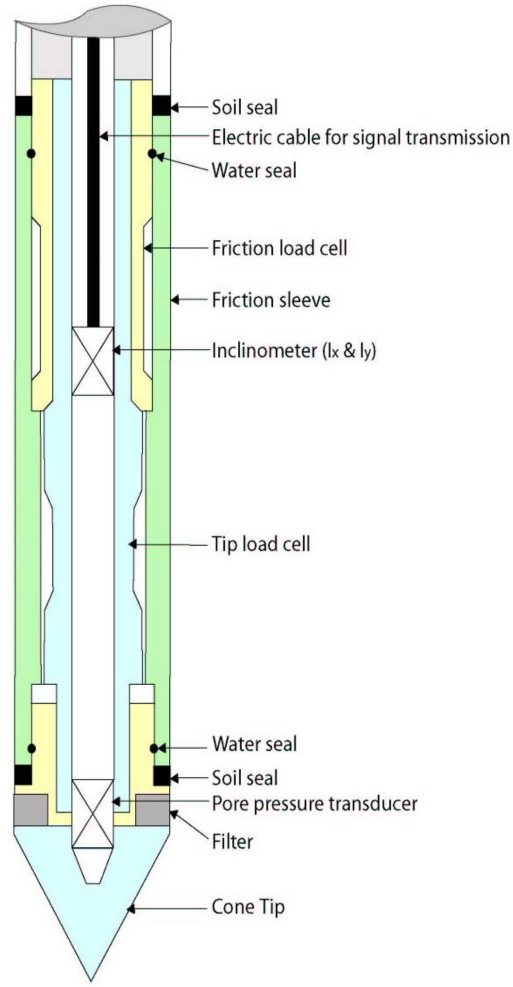


Figure CPT

Gregg 15cm^2 Standard Cone Specifications

Dimensions	
Cone base area	15 cm^2
Sleeve surface area	225 cm^2
Cone net area ratio	0.80
Specifications	
Cone load cell	
Full scale range	180 kN (20 tons)
Overload capacity	150%
Full scale tip stress	120 MPa (1,200 tsf)
Repeatability	120 kPa (1.2 tsf)
Sleeve load cell	
Full scale range	31 kN (3.5 tons)
Overload capacity	150%
Full scale sleeve stress	1,400 kPa (15 tsf)
Repeatability	1.4 kPa (0.015 tsf)
Pore pressure transducer	
Full scale range	7,000 kPa (1,000 psi)
Overload capacity	150%
Repeatability	7 kPa (1 psi)

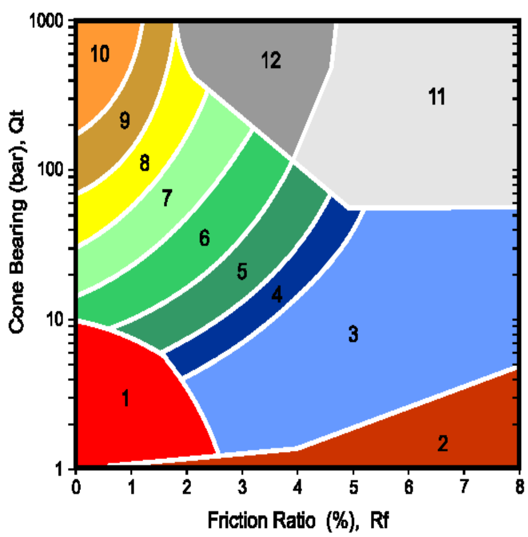
Note: The repeatability during field use will depend somewhat on ground conditions, abrasion, maintenance and zero load stability.

Cone Penetration Test Data & Interpretation

The Cone Penetration Test (CPT) data collected are presented in graphical and electronic form in the report. The plots include interpreted Soil Behavior Type (SBT) based on the charts described by Robertson (1990). Typical plots display SBT based on the non-normalized charts of Robertson et al (1986). For CPT soundings deeper than 30m, we recommend the use of the normalized charts of Robertson (1990) which can be displayed as SBTn, upon request. The report also includes spreadsheet output of computer calculations of basic interpretation in terms of SBT and SBTn and various geotechnical parameters using current published correlations based on the comprehensive review by Lunne, Robertson and Powell (1997), as well as recent updates by Professor Robertson (Guide to Cone Penetration Testing, 2015). The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg Drilling & Testing Inc. does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software. Some interpretation methods require input of the groundwater level to calculate vertical effective stress. An estimate of the in-situ groundwater level has been made based on field observations and/or CPT results, but should be verified by the user.

A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface.

Note that it is not always possible to clearly identify a soil type based solely on q_t, f_s, and u_2. In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the correct soil behavior type.



ZONE		SBT
1		Sensitive, fine grained
2		Organic materials
3		Clay
4		Silty clay to clay
5		Clayey silt to silty clay
6		Sandy silt to clayey silt
7		Silty sand to sandy silt
8		Sand to silty sand
9		Sand
10		Gravely sand to sand
11		Very stiff fine grained*
12		Sand to clayey sand*

*over consolidated or cemented

Figure SBT (After Robertson et al., 1986) – Note: Colors may vary slightly compared to plots

Cone Penetration Test (CPT) Interpretation

Gregg uses a proprietary CPT interpretation and plotting software. The software takes the CPT data and performs basic interpretation in terms of soil behavior type (SBT) and various geotechnical parameters using current published empirical correlations based on the comprehensive review by Lunne, Robertson and Powell (1997). The interpretation is presented in tabular format using MS Excel. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software.

The following provides a summary of the methods used for the interpretation. Many of the empirical correlations to estimate geotechnical parameters have constants that have a range of values depending on soil type, geologic origin and other factors. The software uses 'default' values that have been selected to provide, in general, conservatively low estimates of the various geotechnical parameters.

Input:

1 Units for display (Imperial or metric) (atm. pressure, p_a = 0.96 tsf or 0.1 MPa)
2 Depth interval to average results (ft or m). Data are collected at either 0.02 or 0.05m and can be averaged every 1, 3 or 5 intervals.
3 Elevation of ground surface (ft or m)
4 Depth to water table, z_w (ft or m) – input required
5 Net area ratio for cone, a (default to 0.80)
6 Relative Density constant, C_{Dr} (default to 350)
7 Young's modulus number for sands, α (default to 5)
8 Small strain shear modulus number
   a. for sands, S_G (default to 180 for SBT_n 5, 6, 7)
   b. for clays, C_G (default to 50 for SBT_n 1, 2, 3 & 4)
9 Undrained shear strength cone factor for clays, N_{kt} (default to 15)
10 Over Consolidation ratio number, k_{ocr} (default to 0.3)
11 Unit weight of water, (default to γ_w = 62.4 lb/ft^3 or 9.81 kN/m^3)

Column

1 Depth, z, (m) – CPT data is collected in meters
2 Depth (ft)
3 Cone resistance, q_c (tsf or MPa)
4 Sleeve resistance, f_s (tsf or MPa)
5 Penetration pore pressure, u (psi or MPa), measured behind the cone (i.e. u_2)
6 Other – any additional data
7 Total cone resistance, q_t (tsf or MPa) $q_t = q_c + u\,(1-a)$

8	Friction Ratio, R_f (%)	$R_f = (f_s/q_t) \times 100\%$
9	Soil Behavior Type (non-normalized), SBT	see note
10	Unit weight, γ (pcf or kN/m^3)	based on SBT, see note
11	Total overburden stress, σ_v (tsf)	$\sigma_{vo} = \sigma\ z$
12	In-situ pore pressure, u_o (tsf)	$u_o = \gamma_w\ (z - z_w)$
13	Effective overburden stress, σ'_{vo} (tsf)	$\sigma'_{vo} = \sigma_{vo} - u_o$
14	Normalized cone resistance, Q_{t1}	$Q_{t1} = (q_t - \sigma_{vo}) / \sigma'_{vo}$
15	Normalized friction ratio, F_r (%)	$F_r = f_s / (q_t - \sigma_{vo}) \times 100\%$
16	Normalized Pore Pressure ratio, B_q	$B_q = u - u_o / (q_t - \sigma_{vo})$
17	Soil Behavior Type (normalized), SBT_n	see note
18	SBT_n Index, I_c	see note
19	Normalized Cone resistance, Q_{tn} (n varies with I_c)	see note
20	Estimated permeability, k_{SBT} (cm/sec or ft/sec)	see note
21	Equivalent SPT N_{60}, blows/ft	see note
22	Equivalent SPT $(N_1)_{60}$ blows/ft	see note
23	Estimated Relative Density, D_r, (%)	see note
24	Estimated Friction Angle, ϕ', (degrees)	see note
25	Estimated Young's modulus, E_s (tsf)	see note
26	Estimated small strain Shear modulus, Go (tsf)	see note
27	Estimated Undrained shear strength, s_u (tsf)	see note
28	Estimated Undrained strength ratio	s_u/σ_v'
29	Estimated Over Consolidation ratio, OCR	see note

Notes:

1 Soil Behavior Type (non-normalized), SBT (Lunne et al., 1997 and table below)

2 Unit weight, γ either constant at 119 pcf or based on Non-normalized SBT (Lunne et al., 1997 and table below)

3 Soil Behavior Type (Normalized), SBT_n Lunne et al. (1997)

4 SBT_n Index, I_c $I_c = ((3.47 - \log Q_{t1})^2 + (\log F_r + 1.22)^2)^{0.5}$

5 Normalized Cone resistance, Q_{tn} (n varies with Ic)

$Q_{tn} = ((q_t - \sigma_{vo})/pa)\ (pa/(\sigma'_{vo})^n$ and recalculate I_c, then iterate:

When $I_c < 1.64$, n = 0.5 (clean sand)
When $I_c > 3.30$, n = 1.0 (clays)
When $1.64 < I_c < 3.30$, $n = (I_c - 1.64)0.3 + 0.5$
Iterate until the change in n, $\Delta n < 0.01$

6 Estimated permeability, k_{SBT} based on Normalized SBT_n (Lunne et al., 1997 and table below)

7 Equivalent SPT N_{60}, blows/ft Lunne et al. (1997)

$$\frac{(q_t/p_a)}{N_{60}} = 8.5\left(1 - \frac{I_c}{4.6}\right)$$

8 Equivalent SPT $(N_1)_{60}$ blows/ft $(N_1)_{60} = N_{60}\,C_N,$
where $C_N = (pa/\sigma'_{vo})^{0.5}$

9 Relative Density, D_r, (%) $D_r^2 = Q_{tn} / C_{Dr}$
Only SBT_n 5, 6, 7 & 8 *Show 'N/A' in zones 1, 2, 3, 4 & 9*

10 Friction Angle, ϕ', (degrees) $\tan\phi' = \frac{1}{2.68}\left[\log\left(\frac{q_c}{\sigma'_{vo}}\right) + 0.29\right]$

Only SBT_n 5, 6, 7 & 8 *Show'N/A' in zones 1, 2, 3, 4 & 9*

11 Young's modulus, E_s $E_s = \alpha\, q_t$
Only SBT_n 5, 6, 7 & 8 *Show 'N/A' in zones 1, 2, 3, 4 & 9*

12 Small strain shear modulus, Go

a. $G_o = S_G\,(q_t\ \sigma'_{vo}\ pa)^{1/3}$ *For SBT_n 5, 6, 7*

b. $G_o = C_G\, q_t$ *For SBT_n 1, 2, 3& 4*

Show 'N/A' in zones 8 & 9

13 Undrained shear strength, s_u $s_u = (q_t - \sigma_{vo}) / N_{kt}$
Only SBT_n 1, 2, 3, 4 & 9 *Show 'N/A' in zones 5, 6, 7 & 8*

14 Over Consolidation ratio, OCR $OCR = k_{ocr}\, Q_{t1}$
Only SBT_n 1, 2, 3, 4 & 9 *Show 'N/A' in zones 5, 6, 7 & 8*

The following updated and simplified SBT descriptions have been used in the software:

SBT Zones		**SBT_n Zones**	
1	sensitive fine grained	1	sensitive fine grained
2	organic soil	2	organic soil
3	clay	3	clay
4	clay & silty clay	4	clay & silty clay
5	clay & silty clay		
6	sandy silt & clayey silt		

7	silty sand & sandy silt	5	silty sand & sandy silt
8	sand & silty sand	6	sand & silty sand
9	sand		
10	sand	7	sand
11	very dense/stiff soil*	8	very dense/stiff soil*
12	very dense/stiff soil*	9	very dense/stiff soil*

*heavily overconsolidated and/or cemented

Track when soils fall with zones of same description and print that description (i.e. if soils fall only within SBT zones 4 & 5, print 'clays & silty clays')

Estimated Permeability (see Lunne et al., 1997)

SBT_n	Permeability (ft/sec)	(m/sec)
1	$3x\ 10^{-8}$	$1x\ 10^{-8}$
2	$3x\ 10^{-7}$	$1x\ 10^{-7}$
3	$1x\ 10^{-9}$	$3x\ 10^{-10}$
4	$3x\ 10^{-8}$	$1x\ 10^{-8}$
5	$3x\ 10^{-6}$	$1x\ 10^{-6}$
6	$3x\ 10^{-4}$	$1x\ 10^{-4}$
7	$3x\ 10^{-2}$	$1x\ 10^{-2}$
8	$3x\ 10^{-6}$	$1x\ 10^{-6}$
9	$1x\ 10^{-8}$	$3x\ 10^{-9}$

Estimated Unit Weight (see Lunne et al., 1997)

SBT	Approximate Unit Weight (lb/ft^3)	(kN/m^3)
1	111.4	17.5
2	79.6	12.5
3	111.4	17.5
4	114.6	18.0
5	114.6	18.0
6	114.6	18.0
7	117.8	18.5
8	120.9	19.0
9	124.1	19.5
10	127.3	20.0
11	130.5	20.5
12	120.9	19.0

Pore Pressure Dissipation Tests (PPDT)

Pore Pressure Dissipation Tests (PPDT's) conducted at various intervals can be used to measure equilibrium water pressure (at the time of the CPT). If conditions are hydrostatic, the equilibrium water pressure can be used to determine the approximate depth of the ground water table. A PPDT is conducted when penetration is halted at specific intervals determined by the field representative. The variation of the penetration pore pressure (*u*) with time is measured behind the tip of the cone and recorded.

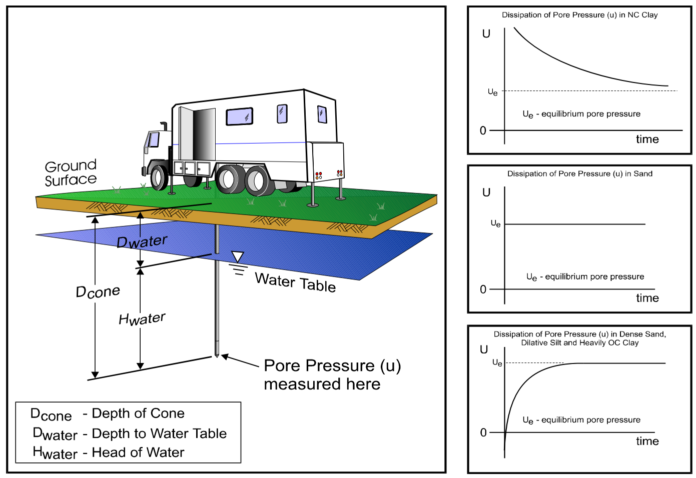
Pore pressure dissipation data can be interpreted to provide estimates of:

- Equilibrium piezometric pressure
- Phreatic Surface
- In situ horizontal coefficient of consolidation (c_h)
- In situ horizontal coefficient of permeability (k_h)

In order to correctly interpret the equilibrium piezometric pressure and/or the phreatic surface, the pore pressure must be monitored until it reaches equilibrium, *Figure PPDT*. This time is commonly referred to as t_{100}, the point at which 100% of the excess pore pressure has dissipated.

A complete reference on pore pressure dissipation tests is presented by Robertson et al. 1992 and Lunne et al. 1997.

A summary of the pore pressure dissipation tests are summarized in Table 1.



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

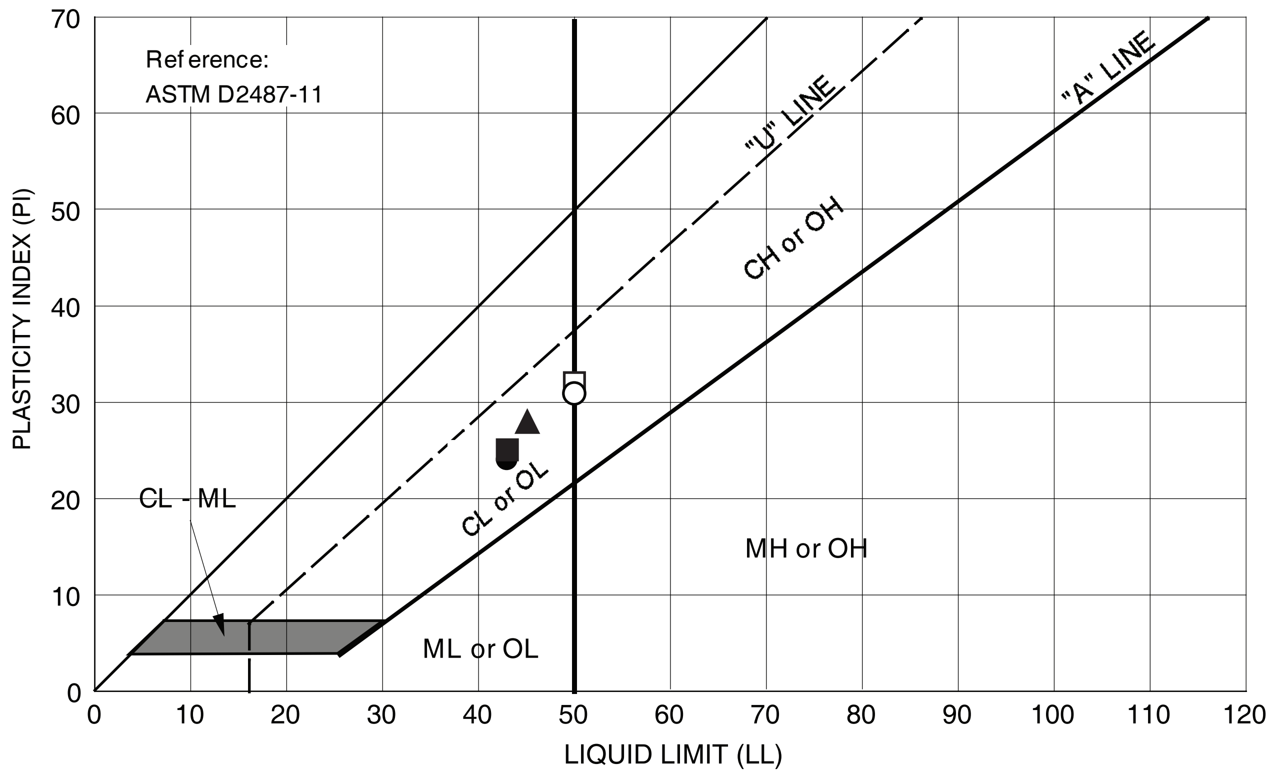
where $H_{water} = U_e$ (depth units)

Useful Conversion Factors: 1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

Figure PPDT

APPENDIX F

LABORATORY TEST RESULTS



Symbol	Source	Description and Classification	Natural M.C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
●	B-1 at 40 feet	GOUGE, yellow-brown to gray	12.0	43	24	--
■	B-2 at 3.5 feet	CLAY with SAND (CL), brown	14.2	43	25	--
▲	B-3 at 11 feet	CLAY with SAND (CL), yellow-brown with gray-brown mottling	24.4	45	28	--
○	DPT-2 at 1.5 feet	CLAY (CL/CH), olive-gray with red-brown and dark brown mottling	18.5	50	31	--
□	DPT-3 at 4.5 feet	CLAY with SAND (CL/CH), red-brown	17.6	50	32	--

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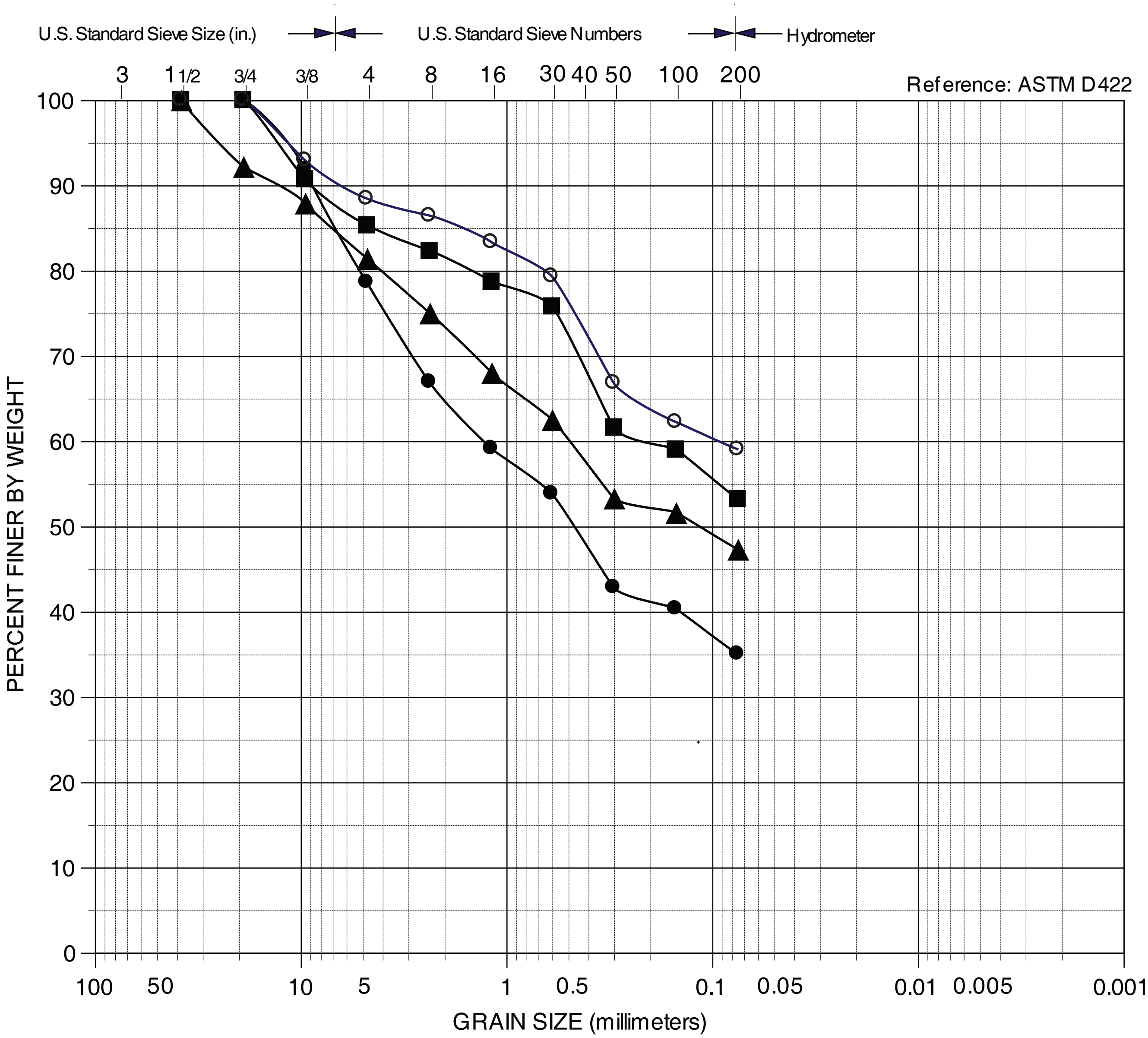
PLASTICITY CHART

Date 10/16/17 | Project No. 731706301 | Figure F-1



	% Gravel		%Sand			% Fines	
Sample	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

Symbol	Sample Source	Classification
●	B-1 at 7.5 feet	CLAYEY SAND with GRAVEL (CL), orange-brown
■	B-2 at 15 feet	CLAY with GRAVEL (CL), gray to yellow-brown
▲	B-3 at 15.5 feet	CLAYEY SAND with GRAVEL (SC), yellow-brown with dark brown mottling
○	DPT-2 at 3.5 feet	SANDY CLAY (CL), red-brown

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Berkeley, California

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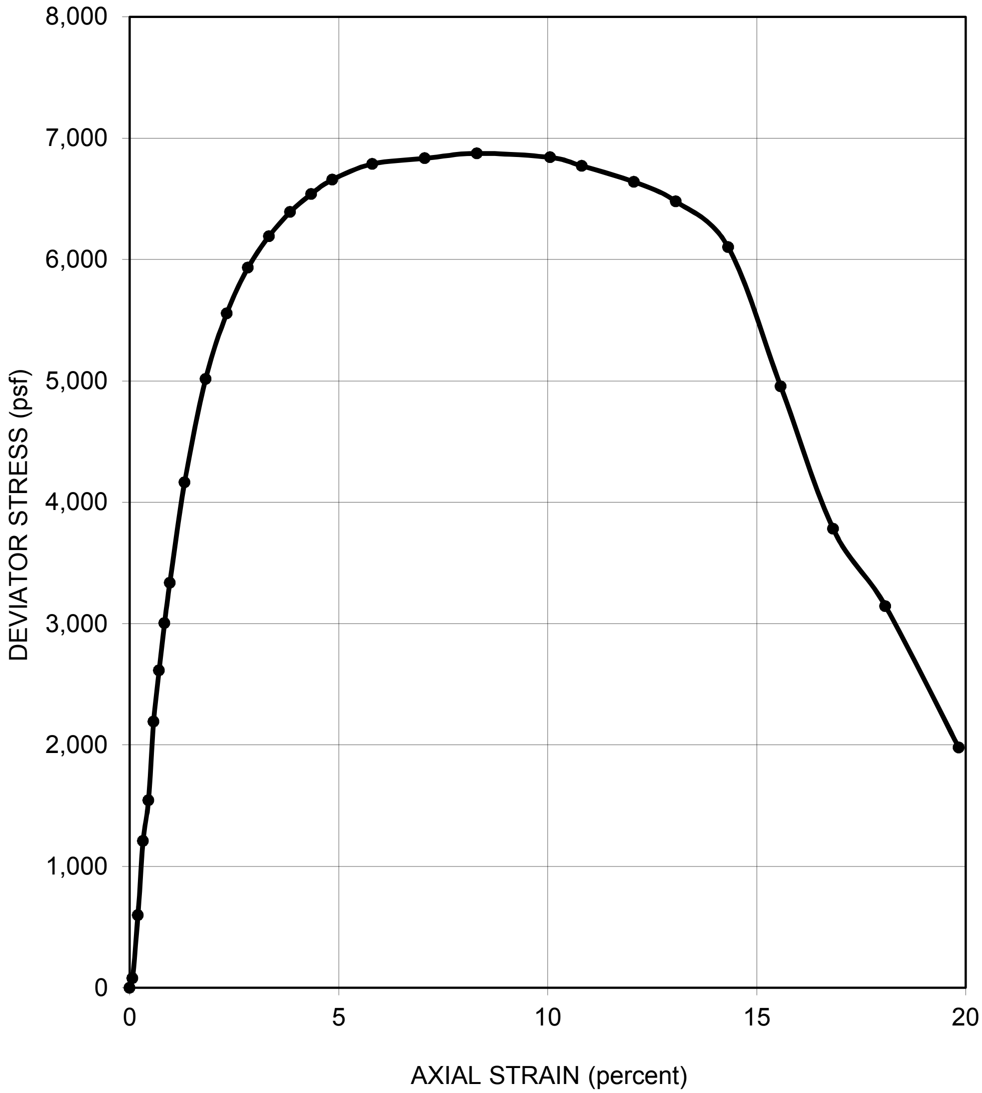
PARTICLE SIZE ANALYSIS

Date 10/16/17 | Project No. 731706301 | Figure F-2



SAMPLER TYPE	Sprague & Henwood		SHEAR STRENGTH	3,440	psf
DIAMETER (in.) 2.41	HEIGHT (in.) 5.52		STRAIN AT FAILURE	8.3	%
MOISTURE CONTENT	20.0	%	CONFINING PRESSURE	2,000	psf
DRY DENSITY	108	pcf	STRAIN RATE	0.75	% / min
DESCRIPTION	SANDY CLAY (CL), yellow-brown with gray-brown mottling		SOURCE	B-2 at 21 feet	

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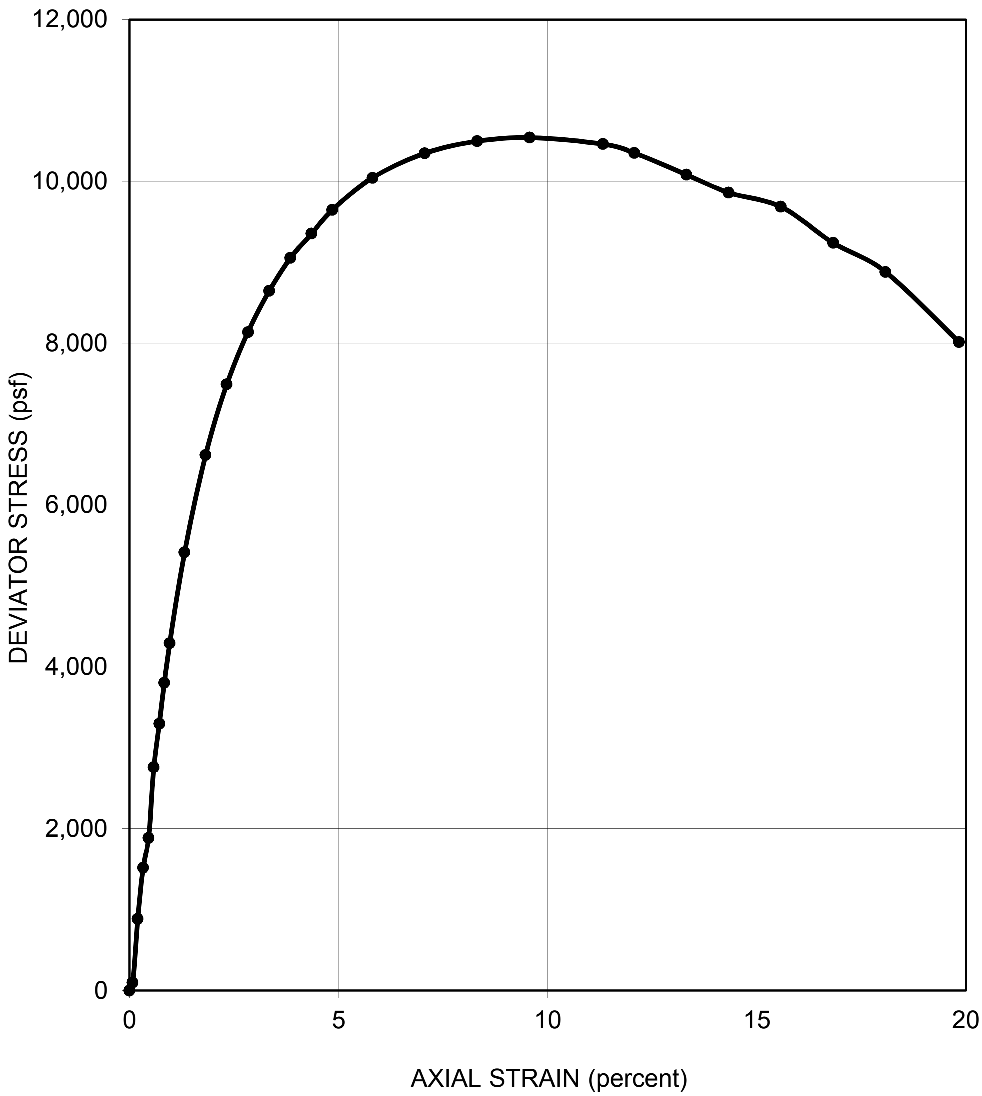
UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

Date 10/19/17 | Project No. 731706301 | Figure F-3



SAMPLER TYPE	Sprague & Henwood			SHEAR STRENGTH	5,270	psf
DIAMETER (in.)	2.41	HEIGHT (in.)	5.62	STRAIN AT FAILURE	9.6	%
MOISTURE CONTENT		16.5	%	CONFINING PRESSURE	2,300	psf
DRY DENSITY		114	pcf	STRAIN RATE	0.75	% / min
DESCRIPTION	CLAY with GRAVEL (CL), yellow-brown with gray-brown mottling			SOURCE	B-3 at 26 feet	

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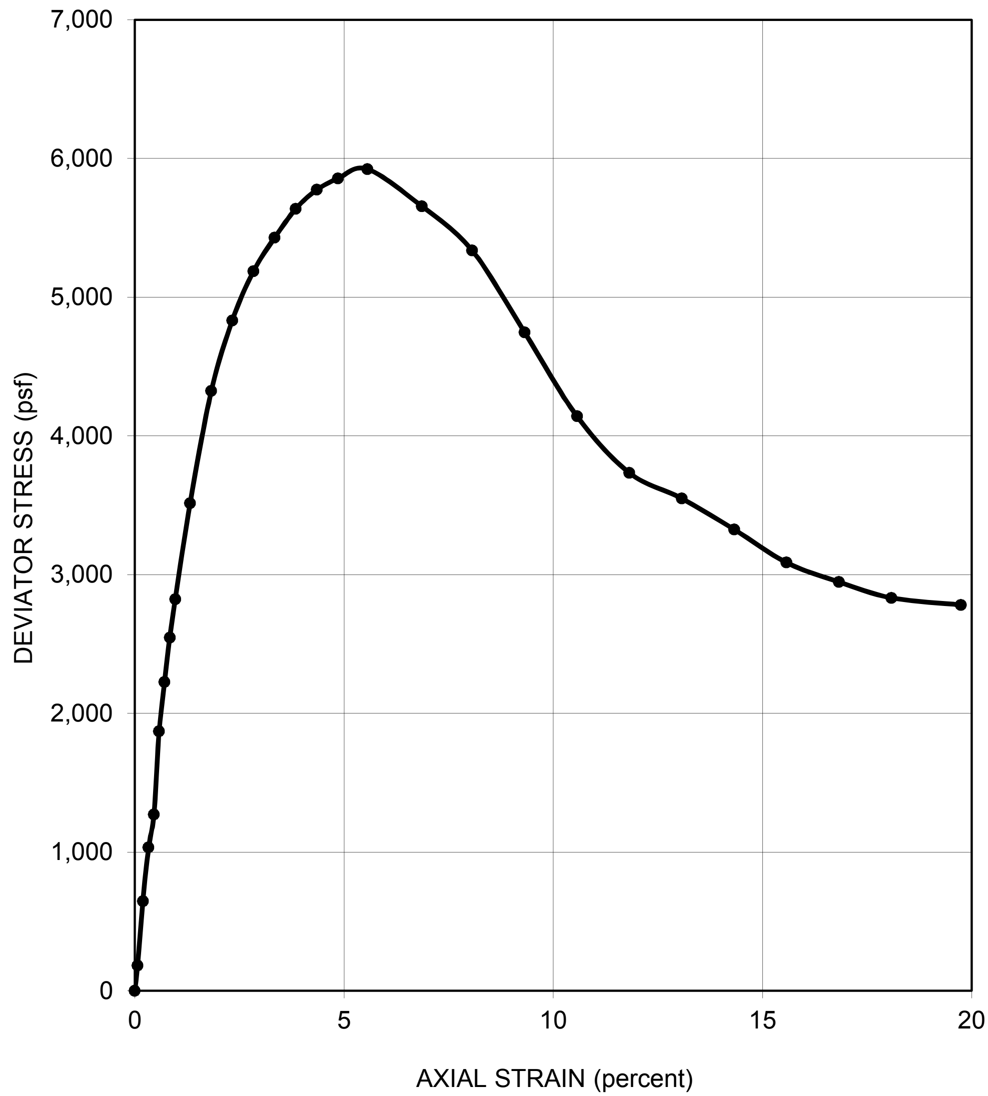
UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

Date 10/19/17 | Project No. 731706301 | Figure F-4



SAMPLER TYPE	Sprague & Henwood			SHEAR STRENGTH	2,960	psf
DIAMETER (in.)	2.41	HEIGHT (in.) 5.62		STRAIN AT FAILURE	5.6	%
MOISTURE CONTENT		16.6	%	CONFINING PRESSURE	2,700	psf
DRY DENSITY		115	pcf	STRAIN RATE	0.75	% / min
DESCRIPTION	CLAY with SAND (CL), yellow-brown				SOURCE	B-3 at 36 feet

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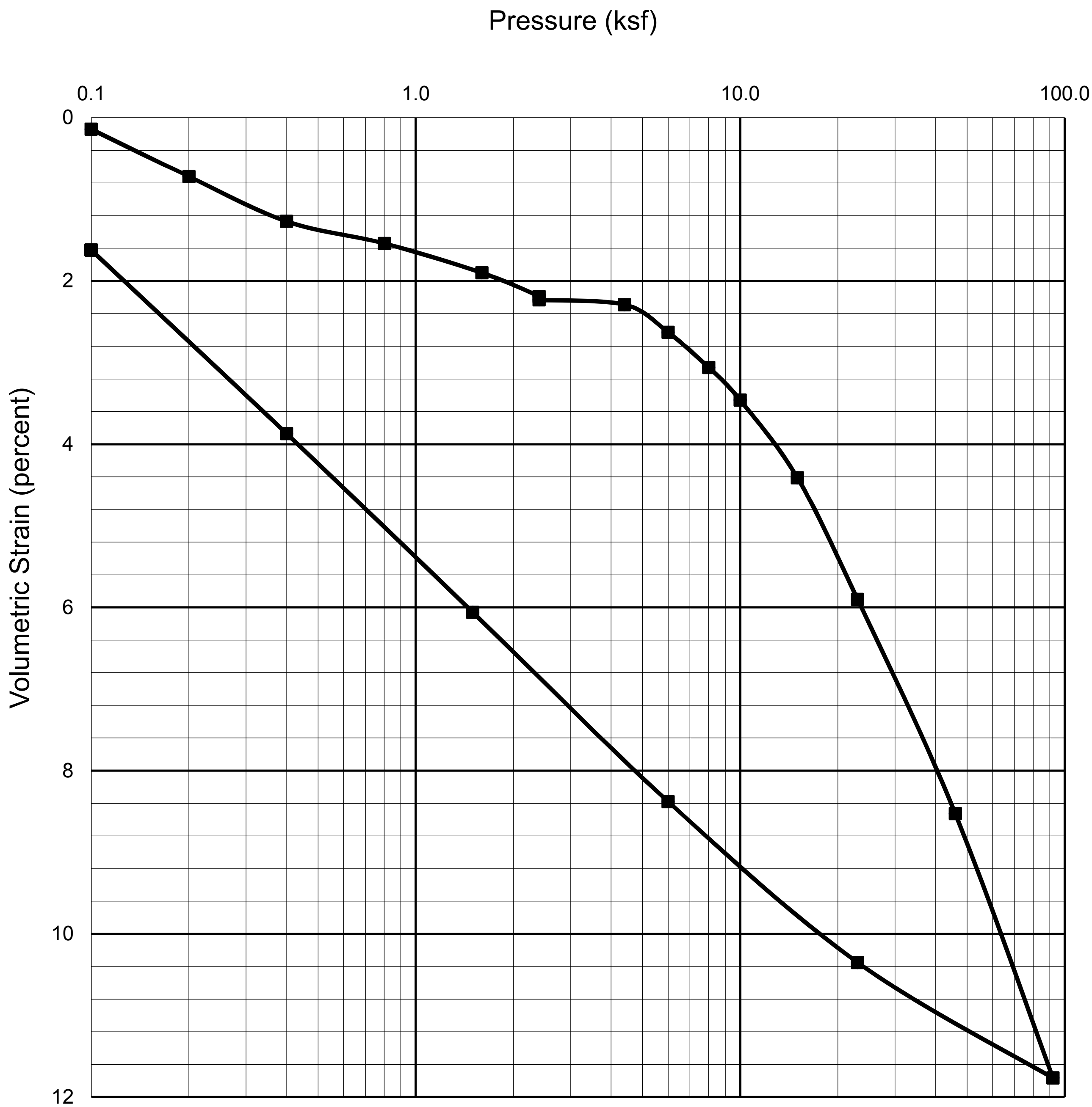
UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

Date 10/19/17 | Project No. 731706301 | Figure F-5



Sampler Type: Sprague & Henwood				Condition	Before Test			After Test		
Diameter (in)	2.42	Height (in)	1.00	Water Content	w_o	17.5	%	w_f	18.7	%
Overburden Pressure, p_o		3,300	psf	Void Ratio	e_o	0.53		e_f	0.50	
Preconsol. Pressure, p_c		10,000	psf	Saturation	S_o	90	%	S_f	100	%
Compression Ratio, $C_{\varepsilon c}$		0.10		Dry Density	γ_d	110	pcf	γ_d	112	pcf
LL	- -	PL	- -	PI	- -	G_s	2.70	(assumed)		
Classification	SANDY CLAY (CL), yellow-brown with gray-brown mottling					Source	B-2 at 26 feet			

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Berkeley, California

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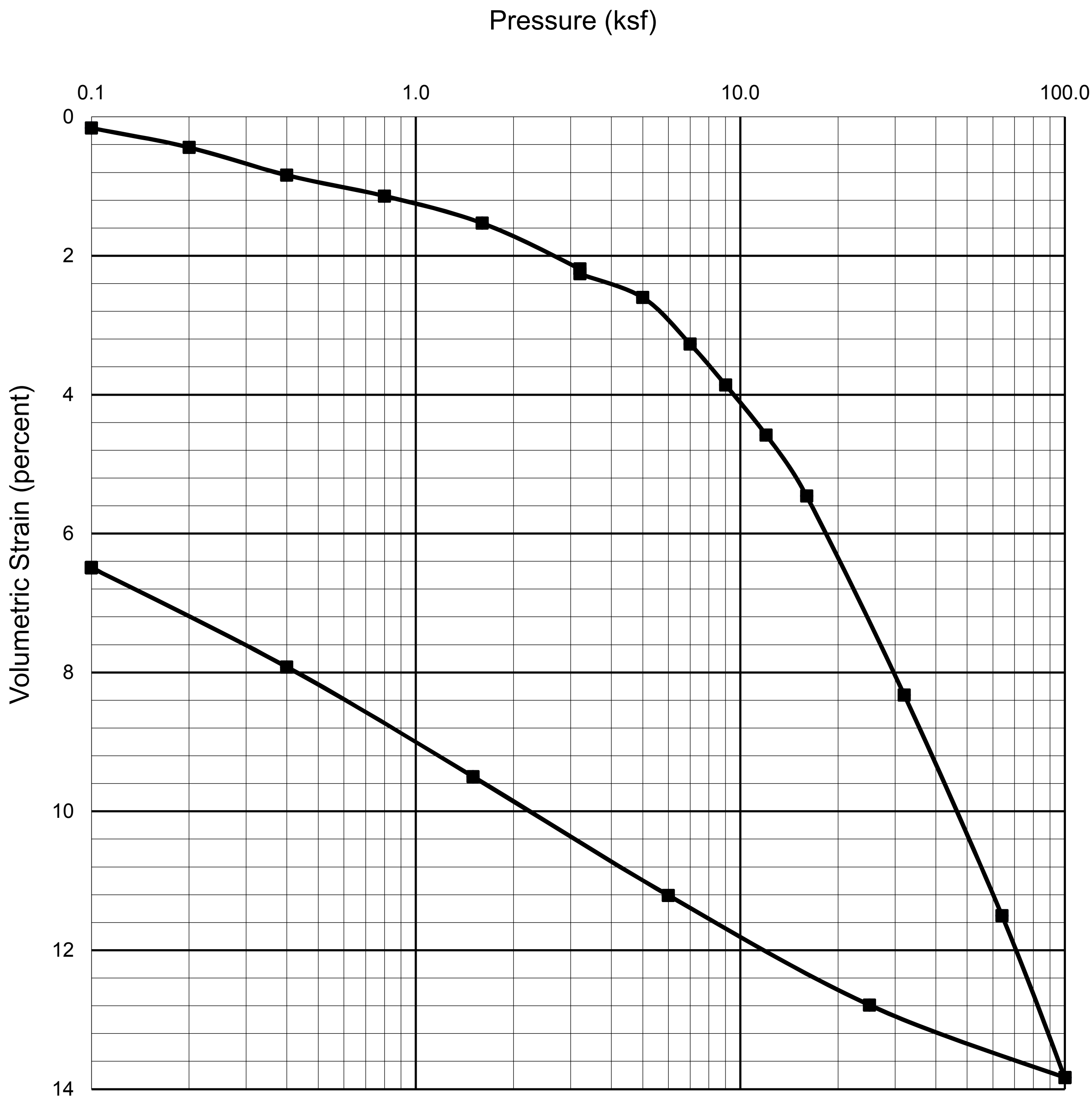
CONSOLIDATION TEST REPORT

Date 10/19/17 | Project No. 731706301 | Figure F-6



Sampler Type: Sprague & Henwood				Condition		Before Test		After Test	
Diameter (in)	2.42	Height (in)	1.00	Water Content	w_o	19.2 %		w_f	16.7 %
Overburden Pressure, p_o	2,700 psf			Void Ratio	e_o	0.55		e_f	0.45
Preconsol. Pressure, p_c	10,000 psf			Saturation	S_o	94 %		S_f	100 %
Compression Ratio, $C_{\varepsilon c}$	0.12			Dry Density	γ_d	109 pcf		γ_d	116 pcf
LL - -		PL - -		PI - -		G_s	2.70	(assumed)	
Classification	CLAYEY SAND with GRAVEL (SC), yellow-brown with gray-brown mottling					Source	B-3 at 21 feet		

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Berkeley, California

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CONSOLIDATION TEST REPORT

Date 10/19/17 | Project No. 731706301 | Figure F-7

APPENDIX G

CORROSIVITY ANALYSIS WITH BRIEF EVALUATION

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

12 October, 2017

Job No. 1709208
Cust. No. 10727

Ms. Sarah Boudreau
Langan Treadwell Rollo
555 Montgomery Street, Suite 1300
San Francisco, CA 94111

Subject: Project No.: 731706301.700.031
Project Name: UC Berkeley Upper Hearst
Corrosivity Analysis – ASTM Methods

Dear Ms. Boudreau:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on September 29, 2017. Based on the analytical results, this brief corrosivity evaluation is enclosed for your consideration.

Based upon the resistivity measurements, the sample is classified as "corrosive" and Sample No.002 is classified as "corrosive". All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentration is none detected with a detection limit of 15 mg/kg.

The sulfate ion concentrations is 240 mg/kg and are determined to be sufficient to potentially be detrimental to reinforced concrete structures and cement mortar-coated steel at these locations. Therefore, concrete that comes into contact with this soil should use sulfate resistant cement such as Type II, with a maximum water-to-cement ratio of 0.55.

The pH of the soil is 7.98 which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potential is 350-mV which is indicative of potentially "slightly corrosive" soils resulting from anaerobic soil conditions.

This corrosivity evaluation is based on general corrosion engineering standards and is non-specific in nature. For specific long-term corrosion control design recommendations or consultation, please call *JDH Corrosion Consultants, Inc. at (925) 927-6630.*

We appreciate the opportunity of working with you on this project. If you have any questions, or if you require further information, please do not hesitate to contact us.

Very truly yours,
CERCO ANALYTICAL, INC.

J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

Client: Langan Treadwell Rollo
Client's Project No.: 731706301.700.031
Client's Project Name: UC Berkeley Upper Hearst
Date Sampled: Not Indicated
Date Received: 29-Sep-17
Matrix: Soil
Authorization: Chain of Custody

Date of Report: 12-Oct-2017

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Conductivity (umhos/cm)*	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
1709208-001	B-2 2 @ 3.5'	350	7.98	-	660	-	N.D.	240

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	10	-	50	15	15
Date Analyzed:	11-Oct-2017	11-Oct-2017	-	11-Oct-2017	-	11-Oct-2017	11-Oct-2017

* Results Reported on "As Received" Basis

N.D. - None Detected

Cheryl McMillen

Cheryl McMillen
Laboratory Director

Quality Control Summary - All laboratory quality control parameters were found to be within established limits

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 **462 2771** Fax. 925 **462 2775**
www.cercoanalytical.com

2 February, 2018

Job No. 1801231
Cust. No. 10727

Ms. Sarah Boudreau
Langan
555 Montgomery Street, Suite 1300
San Francisco, CA 94111

Subject: Project No.: 731706301.700.031
Project Name: UC Berkeley Upper Hearst
Corrosivity Analysis – ASTM Methods

Dear Ms. Boudreau:

Pursuant to your request, CERCO Analytical has analyzed the soil sample submitted on January 29, 2018. Based on the analytical results, this brief corrosivity evaluation is enclosed for your consideration.

Based upon the resistivity measurement, the sample is classified as "corrosive". All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentration is none detected with a detection limit of 15 mg/kg.

The sulfate ion concentration is 26 mg/kg and is determined to be insufficient to damage reinforced concrete structures and cement mortar-coated steel at these locations.

The pH of the soil is 7.49, which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potential is 440-mV which is indicative of aerobic soil conditions.

This corrosivity evaluation is based on general corrosion engineering standards and is non-specific in nature. For specific long-term corrosion control design recommendations or consultation, please call *JDH Corrosion Consultants, Inc. at (925) 927-6630.*

We appreciate the opportunity of working with you on this project. If you have any questions, or if you require further information, please do not hesitate to contact us.

Very truly yours,
CERCO ANALYTICAL, INC.

J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

Client: Langan
Client's Project No.: 731706301.700.031
Client's Project Name: UC Berkeley Upper Hearst
Date Sampled: Not Indicated
Date Received: 29-Jan-18
Matrix: Soil
Authorization: Chain of Custody

Date of Report: 2-Feb-2018

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Conductivity (umhos/cm)*	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
1801231-001	DPT-1 1 @ 1'-4'	440	7.49	-	1,100	-	N.D.	26

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	10	-	50	15	15
Date Analyzed:	1-Feb-2018	1-Feb-2018	-	1-Feb-2018	-	1-Feb-2018	1-Feb-2018

* Results Reported on "As Received" Basis

N.D. - None Detected

Cheryl McMillen
Laboratory Director

Quality Control Summary - All laboratory quality control parameters were found to be within established limits

APPENDIX H

CERTIFIED ANALYTICAL REPORTS

McCampbell Analytical, Inc.

"When Quality Counts"

Analytical Report

WorkOrder: 1709793

Report Created for: Langan

555 Montgomery St., Suite 1300
San Francisco, CA 94111

Project Contact: Peter Cusack
Project P.O.:
Project Name: 731706301; UC Berkeley GSPP & Housing

Project Received: 09/19/2017

Analytical Report reviewed & approved for release on 09/27/2017 by:

Angela Rydelius,
Laboratory Manager

The report shall not be reproduced except in full, without the written approval of the laboratory. The analytical results relate only to the items tested. Results reported conform to the most current NELAP standards, where applicable, unless otherwise stated in the case narrative.

NELAP ACCREDITED TNI LABORATORY

1534 Willow Pass Road, Pittsburg, CA 94565-1701
Toll Free Telephone: (877) 252-9262 / Fax: (925) 252-9269
http://www.mccampbell.com / E-mail: main@mccampbell.com

Glossary of Terms & Qualifier Definitions

Client: Langan
Project: 731706301; UC Berkeley GSPP & Housing
WorkOrder: 1709793

Glossary Abbreviation

%D	Serial Dilution Percent Difference
95% Interval	95% Confident Interval
DF	Dilution Factor
DI WET	(DISTLC) Waste Extraction Test using DI water
DISS	Dissolved (direct analysis of 0.45 µm filtered and acidified water sample)
DLT	Dilution Test (Serial Dilution)
DUP	Duplicate
EDL	Estimated Detection Limit
ERS	External reference sample. Second source calibration verification.
ITEF	International Toxicity Equivalence Factor
LCS	Laboratory Control Sample
MB	Method Blank
MB % Rec	% Recovery of Surrogate in Method Blank, if applicable
MDL	Method Detection Limit
ML	Minimum Level of Quantitation
MS	Matrix Spike
MSD	Matrix Spike Duplicate
N/A	Not Applicable
ND	Not detected at or above the indicated MDL or RL
NR	Data Not Reported due to matrix interference or insufficient sample amount.
PDS	Post Digestion Spike
PDSD	Post Digestion Spike Duplicate
PF	Prep Factor
RD	Relative Difference
RL	Reporting Limit (The RL is the lowest calibration standard in a multipoint calibration.)
RPD	Relative Percent Deviation
RRT	Relative Retention Time
SPK Val	Spike Value
SPKRef Val	Spike Reference Value
SPLP	Synthetic Precipitation Leachate Procedure
ST	Sorbent Tube
TCLP	Toxicity Characteristic Leachate Procedure
TEQ	Toxicity Equivalents
WET (STLC)	Waste Extraction Test (Soluble Threshold Limit Concentration)

Glossary of Terms & Qualifier Definitions

Client: Langan
Project: 731706301; UC Berkeley GSPP & Housing
WorkOrder: 1709793

Analytical Qualifiers

S	Surrogate spike recovery outside accepted recovery limits
a3	Sample diluted due to high organic content.
a4	Reporting limits raised due to the sample's matrix prohibiting a full volume extraction.
c2	Surrogate recovery outside of the control limits due to matrix interference.
d7	Strongly aged gasoline or diesel range compounds are significant in the TPH(g) chromatogram
e2	Diesel range compounds are significant; no recognizable pattern
e7	Oil range compounds are significant
h4	Sulfuric acid permanganate (EPA 3665) cleanup
k10	CARB 435 Exception 1 - No asbestos detected

Quality Control Qualifiers

F2	LCS/LCSD recovery and/or RPD is out of acceptance criteria.
F3	The surrogate standard recovery and/or RPD is outside of acceptance limits.

McCampbell Analytical, Inc.
"When Quality Counts"

1534 Willow Pass Road, Pittsburg, CA 94565-1701
Toll Free Telephone: (877) 252-9262 / Fax: (925) 252-9269
http://www.mccampbell.com / E-mail: main@mccampbell.com

Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/19/17	**Analytical Method:**	SW8082
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Polychlorinated Biphenyls (PCBs) Aroclors

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	**1709793-001A**	**Soil**	**09/15/2017 15:20**	**GC22 09191758.D**	**145782**

Analytes	Result	RL	DF	Date Analyzed
Aroclor1016	ND	1.0	20	09/21/2017 02:52
Aroclor1221	ND	1.0	20	09/21/2017 02:52
Aroclor1232	ND	1.0	20	09/21/2017 02:52
Aroclor1242	ND	1.0	20	09/21/2017 02:52
Aroclor1248	ND	1.0	20	09/21/2017 02:52
Aroclor1254	ND	1.0	20	09/21/2017 02:52
Aroclor1260	ND	1.0	20	09/21/2017 02:52
PCBs, total	ND	1.0	20	09/21/2017 02:52

Surrogates	REC (%)	Limits	
Decachlorobiphenyl	106	70-130	09/21/2017 02:52

Analyst(s): CK   Analytical Comments: h4

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-3.0	**1709793-006A**	**Soil**	**09/15/2017 07:52**	**GC22 09221772.D**	**145782**

Analytes	Result	RL	DF	Date Analyzed
Aroclor1016	ND	0.050	1	09/24/2017 07:43
Aroclor1221	ND	0.050	1	09/24/2017 07:43
Aroclor1232	ND	0.050	1	09/24/2017 07:43
Aroclor1242	ND	0.050	1	09/24/2017 07:43
Aroclor1248	ND	0.050	1	09/24/2017 07:43
Aroclor1254	ND	0.050	1	09/24/2017 07:43
Aroclor1260	ND	0.050	1	09/24/2017 07:43
PCBs, total	ND	0.050	1	09/24/2017 07:43

Surrogates	REC (%)	Limits	
Decachlorobiphenyl	118	70-130	09/24/2017 07:43

Analyst(s): SS   Analytical Comments: h4

1534 Willow Pass Road, Pittsburg, CA 94565-1701
Toll Free Telephone: (877) 252-9262 / Fax: (925) 252-9269
http://www.mccampbell.com / E-mail: main@mccampbell.com

Analytical Report

Client: Langan
Date Received: 9/19/17 16:30
Date Prepared: 9/19/17-9/25/17
Project: 731706301; UC Berkeley GSPP & Housing

WorkOrder: 1709793
Extraction Method: SW5030B
Analytical Method: SW8260B
Unit: mg/kg

Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	1709793-001A	Soil	09/15/2017 15:20	GC38 09251713.D	146037

Analytes	Result	RL	DF	Date Analyzed
Acetone	ND	0.10	1	09/25/2017 15:07
tert-Amyl methyl ether (TAME)	ND	0.0050	1	09/25/2017 15:07
Benzene	ND	0.0050	1	09/25/2017 15:07
Bromobenzene	ND	0.0050	1	09/25/2017 15:07
Bromochloromethane	ND	0.0050	1	09/25/2017 15:07
Bromodichloromethane	ND	0.0050	1	09/25/2017 15:07
Bromoform	ND	0.0050	1	09/25/2017 15:07
Bromomethane	ND	0.0050	1	09/25/2017 15:07
2-Butanone (MEK)	ND	0.020	1	09/25/2017 15:07
t-Butyl alcohol (TBA)	ND	0.050	1	09/25/2017 15:07
n-Butyl benzene	ND	0.0050	1	09/25/2017 15:07
sec-Butyl benzene	ND	0.0050	1	09/25/2017 15:07
tert-Butyl benzene	ND	0.0050	1	09/25/2017 15:07
Carbon Disulfide	ND	0.0050	1	09/25/2017 15:07
Carbon Tetrachloride	ND	0.0050	1	09/25/2017 15:07
Chlorobenzene	ND	0.0050	1	09/25/2017 15:07
Chloroethane	ND	0.0050	1	09/25/2017 15:07
Chloroform	ND	0.0050	1	09/25/2017 15:07
Chloromethane	ND	0.0050	1	09/25/2017 15:07
2-Chlorotoluene	ND	0.0050	1	09/25/2017 15:07
4-Chlorotoluene	ND	0.0050	1	09/25/2017 15:07
Dibromochloromethane	ND	0.0050	1	09/25/2017 15:07
1,2-Dibromo-3-chloropropane	ND	0.0040	1	09/25/2017 15:07
1,2-Dibromoethane (EDB)	ND	0.0040	1	09/25/2017 15:07
Dibromomethane	ND	0.0050	1	09/25/2017 15:07
1,2-Dichlorobenzene	ND	0.0050	1	09/25/2017 15:07
1,3-Dichlorobenzene	ND	0.0050	1	09/25/2017 15:07
1,4-Dichlorobenzene	ND	0.0050	1	09/25/2017 15:07
Dichlorodifluoromethane	ND	0.0050	1	09/25/2017 15:07
1,1-Dichloroethane	ND	0.0050	1	09/25/2017 15:07
1,2-Dichloroethane (1,2-DCA)	ND	0.0040	1	09/25/2017 15:07
1,1-Dichloroethene	ND	0.0050	1	09/25/2017 15:07
cis-1,2-Dichloroethene	ND	0.0050	1	09/25/2017 15:07
trans-1,2-Dichloroethene	ND	0.0050	1	09/25/2017 15:07
1,2-Dichloropropane	ND	0.0050	1	09/25/2017 15:07
1,3-Dichloropropane	ND	0.0050	1	09/25/2017 15:07
2,2-Dichloropropane	ND	0.0050	1	09/25/2017 15:07

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Toll Free Telephone: (877) 252-9262 / Fax: (925) 252-9269
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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW5030B
Date Prepared:	9/19/17-9/25/17	**Analytical Method:**	SW8260B
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	**1709793-001A**	**Soil**	**09/15/2017 15:20**	**GC38 09251713.D**	**146037**

Analytes	Result	RL	DF	Date Analyzed
1,1-Dichloropropene	ND	0.0050	1	09/25/2017 15:07
cis-1,3-Dichloropropene	ND	0.0050	1	09/25/2017 15:07
trans-1,3-Dichloropropene	ND	0.0050	1	09/25/2017 15:07
Diisopropyl ether (DIPE)	ND	0.0050	1	09/25/2017 15:07
Ethylbenzene	ND	0.0050	1	09/25/2017 15:07
Ethyl tert-butyl ether (ETBE)	ND	0.0050	1	09/25/2017 15:07
Freon 113	ND	0.0050	1	09/25/2017 15:07
Hexachlorobutadiene	ND	0.0050	1	09/25/2017 15:07
Hexachloroethane	ND	0.0050	1	09/25/2017 15:07
2-Hexanone	ND	0.0050	1	09/25/2017 15:07
Isopropylbenzene	ND	0.0050	1	09/25/2017 15:07
4-Isopropyl toluene	ND	0.0050	1	09/25/2017 15:07
Methyl-t-butyl ether (MTBE)	ND	0.0050	1	09/25/2017 15:07
Methylene chloride	ND	0.0050	1	09/25/2017 15:07
4-Methyl-2-pentanone (MIBK)	ND	0.0050	1	09/25/2017 15:07
Naphthalene	**0.0073**	0.0050	1	09/25/2017 15:07
n-Propyl benzene	ND	0.0050	1	09/25/2017 15:07
Styrene	ND	0.0050	1	09/25/2017 15:07
1,1,1,2-Tetrachloroethane	ND	0.0050	1	09/25/2017 15:07
1,1,2,2-Tetrachloroethane	ND	0.0050	1	09/25/2017 15:07
Tetrachloroethene	ND	0.0050	1	09/25/2017 15:07
Toluene	ND	0.0050	1	09/25/2017 15:07
1,2,3-Trichlorobenzene	ND	0.0050	1	09/25/2017 15:07
1,2,4-Trichlorobenzene	ND	0.0050	1	09/25/2017 15:07
1,1,1-Trichloroethane	ND	0.0050	1	09/25/2017 15:07
1,1,2-Trichloroethane	ND	0.0050	1	09/25/2017 15:07
Trichloroethene	ND	0.0050	1	09/25/2017 15:07
Trichlorofluoromethane	ND	0.0050	1	09/25/2017 15:07
1,2,3-Trichloropropane	ND	0.0050	1	09/25/2017 15:07
1,2,4-Trimethylbenzene	**0.0075**	0.0050	1	09/25/2017 15:07
1,3,5-Trimethylbenzene	ND	0.0050	1	09/25/2017 15:07
Vinyl Chloride	ND	0.0050	1	09/25/2017 15:07
Xylenes, Total	ND	0.0050	1	09/25/2017 15:07

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW5030B
Date Prepared:	9/19/17-9/25/17	**Analytical Method:**	SW8260B
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	**1709793-001A**	**Soil**	**09/15/2017 15:20**	**GC38 09251713.D**	**146037**

Analytes	Result	RL	DF	Date Analyzed
Surrogates	REC (%)	Limits		
Dibromofluoromethane	121	82-136		09/25/2017 15:07
Toluene-d8	115	92-139		09/25/2017 15:07
4-BFB	110	82-135		09/25/2017 15:07
Benzene-d6	86	55-122		09/25/2017 15:07
Ethylbenzene-d10	95	58-141		09/25/2017 15:07
1,2-DCB-d4	76	51-107		09/25/2017 15:07

Analyst(s): AK

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW5030B
Date Prepared:	9/19/17-9/25/17	**Analytical Method:**	SW8260B
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-2-5.5	1709793-004A	Soil	09/15/2017 08:50	GC28 09231713.D	145735

Analytes	Result	RL	DF	Date Analyzed
Acetone	ND	0.10	1	09/23/2017 15:42
tert-Amyl methyl ether (TAME)	ND	0.0050	1	09/23/2017 15:42
Benzene	ND	0.0050	1	09/23/2017 15:42
Bromobenzene	ND	0.0050	1	09/23/2017 15:42
Bromochloromethane	ND	0.0050	1	09/23/2017 15:42
Bromodichloromethane	ND	0.0050	1	09/23/2017 15:42
Bromoform	ND	0.0050	1	09/23/2017 15:42
Bromomethane	ND	0.0050	1	09/23/2017 15:42
2-Butanone (MEK)	ND	0.020	1	09/23/2017 15:42
t-Butyl alcohol (TBA)	ND	0.050	1	09/23/2017 15:42
n-Butyl benzene	ND	0.0050	1	09/23/2017 15:42
sec-Butyl benzene	ND	0.0050	1	09/23/2017 15:42
tert-Butyl benzene	ND	0.0050	1	09/23/2017 15:42
Carbon Disulfide	ND	0.0050	1	09/23/2017 15:42
Carbon Tetrachloride	ND	0.0050	1	09/23/2017 15:42
Chlorobenzene	ND	0.0050	1	09/23/2017 15:42
Chloroethane	ND	0.0050	1	09/23/2017 15:42
Chloroform	ND	0.0050	1	09/23/2017 15:42
Chloromethane	ND	0.0050	1	09/23/2017 15:42
2-Chlorotoluene	ND	0.0050	1	09/23/2017 15:42
4-Chlorotoluene	ND	0.0050	1	09/23/2017 15:42
Dibromochloromethane	ND	0.0050	1	09/23/2017 15:42
1,2-Dibromo-3-chloropropane	ND	0.0040	1	09/23/2017 15:42
1,2-Dibromoethane (EDB)	ND	0.0040	1	09/23/2017 15:42
Dibromomethane	ND	0.0050	1	09/23/2017 15:42
1,2-Dichlorobenzene	ND	0.0050	1	09/23/2017 15:42
1,3-Dichlorobenzene	ND	0.0050	1	09/23/2017 15:42
1,4-Dichlorobenzene	ND	0.0050	1	09/23/2017 15:42
Dichlorodifluoromethane	ND	0.0050	1	09/23/2017 15:42
1,1-Dichloroethane	ND	0.0050	1	09/23/2017 15:42
1,2-Dichloroethane (1,2-DCA)	ND	0.0040	1	09/23/2017 15:42
1,1-Dichloroethene	ND	0.0050	1	09/23/2017 15:42
cis-1,2-Dichloroethene	ND	0.0050	1	09/23/2017 15:42
trans-1,2-Dichloroethene	ND	0.0050	1	09/23/2017 15:42
1,2-Dichloropropane	ND	0.0050	1	09/23/2017 15:42
1,3-Dichloropropane	ND	0.0050	1	09/23/2017 15:42
2,2-Dichloropropane	ND	0.0050	1	09/23/2017 15:42

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW5030B
Date Prepared:	9/19/17-9/25/17	**Analytical Method:**	SW8260B
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-2-5.5	1709793-004A	Soil	09/15/2017 08:50	GC28 09231713.D	145735

Analytes	Result	RL	DF	Date Analyzed
1,1-Dichloropropene	ND	0.0050	1	09/23/2017 15:42
cis-1,3-Dichloropropene	ND	0.0050	1	09/23/2017 15:42
trans-1,3-Dichloropropene	ND	0.0050	1	09/23/2017 15:42
Diisopropyl ether (DIPE)	ND	0.0050	1	09/23/2017 15:42
Ethylbenzene	ND	0.0050	1	09/23/2017 15:42
Ethyl tert-butyl ether (ETBE)	ND	0.0050	1	09/23/2017 15:42
Freon 113	ND	0.0050	1	09/23/2017 15:42
Hexachlorobutadiene	ND	0.0050	1	09/23/2017 15:42
Hexachloroethane	ND	0.0050	1	09/23/2017 15:42
2-Hexanone	ND	0.0050	1	09/23/2017 15:42
Isopropylbenzene	ND	0.0050	1	09/23/2017 15:42
4-Isopropyl toluene	ND	0.0050	1	09/23/2017 15:42
Methyl-t-butyl ether (MTBE)	ND	0.0050	1	09/23/2017 15:42
Methylene chloride	ND	0.0050	1	09/23/2017 15:42
4-Methyl-2-pentanone (MIBK)	ND	0.0050	1	09/23/2017 15:42
Naphthalene	ND	0.0050	1	09/23/2017 15:42
n-Propyl benzene	ND	0.0050	1	09/23/2017 15:42
Styrene	ND	0.0050	1	09/23/2017 15:42
1,1,1,2-Tetrachloroethane	ND	0.0050	1	09/23/2017 15:42
1,1,2,2-Tetrachloroethane	ND	0.0050	1	09/23/2017 15:42
Tetrachloroethene	ND	0.0050	1	09/23/2017 15:42
Toluene	ND	0.0050	1	09/23/2017 15:42
1,2,3-Trichlorobenzene	ND	0.0050	1	09/23/2017 15:42
1,2,4-Trichlorobenzene	ND	0.0050	1	09/23/2017 15:42
1,1,1-Trichloroethane	ND	0.0050	1	09/23/2017 15:42
1,1,2-Trichloroethane	ND	0.0050	1	09/23/2017 15:42
Trichloroethene	ND	0.0050	1	09/23/2017 15:42
Trichlorofluoromethane	ND	0.0050	1	09/23/2017 15:42
1,2,3-Trichloropropane	ND	0.0050	1	09/23/2017 15:42
1,2,4-Trimethylbenzene	ND	0.0050	1	09/23/2017 15:42
1,3,5-Trimethylbenzene	ND	0.0050	1	09/23/2017 15:42
Vinyl Chloride	ND	0.0050	1	09/23/2017 15:42
Xylenes, Total	ND	0.0050	1	09/23/2017 15:42

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW5030B
Date Prepared:	9/19/17-9/25/17	**Analytical Method:**	SW8260B
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-2-5.5	1709793-004A	Soil	09/15/2017 08:50	GC28 09231713.D	145735

Analytes	Result		RL	DF	Date Analyzed
Surrogates	REC (%)	Qualifiers	Limits		
Dibromofluoromethane	103		82-136		09/23/2017 15:42
Toluene-d8	111		92-139		09/23/2017 15:42
4-BFB	81	S	82-135		09/23/2017 15:42
Benzene-d6	82		55-122		09/23/2017 15:42
Ethylbenzene-d10	93		58-141		09/23/2017 15:42
1,2-DCB-d4	77		51-107		09/23/2017 15:42

Analyst(s): AK

Analytical Comments: c2

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW5030B
Date Prepared:	9/19/17-9/25/17	**Analytical Method:**	SW8260B
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-3.0	1709793-006A	Soil	09/15/2017 07:52	GC28 09231711.D	145735

Analytes	Result	RL	DF	Date Analyzed
Acetone	ND	0.10	1	09/23/2017 14:25
tert-Amyl methyl ether (TAME)	ND	0.0050	1	09/23/2017 14:25
Benzene	ND	0.0050	1	09/23/2017 14:25
Bromobenzene	ND	0.0050	1	09/23/2017 14:25
Bromochloromethane	ND	0.0050	1	09/23/2017 14:25
Bromodichloromethane	ND	0.0050	1	09/23/2017 14:25
Bromoform	ND	0.0050	1	09/23/2017 14:25
Bromomethane	ND	0.0050	1	09/23/2017 14:25
2-Butanone (MEK)	ND	0.020	1	09/23/2017 14:25
t-Butyl alcohol (TBA)	ND	0.050	1	09/23/2017 14:25
n-Butyl benzene	ND	0.0050	1	09/23/2017 14:25
sec-Butyl benzene	ND	0.0050	1	09/23/2017 14:25
tert-Butyl benzene	ND	0.0050	1	09/23/2017 14:25
Carbon Disulfide	ND	0.0050	1	09/23/2017 14:25
Carbon Tetrachloride	ND	0.0050	1	09/23/2017 14:25
Chlorobenzene	ND	0.0050	1	09/23/2017 14:25
Chloroethane	ND	0.0050	1	09/23/2017 14:25
Chloroform	ND	0.0050	1	09/23/2017 14:25
Chloromethane	ND	0.0050	1	09/23/2017 14:25
2-Chlorotoluene	ND	0.0050	1	09/23/2017 14:25
4-Chlorotoluene	ND	0.0050	1	09/23/2017 14:25
Dibromochloromethane	ND	0.0050	1	09/23/2017 14:25
1,2-Dibromo-3-chloropropane	ND	0.0040	1	09/23/2017 14:25
1,2-Dibromoethane (EDB)	ND	0.0040	1	09/23/2017 14:25
Dibromomethane	ND	0.0050	1	09/23/2017 14:25
1,2-Dichlorobenzene	ND	0.0050	1	09/23/2017 14:25
1,3-Dichlorobenzene	ND	0.0050	1	09/23/2017 14:25
1,4-Dichlorobenzene	ND	0.0050	1	09/23/2017 14:25
Dichlorodifluoromethane	ND	0.0050	1	09/23/2017 14:25
1,1-Dichloroethane	ND	0.0050	1	09/23/2017 14:25
1,2-Dichloroethane (1,2-DCA)	ND	0.0040	1	09/23/2017 14:25
1,1-Dichloroethene	ND	0.0050	1	09/23/2017 14:25
cis-1,2-Dichloroethene	ND	0.0050	1	09/23/2017 14:25
trans-1,2-Dichloroethene	ND	0.0050	1	09/23/2017 14:25
1,2-Dichloropropane	ND	0.0050	1	09/23/2017 14:25
1,3-Dichloropropane	ND	0.0050	1	09/23/2017 14:25
2,2-Dichloropropane	ND	0.0050	1	09/23/2017 14:25

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW5030B
Date Prepared:	9/19/17-9/25/17	**Analytical Method:**	SW8260B
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-3.0	1709793-006A	Soil	09/15/2017 07:52	GC28 09231711.D	145735

Analytes	Result	RL	DF	Date Analyzed
1,1-Dichloropropene	ND	0.0050	1	09/23/2017 14:25
cis-1,3-Dichloropropene	ND	0.0050	1	09/23/2017 14:25
trans-1,3-Dichloropropene	ND	0.0050	1	09/23/2017 14:25
Diisopropyl ether (DIPE)	ND	0.0050	1	09/23/2017 14:25
Ethylbenzene	ND	0.0050	1	09/23/2017 14:25
Ethyl tert-butyl ether (ETBE)	ND	0.0050	1	09/23/2017 14:25
Freon 113	ND	0.0050	1	09/23/2017 14:25
Hexachlorobutadiene	ND	0.0050	1	09/23/2017 14:25
Hexachloroethane	ND	0.0050	1	09/23/2017 14:25
2-Hexanone	ND	0.0050	1	09/23/2017 14:25
Isopropylbenzene	ND	0.0050	1	09/23/2017 14:25
4-Isopropyl toluene	ND	0.0050	1	09/23/2017 14:25
Methyl-t-butyl ether (MTBE)	ND	0.0050	1	09/23/2017 14:25
Methylene chloride	ND	0.0050	1	09/23/2017 14:25
4-Methyl-2-pentanone (MIBK)	ND	0.0050	1	09/23/2017 14:25
Naphthalene	ND	0.0050	1	09/23/2017 14:25
n-Propyl benzene	ND	0.0050	1	09/23/2017 14:25
Styrene	ND	0.0050	1	09/23/2017 14:25
1,1,1,2-Tetrachloroethane	ND	0.0050	1	09/23/2017 14:25
1,1,2,2-Tetrachloroethane	ND	0.0050	1	09/23/2017 14:25
Tetrachloroethene	ND	0.0050	1	09/23/2017 14:25
Toluene	ND	0.0050	1	09/23/2017 14:25
1,2,3-Trichlorobenzene	ND	0.0050	1	09/23/2017 14:25
1,2,4-Trichlorobenzene	ND	0.0050	1	09/23/2017 14:25
1,1,1-Trichloroethane	ND	0.0050	1	09/23/2017 14:25
1,1,2-Trichloroethane	ND	0.0050	1	09/23/2017 14:25
Trichloroethene	ND	0.0050	1	09/23/2017 14:25
Trichlorofluoromethane	ND	0.0050	1	09/23/2017 14:25
1,2,3-Trichloropropane	ND	0.0050	1	09/23/2017 14:25
1,2,4-Trimethylbenzene	ND	0.0050	1	09/23/2017 14:25
1,3,5-Trimethylbenzene	ND	0.0050	1	09/23/2017 14:25
Vinyl Chloride	ND	0.0050	1	09/23/2017 14:25
Xylenes, Total	ND	0.0050	1	09/23/2017 14:25

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW5030B
Date Prepared:	9/19/17-9/25/17	**Analytical Method:**	SW8260B
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-3.0	**1709793-006A**	**Soil**	**09/15/2017 07:52**	**GC28 09231711.D**	**145735**

Analytes	Result	RL	DF	Date Analyzed
Surrogates	REC (%)	Limits		
Dibromofluoromethane	102	82-136		09/23/2017 14:25
Toluene-d8	111	92-139		09/23/2017 14:25
4-BFB	82	82-135		09/23/2017 14:25
Benzene-d6	86	55-122		09/23/2017 14:25
Ethylbenzene-d10	96	58-141		09/23/2017 14:25
1,2-DCB-d4	80	51-107		09/23/2017 14:25

Analyst(s): AK

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW5030B
Date Prepared:	9/19/17-9/25/17	**Analytical Method:**	SW8260B
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-5.5	1709793-007A	Soil	09/15/2017 08:03	GC28 09231712.D	145735

Analytes	Result	RL	DF	Date Analyzed
Acetone	ND	0.10	1	09/23/2017 15:04
tert-Amyl methyl ether (TAME)	ND	0.0050	1	09/23/2017 15:04
Benzene	ND	0.0050	1	09/23/2017 15:04
Bromobenzene	ND	0.0050	1	09/23/2017 15:04
Bromochloromethane	ND	0.0050	1	09/23/2017 15:04
Bromodichloromethane	ND	0.0050	1	09/23/2017 15:04
Bromoform	ND	0.0050	1	09/23/2017 15:04
Bromomethane	ND	0.0050	1	09/23/2017 15:04
2-Butanone (MEK)	ND	0.020	1	09/23/2017 15:04
t-Butyl alcohol (TBA)	ND	0.050	1	09/23/2017 15:04
n-Butyl benzene	ND	0.0050	1	09/23/2017 15:04
sec-Butyl benzene	ND	0.0050	1	09/23/2017 15:04
tert-Butyl benzene	ND	0.0050	1	09/23/2017 15:04
Carbon Disulfide	ND	0.0050	1	09/23/2017 15:04
Carbon Tetrachloride	ND	0.0050	1	09/23/2017 15:04
Chlorobenzene	ND	0.0050	1	09/23/2017 15:04
Chloroethane	ND	0.0050	1	09/23/2017 15:04
Chloroform	ND	0.0050	1	09/23/2017 15:04
Chloromethane	ND	0.0050	1	09/23/2017 15:04
2-Chlorotoluene	ND	0.0050	1	09/23/2017 15:04
4-Chlorotoluene	ND	0.0050	1	09/23/2017 15:04
Dibromochloromethane	ND	0.0050	1	09/23/2017 15:04
1,2-Dibromo-3-chloropropane	ND	0.0040	1	09/23/2017 15:04
1,2-Dibromoethane (EDB)	ND	0.0040	1	09/23/2017 15:04
Dibromomethane	ND	0.0050	1	09/23/2017 15:04
1,2-Dichlorobenzene	ND	0.0050	1	09/23/2017 15:04
1,3-Dichlorobenzene	ND	0.0050	1	09/23/2017 15:04
1,4-Dichlorobenzene	ND	0.0050	1	09/23/2017 15:04
Dichlorodifluoromethane	ND	0.0050	1	09/23/2017 15:04
1,1-Dichloroethane	ND	0.0050	1	09/23/2017 15:04
1,2-Dichloroethane (1,2-DCA)	ND	0.0040	1	09/23/2017 15:04
1,1-Dichloroethene	ND	0.0050	1	09/23/2017 15:04
cis-1,2-Dichloroethene	ND	0.0050	1	09/23/2017 15:04
trans-1,2-Dichloroethene	ND	0.0050	1	09/23/2017 15:04
1,2-Dichloropropane	ND	0.0050	1	09/23/2017 15:04
1,3-Dichloropropane	ND	0.0050	1	09/23/2017 15:04
2,2-Dichloropropane	ND	0.0050	1	09/23/2017 15:04

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW5030B
Date Prepared:	9/19/17-9/25/17	**Analytical Method:**	SW8260B
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-5.5	1709793-007A	Soil	09/15/2017 08:03	GC28 09231712.D	145735

Analytes	Result	RL	DF	Date Analyzed
1,1-Dichloropropene	ND	0.0050	1	09/23/2017 15:04
cis-1,3-Dichloropropene	ND	0.0050	1	09/23/2017 15:04
trans-1,3-Dichloropropene	ND	0.0050	1	09/23/2017 15:04
Diisopropyl ether (DIPE)	ND	0.0050	1	09/23/2017 15:04
Ethylbenzene	ND	0.0050	1	09/23/2017 15:04
Ethyl tert-butyl ether (ETBE)	ND	0.0050	1	09/23/2017 15:04
Freon 113	ND	0.0050	1	09/23/2017 15:04
Hexachlorobutadiene	ND	0.0050	1	09/23/2017 15:04
Hexachloroethane	ND	0.0050	1	09/23/2017 15:04
2-Hexanone	ND	0.0050	1	09/23/2017 15:04
Isopropylbenzene	ND	0.0050	1	09/23/2017 15:04
4-Isopropyl toluene	ND	0.0050	1	09/23/2017 15:04
Methyl-t-butyl ether (MTBE)	ND	0.0050	1	09/23/2017 15:04
Methylene chloride	ND	0.0050	1	09/23/2017 15:04
4-Methyl-2-pentanone (MIBK)	ND	0.0050	1	09/23/2017 15:04
Naphthalene	ND	0.0050	1	09/23/2017 15:04
n-Propyl benzene	ND	0.0050	1	09/23/2017 15:04
Styrene	ND	0.0050	1	09/23/2017 15:04
1,1,1,2-Tetrachloroethane	ND	0.0050	1	09/23/2017 15:04
1,1,2,2-Tetrachloroethane	ND	0.0050	1	09/23/2017 15:04
Tetrachloroethene	ND	0.0050	1	09/23/2017 15:04
Toluene	ND	0.0050	1	09/23/2017 15:04
1,2,3-Trichlorobenzene	ND	0.0050	1	09/23/2017 15:04
1,2,4-Trichlorobenzene	ND	0.0050	1	09/23/2017 15:04
1,1,1-Trichloroethane	ND	0.0050	1	09/23/2017 15:04
1,1,2-Trichloroethane	ND	0.0050	1	09/23/2017 15:04
Trichloroethene	ND	0.0050	1	09/23/2017 15:04
Trichlorofluoromethane	ND	0.0050	1	09/23/2017 15:04
1,2,3-Trichloropropane	ND	0.0050	1	09/23/2017 15:04
1,2,4-Trimethylbenzene	ND	0.0050	1	09/23/2017 15:04
1,3,5-Trimethylbenzene	ND	0.0050	1	09/23/2017 15:04
Vinyl Chloride	ND	0.0050	1	09/23/2017 15:04
Xylenes, Total	ND	0.0050	1	09/23/2017 15:04

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW5030B
Date Prepared:	9/19/17-9/25/17	**Analytical Method:**	SW8260B
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-5.5	**1709793-007A**	**Soil**	**09/15/2017 08:03**	**GC28 09231712.D**	**145735**

Analytes	Result	RL	DF	Date Analyzed
Surrogates	REC (%)	Limits		
Dibromofluoromethane	102	82-136		09/23/2017 15:04
Toluene-d8	111	92-139		09/23/2017 15:04
4-BFB	83	82-135		09/23/2017 15:04
Benzene-d6	85	55-122		09/23/2017 15:04
Ethylbenzene-d10	95	58-141		09/23/2017 15:04
1,2-DCB-d4	79	51-107		09/23/2017 15:04

Analyst(s): AK

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/20/17	**Analytical Method:**	SW8270C-SIM
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Polynuclear Aromatic Hydrocarbons (PAHs / PNAs) using SIM Mode

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	**1709793-001A**	**Soil**	**09/15/2017 15:20**	**GC35 09201708.D**	**145799**

Analytes	Result	RL	DF	Date Analyzed
Acenaphthene	ND	0.50	50	09/20/2017 12:37
Acenaphthylene	ND	0.50	50	09/20/2017 12:37
Anthracene	ND	0.50	50	09/20/2017 12:37
Benzo (a) anthracene	ND	0.50	50	09/20/2017 12:37
Benzo (a) pyrene	ND	0.50	50	09/20/2017 12:37
Benzo (b) fluoranthene	ND	0.50	50	09/20/2017 12:37
Benzo (g,h,i) perylene	ND	0.50	50	09/20/2017 12:37
Benzo (k) fluoranthene	ND	0.50	50	09/20/2017 12:37
Chrysene	ND	0.50	50	09/20/2017 12:37
Dibenzo (a,h) anthracene	ND	0.50	50	09/20/2017 12:37
Fluoranthene	**0.94**	0.50	50	09/20/2017 12:37
Fluorene	ND	0.50	50	09/20/2017 12:37
Indeno (1,2,3-cd) pyrene	ND	0.50	50	09/20/2017 12:37
1-Methylnaphthalene	ND	0.50	50	09/20/2017 12:37
2-Methylnaphthalene	ND	0.50	50	09/20/2017 12:37
Naphthalene	ND	0.50	50	09/20/2017 12:37
Phenanthrene	**0.80**	0.50	50	09/20/2017 12:37
Pyrene	**0.73**	0.50	50	09/20/2017 12:37

Surrogates	REC (%)	Limits	Date Analyzed
1-Fluoronaphthalene	117	30-130	09/20/2017 12:37
2-Fluorobiphenyl	114	30-130	09/20/2017 12:37

Analyst(s): REB

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/20/17	**Analytical Method:**	SW8270C-SIM
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Polynuclear Aromatic Hydrocarbons (PAHs / PNAs) using SIM Mode

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-3.0	1709793-006A	Soil	09/15/2017 07:52	GC35 09201709.D	145799

Analytes	Result	RL	DF	Date Analyzed
Acenaphthene	ND	0.010	1	09/20/2017 13:02
Acenaphthylene	ND	0.010	1	09/20/2017 13:02
Anthracene	ND	0.010	1	09/20/2017 13:02
Benzo (a) anthracene	ND	0.010	1	09/20/2017 13:02
Benzo (a) pyrene	ND	0.010	1	09/20/2017 13:02
Benzo (b) fluoranthene	ND	0.010	1	09/20/2017 13:02
Benzo (g,h,i) perylene	ND	0.010	1	09/20/2017 13:02
Benzo (k) fluoranthene	ND	0.010	1	09/20/2017 13:02
Chrysene	ND	0.010	1	09/20/2017 13:02
Dibenzo (a,h) anthracene	ND	0.010	1	09/20/2017 13:02
Fluoranthene	ND	0.010	1	09/20/2017 13:02
Fluorene	ND	0.010	1	09/20/2017 13:02
Indeno (1,2,3-cd) pyrene	ND	0.010	1	09/20/2017 13:02
1-Methylnaphthalene	ND	0.010	1	09/20/2017 13:02
2-Methylnaphthalene	ND	0.010	1	09/20/2017 13:02
Naphthalene	ND	0.010	1	09/20/2017 13:02
Phenanthrene	ND	0.010	1	09/20/2017 13:02
Pyrene	ND	0.010	1	09/20/2017 13:02

Surrogates	REC (%)	Limits	Date Analyzed
1-Fluoronaphthalene	114	30-130	09/20/2017 13:02
2-Fluorobiphenyl	113	30-130	09/20/2017 13:02

Analyst(s): REB

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/20/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	1709793-001A	Soil	09/15/2017 15:20	GC17 09201721.D	145800

Analytes	Result	RL	DF	Date Analyzed
Acenaphthene	ND	20	10	09/20/2017 18:06
Acenaphthylene	ND	20	10	09/20/2017 18:06
Acetochlor	ND	20	10	09/20/2017 18:06
Anthracene	ND	20	10	09/20/2017 18:06
Benzidine	ND	100	10	09/20/2017 18:06
Benzo (a) anthracene	ND	20	10	09/20/2017 18:06
Benzo (a) pyrene	ND	20	10	09/20/2017 18:06
Benzo (b) fluoranthene	ND	20	10	09/20/2017 18:06
Benzo (g,h,i) perylene	ND	20	10	09/20/2017 18:06
Benzo (k) fluoranthene	ND	20	10	09/20/2017 18:06
Benzyl Alcohol	ND	100	10	09/20/2017 18:06
1,1-Biphenyl	ND	20	10	09/20/2017 18:06
Bis (2-chloroethoxy) Methane	ND	20	10	09/20/2017 18:06
Bis (2-chloroethyl) Ether	ND	20	10	09/20/2017 18:06
Bis (2-chloroisopropyl) Ether	ND	20	10	09/20/2017 18:06
Bis (2-ethylhexyl) Adipate	ND	20	10	09/20/2017 18:06
Bis (2-ethylhexyl) Phthalate	ND	20	10	09/20/2017 18:06
4-Bromophenyl Phenyl Ether	ND	20	10	09/20/2017 18:06
Butylbenzyl Phthalate	ND	20	10	09/20/2017 18:06
4-Chloroaniline	ND	40	10	09/20/2017 18:06
4-Chloro-3-methylphenol	ND	20	10	09/20/2017 18:06
2-Chloronaphthalene	ND	20	10	09/20/2017 18:06
2-Chlorophenol	ND	20	10	09/20/2017 18:06
4-Chlorophenyl Phenyl Ether	ND	20	10	09/20/2017 18:06
Chrysene	ND	20	10	09/20/2017 18:06
Dibenzo (a,h) anthracene	ND	20	10	09/20/2017 18:06
Dibenzofuran	ND	20	10	09/20/2017 18:06
Di-n-butyl Phthalate	ND	20	10	09/20/2017 18:06
1,2-Dichlorobenzene	ND	20	10	09/20/2017 18:06
1,3-Dichlorobenzene	ND	20	10	09/20/2017 18:06
1,4-Dichlorobenzene	ND	20	10	09/20/2017 18:06
3,3-Dichlorobenzidine	ND	40	10	09/20/2017 18:06
2,4-Dichlorophenol	ND	20	10	09/20/2017 18:06
Diethyl Phthalate	ND	20	10	09/20/2017 18:06
2,4-Dimethylphenol	ND	20	10	09/20/2017 18:06
Dimethyl Phthalate	ND	20	10	09/20/2017 18:06
4,6-Dinitro-2-methylphenol	ND	100	10	09/20/2017 18:06

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/20/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	1709793-001A	Soil	09/15/2017 15:20	GC17 09201721.D	145800

Analytes	Result	RL	DF	Date Analyzed
2,4-Dinitrophenol	ND	500	10	09/20/2017 18:06
2,4-Dinitrotoluene	ND	20	10	09/20/2017 18:06
2,6-Dinitrotoluene	ND	20	10	09/20/2017 18:06
Di-n-octyl Phthalate	ND	40	10	09/20/2017 18:06
1,2-Diphenylhydrazine	ND	20	10	09/20/2017 18:06
Fluoranthene	ND	20	10	09/20/2017 18:06
Fluorene	ND	20	10	09/20/2017 18:06
Hexachlorobenzene	ND	20	10	09/20/2017 18:06
Hexachlorobutadiene	ND	20	10	09/20/2017 18:06
Hexachlorocyclopentadiene	ND	100	10	09/20/2017 18:06
Hexachloroethane	ND	20	10	09/20/2017 18:06
Indeno (1,2,3-cd) pyrene	ND	20	10	09/20/2017 18:06
Isophorone	ND	20	10	09/20/2017 18:06
2-Methylnaphthalene	ND	20	10	09/20/2017 18:06
2-Methylphenol (o-Cresol)	ND	20	10	09/20/2017 18:06
3 & 4-Methylphenol (m,p-Cresol)	ND	20	10	09/20/2017 18:06
Naphthalene	ND	20	10	09/20/2017 18:06
2-Nitroaniline	ND	100	10	09/20/2017 18:06
3-Nitroaniline	ND	100	10	09/20/2017 18:06
4-Nitroaniline	ND	100	10	09/20/2017 18:06
Nitrobenzene	ND	20	10	09/20/2017 18:06
2-Nitrophenol	ND	100	10	09/20/2017 18:06
4-Nitrophenol	ND	100	10	09/20/2017 18:06
N-Nitrosodiphenylamine	ND	20	10	09/20/2017 18:06
N-Nitrosodi-n-propylamine	ND	20	10	09/20/2017 18:06
Pentachlorophenol	ND	100	10	09/20/2017 18:06
Phenanthrene	ND	20	10	09/20/2017 18:06
Phenol	ND	20	10	09/20/2017 18:06
Pyrene	ND	20	10	09/20/2017 18:06
Pyridine	ND	20	10	09/20/2017 18:06
1,2,4-Trichlorobenzene	ND	20	10	09/20/2017 18:06
2,4,5-Trichlorophenol	ND	20	10	09/20/2017 18:06
2,4,6-Trichlorophenol	ND	20	10	09/20/2017 18:06

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/20/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	**1709793-001A**	**Soil**	**09/15/2017 15:20**	**GC17 09201721.D**	**145800**

Analytes	Result	RL	DF	Date Analyzed
Surrogates	REC (%)	Limits		
2-Fluorophenol	84	30-130		09/20/2017 18:06
Phenol-d5	65	30-130		09/20/2017 18:06
Nitrobenzene-d5	67	30-130		09/20/2017 18:06
2-Fluorobiphenyl	67	30-130		09/20/2017 18:06
2,4,6-Tribromophenol	130	16-130		09/20/2017 18:06
4-Terphenyl-d14	68	30-130		09/20/2017 18:06

Analyst(s): REB   Analytical Comments: a3,a4

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/20/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-2-5.5	1709793-004A	Soil	09/15/2017 08:50	GC17 09201722.D	145800

Analytes	Result	RL	DF	Date Analyzed
Acenaphthene	ND	0.25	1	09/20/2017 18:33
Acenaphthylene	ND	0.25	1	09/20/2017 18:33
Acetochlor	ND	0.25	1	09/20/2017 18:33
Anthracene	ND	0.25	1	09/20/2017 18:33
Benzidine	ND	1.3	1	09/20/2017 18:33
Benzo (a) anthracene	ND	0.25	1	09/20/2017 18:33
Benzo (a) pyrene	ND	0.25	1	09/20/2017 18:33
Benzo (b) fluoranthene	ND	0.25	1	09/20/2017 18:33
Benzo (g,h,i) perylene	ND	0.25	1	09/20/2017 18:33
Benzo (k) fluoranthene	ND	0.25	1	09/20/2017 18:33
Benzyl Alcohol	ND	1.3	1	09/20/2017 18:33
1,1-Biphenyl	ND	0.25	1	09/20/2017 18:33
Bis (2-chloroethoxy) Methane	ND	0.25	1	09/20/2017 18:33
Bis (2-chloroethyl) Ether	ND	0.25	1	09/20/2017 18:33
Bis (2-chloroisopropyl) Ether	ND	0.25	1	09/20/2017 18:33
Bis (2-ethylhexyl) Adipate	ND	0.25	1	09/20/2017 18:33
Bis (2-ethylhexyl) Phthalate	ND	0.25	1	09/20/2017 18:33
4-Bromophenyl Phenyl Ether	ND	0.25	1	09/20/2017 18:33
Butylbenzyl Phthalate	ND	0.25	1	09/20/2017 18:33
4-Chloroaniline	ND	0.50	1	09/20/2017 18:33
4-Chloro-3-methylphenol	ND	0.25	1	09/20/2017 18:33
2-Chloronaphthalene	ND	0.25	1	09/20/2017 18:33
2-Chlorophenol	ND	0.25	1	09/20/2017 18:33
4-Chlorophenyl Phenyl Ether	ND	0.25	1	09/20/2017 18:33
Chrysene	ND	0.25	1	09/20/2017 18:33
Dibenzo (a,h) anthracene	ND	0.25	1	09/20/2017 18:33
Dibenzofuran	ND	0.25	1	09/20/2017 18:33
Di-n-butyl Phthalate	ND	0.25	1	09/20/2017 18:33
1,2-Dichlorobenzene	ND	0.25	1	09/20/2017 18:33
1,3-Dichlorobenzene	ND	0.25	1	09/20/2017 18:33
1,4-Dichlorobenzene	ND	0.25	1	09/20/2017 18:33
3,3-Dichlorobenzidine	ND	0.50	1	09/20/2017 18:33
2,4-Dichlorophenol	ND	0.25	1	09/20/2017 18:33
Diethyl Phthalate	ND	0.25	1	09/20/2017 18:33
2,4-Dimethylphenol	ND	0.25	1	09/20/2017 18:33
Dimethyl Phthalate	ND	0.25	1	09/20/2017 18:33
4,6-Dinitro-2-methylphenol	ND	1.3	1	09/20/2017 18:33

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/20/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-2-5.5	**1709793-004A**	**Soil**	**09/15/2017 08:50**	**GC17 09201722.D**	**145800**

Analytes	Result	RL	DF	Date Analyzed
2,4-Dinitrophenol	ND	6.3	1	09/20/2017 18:33
2,4-Dinitrotoluene	ND	0.25	1	09/20/2017 18:33
2,6-Dinitrotoluene	ND	0.25	1	09/20/2017 18:33
Di-n-octyl Phthalate	ND	0.50	1	09/20/2017 18:33
1,2-Diphenylhydrazine	ND	0.25	1	09/20/2017 18:33
Fluoranthene	ND	0.25	1	09/20/2017 18:33
Fluorene	ND	0.25	1	09/20/2017 18:33
Hexachlorobenzene	ND	0.25	1	09/20/2017 18:33
Hexachlorobutadiene	ND	0.25	1	09/20/2017 18:33
Hexachlorocyclopentadiene	ND	1.3	1	09/20/2017 18:33
Hexachloroethane	ND	0.25	1	09/20/2017 18:33
Indeno (1,2,3-cd) pyrene	ND	0.25	1	09/20/2017 18:33
Isophorone	ND	0.25	1	09/20/2017 18:33
2-Methylnaphthalene	ND	0.25	1	09/20/2017 18:33
2-Methylphenol (o-Cresol)	ND	0.25	1	09/20/2017 18:33
3 & 4-Methylphenol (m,p-Cresol)	ND	0.25	1	09/20/2017 18:33
Naphthalene	ND	0.25	1	09/20/2017 18:33
2-Nitroaniline	ND	1.3	1	09/20/2017 18:33
3-Nitroaniline	ND	1.3	1	09/20/2017 18:33
4-Nitroaniline	ND	1.3	1	09/20/2017 18:33
Nitrobenzene	ND	0.25	1	09/20/2017 18:33
2-Nitrophenol	ND	1.3	1	09/20/2017 18:33
4-Nitrophenol	ND	1.3	1	09/20/2017 18:33
N-Nitrosodiphenylamine	ND	0.25	1	09/20/2017 18:33
N-Nitrosodi-n-propylamine	ND	0.25	1	09/20/2017 18:33
Pentachlorophenol	ND	1.3	1	09/20/2017 18:33
Phenanthrene	ND	0.25	1	09/20/2017 18:33
Phenol	ND	0.25	1	09/20/2017 18:33
Pyrene	ND	0.25	1	09/20/2017 18:33
Pyridine	ND	0.25	1	09/20/2017 18:33
1,2,4-Trichlorobenzene	ND	0.25	1	09/20/2017 18:33
2,4,5-Trichlorophenol	ND	0.25	1	09/20/2017 18:33
2,4,6-Trichlorophenol	ND	0.25	1	09/20/2017 18:33

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/20/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-2-5.5	**1709793-004A**	**Soil**	**09/15/2017 08:50**	**GC17 09201722.D**	**145800**

Analytes	Result	RL	DF	Date Analyzed
Surrogates	REC (%)	Limits		
2-Fluorophenol	79	30-130		09/20/2017 18:33
Phenol-d5	72	30-130		09/20/2017 18:33
Nitrobenzene-d5	72	30-130		09/20/2017 18:33
2-Fluorobiphenyl	62	30-130		09/20/2017 18:33
2,4,6-Tribromophenol	47	16-130		09/20/2017 18:33
4-Terphenyl-d14	74	30-130		09/20/2017 18:33

Analyst(s): REB

(Cont.)

NELAP 4033ORELAP

Angela Rydelius, Lab Manager

Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/20/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-3.0	1709793-006A	Soil	09/15/2017 07:52	GC17 09201723.D	145800

Analytes	Result	RL	DF	Date Analyzed
Acenaphthene	ND	0.25	1	09/20/2017 19:00
Acenaphthylene	ND	0.25	1	09/20/2017 19:00
Acetochlor	ND	0.25	1	09/20/2017 19:00
Anthracene	ND	0.25	1	09/20/2017 19:00
Benzidine	ND	1.3	1	09/20/2017 19:00
Benzo (a) anthracene	ND	0.25	1	09/20/2017 19:00
Benzo (a) pyrene	ND	0.25	1	09/20/2017 19:00
Benzo (b) fluoranthene	ND	0.25	1	09/20/2017 19:00
Benzo (g,h,i) perylene	ND	0.25	1	09/20/2017 19:00
Benzo (k) fluoranthene	ND	0.25	1	09/20/2017 19:00
Benzyl Alcohol	ND	1.3	1	09/20/2017 19:00
1,1-Biphenyl	ND	0.25	1	09/20/2017 19:00
Bis (2-chloroethoxy) Methane	ND	0.25	1	09/20/2017 19:00
Bis (2-chloroethyl) Ether	ND	0.25	1	09/20/2017 19:00
Bis (2-chloroisopropyl) Ether	ND	0.25	1	09/20/2017 19:00
Bis (2-ethylhexyl) Adipate	ND	0.25	1	09/20/2017 19:00
Bis (2-ethylhexyl) Phthalate	ND	0.25	1	09/20/2017 19:00
4-Bromophenyl Phenyl Ether	ND	0.25	1	09/20/2017 19:00
Butylbenzyl Phthalate	ND	0.25	1	09/20/2017 19:00
4-Chloroaniline	ND	0.50	1	09/20/2017 19:00
4-Chloro-3-methylphenol	ND	0.25	1	09/20/2017 19:00
2-Chloronaphthalene	ND	0.25	1	09/20/2017 19:00
2-Chlorophenol	ND	0.25	1	09/20/2017 19:00
4-Chlorophenyl Phenyl Ether	ND	0.25	1	09/20/2017 19:00
Chrysene	ND	0.25	1	09/20/2017 19:00
Dibenzo (a,h) anthracene	ND	0.25	1	09/20/2017 19:00
Dibenzofuran	ND	0.25	1	09/20/2017 19:00
Di-n-butyl Phthalate	ND	0.25	1	09/20/2017 19:00
1,2-Dichlorobenzene	ND	0.25	1	09/20/2017 19:00
1,3-Dichlorobenzene	ND	0.25	1	09/20/2017 19:00
1,4-Dichlorobenzene	ND	0.25	1	09/20/2017 19:00
3,3-Dichlorobenzidine	ND	0.50	1	09/20/2017 19:00
2,4-Dichlorophenol	ND	0.25	1	09/20/2017 19:00
Diethyl Phthalate	ND	0.25	1	09/20/2017 19:00
2,4-Dimethylphenol	ND	0.25	1	09/20/2017 19:00
Dimethyl Phthalate	ND	0.25	1	09/20/2017 19:00
4,6-Dinitro-2-methylphenol	ND	1.3	1	09/20/2017 19:00

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/20/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-3.0	**1709793-006A**	**Soil**	**09/15/2017 07:52**	**GC17 09201723.D**	**145800**

Analytes	Result	RL	DF	Date Analyzed
2,4-Dinitrophenol	ND	6.3	1	09/20/2017 19:00
2,4-Dinitrotoluene	ND	0.25	1	09/20/2017 19:00
2,6-Dinitrotoluene	ND	0.25	1	09/20/2017 19:00
Di-n-octyl Phthalate	ND	0.50	1	09/20/2017 19:00
1,2-Diphenylhydrazine	ND	0.25	1	09/20/2017 19:00
Fluoranthene	ND	0.25	1	09/20/2017 19:00
Fluorene	ND	0.25	1	09/20/2017 19:00
Hexachlorobenzene	ND	0.25	1	09/20/2017 19:00
Hexachlorobutadiene	ND	0.25	1	09/20/2017 19:00
Hexachlorocyclopentadiene	ND	1.3	1	09/20/2017 19:00
Hexachloroethane	ND	0.25	1	09/20/2017 19:00
Indeno (1,2,3-cd) pyrene	ND	0.25	1	09/20/2017 19:00
Isophorone	ND	0.25	1	09/20/2017 19:00
2-Methylnaphthalene	ND	0.25	1	09/20/2017 19:00
2-Methylphenol (o-Cresol)	ND	0.25	1	09/20/2017 19:00
3 & 4-Methylphenol (m,p-Cresol)	ND	0.25	1	09/20/2017 19:00
Naphthalene	ND	0.25	1	09/20/2017 19:00
2-Nitroaniline	ND	1.3	1	09/20/2017 19:00
3-Nitroaniline	ND	1.3	1	09/20/2017 19:00
4-Nitroaniline	ND	1.3	1	09/20/2017 19:00
Nitrobenzene	ND	0.25	1	09/20/2017 19:00
2-Nitrophenol	ND	1.3	1	09/20/2017 19:00
4-Nitrophenol	ND	1.3	1	09/20/2017 19:00
N-Nitrosodiphenylamine	ND	0.25	1	09/20/2017 19:00
N-Nitrosodi-n-propylamine	ND	0.25	1	09/20/2017 19:00
Pentachlorophenol	ND	1.3	1	09/20/2017 19:00
Phenanthrene	ND	0.25	1	09/20/2017 19:00
Phenol	ND	0.25	1	09/20/2017 19:00
Pyrene	ND	0.25	1	09/20/2017 19:00
Pyridine	ND	0.25	1	09/20/2017 19:00
1,2,4-Trichlorobenzene	ND	0.25	1	09/20/2017 19:00
2,4,5-Trichlorophenol	ND	0.25	1	09/20/2017 19:00
2,4,6-Trichlorophenol	ND	0.25	1	09/20/2017 19:00

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/20/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-3.0	**1709793-006A**	**Soil**	**09/15/2017 07:52**	**GC17 09201723.D**	**145800**

Analytes	Result	RL	DF	Date Analyzed
Surrogates	REC (%)	Limits		
2-Fluorophenol	83	30-130		09/20/2017 19:00
Phenol-d5	76	30-130		09/20/2017 19:00
Nitrobenzene-d5	71	30-130		09/20/2017 19:00
2-Fluorobiphenyl	61	30-130		09/20/2017 19:00
2,4,6-Tribromophenol	46	16-130		09/20/2017 19:00
4-Terphenyl-d14	63	30-130		09/20/2017 19:00

Analyst(s): REB

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/20/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-5.5	1709793-007A	Soil	09/15/2017 08:03	GC17 09201724.D	145800

Analytes	Result	RL	DF	Date Analyzed
Acenaphthene	ND	0.25	1	09/20/2017 19:27
Acenaphthylene	ND	0.25	1	09/20/2017 19:27
Acetochlor	ND	0.25	1	09/20/2017 19:27
Anthracene	ND	0.25	1	09/20/2017 19:27
Benzidine	ND	1.3	1	09/20/2017 19:27
Benzo (a) anthracene	ND	0.25	1	09/20/2017 19:27
Benzo (a) pyrene	ND	0.25	1	09/20/2017 19:27
Benzo (b) fluoranthene	ND	0.25	1	09/20/2017 19:27
Benzo (g,h,i) perylene	ND	0.25	1	09/20/2017 19:27
Benzo (k) fluoranthene	ND	0.25	1	09/20/2017 19:27
Benzyl Alcohol	ND	1.3	1	09/20/2017 19:27
1,1-Biphenyl	ND	0.25	1	09/20/2017 19:27
Bis (2-chloroethoxy) Methane	ND	0.25	1	09/20/2017 19:27
Bis (2-chloroethyl) Ether	ND	0.25	1	09/20/2017 19:27
Bis (2-chloroisopropyl) Ether	ND	0.25	1	09/20/2017 19:27
Bis (2-ethylhexyl) Adipate	ND	0.25	1	09/20/2017 19:27
Bis (2-ethylhexyl) Phthalate	ND	0.25	1	09/20/2017 19:27
4-Bromophenyl Phenyl Ether	ND	0.25	1	09/20/2017 19:27
Butylbenzyl Phthalate	ND	0.25	1	09/20/2017 19:27
4-Chloroaniline	ND	0.50	1	09/20/2017 19:27
4-Chloro-3-methylphenol	ND	0.25	1	09/20/2017 19:27
2-Chloronaphthalene	ND	0.25	1	09/20/2017 19:27
2-Chlorophenol	ND	0.25	1	09/20/2017 19:27
4-Chlorophenyl Phenyl Ether	ND	0.25	1	09/20/2017 19:27
Chrysene	ND	0.25	1	09/20/2017 19:27
Dibenzo (a,h) anthracene	ND	0.25	1	09/20/2017 19:27
Dibenzofuran	ND	0.25	1	09/20/2017 19:27
Di-n-butyl Phthalate	ND	0.25	1	09/20/2017 19:27
1,2-Dichlorobenzene	ND	0.25	1	09/20/2017 19:27
1,3-Dichlorobenzene	ND	0.25	1	09/20/2017 19:27
1,4-Dichlorobenzene	ND	0.25	1	09/20/2017 19:27
3,3-Dichlorobenzidine	ND	0.50	1	09/20/2017 19:27
2,4-Dichlorophenol	ND	0.25	1	09/20/2017 19:27
Diethyl Phthalate	ND	0.25	1	09/20/2017 19:27
2,4-Dimethylphenol	ND	0.25	1	09/20/2017 19:27
Dimethyl Phthalate	ND	0.25	1	09/20/2017 19:27
4,6-Dinitro-2-methylphenol	ND	1.3	1	09/20/2017 19:27

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/20/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-5.5	1709793-007A	Soil	09/15/2017 08:03	GC17 09201724.D	145800

Analytes	Result	RL	DF	Date Analyzed
2,4-Dinitrophenol	ND	6.3	1	09/20/2017 19:27
2,4-Dinitrotoluene	ND	0.25	1	09/20/2017 19:27
2,6-Dinitrotoluene	ND	0.25	1	09/20/2017 19:27
Di-n-octyl Phthalate	ND	0.50	1	09/20/2017 19:27
1,2-Diphenylhydrazine	ND	0.25	1	09/20/2017 19:27
Fluoranthene	ND	0.25	1	09/20/2017 19:27
Fluorene	ND	0.25	1	09/20/2017 19:27
Hexachlorobenzene	ND	0.25	1	09/20/2017 19:27
Hexachlorobutadiene	ND	0.25	1	09/20/2017 19:27
Hexachlorocyclopentadiene	ND	1.3	1	09/20/2017 19:27
Hexachloroethane	ND	0.25	1	09/20/2017 19:27
Indeno (1,2,3-cd) pyrene	ND	0.25	1	09/20/2017 19:27
Isophorone	ND	0.25	1	09/20/2017 19:27
2-Methylnaphthalene	ND	0.25	1	09/20/2017 19:27
2-Methylphenol (o-Cresol)	ND	0.25	1	09/20/2017 19:27
3 & 4-Methylphenol (m,p-Cresol)	ND	0.25	1	09/20/2017 19:27
Naphthalene	ND	0.25	1	09/20/2017 19:27
2-Nitroaniline	ND	1.3	1	09/20/2017 19:27
3-Nitroaniline	ND	1.3	1	09/20/2017 19:27
4-Nitroaniline	ND	1.3	1	09/20/2017 19:27
Nitrobenzene	ND	0.25	1	09/20/2017 19:27
2-Nitrophenol	ND	1.3	1	09/20/2017 19:27
4-Nitrophenol	ND	1.3	1	09/20/2017 19:27
N-Nitrosodiphenylamine	ND	0.25	1	09/20/2017 19:27
N-Nitrosodi-n-propylamine	ND	0.25	1	09/20/2017 19:27
Pentachlorophenol	ND	1.3	1	09/20/2017 19:27
Phenanthrene	ND	0.25	1	09/20/2017 19:27
Phenol	ND	0.25	1	09/20/2017 19:27
Pyrene	ND	0.25	1	09/20/2017 19:27
Pyridine	ND	0.25	1	09/20/2017 19:27
1,2,4-Trichlorobenzene	ND	0.25	1	09/20/2017 19:27
2,4,5-Trichlorophenol	ND	0.25	1	09/20/2017 19:27
2,4,6-Trichlorophenol	ND	0.25	1	09/20/2017 19:27

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Angela Rydelius, Lab Manager

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/20/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-5.5	**1709793-007A**	**Soil**	**09/15/2017 08:03**	**GC17 09201724.D**	**145800**

Analytes	Result	RL	DF	Date Analyzed
Surrogates	REC (%)	Limits		
2-Fluorophenol	77	30-130		09/20/2017 19:27
Phenol-d5	71	30-130		09/20/2017 19:27
Nitrobenzene-d5	69	30-130		09/20/2017 19:27
2-Fluorobiphenyl	60	30-130		09/20/2017 19:27
2,4,6-Tribromophenol	42	16-130		09/20/2017 19:27
4-Terphenyl-d14	68	30-130		09/20/2017 19:27

Analyst(s): REB

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3050B
Date Prepared:	9/19/17	**Analytical Method:**	SW6020
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

CAM / CCR 17 Metals

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	**1709793-001A**	**Soil**	**09/15/2017 15:20**	**ICP-MS3 131SMPL.D**	**145773**

Analytes	Result	RL	DF	Date Analyzed
Antimony	**1.3**	0.50	1	09/20/2017 23:20
Arsenic	**3.8**	0.50	1	09/20/2017 23:20
Barium	**120**	5.0	1	09/20/2017 23:20
Beryllium	ND	0.50	1	09/20/2017 23:20
Cadmium	ND	0.25	1	09/20/2017 23:20
Chromium	**30**	0.50	1	09/20/2017 23:20
Cobalt	**11**	0.50	1	09/20/2017 23:20
Copper	**120**	0.50	1	09/20/2017 23:20
Lead	**9.3**	0.50	1	09/20/2017 23:20
Mercury	**0.13**	0.050	1	09/20/2017 23:20
Molybdenum	ND	0.50	1	09/20/2017 23:20
Nickel	**53**	0.50	1	09/20/2017 23:20
Selenium	ND	0.50	1	09/20/2017 23:20
Silver	ND	0.50	1	09/20/2017 23:20
Thallium	ND	0.50	1	09/20/2017 23:20
Vanadium	**34**	0.50	1	09/20/2017 23:20
Zinc	**110**	5.0	1	09/20/2017 23:20

Surrogates	REC (%)	Limits	Date Analyzed
Terbium	101	70-130	09/20/2017 23:20

Analyst(s): DB

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3050B
Date Prepared:	9/19/17	**Analytical Method:**	SW6020
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

CAM / CCR 17 Metals

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-5.5	**1709793-002A**	**Soil**	**09/15/2017 15:30**	**ICP-MS3 132SMPL.D**	**145773**

Analytes	Result	RL	DF	Date Analyzed
Antimony	**0.92**	0.50	1	09/20/2017 23:26
Arsenic	**10**	0.50	1	09/20/2017 23:26
Barium	**140**	5.0	1	09/20/2017 23:26
Beryllium	**0.60**	0.50	1	09/20/2017 23:26
Cadmium	ND	0.25	1	09/20/2017 23:26
Chromium	**40**	0.50	1	09/20/2017 23:26
Cobalt	**12**	0.50	1	09/20/2017 23:26
Copper	**47**	0.50	1	09/20/2017 23:26
Lead	**8.6**	0.50	1	09/20/2017 23:26
Mercury	ND	0.050	1	09/20/2017 23:26
Molybdenum	**0.69**	0.50	1	09/20/2017 23:26
Nickel	**47**	0.50	1	09/20/2017 23:26
Selenium	ND	0.50	1	09/20/2017 23:26
Silver	ND	0.50	1	09/20/2017 23:26
Thallium	ND	0.50	1	09/20/2017 23:26
Vanadium	**70**	0.50	1	09/20/2017 23:26
Zinc	**77**	5.0	1	09/20/2017 23:26

Surrogates	REC (%)	Limits	
Terbium	103	70-130	09/20/2017 23:26

Analyst(s): DB

(Cont.)

Angela Rydelius, Lab Manager

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3050B
Date Prepared:	9/19/17	**Analytical Method:**	SW6020
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

CAM / CCR 17 Metals

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-2-3.0	**1709793-003A**	**Soil**	**09/15/2017 08:40**	**ICP-MS3 133SMPL.D**	**145773**

Analytes	Result	RL	DF	Date Analyzed
Antimony	**0.95**	0.50	1	09/20/2017 23:32
Arsenic	**9.0**	0.50	1	09/20/2017 23:32
Barium	**150**	5.0	1	09/20/2017 23:32
Beryllium	**0.53**	0.50	1	09/20/2017 23:32
Cadmium	ND	0.25	1	09/20/2017 23:32
Chromium	**52**	0.50	1	09/20/2017 23:32
Cobalt	**11**	0.50	1	09/20/2017 23:32
Copper	**39**	0.50	1	09/20/2017 23:32
Lead	**41**	0.50	1	09/20/2017 23:32
Mercury	**0.21**	0.050	1	09/20/2017 23:32
Molybdenum	**0.66**	0.50	1	09/20/2017 23:32
Nickel	**57**	0.50	1	09/20/2017 23:32
Selenium	ND	0.50	1	09/20/2017 23:32
Silver	ND	0.50	1	09/20/2017 23:32
Thallium	ND	0.50	1	09/20/2017 23:32
Vanadium	**54**	0.50	1	09/20/2017 23:32
Zinc	**94**	5.0	1	09/20/2017 23:32

Surrogates	REC (%)	Limits		
Terbium	107	70-130		09/20/2017 23:32

Analyst(s): DB

(Cont.)

Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3050B
Date Prepared:	9/19/17	**Analytical Method:**	SW6020
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

CAM / CCR 17 Metals

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-2-5.5	**1709793-004A**	**Soil**	**09/15/2017 08:50**	**ICP-MS3 134SMPL.D**	**145773**

Analytes	Result	RL	DF	Date Analyzed
Antimony	**0.78**	0.50	1	09/20/2017 23:38
Arsenic	**8.1**	0.50	1	09/20/2017 23:38
Barium	**160**	5.0	1	09/20/2017 23:38
Beryllium	**0.54**	0.50	1	09/20/2017 23:38
Cadmium	ND	0.25	1	09/20/2017 23:38
Chromium	**35**	0.50	1	09/20/2017 23:38
Cobalt	**11**	0.50	1	09/20/2017 23:38
Copper	**37**	0.50	1	09/20/2017 23:38
Lead	**16**	0.50	1	09/20/2017 23:38
Mercury	**0.098**	0.050	1	09/20/2017 23:38
Molybdenum	**0.64**	0.50	1	09/20/2017 23:38
Nickel	**41**	0.50	1	09/20/2017 23:38
Selenium	ND	0.50	1	09/20/2017 23:38
Silver	ND	0.50	1	09/20/2017 23:38
Thallium	ND	0.50	1	09/20/2017 23:38
Vanadium	**59**	0.50	1	09/20/2017 23:38
Zinc	**68**	5.0	1	09/20/2017 23:38

Surrogates	REC (%)	Limits	Date Analyzed
Terbium	99	70-130	09/20/2017 23:38

Analyst(s): DB

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3050B
Date Prepared:	9/19/17	**Analytical Method:**	SW6020
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

CAM / CCR 17 Metals

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-3.0	**1709793-006A**	**Soil**	**09/15/2017 07:52**	**ICP-MS3 138SMPL.D**	**145773**

Analytes	Result	RL	DF	Date Analyzed
Antimony	**0.81**	0.50	1	09/21/2017 00:03
Arsenic	**7.8**	0.50	1	09/21/2017 00:03
Barium	**150**	5.0	1	09/21/2017 00:03
Beryllium	ND	0.50	1	09/21/2017 00:03
Cadmium	ND	0.25	1	09/21/2017 00:03
Chromium	**49**	0.50	1	09/21/2017 00:03
Cobalt	**14**	0.50	1	09/21/2017 00:03
Copper	**41**	0.50	1	09/21/2017 00:03
Lead	**26**	0.50	1	09/21/2017 00:03
Mercury	**0.13**	0.050	1	09/21/2017 00:03
Molybdenum	**0.61**	0.50	1	09/21/2017 00:03
Nickel	**72**	0.50	1	09/21/2017 00:03
Selenium	ND	0.50	1	09/21/2017 00:03
Silver	ND	0.50	1	09/21/2017 00:03
Thallium	ND	0.50	1	09/21/2017 00:03
Vanadium	**62**	0.50	1	09/21/2017 00:03
Zinc	**88**	5.0	1	09/21/2017 00:03

Surrogates	REC (%)	Limits	
Terbium	105	70-130	09/21/2017 00:03

Analyst(s): DB

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3050B
Date Prepared:	9/19/17	**Analytical Method:**	SW6020
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

CAM / CCR 17 Metals

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-5.5	1709793-007A	Soil	09/15/2017 08:03	ICP-MS3 139SMPL.D	145773

Analytes	Result	RL	DF	Date Analyzed
Antimony	**0.86**	0.50	1	09/21/2017 00:09
Arsenic	**9.7**	0.50	1	09/21/2017 00:09
Barium	**140**	5.0	1	09/21/2017 00:09
Beryllium	ND	0.50	1	09/21/2017 00:09
Cadmium	ND	0.25	1	09/21/2017 00:09
Chromium	**36**	0.50	1	09/21/2017 00:09
Cobalt	**8.6**	0.50	1	09/21/2017 00:09
Copper	**33**	0.50	1	09/21/2017 00:09
Lead	**38**	0.50	1	09/21/2017 00:09
Mercury	**0.072**	0.050	1	09/21/2017 00:09
Molybdenum	**0.75**	0.50	1	09/21/2017 00:09
Nickel	**27**	0.50	1	09/21/2017 00:09
Selenium	ND	0.50	1	09/21/2017 00:09
Silver	ND	0.50	1	09/21/2017 00:09
Thallium	ND	0.50	1	09/21/2017 00:09
Vanadium	**57**	0.50	1	09/21/2017 00:09
Zinc	**53**	5.0	1	09/21/2017 00:09

Surrogates	REC (%)	Limits	Date Analyzed
Terbium	100	70-130	09/21/2017 00:09

Analyst(s): DB

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	CARB 435 Asbestos
Date Prepared:	9/20/17	**Analytical Method:**	435 CARB
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	%

Asbestos (CARB 435) 400 Point Count

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-2-3.0	**1709793-003A**	**Soil**	**09/15/2017 08:40**	**WetChem**	**145994**

Analytes	Result	RL	DF	Date Analyzed
Asbestos	ND	0.25	1	09/22/2017 14:00

Analyst(s): DA

Analytical Comments: k10

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW5030B
Date Prepared:	9/19/17-9/25/17	**Analytical Method:**	SW8021B/8015Bm
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Gasoline Range (C6-C12) Volatile Hydrocarbons as Gasoline with BTEX and MTBE

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	**1709793-001A**	**Soil**	**09/15/2017 15:20**	**GC19 09251715.D**	**146028**

Analytes	Result	RL	DF	Date Analyzed
TPH(g) (C6-C12)	**1.4**	1.0	1	09/25/2017 17:18
MTBE	---	0.050	1	09/25/2017 17:18
Benzene	---	0.0050	1	09/25/2017 17:18
Toluene	---	0.0050	1	09/25/2017 17:18
Ethylbenzene	---	0.0050	1	09/25/2017 17:18
Xylenes	---	0.015	1	09/25/2017 17:18

Surrogates	REC (%)	Limits	Date Analyzed
2-Fluorotoluene	89	62-126	09/25/2017 17:18

Analyst(s): IA Analytical Comments: d7

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-5.5	**1709793-002A**	**Soil**	**09/15/2017 15:30**	**GC19 09221717.D**	**145736**

Analytes	Result	RL	DF	Date Analyzed
TPH(g) (C6-C12)	ND	1.0	1	09/22/2017 20:26
MTBE	---	0.050	1	09/22/2017 20:26
Benzene	---	0.0050	1	09/22/2017 20:26
Toluene	---	0.0050	1	09/22/2017 20:26
Ethylbenzene	---	0.0050	1	09/22/2017 20:26
Xylenes	---	0.015	1	09/22/2017 20:26

Surrogates	REC (%)	Limits	Date Analyzed
2-Fluorotoluene	77	62-126	09/22/2017 20:26

Analyst(s): IA

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW5030B
Date Prepared:	9/19/17-9/25/17	**Analytical Method:**	SW8021B/8015Bm
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Gasoline Range (C6-C12) Volatile Hydrocarbons as Gasoline with BTEX and MTBE

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-2-3.0	**1709793-003A**	**Soil**	**09/15/2017 08:40**	**GC19 09221718.D**	**145736**

Analytes	Result	RL	DF	Date Analyzed
TPH(g) (C6-C12)	ND	1.0	1	09/22/2017 20:57
MTBE	---	0.050	1	09/22/2017 20:57
Benzene	---	0.0050	1	09/22/2017 20:57
Toluene	---	0.0050	1	09/22/2017 20:57
Ethylbenzene	---	0.0050	1	09/22/2017 20:57
Xylenes	---	0.015	1	09/22/2017 20:57

Surrogates	REC (%)	Limits	Date Analyzed
2-Fluorotoluene	79	62-126	09/22/2017 20:57

Analyst(s): IA

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-2-5.5	**1709793-004A**	**Soil**	**09/15/2017 08:50**	**GC19 09211736.D**	**145736**

Analytes	Result	RL	DF	Date Analyzed
TPH(g) (C6-C12)	ND	1.0	1	09/22/2017 05:40
MTBE	---	0.050	1	09/22/2017 05:40
Benzene	---	0.0050	1	09/22/2017 05:40
Toluene	---	0.0050	1	09/22/2017 05:40
Ethylbenzene	---	0.0050	1	09/22/2017 05:40
Xylenes	---	0.015	1	09/22/2017 05:40

Surrogates	REC (%)	Limits	Date Analyzed
2-Fluorotoluene	82	62-126	09/22/2017 05:40

Analyst(s): IA

(Cont.)

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW5030B
Date Prepared:	9/19/17-9/25/17	**Analytical Method:**	SW8021B/8015Bm
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Gasoline Range (C6-C12) Volatile Hydrocarbons as Gasoline with BTEX and MTBE

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-3.0	**1709793-006A**	**Soil**	**09/15/2017 07:52**	**GC19 09211738.D**	**145736**

Analytes	Result	RL	DF	Date Analyzed
TPH(g) (C6-C12)	ND	1.0	1	09/22/2017 06:40
MTBE	---	0.050	1	09/22/2017 06:40
Benzene	---	0.0050	1	09/22/2017 06:40
Toluene	---	0.0050	1	09/22/2017 06:40
Ethylbenzene	---	0.0050	1	09/22/2017 06:40
Xylenes	---	0.015	1	09/22/2017 06:40

Surrogates	REC (%)	Limits	Date Analyzed
2-Fluorotoluene	87	62-126	09/22/2017 06:40

Analyst(s): IA

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-5.5	**1709793-007A**	**Soil**	**09/15/2017 08:03**	**GC19 09211739.D**	**145736**

Analytes	Result	RL	DF	Date Analyzed
TPH(g) (C6-C12)	ND	1.0	1	09/22/2017 07:10
MTBE	---	0.050	1	09/22/2017 07:10
Benzene	---	0.0050	1	09/22/2017 07:10
Toluene	---	0.0050	1	09/22/2017 07:10
Ethylbenzene	---	0.0050	1	09/22/2017 07:10
Xylenes	---	0.015	1	09/22/2017 07:10

Surrogates	REC (%)	Limits	Date Analyzed
2-Fluorotoluene	77	62-126	09/22/2017 07:10

Analyst(s): IA

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/19/17	**Analytical Method:**	SW8015B
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Total Extractable Petroleum Hydrocarbons w/out SG Clean-Up

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	**1709793-001A**	**Soil**	**09/15/2017 15:20**	**GC9a 09261710.D**	**145780**

Analytes	Result		RL	DF	Date Analyzed
TPH-Diesel (C10-C23)	**210**		50	50	09/26/2017 13:48
TPH-Motor Oil (C18-C36)	**4300**		250	50	09/26/2017 13:48
Surrogates	**REC (%)**	**Qualifiers**	**Limits**		
C9	271	S	78-126		09/26/2017 13:48

Analyst(s): TK   Analytical Comments: e7,e2,c2

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-5.5	**1709793-002A**	**Soil**	**09/15/2017 15:30**	**GC39A 09251750.D**	**145780**

Analytes	Result	RL	DF	Date Analyzed
TPH-Diesel (C10-C23)	ND	1.0	1	09/26/2017 00:37
TPH-Motor Oil (C18-C36)	ND	5.0	1	09/26/2017 00:37
Surrogates	**REC (%)**	**Limits**		
C9	95	78-126		09/26/2017 00:37

Analyst(s): TK

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-2-3.0	**1709793-003A**	**Soil**	**09/15/2017 08:40**	**GC39A 09251752.D**	**145780**

Analytes	Result	RL	DF	Date Analyzed
TPH-Diesel (C10-C23)	**3.5**	1.0	1	09/26/2017 01:15
TPH-Motor Oil (C18-C36)	**18**	5.0	1	09/26/2017 01:15
Surrogates	**REC (%)**	**Limits**		
C9	97	78-126		09/26/2017 01:15

Analyst(s): TK   Analytical Comments: e7,e2

(Cont.)

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B
Date Prepared:	9/19/17	**Analytical Method:**	SW8015B
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Total Extractable Petroleum Hydrocarbons w/out SG Clean-Up

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-2-5.5	**1709793-004A**	**Soil**	**09/15/2017 08:50**	**GC39A 09251744.D**	**145780**

Analytes	Result	RL	DF	Date Analyzed
TPH-Diesel (C10-C23)	ND	1.0	1	09/25/2017 22:40
TPH-Motor Oil (C18-C36)	**8.6**	5.0	1	09/25/2017 22:40

Surrogates	REC (%)	Limits	Date Analyzed
C9	95	78-126	09/25/2017 22:40

Analyst(s): TK — Analytical Comments: e7

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-3.0	**1709793-006A**	**Soil**	**09/15/2017 07:52**	**GC39A 09251760.D**	**145780**

Analytes	Result	RL	DF	Date Analyzed
TPH-Diesel (C10-C23)	**3.6**	1.0	1	09/26/2017 03:51
TPH-Motor Oil (C18-C36)	**24**	5.0	1	09/26/2017 03:51

Surrogates	REC (%)	Limits	Date Analyzed
C9	97	78-126	09/26/2017 03:51

Analyst(s): TK — Analytical Comments: e7,e2

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-3-5.5	**1709793-007A**	**Soil**	**09/15/2017 08:03**	**GC39A 09251756.D**	**145780**

Analytes	Result	RL	DF	Date Analyzed
TPH-Diesel (C10-C23)	**2.5**	1.0	1	09/26/2017 02:33
TPH-Motor Oil (C18-C36)	**12**	5.0	1	09/26/2017 02:33

Surrogates	REC (%)	Limits	Date Analyzed
C9	95	78-126	09/26/2017 02:33

Analyst(s): TK — Analytical Comments: e7,e2

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/19/17	**BatchID:**	145782
Date Analyzed:	9/21/17	**Extraction Method:**	SW3550B
Instrument:	GC22	**Analytical Method:**	SW8082
Matrix:	Soil	**Unit:**	mg/kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145782 1709793-001AMS/MSD

QC Summary Report for SW8082

Analyte	MB Result	LCS Result	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
Aroclor1016	ND	0.151	0.050	0.15	-	101	70-130
Aroclor1221	ND	-	0.050	-	-	-	-
Aroclor1232	ND	-	0.050	-	-	-	-
Aroclor1242	ND	-	0.050	-	-	-	-
Aroclor1248	ND	-	0.050	-	-	-	-
Aroclor1254	ND	-	0.050	-	-	-	-
Aroclor1260	ND	0.148	0.050	0.15	-	98	70-130
PCBs, total	ND	-	0.050	-	-	-	-
Surrogate Recovery							
Decachlorobiphenyl	0.04906	0.0523		0.050	98	105	70-130

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
Aroclor1016	NR	NR		ND<1	NR	NR	-	NR	-
Aroclor1260	NR	NR		ND<1	NR	NR	-	NR	-
Surrogate Recovery									
Decachlorobiphenyl	NR	NR			NR	NR	-	NR	-

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QA/QC Officer

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/19/17	**BatchID:**	145735
Date Analyzed:	9/20/17 - 9/22/17	**Extraction Method:**	SW5030B
Instrument:	GC10, GC18	**Analytical Method:**	SW8260B
Matrix:	Soil	**Unit:**	mg/kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145735 1709780-002AMS/MSD

QC Summary Report for SW8260B

Analyte	MB Result	LCS Result	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
Acetone	ND	1.18	0.10	1	-	118	48-156
tert-Amyl methyl ether (TAME)	ND	0.0400	0.0050	0.050	-	80	56-115
Benzene	ND	0.0476	0.0050	0.050	-	95	63-131
Bromobenzene	ND	0.0490	0.0050	0.050	-	98	66-127
Bromochloromethane	ND	0.0449	0.0050	0.050	-	90	64-124
Bromodichloromethane	ND	0.0416	0.0050	0.050	-	83	64-120
Bromoform	ND	0.0350	0.0050	0.050	-	70	48-92
Bromomethane	ND	0.0578	0.0050	0.050	-	116	25-163
2-Butanone (MEK)	ND	0.184	0.020	0.20	-	92	51-133
t-Butyl alcohol (TBA)	ND	0.202	0.050	0.20	-	101	52-129
n-Butyl benzene	ND	0.0721	0.0050	0.050	-	144	83-200
sec-Butyl benzene	ND	0.0789	0.0050	0.050	-	158	81-199
tert-Butyl benzene	ND	0.0662	0.0050	0.050	-	132	79-178
Carbon Disulfide	ND	0.0522	0.0050	0.050	-	104	64-136
Carbon Tetrachloride	ND	0.0482	0.0050	0.050	-	96	66-140
Chlorobenzene	ND	0.0453	0.0050	0.050	-	91	73-116
Chloroethane	ND	0.0569	0.0050	0.050	-	114	35-147
Chloroform	ND	0.0454	0.0050	0.050	-	91	65-130
Chloromethane	ND	0.0444	0.0050	0.050	-	89	30-137
2-Chlorotoluene	ND	0.0619	0.0050	0.050	-	124	75-152
4-Chlorotoluene	ND	0.0561	0.0050	0.050	-	112	71-148
Dibromochloromethane	ND	0.0406	0.0050	0.050	-	81	61-106
1,2-Dibromo-3-chloropropane	ND	0.0162	0.0040	0.020	-	81	36-120
1,2-Dibromoethane (EDB)	ND	0.0441	0.0040	0.050	-	88	67-118
Dibromomethane	ND	0.0425	0.0050	0.050	-	85	61-116
1,2-Dichlorobenzene	ND	0.0398	0.0050	0.050	-	80	59-106
1,3-Dichlorobenzene	ND	0.0569	0.0050	0.050	-	114	75-129
1,4-Dichlorobenzene	ND	0.0476	0.0050	0.050	-	95	66-127
Dichlorodifluoromethane	ND	0.0233	0.0050	0.050	-	47	13-74
1,1-Dichloroethane	ND	0.0468	0.0050	0.050	-	94	65-134
1,2-Dichloroethane (1,2-DCA)	ND	0.0449	0.0040	0.050	-	90	57-131
1,1-Dichloroethene	ND	0.0488	0.0050	0.050	-	98	62-127
cis-1,2-Dichloroethene	ND	0.0461	0.0050	0.050	-	92	66-130
trans-1,2-Dichloroethene	ND	0.0484	0.0050	0.050	-	97	60-131
1,2-Dichloropropane	ND	0.0428	0.0050	0.050	-	86	63-127
1,3-Dichloropropane	ND	0.0452	0.0050	0.050	-	90	68-124
2,2-Dichloropropane	ND	0.0503	0.0050	0.050	-	101	63-150

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/19/17	**BatchID:**	145735
Date Analyzed:	9/20/17 - 9/22/17	**Extraction Method:**	SW5030B
Instrument:	GC10, GC18	**Analytical Method:**	SW8260B
Matrix:	Soil	**Unit:**	mg/kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145735 1709780-002AMS/MSD

QC Summary Report for SW8260B

Analyte	MB Result	LCS Result	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
1,1-Dichloropropene	ND	0.0486	0.0050	0.050	-	97	67-134
cis-1,3-Dichloropropene	ND	0.0460	0.0050	0.050	-	92	65-138
trans-1,3-Dichloropropene	ND	0.0458	0.0050	0.050	-	92	66-124
Diisopropyl ether (DIPE)	ND	0.0420	0.0050	0.050	-	84	58-129
Ethylbenzene	ND	0.0540	0.0050	0.050	-	108	73-145
Ethyl tert-butyl ether (ETBE)	ND	0.0431	0.0050	0.050	-	86	62-125
Freon 113	ND	0.0445	0.0050	0.050	-	89	55-116
Hexachlorobutadiene	ND	0.0545	0.0050	0.050	-	109	75-178
Hexachloroethane	ND	0.0593	0.0050	0.050	-	119	75-152
2-Hexanone	ND	0.0396	0.0050	0.050	-	79	41-113
Isopropylbenzene	ND	0.0705	0.0050	0.050	-	141	67-172
4-Isopropyl toluene	ND	0.0695	0.0050	0.050	-	139	88-171
Methyl-t-butyl ether (MTBE)	ND	0.0446	0.0050	0.050	-	89	58-122
Methylene chloride	ND	0.0458	0.0050	0.050	-	92	57-140
4-Methyl-2-pentanone (MIBK)	ND	0.0383	0.0050	0.050	-	77	42-117
Naphthalene	ND	0.0230	0.0050	0.050	-	46	29-65
n-Propyl benzene	ND	0.0711	0.0050	0.050	-	142	85-174
Styrene	ND	0.0422	0.0050	0.050	-	84	63-126
1,1,1,2-Tetrachloroethane	ND	0.0438	0.0050	0.050	-	88	68-131
1,1,2,2-Tetrachloroethane	ND	0.0434	0.0050	0.050	-	87	45-121
Tetrachloroethene	ND	0.0512	0.0050	0.050	-	102	65-150
Toluene	ND	0.0489	0.0050	0.050	-	98	72-135
1,2,3-Trichlorobenzene	ND	0.0291	0.0050	0.050	-	58	35-80
1,2,4-Trichlorobenzene	ND	0.0344	0.0050	0.050	-	69	45-103
1,1,1-Trichloroethane	ND	0.0483	0.0050	0.050	-	97	67-137
1,1,2-Trichloroethane	ND	0.0434	0.0050	0.050	-	87	67-117
Trichloroethene	ND	0.0456	0.0050	0.050	-	91	62-135
Trichlorofluoromethane	ND	0.0470	0.0050	0.050	-	94	56-124
1,2,3-Trichloropropane	ND	0.0538	0.0050	0.050	-	108	58-133
1,2,4-Trimethylbenzene	ND	0.0622	0.0050	0.050	-	124	78-161
1,3,5-Trimethylbenzene	ND	0.0662	0.0050	0.050	-	132	85-170
Vinyl Chloride	ND	0.0489	0.0050	0.050	-	98	32-142
Xylenes, Total	ND	0.152	0.0050	0.15	-	101	70-137

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/19/17	**BatchID:**	145735
Date Analyzed:	9/20/17 - 9/22/17	**Extraction Method:**	SW5030B
Instrument:	GC10, GC18	**Analytical Method:**	SW8260B
Matrix:	Soil	**Unit:**	mg/kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145735 1709780-002AMS/MSD

QC Summary Report for SW8260B

Analyte	MB Result	LCS Result	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
Surrogate Recovery							
Dibromofluoromethane	0.1442	0.144		0.12	115	115	87-127
Toluene-d8	0.1622	0.167		0.12	130	134	93-141
4-BFB	0.01284	0.0136		0.012	103	109	84-137
Benzene-d6	0.1149	0.115		0.10	115	115	67-131
Ethylbenzene-d10	0.132	0.134		0.10	132	135	78-153
1,2-DCB-d4	0.0763	0.0840		0.10	76	84	63-109

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/19/17	**BatchID:**	145735
Date Analyzed:	9/20/17 - 9/22/17	**Extraction Method:**	SW5030B
Instrument:	GC10, GC18	**Analytical Method:**	SW8260B
Matrix:	Soil	**Unit:**	mg/kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145735 1709780-002AMS/MSD

QC Summary Report for SW8260B

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
Acetone	0.992	0.919	1	ND	99	92	36-141	7.67	20
tert-Amyl methyl ether (TAME)	0.0360	0.0332	0.050	ND	72	66	46-105	8.11	20
Benzene	0.0422	0.0396	0.050	ND	84	79	46-124	6.34	20
Bromobenzene	0.0429	0.0394	0.050	ND	86	79	50-119	8.55	20
Bromochloromethane	0.0398	0.0368	0.050	ND	80	74	42-122	7.73	20
Bromodichloromethane	0.0376	0.0353	0.050	ND	75	71	48-112	6.35	20
Bromoform	0.0330	0.0310	0.050	ND	66	62	36-90	6.07	20
Bromomethane	0.0480	0.0489	0.050	ND	96	98	10-149	1.85	20
2-Butanone (MEK)	0.161	0.143	0.20	ND	80	71	43-114	12.0	20
t-Butyl alcohol (TBA)	0.181	0.166	0.20	ND	91	83	33-123	8.51	20
n-Butyl benzene	0.0596	0.0552	0.050	ND	119	111	40-185	7.59	20
sec-Butyl benzene	0.0646	0.0610	0.050	ND	129	122	40-183	5.77	20
tert-Butyl benzene	0.0547	0.0504	0.050	ND	109	101	44-168	8.17	20
Carbon Disulfide	0.0452	0.0427	0.050	ND	90	85	23-139	5.61	20
Carbon Tetrachloride	0.0427	0.0404	0.050	ND	85	81	43-133	5.60	20
Chlorobenzene	0.0404	0.0376	0.050	ND	81	75	51-115	7.06	20
Chloroethane	0.0484	0.0468	0.050	ND	97	94	16-138	3.42	20
Chloroform	0.0404	0.0380	0.050	ND	81	76	54-117	6.13	20
Chloromethane	0.0370	0.0364	0.050	ND	74	73	14-128	1.52	20
2-Chlorotoluene	0.0524	0.0481	0.050	ND	105	96	54-141	8.57	20
4-Chlorotoluene	0.0471	0.0435	0.050	ND	94	87	52-134	7.97	20
Dibromochloromethane	0.0366	0.0343	0.050	ND	73	69	46-102	6.41	20
1,2-Dibromo-3-chloropropane	0.0145	0.0136	0.020	ND	72	68	16-120	6.32	20
1,2-Dibromoethane (EDB)	0.0389	0.0362	0.050	ND	78	72	48-113	7.24	20
Dibromomethane	0.0383	0.0358	0.050	ND	77	72	44-110	6.67	20
1,2-Dichlorobenzene	0.0354	0.0334	0.050	ND	71	67	43-106	5.84	20
1,3-Dichlorobenzene	0.0491	0.0453	0.050	ND	98	91	49-128	8.13	20
1,4-Dichlorobenzene	0.0422	0.0392	0.050	ND	84	78	48-120	7.36	20
Dichlorodifluoromethane	0.0181	0.0186	0.050	ND	36	37	8-63	2.65	20
1,1-Dichloroethane	0.0415	0.0391	0.050	ND	83	78	50-122	6.01	20
1,2-Dichloroethane (1,2-DCA)	0.0402	0.0376	0.050	ND	80	75	46-116	6.44	20
1,1-Dichloroethene	0.0428	0.0406	0.050	ND	86	81	37-124	5.35	20
cis-1,2-Dichloroethene	0.0410	0.0385	0.050	ND	82	77	47-123	6.23	20
trans-1,2-Dichloroethene	0.0426	0.0399	0.050	ND	85	80	31-131	6.35	20
1,2-Dichloropropane	0.0384	0.0360	0.050	ND	77	72	50-116	6.46	20
1,3-Dichloropropane	0.0403	0.0371	0.050	ND	81	74	52-115	8.29	20
2,2-Dichloropropane	0.0444	0.0418	0.050	ND	89	84	43-137	6.25	20

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/19/17	**BatchID:**	145735
Date Analyzed:	9/20/17 - 9/22/17	**Extraction Method:**	SW5030B
Instrument:	GC10, GC18	**Analytical Method:**	SW8260B
Matrix:	Soil	**Unit:**	mg/kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145735 1709780-002AMS/MSD

QC Summary Report for SW8260B

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
1,1-Dichloropropene	0.0431	0.0406	0.050	ND	86	81	43-126	5.99	20
cis-1,3-Dichloropropene	0.0408	0.0374	0.050	ND	82	75	35-134	8.63	20
trans-1,3-Dichloropropene	0.0409	0.0377	0.050	ND	82	75	35-124	8.27	20
Diisopropyl ether (DIPE)	0.0374	0.0347	0.050	ND	75	69	49-116	7.58	20
Ethylbenzene	0.0486	0.0448	0.050	ND	97	90	49-137	8.23	20
Ethyl tert-butyl ether (ETBE)	0.0382	0.0352	0.050	ND	76	70	50-113	8.34	20
Freon 113	0.0373	0.0356	0.050	ND	75	71	28-114	4.90	20
Hexachlorobutadiene	0.0467	0.0431	0.050	ND	93	86	22-180	8.08	20
Hexachloroethane	0.0490	0.0462	0.050	ND	98	92	28-158	5.90	20
2-Hexanone	0.0361	0.0328	0.050	ND	72	66	31-102	9.68	20
Isopropylbenzene	0.0582	0.0536	0.050	ND	116	107	50-153	8.34	20
4-Isopropyl toluene	0.0582	0.0545	0.050	ND	117	109	41-171	6.71	20
Methyl-t-butyl ether (MTBE)	0.0394	0.0362	0.050	ND	79	72	48-110	8.47	20
Methylene chloride	0.0411	0.0391	0.050	ND	82	78	42-127	5.01	20
4-Methyl-2-pentanone (MIBK)	0.0344	0.0316	0.050	ND	69	63	24-114	8.49	20
Naphthalene	0.0219	0.0196	0.050	ND	44	39	19-69	11.0	20
n-Propyl benzene	0.0585	0.0538	0.050	ND	117	108	46-168	8.40	20
Styrene	0.0379	0.0356	0.050	ND	76	71	42-122	6.29	20
1,1,1,2-Tetrachloroethane	0.0389	0.0361	0.050	ND	78	72	52-121	7.39	20
1,1,2,2-Tetrachloroethane	0.0387	0.0367	0.050	ND	77	73	27-116	5.36	20
Tetrachloroethene	0.0450	0.0418	0.050	ND	90	84	37-149	7.19	20
Toluene	0.0490	0.0444	0.050	0.01348	71	62	52-124	9.82	20
1,2,3-Trichlorobenzene	0.0274	0.0252	0.050	ND	55	50	20-86	8.60	20
1,2,4-Trichlorobenzene	0.0314	0.0287	0.050	ND	63	57	24-107	9.12	20
1,1,1-Trichloroethane	0.0428	0.0405	0.050	ND	86	81	48-128	5.60	20
1,1,2-Trichloroethane	0.0388	0.0361	0.050	ND	77	72	51-110	7.18	20
Trichloroethene	0.0406	0.0383	0.050	ND	81	77	42-128	5.93	20
Trichlorofluoromethane	0.0402	0.0381	0.050	ND	80	76	31-121	5.46	20
1,2,3-Trichloropropane	0.0467	0.0427	0.050	ND	93	85	50-115	9.13	20
1,2,4-Trimethylbenzene	0.0524	0.0490	0.050	ND	105	98	48-151	6.68	20
1,3,5-Trimethylbenzene	0.0551	0.0509	0.050	ND	110	102	51-159	7.87	20
Vinyl Chloride	0.0408	0.0403	0.050	ND	82	81	11-136	1.41	20
Xylenes, Total	0.140	0.129	0.15	ND	94	86	38-141	8.32	20

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/19/17	**BatchID:**	145735
Date Analyzed:	9/20/17 - 9/22/17	**Extraction Method:**	SW5030B
Instrument:	GC10, GC18	**Analytical Method:**	SW8260B
Matrix:	Soil	**Unit:**	mg/kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145735 1709780-002AMS/MSD

QC Summary Report for SW8260B

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
Surrogate Recovery									
Dibromofluoromethane	0.144	0.144	0.12		115	115	82-136	0	20
Toluene-d8	0.165	0.162	0.12		132	129	92-139	1.73	20
4-BFB	0.0130	0.0130	0.012		104	104	82-135	0	20
Benzene-d6	0.101	0.0958	0.10		101	96	55-122	5.75	20
Ethylbenzene-d10	0.118	0.110	0.10		118	110	58-141	7.15	20
1,2-DCB-d4	0.0756	0.0720	0.10		76	72	51-107	4.75	20

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/25/17	**BatchID:**	146037
Date Analyzed:	9/26/17	**Extraction Method:**	SW5030B
Instrument:	GC28	**Analytical Method:**	SW8260B
Matrix:	Soil	**Unit:**	mg/kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-146037

QC Summary Report for SW8260B

Analyte	MB Result	LCS Result	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
Acetone	ND	1.04	0.10	1	-	104	48-156
tert-Amyl methyl ether (TAME)	ND	0.0334	0.0050	0.050	-	67	56-115
Benzene	ND	0.0440	0.0050	0.050	-	88	63-131
Bromobenzene	ND	0.0433	0.0050	0.050	-	87	66-127
Bromochloromethane	ND	0.0412	0.0050	0.050	-	82	64-124
Bromodichloromethane	ND	0.0454	0.0050	0.050	-	91	64-120
Bromoform	ND	0.0372	0.0050	0.050	-	74	48-92
Bromomethane	ND	0.0587	0.0050	0.050	-	117	25-163
2-Butanone (MEK)	ND	0.139	0.020	0.20	-	70	51-133
t-Butyl alcohol (TBA)	ND	0.161	0.050	0.20	-	80	52-129
n-Butyl benzene	ND	0.0567	0.0050	0.050	-	113	83-200
sec-Butyl benzene	ND	0.0581	0.0050	0.050	-	116	81-199
tert-Butyl benzene	ND	0.0530	0.0050	0.050	-	106	79-178
Carbon Disulfide	ND	0.0561	0.0050	0.050	-	112	64-136
Carbon Tetrachloride	ND	0.0499	0.0050	0.050	-	100	66-140
Chlorobenzene	ND	0.0434	0.0050	0.050	-	87	73-116
Chloroethane	ND	0.0536	0.0050	0.050	-	107	35-147
Chloroform	ND	0.0438	0.0050	0.050	-	88	65-130
Chloromethane	ND	0.0575	0.0050	0.050	-	115	30-137
2-Chlorotoluene	ND	0.0485	0.0050	0.050	-	97	75-152
4-Chlorotoluene	ND	0.0479	0.0050	0.050	-	96	71-148
Dibromochloromethane	ND	0.0379	0.0050	0.050	-	76	61-106
1,2-Dibromo-3-chloropropane	ND	0.0127	0.0040	0.020	-	64	36-120
1,2-Dibromoethane (EDB)	ND	0.0403	0.0040	0.050	-	81	67-118
Dibromomethane	ND	0.0400	0.0050	0.050	-	80	61-116
1,2-Dichlorobenzene	ND	0.0389	0.0050	0.050	-	78	59-106
1,3-Dichlorobenzene	ND	0.0466	0.0050	0.050	-	93	75-129
1,4-Dichlorobenzene	ND	0.0439	0.0050	0.050	-	88	66-127
Dichlorodifluoromethane	ND	0.0345	0.0050	0.050	-	69	13-74
1,1-Dichloroethane	ND	0.0435	0.0050	0.050	-	87	65-134
1,2-Dichloroethane (1,2-DCA)	ND	0.0391	0.0040	0.050	-	78	57-131
1,1-Dichloroethene	ND	0.0529	0.0050	0.050	-	106	62-127
cis-1,2-Dichloroethene	ND	0.0383	0.0050	0.050	-	77	66-130
trans-1,2-Dichloroethene	ND	0.0514	0.0050	0.050	-	103	60-131
1,2-Dichloropropane	ND	0.0420	0.0050	0.050	-	84	63-127
1,3-Dichloropropane	ND	0.0379	0.0050	0.050	-	76	68-124
2,2-Dichloropropane	ND	0.0507	0.0050	0.050	-	101	63-150

(Cont.)

QA/QC Officer

Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/25/17	**BatchID:**	146037
Date Analyzed:	9/26/17	**Extraction Method:**	SW5030B
Instrument:	GC28	**Analytical Method:**	SW8260B
Matrix:	Soil	**Unit:**	mg/kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-146037

QC Summary Report for SW8260B

Analyte	MB Result	LCS Result	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
1,1-Dichloropropene	ND	0.0476	0.0050	0.050	-	95	67-134
cis-1,3-Dichloropropene	ND	0.0402	0.0050	0.050	-	80	65-138
trans-1,3-Dichloropropene	ND	0.0380	0.0050	0.050	-	76	66-124
Diisopropyl ether (DIPE)	ND	0.0383	0.0050	0.050	-	77	58-129
Ethylbenzene	ND	0.0487	0.0050	0.050	-	97	73-145
Ethyl tert-butyl ether (ETBE)	ND	0.0364	0.0050	0.050	-	73	62-125
Freon 113	ND	0.0482	0.0050	0.050	-	96	55-116
Hexachlorobutadiene	ND	0.0606	0.0050	0.050	-	121	75-178
Hexachloroethane	ND	0.0514	0.0050	0.050	-	103	75-152
2-Hexanone	ND	0.0301	0.0050	0.050	-	60	41-113
Isopropylbenzene	ND	0.0532	0.0050	0.050	-	106	67-172
4-Isopropyl toluene	ND	0.0560	0.0050	0.050	-	112	88-171
Methyl-t-butyl ether (MTBE)	ND	0.0359	0.0050	0.050	-	72	58-122
Methylene chloride	ND	0.0543	0.0050	0.050	-	109	57-140
4-Methyl-2-pentanone (MIBK)	ND	0.0287	0.0050	0.050	-	57	42-117
Naphthalene	ND	0.0206	0.0050	0.050	-	41	29-65
n-Propyl benzene	ND	0.0560	0.0050	0.050	-	112	85-174
Styrene	ND	0.0462	0.0050	0.050	-	93	63-126
1,1,1,2-Tetrachloroethane	ND	0.0480	0.0050	0.050	-	96	68-131
1,1,2,2-Tetrachloroethane	ND	0.0343	0.0050	0.050	-	69	45-121
Tetrachloroethene	ND	0.0518	0.0050	0.050	-	104	65-150
Toluene	ND	0.0471	0.0050	0.050	-	94	72-135
1,2,3-Trichlorobenzene	ND	0.0290	0.0050	0.050	-	58	35-80
1,2,4-Trichlorobenzene	ND	0.0374	0.0050	0.050	-	75	45-103
1,1,1-Trichloroethane	ND	0.0471	0.0050	0.050	-	94	67-137
1,1,2-Trichloroethane	ND	0.0385	0.0050	0.050	-	77	67-117
Trichloroethene	ND	0.0463	0.0050	0.050	-	93	62-135
Trichlorofluoromethane	ND	0.0524	0.0050	0.050	-	105	56-124
1,2,3-Trichloropropane	ND	0.0384	0.0050	0.050	-	77	58-133
1,2,4-Trimethylbenzene	ND	0.0531	0.0050	0.050	-	106	78-161
1,3,5-Trimethylbenzene	ND	0.0538	0.0050	0.050	-	108	85-170
Vinyl Chloride	ND	0.0622	0.0050	0.050	-	124	32-142
Xylenes, Total	ND	0.146	0.0050	0.15	-	97	70-137

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/25/17	**BatchID:**	146037
Date Analyzed:	9/26/17	**Extraction Method:**	SW5030B
Instrument:	GC28	**Analytical Method:**	SW8260B
Matrix:	Soil	**Unit:**	mg/kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-146037

QC Summary Report for SW8260B

Analyte	MB Result	LCS Result	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
Surrogate Recovery							
Dibromofluoromethane	0.1236	0.126		0.12	99	100	87-127
Toluene-d8	0.1412	0.140		0.12	113	112	93-141
4-BFB	0.009991	0.0113		0.012	80,F3	90	84-137
Benzene-d6	0.08958	0.0915		0.10	90	92	67-131
Ethylbenzene-d10	0.1037	0.103		0.10	104	103	78-153
1,2-DCB-d4	0.08249	0.0836		0.10	82	84	63-109

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/20/17	**BatchID:**	145799
Date Analyzed:	9/20/17	**Extraction Method:**	SW3550B
Instrument:	GC35	**Analytical Method:**	SW8270C-SIM
Matrix:	Soil	**Unit:**	mg/kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145799 1709774-001AMS/MSD

QC Summary Report for SW8270C

Analyte	MB Result	LCS Result	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
Acenaphthene	ND	-	0.010	-	-	-	-
Acenaphthylene	ND	-	0.010	-	-	-	-
Anthracene	ND	-	0.010	-	-	-	-
Benzo (a) anthracene	ND	-	0.010	-	-	-	-
Benzo (a) pyrene	ND	0.184	0.010	0.20	-	92	23-129
Benzo (b) fluoranthene	ND	-	0.010	-	-	-	-
Benzo (g,h,i) perylene	ND	-	0.010	-	-	-	-
Benzo (k) fluoranthene	ND	-	0.010	-	-	-	-
Chrysene	ND	0.164	0.010	0.20	-	82	38-104
Dibenzo (a,h) anthracene	ND	-	0.010	-	-	-	-
Fluoranthene	ND	-	0.010	-	-	-	-
Fluorene	ND	-	0.010	-	-	-	-
Indeno (1,2,3-cd) pyrene	ND	-	0.010	-	-	-	-
1-Methylnaphthalene	ND	0.226	0.010	0.20	-	113, F2	59-106
2-Methylnaphthalene	ND	0.214	0.010	0.20	-	107	54-108
Naphthalene	ND	-	0.010	-	-	-	-
Phenanthrene	ND	0.187	0.010	0.20	-	94	48-107
Pyrene	ND	0.204	0.010	0.20	-	102	40-104
Surrogate Recovery							
1-Fluoronaphthalene	0.4606	0.519		0.50	92	104	63-123
2-Fluorobiphenyl	0.424	0.484		0.50	85	97	55-127

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
Benzo (a) pyrene	NR	NR		ND<10	NR	NR	-	NR	-
Chrysene	NR	NR		ND<10	NR	NR	-	NR	-
1-Methylnaphthalene	NR	NR		ND<10	NR	NR	-	NR	-
2-Methylnaphthalene	NR	NR		ND<10	NR	NR	-	NR	-
Phenanthrene	NR	NR		ND<10	NR	NR	-	NR	-
Pyrene	NR	NR		ND<10	NR	NR	-	NR	-
Surrogate Recovery									
1-Fluoronaphthalene	NR	NR			NR	NR	-	NR	-
2-Fluorobiphenyl	NR	NR			NR	NR	-	NR	-

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/20/17	**BatchID:**	145800
Date Analyzed:	9/20/17	**Extraction Method:**	SW3550B
Instrument:	GC17	**Analytical Method:**	SW8270C
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145800 1709774-001AMS/MSD

QC Summary Report for SW8270C

Analyte	MB Result	LCS Result	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
Acenaphthene	ND	2.88	0.25	5	-	58	46-118
Acenaphthylene	ND	3.13	0.25	5	-	63	43-122
Acetochlor	ND	-	0.25	-	-	-	-
Anthracene	ND	3.10	0.25	5	-	62	47-125
Benzidine	ND	1.07	1.3	5	-	21	13-83
Benzo (a) anthracene	ND	3.14	0.25	5	-	63	53-117
Benzo (a) pyrene	ND	4.10	0.25	5	-	82	53-138
Benzo (b) fluoranthene	ND	3.65	0.25	5	-	73	48-125
Benzo (g,h,i) perylene	ND	3.96	0.25	5	-	79	51-146
Benzo (k) fluoranthene	ND	3.42	0.25	5	-	68	53-124
Benzyl Alcohol	ND	3.32	1.3	5	-	66	51-105
1,1-Biphenyl	ND	-	0.25	-	-	-	-
Bis (2-chloroethoxy) Methane	ND	2.85	0.25	5	-	57	48-115
Bis (2-chloroethyl) Ether	ND	3.11	0.25	5	-	62	51-105
Bis (2-chloroisopropyl) Ether	ND	3.08	0.25	5	-	62, F2	85-119
Bis (2-ethylhexyl) Adipate	ND	3.27	0.25	5	-	65	46-117
Bis (2-ethylhexyl) Phthalate	ND	2.92	0.25	5	-	58	50-124
4-Bromophenyl Phenyl Ether	ND	3.01	0.25	5	-	60, F2	70-112
Butylbenzyl Phthalate	ND	3.44	0.25	5	-	69	55-127
4-Chloroaniline	ND	1.72	0.50	5	-	34	18-77
4-Chloro-3-methylphenol	ND	3.33	0.25	5	-	67	49-123
2-Chloronaphthalene	ND	2.74	0.25	5	-	55	44-109
2-Chlorophenol	ND	3.30	0.25	5	-	66	55-116
4-Chlorophenyl Phenyl Ether	ND	3.00	0.25	5	-	60	45-122
Chrysene	ND	3.43	0.25	5	-	69	54-116
Dibenzo (a,h) anthracene	ND	4.02	0.25	5	-	80	52-141
Dibenzofuran	ND	3.09	0.25	5	-	62	46-117
Di-n-butyl Phthalate	ND	2.87	0.25	5	-	57	45-126
1,2-Dichlorobenzene	ND	3.45	0.25	5	-	69	55-105
1,3-Dichlorobenzene	ND	3.28	0.25	5	-	66	51-104
1,4-Dichlorobenzene	ND	3.08	0.25	5	-	62	50-102
3,3-Dichlorobenzidine	ND	2.14	0.50	5	-	43	20-84
2,4-Dichlorophenol	ND	3.61	0.25	5	-	72	54-124
Diethyl Phthalate	ND	2.86	0.25	5	-	57	42-118
2,4-Dimethylphenol	ND	3.41	0.25	5	-	68	53-120
Dimethyl Phthalate	ND	2.79	0.25	5	-	56	45-118
4,6-Dinitro-2-methylphenol	ND	3.69	1.3	5	-	74	32-126

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/20/17	**BatchID:**	145800
Date Analyzed:	9/20/17	**Extraction Method:**	SW3550B
Instrument:	GC17	**Analytical Method:**	SW8270C
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145800 1709774-001AMS/MSD

QC Summary Report for SW8270C

Analyte	MB Result	LCS Result	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
2,4-Dinitrophenol	ND	3.97	6.3	5	-	79	20-130
2,4-Dinitrotoluene	ND	3.17	0.25	5	-	63	47-117
2,6-Dinitrotoluene	ND	3.29	0.25	5	-	66	48-121
Di-n-octyl Phthalate	ND	3.88	0.50	5	-	78	40-150
1,2-Diphenylhydrazine	ND	2.94	0.25	5	-	59, F2	88-117
Fluoranthene	ND	3.03	0.25	5	-	61	45-126
Fluorene	ND	2.90	0.25	5	-	58	43-118
Hexachlorobenzene	ND	2.84	0.25	5	-	57	47-130
Hexachlorobutadiene	ND	3.27	0.25	5	-	65	50-121
Hexachlorocyclopentadiene	ND	2.58	1.3	5	-	52	30-89
Hexachloroethane	ND	3.60	0.25	5	-	72	50-106
Indeno (1,2,3-cd) pyrene	ND	4.02	0.25	5	-	80	51-138
Isophorone	ND	2.45	0.25	5	-	49	38-92
2-Methylnaphthalene	ND	3.17	0.25	5	-	63	51-121
2-Methylphenol (o-Cresol)	ND	3.22	0.25	5	-	65	48-114
3 & 4-Methylphenol (m,p-Cresol)	ND	3.05	0.25	5	-	61	30-130
Naphthalene	ND	3.00	0.25	5	-	60	50-113
2-Nitroaniline	ND	2.91	1.3	5	-	58	45-115
3-Nitroaniline	ND	2.30	1.3	5	-	46	31-93
4-Nitroaniline	ND	2.82	1.3	5	-	56	41-108
Nitrobenzene	ND	3.51	0.25	5	-	70	49-122
2-Nitrophenol	ND	3.80	1.3	5	-	76	54-121
4-Nitrophenol	ND	2.56	1.3	5	-	51	40-102
N-Nitrosodiphenylamine	ND	-	0.25	-	-	-	-
N-Nitrosodi-n-propylamine	ND	2.90	0.25	5	-	58	47-108
Pentachlorophenol	ND	3.12	1.3	5	-	62	39-134
Phenanthrene	ND	3.02	0.25	5	-	60	49-123
Phenol	ND	3.06	0.25	5	-	61	49-107
Pyrene	ND	3.29	0.25	5	-	66	55-124
Pyridine	ND	4.92	0.25	5	-	98	70-130
1,2,4-Trichlorobenzene	ND	3.36	0.25	5	-	67	51-121
2,4,5-Trichlorophenol	ND	3.60	0.25	5	-	72	45-126
2,4,6-Trichlorophenol	ND	3.51	0.25	5	-	70	46-128

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/20/17	**BatchID:**	145800
Date Analyzed:	9/20/17	**Extraction Method:**	SW3550B
Instrument:	GC17	**Analytical Method:**	SW8270C
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145800 1709774-001AMS/MSD

QC Summary Report for SW8270C

Analyte	MB Result	LCS Result	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
Surrogate Recovery							
2-Fluorophenol	4.187	3.91		5	84	78	47-125
Phenol-d5	3.86	3.58		5	77	72	45-117
Nitrobenzene-d5	3.961	3.83		5	79	77	39-121
2-Fluorobiphenyl	3.516	3.37		5	70	67	35-120
2,4,6-Tribromophenol	3.007	3.06		5	60	61	32-111
4-Terphenyl-d14	3.69	3.68		5	74	73	32-128

(Cont.)

Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/20/17	**BatchID:**	145800
Date Analyzed:	9/20/17	**Extraction Method:**	SW3550B
Instrument:	GC17	**Analytical Method:**	SW8270C
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145800 1709774-001AMS/MSD

QC Summary Report for SW8270C

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
Acenaphthene	NR	NR		ND<200	NR	NR	-	NR	-
Acenaphthylene	NR	NR		ND<200	NR	NR	-	NR	-
Anthracene	NR	NR		ND<200	NR	NR	-	NR	-
Benzidine	NR	NR		ND<1000	NR	NR	-	NR	-
Benzo (a) anthracene	NR	NR		ND<200	NR	NR	-	NR	-
Benzo (a) pyrene	NR	NR		ND<200	NR	NR	-	NR	-
Benzo (b) fluoranthene	NR	NR		ND<200	NR	NR	-	NR	-
Benzo (g,h,i) perylene	NR	NR		ND<200	NR	NR	-	NR	-
Benzo (k) fluoranthene	NR	NR		ND<200	NR	NR	-	NR	-
Benzyl Alcohol	NR	NR		ND<1000	NR	NR	-	NR	-
Bis (2-chloroethoxy) Methane	NR	NR		ND<200	NR	NR	-	NR	-
Bis (2-chloroethyl) Ether	NR	NR		ND<200	NR	NR	-	NR	-
Bis (2-chloroisopropyl) Ether	NR	NR		ND<200	NR	NR	-	NR	-
Bis (2-ethylhexyl) Adipate	NR	NR		ND<200	NR	NR	-	NR	-
Bis (2-ethylhexyl) Phthalate	NR	NR		ND<200	NR	NR	-	NR	-
4-Bromophenyl Phenyl Ether	NR	NR		ND<200	NR	NR	-	NR	-
Butylbenzyl Phthalate	NR	NR		ND<200	NR	NR	-	NR	-
4-Chloroaniline	NR	NR		ND<400	NR	NR	-	NR	-
4-Chloro-3-methylphenol	NR	NR		ND<200	NR	NR	-	NR	-
2-Chloronaphthalene	NR	NR		ND<200	NR	NR	-	NR	-
2-Chlorophenol	NR	NR		ND<200	NR	NR	-	NR	-
4-Chlorophenyl Phenyl Ether	NR	NR		ND<200	NR	NR	-	NR	-
Chrysene	NR	NR		ND<200	NR	NR	-	NR	-
Dibenzo (a,h) anthracene	NR	NR		ND<200	NR	NR	-	NR	-
Dibenzofuran	NR	NR		ND<200	NR	NR	-	NR	-
Di-n-butyl Phthalate	NR	NR		ND<200	NR	NR	-	NR	-
1,2-Dichlorobenzene	NR	NR		ND<200	NR	NR	-	NR	-
1,3-Dichlorobenzene	NR	NR		ND<200	NR	NR	-	NR	-
1,4-Dichlorobenzene	NR	NR		ND<200	NR	NR	-	NR	-
3,3-Dichlorobenzidine	NR	NR		ND<400	NR	NR	-	NR	-
2,4-Dichlorophenol	NR	NR		ND<200	NR	NR	-	NR	-
Diethyl Phthalate	NR	NR		ND<200	NR	NR	-	NR	-
2,4-Dimethylphenol	NR	NR		ND<200	NR	NR	-	NR	-
Dimethyl Phthalate	NR	NR		ND<200	NR	NR	-	NR	-
4,6-Dinitro-2-methylphenol	NR	NR		ND<1000	NR	NR	-	NR	-
2,4-Dinitrophenol	NR	NR		ND<5000	NR	NR	-	NR	-
2,4-Dinitrotoluene	NR	NR		ND<200	NR	NR	-	NR	-

(Cont.)

Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/20/17	**BatchID:**	145800
Date Analyzed:	9/20/17	**Extraction Method:**	SW3550B
Instrument:	GC17	**Analytical Method:**	SW8270C
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145800 1709774-001AMS/MSD

QC Summary Report for SW8270C

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
2,6-Dinitrotoluene	NR	NR		ND<200	NR	NR	-	NR	-
Di-n-octyl Phthalate	NR	NR		ND<400	NR	NR	-	NR	-
1,2-Diphenylhydrazine	NR	NR		ND<200	NR	NR	-	NR	-
Fluoranthene	NR	NR		ND<200	NR	NR	-	NR	-
Fluorene	NR	NR		ND<200	NR	NR	-	NR	-
Hexachlorobenzene	NR	NR		ND<200	NR	NR	-	NR	-
Hexachlorobutadiene	NR	NR		ND<200	NR	NR	-	NR	-
Hexachlorocyclopentadiene	NR	NR		ND<1000	NR	NR	-	NR	-
Hexachloroethane	NR	NR		ND<200	NR	NR	-	NR	-
Indeno (1,2,3-cd) pyrene	NR	NR		ND<200	NR	NR	-	NR	-
Isophorone	NR	NR		ND<200	NR	NR	-	NR	-
2-Methylnaphthalene	NR	NR		ND<200	NR	NR	-	NR	-
2-Methylphenol (o-Cresol)	NR	NR		ND<200	NR	NR	-	NR	-
3 & 4-Methylphenol (m,p-Cresol)	NR	NR		ND<200	NR	NR	-	NR	-
Naphthalene	NR	NR		ND<200	NR	NR	-	NR	-
2-Nitroaniline	NR	NR		ND<1000	NR	NR	-	NR	-
3-Nitroaniline	NR	NR		ND<1000	NR	NR	-	NR	-
4-Nitroaniline	NR	NR		ND<1000	NR	NR	-	NR	-
Nitrobenzene	NR	NR		ND<200	NR	NR	-	NR	-
2-Nitrophenol	NR	NR		ND<1000	NR	NR	-	NR	-
4-Nitrophenol	NR	NR		ND<1000	NR	NR	-	NR	-
N-Nitrosodi-n-propylamine	NR	NR		ND<200	NR	NR	-	NR	-
Pentachlorophenol	NR	NR		ND<1000	NR	NR	-	NR	-
Phenanthrene	NR	NR		ND<200	NR	NR	-	NR	-
Phenol	NR	NR		ND<200	NR	NR	-	NR	-
Pyrene	NR	NR		ND<200	NR	NR	-	NR	-
Pyridine	NR	NR		ND<200	NR	NR	-	NR	-
1,2,4-Trichlorobenzene	NR	NR		ND<200	NR	NR	-	NR	-
2,4,5-Trichlorophenol	NR	NR		ND<200	NR	NR	-	NR	-
2,4,6-Trichlorophenol	NR	NR		ND<200	NR	NR	-	NR	-

(Cont.)

Quality Control Report

Client: Langan
Date Prepared: 9/20/17
Date Analyzed: 9/20/17
Instrument: GC17
Matrix: Soil
Project: 731706301; UC Berkeley GSPP & Housing

WorkOrder: 1709793
BatchID: 145800
Extraction Method: SW3550B
Analytical Method: SW8270C
Unit: mg/Kg
Sample ID: MB/LCS-145800
1709774-001AMS/MSD

QC Summary Report for SW8270C

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
Surrogate Recovery									
2-Fluorophenol	NR	NR			NR	NR	-	NR	-
Phenol-d5	NR	NR			NR	NR	-	NR	-
Nitrobenzene-d5	NR	NR			NR	NR	-	NR	-
2-Fluorobiphenyl	NR	NR			NR	NR	-	NR	-
2,4,6-Tribromophenol	NR	NR			NR	NR	-	NR	-
4-Terphenyl-d14	NR	NR			NR	NR	-	NR	-

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/19/17	**BatchID:**	145773
Date Analyzed:	9/20/17	**Extraction Method:**	SW3050B
Instrument:	ICP-MS3	**Analytical Method:**	SW6020
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145773 1709780-001AMS/MSD

QC Summary Report for Metals

Analyte	MB Result	LCS Result	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
Antimony	ND	54.7	0.50	50	-	109	75-125
Arsenic	ND	54.1	0.50	50	-	108	75-125
Barium	ND	546	5.0	500	-	109	75-125
Beryllium	ND	52.6	0.50	50	-	105	75-125
Cadmium	ND	53.6	0.25	50	-	107	75-125
Chromium	ND	53.0	0.50	50	-	106	75-125
Cobalt	ND	50.6	0.50	50	-	101	75-125
Copper	ND	53.4	0.50	50	-	107	75-125
Lead	ND	52.6	0.50	50	-	105	75-125
Mercury	ND	1.40	0.050	1.25	-	112	75-125
Molybdenum	ND	53.4	0.50	50	-	107	75-125
Nickel	ND	54.4	0.50	50	-	109	75-125
Selenium	ND	54.0	0.50	50	-	108	75-125
Silver	ND	52.0	0.50	50	-	104	75-125
Thallium	ND	50.4	0.50	50	-	101	75-125
Vanadium	ND	52.6	0.50	50	-	105	75-125
Zinc	ND	516	5.0	500	-	103	75-125
Surrogate Recovery							
Terbium	546.9	559		500	109	112	70-130

(Cont.)

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/19/17	**BatchID:**	145773
Date Analyzed:	9/20/17	**Extraction Method:**	SW3050B
Instrument:	ICP-MS3	**Analytical Method:**	SW6020
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145773 1709780-001AMS/MSD

QC Summary Report for Metals

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
Antimony	52.3	53.0	50	1.114	102	104	75-125	1.42	20
Arsenic	55.2	57.7	50	5.811	99	104	75-125	4.46	20
Barium	613	628	500	88.94	105	108	75-125	2.32	20
Beryllium	50.3	50.3	50	ND	100	100	75-125	0	20
Cadmium	51.7	52.3	50	ND	103	104	75-125	1.10	20
Chromium	97.5	105	50	46.47	102	117	75-125	7.44	20
Cobalt	53.2	54.5	50	7.060	92	95	75-125	2.41	20
Copper	59.8	60.8	50	9.890	100	102	75-125	1.71	20
Lead	57.1	59.3	50	8.188	98	102	75-125	3.90	20
Mercury	1.40	1.42	1.25	0.05340	108	109	75-125	1.14	20
Molybdenum	51.2	51.9	50	ND	102	103	75-125	1.46	20
Nickel	90.3	97.6	50	42.87	95	110	75-125	7.75	20
Selenium	51.4	52.4	50	ND	102	104	75-125	1.91	20
Silver	50.0	50.0	50	ND	100	100	75-125	0	20
Thallium	49.1	49.6	50	ND	98	99	75-125	0.871	20
Vanadium	87.9	96.4	50	37.11	102	119	75-125	9.25	20
Zinc	525	526	500	28.60	99	99	75-125	0	20
Surrogate Recovery									
Terbium	540	546	500		108	109	70-130	1.01	20

Analyte	DLT Result	DLTRef Val	%D	%D Limit
Antimony	ND<2.5	1.114	-	-
Arsenic	5.56	5.811	4.32	-
Barium	90.4	88.94	1.64	-
Beryllium	ND<2.5	ND	-	-
Cadmium	ND<1.2	ND	-	-
Chromium	48.4	46.47	4.15	20
Cobalt	7.56	7.060	7.08	-
Copper	10.1	9.890	2.12	-
Lead	8.54	8.188	4.30	-
Mercury	ND<0.25	0.05340	-	-
Molybdenum	ND<2.5	ND	-	-
Nickel	45.4	42.87	5.90	20
Selenium	ND<2.5	ND	-	-

(Cont.)

Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/19/17	**BatchID:**	145773
Date Analyzed:	9/20/17	**Extraction Method:**	SW3050B
Instrument:	ICP-MS3	**Analytical Method:**	SW6020
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145773 1709780-001AMS/MSD

QC Summary Report for Metals

Analyte	DLT Result	DLTRef Val	%D	%D Limit
Silver	ND<2.5	ND	-	-
Thallium	ND<2.5	ND	-	-
Vanadium	39.1	37.11	5.36	20
Zinc	ND<25	28.60	-	-

%D Control Limit applied to analytes with concentrations greater than 25 times the reporting limits.

Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/19/17	**BatchID:**	145736
Date Analyzed:	9/20/17	**Extraction Method:**	SW5030B
Instrument:	GC7	**Analytical Method:**	SW8021B/8015Bm
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145736 1709774-001AMS/MSD

QC Summary Report for SW8021B/8015Bm

Analyte	MB Result	RL	SPK Val	MB SS %REC	MB SS Limits
TPH(g) (C6-C12)	ND	1.0	-	-	-
MTBE	ND	0.050	-	-	-
Benzene	ND	0.0050	-	-	-
Toluene	ND	0.0050	-	-	-
Ethylbenzene	ND	0.0050	-	-	-
Xylenes	ND	0.015	-	-	-
Surrogate Recovery					
2-Fluorotoluene	0.08753		0.10	88	75-134

Analyte	LCS Result	LCSD Result	SPK Val	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Limit
TPH(btex)	0.552	-	0.60	92	-	82-118	-	-
MTBE	0.0788	-	0.10	79	-	61-119	-	-
Benzene	0.0963	-	0.10	96	-	77-128	-	-
Toluene	0.0878	-	0.10	88	-	74-132	-	-
Ethylbenzene	0.109	-	0.10	109	-	84-127	-	-
Xylenes	0.335	-	0.30	112	-	86-129	-	-
Surrogate Recovery								
2-Fluorotoluene	0.0910	-	0.10	91	-	75-134	-	-

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
TPH(btex)	NR	NR		130	NR	NR	-	NR	-
MTBE	NR	NR		ND<2.5	NR	NR	-	NR	-
Benzene	NR	NR		ND<0.25	NR	NR	-	NR	-
Toluene	NR	NR		ND<0.25	NR	NR	-	NR	-
Ethylbenzene	NR	NR		ND<0.25	NR	NR	-	NR	-
Xylenes	NR	NR		ND<0.75	NR	NR	-	NR	-
Surrogate Recovery									
2-Fluorotoluene	NR	NR			NR	NR	-	NR	-

(Cont.)

NELAP 4033ORELAP

QA/QC Officer

Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/25/17	**BatchID:**	146028
Date Analyzed:	9/25/17 - 9/27/17	**Extraction Method:**	SW5030B
Instrument:	GC19	**Analytical Method:**	SW8021B/8015Bm
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-146028 1709967-001AMS/MSD

QC Summary Report for SW8021B/8015Bm

Analyte	MB Result	RL	SPK Val	MB SS %REC	MB SS Limits
TPH(g) (C6-C12)	ND	1.0	-	-	-
MTBE	ND	0.050	-	-	-
Benzene	ND	0.0050	-	-	-
Toluene	ND	0.0050	-	-	-
Ethylbenzene	ND	0.0050	-	-	-
Xylenes	ND	0.015	-	-	-
Surrogate Recovery					
2-Fluorotoluene	0.08546		0.10	85	75-134

Analyte	LCS Result	LCSD Result	SPK Val	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Limit
TPH(btex)	0.580	-	0.60	97	-	82-118	-	-
MTBE	0.0947	-	0.10	95	-	61-119	-	-
Benzene	0.106	-	0.10	106	-	77-128	-	-
Toluene	0.108	-	0.10	108	-	74-132	-	-
Ethylbenzene	0.107	-	0.10	107	-	84-127	-	-
Xylenes	0.310	-	0.30	103	-	86-129	-	-
Surrogate Recovery								
2-Fluorotoluene	0.0888	-	0.10	89	-	75-134	-	-

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
TPH(btex)	0.564	0.546	0.60	ND	94	91	58-129	3.18	20
MTBE	0.0897	0.0948	0.10	ND	85	90	47-118	5.48	20
Benzene	0.0970	0.103	0.10	ND	97	103	55-129	5.96	20
Toluene	0.103	0.109	0.10	ND	99	106	56-130	5.81	20
Ethylbenzene	0.0987	0.105	0.10	ND	99	105	63-129	5.98	20
Xylenes	0.296	0.310	0.30	ND	99	103	64-131	4.72	20
Surrogate Recovery									
2-Fluorotoluene	0.0859	0.0885	0.10		86	89	62-126	3.02	20

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/19/17	**BatchID:**	145780
Date Analyzed:	9/20/17	**Extraction Method:**	SW3550B
Instrument:	GC11A	**Analytical Method:**	SW8015B
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-145780 1709793-001AMS/MSD

QC Report for SW8015B w/out SG Clean-Up

Analyte	MB Result	LCS Result	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
TPH-Diesel (C10-C23)	ND	38.4	1.0	40	-	96	75-128
TPH-Motor Oil (C18-C36)	ND	-	5.0	-	-	-	-
Surrogate Recovery							
C9	22.08	21.3		25	88	85	72-122

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
TPH-Diesel (C10-C23)	NR	NR		210	NR	NR	-	NR	-
Surrogate Recovery									
C9	NR	NR			NR	NR	-	NR	-

NELAP 4033ORELAP

QA/QC Officer

McCampbell Analytical, Inc.

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CHAIN-OF-CUSTODY RECORD

WorkOrder: 1709793 **ClientCode: TWRF**

☐ WaterTrax ☐ WriteOn ☐ EDF ☐ Excel ☐ EQuIS ☑ Email ☐ HardCopy ☐ ThirdParty ☐ J-flag
☐ Detection Summary ☐ Dry-Weight

Report to:
Peter Cusack
Langan
555 Montgomery St., Suite 1300
San Francisco, CA 94111
(415) 955-5244 FAX: (415) 955-9041

Email: pcusack@langan.com
cc/3rd Party: kstaehlin@langan.com;
PO:
ProjectNo: 731706301; UC Berkeley GSPP & Housing

Bill to:
Accounts Payable
Langan
555 Montgomery St., Suite 1300
San Francisco, CA 94111
Langan_InvoiceCapture@concursolutio

Requested TAT: **5 days;**

Date Received: **09/19/2017**
Date Logged: **09/19/2017**

Lab ID	Client ID	Matrix	Collection Date	Hold	Requested Tests (See legend below)											
					1	2	3	4	5	6	7	8	9	10	11	12
1709793-001	B-1-2.0	Soil	9/15/2017 15:20	☐	A	A	A	A	A		A	A				
1709793-002	B-1-5.5	Soil	9/15/2017 15:30	☐					A		A	A				
1709793-003	B-2-3.0	Soil	9/15/2017 08:40	☐					A	A	A	A				
1709793-004	B-2-5.5	Soil	9/15/2017 08:50	☐		A		A	A		A	A				
1709793-006	B-3-3.0	Soil	9/15/2017 07:52	☐	A	A	A	A	A		A	A				
1709793-007	B-3-5.5	Soil	9/15/2017 08:03	☐		A		A	A		A	A				

Test Legend:

1	8082_PCB_S	2	8260B_S	3	8270_PNA_S	4	8270_S
5	CAM17MS_TTLC_S	6	CARB435_400	7	G-MBTEX_S	8	TPH(DMO)_S
9		10		11		12	

Prepared by: Alexandra Iniguez

The following SampIDs: 001A, 002A, 003A, 004A, 006A, 007A contain testgroup Multi Range_S.

Comments:

NOTE: Soil samples are discarded 60 days after results are reported unless other arrangements are made (Water samples are 30 days).
Hazardous samples will be returned to client or disposed of at client expense.

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WORK ORDER SUMMARY

Client Name: LANGAN **Project:** 731706301; UC Berkeley GSPP & Housing **Work Order:** 1709793

Client Contact: Peter Cusack **QC Level:** LEVEL 2

Contact's Email: pcusack@langan.com **Comments:** **Date Logged:** 9/19/2017

☐ WaterTrax ☐ WriteOn ☐ EDF ☐ Excel ☐ Fax ☑ Email ☐ HardCopy ☐ ThirdParty ☐ J-flag

Lab ID	Client ID	Matrix	Test Name	Containers /Composites	Bottle & Preservative	De-chlorinated	Collection Date & Time	TAT	Sediment Content	Hold	SubOut
1709793-001A	B-1-2.0	Soil	Multi-Range TPH(g,d,mo) by EPA 8015Bm	1	Stainless Steel tube 2.5"x6"	☐	9/15/2017 15:20	5 days		☐	
			SW6020 (CAM 17)			☐		5 days		☐	
			SW8270C (SVOCs)			☐		5 days		☐	
			SW8270C (PAHs/PNAs)			☐		5 days		☐	
			SW8260B (VOCs)			☐		5 days		☐	
			SW8082 (PCBs Only)			☐		5 days		☐	
1709793-002A	B-1-5.5	Soil	Multi-Range TPH(g,d,mo) by EPA 8015Bm	1	Stainless Steel tube 2.5"x6"	☐	9/15/2017 15:30	5 days		☐	
			SW6020 (CAM 17)			☐		5 days		☐	
1709793-003A	B-2-3.0	Soil	Multi-Range TPH(g,d,mo) by EPA 8015Bm	1	Stainless Steel tube 2.5"x6"	☐	9/15/2017 8:40	5 days		☐	
			Asbestos, CARB 435, 400 Point			☐		5 days		☐	
			SW6020 (CAM 17)			☐		5 days		☐	
1709793-004A	B-2-5.5	Soil	Multi-Range TPH(g,d,mo) by EPA 8015Bm	1	Stainless Steel tube 2.5"x6"	☐	9/15/2017 8:50	5 days		☐	
			SW6020 (CAM 17)			☐		5 days		☐	
			SW8270C (SVOCs)			☐		5 days		☐	
			SW8260B (VOCs)			☐		5 days		☐	

NOTES: **- STLC and TCLP extractions require 2 days to complete; therefore, all TATs begin after the extraction is completed (i.e., One-day TAT yields results in 3 days from sample submission).**

- MAI assumes that all material present in the provided sampling container is considered part of the sample - MAI does not exclude any material from the sample prior to sample preparation unless requested in writing by the client.

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WORK ORDER SUMMARY

Client Name: LANGAN **Project:** 731706301; UC Berkeley GSPP & Housing **Work Order:** 1709793
Client Contact: Peter Cusack **QC Level:** LEVEL 2
Contact's Email: pcusack@langan.com **Comments:** **Date Logged:** 9/19/2017

☐ WaterTrax ☐ WriteOn ☐ EDF ☐ Excel ☐ Fax ☑ Email ☐ HardCopy ☐ ThirdParty ☐ J-flag

Lab ID	Client ID	Matrix	Test Name	Containers /Composites	Bottle & Preservative	De-chlorinated	Collection Date & Time	TAT	Sediment Content	Hold	SubOut
1709793-005A	B-2-8.0	Soil		1	Stainless Steel tube 2.5"x6"	☐	9/15/2017 8:58			☑	
1709793-006A	B-3-3.0	Soil	Multi-Range TPH(g,d,mo) by EPA 8015Bm	1	Stainless Steel tube 2.5"x6"	☐	9/15/2017 7:52	5 days		☐	
			SW6020 (CAM 17)			☐		5 days		☐	
			SW8270C (SVOCs)			☐		5 days		☐	
			SW8270C (PAHs/PNAs)			☐		5 days		☐	
			SW8260B (VOCs)			☐		5 days		☐	
			SW8082 (PCBs Only)			☐		5 days		☐	
1709793-007A	B-3-5.5	Soil	Multi-Range TPH(g,d,mo) by EPA 8015Bm	1	Stainless Steel tube 2.5"x6"	☐	9/15/2017 8:03	5 days		☐	
			SW6020 (CAM 17)			☐		5 days		☐	
			SW8270C (SVOCs)			☐		5 days		☐	
			SW8260B (VOCs)			☐		5 days		☐	
1709793-008A	B-3-10.5	Soil		1	Stainless Steel tube 2.5"x6"	☐	9/15/2017 8:12			☑	

NOTES: - STLC and TCLP extractions require 2 days to complete; therefore, all TATs begin after the extraction is completed (i.e., One-day TAT yields results in 3 days from sample submission).

- MAI assumes that all material present in the provided sampling container is considered part of the sample - MAI does not exclude any material from the sample prior to sample preparation unless requested in writing by the client.

1709793

PLEASE C.C. ANNIE S. AT KSTAEHLIN@LANGAN.COM

10337

LANGAN

CHAIN OF CUSTODY RECORD

Page 1 of 1

- [X] 555 Montgomery Street. Suite 1300, San Francisco, CA 94111
- [ ] 501 14th Street, Third Floor, Oakland CA 94612
- [ ] 3320 Data Drive, Suite 350, Rancho Cordova, CA 95670-7982
- [ ] 4030 Moorpark Ave. Suite 210, San Jose, CA 95117-1849

Site Name: UC BERKELEY GSPP & HOUSING
Job Number: 731706301
Project Manager\Contact: PETER CUSACK
Samplers: KSS
Recorder (Signature Required): [signature]

Turnaround Time: STANDARD

Field Sample Identification No.	Date	Time	Lab Sample No.	Matrix: Soil	Matrix: Water	Matrix: Air	Matrix: Other	No. Containers & Preservative: HCL	H_2SO_4	HNO_3	Ice	Analysis Requested: TPH gd,mo	VOCs	SVOCs	PNAs & PAHs	PCBs	CAM 17	ASBESTOS BY CARB435	LUFT 5 METALS	Silica gel clean-up	Hold	Remarks
B-1-2.0	9/15/17	1520		X							X	X	X	X	X	X	X					
B-1-5.5		1520		X							X	X					X					
B-2-3.0		0840		X							X	X					X	X				
B-2-5.5		0850		X							X	X	X	X			X					
B-2-8.0		0858		X							X	X						X	X		X	PLEASE PLACE THESE SAMPLES ON HOLD. DO NOT ANALYZE.
B-3-3.0		0752		X							X	X	X	X	X	X	X					
B-3-5.5		0803		X							X	X	X	X			X					
B-3-10.5	9/15/17	0812		X							X	X						X	X		X	

Relinquished by: (Signature)	Date:	Time	Received by: (Signature)	Date	Time
[signature]			Basit	9/19/17	12:45
Basit	9/18/17	1630	[illegible]	9/18/17	1630
			Received by Lab: (Signature)		

Sent to Laboratory (Name): McCAMPBELL ANALYTICAL
Laboratory Comments/Notes:

Method of Shipment
- [X] Lab courier
- [ ] Fed Ex
- [ ] Airborne
- [ ] UPS
- [ ] Hand Carried
- [ ] Private Courier (Co. Name) ______

White Copy - Original   Yellow Copy - Laboratory   Pink Copy - Field   COC Number:

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Sample Receipt Checklist

Client Name:	**Langan**	Date and Time Received	**9/19/2017 16:30**
Project Name:	**731706301; UC Berkeley GSPP & Housing**	Date Logged:	**9/19/2017**
		Received by:	Alexandra Iniguez
WorkOrder №:	**1709793** Matrix: Soil	Logged by:	Alexandra Iniguez
Carrier:	Basit Sheikh (MAI Courier)		

Chain of Custody (COC) Information

	Yes	No	NA
Chain of custody present?	☑	☐	
Chain of custody signed when relinquished and received?	☑	☐	
Chain of custody agrees with sample labels?	☑	☐	
Sample IDs noted by Client on COC?	☑	☐	
Date and Time of collection noted by Client on COC?	☑	☐	
Sampler's name noted on COC?	☑	☐	
COC agrees with Quote?	☐	☐	☑

Sample Receipt Information

	Yes	No	NA
Custody seals intact on shipping container/cooler?	☑	☐	☐
Shipping container/cooler in good condition?	☑	☐	
Samples in proper containers/bottles?	☑	☐	
Sample containers intact?	☑	☐	
Sufficient sample volume for indicated test?	☑	☐	

Sample Preservation and Hold Time (HT) Information

	Yes	No	NA
All samples received within holding time?	☑	☐	☐
Sample/Temp Blank temperature	Temp: 3.4°C		☐
Water - VOA vials have zero headspace / no bubbles?	☐	☐	☑
Sample labels checked for correct preservation?	☑	☐	
pH acceptable upon receipt (Metal: <2; 522: <4; 218.7: >8)?	☐	☐	☑
Samples Received on Ice?	☑	☐	

(Ice Type: WET ICE)

UCMR Samples:

	Yes	No	NA
Total Chlorine tested and acceptable upon receipt for EPA 522?	☐	☐	☑
Free Chlorine tested and acceptable upon receipt for EPA 218.7, 300.1, 537, 539?	☐	☐	☑

Comments:

McCampbell Analytical, Inc.

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Analytical Report

WorkOrder: 1709793 A

Report Created for: Langan

555 Montgomery St., Suite 1300
San Francisco, CA 94111

Project Contact: Peter Cusack
Project P.O.:
Project Name: 731706301; UC Berkeley GSPP & Housing

Project Received: 09/19/2017

Analytical Report reviewed & approved for release on 10/10/2017 by:

Angela Rydelius,
Laboratory Manager

The report shall not be reproduced except in full, without the written approval of the laboratory. The analytical results relate only to the items tested. Results reported conform to the most current NELAP standards, where applicable, unless otherwise stated in the case narrative.

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Glossary of Terms & Qualifier Definitions

Client: Langan
Project: 731706301; UC Berkeley GSPP & Housing
WorkOrder: 1709793 A

Glossary Abbreviation

%D	Serial Dilution Percent Difference
95% Interval	95% Confident Interval
DF	Dilution Factor
DI WET	(DISTLC) Waste Extraction Test using DI water
DISS	Dissolved (direct analysis of 0.45 µm filtered and acidified water sample)
DLT	Dilution Test (Serial Dilution)
DUP	Duplicate
EDL	Estimated Detection Limit
ERS	External reference sample. Second source calibration verification.
ITEF	International Toxicity Equivalence Factor
LCS	Laboratory Control Sample
MB	Method Blank
MB % Rec	% Recovery of Surrogate in Method Blank, if applicable
MDL	Method Detection Limit
ML	Minimum Level of Quantitation
MS	Matrix Spike
MSD	Matrix Spike Duplicate
N/A	Not Applicable
ND	Not detected at or above the indicated MDL or RL
NR	Data Not Reported due to matrix interference or insufficient sample amount.
PDS	Post Digestion Spike
PDSD	Post Digestion Spike Duplicate
PF	Prep Factor
RD	Relative Difference
RL	Reporting Limit (The RL is the lowest calibration standard in a multipoint calibration.)
RPD	Relative Percent Deviation
RRT	Relative Retention Time
SPK Val	Spike Value
SPKRef Val	Spike Reference Value
SPLP	Synthetic Precipitation Leachate Procedure
ST	Sorbent Tube
TCLP	Toxicity Characteristic Leachate Procedure
TEQ	Toxicity Equivalents
WET (STLC)	Waste Extraction Test (Soluble Threshold Limit Concentration)

Glossary of Terms & Qualifier Definitions

Client: Langan
Project: 731706301; UC Berkeley GSPP & Housing
WorkOrder: 1709793 A

Analytical Qualifiers

B	Analyte detected in the associated Method Blank and in the sample
H	Samples were analyzed out of holding time
S	Surrogate spike recovery outside accepted recovery limits

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B/3630C
Date Prepared:	9/19/17	**Analytical Method:**	SW8082
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Polychlorinated Biphenyls (PCBs) Aroclors w/ Column Style Clean-up

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	**1709793-001A**	**Soil**	**09/15/2017 15:20**	**GC40 10091763.d**	**146429**

Analytes	Result	MDL	RL	DF	Date Analyzed
Aroclor1016	ND	0.0051	0.050	1	10/09/2017 22:29
Aroclor1221	ND	0.011	0.050	1	10/09/2017 22:29
Aroclor1232	ND	0.0063	0.050	1	10/09/2017 22:29
Aroclor1242	ND	0.0067	0.050	1	10/09/2017 22:29
Aroclor1248	ND	0.0040	0.050	1	10/09/2017 22:29
Aroclor1254	ND	0.0068	0.050	1	10/09/2017 22:29
Aroclor1260	ND	0.0061	0.050	1	10/09/2017 22:29
PCBs, total	ND	0.0040	0.050	1	10/09/2017 22:29

Surrogates	REC (%)	Limits	
Decachlorobiphenyl	71	55-152	10/09/2017 22:29

Analyst(s): KX

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B/3640A
Date Prepared:	10/2/17	**Analytical Method:**	SW8270C-SIM
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/kg

Polynuclear Aromatic Hydrocarbons (PNAs) using SIM Mode w/ GPC Clean-up

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	**1709793-001A**	**Soil**	**09/15/2017 15:20**	**GC35 10031722.D**	**146407**

Analytes	Result	Qualifiers	RL	DF	Date Analyzed
Acenaphthene	ND	H	0.020	2	10/03/2017 20:38
Acenaphthylene	ND	H	0.020	2	10/03/2017 20:38
Anthracene	**0.055**	H	0.020	2	10/03/2017 20:38
Benzo (a) anthracene	**0.12**	H	0.020	2	10/03/2017 20:38
Benzo (a) pyrene	**0.083**	H	0.020	2	10/03/2017 20:38
Benzo (b) fluoranthene	**0.24**	H	0.020	2	10/03/2017 20:38
Benzo (g,h,i) perylene	**0.14**	H	0.020	2	10/03/2017 20:38
Benzo (k) fluoranthene	**0.061**	H	0.020	2	10/03/2017 20:38
Chrysene	**0.45**	H	0.020	2	10/03/2017 20:38
Dibenzo (a,h) anthracene	ND	H	0.020	2	10/03/2017 20:38
Fluoranthene	**0.54**	H	0.020	2	10/03/2017 20:38
Fluorene	ND	H	0.020	2	10/03/2017 20:38
Indeno (1,2,3-cd) pyrene	**0.059**	H	0.020	2	10/03/2017 20:38
1-Methylnaphthalene	**0.023**	H	0.020	2	10/03/2017 20:38
2-Methylnaphthalene	**0.034**	H	0.020	2	10/03/2017 20:38
Naphthalene	ND	H	0.020	2	10/03/2017 20:38
Phenanthrene	**0.55**	H	0.020	2	10/03/2017 20:38
Pyrene	**0.57**	H	0.020	2	10/03/2017 20:38

Surrogates	REC (%)	Qualifiers	Limits	Date Analyzed
1-Fluoronaphthalene	183	SH	30-130	10/03/2017 20:38
2-Fluorobiphenyl	178	SH	30-130	10/03/2017 20:38

Analyst(s): REB

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Angela Rydelius, Lab Manager

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B/3640A
Date Prepared:	10/2/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics (Low Level) with GPC Cleanup

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	1709793-001A	Soil	09/15/2017 15:20	GC21 10021711.D	146411

Analytes	Result	Qualifiers	MDL	RL	DF	Date Analyzed
Acenaphthene	ND	H	1.4	2.5	10	10/02/2017 17:02
Acenaphthylene	ND	H	1.4	2.5	10	10/02/2017 17:02
Acetochlor	ND	H	2.5	2.5	10	10/02/2017 17:02
Anthracene	ND	H	1.4	2.5	10	10/02/2017 17:02
Benzidine	ND	H	2.3	13	10	10/02/2017 17:02
Benzo (a) anthracene	ND	H	0.50	0.50	10	10/02/2017 17:02
Benzo (a) pyrene	**0.080**	BH	0.025	0.025	10	10/02/2017 17:02
Benzo (b) fluoranthene	**0.24**	H	0.12	0.12	10	10/02/2017 17:02
Benzo (g,h,i) perylene	ND	H	1.5	2.5	10	10/02/2017 17:02
Benzo (k) fluoranthene	ND	H	1.6	2.5	10	10/02/2017 17:02
Benzyl Alcohol	ND	H	5.1	13	10	10/02/2017 17:02
1,1-Biphenyl	ND	H	1.5	2.5	10	10/02/2017 17:02
Bis (2-chloroethoxy) Methane	ND	H	1.4	2.5	10	10/02/2017 17:02
Bis (2-chloroethyl) Ether	ND	H	0.012	0.012	10	10/02/2017 17:02
Bis (2-chloroisopropyl) Ether	**0.015**	H	0.012	0.012	10	10/02/2017 17:02
Bis (2-ethylhexyl) Adipate	ND	H	2.5	2.5	10	10/02/2017 17:02
Bis (2-ethylhexyl) Phthalate	ND	H	1.3	2.5	10	10/02/2017 17:02
4-Bromophenyl Phenyl Ether	ND	H	1.6	2.5	10	10/02/2017 17:02
Butylbenzyl Phthalate	ND	H	1.3	2.5	10	10/02/2017 17:02
4-Chloroaniline	ND	H	0.012	0.012	10	10/02/2017 17:02
4-Chloro-3-methylphenol	ND	H	1.2	2.5	10	10/02/2017 17:02
2-Chloronaphthalene	ND	H	1.6	2.5	10	10/02/2017 17:02
2-Chlorophenol	ND	H	0.050	0.050	10	10/02/2017 17:02
4-Chlorophenyl Phenyl Ether	ND	H	1.5	2.5	10	10/02/2017 17:02
Chrysene	ND	H	1.4	2.5	10	10/02/2017 17:02
Dibenzo (a,h) anthracene	**0.064**	H	0.025	0.025	10	10/02/2017 17:02
Dibenzofuran	ND	H	1.3	2.5	10	10/02/2017 17:02
Di-n-butyl Phthalate	ND	H	1.3	2.5	10	10/02/2017 17:02
1,2-Dichlorobenzene	ND	H	1.2	2.5	10	10/02/2017 17:02
1,3-Dichlorobenzene	ND	H	1.4	2.5	10	10/02/2017 17:02
1,4-Dichlorobenzene	ND	H	0.25	0.25	10	10/02/2017 17:02
3,3-Dichlorobenzidine	ND	H	0.050	0.050	10	10/02/2017 17:02
2,4-Dichlorophenol	ND	H	0.025	0.025	10	10/02/2017 17:02
Diethyl Phthalate	ND	H	0.025	0.025	10	10/02/2017 17:02
2,4-Dimethylphenol	ND	H	0.25	0.25	10	10/02/2017 17:02
Dimethyl Phthalate	ND	H	0.025	0.025	10	10/02/2017 17:02
4,6-Dinitro-2-methylphenol	ND	H	1.3	13	10	10/02/2017 17:02

(Cont.)

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B/3640A
Date Prepared:	10/2/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics (Low Level) with GPC Cleanup

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	**1709793-001A**	**Soil**	**09/15/2017 15:20**	**GC21 10021711.D**	**146411**

Analytes	Result	Qualifiers	MDL	RL	DF	Date Analyzed
2,4-Dinitrophenol	ND	H	6.2	6.2	10	10/02/2017 17:02
2,4-Dinitrotoluene	ND	H	0.25	0.25	10	10/02/2017 17:02
2,6-Dinitrotoluene	ND	H	1.4	2.5	10	10/02/2017 17:02
Di-n-octyl Phthalate	ND	H	1.4	5.0	10	10/02/2017 17:02
1,2-Diphenylhydrazine	ND	H	1.6	2.5	10	10/02/2017 17:02
Fluoranthene	ND	H	1.3	2.5	10	10/02/2017 17:02
Fluorene	ND	H	1.4	2.5	10	10/02/2017 17:02
Hexachlorobenzene	ND	H	0.25	0.25	10	10/02/2017 17:02
Hexachlorobutadiene	ND	H	0.25	0.25	10	10/02/2017 17:02
Hexachlorocyclopentadiene	ND	H	7.3	13	10	10/02/2017 17:02
Hexachloroethane	ND	H	1.4	2.5	10	10/02/2017 17:02
Indeno (1,2,3-cd) pyrene	ND	H	0.12	0.12	10	10/02/2017 17:02
Isophorone	ND	H	1.2	2.5	10	10/02/2017 17:02
2-Methylnaphthalene	ND	H	0.25	0.25	10	10/02/2017 17:02
2-Methylphenol (o-Cresol)	ND	H	1.4	2.5	10	10/02/2017 17:02
3 & 4-Methylphenol (m,p-Cresol)	ND	H	1.2	2.5	10	10/02/2017 17:02
Naphthalene	**0.028**	H	0.025	0.025	10	10/02/2017 17:02
2-Nitroaniline	ND	H	6.2	13	10	10/02/2017 17:02
3-Nitroaniline	ND	H	5.9	13	10	10/02/2017 17:02
4-Nitroaniline	ND	H	5.5	13	10	10/02/2017 17:02
Nitrobenzene	ND	H	1.4	2.5	10	10/02/2017 17:02
2-Nitrophenol	ND	H	6.4	13	10	10/02/2017 17:02
4-Nitrophenol	ND	H	4.1	13	10	10/02/2017 17:02
N-Nitrosodiphenylamine	ND	H	1.6	2.5	10	10/02/2017 17:02
N-Nitrosodi-n-propylamine	ND	H	0.12	0.12	10	10/02/2017 17:02
Pentachlorophenol	ND	H	3.2	13	10	10/02/2017 17:02
Phenanthrene	ND	H	1.4	2.5	10	10/02/2017 17:02
Phenol	ND	H	0.050	0.050	10	10/02/2017 17:02
Pyrene	ND	H	1.3	2.5	10	10/02/2017 17:02
Pyridine	ND	H	2.5	2.5	10	10/02/2017 17:02
1,2,4-Trichlorobenzene	ND	H	1.4	2.5	10	10/02/2017 17:02
2,4,5-Trichlorophenol	ND	H	0.12	0.12	10	10/02/2017 17:02
2,4,6-Trichlorophenol	ND	H	0.12	0.12	10	10/02/2017 17:02

(Cont.)

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Analytical Report

Client:	Langan	**WorkOrder:**	1709793
Date Received:	9/19/17 16:30	**Extraction Method:**	SW3550B/3640A
Date Prepared:	10/2/17	**Analytical Method:**	SW8270C
Project:	731706301; UC Berkeley GSPP & Housing	**Unit:**	mg/Kg

Semi-Volatile Organics (Low Level) with GPC Cleanup

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
B-1-2.0	**1709793-001A**	**Soil**	**09/15/2017 15:20**	**GC21 10021711.D**	**146411**

Analytes	Result	Qualifiers	MDL	RL	DF	Date Analyzed
Surrogates	REC (%)	Qualifiers		Limits		
2-Fluorophenol	69	H		30-130		10/02/2017 17:02
Phenol-d5	71	H		30-130		10/02/2017 17:02
Nitrobenzene-d5	59	H		30-130		10/02/2017 17:02
2-Fluorobiphenyl	65	H		30-130		10/02/2017 17:02
2,4,6-Tribromophenol	58	H		16-130		10/02/2017 17:02
4-Terphenyl-d14	79	H		30-130		10/02/2017 17:02

Analyst(s): REB

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Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	9/19/17	**BatchID:**	146429
Date Analyzed:	10/4/17	**Extraction Method:**	SW3550B/3630C
Instrument:	GC40	**Analytical Method:**	SW8082
Matrix:	Soil	**Unit:**	mg/kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS/LCSD-146429

QC Summary for SW8082

Analyte	MB Result	MDL	RL	SPK Val	MB SS %REC	MB SS Limits
Aroclor1016	ND	0.0051	0.050	-	-	-
Aroclor1016	ND	0.0051	0.050	-	-	-
Aroclor1221	ND	0.011	0.050	-	-	-
Aroclor1232	ND	0.0063	0.050	-	-	-
Aroclor1242	ND	0.0067	0.050	-	-	-
Aroclor1248	ND	0.0040	0.050	-	-	-
Aroclor1254	ND	0.0068	0.050	-	-	-
Aroclor1260	ND	0.0061	0.050	-	-	-
Aroclor1260	ND	0.0061	0.050	-	-	-
Aroclor1262	ND	0.050	0.050	-	-	-
Aroclor1268	ND	0.050	0.050	-	-	-
PCBs, total	ND	0.0040	0.050	-	-	-
Surrogate Recovery						
Decachlorobiphenyl	0.05012			0.050	100	57-151
Decachlorobiphenyl	0.04651			0.05	93	59-137
Decachlorobiphenyl	0.04418			0.050	88	57-145

Analyte	LCS Result	LCSD Result	SPK Val	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Limit
Aroclor1016	0.148	0.150	0.15	98	100	35-157	1.24	20
Aroclor1016	0.148	0.150	0.15	98	100	35-157	1.24	20
Aroclor1260	0.150	0.157	0.15	100	105	61-147	4.81	20
Aroclor1260	0.150	0.157	0.15	100	105	61-147	4.81	20
Surrogate Recovery								
Decachlorobiphenyl	0.0531	0.0554	0.050	106	111	68-141	4.25	20
Decachlorobiphenyl	0.0531	0.0554	0.050	106	111	68-141	4.25	20
Decachlorobiphenyl	0.0420	0.0475	0.050	84	95	59-137	4.43	20

Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	10/2/17	**BatchID:**	146407
Date Analyzed:	10/3/17	**Extraction Method:**	SW3550B/3640A
Instrument:	GC35	**Analytical Method:**	SW8270C-SIM
Matrix:	Soil	**Unit:**	mg/kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-146407 1709793-001AMS/MSD

QC Summary Report for SW8270C

Analyte	MB Result	LCS Result	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
Acenaphthene	ND	-	0.010	-	-	-	-
Acenaphthylene	ND	-	0.010	-	-	-	-
Anthracene	ND	-	0.010	-	-	-	-
Benzo (a) anthracene	ND	-	0.010	-	-	-	-
Benzo (a) pyrene	ND	0.165	0.010	0.20	-	83	30-130
Benzo (b) fluoranthene	ND	-	0.010	-	-	-	-
Benzo (g,h,i) perylene	ND	-	0.010	-	-	-	-
Benzo (k) fluoranthene	ND	-	0.010	-	-	-	-
Chrysene	ND	0.192	0.010	0.20	-	96	30-130
Dibenzo (a,h) anthracene	ND	-	0.010	-	-	-	-
Fluoranthene	ND	-	0.010	-	-	-	-
Fluorene	ND	-	0.010	-	-	-	-
Indeno (1,2,3-cd) pyrene	ND	-	0.010	-	-	-	-
1-Methylnaphthalene	ND	0.193	0.010	0.20	-	96	30-130
2-Methylnaphthalene	ND	0.179	0.010	0.20	-	89	30-130
Naphthalene	ND	-	0.010	-	-	-	-
Phenanthrene	ND	0.171	0.010	0.20	-	85	30-130
Pyrene	ND	0.168	0.010	0.20	-	84	30-130
Surrogate Recovery							
1-Fluoronaphthalene	0.5757	0.456		0.50	115	91	30-130
2-Fluorobiphenyl	0.5968	0.458		0.50	119	92	30-130

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
Benzo (a) pyrene	NR	NR		0.083	NR	NR	-	NR	-
Chrysene	NR	NR		0.45	NR	NR	-	NR	-
1-Methylnaphthalene	NR	NR		0.023	NR	NR	-	NR	-
2-Methylnaphthalene	NR	NR		0.034	NR	NR	-	NR	-
Phenanthrene	NR	NR		0.55	NR	NR	-	NR	-
Pyrene	NR	NR		0.57	NR	NR	-	NR	-
Surrogate Recovery									
1-Fluoronaphthalene	NR	NR			NR	NR	-	NR	-
2-Fluorobiphenyl	NR	NR			NR	NR	-	NR	-

NELAP 4033ORELAP

QA/QC Officer

Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	10/2/17	**BatchID:**	146411
Date Analyzed:	10/2/17	**Extraction Method**	SW3550B/3640A
Instrument:	GC21	**Analytical Method:**	SW8270C
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-146411 1709793-001AMS/MSD

QC Summary Report for SW8270C (Low Level) w/ GPC

Analyte	MB Result	LCS Result	MDL	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
Acenaphthene	ND	3.75	0.14	0.25	5	-	75	32-118
Acenaphthylene	ND	4.07	0.14	0.25	5	-	81	32-122
Acetochlor	ND	-	0.25	0.25	-	-	-	-
Anthracene	ND	3.97	0.14	0.25	5	-	79	36-125
Benzidine	ND	1.91	0.23	1.3	5	-	38	4-83
Benzo (a) anthracene	ND	4.37	0.050	0.050	5	-	87	35-117
Benzo (a) pyrene	0.00297	4.51	0.0025	0.0025	5	-	90	42-138
Benzo (b) fluoranthene	ND	4.42	0.012	0.012	5	-	88	37-125
Benzo (g,h,i) perylene	ND	4.73	0.15	0.25	5	-	95	45-146
Benzo (k) fluoranthene	ND	4.08	0.16	0.25	5	-	82	39-124
Benzyl Alcohol	ND	3.91	0.51	1.3	5	-	78	5-105
1,1-Biphenyl	ND	-	0.15	0.25	-	-	-	-
Bis (2-chloroethoxy) Methane	ND	4.16	0.14	0.25	5	-	83	35-115
Bis (2-chloroethyl) Ether	ND	4.04	0.0012	0.0012	5	-	81	35-105
Bis (2-chloroisopropyl) Ether	ND	4.66	0.0012	0.0012	5	-	93	34-119
Bis (2-ethylhexyl) Adipate	ND	5.23	0.25	0.25	5	-	105	27-117
Bis (2-ethylhexyl) Phthalate	ND	4.97	0.13	0.25	5	-	99	34-124
4-Bromophenyl Phenyl Ether	ND	4.18	0.16	0.25	5	-	84	33-112
Butylbenzyl Phthalate	ND	5.02	0.13	0.25	5	-	100	35-127
4-Chloroaniline	ND	2.58	0.0012	0.0012	5	-	52	12-77
4-Chloro-3-methylphenol	ND	4.60	0.12	0.25	5	-	92	35-123
2-Chloronaphthalene	ND	3.59	0.16	0.25	5	-	72	28-109
2-Chlorophenol	0.005781	4.09	0.0050	0.0050	5	-	82	38-116
4-Chlorophenyl Phenyl Ether	ND	4.21	0.15	0.25	5	-	84	33-122
Chrysene	ND	4.18	0.14	0.25	5	-	84	37-116
Dibenzo (a,h) anthracene	ND	4.60	0.0025	0.0025	5	-	92	43-141
Dibenzofuran	ND	4.05	0.13	0.25	5	-	81	33-117
Di-n-butyl Phthalate	ND	4.06	0.13	0.25	5	-	81	38-126
1,2-Dichlorobenzene	ND	4.06	0.12	0.25	5	-	81	34-105
1,3-Dichlorobenzene	ND	4.05	0.14	0.25	5	-	81	33-104
1,4-Dichlorobenzene	ND	3.54	0.025	0.025	5	-	71	31-102
3,3-Dichlorobenzidine	ND	2.33	0.0050	0.0050	5	-	47	14-84
2,4-Dichlorophenol	ND	4.87	0.0025	0.0025	5	-	97	31-124
Diethyl Phthalate	ND	4.05	0.0025	0.0025	5	-	81	35-118
2,4-Dimethylphenol	ND	4.59	0.025	0.025	5	-	92	30-120
Dimethyl Phthalate	ND	3.94	0.0025	0.0025	5	-	79	33-118
4,6-Dinitro-2-methylphenol	ND	3.94	0.13	1.3	5	-	79	12-126

(Cont.)

NELAP 4033ORELAP

QA/QC Officer

Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	10/2/17	**BatchID:**	146411
Date Analyzed:	10/2/17	**Extraction Method**	SW3550B/3640A
Instrument:	GC21	**Analytical Method:**	SW8270C
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-146411 1709793-001AMS/MSD

QC Summary Report for SW8270C (Low Level) w/ GPC

Analyte	MB Result	LCS Result	MDL	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
2,4-Dinitrophenol	ND	3.98	0.62	0.62	5	-	80	8-130
2,4-Dinitrotoluene	ND	4.29	0.025	0.025	5	-	86	38-117
2,6-Dinitrotoluene	ND	4.19	0.14	0.25	5	-	84	35-121
Di-n-octyl Phthalate	ND	5.16	0.14	0.50	5	-	103	42-150
1,2-Diphenylhydrazine	ND	4.09	0.16	0.25	5	-	82	0-117
Fluoranthene	ND	4.06	0.13	0.25	5	-	81	38-126
Fluorene	ND	3.93	0.14	0.25	5	-	79	34-118
Hexachlorobenzene	ND	3.73	0.025	0.025	5	-	75	30-130
Hexachlorobutadiene	ND	4.26	0.025	0.025	5	-	85	33-121
Hexachlorocyclopentadiene	ND	3.06	0.73	1.3	5	-	61	8-89
Hexachloroethane	ND	4.09	0.14	0.25	5	-	82	32-106
Indeno (1,2,3-cd) pyrene	ND	4.57	0.012	0.012	5	-	91	43-138
Isophorone	ND	3.56	0.12	0.25	5	-	71	26-92
2-Methylnaphthalene	ND	4.44	0.025	0.025	5	-	89	30-121
2-Methylphenol (o-Cresol)	ND	3.85	0.14	0.25	5	-	77	34-114
3 & 4-Methylphenol (m,p-Cresol)	ND	3.98	0.12	0.25	5	-	80	26-130
Naphthalene	ND	3.99	0.0025	0.0025	5	-	80	33-113
2-Nitroaniline	ND	4.31	0.62	1.3	5	-	86	29-115
3-Nitroaniline	ND	2.77	0.59	1.3	5	-	55	25-93
4-Nitroaniline	ND	3.70	0.55	1.3	5	-	74	31-108
Nitrobenzene	ND	4.27	0.14	0.25	5	-	85	33-122
2-Nitrophenol	ND	4.69	0.64	1.3	5	-	94	32-121
4-Nitrophenol	ND	3.79	0.41	1.3	5	-	76	27-102
N-Nitrosodiphenylamine	ND	-	0.16	0.25	-	-	-	-
N-Nitrosodi-n-propylamine	ND	4.30	0.012	0.012	5	-	86	25-108
Pentachlorophenol	ND	5.85	0.32	1.3	5	-	117	28-134
Phenanthrene	ND	4.54	0.14	0.25	5	-	91	36-123
Phenol	ND	3.99	0.0050	0.0050	5	-	80	33-107
Pyrene	ND	4.47	0.13	0.25	5	-	89	38-124
Pyridine	ND	5.07	0.25	0.25	5	-	101	30-130
1,2,4-Trichlorobenzene	ND	4.44	0.14	0.25	5	-	89	34-121
2,4,5-Trichlorophenol	ND	4.28	0.012	0.012	5	-	86	31-126
2,4,6-Trichlorophenol	ND	4.52	0.012	0.012	5	-	90	32-128

(Cont.)

Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	10/2/17	**BatchID:**	146411
Date Analyzed:	10/2/17	**Extraction Method**	SW3550B/3640A
Instrument:	GC21	**Analytical Method:**	SW8270C
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-146411 1709793-001AMS/MSD

QC Summary Report for SW8270C (Low Level) w/ GPC

Analyte	MB Result	LCS Result	MDL	RL	SPK Val	MB SS %REC	LCS %REC	LCS Limits
Surrogate Recovery								
2-Fluorophenol	4.601	4.53			5	92	91	31-108
Phenol-d5	4.609	4.42			5	92	88	32-106
Nitrobenzene-d5	4.104	4.32			5	82	86	27-109
2-Fluorobiphenyl	3.923	4.10			5	78	82	26-100
2,4,6-Tribromophenol	4.197	4.89			5	84	98	25-106
4-Terphenyl-d14	4.415	4.97			5	88	99	27-113

(Cont.)

Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	10/2/17	**BatchID:**	146411
Date Analyzed:	10/2/17	**Extraction Method**	SW3550B/3640A
Instrument:	GC21	**Analytical Method:**	SW8270C
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-146411 1709793-001AMS/MSD

QC Summary Report for SW8270C (Low Level) w/ GPC

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
Acenaphthene	NR	NR		ND<2.5	NR	NR	-	NR	-
Acenaphthylene	NR	NR		ND<2.5	NR	NR	-	NR	-
Anthracene	NR	NR		ND<2.5	NR	NR	-	NR	-
Benzidine	NR	NR		ND<13	NR	NR	-	NR	-
Benzo (a) anthracene	NR	NR		ND<0.5	NR	NR	-	NR	-
Benzo (a) pyrene	NR	NR		0.08	NR	NR	-	NR	-
Benzo (b) fluoranthene	NR	NR		0.24	NR	NR	-	NR	-
Benzo (g,h,i) perylene	NR	NR		ND<2.5	NR	NR	-	NR	-
Benzo (k) fluoranthene	NR	NR		ND<2.5	NR	NR	-	NR	-
Benzyl Alcohol	NR	NR		ND<13	NR	NR	-	NR	-
Bis (2-chloroethoxy) Methane	NR	NR		ND<2.5	NR	NR	-	NR	-
Bis (2-chloroethyl) Ether	NR	NR		ND<0.012	NR	NR	-	NR	-
Bis (2-chloroisopropyl) Ether	NR	NR		0.015	NR	NR	-	NR	-
Bis (2-ethylhexyl) Adipate	NR	NR		ND<2.5	NR	NR	-	NR	-
Bis (2-ethylhexyl) Phthalate	NR	NR		ND<2.5	NR	NR	-	NR	-
4-Bromophenyl Phenyl Ether	NR	NR		ND<2.5	NR	NR	-	NR	-
Butylbenzyl Phthalate	NR	NR		ND<2.5	NR	NR	-	NR	-
4-Chloroaniline	NR	NR		ND<0.012	NR	NR	-	NR	-
4-Chloro-3-methylphenol	NR	NR		ND<2.5	NR	NR	-	NR	-
2-Chloronaphthalene	NR	NR		ND<2.5	NR	NR	-	NR	-
2-Chlorophenol	NR	NR		ND<0.05	NR	NR	-	NR	-
4-Chlorophenyl Phenyl Ether	NR	NR		ND<2.5	NR	NR	-	NR	-
Chrysene	NR	NR		ND<2.5	NR	NR	-	NR	-
Dibenzo (a,h) anthracene	NR	NR		0.064	NR	NR	-	NR	-
Dibenzofuran	NR	NR		ND<2.5	NR	NR	-	NR	-
Di-n-butyl Phthalate	NR	NR		ND<2.5	NR	NR	-	NR	-
1,2-Dichlorobenzene	NR	NR		ND<2.5	NR	NR	-	NR	-
1,3-Dichlorobenzene	NR	NR		ND<2.5	NR	NR	-	NR	-
1,4-Dichlorobenzene	NR	NR		ND<0.25	NR	NR	-	NR	-
3,3-Dichlorobenzidine	NR	NR		ND<0.05	NR	NR	-	NR	-
2,4-Dichlorophenol	NR	NR		ND<0.025	NR	NR	-	NR	-
Diethyl Phthalate	NR	NR		ND<0.025	NR	NR	-	NR	-
2,4-Dimethylphenol	NR	NR		ND<0.25	NR	NR	-	NR	-
Dimethyl Phthalate	NR	NR		ND<0.025	NR	NR	-	NR	-
4,6-Dinitro-2-methylphenol	NR	NR		ND<13	NR	NR	-	NR	-
2,4-Dinitrophenol	NR	NR		ND<6.2	NR	NR	-	NR	-
2,4-Dinitrotoluene	NR	NR		ND<0.25	NR	NR	-	NR	-

(Cont.)

Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	10/2/17	**BatchID:**	146411
Date Analyzed:	10/2/17	**Extraction Method**	SW3550B/3640A
Instrument:	GC21	**Analytical Method:**	SW8270C
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-146411 1709793-001AMS/MSD

QC Summary Report for SW8270C (Low Level) w/ GPC

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
2,6-Dinitrotoluene	NR	NR		ND<2.5	NR	NR	-	NR	-
Di-n-octyl Phthalate	NR	NR		ND<5	NR	NR	-	NR	-
1,2-Diphenylhydrazine	NR	NR		ND<2.5	NR	NR	-	NR	-
Fluoranthene	NR	NR		ND<2.5	NR	NR	-	NR	-
Fluorene	NR	NR		ND<2.5	NR	NR	-	NR	-
Hexachlorobenzene	NR	NR		ND<0.25	NR	NR	-	NR	-
Hexachlorobutadiene	NR	NR		ND<0.25	NR	NR	-	NR	-
Hexachlorocyclopentadiene	NR	NR		ND<13	NR	NR	-	NR	-
Hexachloroethane	NR	NR		ND<2.5	NR	NR	-	NR	-
Indeno (1,2,3-cd) pyrene	NR	NR		ND<0.12	NR	NR	-	NR	-
Isophorone	NR	NR		ND<2.5	NR	NR	-	NR	-
2-Methylnaphthalene	NR	NR		ND<0.25	NR	NR	-	NR	-
2-Methylphenol (o-Cresol)	NR	NR		ND<2.5	NR	NR	-	NR	-
3 & 4-Methylphenol (m,p-Cresol)	NR	NR		ND<2.5	NR	NR	-	NR	-
Naphthalene	NR	NR		0.028	NR	NR	-	NR	-
2-Nitroaniline	NR	NR		ND<13	NR	NR	-	NR	-
3-Nitroaniline	NR	NR		ND<13	NR	NR	-	NR	-
4-Nitroaniline	NR	NR		ND<13	NR	NR	-	NR	-
Nitrobenzene	NR	NR		ND<2.5	NR	NR	-	NR	-
2-Nitrophenol	NR	NR		ND<13	NR	NR	-	NR	-
4-Nitrophenol	NR	NR		ND<13	NR	NR	-	NR	-
N-Nitrosodi-n-propylamine	NR	NR		ND<0.12	NR	NR	-	NR	-
Pentachlorophenol	NR	NR		ND<13	NR	NR	-	NR	-
Phenanthrene	NR	NR		ND<2.5	NR	NR	-	NR	-
Phenol	NR	NR		ND<0.05	NR	NR	-	NR	-
Pyrene	NR	NR		ND<2.5	NR	NR	-	NR	-
Pyridine	NR	NR		ND<2.5	NR	NR	-	NR	-
1,2,4-Trichlorobenzene	NR	NR		ND<2.5	NR	NR	-	NR	-
2,4,5-Trichlorophenol	NR	NR		ND<0.12	NR	NR	-	NR	-
2,4,6-Trichlorophenol	NR	NR		ND<0.12	NR	NR	-	NR	-

(Cont.)

NELAP 4033ORELAP

QA/QC Officer

Quality Control Report

Client:	Langan	**WorkOrder:**	1709793
Date Prepared:	10/2/17	**BatchID:**	146411
Date Analyzed:	10/2/17	**Extraction Method**	SW3550B/3640A
Instrument:	GC21	**Analytical Method:**	SW8270C
Matrix:	Soil	**Unit:**	mg/Kg
Project:	731706301; UC Berkeley GSPP & Housing	**Sample ID:**	MB/LCS-146411 1709793-001AMS/MSD

QC Summary Report for SW8270C (Low Level) w/ GPC

Analyte	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
Surrogate Recovery									
2-Fluorophenol	NR	NR			NR	NR	-	NR	-
Phenol-d5	NR	NR			NR	NR	-	NR	-
Nitrobenzene-d5	NR	NR			NR	NR	-	NR	-
2-Fluorobiphenyl	NR	NR			NR	NR	-	NR	-
2,4,6-Tribromophenol	NR	NR			NR	NR	-	NR	-
4-Terphenyl-d14	NR	NR			NR	NR	-	NR	-

McCampbell Analytical, Inc.
1534 Willow Pass Rd
Pittsburg, CA 94565-1701
(925) 252-9262

CHAIN-OF-CUSTODY RECORD

WorkOrder: 1709793 **A** **ClientCode: TWRF**

☐ WaterTrax ☐ WriteOn ☐ EDF ☐ Excel ☐ Fax ☑ Email ☐ HardCopy ☐ ThirdParty ☐ J-flag
☐ Detection Summary ☐ Dry-Weight

Report to:
Peter Cusack
Langan
555 Montgomery St., Suite 1300
San Francisco, CA 94111
(415) 955-5244 FAX: (415) 955-9041

Email: pcusack@langan.com
cc/3rd Party: kstaehlin@langan.com;
PO:
ProjectNo: 731706301; UC Berkeley GSPP & Housing

Bill to:
Accounts Payable
Langan
555 Montgomery St., Suite 1300
San Francisco, CA 94111
Langan_InvoiceCapture@concursolutio

Requested TAT: **5 days;**

Date Received: **09/19/2017**
Date Logged: **09/19/2017**
Date Add-On: **10/02/2017**

Lab ID	Client ID	Matrix	Collection Date	Hold	1	2	3	4	5	6	7	8	9	10	11	12
					Requested Tests (See legend below)											
1709793-001	B-1-2.0	Soil	9/15/2017 15:20	☐	A	A	A									

Test Legend:

1	8082_PCB_ESL_S [J]	2	8270_ESL_S [J]	3	8270_PNA_GPC_S	4	
5		6		7		8	
9		10		11		12	

Prepared by: Alexandra Iniguez

Add-On Prepared By: Kena Ponce

Comments: PCB & 8270 ESLs added 10/02/17 STAT

NOTE: Soil samples are discarded 60 days after results are reported unless other arrangements are made (Water samples are 30 days).
Hazardous samples will be returned to client or disposed of at client expense.

McCampbell Analytical, Inc.
"When Quality Counts"

1534 Willow Pass Road, Pittsburg, CA 94565-1701
Toll Free Telephone: (877) 252-9262 / Fax: (925) 252-9269
http://www.mccampbell.com / E-mail: main@mccampbell.com

WORK ORDER SUMMARY

Client Name: LANGAN
Client Contact: Peter Cusack
Contact's Email pcusack@langan.com

Project: 731706301; UC Berkeley GSPP & Housing
Comments: PCB & 8270 ESLs added 10/02/17 STAT

Work Order: 1709793
QC Level: LEVEL 2
Date Logged: 9/19/2017
Date Add-On: 10/2/2017

Lab ID	Client ID	Matrix	Test Name	Containers /Composites	Bottle & Preservative	Collection Date & Time	TAT	Sediment Content	Hold	SubOut
1709793-001A	B-1-2.0	Soil	SW8270C (PNAs w/ GPC)	1	Stainless Steel tube 2.5"x6"	9/15/2017 15:20	5 days		☐	
			SW8270C (SVOCs) ESLs				5 days		☐	
			SW8082 (PCBs Only)				5 days		☐	

NOTES: - STLC and TCLP extractions require 2 days to complete; therefore, all TATs begin after the extraction is completed (i.e., One-day TAT yields results in 3 days from sample submission).

- MAI assumes that all material present in the provided sampling container is considered part of the sample - MAI does not exclude any material from the sample prior to sample preparation unless requested in writing by the client.

1709793

PLEASE C.C. ANNIE S. AT
KSTAEHLIN@LANGAN.com

10337

LANGAN

CHAIN OF COUSTODY RECORD

- [X] 555 Montgomery Street. Suite 1300, San Francisco, CA 94111
- [ ] 501 14th Street, Third Floor, Oakland CA 94612
- [ ] 3320 Data Drive, Suite 350, Rancho Cordova, CA 95670-7982
- [ ] 4030 Moorpark Ave. Suite 210, San Jose, CA 95117-1849

Site Name: UC BERKELEY GSPP & HOUSING
Job Number: 731706301
Project Manager\Contact: PETER CUSACK
Samplers: KSS
Recorder (Signature Required): [signature]

Turnaround Time
STANDARD

Field Sample Identification No.	Date	Time	Lab Sample No.	Matrix: Soil	Water	Air	Other	No. Containers & Preservative: HCL	H_2SO_4	HNO_3	Ice			Analysis Requested: TPH gd, mo	VOCs	SVOCs	PNAs & PAHs	PCBs	CAM 17	ASBESTOS by CARB435	LUFT 5 METALS	PCB ESL 10/2/17 SMT	8270 ESL 10/2/17 SMT	8270 PNA ESL 10/2/17 SMT		Silica gel clean-up	Hold	Remarks
B-1-2.0	9/15/17	1520		X							X			X	X	X	X	X	X			X	X	X				
B-1-5.5		1530		X							X			X					X									
B-2-3.0		0840		X							X			X					X	X								
B-2-5.5		0850		X							X			X	X	X			X									
B-2-8.0		0858		X							X			X						X	X						X	PLEASE PLACE THESE SAMPLES ON HOLD, DO NOT ANALYZE.
B-3-3.0		0752		X							X			X	X	X	X	X	X									
B-3-5.5		0803		X							X			X	X	X			X									
B-3-10.5	9/15/17	0812		X							X			X						X	X						X	

Relinquished by: (Signature)	Date:	Time	Received by: (Signature)	Date	Time
[signature]			Basit	9/19/17	12:45
Basit	9/18/17	1630	[signature]	9/18/17	1030
			Received by Lab: (Signature)		

Sent to Laboratory (Name): McCAMPBELL ANALYTICAL
Laboratory Comments/Notes:

Method of Shipment: [X] Lab courier [ ] Fed Ex [ ] Airborne [ ] UPS [ ] Hand Carried [ ] Private Courier (Co. Name) ______

White Copy - Original   Yellow Copy - Laboratory   Pink Copy - Field   COC Number:

DISTRIBUTION

Electronic Copy:	Charlie MacDonald ACC OP Development LLC 12700 Hill Country Boulevard, Suite T-200 Austin, TX 78738
Electronic Copy:	Mike Korolyk, SE Tipping Structural Engineers 1906 Shattuck Avenue Berkeley, CA 94704
Electronic Copy:	Tim Stevens Solomon Cordwell Buenz Architecture 255 California Street, 3rd Floor San Francisco, CA 94111

QUALITY CONTROL REVIEWER:

Richard D. Rodgers

Richard D. Rodgers, PE, GE
Principal/Senior Consultant

APPENDIX E

NOISE TECHNICAL APPENDIX

- Freq Weight : A
- Time Weight : FAST
- Level Range : 40-100
- Max dB : 86.8 - 2018/05/04 16:25:47
- Level Range : 40-100
- SEL : 94.6
- Leq : 65.1
-

No.s	Date Time	(dB)
1	2018/05/04 16:12:18	57.7
2	2018/05/04 16:12:19	57.4
3	2018/05/04 16:12:20	59.0
4	2018/05/04 16:12:21	55.2
5	2018/05/04 16:12:22	56.8
6	2018/05/04 16:12:23	56.0
7	2018/05/04 16:12:24	54.6
8	2018/05/04 16:12:25	55.2
9	2018/05/04 16:12:26	56.5
10	2018/05/04 16:12:27	58.4
11	2018/05/04 16:12:28	59.2
12	2018/05/04 16:12:29	57.7
13	2018/05/04 16:12:30	55.0
14	2018/05/04 16:12:31	53.3
15	2018/05/04 16:12:32	52.9
16	2018/05/04 16:12:33	53.4
17	2018/05/04 16:12:34	53.9
18	2018/05/04 16:12:35	54.1
19	2018/05/04 16:12:36	54.7
20	2018/05/04 16:12:37	56.2
21	2018/05/04 16:12:38	55.7
22	2018/05/04 16:12:39	56.8
23	2018/05/04 16:12:40	58.4
24	2018/05/04 16:12:41	61.7
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887	2018/05/04	16:27:04	57.7
888	2018/05/04	16:27:05	57.8
889	2018/05/04	16:27:06	58.0
890	2018/05/04	16:27:07	56.7
891	2018/05/04	16:27:08	56.5
892	2018/05/04	16:27:09	56.9
893	2018/05/04	16:27:10	56.4
894	2018/05/04	16:27:11	58.1
895	2018/05/04	16:27:12	61.5
896	2018/05/04	16:27:13	61.8
897	2018/05/04	16:27:14	60.1
898	2018/05/04	16:27:15	59.5
899	2018/05/04	16:27:16	59.5
900	2018/05/04	16:27:17	60.4

- Freq Weight : A
- Time Weight : FAST
- Level Range : 40-100
- Max dB : 87.7 - 2018/05/04 16:35:37
- Level Range : 40-100
- SEL : 93.7
- Leq : 64.2
-

No.s	Date Time	(dB)
1	2018/05/04 16:31:03	61.4
2	2018/05/04 16:31:04	60.5
3	2018/05/04 16:31:05	61.4
4	2018/05/04 16:31:06	61.1
5	2018/05/04 16:31:07	60.8
6	2018/05/04 16:31:08	60.6
7	2018/05/04 16:31:09	60.3
8	2018/05/04 16:31:10	59.6
9	2018/05/04 16:31:11	59.4
10	2018/05/04 16:31:12	61.5
11	2018/05/04 16:31:13	63.0
12	2018/05/04 16:31:14	63.7
13	2018/05/04 16:31:15	64.7
14	2018/05/04 16:31:16	64.2
15	2018/05/04 16:31:17	63.7
16	2018/05/04 16:31:18	64.8
17	2018/05/04 16:31:19	60.5
18	2018/05/04 16:31:20	58.8
19	2018/05/04 16:31:21	59.1
20	2018/05/04 16:31:22	58.9
21	2018/05/04 16:31:23	56.4
22	2018/05/04 16:31:24	54.2
23	2018/05/04 16:31:25	54.4
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27	2018/05/04 16:31:29	60.8
28	2018/05/04 16:31:30	60.7
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53	2018/05/04 16:31:55	59.2
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55	2018/05/04 16:31:57	62.2
56	2018/05/04 16:31:58	68.0
57	2018/05/04 16:31:59	62.2
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69	2018/05/04 16:32:11	56.8
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420	2018/05/04	16:38:02	59.9
421	2018/05/04	16:38:03	63.7
422	2018/05/04	16:38:04	63.8
423	2018/05/04	16:38:05	62.9
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840	2018/05/04	16:45:02	62.3
841	2018/05/04	16:45:03	68.6
842	2018/05/04	16:45:04	70.9
843	2018/05/04	16:45:05	68.1
844	2018/05/04	16:45:06	67.4
845	2018/05/04	16:45:07	66.1
846	2018/05/04	16:45:08	65.5
847	2018/05/04	16:45:09	67.0
848	2018/05/04	16:45:10	65.3
849	2018/05/04	16:45:11	66.8
850	2018/05/04	16:45:12	65.2
851	2018/05/04	16:45:13	64.8
852	2018/05/04	16:45:14	61.7
853	2018/05/04	16:45:15	60.7
854	2018/05/04	16:45:16	62.9
855	2018/05/04	16:45:17	60.8
856	2018/05/04	16:45:18	60.0
857	2018/05/04	16:45:19	60.2
858	2018/05/04	16:45:20	61.1
859	2018/05/04	16:45:21	59.4
860	2018/05/04	16:45:22	58.6
861	2018/05/04	16:45:23	59.2
862	2018/05/04	16:45:24	59.5
863	2018/05/04	16:45:25	63.0
864	2018/05/04	16:45:26	63.8
865	2018/05/04	16:45:27	63.0
866	2018/05/04	16:45:28	62.0
867	2018/05/04	16:45:29	60.1
868	2018/05/04	16:45:30	60.5
869	2018/05/04	16:45:31	61.3
870	2018/05/04	16:45:32	61.5
871	2018/05/04	16:45:33	65.0
872	2018/05/04	16:45:34	65.5
873	2018/05/04	16:45:35	66.6
874	2018/05/04	16:45:36	69.4
875	2018/05/04	16:45:37	72.9
876	2018/05/04	16:45:38	74.8
877	2018/05/04	16:45:39	77.5

878	2018/05/04	16:45:40	78.1
879	2018/05/04	16:45:41	73.3
880	2018/05/04	16:45:42	69.6
881	2018/05/04	16:45:43	67.1
882	2018/05/04	16:45:44	64.7
883	2018/05/04	16:45:45	63.2
884	2018/05/04	16:45:46	63.0
885	2018/05/04	16:45:47	62.1
886	2018/05/04	16:45:48	61.2
887	2018/05/04	16:45:49	61.6
888	2018/05/04	16:45:50	59.5
889	2018/05/04	16:45:51	56.8
890	2018/05/04	16:45:52	56.1
891	2018/05/04	16:45:53	55.6
892	2018/05/04	16:45:54	55.1
893	2018/05/04	16:45:55	56.1
894	2018/05/04	16:45:56	55.6
895	2018/05/04	16:45:57	54.5
896	2018/05/04	16:45:58	56.6
897	2018/05/04	16:45:59	59.5
898	2018/05/04	16:46:00	58.1
899	2018/05/04	16:46:01	56.4
900	2018/05/04	16:46:02	58.0

- Freq Weight : A
- Time Weight : FAST
- Level Range : 40-100
- Max dB : 71.5 - 2018/05/04 17:02:15
- Level Range : 40-100
- SEL : 88.2
- Leq : 58.7
-

No.s	Date Time	(dB)
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2	2018/05/04 16:48:52	53.7
3	2018/05/04 16:48:53	54.0
4	2018/05/04 16:48:54	52.5
5	2018/05/04 16:48:55	54.1
6	2018/05/04 16:48:56	57.7
7	2018/05/04 16:48:57	56.9
8	2018/05/04 16:48:58	56.9
9	2018/05/04 16:48:59	58.1
10	2018/05/04 16:49:00	56.9
11	2018/05/04 16:49:01	58.4
12	2018/05/04 16:49:02	61.4
13	2018/05/04 16:49:03	57.4
14	2018/05/04 16:49:04	58.1
15	2018/05/04 16:49:05	58.2
16	2018/05/04 16:49:06	56.4
17	2018/05/04 16:49:07	57.3
18	2018/05/04 16:49:08	57.8
19	2018/05/04 16:49:09	57.3
20	2018/05/04 16:49:10	57.4
21	2018/05/04 16:49:11	58.8
22	2018/05/04 16:49:12	56.8
23	2018/05/04 16:49:13	54.6
24	2018/05/04 16:49:14	54.3
25	2018/05/04 16:49:15	59.5
26	2018/05/04 16:49:16	57.8
27	2018/05/04 16:49:17	63.7
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29	2018/05/04 16:49:19	63.3
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31	2018/05/04 16:49:21	58.0
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34	2018/05/04 16:49:24	52.3
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39	2018/05/04 16:49:29	53.5
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61	2018/05/04 16:49:51	52.5
62	2018/05/04 16:49:52	50.7
63	2018/05/04 16:49:53	51.1
64	2018/05/04 16:49:54	52.1
65	2018/05/04 16:49:55	61.3
66	2018/05/04 16:49:56	57.3
67	2018/05/04 16:49:57	49.7
68	2018/05/04 16:49:58	51.2
69	2018/05/04 16:49:59	53.2
70	2018/05/04 16:50:00	53.1
71	2018/05/04 16:50:01	51.3
72	2018/05/04 16:50:02	52.3
73	2018/05/04 16:50:03	53.9
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76	2018/05/04 16:50:06	56.0
77	2018/05/04 16:50:07	56.0
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79	2018/05/04 16:50:09	56.6
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82	2018/05/04 16:50:12	56.7
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370	2018/05/04	16:55:00	56.9
371	2018/05/04	16:55:01	56.6
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374	2018/05/04	16:55:04	55.7
375	2018/05/04	16:55:05	57.2
376	2018/05/04	16:55:06	58.4
377	2018/05/04	16:55:07	56.2
378	2018/05/04	16:55:08	55.0
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792	2018/05/04	17:02:02	58.8
793	2018/05/04	17:02:03	58.7
794	2018/05/04	17:02:04	58.7
795	2018/05/04	17:02:05	58.8
796	2018/05/04	17:02:06	59.3
797	2018/05/04	17:02:07	57.2
798	2018/05/04	17:02:08	58.3
799	2018/05/04	17:02:09	59.5
800	2018/05/04	17:02:10	58.5
801	2018/05/04	17:02:11	57.9
802	2018/05/04	17:02:12	56.3
803	2018/05/04	17:02:13	57.2
804	2018/05/04	17:02:14	62.3
805	2018/05/04	17:02:15	59.5
806	2018/05/04	17:02:16	58.7
807	2018/05/04	17:02:17	62.7
808	2018/05/04	17:02:18	61.7
809	2018/05/04	17:02:19	59.4
810	2018/05/04	17:02:20	58.0
811	2018/05/04	17:02:21	57.0
812	2018/05/04	17:02:22	58.1
813	2018/05/04	17:02:23	55.7
814	2018/05/04	17:02:24	55.8
815	2018/05/04	17:02:25	57.5
816	2018/05/04	17:02:26	56.3
817	2018/05/04	17:02:27	56.8
818	2018/05/04	17:02:28	57.4
819	2018/05/04	17:02:29	57.7
820	2018/05/04	17:02:30	53.8
821	2018/05/04	17:02:31	53.6
822	2018/05/04	17:02:32	52.1
823	2018/05/04	17:02:33	52.0
824	2018/05/04	17:02:34	52.3
825	2018/05/04	17:02:35	52.7
826	2018/05/04	17:02:36	52.5
827	2018/05/04	17:02:37	53.4
828	2018/05/04	17:02:38	56.1
829	2018/05/04	17:02:39	57.4
830	2018/05/04	17:02:40	57.0
831	2018/05/04	17:02:41	59.8
832	2018/05/04	17:02:42	57.2
833	2018/05/04	17:02:43	56.7
834	2018/05/04	17:02:44	56.3
835	2018/05/04	17:02:45	58.3
836	2018/05/04	17:02:46	58.5
837	2018/05/04	17:02:47	62.0
838	2018/05/04	17:02:48	60.1
839	2018/05/04	17:02:49	58.7
840	2018/05/04	17:02:50	58.0
841	2018/05/04	17:02:51	57.5
842	2018/05/04	17:02:52	58.1
843	2018/05/04	17:02:53	60.7
844	2018/05/04	17:02:54	65.1
845	2018/05/04	17:02:55	61.1
846	2018/05/04	17:02:56	57.4
847	2018/05/04	17:02:57	58.4
848	2018/05/04	17:02:58	57.5
849	2018/05/04	17:02:59	59.1
850	2018/05/04	17:03:00	58.7
851	2018/05/04	17:03:01	57.3
852	2018/05/04	17:03:02	56.3
853	2018/05/04	17:03:03	56.2
854	2018/05/04	17:03:04	54.8
855	2018/05/04	17:03:05	55.0
856	2018/05/04	17:03:06	60.5
857	2018/05/04	17:03:07	56.9
858	2018/05/04	17:03:08	58.8
859	2018/05/04	17:03:09	60.5
860	2018/05/04	17:03:10	59.2
861	2018/05/04	17:03:11	57.6
862	2018/05/04	17:03:12	56.2
863	2018/05/04	17:03:13	55.8
864	2018/05/04	17:03:14	55.6
865	2018/05/04	17:03:15	55.5
866	2018/05/04	17:03:16	54.8
867	2018/05/04	17:03:17	56.5
868	2018/05/04	17:03:18	58.6
869	2018/05/04	17:03:19	58.4
870	2018/05/04	17:03:20	60.2
871	2018/05/04	17:03:21	61.4
872	2018/05/04	17:03:22	60.3
873	2018/05/04	17:03:23	59.4
874	2018/05/04	17:03:24	59.5
875	2018/05/04	17:03:25	62.1
876	2018/05/04	17:03:26	68.4
877	2018/05/04	17:03:27	64.5

878	2018/05/04	17:03:28	62.9
879	2018/05/04	17:03:29	59.1
880	2018/05/04	17:03:30	61.8
881	2018/05/04	17:03:31	57.8
882	2018/05/04	17:03:32	55.1
883	2018/05/04	17:03:33	57.0
884	2018/05/04	17:03:34	55.4
885	2018/05/04	17:03:35	53.5
886	2018/05/04	17:03:36	54.9
887	2018/05/04	17:03:37	55.8
888	2018/05/04	17:03:38	54.8
889	2018/05/04	17:03:39	55.0
890	2018/05/04	17:03:40	53.9
891	2018/05/04	17:03:41	61.0
892	2018/05/04	17:03:42	51.9
893	2018/05/04	17:03:43	56.9
894	2018/05/04	17:03:44	53.2
895	2018/05/04	17:03:45	52.3
896	2018/05/04	17:03:46	50.9
897	2018/05/04	17:03:47	50.7
898	2018/05/04	17:03:48	50.5
899	2018/05/04	17:03:49	52.8
900	2018/05/04	17:03:50	52.3

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9 May 2018

Melissa Godfrey
Solomon Cordwell Buenz
255 California Street, Floor 3
San Francisco, CA 94111
Email: melissa.godfrey@scb.com

Subject: **UC Upper Hearst**
Environmental Noise Study
Salter Project 18-0018

Dear Melissa:

As requested, we have conducted a preliminary environmental noise study for this project. The purpose of this study is to quantify the existing and future noise levels at the project site, compare the noise levels with applicable standards, and propose mitigation measures as necessary. This report summarizes the results of our study.

Our analysis was based on the floor plans of the 100% SD drawings received 4 May 2018. The project includes a six-story residential building and a four-story faculty building for the Goldman School of Public Policy (GSPP).

PROJECT CRITERIA

State Noise Standards (Title 24)

Section 1207 of the 2016 California Building Code (Title 24) requires that the indoor noise level in residential units of multi-family dwellings not exceed DNL[1] 45 dB due to exterior sources. This is applicable to the residential portion of the project.

CALGreen

The CALGreen code addresses exterior noise intrusion in Section 5.507.4, *Acoustical Control*. This applies to non-residential buildings, which includes the GSPP faculty building.

> ***Section 5.507.4 Acoustical Control.*** *There is a requirement for mitigating exterior noise at commercial spaces where sound levels regularly exceed 65 dB. If the exterior noise level regularly exceeds 65 dB, then the building envelope must have wall and roof-ceiling assemblies*

1 DNL (Day-Night Average Sound Level) – A descriptor for a 24-hour A-weighted average noise level. DNL accounts for the increased acoustical sensitivity of people to noise during the nighttime hours. DNL penalizes sound levels by 10 dB during the hours from 10 PM to 7 AM. For practical purposes, the DNL and CNEL are usually interchangeable. DNL is sometimes written as L_{dn}.

> *designed to provide an interior noise environment not exceeding an $L_{eq}(h)$[2] of 50 dB in occupied areas during hours of operation.*

We assumed that the hours of operation for the faculty spaces would be from 7 am to 10 pm and used the loudest $L_{eq}(h)$ during that period as the basis of design.

NOISE ENVIRONMENT

The project is bounded by Hearst Avenue, La Loma Avenue, and Ridge Road. The noise environment is dominated by street traffic along these streets.

To quantify the existing noise environment, we conducted two multi-day measurements at the site between 4 and 6 April 2018. The long-term meters were placed at a height of 12 feet above grade. See **Figure 1** for measurement locations and measured noise levels.

Based on our measured data, we calculated the expected noise levels at the various facades and elevations. A traffic volume study has not been provided for the roadways, so we have added 1 dB to the measured noise level to account for future traffic increases[3].

RECOMMENDATIONS

General

Using the abovementioned drawings that show unit plans and elevations, we calculated the window and exterior door STC[4] ratings needed to meet the criteria.

The recommended STC ratings are for full window assemblies (glass and frame) rather than just the glass itself. Tested sound-rated assemblies should be used.

For reference, typical construction-grade dual-pane windows achieve an STC rating of 28. One-inch glazing assemblies (two 1/4-inch thick panes with a 1/2-inch airspace) typically achieve an STC rating of 32. Where STC ratings above 33 are required, at least one pane will need to be laminated.

2 $L_{eq}(h)$ – The equivalent steady-state A-weighted sound level that, in an hour, would contain the same acoustic energy as the time-varying sound level during the same hour.

3 The California Department of Transportation (DOT) assumes a traffic volume increase of three-percent per year, which corresponds to a 1 dB increase in DNL over a ten-year period.

4 STC (Sound Transmission Class) – A single-number rating defined in ASTM E90 that quantifies the airborne sound insulating performance of a partition under laboratory conditions. Increasing STC ratings correspond to improved airborne sound insulation.

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GSPP Faculty Building

To meet the CALGreen interior noise criterion of L_{eq}(h) 50 dB, the window STC ratings need to be as shown on **Figures 2 through 6** with STC ratings up to 36. Since the finishes for the GSPP are in flux, our calculations are based on the assumption that office spaces and learning spaces will have carpeted flooring or acoustical tile ceilings.

Residential Building

To meet the Title 24 interior DNL 45 dB noise goal, it will be necessary for all facades to be sound-rated. The minimum required window and exterior door STC ratings will need to be as shown on **Figures 4 through 7**. Our calculations are based on the following assumptions:

- 9-foot high ceilings
- All rooms (including bedrooms) will have hard-surfaced flooring

Where windows need to be closed to achieve an indoor DNL of 45 dB, an alternative method of supplying fresh air (e.g., mechanical ventilation) should be provided. This applies to all residences. This issue should be discussed with the project mechanical engineer.

* * *

This concludes our environmental noise study for the UC Upper Hearst project. Should you have any questions, please give us a call.

Sincerely,

CHARLES M. SALTER ASSOCIATES

Sybille Roth
Consultant

Valerie Smith, PE
Principal Consultant

Enclosures as noted

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UC BERKELEY UPPER HEARST MEASUREMENT LOCATIONS AND MEASURED NOISE LEVELS

FIGURE 1

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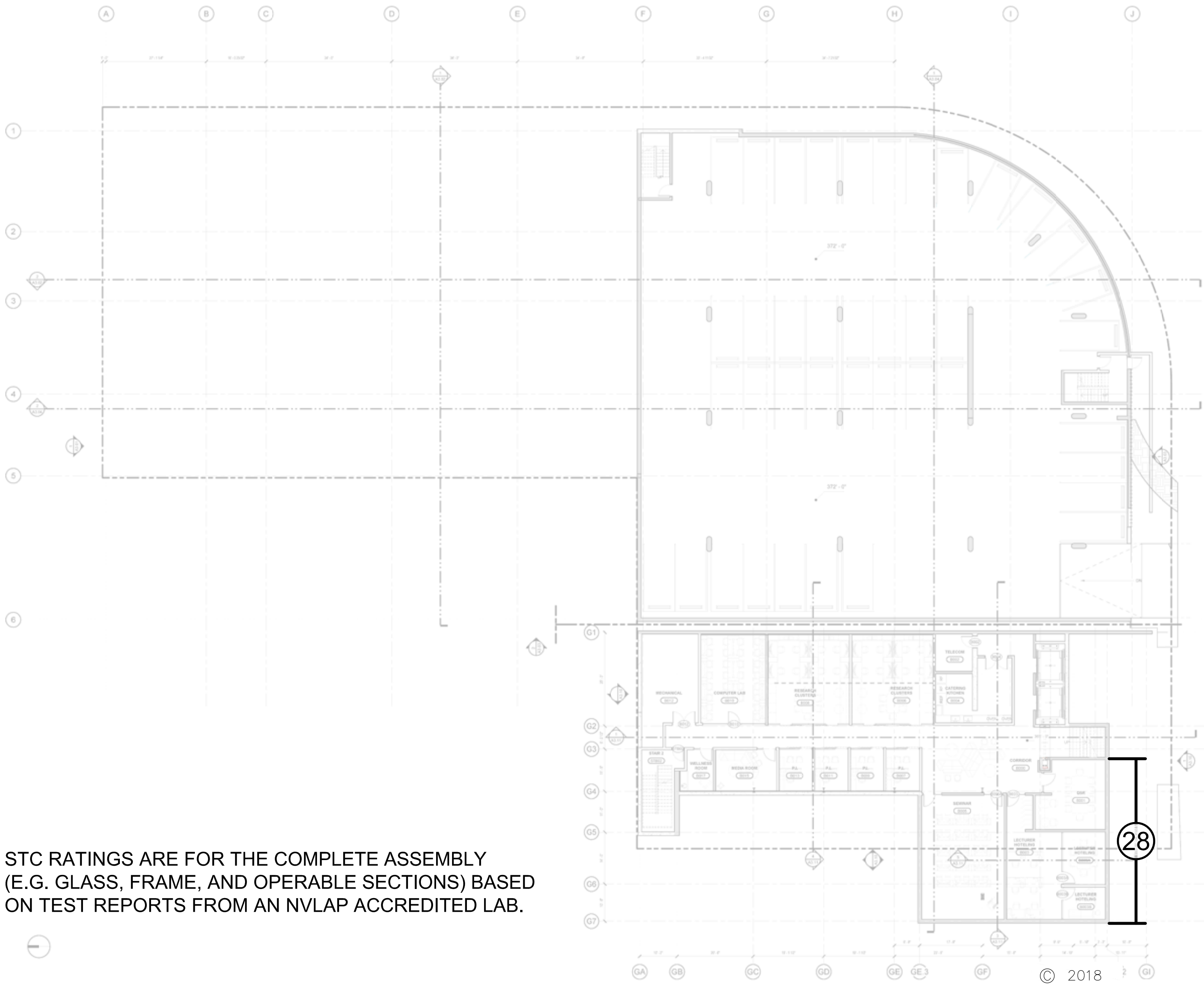

NOTE: STC RATINGS ARE FOR THE COMPLETE ASSEMBLY (E.G. GLASS, FRAME, AND OPERABLE SECTIONS) BASED ON TEST REPORTS FROM AN NVLAP ACCREDITED LAB.

GSPP - BASEMENT

UC BERKELEY UPPER HEARST
MINIMUM CODE–REQUIRED STC RATINGS FOR WINDOWS AND EXTERIOR DOORS

FIGURE 2

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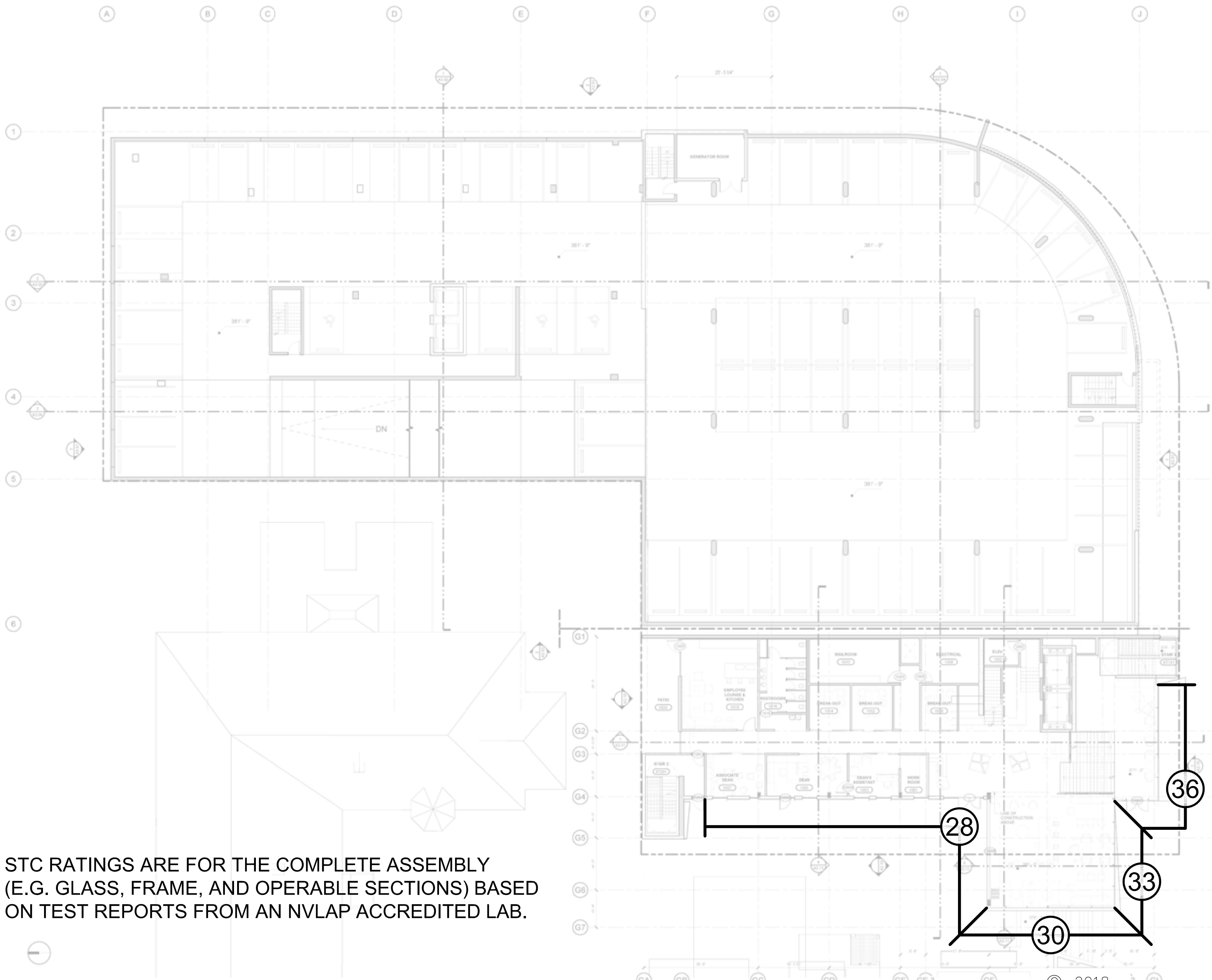

NOTE: STC RATINGS ARE FOR THE COMPLETE ASSEMBLY (E.G. GLASS, FRAME, AND OPERABLE SECTIONS) BASED ON TEST REPORTS FROM AN NVLAP ACCREDITED LAB.

GSPP - LEVEL 1

UC BERKELEY UPPER HEARST
MINIMUM CODE–REQUIRED STC RATINGS FOR WINDOWS AND EXTERIOR DOORS

FIGURE 3

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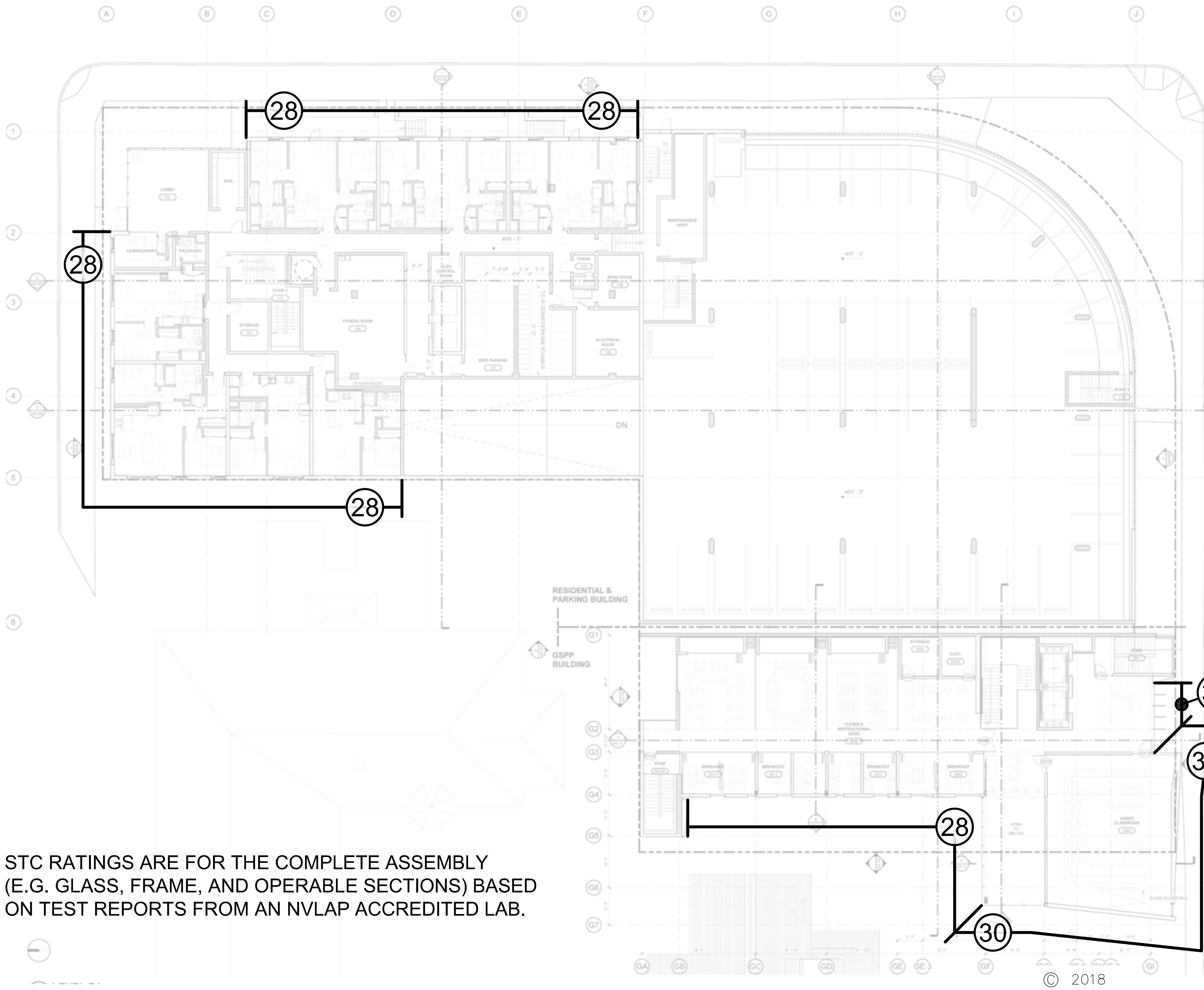

NOTE: STC RATINGS ARE FOR THE COMPLETE ASSEMBLY (E.G. GLASS, FRAME, AND OPERABLE SECTIONS) BASED ON TEST REPORTS FROM AN NVLAP ACCREDITED LAB.

GSPP - LEVEL 2 / RESIDENTIAL - LEVEL 1

UC BERKELEY UPPER HEARST MINIMUM CODE–REQUIRED STC RATINGS FOR WINDOWS AND EXTERIOR DOORS

FIGURE 4

Salter #
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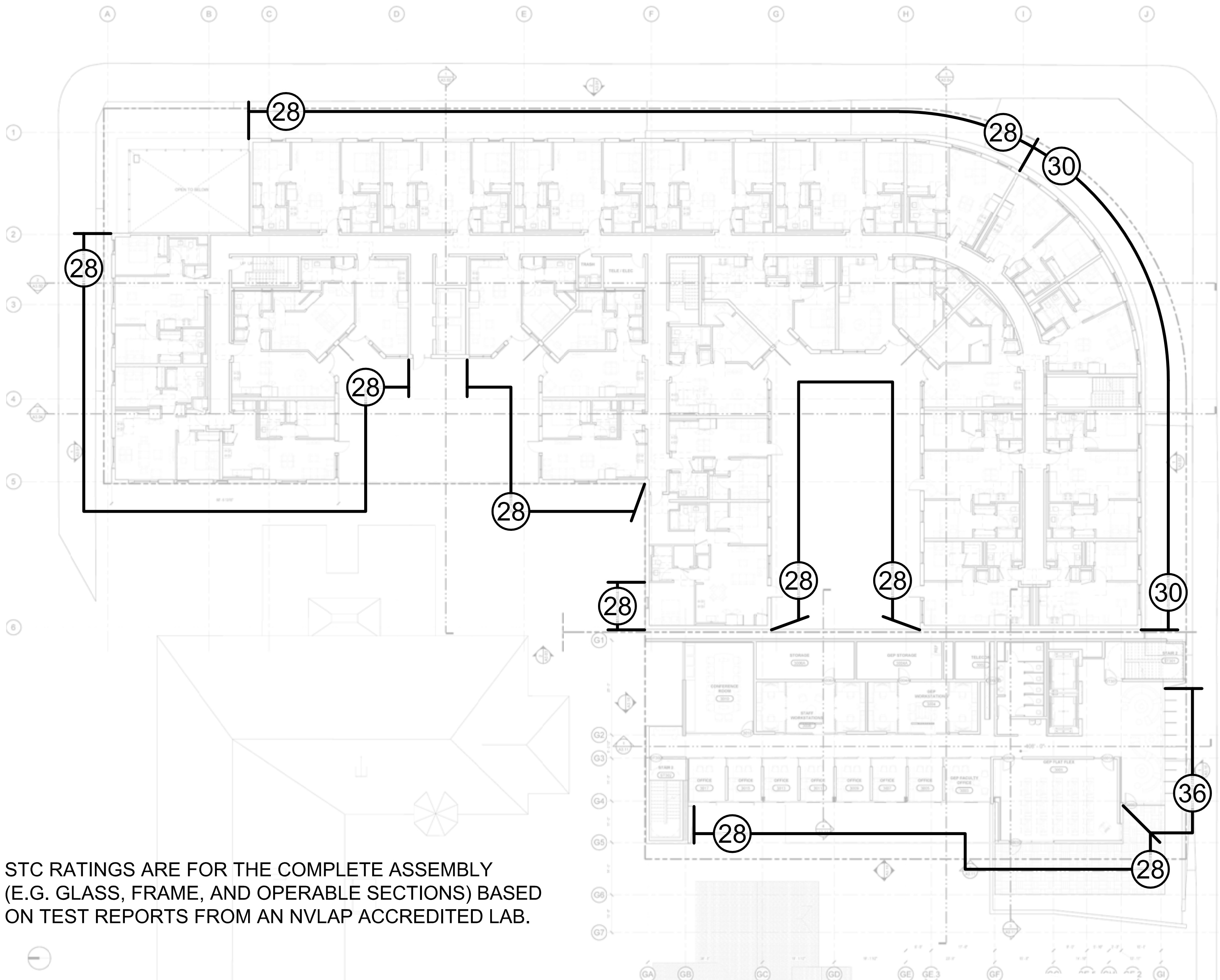

NOTE: STC RATINGS ARE FOR THE COMPLETE ASSEMBLY
(E.G. GLASS, FRAME, AND OPERABLE SECTIONS) BASED
ON TEST REPORTS FROM AN NVLAP ACCREDITED LAB.

GSPP - LEVEL 3 / RESIDENTIAL - LEVEL 2

UC BERKELEY UPPER HEARST
MINIMUM CODE–REQUIRED STC RATINGS
FOR WINDOWS AND EXTERIOR DOORS

FIGURE 5

Salter #
18–0018

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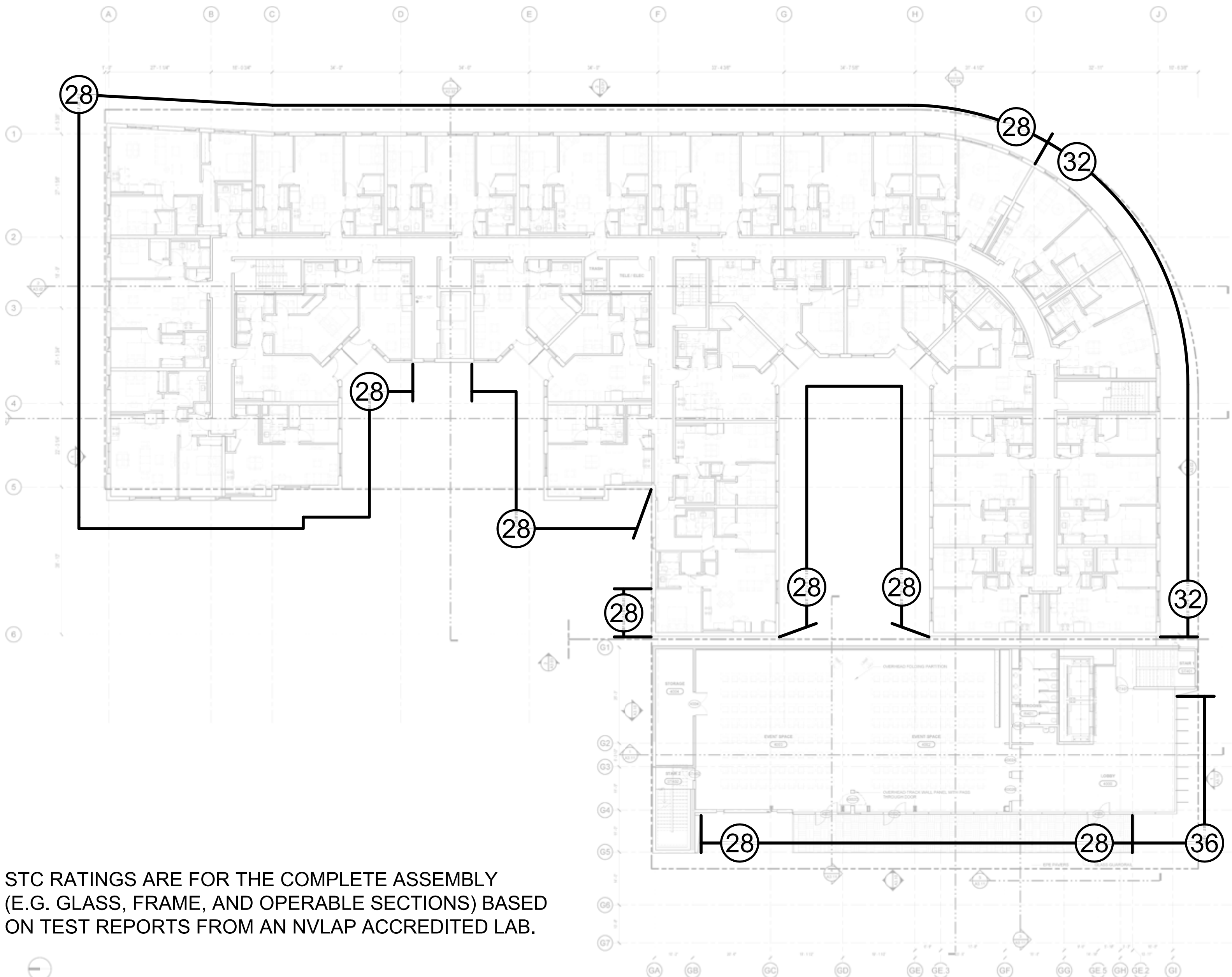

NOTE: STC RATINGS ARE FOR THE COMPLETE ASSEMBLY (E.G. GLASS, FRAME, AND OPERABLE SECTIONS) BASED ON TEST REPORTS FROM AN NVLAP ACCREDITED LAB.

GSPP - LEVEL 4 / RESIDENTIAL - LEVELS 3 TO 5

UC BERKELEY UPPER HEARST
MINIMUM CODE–REQUIRED STC RATINGS FOR WINDOWS AND EXTERIOR DOORS

FIGURE 6

Salter #
18–0018

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05.09.18

APPENDIX F

UPPER HEARST DEVELOPMENT – TRANSPORTATION ASSESSMENT

FEHR & PEERS

DRAFT MEMORANDUM

Date: January 25, 2019

To: Jonathan Berlin, Rincon Consultants

From: Huma Husain and Sam Tabibnia, Fehr & Peers

Subject: Upper Hearst Development – Transportation Assessment

OK18-0253

Fehr & Peers assessed the existing conditions and vehicle trip generation for the proposed Upper Hearst development in Berkeley, California (Proposed Project). Based on our assessment, an intersection impact analysis is not needed for the Proposed Project because the project would generate fewer vehicle trips than existing conditions during both the AM and PM peak hours.

This memorandum summarizes the project description, existing conditions, and trip generation estimates and driveway queuing for both project options.

PROJECT DESCRIPTION

The Proposed Project is located at the northwest corner of the La Loma Avenue/Hearst Avenue intersection. The site is currently occupied by the Upper Hearst surface parking lot and the multi-level Upper Hearst parking structure providing a total of 407 parking spaces, which includes 357 standard parking spaces and 50 attendant spaces. The existing parking spaces can be accessed through driveways on Ridge Road and Hearst and La Loma Avenues.

The Proposed Project would provide a total of 200 parking spaces, including 175 standard parking spaces and 25 attendant spaces, where attendant parking is estimated using the same proportion of standard spaces to attendant spaces in the existing garage. The Project would therefore eliminate 207 existing parking spaces by demolishing the surface parking and removing a portion of the parking structure to construct up to 150 new graduate student and/or faculty/staff housing units (consisting of 225 bedrooms) and up to 37,000 square feet of academic building. It is assumed that the Project may not provide dedicated parking spaces for the project, but the retained parking facility would continue to provide parking for

University of California, Berkeley parking permit holders and visitors. Automobile access to and from the parking structure would be provided through one driveway on Hearst Avenue.

EXISTING CONDITIONS

EXISTING ROADWAY NETWORK

The project site is bordered by the following local roadways described below.

LOCAL ROADWAYS

Hearst Avenue is a two-lane east-west minor arterial extending between the Eastshore Freeway in the west and Highland Place in the east. Directly adjacent to the project area, westbound Hearst Avenue has metered parallel vehicle and motorcycle parking, and eastbound Hearst Avenue has metered motorcycle parking with a right-turn pocket. Hearst Avenue borders the south side of the project site.

La Loma Avenue/Gayley Road is a two-lane north-south local street extending between the UC Berkeley campus in the south and Glendale La Loma Park in the north. Adjacent to the project site, both directions of La Loma have Residential Parking Permit (RPP) and two-hour parallel vehicle parking. La Loma Avenue borders the east side of the project site.

Ridge Road is a two-lane east-west local street extending between the Pacific School of Religion at Le Conte Avenue in the west and Highland Place in the east. Adjacent to the project site, both directions of Ridge Road have RPP and two-hour parallel vehicle parking. Ridge Road borders the north side of the project site.

Le Roy Avenue is a two-lane north-south local street extending between the UC Berkeley campus to the south and residential neighborhoods near the Berkeley Rose Garden to the north. Adjacent to the project site, northbound Le Roy has metered one-hour parallel parking, and southbound Le Roy has metered one-hour parallel parking with a third of the block dedicated to disabled parking.

EXISTING TRANSIT AND SHUTTLE SERVICES

Transit service providers in the project vicinity include AC Transit, which provides local and Transbay bus service, and Bear Transit, which is UC Berkeley's shuttle system.

AC TRANSIT

Local bus service in Berkeley is provided by AC Transit. The nearest bus stop to the project site is on eastbound Hearst Avenue just east of Le Roy Avenue, which is shared with UC Berkeley Bear Transit. This bus stop is served by Lines 52 and F and provides a bench and shelter. Line 52 operates in a clockwise loop around Campus Park and provides connections to University Village in Albany, North Berkeley BART, and Downtown Berkeley. Line F operates in a clockwise loop around the Campus Park and provides connections to Downtown Berkeley, Ashby BART, Emeryville, and Downtown San Francisco. **Table 1** summarizes the characteristics of the AC Transit Lines operating in the project area.

UC BERKELEY BEAR TRANSIT

Bear Transit is UC Berkeley's shuttle system, serving the Campus Park and vicinity. The nearest bus stop to the project site is on eastbound Hearst Avenue just east of Le Roy Avenue, which is shared with AC Transit. This bus stop is served by the Perimeter Line, Central Campus, and Night Safety Shuttle. The Perimeter Line and the Night Safety Shuttle operate in a clockwise loop around Campus Park, and the Central Campus Line operates in a clockwise loop around the northern parts of the Campus Park and provides connections to Downtown Berkeley. **Table 1** summarizes the characteristics of the UC Berkeley BEAR Transit lines in the project area.

TABLE 1 - TRANSIT ROUTES IN THE PROJECT AREA

Line	Route	Nearest Stop	Weekday		Weekend	
			Hours	Headway[1]	Hours	Headway[1]
AC Transit Local Lines						
52	University Village to UC Campus	Eastbound Hearst Avenue just east of Le Roy Avenue	6:00 AM–12:00 AM	15 (20)	8:00 AM–8:30 PM	20 (20)
AC Transit Transbay Lines						
F	UC Campus to Transbay Terminal	Eastbound Hearst Avenue just east of Le Roy Avenue	5:00 AM-1:30 AM	30 (30)	5:00 AM-12:30AM	30 (30)
Bear Transit Lines						
Perimeter	Clockwise loop around campus	Eastbound Hearst Avenue just east of Le Roy Avenue	7:00 AM – 7:30 PM	30 (30)	N/A	N/A
Central Campus	Downtown Berkeley to UC Campus	Eastbound Hearst Avenue just east of Le Roy Avenue	6:45 AM – 10:45 AM 4:15 PM – 7:15 PM	20 (20)	N/A	N/A
Night Safety	UC Campus to BART, Clark Kerr Campus, and residences	Eastbound Hearst Avenue just east of Le Roy Avenue	7:30 PM – 3:00 AM	15-30	N/A	N/A

1. Headway is the frequency, or interval of time, between buses travelling in any given direction along a designated route: Peak Period Headway (Off-Peak Period Headway).

Source: AC Transit website; summarized by Fehr & Peers, 2019.

EXISTING PEDESTRIAN AND BICYCLE CIRCULATION

Within the project study area, all roadways provide sidewalks on at least one side of the street and all intersections have marked crosswalks. The Hearst Avenue/Le Roy Avenue and Hearst Avenue/La Loma Avenue intersections are signalized with high-visibility ladder crosswalks on all approaches. The La Loma Avenue/Ridge Road and Le Roy Avenue/Ridge Road intersections are all-way stop-controlled intersections with standard (transverse lines) crosswalks.

Based on the City of Berkeley *Bicycle Master Plan* (May 2017), bicycle facilities can be classified into the following types:

- ***Multi-Use Paths (Class I)*** – These facilities provide completely separated, exclusive right-of-way for bicycling, walking, and other non-motorized uses.

- ***Bicycle Lanes (Class II)*** – These facilities are striped, preferential lanes for one-way bicycle travel on roadways. Some Class II bicycle lanes include striped buffers that add a few feet of separation between the bicycle lane and traffic lane or parking aisle. Caltrans requires a minimum of four feet of paved surface for Class II bikeways on roadways without gutters and five feet for roadways with gutters or adjacent to on-street parking.

- ***Bicycle Routes (Class III)*** – These facilities are signed bicycle routes where people riding bicycles share a travel lane with people driving motor vehicles. Because they are mixed-flow facilities, Class III bicycle routes are only appropriate for low-volume streets with slow travel speeds. Bicycle Boulevards are included in this classification.

- ***Separated Bikeways (Class IV)*** – These are separated and protected bikeways where a type of barrier, usually curbs, bollards, or parking isles, separate the bike lane from the vehicular flow of traffic. These are also known as cycle tracks.

Currently, bicyclists are allowed on all streets within the study area. Hearst Avenue is a Class III Bicycle Route on both directions of the street adjacent to the project site. There are no designated bicycle facilities on La Loma Avenue, Gayley Road, Ridge Road, and Le Roy Avenue. The 2017 *Bicycle Master Plan* proposes Class III Bicycle Routes along La Loma Avenue and Gayley Road within the project vicinity.

EXISTING INTERSECTION OPERATIONS

Fehr & Peers collected weekday AM and PM peak period (7:00 to 9:00 AM and 4:00 to 6:00 PM) traffic counts, including counts of heavy vehicles, pedestrians and bicycles, at the Gayley Road/La Loma Avenue/ Hearst Avenue intersection in April 2018, while UC Berkeley was in normal session. **Appendix A** presents the raw collected traffic data.

Based on the observed volumes, intersection control, and roadway configurations collected through field observations, Fehr & Peers calculated the AM and PM peak hour intersection level of service (LOS)[1] at the

[1] The operations of roadway facilities are typically described with the term level of service (LOS), a qualitative description of traffic flow based on factors such as speed, travel time, delay, and freedom to maneuver. Six levels are defined from LOS A, which reflects free-flow conditions where there is very little interaction between vehicles, to LOS F, where the vehicle demand exceeds the capacity and high levels of vehicle delay result. LOS E represents at-capacity operations. When traffic volumes exceed the intersection capacity, stop-and-go conditions result and a vehicle may wait through multiple signal cycles before passing through the intersection; these operations are designated as LOS F.

Gayley intersection using the HCM 2010 methodology. **Table 2** summarizes the existing weekday AM and PM peak hour intersection LOS analysis results. **Appendix B** provides the detailed calculation work sheets. As shown in the table, the intersection operates at LOS B during both AM and PM peak hours.

TABLE 2 - EXISTING WEEKDAY INTERSECTION LOS SUMMARY

Intersection	Control[1]	AM Peak Hour		PM Peak Hour	
		Delay (Seconds)[2]	LOS	Delay (Seconds)[2]	LOS
1. Gayley Road/La Loma Avenue/Hearst Avenue	Signalized	16	B	17	B

1. Average intersection delay and LOS based on the 2010 HCM method, unless noted. Average delay is reported for signalized intersections.
2. Estimated based on 2010 HCM delay thresholds.

Source: Fehr & Peers, 2019.

PROJECT EVALUATION

PROJECT TRIP GENERATION

Trip generation refers to the process of estimating the amount of vehicular traffic a project would add to the surrounding roadway system. Vehicle trips were estimated for the peak one-hour period during the morning (7:00 to 9:00 AM) and evening (4:00 to 6:00 PM) commute periods when traffic volumes on the adjacent streets are highest. The trip generation for each project component is described below:

CAMPUS HOUSING

The Institute of Transportation Engineers (ITE) *Trip Generation Manual (10th Edition)* was used to estimate the trips generated by the residential component of the project. The ITE trip generation rates are based on national data, collected in both suburban and urban locations, including dense urban locations with higher rates of non-automobile travel. Trips generated by the housing units were estimated using the ITE rates for off-campus student apartments adjacent to campus (ITE code 225), which estimates the number of trips generated based on the number of bedrooms.

The housing component of the project is estimated to generate about 27 AM and 56 PM peak hour trips . This estimate is conservative in that the ITE data used to estimate trip generation is based on data collected at mostly urban sites that are more auto-dependent and provide more parking supply than the project setting. The estimate does not account for the constrained parking supply at or near the site. Considering that the project may not provide dedicated parking for residents and that on-street parking is generally at or near-capacity, it is likely that the project would generate fewer trips than estimated.

ACADEMIC BUILDING

The trip generation for the academic building component of the project was estimated based on the methodology developed for the UC Berkeley 2020 Long Range Development Plan (LRDP) EIR and updated based on the results of the 2016-2017 commute survey of various population groups. UC Berkeley estimates that the new academic building would result in up to 30 net new graduate students and 30 net new faculty and staff.

The academic building component of the project is estimated to generate about eight AM and seven PM peak hour trips. This estimate is conservative in that it does not account for the constrained parking supply at or near the site and assumes that all those who wish to drive to the site would be able to drive and park in the project vicinity.

PARKING STRUCTURE

Fehr & Peers collected peak period vehicle counts at the four existing parking driveways on Tuesday, May 1, 2018. These counts were used to develop an average trip generation rate per parking space for the AM and PM peak hours. Based on these rates, the demolition of the 207 parking spaces under the Proposed Project is estimated to reduce trip generation by 50 AM and 68 PM peak hour trips. Daily trips for the parking structure were estimated based on the observed trip generation rate per parking space in the 2020 LRDP EIR of about 2.6 daily trips per space.

TRIP GENERATION SUMMARY

Table 3 presents the trip generation estimates for the project. The Proposed Project is estimated to increase daily trip generation by about 150 trips, reduce peak hour trip generation by about 15 trips during the AM peak hour, and by five trips during the PM peak hour.

The reason that daily trips increase while peak hour trips decrease is due to the difference in the trip generation rate per space during the peak and off-peak hours. The trip generation rate per space is lower in the off-peak hours because most parking structure users enter and exit during the peak hours. Thus, the removal of parking would result in a relatively smaller decrease in daily trips than the decrease during peak hours.

Since the Proposed Project would reduce automobile trip generation during both the AM and PM peak hours, it would not deteriorate intersection operations in the project area during peak conditions. The increase in daily trips would not warrant an intersection analysis because the increase in trips would be added to the study intersection during off-peak hours, when overall intersection volumes are lower than during the peak hours. Additionally, the daily trips would be distributed across all off-peak hours, resulting in minimal additional trips per hour. Thus, no intersection impact analysis is necessary.

TABLE 3 - PROJECT TRIP GENERATION

Land Use	Size	Daily Trips	AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
Campus Housing[1]								
Campus Housing	225 Bedrooms	**710**	11	16	**27**	28	28	**56**
Academic Building								
Graduate Student[2]	30 Students	**10**	1	0	**1**	0	1	**1**
Faculty and Staff[3]	30 Persons	**30**	6	1	**7**	1	5	**6**
	Subtotal	***40***	*7*	*1*	***8***	*1*	*6*	***7***
Parking Structure[4]								
Parking Structure	-207 Spaces	**-600**	-48	-2	**-50**	-15	-52	**-68**
Net New Trips		**150**	**-30**	**15**	**-15**	**14**	**-18**	**-5**

1. ITE *Trip Generation (10th Edition)* land use category 225 (off-campus student apartment) adjacent to campus setting:
   Daily Rate: 3.15 trips per bedroom
   AM Peak Hour Rate: 0.12 trips per bedroom (41% in, 59% out)
   PM Peak Hour Rate: 0.25 trips per bedroom (50% in, 50% out)
2. Based on the UC Berkeley 2020 LRDP methodology and the travel modes from 2016-2017 survey data:
   Daily Rate: 0.23 trips per student
   AM Peak Hour Rate: 0.05 trips per student (91% in, 9% out)
   PM Peak Hour Rate: 0.05 trips per student (12% in, 88% out)
3. Based on the UC Berkeley 2020 LRDP methodology and the travel modes from 2016-2017 survey data:
   Daily Rate: 0.85 trips per faculty/staff
   AM Peak Hour Rate: 0.20 trips per faculty/staff (91% in, 9% out)
   PM Peak Hour Rate: 0.19 trips per faculty/staff (12% in, 88% out)
4. Based on peak period driveway counts at the existing Upper Hearst parking facilities:
   Daily Rate: 2.6 trips per parking space
   AM Peak Hour Rate: 0.24 trips per parking space (96% in, 4% out)

PM Peak Hour Rate: 0.33 trips per parking space (23% in, 77% out)
Source: Fehr & Peers, 2019.

QUEUEING ANALYSIS AND DRIVEWAY OPERATIONS

A queuing analysis was completed for the Gayley Road/La Loma Avenue/Hearst Avenue intersection and the adjacent garage driveway to assess the impact of the Proposed Project driveway on queuing. Queues were analyzed by modeling traffic operations at the Gayley Road/La Loma Avenue/Hearst Avenue intersection and the project driveway on Hearst Avenue using Synchro 10 software to estimate the 95th percentile queues during the AM and PM peak hours. [2] Driveway volumes were estimated by applying the existing average trip generation rate per space (summarized in the trip generation section above) to the proposed number of spaces under the Proposed Project and all trips were assigned to the single driveway. Queue reports are provided in **Appendix C**.

The Proposed Project would provide one driveway on Hearst Avenue approximately 200 feet west of the Gayley Road/La Loma Avenue/Hearst Avenue intersection. **Table 4** summarizes the 95th percentile queue lengths. Vehicles queues are not expected to result in queue spillbacks and block upstream intersections or driveways during the AM and PM peak hours. Therefore, the project driveway would not cause a significant queuing conflict.

TABLE 4 – PROJECT QUEUING SUMMARY

Movement	Storage Length[1]	95th Percentile Queue Length[2]	
		AM Peak Hour	PM Peak Hour
Gayley Road/La Loma Avenue/Hearst Avenue			
Eastbound	200 feet	110 feet	50 feet
Hearst Avenue Driveway			
Eastbound	240 feet	<20 feet	<20 feet
Westbound	200 feet	<20 feet	<20 feet

Bold indicated that 95th percentile queue would exceed the available storage.
1. Storage length is defined as the length in feet between the study intersection and the nearest adjacent intersection.
2. 95th percentile queue based on the Synchro 10 software.

Source: Fehr & Peers, 2019.

[2] 95th percentile queue means that 95% of the time, the queue is below the values shown. The remaining 5% of the time, the queue is above that value.

Based on our review of the preliminary site plan for the Proposed Project, the Hearst Avenue driveway may not provide adequate sight distance between vehicles exiting the driveway and pedestrians on the adjacent sidewalk. Adequate sight distance is defined as a clear line-of-sight between a motorist ten feet back from the sidewalk and a pedestrian ten feet away on each side of the driveway.

> **Recommendation 1:** For the Proposed Project, ensure that the garage driveway on Hearst Avenue would provide adequate sight distance between vehicles existing the parking garage and pedestrians on the adjacent crosswalk. If adequate sight distance cannot be provided, install mirrors on both sides of the driveway to aid drivers' and pedestrians' visibility and install flashing lights to alert pedestrians when a vehicle is exiting the driveway.

Please contact us with questions or comments.

Attachments:

Appendix A – Intersection Counts

Appendix B – Intersection LOS Calculations

Appendix C – Intersection Queue Results

Prepared by National Data & Surveying Services

Gayley Rd & Hearst Ave

Peak Hour Turning Movement Count

ID: 18-08207-001
City: Berkeley

Day: Tuesday
Date: 04/24/2018

	PEAK HOURS	COUNT PERIODS
AM	08:00 AM - 09:00 AM	07:00 AM - 09:00 AM
NOON	NONE	NONE
PM	04:45 PM - 05:45 PM	04:00 PM - 06:00 PM

Gayley Rd SOUTHBOUND

	Right	Through	Left	U-Turn	Exit
AM	14	265	23	0	226
NOON	0	0	0	0	0
PM	23	224	7	0	330
Lanes	0.5	0.5	0	0	

Hearst Ave EASTBOUND

	AM	NOON	PM	Lanes
Exit	266	0	345	
U-Turn	0	0	0	0
Left	21	0	23	0
Through	131	0	33	0.5
Right	222	0	255	0.5

Hearst Ave WESTBOUND

	PM	NOON	AM	Lanes
Right	30	0	4	0
Through	118	0	39	2
Left	62	0	18	0
U-Turn	0	0	0	0
Exit	62	0	219	

Gayley Rd NORTHBOUND

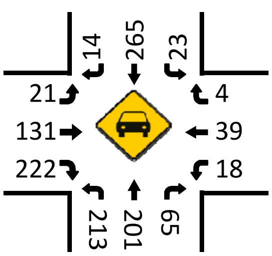
	Exit	U-Turn	Left	Through	Right
Lanes		0	0	0.5	0.5
PM	541	0	204	277	22
NOON	0	0	0	0	0
AM	505	0	213	201	65

CONTROL

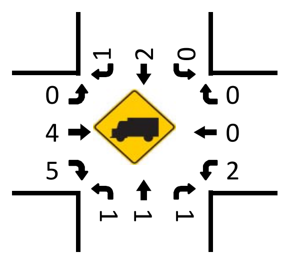
Signalized

	AM	NOON	PM
TEV	1216	0	1278
PHF	0.97		0.93

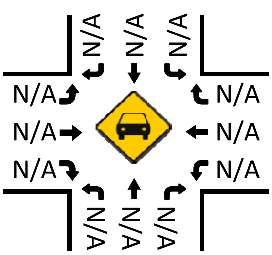
Total Vehicles (AM)



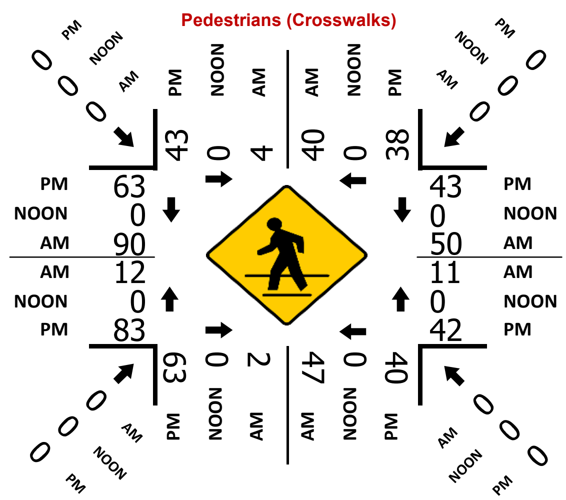
Bikes (AM)



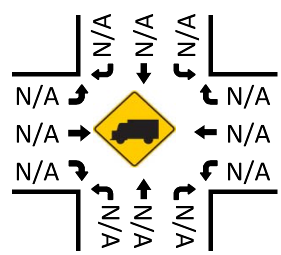
Total Vehicles (Noon)



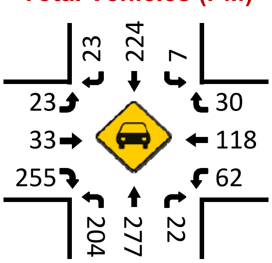
Pedestrians (Crosswalks)



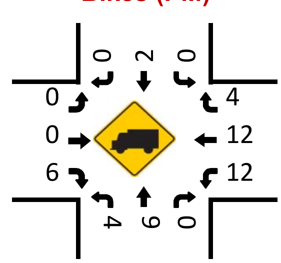
Bikes (NOON)



Total Vehicles (PM)



Bikes (PM)



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	21	131	222	18	39	4	213	201	65	23	265	14
Future Volume (veh/h)	21	131	222	18	39	4	213	201	65	23	265	14
Number	1	6	16	5	2	12	7	4	14	3	8	18
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	0.93		0.90	0.96		0.92	0.96		1.00	0.98		0.89
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1900	1900	1900	1900	1900	1900	1976	1976	1900	1900	1900
Adj Flow Rate, veh/h	22	135	229	19	40	4	220	207	0	24	273	14
Adj No. of Lanes	0	1	1	1	1	0	0	1	1	0	1	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Percent Heavy Veh, %	0	0	0	0	0	0	0	0	0	0	0	0
Cap, veh/h	98	537	464	346	537	54	475	405	955	92	948	47
Arrive On Green	0.32	0.32	0.32	0.32	0.32	0.32	0.57	0.57	0.00	0.57	0.57	0.57
Sat Flow, veh/h	147	1683	1454	994	1685	169	715	712	1680	77	1666	82
Grp Volume(v), veh/h	157	0	229	19	0	44	427	0	0	311	0	0
Grp Sat Flow(s),veh/h/ln	1830	0	1454	994	0	1854	1426	0	1680	1825	0	0
Q Serve(g_s), s	0.0	0.0	10.2	1.2	0.0	1.3	7.3	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	4.9	0.0	10.2	6.1	0.0	1.3	14.2	0.0	0.0	6.9	0.0	0.0
Prop In Lane	0.14		1.00	1.00		0.09	0.52		1.00	0.08		0.05
Lane Grp Cap(c), veh/h	635	0	464	346	0	591	879	0	955	1087	0	0
V/C Ratio(X)	0.25	0.00	0.49	0.05	0.00	0.07	0.49	0.00	0.00	0.29	0.00	0.00
Avail Cap(c_a), veh/h	635	0	464	346	0	591	879	0	955	1087	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	20.2	0.0	22.0	22.5	0.0	19.0	10.4	0.0	0.0	8.9	0.0	0.0
Incr Delay (d2), s/veh	0.9	0.0	3.7	0.3	0.0	0.2	1.9	0.0	0.0	0.7	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.7	0.0	4.6	0.3	0.0	0.7	6.2	0.0	0.0	3.7	0.0	0.0
LnGrp Delay(d),s/veh	21.2	0.0	25.8	22.8	0.0	19.3	12.3	0.0	0.0	9.6	0.0	0.0
LnGrp LOS	C		C	C		B	B			A		
Approach Vol, veh/h		386			63			427			311	
Approach Delay, s/veh		23.9			20.3			12.3			9.6	
Approach LOS		C			C			B			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		30.0		50.0		30.0		50.0
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		25.5		45.5		25.5		45.5
Max Q Clear Time (g_c+I1), s		8.1		16.2		12.2		8.9
Green Ext Time (p_c), s		2.1		6.0		1.8		6.3

Intersection Summary	
HCM 2010 Ctrl Delay	15.8
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	23	33	255	62	118	30	204	277	22	7	224	23
Future Volume (veh/h)	23	33	255	62	118	30	204	277	22	7	224	23
Number	1	6	16	5	2	12	7	4	14	3	8	18
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	0.89		0.84	0.91		0.81	0.94		1.00	0.98		0.85
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1900	1900	1900	1900	1900	1900	1976	1976	1900	1900	1900
Adj Flow Rate, veh/h	25	35	274	67	127	32	219	298	0	8	241	25
Adj No. of Lanes	0	1	1	1	1	0	0	1	1	0	1	0
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	0	0	0	0	0	0	0	0	0	0	0	0
Cap, veh/h	223	288	437	346	449	113	414	498	939	57	919	93
Arrive On Green	0.32	0.32	0.32	0.32	0.32	0.32	0.56	0.56	0.00	0.56	0.56	0.56
Sat Flow, veh/h	482	892	1357	993	1392	351	620	891	1680	15	1643	166
Grp Volume(v), veh/h	60	0	274	67	0	159	517	0	0	274	0	0
Grp Sat Flow(s),veh/h/ln	1375	0	1357	993	0	1742	1511	0	1680	1825	0	0
Q Serve(g_s), s	0.1	0.0	13.0	4.1	0.0	5.2	10.7	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	5.3	0.0	13.0	9.4	0.0	5.2	16.5	0.0	0.0	5.9	0.0	0.0
Prop In Lane	0.42		1.00	1.00		0.20	0.42		1.00	0.03		0.09
Lane Grp Cap(c), veh/h	510	0	437	346	0	562	913	0	939	1069	0	0
V/C Ratio(X)	0.12	0.00	0.63	0.19	0.00	0.28	0.57	0.00	0.00	0.26	0.00	0.00
Avail Cap(c_a), veh/h	510	0	437	346	0	562	913	0	939	1069	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	18.1	0.0	21.9	22.7	0.0	19.2	10.8	0.0	0.0	8.7	0.0	0.0
Incr Delay (d2), s/veh	0.5	0.0	6.6	1.2	0.0	1.3	2.5	0.0	0.0	0.6	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.9	0.0	5.7	1.2	0.0	2.7	7.7	0.0	0.0	3.1	0.0	0.0
LnGrp Delay(d),s/veh	18.5	0.0	28.5	24.0	0.0	20.5	13.4	0.0	0.0	9.3	0.0	0.0
LnGrp LOS	B		C	C		C	B			A		
Approach Vol, veh/h		334			226			517			274	
Approach Delay, s/veh		26.7			21.5			13.4			9.3	
Approach LOS		C			C			B			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		29.0		47.0		29.0		47.0
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5
Max Green Setting (Gmax), s		24.5		42.5		24.5		42.5
Max Q Clear Time (g_c+I1), s		11.4		18.5		15.0		7.9
Green Ext Time (p_c), s		2.5		6.3		2.1		6.9

Intersection Summary	
HCM 2010 Ctrl Delay	17.2
HCM 2010 LOS	B

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	24	373	243	23	1	1
Future Vol, veh/h	24	373	243	23	1	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	24	373	243	23	1	1

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	266	0	-	0	676	255
Stage 1	-	-	-	-	255	-
Stage 2	-	-	-	-	421	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1298	-	-	-	419	784
Stage 1	-	-	-	-	788	-
Stage 2	-	-	-	-	662	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1298	-	-	-	409	784
Mov Cap-2 Maneuver	-	-	-	-	409	-
Stage 1	-	-	-	-	770	-
Stage 2	-	-	-	-	662	-

Approach	EB	WB	SB
HCM Control Delay, s	0.5	0	11.7
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1298	-	-	-	538
HCM Lane V/C Ratio	0.018	-	-	-	0.004
HCM Control Delay (s)	7.8	0	-	-	11.7
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	8	286	338	7	25	26
Future Vol, veh/h	8	286	338	7	25	26
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	8	286	338	7	25	26

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	345	0	-	0	644	342
Stage 1	-	-	-	-	342	-
Stage 2	-	-	-	-	302	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1214	-	-	-	437	701
Stage 1	-	-	-	-	719	-
Stage 2	-	-	-	-	750	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1214	-	-	-	434	701
Mov Cap-2 Maneuver	-	-	-	-	434	-
Stage 1	-	-	-	-	713	-
Stage 2	-	-	-	-	750	-

Approach	EB		WB		SB	
HCM Control Delay, s	0.2		0		12.4	
HCM LOS					B	

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1214	-	-	-	539
HCM Lane V/C Ratio	0.007	-	-	-	0.095
HCM Control Delay (s)	8	0	-	-	12.4
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.3

Lane Group	EBT	EBR	WBL	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	157	229	19	44	427	67	311
v/c Ratio	0.27	0.37	0.06	0.07	0.58	0.08	0.32
Control Delay	21.9	5.0	19.7	18.2	15.1	4.1	10.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.9	5.0	19.7	18.2	15.1	4.1	10.0
Queue Length 50th (ft)	58	0	7	14	126	5	74
Queue Length 95th (ft)	105	47	21	36	214	21	121
Internal Link Dist (ft)	157			326	271		278
Turn Bay Length (ft)		50	40			40	
Base Capacity (vph)	577	611	334	594	737	866	982
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.37	0.06	0.07	0.58	0.08	0.32

Intersection Summary

Lane Group	EBT	EBR	WBL	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	58	263	64	153	496	23	262
v/c Ratio	0.11	0.41	0.17	0.26	0.60	0.03	0.26
Control Delay	20.1	5.1	21.3	19.4	15.3	3.9	9.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.1	5.1	21.3	19.4	15.3	3.9	9.2
Queue Length 50th (ft)	20	0	23	50	150	1	58
Queue Length 95th (ft)	47	50	52	95	247	10	98
Internal Link Dist (ft)	157			326	271		278
Turn Bay Length (ft)		50	40			40	
Base Capacity (vph)	515	634	371	586	820	856	1004
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.41	0.17	0.26	0.60	0.03	0.26

Intersection Summary

APPENDIX G

UC BERKELEY LONG RANGE DEVELOPMENT PLAN TRIP GENERATION COMPARISON

FEHR & PEERS

DRAFT MEMORANDUM

Date: September 13, 2018

To: Todd Henry, UC Berkeley

From: Sam Tabibnia and Lee Reis

Subject: UC Berkeley Long Range Development Plan – Trip Generation Comparison

OK18-0265.01

Using the most recent data available, Fehr & Peers estimated the current (2017-2018) automobile trip generation for the UC Berkeley Campus Park and estimated the automobile trip generation for the year 2022-2023 based on projected population increases. Based on our analysis, both the current and projected 2022-2023 trip generation are less than the 2001-2002 and the estimated year 2020 as presented in the *2020 Long Range Development Plan Draft Environmental Impact Report* (LRDP EIR). This memorandum presents our estimates the Campus Park trip generation for 2017-2018 and 2022-2023, reasons for the decrease in trip generation, and comparison to the observed traffic and transit data

Trip Generation Estimates

Table 1 summarizes the total trip generation for 2001-2002 and 2020 as estimated by the 2020 LRDP EIR, and the actual 2017-2018 and estimated 2022-2023 based on more recent available data. **Appendix A** provides the detailed trip generation estimates for each scenario and summarizes the population and mode share data used to estimate the trip generation.

The 2020 LRDP EIR estimated trip generation by applying mode share data from surveys of the various population groups conducted in 2001 to the population numbers. Similarly, the results of the more recent 2017 surveys were applied to the actual 2017-2018 and estimated 2022-2023 population numbers to estimate the more current daily trip generations. The 2017-2018 and 2022-2023 peak hour trip generation estimates assume the same factors used in the 2020 LRDP EIR to estimate the peak hour trip generation.

TABLE 1 – AUTOMBILE TRIP GENERATION SUMMARY

Scenario	Daily Trips	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
A. 2001-2002 (Based on 2001 Data) [1]	20,550	4,309	430	4,739	565	4,033	4,598
B. Estimated 2020 LRDP [1]	24,040	5,228	522	5,750	679	4,849	5,528
C. Actual 2017-2018 [1]	19,140	4,014	400	4,415	526	3,757	4,283
D. Estimated 2022-2023 [1]	20,420	4,283	427	4,710	562	4,008	4,570
E. LRDP EIR (2001-2002 to 2020)[2]	3,490	918	92	1,010	114	816	930
F. Actual (2001-2002 to 2017-2018)[3]	-1,410	-295	-29	-324	-39	-276	-315
G. Estimated (2001-2002 to 2022-2023)[4]	-130	-26	-3	-29	-3	-25	-28

Notes: See Appendix A for detailed calculations.
1. Source: 2020 LRDP EIR
2. E = B – A
3. F = C – A
4. G = D – A

The actual 2017-2018 trip generation is about seven percent lower than the trip generation in 2001-2002, while the 2020 LRDP EIR estimated a net increase of 16 percent in daily trips and 20 percent in peak hour trips between 2001-2002 and 2020 when the LRDP would be completed. The net decrease in automobile trip generation is mostly due to the decrease in the number of people across all population groups driving to/from the Campus Park. The 2020 LRDP EIR assumed that similar percentages of the different population groups as in 2001-2002 would continue to drive to/from Campus Park in 2020. However, comparing the 2001 and 2017 surveys shows a decrease in the drive alone mode share for all population groups. Overall, it is estimated that in 2001 about 23 percent of the total population commuted to/from Campus Park by driving alone, which by 2017 decreased to 16 percent. Although the Campus Park population in 2017-2018 was about 6,400 higher (corresponding to about 12 percent) than estimated by the 2020 LRDP EIR in 2020, the overall automobile trip generation decreased due to the overall decrease in the number of people driving across all population groups.

The estimated 2022-2023 trip generation assumes the same travel characteristics as the 2017-2018 population, which is a conservative estimate for automobile trip generation based on recent trends of fewer people driving to and from Campus Park and the limited UC-operated parking which is expected to remain the same as the current supply. The overall population is estimated to increase by about 34 percent between 2001-2002 and 2022-2023, while the total automobile trip generation is estimated to be about one percent less than in 2001-2002. While the campus population is expected to increase for all population groups by 2022-2023, the largest proportion of the increase would be undergraduate and graduate students, who are more likely to walk, ride bicycles, or take public transit compared to faculty and staff.

Reasons for Trip Generation Decrease

The factors that are likely contributing to the decrease in automobile trip generation between 2001-2002 and 2017-2018 include:

- The number of parking spaces operated by the University has decreased. The 2020 LRDP EIR analysis was based on an estimated increase of 2,300 university-operated parking spaces from 7,690 spaces in 2001 to 9,990 spaces in 2020. In reality, the University is currently operating 6,560 parking spaces, a decrease of 1,130 spaces (15 percent) since 2001. During the same period, the number of parking permits has decreased by 100 (two percent). In 2016-2017, there were 1.2 permits for each parking space, compared to 1.0 permits per space in 2001-2002.
- The number of beds available in University-affiliated housing in the vicinity of the Campus Park has increased from 6,004 in 2001-2002 to 7,578 in 2017-2018.[1] As a result, more students live within walking and biking distance of Campus Park.
- The University has expanded its Transportation Demand Management (TDM) program to include the following strategies that further encourage students, faculty, and staff to use non-automobile travel modes:

    - AC Transit Class Pass for all students
    - Easy Pass for non-students
    - Bike share through Ford GoBike, including new stations around the Campus Park, and subsidized memberships for Educational Opportunity Program students
    - BerkeleyMoves! Commuter Club (app and website)
    - Addition of about 1,000 bicycle parking spaces. New buildings must provide bike parking for 15 percent of occupants and include an indoor secure bike parking storage area
    - Bike fix-it stations for bike commuters
    - Electronic bike lockers

[1] The recently completed Blackwell Hall (752 beds) and Shattuck Studios (21 units) are not included in the total.

- Zipcar discount rates
- GIG Car Share
- BART subsidy
- Increased parking costs
- Modified night-safety programs
- Designated TDM Administrator and increased marketing

- Improvements in pedestrian and bicycle facilities in the surrounding areas, such as the addition of sidewalks on the south side of Hearst Avenue and parking protected bikeways on Fulton Street and Bancroft Way.

Consistency with Observed Traffic and Transit Data

The estimated decrease in trip generation is also consistent with observed traffic volumes. The 2020 LRDP EIR evaluated the impacts of the LRDP at 75 intersections by collecting AM and PM peak period counts in 2002 and forecasting traffic volumes for 2020 conditions with the completion of the 2020 LRDP. **Appendix B** compares the traffic volumes and level of service (LOS) at 32 intersections where recent traffic data (2015-2018) is available. The total intersection volumes in 2015-2018 are on average about 11 percent lower during the AM peak hour and 16 percent lower during the PM peak hour than in 2002. Similarly, the total intersection volumes in 2015-2018 at the 32 intersections are on average about 34 percent lower during both peak hours than the year 2020 forecasts as estimated in the 2020 LRDP EIR. The year 2020 intersection volume forecasts estimated in the 2020 LRDP EIR account for the completion of the LRDP and other likely developments in the City of Berkeley and beyond.

Similarly, BART ridership has also increased during the same period. Weekday exits at the Downtown Berkeley BART Station increased from about 10,800 in 2001 to 13,250 in 2017. [2]

Please contact us with questions or comments.

Attachments:

Appendix A – Population, Mode Share, and Trip Generation Estimates

Appendix B – Intersection Volume and LOS Comparison

[2] http://www.bart.gov/sites/default/files/docs/FY%20Avg%20Wkdy%20Exits%20by%20Station_6.xlsx

1. Population Comparison

Population Group	Actual 2001-2002	Estimated 2020 (LRDP)	Actual 2017-2018	Estimated 2022-2023	Estimated Change, 2001-2002 to 2020 (LRDP)	Actual Change, 2001-2002 to 2017-2018	Estimated Change, 2017-2018 to 2022-2023	Estimated change (2001-2002 to 2020) compared to actual (2001-2002 to 2017-2018)
	[A]	[B]	[C]	[D]	[E = B - A]	[F = C -A]	[G = D - C]	[H = F- E]
Students	31,800	33,450	40,955	44,735	+1,650	+9,155	+3,781	+7,505
Undergraduate	23,100	23,950	29,783	31,380	+850	+6,683	+1,597	+5,833
Graduate	8,700	9,500	11,172	13,355	+800	+2,472	+2,184	+1,672
Faculty	1,760	1,980	1,513	1,653	+220	-247	+140	-467
Post-docs and Visiting Scholars	1,935	3,075	1,296	1,416	+1,140	-639	+120	-1,779
Academic Staff	1,105	1,805	3,426	3,545	+700	+2,321	+119	+1,621
Non-Academic Staff	8,140	8,950	8,447	8,741	+810	+307	+294	-503
Total	**44,740**	**49,260**	**55,637**	**60,090**	**+4,520**	**+10,897**	**+4,454**	**+6,377**

Note:

1. Population is average of fall and spring enrollment and excludes off-campus students.

Sources: UC Berkeley 2020 LRDP (Columns A and B), UC Berkeley, 2018 (Columns C and D)

2a. Mode Share, Actual 2001-2002

Population Group	Walk	Bicycle	Drive Alone	Carpool/ Vanpool	Public Transit	Did not work/ telecommute/Other[1]	Total
Undergraduate Students	55%	5%	8%	1%	21%	10%	100%
Graduate Students	22%	16%	16%	2%	34%	10%	100%
Faculty	9%	14%	51%	6%	10%	10%	100%
Post-docs and Visiting Scholars	9%	14%	51%	6%	10%	10%	100%
Academic Staff	11%	10%	51%	7%	11%	10%	100%
Non-Academic Staff	8%	6%	47%	10%	19%	10%	100%

Note:

1. The LRDP EIR assumed 10% of the campus population did not travel to campus on a given day.

Source: UC Berkeley 2020 LRDP EIR

2b. Mode Share, Actual 2017-2018

Population Group	Walk	Bicycle	Drive Alone	Carpool/ Vanpool	Public Transi	Did not work/ telecommute/Other[1]	Total
Undergraduate Students	63%	8%	6%	2%	17%	4%	100%
Graduate Students	25%	24%	10%	3%	29%	9%	100%
Faculty	11%	18%	36%	6%	14%	15%	100%
Post-docs and Visiting Scholars[2]	11%	18%	36%	6%	14%	15%	100%
Academic Staff[3]	8%	11%	39%	8%	29%	5%	100%
Non-Academic Staff[3]	8%	11%	39%	8%	29%	5%	100%

Notes:

1. The estimates for 2018 used survey data on the percent of people who did not travel to campus on a given day or used a mode different from those listed. This is considered a conservative estimate compared to 2001-2002, since it does not account for people who do not travel to campus on a given day due to travel, illness, or other reasons.

2. Post-docs and Visiting Scholars were not differentiated in 2016-2017 surveying and were assumed to have the same travel characteristics as Faculty.

3. Academic and Non-Academic staff were grouped in one staff category in 2016-2017 surveying and were assumed to have the same travel characteristics.

Source: 2016-2017 UC Berkeley Transportation Survey

3a. Daily Trip Generation Estimate (2001-2002 Total)

Population Group	Walk	Bicycle	Drive Alone	Carpool/ Vanpool	Public Transit	Total	
Students	29,238	5,094	6,480	810	15,618	57,240	
Undergraduate	25,410	2,310	3,696	462	9,702	41,580	
Graduate	3,828	2,784	2,784	348	5,916	15,660	
Faculty	317	493	1,795	211	352	3,168	
Post-docs and Visiting Scholars	348	542	1,974	232	387	3,483	
Academic Staff	243	221	1,127	155	243	1,989	
Non-Academic Staff	1,302	977	7,652	1,628	3,093	14,652	**Automobile Trips**
Total	**31,448**	**7,327**	**19,028**	**3,036**	**19,693**	**80,532**	**20,546**

3b. Daily Trip Generation Estimate (2020 Total as Estimated in LRDP EIR)

Population Group	Walk	Bicycle	Drive Alone	Carpool/ Vanpool	Public Transit	Total	
Students	30,525	5,435	6,872	859	16,519	60,210	
Undergraduate	26,345	2,395	3,832	479	10,059	43,110	
Graduate	4,180	3,040	3,040	380	6,460	17,100	
Faculty	356	554	2,020	238	396	3,564	
Post-docs and Visiting Scholars	554	861	3,137	369	615	5,536	
Academic Staff	397	361	1,841	253	397	3,249	
Non-Academic Staff	1,432	1,074	8,413	1,790	3,401	16,110	**Automobile Trips**
Total	**33,264**	**8,285**	**22,283**	**3,509**	**21,328**	**88,669**	**24,038**
Difference from 2001-2002	+1,816	+958	+3,255	+473	+1,635	+8,137	+3,492

3c. Daily Trip Generation Estimate (Actual 2017-2018 Total)

Population Group	Walk	Bicycle	Drive Alone	Carpool/ Vanpool	Public Transit	Total	
Students	43,113	10,127	5,808	1,861	16,605	77,514	
Undergraduate	37,527	4,765	3,574	1,191	10,126	57,183	
Graduate	5,586	5,362	2,234	670	6,479	20,331	
Faculty	333	545	1,089	182	424	2,573	
Post-docs and Visiting Scholars	285	467	933	156	363	2,204	
Academic Staff	548	754	2,672	548	1,987	6,509	
Non-Academic Staff	1,352	1,858	6,589	1,352	4,899	16,050	**Automobile Trips**
Total	**45,631**	**13,751**	**17,091**	**4,099**	**24,278**	**104,850**	**19,140**
Difference from 2001-2002	+14,183	+6,424	-1,937	+1,063	+4,585	+24,318	-1,406
Difference from 2020 Estimated Change	+12,367	+5,466	-5,192	+590	+2,950	+16,181	-4,898

3d. Daily Trip Generation Estimate (2022-2023 Forecast Total)

Population Group	Walk	Bicycle	Drive Alone	Carpool/ Vanpool	Public Transit	Total	
Students	46,217	11,431	6,437	2,056	18,415	84,556	
Undergraduate	39,539	5,021	3,766	1,255	10,669	60,250	
Graduate	6,678	6,410	2,671	801	7,746	24,306	
Faculty	364	595	1,190	198	463	2,810	
Post-docs and Visiting Scholars	311	510	1,019	170	396	2,406	
Academic Staff	567	780	2,765	567	2,056	6,735	
Non-Academic Staff	1,399	1,923	6,818	1,399	5,070	16,609	**Automobile Trips**
Total	**48,858**	**15,239**	**18,229**	**4,390**	**26,400**	**113,116**	**20,420**
Difference from 2001-2002	+17,410	+7,912	-799	+1,354	+6,707	+32,584	-126
Difference from 2020 Estimated Change	+15,594	+6,954	-4,054	+881	+5,072	+24,447	-3,618

Appendix B - Intersection Volume and LOS Comparison

			LRDP EIR												2015-2018 Data								Percent Difference in Volume			
			Existing Conditions (2002)						*2020 With Project Conditions*						*Existing Conditions*								2002 to 2014-2018		LRDP 2020 Forecast to 2014-2018	
		Intersection	AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour								
ID	Intersection Name	Control	Volume	Delay	LOS	Volume	Delay	LOS	Volume	Delay	LOS	Volume	Delay	LOS	Volume	Delay	LOS	Volume	Delay	LOS	Source	Count Date	AM	PM	AM	PM
1	Marin Avenue / San Pablo Avenue	Signalized	3,486	79	E	4,055	50	D	4,580	>80	F	5,389	>80	F	3,289	38	D	3,695	43	D	Existing Conditions Report, San Pablo Avenue Corridor Project (March 2018)	November 2016	-6%	-9%	-28%	-31%
4	Gilman Street / San Pablo Avenue	Signalized	2,575	41	D	3,381	42	D	3,438	46	D	4,404	69	E	2,564	47	D	3,201	50	D	1500 San Pablo Avenue TIS (May 2015)	December 2014	0%	-5%	-25%	-27%
															2,607	47	D	2,956	30	C	Existing Conditions Report, San Pablo Avenue Corridor Project (March 2018)	November 2016	1%	-13%	-24%	-33%
8	Cedar Street / Oxford Street	Signalized	1,784	49	D	1,680	22	C	2,229	58	E	2,327	63	E	1,367	16	B	1,532	19	B	Realm Middle School TIA (July 2018)	May 2018	-23%	-9%	-39%	-34%
12	Hearst Avenue / Oxford Street	Signalized	2,713	10	B	2,899	54	D	3,389	12	B	4,767	49	D	1,789	22	C	2,036	23	C	Realm Middle School TIA (July 2018)	May 2018	-34%	-30%	-47%	-57%
14	Hearst Avenue / Arch Street / Le Conte Avenue	Side-Street Stop-Controlled in 2002, Signalized in 2018	1,285	11 (SB)	B	1,400	14 (SB)	B	1,656	11 (SB)	B	1,865	18 (SB)	C	816	23	C	946	27	C	Realm Middle School TIA (July 2018)	May 2018	-36%	-32%	-51%	-49%
17	Hearst Avenue / Le Roy Avenue	Side-Street Stop-Controlled in 2002, Signalized in 2018	807	12 (SB)	B	1,005	15 (SB)	C	1,084	14(SB)	B	1,378	19 (SB)	C	694			732			UC Berkeley	April 2018	-14%	-27%	-36%	-47%
18	Hearst Ave / Gayley Rd / La Loma Ave	Signalized	1,440	23	C	1,555	25	C	1,951	>60	E	2,052	>69	E	1,216	16	B	1,278	17	B	UC Berkeley	April 2018	-16%	-18%	-38%	-38%
20	University Avenue / Sixth Street	Signalized	3,375	>80	F	4,031	>80	F	4,338	>80	F	5,210	>80	F	3,584	52	D	3,970	74	E	1500 San Pablo Avenue TIS (May 2015)	December 2014	6%	-2%	-17%	-24%
															3,372	44	D	3,798	52	D	1050 Parker Street TIA (June 2017)	February 2016	0%	-6%	-22%	-27%
21	University Avenue / San Pablo Avenue	Signalized	3,604	>80	F	4,457	>80	F	4,793	>80	F	5,788	>80	F	3,454	46	D	3,899	59	E	1500 San Pablo Avenue TIS (May 2015)	December 2014	-4%	-13%	-28%	-33%
															3,350	37	D	3,746	43	D	1050 Parker Street TIA (June 2017)	February 2016	-7%	-16%	-30%	-35%
															3,411	47	D	3,699	43	D	Existing Conditions Report, San Pablo Avenue Corridor Project (March 2018)	November 2016	-5%	-17%	-29%	-36%
22	University Avenue / MLK Way	Signalized	3,337	21	C	3,859	32	C	4,534	40	D	4,975	41	D	3,384	28	C	3,657	29	C	2190 Shattuck Avenue Mixed Use Project Draft EIR (August 2017)	October 2016	1%	-5%	-25%	-26%
24	University Avenue / Shattuck Avenue (West)	Signalized	2,295	20	B	2,892	18	B	3,346	37	D	4,071	22	C	2,059	21	C	2,372	20	B	2190 Shattuck Avenue Mixed Use Project Draft EIR (August 2017)	October 2016	-10%	-18%	-38%	-42%
26	University Avenue / Oxford Street	Signalized	2,453	29	C	2,799	18	B	3,168	39	D	3,565	29	C	1,583			1,896			Realm Middle School TIA (July 2018)	May 2018	-35%	-32%	-50%	-47%
28	Addison Street / Oxford Street	Side-Street Stop-Controlled	1,962	10 (EB)	A	2,142	17 (EB)	C	2,541	35 (EB)	E	2,780	>45 (EB)	E	1,414	60 (EB)	F	1,849	88 (EB)	F	2129 Shattuck Avenue Project Draft EIR (April 2016)	May 2015	-28%	-14%	-44%	-33%
															1,342			1,438			2129 Shattuck Traffic Control Plan	April 2018	-32%	-33%	-47%	-48%
29	Center Street / Shattuck Avenue	Signalized	1,797	15	B	2,555	14	B	2,568	17	B	3,407	17	B	1,776	15	B	1,978	18	B	2190 Shattuck Avenue Mixed Use Project Draft EIR (August 2017)	October 2016	-1%	-23%	-31%	-42%
31	Center Street / Oxford Street	Signalized	2,062	8	A	2,360	8	A	2,666	13	B	3,033	11	B	1,495			1,609			2129 Shattuck Traffic Control Plan	April 2018	-27%	-32%	-44%	-47%
36	Bancroft Way / Shattuck Avenue	Signalized	2,042	9	A	2,693	13	B	2,804	11	B	3,579	22	C	1,973	12	B	2,244	16	B	2190 Shattuck Avenue Mixed Use Project Draft EIR (August 2017)	October 2016	-3%	-17%	-30%	-37%
37	Bancroft Way / Fulton Street	Signalized	2,216	6	A	2,610	7	A	2,723	10	A	3,344	10	B				1,983			AC Transit	April 2014		-24%		-41%
																		1,986			City of Berkeley Counts (April 2017)	April 2017		-24%		-41%
38	Bancroft Way / Ellsworth Street	Side-Street Stop-Controlled	1,025	16 (NB)	C	1,342	13 (NB)	B	1,389	22 (NB)	C	1,791	39 (NB)	E				1,074			City of Berkeley Counts (April 2017)	April 2017		-20%		-40%
39	Bancroft Way / Dana Street	Side-Street Stop-Controlled in 2002, Signalized in 2018	866	0	A	1,155	0	A	1,178	0	A	1,624	0	A				875			City of Berkeley Counts (April 2017)	April 2017		-24%		-46%
41	Bancroft Way / Bowditch Street	All-Way Stop-Controlled	784	12	B	784	12	B	1,020	14	B	1,127	16	C	309	9	A	544	10	A	2580 Bancroft Way Mixed-Use Project Draft EIR (April 2018)	November 2017	-61%	-31%	-70%	-52%
58	Dwight Way / Shattuck Avenue	Signalized	2,928	10	B	3,622	13	B	3,657	17	B	4,311	17	B	2,480	21	C	2,925	21	C	Adeline Corridor Specific Plan Existing Conditions Report (August 2015)	April 2015	-15%	-19%	-32%	-32%
64	Adeline Street / Shattuck Avenue	Signalized	2,796	15	B	3,382	24	C	3,325	20	C	3,987	33	C	2,357	16	B	2,646	16	B	Adeline Corridor Specific Plan Existing Conditions Report (August 2015)	April 2015	-16%	-22%	-29%	-34%
67	Ashby Avenue / Seventh	Signalized	3,202	34	C	3,284	52	D	3,899	54	D	3,938	>80	F	3,264	39	D	3,484	65	E	1050 Parker Street TIA (June 2017)	June 2015	2%	6%	-16%	-12%
68	Ashby Avenue / San Pablo Avenue	Signalized	3,354	29	C	4,034	31	C	4,525	42	D	5,253	41	D	3,129	44	D	3,769	51	D	3100 San Pablo Avenue TIA (April 2017)	June 2015	-7%	-7%	-31%	-28%
															3,497	39	D	3,776	58	E	Existing Conditions Report, San Pablo Avenue Corridor Project (March 2018)	November 2016	4%	-6%	-23%	-28%
69	Ashby Avenue / Adeline Street	Signalized	2,695	40	D	3,089	37	D	3,400	42	D	3,772	39	D	2,681	31	C	3,070	35	C	Adeline Corridor Specific Plan Existing Conditions Report (August 2015)	April 2015	-1%	-1%	-21%	-19%
70	Ashby Avenue / Shattuck Avenue	Signalized	2,695	15	B	2,837	30	C	3,331	17	B	3,426	43	D	2,520	13	B	2,589	14	B	3000 Shattuck Avenue Mixed Use Project (May 2017)	August 2014	-6%	-9%	-24%	-24%
															2,444	28	C	2,567	28	C	Adeline Corridor Specific Plan Existing Conditions Report (August 2015)	April 2015	-9%	-10%	-27%	-25%
72	Ashby Avenue /College Avenue	Signalized	2,332	31	C	2,344	29	C	2,783	36	D	2,871	39	D	2,005	25	C	2,064	24	C	Claremont Hotel - Club Expansion and Residential Project EIR (Not Published)	October 2015	-14%	-12%	-28%	-28%
73	Ashby Avenue / Claremont Avenue	Signalized	2,844	22	C	2,819	22	B	3,505	27	C	3,590	27	C	2,498	23	C	2,623	81	F	Claremont Hotel - Club Expansion and Residential Project EIR (Not Published)	October 2015	-12%	-7%	-29%	-27%
74	Tunnel Road / Highway 13	Signalized	3,335	16	B	3,298	14	B	3,865	17	B	3,879	16	B	2,430	16	B	2,732	13	B	Claremont Hotel - Club Expansion and Residential Project EIR (Not Published)	October 2015	-27%	-17%	-37%	-30%

APPENDIX H

APPLICABLE 2020 LRDP EIR MITIGATION MEASURES AND CONTINUING BEST PRACTICES

APPLICABLE 2020 LRDP EIR MITIGATION MEASURES AND CONTINUING BEST PRACTICES

AESTHETICS

Continuing Best Practice AES-1-b: Major new campus projects would continue to be reviewed at each stage of design by the UC Berkeley Design Review Committee. The provisions of the 2020 LRDP, as well as project specific design guidelines prepared for each such project, would guide these reviews.

Continuing Best Practice AES-1-e: UC Berkeley would make informational presentations of all major projects in the City Environs in Berkeley to the Berkeley Planning Commission and, if relevant, the Berkeley Landmarks Commission for comment prior to schematic design review by the UC Berkeley Design Review Committee. Major projects in the City Environs in Oakland would similarly be presented to the Oakland Planning Commission and, if relevant, to the Oakland Landmarks Preservation Advisory Board.

Continuing Best Practice AES-1-f: Each individual project built in the City Environs under the 2020 LRDP would be assessed to determine whether it could pose potential significant aesthetic impacts not anticipated in the 2020 LRDP, and if so, the project would be subject to further evaluation under CEQA.

Continuing Best Practice AES-1-g: To the extent feasible, University housing projects in the 2020 LRDP Housing Zone would not have a greater number of stories nor have setback dimensions less than could be permitted for a project under the relevant city zoning ordinance as of July 2003.

Mitigation Measure AES-3-a: Lighting for new development projects would be designed to include shields and cut-offs that minimize light spillage onto unintended surfaces and minimize atmospheric light pollution. The only exception to this principle would be in those areas where such features would be incompatible with the visual and/or historic character of the area.

Mitigation Measure AES-3-b: As part of the design review procedures described in the above Continuing Best Practices, light and glare would be given specific consideration, and measures incorporated into the project design to minimize both. In general, exterior surfaces would not be reflective: architectural screens and shading devices are preferable to reflective glass.

AIR QUALITY

Continuing Best Practice AIR-4-a: UC Berkeley shall continue to include in all construction contracts the measures specified below to reduce fugitive dust impacts:

- All disturbed areas, including quarry product piles, which are not being actively utilized for construction purposes, shall be effectively stabilized of dust emissions using tarps, water, (non-toxic) chemical stabilizer/suppressant, or vegetative ground cover.
- All on-site unpaved roads and off-site unpaved access roads shall be effectively stabilized of dust emissions using water or (non-toxic) chemical stabilizer/suppressant.

- When quarry product or trash materials are transported off-site, all material shall be covered, or at least two feet of freeboard space from the top of the container shall be maintained.

Mitigation Measure AIR-4-a: In addition, UC Berkeley shall include in all construction contracts the measures specified below to reduce fugitive dust impacts, including but not limited to the following:

- All land clearing, grubbing, scraping, excavation, land leveling, grading, cut and fill, and demolition activities shall be effectively controlled of fugitive dust emissions utilizing application of water or by presoaking.
- When demolishing buildings, water shall be applied to all exterior surfaces of the building for dust suppression.
- All operations shall limit or expeditiously remove the accumulation of mud or dirt from paved areas of construction sites and from adjacent public streets as necessary. See also CBP HYD 1-b.
- Following the addition of materials to, or the removal of materials from, the surface of outdoor storage piles, said piles shall be effectively stabilized of fugitive dust emissions by utilizing sufficient water or by covering.
- Limit traffic speeds on unpaved roads to 15 mph.
- Water blasting shall be used in lieu of dry sand blasting wherever feasible.
- Install sandbags or other erosion control measures to prevent silt runoff to public roadways from sites with slopes over one percent.
- To the extent feasible, limit area subject to excavation, grading, and other construction activity at any one time.
- Replant vegetation in disturbed areas as quickly as possible.

Continuing Best Practice AIR-4-b: UC Berkeley shall continue to implement the following control measure to reduce emissions of diesel particulate matter and ozone precursors from construction equipment exhaust:

- Minimize idling time when construction equipment is not in use.

Mitigation Measure AIR-4-b: UC Berkeley shall implement the following control measures to reduce emissions of diesel particulate matter and ozone precursors from construction equipment exhaust:

- To the extent that equipment is available and cost effective, UC Berkeley shall require contractors to use alternatives to diesel fuel, retrofit existing engines in construction equipment and employ diesel particulate matter exhaust filtration devices.
- To the extent practicable, manage operation of heavy-duty equipment to reduce emissions, including the use of particulate traps.

Continuing Best Practice AIR-5: UC Berkeley will continue to implement transportation control measures such as supporting voluntary trip-reduction programs, ridesharing, and implementing facilities.

Mitigation Measure AIR-5: UC Berkeley will work with the City of Berkeley, ABAG and BAAQMD to ensure that emissions directly and indirectly associated with the campus are adequately accounted for and mitigated in applicable air quality planning efforts.

BIOLOGICAL RESOURCES

Mitigation Measure BIO-1-a: UC Berkeley will, to the full feasible extent, avoid the disturbance or removal of nests of raptors and other special-status bird species when in active use. A pre-construction nesting survey for loggerhead shrike or raptors, covering a 100 yard perimeter of the project site, would be conducted during the months of March through July prior to commencement of any project that may impact suitable nesting habitat on the Campus Park and Hill Campus. The survey would be conducted by a qualified biologist no more than 30 days prior to initiation of disturbance to potential nesting habitat. In the Hill Campus, surveys would be conducted for new construction projects involving removal of trees and other natural vegetation. In the Campus Park, surveys would be conducted for construction projects involving removal of mature trees within 100 feet of a Natural Area, Strawberry Creek, and the Hill Campus. If any of these species are found within the survey area, grading and construction in the area would not commence, or would continue only after the nests are protected by an adequate setback approved by a qualified biologist. To the full feasible extent, the nest location would be preserved, and alteration would only be allowed if a qualified biologist verifies that birds have either not begun egg-laying and incubation, or that the juveniles from those nests are foraging independently and capable of survival. A pre-construction survey is not required if construction activities commence during the non-nesting season (August through February).

Mitigation Measure BIO-1-b: UC Berkeley will, to the full feasible extent, avoid the remote potential for direct mortality of special-status bats and destruction of maternal roosts. A pre-construction roosting survey for special-status bat species, covering the project site and any affected buildings, would be conducted during the months of March through August prior to commencement of any project that may impact suitable maternal roosting habitat on the Campus Park and Hill Campus. The survey would be conducted by a qualified biologist no more than 30 days prior to initiation of disturbance to potential roosting habitat. In the Hill Campus, surveys would be conducted for new construction projects prior to grading, vegetation removal, and remodel or demolition of buildings with isolated attics and other suitable roosting habitat. In the Campus Park, surveys would be conducted for construction projects prior to remodel or demolition of buildings with isolated attics. If any maternal roosts are detected during the months of March through August, construction activities would not commence, or would continue only after the roost is protected by an adequate setback approved by a qualified biologist. To the full feasible extent, the maternal roost location would be preserved, and alteration would only be allowed if a qualified biologist verifies that bats have completed rearing young, that the juveniles are foraging independently and capable of survival, and bats have been subsequently passively excluded from the roost location. A pre-construction survey is not required if construction activities commence outside the maternal roosting season (September through February).

Continuing Best Practice BIO-1-a: UC Berkeley will continue to implement the Campus Specimen Tree Program to reduce adverse effects to specimen trees and flora. Replacement landscaping will be provided where specimen resources are adversely affected, either through salvage and relocation of existing trees and shrubs or through new plantings of the same genetic strain, as directed by the Campus Landscape Architect.

CLIMATE CHANGE
Continuing Best Practice CLI-1 : UC Berkeley would continue to implement provisions of the UC Policy on Sustainable Practices including, but not limited to: Green Building Design; Clean Energy Standards; Climate Protection Practices; Sustainable Transportation Practices; Sustainable Operations; Recycling and Waste Management; and Environmentally Preferable Purchasing Practices.

Continuing Best Practice CLI-2 : UC Berkeley would continue to implement energy conservation measures (such as energy-efficient lighting and microprocessor-controlled HVAC equipment) to reduce the demand for electricity and natural gas. The energy conservation measures may be subject to modification as new technologies are developed or if current technologies become obsolete through replacement.

Continuing Best Practice CLI-3: UC Berkeley would continue to annually monitor and report upon its progress toward its greenhouse gas emission targets. UC Berkeley would continue to report actions undertaken in the past year, and update its climate action plan annually to specify actions that UC Berkeley is planning to undertake in the current year and future years to achieve emission targets.

CULTURAL RESOURCES
Continuing Best Practice CUL-1: In the event that paleontological resource evidence or a unique geological feature is identified during project planning or construction, the work would stop immediately and the find would be protected until its significance can be determined by a qualified paleontologist or geologist. If the resource is determined to be a 'unique resource,' a mitigation plan would be formulated and implemented to appropriately protect the significance of the resource by preservation, documentation, and/or removal, prior to recommencing activities.

Continuing Best Practice CUL-2-a: If a project could cause a substantial adverse change in features that convey the significance of a primary or secondary resource, an Historic Structures Assessment (HSA) would be prepared. Recommendations of the HSA made in accordance with the Secretary of the Interior's Standards would be implemented, in consultation with the UC Berkeley Design Review Committee and the State Historic Preservation Office, such that the integrity of the significant resource is preserved and protected. Copies of all reports would be filed in the University Archives/Bancroft Library.

Continuing Best Practice CUL-2-b: UC Berkeley would make informational presentations of all major projects in the City Environs in Berkeley to the Berkeley Planning Commission and, if relevant, the Berkeley Landmarks Commission for comment prior to schematic design review by the UC Berkeley Design Review Committee. Major projects in the City Environs in Oakland would similarly be presented to the Oakland Planning Commission and, if relevant, to the Oakland Landmarks Preservation Advisory Board.

Mitigation Measure CUL-3: If, in furtherance of the educational mission of the University, a project would require the demolition of a primary or secondary resource, or the alteration of such a resource in a manner not in conformance with the Secretary of the Interior's Standards, the resource would be recorded to archival standards prior to its demolition or alteration.

Continuing Best Practice CUL-4-a: In the event resources are determined to be present at a project site, the following actions would be implemented as appropriate to the resource and the proposed disturbance:

- UC Berkeley shall retain a qualified archaeologist to conduct a subsurface investigation of the project site, to ascertain the extent of the deposit of any buried archaeological materials relative to the project's area of potential effects. The archaeologist would prepare a site record and file it with the California Historical Resource Information System.
- If the resource extends into the project's area of potential effects, the resource would be evaluated by a qualified archaeologist. UC Berkeley as lead agency would consider this evaluation in determining whether the resource qualifies as a historical resource or a unique archaeological resource under the criteria of CEQA Guidelines section 15064.5. If the resource does not qualify, or if no resource is present within the project area of potential effects, this would be noted in the environmental document and no further mitigation is required unless there is a discovery during construction (see below).
- If a resource within the project area of potential effect is determined to qualify as an historical resource or a unique archaeological resource in accordance with CEQA, UC Berkeley shall consult with a qualified archaeologist to mitigate the effect through data recovery if appropriate to the resource, or to consider means of avoiding or reducing ground disturbance within the site boundaries, including minor modifications of building footprint, landscape modification, the placement of protective fill, the establishment of a preservation easement, or other means that would permit avoidance or substantial preservation in place of the resource. If further data recovery, avoidance or substantial preservation in place is not feasible, UC Berkeley shall implement LRDP Mitigation Measure CUL-5, outlined below.
- A written report of the results of investigations would be prepared by a qualified archaeologist and filed with the University Archives/ Bancroft Library and the Northwest Information Center.

Mitigation Measure CUL-4-b: If a resource is discovered during construction (whether or not an archaeologist is present), all soil disturbing work within 35 feet of the find shall cease. UC Berkeley shall contact a qualified archaeologist to provide and implement a plan for survey, subsurface investigation as needed to define the deposit, and assessment of the remainder of the site within the project area to determine whether the resource is significant and would be affected by the project, as outlined in Continuing Best Practice CUL-3-a. UC Berkeley would implement the recommendations of the archaeologist.

Continuing Best Practice CUL-4-b: In the event human or suspected human remains are discovered, UC Berkeley would notify the County Coroner who would determine whether the remains are subject to his or her authority. The Coroner would notify the Native American Heritage Commission if the remains are Native American. UC Berkeley would comply with the provisions of Public Resources Code Section 5097.98 and CEQA Guidelines Section 15064.5(d) regarding identification and involvement of the Native American Most Likely Descendant and with the provisions of the California Native American Graves Protection and Repatriation Act to ensure that the remains and any associated artifacts recovered are repatriated to the appropriate group, if requested.

Continuing Best Practice CUL-4-c: Prior to disturbing the soil, contractors shall be notified that they are required to watch for potential archaeological sites and artifacts and to notify UC Berkeley if any are found. In the event of a find, UC Berkeley shall implement LRDP Mitigation Measure CUL-4-b.

Mitigation Measure CUL-5: If, in furtherance of the educational mission of the University, a project would require damage to or demolition of a significant archaeological resource, a qualified archaeologist shall, in consultation with UC Berkeley:

- Prepare a research design and archaeological data recovery plan that would attempt to capture those categories of data for which the site is significant, and implement the data recovery plan prior to or during development of the site.
- Perform appropriate technical analyses, prepare a full written report and file it with the appropriate information center, and provide for the permanent curation of recovered materials.

GEOLOGY, SEISMICITY AND SOILS

Continuing Best Practice GEO-1-a: UC Berkeley will continue to comply with the California Building Code and the *University Policy on Seismic Safety*.

Continuing Best Practice GEO-1-b: Site-specific geotechnical studies will be conducted under the supervision of a California Registered Engineering Geologist or licensed geotechnical engineer and UC Berkeley will incorporate recommendations for geotechnical hazard prevention and abatement into project design.

Continuing Best Practice GEO-1-c: The Seismic Review Committee (SRC) shall continue to review all seismic and structural engineering design for new and renovated existing buildings on campus and ensure that it conforms to the California Building Code and the *University Policy on Seismic Safety*.

Continuing Best Practice GEO-1-d: UC Berkeley shall continue to use site-specific seismic ground motion specifications developed for analysis and design of campus projects. The information provides much greater detail than conventional codes and is used for performance-based analyses.

Continuing Best Practice GEO-1-g: As stipulated in the *University Policy on Seismic Safety*, the design parameters for specific site peak acceleration and structural reinforcement will be determined by the geotechnical and structural engineer for each new or rehabilitation project proposed under the 2020

LRDP. The acceptable level of actual damage that could be sustained by specific structures would be calculated based on geotechnical information obtained at the specific building site.

Continuing Best Practice GEO-1-i: The site-specific geotechnical studies conducted under GEO-1-b will include an assessment of landslide hazard, including seismic vibration and other factors contributing to slope stability.

Continuing Best Practice GEO-2: Campus construction projects with potential to cause erosion or sediment loss, or discharge of other pollutants, would include the campus Stormwater Pollution Prevention Specification. This specification includes by reference the "Manual of Standards for Erosion and Sediment Control" of the Association of Bay Area Governments and requires that each large and exterior project develop an Erosion Control Plan.

HAZARDOUS MATERIALS

Continuing Best Practice HAZ-4: UC Berkeley shall continue to perform site histories and due diligence assessments of all sites where ground-disturbing construction is proposed, to assess the potential for soil and groundwater contamination resulting from past or current site land uses at the site or in the vicinity. The investigation will include review of regulatory records, historical maps and other historical documents, and inspection of current site conditions. UC Berkeley would act to protect the health and safety of workers or others potentially exposed should hazardous site conditions be found.

Continuing Best Practice HAZ-5: UC Berkeley shall continue to perform hazardous materials surveys prior to capital projects in existing campus buildings. The campus shall continue to comply with federal, state, and local regulations governing the abatement and handling of hazardous building materials and each project shall address this requirement in all construction.

HYDROLOGY AND WATER QUALITY

Continuing Best Practices HYD-1-a: During the plan check review process and construction phase monitoring, UC Berkeley (EH&S) will verify that the proposed project complies with all applicable requirements and BMPs.

Continuing Best Practice HYD-1-b: UC Berkeley shall continue implementing an urban runoff management program containing BMPs as published in the Strawberry Creek Management Plan, and as developed through the campus municipal Stormwater Management Plan (SWMP) completed for its pending Phase II MS4 NPDES permit. UC Berkeley will continue to comply with the NPDES stormwater permitting requirements by implementing construction and post construction control measures and BMPs required by project-specific SWPPPs and, upon its approval, by the Phase II SWMP to control pollution. SWPPPs would be prepared as required by the appropriate regulatory agencies including the Regional Water Quality Control Board and where applicable, according to the UC Berkeley Stormwater Pollution Prevention Specification to prevent discharge of pollutants and to minimize sedimentation resulting from construction and the transport of soils by construction vehicles.

Continuing Best Practice HYD-2-a: In addition to Hydrology Continuing Best Practices 1-a and 1-b above, UC Berkeley will continue to review each development project, to determine whether project runoff would increase pollutant loading. If it is determined that pollutant loading could lead to a violation of the Basin Plan, UC Berkeley would design and implement the necessary improvements to treat stormwater. Such improvements could include grassy swales, detention ponds, continuous centrifugal system units, catch basin oil filters, disconnected downspouts and stormwater planter boxes.

Continuing Best Practice HYD-2-b: Where feasible, parking would be built in covered parking structures and not exposed to rain to address potential stormwater runoff pollutant loads. See also HYD-2-a.

Continuing Best Practice HYD-2-c: Landscaped areas of development sites shall be designed to absorb runoff from rooftops and walkways. The Campus Landscape Architect shall ensure open or porous paving systems be included in project designs wherever feasible, to minimize impervious surfaces and absorb runoff.

Continuing Best Practice HYD-3: In addition to Best Practices 1-a, 1-b, 2-a and 2-c above, UC Berkeley will continue to review each development project, to determine whether rainwater infiltration to groundwater is affected. If it is determined that existing infiltration rates would be adversely affected, UC Berkeley would design and implement the necessary improvements to retain and infiltrate stormwater. Such improvements could include retention basins to collect and retain runoff, grassy swales, infiltration galleries, planter boxes, permeable pavement, or other retention methods. The goal of the improvement should be to ensure that there is no net decrease in the amount of water recharged to groundwater that serves as freshwater replenishment to Strawberry Creek. The improvement should maintain the volume of flows and times of concentration from any given site at pre-development conditions.

Continuing Best Practice HYD-4-a: In addition to Hydrology Continuing Best Practices 1-a, 1-b, and 2-c, the campus storm drain system would be maintained and cleaned to accommodate existing runoff.

Continuing Best Practice HYD-4-b: For 2020 LRDP projects in the City Environs (excluding the Campus Park or Hill Campus) improvements would be coordinated with the City Public Works Department.

Continuing Best Practice HYD-4-e: UC Berkeley shall continue to manage runoff into storm drain systems such that the aggregate effect of projects implementing the 2020 LRDP is no net increase in runoff over existing conditions.

LAND USE

Continuing Best Practice LU-2-b: UC Berkeley would make informational presentations of all major projects in the City Environs in Berkeley to the Berkeley Planning Commission and, if relevant, the Berkeley Landmarks Preservation Commission for comment prior to schematic design review by the

UC Berkeley Design Review Committee. Major projects in the City Environs in Oakland would similarly be presented to the Oakland Planning Commission and, if relevant, to the Oakland Landmarks Preservation Advisory Board. Whenever a project in the City Environs is under consideration by the UC Berkeley DRC, a staff representative designated by the city in which it is located would be invited to attend and comment on the project.

Continuing Best Practice LU-2-c: Each individual project built in the Hill Campus or the City Environs under the 2020 LRDP would be assessed to determine whether it could pose potential significant land use impacts not anticipated in the 2020 LRDP, and if so, the project would be subject to further evaluation under CEQA. In general, a project in the Hill Campus or the City Environs would be assumed to have the potential for significant land use impacts if it:

- Includes a use that is not permitted within the city general plan designation for the project site, or
- Has a greater number of stories and/or lesser setback dimensions than could be permitted for a project under the relevant city zoning ordinance as of July 2003.

NOISE

Continuing Best Practice NOI-2: Mechanical equipment selection and building design shielding would be used, as appropriate, so that noise levels from future building operations would not exceed the City of Berkeley Noise Ordinance limits for commercial areas or residential zones as measured on any commercial or residential property in the area surrounding a project proposed to implement the 2020 LRDP. Controls that would typically be incorporated to attain this outcome include selection of quiet equipment, sound attenuators on fans, sound attenuator packages for cooling towers and emergency generators, acoustical screen walls, and equipment enclosures.

Mitigation Measure NOI-3: The University would comply with building standards that reduce noise impacts to residents of University housing to the full feasible extent; additionally, any housing built in areas where noise exposure levels exceed 60 Ldn would incorporate design features to minimize noise exposures to occupants.

Continuing Best Practice NOI-4-a: The following measures would be included in all construction projects:

- Construction activities will be limited to a schedule that minimizes disruption to uses surrounding the project site as much as possible. Construction outside the Campus Park area will be scheduled within the allowable construction hours designated in the noise ordinance of the local jurisdiction to the full feasible extent, and exceptions will be avoided except where necessary.
- As feasible, construction equipment will be required to be muffled or controlled.
- The intensity of potential noise sources will be reduced where feasible by selection of quieter equipment (e.g. gas or electric equipment instead of diesel powered, low noise air compressors).
- Functions such as concrete mixing and equipment repair will be performed off-site whenever possible.

For projects requiring pile driving:

- With approval of the project structural engineer, pile holes will be pre-drilled to minimize the number of impacts necessary to seat the pile.
- Pile driving will be scheduled to have the least impact on nearby sensitive receptors.
- Pile drivers with the best available noise control technology will be used. For example, pile driving noise control may be achieved by shrouding the pile hammer point of impact, by placing resilient padding directly on top of the pile cap, and/or by reducing exhaust noise with a sound-absorbing muffler.
- Alternatives to impact hammers, such as oscillating or rotating pile installation systems, will be used where possible.

Continuing Best Practice NOI-4-b: UC Berkeley would continue to precede all new construction projects with community outreach and notification, with the purpose of ensuring that the mutual needs of the particular construction project and of those impacted by construction noise are met, to the extent feasible.

Mitigation Measure NOI-4: UC Berkeley will develop a comprehensive construction noise control specification to implement additional noise controls, such as noise attenuation barriers, siting of construction laydown and vehicle staging areas, and the measures outlined in Continuing Best Practice NOI-4-a as appropriate to specific projects. The specification will include such information as general provisions, definitions, submittal requirements, construction limitations, requirements for noise and vibration monitoring and control plans, noise control materials and methods. This documentation will be modified as appropriate for a particular construction project and included within the construction specification.

Mitigation Measure NOI-5: The following measures will be implemented to mitigate construction vibration:

- UC Berkeley will conduct a pre-construction survey prior to the start of pile driving. The survey will address susceptibility ratings of structures, proximity of sensitive receivers and equipment/ operations, and surrounding soil conditions. This survey will document existing conditions as a baseline for determining changes subsequent to pile driving.
- UC Berkeley will establish a vibration checklist for determining whether or not vibration is an issue for a particular project.
- Prior to conducting vibration-causing construction, UC Berkeley will evaluate whether alternative methods are available, such as:
- Using an alternative to impact pile driving such as vibratory pile drivers or oscillating or rotating pile installation methods.
- Jetting or partial jetting of piles into place using a water injection at the tip of the pile.
- If vibration monitoring is deemed necessary, the number, type, and location of vibration sensors would be determined by UC Berkeley.

PUBLIC SERVICES

Continuing Best Practice PUB-1.1: UCPD would continue its partnership with the City of Berkeley police department to review service levels in the City Environs.

Continuing Best Practice PUB-2.1-a: UC Berkeley would continue to comply with Title 19 of the California Code of Regulations, which mandates firebreaks of up to 100 feet around buildings or structures in, upon or adjoining any mountainous, forested, brush- or grass-covered lands.

Continuing Best Practice PUB-2.1-b: UC Berkeley would continue on-going implementation of the Hill Area Fuel Management Program.

Continuing Best Practice PUB-2.1-c: UC Berkeley would continue to plan and implement programs to reduce risk of wildland fires, including plan review and construction inspection programs that ensure that campus projects incorporate fire prevention measures.

Continuing Best Practice PUB-2.3: UC Berkeley would continue its partnership with LBNL, ACFD, and the City of Berkeley to ensure adequate fire and emergency service levels to the campus and UC facilities. This partnership shall include consultation on the adequacy of emergency access routes to all new University buildings.

Mitigation Measure PUB-2.4-a: In order to ensure adequate access for emergency vehicles when construction projects would result in temporary lane or roadway closures, campus project management staff would consult with the UCPD, campus EH&S, the BFD and ACFD to evaluate alternative travel routes and temporary lane or roadway closures prior to the start of construction activity. UC Berkeley will ensure the selected alternative travel routes are not impeded by UC Berkeley activities.

Mitigation Measure PUB-2.4-b: To the extent feasible, the University would maintain at least one unobstructed lane in both directions on campus roadways at all times, including during construction. At any time only a single lane is available due to construction-related road closures, the University would provide a temporary traffic signal, signal carriers (i.e. flagpersons), or other appropriate traffic controls to allow travel in both directions. If construction activities require the complete closure of a roadway, UC Berkeley would provide signage indicating alternative routes. In the case of Centennial Drive, any complete road closure would be limited to brief interruptions of traffic required by construction operations.

Continuing Best Practice PUB-2.4: To the extent feasible, for all projects in the City Environs, the University would include the undergrounding of surface utilities along project street frontages, in support of Berkeley General Plan Policy S-22.

TRANSPORTATION AND TRAFFIC

Continuing Best Practice TRA-1-b: UC Berkeley will continue to do strategic bicycle access planning. Issues addressed include bicycle access, circulation and amenities with the goal of increasing bicycle commuting and safety. Planning considers issues such as bicycle access to the campus from adjacent streets and public transit; bicycle, vehicle, and pedestrian interaction; bicycle parking; bicycle safety; incentive programs; education and enforcement; campus bicycle routes; and amenities such as showers.

Continuing Best Practice TRA-2: The following housing and transportation policies will be continued:

- Except for disabled students, students living in UC Berkeley housing would only be eligible for a daytime student fee lot permit or residence hall parking based upon demonstrated need, which could include medical, employment, academic or other criteria.
- An educational and informational program for students on commute alternatives would be expanded to include all new housing sites.

Mitigation Measure TRA-2: The planned parking supply for University housing projects under the 2020 LRDP would comply with the relevant municipal zoning ordinance as of July 2003. Where the planned parking supply included in a University housing project would make it ineligible for approval under the subject ordinance, UC Berkeley would conduct further review of parking demand and supply in accordance with CEQA.

Continuing Best Practice TRA-3-a: Early in construction period planning UC Berkeley shall meet with the contractor for each construction project to describe and establish best practices for reducing construction-period impacts on circulation and parking in the vicinity of the project site.

Continuing Best Practice TRA-3-b: For each construction project, UC Berkeley will require the prime contractor to prepare a Construction Traffic Management Plan which will include the following elements:

- Proposed truck routes to be used, consistent with the City truck route map.
- Construction hours, including limits on the number of truck trips during the a.m. and p.m. peak traffic periods (7:00 – 9:00 a.m. and 4:00 – 6:00 p.m.), if conditions demonstrate the need.
- Proposed employee parking plan (number of spaces and planned locations).
- Proposed construction equipment and materials staging areas, demonstrating minimal conflicts with circulation patterns.
- Expected traffic detours needed, planned duration of each, and traffic control plans for each.

Continuing Best Practice TRA-3-c: UC Berkeley will manage project schedules to minimize the overlap of excavation or other heavy truck activity periods that have the potential to combine impacts on traffic loads and street system capacity, to the extent feasible.

Continuing Best Practice TRA-5: The University shall continue to work to coordinate local transit services as new academic buildings, parking facilities, and campus housing are completed, in order to accommodate changing demand locations or added demand.

Continuing Best Practice PUB-2.3: UC Berkeley would continue its partnership with LBNL, ACFD, and the City of Berkeley to ensure adequate fire and emergency service levels to the campus and UC facilities. This partnership shall include consultation on the adequacy of emergency access routes to all new University buildings.

UTILITIES AND SERVICE SYSTEMS

Continuing Best Practice USS-1.1: For campus development that increases water demand, UC Berkeley would continue to evaluate the size of existing distribution lines as well as pressure of the specific feed affected by development on a project-by-project basis, and necessary improvements would be incorporated into the scope of work for each project to maintain current service and performance levels. The design of the water distribution system, including fire flow, for new buildings would be coordinated among UC Berkeley staff, EBMUD, and the Berkeley Fire Department.

Continuing Best Practice USS-2.1-a: UC Berkeley will promote and expand the central energy management system (EMS), to tie building water meters into the system for flow monitoring.

Continuing Best Practice USS-2.1-b: UC Berkeley will analyze water and sewer systems on a project-by-project basis to determine specific capacity considerations in the planning of any project proposed 2020 under the LRDP.

Continuing Best Practice USS-2.1-c: UC Berkeley will continue and expand programs retrofitting plumbing in high-occupancy buildings and seek funding for these programs from EBMUD or other outside agencies as appropriate.

Continuing Best Practice USS-2.1-d: UC Berkeley will continue to incorporate specific water conservation measures into project design to reduce water consumption and wastewater generation. This could include the use of special air-flow aerators, water-saving shower heads, flush cycle reducers, low-volume toilets, weather based or evapotranspiration irrigation controllers, drip irrigation systems, the use of drought resistant plantings in landscaped areas, and collaboration with EBMUD to explore suitable uses of recycled water.

Continuing Best Practice USS-3.1: UC Berkeley shall continue to manage runoff into storm drain systems such that the aggregate effect of projects implementing the 2020 LRDP is no net increase in runoff over existing conditions.

Continuing Best Practice USS-3.2: In addition to Best Practice USS-3.1, projects proposed with potential to alter drainage patterns in the Hill Campus would be accompanied by a hydrologic modification analysis, and would incorporate a plan to prevent increases of flow from the project site, preventing downstream flooding and substantial siltation and erosion.

Continuing Best Practice USS-5.1: UC Berkeley would continue to implement a solid waste reduction and recycling program designed to reduce the total quantity of campus solid waste that is disposed of in landfills during implementation of the 2020 LRDP.

Continuing Best Practice USS-5.2: In accordance with the Regents-adopted green building policy and the policies of the 2020 LRDP, the University would develop a method to quantify solid waste diversion. Contractors working for the University would be required under their contracts to report their solid waste diversion according to the University’s waste management reporting requirements.

Mitigation Measure USS-5.2: Contractors on future UC Berkeley projects implemented under the 2020 LRDP will be required to recycle or salvage at least 50% of construction, demolition, or land clearing waste. Calculations may be done by weight or volume but must be consistent throughout.

APPENDIX I

CUMULATIVE PROJECTS LIST

University's Cumulative Project List for Upper Hearst Development for the Goldman School of Public Policy SEIR:

Section 15130 of the CEQA Guidelines suggest that the following elements are necessary to an adequate discussion of significant cumulative impacts: Either

> (A) A list of past, present, and probable future projects producing related or cumulative impacts, including, if necessary, those projects outside the control of the agency, or
> (B) a summary of projections contained in an adopted general plan or related planning document, or in a prior environmental document which has been adopted or certified, which described or evaluated regional or area wide conditions contributing to the cumulative impact. Any such planning document shall be referenced and made available to the public at a location specified by the Lead Agency.

A list of projects that are currently approved, under construction, proposed, or foreseeable follows.

I. LIST OF FORESEEABLE PROJECTS AS OF FEBRUARY 2019:

PROJECTS CURRENTLY APPROVED OR UNDER CONSTRUCTION – UC BERKELEY CAMPUS

Hearst Greek Theatre Upper Lawn Renovation
Located above Piedmont Avenue in the Adjacent Blocks North City Environs, the project is to lower the grade of the lawn area to make it more comfortable for patrons. The project also includes an improved loading dock on the south side of the facility and upgrades to the electrical system.

Hearst Greek Theatre North Restroom Facility
There is also a separate project at the Greek Theatre to construct a new two-story building with a total of 46 restroom stalls that will be up to 7,000 GSF. The project will include a connection plaza, as well as improved concessions and is slated to open in October 2018.

Tolman Hall Demolition
Tolman Hall, built in 1962 and designed by Gardner Dailey, is located within the northwestern edge of the campus and is one of the largest academic buildings on campus and is seismically deficient. Tolman Hall, 8 stories tall and having 247,000 GSF, is scheduled to be demolished starting in October of this year with hard demolition

starting spring 2019. Demolition will last up to one year. The building is currently vacant.

Anna Head Complex Buildings B, C and D Facade Improvements

The Anna Head Complex, comprising six buildings, listed in the National Register of Historic Places, occupies the east portion of the property bordered by Bowditch Street, Channing Way and Haste Street within the City of Berkeley. The project would focus on roof replacements and walkway coverings to minimize water intrusion.

2223 Fulton Street Demolition

The project would demolish the building built in 1929 located at the southwest corner of the campus adjacent to Edwards Stadium. The building is 51,814 GSF and has a ‘V’ seismic rating (poor) and obsolete building systems. The building is currently vacant. Landscaping will temporarily replace the building until the campus determines the best use of the site. The project will occur in 2018 through January 2019.

Giannini Hall Seismic Corrections

This 68,702 GSF building, which is occupied by the College of Natural Resources and classrooms, has a poor seismic rating. The building was built in 1930 and is listed in the National Register of Historic Places. The project would reinforce Giannini Hall to improve seismic resistance and is scheduled to begin October 2018 and be completed by June 2020.

Proposed or Foreseeable Projects - UCB:

Centennial Bridge Replacement

The project involves replacement of the Centennial Bridge located at the intersection of Centennial Road and Lawrence Road in the Hill Campus. Bridge replacement options include: a) at-grade bridge, b) at-grade intersection and c) a relocated short bridge, among others. The existing bridge has notable landslide-related damage that must be repaired.

Woo Hon Fai/BioEnginuity Hub

A donor development project would seismically retrofit and renovate Woo Hon Fai Hall, located at 2626 Bancroft Way in the City of Berkeley (the former Berkeley Art Museum) as a full-service life science incubator. The building has a ‘V’ seismic rating (poor). Once renovated, the building will provide wet laboratory and collaborative space and include a 6,600 square foot single-story building office addition.

The building has not been occupied since 2015 and is currently used by the University as storage. Per UC Berkeley building records, the building is 102,794 GSF (58,544 assignable square feet). Woo Hon Fai Hall is a 46-year old building listed in the National Register of Historic Places.

Housing Projects

The University has identified several potential housing locations near campus in traditional residence halls and apartment buildings for students and faculty. Potential housing sites include:

- Channing Ellsworth: located south of campus, this includes a residence hall or apartments with 200-400 beds.
- Oxford Tract: located north of campus, this includes a residence hall or apartment with 1,000-3,000 beds.
- Bancroft and Oxford: located immediately south of campus, this includes 100-200 apartments.
- Unit 3 Densification: located south of campus, this includes adding 650-900 beds to the existing residence hall.
- People’s Park: located south of campus, this includes a residence hall with up to 1,000 beds, as well as a transitional housing component operated by a non-profit, with approximately 100 beds.
- Albany Village: located off campus in Albany, this includes 150-200 apartments.
- Smyth-Fernwald: located adjacent to the Clark Kerr Campus, this involves developing this mostly vacant site with 200-250 apartments.

Minor Hall Optometry Clinic Expansion

The School of Optometry is located in the southwest quadrant of the main campus and consists of Minor Hall, built in 1941 and Minor Hall Addition, added in 1978. The School of Optometry proposes to expand its academic, clinic and circulation space from its current total of 98,100 GSF to approximately 135,800 GSF, an expansion of 37,700 GSF. The proposed expansion would be located immediately north and adjacent to the existing two School of Optometry buildings.

Beach Volleyball Facility

The proposed project would relocate the existing beach volleyball courts on the Clark Kerr Campus to another location on the CKC: the softball field near the intersection of Sports Lane and Dwight Way. The project includes four sand volleyball courts, as well as a locker room building, restrooms, scoreboard and lighting. The new facility would include lawn for spectators. Beach volleyball currently has two courts on CKC.

Levine Fricke Softball Field Replacement
The proposed project involves complete demolition and re-orientation of the existing softball field and its support facilities located in the Hill Campus along Centennial Drive. The proposed project would expand the capacity of the field from about 300 seats to 1,500 permanent seats. The project also includes covered batting cages, locker rooms, video board, restrooms, field lighting and an elevated press box.

Moffitt Undergraduate Library Renovation Phase 2
The project would renovate the interior of the lower three levels of the library located near the center of campus.

Seismic Correction Projects
UC Office of the President has determined that on all UC campuses, including Berkeley, buildings that have a seismic performance rating of V (poor) or worse, the affected campus must develop a prioritization plan that is included annually within the 10-year Capital Financial Plan. The UC Berkeley campus has about 70 seismically deficient buildings. UCOP has stated that all facilities with a seismic performance rating of V or VI cannot be occupied beyond December 31, 2030. The following projects have been identified related to seismic corrections, and there will be other projects as well in the next 10+ years:

- University Hall Seismic Corrections: located on Oxford Street across from the western edge of the campus, this project includes minor upgrades to the building to make it seismically stable.
- Hearst Memorial Gymnasium Seismic Improvements: this project would retrofit the seismically deficient two-story Hearst Memorial Gymnasium building listed in the National Register of Historic Places. The building built in 1926, is located on the southern edge of the campus along Bancroft Way, neighboring Barrows Hall to the northwest. It contains large and small gyms and three swimming pools including an outdoor pool and houses instructional space.
- Evans Hall Seismic Remediation or Replacement: the Campus is evaluating a seismic renovation of Evans Hall or demolishing it and building a replacement facility. Sites considered for a replacement facility include Hearst Field Annex, the Tolman Hall site, Dwinelle Parking Lot, and North Field. Evans Hall, 12-stories tall, was built in 1971 and is located north of the Campanile. The building houses departments of Economics, Mathematics and Statistics and is campus's highest remaining seismic priority and one of the campus's most intensively used buildings, with classroom space highly utilized.
    - An Academic and Classroom Building for surge space will need to be associated with the demolition of Evans Hall. While no location has been identified the surge building would include theoretically 135,000 GSF of

swing space (it would also accommodate other renovation/replacement projects).

- 2111 Bancroft Street (Banway Building) Demolition: located on Bancroft Street, west of campus, this project would demolish this seismically deficient building.

Vegetation Management Projects

The University was awarded a Fire Prevention Grant from the California Department of Forestry and Fire Protection (Cal Fire) to conduct vegetation management activities in 250 acres in the Hill Campus. Activities would reduce wildfire hazard and potential damage to habitable structures, as well as life safety for more than 3,000 residents.

Projects Currently Under Construction - LBNL

IGB construction/operation (Integrative Genomics Building)

This is a 77,000 GSF, 4-story, 333-occupant (mostly existing, though currently located off-site, staff) lab (research and academic use) building that will be completed in 2019 or 2020. The project is located in the Bayview lot area, which is in the interior of the Lab and the site of the former "Bevatron" accelerator facility in the geographic interior of the Berkeley Lab. http://www.lbl.gov/community/integrative-genomics-building/

"Old Town" Demolition

Several buildings that comprise the Lab's "Old Town" area have been, or are in the process of, being demolished and removed, specifically Buildings 4, 5, 7, 7C, 14, 16 and 16A. These buildings are located adjacent to Segre Road in LBNL and between Segre and McMillan Roads. There is legacy contamination in old building materials and underlying soils that require characterization and remediation. This process has been underway for some years and is expected to continue for several more years. See table below listing buildings, GSF, footprint and demolition dates/planned dated.

Bldg #	Description	Gross FT²	Footprint FT²	Demo Date
5	Ion Beam and AFRD Research	7,176	6,515	2015
16	Ion Beam & Mag Fusion Research	11,808	11,808	2015
16A	Building 16 Equipment Annex	339	339	2015

4	**ALS Support Facility / Offices**	**10,176**	**4,924**	**2019**
14	**Earth Sciences and ES&H**	**4,201**	**4,201**	**2019**
7	**ALS shipping and receiving**	**21,435**	**10,718**	**2020**
7C	**Building 7 Admin Annex**	**480**	**480**	**2020**
Note: The following above-slab building structures were removed during previous efforts; however the floor slabs were removed during the recent Old Town Project on dates shown				
40	**Ex-Dry Lab, Assembly & Storage Building slab**	**0**	**993**	**2016**
41	**Ex-offices & Communication Lab slab**	**0**	**995**	**2016**
52	**Ex-General Research and Shop Facility**	**0**	**6,425**	**2017**
52A	**Ex-General Storage Facility**	**0**	**516**	**2017**

Notable approved projects, not yet underway:

NERSC-9 (National Energy Research Scientific Computing Center)
This is a new supercomputing system that will be emplaced in the existing Computational Research and Theory (CRT) Building along with some minor building upgrades. NERSC-9 will replace the older NERSC-7 system (while NERSC-8 continues to operate in tandem) and will require a substantial increase in electrical power (triggering an updated GHG analysis) and cooling water over the older system. Construction period is anticipated to be 2019-2021. Construction impacts and deliveries will be relatively minor. The CRT building, aka Wang Hall, is the relatively new 140,000-GSF structure that sits at the Lab's main entrance on Cyclotron Road.
http://www.lbl.gov/community/nersc-9-project/

LBNL Proposed or Foreseeable Projects:

ALS-U (Advanced Light Source -- upgrade)
The "Advanced Light Source" accelerator (housed in the iconic domed building visible from UC Berkeley campus) will be shut down for upgrades. The building is located between Segre and Lawrence Roads. The project will involve taking out old parts and swapping in new parts. On- and (possibly) off-site staging space will be needed. Some slightly activated and/or hazardous material from the current accelerator would need to be processed and then transported out for disposal (at an appropriate facility). Construction will occur between 2021 and 2025.

Hazardous Waste Handling Facility (HWHF) Permit Renewal
Currently LBNL is applying to the Department of Toxic Substances Control (DTSC) for a renewed permit to continue its current HWHF operations. LBNL is completing an (internal draft) Addendum to its original HWHF EIR. DTSC will stage its own public process (featuring the Addendum, as well as its own documentation) per its own CEQA and noticing procedures. This project should have no environmental impacts or changes, but could generate possible controversy as the HWHF has had the attention of local activist groups in the more distant past.

BioEPIC construction/operation
This is a building similar to Integrative Genomics Building (IGB) around 70,000-80,000 GSF, 230 occupants, most already on site and would be situated adjacent to it in the Bayview lot. Construction is likely to begin around 2021 -- 2023. LBNL is beginning a CEQA process and envisions a straight-to-findings CEQA approach that relies on its existing LRDP EIR. A NEPA Categorical Exclusion is likely.

City of Berkeley Public Works Improvements

The City has on-going public works improvement programs, including storm drain and paving. See City scheduled construction activities, regularly updated, here: https://www.cityofberkeley.info/pw/

City of Berkeley Projects

Project address	Status	Use	Dwelling units	Commercial area (sq. Ft.)	Building/ height
2012 Berkeley Way	approved	residential/temporary housing/support services	142	-	6 stories (65 ft.)
1601 Oxford Street	approved	residential	37	-	5 stories (52 ft.)
2072 Addison Street	approved	residential/commercial	66	1,425	7 stories (75 ft.)
2129 Shattuck Avenue	under construction	commercial	-	251,579	16 stories (168 ft.)

Source: City of Berkeley, January 2019