LIVERMORE
CALIFORNIA

CITY COUNCIL

AGENDA
THURSDAY, AUGUST 20, 2026

SPECIAL MEETING – 12:00 PM

REVISED

MEETING PARTICIPATION INFORMATION CAN BE FOUND AT THE BEGINNING OF THE AGENDA

IN PERSON INFORMATION
CIVIC CENTER MEETING HALL
DR. JOHN SHIRLEY COUNCIL CHAMBER
1016 S. LIVERMORE AVENUE

TELECONFERENCE INFORMATION
ZOOM WEBINAR:
ATTENTION: Zoom update requirements found at the end of the agenda
https://us02web.zoom.us/j/84678704376
Zoom dial in phone number:
1 669 900 6833
Meeting ID: 846 7870 4376

CITY OF LIVERMORE YOUTUBE CHANNEL:
https://www.youtube.com/c/CityofLivermoreCalifornia

TV29:
Comcast TV Channel 29
tv29live.org

John P Marchand, Mayor
Kristie Wang, Vice Mayor
Ben Barrientos, Council Member
Evan Branning, Council Member
Steven Dunbar, Council Member

How to Participate in a City Council Meeting

GENERAL RULES

Council meetings are **hybrid** — the public may join **in person** or **remotely** (Zoom or telephone). Meetings may also be viewed without commenting on the City's YouTube channel and TV29 (Comcast Channel 29).

Agenda availability	Agenda & staff reports are posted 24+ hrs before special meetings at LivermoreCA.gov/agenda; also available at the Civic Center Library and City Clerk's Office.
Non-agenda items	State law prohibits the City Council from taking action on any items not listed on the agenda.
Speaker Limits	Up to **3 minutes per item** (Presiding Officer may reduce time if needed). **One comment per item per speaker.**
Accessibility	In compliance with the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973, the City does not discriminate on the basis of disability. To request an accommodation, contact the ADA Coordinator at least 3 business days prior to the meeting at ADACoordinator@LivermoreCA.gov or (925) 960-4170 (voice) / (925) 960-4104 (TDD).
Translation	Public may post their own agenda translation at City Hall, 1052 S. Livermore Ave. Members of the public wishing to receive translation or interpretation services from a third party during a meeting, please contact CityClerk@LivermoreCA.gov or visit the City's webpage at LivermoreCA.gov/agenda.

PUBLIC COMMENT

Public comment may be offered during **Open Forum** (any matter within the City's subject matter jurisdiction), **Consent Calendar**, **Public Hearings**, and **Matters for Consideration**.

For **Open Forum**, in-person speakers will collectively have the opportunity to address the City Council for up to 30 minutes. Any additional in-person speakers who wish to speak at the conclusion of the 30-minute time period, or any speakers participating remotely, will have the opportunity to address the City Council at the end of the meeting.

For **Consent Calendar, Public Hearings, and Matters for Consideration**, in-person speakers will be called upon first, followed by speakers participating remotely.

In Person	Remotely by Zoom	Remotely by Telephone
• Complete a speaker card (available in the Civic Center Meeting Hall lobby) • Write the agenda item number & submit to the City Clerk before that item's comment period closes (may not submit on behalf of another speaker) • When the Clerk calls your name, approach the podium and speak into the microphone	• Join via the Zoom link, Meeting ID, and dial-in number on the agenda cover page • When your item begins, use the “raise hand” feature • Wait to be called on, then unmute and speak • Use an updated Zoom app —outdated versions may block commenting (zoom.us/download)	• Call the Zoom dial-in number on the agenda and enter the Meeting ID • When your item begins, press *9 to raise your virtual hand • Wait to be called on; press *6 to unmute and speak when recognized

Written Public Comment Submitted Before the Meeting

Written comments submitted before the meeting are provided to the Council and made available to the public in advance. These comments are not read aloud into the record.

By Email	Send to CityClerk@LivermoreCA.gov. Must be received by **9:00 a.m. on the day of the meeting** to be provided to City Council and posted on the City's website prior to the meeting.
By eComment	Submit online via the eComment link on the City Council Meeting Calendar & Agendas page. Comments may be up to **1,000 characters**; accepted until **9:00 a.m. on the day of the meeting**. Viewable by Council and the public immediately upon submittal.
Materials to Distribute at Meeting	In person: bring **8 copies** to the City Clerk with your speaker card. By Zoom: identify the material in your comment and email it to the City Clerk at CityClerk@LivermoreCA.gov by the end of the meeting. Materials received after **9:00 a.m.** will be included in the supplemental packet.

WRITTEN COMMENT SUBMITTED AFTER THE AGENDA IS POSTED (SUPPLEMENTAL MATERIAL)

- Supplemental material distributed to the City Council after the posting of the agenda will be available for public review at the City Clerk's Office, 1052 S. Livermore Avenue, Livermore and included in the agenda packet on the City's website at LivermoreCA.gov/agenda on the day of the meeting.
- Comments received after the email or eComment deadlines on meeting day are treated as supplemental material and, if received before the meeting concludes, are provided to the City Council following the meeting.

1. CALL TO ORDER

2. ROLL CALL

Council Member Ben Barrientos
Council Member Evan Branning
Council Member Steven Dunbar
Vice Mayor Kristie Wang
Mayor John Marchand

3. SPECIAL MEETING ITEM

AN OPPORTUNITY FOR THE PUBLIC TO ADDRESS THE CITY COUNCIL REGARDING THE SPECIAL MEETING ITEM WILL BE PROVIDED BY THE MAYOR.

3.1 Adopt a Resolution Appointing John Marchand to the Office of Mayor and Evan Branning to the Office of City Council Member, District 1 and Cancelling the November 3, 2026, Election for the uncontested seats in accordance with Elections Code Section 10229.

Recommendation:
The City Clerk's Office and Staff recommend the City Council:

Adopt a resolution appointing the uncontested nominated candidates for the offices of Mayor and City Council Member, District 1, and cancelling the November 3, 2026, General Municipal Election for those seats.

Staff Report

Attachments:
1. Notice of Facts 2026
2. Resolution

3.2 A resolution rescinding Resolution No. 2026-125 and authorizing a supplemental appropriation of Low-Income Housing Funds (Fund 200) in the amount of $75,000; authorizing a budget reduction of $75,000 from the Human Services Facility Fees (Fund 290) to replace Human Services Facility Fees; awarding a construction contract to Bay Cities Paving & Grading, Inc., in the amount of $2,285,985 for the Livermore Village Remediation Project DR202118

Recommendation:
Staff recommends the City Council adopt a resolution for the Livermore Village Remediation Project DR202118, which is necessary for the implementation of the Downtown Workforce Housing Project:

1. Rescinding Resolution No. 2026-125 in its entirety;
2. Finding the project exempt from the California Environmental Quality Act pursuant to Government Code Section 65457 and CEQA Guidelines Section 15182(c) and within the scope of the 2004 Downtown Specific Plan EIR, the 2009 Subsequent EIR, and Addenda. Pursuant to Public Resources Code Section 21166 and CEQA Guidelines Section 15162, no additional environmental review is required.
3. Authorizing a supplemental appropriation of $75,000 from the Low-Income Housing Fund (200) to the budget for the Livermore Village Remediation Project DR202118;
4. Authorizing a budget reduction of $75,000 in Human Services Facility Fees (Fund 290)

to the budget for the Livermore Village Remediation Project DR202118;

5. Awarding and authorizing the City Manager to execute a contract with Bay Cities Paving & Grading, Inc., in the amount of $2,285,985, for construction of the Livermore Village Remediation Project DR202118, pursuant to Livermore Municipal Code Section 2.68.570(C);
6. Rejecting all other bids or proposals;
7. Authorizing the City Manager to approve and execute change orders up to a cumulative amount of ten percent (10%) of the construction contract value of $2,285,985; and
8. Authorizing the City Manager to take whatever actions are necessary and appropriate to carry out the purpose and intent of this resolution.

Staff Report

Attachments:

1. Location Map
2. Prior Environmental Review
3. Mitigation Monitoring and Reporting Program (MMRP)
4. Link to Water Board Documents
5. Site Management Plan
6. Resolution
7. Exhibit A - Bay Cities Paving and Grading Inc. Contract
8. Presentation

4. ADJOURNMENT

To a Regular City Council meeting on Monday, September 14, 2026 at 7:00 pm, Civic Center Meeting Hall, Dr. John Shirley Council Chamber, 1016 S. Livermore Avenue and virtually using Zoom.

LIVERMORE
CALIFORNIA

CITY COUNCIL STAFF REPORT **ITEM NO. 3.1**

DATE: August 20, 2026

TO: Honorable Mayor and City Council

FROM: Marianna A. Burch, City Manager

SUBJECT: Adopt a Resolution Appointing John Marchand to the Office of Mayor and Evan Branning to the Office of City Council Member, District 1 and Cancelling the November 3, 2026, Election for the uncontested seats in accordance with Elections Code Section 10229.

RECOMMENDED ACTION

The City Clerk's Office and Staff recommend the City Council:

Adopt a resolution appointing the uncontested nominated candidates for the offices of Mayor and City Council Member, District 1, and cancelling the November 3, 2026, General Municipal Election for those seats.

SUMMARY

The nomination period for Livermore's Mayor and District 1 Council Member closed with only one candidate qualifying for each seat: John Marchand for Mayor and Evan Branning for District 1. According to Elections Code § 10229, the City Council may either appoint the nominated candidates or proceed with an election; if no action is taken, the election will be held.

DISCUSSION

The City of Livermore ("City") adopted Resolution No. 2026-072 to consolidate the November 3, 2026 General Municipal Election ("Election") with the Alameda County Registrar of Voters. The Election was to be held for the following offices: Mayor and City Council Member District 1 and District 2. The nomination period for all three offices was open from July 13 - August 7, 2026. At the close of the nomination period, the following candidates qualified for the Election ballot:

The person nominated for the at-large seat of Mayor is: John Marchand

The person nominated for District 1 is: Evan Branning

The persons nominated for District 2 are: Ben Barrientos
Narayan Tadimeti

As there were not more candidates than offices to be elected for the Mayoral and District 1 seats, Elections Code § 10229 allows one of the following courses of action to be taken by the Livermore City Council:

1) Appoint to the office the person who has been nominated.
2) Hold the election if either no one or only one person has been nominated.

A notice was published in the newspaper on August 13, 2026, notifying the public of these facts, as required by Section 10229. The City Council has until August 20, 2026 (the 75th day before the election) to take action, as stated above.

If no action is taken by the City Council, the election for the Mayor and City Council Member, District 1 seats shall be held. If the City Council proceeds with Option 1 and makes an appointment(s) pursuant to California Elections Code § 10229, the City Clerk shall not accept for filing any statement of write-in candidacy submitted after the appointment(s) is made.

The Election for the City Council Member, District 2 seat shall be conducted as scheduled.

FISCAL AND ADMINISTRATIVE IMPACTS

During the 2024 General Election, the City of Livermore had three seats up for election: Mayor, District 3, and District 4. The costs associated with each race were as follows:

- Mayoral Race: $267,357
- District 3: $71,838
- District 4: $69,938

Major components of the overall election costs included Registrar of Voters staffing, official ballot printing, ballot transportation, and postage.

If the Livermore City Council elects to cancel the 2026 election for the Mayor and Council Member, District 1 seats, the City could realize estimated cost savings of approximately $200,000 to $300,000.

COMMUNITY PILLAR
5: A City That Works

GOAL
1: Engage effectively with the Mayor and City Council

ATTACHMENTS

1. Notice of Facts 2026
2. Resolution

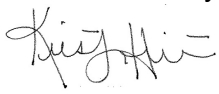
Prepared by: Olivia Nashed
City Clerk

Approved by:



Marianna A. Burch
City Manager

Fiscal Review by:



Kristen Hilton
Acting Administrative Services Director

CITY CLERK CERTIFICATION
PURSUANT TO CALIFORNIA ELECTIONS CODE § 10229
THAT THERE ARE NOT MORE CANDIDATES THAN OFFICES TO BE ELECTED
FOR THE AT-LARGE SEAT OF MAYOR AND IN DISTRICT 1

I, Olivia Nashed, City Clerk of the City of Livermore, do hereby certify that pursuant to California Elections Code § 10229, to the following facts relating to the General Municipal Election in the City of Livermore to be held on November 3, 2026:

As of the close of the nomination period on August 7, 2026, there are not more candidates than offices to be elected for the at-large seat of Mayor and in District 1. There is one seat available for at-large Mayor and one candidate qualified for the election for at-large Mayor. There is one seat available in District 1 and one candidate qualified for the election in District 1.

The person nominated for the at-large seat of Mayor is: John Marchand

The person nominated for District 1 is: Evan Branning

§ 10229 of the Elections Code allows one of the following courses of action to be taken by the Livermore City Council for each the at-large Mayor seat and District 1:

1) Appoint to the office the person who has been nominated.
2) Appoint to the office any eligible voter if no one has been nominated.
3) Hold the election if either no one or only one person has been nominated.

Option 2 above is not applicable as John Marchand and Evan Branning have been nominated and qualify for the at-large Mayor seat and District 1 seat, respectively.

Notice of these facts will be published on August 13, 2026, in a newspaper of general circulation pursuant to Section 6061 of the Government Code. After the fifth day following the date of publication, the Livermore City Council will meet to either make an appointment or direct an election to be held for each the at-large Mayor seat and District 1. The person appointed for the at-large Mayor seat and the person appointed for District 1, if any, shall qualify and take office and serve exactly as if elected at a municipal election for the office.

If by the 75th day before the election, August 20, 2026, no person has been appointed to the office for the at-large Mayor seat and District 1, the election shall be held for each of these offices.

If the City Council makes an appointment(s) pursuant to California Elections Code § 10229, the City Clerk shall not accept for filing any statement of write in candidacy, which is submitted after the appointment is made.

/s/ Olivia Nashed

_____

Olivia Nashed, City Clerk
City of Livermore
Dated: August 7, 2026

IN THE CITY COUNCIL OF THE CITY OF LIVERMORE, CALIFORNIA

A RESOLUTION APPOINTING THE UNCONTESTED NOMINATED CANDIDATES FOR THE OFFICES OF MAYOR AND CITY COUNCIL MEMBER, DISTRICT 1 AND CANCELLING THE NOVEMBER 3, 2026, GENERAL MUNICIPAL ELECTION FOR THOSE SEATS

At the close of the nomination period on August 7, 2026, there was one candidate for the office of Mayor and one candidate for the office of City Council Member, District 1 to be filled at the November 3, 2026, General Municipal Election.

Section 10229 of the California Elections Code allows the City Council to take one of the following courses of action when there are no more candidates than offices to be elected:

1. Appoint to the office the person(s) who has/have been nominated.
2. Hold the election if either no one or only one person has been nominated.

The City Clerk notified the City Council of these facts on August 8, 2026, and a notice of these facts was published on August 13, 2026, in a newspaper of general circulation pursuant to Section 10229.

Section 10229 provides that the City Council has until the close of business on August 20, 2026 (the 75th day before the election) to take action to appoint the candidates or continue the election for the Mayoral and City Council Member, District 1 offices as scheduled.

The City Council now desires to appoint the two candidates and cancel the elections for the seats of Mayor and City Council Member, District 1, which will result in cost savings of approximately $200,000 to $300,000.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Livermore:

SECTION 1. That pursuant to Section 10229 of the Elections Code of the State of California, the following actions are being taken:

a. John Marchand is hereby appointed to the Office of Mayor of the City Council for a Two-Year Term.

b. Evan Branning is hereby appointed to the Office of City Council Member, District 1, for a Four-Year Term.

c. The election scheduled to be held on Tuesday, November 3, 2026, for the purpose of electing officers to the offices of Mayor and City Council Member,

District 1, is now canceled. The election scheduled for the office of City Council Member, District 2 shall proceed as scheduled.

d. The two candidates appointed shall qualify, take office and serve exactly as if elected at the November 3, 2026, General Municipal Election.

e. The City Clerk shall certify to the passage and adoption of this resolution, enter it into the book of original resolutions, and transmit a certified copy of the Resolution and all necessary documents to the Alameda County Registrar of Voters and Board of Supervisors of this action.

f. The City Clerk shall not accept for filing any statement for write-in candidacy for the Office of Mayor or City Council Member, District 1 following the appointment of the nominees to those seats.

g. This Resolution shall become effective immediately upon adoption.

On motion of Council Member _____, seconded by Council Member _____, the foregoing resolution was passed and adopted on August 20, 2026, by the following vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

ATTEST:

_____
Olivia Nashed
City Clerk

APPROVED AS TO FORM:

/s/ Kimberly D. Cilley
Kimberly D. Cilley
City Attorney

LIVERMORE
CALIFORNIA

CITY COUNCIL STAFF REPORT **ITEM NO. 3.2**

DATE: August 20, 2026

TO: Honorable Mayor and City Council

FROM: Brent Smith, Community Development Director

SUBJECT: A resolution rescinding Resolution No. 2026-125 and authorizing a supplemental appropriation of Low-Income Housing Funds (Fund 200) in the amount of $75,000; authorizing a budget reduction of $75,000 from the Human Services Facility Fees (Fund 290) to replace Human Services Facility Fees; awarding a construction contract to Bay Cities Paving & Grading, Inc., in the amount of $2,285,985 for the Livermore Village Remediation Project DR202118

RECOMMENDED ACTION

Staff recommends the City Council adopt a resolution for the Livermore Village Remediation Project DR202118, which is necessary for the implementation of the Downtown Workforce Housing Project:

1. Rescinding Resolution No. 2026-125 in its entirety;
2. Finding the project exempt from the California Environmental Quality Act pursuant to Government Code Section 65457 and CEQA Guidelines Section 15182(c) and within the scope of the 2004 Downtown Specific Plan EIR, the 2009 Subsequent EIR, and Addenda. Pursuant to Public Resources Code Section 21166 and CEQA Guidelines Section 15162, no additional environmental review is required.
3. Authorizing a supplemental appropriation of $75,000 from the Low-Income Housing Fund (200) to the budget for the Livermore Village Remediation Project DR202118;
4. Authorizing a budget reduction of $75,000 in Human Services Facility Fees (Fund 290) to the budget for the Livermore Village Remediation Project DR202118;
5. Awarding and authorizing the City Manager to execute a contract with Bay Cities Paving & Grading, Inc., in the amount of $2,285,985, for construction of the Livermore Village Remediation Project DR202118, pursuant to Livermore Municipal Code Section 2.68.570(C);
6. Rejecting all other bids or proposals;
7. Authorizing the City Manager to approve and execute change orders up to a cumulative amount of ten percent (10%) of the construction contract value of $2,285,985; and
8. Authorizing the City Manager to take whatever actions are necessary and appropriate to carry out the purpose and intent of this resolution.

SUMMARY

On January 29, 2018, the City Council approved the 2018 Downtown Plan for the development of portions of the Livermore Village Site, including the Downtown Workforce Housing Project, which consists of Veterans Park and up to 130 units of workforce housing, which was the subject of a certified Subsequent Environmental Impact Report (SEIR). The City Council approved the Downtown Workforce Housing Project on May 25, 2021, finding that the Downtown Workforce Housing Project was consistent with a Specific Plan for which an EIR was certified, that the Downtown Workforce Housing Project was within the scope of the previously certified EIR, and that none of the criteria triggering subsequent environmental review were present. Therefore, the Downtown Workforce Housing Project was exempt from further review under the California Environmental Quality Act (CEQA). This determination was upheld by the California Court of Appeal in *Save Livermore Downtown v. City of Livermore* (2022) 87 Cal. App. 5th 1116. The California Supreme Court denied review. (*Save Livermore Downtown v. City of Livermore* (2023) Cal. LEXIS 2167.)

Prior to the City of Livermore (City) purchasing the site, historic property use impacted shallow soil. As contemplated in the SEIR, the San Francisco Bay Regional Water Quality Control Board (Water Board) approved a Site Management Plan that identifies soil handling requirements during development of the Downtown Workforce Housing Project at the site. The current action, the Livermore Village Remediation Project DR202118 (Project), involves the next step in the approved remediation and development plan: soil removal in compliance with the Site Management Plan to facilitate subsequent construction of the Downtown Workforce Housing Project.

On June 24, 2026, eleven (11) bids were received for the Project. A timely bid protest was received from Goodfellow Bros. California, LLC (GBI), the second lowest bidder, claiming that the bid proposal from Bay Cities Paving & Grading, Inc., (Bay Cities) was non-responsive. After detailed review by staff in coordination with the City Attorney's Office, staff ultimately determined that Bay Cities' bid proposal is responsive.

On July 27, 2026, City Council passed and adopted Resolution No. 2026-125 awarding and authorizing the City Manager to execute a construction contract with Bay Cities, the lowest responsible and responsive bidder, in an amount of $2,285,985, and authorizing a supplemental appropriation in the amount of $75,000 from the Low-Income Housing Fund (Fund 200) to replace Human Services Facility Fees (Fund 290).

On August 3, 2026, the City received a Ralph M. Brown Act Demand to Cure and Correct Under Government Code section 54960.1, related to the noticing of the July 27, 2026, Agenda Item No. 6.8, the Livermore Village Remediation Project DR202118. The Demand alleged that the City violated the Brown Act because the noticing did not identify the City’s proposed pathway for complying with CEQA along with the substantive actions the City Council was considering. The City maintains that the agenda description substantively complied with the Brown Act’s requirements; however, for the avoidance of doubt and to promote transparency in the public process, staff has revised the agenda description to expressly identify the relevant CEQA exemptions applicable to the current action and recommends the City Council adopt the recommended actions. To avoid confusion regarding the operative date of the construction contract, staff recommends the City Council rescind the prior actions taken in Resolution No. 2026-125.

In accordance with the revised agenda description, staff recommends the City Council award and authorize the City Manager to execute a construction contract with Bay Cities, the lowest responsible and responsive bidder, pursuant to Section 2.68.570(C) of the Livermore Municipal Code (LMC), in an amount of $2,285,985. Staff also recommends the City Council authorize a supplemental appropriation in the amount of $75,000 from the Low-Income Housing Fund (Fund 200) to replace Human Services Facility Fees (Fund 290).

Staff further recommends the City Council find that the construction contract is exempt from the California Environmental Quality Act pursuant to Government Code Section 65457 and CEQA Guidelines Section 15182(c). Additionally, the construction contract is within the scope of the Specific Plan EIR, dated February 9, 2004 (SCH No. 2003032038), the Specific Plan Subsequent EIR, dated March 30, 2009 (SCH No. 2008092085), and the Specific Plan Subsequent EIR Addenda adopted by City Council by Resolution 2018-153, Resolution 2019-064, and Resolution 2020-178. In accordance with Public Resources Code Section 21166 and CEQA Guidelines section 15162, no additional environmental review is required.

DISCUSSION

In 2008, the City Redevelopment Agency purchased the property bounded by First Street, L Street, Railroad Avenue, and South Livermore Avenue, generally referred to as the Livermore Village Site, and the City subsequently purchased the property in 2011.

On January 29, 2018, the City Council approved the 2018 Downtown Specific Plan for the development of portions of the Livermore Village Site to include:

- Stockmen's Park
- Up to 130 units of workforce housing
- A science center
- A black box theater
- Retail space
- A linear public park (that would come to be known as Veterans Park)

To comply with CEQA, the Downtown Specific Plan relies on the certified SEIR. On November 26, 2018, the City Council approved the Disposition, Development and Loan Agreement to sell a portion of the Livermore Village Site to Eden Housing, Inc., to develop a multifamily affordable housing project with up to 130 units of workforce housing on an approximately 2-acre parcel located southeast of the Railroad Avenue and L Street intersection (the Downtown Workforce Housing Project; see Location Map - Attachment 1). The City Council approved project-specific entitlements for the Downtown Workforce Housing Project on May 25, 2021, and found the action to be exempt from CEQA.

The Disposition, Development and Loan Agreement was further amended and restated on May 26, 2021, and May 24, 2022, and supplemented with an Indemnity and Cooperation Agreement on September 2, 2022. These latter two amendments provide details regarding the responsibilities related to management of existing environmental conditions at the site. The site was sold to Eden Housing in 2022 in preparation for the development of the Downtown Workforce Housing Project.

As set forth in the SEIR, due to historic commercial activities at the site, the Water Board requested characterization of soil and groundwater throughout the Livermore Village Site. Site investigations and

testing have been ongoing since the early 2000's. Pursuant to the SEIR's mitigation monitoring and reporting program, the City submitted the testing results to the Water Board, which is overseeing the cleanup of various sites throughout the Livermore Village area. Environmental testing results and reports are readily available to the public on the Water Board's GeoTracker website. Information specifically addressing the location of the Project can be found using the GeoTracker website link included in Attachment 4.

In 2022, a Site Management Plan was prepared to inform future construction and maintenance workers of site environmental conditions; provide guidelines for appropriate health and safety precautions; establish protocols for managing soil and groundwater disturbed during construction; and define post-construction testing and reporting procedures to verify compliance with Water Board requirements. The Site Management Plan was approved by the Water Board in 2022. The Site Management Plan is included as Attachment 5.

The scope of the current action includes excavation, removal, profiling, transportation, and disposal of soil materials containing elevated concentrations of heavy metals; backfill and compaction with clean import; and site grading and restoration to stabilize the site ahead of the Downtown Workforce Housing Project construction as required by the Site Management Plan and consistent with the SEIR. The work is funded by a grant from the State of California Department of Toxic Substances Control (DTSC). The grant terminates on February 26, 2027, so time is of the essence in completing the Project.

Staff advertised the Project on June 3, 2026. On June 24, 2026, the City received eleven (11) bids for the Project. The following is a list of the bids received and the Engineer's Estimate for the Project:

Contractor Name	City	Base Bid
Bay Cities Paving & Grading, Inc.	Concord, CA	$932,235
Goodfellow Bros. California, LLC	Livermore, CA	$971,092
Innovative Construction Solutions	Concord, CA	$987,592
Mountain Cascade Inc.	Livermore, CA	$1,230,116
Grade Tech Inc.	Livermore, CA	$1,237,045
ETIC	Pleasant Hill, CA	$1,258,408
Pacific States	Dublin, CA	$1,293,101
Brannon Corporation	Morgan Hill, CA	$1,335,560
McGuire and Hester	Oakland, CA	$1,385,100
Engineering/Remediation Resources Group, Inc.	Martinez, CA	$1,602,812
Clean Harbors Environmental Services, Inc.	Norwell, MA	$2,416,484
	Engineer's Estimate	$2,200,000

Ten (10) of the eleven (11) bid results represent significant savings from the previously estimated Project construction cost. Based on feedback from the design consultant and prospective bidders, the cost savings are attributed to the aggressive bidding climate associated with this Project. The pre-bid conference was well-attended, and several inquiries were received during the bidding period expressing detailed interest in winning the Project.

Bay Cities Paving & Grading, Inc. (Bay Cities) was the apparent lowest bidder at the time the bids were received. The City acknowledged the receipt of a timely protest letter from Goodfellow Bros. California,

LLC (GBI), dated June 25, 2026, and a timely protest letter response from Bay Cities, dated June 29, 2026. Staff conducted a detailed review of the individual Bid Proposals and bid protest letters. As a result of this review, staff deemed Bay Cities' Bid Proposal to be responsive based on the following reasons:

- The bid protest identifies discrepancies in the Base Bid and Bid Alternate amounts indicated on Bay Cities' Bid Proposal and Bid Schedule. The Base Bid discrepancy is governed and resolved by Paragraph 12.1.1 of the Instructions to Bidders. The Bid Alternate discrepancies are governed by Paragraph 12.1.4 of the Instructions to Bidders and are immaterial to the award, which is based on the Base Bid amount. Neither discrepancy reaches the threshold for non-responsiveness identified in Paragraph 12.2 of the Instructions to Bidders.
- The bid protest asserts that Bay Cities' bid must be rejected as non-responsive because project summaries were provided in a different format than required for the Bidder's Questionnaire and certain project summaries did not identify the name and/or contact for the Architect/Engineer. These irregularities do not constitute material deviations from the bidding requirements, do not affect the competitive bidding process, and do not require rejection of Bay Cities' bid as non-responsive. The City therefore retains discretion to waive these irregularities as immaterial. Staff was able to contact references identified on the project sheets and received consistently positive endorsements of Bay Cities' performance. The provided project sheets did not pose an impediment or source of additional effort in reviewing Bay Cities' qualifications. Accordingly, staff deems these bid irregularities to be immaterial, in accordance with Paragraph 22 of the Instructions to Bidders.
- The bid protest acknowledges that Bay Cities submitted a Subcontractor List with no subcontractors listed and was not initialed. Bay Cities did, however, indicate in writing "No Subcontractors." Moreover, Bay Cities signed and submitted the Bid Proposal, verifying under oath that Bay Cities would self-perform all work. Bay Cities receives no competitive advantage from this omission. No other bidder's position is affected. There is no uncertainty about Bay Cities' self-performance representation since it is written on the form in plain English. This irregularity does not constitute a material deviation from the bidding requirements, does not affect the competitive bidding process, and does not require rejection of Bay Cities' bid as non-responsive. The City therefore retains discretion to waive this irregularity as immaterial. Accordingly, the City deems this bid irregularity to be immaterial, in accordance with Paragraph 22 of the Instructions to Bidders.

Staff determined that these bid irregularities can be waived as inconsequential and that Bay Cities' Bid Proposal is responsive. A letter dated July 1, 2026, was sent to GBI by the City Engineer containing staff analysis of the bid protest. Staff recommends the City Council authorize a construction contract with Bay Cities, the lowest responsible and responsive bidder. Bay Cities has extensive experience completing earthwork projects for public agencies throughout Northern California and has worked on projects for the City with satisfactory performance. Staff contacted references included in Bay Cities' bid and received consistently positive endorsements of Bay Cities' performance.

The Base Bid scope of work involves removal of soil to a depth of two (2) feet below ground surface. Staff recommends adding Bid Alternate 2 to the contract. Bid Alternate 2 includes additional excavation to extend the depth of soil removal by three (3) feet to a total of five (5) feet below ground surface, with associated off haul, backfill, and compaction. The benefits of Bid Alternate 2 includes removing additional soil containing elevated concentrations of heavy metals in advance of the park and housing developments, thereby reducing the amount of landfill off hauling required during construction of the park and housing developments, improving worker health and safety during construction and future routine maintenance activities, and minimizing the potential for delays that may be associated with the earthwork

activities. Bay Cities submitted a Base Bid amount of $932,235 with the Bid Alternate 2 work totaling $1,353,750. The total amount of the Base Bid and Bid Alternate 2, $2,285,985, is less than the Engineer's Estimate and within the DTSC grant amount. The current budget covers this contract award of $2,285,985.

On July 27, 2026, City Council passed and adopted Resolution No. 2026-125 awarding and authorizing the City Manager to execute a construction contract with Bay Cities in an amount of $2,285,985 and authorizing a supplemental appropriation in the amount of $75,000 from the Low-Income Housing Fund (Fund 200) to replace Human Services Facility Fees (Fund 290). On August 3, 2026, the City received a Ralph M. Brown Act Demand to Cure and Correct Under Government Code section 54960.1, related to the noticing of the July 27, 2026, Agenda Item No. 6.8, the Livermore Village Remediation Project DR202118. The Demand alleged that the City's notice did not comply with the Brown Act, because the notice did not disclose the actions the City may take to comply with CEQA in connection with action on the contract itself. Although the City finds that the noticing for the agenda item substantively complied with the Brown Act's requirements, for the avoidance of doubt and to promote transparency in the public process, staff revised the agenda description and recommends the City Council reconsider the item. To avoid confusion regarding the operative date of the construction contract, staff recommends the City Council rescind the prior actions taken in Resolution No. 2026-125; award and authorize the City Manager to execute a construction contract with Bay Cities, the lowest responsible and responsive bidder, pursuant to Section 2.68.570(C) of the LMC, in an amount of $2,285,985; and reauthorize a supplemental appropriation in the amount of $75,000 from the Low-Income Housing Fund (Fund 200) to replace Human Services Facility Fees (Fund 290).

In accordance with Livermore Municipal Code Section 2.68.590(B), a cumulative Change Order authorization of 10% of the contract value is allowed. Given the uncertainty associated with underground conditions and the potential for encountering additional contaminated materials, staff will return to City Council for additional Change Order authorization if needed.

Staff will coordinate with the Downtown businesses affected by the Project work and inform them of the planned construction activities. Advance notification will be provided regarding roadway closures, parking restrictions, and construction schedules before work commences. An updated schedule will be made available to the Downtown businesses on the City's website. Fencing will be installed around the perimeter of the construction site to exclude the public from the work area. The fencing will include informational banners to apprise the public of the work being performed.

ENVIRONMENTAL DETERMINATION

The construction contract with Bay Cities is a subsequent approval that implements the Downtown Workforce Housing Project and therefore it is exempt from the provisions of the California Environmental Quality Act ("CEQA") pursuant to Government Code section 65457 and CEQA Guidelines Section 15182(c). The construction contract is also within the scope of the 2004 Specific Plan EIR, the 2009 Subsequent EIR, and Addenda adopted by City Council. Pursuant to Public Resources Code section 21166 and CEQA Guidelines section 15162, none of the factors that would require additional environmental review are present. The findings in support of the environmental determination are set forth in the attached Resolution.

The record of project approval is available to the general public at: City of Livermore, 1052 South Livermore Avenue, Livermore, CA 94550. Documents are also available electronically using the links

included in Attachment 2. The Mitigation Monitoring and Reporting Program is included as Attachment 3.

FISCAL AND ADMINISTRATIVE IMPACTS

The Livermore Village Remediation Project DR202118 is included in the FY 2025-30 Capital Improvement Plan. The budget for the Project covers the cost of this $2,285,985 construction contract with Bay Cities and all other associated Change Orders, construction management, materials testing, project management, and reporting. DTSC has approved funding for remediation activities at the site through February 26, 2027. Based on the contract time of completion, the work covered under this construction contract will be completed within the grant term and is eligible for grant reimbursements.

Human Services Facility Fees (Fund 290) are currently allocated in FY 2026-27 to fund expenses to support site closure tasks at the workforce housing site that may be required by the Water Board after the period covered by the DTSC grant. Human Services Facility Fees are not the appropriate funding source for tasks supporting workforce housing. To align the anticipated Project expenditures with the proper funding to account for housing-related costs, a supplemental appropriation from the Low-Income Housing Fund (Fund 200) will be made to the Project budget as follows:

- For Fund 200, add $75,000
- For Fund 290, remove $75,000

This project will not increase Operational and Maintenance (O&M) costs.

COMMUNITY PILLAR

4: Inclusive and Inviting Spaces and Places

GOAL

3: Continue to implement the Downtown Specific Plan

GUIDING DOCUMENT

5-Year Capital Improvement Plan Fiscal Years 2025-2030

ATTACHMENTS

1. Location Map
2. Prior Environmental Review
3. Mitigation Monitoring and Reporting Program (MMRP)
4. Link to Water Board Documents
5. Site Management Plan
6. Resolution
7. Exhibit A - Bay Cities Paving and Grading Inc. Contract
8. Presentation

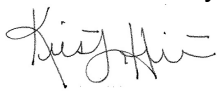
Prepared by: Rick Teczon
Senior Civil Engineer

Approved by:



Marianna A. Burch
City Manager

Fiscal Review by:



Kristen Hilton
Acting Administrative Services Director



N

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ft

1" =

LEGEND

ALL LOCATIONS ARE APPROXIMATE

Address Type

- Primary Address/Single Family
- Unit
- Utility

Street Name Labels (White Font)

- Parcels
- Livermore City Limits
- Alameda County

RGB

- Red: Band_1
- Green: Band_2
- Blue: Band_3

CITY OF LIVERMORE CALIFORNIA

Livermore Web Map

Date: 6/22/2026

Path: /Web Map

Prior Environmental Review

The record of project approval is available to the General Public at: City of Livermore, 1052 South Livermore Avenue, Livermore, CA 94550. Documents are also electronically accessible using the following links:

- Downtown Specific Plan (DSP): https://www.livermoreca.gov/departments/community-development/downtown/downtown-specific-plan
- 2003 General Plan and DSP Environmental Impact Report (EIR):
  Volume I - https://www.livermoreca.gov/home/showpublisheddocument/7287/637587704102770000
  Volume II - https://www.livermoreca.gov/departments/community-development/planning/environmental-documents#docaccess-9264e958987bd99632f795418d9147c2
- 2009 Supplemental EIR (SEIR): https://www.livermoreca.gov/departments/community-development/planning/environmental-documents#docaccess-0b507d0938595e0163c106573b97f65b
- 2018 Addenda: https://www.livermoreca.gov/departments/community-development/planning/environmental-documents#docaccess-4a1c2f0e79fd8a3d57816ac189492f0e
- 2019 Addenda: https://www.livermoreca.gov/departments/community-development/planning/environmental-documents#docaccess-a18212dd86ff7f84087a3363ce3f6779
- 2020 Addenda: https://www.livermoreca.gov/departments/community-development/planning/environmental-documents#docaccess-c8a728458390963d59aa60f75731ccbd
  and
  https://www.livermoreca.gov/departments/community-development/planning/environmental-documents#docaccess-b5fe995a44b8e1bdc4925f5807396d7e

MITIGATION MONITORING AND REPORTING PROGRAM

This Mitigation Monitoring and Reporting Program (MMRP) has been updated based upon the findings of the Addendum[1] to the Downtown Specific Plan Amendments and Regional Performing Arts Theater Subsequent Environmental Impact Report (2009 Subsequent EIR). The MMRP, which is found in Table A of this section, lists mitigation measures recommended in the 2009 Subsequent EIR for the proposed project and identifies mitigation monitoring requirements as modified by the minor modifications to the project evaluated in the Addendum. The MMRP must be adopted when the City Council makes a final decision on the modified project.

This MMRP has been prepared to comply with the requirements of State law (Public Resources Code Section 21081.6). State law requires the adoption of an MMRP when mitigation measures are required to avoid significant impacts. The MMRP is intended to ensure compliance during implementation of the project.

The MMRP is organized in a matrix format. The first column identifies the mitigation measure. The second column, entitled "Mitigation Responsibility," refers to the party responsible for implementing the mitigation measure. The third column, entitled "Monitoring/Reporting Agency," refers to the agency responsible for oversight or ensuring that the mitigation measure is implemented. The fourth column, entitled "Monitoring Schedule," refers to when monitoring will occur to ensure that the mitigating action is completed. Please note that these mitigation measures include any revisions made as a result of the Response to Comments Document and the 2018 Addendum to the 2009 Subsequent EIR.

[1] LSA Associates Inc. 2018. *California Environmental Quality Act (CEQA) Addendum for the Downtown Specific Plan Amendment Project; Livermore, California Memorandum*. August 2.

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Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule
A. LAND USE AND PLANNING POLICY			
There are no significant impacts to land use and planning policy.			
B. POPULATION, EMPLOYMENT AND HOUSING			
There are no significant impacts to population, employment and housing.			
C. TRANSPORTATION, CIRCULATION AND PARKING			
TRANS-1: Widen Stanley Boulevard to six lanes through the Murrieta Boulevard intersection as defined in the City General Plan. This action will improve operations by maintaining LOS D but reducing the delay from greater than 45 seconds to less than 45 seconds. While this measure is identified in the city's Traffic Impact Fee program and is identified in the Capital Improvement Program, it is likely to be constructed several years after the Theater is constructed. During this interim time period, the impact would remain significant and unavoidable.	City of Livermore Engineering Division	City of Livermore Engineering Division	Ongoing
TRANS-2: Complete the Isabel Interchange Project including the removal of the Portola Avenue Interchange. This is a regional project. Downtown development will pay its fair share of this improvement through the City Traffic Impact Fees. This measure is fully funded and construction documents are being prepared. At this time, the interchange construction is expected to be complete in 2011. Should the Theater open prior to 2011, the impact would remain significant and unavoidable until 2011 when the Isabel Interchange Project is complete.	City of Livermore Engineering Division; Project Applicant	City of Livermore Engineering Division	Ongoing
TRANS-3b: For construction of the Theater at any alternative site or redevelopment of the Livermore Village site, install enhanced pedestrian crossing features on South Livermore Avenue between First Street and Railroad Avenue.	City of Livermore Engineering Division	City of Livermore Engineering Division	Prior to issuance of occupancy permit
TRANS-3c: Prior to buildout of the Livermore Village site, install enhanced pedestrian crossing features on South L Street between First Street and Railroad Avenue.	City of Livermore Community Development Department	City of Livermore Community Development Department	Prior to issuance of occupancy permit
TRANS-5: If the Theater is constructed at the Livermore Village site, design the passenger loading zones as follows: • Maintain a minimum 150-foot passenger loading zone on South Livermore Avenue. • If feasible, provide a second 100-foot passenger loading zone on the internal circulation road adjacent to the Theater. • Design the passenger loading zones to have a 12-foot width measured from face-of-curb.	Project Applicant	City of Livermore Engineering Division	Prior to site plan approval

Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule
TRANS-8: If the Theater is constructed at the Livermore Village site, ensure that the loading dock is situated on the site such that trucks with trailers can maneuver in and out of the loading dock without encroaching onto the sidewalk on the opposite side of the internal street.	Project Applicant	City of Livermore Engineering Division	Prior to site plan approval
TRANS-10a: Monitor parking supply and demand over time and provide the following or equivalent parking facilities to meet identified demands: • Construct a 500 space parking garage (rather than 350 spaces) at the Livermore Village site, adding 150 more parking spaces to the Downtown, or construct a 200 space parking garage east of the Downtown; and • Increase on-street parking within the Livermore Village site, adding about 40 parking spaces to the Downtown;	City of Livermore Community Development Department	City of Livermore Community Development Department	Ongoing
TRANS-10c: Promote valet parking operations in Downtown. The large number of restaurants, cultural facilities, and hotel are excellent candidates for valet parking. As the Downtown parking supplies are more fully utilized, visitors will self-select valet parking to minimize their time to search for an available parking space. Valet parking operators may enter into agreements with businesses or the City to use their privately owned or public parking areas. Valet parked facilities can accommodate about 10 percent more vehicles than a self-parked facility. For example, valet operators may be able to add an additional 30 parked vehicles on the top floor of the Livermore Valley Center garage.	City of Livermore Community Development Department	City of Livermore Community Development Department	Ongoing
TRANS-10d: Consider utilizing time-limited and pay parking strategies to manage employee parking behavior, increasing available parking spaces for customers. As Livermore's Downtown transforms into a more vibrant community with a diverse mix of land uses, there will be more pressure to actively manage the parking resources in the area. Employees tend to use the most convenient on-street parking spaces which forces customers to park further from their ultimate destination. Time-limited parking can alter employee parking behavior, but requires diligent enforcement. As Downtowns mature, pay parking strategies (or a Business Improvement District (BID) to secure a location(s) solely for employee use) become a more effective tool to manage employee parking behavior. Employees are expected to utilize 15 percent to 20 percent of the Downtown parking spaces, so shifting employee parking away from the Downtown core has the net effect of increasing parking supply near destinations by 15 percent to 20 percent for customers. The revenue generated by pay parking strategies can be re-invested into the Downtown. For example, the revenue could be used to provide employee parking or operate a valet parking program.	City of Livermore Community Development Department	City of Livermore Engineering Division	Ongoing

Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule
TRANS-10e: Provide handicap accessible on-street parking spaces in the Downtown and particularly within the project. Handicap accessible parking in Downtown environments is challenging. Parking spaces are dispersed and some individual land uses do not have any parking, but rely on public parking nearby. The Institute of Transportation Engineers publication Special Report: Accessible Public Rights-of-Way Planning and Design for Alterations (July 2007) provides good design parameters for on-street handicap accessible parking spaces. The City currently provides on-street accessible parking spaces at the corners of blocks. Each accessible on-street parking space could then serve two block faces; whereas, a mid-block parking space only serves one block face. Thus, two accessible parking spaces could serve the four block faces of a typical block. The City should continue to look for opportunities to provide handicap accessible parking spaces with a consistent design.	City of Livermore Community Development Department	City of Livermore Community Development Department	Ongoing
TRANS-11: The City shall require development of a construction traffic management plan for each new development proposed within the Downtown area. The construction traffic management plan could include: timing of construction and deliveries; travel routes for large construction vehicles; control and monitoring by flaggers for construction vehicle ingress and egress; a regular street cleaning program; and an employee parking program. The provisions of such a plan shall address the adverse effects, to the satisfaction of the City, on vehicular, pedestrian, bicycle, and transit of construction-related traffic associated with each particular project.	Project applicant	City of Livermore Engineering Division	Prior to issuance of grading or construction permits
D. AIR QUALITY			
AIR-1a: Consistent with guidance from the BAAQMD, the following actions shall be required of all construction contracts and specifications for the project: *Demolition.* The following controls shall be implemented during demolition: • Water during demolition work, including the break-up of pavement and infrastructure, to control dust generation; • Cover all trucks hauling demolition debris from the site; and • Use dust-proof chutes to load debris into trucks whenever feasible. *Construction.* The following controls shall be implemented at all construction sites: • Water all active construction areas at least twice daily and more often during windy periods; active areas adjacent to existing land uses shall be kept damp at all times, or shall be treated with non-toxic stabilizers to control dust; • Cover all trucks hauling soil, sand, and other loose materials; • Pave, apply water three times daily, or apply (non-toxic) soil stabilizers on all unpaved access roads, parking areas, and staging areas at construction sites;	Project applicant	City of Livermore Community Development Department	Ongoing during demolition, grading and construction activities

Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule
• Sweep daily (with water sweepers) all paved access roads, parking areas, and staging areas at construction sites; water sweepers shall vacuum up excess water to avoid runoff-related impacts to water quality; • Sweep streets daily (with water sweepers) if visible soil material is carried onto adjacent public streets; • Apply non-toxic soil stabilizers to inactive construction areas; • Enclose, cover, water twice daily, or apply non-toxic soil binders to exposed stockpiles (dirt, sand, etc.); • Diesel equipment standing idle for more than 5 minutes shall be turned off. This would include trucks waiting to deliver or receive soil, aggregate, or other bulk materials. Rotating drum concrete trucks may keep their engines running continuously as long as they are onsite; • Properly tune and maintain equipment to reduce emissions; • Avoid staging equipment within 200 feet of residences, or to the greatest extent possible; • Limit traffic speeds on unpaved roads to 15 mph; • Install sandbags or other erosion control measures to prevent silt runoff to public roadways; • Replant vegetation in disturbed areas as quickly as possible; • Any temporary haul roads to soil stockpile areas shall be routed away from existing neighboring land uses; • Water sprays shall be utilized to control dust when material is being added or removed from stockpiles. When stockpiles are undisturbed for more than one week, storage piles shall be treated with a dust suppressant or crusting agent to eliminate wind-blown dust generation; • Install baserock at unpaved entryways for all exiting trucks, and wash off the tires or tracks of all trucks and equipment in designated areas before leaving the site; and • Suspend excavation and grading activity when winds (instantaneous gusts) exceed 25 mph.			

Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule
AIR-1b: Development applicants shall provide a construction dust control coordinator as part of a construction-period air pollution control plan (required under General Plan Policy OSC-6.1P1). All neighboring properties located within 500 feet of property lines of a construction site shall be provided with the name and phone number of a designated construction dust control coordinator who will respond to complaints within 24 hours by suspending dust-producing activities or providing additional personnel or equipment for dust control as deemed necessary. The phone number of the BAAQMD pollution complaints contact shall also be provided. The dust control coordinator shall be on-call during construction hours. The coordinator shall keep a log of complaints received and remedial actions taken in response. This log shall be made available to City staff upon its request.	Project applicant	City of Livermore Community Development Department	Ongoing during demolition, grading and construction activities
E. GLOBAL CLIMATE CHANGE			

GCC-1: To the extent feasible and to the satisfaction of the City, the following measures shall be incorporated into the design and construction of the projects seeking City approval and developed as part of the Amendments:
Construction and Building Materials
• Use locally produced and/or manufactured building materials for construction of the project;
• Recycle/reuse demolished construction material; and
• Use "green building materials," such as those materials which are resource efficient, and recycled and manufactured in an environmentally friendly way, including low volatile organic compound (VOC) materials.
Energy Efficiency Measures
• Design all new buildings to be consistent with the State's CALGreen Code, as currently written or as amended in the future. Encourage energy efficient building techniques including:
  ○ Increase insulation such that heat transfer and thermal bridging is minimized;
  ○ Limit air leakage through the structure or within the heating and cooling distribution system to minimize energy consumption; and
  ○ Incorporate ENERGY STAR or better rated windows, space heating and cooling equipment, light fixtures, appliances or other applicable electrical equipment.
• Design, construct and operate all newly constructed and renovated buildings and facilities to meet the State's CALGreen Code requirements as currently written or as amended in the future;
• Provide a landscape and development plan for the project that takes advantage of shade, prevailing winds, and landscaping;
	Project applicant	City of Livermore Community Development Department	Prior to design review approval

Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule

• Use combined heat and power in appropriate applications;
• Install efficient lighting and lighting control systems. Use daylight as an integral part of lighting systems in buildings;
• Install light colored "cool" roofs and cool pavements;
• Install energy efficient heating and cooling systems, appliances and equipment, and control systems; and
• Install light emitting diodes (LEDs) for outdoor lighting.
Water Conservation and Efficiency Measures
• Devise a comprehensive water conservation strategy appropriate for the project and location. The strategy may include the following, plus other innovative measures that might be appropriate:
  ○ Create water-efficient landscapes within the development;
  ○ Install water-efficient irrigation systems and devices, such as soil moisture-based irrigation controls;
  ○ Design buildings to be water-efficient. Install water-efficient fixtures and appliances, including low-flow faucets, dual-flush toilets and waterless urinals; and
  ○ Restrict watering methods (e.g., prohibit systems that apply water to non-vegetated surfaces) and control runoff.
Transportation and Motor Vehicle Measures
• Commercial trucks, including construction and delivery vehicles, shall limit idling time and will be subject to state anti-idling regulations adopted by ARB in 2005;
• Provide bicycle lanes and/or paths, incorporated into the proposed street systems and connected to a community-wide network;
• Provide adequate bicycle parking near building entrances to promote cyclist safety, security, and convenience. For large employers, provide facilities that encourage bicycle commuting, including, e.g., locked bicycle storage or covered or indoor bicycle parking.
• Provide sidewalks and/or paths, connected to adjacent land uses, transit stops, and/or community-wide network;
• Size parking capacity to not exceed the City's zoning requirements AND provide infrastructure and support programs to facilitate shared vehicle usage such as carpool drop-off areas, designated parking for vanpools, or car-share services, ride boards, and shuttle service to mass transit.			

Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule
F. NOISE			
NOISE-1: Construction activities associated with implementation of the Amendments and the Theater shall comply with the following noise reduction measures: • General construction noise shall be limited to the hours of 7:00 a.m. to 8:00 p.m. Monday through Friday, 9:00 a.m. to 6:00 p.m. on weekends, and no noise producing construction activities shall be allowed on City-observed holidays in conformance with the Noise Ordinance. • All heavy construction equipment that is used shall be maintained in good operating condition, with all internal combustion, engine-driven equipment equipped with intake and exhaust mufflers that are in good condition. All stationary noise-generating equipment shall be located as far away as possible from neighboring property lines, especially residential uses. • The construction contractor shall locate equipment staging in areas that would create the greatest distance feasible between construction-related noise sources and noise-sensitive receptors nearest the development sites during all project construction.	Project applicant and construction contractor	City of Livermore Community Development Department	Ongoing during demolition, grading and construction activities
NOISE-2a: All residential land use development on the Livermore Village site located within 390 feet of the centerline of Railroad Avenue or within 105 feet of the centerline of South Livermore Avenue shall include an alternate form of ventilation, such as an air conditioning system, in order to ensure that windows can remain closed for a prolonged period of time.	Project applicant	City of Livermore Community Development Department	Prior to issuance of occupancy permits
NOISE-2b: All residential land use development on the First Street/South Livermore Avenue site located within 80 feet of the centerline of South Livermore Avenue shall include an alternate form of ventilation, such as an air conditioning system, in order to ensure that windows can remain closed for a prolonged period of time.	Project applicant	City of Livermore Community Development Department	Prior to issuance of occupancy permits
NOISE-2c: Project-specific acoustical studies shall be performed for all proposed residential development projects at any other location within the Downtown Specific Plan area. The impact assessment shall be submitted to the Community Development Department for review and approval prior to issuance of grading permits. Measures shall be identified and implemented that would reduce exterior noise level impacts to meet the City's interior noise level criteria of 45 dBA CNEL for residential land uses within the Downtown Area.	Project applicant	City of Livermore Community Development Department	Prior to issuance of grading permit

Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule
NOISE-3a: Project-specific stationary noise impact studies shall be performed for all proposed noise-sensitive development within the Downtown Specific Plan area. The noise impact studies shall describe how the City's Downtown exterior and interior acceptable noise level standards will be achieved for the proposed development. For any proposed multi-family residential, motel, or hotel development projects, the acoustical study must also satisfy the requirements set forth in Title 24, Part 2, of the California Administrative Code, Noise Insulation Standards, for multiple-family attached residential units, hotels and motels. These studies must be performed and submitted to the Community Development Department for review prior to issuance of any permits.	Project applicant	City of Livermore Community Development Department	Prior to issuance of any permits
NOISE-3b: Project-specific stationary noise impact studies shall be performed for all proposed development projects within the Downtown Specific Plan area which include any machinery, equipment, pump, fan, air conditioning apparatus, or similar mechanical device, or delivery docks, that would generate noise levels in excess of the City's exterior noise standards. These noise impact studies shall include mitigation measures that would reduce project-related stationary noise impacts to comply with the City's Downtown exterior and interior acceptable noise level standards. These studies must be performed and submitted to the Community Development Department for review and approval prior to issuance of any permits.	Project applicant	City of Livermore Community Development Department	Prior to issuance of any permits
NOISE-4: For all proposed development constructed as part of the proposed project, the project applicants shall prepare a vibration impact assessment to determine potential construction-related groundborne vibration impacts for any structure located within 50 feet of proposed earthmoving or pile driving activities. The vibration impact assessment shall be submitted to the Community Development Department for review and approval prior to issuance of grading permits. Measures shall be identified and implemented that would reduce groundborne vibration impacts from extreme noise generators (such as heavy construction equipment or pile driving) and to prescribe methods of construction to be utilized so as not to exceed the identified thresholds. Such measures may include restrictions on the number or types of construction equipment that may operate at a time within 100 feet of structures, restrictions on equipment hours of operation, or require-ments to use alternative construction techniques such as auger cast piles in lieu of driven piles.	Project applicant	City of Livermore Community Development Department	Prior to issuance of demolition, grading, or occupancy permits

Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule
G. CULTURAL RESOURCES			
CULT-1: A qualified cultural resources professional shall review additional project developments allowed under the Downtown Specific Plan Amendments once project-specific plans are available. At a minimum, these reviews shall include a records search to determine the presence of recorded cultural resources within a proposed project development site, a project site survey to identify cultural resources, and the determination if a qualified archaeologist is required to monitor ground disturbing activities associated with the project. The results of the assessment shall be presented in a report submitted to the City of Livermore Community Development Department Planning Division and include recommendations for mitigation of project impacts to significant cultural resources, as appropriate. The City shall ensure that mitigation measures proposed as part of the cultural resources assessments are implemented as a condition to site development.	Project applicant	City of Livermore Community Development Department	Prior to approval of site development plan
CULT-2: If the proposed First Street/South Livermore Avenue or the Livermore Village alternative site is selected for development of the regional Theater, the Pacific Telephone & Telegraph (PT&T) or Southern Pacific Railroad Depot buildings, respectively, shall be moved from its current location to prevent its demolition. The relocated building shall retain its general physical context, including its orientation and relationship to the street as it has in its current location and shall be moved to a similar location within the Downtown Core. The recommendations provided by Carey & Co. Inc., for the PT&T building also shall apply to the SPRR Depot: • A relocation plan should be prepared by an architect and engineer, retained by the project applicant and approved by the Redevelopment Agency, with a minimum of five years' experience in the rehabilitation of historic buildings. The plan would address the issues of documenting historic fabric prior to the move, protecting historic fabric during the move, and restoration following the relocation. • If feasible, non-historic additions to the PT&T and Southern Pacific Railroad Depot buildings shall not be moved, and the building shall be restored to its original condition. Restoration of the building shall be done in accordance with the Design Standards and Guidelines (Chapter 6) of the *City of Livermore Downtown Specific Plan* and the *Secretary of the Interior's Standards for the Treatment of Historic Properties*. • A report shall be prepared that includes photographic documentation of the building's current location and character defining elements and post-relocation conditions. The report shall also detail the building's significance in local and regional history. The report shall be submitted to local historical archives, libraries, and the Northwest Information Center.	Project applicants architect/engineer	City of Livermore Redevelopment Agency	Prior to issuance of a demolition permit

Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule
CULT-3: A qualified archaeologist shall monitor ground-disturbing project activities at the proposed Theater sites due to the possibility of encountering subsurface historical archaeological deposits at one of the three potential locations. Archaeological monitors must be empowered to halt construction activities at the location of the discovery to review possible archaeological materials and to protect the resource while the finds are being evaluated. Monitoring shall continue until, in the archaeologist's judgment, archaeological deposits are not likely to be encountered. If archaeological materials are discovered during project activities, all work within 25 feet of the discovery shall be redirected until the archaeological monitor assesses the situation, consults with agencies as appropriate, and provides recommendations for the treatment of the discovery. If archaeological deposits are discovered during project activities, all work within 25 feet of the discovery shall be redirected until the archaeological monitor assesses the situation, consults with agencies as appropriate, and provides recommendations for the treatment of the discovery. Adverse effects to archaeological deposits should be avoided by project activities. If such deposits cannot be avoided, they shall be evaluated for their California Register of Historical Resources eligibility. If the deposits are not eligible, a determination shall be made as to whether it qualifies as a "unique archaeological resource" under CEQA. If the deposits are neither a historical nor unique archaeological resource, avoidance is not necessary. If the deposits qualify as either a historical or archaeological resource, they will need to be avoided and, in accordance with General Plan policy CC-3.4.P4, archaeological sites should be preserved for research and educational programs. Adverse effects to significant sites that cannot be avoided, or sites that cannot be preserved, must be mitigated. Mitigation can include, but is not necessarily limited to, excavation of the deposit in accordance with a data recovery plan (see *CEQA Guidelines* Section 15126.4(b)(3)(C)) and standard archaeological field methods and procedures; laboratory and technical analyses of recovered archaeological materials; preparation of a report detailing the methods, findings, and significance of the archaeological site and associated materials; and accessioning of archaeological materials and a technical data recovery report at a curation facility. Educational public outreach may also be appropriate. Upon completion of the monitoring, the archaeologist should prepare a report that describes the results of the monitoring, including any measures that may have been	Project applicant and qualified archaeologist	City of Livermore Community Development Department	Ongoing during ground-disturbing project activities

Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule
implemented for mitigation of impacts to significant archaeological deposits identified during monitoring. The report should be submitted to the City of Livermore Planning Division and the Northwest Information Center.			
CULT-4: The project applicant shall inform its contractor(s) of the sensitivity of the project area for paleontological resources by including the following directive in contract documents: The subsurface at the construction site may be sensitive for paleontological resources. If paleontological resources are encountered during project subsurface construction, all ground-disturbing activities within 25 feet shall be redirected and a qualified paleontologist contacted to assess the situation, consult with agencies as appropriate, and make recommendations for the treatment of the discovery. Project personnel shall not collect or move any paleontological materials. Paleontological resources include fossil plants and animals, and such trace fossil evidence of past life as tracks. Ancient marine sediments may contain invertebrate fossils such as snails, clam and oyster shells, sponges, and protozoa; and vertebrate fossils such as fish, whale, and sea lion bones. Vertebrate land mammals may include bones of mammoth, camel, saber tooth cat, horse, and bison. Paleontological resources also include plant imprints, petrified wood, and animal tracks. The City shall verify that the language has been included in the contract documents before issuing a grading permit. Adverse effects to such deposits shall be avoided by project activities. If avoidance is not feasible, the paleontological resources shall be evaluated for their significance. If the resources are not significant, avoidance is not necessary. If the resources are significant, project activities shall avoid disturbing the deposits, or the adverse effects of disturbance shall be mitigated. Upon completion of the paleontological assessment, a report shall be prepared documenting the methods, results, and recommendations of the assessment. The report shall be submitted to the City of Livermore Planning Division and, if paleontological materials are recovered, a paleontological repository, such as the University of California Museum of Paleontology.	Project applicant and construction contractor	City of Livermore Community Development Department	Prior to issuance of grading permit and ongoing during ground-disturbing project activities

Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule
CULT-5: If human remains are encountered, these remains shall be treated in accordance with Health and Safety Code Section 7050.5 and *CEQA Guidelines* Section 15064.5(e). The project applicant shall inform its contractor(s) of the appropriate protocols in the event that human remains are unearthed by including the following directive in contract documents: If human remains are encountered during project activities, work within 25 feet of the discovery shall be redirected and the Alameda County Coroner notified immediately. At the same time, an archaeologist shall be contacted to assess the situation and consult with agencies as appropriate. Project personnel shall not collect or move any human remains and associated materials. If the human remains are of Native American origin, the Coroner must notify the Native American Heritage Commission within 24 hours of this identification. The Native American Heritage Commission will identify a Most Likely Descendant to inspect the site and provide recommendations for the proper treatment of the remains and associated grave goods. The City shall verify that the language has been included in the contract documents before issuing a grading permit. Upon completion of the assessment, the archaeologist shall prepare a report documenting the methods and results, and provide recommendations for the treatment of the human remains and any associated cultural materials, as appropriate and in coordination with the recommendations of the MLD. The report should be submitted to the City of Livermore Planning Division and the Northwest Information Center.	Project applicant	City of Livermore Community Development Department	Prior to issuance of grading permit and ongoing during ground-disturbing project activities
H. HAZARDS AND HAZARDOUS MATERIALS			
HAZ-1: Prior to development within the Downtown Specific Plan area, a Phase I investigation shall be conducted in accordance with ASTM standards (E1527-05) to determine whether past land uses could potentially have affected subsurface soil and/or groundwater. If potential effects are identified related to soil, soil vapor, or groundwater, a licensed professional shall provide recommendations for a subsurface investigation (Phase II). The results of the Phase II investigation shall be evaluated by a licensed professional and recommendations provided regarding remediation of soil and/or groundwater in consultation with a local or state regulatory agency. Depending on the results of the subsurface investigation, regulatory agency oversight shall be requested.	Project applicant	City of Livermore Community Development Department	Prior to issuance of demolition or grading permits

Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule
HAZ-2: Prior to the issuance of grading permits for redevelopment of the Livermore Village and hotel sites, a Soil Management Plan (SMP) shall be prepared to address potential hazardous material issues during construction of the project. The SMP shall include any available environmental data from sampling at the specific site, a worker health and safety plan, and requirements for soil management and off-site disposal. The applicant shall ensure that appropriate response measures are included in the SMP to protect human health and the environment if evidence (e.g., odors or visual staining) of previously unknown contaminated soil and/or groundwater or buried debris are encountered during project construction. A contingency plan for sampling and analysis of previously unknown hazardous materials and reporting of the results shall be prepared by the applicant as part of the SMP.	Project applicant	City of Livermore Community Development Department	Prior to issuance of grading permits
HAZ-3: A hazardous building materials survey shall be conducted by a qualified professional for structures proposed for demolition during redevelopment of the Livermore Village and hotel sites. All loose and peeling lead-based paint and asbestos-containing material shall be abated by a certified contractor(s) in accordance with local, state, and federal requirements. All other hazardous materials must be removed from buildings prior to demolition in accordance with DOSH regulations. The findings of the abatement activities shall be documented by a qualified environmental professional(s) and submitted to the City of Livermore prior to the issuance of construction and demolition permits.	Project applicant	City of Livermore Community Development Department	Prior to issuance of demolition, grading or construction permits
HAZ-4: An investigation workplan including soil, groundwater and soil vapor sampling shall be prepared and implemented by a licensed professional to evaluate potential hazardous material impacts from operation of the Southern Pacific Railroad at the Livermore Village site and Quality Cleaners adjacent to the Livermore Village site. The workplan shall include representative sampling and analysis of soil an soil vapor and/or groundwater samples for heavy metals, petroleum hydrocarbons, pesticides, and chlorinated solvents. Depending on the results of the subsurface investigation, regulatory agency oversight shall be requested, if contamination is identified that could affect public health and the environment. Future remedies for identified contamination could include removal of contaminated materials, on-site treatment and/or institutional or engineering controls (i.e., deed restrictions on certain land uses or capping of development sites).	Project applicant	City of Livermore Community Development Department	Prior to issuance of demolition, grading or construction permits

Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule
HAZ-5: A soil investigation workplan shall be prepared and implemented by a licensed professional to evaluate the extent of soils impacted by lead at the former marine service facility and potential hazardous material impacts in the former Southern Pacific Railroad right-of-way on the Railroad Avenue realignment or the First Street/Maple Street site. The workplan shall include representative sampling and analysis of soil samples for heavy metals, petroleum hydrocarbons, and pesticides. Depending on the results of the subsurface investigation, regulatory agency oversight shall be requested, if contamination is identified that could affect public health and the environment. Future remedies for identified contamination could include removal of contaminated materials, on-site treatment and/or institutional or engineering controls (i.e., deed restrictions on certain land uses or capping of development sites).	Project applicant	City of Livermore Community Development Department	Prior to issuance of demolition, grading or construction permits
I. UTILITIES AND INFRASTRUCTURE			
UTIL-1: When detailed site plans for the Livermore Village site are submitted, City staff, the Livermore Pleasanton Fire District, and Cal Water shall review and approve the plans to ensure the provision of adequate fire water flows. Should increasing the size of the water main in Railroad Avenue be required, the City and the water providers shall require and approve a plan for infrastructure improvements prior to issuance of grading permits. The project applicant shall be required to contribute their fair share towards this improvement, to the satisfaction of the City staff. An occupancy permit for the Theater shall not be issued until the Livermore Pleasanton Fire District has confirmed adequate fire water flow is available.	Project applicant	City of Livermore Community Development Department; Livermore Fire District; and Cal Water	Prior to issuance of an occupancy permit
UTIL-2: When detailed site plans for the Railroad Avenue realignment are available, the City should coordinate with all utility providers to prepare plans for relocation of existing utility lines as necessary. Prior to issuance of any grading or demolition permits, the city and utilities providers shall approve plans for utility line relocation.	Project applicant	City of Livermore Community Development Department and utilities providers	Prior to issuance of grading or demolition permits
J. VISUAL RESOURCES			
VIS-3: The applicant shall incorporate into the Theater project glass surfaces that are non-mirrored or include non-reflective films, coatings and shading devices to reduce glare. The architectural detail regarding lighting and glass shall be reviewed and approved by the City during the Design Review process.	Project applicant	City of Livermore Community Development Department	Prior to design review approval

Table A: Draft Mitigation Monitoring and Reporting Program

Mitigation Measures	Mitigation Responsibility	Monitoring/Reporting Agency	Monitoring Schedule
INITIAL STUDY IMPACTS AND MITIGATION MEASURES			
GEO-1: A site-specific design-level geotechnical investigation for the Theater project shall be prepared by a licensed professional and shall provide design criteria for construction in response to the moderately high ground shaking potential. In addition, the design criteria for construction of a development project shall comply with the current 2007 CBC standards and local regulations. All final design and engineering plans for either the project or project alternatives shall be reviewed and approved by the City of Livermore prior to issuance of a grading permit.	Project applicant	City of Livermore Community Development Department	Prior to issuance of a grading permit
GEO-2: A site-specific design-level geotechnical investigation report prepared by a licensed professional is required for the project by the City of Livermore prior to issuance of a grading permit. The report shall identify potential liquefiable sediments and include recommendations to minimize the potential for damage from liquefiable sediments. The applicant shall implement design elements as recommended in the investigation report to reduce the potential impact from liquefaction.	Project applicant	City of Livermore Community Development Department	Prior to issuance of a grading permit

Source: LSA (2018).

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Link to Water Board Documents

Environmental testing results and reports are readily available to the public on the Water Board's GeoTracker website. Information specifically addressing the location of the Project can be found at the following GeoTracker website link:

https://geotracker.waterboards.ca.gov/profile_report.asp?global_id=T10000016758

July 1, 2022

Joel Waxdeck
Assistant City Engineer
Engineering Division
City of Livermore
1052 South Livermore Ave
Livermore, CA 94550
jhwaxdeck@cityoflivermore.net

Re: **Site Management Plan - Livermore Old Train Depot**
Downtown Core Development Project
Livermore, California

Dear Mr. Waxdeck:

On behalf of the City of Livermore, PANGEA Environmental Services, Inc. prepared this *Site Management Plan* (SMP) for the Livermore Old Train Depot Site. This SMP provides guidelines for the protection of human health and the environment during potential future handling of and exposure to Site soil and soil vapor. This SMP summarizes historical Site use information and subsurface data from available reports for the subject site. This SMP was prepared for initial project activity and may be updated or superseded as additional information becomes available for current or future Site activity.

If you have any questions or comments, please call me at (510) 435-8664.

Sincerely,
PANGEA Environmental Services, Inc.

Bob Clark-Riddell, P.E.
Principal Engineer

Attachment: *Site Management Plan*

SITE MANAGEMENT PLAN

Livermore Old Train Depot
Livermore, California

July 1, 2022

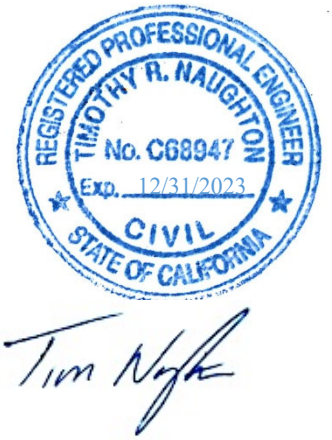
Prepared for:

City of Livermore
Engineering Division
1052 South Livermore Ave
Livermore, CA 94550

Prepared by:

PANGEA Environmental Services, Inc.
1250 Addison Street, Suite 213
Berkeley, California 94702

Written by:



Tim Naughton
Principal Engineer



Bob Clark-Riddell, P.E.
Principal Engineer

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ACRONYMS AND ABBREVIATIONS

ACDEH	Alameda County Department of Environmental Health
AER	Air Exchange Rate
bgs	below ground surface
BMP	Best Management Practice
Cal-OSHA	California Occupational Safety and Health
CASQA	California Stormwater Quality Association
CCR	California Code of Regulations
cfm	cubic feet per minute
CHP	California Highway Patrol
COPC	chemical of potential concern
CSM	conceptual site model
CUPA	Certified Unified Program Agency
DCE	dichloroethylene
DOT	Department of Transportation (Federal and California)
DTSC	California Department of Toxic Substances Control
EPA	United States Environmental Protection Agency
ESL	environmental screening level
ft	foot/feet
HAZWOPER	Hazardous Waste Operations and Emergency Response
HASP	Health and Safety Plan
HHRA	human health risk assessment
HVAC	heating, ventilation, and air conditioning
mg/kg	milligram per kilogram
mph	miles per hour
NOI	Notice of Intent
NPDES	National Pollution Discharge Elimination System
OSHA	United States Occupational Safety and Health Administration
Pa	Pascals
PANGEA	Pangea Environmental Services, Inc.
PCE	tetrachloroethylene
PEL	Permissible Exposure Limit
PPE	Personal Protective Equipment
ppmv	parts per million, by volume
QSP	Qualified SWPPP Practitioner
SFRWQCB	San Francisco Bay Regional Water Quality Control Board
SMP	Site Management Plan
STLC	soluble threshold limit concentration
SVOC	semi-volatile organic compounds
SWPPP	Stormwater Pollution Prevention Plan
TCE	trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TPH	total petroleum hydrocarbons
TPHg	total petroleum hydrocarbons as gasoline
TPHd	total petroleum hydrocarbons as diesel
TPHmo	total petroleum hydrocarbons as motor oil
UST	Underground Storage Tank
VI	Vapor Intrusion

VOC	volatile organic compound
WET	Waste Extraction Test
µg/L	micrograms per liter
µg/m^3	microgram per cubic meter

1.0 INTRODUCTION

This Site Management Plan (SMP) has been prepared by PANGEA Environmental Services, Inc. (PANGEA) on behalf of the City of Livermore (City) for the *Livermore Old Train Depot Site* (Site). The project location is shown in Figure 1. Site-specific data from samples collected at the Site indicate soil, soil gas, and groundwater impacts by chemicals from historical land use practices at the Site and adjacent properties. This SMP provides guidelines for the protection of human health and the environment during potential future handling of and exposure to Site soil and soil gas. This SMP was prepared for the planned redevelopment project at the Site and may be updated or superseded as additional information becomes available for current or future Site activity.

Terms used in this SMP include the following:

- Owner – Current property owner or their agent responsible for managing the property at any given time. The Site is currently owned and operated by the City of Livermore.
- Contractor – Party conducting onsite activities as engaged by the Owner or other parties.
- Engineer/Consultant – Current engineer/consultant engaged by the Owner to assist in implementing this SMP.

Owner's workers and/or Contractor(s) are responsible for adhering to this SMP and maintaining job and Site safety. Each Contractor is also responsible for providing a copy of this SMP to its subcontractors.

1.1. Objectives

The objectives of this SMP are as follows:

- Communicate information to future Site construction and maintenance workers about Site environmental conditions;
- Present guidelines for appropriate health and safety precautions for onsite workers who may encounter soil, soil vapor, and groundwater that could contain residual chemicals of concern;
- Provide protocols for management of Site soil and groundwater disturbed during operations, maintenance, or development activities; and,
- Establish post-construction procedures to verify that the planned multi-family parking garages function per code requirements and thus, are consistent with site-specific conditions described in the agency-approved human health risk assessment (HHRA).

Soil management protocols are required due to the potential for encountering chemical concentrations in soil that may be greater than generic screening levels identified for construction workers[1]. Soil disturbed at the Site will be managed and/or disposed of in accordance with applicable federal, state, and local laws and regulations. This SMP provides standard procedures for the handling and reporting of disturbed soil so that response expectations are clear when potentially contaminated soil is encountered during routine maintenance, new construction, or other subsurface operations. The SMP is used to guide notification, investigation, cleanup, and reporting activities, as needed and appropriate.

The HHRA (Exponent 2022) evaluated human health risks associated with potential residential exposures to volatile organic compounds (VOCs) in soil gas via vapor intrusion assuming site-specific development and exposure conditions. Based on these conditions, the HHRA concluded that estimated risks are less than one in a million. The estimated noncarcinogenic hazards were less than the threshold of one. Thus, the estimated risks are well within the levels considered by Cal/EPA and EPA to protective of human health and do not warrant further action. This SMP defines the verification procedures that will be implemented following completion of the development project to confirm that post-construction conditions are consistent with those considered in the HHRA and thus, are protective of human health. The SMP also defines protocols if the post-construction assessment results do not align with the HHRA.

1.2. SMP Scope

The Livermore Downtown Core Development project will involve several work phases by numerous contractors. This SMP was prepared regarding the following project work planned for the Site project area shown on Figure 1:

- Removal of trees, tree trunks, asphalt, concrete, landscaping, lighting, signs and other Site improvements;
- Soil grading;
- Trenching and installation of subgrade utilities;
- Construction of two multi-story, multi-family residential buildings over underground parking structures;
- Offsite soil disposal;
- Installation of bio-retention planters, lighting, signs, fire hydrants, trees, landscaping; and,
- Pavement for parking.

[1] In general, generic screening levels are more stringent (i.e., more likely to significantly overstate actual risks) than Site-specific screening levels due to the conservative nature of the assumptions used. Thus, when contaminant concentrations are below generic screening levels, no further action is typically warranted.

This work scope will disturb the upper approximate 20 ft of soil under Building A (North building), the upper 9 ft of soil under Building B (South building), and the upper 2 ft of soil in the remaining project area. This SMP may be updated or superseded as additional information becomes available for current or future Site activity.

1.3. Intended Users

This SMP was prepared for use by the following to ensure protection of construction workers during development activities at the Site:

- Owner
- Developer
- Contractor(s)
- Engineer/Consultant

2.0 BACKGROUND

This section provides information regarding the current and past Site setting, as well as environmental investigation activities that have been conducted at and near the Site.

2.1. Site Setting, Historical Uses, and Planned Use

The Site is currently developed with paved and unpaved parking lots. The project is part of a multi-phase development project. Additional phases of the development project consist of construction of the following: (1) a multi-level parking structure; (2) several one-story commercial retail and two-story arts and science buildings; (3) a four-story hotel; (4) communal landscaped areas surrounding the proposed buildings, and (5) surface parking areas.

According to project documents, historical Site use included, but was not limited to, the following:

- Multiple railroad lines that ran parallel and approximately 100 to 350 south of Railroad Avenue;
- Former railroad depot building (Southern Pacific Railroad) at 22 South L Street;
- Former lumber storage yard located at the corner of Railroad Avenue and L Street; and,
- Various other Commercial and industrial uses, as well as paved parking lots.

2.2. Previous Environmental Investigations

Multiple environmental investigations have been performed for the Livermore Downtown Core Development project area. Initial reports documenting environmental site assessment are listed by address on Figure 1. This document list includes Phase I environmental site assessments that reviewed available records, described historical site use, and provided recommendations regarding the need for further assessment. Subsequent investigations provided subsurface data for the Site referenced in Section 2.1, as documented in the following reports:

- 2009-2111 Railroad (Lucky): Phase 2 Summary Report, May 2005, Fugro West Inc.
- Various Addresses: Soil Data Tables, April and May 2018, BSK Associates.
- 20-24 L ST and 2009-2073 Railroad (Old Train Depot): Subsurface Investigations, 2018 and 2021, Pangea Environmental Services, Inc.

From 2018 to 2021 additional investigation was performed at the Site, as summarized in the *Data Gap Assessment Report and Path to Closure* (Pangea 2022). A narrative description of prior and recent investigation is provided in Appendix C. These investigations involved sampling of soil, groundwater, and soil gas. Soil, groundwater, and soil gas sample locations and data are summarized in Appendix C.

2.3. Constituents of Potential Concern

Based on comparison to Environmental Screening Levels (ESLs)[2] established by the San Francisco Bay Regional Water Quality Control Board (SFRWQCB) updated in January 2019 (SFRWQCB, 2019), constituents of potential concern within Old Train Depot site media from historical assessment include the following:

- Metals arsenic, lead, and nickel in shallow soil,
- Petroleum hydrocarbons in soil and groundwater, including naphthalene, total petroleum hydrocarbons as gasoline (TPHg), diesel (TPHd), and motor oil-range (TPHmo),
- Volatile organic compounds (VOCs) in groundwater including tetrachloroethene (PCE) and breakdown product trichloroethene (TCE), and
- VOCs in soil gas, primarily PCE.

2.4. Nature and Extent of Impacted Media

The nature and extents of potential soil, soil gas, and groundwater impacts at the Site are discussed in the following subsections. Soil and soil gas sampling locations are shown on Figure 2 (and described within background conditions in Appendix C).

It is each Contractor's responsibility to determine potential exposure risks for their workers related to residual impacts in soil, soil gas, and groundwater. Contractors and other interested parties may refer to the most current and applicable ESLs (SFRWQCB, 2019) as a screening tool.

2.4.1 Soil

No PCE or other VOCs have been detected in shallow soil at the Old Train Depot site. SVOCs and TPHd and TPHmo have been detected in a limited number of shallow soil samples at concentrations less than 2019 Tier 1 Residential ESLs at the Old Train Depot site. Arsenic, lead, and nickel have been detected in shallow soil at levels greater than 2019 Construction Worker Direct Exposure ESLs at the Site. However, most metal concentrations in Site soils are consistent with background levels (Bradford 1996, Duverge 2011). Soil disturbing activities that occur at this Site must be performed under the requirements included in this SMP.

A summary of soil data at the Site is provided on Figure 3 (metals) and Figure 4 (PCE). Available soil analytical data within the Site area are compared to applicable screening criteria and background levels

[2] ESLs have been developed by the SFRWQCB to guide environmental investigations at Sites in California.

(Table 1). Soil sample locations and data for the Livermore Downtown Core Project Area are presented in Table 1 in Appendix C.

2.4.2 Soil Vapor

As noted previously, an HHRA (Exponent 2022) was conducted at the Site to evaluate human health risks associated with potential residential exposures via vapor intrusion to VOCs in soil gas assuming site-specific development and exposure conditions. Based on these conditions, the HHRA concluded that estimated risks are less than one in a million. The estimated noncarcinogenic hazards were less than the threshold of one. Thus, the estimated risks are well within the levels considered by Cal/EPA and EPA to protective of human health and do not warrant further action.

The SFRWQCB has not established soil gas ESLs for construction workers. However, the maximum PCE concentration detected in soil gas at the Site of 5,340 $\mu g/m^3$ (equivalent to 0.71 parts per million by volume [ppmv]) is less than the Occupational Safety and Health Administration (OSHA) (Table 1910.1000 Table Z-2) permissible exposure limit (PEL) for PCE of 100 ppmv (8-hour time weighed average).

Site soil vapor data is presented in Table 2. Soil vapor sampling locations are shown on Figure 5 (shallow soil) and Figure 6 (deeper soil). Soil gas analytical data for surrounding sites are presented in Appendix C. During soil disturbing activity, the Contractor should respond appropriately to any identified subsurface conditions of potential concern consistent with SMP procedures and their Health and Safety Plan (HASP).

Soil vapor monitoring at the location of the Old Train Depot will be performed in conjunction with remediation activities associated with the upgradient Quality Cleaners site, which is the source of the contamination. This monitoring will help verify that PCE concentrations in soil gas at the off-site portion of the Quality Cleaner's site are stable or decreasing.

2.4.3 Groundwater

Chemicals have been detected at concentrations greater than their respective Tier 1 ESLs in groundwater in areas upgradient, downgradient and crossgradient to the Site, and are characteristic of the Livermore Downtown area and vicinity. Chemicals detected in off-site groundwater have included TPHg, TPHd, and PCE and its degradation products TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride. Chemicals detected in shallow zone groundwater beneath the Site attenuate vertically and horizontally.

Available Site groundwater analytical data is compared to select screening criteria on Table 3. As shown in Table 3, only TPH, PCE and chloroform have been detected in groundwater samples collected at the Old Train Depot Site. Groundwater analytical data for surrounding sites are presented in Appendix C.

Activities that disturb or generate groundwater waste from the Site must be performed under the requirements included in this SMP. Groundwater is present approximately 35-50 ft bgs, so encountering groundwater is not expected nor anticipated during the planned shallower construction activity at the Site.

2.5. Conceptual Site Model Summary

A Conceptual Site Model is a written representation of the conditions and the physical, chemical and biological processes that control the transport, migration and potential impacts of soil, groundwater, and air contamination. The updated Site CSM, presented in *Data Gap Assessment Report and Path to Closure* (Pangea 2022), reflects that site investigations have found the following:

- No on-site shallow soil sources of VOCs at the Site have been identified. Metal concentrations in soil were found not to pose an increased risk to future Site users based on a comparison to screening levels, naturally occurring background concentrations, and development related-excavation of impacted soils.
- Historical perched (30-45 ft bgs) and shallow (50-72 ft bgs) groundwater concentrations at the upgradient former Quality Cleaners site, which is the source of VOCs at the Site, are comparatively greater than groundwater concentrations at the Site. Direct exposure to groundwater will not pose a threat to future residential Site users following development, as groundwater is located at greater than 50 ft bgs. Additionally, drinking water is treated and provided by the California Water Service Company, and well water will not be used by future residents or other Site users.
- Concentrations of soil vapor detected at the Site are consistent with VOCs partitioning from perched and shallow groundwater. PCE is the primary risk driver and chemical of potential concern (COPC) for soil vapor. A summary of soil vapor risk is described in Section 2.6.

Multiple lines of evidence support a conclusion that concentrations of PCE in soil gas and groundwater at the Site result from releases at the historical operations at the former Quality Cleaners Site and likely not from a significant, undocumented release at the Old Train Depot site.

2.6. Risk Assessment Summary

An HHRA (Exponent 2022) was conducted at the Site to evaluate human health risks associated with potential residential exposures via vapor intrusion to VOCs in soil gas assuming site-specific development and exposure conditions. Specifically, the HHRA was performed to evaluate human health risks associated with potential exposure to COPCs in soil gas via inhalation of indoor air of the planned multi-family residential units. The HHRA is included in Appendix A. Based on the site-specific evaluations presented in the HHRA report, the estimated lifetime residential cancer risk is less than (safer than) one in a million (1×10^{-6} or 1E-06) and the non-carcinogenic hazard is less than (safer than) one. Thus, the estimated risk for residential exposure to COPCs in soil gas via the vapor intrusion pathway is present at levels considered by Cal/EPA and EPA to be protective of human health and that do not require further action. This SMP (Section 6.4) defines the verification procedures that will be implemented following completion of the development project to confirm that post-construction conditions are consistent with those considered in the HHRA and thus, are protective of human health. The SMP also defines protocols if the post-construction assessment results do not align with the HHRA.

3.0 REGULATORY STATUS AND GENERAL REQUIREMENTS

Stakeholder agencies include the City of Livermore and the SFRWQCB.

3.1. Regulatory Requirements

Historic Site investigations and planned Site redevelopment are performed under the ongoing oversight of the SFRWQCB. This SMP, including specific protocols and procedures outlined herein, were prepared in response to a SFRWQCB letter dated January 31, 2022. The letter has been included in Appendix B.

Operations, maintenance, monitoring, and earthwork activities may be subject to federal, state, and local laws and regulations, including those promulgated by U.S. Environmental Protection Agency (EPA), California Environmental Protection Agency, California Department of Toxic Substances (DTSC), the Bay Area Air Quality Management District (BAAQMD), and the Occupational Safety and Health Administration (OSHA). These laws address issues such as dust generation, hazardous waste, storm water, health and safety, Proposition 65 notifications, and community right-to-know. While some of these issues are discussed in this SMP, it is the responsibility of the entity performing work that may involve exposure to potentially impacted Site soil, groundwater, and soil vapor to ensure worker safety and to comply with currently applicable laws and regulations.

3.2. Roles and Responsibilities

The roles and responsibilities for the execution of work under this SMP are as follows:

- Owner – The owner (City of Livermore) is responsible for managing the soil and groundwater case with the RWQCB. The owner is also responsible for notifying the Developer of changed environmental conditions of which it becomes aware.
- Developer - The Developer is responsible for contracting the work at the site and monitoring that all work was performed in accordance with plans and regulatory requirements. The Developer is also responsible for notifying the General Contractor of changed environmental conditions of which it becomes aware.
- Contractor – The General Contractor by itself and through its sub-contractors is responsible for performing all work, as contracted by the Developer. It is also responsible for performing work, and ensuring that work is performed, in compliance with regulatory requirements and in accordance with this SMP. It is also responsible for updating its Health and Safety Plan (HASP) in response to notifications of changed environmental conditions for the protection of its workers.
- Engineer/Consultant – The Engineer/Consultant is responsible for overseeing work related to this SMP, including performing construction inspections and performing confirmation testing.
- SFRWQCB – The SFRWQCB is responsible for oversight of redevelopment activities to ensure future Site use is protective of human health and the environment.

3.3. Notifications

The Owner must be contacted prior to any ground-disturbing work, which includes, but is not limited to the following:

- Grading, drilling, and/or excavation or other activity disturbing shallow soil; and
- Drilling or other activity that encounters or extracts groundwater.

The following Owner's personnel and representatives are the primary points of contact regarding environmental conditions:

City of Livermore	
Project Inspector (First)	TBD
Construction Inspection Manager (Second)	Mike Stamm (925) 960-4500 mgstamm@cityoflivermore.net
Project Manager (Third)	Joel Waxdeck (925) 960-4500 jhwaxdeck@cityoflivermore.net
Engineer/Consultant	Bob Clark-Riddell (510) 435-8664; (510) 836-3700 briddell@pangeaenv.com

3.4. Site Inspections and Reporting

Below is a summary of the inspections and reporting associated with this SMP. The contents of this section may be subject to change based on regulatory updates and change of conditions.

The Contractor will notify the Owner/Developer prior to commencement of ground-disturbing activities. Site inspections will be arranged by the Owner/Developer and will be conducted to observe and document Site activity to confirm that required on-site documentation is available and up-to-date (e.g., copies of this SMP).

Inspections and reporting requirements related to soil management are presented in Section 4.0. Confirmation inspection, testing, and reporting requirements for indoor air following construction are described in Section 6.0.

3.5. Publicly Available Information

Environmental information presented in this SMP is publicly available on the California State Water Resources Control Board's "Geotracker," a data management system for sites that impact groundwater or have the potential to impact groundwater. The following is the link to the Site information page in Geotracker:

- Old Train Depot (Site), ID: T1000001675, 2009 to 2073 Railroad Ave, Livermore, CA 94550 - https://geotracker.waterboards.ca.gov/profile_report?global_id=T10000016758.

Information specific to the proposed development project at the Site is also available from the City of Livermore website:

- https://www.cityoflivermore.net/government/community-development/downtown-eden-housing-project

A summary fact sheet of environmental information related to planned development at the Site is included as Appendix D. Additional information is available upon request with the City of Livermore Engineering Department.

4.0 GUIDELINES FOR HEALTH AND SAFETY DURING CONSTRUCTION ACTIVITIES

The Owner is responsible for the health and safety of its employees during activities that could encounter Site soil, groundwater, or soil vapor. Contractors are responsible for the health and safety of their employees engaged in work at the Site. Preparation of a site-specific HASP covering applicable activities is the responsibility of the Contractor at the Site and must be prepared by an appropriately trained person (e.g., certified industrial hygienist or another qualified professional). Such HASPs must meet the requirements of Title 8 in California Code of Regulations (CCR), at a minimum, and must cover all activities to be performed by Contractor or subcontractors' personnel. All applicable federal, state, and local regulations and codes relating to health and safety must be adhered to, including all sections of California Occupational Safety and Health Administration ("Cal-OSHA") regulations contained in CCR Title 8 as they apply to Site activities.

Guidelines provided in this SMP apply only to the classes of chemicals previously detected and characterized at or near the Site and do NOT address health and safety issues related to any other hazards or activities at the Site (including, but not limited to, activities related to demolition and abatement of existing structures, electrical work, trenching and shoring, and weather-related hazards). These guidelines represent minimum health and safety measures related to the chemical impacts addressed herein. Additional measures may be implemented at the discretion of the Contractor(s), based on the specific construction tasks to be performed.

The depth intervals of ground-disturbing construction activities are relevant to worker health and safety monitoring and protection and should be considered in the development of HASPs and protocols, as described above, in Section 2.4.

Upon discovery of any potentially hazardous conditions or in the event of a chemical spill or release, follow procedures described in Sections 4.3, 4.4 and 4.5.

A fact sheet summarizing health and safety guidelines associated with noise, dust, and potential chemical exposure is included as Appendix D.

4.1. Personal Protective Equipment

Site workers who have the potential to be in contact with soil, soil vapor, and/or groundwater at the Site will use appropriate personal protective equipment (PPE) to minimize potential exposures in accordance with the HASP. The PPE required may be upgraded (e.g., use of a respirator may be required) in the event that Site conditions change. Potential events that may require an upgrade of PPE may include the following:

- Identification of additional chemicals or an increase in chemical concentrations in soil, groundwater, and/or soil vapor during any future sampling conducted by Owner and/or Contractor;
- Exposure monitoring indicating the need to upgrade PPE; and/or
- Temperature or individual medical conditions limiting the effectiveness of PPE.

Any Site worker without the proper PPE or appropriate training shall exit the area of concern and follow procedures specified in the HASP and this SMP.

4.2. Decontamination Procedures

Decontamination procedures will be used during removal of potentially contaminated soil to reduce tracking offsite. The decontamination process will involve the removal of accumulated soil, dust, and other materials from earthwork equipment, vehicles, and personnel, while these items are physically located within a designated decontamination area. The proper onsite management and offsite disposal of decontamination wastes such as wash water and contaminated protective equipment used by onsite personnel will be required.

Contractors engaged in soil-disturbing activities in areas with contaminated soil will provide an area for personnel decontamination adjacent to the work area in accordance with the Contractor's HASP. This area will include boot washing and hand washing facilities, toilet facilities, and receptacles for used protective clothing. Decontamination procedures for Site workers wearing PPE may include:

- Wash boots and gloves (if washable);
- Remove protective gloves and place in plastic bags for disposal (if disposable);
- Wash hands and face with soap and water before eating, drinking, using tobacco, or leaving the work area; and
- Clean respirators, if used, and dry as needed, and place in sealed plastic bags with individual identification.

Equipment contacting impacted soil or groundwater within the known area of impacts may require decontamination prior to leaving the active area due to the possible presence of metals, VOCs and other potential contaminants. Decontamination requirements will vary depending on the type of equipment and nature and condition of subsurface material encountered. For dry soils, dry removal of dirt from tires and bucket or blade using brooms should be performed, at a minimum (see Section 5.0 for additional discussion on soil and dust management measures). For equipment encountering saturated soils or groundwater,

cleaning with a steam cleaner or pressure washer should be performed on the portions of the equipment in contact with the saturated soil or groundwater.

If equipment contacts contaminated soil or groundwater, equipment decontamination will be performed in a contained area with the means to contain and collect decontamination rinsate. Decontamination water, if generated, will be containerized, sampled, and properly recycled/disposed. The use of water for decontamination will be minimized to the extent reasonable. Use of solvents to decontaminate equipment or use of petroleum products to prevent soil from adhering to the excavation equipment will not be allowed.

4.3. Contingency Measures for Previous Unidentified Suspect Soil

Contingency measures will be implemented if previously unidentified suspected chemically-affected soil is identified during Site excavation as described in Section 5.8. Additionally, the Owner and Engineer/Consultant shall be notified prior to implementation of this contingency measure. After review of Site conditions, field inspections, and any analytical testing, future work pertaining to the suspect soil or condition will be conducted by properly trained personnel. Owner and Engineer/Consultant will notify Contractor(s) should previously unknown conditions are discovered, and Contractor(s) will determine if additional or different measures or training included in the HASP are required in accordance CCR, Title 29, Part 1910.120 Hazardous Waste Operations and Emergency Response (HAZWOPER) standards.

4.4. Spill Response Procedures

In the event of a release of hazardous material or waste to the surface during construction or ground-disturbing activities, such as a fuel release associated with construction equipment, the following spill response procedures will be implemented: (1) Evacuate all on-site personnel to a designated assembly area in an upwind direction until the Site safety officer determines that it is safe for work to resume, (2) Contain the spill, if it is possible and it can be performed safely, and (3) Immediately notify the appropriate emergency contacts (the current contacts are shown below). The Owner's emergency contact will subsequently notify the appropriate regulatory agency(ies).

4.5. Emergency Contacts

Current emergency contacts for the Site are shown below:

Emergency Response Services	
Local police, fire and rescue services	911
Emergency response	911
City of Livermore	

Project Inspector (First)	TBD
Construction Inspection Manager (Second)	Mike Stamm (925) 960-4500 mgstamm@cityoflivermore.net
Project Manager (Third)	Joel Waxdeck (925) 960-4500 jhwaxdeck@cityoflivermore.net
Engineer/Consultant	Bob Clark-Riddell (510) 435-8664; (510) 836-3700 briddell@pangeaenv.com
Certified Unified Program Agency	
CUPA	(510) 567-6700; dehalamedacers@acgov.org

4.5.1 Twenty-four (24) Hour Notification

The Owner will be notified within 24 hours of discovery if any of the following potentially hazardous conditions are encountered:

- Spills or releases of hazardous substances or petroleum hydrocarbons to soil or water that are considered, based on best professional judgement and/or physical evidence (including but not limited to olfactory, visual, field instrument, and lab data), to be an immediate threat to human health and the environment; and/or
- Discovery of unknown conditions (underground storage tanks, sumps, vaults, piping, etc.) or newly found contamination.

In the event of the discovery of underground storage tanks (USTs), vaults, hoists, or pipelines, the SFRWQCB or the Alameda County Department of Environmental Health (ACDEH) Certified Unified Program Agency (CUPA) must also be notified within 24 hours of the discovery.

4.5.2 Agency Notification

In addition to the Owner and ACDEH CUPA notification requirements discussed above, other agency notifications may be required. Contact information for other agency notifications that may be required is provided below.

Conditions Posing an Immediate Threat. For life-threatening or serous hazardous materials incidents, the following number will be contacted immediately upon discovery.	
Local police, fire and rescue services	911
Releases to Water. For spills or releases of hazardous substances or petroleum hydrocarbons to surface water, the following agencies will be contacted immediately upon discovery.	

National Spill Response Center	(800) 424-8802
United States Coast Guard – San Francisco Sector (if spill is going to reach navigable waters)	(415) 399-3547
California Office of Emergency Services	(800) 852-7550; (916) 845-8911
California Regional Water Quality Control Board – San Francisco Bay Region	(510) 622-2300
Local Emergency Response Agency	911
Stormwater/Sewer Discharges. For questions relating to permitted discharges to the storm drain or sanitary sewer.	
Livermore Water Resources Division	(925) 960-8100 (M-F 8-4PM) (925) 960-8160 Outside Business Hours
VOC-Impacted Soil. If VOC-impacted soil is discovered during Site grading activities, the following agency will be notified.	
Bay Area Air Quality Management District (BAAQMD)	(415) 749-4999
Dust Complaints. For dust complaints during ground disturbing activities, the following agencies will be notified.	
City of Livermore, Project Inspector	TBD
BAAQMD	(415) 749-4999

4.6. Record Keeping & Reporting Requirements

All soil excavation, groundwater removal, disposal and import activities will be documented in daily field reports by the Contractor and/or Engineer/Consultant and will be kept at the Site during Contractor work. Documentation will include at a minimum the following, as applicable:

- **Soil Handling and Excavation** – Description of soil disturbance area, volume of excavated soil, soil segregation and characterization, volume of any stockpiled or contained soil, management method of soil (e.g., stockpiled and covered with plastic sheeting, stored in bins, etc.), dust suppression methods, and offsite disposal;

- **Groundwater** – Description of groundwater that is removed and stored, volume of extracted groundwater, management method of water (e.g., stored in aboveground tank, 55-gallon DOT-approved drums, etc.), and offsite disposal;

- **Underground Structures** – Type, contents, characterization, and destination (e.g., abandoned in place, disposed of offsite, etc.);

- **Imported Soil** – Origin, volume, characterization, and destination (location on Site), and documentation regarding import soil quality (e.g., analytical data, source certification, etc.);

- **Offsite Disposal Records** – Date, time, trucking company, driver and vehicles used for the trip, equipment decontamination and tarping, waste/material type, volume, copies of bills-of-lading, and hazardous waste manifests;

- **Dust Complaint Logs** – Time, name and contact information, compliant description, earthwork activities associated with complaint, and measures taken to mitigate dust; and,

- **Analytical Reports** – Copies of waste characterization laboratory analytical results.

Following completion of the work covered by this SMP, Contractor will provide relevant documentation to the Owner/Developer in a completion report.

5.0 SOIL AND WATER MANAGEMENT PROCEDURES

Based on the documented environmental impacts at the Site, there remains a small potential for encountering unanticipated soil impacts onsite, even in areas considered uncontaminated. These soil management protocols are intended to facilitate protection of human health and the environment from chemicals that may be discovered in soil within the project area. Soil determined to be contaminated will be managed in accordance with applicable regulations, health and safety requirements, and the procedures described in this SMP. Soil management protocols generally involve notification and characterization of the nature and extent of potential soil impacts within the limits of proposed work, soil excavation, stockpile management, characterization, transportation, and disposal. Soil and groundwater handling procedures to be followed during future ground-disturbing activities are summarized in the following sections.

5.1. Site Development Scope

The planned development of the Site includes the construction of two multi-story, multi-family residential structures over subterranean garages. Building A (North Building) is planned to have a subgrade garage beneath the building footprint to a total depth of 10-20 ft bgs with an area of approximately 24,295 ft^2. Building B (South Building) is planned to have subgrade garage beneath the building footprint to a total depth of 9 ft bgs with an area of approximately 16,731 ft^2. Grading in the planned "Veteran's Park", which is approximately 31,165 ft^2 per developer plans, will be completed to a depth of approximately 2 ft bgs. The HHRA found that based on planned development of the subterranean garages and multi-family residential structures, including the podium-type construction, the inter-unit transfer rate between the garage and first floor, and HVAC and garage ventilation systems, the Site development will be protective of human health. The garage floorplans with ventilation and elevation profiles for Buildings A and B are presented in Figure 7 and 8, respectively. The conceptual model for the Veteran's Park area is presented in Figure 9.

This SMP applies to the planned development scope, and any future scope of work at the Site that includes soil disturbance.

5.2. Soil Handling

During any excavation, when handling soil, health and safety protocols will be followed, including all applicable federal, state, and local regulations and codes relating to health and safety and all sections of Cal-OSHA regulations contained in CCR Title 8 (see Section 3.0). Additionally, dust control and monitoring measures will be followed in accordance with Cal-OSHA and BAAQMD requirements (see Section 5.6). If any soil is encountered that exhibits physical evidence of environmental impacts (e.g., staining, sheen, or odors), Contractor will notify the Owner (see Section 3.3) and follow procedures specified in the HASP and this SMP (Section 5.9). Such soil will be segregated for characterization and

off-site disposal using appropriately trained personnel and appropriately-licensed contractors. If offsite removal of stockpiled material is required, the procedures described in Section 5.5 will be implemented.

5.3. Soil Stockpiling

Soil management will typically involve temporary stockpiling near the excavation locations to facilitate such activities as testing, loading, and off-site disposal. The Contractor will prepare and maintain excavation staging facilities for stockpiling of excavated material. Excavated soil will be temporarily stockpiled on 10 mil Visqueen or similar plastic sheeting and protected as necessary from the adverse effects of rainfall (runoff) and/or wind (dust), by covering with plastic sheeting, or equivalent, when not in use for a period of one hour or longer. For utility trench excavation, soil may be stockpiled in long stockpiles adjacent the utility trenches. All soil stockpiles will be watered, as needed, and securely covered with a suitable tarp to prevent wind erosion and dust generation. To limit public access to stockpiled soil, stockpiled soil areas will be fenced or otherwise protected and will be located in a contained area with no direct connection to storm drains. Soil and stockpile management will be performed in accordance with dust control and storm water management practices and will be consistent with all applicable rules and regulations, as described in Sections 5.6 and 5.10.

5.4. Excavation Backfilling

Non-hardscaped areas will contain two feet of clean soil covering the existing soil. Soil below the top two feet of existing ground surface is anticipated to be suitable for reuse on site, as describe below.

5.4.1 On-Site Soil Reuse

Soil excavated during ground-disturbing activities will be stockpiled per Section 5.3. The Contractor shall coordinate sampling and analytical testing of stockpiled soil prior to reuse or off-site disposal, consistent with project documents. Absent indication of suspected chemical impact, soil excavated below a depth of 24 inches may be reused at a similar depth or deeper without sampling and analytical testing. Contractor shall notify Owner of areas where soil reuse is planned or was conducted, and shall record the quantity of soil reused. Where practicable, reused soil shall be reused near its original excavation location (e.g., within the same utility trench at the same depth).

5.4.2 Soil Import

If there is a need to import soil to the Site, a Soil Import Plan must be prepared by the contractor and submitted to the SFRWQCB. The processes to identify potentially suitable import sources and conduct sampling and analysis of those sources will be in accordance with the 2001 DTSC Information Advisory-Clean Fill Material (DTSC 2001). The criteria to be used for evaluating the testing results will be developed in accordance with the SFRWQCB Draft Imported Fill Material Definitions (Appendix E). For soil, topsoil, and rock imported from a commercial facility, the facility will provide documentation representing the

quality and any available analytical data for the imported material. Any rock used the Site will be of virgin quality.

5.5. Off-Site Soil Disposal

Should soil deposits exhibiting potential contamination be encountered during soil disturbing activities, characterization and potential waste profiling activities may be initiated. Sampling and analysis may be performed to characterize potential soil contamination and profile materials for potential offsite disposal, as required by the receiving facility. It is anticipated that approximately 6% percent of Site soil (i.e., 2,466 tons) will be exported for off-site disposal to a Class 2 landfill.

The Contractor will coordinate sampling and analytical testing of stockpiled soil prior to off-site disposal. For bidding purposes, the Contractor shall assume, unless otherwise instructed, that all off-site soil disposal will be at a Class II facility. Depending on available Site information, field observations of suspected contamination, and professional judgment, samples may be analyzed for the following constituents:

- Title 22 metals.
- Waste Extraction Test (WET).
- Toxicity Characteristic Leaching Procedure (TCLP).
- Total Petroleum Hydrocarbons (TPH).
- Volatile organic compounds (VOCs).

Following acceptance of the excavated soil at an appropriate-licensed disposal facility, the soil will be loaded in licensed haul trucks (e.g., end-dumps or transfers) and transported off the Site following appropriate California and Federal requirements. Haulers licensed for commercial transportation will transport non-hazardous wastes and haulers licensed in accordance with 49 CFR 171-179 will transport hazardous waste.

The appropriate waste manifest documentation will be provided to truck drivers hauling the affected soil off-site. Transportation equipment will be chosen to safely transport the expected volumes of soil, taking into consideration the types of roads to be traveled and their loading capacity. Routine truck maintenance and repairs will be performed at the Contractor's premises prior to picking up loads of waste material from the Site.

As each truck is filled, an inspection will be made to verify that the waste soil is securely covered, to the extent practicable, and that the tires of the haul trucks are reasonably free of accumulated soil prior to leaving the Site. During loading, dust and odor emissions will be monitored and mitigated as necessary. During transportation, the hauling trucks will be equipped to fully cover all soil and debris, such as with a

heavy tarpaulin. A street sweeper will be made available, as needed, to keep the loading area clean. The soil will be wetted, as necessary, to reduce the potential for dust generation during loading and transportation activities.

A detailed log of the loads hauled from the Site will be maintained. The log will include, at a minimum, the date and the time trucks were loaded and off-loaded, the destination, size (volume and weight) of the load, description of contents, name and signature of the hauler, and name and signature of the Contractor's representative. The waste will be off-loaded for treatment or disposal in a manner consistent with current Federal, State, and local regulations. Shipments of hazardous waste will be tracked with the appropriate hazardous waste manifests.

All transportation activities will be performed in strict compliance with all regulations and ordinances. Hauling contractor(s) used to transport non-hazardous or hazardous waste will be fully licensed and permitted by the State of California. For hazardous waste haulers, the selected transportation company will be certified by the State of California as a hazardous waste hauler, and appropriately permitted to haul contaminated waste material. All Department of Transportation (DOT) and California Highway Patrol (CHP) safety regulations will be strictly followed by both hazardous and non-hazardous waste haulers.

Transportation routes will be developed to minimize transporting the affected soil through residential areas. The affected soil will be transported via surface streets to the closest suitable freeway.

5.6. Erosion, Dust, and Odor Management Measures

Workers at the Site may need to disturb soil in areas where residual organic chemicals (e.g., petroleum hydrocarbons) and naturally occurring metals (e.g., arsenic, lead, and/or nickel) at concentrations above ESLs or background are present. To mitigate the potential emission of fugitive dust during soil disturbing activities, dust control practices may be implemented to minimize the occurrence of visual dust at the perimeter of the construction zone. The dust and odor management measures provided herein are designed to minimize potential exposures to residual organic chemicals and/or naturally occurring metals in dust.

Emission (dust and odor) control measures will at a minimum comply with those established by OSHA and the BAAQMD for construction-related activities. Erosion, dust, and odor control measures will be based on "Best Management Practices (BMPs)" and will be used throughout all phases of construction.

5.6.1 Dust Control

Chemicals identified in soil at the Site include petroleum hydrocarbons and naturally occurring metals (e.g., arsenic, lead, and nickel). When earthwork activities occur, dust control measures must be implemented to minimize dust generation, as recommended by the BAAQMD, and other best management practices may be undertaken. Engineering controls are the preferred methods of controlling on-site and off-site exposures

to dust generated through ground-disturbing activities. Additional dust control measures may be required by the project specifications.

5.6.2 Minimum Requirements for Dust Control

The generation of dust during ground-disturbing activities will be minimized and controlled through implementation of the following requirements based on BAAQMD California Environmental Quality Act Guidelines (BAAQMD 2017), at a minimum, so that no visible dust will be generated during the ground-disturbing activities at the Site:

- Have a water supply available on-site at all times to mist or spray water while excavating, stockpiling, and/or loading soil onto transportation vehicles;
- Control excavation activities to minimize dust generation;
- Keep drop heights to a minimum while loading transportation vehicles;
- Cover soil stockpiles and/or soil bins when not actively adding to or subtracting from the pile and at the end of each day.
- Cover all haul trucks transporting soil, sand, or other loose material off-site;
- Limit all vehicle speeds on unpaved roads to 15 miles per hour (mph);
- Minimize idling times either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure CCR Title 13, Section 2485). Clear signage will be provided for construction workers at all access points; and,
- Maintain all construction equipment in accordance with manufacturer‘s specifications. All equipment will be checked by a certified mechanic and determined to be running in proper condition prior to operation.

To prevent dirt-truck out and dust generation off-site the following is required:

- Maintain rumble strips near exits onto public roads to minimize the potential for track-out.
- Remove all visible mud or dirt track-out onto adjacent public roads, if present, using wet power vacuum street sweepers. Dry “kick-broom” style street sweepers shall not be used.

5.6.3 Contingency Requirements for Dust Control

No visible dust will be permitted during Site preparation, soil excavation, or excavated soil stockpiling or loading. If visible dust is observed during ground-disturbing activities, the Contractor will be required to immediately cease all dust generating activities until alternative dust control measures acceptable to Owner

are implemented. If visible dust is observed, the following additional dust-control measures will be performed:

- Increase the magnitude of dust control measures;
- Increase the frequency of implementation of dust control measures; and/or,
- Use Engineer-approved dust suppressant additives in the water.

5.6.4 Excessive Watering

Except where specifically approved by the Engineer/Consultant, the dust control methods which result in ponded water or surface erosion will not be performed.

5.6.5 Odor and Vapor Suppression Measures

The dust control measures will help suppress odor and vapor emission. The water spray used to control dust will reduce the emissions of any potential volatiles that may be present in the soil. Stockpile covering with plastic sheeting will minimize odor and vapors. If odor is excessive and vapor emissions are detected, some or all of the following mitigation procedures may be implemented:

- Use of chemical suppressants mixed with water and applied using various applications such as spray or mist;
- Use of plastic sheeting to cover the sidewalls of the trench during non-active activities;
- Alternative work sequencing, such that excavation of soil with potential odor during mid- day or afternoon (during hot weather) is avoided;
- Any highly odorous soil could be segregated and placed inside a roll-off bin equipped with a lid. This will minimize the amount of highly odorous soil during loading; and,
- Balancing the excavation with transportation so that the need for large stockpiles is reduced.

Other emissions include exhaust from Site equipment. Equipment will be maintained properly so that exhaust emissions will be within acceptable standards.

5.7. Dust and Odor Monitoring

Dust monitoring will be conducted adjacent to the earthwork activities and along the downwind perimeter of these activities. The dust standard will be based on the PM_{10} ambient air quality standards adopted by BAAQMD (BAAQMD 2017), which specifies a ceiling level of no more than 50 micrograms per cubic meter ($\mu g/m^3$) difference between upwind and downwind sampling locations. The ceiling level of 50 $\mu g/m^3$ represents the Bay Area 24-hour time-weighted average standard for 10-micron diameter particulate matter

(the PM_{10} 24-hour standard). An air exceedance is defined as a PM_{10} concentration of 50 µg/m^3 above the upwind baseline level for more than for 5 minutes along the perimeter, or for more than 15 minutes directly adjacent to the earthwork location. Should any visible clouds of dust be observed or at any time a PM_{10} reading exceeds 50 µg/m^3, soil will immediately be wetted with water, or otherwise suitably contained to prevent nuisance from dust. If perimeter readings exceed action levels, work will be stopped, engineering controls will be implemented, and the work will be adjusted until background levels are reached.

Dust monitoring will be conducted daily during any excavation activities at the Site using a portable dust meter. Perimeter dust monitoring for real-time PM_{10} concentrations will be conducted using a handheld respirable air monitor (TSI Sidepak™, Model AM520 or equivalent). Perimeter dust monitoring results will be recorded at the downwind property boundary at two locations and the upwind property boundary at one location. Wind direction and wind speed will also be monitored periodically throughout the day using a handheld digital anemometer.

Odor monitoring may be implemented, along with the specific health and safety requirements of the Contractor, based on the scope of the specific ground-disturbing activities to be conducted. If odor monitoring is implemented, the results of the monitoring should be used to evaluate the effectiveness of the odor control measures and determine the need for additional control procedures.

If either observations or measurements during perimeter air monitoring indicate the need for more stringent dust and/or odor control, the magnitude and frequency of the dust/odor control measures may be increased. Palliatives may be added to the dust control water as an engineering control.

5.8. Site Access and Security

Vehicle and personnel access will be controlled in areas where soil will be disturbed. Caution tape, cones, fencing, steel plates, or other measures will be used to clearly designate the active work area and to prevent access by the public. Stockpiles of excavated soil will be protected and secured by temporary fences or other means as necessary to prevent unauthorized access.

Site security fencing will include contact information in the event of community concerns or questions. The contact information will be as follow:

- (510) 334-4866 (24 hours a day, 7 days a week).
- Tracy Craig, tracy@craig-communications.com.

5.9. Unanticipated Subsurface Conditions and Contingency Measures

It is unlikely, but possible, that unknown, historical subsurface features and structures may remain at the Site. If present, these structures or features may be encountered during ground-disturbing activities. Unanticipated subsurface conditions may include, but are not limited to, the following items:

- Slabs and piping associated with former aboveground storage tanks;
- USTs;
- Concrete vault(s);
- Underground piping; or
- Chemically-impacted soil (e.g., with staining, sheen, or odor).

Whenever unanticipated conditions are encountered, Contractor(s) will stop work in that area, secure the work area, and evaluate the situation before any further action is taken. The Contractor will notify the Owner/Developer and Engineer/Consultant if unanticipated subsurface conditions are encountered, and the Contractor will be responsible for notifying the appropriate agency, as necessary (see Section 4.5).

After review of Site conditions, field inspections, and any required analytical testing by Owner/Developer, Contractor, and Engineer/Consultant, future work pertaining to the suspect soil or condition will be conducted by properly trained personnel. This evaluation will determine if Contractor's personnel require training in accordance CCR, Title 29, Part 1910.120 HAZWOPER standards.

Suspect soil and materials will be segregated for characterization and off-site disposal using appropriately trained personnel and appropriately-licensed contractors.

5.10. Storm Water Management

Under the General Permit for Discharges of Storm Water Associated with Construction Activity (currently 2009-0009-DWQ as Modified by 2010-0014-DWQ and 2012-0006-DWQ; "General Permit"), storm water pollution controls are required at construction sites where the surface area of construction activities is greater than 1 acre in size, or for projects that disturb less than 1 acre but are part of a larger common plan of development that in total disturbs 1 or more acres. This project is part of a larger common plan and requires the Contractor to comply with the requirements of the Storm Water Pollution Prevention Plan (SWPPP) prepared for the project. The Construction General Permit requires that a SWPPP be developed by Qualified SWPPP Developers and that implementation of the plan be performed by Qualified SWPPP Practitioners (QSPs). If future ground-disturbing work at the Site falls within these categories, the Contractor(s) must file a Notice of Intent (NOI) to comply with the General Permit for earthwork activities disturbing greater than 1 acre of the Site.

Prior to mobilization, the Contractors must develop SWPPPs in accordance with the General Permit. Under those circumstances, storm water pollution controls will be implemented by the Contractor(s) and will be based on BMPs. BMPs will be installed and maintained in accordance with industry standard practices, such as those described in the California Stormwater Quality Association's (CASQA's) Storm Water Best Management Practice Handbook Construction. Regular inspections will be conducted by the Contractor's

QSP to maintain, adjust, and update the implemented stormwater pollution controls. Specific practices that may be implemented to reduce the sediment load of storm water runoff from the Site include grading the Site, installing storm water control devices (earth berms, silt fences, or other barriers) around the perimeter of unpaved portions of the Site until construction is completed, and protecting existing catch basins with silt fences or gravel bags. In addition, all contractors will store fuel and chemicals in such a manner that prevents accidental spills from impacting storm water (e.g., within secondary containment).

5.11. Water and Liquid Management

Contractor will implement procedures to limit the dermal contact by workers with any liquid or groundwater that collects in Site excavations. Given the Site groundwater depth of approximately 30-50 ft bgs, it is unlikely that Site excavation will extend into the saturated zone, where the presence of VOCs and petroleum hydrocarbons has been documented at some areas near the Site. Any surface water runoff or other water sources could come into contact with potentially contaminated soils (contact water). Preparations will be made to remove, store, characterize, and properly dispose of standing water from excavations and/or contact water during ground-disturbing activities such as excavation and soil stockpiling activities. BMPs will be installed to control and collect soils/liquids and prevent them from migrating outside of the designated areas.

Water will be managed in accordance with applicable regulations, health and safety requirements, and the applicable procedures described in this SMP. Appropriate precautions may include having an above-ground storage tank on Site to temporarily contain decontamination water, or groundwater/stormwater that may be removed from the excavation. Contained water or groundwater may be disposed off-site at an appropriate facility or through other arrangements, such as on-site following a prearranged disposal agreement (e.g., with the City of Livermore Water Resources Division). Prior to disposal, the water must be tested in accordance with requirements of the receiving facility. In the event that the dewatering effluent is to be disposed to the storm system, a permit (e.g., National Pollution Discharge Elimination System [NPDES]) from the Water Board will likely be required. Specific testing requirements and sampling frequency will be designated in the permit to discharge water. Water containing chemical concentrations exceeding applicable discharge limits may require pre-treatment to reduce contaminant concentration to comply with discharge limits. If pre-treatment is infeasible, then water may be collected into DOT-approved containers for offsite transport and disposal at an appropriate facility.

6.0 POST-CONSTRUCTION CONFIRMATION TESTING

This section describes post-construction testing that will be conducted to verify that (1) the planned multi-family parking garages function per code requirements and (2) conditions are consistent with site-specific conditions described in the agency-approved human health risk assessment (HHRA). The planned development at the Site includes construction of two multi-family residential buildings, each with underground parking garages. Both parking garages are required to comply with California Mechanical Code.

The HHRA evaluated human health risks associated with potential exposure to VOCs in soil gas via inhalation of indoor air under site-specific development and exposure conditions. As a conservative measure, the HHRA estimated risks assuming VOCs in the subsurface soil gas migrate to the indoor air of the garage (vapor intrusion) and that ten percent of the garage air migrates into occupied residential units. Indoor air concentrations of VOCs estimated in the HHRA were below the ESLs for residential air. For example, the PCE concentrations estimated in indoor air of the first floor residential unit in Building A (0.042 $\mu g/m^3$) and Building B (0.05 $\mu g/m^3$) are well below the ESL for residential air for the cancer endpoint (0.46 $\mu g/m^3$) and non-cancer endpoint (42 $\mu g/m^3$). Further, the HHRA concluded that estimated cancer risks are less than (safer than) one in a million and non-carcinogenic hazard less than (safer than) the threshold of one. Thus, estimated risks are at levels considered by CalEPA and EPA to be protective of human health.

6.1. Confirmation Objective

The objective of post-construction confirmation testing is to verify the results of the HHRA and thus, that occupancy of the multi-family residential units is protective of human health. To meet this objective, the as-built building system components, design, system performance and operation will be reviewed to confirm they are operating in accordance with the California Code requirements, will prevent soil gas from entering the occupied residential units and are consistent with the site-specific assumptions used in the HHRA.

In addition, indoor air samples will be collected in the garages. The results of indoor air testing in the garage will be compared to a screening level equivalent to ten times the ESL for residential air, based on the agency-approved assumption that ten percent of the garage air could migrate into the occupied residential units on the overlying first floor. The initial garage indoor air sampling will be conducted prior to occupancy to verify that site conditions are protective of human health. A subsequent sampling event will be conducted approximately 6 months after the initial sampling event to evaluate the potential influence of seasonal variability.

6.2. Building System Components and Design

The risk assessment for the proposed development was performed assuming the following design of the subgrade garage system components:

- **Footprint:** Building A (North Building) has a planned garage footprint of approximately 24,295 ft^2 that entirely extends across the footprint of the overlying building floors. Building B (South Building) has a planned garage footprint of approximately 16,731 ft^2 that entirely extends across the footprint of the overlying building floors.

- **Depth:** Building A (North Building) involves excavation to a total depth of approximately 10-20 ft bgs. Building B (South Building) involves excavation to total depth of approximately 9 ft bg.

- **Ceiling Height:** Building A (North Building) ceiling heights range from 12-22 ft. Building B (South Building) ceiling height is 11 ft.

- **Structural Sections:** The subgrade garages will be comprised of 6-inch concrete slab foundation at bottom of garage. Other structural sections may also include, beginning from the bottom of the construction excavation, and proceeding vertically to the boundary between the garage and the first floor of the building: 4-inch gravel rock base; Class B vapor retarder (e.g., moisture barrier) complying with ASTM E1745 and E1643; 12-inch concrete slab foundations at elevator pits and the Building A (North Building) parking pit; and a 13-inch concrete ceiling/floor slab between garage and first floor.

Ventilation System: Underground parking structures are required to meet the California building codes for ventilation and pressure. The codes were established to limit buildup of chemicals associated with vehicle exhaust (in particular, carbon monoxide) and prevent air in the garage from migrating into residential units. The 2019 California Mechanical Code (Chapter 4, Section 403.7) mandates a ventilation rate of 0.75 cubic feet per minute per square foot (cfm/sf^2). However, the California Energy Commission allows a lower ventilation rate (0.15 cfm/ft^2) in garages when the system includes approved sensors which measure carbon monoxide (CO) levels in the garage increase ventilation when a specified level is reached (California Energy Code Chapter 4 [3.3]). Both the California Mechanical and California Energy codes require that garages maintain negative or neutral pressure relative to other occupiable spaces in order to prevent any air in the garage from migrating into those spaces. The garage ventilation system will operate at negative pressure, further preventing air in the garage from migrating into the occupiable floors above.

Buildings A and B garages will be designed to meet or exceed the minimum ventilation rates (0.15 cfm/ft^2) required in the California Energy Code. At this time, it is anticipated that the system will typically operate at 0.15 cfm/ft^2; however, in accordance with the California Energy Commission's Guidance *Enclosed Parking Garages* (CEC 2019), greater ventilation will be deployed when the CO sensors are triggered. The

system has been designed to achieve ventilation rates up to and including the levels required in the California Mechanical Code (0.75 cfm/ft^2) when necessary. Thus, it is anticipated that the average ventilation rate will be greater than the minimum levels established by the California Energy Commission on most days. To be conservative, the HHRA used air exchange rates (AERs), a measure of the air volume removed from the garage in one hour, corresponding to the minimum ventilation rate of 0.15 cfm/ft^2. For comparison, risks were also estimated using a range of AERs between 0.7 to 4 exchanges per hour (corresponding to ventilation rates between 0.15 and 0.75 cfm/ft^2). The Building A Garage HVAC layout and elevation profile are presented in Figure 7, while the Building B Garage HVAC layout and elevation profile are presented in Figure 8.

6.3. Building System Performance and Operational Parameters

As discussed above, the garages for Buildings A and B will be designed to meet or exceed the minimum ventilation rates (0.15 to 0.75 cfm/ft^2) required in the building codes. Current features designed to meet this objective for each building are described below.

The current Building A garage design includes two blowers operating to ventilate the garage. A blower located in the southwest area of the garage and a blower in the east area of the garage are designed to meet or exceed the minimum required ventilation rates. Garage exhaust make up air will be provided by the open drive entrance with a minimum free area of 42.5 ft^2. Standard operation of the blower will result in an AER for the Building A garage of 0.7 to 3.3 (Exponent 2022). The locations of the blowers are shown in the Site Garage Plan for Building A (Figure 7).

The current Building B garage design includes one blower operating to ventilate the garage at, or above the minimum required rate. Garage exhaust make up air will be provided by the open drive entrance with a minimum free area of 30 ft^2. Standard operation of the blower will result in an AER for the Building B garage of 0.8 to 4.1 (Exponent 2022). The location of the blower is shown in the Site Garage Plan for Building B (Figure 8).

All garage blower motors will be controlled with a variable frequency drive (VFD) that allows for adjusting the motor speed and blower flowrate. The VFDs will adjust based on input from CO monitors installed near each of the VFDs. The CO monitors will provide real-time monitoring of CO in the garage air. The blower will regularly operate at the standard 0.15 cfm/ft^2 when CO in the garage is less than 15 ppmv, will increase by at least 50% for a CO sensor reading between 15 and 25 ppmv, and will increase by at least 100% from standard operation for CO sensor readings above 25 ppmv.

6.4. Confirmation Testing and Reporting

Confirmation testing will consist of indoor air sampling in each of the Building A and B garage spaces for PCE under HVAC-on and HVAC-off conditions. As discussed previously, PCE is the primary risk driver and COPC detected at the Site. All other PCE breakdown product concentrations were either not detected or detected below their respective residential ESLs.

The first confirmation testing event will be performed prior to building occupancy to confirm that based on the design of the residential project, including subsurface garage, vapor intrusion would not pose a risk to future occupants. Sampling will be performed following a 30-day period of equilibration in the garage air following completion of garage construction, per SFRWQCB recommendations. The equilibration period will follow completion of the exterior building construction, and can coincide with the completion of interior construction. Following the receipt of the pre-occupancy confirmation testing event results verifying this objective, building occupancy will proceed. A second confirmation testing event will be performed to verify the results of the initial testing event, while also accounting for changes in atmospheric conditions due to seasonality. This semiannual testing will be performed again in the following year to demonstrate repeatability and consistency of the results. These subsequent testing events will be performed at the same locations as the first testing event. See below for a summary of the sequence of testing events.

Testing Event	Timing
First	Pre-Occupancy – 30 days following garage construction
Second	Post-Occupancy – 6 months following the first sampling event
Third	Post-Occupancy – 12 months following the first sampling event
Fourth	Post-Occupancy – 18 months following the first sampling event

Each testing event will consist of collecting ambient air samples as well as representative samples within the building garages, first with the HVAC system off, then with the system running. Five air samples will be collected in Building A and four samples will be collected in Building B at breathing height in each garage per SFRWQCB and New Jersey Department of Environmental Protection guidance (NJDEP 2018). These samples will be sufficient to characterize the air in the common HVAC zones within each garage. Though not anticipated, additional samples may be warranted depending on final construction components (e.g., presence of multiple HVAC zones, presence of grade beams, walls, etc.). The garage air samples will be collected in locations near features that provide a potential pathway to upper floors (e.g., utilities,

stairwells, and elevator shafts), preferentially away from ventilation intakes and sources of garage make up air. Garage sampling locations will be finalized in the field.

Three ambient air samples will be collected during each event from the upwind side of the buildings, in a secure location, away from known soil gas impacts, and at an elevation of approximately 6-feet above the ground. Sampling locations will be finalized in the field.

Standard operating procedures for indoor air sampling are provided in Appendix F and will follow DTSC's "*Final Guidance for the Evaluation & Mitigation of Subsurface Vapor Intrusion to Indoor Air*" (VIG) October 2011 (DTSC, 2011a). Samples will be collected over a period of 24-hours, before and after activation of the HVAC system. Samples will be transported to an accredited laboratory. Indoor garage air samples will be analyzed for PCE using EPA Method Toxic Organics 15 (TO-15 Select Ion Monitoring).

To confirm site conditions are protective of human health, the results of indoor air testing will be compared to trigger levels. For the garage, the trigger levels are equivalent to ten times the ESL for residential air, based on the agency-approved assumption that ten percent of the garage air could migrate into the occupied residential units on the overlying first floor. For PCE, the screening level for garage indoor air is 4.6 $\mu g/m^3$.

The results of each test will be presented in a letter report addressed to the SFRWQCB and uploaded to Geotracker. Each report will present the procedures followed, sampling locations, conditions of each sampling event (e.g., HVAC system operation), and results of the test. If contingency measures were employed, as described in Section 6.5, a written description of the contingency measures taken and results of subsequent testing will be provided in the report.

Indoor air testing may be discontinued if any one of the following conditions is identified in conjunction with the confirmation testing, soil vapor testing referenced in Section 2.4.2, or otherwise, following written approval by the SFRWQCB:

- There is no current VI exposure risk above trigger levels.
- Subsurface VOC source zones have been remediated to the extent feasible.
- Multiple lines of evidence support that residual subsurface contamination will not pose a future vapor intrusion risk.
- No other changes in the conceptual site model are expected that would increase the future vapor intrusion risk (e.g., subsurface VOC concentrations are stable or decreasing).

Request to discontinue testing will be provided in writing to the SFRWQCB.

6.5. HVAC System Maintenance, Inspection, and Recordkeeping

It is anticipated that the Developer will operate the HVAC system as indicated in Sections 6.2 and 6.3, and in compliance with the codes referenced in Section 6.2. It is also anticipated that the Developer will maintain the HVAC system in accordance with the manufacturer's recommendations and general industry standards. The HVAC system will be inspected on a schedule to be prepared by the Developer. At minimum, the garage HVAC systems will be inspected annually for five years following the first confirmation testing event. The HVAC inspections will include the following:

- An acknowledgement that the HVAC system has continued to operate consistent with the operations anticipated in this SMP.
- Identification and description of any planned or unplanned interruptions in the operation of the HVAC system.
- Identification and description of any repairs and/or modifications to the HVAC system.

These annual HVAC inspections will be reported to the SFRWQCB and logged in the HVAC system maintenance logs.

6.6. Contingency Measures

Based on the planned building design and the results of the HHRA, it is not anticipated that chemical concentrations in the garage will exceed the trigger levels. Thus, when concentrations of PCE detected in indoor air samples are below trigger levels, occupancy of the residential units would be deemed protective of human health. However, contingency measures have been identified in the event that concentrations reported in garage air exceed the applicable trigger levels.

6.6.1. Verify Indoor Air Sampling Results

For sample results that exceed the trigger levels, these locations will be resampled under similar conditions. If the results from resampling do not exceed the trigger levels, no additional samples will be collected, nor will additional contingency measures be employed. If the initial sample result is confirmed by a follow-up sample, the contingency measures identified in Sections 6.5.3 and 6.5.4 may be implemented.

6.6.2. Pressure Differential Testing

Following a retesting result that exceeds the trigger value, pressure differential testing between the occupied first floor and the garage will be performed. The test will be run with the HVAC systems operating. The pressure differential will be assessed to confirm air flow conditions between the garage space and the occupied first floor meet building code and therefore operate at negative or neutral pressure. This testing

will confirm that the overlying occupied spaces will not be affected by air from the garage. If the test result shows that there is potential for air flow from the garage to the occupied first floor of the building, the HVAC system will be adjusted to manage indoor air in the garage per Section 6.5.4.

6.6.3. HVAC Modifications

The HVAC system can be adjusted to increase the AER in the garage. Motors installed for the HVAC system will include variable frequency drives to allow for the adjustment of the blower rate.

6.6.4. Other Contingency Conditions

Additional conditions may affect VOC migrating from soil gas to indoor air in the garage. Conditions that lead to the HVAC system not operating (e.g., power outages) or compromise the integrity of the foundation (e.g., earthquakes) have the potential to increase soil gas intrusion in the garage.

As discussed in Section 6.4, confirmation sampling events will be performed with the HVAC system off. The results of samples collected while the HVAC system is off will be analyzed to assess PCE in indoor air in the scenario that the HVAC system becomes incapacitated. This scenario is likely to be of a short duration, and therefore does not represent a significant risk. If PCE exceeds the trigger value with the system off, additional mitigation measures may be incorporated into the design, including emergency generators to operate the HVAC systems.

In an event (e.g., an earthquake) that may affect the integrity of the garage foundation, an inspection will be performed. The garage floor will be inspected for cracks. Cracks in the slab will be sealed to limit vapor intrusion from soil gas into the garage. Additional indoor air sampling may be performed to confirm no increase in PCE migration from soil gas to indoor air in the garage.

7.0 SCOPE, REPRESENTATIONS, AND LIMITATIONS

This SMP was developed exclusively to manage worker exposure to residual chemicals (i.e., metals, petroleum hydrocarbons, and VOCs) in soil, soil vapor, and groundwater at the Site during ground-disturbing activities. This SMP has also been developed to protect future tenants of the proposed development following post-construction confirmation testing.

This SMP does not address issues related to other chemicals or media that may be encountered during construction or other activities including, but not limited to, demolition and construction debris, asphalt, concrete, asbestos-containing building materials, lead-based paint, or any chemicals brought on-site by workers. If such materials are encountered during a project, each Contractor is responsible for complying with all applicable laws pertaining to the handling and disposal of these materials.

This SMP does not address issue related to chemicals that may be encountered in, or released from, materials used in the construction of the future development. It is the developer's responsibility for complying with all applicable laws pertaining to the communication of any hazards associated with these materials.

This SMP is based on current known Site conditions and current laws, policies, and regulations as of publication in February 2022. No representation is made to any present or future developer or Owner of the Site or portions of the Site with respect to future Site conditions, other than those specifically identified within this plan.

8.0 REFERENCES

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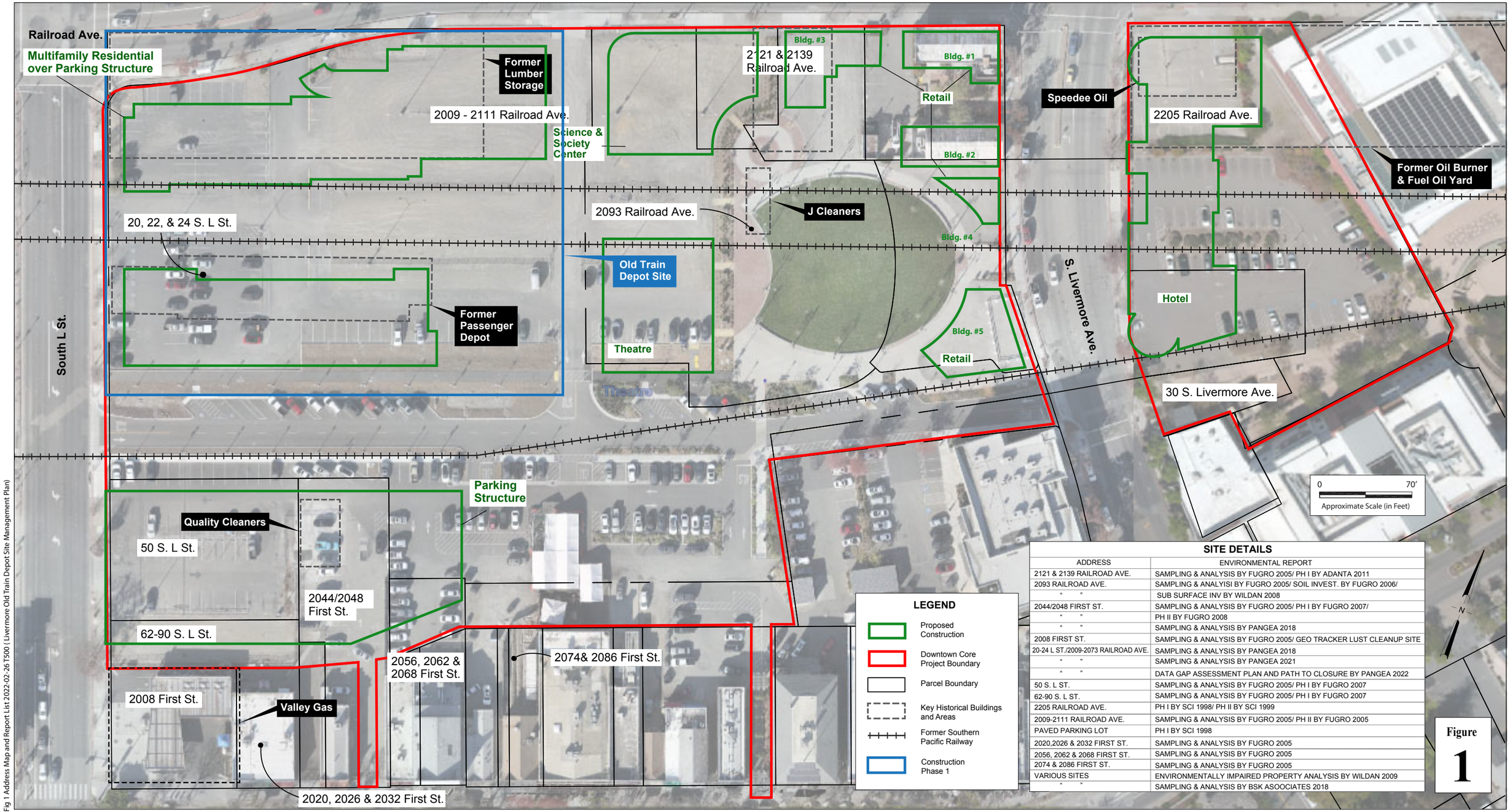


SITE DETAILS

ADDRESS	ENVIRONMENTAL REPORT
2121 & 2139 RAILROAD AVE.	SAMPLING & ANALYSIS BY FUGRO 2005/ PH I BY ADANTA 2011
2093 RAILROAD AVE.	SAMPLING & ANALYISI BY FUGRO 2005/ SOIL INVEST. BY FUGRO 2006/
" "	SUB SURFACE INV BY WILDAN 2008
2044/2048 FIRST ST.	SAMPLING & ANALYSIS BY FUGRO 2005/ PH I BY FUGRO 2007/
" "	PH II BY FUGRO 2008
" "	SAMPLING & ANALYSIS BY PANGEA 2018
2008 FIRST ST.	SAMPLING & ANALYSIS BY FUGRO 2005/ GEO TRACKER LUST CLEANUP SITE
20-24 L ST./2009-2073 RAILROAD AVE.	SAMPLING & ANALYSIS BY PANGEA 2018
" "	SAMPLING & ANALYSIS BY PANGEA 2021
" "	DATA GAP ASSESSMENT PLAN AND PATH TO CLOSURE BY PANGEA 2022
50 S. L ST.	SAMPLING & ANALYSIS BY FUGRO 2005/ PH I BY FUGRO 2007
62-90 S. L ST.	SAMPLING & ANALYSIS BY FUGRO 2005/ PH I BY FUGRO 2007
2205 RAILROAD AVE.	PH I BY SCI 1998/ PH II BY SCI 1999
2009-2111 RAILROAD AVE.	SAMPLING & ANALYSIS BY FUGRO 2005/ PH II BY FUGRO 2005
PAVED PARKING LOT	PH I BY SCI 1998
2020,2026 & 2032 FIRST ST.	SAMPLING & ANALYSIS BY FUGRO 2005
2056, 2062 & 2068 FIRST ST.	SAMPLING & ANALYSIS BY FUGRO 2005
2074 & 2086 FIRST ST.	SAMPLING & ANALYSIS BY FUGRO 2005
VARIOUS SITES	ENVIRONMENTALLY IMPAIRED PROPERTY ANALYSIS BY WILDAN 2009
" "	SAMPLING & ANALYSIS BY BSK ASOCIATES 2018

Figure 1

Fig 1 Address Map and Report List 2022-02-26 T500 (Livermore Old Train Depot Site Management Plan)

Old Train Depot Site Management Plan
Livermore, California

PANGEA

Address Map and Report List

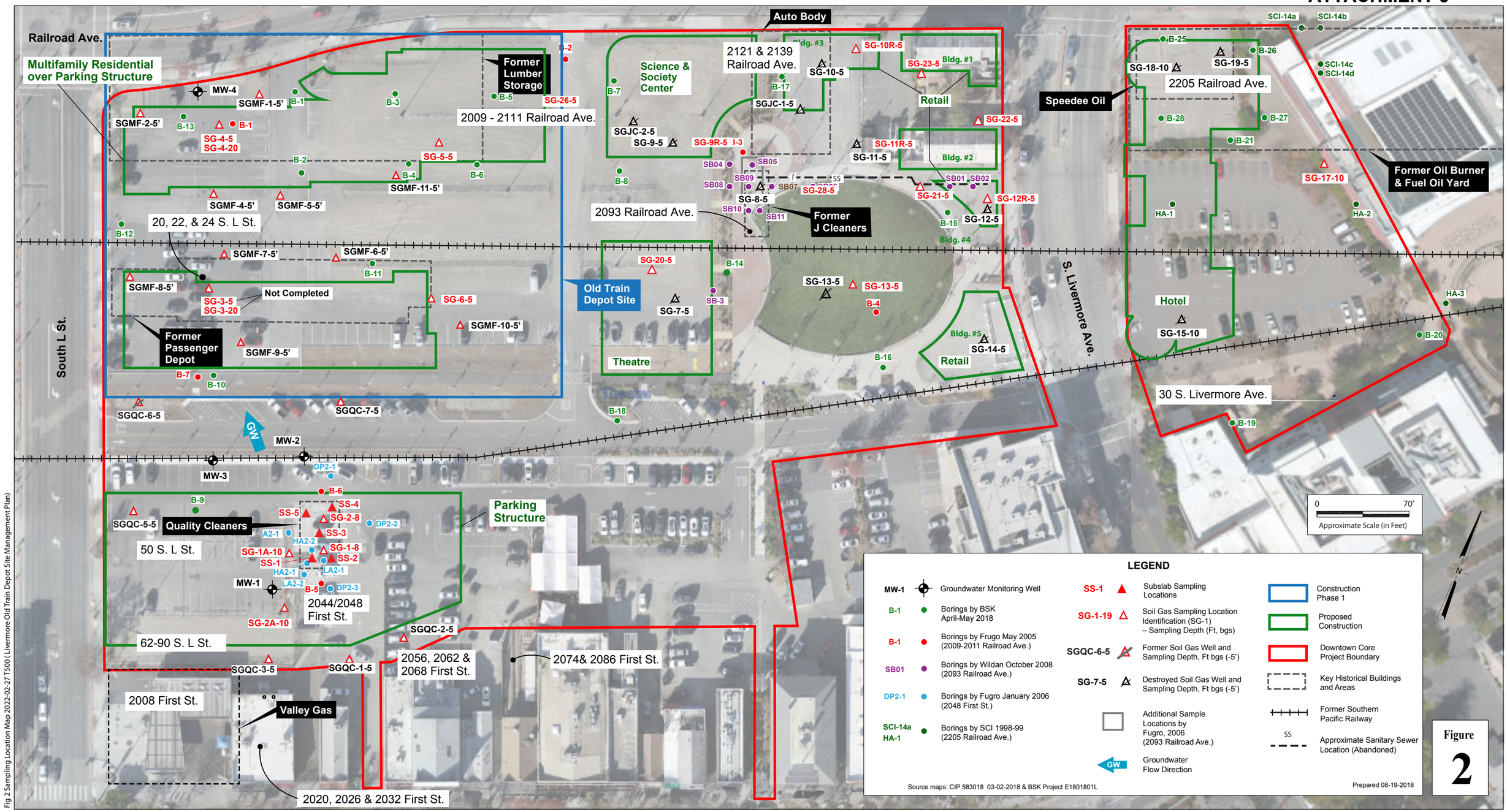


Figure 2

Fig 2 Sampling Location Map 2022-02-27 T500 (Livermore Old Train Depot Site Management Plan)

Old Train Depot Site Management Plan
Livermore, California

PANGEA

Sampling Location Map

ATTACHMENT 5

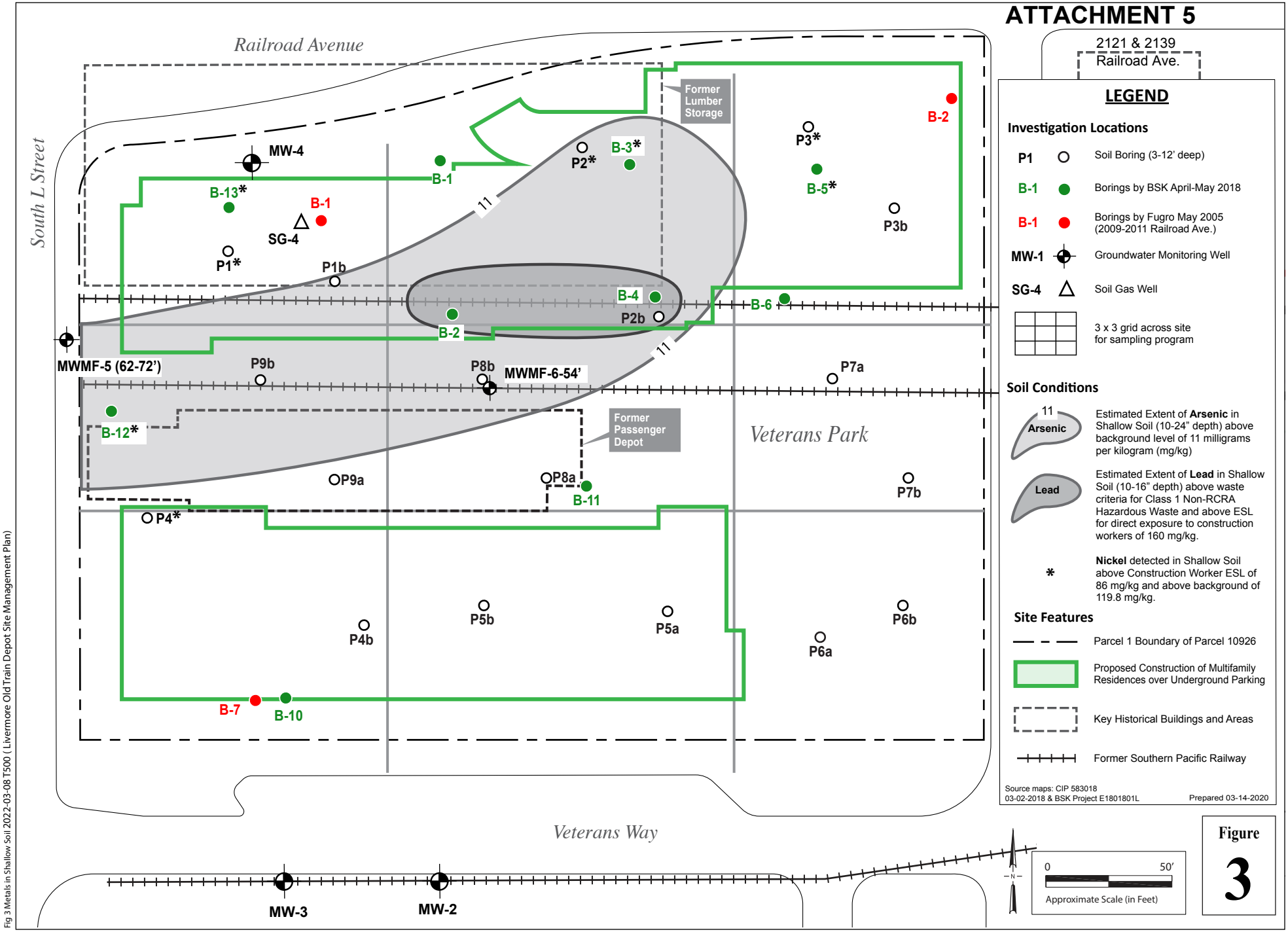


Fig 3 Metals in Shallow Soil 2022-03-08 T500 (Livermore Old Train Depot Site Management Plan)

Old Train Depot Site Management Plan
Livermore, California

PANGEA

Metals in Shallow Soil

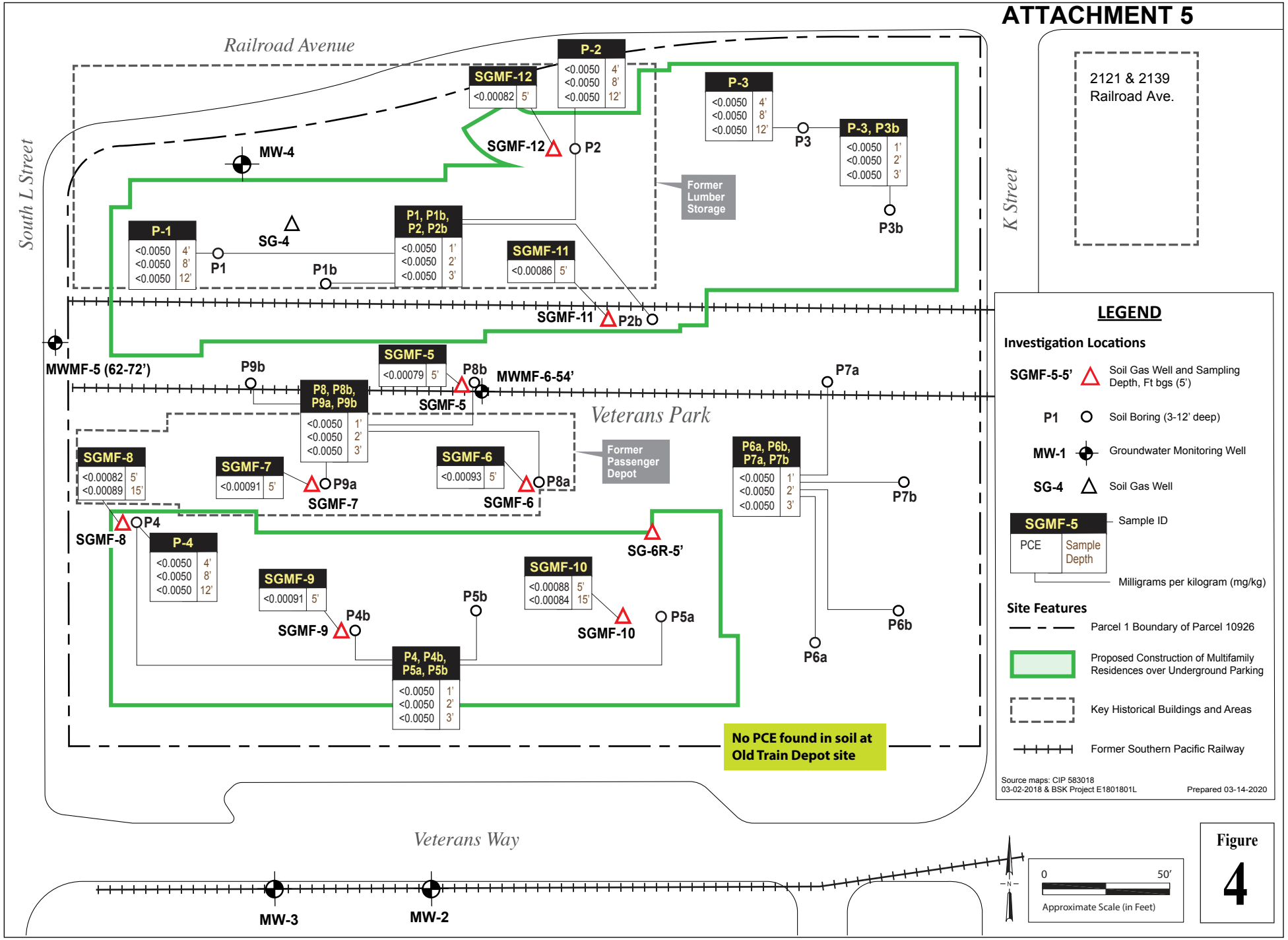


Figure 4

Fig 4 PCE in Soil 2022-3-08 T500 (Livermore Old Train Depot Site Management Plan)

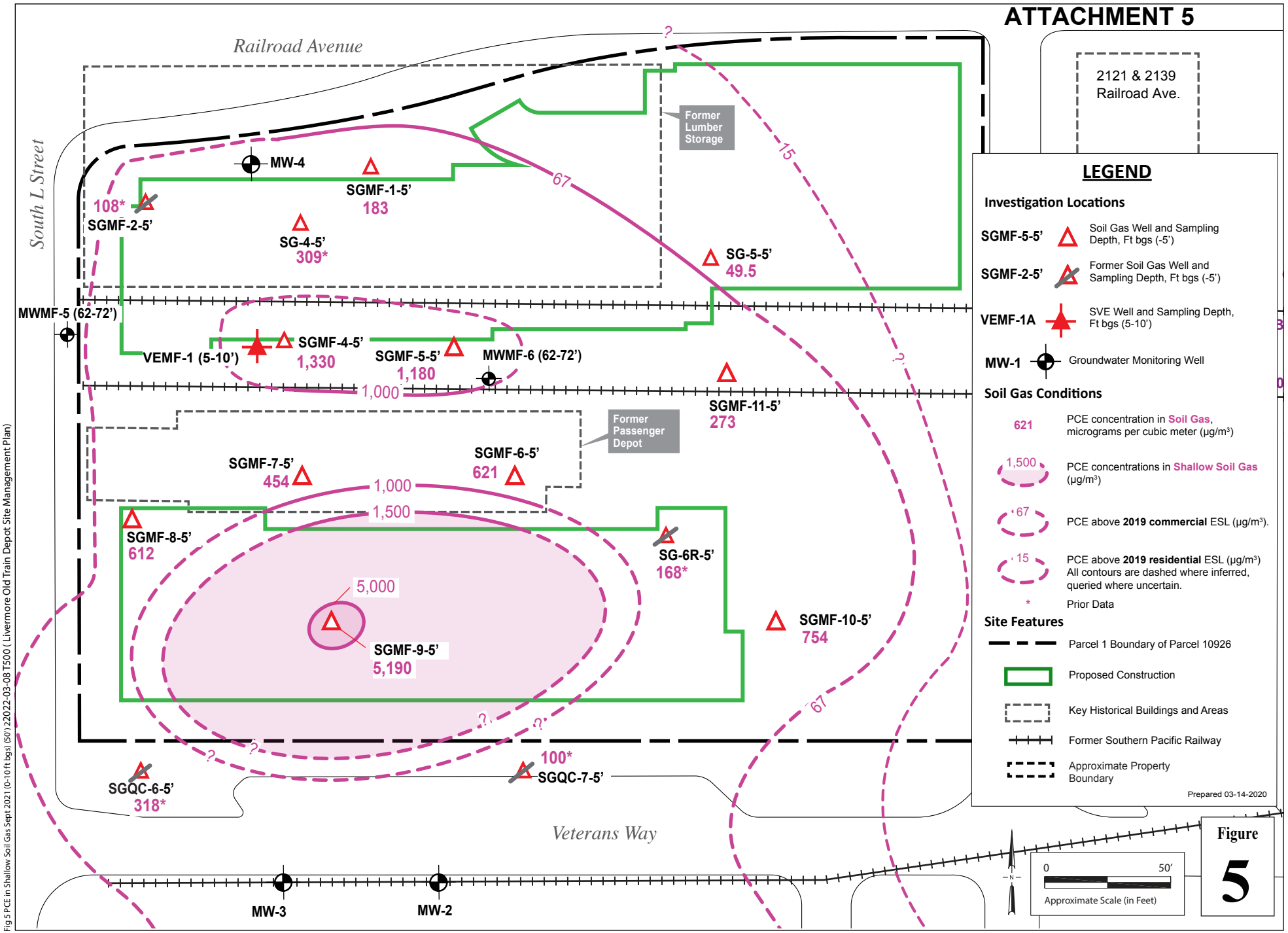


Fig 5 PCE in Shallow Soil Gas Sept 2021 (0-10 ft bgs) (50') 22022-03-08 T500 (Livermore Old Train Depot Site Management Plan)

Old Train Depot Site Management Plan
Livermore, California

PANGEA

PCE in Shallow Soil Gas (0-10 ft bgs), September 2021

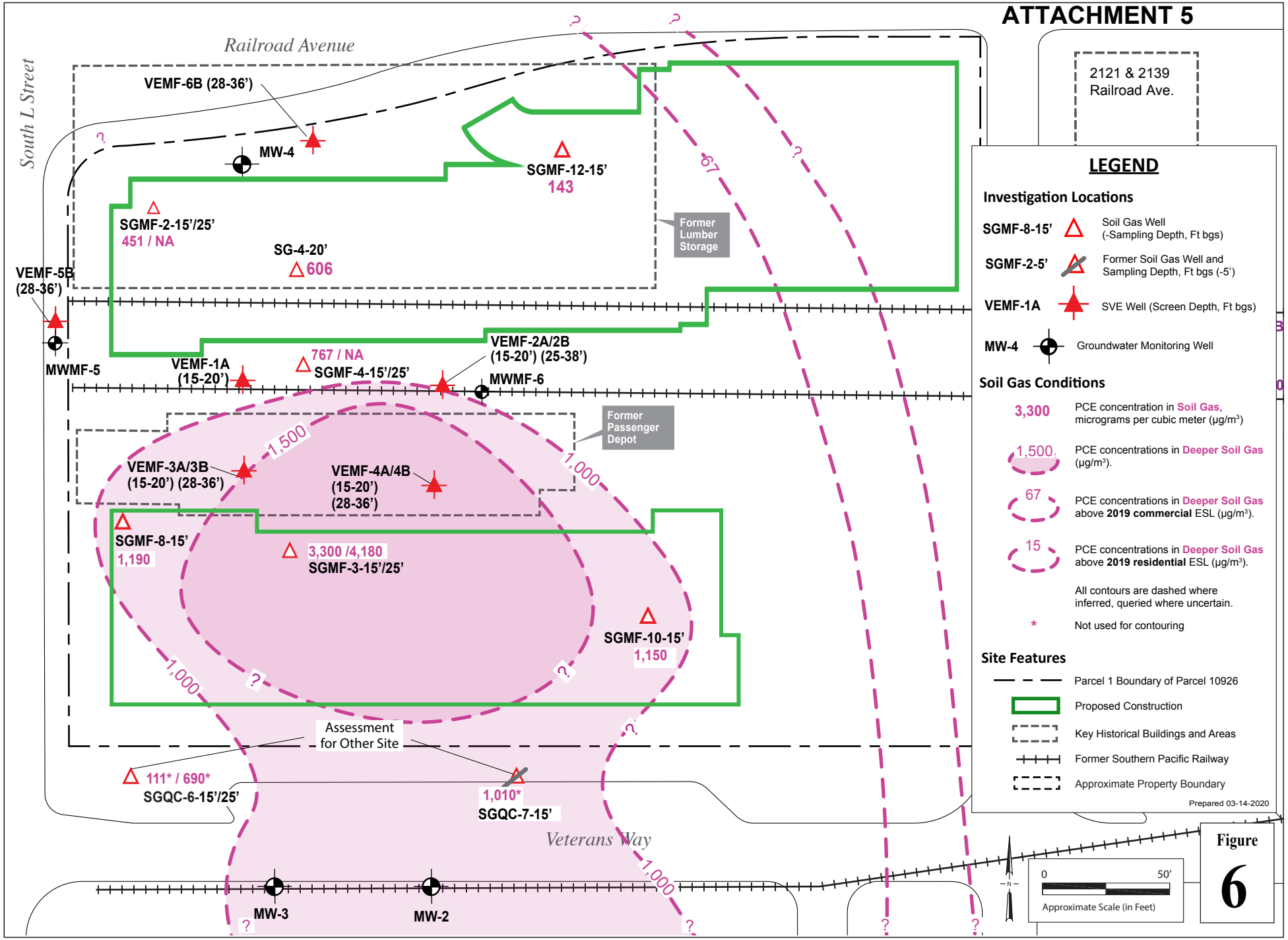
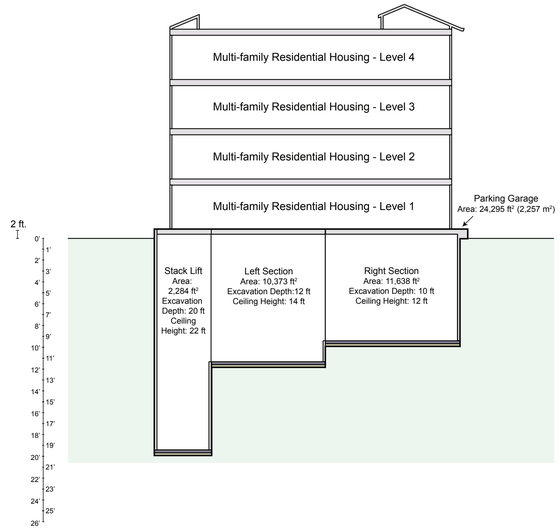


Fig 6 PCE in Deeper Soil Gas (15-30 ft bgs) (50') 2022-3-08 T500 (Livermore Old Train Depot Site Management Plan)

Old Train Depot Site Management Plan
Livermore, California

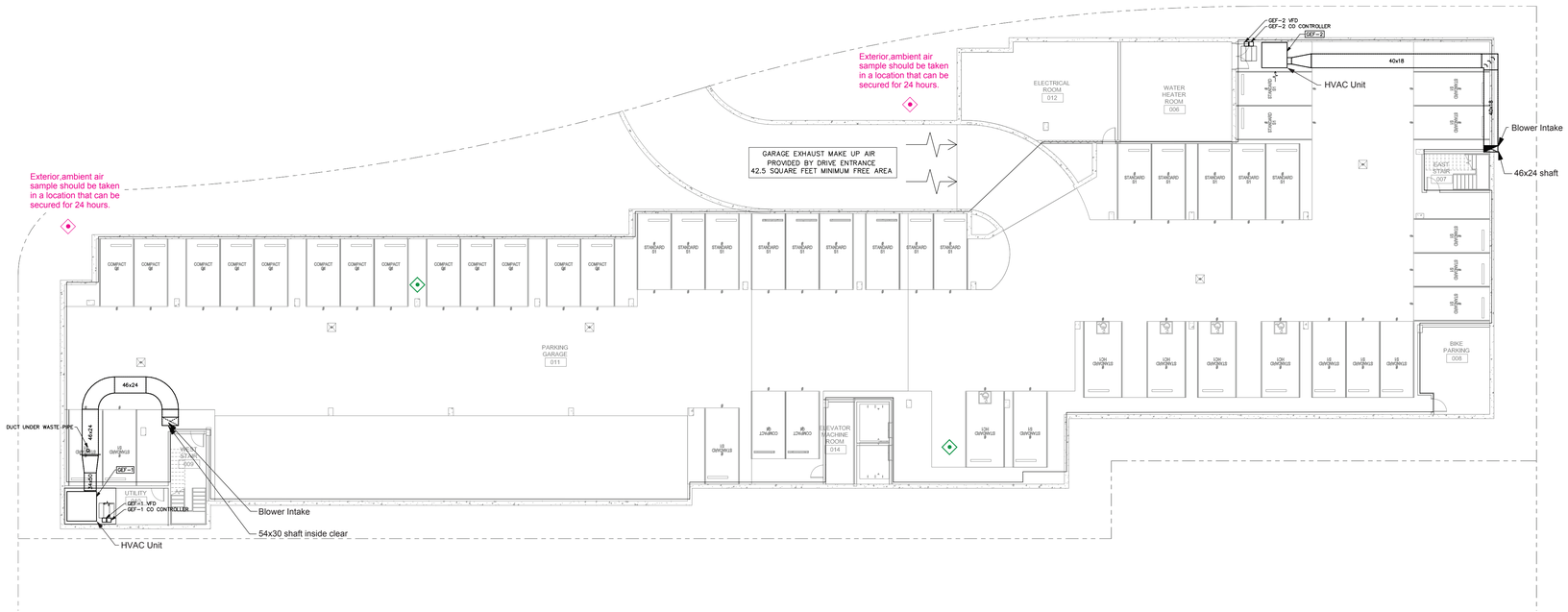
PANGEA

PCE in Deeper Soil Gas (15-30 ft bgs), September 2021



BUILDING A ELEVATION PROFILE

SOURCE: EXPONENT, INC. 2022



BASEMENT GARAGE

SOURCE: DAHLIN, 03-02-21

Fig 7 Site Garage Plan and Building Elevation - Building A (North Building) 2022-03-14 T500 (Livermore Old Train Depot Site Management Plan)

LEGEND

- Proposed Indoor (Garage) Air Sample Location
- Proposed Exterior (Ambient) Air Sample Location

PANGEA
ENVIRONMENTAL SERVICES, INC
1250 ADDISON STREET, SUITE 213
BERKELEY, CA. 94702

PROJECT

Old Train Depot Site Management Plan Livermore, California

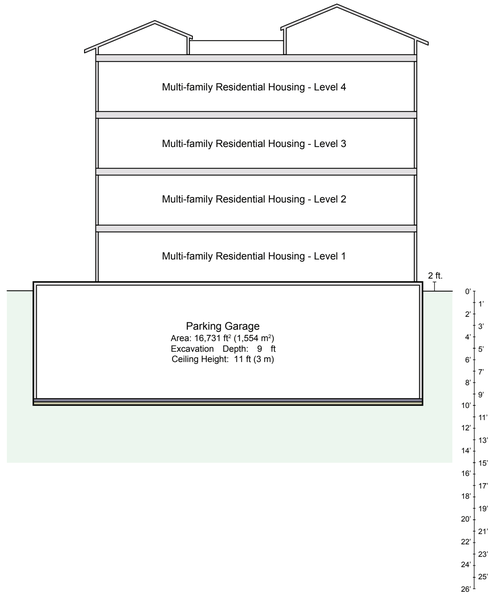
TITLE

Site Garage Plan and Building Elevation, Building A (North Building)

DRAWING

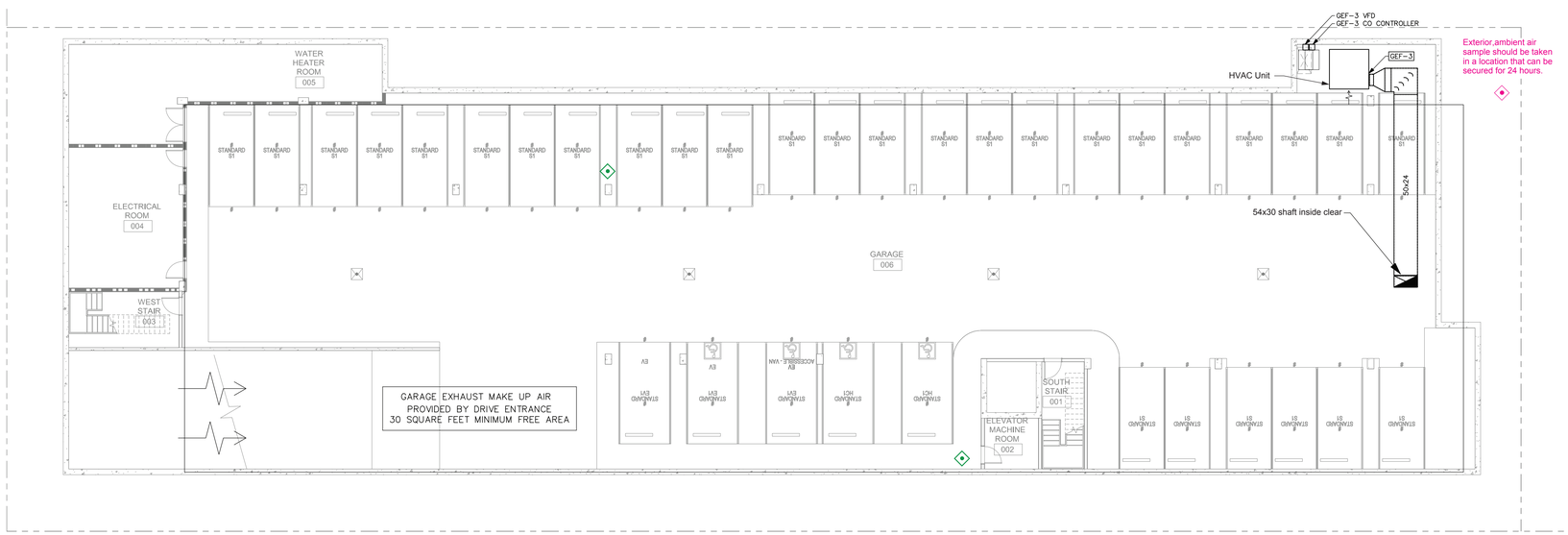
FIG. 7

0 16'
APPROXIMATE SCALE
(1" = 16')



BUILDING B ELEVATION PROFILE

SOURCE: EXPONENT, INC. 2022



BASEMENT GARAGE

SOURCE: DAHLIN, 03-02-21

LEGEND

- Proposed Indoor (Garage) Air Sample Location
- Proposed Exterior (Ambient) Air Sample Location

0 16'

APPROXIMATE SCALE (1" = 16')

PANGEA
ENVIRONMENTAL SERVICES, INC
1250 ADDISON STREET, SUITE 213
BERKELEY, CA. 94702

PROJECT

Old Train Depot Site Management Plan Livermore, California

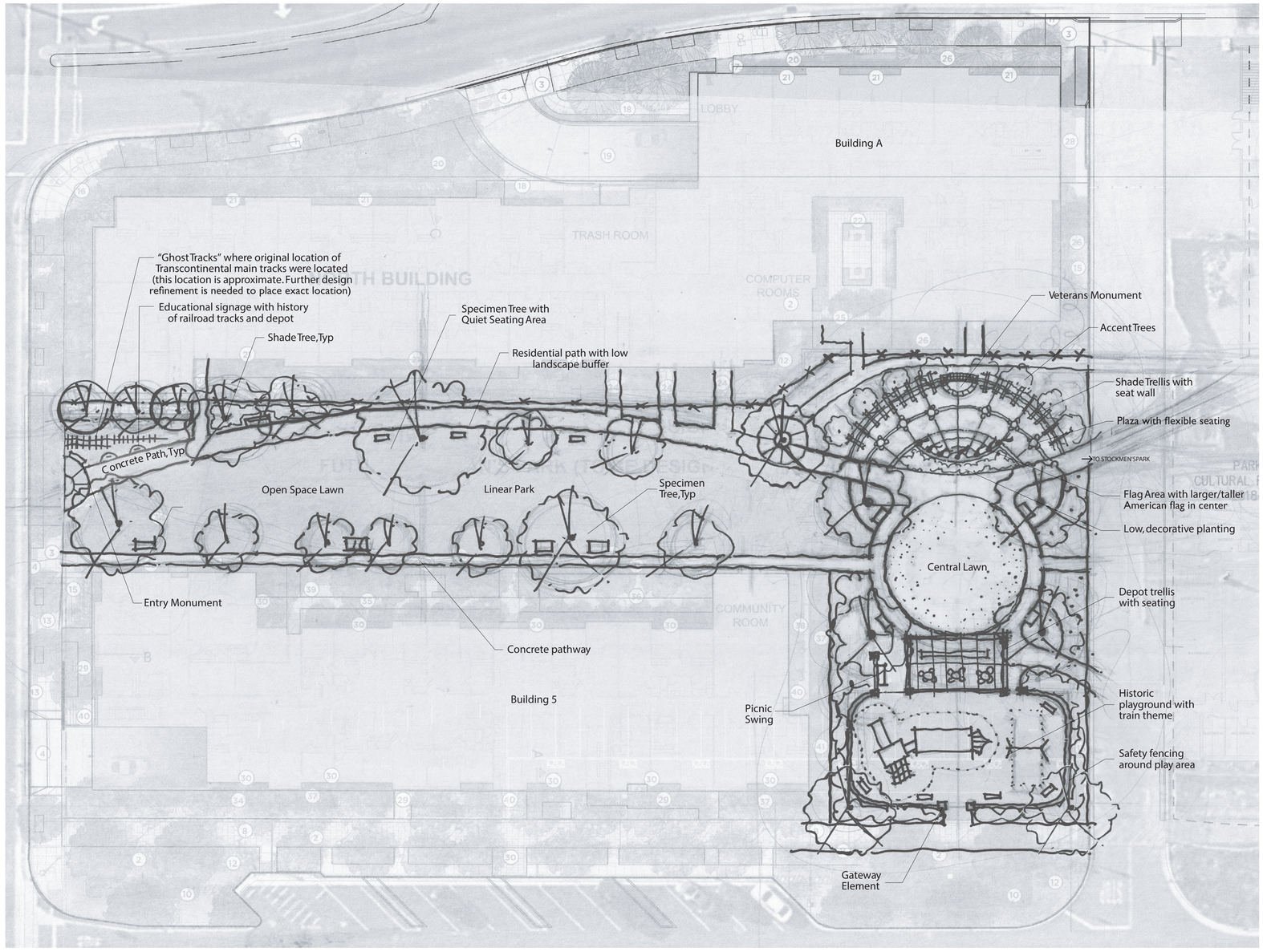
TITLE

Site Garage Plan and Building Elevation, Building B (South Building)

DRAWING

FIG. 8

Fig 8 Site Garage Plan and Building Elevation Building B (South Building) 2022-03-14 TSOO (Livermore Old Train Depot Site Management Plan)



Source: RRM Design Group, 2021

PANGEA
ENVIRONMENTAL SERVICES, INC
1250 ADDISON STREET, SUITE 213
BERKELEY, CA. 94702

PROJECT

Old Train Depot Site Management Plan Livermore, California

TITLE

Veteran's Park Conceptual Design

DRAWING

FIG. 9

Fig 9 Veteran's Park Conceptual Design 2022-03-10 T500 (Livermore Old Train Depot Site Management Plan)

Pangea

Table 1. Soil Analytical Data - Old Train Depot, Livermore Downtown Core Development, Livermore, California

Boring / Sample ID	Date Sampled	Sample Depth (ft bgs)	TPHg	TPHd	TPHmo	Benzene	Toluene	Ethylbenzene	Total Xylenes	PCE	TCE	Cis-1,2-DCE	Trans-1,2-DCE	Vinyl Chloride	Methylene Chloride	Other VOCs	Arsenic	Total Chromium	Chromium STLC (mg/L)	Lead	Lead STLC (mg/L)	Nickel	Nickel STLC (mg/L)	Other Metals	Chlorinated Herbicides	Asbestos	Organochlorine Pesticides + PCBs	Benzo (a) pyrene	Benzo (g,h,i) perylene	Chrysene	Bis (2-ethylhexyl) Phthalate	Fluoranthene	Phenol	Pyrene	Other SVOCs	o-cresol *	m,p-cresol *	pentachlorophenol	Notes
			mg/kg																							%	mg/kg												
Tier 1 ESL:			**100**	**260**	**1,600**	**0.025**	**3.2**	**0.4**	**2.1**	**0.08**	**0.085**	**0.19**	**0.65**	**0.0015**	**0.1**	**varies**	**0.067**	**160**	--	32	--	**86**	--	varies	varies	--	varies	**0.11**	**2.5**	**2.2**	**0.8**	**0.69**	**0.16**	**45**	**varies**	--	--	**0.13**	
Direct Exposure, Construction Worker ESL:			1,800	1,100	54,000	33	4,700	540	2,400	33	130	78	570	3.4	1.9	varies	2.00	530,000	--	160	--	86	--	**varies**	**varies**	--	**varies**	11	--	9100	950	6700	98000	5000	varies	--	--	1	
Direct Exposure, Residential, Shallow Soil ESL:			430	260	12,000	0.33	1,100	5.9	580	0.59	0.95	19	130	0.0083	490	varies	0.067	120,000	--	**80**	--	820	--	varies	varies	--	varies	0.11	--	110	39	2400	23000	1800	varies	--	--	4	
Background Levels[1]:			--	--	--	--	--	--	--	--	--	--	--	--	--	--	**11**	**1,579**	--	**97**	--	**509**	--	**varies**	--	--	--	--	--	--	--	--	--	--	--	--	**1.7**	
OLD TRAIN DEPOT																																						
B-1	5/2/2005	0.5	<1	35	110	<5	<5	<5	<5	<5	<5	<5	<5	<5	--	<5	<1	30	--	12	--	58	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	
		3.0	<1	11	40	<5	<5	<5	<5	<5	<5	<5	<5	<5	--	<5	<1	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-2	5/2/2005	0.5	<1	17	53	<5	<5	<5	<5	<5	<5	<5	<5	<5	--	<5	<1	32	--	27	--	63	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	
		3.0	<1	4.2	10	<5	<5	<5	<5	<5	<5	<5	<5	<5	--	<5	<1	--	--	7.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		22.0	--	--	--	<5	<5	<5	<5	<5	<5	<5	<5	<5	--	<5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-7	5/3/2005	0.5	<1	43	99	<5	<5	<5	<5	<5	<5	<5	<5	<5	--	<5	<1	32	--	44	--	60	--	+	+	--	+	--	--	--	--	--	--	--	+	--	--	--	
		3.0	<1	2.8	6.8	<5	<5	<5	<5	<5	<5	<5	<5	<5	--	<5	<1	--	--	5.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-1	4/13/2018	0"-6"	--	5.4	70	--	--	--	--	--	--	--	--	--	--	--	**7.5**	38	--	56	1.8	**81**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
		10"-16"	--	4.6	24	--	--	--	--	--	--	--	--	--	--	--	**6.2**	39	--	65	2.7	**77**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
		18"-24"	--	13	60	--	--	--	--	--	--	--	--	--	--	--	**8.1**	40	--	**100 a**	3.9	**74**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
B-2	4/13/2018	0"-6"	--	6.2	22	--	--	--	--	--	--	--	--	--	--	--	**2.8**	30	--	19	--	**68**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
		10"-16"	--	33	200	--	--	--	--	--	--	--	--	--	--	--	**55**	13	--	**170 a**	9.5	**23**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
		18"-24"	--	16	78	--	--	--	--	--	--	--	--	--	--	--	**11**	21	--	**93 a**	2.1	**46**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
B-3	4/13/2018	0"-6"	--	6.4	40	--	--	--	--	--	--	--	--	--	--	--	**20**	41	--	**89 a**	3.0	**96**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
		10"-16"	--	4.7	32	--	--	--	--	--	--	--	--	--	--	--	**5.9**	47	--	**120 a**	1.6	**120**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
		18"-24"	--	8.1	22	--	--	--	--	--	--	--	--	--	--	--	**8.4**	37	--	**140 a**	4.3	**90**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
B-4	4/13/2018	0"-6"	--	4.6	23	--	--	--	--	--	--	--	--	--	--	--	**5.0**	56	<0.50	58	2.1	**110**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
		10"-16"	--	29	120	--	--	--	--	--	--	--	--	--	--	--	**28**	30	--	**200 a**	7.3	**66**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
		18"-24"	--	2.3	<2.0	--	--	--	--	--	--	--	--	--	--	--	**6.4**	36	--	**130 a**	2.8	**86**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
B-5	4/13/2018	0"-6"	--	60	280	--	--	--	--	--	--	--	--	--	--	--	**7.1**	43	--	41	--	**98**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
		10"-16"	--	3.9	24	--	--	--	--	--	--	--	--	--	--	--	**5.0**	52	<0.50	22	--	**130**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
		18"-24"	--	4.6	16	--	--	--	--	--	--	--	--	--	--	--	**7.7**	45	--	27	--	**130**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
B-6	4/16/2018	0"-6"	--	3.0	18	--	--	--	--	--	--	--	--	--	--	--	**4.6**	62	<0.50	11	--	**140**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
		10"-16"	--	9.0	24	--	--	--	--	--	--	--	--	--	--	--	**8.4**	44	--	43	--	**100**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
		18"-24"	--	11	34	--	--	--	--	--	--	--	--	--	--	--	**7.5**	38	--	41	--	**94**	--	+	ND	--	ND	--	--	--	--	--	--	--	ND	--	--	--	
B-11	4/17/2018	0"-6"	--	17	120	--	--	--	--	--	--	--	--	--	--	--	**7.3**	36	--	63	1.6	**74**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10"-16"	--	14	72	--	--	--	--	--	--	--	--	--	--	--	**5.1**	30	--	**120 a**	3.8	**46**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18"-24"	--	5.3	15	--	--	--	--	--	--	--	--	--	--	--	**3.6**	18	--	55	1.4	**32**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-12	4/17/2018	0"-6"	--	6.1	53	--	--	--	--	--	--	--	--	--	--	--	**3.2**	25	--	<6.3	--	**53**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10"-16"	--	37	130	--	--	--	--	--	--	--	--	--	--	--	**48**	67	<0.50	7.3	--	**120**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18"-24"	--	37	100	--	--	--	--	--	--	--	--	--	--	--	**18**	52	<0.50	7.0	--	**140**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-13	4/17/2018	0"-6"	--	12	18	--	--	--	--	--	--	--	--	--	--	--	**2.6**	30	--	<6.3	--	**55**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10"-16"	--	<1.0	<2.0	--	--	--	--	--	--	--	--	--	--	--	**2.9**	55	<0.50	9.0	--	**160**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18"-24"	--	3.1	42	--	--	--	--	--	--	--	--	--	--	--	**3.4**	52	<0.50	<6.3	--	**140**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-4-3	6/20/2018	3.0	<1.0	<1.0	<5.0	--	--	--	--	--	--	--	--	--	--	--	**4.0**	54	0.18	7.1	--	**140**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-4-6	6/20/2018	6.0	<1.0	<1.0	<5.0	--	--	--	--	--	--	--	--	--	--	--	**3.3**	50	<0.10	4.7	--	**110**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-4-12	6/20/2018	12.0	<1.0	<1.0	<5.0	--	--	--	--	--	--	--	--	--	--	--	**4.3**	48	--	5.3	--	**120**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-2-23	11/14/2018	23.0	--	--	--	<3.8	<3.8	<3.8	<7.6	<3.8	<3.8	<3.8	<3.8	<3.8	--	<3.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-5-5	8/25/2021	5.0	--	--	--	<0.00079	<0.00079	<0.00079	<0.0031	<0.00079	<0.00079	<0.00079	<0.00079	<0.00039	--		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-6-5	8/25/2021	5.0	--	--	--	<0.00093	<0.00093	<0.00093	<0.0037	<0.00093	<0.00093	<0.00093	<0.00093	<0.00047	--		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-7-5	8/25/2021	5.0	--	--	--	<0.00091	<0.00091	<0.00091	<0.0037	<0.00091	<0.00091	<0.00091	<0.00091	<0.00046	--		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-8-5	8/23/2021	5.0	--	--	--	<0.00082	<0.00082	<0.00082	<0.033	<0.00082	<0.00082	<0.00082	<0.00082	<0.00041	0.0023		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-8-15	8/24/2021	15.0	--	--	--	<0.00089	<0.00089	<0.00089	<0.036	<0.00089	<0.00089	<0.00089	<0.00089	<0.00044	0.0019		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-9-5	8/23/2021	5.0	--	--	--	<0.00091	<0.00091	<0.00091	<0.0037	<0.00091	<0.00091	<0.00091	<0.00091	<0.00046	0.0022		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-10-5	8/24/2021	5.0	--	--	--	<0.00088	<0.00088	<0.00088	<0.035	<0.00088	<0.00088	<0.00088	<0.00088	<0.00044	--		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-10-15	8/24/2021	15.0	--	--	--	<0.00084	<0.00084	<0.00084	<0.0034	<0.00084	<0.00084	<0.00084	<0.00084	<0.00042	--		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-11-5	8/26/2021	5.0	--	--	--	<0.00086	<0.00086	<0.00086	<0.0034	<0.00086	<0.00086	<0.00086	<0.00086	<0.00043	--		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-12-5	8/26/2021	5.0	--	--	--	<0.00082	<0.00082	<0.00082	<0.0033	<0.00082	<0.00082	<0.00082	<0.00082	<0.00041	--		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

Pangea

Table 1. Soil Analytical Data - Old Train Depot, Livermore Downtown Core Development, Livermore, California

Boring / Sample ID	Date Sampled	Sample Depth (ft bgs)	TPHg	TPHd	TPHmo	Benzene	Toluene	Ethylbenzene	Total Xylenes	PCE	TCE	Cis-1,2-DCE	Trans-1,2-DCE	Vinyl Chloride	Methylene Chloride	Other VOCs	Arsenic	Total Chromium	Chromium STLC (mg/L)	Lead	Lead STLC (mg/L)	Nickel	Nickel STLC (mg/L)	Other Metals	Chlorinated Herbicides	Asbestos	Organochlorine Pesticides + PCBs	Benzo (a) pyrene	Benzo (g,h,i) perylene	Chrysene	Bis (2-ethylhexyl) Phthalate	Fluoranthene	Phenol	Pyrene	Other SVOCs	o-cresol *	m,p-cresol *	pentachlorophenol	Notes
			mg/kg																							%	mg/kg												
	Tier 1 ESL:		**100**	**260**	**1,600**	**0.025**	**3.2**	**0.4**	**2.1**	**0.08**	**0.085**	**0.19**	**0.65**	**0.0015**	**0.1**	**varies**	**0.067**	**160**	--	32	--	**86**	--	varies	varies	--	varies	**0.11**	**2.5**	**2.2**	**0.8**	**0.69**	**0.16**	**45**	**varies**	--	--	**0.13**	
	Direct Exposure, Construction Worker ESL:		1,800	1,100	54,000	33	4,700	540	2,400	33	130	78	570	3.4	1.9	varies	2.00	530,000	--	160	--	86	--	**varies**	**varies**	--	**varies**	11	--	9100	950	6700	98000	5000	varies	--	--	1	
	Direct Exposure, Residential, Shallow Soil ESL:		430	260	12,000	0.33	1,100	5.9	580	0.59	0.95	19	130	0.0083	490	varies	0.067	120,000	--	**80**	--	**97**	--	820	--	varies	varies	--	varies	0.11	--	110	39	2400	23000	1800	varies	--	--	4	
	Background Levels[1]:		--	--	--	--	--	--	--	--	--	--	--	--	--	--	**11**	**1,579**	--	**97**	--	**509**	--	**varies**	--	--	--	--	--	--	--	--	--	--	--	--	--	**1.7**	
P1-4	8/26/2021	4.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**4.7**	72	--	5.2	--	**140**	--	+	--	ND	ND	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	**ND**	<0.25	<0.25	<0.062	
P1-8	8/26/2021	8.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**4.5**	77	--	5.0	--	**300**	--	+	--	ND	+	0.0010	<0.0025	0.0021	<0.0025	<0.0025	<0.05	<0.0025	**ND**	<0.25	<0.25	<0.062	
P1-12	8/26/2021	12.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**5.0**	67	--	9.4	--	**220**	--	+	--	ND	ND	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	**ND**	<0.25	<0.25	<0.062	
P2-4	8/26/2021	4.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**5.1**	77	--	7.2	--	**140**	--	+	--	ND	ND	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	**ND**	<0.25	<0.25	<0.062	
P2-8	8/26/2021	8.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**4.1**	42	--	3.8	--	**95**	--	+	--	ND	ND	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	**ND**	<0.25	<0.25	<0.062	
P2-12	8/26/2021	12.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**5.0**	81	--	6.4	--	**180**	--	+	--	ND	ND	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	**ND**	<0.25	<0.25	<0.062	
P3-4	8/26/2021	4.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**11.0**	70	--	16	--	**150**	--	+	--	ND	ND	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	**ND**	<2	<2	<0.5	
P3-8	8/26/2021	8.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**3.4**	**160**	--	2.6	--	**670 b**	--	+	--	ND	ND	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	**ND**	<0.25	<0.25	<0.062	
P3-12	8/26/2021	12.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**4.9**	47	--	5.9	--	**150**	--	+	--	ND	ND	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	**ND**	<0.25	<0.25	<0.062	
P4-4	8/23/2021	4.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**4.1**	69	--	6.3	--	**130**	--	+	--	ND	+	<0.0025	<0.0025	<0.0025	0.0280	0.0017	<0.05	<0.0025	**ND**	<0.25	<0.25	<0.062	
P4-8	8/24/2021	8.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**4.0**	120	--	4.2	--	**340**	--	+	--	ND	+	<0.0025	<0.0025	<0.0025	0.0340	<0.0013	<0.05	<0.0025	**ND**	<0.25	<0.25	<0.062	
P4-12	8/24/2021	12.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**5.8**	72	--	5.2	--	**310**	--	+	--	ND	+	<0.0025	<0.0025	<0.0025	<0.0025	<0.0013	0.054	<0.0025	**ND**	<0.25	<0.25	<0.062	
P5-4	8/24/2021	4.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**3.1**	41	--	6.7	--	**99**	--	+	--	ND	+	<0.0025	<0.0025	<0.0025	<0.0025	0.0390	<0.05	<0.0025	**ND**	<0.25	<0.25	<0.062	
P5-8	8/24/2021	8.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**4.6**	51	--	6.8	--	**490**	--	+	--	ND	+	0.0031	0.0030	0.0028	<0.0025	0.0045	<0.05	0.0028	**ND**	<0.25	<0.25	<0.062	
P5-12	8/24/2021	12.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	--		**6.0**	80	--	7.0	--	**160**	--	+	--	ND	+	<0.0025	<0.0025	<0.0025	<0.0025	0.0032	<0.05	<0.0025	**ND**	<0.25	<0.25	<0.062	

Notes and Abbreviations:

TPH = Total petroleum hydrocarbons as gasoline (TPHg), diesel (TPHd), and/or motor oil (TPHmo) range. Analyzed by EPA Method 8015.

PCE = tetrachloroethene

TCE = trichloroethene

DCE = dichloroethene

VOCs = Volatile organic compounds by EPA Method 8260.

Other VOCs = volatile organic compounds not otherwise listed

SVOCs = Semi-volatile organic compounds by EPA Method 8270.

Creosote compounds and pentachlorophenol by EPA Method 8270.

PCBs = Polychlorinated Biphelnyls by EPA Method 8082

ft bgs = feet below ground surface

mg/kg = milligrams per kilogram

< n = Chemical not present at a concentration in excess of detection limit shown.

+ = chemicals detected at relatively low concentrations. See laboratory reports for details.

-- = not applicable

ND = Not Detected at levels above laboratory reporting limits. Limits vary by constituent.

ESL = Environmental Screening Level, from California Regional Water Quality Control Board - San Francisco Bay Region, Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater, January 2019 (Revision 2).

1 = background levels (except arsenic) taken from Bradford (1996) *Background Concentrations of Trace and Major Elements in California Soils* . Arsenic background taken from Establishing Background Arsenic in Soil of the Urbanized San Francisco Bay Region, by Dylan Jacques Duverge (December 2011).

BOLD = Analyte detected above Tier 1 ESL, except total lead is bold above the residential human health direct exposure ESL of 80 mg/kg (and STLC > 5 mg/L).

GREY HIGHLIGHT = Analyte concentration exceeds construction worker ESL and background level if applicable (see notes a, b).

RED HIGHLIGHT = Analyte concentration exceeds criteria for waste soil classification as Class I Non-RCRA (California) hazardous waste.

a= 95 UCL concentration of lead (68 mg/kg) in Old Train Depot site soils is below the residential ESL for soil (80 mg/kg) and construction ESL for soil (160 mg/kg).

b = Only one concentration of nickel (670 mg/kg) in Old Train Depot site soils exceeds background (509 mg/kg); the 95 UCL concentration of nickel is 162 mg/kg.

Pangea

Table 2. Soil Gas Analytical Data - Old Train Depot, Livermore Downtown Core, Livermore, CA

Boring / Sample ID	Date Sampled	Sample Depth (ft bgs)	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	Benzene	Ethylbenzene	TPH (Low Fraction)	2-Propanol (Leak Check)	Other VOCs	Notes
			µg/m³										
Old Train Depot													
SG-4-5	6/22/2018	5.0	309	<1.07	<0.793	<0.793	<0.511	0.997	2.35	551	5.04	a	
SG-4-20	6/22/2018	20.0	420	<1.07	<0.793	<0.793	<0.511	2.70	0.954	1,900	<3.07	a	
SG-4-20	9/14/2021	20.0	606	<1.07	<0.793	<0.793	<0.511	<0.639	1.66	<826	6.39	a	
SG-5-5	6/21/2018	5.0	34.6	<1.07	<0.793	<0.793	<0.511	0.676	<0.867	512	4.70	a	
SG-5-5	9/16/2021	5.0	49.5	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<826	3.32	a	
SG-6-5	6/21/2018	5.0	168	<1.07	<0.793	<0.793	<0.511	<0.639	1.27	329	242	a	
Shroud	6/22/2018	--	--	--	--	--	--	--	--	--	219,000	---	
SGMF-1-5	11/27/2018	4.5-5.5	56.5	<1.07	<0.908	<0.908	<0.511	<0.639	2.18	<207	7.11	a	
SGMF-1-5	9/14/2021	5	183	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<826	3.17	a	
SGMF-2-5	11/27/2018	4.5-5.5	108	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<207	38.9	a	
SGMF-2-15	11/27/2018	14.5-15.5	809	<1.07	<0.793	<0.793	<0.511	1.92	<0.867	960	<3.07	a	
SGMF-2-15	9/14/2021	15	451	1.24	<0.793	<0.793	<0.511	2.18	<0.867	1,060	5.58	a	
SGMF-2-25	11/27/2018	24.5-25.5	1,850	3.9	<0.793	<0.793	<0.511	58	1.1	3,870	8.23	a	
SGMF-3-15	11/28/2018	14.5-15.5	1,860	1.4	<0.793	<0.793	<0.511	2.1	<0.867	2,130	28.7	a	
SGMF-3-15	9/16/2021	15	3,300	1.44	<0.793	<0.793	<0.511	<0.639	<0.867	2,260	14.30	a	
SGMF-3-25	11/28/2018	24.5-25.5	5,340	7.2	<0.793	<0.793	<0.511	5.0	<0.867	3,680	4.86	a	
SGMF-3-25	9/16/2021	25	4,180	1.97	<0.793	<0.793	<0.511	<0.639	<0.867	3,020	20.00	a	
SGMF-3-25-DUP	9/16/2021	25	3,350	2.79	<0.793	<0.793	<0.511	<0.639	<0.867	2,290	36.40	a	
SGMF-4-5	11/28/2018	4.5-5.5	387	<1.07	<0.793	<0.793	<0.511	0.863	4.19	611	14.5	a	
SGMF-4-5	9/14/2021	5	1,330	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	1,210	3.91	a	
SGMF-4-15	9/14/2021	15	767	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	1,100	5.68	a	
SGMF-4-15-DUP	9/14/2021	15	657	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<826	5.28	a	
SGMF-4-15	11/28/2018	14.5-15.5	1,070	<1.07	<0.793	<0.793	<0.511	3.55	10.6	1,540	96.1	a	
SGMF-4-25	11/28/2018	24.5-25.5	3,320	12	<0.793	0.826	<0.511	14.1	22.1	4,080	7.87	a	
SGMF-5-5	9/16/2021	5	1,180	1.18	<0.793	<0.793	<0.511	<0.639	<0.867	1,320	<3.07	a	
SGMF-6-5	9/16/2021	5	621	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	946	<3.07	a	
SGMF-7-5	9/14/2021	5	454	<1.07	<0.793	<0.793	<0.511	0.850	<0.867	901	6.29	a	
SGMF-8-5	9/16/2021	5	612	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<826	23.60	a	
SGMF-8-15	9/16/2021	15	1,190	4.20	<0.793	<0.793	<0.511	0.917	<0.867	1,070	15.20	a	
SGMF-9-5	9/16/2021	5	5,190	2.65	<0.793	<0.793	<0.511	<0.639	<0.867	2,160	60.00	a	
SGMF-10-5	9/16/2021	5	754	1.69	<0.793	<0.793	<0.511	<0.639	<0.867	1,280	25.80	a	
SGMF-10-15	9/16/2021	15	1,150	<1.07	<0.793	<0.793	<0.511	2.66	<0.867	1,260	9.29	a	
SGMF-11-5	9/16/2021	5	273	<1.07	<0.793	<0.793	<0.511	0.69	1.29	<826	3.44	a	
SGMF-12-15	9/16/2021	15	14.3	<1.07	<0.793	<0.793	<0.511	5.43	<0.867	<826	<3.07	a	
SHROUD 1	9/16/2021	--	--	--	--	--	--	--	--	--	59500	--	
SHROUD 2	9/16/2021	--	--	--	--	--	--	--	--	--	102000	--	

Notes and Abbreviations:

PCE = Tetrachloroethene

TCE = Trichloroethene

DCE = Dichloroethene

VOCs = Volatile organic compounds by EPA Method TO-15.

Other VOCs = Volatile organic compounds by EPA Method TO-15 or EPA Method 8260.

TPH (Low Fraction = Total Petroleum Hydrocarbons, Gasoline Range Organics by EPA Method TO-15.

µg/m3 = Micrograms per cubic meter of air results calculated by laboratory from parts per billion results using normal pressure and temperature (NPT).

ft bgs = feet below ground surface.

< n = Chemical not present above laboratory detection limit.

--- = Not analyzed

a= Other analytes detected below evaluation criteria, if established, including acetone, bromodichloromethane, carbon disulfide, ethanol, MEK, trichloroflouromethane, dichloroflouromethane, propene, toluene, xylenes, 1,1,1-trichloroethane, 1,2,4-trimethylbenzene, n-hexane, and methylene chloride.

Table 3. Groundwater Analytical Data - Old Train Depot, Livermore Downtown Core Development, Livermore, California

Sample / Boring ID	Date Sampled	TOC Elevation (ft amsl)	Sample Depth / Screened Interval (ft bgs)	Depth to Water (feet below TOC)	Groundwater Elevation (feet amsl)	TPHg	TPHd	TPHmo	Benzene	Naphthalene	PCE	TCE	Cis-1,2-DCE	Trans-1,2-DCE	Vinyl Chloride	Chloroform	Other VOCs	Notes
						µg/L												
					Tier 1 ESL:	**100**	**100**	**--**	**0.42**	**0.17**	**0.64**	**1.2**	**6.0**	**10**	**0.0086**	**0.81**	**--**	
					MCL:	**--**	**--**	**--**	**5.0**	**17**	**5.0**	**5.0**	**70**	**100**	**2.0**	**--**	**--**	
GROUNDWATER MONITORING WELL DATA																		
Train Depot Wells																		
MW-4	7/26/2018	484.31	62-67	36.71	447.60	--	--	--	<0.102	0.117	**10.2**	0.138	<0.114	<0.104	<0.129	0.708	<3.45	
	9/22/2021	484.31	62-67	51.29	433.02	<50	<100	<500	<0.2	<0.3	**5.6**	<0.5	<0.5	<0.5	<0.0050	**1.1**	--	
MWMF-5	9/22/2021	481.90	62-72	51.74	430.16	<50	<100	<500	<0.2	<0.3	**7.5**	<0.5	<0.5	<0.5	<0.0050	0.460	--	
MWMF-6	9/22/2021	482.87	62-72	51.11	431.76	<50	<100	<500	<0.2	<0.3	**5.8**	<0.5	<0.5	<0.5	<0.0050	0.850	--	
Dup	9/22/2021	482.87	62-72	51.11	431.76	<50	<100	<500	<0.2	<0.3	**6.1**	<0.5	<0.5	<0.5	<0.0050	0.860	--	
GRAB GROUNDWATER DATA																		
Train Depot Grab Samples																		
B-1	5/2/2005	--	31-35	--	--	**160**	<62	<62	<0.5	--	**19**	<0.5	<0.5	<0.5	<0.5	<0.5	ND	Perched zone
Duplicate-1(B-1)	5/2/2005	--	31-35	--	--	**160**	--	--	<0.5	--	**21**	<0.5	--	--	--	--	ND	Duplicate sample
B-1	5/2/2005	--	40-44	--	--	**160**	**330**	480	<0.5	--	**18**	<0.5	<0.5	<0.5	<0.5	<0.5	ND	Perched zone
B-2	5/2/2005	--	31-35	--	--	<50	**230**	72	<0.5	--	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	ND	Perched zone
MW-4	7/11/2018	--	41-45	41.00	--	**--**	--	--	<0.50	<0.50	**4.9**	<0.50	<0.50	<0.50	<0.50	**1.3**	a	Perched zone
HP-1-MF	11/12/2018	--	66-70	50.10	--	**--**	--	--	<0.5	<2.0	**16**	<0.5	<0.5	<0.5	<0.5	0.60	<1.0	
HP-2-MF	11/13/2018	--	66-70	46.80	--	**--**	--	--	<0.5	<0.5	**4.6**	<0.5	<0.5	<0.5	<0.5	0.77	<0.5	
HP-3-MF	11/13/2018	--	62-70	52.00	--	**--**	--	--	<0.5	<0.5	**10**	<0.5	<0.5	<0.5	<0.5	0.72	<0.5	
MWMF-6-54	8/5/2021	--	54	--	--	<50	<50	<250	<0.2	<0.3	**8.1**	<0.5	<0.5	<0.5	<.005	**1.0**	--	
HP-5-MF54	9/8/2021	--	54	--	--	--	--	--	<0.2	<0.3	**7.4**	<0.5	<0.5	<0.5	<.005	0.260	--	no TPH information in lab PDF
HP-6-MF56	8/12/2021	--	56	--	--	<50	<50	<250	<0.2	<0.3	**8.9**	<0.5	<0.5	<0.5	<.005	**1.3**	--	
HP-7-MF54	8/5/2021	--	54	--	--	<50	<50	<250	<0.5	<1.8	**9.5**	<0.21	<0.22	<0.24	<0.3	<0.18	--	
HP-7-MF72	8/9/2021	--	72	--	--	<50	<50	<250	<0.2	<0.3	**8.8**	<0.5	<0.5	<0.5	<.005	0.25	--	
HP-8-MF71	8/18/2021	--	71	--	--	<50	**140**	450	<0.2	<0.3	**6.4**	<0.5	<0.5	<0.5	<.005	0.30	--	
HP-11-MF72	8/14/2021	--	72	--	--	<50	64	<250	<0.2	<0.3	**2.3**	<0.5	<0.5	<0.5	<.005	0.29	--	

Notes & Abbreviations:

TOC Elevation - Top of casing elevation surveyed on October 5, 2018 by Virigl Chvez Land Surveying using NAVD 88 benchmark elevation. Reported in feet above mean sea level.

TPH = Total petroleum hydrocarbons as gasoline (TPHg), diesel (TPHd), and/or motor oil (TPHmo) range by EPA Method 8015.

PCE = Tetrachloroethene

TCE = Trichloroethene

DCE = Dichloroethene

VOCs = Volatile organic compounds by EPA Method 8260.

Other VOCs = Volatile organic compounds not otherwise listed

ft bgs = Feet below ground surface

amsl - above mean sea level

µg/L = Micrograms per liter

< n = Chemical not present at a concentration in excess of detection limit shown.

-- = Not applicable or not available

ESL = Environmental Screening Level, from California Regional Water Quality Control Board - San Francisco Bay Region, Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater, January 2019 (Revision 2).

MCL = Maximum Contaminant Level, from United States Environmental Protection Agency, National Primary Drinking Water Regulation

a= Bromodichloromethane detected at 0.57 ug/L, below its Tier 1 ESL of 0.87 ug/L.

BOLD = Analyte detected above Tier 1 ESL.

APPENDIX A

Human Health Risk Assessment

Exponent®

Human Health Risk Assessment

Old Train Depot
APN: 098-0289-02100
20, 22 & 24 S. L Street & 2009 – 2073 Railroad Avenue
Livermore, California
SFRWQCB Case No. 01S0831
Global ID T10000016758

Exponent®

Human Health Risk Assessment Report

Old Train Depot
APN: 098-0289-02100
20, 22 & 24 S. L Street & 2009 – 2073 Railroad Avenue
Livermore, California
SFRWQCB Case No. 01S0831
Global ID T10000016758

Prepared for

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On behalf of

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January 13, 2022

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Acronyms and Abbreviations

AF	attenuation factor
ACH	air exchange rate
bgs	below ground surface
Cal/EPA	California Environmental Protection Agency
COPC	chemical of potential concern
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
ESL	environmental screening level
HI	hazard index
HQ	hazard quotient
HHRA	human health risk assessment
J&E	Johnson and Ettinger
NCP	National Contingency Plan
OEHHA	Office of Environmental Health Hazard Assessment
PCE	tetrachloroethene
RBSL	risk-based screening level
RfC	reference concentration
RME	reasonable maximum exposure
SFRWQCB	San Francisco Regional Water Quality Control Board
TF	transfer factor
UCL	upper confidence limit
URF	unit risk factor
USCS	Unified Soil Classification System
USDA	United States Department of Agriculture
VOC	volatile organic compound

1 Introduction

At the request of Pangea Environmental Services, Inc. (Pangea), on behalf of the City of Livermore, Exponent prepared this human health risk assessment (HHRA) for the Old Train Depot property located at 20, 22 & 24 S. L Street & 2009-2073 Railroad Avenue, Livermore, California (APN: 098-0289-02100). This HHRA report is included as Appendix H of the Data Gap Assessment Report, prepared by Pangea.

1.1 Purpose of the HHRA

This HHRA evaluates human health risks associated with potential exposure to volatile organic compounds (VOCs) in soil gas via inhalation of indoor air under a residential scenario. The objective of the HHRA is to assess whether concentrations of VOCs detected in Site soil gas pose unacceptable risks to human health under site-specific development and exposure conditions. Planned development at the Old Train Depot site includes construction of two multi-family residential buildings, each with underground parking garages. Both parking garages will comply with California building code measures which require each garage to prevent airflow from the garage to occupied spaces. If the garages function per code requirements, no soil gas would enter any permanently occupied space (i.e., the vapor intrusion pathway would be incomplete). However, as a conservative measure, this HHRA estimates risks assuming VOCs in subsurface soil gas migrate to indoor air of the garage (vapor intrusion) and ten percent of the air in the garage migrates into occupied residential units.

This report presents the methods and findings of the HHRA.

1.2 Findings of the HHRA

Based on the data and site-specific evaluations presented below, the estimated risks associated with potential residential exposures to VOCs in soil vapor via the vapor intrusion pathway are less than one in a million (1×10^{-6} or 1E-06). The estimated noncarcinogenic hazards are less than the threshold of one. Thus, estimated risks are well within levels considered by California

Environmental Protection Agency (Cal/EPA) and the United States Environmental Protection Agency (EPA) to be protective of human health and that do not warrant further action.

2 Human Health Risk Assessment Methods

The objective of this HHRA is to evaluate human health risks associated with potential exposure to volatile organic compounds (VOCs) in soil vapor via inhalation of indoor air under a residential scenario. The methods used in this HHRA are consistent with Cal/EPA (DTSC 2011; 2019; SFRWQCB 2019; Cal/EPA 2020) and EPA (1989; 2015; 2020) guidance for risk assessment and vapor intrusion analysis.

The following sections discuss the components of the HHRA. Section 2.1 describes the exposure scenarios identified for evaluation in this HHRA. Section 2.2 describes the data, chemicals of potential concern (COPCs), and concentration terms considered in this HHRA. The methodologies for calculating cancer risks and non-cancer hazard indices are presented in Section 2.3. The results of the HHRA are presented in Section 3.

2.1 Exposure Scenarios Identified for this HHRA

The exposure scenario considered in this HHRA is potential inhalation of VOCs that may migrate from the subsurface soil gas into indoor air of the two planned multi-family residential units. Evaluation of this exposure scenario was identified based on the current understanding of Site history, suspected sources of chemicals identified at the Site, the mechanisms by which the chemicals might be released and transported in the environment, anticipated future land use, and the means by which the receptors could come in contact with the chemicals. These elements were considered to develop the vapor intrusion conceptual site model for this HHRA, which is illustrated in Figures 1 and 2.

2.1.1 Site History

As described in the Pangea Data Gap Assessment report, historical use of the Site included:

- Multiple railroad lines that ran parallel and approximately 100 to 350 ft. south of Railroad Avenue;
- Former railroad depot building (Southern Pacific Railroad) at 22 South L Street; and

- Former lumber storage yard located at the corner of Railroad Avenue and L Street.

Properties in the vicinity of the Site include:

- Former dry cleaner operations (J Cleaners) at 2093 Railroad Avenue and former dry cleaner operations (Quality Cleaners) at 2048 First Street;
- Auto body operations at 2121 and 2139 Railroad Avenue; and
- Various other commercial and industrial site uses as well as paved parking lots.

2.1.2 Potential Contaminant Sources

Environmental investigations have identified VOCs (primarily, tetrachloroethene [PCE]) in soil gas and groundwater underlying the Old Train Depot site. PCE has not been detected in soil. No source for PCE has been identified at the Site, and a review of historical site uses suggest that it is unlikely past operations on the site resulted in significant sources of the VOCs identified in soil gas and groundwater. Rather, as described in the Pangea Data Gap Assessment report, consideration of multiple lines of evidence strongly suggests that historical dry-cleaning operations at the upgradient off-site former Quality Cleaners were the primary source of VOCs detected at the Old Train Depot Site.

2.1.3 Potential Contaminant Release and Transport

Historical releases from the former dry-cleaning operations at Quality Cleaners have impacted the underlying subsurface with VOCs at that off-site property. Chemicals associated with former dry-cleaning operations, including PCE and its breakdown products, have been identified in soil, soil gas, and groundwater underlying the Quality Cleaners site. Investigations performed at the Old Train Depot site have detected PCE in soil gas and groundwater that likely migrated from the upgradient Quality Cleaners site. As discussed in the Pangea Data Gap Assessment report, multiple lines of evidence suggest that PCE released from the former Quality Cleaners dry cleaning facility migrated vertically down to perched and shallow groundwater beneath the Quality Cleaners site and then migrated downgradient beneath the Old Train Depot Site. Although perched groundwater was not identified during the recent 2021 sampling event, perched groundwater was historically encountered at depths between 31 to 35

feet below ground surface (bgs) and 40 to 46 feet bgs. The highest PCE concentrations reported in perched groundwater have been found beneath the Quality Cleaners site, with concentrations decreasing downgradient towards the Old Train Depot Site. It is likely that as the former perched groundwater evaporated or percolated deeper, residual PCE volatilized into soil gas beneath the Old Train Depot site. This conceptual understanding of the Site is supported by the distribution of PCE concentrations in the subsurface; PCE concentrations are generally higher near the suspected subsurface vapor source (perched groundwater zone) and decrease vertically upward toward the ground surface.

VOCs, including PCE, detected in subsurface soil gas have the ability to migrate into indoor air of a building via vapor intrusion. The vapor concentrations attenuate, or decrease, as they migrate upwards as a result of diffusion and advection, couple with the dilution that occurs when the vapors enter a building and mix with indoor air.

2.1.4 Potentially Exposed Population and Exposure Pathways

Currently, there are no buildings present on the Site, and the property is not used for any purpose. Planned development of the Site consists of two multi-family residential buildings (Buildings A [North Building] and Building B [South Building]) and a communal park (Veteran's Park). The proposed configurations of the planned buildings are shown in Figure 3.

Each building will be constructed with a subterranean parking garage and four levels of above-ground multi-family residential housing. Building A (North Building) will include a 24,295 square foot subterranean parking garage and four levels of multi-family housing consisting of 79 residential units. Construction of the Building A (North Building) parking garage will involve excavation of soil to various depths; (1) soils in the 2,284 square foot stack lift area will be excavated to 20 feet bgs; (2) soils in the 10,373 square foot area in the western portion (Left Section) of the garage will be excavated to 12 feet bgs; and (3) the 11,638 square foot area near the garage entrance on the eastern side (Right Section) of the garage will be excavated to 10 feet bgs. Building B (South Building) will include a 16,731 square foot subterranean parking garage and four levels of multi-family housing consisting of 51 residential units. Construction of the Building B (South Building) parking garage will involve excavation of soil to 9 feet bgs. The

underground parking garages of both buildings will underlie the entire footprint of the above-ground residential units.

Parking in the garage will be restricted to residents and guests of the multi-family housing units. While building maintenance workers may enter the garage to service utilities on an occasional basis, the parking structures are designed so that parking attendants are not required. Further, the parking structure will be constructed to meet requirements established in California building codes for ventilation and pressure, which are designed to increase air circulation, eliminate chemicals associated with vehicle exhaust (in particular, carbon monoxide), and prevent air in the garage from flowing into occupied residential units. Because the frequency and duration that individuals will spend in the parking structure are negligible compared to the daily potential exposure assumed for a future resident of the multi-family residential units and the garages will meet requirements developed to significantly reduce or eliminate chemicals in the garage, potential inhalation exposures inside the parking structures from vapor intrusion are considered to be minimal and are not evaluated in this HHRA.

Based on the planned redevelopment of the site for multi-family residential use, residents of the multi-family units were identified as the primary potentially exposed populations identified in the HHRA. The exposure scenario evaluated was inhalation of VOCs migrating from soil gas into indoor air of the garage and then to the future residential units within the two buildings. As discussed previously, California code requires that garages must be designed to ensure that air in the garage does not migrate into the residential units. However, to be conservative, the HHRA assumes a significant fraction (10 percent) of the air in the garage flows into the residential units. Only inhalation of VOCs in indoor air of the residential units was evaluated since outdoor concentrations of VOCs related to the subsurface vapor source are expected to be lower than indoor air concentrations due to greater mixing and dilution in the ambient environment.

In summary, the exposure scenario and pathway considered in this HHRA includes:

- Residential inhalation exposure to VOCs migrating from soil gas to indoor air of a multi-family residential unit (vapor intrusion pathway)

2.2 Data Evaluation and Selection of COPCs

This section discusses the analytical data considered in this HHRA, the process used to select the chemicals of potential concern (COPCs), and the concentration term used to evaluate each COPC.

2.2.1 Data Considered in the HHRA

Soil gas samples are considered by CalEPA (2011; 2020) to provide the most representative samples for evaluating vapor intrusion exposures for occupants of future buildings. Therefore, in accordance with CalEPA guidance, Exponent evaluated potential risks associated with migration of VOCs from the subsurface using soil gas data collected at the Site.

All analytical results from soil gas samples presented in Table 3 of the Pangea Data Gap Assessment Report (adapted for Table 1 of this HHRA report) were considered for inclusion in this HHRA. The soil gas sampling locations are shown on Figure 3. A detailed discussion of the methods used to collect soil gas samples at the Site as well as the findings of investigations performed at the Site are provided in the Pangea Data Gap Assessment report.

2.2.2 Selection of Chemicals of Potential Concern (COPCs)

COPCs were selected for quantitative assessment in this HHRA when the maximum concentration of the chemical detected in soil gas exceeded the San Francisco Regional Water Quality Control Board (SFRWQCB) residential Environmental Screening Levels (ESLs). This approach is consistent with SFRWQCB (2019), DTSC (2020) and EPA (2021) guidance, which indicates that chemical concentrations below the agency-recommended default screening levels, such as the ESLs, are expected to be protective of human health and, thus, do not warrant further evaluation or action. Elimination of chemicals with concentrations below the ESLs allows risk managers to focus on those chemicals likely to contribute most to the overall risks at the site.

Table 1 presents a comparison of the maximum concentrations of each chemical detected in soil gas to the SFRWQCB ESLs for residential land use. As shown in Table 1, only PCE and

benzene were detected at concentrations above the residential ESLs for soil gas. Thus, PCE and benzene were identified as COPCs and are quantitatively evaluated in this HHRA.

2.2.3 Concentration Terms

As shown in Table 1 and discussed in detail in the Pangea Data Gap Assessment report, soil gas samples were collected at the Old Train Depot site in 2015, 2018, and more recently in 2021. The more recent data is considered the most representative of current site conditions. Thus, for this HHRA, the results from the most recent soil gas samples were selected for inclusion in the HHRA when a soil gas sample was collected at the same location and depths as a previous sample. Further, data collected within the building footprint of the planned buildings are more representative of the concentrations that are likely to migrate vertically from the subsurface to indoor air of a building. Consideration of data from 5 feet bgs is not representative of anticipated future site conditions because soil gas within the footprint will be removed when soils are excavated from 9 to 20 feet bgs during construction of the planned parking garages. Therefore, only the soil gas data collected from 15 to 25 feet bgs were identified for inclusion in this HHRA. Table 2 identifies the most recent soil gas data collected within the building footprints at depths between 15 and 25 feet bgs considered in this HHRA.

To be conservative (i.e., health-protective), the maximum concentrations reported closest (25 feet bgs) to the subsurface vapor source (perched groundwater zone of 31 feet bgs) were selected for use as the concentration terms in this HHRA. For PCE, the concentration terms are the maximum concentration reported at 25 feet bgs in the more recent soil gas samples collected at the Site; these concentration are also the maximum concentration of PCE reported in recent soil gas samples collected beneath the footprints of the buildings. For Building A, the maximum concentration of benzene was also detected at 25 feet bgs; this maximum concentration was used in the site-specific HHRA for Building A. Benzene was not detected in the recent 25 feet bgs soil gas sample collected beneath planned Building B; thus, to be conservative, the maximum concentration reported in 15 feet bgs soil gas was used. The benzene concentration reported in the 15 foot sample is also the maximum concentration detected in recent soil gas samples collected beneath the footprint of planned Building B. Use of the maximum concentration provides a risk estimate for the worst-case exposure scenario;

thus, if the risks estimated using the maximum concentration are acceptable, exposure to all concentrations reported in soil are considered protective of human health. However, EPA (2002) recommends using the 95th upper confidence limit (95UCL) of the arithmetic mean concentration for purposes of estimating reasonable maximum or upper-end exposures when sufficient data are available. For comparison, the 95UCLs of all soil gas data collected at the Site are presented in Table 2[1]. Exponent used EPA ProUCL version 5.1 to calculate the 95UCL for PCE and benzene; the ProUCL printout is provided in Appendix A. However, the 95UCLs are not used to estimate risk in this HHRA because the maximum concentration detected in recent samples provides a conservative (i.e., health-protective) representation of exposure.

[1] 95UCLs were not calculated for the recent data collected beneath the footprint of the buildings because the EPA (2015) ProUCL Version 5.1 User Guide recommends calculation of a 95UCL using at least 8 to 10 samples.

2.3 Methodology for Calculating Risks

The methods used to estimate carcinogenic risks and noncarcinogenic hazard indices are described in this section. The methods used a three-step process as follows:

1. Agency-recommended risk-based screening levels (RBSLs) for residential indoor air were selected for COPCs.

2. Concentrations of COPCs in indoor air of the residential units were estimated using the results of soil gas samples collected in the subsurface.

3. The indoor air RBSLs and estimated indoor air concentrations were used to estimate cumulative cancer risks and non-cancer hazard indices associated with simultaneous exposure to all COPCs.

2.3.1 Risk-based Screening Levels

RBSLs selected for use in this HHRA are the residential environmental screening levels (ESLs) for indoor air developed by the SFRWQCB (2019). ESLs are generic screening levels that have been derived using standard default exposure assumptions and EPA- or CalEPA-recommended toxicity values. The default exposure parameters used to develop the ESLs and, thus, considered in this HHRA are based on a reasonable maximum exposure (RME) scenario, which is defined by EPA as the highest exposure that could reasonably be expected to occur for a given exposure pathway at a site (EPA 1989). To achieve this goal, the RME scenario uses highly conservative exposure assumptions. For example, under RME conditions, a resident is assumed to be exposed to COPCs migrating from soil gas to indoor air for 24 hours per day, 350 days per year for 26 years. This scenario also assumes that COPC concentrations in soil gas do not decrease over time.

The ESLs correspond to a cancer risk level of one in a million (1×10^{-6} or also notated as 1E-06), the level at the more conservative end of the target risk range of one in a million to 100 in a million (1×10^{-6} to 1×10^{-4} or also notated as 1E-06 to 1E-04) considered by EPA and CalEPA to be protective of human health. A hazard quotient of one (1) is used as the basis for the non-cancer screening levels.

For PCE, the residential indoor air ESLs are 0.46 µg/m^3 (cancer endpoint) and 42 µg/m^3 (non-cancer endpoint). The residential indoor air ESLs for benzene are 0.097 µg/m^3 (cancer endpoint) and 3.1 µg/m^3 (non-cancer endpoint). As discussed in the SFRWQCB (2019) ESL Users Guide, background or ambient concentrations can be greater than the ESLs. If site-specific background or ambient concentrations are greater than the ESLs, the background concentrations may be considered in an HHRA. While site-specific ambient air samples have not been collected at this Site to date, benzene in particular is commonly found in ambient air at levels above the residential air ESLs[2]. Further, benzene concentrations reported in indoor air are often related to sources other than subsurface soil vapor, including vehicle emissions and storage in garages.

In general, generic screening levels are more stringent (i.e., more likely to significantly overstate actual risks) than Site-specific screening levels due to the conservative nature of the assumptions used. Thus, as noted previously, when contaminant concentrations are below generic screening levels, no further action or study is typically warranted. Further, these screening levels are not intended for use as cleanup levels; however, additional evaluation could be warranted to determine whether concentrations exceeding screening levels potentially pose significant health risks.

2.3.2 Estimation of Residential Unit Indoor Air Concentrations

Concentrations of COPCs in indoor air of the residential units were estimated using a two-step process. First, the migration of COPCs in soil vapor from the subsurface to indoor air of the garage was estimated using attenuation factors (AFs) calculated using the EPA spreadsheet-based model (EPA Version 6.0), which is based on the vapor intrusion model Johnson & Ettinger (J & E) (1991). Second, an inter-unit transfer factor (TF) was used to estimate the concentration of the chemical that is predicted to enter the residential units from the garage.

[2] The California Air Resources Board Annual Statewide Toxic Summary presents VOC concentrations, including benzene, measured in air monitoring stations throughout California. In 2019 (the last full reported year), benzene was detected in California air monitoring stations at concentrations ranging from 0.025 to 0.86 parts per billion (ppb) (0.079 to 2.75 µg/m^3), with a mean of 0.174 ppb (0.56 µg/m^3). https://www.arb.ca.gov/adam/toxics/statepages/benzstate.html

The factors were combined with the COPC concentration terms for soil gas to yield an estimated concentration in indoor air using the following equation:

$$C_{IA-Res} = C_{sg} \times AF \times TF$$

Where:

C_{IA-Res}	=	estimated indoor air concentration in residential unit (µg/m^3)
C_{sg}	=	soil gas concentration (µg/m^3)
AF	=	attenuation factor for migration of soil gas to garage indoor air (unitless)
TF	=	inter-unit transfer factor for transfer of garage air to indoor air of residential unit (unitless)

The methods used to estimate the soil gas attenuation factors and select an inter-unit transfer factor are described below. The EPA J & E model input parameters used in the HHRA to calculate soil gas attenuation factors are presented on Tables 3 and 4. The resultant soil gas attenuation factors are presented in Table 5. Table 6 presents the indoor air concentrations estimated using the soil gas concentrations terms for PCE and benzene, estimated soil gas attenuation factors and inter-unit transfer factor.

2.3.2.1 Soil Gas Attenuation Factor

The EPA Johnson and Ettinger (J & E) model spreadsheet tool (EPA Version 6.0)[3] was used to calculate Site-specific attenuation factors which represent the attenuation or decrease in concentrations expected as the COPCs migrate from soil gas to garage indoor air.

2.3.2.1.1 Johnson & Ettinger Model

The J & E model incorporates both convective and diffusive mechanisms for estimating the transport of vapors emanating from subsurface media impacted by VOCs into indoor spaces. The major assumption of the J&E model is that the model is one-dimensional and transport is directed exclusively into the building. That is, vapors only migrate upward from the impacted subsurface media and into the building. Lateral deflection due to the presence of low

[3]EPA J & E Model was obtained from https://www.epa.gov/vaporintrusion/epa-spreadsheet-modeling-subsurface-vapor-intrusion

permeability units or multi-dimensional diffusive transport that reduces the amount of VOC mass that may enter the indoor space is conservatively ignored (i.e., ignoring that diffusion is, physically and mathematically, a three-dimensional process).

Other assumptions/limitations of the J&E model are as follows (EPA 2004):

- Contaminant vapors enter the structure primarily through cracks and openings in the walls and foundation
- Convective transport occurs primarily within the building zone of influence and vapor velocities decrease rapidly with increasing distance from the structure
- Diffusion dominates vapor transport between the source of contamination and the building zone of influence
- All vapors originating from below the building will enter the building unless the floors and walls are perfect barriers
- All soil properties in any horizontal plane are homogenous
- The contaminant is homogeneously distributed within the zone of contamination
- The areal extent of contamination is greater than that of the building floor in contact with the soil
- Vapor transport can occur in the absence of convective water movement within the soil column (i.e., evaporation or infiltration), and in the absence of mechanical dispersion
- The model does not account for transformation processes (e.g., biodegradation, hydrolysis, etc.). In particular, the model does not account for biodegradation of petroleum hydrocarbons, such as benzene, which are known to degrade under the aerobic environmental conditions present at

many sites. The potential impact of this model limitation on the HHRA of this model limitation is discussed further in Section 3.3.

- The soil layer in contact with the structure floor and walls is uniform with respect to permeability

- Both the building ventilation rate and the difference in dynamic pressure between the interior of the structure and the soil surface are constant values

2.3.2.1.2 J & E Model Input Parameters

Site-specific and agency-recommended default parameters were used in the EPA J&E model spreadsheet tool (Version 6.0) to determine soil gas attenuation factors. It is important to note that the J & E model was only used to estimate the attenuation factors[4]. The EPA version of the J & E model was not used to estimate risks because the EPA-recommended toxicity values used in the J & E model are less conservative and, thus, not consistent with those recommended by Cal/EPA (DTSC 2019).

The J & E input parameters used to develop soil gas attenuation factors in this HHRA are presented in Tables 3 and 4. The calculated soil gas attenuation factors are presented in Table 5. The J & E input parameters and calculated soil gas attenuation factors are also shown in the model output printouts provided in Appendix B. Key input parameters are discussed below:

Depth Below Grade to Soil Gas Sample

During site investigation activities, soil gas samples have been collected from 5 to 25 feet bgs. Consistent with CalEPA (2020) guidance, soil gas concentrations reported in samples collected at 25 feet bgs and, thus, closest to the subsurface vapor source (perched groundwater zone of 31 feet bgs) were selected as the concentration terms in this HHRA. Given that construction of the subterranean garages requires excavation of soils and associated soil gas to depths of 9 to 20 feet bgs, near-source COPC concentrations are considered most representative of vapors that

[4] A soil gas concentration is not required to calculate attenuation factors; therefore, the soil gas concentration is set to a value of 1 $\mu g/m^3$ rather than the site-specific soil gas concentrations used to estimate risks in this HHRA.

may migrate from the subsurface to the garage. Further, COPC concentrations reported in soil gas samples are generally greatest at 25 feet bgs and decrease vertically upward toward the ground surface (Table 1). Thus, evaluation of soil gas samples collected at a depth of 25 feet below grade likely provides an upper-bound estimate of the COPC concentrations migrating from the subsurface to indoor air of the garages.

Soil Type

The soil types used in the J & E model are based on the United States Department of Agricultural (USDA) soil classification system. In contrast, the Unified Soil Classification System (USCS) is used by geologists when characterizing sites and developing associated boring logs. To identify the USDA soil type for this HHRA, an Exponent certified associate professional soil scientist reviewed the geological information and boring logs prepared and provided by Pangea and relied on J & E guidance to translate the USCS classification to the USDA soil type for use in the model. Critically, USDA soil texture considers only sand, silt, and clay fractions, not gravel. The Pangea boring logs and an Exponent table (Table C-1) presenting the translation from USCS to the USDA soil type classifications are presented in Appendix C. As shown on Table C-1, the USDA soil textures ranged from sand to silt to sandy clay loam. Based on review of the site boring logs and understanding of the geology in the area, the most frequent soil textures at the Site were sandy loam, silt loam and loamy sand. Texture differences within individual boring logs indicate inter-bedding of coarser and finer textured soils. For purposes of the J & E model, we assigned the soil types as sandy loam from 0 to 15 feet bgs and silt loam from 15 to 25 feet bgs[5].

Foundation Type

Building types included in the J & E model do not include an underground garage. However, the J & E model basement with slab building type was deemed sufficiently similar to that of an

[5] For Building A (North Building), soils will be excavated to 20 feet bgs to construct the stack lift portion of the underground parking garage. To calculate attenuation factors for this area, soils were assumed to be sandy loam to the base of the foundation (20 feet bgs) and silt loam from 20 to 25 feet bgs because the J & E model does not allow consideration of more than one soil type from ground surface to the base of the foundation.

underground garage with slab and, thus, was selected to estimate soil gas attenuation factors for this HHRA.

Depth Below Grade to Base of Foundation

The depths below grade to base of foundation were identified as the depth of excavation planned for construction of the Building A and Building B subterranean garages. As discussed in Section 2, construction of the Building A (North Building) parking garage will involve excavation of soil to various depths; (1) soils in the 2,284 ft^2 (212 m^2) stack lift area will be excavated to 20 ft (6.1 m); (2) soils in the 10,373 ft^2 (964 m^2) area in the western portion (Left Section) of the garage will be excavated to 12 ft (3.7 m); and (3) the 11,638 ft^2 (1,081 m^2) area near the garage entrance on the eastern side (Right Section) of the garage will be excavated to 10 ft (3 m). Construction of the Building B (South Building) parking garage will involve excavation of soil to 9 ft (2.7 m).

Building Dimensions

Site-specific garage dimensions (e.g., slab foundation thickness, enclosed space floor area, mixing height) obtained from construction design documents were used in the model to estimate soil gas attenuation factors and are presented in Table 3.

Air Exchange Rate

As discussed in Section 2, underground parking structures are required to meet the California building codes for ventilation and pressure. The codes were established to limit buildup of chemicals associated with vehicle exhaust (in particular, carbon monoxide) and prevent air in the garage from migrating into residential units. The California Mechanical Code mandates a ventilation rate of 0.75 cubic feet per minute per square foot (cfm/sf^2) for garages which correspond to an air exchange rates of approximately 3 and 4 exchanges per hour (Table 4). However, the California Energy Commission allows a lower ventilation rate (0.15 cfm/ft^2) in garages when the system includes approved sensors which measure carbon monoxide levels in the garage increase ventilation when a specified level is reached. Both the California Mechanical and California Energy building codes require that garages maintain negative or

neutral pressure relative to other occupiable spaces in order to prevent any air in the garage from migrating into those spaces.

According to the mechanical engineers for the planned development at the Old Train Depot site, Buildings A and B garages will be designed to meet or exceed the minimum ventilation rates (0.15 cfm/ft^2) required in the building codes. At this time, it is anticipated that the system will typically operate at 0.15 cfm/ft^2; however, in accordance with the California building codes, greater ventilation will be deployed when the carbon monoxide sensors are triggered. The system has been designed to achieve ventilation rates up to and including the levels required in the California Mechanical Code (0.75 cfm/ft^2) when necessary. Thus, it is anticipated that the average ventilation rate will be greater than the minimum levels established by the California Energy Commission on most days. To be conservative, this site-specific HHRA used air exchange rates corresponding to the minimum ventilation rate of 0.15 cfm/ft^2. These air exchange rates, which are dependent on ventilation rate as well as the area, height, and volume of each garage, are presented in Table 4.

To support for risk management decisions at the Old Train Depot Site, Appendix D presents risks estimated using a range of air exchange rates between 0.7 to 4 exchanges per hour (corresponding to ventilation rates between 0.15 and 0.75 cfm/f^2).

2.3.2.2 Inter-unit Transfer Factor

As discussed above, California building codes require that garages maintain negative or neutral pressure relative to other occupiable spaces in order to prevent any air in the garage from migrating into those spaces. However, for this HHRA, it was conservatively assumed that a significant amount (10 percent) of air in each garage would flow into the residential units. Therefore, an inter-unit transfer factor (TF) of 10 percent was used to estimate the concentration of the chemical that is predicted to enter the residential units from the garage. Use of the TF of 10 percent was recommended by the SFRWQCB and is based on research conducted by the Center for Energy and Environment (CEE 2004). The CEE study investigated indoor airflow between adjacent residential units in multi-family buildings and found that each building had at least one unit for which more than 10 percent of the air entering the unit came from another unit. The building average fraction of inter-unit airflow was 2 percent for a new, four-story

condominium, the building design most similar to planned development at the Old Train Depot Site.

While the study suggests that an airflow of 2 percent is applicable to the planned building design, this estimate also likely overpredicts airflow from an underground garage. The study includes airflow from neighboring units on the same level and is not limited to evaluation of airflow from units below. Further, during colder seasons, much of the air entering the lower unit comes from outdoor fresh air. In addition, this study did not evaluate airflow from a garage into a residential unit. As noted previously, building codes mandate that garages be maintained at specified ventilation rates and pressure to prevent any air from flowing into occupied spaces.

2.3.3 Risk Characterization

The methods used to characterize the risks and non-cancer hazards are discussed below.

2.3.3.1 Estimation of Cancer Risk

Cancer risks are estimated as the incremental probability of developing cancer over a lifetime as a result of exposure to a given chemical at a given concentration. Cancer risks are estimated as follows:

$$Cancer\ Risk = \frac{C_{IA}}{\mathrm{ESL}_{cancer}} \times 10^{-6}$$

Where:

C_{IA} = Estimated indoor air concentration of COPC in residential unit ($\mu g/m^3$)

ESL_{cancer} = SFRWQCB Environmental Screening level for residential indoor air (cancer endpoint) ($\mu g/m^3$)

2.3.3.2 Estimation of Non-cancer Hazard Index

Non-cancer adverse health effects are evaluated by comparing a chemical concentration in a given medium to a non-cancer ESL as follows:

$$\text{Hazard Quotient} = \frac{C_{IA}}{\mathrm{ESL}_{noncancer}}$$

Where:

C_{IA} = Estimated indoor air concentration of COPC in residential unit ($\mu g/m^3$)

$ESL_{noncancer}$ = SFRWQCB Environmental Screening level for residential indoor air (noncancer endpoint) ($\mu g/m^3$)

3 Results of the Health Risk Assessment

The results of the HHRA are presented in this section. To aid in the interpretation of the results, estimated cancer risks and hazards are compared to levels considered by EPA to be protective of human health. The National Contingency Plan (NCP) (40 CFR §300) is commonly cited as the basis for target risk levels. According to the NCP, the EPA recommends an acceptable target cancer risk range of one in a million (1×10^{-6}) to one hundred in a million (1×10^{-4}) for the purpose of risk management decisions at federal Superfund sites. When risks are below one in a million (1×10^{-6}), no further action or study is typically warranted. Estimated risks within this target risk range (1×10^{-6} to 1×10^{-4}) are considered by CalEPA and EPA to be protective of human health.

A hazard quotient (HQ)[6] less than or equal to 1 indicates that the predicted exposure to that chemical should not result in an adverse noncarcinogenic health effect (EPA 1989). It should be noted that HQ values greater than 1 do not necessarily mean that adverse health effects will be observed because a substantial margin of safety has been incorporated into many of the toxicological criteria.

3.1 HHRA Results

Site-specific cancer risks and non-cancer hazards associated with potential residential exposure to COPCs migrating from subsurface soil gas to indoor of the planned multi-family residential units was evaluated in this HHRA and are presented in Table 7. A summary of the cancer risks and non-cancer hazards estimated for the residential scenario using the maximum concentrations of PCE and benzene report in the most recent near-source soil gas samples is provided below.

[6] According to EPA (1989) risk assessment, a hazard quotient (HQ) is estimated for a single chemical; a hazard index (HI) is calculated as the sum of the HQs for multiple chemicals.

Estimated Risks for Residential Exposure to Benzene and PCE in Soil Gas

Building	Estimated Residential Risks	
	Cancer Risk	Non-cancer Hazard Index
Building A (North Building)	1E-07	0.002
Building B (South Building)	1E-07	0.001

As shown above, the estimated residential risks associated with simultaneous exposure to the maximum concentrations, and, thus, all concentrations of benzene and PCE reported in the most recent soil gas samples collected at the Site are less than one in a million (1×10^{-6} or 1E-06). Thus, the estimated risks for residential exposure to benzene and PCE in soil gas via the vapor intrusion pathway are present at levels considered by Cal/EPA and EPA to be protective of human health and that do not warrant further action or evaluation.

As discussed in Section 2, the risk estimated in this HHRA conservatively assumes the ventilation system in the garages operates at the minimum level necessary to meet the California Energy Commission requirements (ventilation rate of 0.15 cfm/sf^2) at all times. However, as discussed previously, periodic increases in ventilation will be required to meet building codes for limit carbon monoxide buildup from engine exhaust in the garage. The system has been designed to achieve ventilation rates up to and including the requirements of the California Mechanical Code (ventilation rate of 0.75 cfm/ft^2 corresponding to an air exchange rate of 4 exchanges per hour) when necessary. To support for risk management decisions at the Old Train Depot Site, Appendix D presents risks estimated using a range of air exchange rates between 0.7 to 4 exchanges per hour (corresponding to ventilation rates between 0.15 and 0.75 cfm/f^2). For this evaluation, only the air exchange rates were modified; all other J & E model input parameters are the same as those described above. Risks estimated using a range of air exchange rates are presented in Appendix D, Table D-1. Higher air exchange rates result in more chemical dilution in air and thus, correspond to lower estimated risks. Since the site-specific HHRA risks estimated in this HHRA (Table 7) used the lowest (most conservative air exchange rate), risks estimates using the higher air exchange rates in Appendix D are lower than those presented in Table 7. Further, all HHRA estimates, including the Site-specific evaluation

presented in Table 7 and those shown on Table D-1, do not account for the fact that the garage is required to maintain negative or neutral pressure which would prevent any air (and all associated chemicals) from entering the residential units.

3.2 Sensitivity Analysis

Numerous soil gas attenuation factors have been published by regulatory agencies in California as well as EPA for use in evaluating the vapor intrusion pathway when site-specific information is not available. These generic attenuation factors do not reflect actual conditions at a given site; rather, they have been developed from research studies or modeling that represent limited geographical areas, site conditions, and building configurations. Similar to generic screening levels, generic attenuation factors are generally more stringent (i.e., more likely to significantly overstate actual risks) than Site-specific factors. Thus, they are often used in screening level assessments to evaluate whether additional evaluation, including further investigation and site-specific risk evaluation is warranted at a site. In general, when contaminant concentrations are below screening levels developed using generic attenuation factors, no further action or study is warranted. Further, screening levels developed using generic attenuation factors are not intended for use as cleanup levels; however, additional evaluation is typically recommended to confirm whether concentrations exceeding these screening levels pose significant health risks.

Given that Site characterization efforts at the Old Train Depot Site have advanced beyond the screening stage of the assessment and that site-specific information which best represents the actual conditions, potential exposures and risks at the site is available, this HHRA was conducted using Site-specific attenuation factors rather than generic attenuation factors. However, to support risk management decisions at the Site, Exponent considered currently available proposed and recommended generic attenuation factors in a sensitivity analysis presented in this section.

The generic attenuation factors considered in this sensitivity analysis include factors proposed and recommended by EPA, SFRWQCB and DTSC as follows:

3.2.1 EPA Generic Soil Gas Attenuation Factors

EPA recommends use of generic soil gas attenuation factors based on observed values reported at sites and contained in EPA's vapor intrusion database up to 2010 (EPA 2012). The database includes paired measurements of soil gas and indoor air collected across the United States, although few were collected in California. Of these measurements, the majority (54 percent) are paired measurement of sub-slab soil gas and indoor air; only 8 percent represent paired measurements of exterior subsurface soil gas and indoor air. Further, most (85 percent) of paired measurements were collected from single-family homes; only 10 percent were collected from commercial or institutional buildings, and no data were identified for underground parking garages. EPA selected an attenuation factor of 0.03 to represent the 95th percentile of observed values reported at sites contained in EPA's vapor intrusion database up to 2010 (EPA 2012). An attenuation factor of 0.003 was identified by EPA as the median value observed in the database.

Use of the attenuation factor of 0.03 (corresponding to the 95 percentile value) is recommended by EPA (2015) for screening purposes and, thus, is incorporated into the EPA vapor intrusion screening levels (VISLs). In 2019, the SFRWQCB updated the ESLs to incorporate the EPA attenuation factor of 0.03. Although the guidance has not yet been finalized, the Cal/EPA (2020) *Draft Supplemental Guidance: Screening and Evaluating Vapor Intrusion* also recommends using the attenuation factor of 0.03 as a screening tool at small vapor intrusion sites in California. Consistent with agency guidance, the SFRWQCB ESLs, which were developed using the attenuation factor of 0.03, were used as a screening tool to identify COPCs for this HHRA (Section 2.2.2). However, given that Site characterization efforts at the Site have advanced beyond the screening stage of the assessment and that the screening attenuation factor of 0.03 does not reflect current or future site conditions, this HHRA was conducted using Site-specific attenuation factors.

The median attenuation factor (0.003) reported in the EPA's vapor intrusion database (EPA, 2012) may be considered for screening purposes when sufficient data are available. The attenuation factor of 0.003 does not reflect current or future site conditions at the Old Train Depot site. As noted above, the data contained in the database do not include paired measurements for soil gas and indoor air of a garage. Further, most of the soil gas

measurements were obtained from just beneath the foundation (sub-slab) of single-family residential homes and thus, the attenuation factor of 0.003 is applicable to sub-slab data rather than near source data. Sub-slab soil gas data are not available at the Old Train Depot site since the site is vacant and the planned buildings have not yet been constructed. However, for screening purposes, Exponent has included an evaluation of the risks using the maximum concentrations reported in soil gas samples collected closest (depth of 15 feet bgs) to the proposed building foundation (sub-slab). The maximum concentrations reported in a soil gas sample closest to the garage foundation (15 to 20 feet bgs) were used in this screening level evaluation because the EPA attenuation factor of 0.003 is applicable to sub-slab soil gas. Sub-slab data are not available for the site because the site is currently vacant. Use of the maximum concentration reported in soil gas samples collected from 15 to 20 feet bgs is conservative since the chemical concentrations would likely attenuate or decrease as they migrate vertically upward to sub-slab of the future buildings.

The results of this screening assessment are presented in Appendix E, Table E-1. As shown in Table E-1, the results of this screening level assessment are at the lower end and thus well within the risk range considered by Cal/EPA and EPA to be protective of human health.

3.2.2 DTSC Default Attenuation Factors for Soil Gas

DTSC (2011) has also developed default attenuation factors for use in evaluating exterior subsurface soil gas collected near the contaminant source at sites in California. These attenuation factors were developed using a DTSC-modified version of the J & E model and conservative assumptions regarding site conditions and exposure. The DTSC (2011)-recommended default soil gas attenuation factor for future residential buildings is 0.001. However, use of the DTSC default for future commercial buildings (0.0005) is likely more appropriate for a screening-level evaluation of a garage than the residential attenuation factors. For this sensitivity analysis, Exponent calculated screening-level risks using both the DTSC default soil gas attenuation factor of 0.001 (future residential building) and 0.0005 (future commercial building) in Tables E-2 and E-3, respectively. Similar to the Site-specific HHRA described above, the soil gas concentrations considered closest to the source was used in this assessment, thus, the same concentration terms used in the Site-specific HHRA were used. The

maximum concentration reported in recent soil gas samples collected near the source was used in this screening level evaluation because the DTSC attenuation factors of 0.001 is recommended for evaluation of subsurface soil gas near the contaminant source. Thus, the same concentration terms used in the Site-specific HHRA were used for this evaluation. For PCE, the concentrations are the maximum concentration reported at 25 feet bgs in the more recent soil gas samples collected at the Site; these concentration are also the maximum concentration of PCE reported in recent soil gas samples collected beneath the footprints of the buildings. For Building A, the maximum concentration of benzene was also detected at 25 feet bgs; this maximum concentration was used in the site-specific HHRA for Building A. Benzene was not detected in the recent 25 feet bgs soil gas sample collected beneath planned Building B; thus, to be conservative, the maximum concentration reported in 15 feet bgs soil gas was used. The benzene concentration reported in the 15 foot sample is also the maximum concentration detected in recent soil gas samples collected beneath the footprint of planned Building B. As shown in Tables E-2 and E-3, the risks estimated using the DTSC default attenuation factors are at levels considered by CalEPA and EPA to be protective of human health.

3.3 Uncertainty Analysis

Uncertainty is inherent in many aspects of the risk assessment process. Uncertainty generally arises from a lack of knowledge as well as variability of 1) site conditions and future site use; 2) toxicity and dose-response of the chemicals evaluated; and/or 3) the extent to which an individual may be exposed (if at all) to the chemicals. This lack of knowledge means that assumptions must be made based on information presented in the scientific literature or on professional judgment. Although some assumptions have significant scientific basis, many do not. The assumptions that introduce the greatest amount of uncertainty, and their effects on the findings of this HHRA, are discussed below. This discussion is qualitative in nature, reflecting the difficulty in quantifying the uncertainty in specific assumptions. In general, assumptions were selected in a manner that purposely biases the process toward health protection.

3.3.1 Concentration Term

Estimated excess cancer risks and non-cancer hazard indices were calculated using the maximum concentration reported in the most recent near-source soil gas sample collected at 25 feet bgs. Assuming long-term exposure to the maximum concentration reported in recent soil gas samples is expected to overestimate the risk since all other concentrations reported in recent soil gas samples collected beneath the building footprints are lower.

3.3.2 J & E Model Limitations

Limitations associated with the J & E model are identified in Section 2.3. One important, and potentially influential limitation for this HHRA, is that the model does not account for transformation processes, including biodegradation. In particular, it does not account for biodegradation of petroleum hydrocarbons, such as gasoline and diesel, which are known to readily biodegrade under aerobic (oxygenated) environmental conditions of many sites (EPA 2012). Biodegradation refers to the process by which chemicals are altered through the biological activity of microorganisms in the subsurface, reducing them to nontoxic end products. When present, biodegradation limits upward migration of petroleum vapors (referred to as bioattenuation), in many cases rendering the vapor intrusion pathway incomplete (SFRWQCB 2019). Biodegradation is influenced by the concentration of the vapor source, distance the vapor must travel through soil from the source to potential receptors, and the presence of oxygen in the subsurface environment between the source and potential receptors (ITRC 2014). Under appropriate conditions and with confirmation that biodegradation is occurring, the vapor intrusion pathway for petroleum hydrocarbons can be eliminated from further consideration. A number of scientific and regulatory guidelines, including the California State Water Resources Control Board (SWRCB 2012) Low-Threat Underground Storage Tank Case Closure Policy, identify specific criteria for screening out the vapor intrusion pathway for petroleum hydrocarbons. Since these criteria and biodegradation are not included in the J & E model, they were not considered in this HHRA. Therefore, if biodegradation is occurring at the Old Train Depot Site, the HHRA over-estimates the risks for benzene in soil gas at the Site.

3.3.3 Exposure Assessment

The exposure assessment in this HHRA is based on a reasonable maximum exposure (RME) scenario, which is defined by EPA as the highest exposure that could reasonably be expected to occur for a given exposure pathway at a site (EPA 1989). To achieve this goal, the RME scenario uses highly conservative exposure assumptions. For example, this HHRA assumes that a future onsite resident is present at the site 24 hours per day, 350 days per year, for 26 years. These and other upper-bound default estimates of exposure most likely overestimate the potential health risks associated with the Site.

3.3.4 Toxicity Assessment

One of the largest sources of uncertainty in any risk assessment is the limited understanding of toxicity to humans who are exposed to the low concentrations that are generally encountered in the environment. The majority of the available toxicity data are from animal studies; these data are extrapolated using mathematical models or multiple uncertainty factors to predict what might occur in humans. Sources of conservatism in the toxicity criteria used in this HHRA include:

- The use of conservative methods and assumptions to extrapolate from high-dose animal studies to predict the possible response in humans at exposure levels far below those administered to animals
- The assumption that chemicals considered to be carcinogens do not have thresholds (i.e., for all doses greater than zero, some risk is assumed to be present)
- The fact that epidemiological studies (i.e., human exposure studies) are limited and are not generally considered in a quantitative manner in deriving toxicity values.

In aggregate, these assumptions lead to overestimates of risk, such that the actual risk is unlikely to be higher than the estimated risk, but could be considerably lower.

Consistent with DTSC (2019) guidance, this HHRA incorporated toxicity values recommended by the California Office of Environmental Health Hazard Assessment (OEHHA). For PCE, toxicity values recommended by OEHHA for evaluation of cancer risk are significantly more conservative than those recommended by EPA. The unit risk factor (URF) recommended by OEHHA to estimate inhalation cancer risk for PCE of 6.1×10^{-6} $(\mu g/m^3)^{-1}$ is approximately 23-fold greater (more stringent) than the value recommended by EPA of 2.6×10^{-7} $(\mu g/m^3)^{-1}$.

3.3.5 Risk Characterization

The uncertainties associated with risk characterization are generally the result of the combined uncertainties in the site conditions, exposure assumptions, and toxicity criteria. In this HHRA, potential health risks were quantified for future residents associated with exposure to chemicals in soil gas through inhalation of vapors in indoor air. Given the highly conservative nature of the exposure parameters used to characterize this pathway, especially for the RME scenario, it is unlikely that the same receptor would be exposed at that level over the entire duration of exposure. These conservative estimates of exposure were then combined with even more conservative estimates of acceptable exposure (reference concentration [RfC]) or carcinogenic potency (URF) to estimate the magnitude (non-cancer) or likelihood (cancer) of potential effects.

In summary, these and other assumptions contribute to the overall uncertainty in the results of the HHRA. However, given that the largest sources of uncertainty generally result in overestimates of exposure or risk, it is believed that the noncarcinogenic and carcinogenic risks presented in this HHRA represent conservative estimates of the risks, if any, posed by COPCs in soil gas.

4 Conclusions

This HHRA evaluates human health risks associated with potential exposure to VOCs in soil gas via inhalation of indoor air under a residential scenario. The objective of the HHRA is to assess whether concentrations of VOCs detected in Site soil gas pose unacceptable risks to human health under site-specific development and exposure conditions. Planned development at the Old Train Depot site includes construction of two multi-family residential buildings, each with underground parking garages. Both parking garages will comply with California building code measures which require each garage to prevent airflow from the garage to occupied spaces. If the garages function per code requirements, no soil gas would enter any permanently occupied space (i.e., the vapor intrusion pathway would be incomplete). However, as a conservative measure, this HHRA estimates risks assuming VOCs in the subsurface soil gas migrate to indoor air of the garage (vapor intrusion) and ten percent of the garage air migrates into occupied residential units.

Based on the data and site-specific evaluations presented below, the estimated risks associated with potential residential exposures to VOCs in soil vapor via the vapor intrusion pathway are less than one in a million (1×10^{-6} or 1E-06). The estimated noncarcinogenic hazards are less than the threshold of one. Thus, estimated risks are well within levels considered by Cal/EPA and EPA to be protective of human health and that do not warrant further action.

5 Limitations

This evaluation was performed in accordance with generally accepted health risk assessment principles and practices currently applied by Cal/EPA and EPA. The data were provided by a third party, and we did not provide independent verification of this information, nor did we conduct field sampling or oversee data analysis. The judgments, conclusions, and recommendations described in this document pertain to the conditions judged to be present or applicable at the time this document was prepared. Future conditions may differ from those described herein, and this document is not intended for use in future evaluations of the Site. The purpose of the document is to provide information about the Site relative to environmental investigations conducted to date. Any reliance on, or use of, this document by any third party shall be at such party's sole risk.

6 References

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Figures

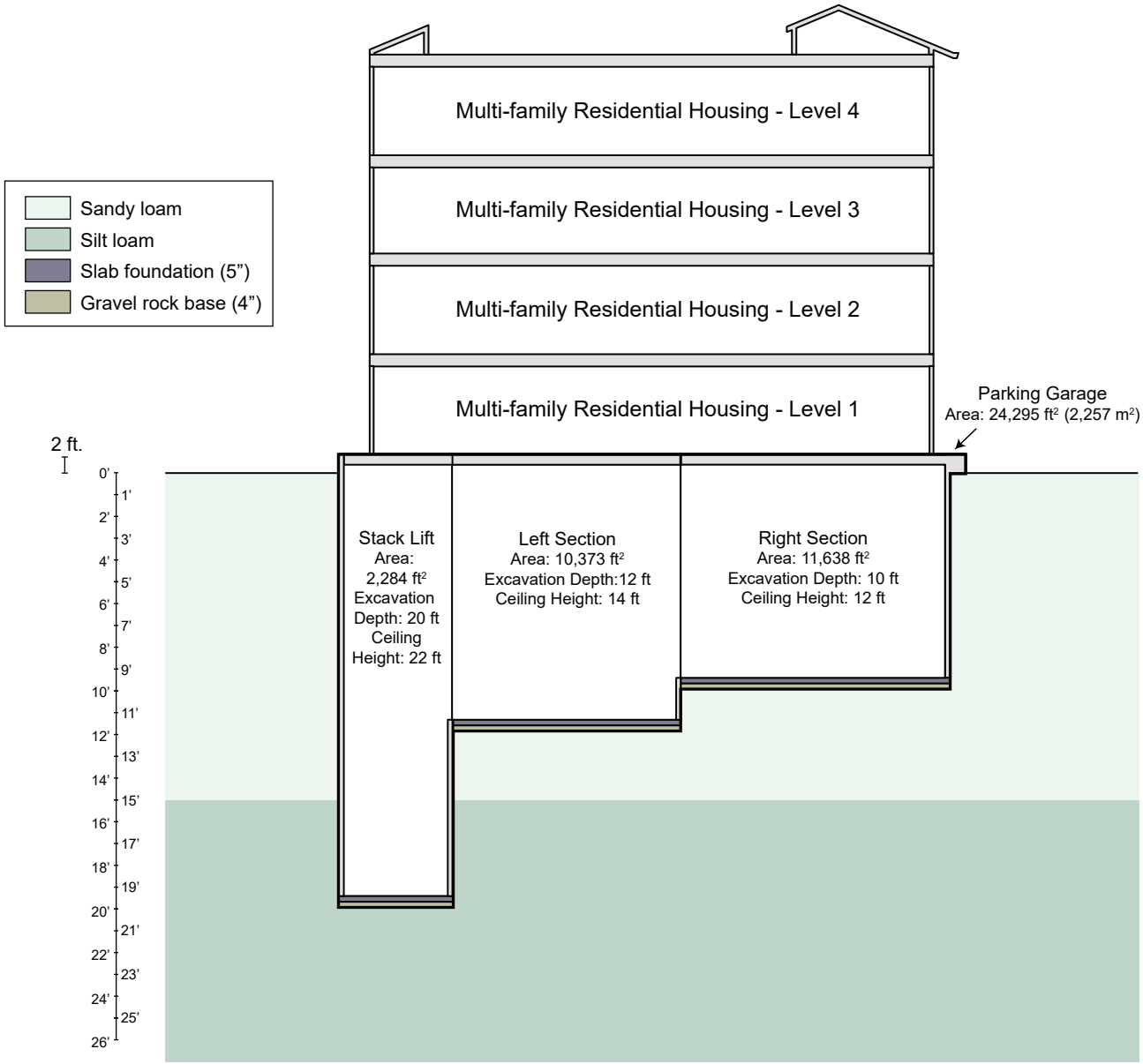


Figure 1. Vapor Intrusion Conceptual Site Model, Building A (North Building)

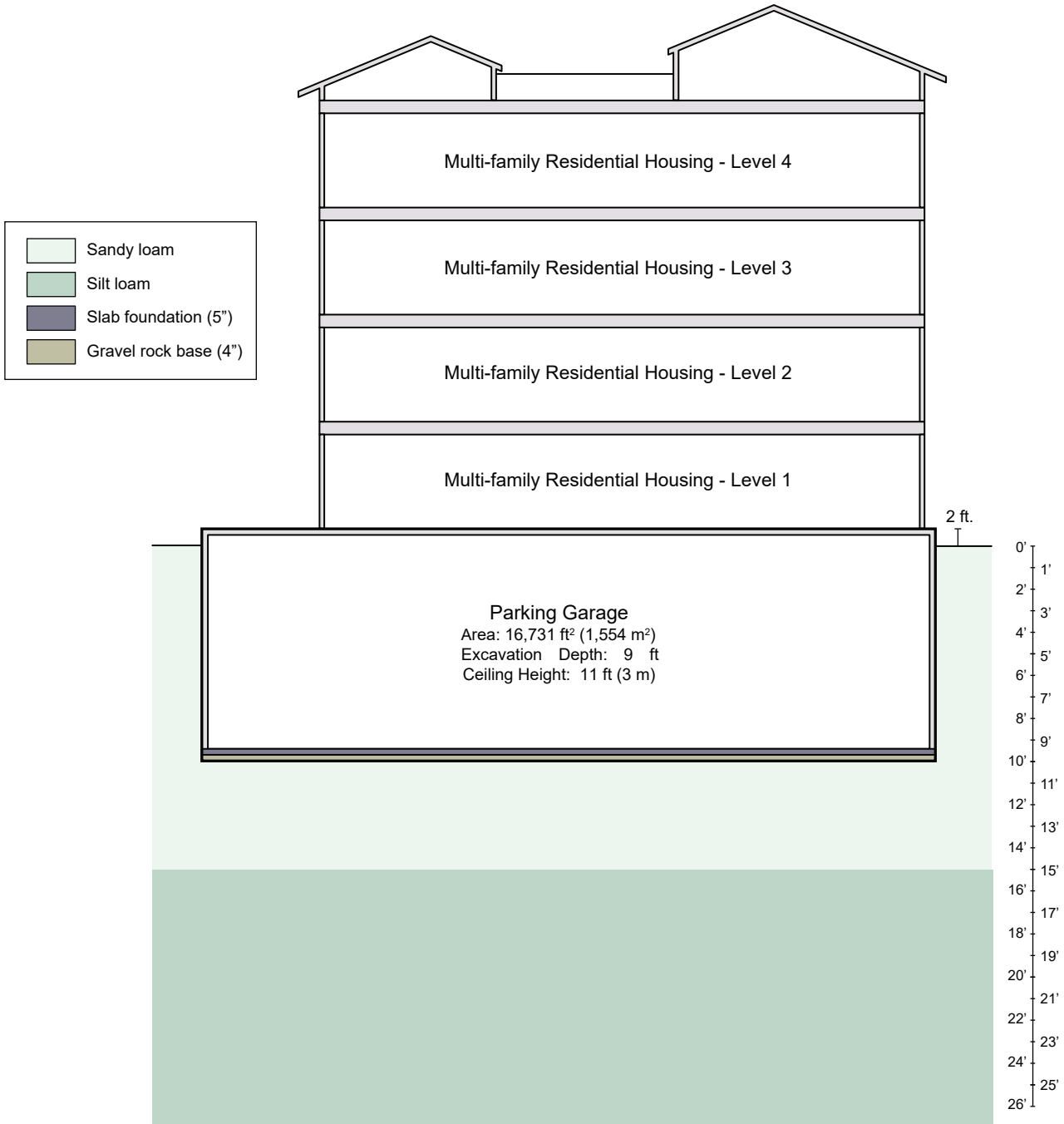


Figure 2. Vapor Intrusion Conceptual Site Model, Building B (South Building)

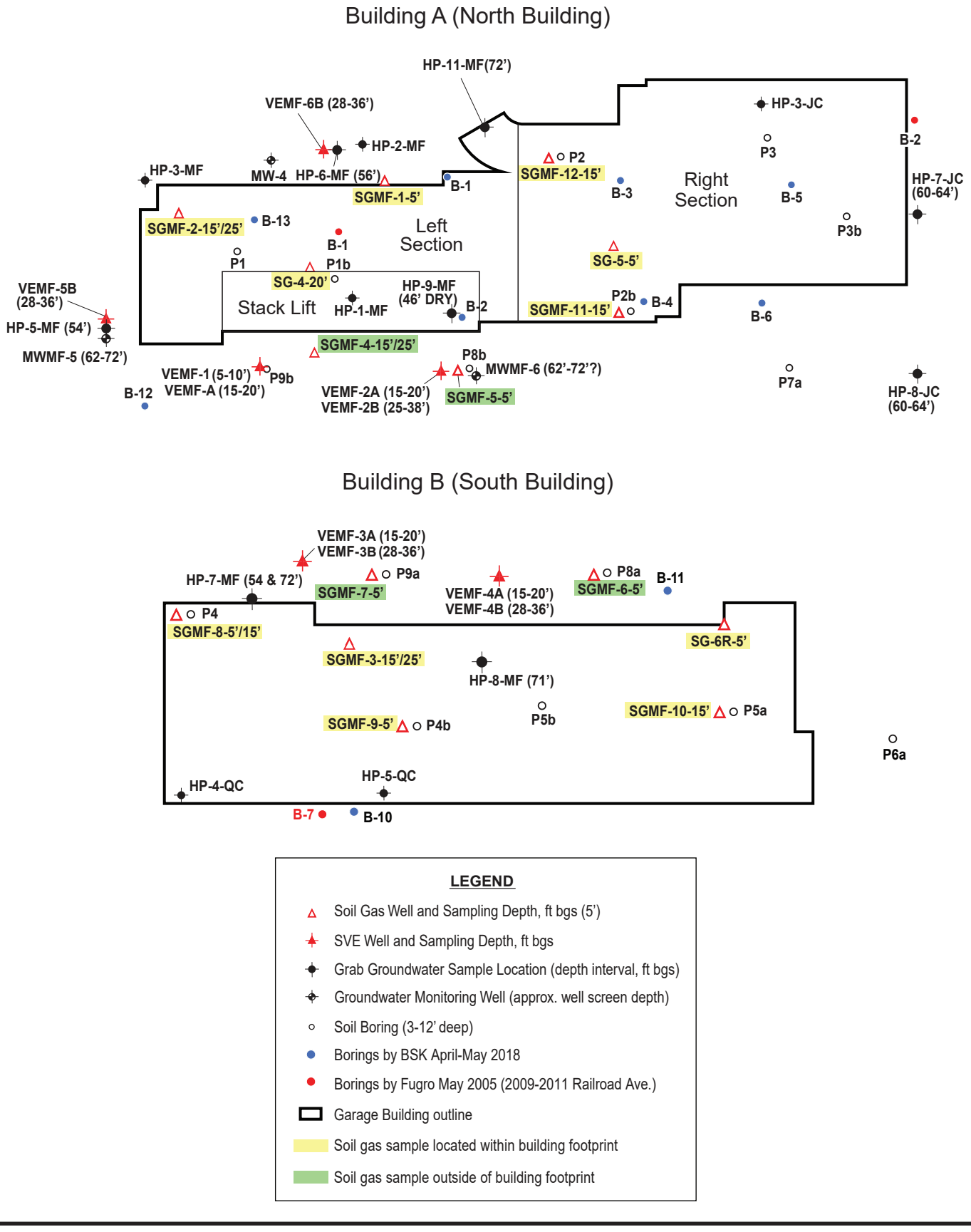


Figure 3. Garage Configurations and Soil Gas Sampling Locations

Tables

Table 1. Soil Gas Analytical Data for Old Train Depot Site from Pangea Data Gap Assessment Report Table 3 (µg/m^3)

Boring / Sample ID	Date Sampled	Sample Depth (ft bgs)	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	Benzene	Ethylbenzene	TPH
SG-4-5	6/22/2018	5.0	**309**	<1.07	<0.793	<0.793	<0.511	0.997	2.35	551
SG-4-20	6/22/2018	20.0	**420**	<1.07	<0.793	<0.793	<0.511	2.70	0.954	1,900
SG-4-20	9/14/2021	20	**606**	<1.07	<0.793	<0.793	<0.511	<0.639	1.66	<826
SG-5-5	6/21/2018	5.0	**34.6**	<1.07	<0.793	<0.793	<0.511	0.676	<0.867	512
SG-5-5	9/16/2021	5	**49.5**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<826
SG-6-5	6/21/2018	5.0	**168**	<1.07	<0.793	<0.793	<0.511	<0.639	1.27	329
SGMF-1-5	11/27/2018	4.5-5.5	**56.5**	<1.07	<0.908	<0.908	<0.511	<0.639	2.18	<207
SGMF-1-5	9/14/2021	5	**183**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<826
SGMF-2-5	11/27/2018	4.5-5.5	**108**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<207
SGMF-2-15	11/27/2018	14.5-15.5	**809**	<1.07	<0.793	<0.793	<0.511	1.92	<0.867	960
SGMF-2-15	9/14/2021	15	**451**	1.24	<0.793	<0.793	<0.511	2.18	<0.867	1,060
SGMF-2-25	11/27/2018	24.5-25.5	**1,850**	3.9	<0.793	<0.793	<0.511	**58**	1.1	3,870
SGMF-3-15	11/28/2015	14.5-15.5	**1,860**	1.4	<0.793	<0.793	<0.511	2.1	<0.867	2,130
SGMF-3-15	9/16/2021	15	**3,300**	1.44	<0.793	<0.793	<0.511	<0.639	<0.867	2,260
SGMF-3-25	11/28/2015	24.5-25.5	**5,340**	7.2	<0.793	<0.793	<0.511	**5.0**	<0.867	3,680
SGMF-3-25	9/16/2021	25	**4,180**	1.97	<0.793	<0.793	<0.511	<0.639	<0.867	3,020
SGMF-3-25-DUP	9/16/2021	25	**3,350**	2.79	<0.793	<0.793	<0.511	<0.639	<0.867	2,290
SGMF-4-5	11/28/2015	4.5-5.5	**387**	<1.07	<0.793	<0.793	<0.511	0.863	4.19	611
SGMF-4-5	9/14/2021	5	**1,330**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	1,210
SGMF-4-15	9/14/2021	15	**767**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	1,100
SGMF-4-15-DUP	9/14/2021	15	**657**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<826
SGMF-4-15	11/28/2015	14.5-15.5	**1,070**	<1.07	<0.793	<0.793	<0.511	**3.55**	10.6	1,540
SGMF-4-25	11/28/2015	24.5-25.5	**3,320**	12	<0.793	0.826	<0.511	**14.1**	22.1	4,080
SGMF-5-5	9/16/2021	5	**1,180**	1.18	<0.793	<0.793	<0.511	<0.639	<0.867	1,320
SGMF-6-5	9/16/2021	5	**621**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	946
SGMF-7-5	9/14/2021	5	**454**	<1.07	<0.793	<0.793	<0.511	0.850	<0.867	901
SGMF-8-5	9/16/2021	5	**612**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<826
SGMF-8-15	9/16/2021	15	**1,190**	4.20	<0.793	<0.793	<0.511	0.917	<0.867	1,070
SGMF-9-5	9/16/2021	5	**5,190**	2.65	<0.793	<0.793	<0.511	<0.639	<0.867	2,160
SGMF-10-5	9/16/2021	5	**754**	1.69	<0.793	<0.793	<0.511	<0.639	<0.867	1,280
SGMF-10-15	9/16/2021	15	**1,150**	<1.07	<0.793	<0.793	<0.511	2.66	<0.867	1,260
SGMF-11-5	9/16/2021	5	**273**	<1.07	<0.793	<0.793	<0.511	0.69	1.29	<826
SGMF-12-15	9/16/2021	15	14	<1.07	<0.793	<0.793	<0.511	**5.43**	<0.867	<826
Maximum Concentration			**5,340**	12	ND	0.83	ND	**58**	22	4,080
SFRWQCB Residential ESL for Soil Gas			15	16	280	2,800	0.32	3.2	37	8,900
SFRWQCB Commercial ESL for Soil Gas			67	100	1,200	12,000	5.2	14	160	37,000

Notes:
ESL = Environmental Screening Level
ND = not detected
PCE = Tetrachloroethene
TCE = Trichloroethene
DCE = Dichloroethene
SFRWQCB = San Francisco Regional Water Quality Control Board
TPH = Total Petroleum Hydrocarbons
µg/m^3 = Micrograms per cubic meter
ft bgs = feet below ground surface
< n = Chemical not present above laboratory detection limit
Bold = Concentrations exceed Residential ESLs for soil gas

Table 2. Data Summary Statistics and Concentration Terms (µg/m^3)

Boring / Sample ID	Date Sampled	Sample Depth (ft bgs)	Tetrachloroethene (PCE)		Benzene	
			All Data[1]	Recent Data within Building Footprint[2.3] (15 to 25 ft bgs)	All Data[1]	Recent Data within Building Footprint[2.3] (15 to 25 ft bgs)
Building A (North Building)						
SG-4-5	6/22/2018	5.0	309		0.997	
SG-4-20	6/22/2018	20.0	420		2.70	
SG-4-20	9/14/2021	20	606	606	<0.639	<0.639
SG-5-5	6/21/2018	5.0	34.6		0.676	
SG-5-5	9/16/2021	5	49.5		<0.639	
SGMF-1-5	11/27/2018	4.5-5.5	56.5		<0.639	
SGMF-1-5	9/14/2021	5	183		<0.639	
SGMF-2-5	11/27/2018	4.5-5.5	108		<0.639	
SGMF-2-15	11/27/2018	14.5-15.5	809		1.92	
SGMF-2-15	9/14/2021	15	451	451	2.18	2.18
SGMF-2-25	11/27/2018	24.5-25.5	1,850	1,850	58	58
SGMF-4-5	11/28/2015	4.5-5.5	387		0.863	
SGMF-4-5	9/14/2021	5	1,330		<0.639	
SGMF-4-15	9/14/2021	15	767		<0.639	
SGMF-4-15-DUP	9/14/2021	15	657		<0.639	
SGMF-4-15	11/28/2015	14.5-15.5	1,070		3.55	
SGMF-4-25	11/28/2015	24.5-25.5	3,320		14.1	
SGMF-5-5	9/16/2021	5	1,180		<0.639	
SGMF-11-5	9/16/2021	5	273		0.69	
SGMF-12-15	9/16/2021	15	14	14	5.43	5.43
Maximum Concentration (All Data)			**3,320**	**1,850**	**58**	**58**
Maximum Concentration (15 - 20 ft bgs)			**767**	**606**	**5.43**	**5.43**
Maximum Concentration (25 ft bgs)			**3,320**	**1,850**	**58**	**58**
95UCL[3]			**1,177**	**--**	**18.7**	**--**

Table 2. Data Summary Statistics and Concentration Terms (µg/m^3)

Boring / Sample ID	Date Sampled	Sample Depth (ft bgs)	Tetrachloroethene (PCE)		Benzene	
			All Data[1]	Recent Data within Building Footprint[2,3] (15 to 25 ft bgs)	All Data[1]	Recent Data within Building Footprint[2,3] (15 to 25 ft bgs)
Building B (South Building)						
SG-6-5	6/21/2018	5.0	168		<0.639	<0.639
SGMF-3-15	11/28/2015	14.5-15.5	1,860		2.1	
SGMF-3-15	9/16/2021	15	3,300	3,300	<0.639	<0.639
SGMF-3-25	11/28/2015	24.5-25.5	5,340		5.0	
SGMF-3-25	9/16/2021	25	4,180	4,180	<0.639	<0.639
SGMF-3-25-DUP	9/16/2021	25	3,350		<0.639	
SGMF-6-5	9/16/2021	5	621		<0.639	
SGMF-7-5	9/14/2021	5	454		0.850	
SGMF-8-5	9/16/2021	5	612		<0.639	<0.639
SGMF-8-15	9/16/2021	15	1,190	1,190	0.917	0.917
SGMF-9-5	9/16/2021	5	5,190		<0.639	<0.639
SGMF-10-5	9/16/2021	5	754		<0.639	<0.639
SGMF-10-15	9/16/2021	15	1,150	1,150	2.66	2.66
Maximum Concentration (All Data)			**5,340**	**4,180**	**5**	**2.66**
Maximum Concentration (15 - 20 ft bgs)			**3,300**	**3,300**	**2.66**	**2.66**
Maximum Concentration (25 ft bgs)			**5,340**	**4,180**	**5**	ND
95UCL[4]			**3,929**	**--**	**1.97**	**--**

Notes:

[1] Soil gas data was collected at the site in 2015, 2018, and 2019.

[2] The more recent soil gas data collected at the site are considered to be the most representative of current site conditions. Thus, when a soil gas sample was collected in 2021 at the sample location as a sample collected in 2018 and/or 2015, the concentration reported in 2021 was considered in the HHRA.

[3] Recent Data Within Footprint includes soil gas samples (sample IDs highlighted in **bold**) collected within the footprint of the planned building and thus, data considered to be more representative of concentrations that are likely to migrate vertically from the subsurface to indoor air of the building. Sample locations are shown in Figure 3.

[4] The maximum concentration of recent data is used in the HHRA rather than the 95 percent upper confidence limit of the arithmetic mean (95UCL). However, the 95UCL calculated using EPA ProUCL Version 6.0 is presented in this table for comparison. 95UCLs were not calculated for the recent data collected beneath the footprint of the buildings because the EPA (2015) ProUCL Version 5.1 User Guide recommends calculation of a 95UCL using at least 8 to 10 samples.

Table 3. EPA Johnson & Ettinger Model Parameters

Parameter	Units	Building A (North Building)			Building B (South Building)	Reference/Rationale
		Stack Lift Area	Left Section Area	Right Section Area		
Source medium		Exterior Soil Gas	Exterior Soil Gas	Exterior Soil Gas	Exterior Soil Gas	
Soil Gas Concentration		NA	NA	NA	NA	Calculation of attenuation factor does not use the soil gas concentration input parameter; a value of 1 $\mu g/m^3$ is used for all
Depth below grade to soil gas sample	m	7.6	7.6	7.6	7.6	Site-specific: sample nearest to the subsurface vapor source (perched groundwater)
Average vadose zone temperature	°C	22	22	22	22	OEHHA 2005
Foundation Type	--	Basement with slab	Basement with slab	Basement with slab	Basement with slab	
Depth below grade to base of foundation	m	6.1	3.7	3.0	2.7	Site-specific: Eden Housing Building Designs
Foundation thickness	m	0.15	0.15	0.15	0.15	Site-specific: Eden Housing Building Designs
Fraction of foundation area with cracks	unitless	0.005	0.005	0.005	0.005	DTSC 2011 - Default parameter
Enclosed space floor area	m^2	212	964	1,081	1,554	Site-specific: Eden Housing Building Designs
Enclosed space mixing height	m	6.7	4.3	3.7	3.4	Site-specific: Eden Housing Building Designs
Indoor air exchange rate	1/hour	0.4	0.6	0.8	0.8	Calculated: See Table 4
Qsoil/Qbuilding	unitless	0.03	0.03	0.03	0.03	SFRWQCB 2019 - Default parameter
Stratum A SCS Soil Type[1]	--	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Site-specific: See Appendix C
Stratum A thickness[1]	m	6.1	4.6	4.6	4.6	Site-specific: See Appendix C
Stratum B SCS Soil Type[1]	--	Silt Loam	Silt Loam	Silt Loam	Silt Loam	Site-specific: See Appendix C
Stratum B thickness[1]	m	1.5	3.0	3.0	3.0	Site-specific: See Appendix C
Stratum C Soil Type	--	Not Present	Not Present	Not Present	Not Present	Site-specific: See Appendix C
Stratum C thickness	m					Site-specific: See Appendix C

Notes:
°C = degrees centigrade
m = meter
m^2 = square meters
NA = not applicable

[1] An evaluation of soil types presented in Appendix C identifies the site-specific soil types as generally sandy loam from 0 to 15 feet bgs and silt loam from 15 to 25 feet bgs and deeper. The soil stratum thickness correspond to this soil type identification for all areas except the Building B stack lift area, which will be excavated to 20 feet bgs. To estimate soil gas attenuation factors for the stack lift area, soils from 0 to 20 feet bgs were conservatively assumed to be sandy loam and silt loam from 20 to 25 feet bgs because the J & E model does not allow consideration of more than one soil type from the ground surface to the base of the foundation.

Table 4. Air Exchange Rates

Parameter	Unit	Building A (North Building)						Building B (South Building)	
		Stack Lift Area		Left Section		Right Section			
Ventilation Rate Required by California Building Codes[1,2]	cfm/ft^2	0.15	0.75	0.15	0.75	0.15	0.75	0.15	0.75
Area	ft^2	2,284	2,284	10,373	10,373	11,638	11,638	16,732	16,732
Height	ft	22	22	14	14	12	12	11	11
Volume	ft^3	50,248	50,248	145,222	145,222	139,656	139,656	184,052	184,052
Air Exchange Rate (ACH)[3]	**1/hour**	**0.41**	**2.0**	**0.6**	**3.2**	**0.8**	**3.8**	**0.8**	**4.1**
Weighted ACH Corresponding to 0.15 cfm/ft^2	**1/hour**	**0.7**						**0.8**	
Weighted ACH Corresponding to 0.75 cfm/ft^2	**1/hour**	**3.3**						**4.1**	

Notes:

cfm/ft^2 = cubic feet per minute per square foot

ft^3 = cubic feet

[1] California Energy Code requires a minimum ventilation rate of 0.15 cfm/ft^2 in a garage but with modulation to increase the ventilation rate to reduce carbon monoxide concentrations.

[2] California Mechanical Code requires ventilation rate of 0.75 cfm/ft^2 in a garage.

[3] Equation for calculating air exchange rate: ACH (1/hour) = (Ventilation rate (cfm/ft^2) x Area (ft^2) x 60 minutes)/Volume (ft^3)

Table 5. Soil Gas Attenuation Factors

COPC	Soil Gas Attenuation Factors (AF) (Unitless)[1]				
	Building A (North Building)				Building B (South Building)
	Stack Lift Section	Left Section	Right Section	Building Weighted Attenuation Factor[2]	
Benzene	1.2E-03	3.0E-04	2.2E-04	4.0E-04	2.1E-04
Tetrachloroethene (PCE)	6.8E-04	1.7E-04	1.2E-04	2.3E-04	1.2E-04

Notes:

[1] Soil gas attenuation factors were calculated using the EPA Johnson & Ettinger model and the input parameters presented in Table 3.

[2] The building weighted attenuation factor was calculated using the following equation:

Building weighted attenuation factor (unitless) = (Stack Lift Section-specific AF x section volume of 50,248 ft^3) + (Left Section-specific AF x section volume of 145,222 ft^3) + (Right Section-specific AF x section volume of 139,656 ft^3)/ Total Building A volume of 355,126 ft^3

Table 6: Estimated Concentrations of COPCs in Indoor Air of Residential Units

Building A (North Building)

Chemical	Soil Gas Concentration C_{sv}	Building-weighted Attenuation Factor AF	Inter-unit Transfer Factor TF	Residential Unit Indoor Air Concentration $C_{IA\text{-}Residence}$
	µg/m^3	unitless	unitless	µg/m^3
Benzene	58	4.0E-04	0.1	0.002
Tetrachloroethene (PCE)	1,850	2.3E-04	0.1	0.042

Building B (South Building)

Chemical	Soil Gas Concentration C_{sv}	Attenuation Factor AF	Intra-unit Transfer Factor TF	Residential Unit Indoor Air Concentration $C_{IA\text{-}Residence}$
	µg/m^3	unitless	unitless	µg/m^3
Benzene	2.66	2.1E-04	0.1	0.0001
Tetrachloroethene (PCE)	4,180	1.2E-04	0.1	0.05

Table 7. Estimated Site-specific Cancer Risks and Non-carcinogenic Hazards

Building A (North Building)

Chemical	Soil Gas Concentration[1] (C_{sg}) (µg/m^3)	Building-weighted Attenuation Factor[2] (AF) (unitless)	Inter-unit Transfer Factor[3] (TF) (unitless)	Indoor Air Concentration (C_{IA}) (µg/m^3)	Residential Indoor Air Environmental Screening Level (ESL) (µg/m^3)		Cancer Risk	Non-cancer Hazard Quotient
					Cancer Endpoint	Non-cancer Endpoint		
Benzene	58	4.0E-04	0.1	0.002	0.097	3.1	2E-08	0.0008
Tetrachloroethene (PCE)	1,850	2.3E-04	0.1	0.042	0.46	42	9E-08	0.001
						Total =	**1E-07**	**0.002**

Building B (South Building)

Chemical	Soil Gas Concentration[1] (C_{sg}) (µg/m^3)	Attenuation Factor[2] (AF) (unitless)	Inter-unit Transfer Factor[3] (TF) (unitless)	Indoor Air Concentration (C_{IA}) (µg/m^3)	Residential Indoor Air Environmental Screening Level (ESL) (µg/m^3)		Cancer Risk	Non-cancer Hazard Quotient
					Cancer Endpoint	Non-cancer Endpoint		
Benzene	2.66	2.1E-04	0.1	0.0001	0.097	3.1	6E-10	0.00002
Tetrachloroethene (PCE)	4,180	1.2E-04	0.1	0.05	0.46	42	1E-07	0.001
						Total =	**1E-07**	**0.001**

Notes:

[1] The maximum concentration reported in recent soil gas samples collected near the subsurface soil gas source was used in this site-specific HHRA to represent concentrations nearest to the contaminant source (Table 2). For PCE, the concentrations are the maximum concentration reported at 25 feet bgs in the more recent soil gas samples collected at the Site; these concentration are also the maximum concentration of PCE reported in recent soil gas samples collected beneath the footprints of the buildings. For Building A, the maximum concentration of benzene was also detected at 25 feet bgs; this maximum concentration was used in the site-specific HHRA for Building A. Benzene was not detected in the recent 25 feet bgs soil gas sample; thus, to be conservative, the maximum concentration reported in 15 feet bgs soil gas was used. The benzene concentration reported in the 15 foot sample is also the maximum concentration detected in recent soil gas samples collected beneath the footprint of the planned building.

[2] The attenuation factors were estimated using the EPA J & E model (Version 6) and site-specific model inputs. For Building A (North Building), the building-weighted attenuation factor presented on Table 5 was used.

[3] Although California building codes require garages to maintain ventilation and pressure to prevent air from flowing from a garage to occupiable spaces, this HHRA conservatively assumed that 10 percent of the air in the garage flows into the residential units.

Appendix A

EPA ProUCL Printouts – 95UCLs for Soil Gas

UCL Statistics for Uncensored Full Data Sets **ATTACHMENT 5**

User Selected Options	
Date/Time of Computation	ProUCL 5.112/31/2021 1:55:28 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Building A (North Building) PCE: All Data

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	14	Mean	693.7
Maximum	3320	Median	435.5
SD	792	Std. Error of Mean	177.1
Coefficient of Variation	1.142	Skewness	2.169

Normal GOF Test

Shapiro Wilk Test Statistic	0.776	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.195	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1000	95% Adjusted-CLT UCL (Chen-1995)	1077
		95% Modified-t UCL (Johnson-1978)	1014

Gamma GOF Test

A-D Test Statistic	0.142	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.776	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0892	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.201	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.828	k star (bias corrected MLE)	0.737
Theta hat (MLE)	837.9	Theta star (bias corrected MLE)	941.2
nu hat (MLE)	33.12	nu star (bias corrected)	29.48
MLE Mean (bias corrected)	693.7	MLE Sd (bias corrected)	808
		Approximate Chi Square Value (0.05)	18.09
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	17.38

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	1131	95% Adjusted Gamma UCL (use when n<50)	1177

51	**Lognormal GOF Test**									**ATTACHMENT 5**		
52				Shapiro Wilk Test Statistic		0.952	**Shapiro Wilk Lognormal GOF Test**					
53				5% Shapiro Wilk Critical Value		0.905	Data appear Lognormal at 5% Significance Level					
54				Lilliefors Test Statistic		0.139	**Lilliefors Lognormal GOF Test**					
55				5% Lilliefors Critical Value		0.192	Data appear Lognormal at 5% Significance Level					
56	**Data appear Lognormal at 5% Significance Level**											
57												
58	**Lognormal Statistics**											
59				Minimum of Logged Data		2.639	Mean of logged Data			5.828		
60				Maximum of Logged Data		8.108	SD of logged Data			1.436		
61												
62	**Assuming Lognormal Distribution**											
63				95% H-UCL	2845		90% Chebyshev (MVUE) UCL			1863		
64				95% Chebyshev (MVUE) UCL	2313		97.5% Chebyshev (MVUE) UCL			2938		
65				99% Chebyshev (MVUE) UCL	4166							
66												
67	**Nonparametric Distribution Free UCL Statistics**											
68	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
69												
70	**Nonparametric Distribution Free UCLs**											
71				95% CLT UCL	985		95% Jackknife UCL			1000		
72				95% Standard Bootstrap UCL	967.9		95% Bootstrap-t UCL			1185		
73				95% Hall's Bootstrap UCL	2304		95% Percentile Bootstrap UCL			1003		
74				95% BCA Bootstrap UCL	1087							
75				90% Chebyshev(Mean, Sd) UCL	1225		95% Chebyshev(Mean, Sd) UCL			1466		
76				97.5% Chebyshev(Mean, Sd) UCL	1800		99% Chebyshev(Mean, Sd) UCL			2456		
77												
78	**Suggested UCL to Use**											
79				95% Adjusted Gamma UCL	1177							
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
85												

UCL Statistics for Data Sets with Non-Detects **ATTACHMENT 5**

User Selected Options	
Date/Time of Computation	ProUCL 5.112/31/2021 2:10:07 PM
From File	WorkSheet_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Building A (North Building)_Benzene_All Data

General Statistics

Total Number of Observations	20	Number of Distinct Observations	12
Number of Detects	11	Number of Non-Detects	9
Number of Distinct Detects	11	Number of Distinct Non-Detects	1
Minimum Detect	0.676	Minimum Non-Detect	0.639
Maximum Detect	58	Maximum Non-Detect	0.639
Variance Detects	286.9	Percent Non-Detects	45%
Mean Detects	8.282	SD Detects	16.94
Median Detects	2.18	CV Detects	2.045
Skewness Detects	3.034	Kurtosis Detects	9.485
Mean of Logged Detects	1.016	SD of Logged Detects	1.376

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.503	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.385	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.251	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	4.843	KM Standard Error of Mean	2.947
KM SD	12.57	95% KM (BCA) UCL	10.21
95% KM (t) UCL	9.938	95% KM (Percentile Bootstrap) UCL	10.17
95% KM (z) UCL	9.69	95% KM Bootstrap t UCL	42.37
90% KM Chebyshev UCL	13.68	95% KM Chebyshev UCL	17.69
97.5% KM Chebyshev UCL	23.25	99% KM Chebyshev UCL	34.16

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.074	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.776	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.265	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.268	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.567	k star (bias corrected MLE)	0.473
Theta hat (MLE)	14.6	Theta star (bias corrected MLE)	17.5
nu hat (MLE)	12.48	nu star (bias corrected)	10.41
Mean (detects)	8.282		

51												
52	**Gamma ROS Statistics using Imputed Non-Detects**											
53	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)											
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
56	This is especially true when the sample size is small.											
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
58					Minimum	0.01				Mean	4.56	
59					Maximum	58				Median	0.683	
60					SD	12.99				CV	2.849	
61					k hat (MLE)	0.236				k star (bias corrected MLE)	0.234	
62					Theta hat (MLE)	19.28				Theta star (bias corrected MLE)	19.46	
63					nu hat (MLE)	9.459				nu star (bias corrected)	9.373	
64					Adjusted Level of Significance (β)	0.038						
65					Approximate Chi Square Value (9.37, α)	3.554				Adjusted Chi Square Value (9.37, β)	3.275	
66					95% Gamma Approximate UCL (use when n>=50)	12.03				95% Gamma Adjusted UCL (use when n<50)	13.05	
67												
68	**Estimates of Gamma Parameters using KM Estimates**											
69					Mean (KM)	4.843				SD (KM)	12.57	
70					Variance (KM)	157.9				SE of Mean (KM)	2.947	
71					k hat (KM)	0.149				k star (KM)	0.16	
72					nu hat (KM)	5.941				nu star (KM)	6.384	
73					theta hat (KM)	32.6				theta star (KM)	30.35	
74					80% gamma percentile (KM)	5.534				90% gamma percentile (KM)	14.47	
75					95% gamma percentile (KM)	26.32				99% gamma percentile (KM)	60.29	
76												
77	**Gamma Kaplan-Meier (KM) Statistics**											
78					Approximate Chi Square Value (6.38, α)	1.839				Adjusted Chi Square Value (6.38, β)	1.653	
79					95% Gamma Approximate KM-UCL (use when n>=50)	16.81				95% Gamma Adjusted KM-UCL (use when n<50)	18.7	
80												
81	**Lognormal GOF Test on Detected Observations Only**											
82					Shapiro Wilk Test Statistic	0.894				**Shapiro Wilk GOF Test**		
83					5% Shapiro Wilk Critical Value	0.85				Detected Data appear Lognormal at 5% Significance Level		
84					Lilliefors Test Statistic	0.155				**Lilliefors GOF Test**		
85					5% Lilliefors Critical Value	0.251				Detected Data appear Lognormal at 5% Significance Level		
86	**Detected Data appear Lognormal at 5% Significance Level**											
87												
88	**Lognormal ROS Statistics Using Imputed Non-Detects**											
89					Mean in Original Scale	4.6				Mean in Log Scale	-0.708	
90					SD in Original Scale	12.98				SD in Log Scale	2.332	
91					95% t UCL (assumes normality of ROS data)	9.618				95% Percentile Bootstrap UCL	9.943	
92					95% BCA Bootstrap UCL	13.33				95% Bootstrap t UCL	39.88	
93					95% H-UCL (Log ROS)	103.5						
94												
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
96					KM Mean (logged)	0.357				KM Geo Mean	1.43	
97					KM SD (logged)	1.215				95% Critical H Value (KM-Log)	2.96	
98					KM Standard Error of Mean (logged)	0.285				95% H-UCL (KM -Log)	6.828	
99					KM SD (logged)	1.215				95% Critical H Value (KM-Log)	2.96	
100					KM Standard Error of Mean (logged)	0.285						

	A	B	C	D	E	F	G	H	I	J	K	L
101										**ATTACHMENT 5**		
102	**DL/2 Statistics**											
103	**DL/2 Normal**						**DL/2 Log-Transformed**					
104	Mean in Original Scale					4.699	Mean in Log Scale					0.0454
105	SD in Original Scale					12.94	SD in Log Scale					1.486
106	95% t UCL (Assumes normality)					9.703	95% H-Stat UCL					10.07
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Approximate Gamma Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113	Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)					18.7						
114												
115	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
116	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
117												
118	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
119	Recommendations are based upon data size, data distribution, and skewness.											
120	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
121	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
122												

1	UCL Statistics for Uncensored Full Data Sets									ATTACHMENT 5		
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.112/31/2021 2:30:10 PM										
5	From File	WorkSheet_j.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10	Building B (South Building)_PCE_All Data											
11	C0											
12												
13	General Statistics											
14	Total Number of Observations	13						Number of Distinct Observations	13			
15								Number of Missing Observations	0			
16	Minimum	168						Mean	2167			
17	Maximum	5340						Median	1190			
18	SD	1865						Std. Error of Mean	517.4			
19	Coefficient of Variation	0.861						Skewness	0.691			
20												
21	Normal GOF Test											
22	Shapiro Wilk Test Statistic	0.859						Shapiro Wilk GOF Test				
23	5% Shapiro Wilk Critical Value	0.866						Data Not Normal at 5% Significance Level				
24	Lilliefors Test Statistic	0.238						Lilliefors GOF Test				
25	5% Lilliefors Critical Value	0.234						Data Not Normal at 5% Significance Level				
26	Data Not Normal at 5% Significance Level											
27												
28	Assuming Normal Distribution											
29	95% Normal UCL							95% UCLs (Adjusted for Skewness)				
30	95% Student's-t UCL	3089						95% Adjusted-CLT UCL (Chen-1995)	3124			
31								95% Modified-t UCL (Johnson-1978)	3106			
32												
33	Gamma GOF Test											
34	A-D Test Statistic	0.403						Anderson-Darling Gamma GOF Test				
35	5% A-D Critical Value	0.754						Detected data appear Gamma Distributed at 5% Significance Level				
36	K-S Test Statistic	0.172						Kolmogorov-Smirnov Gamma GOF Test				
37	5% K-S Critical Value	0.242						Detected data appear Gamma Distributed at 5% Significance Level				
38	Detected data appear Gamma Distributed at 5% Significance Level											
39												
40	Gamma Statistics											
41	k hat (MLE)	1.264						k star (bias corrected MLE)	1.024			
42	Theta hat (MLE)	1714						Theta star (bias corrected MLE)	2117			
43	nu hat (MLE)	32.86						nu star (bias corrected)	26.61			
44	MLE Mean (bias corrected)	2167						MLE Sd (bias corrected)	2142			
45								Approximate Chi Square Value (0.05)	15.85			
46	Adjusted Level of Significance	0.0301						Adjusted Chi Square Value	14.68			
47												
48	Assuming Gamma Distribution											
49	95% Approximate Gamma UCL (use when n>=50)	3638						95% Adjusted Gamma UCL (use when n<50)	3929			
50												

	A	B	C	D	E	F	G	H	I	J	K	L
51	**Lognormal GOF Test**										**ATTACHMENT 5**	
52					Shapiro Wilk Test Statistic	0.938	**Shapiro Wilk Lognormal GOF Test**					
53					5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level					
54					Lilliefors Test Statistic	0.175	**Lilliefors Lognormal GOF Test**					
55					5% Lilliefors Critical Value	0.234	Data appear Lognormal at 5% Significance Level					
56	**Data appear Lognormal at 5% Significance Level**											
57												
58	**Lognormal Statistics**											
59					Minimum of Logged Data	5.124			Mean of logged Data			7.236
60					Maximum of Logged Data	8.583			SD of logged Data			1.074
61												
62	**Assuming Lognormal Distribution**											
63					95% H-UCL	6220			90% Chebyshev (MVUE) UCL			4570
64					95% Chebyshev (MVUE) UCL	5589			97.5% Chebyshev (MVUE) UCL			7004
65					99% Chebyshev (MVUE) UCL	9782						
66												
67	**Nonparametric Distribution Free UCL Statistics**											
68	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
69												
70	**Nonparametric Distribution Free UCLs**											
71					95% CLT UCL	3018			95% Jackknife UCL			3089
72					95% Standard Bootstrap UCL	2979			95% Bootstrap-t UCL			3223
73					95% Hall's Bootstrap UCL	2955			95% Percentile Bootstrap UCL			3047
74					95% BCA Bootstrap UCL	3085						
75					90% Chebyshev(Mean, Sd) UCL	3719			95% Chebyshev(Mean, Sd) UCL			4422
76					97.5% Chebyshev(Mean, Sd) UCL	5398			99% Chebyshev(Mean, Sd) UCL			7315
77												
78	**Suggested UCL to Use**											
79					95% Adjusted Gamma UCL	3929						
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
85												

UCL Statistics for Data Sets with Non-Detects **ATTACHMENT 5**

User Selected Options	
Date/Time of Computation	ProUCL 5.11/6/2022 9:48:50 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Building B (South Building)_Benzene_All Data

Benzene

General Statistics

Total Number of Observations	13	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	8
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.85	Minimum Non-Detect	0.639
Maximum Detect	5	Maximum Non-Detect	0.639
Variance Detects	2.869	Percent Non-Detects	61.54%
Mean Detects	2.305	SD Detects	1.694
Median Detects	2.1	CV Detects	0.735
Skewness Detects	1.187	Kurtosis Detects	1.257
Mean of Logged Detects	0.616	SD of Logged Detects	0.747

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.881	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.217	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.28	KM Standard Error of Mean	0.385
KM SD	1.241	95% KM (BCA) UCL	1.838
95% KM (t) UCL	1.966	95% KM (Percentile Bootstrap) UCL	1.919
95% KM (z) UCL	1.913	95% KM Bootstrap t UCL	2.23
90% KM Chebyshev UCL	2.434	95% KM Chebyshev UCL	2.957
97.5% KM Chebyshev UCL	3.683	99% KM Chebyshev UCL	5.109

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.313	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.684	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.246	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.36	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.435	k star (bias corrected MLE)	1.107
Theta hat (MLE)	0.947	Theta star (bias corrected MLE)	2.082
nu hat (MLE)	24.35	nu star (bias corrected)	11.07
Mean (detects)	2.305		

ATTACHMENT 5

Gamma ROS Statistics using Imputed Non-Detects				
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs				
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)				
For such situations, GROS method may yield incorrect values of UCLs and BTVs				
This is especially true when the sample size is small.				
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates				
Minimum	0.01	Mean	0.893	
Maximum	5	Median	0.01	
SD	1.519	CV	1.701	
k hat (MLE)	0.281	k star (bias corrected MLE)	0.267	
Theta hat (MLE)	3.181	Theta star (bias corrected MLE)	3.342	
nu hat (MLE)	7.297	nu star (bias corrected)	6.947	
Adjusted Level of Significance (β)	0.0301			
Approximate Chi Square Value (6.95, α)	2.141	Adjusted Chi Square Value (6.95, β)	1.782	
95% Gamma Approximate UCL (use when n>=50)	2.896	95% Gamma Adjusted UCL (use when n<50)	3.48	
Estimates of Gamma Parameters using KM Estimates				
Mean (KM)	1.28	SD (KM)	1.241	
Variance (KM)	1.54	SE of Mean (KM)	0.385	
k hat (KM)	1.064	k star (KM)	0.87	
nu hat (KM)	27.66	nu star (KM)	22.61	
theta hat (KM)	1.203	theta star (KM)	1.472	
80% gamma percentile (KM)	2.081	90% gamma percentile (KM)	3.05	
95% gamma percentile (KM)	4.03	99% gamma percentile (KM)	6.328	
Gamma Kaplan-Meier (KM) Statistics				
Approximate Chi Square Value (22.61, α)	12.8	Adjusted Chi Square Value (22.61, β)	11.76	
95% Gamma Approximate KM-UCL (use when n>=50)	2.261	95% Gamma Adjusted KM-UCL (use when n<50)	2.462	
Lognormal GOF Test on Detected Observations Only				
Shapiro Wilk Test Statistic	0.921	**Shapiro Wilk GOF Test**		
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level		
Lilliefors Test Statistic	0.226	**Lilliefors GOF Test**		
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level		
Detected Data appear Lognormal at 5% Significance Level				
Lognormal ROS Statistics Using Imputed Non-Detects				
Mean in Original Scale	1	Mean in Log Scale	-1.011	
SD in Original Scale	1.457	SD in Log Scale	1.586	
95% t UCL (assumes normality of ROS data)	1.72	95% Percentile Bootstrap UCL	1.673	
95% BCA Bootstrap UCL	1.866	95% Bootstrap t UCL	2.291	
95% H-UCL (Log ROS)	7.764			
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution				
KM Mean (logged)	-0.0386	KM Geo Mean	0.962	
KM SD (logged)	0.663	95% Critical H Value (KM-Log)	2.319	
KM Standard Error of Mean (logged)	0.206	95% H-UCL (KM -Log)	1.869	
KM SD (logged)	0.663	95% Critical H Value (KM-Log)	2.319	
KM Standard Error of Mean (logged)	0.206			

	A	B	C	D	E	F	G	H	I	J	K	L
101	**ATTACHMENT 5**											
102	**DL/2 Statistics**											
103	**DL/2 Normal**						**DL/2 Log-Transformed**					
104	Mean in Original Scale					1.083	Mean in Log Scale					-0.465
105	SD in Original Scale					1.403	SD in Log Scale					0.989
106	95% t UCL (Assumes normality)					1.777	95% H-Stat UCL					2.296
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Normal Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113	95% KM (t) UCL					1.966						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

Appendix B

EPA Johnson and Ettinger Model Printouts

Building A (North Building)_Stack Lift Section_Benzene

Model Input **Site Name/Run Number:** Example, Run 1

Note:
-Yellow highlighted cells indicate parameters that typically are changed or must be inputted by the user.
-Dotted outline cells indicate default values that may be changed with justification.
-Toxicity values are taken from Regional Screening Level tables. These tables are updated semi-annually and may not reflect the most current toxicity information.

Use English / Metric Converter

Source Characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Source medium		Source	Exterior Soil Gas					
Soil gas concentration	(ug/m3)	Cmedium	1		NA			
Depth below grade to soil gas sample	(m)	Ls	7.60		Vary - 50	NA		
Average vadose zone temperature	(°C)	Ts	22	25	3-30			
Calc: Source vapor concentration	(ug/m3)	Cs	1					
Calc: % of pure component saturated vapor concentration	(%)	%Sat	0.000%					

Chemical:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Chemical Name		Chem	Benzene					
CAS No.		CAS	71-43-2					
Toxicity Factors								
Unit risk factor	$(ug/m^3)^{-1}$	IUR	7.80E-06	7.80E-06	NA	NA		
Mutagenic compound		Mut	No	NA	NA	NA		
Reference concentration	(mg/m^3)	RfC	3.00E-02	3.00E-02	NA	NA		

Chemical Properties:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Pure component water solubility	(mg/L)	S	1.79E+03	1.79E+03	NA	NA		
Henry's Law Constant @ 25°C	$(atm\text{-}m^3/mol)$	Hc	5.55E-03	5.55E-03	NA	NA		
Calc: Henry's Law Constant @ 25°C	(dimensionless)	Hr	2.27E-01	2.27E-01				
Calc: Henry's Law Constant @ system temperature	(dimensionless)	Hs	2.00E-01	2.29E-01				
Diffusivity in air	(cm2/s)	Dair	8.95E-02	8.95E-02	NA	NA		
Diffusivity in water	(cm2/s)	Dwater	1.03E-05	1.03E-05	NA	NA		

Building Characteristics:

Select Building Assumptions

(●) Use ratio for Qsoil/Qbuilding (recommended if no site specific data available)

( ) Specify Qsoil and Qbuilding separately; calculate ratio

	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Building setting		Bldg_Setting	Commercial	Commercial				
Foundation type		Found_Type	Basement w/ slab	Basement w/ slab				
Depth below grade to base of foundation	(m)	Lb	6.10	2.00	0.1 - 2.44	NA		
Foundation thickness	(m)	Lf	0.15	0.20	0.1 - 0.25	NA		
Fraction of foundation area with cracks	(-)	eta	0.005	0.005	0.0001-0.001	1.00		
Enclosed space floor area	(m2)	Abf	212.00	1500.00	80-1000	NA		
Enclosed space mixing height	(m)	Hb	6.70	3.00	2.44 - 4.88	NA		
Indoor air exchange rate	(1 / hr)	ach	0.40	1.50	.3-4.1	NA		
Qsoil/Qbuilding	(-)	Qsoil_Qb	0.0300	0.0300	0.0001 - 0.05	1.24		
Calc: Building ventilation rate	(m3/hr)	Qb	568.16	6750.00	NA	0.30		
Calc: Average vapor flow rate into building	(m3/hr)	Qsoil	17.04	202.50	NA	NA		

Model Input **Site Name/Run Number:** Example, Run 1

Chemical Name: Benzene CAS No. 71-43-2

Depth below grade to soil gas sample: 7.60 meters

Vadose zone characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Stratum A (Top of soil profile):								
Stratum A SCS soil type		SCS_A	Sandy Loam					
Stratum A thickness (from surface)	(m)	hSA	6.10					
Stratum A total porosity	(-)	nSA	0.387	0.387	NA	0.20		
Stratum A water-filled porosity	(-)	nwSA	0.103	0.103	0.039 - 0.17	0.25		
Stratum A bulk density	(g/cm^3)	rhoSA	1.620	1.620	NA	0.05		
Stratum B (Soil layer below Stratum A):								
Stratum B SCS soil type		SCS_B	Silt Loam					
Stratum B thickness	(m)	hSB	1.50					
Stratum B total porosity	(-)	nSB	0.439	0.439	NA	0.20		
Stratum B water-filled porosity	(-)	nwSB	0.180	0.180	0.065 - 0.3	0.25		
Stratum B bulk density	(g/cm^3)	rhoSB	1.490	1.490	NA	0.05		
Stratum C (Soil layer below Stratum B):								
Stratum C SCS soil type		SCS_C	Not Present					
Stratum C thickness	(m)	hSC	0.00					
Stratum C total porosity	(-)	nSC			NA	NA		
Stratum C water-filled porosity	(-)	nwSC			NA	NA		
Stratum C bulk density	(g/cm^3)	rhoSC			NA	NA		
Stratum containing soil gas sample								
Stratum A, B, or C		src_soil	Stratum B					
					NA	NA		
					NA			
					NA			

Exposure Parameters:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Target risk for carcinogens	(-)	Target_CR	1.00E-06	1.00E-06	NA	NA		
Target hazard quotient for non-carcinogens	(-)	Target_HQ	1	1	NA	NA		
Exposure Scenario		Scenario	Commercial	Commercial				
Averaging time for carcinogens	(yrs)	ATc	70	70	NA	NA		
Averaging time for non-carcinogens	(yrs)	ATnc	25	25	NA	NA		
Exposure duration	(yrs)	ED	25	25	NA	NA		
Exposure frequency	(days/yr)	EF	250	250	NA	NA		
Exposure time	(hrs/24 hrs)	ET	8	8	NA	NA		
Mutagenic mode-of-action factor	(yrs)	MMOAF	72	72	NA	NA		

Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Benzene CAS No. 71-43-2

Range is based on the reasonable range of Qsoil/Qbuilding values, as reported in the literature.

Source to Indoor Air Attenuation Factor	Units	Symbol	Value	Range	Default	Default Range	Flag
Soil gas to indoor air attenuation coefficient	**(-)**	**alpha**	**1.2E-03**	1.5E-04 - 1.2E-03	**1.3E-04**	5.7E-05 - 1.3E-04	
Predicted Indoor Air Concentration	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Indoor air concentration due to vapor intrusion	(ug/m3)	**Cia**	**1.2E-03**	1.5E-04 - 1.2E-03	**1.3E-04**	5.7E-05 - 1.3E-04	
	(ppbv)		**3.7E-04**	4.6E-05 - 3.8E-04	**4.0E-05**	1.8E-05 - 4.1E-05	
Predicted Vapor Conc. Beneath Foundation	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Subslab vapor concentration	(ug/m3)	**Css**	**4.0E-02**	2.4E-02 - 1.5E+00	**4.3E-03**	5.7E-01 - 1.3E+00	
	(ppbv)		**1.2E-02**	7.6E-03 - 4.6E-01	**1.3E-03**	1.8E-01 - 4.1E-01	
Diffusive Transport Upward Through Vadose Zone	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Effective diffusion coefficient through Stratum A	(cm2/sec)	DeffA	9.0E-03	-	9.0E-03	-	
Effective diffusion coefficient through Stratum B	(cm2/sec)	DeffB	5.2E-03	-	5.2E-03	-	
Effective diffusion coefficient through Stratum C	(cm2/sec)	DeffC		-		-	
				-		-	
Effective diffusion coefficient through unsaturated zone	(cm2/sec)	DeffT	5.2E-03	-	7.5E-03	-	
Critical Parameters		**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
α for diffusive transport from source to building with dirt floor foundation	(-)	A_Param	1.2E-03	-	1.3E-04		
Pe (Peclet Number) for transport through the foundation (advection / diffusion)	(-)	B_Param	2.8E+02	9.2E-01 - 4.6E+02	1.4E+03	4.6E+00 - 2.3E+03	
α for convective transport from subslab to building	(-)	C_Param	3.0E-02	1.0E-04 - 5.0E-02	3.0E-02	1.0E-04 - 5.0E-02	

Interpretation

Advection is the dominant mechanism across the foundation.
Diffusion through soil is the overall rate limiting process.

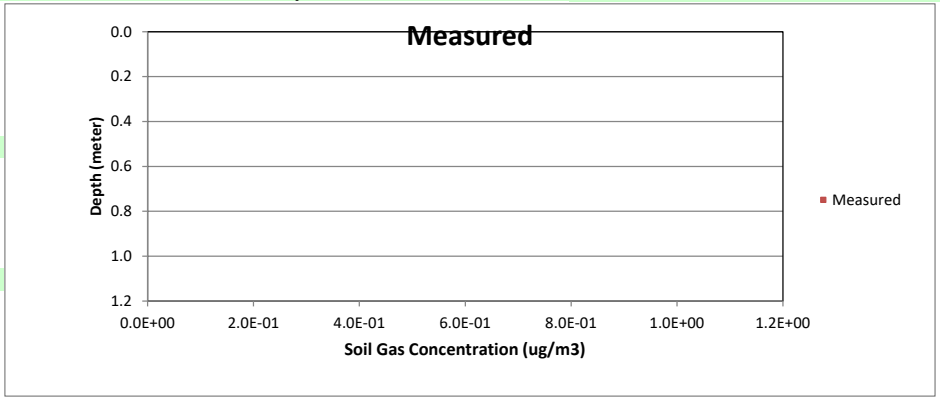
Critical Parameters

Hb, Ls, DeffT, ach

Non-Critical Parameters

Qsoil_Qb, Lf, DeffA, eta

Concentration versus Depth Profile



Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Benzene CAS No. 71-43-2

Risk Calculations	Units	Symbol	Value	Range	Default	Range	Flag
Risk-Based Target Screening Levels	**Scenario: Commercial**						
Target risk for carcinogens	(-)	Target_CR	1E-06	-	1E-06	-	
Target hazard quotient for noncarcinogens	(-)	Target_HQ	1	-	1	-	
Target indoor air concentration	**(ug/m3)**	**Target_IA**	**1.57E+00**	-	**1.57E+00**	-	
	(ppbv)		**4.92E-01**	-	**4.92E-01**	-	
Target soil gas concentration	**(ug/m3)**	**Target_SV**	**1.32E+03**	**1.3E+03 - 1.1E+04**	**1.22E+04**	**1.2E+04 - 2.8E+04**	
Incremental Risk Estimates							
Incremental cancer risk from vapor intrusion	**(-)**	**Cancer_Risk**	**7.57E-10**	**9.3E-11 - 7.7E-10**	**8.22E-11**	**3.6E-11 - 8.2E-11**	
Hazard quotient from vapor intrusion	**(-)**	**HQ**	**9.05E-06**	**1.1E-06 - 9.2E-06**	**9.83E-07**	**4.3E-07 - 9.9E-07**	

Building A (North Building)_Left Section of Garage_Benzene

Model Input **Site Name/Run Number:** Example, Run 1

Note:
-Yellow highlighted cells indicate parameters that typically are changed or must be inputted by the user.
-Dotted outline cells indicate default values that may be changed with justification.
-Toxicity values are taken from Regional Screening Level tables. These tables are updated semi-annually and may not reflect the most current toxicity information.

Use English / Metric Converter

Source Characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Source medium		Source	Exterior Soil Gas					
Soil gas concentration	(ug/m3)	Cmedium	1		NA			
Depth below grade to soil gas sample	(m)	Ls	7.60		Vary - 50	NA		
Average vadose zone temperature	(°C)	Ts	22	25	3-30			
Calc: Source vapor concentration	(ug/m3)	Cs	1					
Calc: % of pure component saturated vapor concentration	(%)	%Sat	0.000%					

Chemical:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Chemical Name		Chem	Benzene					
CAS No.		CAS	71-43-2					
Toxicity Factors								
Unit risk factor	$(ug/m^3)^{-1}$	IUR	7.80E-06	7.80E-06	NA	NA		
Mutagenic compound		Mut	No	NA	NA	NA		
Reference concentration	(mg/m^3)	RfC	3.00E-02	3.00E-02	NA	NA		

Chemical Properties:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Pure component water solubility	(mg/L)	S	1.79E+03	1.79E+03	NA	NA		
Henry's Law Constant @ 25°C	$(atm\text{-}m^3/mol)$	Hc	5.55E-03	5.55E-03	NA	NA		
Calc: Henry's Law Constant @ 25°C	(dimensionless)	Hr	2.27E-01	2.27E-01				
Calc: Henry's Law Constant @ system temperature	(dimensionless)	Hs	2.00E-01	2.29E-01				
Diffusivity in air	(cm2/s)	Dair	8.95E-02	8.95E-02	NA	NA		
Diffusivity in water	(cm2/s)	Dwater	1.03E-05	1.03E-05	NA	NA		

Building Characteristics:

Select Building Assumptions

(•) Use ratio for Qsoil/Qbuilding (recommended if no site specific data available)

( ) Specify Qsoil and Qbuilding separately; calculate ratio

	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Building setting		Bldg_Setting	Commercial	Commercial				
Foundation type		Found_Type	Basement w/ slab	Basement w/ slab				
Depth below grade to base of foundation	(m)	Lb	3.70	2.00	0.1 - 2.44	NA		
Foundation thickness	(m)	Lf	0.15	0.20	0.1 - 0.25	NA		
Fraction of foundation area with cracks	(-)	eta	0.005	0.005	0.0001-0.001	1.00		
Enclosed space floor area	(m2)	Abf	964.00	1500.00	80-1000	NA		
Enclosed space mixing height	(m)	Hb	4.30	3.00	2.44 - 4.88	NA		
Indoor air exchange rate	(1 / hr)	ach	0.60	1.50	.3-4.1	NA		
Qsoil/Qbuilding	(-)	Qsoil_Qb	0.0300	0.0300	0.0001 - 0.05	1.24		
Calc: Building ventilation rate	(m3/hr)	Qb	2487.12	6750.00	NA	0.30		
Calc: Average vapor flow rate into building	(m3/hr)	Qsoil	74.61	202.50	NA	NA		

Model Input **Site Name/Run Number:** Example, Run 1

Chemical Name: Benzene CAS No. 71-43-2

Depth below grade to soil gas sample: 7.60 meters

Vadose zone characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Stratum A (Top of soil profile):								
Stratum A SCS soil type		SCS_A	Sandy Loam					
Stratum A thickness (from surface)	(m)	hSA	4.60					
Stratum A total porosity	(-)	nSA	0.387	0.387	NA	0.20		
Stratum A water-filled porosity	(-)	nwSA	0.103	0.103	0.039 - 0.17	0.25		
Stratum A bulk density	(g/cm^3)	rhoSA	1.620	1.620	NA	0.05		
Stratum B (Soil layer below Stratum A):								
Stratum B SCS soil type		SCS_B	Silt Loam					
Stratum B thickness	(m)	hSB	3.00					
Stratum B total porosity	(-)	nSB	0.439	0.439	NA	0.20		
Stratum B water-filled porosity	(-)	nwSB	0.180	0.180	0.065 - 0.3	0.25		
Stratum B bulk density	(g/cm^3)	rhoSB	1.490	1.490	NA	0.05		
Stratum C (Soil layer below Stratum B):								
Stratum C SCS soil type		SCS_C	Not Present					
Stratum C thickness	(m)	hSC	0.00					
Stratum C total porosity	(-)	nSC			NA	NA		
Stratum C water-filled porosity	(-)	nwSC			NA	NA		
Stratum C bulk density	(g/cm^3)	rhoSC			NA	NA		
Stratum containing soil gas sample								
Stratum A, B, or C		src_soil	Stratum B					
					NA	NA		
					NA			
					NA			

Exposure Parameters:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Target risk for carcinogens	(-)	Target_CR	1.00E-06	1.00E-06	NA	NA		
Target hazard quotient for non-carcinogens	(-)	Target_HQ	1	1	NA	NA		
Exposure Scenario		Scenario	Commercial	Commercial				
Averaging time for carcinogens	(yrs)	ATc	70	70	NA	NA		
Averaging time for non-carcinogens	(yrs)	ATnc	25	25	NA	NA		
Exposure duration	(yrs)	ED	25	25	NA	NA		
Exposure frequency	(days/yr)	EF	250	250	NA	NA		
Exposure time	(hrs/24 hrs)	ET	8	8	NA	NA		
Mutagenic mode-of-action factor	(yrs)	MMOAF	72	72	NA	NA		

Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Benzene CAS No. 71-43-2

Range is based on the reasonable range of Qsoil/Qbuilding values, as reported in the literature.

Source to Indoor Air Attenuation Factor	Units	Symbol	Value	Range	Default	Default Range	Flag
Soil gas to indoor air attenuation coefficient	**(-)**	**alpha**	**3.0E-04**	8.8E-05 - 3.0E-04	**1.1E-04**	5.3E-05 - 1.1E-04	
Predicted Indoor Air Concentration	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Indoor air concentration due to vapor intrusion	(ug/m3)	**Cia**	**3.0E-04**	8.8E-05 - 3.0E-04	**1.1E-04**	5.3E-05 - 1.1E-04	
	(ppbv)		**9.4E-05**	2.8E-05 - 9.4E-05	**3.5E-05**	1.7E-05 - 3.5E-05	
Predicted Vapor Conc. Beneath Foundation	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Subslab vapor concentration	(ug/m3)	**Css**	**1.0E-02**	6.0E-03 - 8.8E-01	**3.7E-03**	5.3E-01 - 1.1E+00	
	(ppbv)		**3.1E-03**	1.9E-03 - 2.8E-01	**1.2E-03**	1.7E-01 - 3.5E-01	
Diffusive Transport Upward Through Vadose Zone	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Effective diffusion coefficient through Stratum A	(cm2/sec)	DeffA	9.0E-03	-	9.0E-03	-	
Effective diffusion coefficient through Stratum B	(cm2/sec)	DeffB	5.2E-03	-	5.2E-03	-	
Effective diffusion coefficient through Stratum C	(cm2/sec)	DeffC		-		-	
				-		-	
Effective diffusion coefficient through unsaturated zone	(cm2/sec)	DeffT	5.7E-03	-	6.5E-03	-	
Critical Parameters		**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
α for diffusive transport from source to building with dirt floor foundation	(-)	A_Param	3.0E-04	-	1.1E-04		
Pe (Peclet Number) for transport through the foundation (advection / diffusion)	(-)	B_Param	4.8E+02	1.6E+00 - 8.1E+02	1.4E+03	4.6E+00 - 2.3E+03	
α for convective transport from subslab to building	(-)	C_Param	3.0E-02	1.0E-04 - 5.0E-02	3.0E-02	1.0E-04 - 5.0E-02	

Interpretation

Advection is the dominant mechanism across the foundation.
Diffusion through soil is the overall rate limiting process.

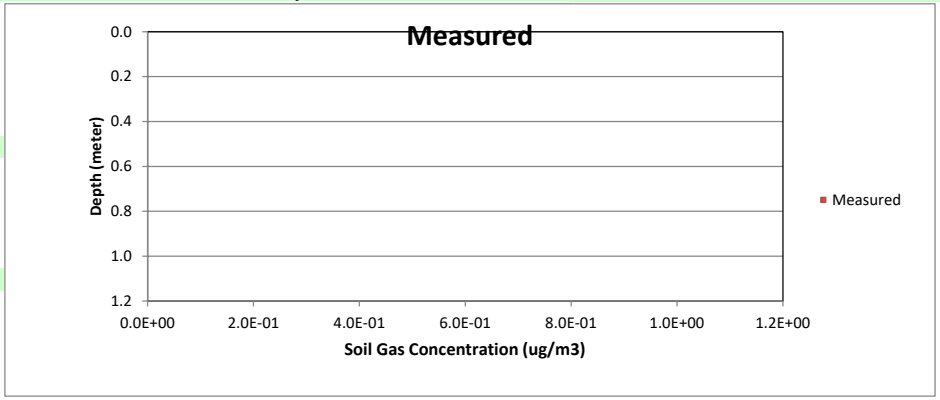
Critical Parameters

Hb, Ls, DeffT, ach

Non-Critical Parameters

Qsoil_Qb, Lf, DeffA, eta

Concentration versus Depth Profile



Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Benzene CAS No. 71-43-2

Risk Calculations	Units	Symbol	Value	Range	Default	Range	Flag
Risk-Based Target Screening Levels	**Scenario: Commercial**						
Target risk for carcinogens	(-)	Target_CR	1E-06	-	1E-06	-	
Target hazard quotient for noncarcinogens	(-)	Target_HQ	1	-	1	-	
Target indoor air concentration	**(ug/m3)**	**Target_IA**	**1.57E+00**	-	**1.57E+00**	-	
	(ppbv)		**4.92E-01**	-	**4.92E-01**	-	
Target soil gas concentration	**(ug/m3)**	**Target_SV**	**5.24E+03**	**5.2E+03 - 1.8E+04**	**1.42E+04**	**1.4E+04 - 3.0E+04**	
Incremental Risk Estimates							
Incremental cancer risk from vapor intrusion	**(-)**	**Cancer_Risk**	**1.91E-10**	**5.6E-11 - 1.9E-10**	**7.05E-11**	**3.4E-11 - 7.1E-11**	
Hazard quotient from vapor intrusion	**(-)**	**HQ**	**2.28E-06**	**6.7E-07 - 2.3E-06**	**8.43E-07**	**4.0E-07 - 8.4E-07**	

Building A (North Building)_Right Section of Garage_Benzene

Model Input **Site Name/Run Number:** Example, Run 1

Note:
-Yellow highlighted cells indicate parameters that typically are changed or must be inputted by the user.
-Dotted outline cells indicate default values that may be changed with justification.
-Toxicity values are taken from Regional Screening Level tables. These tables are updated semi-annually and may not reflect the most current toxicity information.

Use English / Metric Converter

Source Characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Source medium		Source	Exterior Soil Gas					
Soil gas concentration	(ug/m3)	Cmedium	1		NA			
Depth below grade to soil gas sample	(m)	Ls	7.60		Vary - 50	NA		
Average vadose zone temperature	(°C)	Ts	22	25	3-30			
Calc: Source vapor concentration	(ug/m3)	Cs	1					
Calc: % of pure component saturated vapor concentration	(%)	%Sat	0.000%					

Chemical:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Chemical Name		Chem	Benzene					
CAS No.		CAS	71-43-2					
Toxicity Factors								
Unit risk factor	$(ug/m^3)^{-1}$	IUR	7.80E-06	7.80E-06	NA	NA		
Mutagenic compound		Mut	No	NA	NA	NA		
Reference concentration	(mg/m^3)	RfC	3.00E-02	3.00E-02	NA	NA		

Chemical Properties:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Pure component water solubility	(mg/L)	S	1.79E+03	1.79E+03	NA	NA		
Henry's Law Constant @ 25°C	$(atm\text{-}m^3/mol)$	Hc	5.55E-03	5.55E-03	NA	NA		
Calc: Henry's Law Constant @ 25°C	(dimensionless)	Hr	2.27E-01	2.27E-01				
Calc: Henry's Law Constant @ system temperature	(dimensionless)	Hs	2.00E-01	2.29E-01				
Diffusivity in air	(cm2/s)	Dair	8.95E-02	8.95E-02	NA	NA		
Diffusivity in water	(cm2/s)	Dwater	1.03E-05	1.03E-05	NA	NA		

Building Characteristics:

Select Building Assumptions

- (●) Use ratio for Qsoil/Qbuilding (recommended if no site specific data available)
- ( ) Specify Qsoil and Qbuilding separately; calculate ratio

	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Building setting		Bldg_Setting	Commercial	Commercial				
Foundation type		Found_Type	Basement w/ slab	Basement w/ slab				
Depth below grade to base of foundation	(m)	Lb	3.00	2.00	0.1 - 2.44	NA		
Foundation thickness	(m)	Lf	0.15	0.20	0.1 - 0.25	NA		
Fraction of foundation area with cracks	(-)	eta	0.005	0.005	0.0001-0.001	1.00		
Enclosed space floor area	(m2)	Abf	1081.00	1500.00	80-1000	NA		
Enclosed space mixing height	(m)	Hb	3.70	3.00	2.44 - 4.88	NA		
Indoor air exchange rate	(1 / hr)	ach	0.80	1.50	.3-4.1	NA		
Qsoil/Qbuilding	(-)	Qsoil_Qb	0.0300	0.0300	0.0001 - 0.05	1.24		
Calc: Building ventilation rate	(m3/hr)	Qb	3199.76	6750.00	NA	0.30		
Calc: Average vapor flow rate into building	(m3/hr)	Qsoil	95.99	202.50	NA	NA		

Model Input **Site Name/Run Number:** Example, Run 1

Chemical Name: Benzene CAS No. 71-43-2

Depth below grade to soil gas sample: 7.60 meters

Vadose zone characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Stratum A (Top of soil profile):								
Stratum A SCS soil type		SCS_A	Sandy Loam					
Stratum A thickness (from surface)	(m)	hSA	4.60					
Stratum A total porosity	(-)	nSA	0.387	0.387	NA	0.20		
Stratum A water-filled porosity	(-)	nwSA	0.103	0.103	0.039 - 0.17	0.25		
Stratum A bulk density	(g/cm^3)	rhoSA	1.620	1.620	NA	0.05		
Stratum B (Soil layer below Stratum A):								
Stratum B SCS soil type		SCS_B	Silt Loam					
Stratum B thickness	(m)	hSB	3.00					
Stratum B total porosity	(-)	nSB	0.439	0.439	NA	0.20		
Stratum B water-filled porosity	(-)	nwSB	0.180	0.180	0.065 - 0.3	0.25		
Stratum B bulk density	(g/cm^3)	rhoSB	1.490	1.490	NA	0.05		
Stratum C (Soil layer below Stratum B):								
Stratum C SCS soil type		SCS_C	Not Present					
Stratum C thickness	(m)	hSC	0.00					
Stratum C total porosity	(-)	nSC			NA	NA		
Stratum C water-filled porosity	(-)	nwSC			NA	NA		
Stratum C bulk density	(g/cm^3)	rhoSC			NA	NA		
Stratum containing soil gas sample								
Stratum A, B, or C		src_soil	Stratum B					
					NA	NA		
					NA			
					NA			

Exposure Parameters:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Target risk for carcinogens	(-)	Target_CR	1.00E-06	1.00E-06	NA	NA		
Target hazard quotient for non-carcinogens	(-)	Target_HQ	1	1	NA	NA		
Exposure Scenario		Scenario	Commercial	Commercial				
Averaging time for carcinogens	(yrs)	ATc	70	70	NA	NA		
Averaging time for non-carcinogens	(yrs)	ATnc	25	25	NA	NA		
Exposure duration	(yrs)	ED	25	25	NA	NA		
Exposure frequency	(days/yr)	EF	250	250	NA	NA		
Exposure time	(hrs/24 hrs)	ET	8	8	NA	NA		
Mutagenic mode-of-action factor	(yrs)	MMOAF	72	72	NA	NA		

Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Benzene CAS No. 71-43-2

Range is based on the reasonable range of Qsoil/Qbuilding values, as reported in the literature.

Source to Indoor Air Attenuation Factor	Units	Symbol	Value	Range	Default	Default Range	Flag
Soil gas to indoor air attenuation coefficient	**(-)**	**alpha**	**2.2E-04**	7.6E-05 - 2.2E-04	**1.1E-04**	5.3E-05 - 1.1E-04	
Predicted Indoor Air Concentration	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Indoor air concentration due to vapor intrusion	(ug/m3)	**Cia**	**2.2E-04**	7.6E-05 - 2.2E-04	**1.1E-04**	5.3E-05 - 1.1E-04	
	(ppbv)		**6.8E-05**	2.4E-05 - 6.8E-05	**3.5E-05**	1.7E-05 - 3.5E-05	
Predicted Vapor Conc. Beneath Foundation	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Subslab vapor concentration	(ug/m3)	**Css**	**7.3E-03**	4.4E-03 - 7.6E-01	**3.7E-03**	5.3E-01 - 1.1E+00	
	(ppbv)		**2.3E-03**	1.4E-03 - 2.4E-01	**1.2E-03**	1.7E-01 - 3.5E-01	
Diffusive Transport Upward Through Vadose Zone	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Effective diffusion coefficient through Stratum A	(cm2/sec)	DeffA	9.0E-03	-	9.0E-03	-	
Effective diffusion coefficient through Stratum B	(cm2/sec)	DeffB	5.2E-03	-	5.2E-03	-	
Effective diffusion coefficient through Stratum C	(cm2/sec)	DeffC		-		-	
				-		-	
Effective diffusion coefficient through unsaturated zone	(cm2/sec)	DeffT	6.1E-03	-	6.5E-03	-	
Critical Parameters		**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
α for diffusive transport from source to building with dirt floor foundation	(-)	A_Param	2.2E-04	-	1.1E-04		
Pe (Peclet Number) for transport through the foundation (advection / diffusion)	(-)	B_Param	6.0E+02	2.0E+00 - 1.0E+03	1.4E+03	4.6E+00 - 2.3E+03	
α for convective transport from subslab to building	(-)	C_Param	3.0E-02	1.0E-04 - 5.0E-02	3.0E-02	1.0E-04 - 5.0E-02	

Interpretation

Advection is the dominant mechanism across the foundation.
Diffusion through soil is the overall rate limiting process.

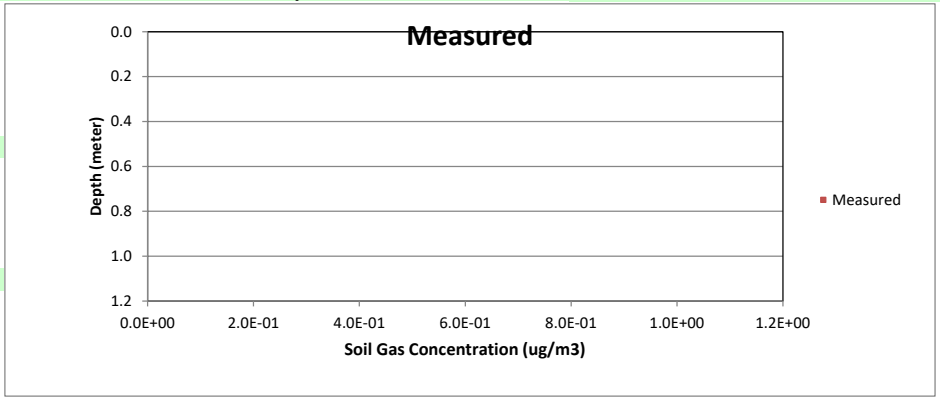
Critical Parameters

Hb, Ls, DeffT, ach

Non-Critical Parameters

Qsoil_Qb, Lf, DeffA, eta

Concentration versus Depth Profile



Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Benzene CAS No. 71-43-2

Risk Calculations	Units	Symbol	Value	Range	Default	Range	Flag
Risk-Based Target Screening Levels	**Scenario: Commercial**						
Target risk for carcinogens	(-)	Target_CR	1E-06	-	1E-06	-	
Target hazard quotient for noncarcinogens	(-)	Target_HQ	1	-	1	-	
Target indoor air concentration	**(ug/m3)**	**Target_IA**	**1.57E+00**	-	**1.57E+00**	-	
	(ppbv)		**4.92E-01**	-	**4.92E-01**	-	
Target soil gas concentration	**(ug/m3)**	**Target_SV**	**7.23E+03**	**7.2E+03 - 2.1E+04**	**1.42E+04**	**1.4E+04 - 3.0E+04**	
Incremental Risk Estimates							
Incremental cancer risk from vapor intrusion	**(-)**	**Cancer_Risk**	**1.38E-10**	**4.8E-11 - 1.4E-10**	**7.05E-11**	**3.4E-11 - 7.1E-11**	
Hazard quotient from vapor intrusion	**(-)**	**HQ**	**1.66E-06**	**5.8E-07 - 1.7E-06**	**8.43E-07**	**4.0E-07 - 8.4E-07**	

Building A (North Building)_ Stack Lift Section of Garage_PCE

Model Input **Site Name/Run Number:** Example, Run 1

Note:
-Yellow highlighted cells indicate parameters that typically are changed or must be inputted by the user.
-Dotted outline cells indicate default values that may be changed with justification.
-Toxicity values are taken from Regional Screening Level tables. These tables are updated semi-annually and may not reflect the most current toxicity information.

Use English / Metric Converter

Source Characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Source medium		Source	Exterior Soil Gas					
Soil gas concentration	(ug/m3)	Cmedium	1		NA			
Depth below grade to soil gas sample	(m)	Ls	7.60		Vary - 50	NA		
Average vadose zone temperature	(°C)	Ts	22	25	3-30			
Calc: Source vapor concentration	(ug/m3)	Cs	1					
Calc: % of pure component saturated vapor concentration	(%)	%Sat	0.000%					

Chemical:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Chemical Name		Chem	Tetrachloroethylene					
CAS No.		CAS	127-18-4					
Toxicity Factors								
Unit risk factor	$(ug/m^3)^{-1}$	IUR	2.60E-07	2.60E-07	NA	NA		
Mutagenic compound		Mut	No	NA	NA	NA		
Reference concentration	(mg/m^3)	RfC	4.00E-02	4.00E-02	NA	NA		

Chemical Properties:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Pure component water solubility	(mg/L)	S	2.06E+02	2.06E+02	NA	NA		
Henry's Law Constant @ 25°C	($atm\text{-}m^3/mol$)	Hc	1.77E-02	1.77E-02	NA	NA		
Calc: Henry's Law Constant @ 25°C	(dimensionless)	Hr	7.24E-01	7.24E-01				
Calc: Henry's Law Constant @ system temperature	(dimensionless)	Hs	6.22E-01	7.31E-01				
Diffusivity in air	(cm2/s)	Dair	5.05E-02	5.05E-02	NA	NA		
Diffusivity in water	(cm2/s)	Dwater	9.46E-06	9.46E-06	NA	NA		

Building Characteristics:

Select Building Assumptions

(●) Use ratio for Qsoil/Qbuilding (recommended if no site specific data available)

( ) Specify Qsoil and Qbuilding separately; calculate ratio

	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Building setting		Bldg_Setting	Commercial	Commercial				
Foundation type		Found_Type	Basement w/ slab	Basement w/ slab				
Depth below grade to base of foundation	(m)	Lb	6.10	2.00	0.1 - 2.44	NA		
Foundation thickness	(m)	Lf	0.15	0.20	0.1 - 0.25	NA		
Fraction of foundation area with cracks	(-)	eta	0.005	0.005	0.0001-0.001	1.00		
Enclosed space floor area	(m2)	Abf	212.00	1500.00	80-1000	NA		
Enclosed space mixing height	(m)	Hb	6.70	3.00	2.44 - 4.88	NA		
Indoor air exchange rate	(1 / hr)	ach	0.40	1.50	.3-4.1	NA		
Qsoil/Qbuilding	(-)	Qsoil_Qb	0.0300	0.0300	0.0001 - 0.05	1.24		
Calc: Building ventilation rate	(m3/hr)	Qb	568.16	6750.00	NA	0.30		
Calc: Average vapor flow rate into building	(m3/hr)	Qsoil	17.04	202.50	NA	NA		

0

Model Input **Site Name/Run Number:** Example, Run 1

Chemical Name: Tetrachloroethylene CAS No. 127-18-4

Depth below grade to soil gas sample: 7.60 meters

Vadose zone characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Stratum A (Top of soil profile):								
Stratum A SCS soil type		SCS_A	Sandy Loam					
Stratum A thickness (from surface)	(m)	hSA	6.10					
Stratum A total porosity	(-)	nSA	0.387	0.387	NA	0.20		
Stratum A water-filled porosity	(-)	nwSA	0.103	0.103	0.039 - 0.17	0.25		
Stratum A bulk density	(g/cm^3)	rhoSA	1.620	1.620	NA	0.05		
Stratum B (Soil layer below Stratum A):								
Stratum B SCS soil type		SCS_B	Silt Loam					
Stratum B thickness	(m)	hSB	1.50					
Stratum B total porosity	(-)	nSB	0.439	0.439	NA	0.20		
Stratum B water-filled porosity	(-)	nwSB	0.180	0.180	0.065 - 0.3	0.25		
Stratum B bulk density	(g/cm^3)	rhoSB	1.490	1.490	NA	0.05		
Stratum C (Soil layer below Stratum B):								
Stratum C SCS soil type		SCS_C	Not Present					
Stratum C thickness	(m)	hSC	0.00					
Stratum C total porosity	(-)	nSC			NA	NA		
Stratum C water-filled porosity	(-)	nwSC			NA	NA		
Stratum C bulk density	(g/cm^3)	rhoSC			NA	NA		
Stratum containing soil gas sample								
Stratum A, B, or C		src_soil	Stratum B					
					NA	NA		
					NA			
					NA			

Exposure Parameters:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Target risk for carcinogens	(-)	Target_CR	1.00E-06	1.00E-06	NA	NA		
Target hazard quotient for non-carcinogens	(-)	Target_HQ	1	1	NA	NA		
Exposure Scenario		Scenario	Commercial	Commercial				
Averaging time for carcinogens	(yrs)	ATc	70	70	NA	NA		
Averaging time for non-carcinogens	(yrs)	ATnc	25	25	NA	NA		
Exposure duration	(yrs)	ED	25	25	NA	NA		
Exposure frequency	(days/yr)	EF	250	250	NA	NA		
Exposure time	(hrs/24 hrs)	ET	8	8	NA	NA		
Mutagenic mode-of-action factor	(yrs)	MMOAF	72	72	NA	NA		

0

Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Tetrachloroethylene **CAS No. 127-18-4**

Range is based on the reasonable range of Qsoil/Qbuilding values, as reported in the literature.

Source to Indoor Air Attenuation Factor	Units	Symbol	Value	Range	Default	Default Range	Flag
Soil gas to indoor air attenuation coefficient	**(-)**	**alpha**	**6.8E-04**	1.1E-04 - 6.9E-04	**7.3E-05**	4.2E-05 - 7.3E-05	
Predicted Indoor Air Concentration	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Indoor air concentration due to vapor intrusion	(ug/m3)	**Cia**	**6.8E-04**	1.1E-04 - 6.9E-04	**7.3E-05**	4.2E-05 - 7.3E-05	
	(ppbv)		**1.0E-04**	1.6E-05 - 1.0E-04	**1.1E-05**	6.2E-06 - 1.1E-05	
Predicted Vapor Conc. Beneath Foundation	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Subslab vapor concentration	(ug/m3)	**Css**	**2.3E-02**	1.4E-02 - 1.1E+00	**2.4E-03**	4.2E-01 - 7.3E-01	
	(ppbv)		**3.4E-03**	2.0E-03 - 1.6E-01	**3.6E-04**	6.2E-02 - 1.1E-01	
Diffusive Transport Upward Through Vadose Zone	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Effective diffusion coefficient through Stratum A	(cm2/sec)	DeffA	5.1E-03	-	5.1E-03	-	
Effective diffusion coefficient through Stratum B	(cm2/sec)	DeffB	2.9E-03	-	2.9E-03	-	
Effective diffusion coefficient through Stratum C	(cm2/sec)	DeffC		-		-	
				-		-	
Effective diffusion coefficient through unsaturated zone	(cm2/sec)	DeffT	2.9E-03	-	4.2E-03	-	
Critical Parameters		**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
α for diffusive transport from source to building with dirt floor foundation	(-)	A_Param	7.0E-04	-	7.3E-05		
Pe (Peclet Number) for transport through the foundation (advection / diffusion)	(-)	B_Param	4.9E+02	1.6E+00 - 8.2E+02	2.4E+03	8.1E+00 - 4.1E+03	
α for convective transport from subslab to building	(-)	C_Param	3.0E-02	1.0E-04 - 5.0E-02	3.0E-02	1.0E-04 - 5.0E-02	

Interpretation

Advection is the dominant mechanism across the foundation.
Diffusion through soil is the overall rate limiting process.

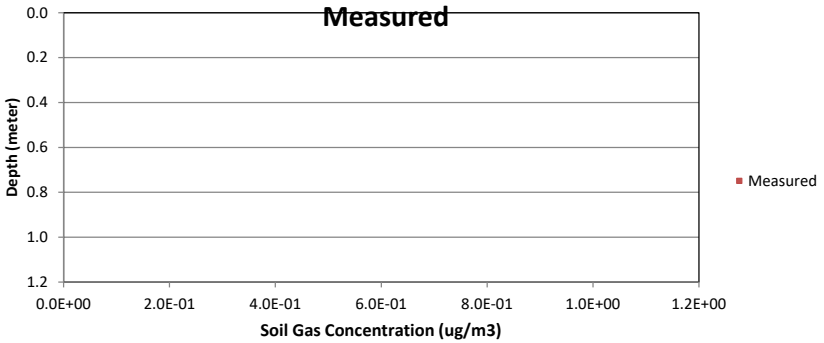
Critical Parameters

Hb, Ls, DeffT, ach

Non-Critical Parameters

Qsoil_Qb, Lf, DeffA, eta

Concentration versus Depth Profile



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Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Tetrachloroethylene **CAS No. 127-18-4**

Risk Calculations	Units	Symbol	Value	Range	Default	Range	Flag
Risk-Based Target Screening Levels	**Scenario: Commercial**						
Target risk for carcinogens	(-)	Target_CR	1E-06	-	1E-06	-	
Target hazard quotient for noncarcinogens	(-)	Target_HQ	1	-	1	-	
Target indoor air concentration	**(ug/m3)**	**Target_IA**	**4.72E+01**	-	**4.72E+01**	-	
	(ppbv)		**6.96E+00**	-	**6.96E+00**	-	
Target soil gas concentration	**(ug/m3)**	**Target_SV**	**6.91E+04**	**6.9E+04 - 4.5E+05**	**6.46E+05**	**6.5E+05 - 1.1E+06**	
Incremental Risk Estimates							
Incremental cancer risk from vapor intrusion	**(-)**	**Cancer_Risk**	**1.45E-11**	**2.2E-12 - 1.5E-11**	**1.55E-12**	**9.0E-13 - 1.5E-12**	
Hazard quotient from vapor intrusion	**(-)**	**HQ**	**3.89E-06**	**6.0E-07 - 3.9E-06**	**4.16E-07**	**2.4E-07 - 4.2E-07**	

Building A (North Building)_Left Section of Garage_PCE

Model Input **Site Name/Run Number:** Example, Run 1

Note:
-Yellow highlighted cells indicate parameters that typically are changed or must be inputted by the user.
-Dotted outline cells indicate default values that may be changed with justification.
-Toxicity values are taken from Regional Screening Level tables. These tables are updated semi-annually and may not reflect the most current toxicity information.

Use English / Metric Converter

Source Characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Source medium		Source	Exterior Soil Gas					
Soil gas concentration	(ug/m3)	Cmedium	1		NA			
Depth below grade to soil gas sample	(m)	Ls	7.60		Vary - 50	NA		
Average vadose zone temperature	(°C)	Ts	22	25	3-30			
Calc: Source vapor concentration	(ug/m3)	Cs	1					
Calc: % of pure component saturated vapor concentration	(%)	%Sat	0.000%					

Chemical:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Chemical Name		Chem	Tetrachloroethylene					
CAS No.		CAS	127-18-4					
Toxicity Factors								
Unit risk factor	$(ug/m^3)^{-1}$	IUR	2.60E-07	2.60E-07	NA	NA		
Mutagenic compound		Mut	No	NA	NA	NA		
Reference concentration	(mg/m^3)	RfC	4.00E-02	4.00E-02	NA	NA		

Chemical Properties:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Pure component water solubility	(mg/L)	S	2.06E+02	2.06E+02	NA	NA		
Henry's Law Constant @ 25°C	$(atm\text{-}m^3/mol)$	Hc	1.77E-02	1.77E-02	NA	NA		
Calc: Henry's Law Constant @ 25°C	(dimensionless)	Hr	7.24E-01	7.24E-01				
Calc: Henry's Law Constant @ system temperature	(dimensionless)	Hs	6.22E-01	7.31E-01				
Diffusivity in air	(cm2/s)	Dair	5.05E-02	5.05E-02	NA	NA		
Diffusivity in water	(cm2/s)	Dwater	9.46E-06	9.46E-06	NA	NA		

Building Characteristics:

Select Building Assumptions

(●) Use ratio for Qsoil/Qbuilding (recommended if no site specific data available)

( ) Specify Qsoil and Qbuilding separately; calculate ratio

	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Building setting		Bldg_Setting	Commercial	Commercial				
Foundation type		Found_Type	Basement w/ slab	Basement w/ slab				
Depth below grade to base of foundation	(m)	Lb	3.70	2.00	0.1 - 2.44	NA		
Foundation thickness	(m)	Lf	0.15	0.20	0.1 - 0.25	NA		
Fraction of foundation area with cracks	(-)	eta	0.005	0.005	0.0001-0.001	1.00		
Enclosed space floor area	(m2)	Abf	964.00	1500.00	80-1000	NA		
Enclosed space mixing height	(m)	Hb	4.30	3.00	2.44 - 4.88	NA		
Indoor air exchange rate	(1 / hr)	ach	0.60	1.50	.3-4.1	NA		
Qsoil/Qbuilding	(-)	Qsoil_Qb	0.0300	0.0300	0.0001 - 0.05	1.24		
Calc: Building ventilation rate	(m3/hr)	Qb	2487.12	6750.00	NA	0.30		
Calc: Average vapor flow rate into building	(m3/hr)	Qsoil	74.61	202.50	NA	NA		

Model Input **Site Name/Run Number:** Example, Run 1

Chemical Name: Tetrachloroethylene CAS No. 127-18-4

Depth below grade to soil gas sample: 7.60 meters

Vadose zone characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Stratum A (Top of soil profile):								
Stratum A SCS soil type		SCS_A	Sandy Loam					
Stratum A thickness (from surface)	(m)	hSA	4.60					
Stratum A total porosity	(-)	nSA	0.387	0.387	NA	0.20		
Stratum A water-filled porosity	(-)	nwSA	0.103	0.103	0.039 - 0.17	0.25		
Stratum A bulk density	(g/cm^3)	rhoSA	1.620	1.620	NA	0.05		
Stratum B (Soil layer below Stratum A):								
Stratum B SCS soil type		SCS_B	Silt Loam					
Stratum B thickness	(m)	hSB	3.00					
Stratum B total porosity	(-)	nSB	0.439	0.439	NA	0.20		
Stratum B water-filled porosity	(-)	nwSB	0.180	0.180	0.065 - 0.3	0.25		
Stratum B bulk density	(g/cm^3)	rhoSB	1.490	1.490	NA	0.05		
Stratum C (Soil layer below Stratum B):								
Stratum C SCS soil type		SCS_C	Not Present					
Stratum C thickness	(m)	hSC	0.00					
Stratum C total porosity	(-)	nSC			NA	NA		
Stratum C water-filled porosity	(-)	nwSC			NA	NA		
Stratum C bulk density	(g/cm^3)	rhoSC			NA	NA		
Stratum containing soil gas sample								
Stratum A, B, or C		src_soil	Stratum B					
					NA	NA		
					NA			
					NA			

Exposure Parameters:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Target risk for carcinogens	(-)	Target_CR	1.00E-06	1.00E-06	NA	NA		
Target hazard quotient for non-carcinogens	(-)	Target_HQ	1	1	NA	NA		
Exposure Scenario		Scenario	Commercial	Commercial				
Averaging time for carcinogens	(yrs)	ATc	70	70	NA	NA		
Averaging time for non-carcinogens	(yrs)	ATnc	25	25	NA	NA		
Exposure duration	(yrs)	ED	25	25	NA	NA		
Exposure frequency	(days/yr)	EF	250	250	NA	NA		
Exposure time	(hrs/24 hrs)	ET	8	8	NA	NA		
Mutagenic mode-of-action factor	(yrs)	MMOAF	72	72	NA	NA		

Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Tetrachloroethylene **CAS No. 127-18-4**

Range is based on the reasonable range of Qsoil/Qbuilding values, as reported in the literature.

Source to Indoor Air Attenuation Factor	Units	Symbol	Value	Range	Default	Default Range	Flag
Soil gas to indoor air attenuation coefficient	**(-)**	**alpha**	**1.7E-04**	6.5E-05 - 1.7E-04	**6.3E-05**	3.9E-05 - 6.3E-05	
Predicted Indoor Air Concentration	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Indoor air concentration due to vapor intrusion	(ug/m3)	**Cia**	**1.7E-04**	6.5E-05 - 1.7E-04	**6.3E-05**	3.9E-05 - 6.3E-05	
	(ppbv)		**2.5E-05**	9.7E-06 - 2.5E-05	**9.2E-06**	5.7E-06 - 9.2E-06	
Predicted Vapor Conc. Beneath Foundation	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Subslab vapor concentration	(ug/m3)	**Css**	**5.7E-03**	3.4E-03 - 6.5E-01	**2.1E-03**	3.9E-01 - 6.3E-01	
	(ppbv)		**8.4E-04**	5.0E-04 - 9.7E-02	**3.1E-04**	5.7E-02 - 9.2E-02	
Diffusive Transport Upward Through Vadose Zone	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Effective diffusion coefficient through Stratum A	(cm2/sec)	DeffA	5.1E-03	-	5.1E-03	-	
Effective diffusion coefficient through Stratum B	(cm2/sec)	DeffB	2.9E-03	-	2.9E-03	-	
Effective diffusion coefficient through Stratum C	(cm2/sec)	DeffC		-		-	
				-		-	
Effective diffusion coefficient through unsaturated zone	(cm2/sec)	DeffT	3.2E-03	-	3.6E-03	-	
Critical Parameters		**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
α for diffusive transport from source to building with dirt floor foundation	(-)	A_Param	1.7E-04	-	6.3E-05		
Pe (Peclet Number) for transport through the foundation (advection / diffusion)	(-)	B_Param	8.6E+02	2.9E+00 - 1.4E+03	2.4E+03	8.1E+00 - 4.1E+03	
α for convective transport from subslab to building	(-)	C_Param	3.0E-02	1.0E-04 - 5.0E-02	3.0E-02	1.0E-04 - 5.0E-02	

Interpretation

Advection is the dominant mechanism across the foundation.
Diffusion through soil is the overall rate limiting process.

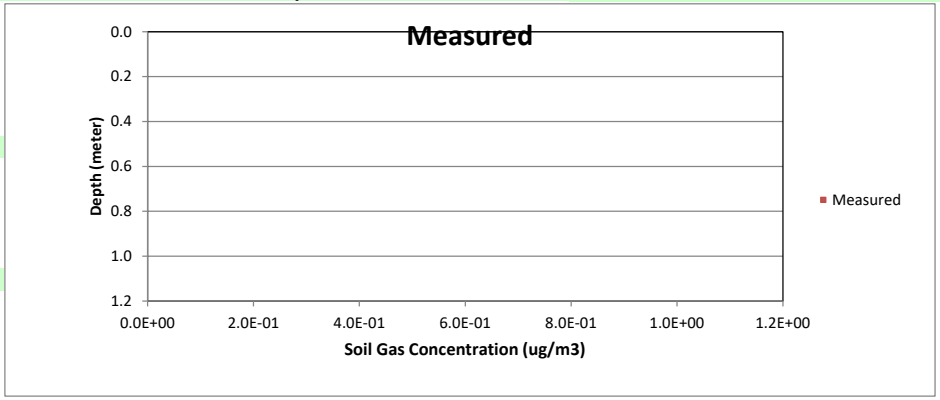
Critical Parameters

Hb, Ls, DeffT, ach

Non-Critical Parameters

Qsoil_Qb, Lf, DeffA, eta

Concentration versus Depth Profile



Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Tetrachloroethylene **CAS No. 127-18-4**

Risk Calculations	Units	Symbol	Value	Range	Default	Range	Flag
Risk-Based Target Screening Levels	**Scenario: Commercial**						
Target risk for carcinogens	(-)	Target_CR	1E-06	-	1E-06	-	
Target hazard quotient for noncarcinogens	(-)	Target_HQ	1	-	1	-	
Target indoor air concentration	**(ug/m3)**	**Target_IA**	**4.72E+01**	-	**4.72E+01**	-	
	(ppbv)		**6.96E+00**	-	**6.96E+00**	-	
Target soil gas concentration	**(ug/m3)**	**Target_SV**	**2.78E+05**	**2.8E+05 - 7.2E+05**	**7.54E+05**	**7.5E+05 - 1.2E+06**	
Incremental Risk Estimates							
Incremental cancer risk from vapor intrusion	**(-)**	**Cancer_Risk**	**3.60E-12**	**1.4E-12 - 3.6E-12**	**1.33E-12**	**8.2E-13 - 1.3E-12**	
Hazard quotient from vapor intrusion	**(-)**	**HQ**	**9.69E-07**	**3.7E-07 - 9.7E-07**	**3.57E-07**	**2.2E-07 - 3.6E-07**	

Building A (North Building)_Right Section of Garage_PCE

Model Input **Site Name/Run Number:** Example, Run 1

Note:
-Yellow highlighted cells indicate parameters that typically are changed or must be inputted by the user.
-Dotted outline cells indicate default values that may be changed with justification.
-Toxicity values are taken from Regional Screening Level tables. These tables are updated semi-annually and may not reflect the most current toxicity information.

Use English / Metric Converter

Source Characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Source medium		Source	Exterior Soil Gas					
Soil gas concentration	(ug/m3)	Cmedium	1		NA			
Depth below grade to soil gas sample	(m)	Ls	7.60		Vary - 50	NA		
Average vadose zone temperature	(°C)	Ts	22	25	3-30			
Calc: Source vapor concentration	(ug/m3)	Cs	1					
Calc: % of pure component saturated vapor concentration	(%)	%Sat	0.000%					

Chemical:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Chemical Name		Chem	Tetrachloroethylene					
CAS No.		CAS	127-18-4					
Toxicity Factors								
Unit risk factor	$(ug/m^3)^{-1}$	IUR	2.60E-07	2.60E-07	NA	NA		
Mutagenic compound		Mut	No	NA	NA	NA		
Reference concentration	(mg/m^3)	RfC	4.00E-02	4.00E-02	NA	NA		

Chemical Properties:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Pure component water solubility	(mg/L)	S	2.06E+02	2.06E+02	NA	NA		
Henry's Law Constant @ 25°C	(atm-m^3/mol)	Hc	1.77E-02	1.77E-02	NA	NA		
Calc: Henry's Law Constant @ 25°C	(dimensionless)	Hr	7.24E-01	7.24E-01				
Calc: Henry's Law Constant @ system temperature	(dimensionless)	Hs	6.22E-01	7.31E-01				
Diffusivity in air	(cm2/s)	Dair	5.05E-02	5.05E-02	NA	NA		
Diffusivity in water	(cm2/s)	Dwater	9.46E-06	9.46E-06	NA	NA		

Building Characteristics:

Select Building Assumptions

(●) Use ratio for Qsoil/Qbuilding (recommended if no site specific data available)

( ) Specify Qsoil and Qbuilding separately; calculate ratio

	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Building setting		Bldg_Setting	Commercial	Commercial				
Foundation type		Found_Type	Basement w/ slab	Basement w/ slab				
Depth below grade to base of foundation	(m)	Lb	3.00	2.00	0.1 - 2.44	NA		
Foundation thickness	(m)	Lf	0.15	0.20	0.1 - 0.25	NA		
Fraction of foundation area with cracks	(-)	eta	0.005	0.005	0.0001-0.001	1.00		
Enclosed space floor area	(m2)	Abf	1081.00	1500.00	80-1000	NA		
Enclosed space mixing height	(m)	Hb	3.70	3.00	2.44 - 4.88	NA		
Indoor air exchange rate	(1 / hr)	ach	0.80	1.50	.3-4.1	NA		
Qsoil/Qbuilding	(-)	Qsoil_Qb	0.0300	0.0300	0.0001 - 0.05	1.24		
Calc: Building ventilation rate	(m3/hr)	Qb	3199.76	6750.00	NA	0.30		
Calc: Average vapor flow rate into building	(m3/hr)	Qsoil	95.99	202.50	NA	NA		

Model Input **Site Name/Run Number:** Example, Run 1

Chemical Name: Tetrachloroethylene CAS No. 127-18-4

Depth below grade to soil gas sample: 7.60 meters

Vadose zone characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Stratum A (Top of soil profile):								
Stratum A SCS soil type		SCS_A	Sandy Loam					
Stratum A thickness (from surface)	(m)	hSA	4.60					
Stratum A total porosity	(-)	nSA	0.387	0.387	NA	0.20		
Stratum A water-filled porosity	(-)	nwSA	0.103	0.103	0.039 - 0.17	0.25		
Stratum A bulk density	(g/cm^3)	rhoSA	1.620	1.620	NA	0.05		
Stratum B (Soil layer below Stratum A):								
Stratum B SCS soil type		SCS_B	Silt Loam					
Stratum B thickness	(m)	hSB	3.00					
Stratum B total porosity	(-)	nSB	0.439	0.439	NA	0.20		
Stratum B water-filled porosity	(-)	nwSB	0.180	0.180	0.065 - 0.3	0.25		
Stratum B bulk density	(g/cm^3)	rhoSB	1.490	1.490	NA	0.05		
Stratum C (Soil layer below Stratum B):								
Stratum C SCS soil type		SCS_C	Not Present					
Stratum C thickness	(m)	hSC	0.00					
Stratum C total porosity	(-)	nSC			NA	NA		
Stratum C water-filled porosity	(-)	nwSC			NA	NA		
Stratum C bulk density	(g/cm^3)	rhoSC			NA	NA		
Stratum containing soil gas sample								
Stratum A, B, or C		src_soil	Stratum B					
					NA	NA		
					NA			
					NA			

Exposure Parameters:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Target risk for carcinogens	(-)	Target_CR	1.00E-06	1.00E-06	NA	NA		
Target hazard quotient for non-carcinogens	(-)	Target_HQ	1	1	NA	NA		
Exposure Scenario		Scenario	Commercial	Commercial				
Averaging time for carcinogens	(yrs)	ATc	70	70	NA	NA		
Averaging time for non-carcinogens	(yrs)	ATnc	25	25	NA	NA		
Exposure duration	(yrs)	ED	25	25	NA	NA		
Exposure frequency	(days/yr)	EF	250	250	NA	NA		
Exposure time	(hrs/24 hrs)	ET	8	8	NA	NA		
Mutagenic mode-of-action factor	(yrs)	MMOAF	72	72	NA	NA		

Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Tetrachloroethylene **CAS No. 127-18-4**

Range is based on the reasonable range of Qsoil/Qbuilding values, as reported in the literature.

Source to Indoor Air Attenuation Factor	Units	Symbol	Value	Range	Default	Default Range	Flag
Soil gas to indoor air attenuation coefficient	**(-)**	**alpha**	**1.2E-04**	5.6E-05 - 1.2E-04	**6.3E-05**	3.9E-05 - 6.3E-05	
Predicted Indoor Air Concentration	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Indoor air concentration due to vapor intrusion	(ug/m3)	**Cia**	**1.2E-04**	5.6E-05 - 1.2E-04	**6.3E-05**	3.9E-05 - 6.3E-05	
	(ppbv)		**1.8E-05**	8.3E-06 - 1.8E-05	**9.2E-06**	5.7E-06 - 9.2E-06	
Predicted Vapor Conc. Beneath Foundation	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Subslab vapor concentration	(ug/m3)	**Css**	**4.1E-03**	2.5E-03 - 5.6E-01	**2.1E-03**	3.9E-01 - 6.3E-01	
	(ppbv)		**6.0E-04**	3.6E-04 - 8.3E-02	**3.1E-04**	5.7E-02 - 9.2E-02	
Diffusive Transport Upward Through Vadose Zone	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Effective diffusion coefficient through Stratum A	(cm2/sec)	DeffA	5.1E-03	-	5.1E-03	-	
Effective diffusion coefficient through Stratum B	(cm2/sec)	DeffB	2.9E-03	-	2.9E-03	-	
Effective diffusion coefficient through Stratum C	(cm2/sec)	DeffC		-		-	
				-		-	
Effective diffusion coefficient through unsaturated zone	(cm2/sec)	DeffT	3.4E-03	-	3.6E-03	-	
Critical Parameters		**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
α for diffusive transport from source to building with dirt floor foundation	(-)	A_Param	1.2E-04	-	6.3E-05		
Pe (Peclet Number) for transport through the foundation (advection / diffusion)	(-)	B_Param	1.1E+03	3.5E+00 - 1.8E+03	2.4E+03	8.1E+00 - 4.1E+03	
α for convective transport from subslab to building	(-)	C_Param	3.0E-02	1.0E-04 - 5.0E-02	3.0E-02	1.0E-04 - 5.0E-02	

Interpretation

Advection is the dominant mechanism across the foundation.
Diffusion through soil is the overall rate limiting process.

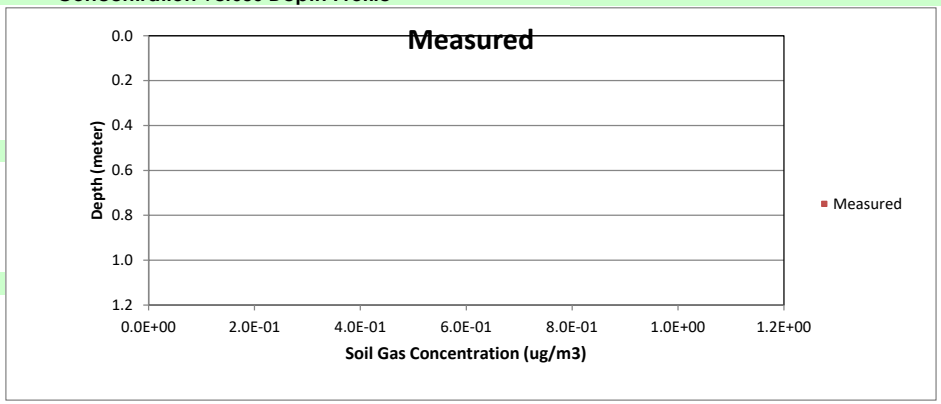
Critical Parameters

Hb, Ls, DeffT, ach

Non-Critical Parameters

Qsoil_Qb, Lf, DeffA, eta

Concentration versus Depth Profile



Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Tetrachloroethylene **CAS No. 127-18-4**

Risk Calculations	Units	Symbol	Value	Range	Default	Range	Flag
Risk-Based Target Screening Levels	**Scenario: Commercial**						
Target risk for carcinogens	(-)	Target_CR	1E-06	-	1E-06	-	
Target hazard quotient for noncarcinogens	(-)	Target_HQ	1	-	1	-	
Target indoor air concentration	**(ug/m3)**	**Target_IA**	**4.72E+01**	-	**4.72E+01**	-	
	(ppbv)		**6.96E+00**	-	**6.96E+00**	-	
Target soil gas concentration	**(ug/m3)**	**Target_SV**	**3.83E+05**	**3.8E+05 - 8.4E+05**	**7.54E+05**	**7.5E+05 - 1.2E+06**	
Incremental Risk Estimates							
Incremental cancer risk from vapor intrusion	**(-)**	**Cancer_Risk**	**2.61E-12**	**1.2E-12 - 2.6E-12**	**1.33E-12**	**8.2E-13 - 1.3E-12**	
Hazard quotient from vapor intrusion	**(-)**	**HQ**	**7.02E-07**	**3.2E-07 - 7.0E-07**	**3.57E-07**	**2.2E-07 - 3.6E-07**	

Building B (South Building)_Benzene

Model Input **Site Name/Run Number:** Example, Run 1

Note:
-Yellow highlighted cells indicate parameters that typically are changed or must be inputted by the user.
-Dotted outline cells indicate default values that may be changed with justification.
-Toxicity values are taken from Regional Screening Level tables. These tables are updated semi-annually and may not reflect the most current toxicity information.

Use English / Metric Converter

Source Characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Source medium		Source	Exterior Soil Gas					
Soil gas concentration	(ug/m3)	Cmedium	1		NA			
Depth below grade to soil gas sample	(m)	Ls	7.60		Vary - 50	NA		
Average vadose zone temperature	(°C)	Ts	22	25	3-30			
Calc: Source vapor concentration	(ug/m3)	Cs	1					
Calc: % of pure component saturated vapor concentration	(%)	%Sat	0.000%					

Chemical:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Chemical Name		Chem	Benzene					
CAS No.		CAS	71-43-2					
Toxicity Factors								
Unit risk factor	$(ug/m^3)^{-1}$	IUR	7.80E-06	7.80E-06	NA	NA		
Mutagenic compound		Mut	No	NA	NA	NA		
Reference concentration	(mg/m^3)	RfC	3.00E-02	3.00E-02	NA	NA		

Chemical Properties:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Pure component water solubility	(mg/L)	S	1.79E+03	1.79E+03	NA	NA		
Henry's Law Constant @ 25°C	$(atm\text{-}m^3/mol)$	Hc	5.55E-03	5.55E-03	NA	NA		
Calc: Henry's Law Constant @ 25°C	(dimensionless)	Hr	2.27E-01	2.27E-01				
Calc: Henry's Law Constant @ system temperature	(dimensionless)	Hs	2.00E-01	2.29E-01				
Diffusivity in air	(cm2/s)	Dair	8.95E-02	8.95E-02	NA	NA		
Diffusivity in water	(cm2/s)	Dwater	1.03E-05	1.03E-05	NA	NA		

Building Characteristics:

Select Building Assumptions

(●) Use ratio for Qsoil/Qbuilding (recommended if no site specific data available)

( ) Specify Qsoil and Qbuilding separately; calculate ratio

	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Building setting		Bldg_Setting	Commercial	Commercial				
Foundation type		Found_Type	Basement w/ slab	Basement w/ slab				
Depth below grade to base of foundation	(m)	Lb	2.70	2.00	0.1 - 2.44	NA		
Foundation thickness	(m)	Lf	0.15	0.20	0.1 - 0.25	NA		
Fraction of foundation area with cracks	(-)	eta	0.005	0.005	0.0001-0.001	1.00		
Enclosed space floor area	(m2)	Abf	1554.00	1500.00	80-1000	NA		
Enclosed space mixing height	(m)	Hb	3.40	3.00	2.44 - 4.88	NA		
Indoor air exchange rate	(1 / hr)	ach	0.80	1.50	.3-4.1	NA		
Qsoil/Qbuilding	(-)	Qsoil_Qb	0.0300	0.0300	0.0001 - 0.05	1.24		
Calc: Building ventilation rate	(m3/hr)	Qb	4226.88	6750.00	NA	0.30		
Calc: Average vapor flow rate into building	(m3/hr)	Qsoil	126.81	202.50	NA	NA		

Model Input **Site Name/Run Number:** Example, Run 1

Chemical Name: Benzene CAS No. 71-43-2

Depth below grade to soil gas sample: 7.60 meters

Vadose zone characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Stratum A (Top of soil profile):								
Stratum A SCS soil type		SCS_A	Sandy Loam					
Stratum A thickness (from surface)	(m)	hSA	4.60					
Stratum A total porosity	(-)	nSA	0.387	0.387	NA	0.20		
Stratum A water-filled porosity	(-)	nwSA	0.103	0.103	0.039 - 0.17	0.25		
Stratum A bulk density	(g/cm^3)	rhoSA	1.620	1.620	NA	0.05		
Stratum B (Soil layer below Stratum A):								
Stratum B SCS soil type		SCS_B	Silt Loam					
Stratum B thickness	(m)	hSB	3.00					
Stratum B total porosity	(-)	nSB	0.439	0.439	NA	0.20		
Stratum B water-filled porosity	(-)	nwSB	0.180	0.180	0.065 - 0.3	0.25		
Stratum B bulk density	(g/cm^3)	rhoSB	1.490	1.490	NA	0.05		
Stratum C (Soil layer below Stratum B):								
Stratum C SCS soil type		SCS_C	Not Present					
Stratum C thickness	(m)	hSC	0.00					
Stratum C total porosity	(-)	nSC			NA	NA		
Stratum C water-filled porosity	(-)	nwSC			NA	NA		
Stratum C bulk density	(g/cm^3)	rhoSC			NA	NA		
Stratum containing soil gas sample								
Stratum A, B, or C		src_soil	Stratum B					
					NA	NA		
					NA			
					NA			

Exposure Parameters:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Target risk for carcinogens	(-)	Target_CR	1.00E-06	1.00E-06	NA	NA		
Target hazard quotient for non-carcinogens	(-)	Target_HQ	1	1	NA	NA		
Exposure Scenario		Scenario	Commercial	Commercial				
Averaging time for carcinogens	(yrs)	ATc	70	70	NA	NA		
Averaging time for non-carcinogens	(yrs)	ATnc	25	25	NA	NA		
Exposure duration	(yrs)	ED	25	25	NA	NA		
Exposure frequency	(days/yr)	EF	250	250	NA	NA		
Exposure time	(hrs/24 hrs)	ET	8	8	NA	NA		
Mutagenic mode-of-action factor	(yrs)	MMOAF	72	72	NA	NA		

Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Benzene CAS No. 71-43-2

Range is based on the reasonable range of Qsoil/Qbuilding values, as reported in the literature.

Source to Indoor Air Attenuation Factor	Units	Symbol	Value	Range	Default	Default Range	Flag
Soil gas to indoor air attenuation coefficient	**(-)**	**alpha**	**2.1E-04**	7.5E-05 - 2.1E-04	**1.1E-04**	5.3E-05 - 1.1E-04	
Predicted Indoor Air Concentration	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Indoor air concentration due to vapor intrusion	(ug/m3)	**Cia**	**2.1E-04**	7.5E-05 - 2.1E-04	**1.1E-04**	5.3E-05 - 1.1E-04	
	(ppbv)		**6.6E-05**	2.4E-05 - 6.7E-05	**3.5E-05**	1.7E-05 - 3.5E-05	
Predicted Vapor Conc. Beneath Foundation	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Subslab vapor concentration	(ug/m3)	**Css**	**7.1E-03**	4.2E-03 - 7.5E-01	**3.7E-03**	5.3E-01 - 1.1E+00	
	(ppbv)		**2.2E-03**	1.3E-03 - 2.4E-01	**1.2E-03**	1.7E-01 - 3.5E-01	
Diffusive Transport Upward Through Vadose Zone	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Effective diffusion coefficient through Stratum A	(cm2/sec)	DeffA	9.0E-03	-	9.0E-03	-	
Effective diffusion coefficient through Stratum B	(cm2/sec)	DeffB	5.2E-03	-	5.2E-03	-	
Effective diffusion coefficient through Stratum C	(cm2/sec)	DeffC		-		-	
				-		-	
Effective diffusion coefficient through unsaturated zone	(cm2/sec)	DeffT	6.2E-03	-	6.5E-03	-	
Critical Parameters		**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
α for diffusive transport from source to building with dirt floor foundation	(-)	A_Param	2.1E-04	-	1.1E-04		
Pe (Peclet Number) for transport through the foundation (advection / diffusion)	(-)	B_Param	5.9E+02	2.0E+00 - 9.8E+02	1.4E+03	4.6E+00 - 2.3E+03	
α for convective transport from subslab to building	(-)	C_Param	3.0E-02	1.0E-04 - 5.0E-02	3.0E-02	1.0E-04 - 5.0E-02	

Interpretation

Advection is the dominant mechanism across the foundation.
Diffusion through soil is the overall rate limiting process.

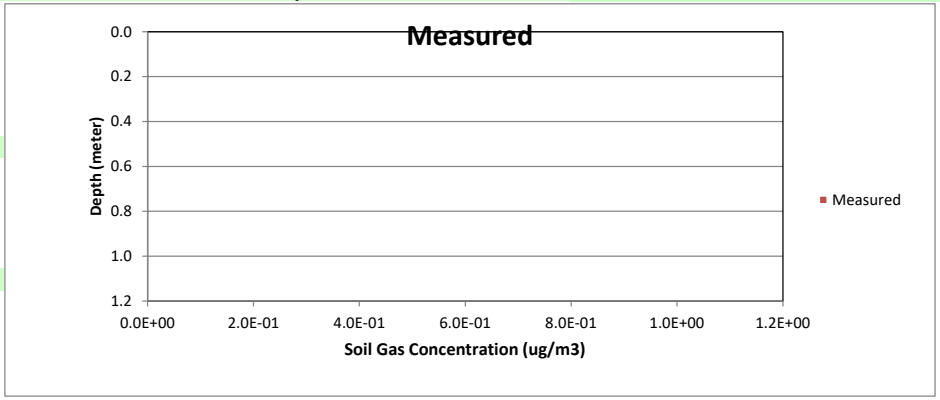
Critical Parameters

Hb, Ls, DeffT, ach

Non-Critical Parameters

Qsoil_Qb, Lf, DeffA, eta

Concentration versus Depth Profile



Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Benzene CAS No. 71-43-2

Risk Calculations	Units	Symbol	Value	Range	Default	Range	Flag
Risk-Based Target Screening Levels	**Scenario: Commercial**						
Target risk for carcinogens	(-)	Target_CR	1E-06	-	1E-06	-	
Target hazard quotient for noncarcinogens	(-)	Target_HQ	1	-	1	-	
Target indoor air concentration	**(ug/m3)**	**Target_IA**	**1.57E+00**	-	**1.57E+00**	-	
	(ppbv)		**4.92E-01**	-	**4.92E-01**	-	
Target soil gas concentration	**(ug/m3)**	**Target_SV**	**7.42E+03**	**7.4E+03 - 2.1E+04**	**1.42E+04**	**1.4E+04 - 3.0E+04**	
Incremental Risk Estimates							
Incremental cancer risk from vapor intrusion	**(-)**	**Cancer_Risk**	**1.35E-10**	**4.8E-11 - 1.4E-10**	**7.05E-11**	**3.4E-11 - 7.1E-11**	
Hazard quotient from vapor intrusion	**(-)**	**HQ**	**1.61E-06**	**5.7E-07 - 1.6E-06**	**8.43E-07**	**4.0E-07 - 8.4E-07**	

Building B (South Building)_PCE

Model Input **Site Name/Run Number:** Example, Run 1

Note:
-Yellow highlighted cells indicate parameters that typically are changed or must be inputted by the user.
-Dotted outline cells indicate default values that may be changed with justification.
-Toxicity values are taken from Regional Screening Level tables. These tables are updated semi-annually and may not reflect the most current toxicity information.

Use English / Metric Converter

Source Characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Source medium		Source	Exterior Soil Gas					
Soil gas concentration	(ug/m3)	Cmedium	1		NA			
Depth below grade to soil gas sample	(m)	Ls	7.60		Vary - 50	NA		
Average vadose zone temperature	(°C)	Ts	22	25	3-30			
Calc: Source vapor concentration	(ug/m3)	Cs	1					
Calc: % of pure component saturated vapor concentration	(%)	%Sat	0.000%					

Chemical:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Chemical Name		Chem	Tetrachloroethylene					
CAS No.		CAS	127-18-4					
Toxicity Factors								
Unit risk factor	$(ug/m^3)^{-1}$	IUR	2.60E-07	2.60E-07	NA	NA		
Mutagenic compound		Mut	No	NA	NA	NA		
Reference concentration	(mg/m^3)	RfC	4.00E-02	4.00E-02	NA	NA		

Chemical Properties:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Pure component water solubility	(mg/L)	S	2.06E+02	2.06E+02	NA	NA		
Henry's Law Constant @ 25°C	$(atm\text{-}m^3/mol)$	Hc	1.77E-02	1.77E-02	NA	NA		
Calc: Henry's Law Constant @ 25°C	(dimensionless)	Hr	7.24E-01	7.24E-01				
Calc: Henry's Law Constant @ system temperature	(dimensionless)	Hs	6.22E-01	7.31E-01				
Diffusivity in air	(cm2/s)	Dair	5.05E-02	5.05E-02	NA	NA		
Diffusivity in water	(cm2/s)	Dwater	9.46E-06	9.46E-06	NA	NA		

Building Characteristics:

Select Building Assumptions

- (●) Use ratio for Qsoil/Qbuilding (recommended if no site specific data available)
- ( ) Specify Qsoil and Qbuilding separately; calculate ratio

	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Building setting		Bldg_Setting	Commercial	Commercial				
Foundation type		Found_Type	Basement w/ slab	Basement w/ slab				
Depth below grade to base of foundation	(m)	Lb	2.70	2.00	0.1 - 2.44	NA		
Foundation thickness	(m)	Lf	0.15	0.20	0.1 - 0.25	NA		
Fraction of foundation area with cracks	(-)	eta	0.005	0.005	0.0001-0.001	1.00		
Enclosed space floor area	(m2)	Abf	1554.00	1500.00	80-1000	NA		
Enclosed space mixing height	(m)	Hb	3.40	3.00	2.44 - 4.88	NA		
Indoor air exchange rate	(1 / hr)	ach	0.80	1.50	.3-4.1	NA		
Qsoil/Qbuilding	(-)	Qsoil_Qb	0.0300	0.0300	0.0001 - 0.05	1.24		
Calc: Building ventilation rate	(m3/hr)	Qb	4226.88	6750.00	NA	0.30		
Calc: Average vapor flow rate into building	(m3/hr)	Qsoil	126.81	202.50	NA	NA		

Model Input **Site Name/Run Number:** Example, Run 1

Chemical Name: Tetrachloroethylene CAS No. 127-18-4

Depth below grade to soil gas sample: 7.60 meters

Vadose zone characteristics:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Stratum A (Top of soil profile):								
Stratum A SCS soil type		SCS_A	Sandy Loam					
Stratum A thickness (from surface)	(m)	hSA	4.60					
Stratum A total porosity	(-)	nSA	0.387	0.387	NA	0.20		
Stratum A water-filled porosity	(-)	nwSA	0.103	0.103	0.039 - 0.17	0.25		
Stratum A bulk density	(g/cm^3)	rhoSA	1.620	1.620	NA	0.05		
Stratum B (Soil layer below Stratum A):								
Stratum B SCS soil type		SCS_B	Silt Loam					
Stratum B thickness	(m)	hSB	3.00					
Stratum B total porosity	(-)	nSB	0.439	0.439	NA	0.20		
Stratum B water-filled porosity	(-)	nwSB	0.180	0.180	0.065 - 0.3	0.25		
Stratum B bulk density	(g/cm^3)	rhoSB	1.490	1.490	NA	0.05		
Stratum C (Soil layer below Stratum B):								
Stratum C SCS soil type		SCS_C	Not Present					
Stratum C thickness	(m)	hSC	0.00					
Stratum C total porosity	(-)	nSC			NA	NA		
Stratum C water-filled porosity	(-)	nwSC			NA	NA		
Stratum C bulk density	(g/cm^3)	rhoSC			NA	NA		
Stratum containing soil gas sample								
Stratum A, B, or C		src_soil	Stratum B					
					NA	NA		
					NA			
					NA			

Exposure Parameters:	Units	Symbol	Value	Default	Potential Span	CV	Flag	Comment
Target risk for carcinogens	(-)	Target_CR	1.00E-06	1.00E-06	NA	NA		
Target hazard quotient for non-carcinogens	(-)	Target_HQ	1	1	NA	NA		
Exposure Scenario		Scenario	Commercial	Commercial				
Averaging time for carcinogens	(yrs)	ATc	70	70	NA	NA		
Averaging time for non-carcinogens	(yrs)	ATnc	25	25	NA	NA		
Exposure duration	(yrs)	ED	25	25	NA	NA		
Exposure frequency	(days/yr)	EF	250	250	NA	NA		
Exposure time	(hrs/24 hrs)	ET	8	8	NA	NA		
Mutagenic mode-of-action factor	(yrs)	MMOAF	72	72	NA	NA		

Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Tetrachloroethylene **CAS No. 127-18-4**

Range is based on the reasonable range of Qsoil/Qbuilding values, as reported in the literature.

Source to Indoor Air Attenuation Factor	Units	Symbol	Value	Range	Default	Default Range	Flag
Soil gas to indoor air attenuation coefficient	**(-)**	**alpha**	**1.2E-04**	5.6E-05 - 1.2E-04	**6.3E-05**	3.9E-05 - 6.3E-05	
Predicted Indoor Air Concentration	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Indoor air concentration due to vapor intrusion	(ug/m3)	**Cia**	**1.2E-04**	5.6E-05 - 1.2E-04	**6.3E-05**	3.9E-05 - 6.3E-05	
	(ppbv)		**1.8E-05**	8.2E-06 - 1.8E-05	**9.2E-06**	5.7E-06 - 9.2E-06	
Predicted Vapor Conc. Beneath Foundation	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Subslab vapor concentration	(ug/m3)	**Css**	**4.0E-03**	2.4E-03 - 5.6E-01	**2.1E-03**	3.9E-01 - 6.3E-01	
	(ppbv)		**5.9E-04**	3.5E-04 - 8.2E-02	**3.1E-04**	5.7E-02 - 9.2E-02	
Diffusive Transport Upward Through Vadose Zone	**Units**	**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
Effective diffusion coefficient through Stratum A	(cm2/sec)	DeffA	5.1E-03	-	5.1E-03	-	
Effective diffusion coefficient through Stratum B	(cm2/sec)	DeffB	2.9E-03	-	2.9E-03	-	
Effective diffusion coefficient through Stratum C	(cm2/sec)	DeffC		-		-	
				-		-	
Effective diffusion coefficient through unsaturated zone	(cm2/sec)	DeffT	3.5E-03	-	3.6E-03	-	
Critical Parameters		**Symbol**	**Value**	**Range**	**Default**	**Default Range**	**Flag**
α for diffusive transport from source to building with dirt floor foundation	(-)	A_Param	1.2E-04	-	6.3E-05		
Pe (Peclet Number) for transport through the foundation (advection / diffusion)	(-)	B_Param	1.0E+03	3.5E+00 - 1.7E+03	2.4E+03	8.1E+00 - 4.1E+03	
α for convective transport from subslab to building	(-)	C_Param	3.0E-02	1.0E-04 - 5.0E-02	3.0E-02	1.0E-04 - 5.0E-02	

Interpretation

Advection is the dominant mechanism across the foundation.
Diffusion through soil is the overall rate limiting process.

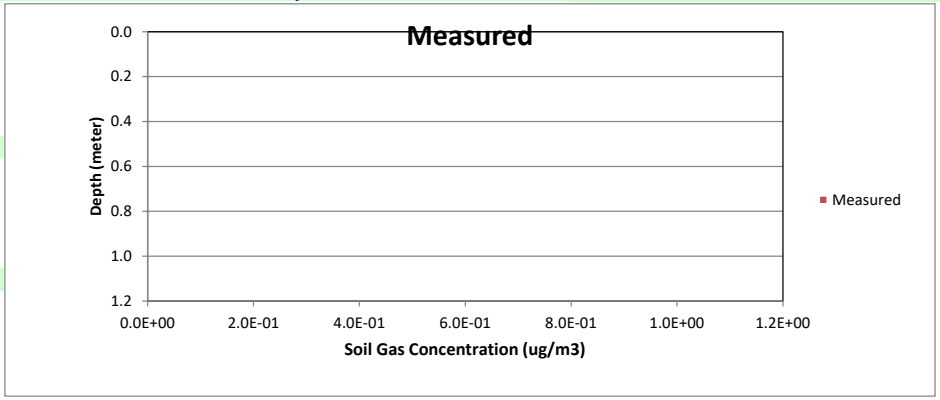
Critical Parameters

Hb, Ls, DeffT, ach

Non-Critical Parameters

Qsoil_Qb, Lf, DeffA, eta

Concentration versus Depth Profile



Model Output **Site Name/Run Number:** Example, Run 1

Chemical Name: Tetrachloroethylene **CAS No. 127-18-4**

Risk Calculations	Units	Symbol	Value	Range	Default	Range	Flag
Risk-Based Target Screening Levels	**Scenario: Commercial**						
Target risk for carcinogens	(-)	Target_CR	1E-06	-	1E-06	-	
Target hazard quotient for noncarcinogens	(-)	Target_HQ	1	-	1	-	
Target indoor air concentration	**(ug/m3)**	**Target_IA**	**4.72E+01**	-	**4.72E+01**	-	
	(ppbv)		**6.96E+00**	-	**6.96E+00**	-	
Target soil gas concentration	**(ug/m3)**	**Target_SV**	**3.94E+05**	**3.9E+05 - 8.5E+05**	**7.54E+05**	**7.5E+05 - 1.2E+06**	
Incremental Risk Estimates							
Incremental cancer risk from vapor intrusion	**(-)**	**Cancer_Risk**	**2.54E-12**	**1.2E-12 - 2.5E-12**	**1.33E-12**	**8.2E-13 - 1.3E-12**	
Hazard quotient from vapor intrusion	**(-)**	**HQ**	**6.83E-07**	**3.2E-07 - 6.8E-07**	**3.57E-07**	**2.2E-07 - 3.6E-07**	

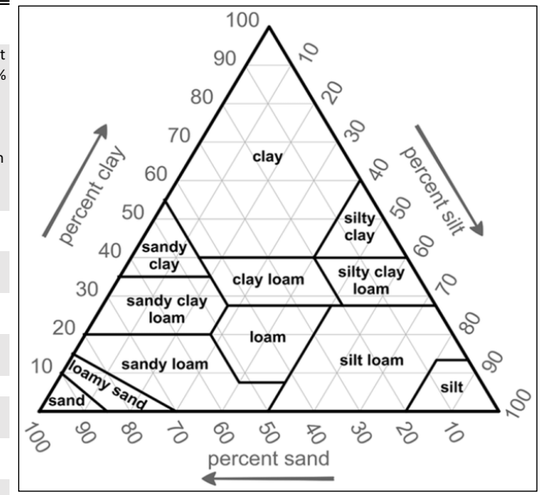
Appendix C

Soil Type Identification and Boring Logs

Appendix C, Table C-1. Translation from USCS to USDA Soil Type Classification

Depth below grade to base of foundation	Lb	4.6	(m)	Stratum A must be at least this deep. Deepest layer description containing this depth is used as Stratum A
Depth below grade to soil gas sample	Ls	7.6	(m)	Stratums (A-C) must extend at least this deep.

						Raw Texture Data				Converted Texture Data[a]				
Soil Boring	J & E Soil Stratum	Depth BGS (ft)	Layer Depth (ft)	Depth (m)	Depth BGS (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Sand (%)	Silt (%)	Clay (%)	Soil Texture	Description [Exponent comments in brackets]
P3		0 - 11	11.0	3.4	3.4	15%	30%	55%	0%	35%	65%	0%	Silt Loam	Sandy silt w/ gravel; graded sand & fine gravel
P3		11 - 12	1.0	0.3	3.7	0%	25%	70%	5%	25%	70%	5%	Silt Loam	Sandy silt, trace clay
P6a		0.25 - 3	2.8	0.8	0.8	15%	20%	50%	15%	24%	59%	18%	Silt Loam	Sandy silt (ML) with clay & gravel [Description consistent with USCS code ML, which means >30% sand & gravel, % sand > %gravel, and >15% gravel]
P6a		3 - 12	9.0	2.7	3.6									Sandy gravel with silt [Description not consistent with USCS standard terminology; may corresponed with codes GW-GM, GW-GC, GP-GM, or GP-GC depending on grading of gravel, type of fines, and percentage of sand (< or > 15%)]
SGMF-5-5 / P8b														[Total depth 6 ft. No texture data within relevant depth range]
SGMF-6-5 / P8a														[Total depth 5.5 ft. No texture data within relevant depth range]
SGMF-7-5 / P9a														[Total depth 5.5 ft. No texture data within relevant depth range]
SGMF-8-5 / P4														[Total depth 5.5 ft. No texture data within relevant depth range]
SGMF-8-15 / P4	A	0.25 - 15.5	15.25	4.6	4.6	50%	35%	15%	0%	70%	30%	0%	Sandy Loam	Sandy gravel with silt
SGMF-9-5 / P4b														[Total depth 5.5 ft. No texture data within relevant depth range]
SGMF-10-5														[Total depth 5.5 ft. No texture data within relevant depth range]
SGMF-10-15 / P5		0.25 - 9	8.8	2.7	2.7	50%	35%	15%	0%	70%	30%	0%	Sandy Loam	Sandy gravel with silt
SGMF-10-15 / P5		9 - 13	4.0	1.2	3.9	0%	15%	70%	15%	15%	70%	15%	Silt Loam	Silt with sand & clay; fine sand
SGMF-10-15 / P5	A	13 - 15.5	2.5	0.8	4.6	55%	25%	15%	5%	56%	33%	11%	Sandy Loam	Gravel with sand & silt, trace clay
SGMF-11-5 / P2b														[Total depth 5.5 ft. No texture data within relevant depth range]
SGMF-12-15 / P2														[No soil texture description]
HP-7-MF		0-21	21	6.4	6.4									[No quantitative texture descriptions provided; no recovery from 8.5' to 21']
HP-7-MF	B	21-23.5	2.5	0.8	6.4	30%	60%	10%	0%	86%	14%	0%	Sand	WELL-GRADED GRAVELLY SAND with SILT (SW); moist, 60% sand, 30% gravel, 10% silt, medium-high permeability. (22') Light brown, moist, 50% sand, 40% gravel, 10% silt, medium-high permeability.
HP-7-MF	B	23.5-26	2.5	0.8	6.4	65%	20%	15%	0%	57%	43%	0%	Sandy Loam	SANDY GRAVEL (GP); moist, 60% gravel, 35% sand (coarse-grained), 5% silt, medium-high permeability.
HP-9-MF		0 - 2.5	2.5	0.8	0.8								Sand	Sand & gravel fill (GP)
HP-9-MF		2.5 - 8.5	6	1.8	2.6	25%	75%	0%	0%	100%	0%	0%	Sand	Coarse sand with gravel (SP), sub-rounded to sub-angular with cobbles to 6 ft
HP-9-MF		8.5 - 13.5	5	1.5	4.1	0%	5%	85%	10%	5%	85%	10%	Silt	Clayey silt (ML), soft to med stiff
HP-9-MF	A	13.5 - 18.5	5	1.5	5.6	55%	30%	15%	0%	67%	33%	0%	Sandy Loam	Sandy gravel with silt (GM), med-coarse sand, subangular to subrounded. 15-18.5 ft no recovery
HP-9-MF	B	18.5 - 22	3.5	1.1	6.7	70%	25%	5%	0%	83%	17%	0%	Loamy Sand	Gravel with sand (GP) coarse sand, sub rounded. 21-22 ft same as above with rusty brown clay ball with root
HP-9-MF	B	22 - 26	4	1.2	7.9	60%	25%	10%	5%	63%	25%	13%	Sandy Loam	Same as above with silt & clay (GM) [How same? - different USCS & more fines. Added 5% to silt & clay]
MWMF-5														[No texture data within relevant depth range]
MWMF-6		0.25-8.5	8.25	2.5	2.5	25%	75%	0%	0%	100%	0%	0%	Sand	See HP-9 for 0-10 ft [Used data from HP-9 2.5-8.5 ft bgs]
MWMF-6		8.5-14	5.5	1.7	4.2		5%	85%	10%	5%	85%	10%	Silt	SILT (ML); light brown, dry, medium stiff, 85% silt, 10% clay, 5% sand, low plasticity, low permeability.
MWMF-6	A	14-21.5	7.5	2.3	6.5	15%	20%	60%	5%	24%	71%	6%	Silt Loam	Sandy silt with gravel (ML) [Description with ML means >30% sand & gravel, % sand > %gravel, and >15% gravel]
MWMF-6	B	21.5 - 26.5	5	1.5	8.0	75%	20%	5%	0%	80%	20%	0%	Loamy Sand	Gravel with sand & trace silt (GP)
MWMF-6	B	26.5-29	2.5	0.8	8.8	20%	30%	50%	0%	38%	63%	0%	Silt Loam	Sandy silt with gravel (ML). 24-26.5 no recovery.
VEMF-2B		0 - 22	22	6.7	6.7									[No soil texture description]
VEMF-2B		22 - 22.5	0.5	0.2	6.9	15%	50%	35%	0%	59%	41%	0%	Sandy Loam	Silty sand with trace fine gravel
VEMF-2B	B	22.5 - 24.5	2	0.6	7.5	40%	30%	20%	10%	50%	33%	17%	Loam	Silty gravel with sand, with silt trace clay and rusty clayey blobs
VEMF-2B	B	24.5 - 26	1.5	0.5	7.9	50%	35%	15%	0%	70%	30%	0%	Sandy Loam	Sandy gravel with silt



Soil Boring	J & E Soil Stratum	Depth BGS (ft)	Layer Depth (ft)	Depth (m)	Depth BGS (m)	Raw Texture Data				Converted Texture Data[a]			Soil Texture	Description [Exponent comments in brackets]
						Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Sand (%)	Silt (%)	Clay (%)		
VEMF-3B		0 - 14	14	4.3	4.3									No sampling 0-14'
VEMF-3B	A	14 - 15.5	1.5	0.5	4.7	50%	40%	10%	0%	80%	20%	0%	Loamy Sand	Sandy gravel
VEMF-3B	A	15.5 - 16.5	1	0.3	5.0	15%	5%	70%	10%	6%	82%	12%	Silt	Silt with clay & gravel, trace fine sand, silty sand bottom
VEMF-3B	B	16.5 - 18	1.5	0.5	5.5	15%	65%	20%	0%	76%	24%	0%	Loamy Sand	Silty sand with gravel [Raw texture percentages estimated from description, which is consistent with USCS code SM. This corresponds to >15% fines with fines = ML or MH and >15% gravel]
VEMF-3B	B	18 - 23	5	1.5	7.0	60%	10%	30%	0%	25%	75%	0%	Silt Loam	Silty gravel, well graded with sand & cobbles, subrounded to subangular
VEMF-3B	B	23 - 25.5	2.5	0.8	7.8	20%	15%	65%	0%	19%	81%	0%	Silt	Gravelly sandy silt & cobbles [Description not consistent with USCS standard terminology; may correspond with codes ML or MH, which both require >30% coarse fraction, % gravel > % sand, and >15% sand]
VEMF-4A		0 - 15												[No description or sampling]
VEMF-4A	A	15 - 17.5	17.5	5.3	5.3	60%	30%	10%	0%	75%	25%	0%	Loamy Sand	Sandy gravel with trace silt
VEMF-4A	B	17.5 - 19	1.5	0.5	5.8	0%	20%	70%	10%	20%	70%	10%	Silt Loam	Silt with sand, trace ML clay
VEMF-4A	B	19 - 21	2	0.6	6.4	60%	30%	10%	0%	75%	25%	0%	Loamy Sand	Sandy gravel as above (GP)
VEMF-4B		0 - 26.5	26.5	8.1	8.1									[No description or recovery until 26.5 ft bgs. Assume same texture as first layer with description]
VEMF-4B	B	26.5 - 28	1.5	0.5	8.5	50%	30%	15%	5%	60%	30%	10%	Sandy Loam	Sandy gravel with silt (GP)
VEMF-5		0 - 25	25	7.6	7.6									[No soil texture description]
VEMF-5	B	25 - 26.5	1.5	0.5	8.1	50%	25%	20%	5%	50%	40%	10%	Loam	SILTY GRAVEL with SAND (GM); light brown to yellowish orange, dry, 50% gravel, 25% sand, 20% silt, 5% clay, low permeability
VEMF-6B (HP-6)		0 - 25	25	7.6	7.6									[No soil texture description]
VEMF-6B (HP-6)	B	25 - 35	10	3.0	10.7	50%	30%	15%	5%	60%	30%	10%	Sandy Loam	Graded gravel & coarse sand with silt, trace clay
SGMF-2-5/15/25														[No texture data within relevant depth range]
SGMF-3-15/25	A	0 - 25.5	25.5	7.8	7.8		85%	15%	0%	85%	15%	0%	Loamy Sand	USCS: Gravelly SAND with silt (SM). [SM is defined as >15% fines. Therefore, max sand % = 85%]
SGMF-4-5/15/25														[No texture data within relevant depth range]
SG-4-5/20		0.25 - 9	8.75	2.7	2.7	30%	40%	30%	0%	57%	43%	0%	Sandy Loam	Silty SAND with small gravel (<0.75") (SM); brown, dry, 30% silt, 40% sand, 30% gravel
SG-4-5/20		9 - 11.5	2.5	0.8	3.4	50%	10%	40%	0%	20%	80%	0%	Silt Loam	Silty GRAVEL (0.25") (GM); hard to 11.5' bgs, tan, dry, 40% silt, 10% sand, 50% gravel, low permeability
SG-4-5/20	A	11.5 - 19	7.5	2.3	5.7	30%	40%	20%	10%	57%	29%	14%	Sandy Loam	Gravelly SAND with silt (SM); gravel (<0.75"), increasing clay with depth, tan, dry, 10% clay, 20% silt, 40% sand, 30% gravel, high permeability
SG-4-5/20	B	19 - 20	1	0.3	6.0	30%	40%	10%	20%	57%	14%	29%	Sandy Clay Loam	Gravelly SAND with clay (SC); 20% clay, 10% silt, 40% sand, 30% gravel, medium permeability
MW-4		0 - 0.5	0.5	0.2	0.2	55%	20%	25%	0%	44%	56%	0%	Silt Loam	SILTY GRAVEL (GM); brown/gray, trace moist, loose, 55% gravel (<2", subangular), 25% silt, 20% sand, high permeability
MW-4		0.5 - 4	3.5	1.1	1.2	10%	20%	70%	0%	22%	78%	0%	Silt Loam	SANDY SILT (ML); brown, trace moist, soft, 70% silt, 20% sand (well-graded), 10% gravel, high permeability
MW-4	A	4 - 20	16	4.9	6.1	50%	15%	35%	0%	30%	70%	0%	Silt Loam	SILTY GRAVEL (GM); brown/gray, moist, loose/soft, 50% gravel (<3", subangular), 35% silt, 15% sand, high permeability
MW-4	B	20 - 33	13	4.0	10.1	65%	25%	10%	0%	71%	29%	0%	Loamy Sand	SANDY GRAVEL (GW); brown/gray, moist, loose, 65% gravel (<1.5", subangular), 25% sand (well-graded), 10% silt, high permeability

[a] SCS & USDA NCRS soil texture does not include gravel as part of soil texture (see texture triangle) and instead only uses coarse fragments as a modifier. Thus, the converted texture is the texture calculated only for the sand, silt, and clay percentages.

Appendix C

Boring Logs

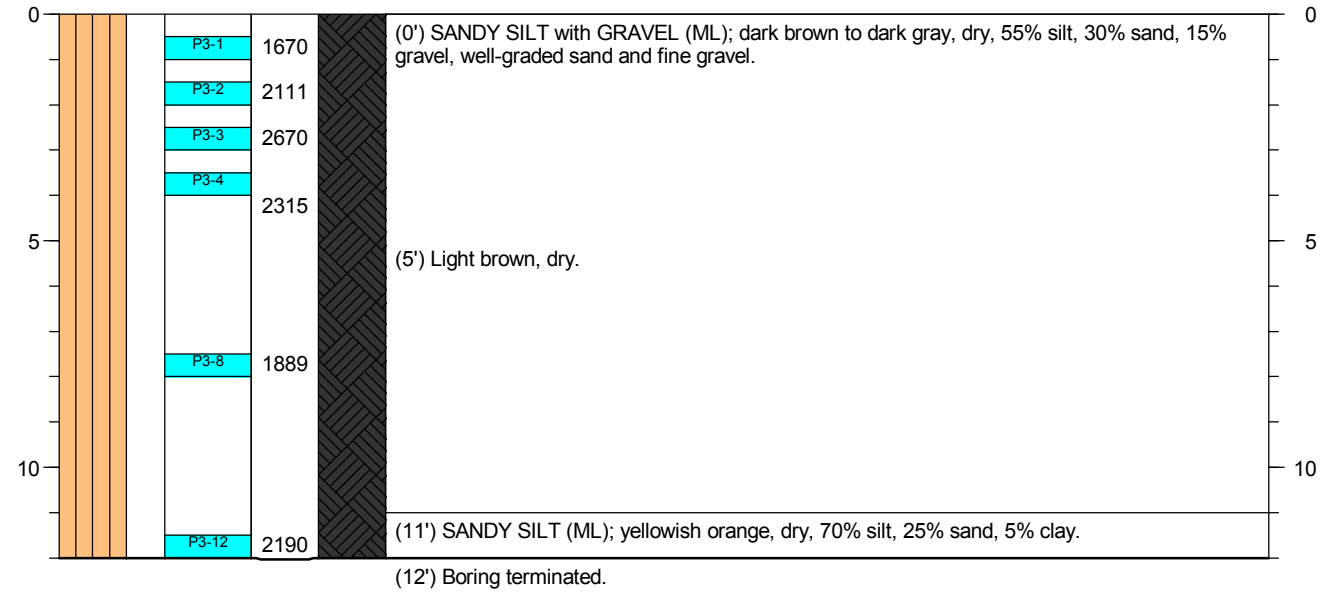
BORING AND WELL LOG LEGEND

LITHOLOGY	WATER LEVEL	WELL/BORING COMPLETION	SAMPLE TYPE	DESCRIPTION
				ASPHALT
				CONCRETE
				FILL
				TOPSOIL
				COBBLES
				IGNEOUS Rock
				METAMORPHIC Rock
				SEDIMENTARY Rock
				Well-graded GRAVEL (GW)
				Poorly graded GRAVEL (GP)
				Silty GRAVEL (GM)
				Clayey GRAVEL (GC)
				Well-graded GRAVEL with silt (GW-GM)
				Poorly graded GRAVEL with silt (GP-GM)
				Well-graded GRAVEL with clay (GW-GC)
				Poorly graded GRAVEL with clay (GP-GC)
				Well-graded SAND (SW)
				Poorly graded SAND (SP)
				Silty SAND (SM)
				Clayey SAND (SC)
				Well-graded SAND with silt (SW-SM)
				Poorly graded SAND with silt (SP-SM)
				Well-graded SAND with clay (SW-SC)
				Poorly graded SAND with clay (SP-SC)
				SILT (ML)
				Lean CLAY (CL)
				Organic SOIL (OL)
				Elastic SILT (MH)
				Fat CLAY (CH)
				Organic SOIL (OH)
				PEAT (PT)
				Volume Descriptors: Trace = <5% Few = 5-10% Little = 15-25% Some = 30-45% Mostly = >=50%
	▽ ▼			Water Level During Drilling Water Level at End of Drilling/in Completed Well
				Cap Riser Screen Cement Bentonite Grout Bentonite Seal Filter Pack Backfill
			GR	Grab
			EN	Encore
			SS	Split Spoon
			SH	Shelby Tube
			CO	Core Barrel
			DP	Direct Push
			ID	Lab Sample and ID

NOTES:

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**BORING LOG** **Boring No. P3** **Page: 1 of 1**

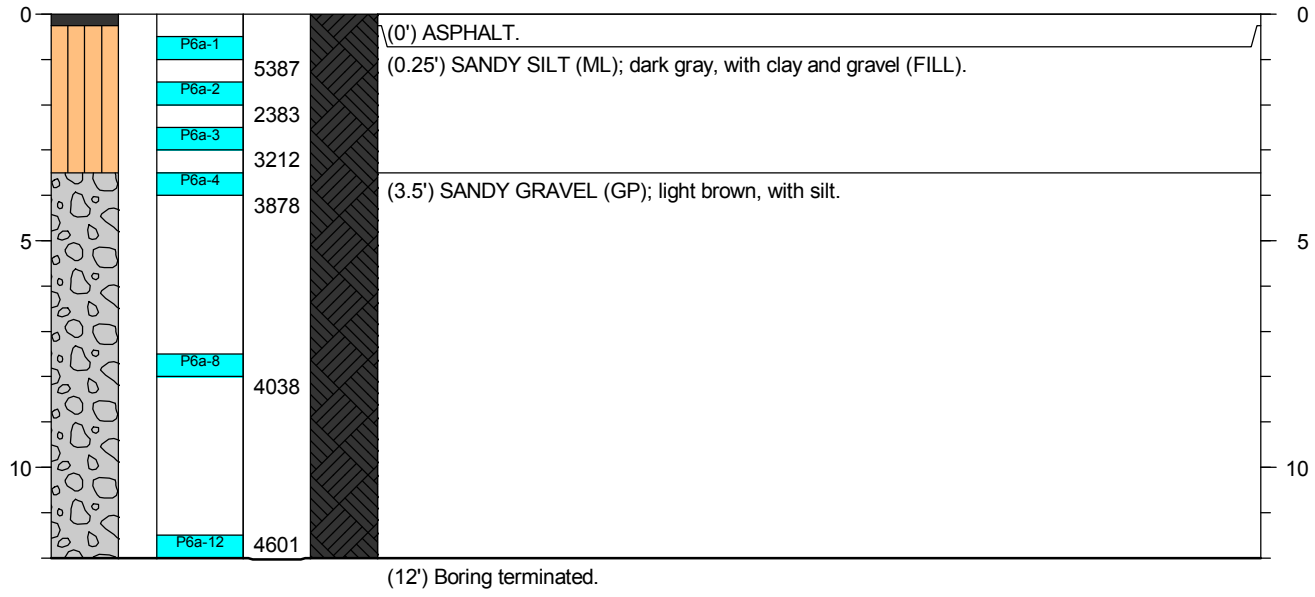
Drilling Start Date:	**8/26/2021**	Boring Depth (ft):	**12**
Drilling End Date:	**8/26/2021**	Boring Diameter (in):	**3.25, 2.25**
Drilling Company:	**Cascade Drilling**	Sampling Method(s):	**Hand Auger/Direct Push**
Drilling Method:	**Hand Auger/Direct Push**	DTW During Drilling (ft):	**--**
Drilling Equipment:	**DT-22**	DTW After Drilling (ft):	**--**
Logged By:	**D. Cardiff**	Ground Surface Elev. (ft):	**--**
Reviewed By:	**A. Simmons, P.G.**	Location (X,Y):	**--**



NOTES: Boring backfilled with neat cement.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**BORING LOG** **Boring No. P6a** **Page: 1 of 1**

Drilling Start Date:	**8/27/2021**	Boring Depth (ft):	**12**
Drilling End Date:	**8/27/2021**	Boring Diameter (in):	**3.25, 2.25**
Drilling Company:	**Cascade Drilling**	Sampling Method(s):	**Hand Auger/Direct Push**
Drilling Method:	**Hand Auger/Direct Push**	DTW During Drilling (ft):	**--**
Drilling Equipment:	**DT-22**	DTW After Drilling (ft):	**--**
Logged By:	**D. Cardiff**	Ground Surface Elev. (ft):	**--**
Reviewed By:	**A. Simmons, P.G.**	Location (X,Y):	**--**



NOTES: Boring backfilled with neat cement.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No.** SGMF-5-5 / P8b **Page:** 1 of 1

Drilling Start Date: **8/25/2021**	Boring Depth (ft): **5.5**	Well Depth (ft): **5**
Drilling End Date: **8/25/2021**	Boring Diameter (in): **3.5**	Well Diameter (in): **1**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Hand Auger**	Well Material: **1/4" Teflon Tubing**
Drilling Method: **Hand Auger**	DTW During Drilling (ft): **--**	Screen Interval (ft): **Vapor Probe (NA slot)**
Drilling Equipment: **Hand Auger**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-4.5 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **482.77**	Filter Pack Interval (ft): **4.5-5.5 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193805.121, 2073428.614**	Top of Casing Elev. (ft): **--**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	SAMPLE ID	PID (ppb)	WELL COMPLETION	SOIL/ROCK VISUAL DESCRIPTION	DEPTH (ft)
0			P8b-1 P8b-2 P8b-3			(0') ASPHALT. (0.25') SANDY GRAVEL (GP); dark brown, dry, medium permeability, with silt.	0
5			SGMF-5-5			(4') SANDY GRAVEL (GP); light gray, dry, 55% gravel (well-graded, fine-medium, subangular), 40% sand (well-graded), 5% silt. (5.5') Boring terminated.	5

NOTES: Bentonite hydrated from 3.5-4 ft bgs. Soil gas probe completed with flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No.** SGMF-6-5 / P8a **Page:** 1 of 1

Drilling Start Date: **8/25/2021**	Boring Depth (ft): **5.5**	Well Depth (ft): **5**
Drilling End Date: **8/25/2021**	Boring Diameter (in): **3.5**	Well Diameter (in): **1**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Hand Auger**	Well Material: **1/4" Teflon Tubing**
Drilling Method: **Hand Auger**	DTW During Drilling (ft): **--**	Screen Interval (ft): **Vapor Probe (NA slot)**
Drilling Equipment: **Hand Auger**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-4.5 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **483.21**	Filter Pack Interval (ft): **4.5-5.5 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193834.313, 2073409.475**	Top of Casing Elev. (ft): **--**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	SAMPLE ID	PID (ppb)	WELL COMPLETION	SOIL/ROCK VISUAL DESCRIPTION	DEPTH (ft)
0			P8a-1			(0') ASPHALT.	0
			P8a-2			(0.25') FILL (GP).	
			P8a-3			(2') GRAVEL (GP); pea gravel.	
						(2.5') FILL (GP).	
5			SGMF-6-5				5

(5.5') Boring terminated.

NOTES: Bentonite hydrated from 3.5-4 ft bgs. Soil gas probe completed with flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No. SGMF-7-5 / P9a** **Page: 1 of 1**

Drilling Start Date: **8/24/2021**	Boring Depth (ft): **5.5**	Well Depth (ft): **5**
Drilling End Date: **8/25/2021**	Boring Diameter (in): **3.5**	Well Diameter (in): **1**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Hand Auger**	Well Material: **1/4" Teflon Tubing**
Drilling Method: **Hand Auger**	DTW During Drilling (ft): **--**	Screen Interval (ft): **Vapor Probe (NA slot)**
Drilling Equipment: **Hand Auger**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-4.5 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **482.43**	Filter Pack Interval (ft): **4.5-5.5 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193754.912, 2073369.891**	Top of Casing Elev. (ft): **--**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	SAMPLE ID	PID (ppb)	WELL COMPLETION	SOIL/ROCK VISUAL DESCRIPTION	DEPTH (ft)
0			P9a-1 P9a-2 P9a-3 SGMF-7-5			(0') Not logged. (5.5') Boring terminated.	0
5							5

NOTES: Bentonite hydrated from 3.5-4 ft bgs. Soil gas probe completed with flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No.** SGMF-8-5 / P4 **Page:** 1 of 1

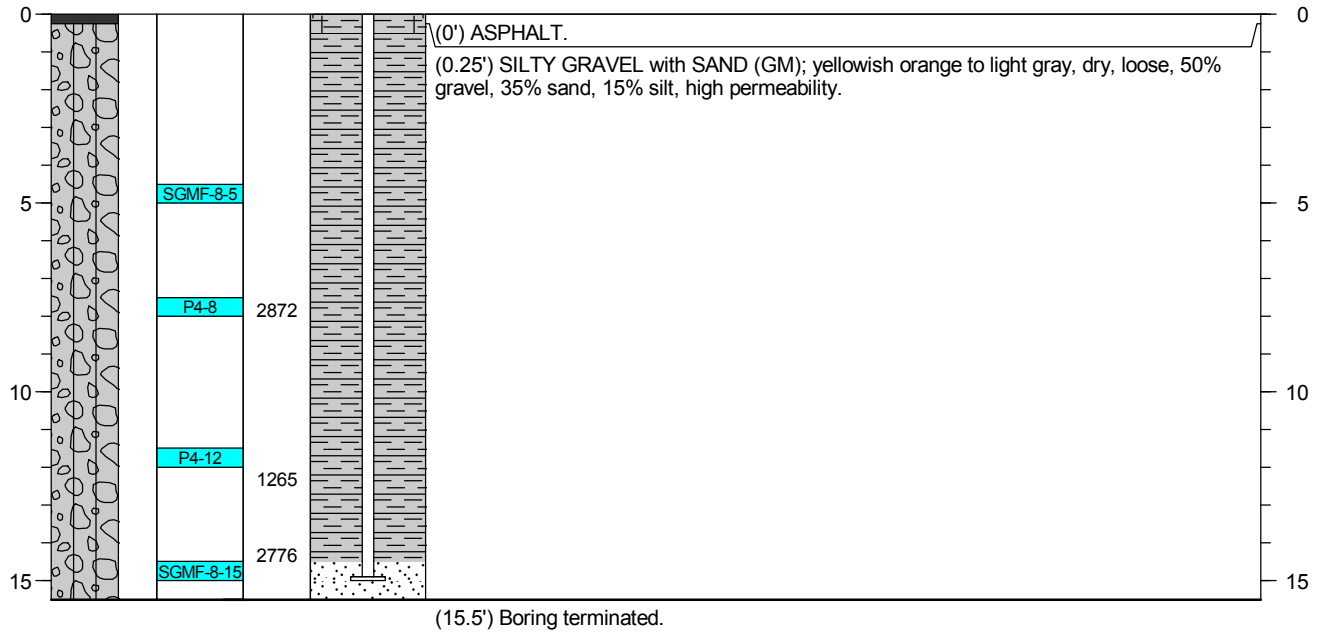
Drilling Start Date: **8/23/2021**	Boring Depth (ft): **5.5**	Well Depth (ft): **5**
Drilling End Date: **8/23/2021**	Boring Diameter (in): **3.5**	Well Diameter (in): **1**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Hand Auger**	Well Material: **1/4" Teflon Tubing**
Drilling Method: **Hand Auger**	DTW During Drilling (ft): **--**	Screen Interval (ft): **Vapor Probe (NA slot)**
Drilling Equipment: **Hand Auger**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-4.5 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **483.10**	Filter Pack Interval (ft): **4.5-5.5 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193689.998, 2073338.919**	Top of Casing Elev. (ft): **--**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	SAMPLE ID	PID (ppb)	WELL COMPLETION	SOIL/ROCK VISUAL DESCRIPTION	DEPTH (ft)
0			P4-1 P4-2 P4-3 P4-4			(0') ASPHALT. (0.25') Not logged.	0
5						(5.5') Boring terminated.	5

NOTES: Bentonite hydrated from 3.5-4 ft bgs. Soil gas probe completed with flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No.** SGMF-8-15 / P4 cont. **Page:** 1 of 1

Drilling Start Date: **8/23/2021**	Boring Depth (ft): **15.5**	Well Depth (ft): **15**
Drilling End Date: **8/24/2021**	Boring Diameter (in): **3.25, 2.25**	Well Diameter (in): **1**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Hand Auger/Direct Push**	Well Material: **1/4" Teflon Tubing**
Drilling Method: **Hand Auger/Direct Push**	DTW During Drilling (ft): **--**	Screen Interval (ft): **Vapor Probe (NA slot)**
Drilling Equipment: **DT-22**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-14.5 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **483.13**	Filter Pack Interval (ft): **14.5-15.5 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193692.953, 2073339.95**	Top of Casing Elev. (ft): **--**



(15.5') Boring terminated.

NOTES: Bentonite hydrated from 13.5-14 ft bgs. Soil gas probe completed with flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No.** SGMF-9-5 / P4b **Page:** 1 of 1

Drilling Start Date: **8/23/2021**	Boring Depth (ft): **5.5**	Well Depth (ft): **5**
Drilling End Date: **8/23/2021**	Boring Diameter (in): **3.5**	Well Diameter (in): **1**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Hand Auger**	Well Material: **1/4" Teflon Tubing**
Drilling Method: **Hand Auger**	DTW During Drilling (ft): **--**	Screen Interval (ft): **Vapor Probe (NA slot)**
Drilling Equipment: **Hand Auger**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-4.5 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **482.16**	Filter Pack Interval (ft): **4.5-5.5 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193789.615, 2073324.144**	Top of Casing Elev. (ft): **--**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	SAMPLE ID	PID (ppb)	WELL COMPLETION	SOIL/ROCK VISUAL DESCRIPTION	DEPTH (ft)
0			P4b-1 P4b-2 P4b-3 SGMF-9-5			(0') Not logged. (5.5') Boring terminated.	0
5							5

NOTES: Bentonite hydrated from 3.5-4 ft bgs. Soil gas probe completed with flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No. SGMF-10-5** **Page: 1 of 1**

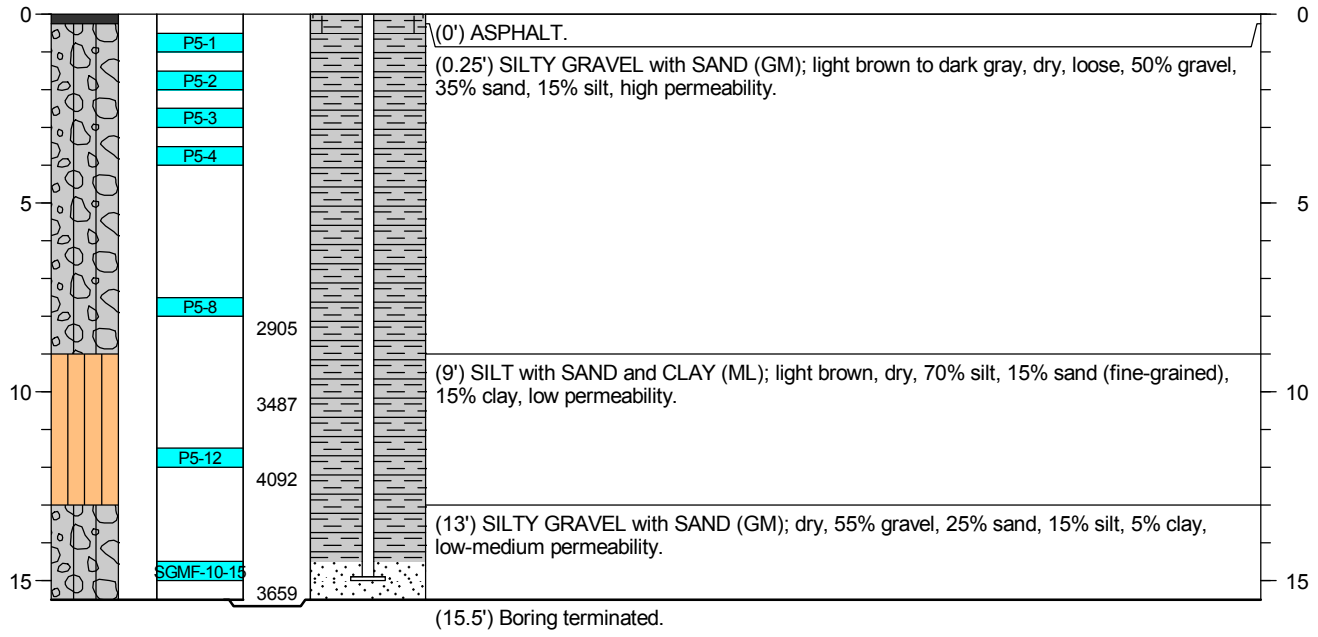
Drilling Start Date: **8/24/2021**	Boring Depth (ft): **5.5**	Well Depth (ft): **5**
Drilling End Date: **8/24/2021**	Boring Diameter (in): **3.5**	Well Diameter (in): **1**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Hand Auger**	Well Material: **1/4" Teflon Tubing**
Drilling Method: **Hand Auger**	DTW During Drilling (ft): **--**	Screen Interval (ft): **Vapor Probe (NA slot)**
Drilling Equipment: **Hand Auger**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-4.5 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **483.22**	Filter Pack Interval (ft): **4.5-5.5 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193902.923, 2073374.405**	Top of Casing Elev. (ft): **--**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	SAMPLE ID	PID (ppb)	WELL COMPLETION	SOIL/ROCK VISUAL DESCRIPTION	DEPTH (ft)
0						(0') Not logged.	0
5			SGMF-10-5			(5.5') Boring terminated.	5

NOTES: Bentonite hydrated from 3.5-4 ft bgs. Soil gas probe completed with flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No.** SGMF-10-15 / P5 **Page:** 1 of 1

Drilling Start Date: **8/24/2021**	Boring Depth (ft): **15.5**	Well Depth (ft): **15**
Drilling End Date: **8/24/2021**	Boring Diameter (in): **3.25, 2.25**	Well Diameter (in): **1**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Hand Auger/Direct Push**	Well Material: **1/4" Teflon Tubing**
Drilling Method: **Hand Auger/Direct Push**	DTW During Drilling (ft): **--**	Screen Interval (ft): **Vapor Probe (NA slot)**
Drilling Equipment: **DT-22**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-14.5 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **--**	Filter Pack Interval (ft): **14.5-15.5 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **--**	Top of Casing Elev. (ft): **--**



NOTES: Bentonite hydrated from 13.5-14 ft bgs. Soil gas probe completed with flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No. SGMF-11-5 / P2b** **Page: 1 of 1**

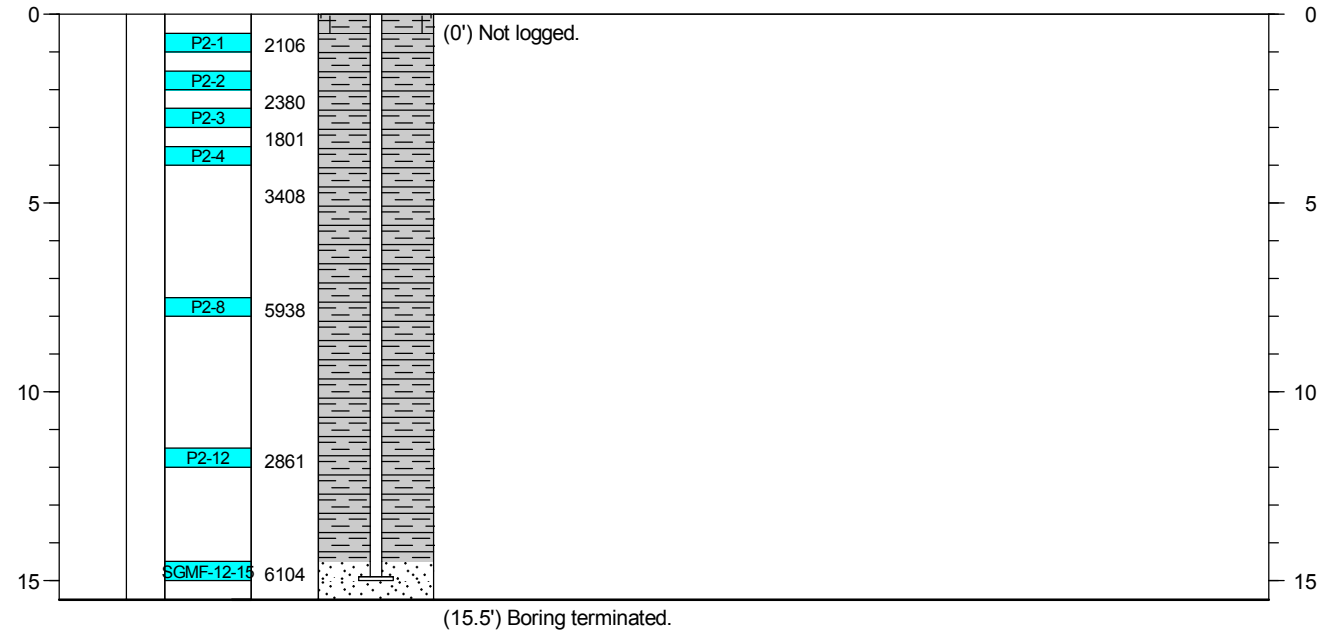
Drilling Start Date: **8/26/2021**	Boring Depth (ft): **5.5**	Well Depth (ft): **5**
Drilling End Date: **8/26/2021**	Boring Diameter (in): **3.5**	Well Diameter (in): **1**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Hand Auger**	Well Material: **1/4" Teflon Tubing**
Drilling Method: **Hand Auger**	DTW During Drilling (ft): **--**	Screen Interval (ft): **Vapor Probe (NA slot)**
Drilling Equipment: **Hand Auger**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-4.5 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **484.17**	Filter Pack Interval (ft): **4.5-5.5 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193868.574, 2073474.941**	Top of Casing Elev. (ft): **--**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	SAMPLE ID	PID (ppb)	WELL COMPLETION	SOIL/ROCK VISUAL DESCRIPTION	DEPTH (ft)
0			P2b-1			(0') FILL (GP); dry.	0
			P2b-2			(1.25') CONCRETE.	
			P2b-3			(1.75') SANDY GRAVEL (GP); light gray, dry, subangular gravel with silt.	
5			SGMF11-5			(4') Dry, less silt and more well-graded sand.	5
						(5.5') Boring terminated.	

NOTES: Bentonite hydrated from 3.5-4 ft bgs. Soil gas probe completed with flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No.** SGMF-12-15 / P2 **Page:** 1 of 1

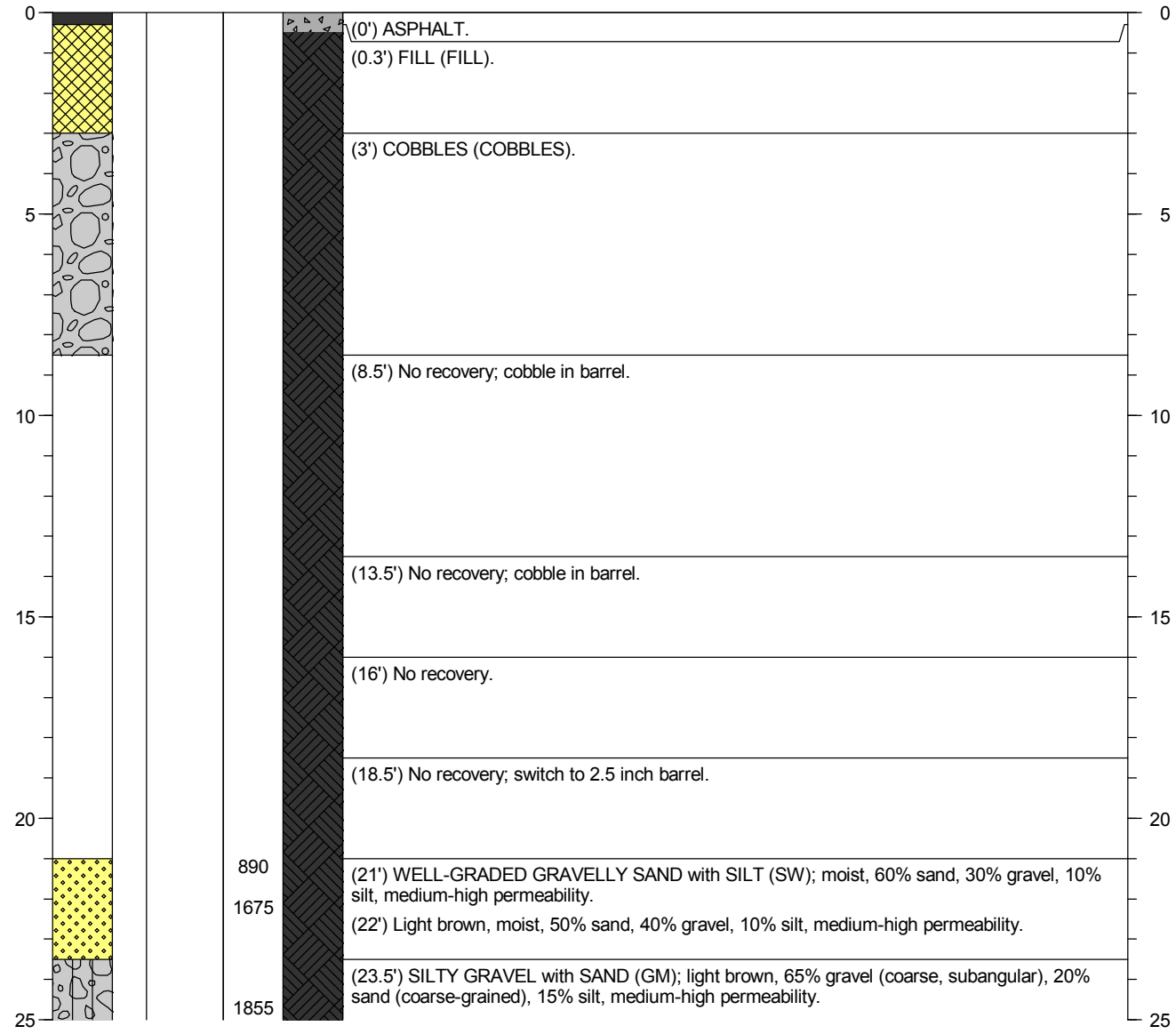
Drilling Start Date: **8/26/2021**	Boring Depth (ft): **15.5**	Well Depth (ft): **15**
Drilling End Date: **8/26/2021**	Boring Diameter (in): **3.25, 2.25**	Well Diameter (in): **1**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Hand Auger/Direct Push**	Well Material: **1/4" Teflon Tubing**
Drilling Method: **Hand Auger/Direct Push**	DTW During Drilling (ft): **--**	Screen Interval (ft): **Vapor Probe (NA slot)**
Drilling Equipment: **DT-22**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-14.5 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **483.49**	Filter Pack Interval (ft): **14.5-15.5 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193825.822, 2073541.688**	Top of Casing Elev. (ft): **--**



NOTES: Bentonite hydrated from 13.5-14 ft bgs. Soil gas probe completed with flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2009 Railroad Ave, Livermore, CA	**BORING LOG** **Boring No.** HP-7-MF **Page:** 1 of 3

Drilling Start Date:	**8/3/2021**	Boring Depth (ft):	**72**
Drilling End Date:	**8/6/2021**	Boring Diameter (in):	**8**
Drilling Company:	**Cascade Drilling**	Sampling Method(s):	**Continuous Core Barrel**
Drilling Method:	**HSA**	DTW During Drilling (ft):	**52**
Drilling Equipment:	**CME-85**	DTW After Drilling (ft):	**--**
Logged By:	**D. Cardiff**	Ground Surface Elev. (ft):	**--**
Reviewed By:	**A. Simmons, P.G.**	Location (X,Y):	**--**



NOTES: Boring location cleared to 5 feet bgs with hand auger prior to drilling. Boring backfilled with neat cement to near surface and finished to grade with concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2009 Railroad Ave, Livermore, CA	**BORING LOG** **Boring No.** HP-7-MF **Page:** 2 of 3

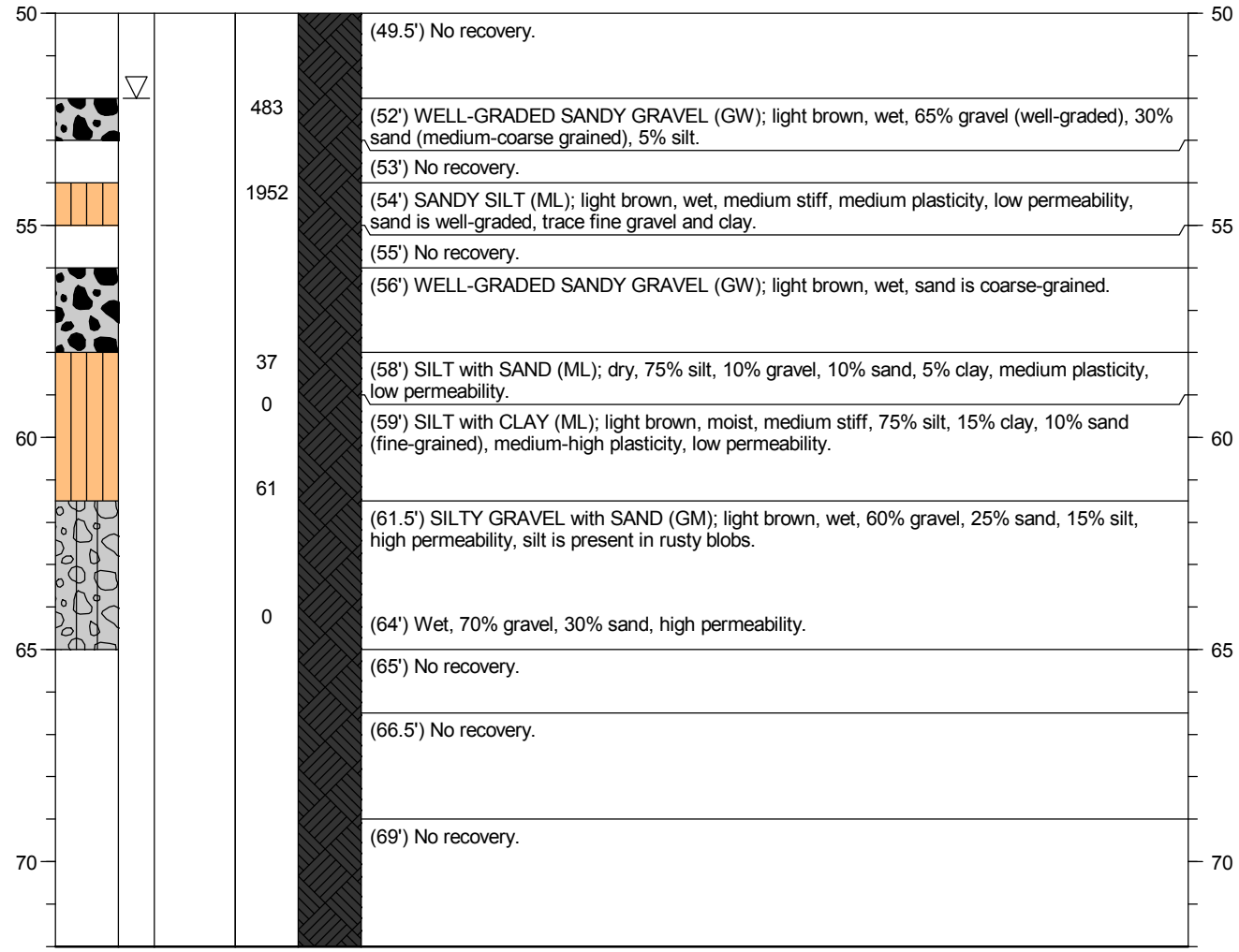
Drilling Start Date:	**8/3/2021**	Boring Depth (ft):	**72**
Drilling End Date:	**8/6/2021**	Boring Diameter (in):	**8**
Drilling Company:	**Cascade Drilling**	Sampling Method(s):	**Continuous Core Barrel**
Drilling Method:	**HSA**	DTW During Drilling (ft):	**52**
Drilling Equipment:	**CME-85**	DTW After Drilling (ft):	**--**
Logged By:	**D. Cardiff**	Ground Surface Elev. (ft):	**--**
Reviewed By:	**A. Simmons, P.G.**	Location (X,Y):	**--**

DEPTH (ft)	PID (ppb)	SOIL/ROCK VISUAL DESCRIPTION
25		
	304	(26') SANDY GRAVEL (GP); moist, 60% gravel, 35% sand (coarse-grained), 5% silt, medium-high permeability.
		(27') No recovery.
	0	(28.5') GRAVELLY SAND (SP); moist, with 4 inch medium poorly graded sand and rusty colored clay blobs.
30		(29.5') No recovery.
	0	(31') WELL-GRADED SANDY GRAVEL with SILT (GW); light brown, moist, 60% gravel (well-graded, subangular-subrounded), 30% sand (medium-coarse grained), 10% silt, high permeability.
		(32') No recovery.
	10	(33.5') WELL-GRADED SANDY GRAVEL with SILT (GW); light brown, moist, 60% gravel (well-graded, subangular-subrounded), 30% sand (medium-coarse grained), 10% silt, high permeability, with broken cobbles.
35		(36') No recovery.
	185	(37') WELL-GRADED SANDY GRAVEL (GW); light brown, moist, 65% gravel (well-graded, subangular-subrounded), 35% sand (medium-coarse grained), high permeability, with broken cobbles.
		(38') No recovery.
40	0	(39.5') SANDY GRAVEL with SILT (GP); light brown, moist, 60% gravel (subangular-subrounded), 30% sand (medium-coarse grained), 10% silt, high permeability.
		(41') No recovery.
	0	(42') SANDY GRAVEL with SILT (GP); light brown, moist, 70% gravel (subangular-subrounded), 30% sand (medium-coarse grained), 10% silt, high permeability.
		(43') No recovery.
45	414	(44.5') SANDY GRAVEL with SILT (GP); light brown, moist, 70% gravel (subangular-subrounded), 30% sand (medium-coarse grained), 10% silt, high permeability.
	0	(46') SANDY GRAVEL with SILT (SP); light brown, moist, 60% gravel (2"), 30% sand, 10% silt, high permeability.
	296	(48.5') SILTY SAND (SM); light brown, moist, 60% sand (well-graded), 30% silt, 10% gravel (fine, subangular-subrounded), medium-high permeability.
50		

NOTES: Boring location cleared to 5 feet bgs with hand auger prior to drilling. Boring backfilled with neat cement to near surface and finished to grade with concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2009 Railroad Ave, Livermore, CA	**BORING LOG** **Boring No.** HP-7-MF **Page:** 3 of 3

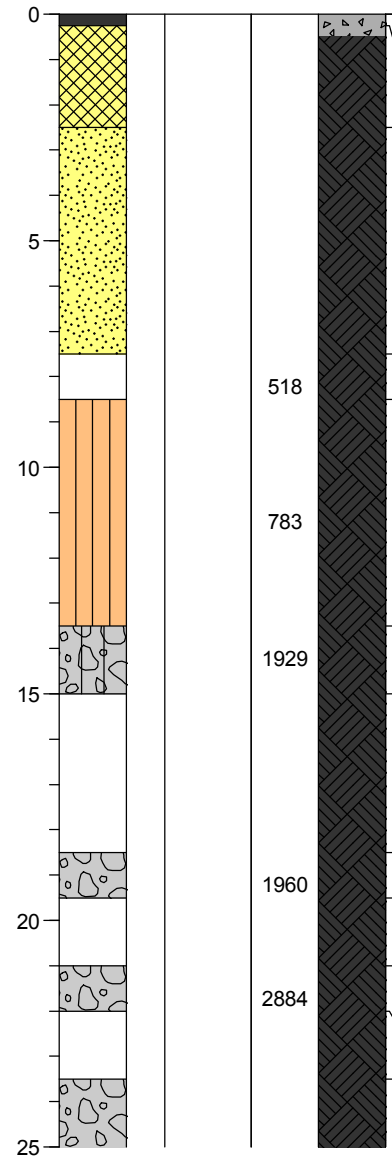
Drilling Start Date:	**8/3/2021**	Boring Depth (ft):	**72**
Drilling End Date:	**8/6/2021**	Boring Diameter (in):	**8**
Drilling Company:	**Cascade Drilling**	Sampling Method(s):	**Continuous Core Barrel**
Drilling Method:	**HSA**	DTW During Drilling (ft):	**52**
Drilling Equipment:	**CME-85**	DTW After Drilling (ft):	**--**
Logged By:	**D. Cardiff**	Ground Surface Elev. (ft):	**--**
Reviewed By:	**A. Simmons, P.G.**	Location (X,Y):	**--**



NOTES: Boring location cleared to 5 feet bgs with hand auger prior to drilling. Boring backfilled with neat cement to near surface and finished to grade with concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2009 Railroad Ave, Livermore, CA	**BORING LOG** **Boring No.** HP-9-MF **Page:** 1 of 2

Drilling Start Date:	**8/2/2021**	Boring Depth (ft):	**46**
Drilling End Date:	**8/3/2021**	Boring Diameter (in):	**8**
Drilling Company:	**Cascade Drilling**	Sampling Method(s):	**Continuous Core Barrel**
Drilling Method:	**HSA**	DTW During Drilling (ft):	**--**
Drilling Equipment:	**CME-85**	DTW After Drilling (ft):	**--**
Logged By:	**D. Cardiff**	Ground Surface Elev. (ft):	**--**
Reviewed By:	**A. Simmons, P.G.**	Location (X,Y):	**--**



SOIL/ROCK VISUAL DESCRIPTION

(0') ASPHALT.

(0.25') SAND and GRAVEL (FILL); [FILL].

(2.5') POORLY GRADED SAND with GRAVEL (SP); light brown, dry, 75% sand (coarse-grained), 25% gravel (subangular-subrounded), high permeability, cobbles up to 6 inches.

(7.5') No recovery; clayey/silty material in bottom under cobble.

(8.5') SILT (ML); light brown, moist, medium stiff, 85% silt, 10% clay, 5% sand, low plasticity, low permeability.

(13.5') SILTY GRAVEL with SAND (GM); light brown, moist, 55% gravel (subangular-subrounded), 30% sand (medium-coarse grained), 15% silt, high permeability.

(15') No recovery.

(18.5') GRAVEL with SAND (GP); moist.

(19.5') No recovery.

(21') GRAVEL with SAND (GP); moist, 70% gravel (2", subrounded), 25% sand (coarse-grained), 5% silt, high permeability, with rusty brown clay ball with root.

(22') No recovery.

(23.5') SILTY GRAVEL (GP); moist, high permeability, with silt and clay.

DEPTH (ft)
0
5
10
15
20
25

NOTES: Boring location cleared to 5 feet bgs with hand auger prior to drilling. Boring backfilled with neat cement to near surface and finished to grade with concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2009 Railroad Ave, Livermore, CA	**BORING LOG** **Boring No.** HP-9-MF **Page:** 2 of 2

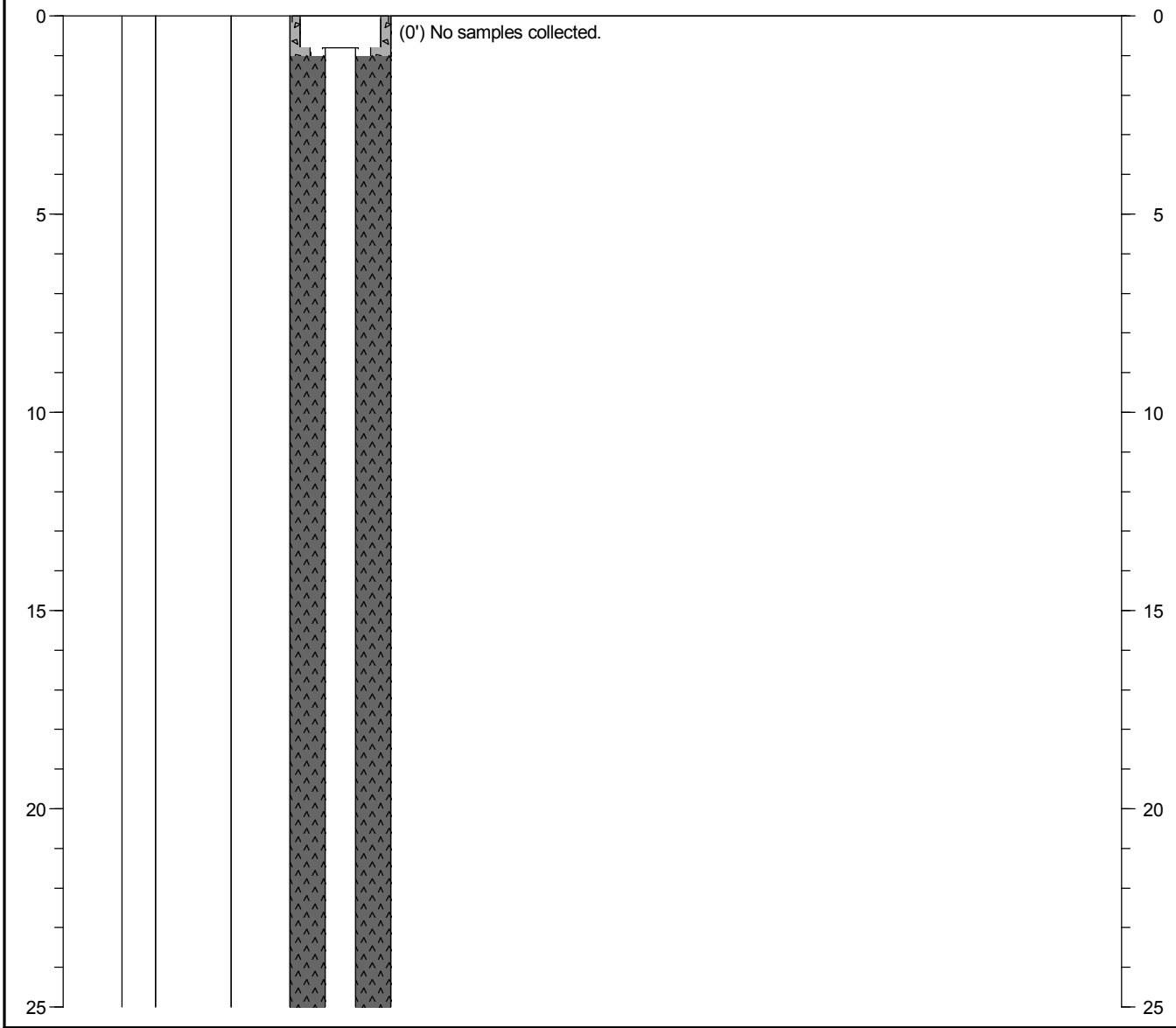
Drilling Start Date:	**8/2/2021**	Boring Depth (ft):	**46**
Drilling End Date:	**8/3/2021**	Boring Diameter (in):	**8**
Drilling Company:	**Cascade Drilling**	Sampling Method(s):	**Continuous Core Barrel**
Drilling Method:	**HSA**	DTW During Drilling (ft):	**--**
Drilling Equipment:	**CME-85**	DTW After Drilling (ft):	**--**
Logged By:	**D. Cardiff**	Ground Surface Elev. (ft):	**--**
Reviewed By:	**A. Simmons, P.G.**	Location (X,Y):	**--**

DEPTH (ft)	PID (ppb)	SOIL/ROCK VISUAL DESCRIPTION
25	526	
	562	(26') SANDY SILT with GRAVEL (ML); moist, 50% silt, 30% sand (fine-grained), 15% gravel (fine), 5% clay, low plasticity, low permeability.
30		(29') No recovery.
	623	(31') SILT with CLAY (ML); light brown, 75% silt, 15% clay, 10% sand (fine-grained), low plasticity, low permeability.
35	1297	
	2381	(36') SILTY GRAVEL with SAND (GM); light brown, moist, 50% gravel (2", angular), 35% sand (well-graded), 15% silt, high permeability, with 3 inch fine to medium sand lens at 36 feet.
	3351	(38.5') Same as above from 38.5-41 feet.
40		(40') 6-inch medium sand lens from 40-40.5 feet.
		(41') SANDY GRAVEL (GP).
	4573	(42') CLAYEY SILT (ML); moist, 65% silt, 30% clay, 5% sand.
		(43') No recovery.
45	140	(43.5') SILTY GRAVEL with SAND (GM); 60% gravel, 25% sand, 10% silt, 5% clay, high permeability.
		(46') Boring terminated.

NOTES: Boring location cleared to 5 feet bgs with hand auger prior to drilling. Boring backfilled with neat cement to near surface and finished to grade with concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2009 Railroad Ave, Livermore, CA	**WELL LOG** **Well No.** MWMF-5 **Page:** 1 of 3

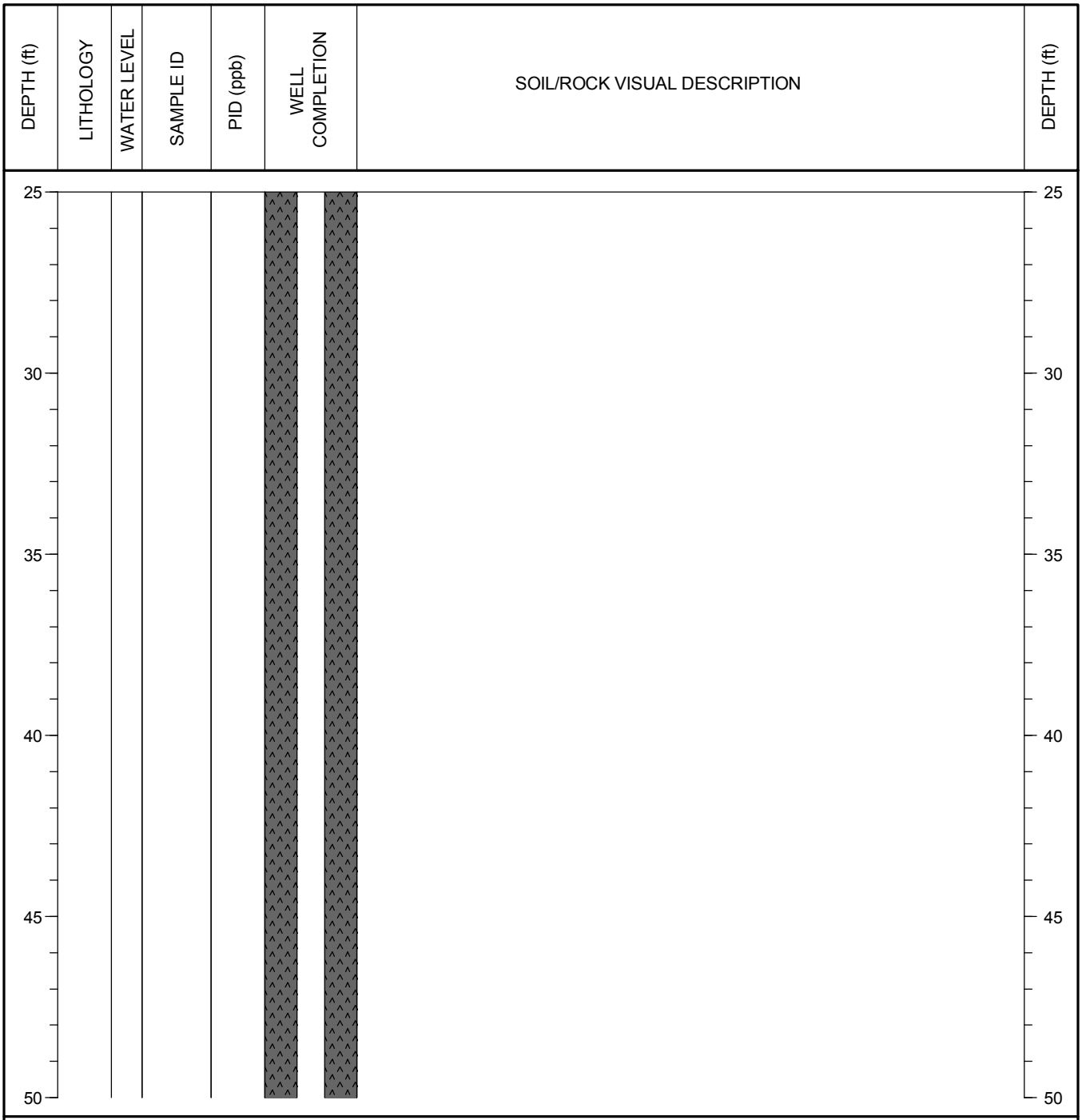
Drilling Start Date: **9/8/2021**	Boring Depth (ft): **72**	Well Depth (ft): **72**
Drilling End Date: **9/9/2021**	Boring Diameter (in): **8**	Well Diameter (in): **2**
Drilling Company: **Gregg Drilling**	Sampling Method(s): **Split Spoon**	Well Material: **Sch 40 PVC**
Drilling Method: **HSA**	DTW During Drilling (ft): **--**	Screen Interval (ft): **62-72 (0.010 slot)**
Drilling Equipment: **Marl**	DTW After Well Installation (ft): **51.8**	Seal Interval (ft): **0.5-60 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **481.90**	Filter Pack Interval (ft): **60-72 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193649.941, 2073396.32**	Top of Casing Elev. (ft): **--**



NOTES: Boring location cleared to 5 feet bgs with vacuum truck. Drilled to 54 feet bgs, pulled back to 50 feet and collected water sample HP-5-MF54 at 1105. Continued drilling to 60 feet before starting sampling. Well completed with 10-inch flush-mount well cover set in concrete. Bentonite hydrated from 58-60 ft bgs.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2009 Railroad Ave, Livermore, CA	**WELL LOG** **Well No. MWMF-5** **Page: 2 of 3**

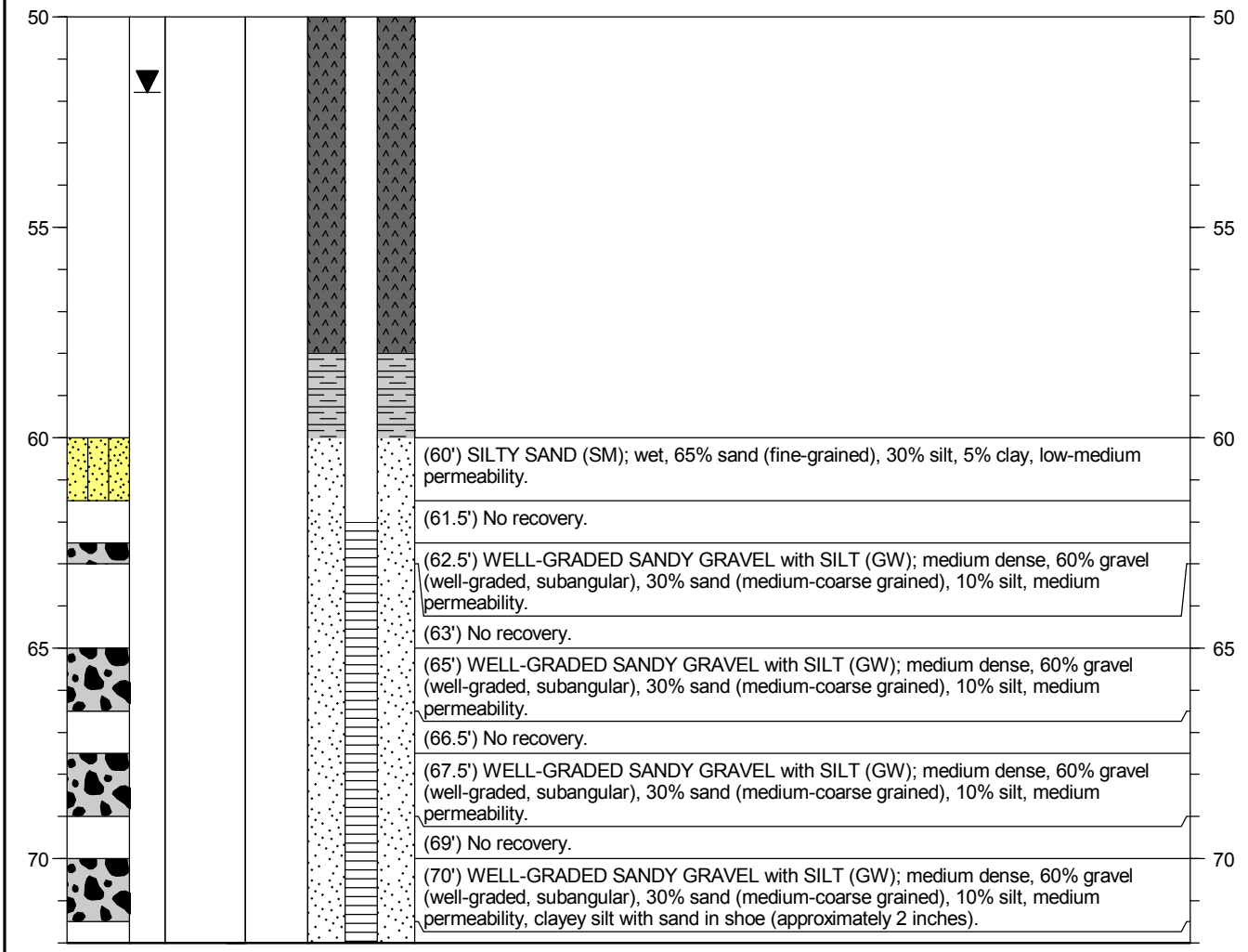
Drilling Start Date:	**9/8/2021**	Boring Depth (ft):	**72**	Well Depth (ft):	**72**
Drilling End Date:	**9/9/2021**	Boring Diameter (in):	**8**	Well Diameter (in):	**2**
Drilling Company:	**Gregg Drilling**	Sampling Method(s):	**Split Spoon**	Well Material:	**Sch 40 PVC**
Drilling Method:	**HSA**	**DTW During Drilling (ft): --**		Screen Interval (ft):	**62-72 (0.010 slot)**
Drilling Equipment:	**Marl**	**DTW After Well Installation (ft):51.8**		Seal Interval (ft):	**0.5-60 (Grout/Bentonite)**
Logged By:	**D. Cardiff**	**Ground Surface Elev. (ft): 481.90**		Filter Pack Interval (ft):	**60-72 (#2/12 Sand)**
Reviewed By:	**A. Simmons, P.G.**	**Location (X,Y): 6193649.941, 2073396.32**		Top of Casing Elev. (ft):	**--**



NOTES: Boring location cleared to 5 feet bgs with vacuum truck. Drilled to 54 feet bgs, pulled back to 50 feet and collected water sample HP-5-MF54 at 1105. Continued drilling to 60 feet before starting sampling. Well completed with 10-inch flush-mount well cover set in concrete. Bentonite hydrated from 58-60 ft bgs.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2009 Railroad Ave, Livermore, CA	**WELL LOG** **Well No.** MWMF-5 **Page:** 3 of 3

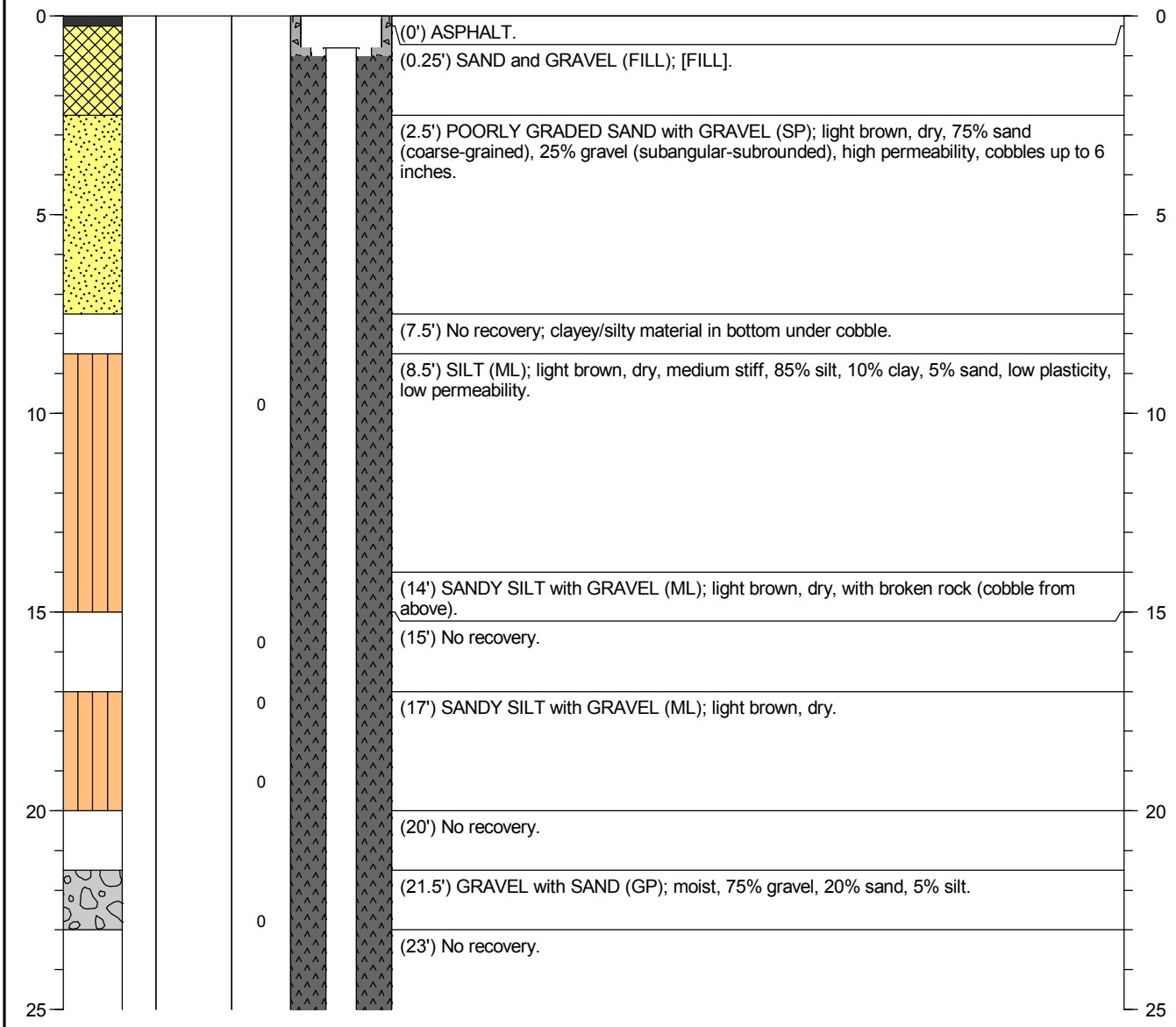
Drilling Start Date:	**9/8/2021**	Boring Depth (ft):	**72**	Well Depth (ft):	**72**
Drilling End Date:	**9/9/2021**	Boring Diameter (in):	**8**	Well Diameter (in):	**2**
Drilling Company:	**Gregg Drilling**	Sampling Method(s):	**Split Spoon**	Well Material:	**Sch 40 PVC**
Drilling Method:	**HSA**	**DTW During Drilling (ft): --**		Screen Interval (ft):	**62-72 (0.010 slot)**
Drilling Equipment:	**Marl**	**DTW After Well Installation (ft):51.8**		Seal Interval (ft):	**0.5-60 (Grout/Bentonite)**
Logged By:	**D. Cardiff**	**Ground Surface Elev. (ft): 481.90**		Filter Pack Interval (ft):	**60-72 (#2/12 Sand)**
Reviewed By:	**A. Simmons, P.G.**	**Location (X,Y): 6193649.941, 2073396.32**		Top of Casing Elev. (ft):	**--**



NOTES: Boring location cleared to 5 feet bgs with vacuum truck. Drilled to 54 feet bgs, pulled back to 50 feet and collected water sample HP-5-MF54 at 1105. Continued drilling to 60 feet before starting sampling. Well completed with 10-inch flush-mount well cover set in concrete. Bentonite hydrated from 58-60 ft bgs.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2009 Railroad Ave, Livermore, CA	**WELL LOG** **Well No.** MWMF-6 **Page:** 1 of 3

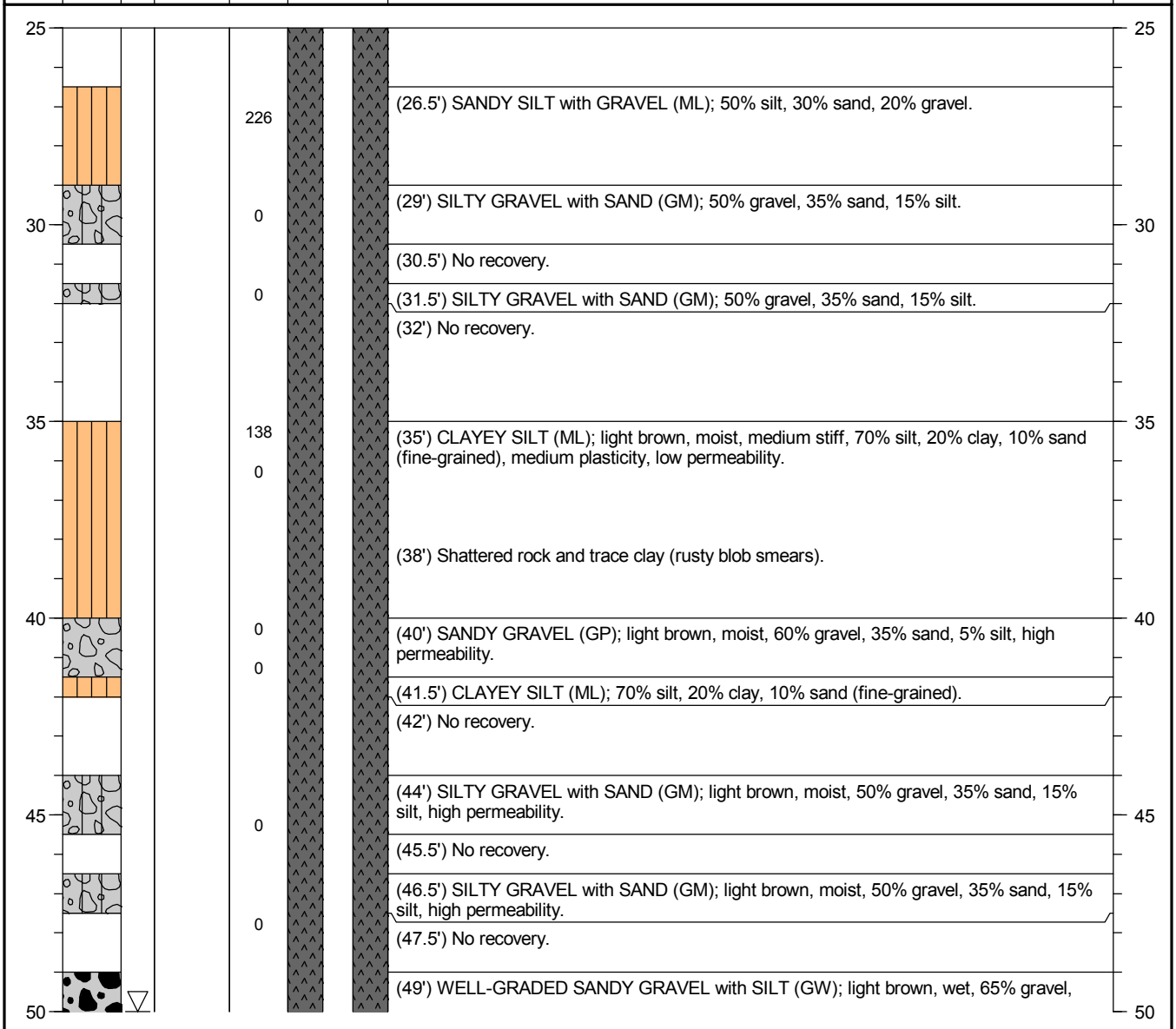
Drilling Start Date:	**8/4/2021**	Boring Depth (ft):	**72**	Well Depth (ft):	**71**
Drilling End Date:	**8/5/2021**	Boring Diameter (in):	**8**	Well Diameter (in):	**2**
Drilling Company:	**Gregg Drilling**	Sampling Method(s):	**Split Spoon**	Well Material:	**Sch 40 PVC**
Drilling Method:	**HSA**	DTW During Drilling (ft):	**50.0**	Screen Interval (ft):	**61-71 (0.010 slot)**
Drilling Equipment:	**Marl**	DTW After Well Installation (ft):	**50.3**	Seal Interval (ft):	**0.5-59 (Grout/Bentonite)**
Logged By:	**D. Cardiff**	Ground Surface Elev. (ft):	**482.87**	Filter Pack Interval (ft):	**59-71 (#2/12 Sand)**
Reviewed By:	**A. Simmons, P.G.**	Location (X,Y):	**6193804.912, 2073435.406**	Top of Casing Elev. (ft):	**--**



NOTES: Boring location cleared to 5 feet bgs with hand auger prior to drilling. Well completed with 10-inch flush-mount well cover set in concrete. Bentonite hydrated from 57-59 ft bgs.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2009 Railroad Ave, Livermore, CA	**WELL LOG** **Well No. MWMF-6** **Page: 2 of 3**

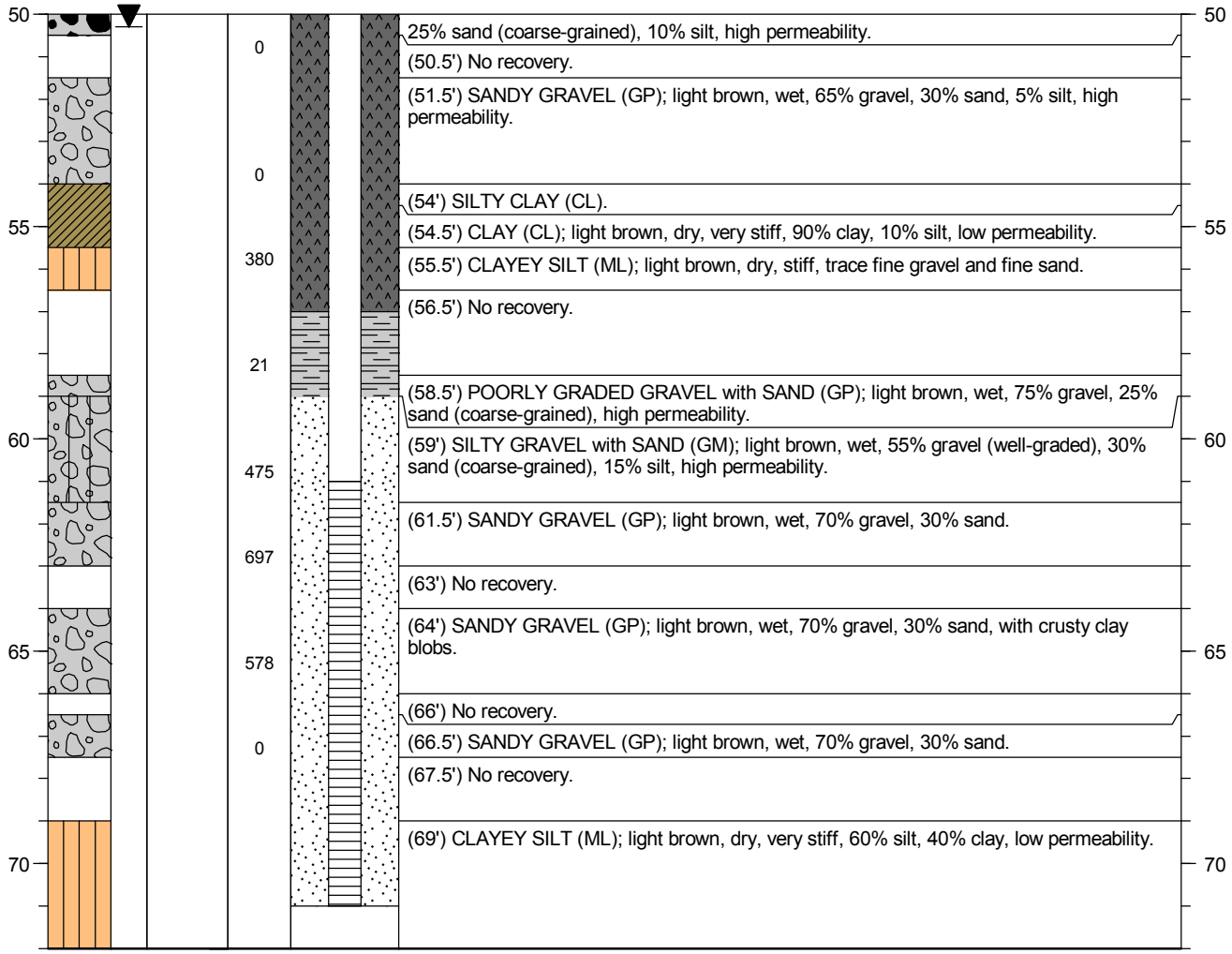
Drilling Start Date:	**8/4/2021**	Boring Depth (ft):	**72**	Well Depth (ft):	**71**
Drilling End Date:	**8/5/2021**	Boring Diameter (in):	**8**	Well Diameter (in):	**2**
Drilling Company:	**Gregg Drilling**	Sampling Method(s):	**Split Spoon**	Well Material:	**Sch 40 PVC**
Drilling Method:	**HSA**	**DTW During Drilling (ft): 50.0**		Screen Interval (ft):	**61-71 (0.010 slot)**
Drilling Equipment:	**Marl**	**DTW After Well Installation (ft):50.3**		Seal Interval (ft):	**0.5-59 (Grout/Bentonite)**
Logged By:	**D. Cardiff**	**Ground Surface Elev. (ft): 482.87**		Filter Pack Interval (ft):	**59-71 (#2/12 Sand)**
Reviewed By:	**A. Simmons, P.G.**	**Location (X,Y): 6193804.912, 2073435.406**		Top of Casing Elev. (ft):	**--**



NOTES: Boring location cleared to 5 feet bgs with hand auger prior to drilling. Well completed with 10-inch flush-mount well cover set in concrete. Bentonite hydrated from 57-59 ft bgs.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2009 Railroad Ave, Livermore, CA	**WELL LOG** **Well No.** MWMF-6 **Page:** 3 of 3

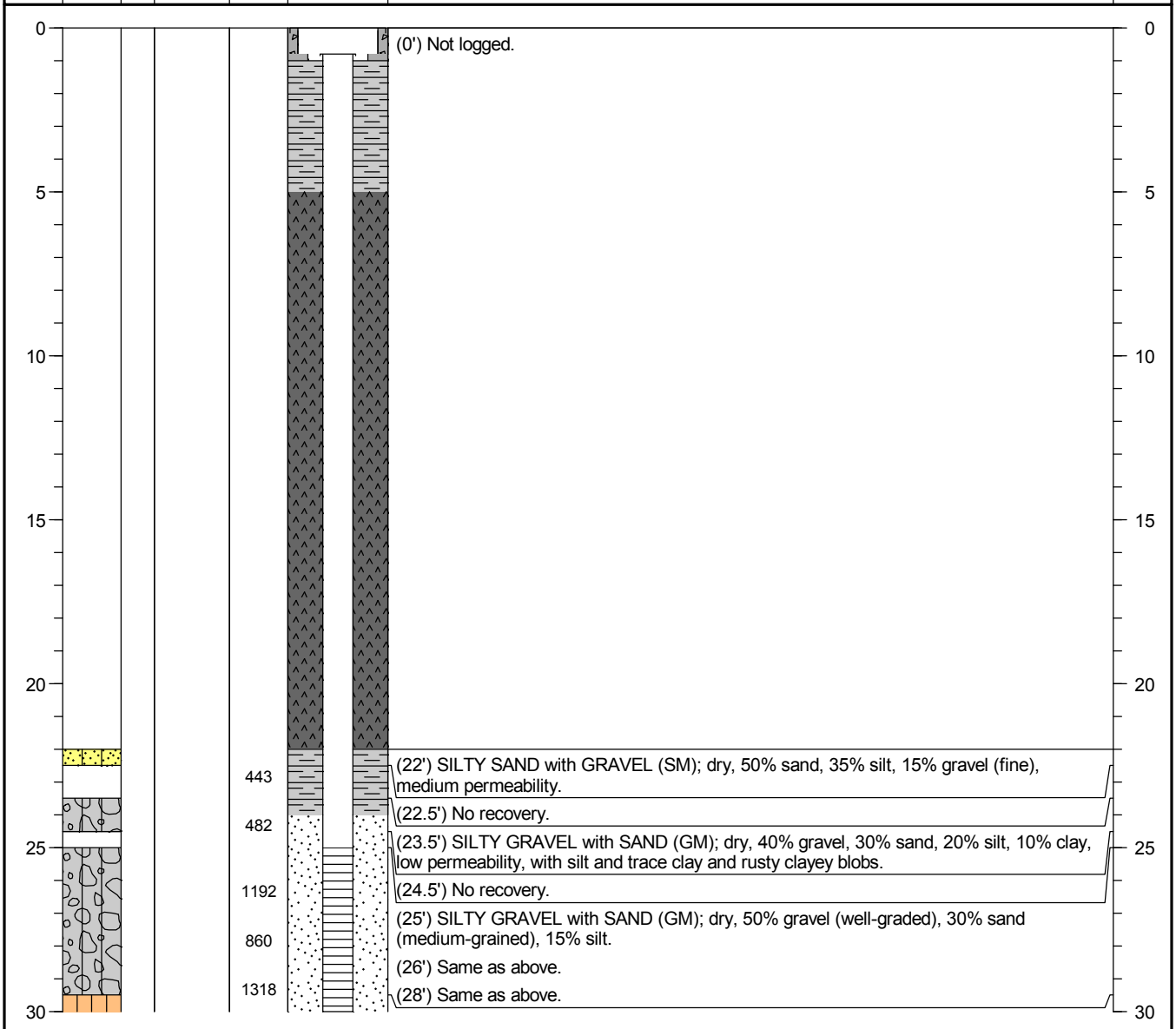
Drilling Start Date:	**8/4/2021**	Boring Depth (ft):	**72**	Well Depth (ft):	**71**
Drilling End Date:	**8/5/2021**	Boring Diameter (in):	**8**	Well Diameter (in):	**2**
Drilling Company:	**Gregg Drilling**	Sampling Method(s):	**Split Spoon**	Well Material:	**Sch 40 PVC**
Drilling Method:	**HSA**	**DTW During Drilling (ft): 50.0**		Screen Interval (ft):	**61-71 (0.010 slot)**
Drilling Equipment:	**Marl**	**DTW After Well Installation (ft):50.3**		Seal Interval (ft):	**0.5-59 (Grout/Bentonite)**
Logged By:	**D. Cardiff**	**Ground Surface Elev. (ft): 482.87**		Filter Pack Interval (ft):	**59-71 (#2/12 Sand)**
Reviewed By:	**A. Simmons, P.G.**	**Location (X,Y): 6193804.912, 2073435.406**		Top of Casing Elev. (ft):	**--**



NOTES: Boring location cleared to 5 feet bgs with hand auger prior to drilling. Well completed with 10-inch flush-mount well cover set in concrete. Bentonite hydrated from 57-59 ft bgs.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No. VEMF-2B** **Page: 1 of 2**

Drilling Start Date: **8/11/2021**	Boring Depth (ft): **42**	Well Depth (ft): **32**
Drilling End Date: **8/11/2021**	Boring Diameter (in): **8**	Well Diameter (in): **2**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Core Barrel**	Well Material: **Sch 40 PVC**
Drilling Method: **Hollow Stem Auger**	DTW During Drilling (ft): **--**	Screen Interval (ft): **25-32 (0.010 slot)**
Drilling Equipment: **CME-85**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-24 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **482.27**	Filter Pack Interval (ft): **24-32 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193788.026, 2073431.933**	Top of Casing Elev. (ft): **--**



NOTES: Boring backfilled with bentonite chips to 32 feet prior to well installation. Grout to 5 ft bgs, then bentonite to 1 foot bgs. Well completed with 10-inch flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No. VEMF-2B** **Page: 2 of 2**

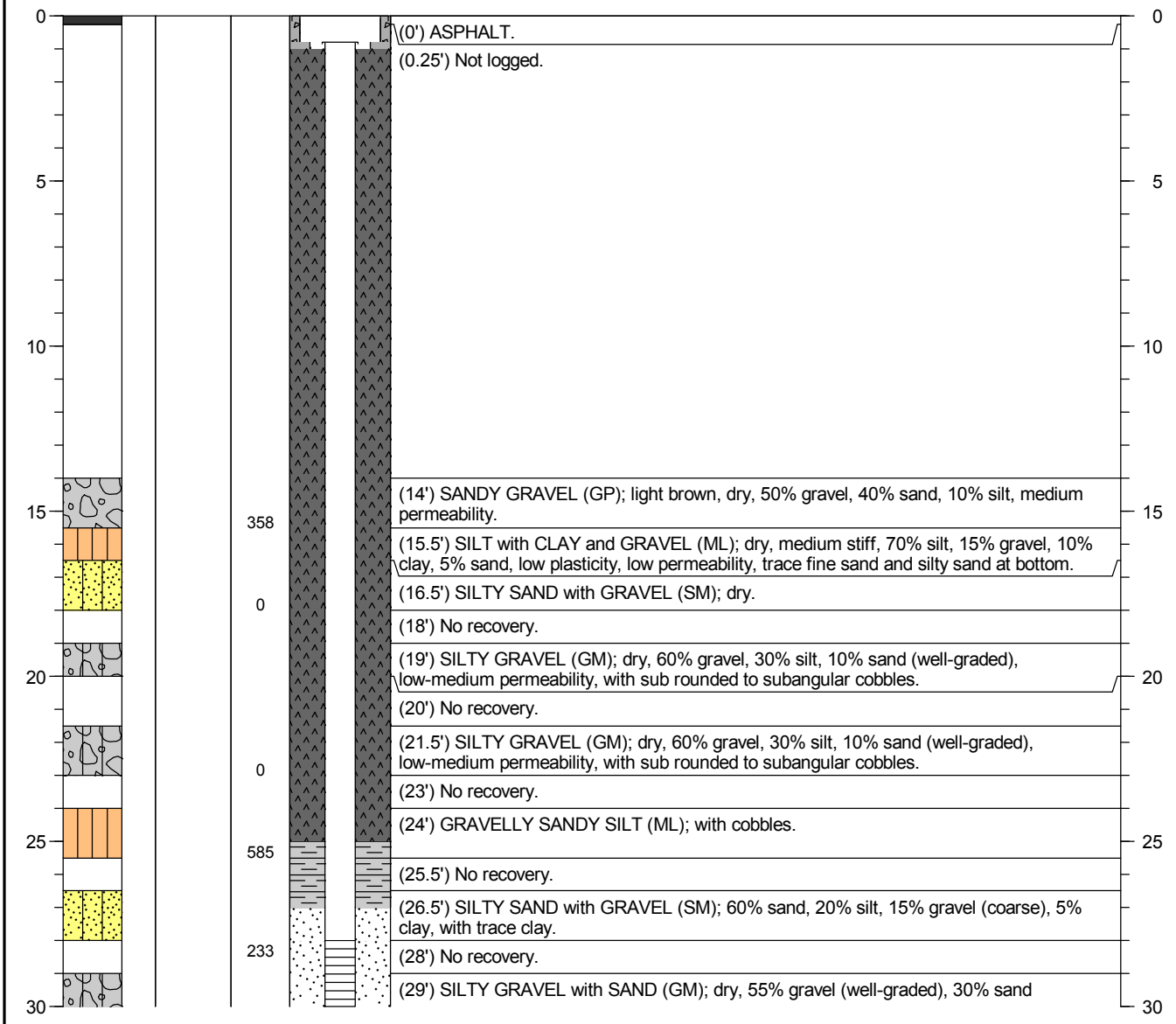
Drilling Start Date: **8/11/2021**	Boring Depth (ft): **42**	Well Depth (ft): **32**
Drilling End Date: **8/11/2021**	Boring Diameter (in): **8**	Well Diameter (in): **2**
Drilling Company: **Cascade Drilling**	**Sampling Method(s): Core Barrel**	Well Material: **Sch 40 PVC**
Drilling Method: **Hollow Stem Auger**	**DTW During Drilling (ft): --**	Screen Interval (ft): **25-32 (0.010 slot)**
Drilling Equipment: **CME-85**	**DTW After Well Installation (ft):--**	Seal Interval (ft): **0.5-24 (Grout/Bentonite)**
Logged By: **D. Cardiff**	**Ground Surface Elev. (ft): 482.27**	Filter Pack Interval (ft): **24-32 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	**Location (X,Y): 6193788.026, 2073431.933**	Top of Casing Elev. (ft): **--**

DEPTH (ft)	PID (ppb)	SOIL/ROCK VISUAL DESCRIPTION
30	1087	(29.5') SANDY SILT (ML); light brown, 50% silt, 35% sand, 15% clay, low permeability, with silt as above.
		(31') Same as above.
	1616	(31.5') SANDY SILT (ML); fine sand and with clay.
		(32.5') Same as above.
	2291	(34') Same as above.
35	2457	(35') WELL GRADED SAND (SW); dry, 80% sand (well-graded), 10% gravel, 10% silt, medium permeability.
		(35.5') No recovery.
	381	(36') WELL GRADED GRAVEL with SAND (GW); 65% gravel (well-graded), 25% sand, 10% silt.
	1005	(37.5') Same as above.
40	1544	(39') Same as above.
		(40.5') Same as above.
	802	(41.5') SILT with CLAY (ML); with fine sand.
		(42') Boring terminated.

NOTES: Boring backfilled with bentonite chips to 32 feet prior to well installation. Grout to 5 ft bgs, then bentonite to 1 foot bgs. Well completed with 10-inch flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No. VEMF-3B** **Page: 1 of 2**

Drilling Start Date: **8/10/2021**	Boring Depth (ft): **38**	Well Depth (ft): **38**
Drilling End Date: **8/11/2021**	Boring Diameter (in): **8**	Well Diameter (in): **2**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Core Barrel**	Well Material: **Sch 40 PVC**
Drilling Method: **Hollow Stem Auger**	DTW During Drilling (ft): **--**	Screen Interval (ft): **28-38 (0.010 slot)**
Drilling Equipment: **CME-85**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-27 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **482.12**	Filter Pack Interval (ft): **27-38 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193739.435, 2073373.397**	Top of Casing Elev. (ft): **--**



NOTES: Grout to 0.5 feet bgs. Well completed with 10-inch flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No. VEMF-3B** **Page: 2 of 2**

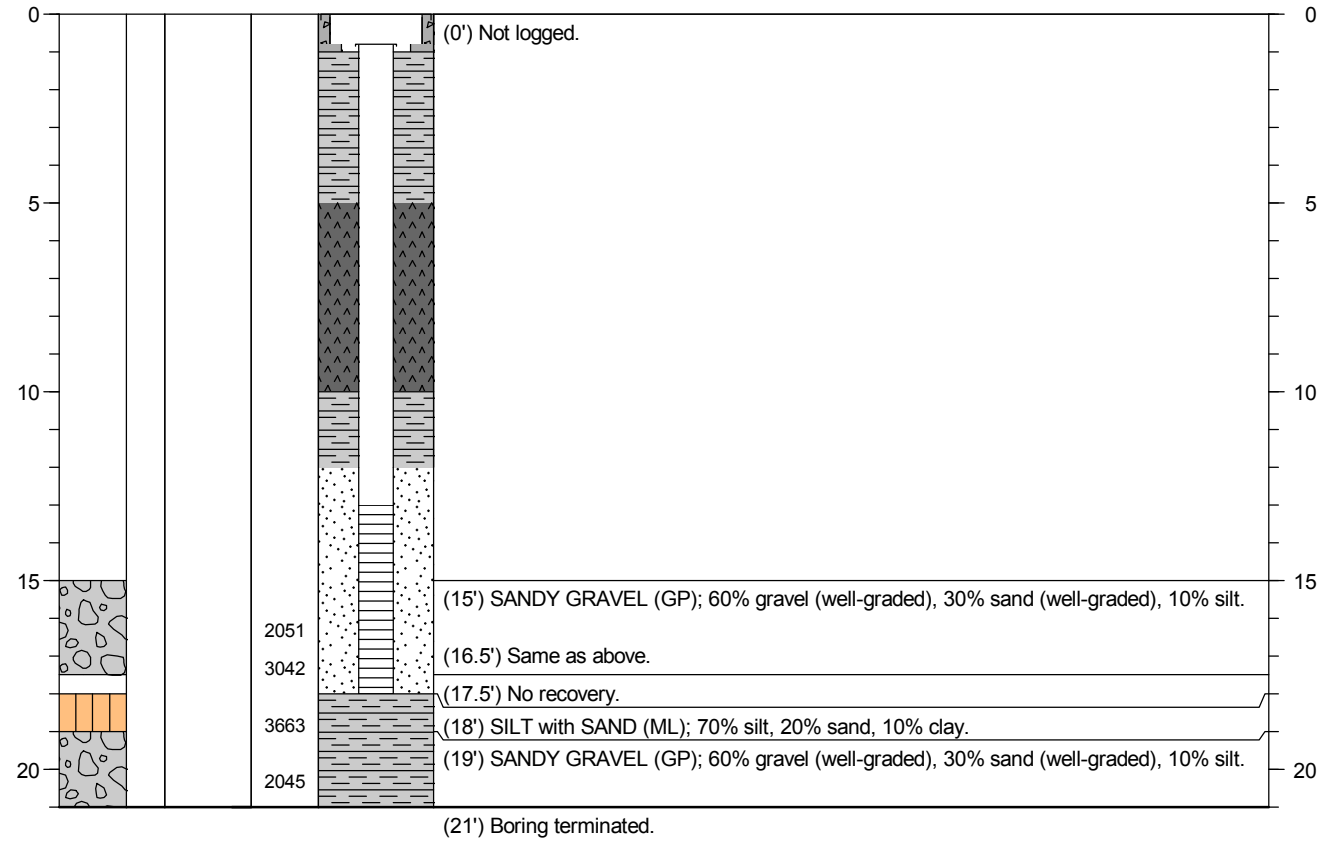
Drilling Start Date: **8/10/2021**	Boring Depth (ft): **38**	Well Depth (ft): **38**
Drilling End Date: **8/11/2021**	Boring Diameter (in): **8**	Well Diameter (in): **2**
Drilling Company: **Cascade Drilling**	**Sampling Method(s): Core Barrel**	Well Material: **Sch 40 PVC**
Drilling Method: **Hollow Stem Auger**	**DTW During Drilling (ft): --**	Screen Interval (ft): **28-38 (0.010 slot)**
Drilling Equipment: **CME-85**	**DTW After Well Installation (ft):--**	Seal Interval (ft): **0.5-27 (Grout/Bentonite)**
Logged By: **D. Cardiff**	**Ground Surface Elev. (ft): 482.12**	Filter Pack Interval (ft): **27-38 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	**Location (X,Y): 6193739.435, 2073373.397**	Top of Casing Elev. (ft): **--**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	SAMPLE ID	PID (ppb)	WELL COMPLETION	SOIL/ROCK VISUAL DESCRIPTION	DEPTH (ft)
30				0		(medium-coarse grained), 15% silt, medium permeability.	30
						(31') No recovery.	
				0		(31.5') SILTY GRAVEL with SAND (GM); dry, 55% gravel (well-graded), 30% sand (medium-coarse grained), 15% silt, medium permeability.	
						(33.5') No recovery.	
				0		(34') SILTY GRAVEL with SAND (GM); dry, 55% gravel (well-graded), 30% sand (medium-coarse grained), 15% silt, medium permeability.	
35						(36') SANDY GRAVEL (GW); dry, 60% gravel (well-graded), 35% sand (well-graded), 5% silt, medium permeability.	35
				0		(37.5') No recovery.	
						(38') Boring terminated.	

NOTES: Grout to 0.5 feet bgs. Well completed with 10-inch flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No. VEMF-4A** **Page: 1 of 1**

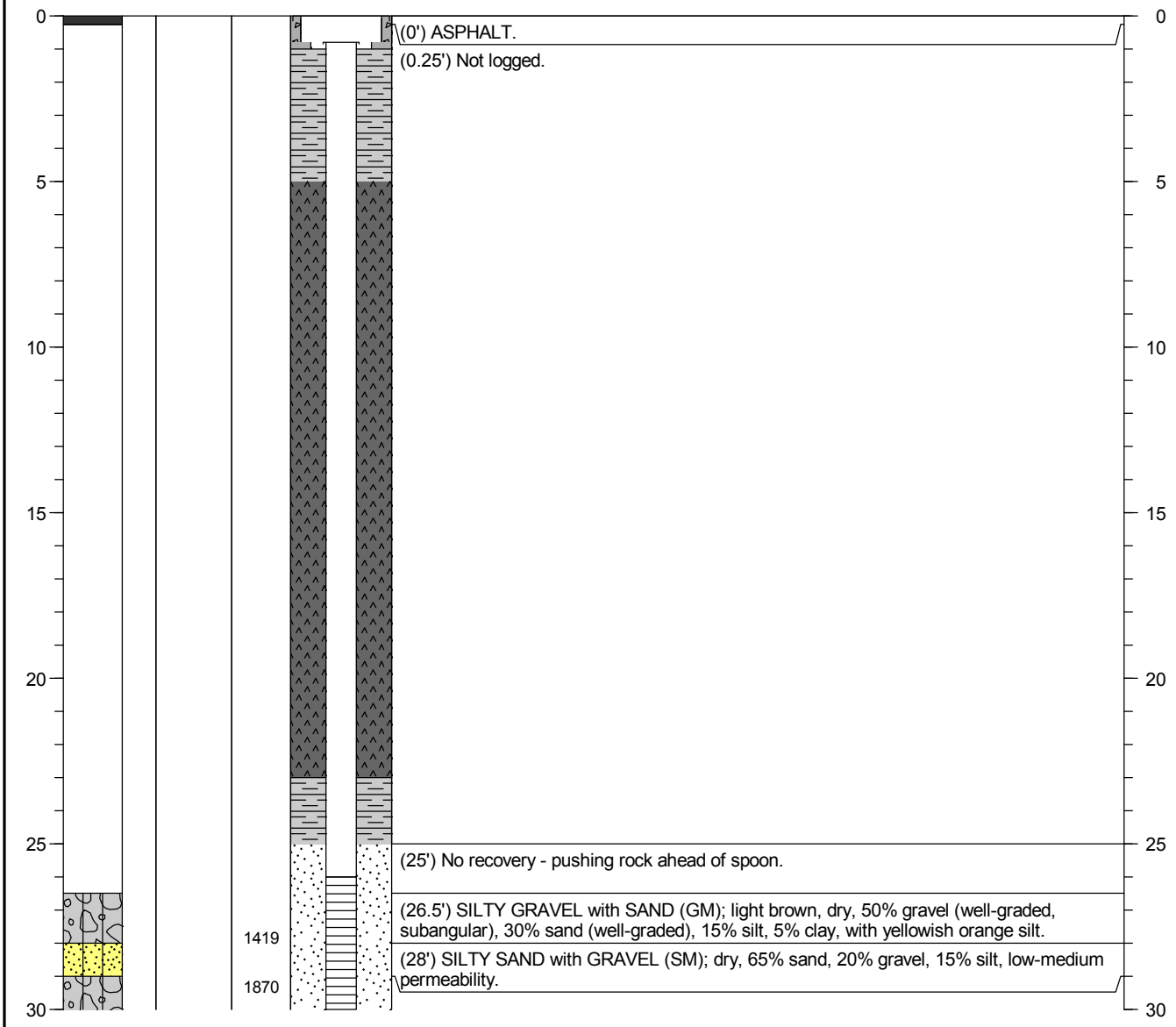
Drilling Start Date: **8/16/2021**	Boring Depth (ft): **21**	Well Depth (ft): **18**
Drilling End Date: **8/17/2021**	Boring Diameter (in): **8**	Well Diameter (in): **2**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Split Spoon**	Well Material: **Sch 40 PVC**
Drilling Method: **Hollow Stem Auger**	DTW During Drilling (ft): **--**	Screen Interval (ft): **13-18 (0.010 slot)**
Drilling Equipment: **CME-85**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-12 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **482.50**	Filter Pack Interval (ft): **12-18 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193804.573, 2073391.093**	Top of Casing Elev. (ft): **--**



NOTES: Boring backfilled with bentonite chips to 18 feet prior to well installation. Grout to 5 ft bgs, then bentonite to 1 foot bgs. Well completed with 10-inch flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No. VEMF-4B** **Page: 1 of 2**

Drilling Start Date: **8/16/2021**	Boring Depth (ft): **35.5**	Well Depth (ft): **33**
Drilling End Date: **8/16/2021**	Boring Diameter (in): **8**	Well Diameter (in): **2**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Split Spoon**	Well Material: **Sch 40 PVC**
Drilling Method: **Hollow Stem Auger**	DTW During Drilling (ft): **--**	Screen Interval (ft): **26-33 (0.010 slot)**
Drilling Equipment: **CME-85**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-25 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **482.62**	Filter Pack Interval (ft): **25-33 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193809.881, 2073392.339**	Top of Casing Elev. (ft): **--**



NOTES: Boring backfilled with bentonite chips to 33 feet prior to well installation. Grout to 5 ft bgs, then bentonite to 1 foot bgs. Well completed with 10-inch flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No. VEMF-4B** **Page: 2 of 2**

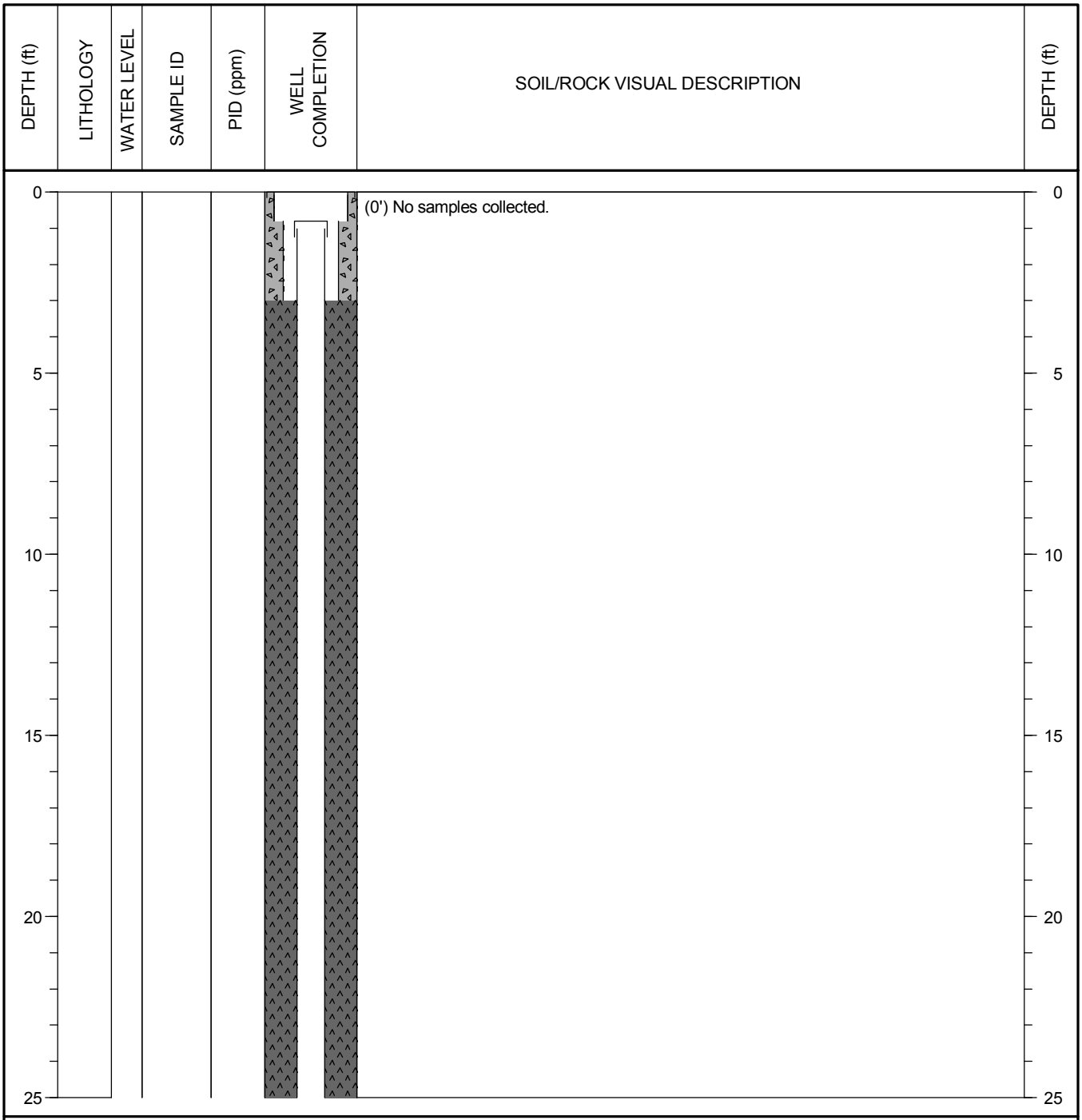
Drilling Start Date: **8/16/2021**	Boring Depth (ft): **35.5**	Well Depth (ft): **33**
Drilling End Date: **8/16/2021**	Boring Diameter (in): **8**	Well Diameter (in): **2**
Drilling Company: **Cascade Drilling**	**Sampling Method(s): Split Spoon**	Well Material: **Sch 40 PVC**
Drilling Method: **Hollow Stem Auger**	**DTW During Drilling (ft): --**	Screen Interval (ft): **26-33 (0.010 slot)**
Drilling Equipment: **CME-85**	**DTW After Well Installation (ft):--**	Seal Interval (ft): **0.5-25 (Grout/Bentonite)**
Logged By: **D. Cardiff**	**Ground Surface Elev. (ft): 482.62**	Filter Pack Interval (ft): **25-33 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	**Location (X,Y): 6193809.881, 2073392.339**	Top of Casing Elev. (ft): **--**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	SAMPLE ID	PID (ppb)	WELL COMPLETION	SOIL/ROCK VISUAL DESCRIPTION	DEPTH (ft)
30						(29') SILTY GRAVEL with SAND (GM); light brown, dry, 50% gravel (well-graded, subangular), 30% sand (well-graded), 15% silt, 5% clay, with yellowish orange silt.	30
				2918		(30.5') No recovery.	
				2982		(31') SILTY GRAVEL with SAND (GM); light brown, dry, 50% gravel (well-graded, subangular), 30% sand (well-graded), 15% silt, 5% clay, low permeability, with yellowish orange silt and small (0.5-1 inch) rusty clay blobs in top 1 foot.	
35				3768		(33') SILT with SAND (ML); dry, medium stiff, 75% silt, 15% sand, 10% clay, low plasticity, low permeability.	35
						(34') Same as above.	
						(35') SILTY GRAVEL with SAND (GM); dry, 50% gravel, 30% sand, 15% silt, 5% clay, low permeability.	
						(35.5') Boring terminated.	

NOTES: Boring backfilled with bentonite chips to 33 feet prior to well installation. Grout to 5 ft bgs, then bentonite to 1 foot bgs. Well completed with 10-inch flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2009 Railroad Ave, Livermore, CA	**WELL LOG** **Well No.** VEMF-5 **Page:** 1 of 2

Drilling Start Date: **9/9/2021**	Boring Depth (ft): **36.5**	Well Depth (ft): **36**
Drilling End Date: **9/10/2021**	Boring Diameter (in): **8**	Well Diameter (in): **2**
Drilling Company: **Gregg Drilling**	Sampling Method(s): **Split Spoon**	Well Material: **Sch 40 PVC**
Drilling Method: **HSA**	DTW During Drilling (ft): **--**	Screen Interval (ft): **28-36 (0.010 slot)**
Drilling Equipment: **Marl**	DTW After Drilling (ft): **--**	Seal Interval (ft): **3-27 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **481.84**	Filter Pack Interval (ft): **27-36 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (Y,X): **6193648.69, 2073400.958**	Top of Casing Elev. (ft): **--**



NOTES: Boring location cleared to 5 feet bgs with vacuum truck. Drilled to 25 feet before starting sampling. Well completed with 10-inch flush-mount well cover set in concrete. Bentonite hydrated from 25-27 ft bgs.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2009 Railroad Ave, Livermore, CA	**WELL LOG** **Well No.** VEMF-5 **Page:** 2 of 2

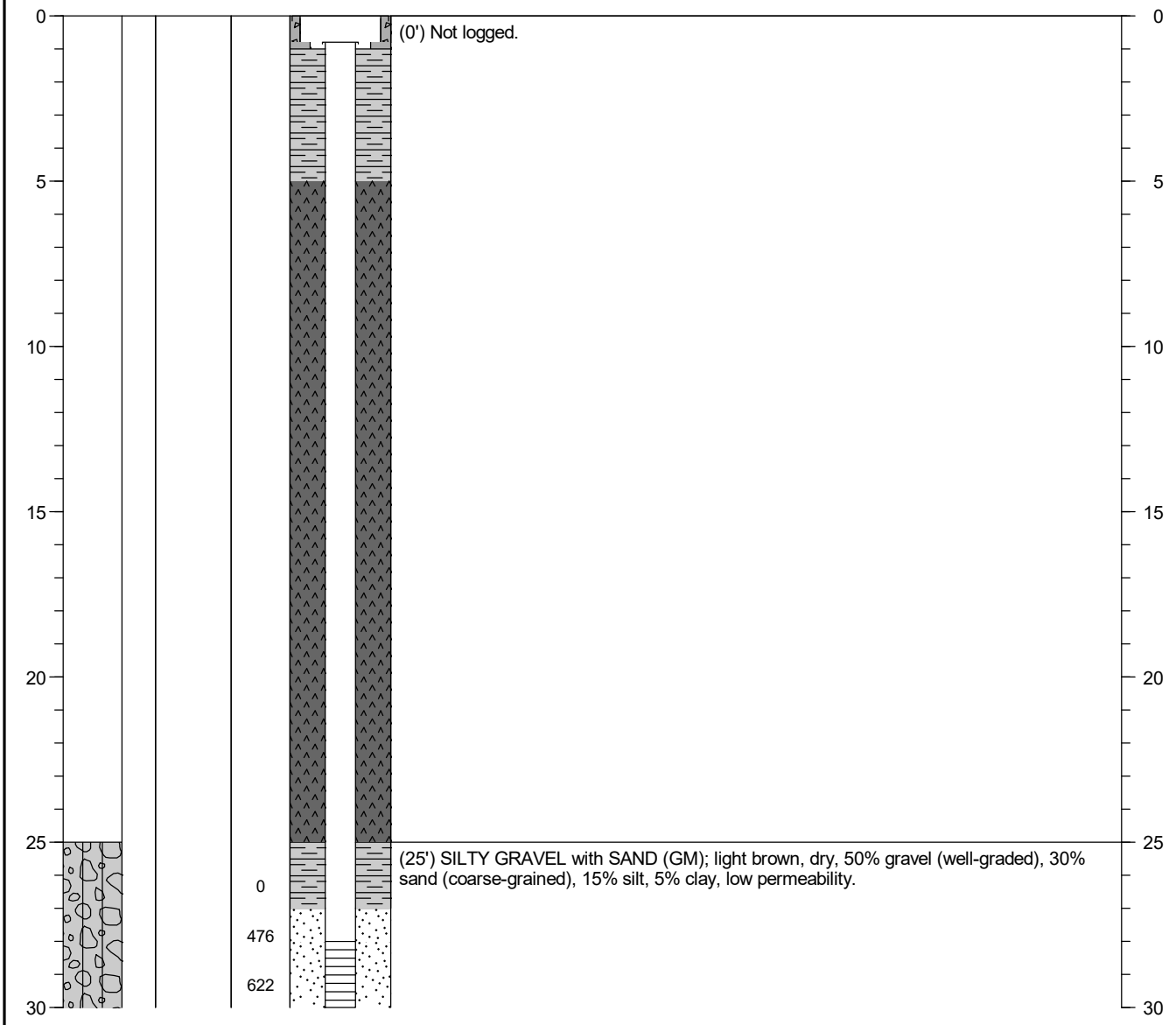
Drilling Start Date:	**9/9/2021**	Boring Depth (ft):	**36.5**	Well Depth (ft):	**36**
Drilling End Date:	**9/10/2021**	Boring Diameter (in):	**8**	Well Diameter (in):	**2**
Drilling Company:	**Gregg Drilling**	Sampling Method(s):	**Split Spoon**	Well Material:	**Sch 40 PVC**
Drilling Method:	**HSA**	DTW During Drilling (ft):	**--**	Screen Interval (ft):	**28-36 (0.010 slot)**
Drilling Equipment:	**Marl**	DTW After Drilling (ft):	**--**	Seal Interval (ft):	**3-27 (Grout/Bentonite)**
Logged By:	**D. Cardiff**	**Ground Surface Elev. (ft): 481.84**		Filter Pack Interval (ft):	**27-36 (#2/12 Sand)**
Reviewed By:	**A. Simmons, P.G.**	**Location (Y,X): 6193648.69, 2073400.958**		Top of Casing Elev. (ft):	**--**

DEPTH (ft)	PID (ppm)	SOIL/ROCK VISUAL DESCRIPTION
25	57.5	(25') SILTY GRAVEL with SAND (GM); light brown to yellowish orange, dry, 50% gravel, 25% sand, 20% silt, 5% clay, low permeability.
		(26.5') No recovery.
	24.8	(27.5') SILTY GRAVEL with SAND (GM); light brown to yellowish orange, dry, 50% gravel, 30% sand, 20% silt, low-medium permeability.
		(29') No recovery.
30	6.7	(30') SILTY GRAVEL with SAND (GM); light brown to yellowish orange, dry, 50% gravel, 30% sand, 20% silt, low-medium permeability.
		(31.5') No recovery.
	4.2	(32.5') SILTY GRAVEL with SAND (GM); light brown to yellowish orange, dry, 50% gravel, 30% sand, 20% silt, low-medium permeability.
		(34') No recovery.
35	3.9	(35') SILTY GRAVEL with SAND (GM); light brown to yellowish orange, dry, 50% gravel, 30% sand, 20% silt, low-medium permeability.
		(36.5') Boring terminated.

NOTES: Boring location cleared to 5 feet bgs with vacuum truck. Drilled to 25 feet before starting sampling. Well completed with 10-inch flush-mount well cover set in concrete. Bentonite hydrated from 25-27 ft bgs.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No. VEMF-6B / HP-6** **Page: 1 of 2**

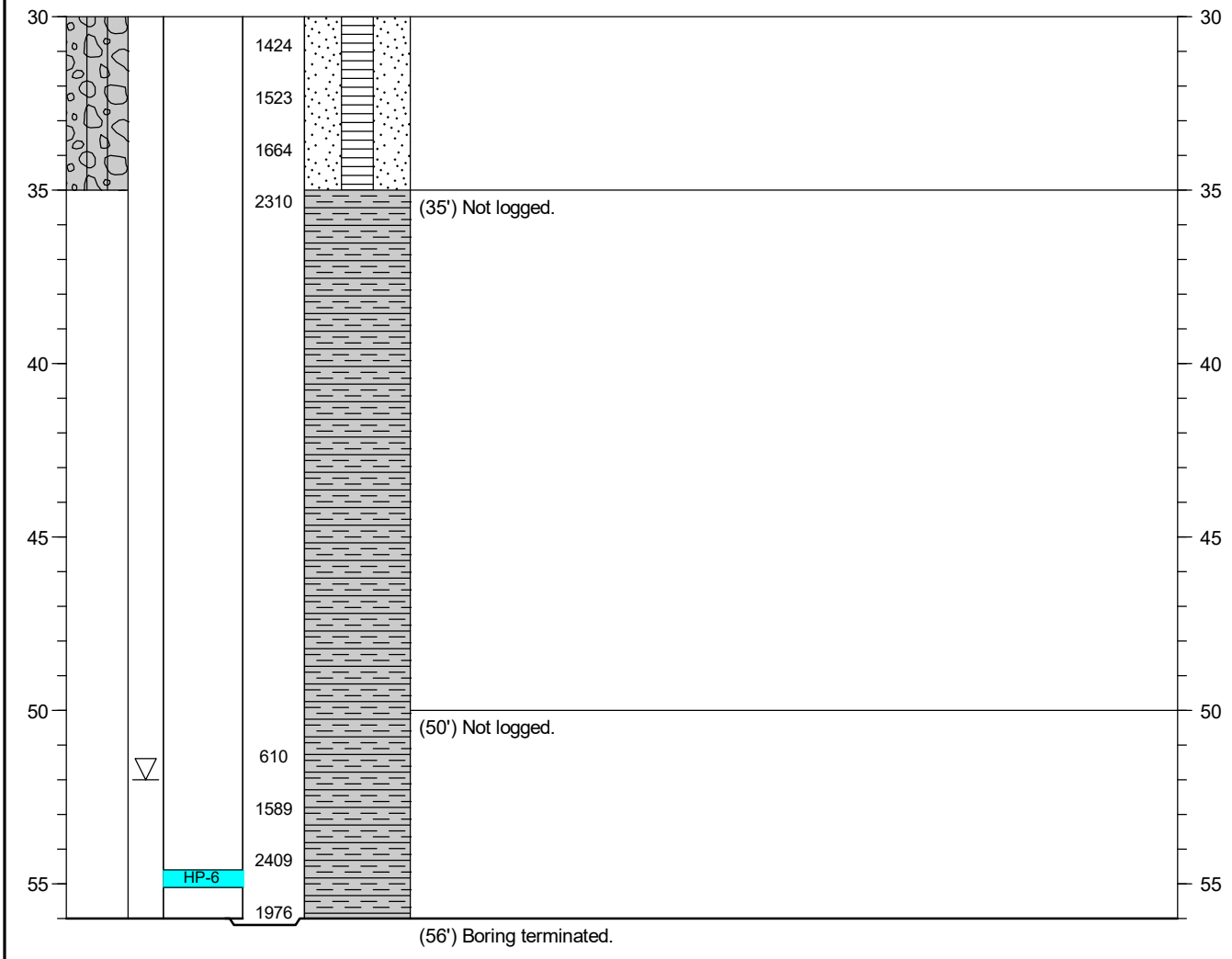
Drilling Start Date: **8/12/2021**	Boring Depth (ft): **56**	Well Depth (ft): **35**
Drilling End Date: **8/12/2021**	Boring Diameter (in): **8**	Well Diameter (in): **2**
Drilling Company: **Cascade Drilling**	Sampling Method(s): **Split Spoon**	Well Material: **Sch 40 PVC**
Drilling Method: **Hollow Stem Auger**	DTW During Drilling (ft): **52.0**	Screen Interval (ft): **28-35 (0.010 slot)**
Drilling Equipment: **CME-85**	DTW After Well Installation (ft): **--**	Seal Interval (ft): **0.5-27 (Grout/Bentonite)**
Logged By: **D. Cardiff**	Ground Surface Elev. (ft): **482.65**	Filter Pack Interval (ft): **27-35 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	Location (X,Y): **6193710.876, 2073504.543**	Top of Casing Elev. (ft): **--**



NOTES: Boring backfilled with bentonite chips to 35 feet prior to well installation. Grout to 5 ft bgs, then bentonite to 1 foot bgs. Well completed with 10-inch flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** Old Train Depot – 2165.004 **Address:** 2205 Railroad Ave, Livermore, CA	**WELL LOG** **Well No. VEMF-6B / HP-6** **Page: 2 of 2**

Drilling Start Date: **8/12/2021**	Boring Depth (ft): **56**	Well Depth (ft): **35**
Drilling End Date: **8/12/2021**	Boring Diameter (in): **8**	Well Diameter (in): **2**
Drilling Company: **Cascade Drilling**	**Sampling Method(s): Split Spoon**	Well Material: **Sch 40 PVC**
Drilling Method: **Hollow Stem Auger**	**DTW During Drilling (ft): 52.0**	Screen Interval (ft): **28-35 (0.010 slot)**
Drilling Equipment: **CME-85**	**DTW After Well Installation (ft):--**	Seal Interval (ft): **0.5-27 (Grout/Bentonite)**
Logged By: **D. Cardiff**	**Ground Surface Elev. (ft): 482.65**	Filter Pack Interval (ft): **27-35 (#2/12 Sand)**
Reviewed By: **A. Simmons, P.G.**	**Location (X,Y): 6193710.876, 2073504.543**	Top of Casing Elev. (ft): **--**



NOTES: Boring backfilled with bentonite chips to 35 feet prior to well installation. Grout to 5 ft bgs, then bentonite to 1 foot bgs. Well completed with 10-inch flush-mount well cover set in concrete.

PANGEA	**Client:** Livermore Downtown Core **Project:** 2165.002.210 **Address:** L St, Railroad Ave and S Livermore Ave, Livermore, CA	**WELL LOG** **Well No.** SGMF-2-5/15/25 **Page:** 1 of 2

Drilling Start Date:	**11/14/2018**	Boring Depth (ft):	**25.5**	Well Depth (ft):	**5; 15; 25**
Drilling End Date:	**11/14/2018**	Boring Diameter (in):	**3.25**	Well Diameter (in):	**0.25**
Drilling Company:	**Cascade Drilling**	Sampling Method(s):	**--**	Screen Slot (in):	**N/A**
Drilling Method:	**HA & DP**	DTW During Drilling (ft):	**Not Observed**	Riser Material:	**1/4" Teflon Tubing**
Drilling Equipment:	**Geoprobe 8040**	DTW After Drilling (ft):	**Not Observed**	Screen Material:	**Vapor Implant**
Logged By:	**E. Lervaag**	Top of Casing Elev. (ft):	**--**	Seal Material(s):	**Hydrated Bentonite**
Reviewed By:	**Bob Clark-Riddell, PE**	Location (X,Y):	**--**	Filter Pack:	**#2/12 Sand**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	WELL COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION	MEASURE: PID (ppm)	MEASURE: Lab Sample	DEPTH (ft)
0								(0') Landscape area.			0
5									0.0		5
10									0.0		10
15									0.6		15
20									0.4		20

NOTES: HA - Hand Auger
DP - Direct Push

PANGEA	**Client:** Livermore Downtown Core **Project:** 2165.002.210 **Address:** L St, Railroad Ave and S Livermore Ave, Livermore, CA	**WELL LOG** **Well No.** SGMF-2-5/15/25 **Page:** 2 of 2

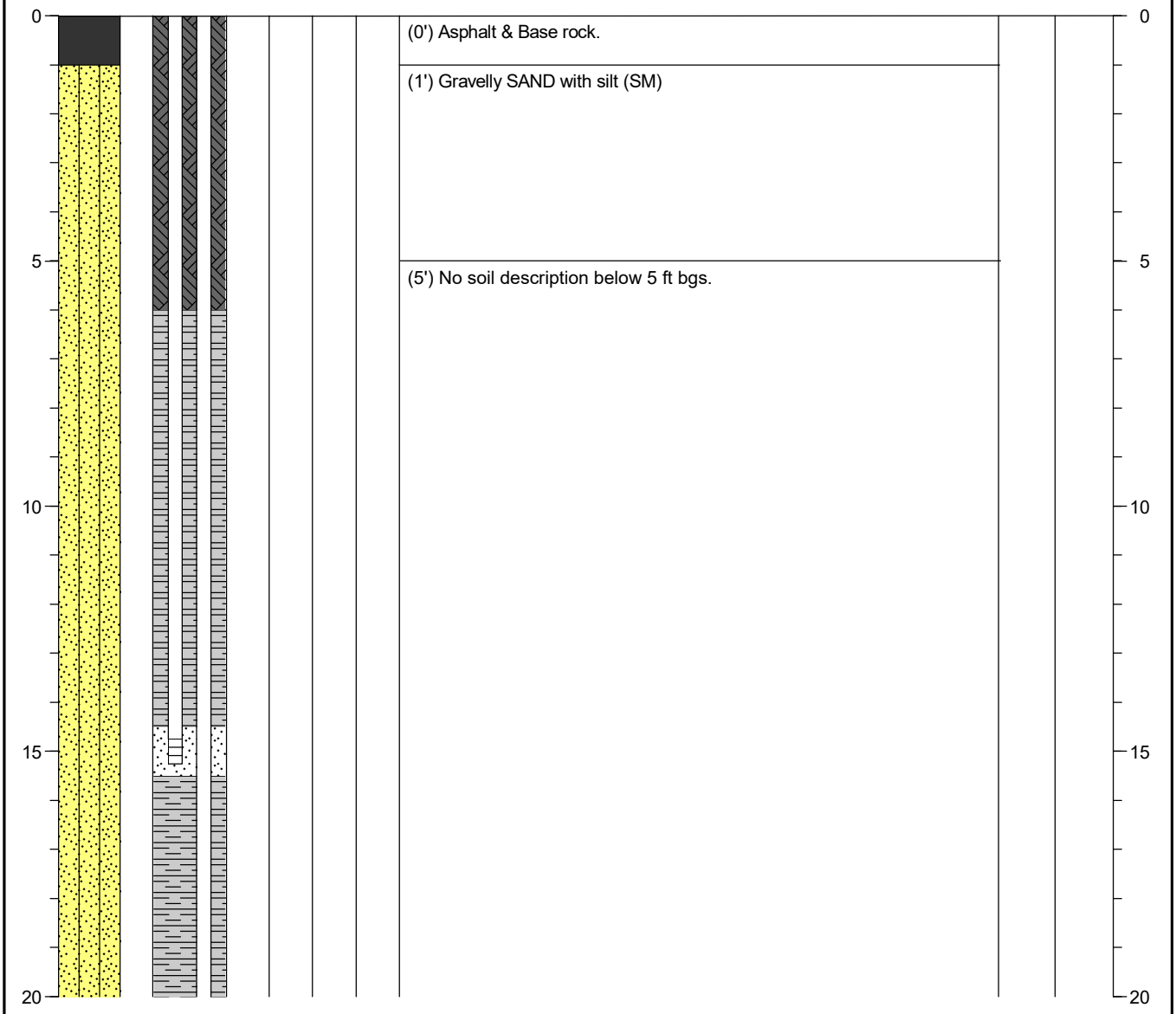
Drilling Start Date:	**11/14/2018**	Boring Depth (ft):	**25.5**	Well Depth (ft):	**5; 15; 25**
Drilling End Date:	**11/14/2018**	Boring Diameter (in):	**3.25**	Well Diameter (in):	**0.25**
Drilling Company:	**Cascade Drilling**	Sampling Method(s):	**--**	Screen Slot (in):	**N/A**
Drilling Method:	**HA & DP**	DTW During Drilling (ft):	**Not Observed**	Riser Material:	**1/4" Teflon Tubing**
Drilling Equipment:	**Geoprobe 8040**	DTW After Drilling (ft):	**Not Observed**	Screen Material:	**Vapor Implant**
Logged By:	**E. Lervaag**	Top of Casing Elev. (ft):	**--**	Seal Material(s):	**Hydrated Bentonite**
Reviewed By:	**Bob Clark-Riddell, PE**	Location (X,Y):	**--**	Filter Pack:	**#2/12 Sand**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	WELL COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION	MEASURE: PID (ppm)	MEASURE: Lab Sample	DEPTH (ft)
20											20
									1.0	SGMF-2-23	
25									0.7		25
								(25.5') End of Boring. Hydrated bentonite: 3 - 4' & 5.5 - 14' & 15.5 - 24' Dry bentonite: 4 - 4.5' & 14 - 14.5' & 24 - 24.5'			
30											30

NOTES: HA - Hand Auger
DP - Direct Push

PANGEA	**Client:** Livermore Downtown Core **Project:** 2165.002.210 **Address:** L St, Railroad Ave and S Livermore Ave, Livermore, CA	**WELL LOG** **Well No.** SGMF-3-15/25 **Page:** 1 of 2

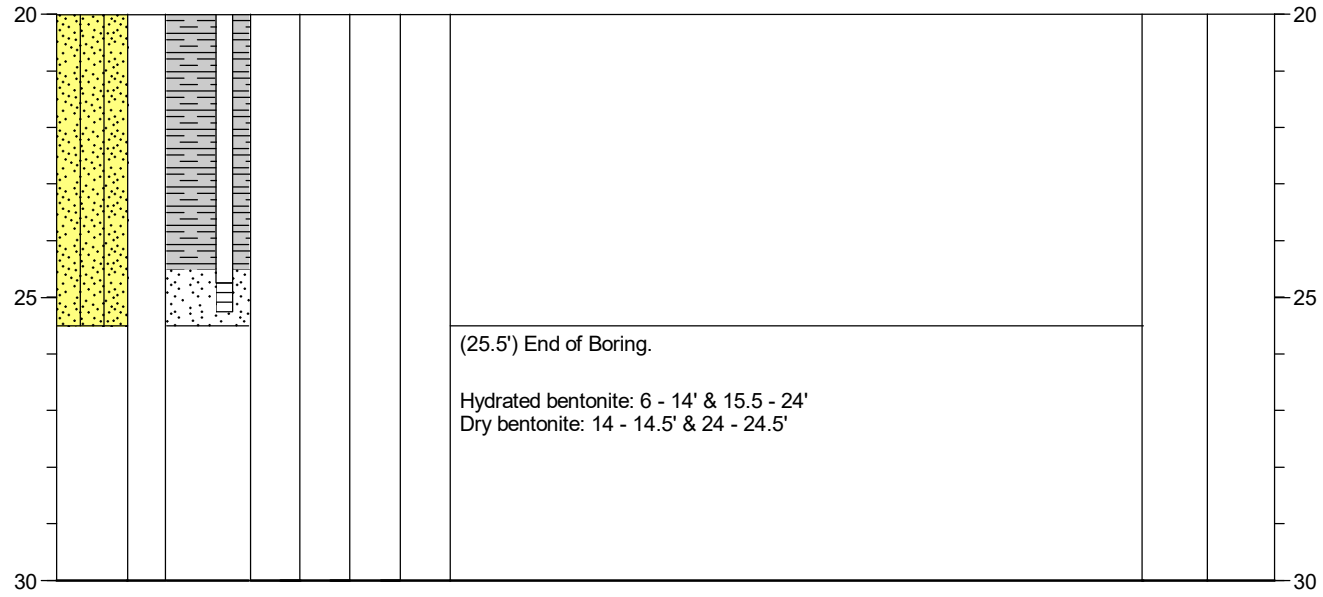
Drilling Start Date:	**11/13/2018**	Boring Depth (ft):	**25.5**	Well Depth (ft):	**15; 25**
Drilling End Date:	**11/13/2018**	Boring Diameter (in):	**3.25**	Well Diameter (in):	**0.25**
Drilling Company:	**Cascade Drilling**	Sampling Method(s):	**--**	Screen Slot (in):	**N/A**
Drilling Method:	**HA & DP**	DTW During Drilling (ft):	**Not Observed**	Riser Material:	**1/4" Teflon Tubing**
Drilling Equipment:	**Geoprobe 8040**	DTW After Drilling (ft):	**Not Observed**	Screen Material:	**Vapor Implant**
Logged By:	**E. Lervaag**	Top of Casing Elev. (ft):	**--**	Seal Material(s):	**Hydrated Bentonite**
Reviewed By:	**Bob Clark-Riddell, PE**	Location (X,Y):	**--**	Filter Pack:	**#2/12 Sand**



NOTES: HA - Hand Auger
DP - Direct Push
Hand augered to 5' bgs.

PANGEA	**Client:** Livermore Downtown Core **Project:** 2165.002.210 **Address:** L St, Railroad Ave and S Livermore Ave, Livermore, CA	**WELL LOG** **Well No.** SGMF-3-15/25 **Page:** 2 of 2

Drilling Start Date:	**11/13/2018**	Boring Depth (ft):	**25.5**	Well Depth (ft):	**15; 25**
Drilling End Date:	**11/13/2018**	Boring Diameter (in):	**3.25**	Well Diameter (in):	**0.25**
Drilling Company:	**Cascade Drilling**	Sampling Method(s):	**--**	Screen Slot (in):	**N/A**
Drilling Method:	**HA & DP**	DTW During Drilling (ft):	**Not Observed**	Riser Material:	**1/4" Teflon Tubing**
Drilling Equipment:	**Geoprobe 8040**	DTW After Drilling (ft):	**Not Observed**	Screen Material:	**Vapor Implant**
Logged By:	**E. Lervaag**	Top of Casing Elev. (ft):	**--**	Seal Material(s):	**Hydrated Bentonite**
Reviewed By:	**Bob Clark-Riddell, PE**	Location (X,Y):	**--**	Filter Pack:	**#2/12 Sand**



NOTES: HA - Hand Auger
DP - Direct Push
Hand augered to 5' bgs.

PANGEA	**Client:** Livermore Downtown Core **Project:** 2165.002.210 **Address:** L St, Railroad Ave and S Livermore Ave, Livermore, CA	**WELL LOG** **Well No.** SGMF-4-5/15/25 **Page:** 1 of 2

Drilling Start Date:	**11/12/2018**	Boring Depth (ft):	**25.5**	Well Depth (ft):	**5; 15; 25**
Drilling End Date:	**11/12/2018**	Boring Diameter (in):	**3.25**	Well Diameter (in):	**0.25**
Drilling Company:	**Cascade Drilling**	Sampling Method(s):	**--**	Screen Slot (in):	**N/A**
Drilling Method:	**HA & DP**	DTW During Drilling (ft):	**Not Observed**	Riser Material:	**1/4" Teflon Tubing**
Drilling Equipment:	**Geoprobe 8040**	DTW After Drilling (ft):	**Not Observed**	Screen Material:	**Vapor Implant**
Logged By:	**E. Lervaag**	Top of Casing Elev. (ft):	**--**	Seal Material(s):	**Hydrated Bentonite**
Reviewed By:	**Bob Clark-Riddell, PE**	Location (X,Y):	**--**	Filter Pack:	**#2/12 Sand**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	WELL COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION	MEASURE: PID (ppm)	MEASURE: Lab Sample	DEPTH (ft)
0								(0') Asphalt & Base rock.			0
5											5
10											10
15											15
20											20

NOTES: HA - Hand Auger
DP - Direct Push

PANGEA	**Client:** Livermore Downtown Core **Project:** 2165.002.210 **Address:** L St, Railroad Ave and S Livermore Ave, Livermore, CA	**WELL LOG** **Well No.** SGMF-4-5/15/25 **Page:** 2 of 2

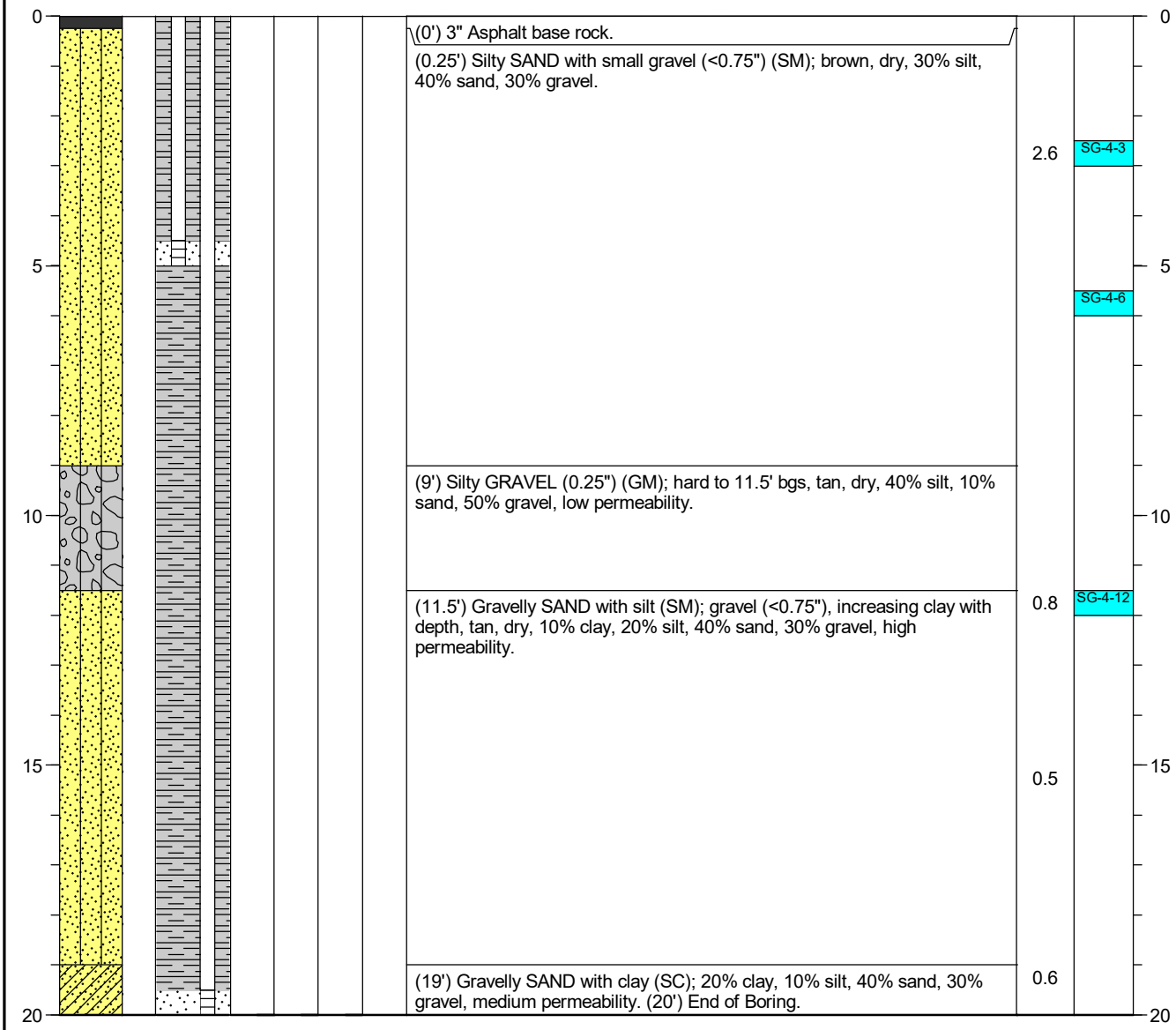
Drilling Start Date:	**11/12/2018**	Boring Depth (ft):	**25.5**	Well Depth (ft):	**5; 15; 25**
Drilling End Date:	**11/12/2018**	Boring Diameter (in):	**3.25**	Well Diameter (in):	**0.25**
Drilling Company:	**Cascade Drilling**	Sampling Method(s):	**--**	Screen Slot (in):	**N/A**
Drilling Method:	**HA & DP**	DTW During Drilling (ft):	**Not Observed**	Riser Material:	**1/4" Teflon Tubing**
Drilling Equipment:	**Geoprobe 8040**	DTW After Drilling (ft):	**Not Observed**	Screen Material:	**Vapor Implant**
Logged By:	**E. Lervaag**	Top of Casing Elev. (ft):	**--**	Seal Material(s):	**Hydrated Bentonite**
Reviewed By:	**Bob Clark-Riddell, PE**	Location (X,Y):	**--**	Filter Pack:	**#2/12 Sand**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	WELL COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION	MEASURE: PID (ppm)	MEASURE: Lab Sample	DEPTH (ft)
20											20
25								(25.5') End of Boring. Hydrated bentonite: 3 - 4' & 5.5 - 14' & 15.5 - 24' Dry bentonite: 4 - 4.5' & 14 - 14.5' & 24 - 24.5'			25
30											30

NOTES: HA - Hand Auger
DP - Direct Push

PANGEA	**Client:** City of Livermore **Project:** 2165.002 **Address:** L St, Railroad Ave and S Livermore Ave, Livermore, CA	**WELL LOG** **Well No.** SG-4-5/20 **Page:** 1 of 1

Drilling Start Date:	**6/20/2018**	Boring Depth (ft):	**20**	Well Depth (ft):	**5; 20**
Drilling End Date:	**6/20/2018**	Boring Diameter (in):	**3.25/2.25**	Well Diameter (in):	**0.25**
Drilling Company:	**Confluence**	Sampling Method(s):	**--**	Screen Slot (in):	**N/A**
Drilling Method:	**HA & DP**	DTW During Drilling (ft):	**--**	Riser Material:	**1/4" Teflon Tubing**
Drilling Equipment:		DTW After Drilling (ft):	**--**	Screen Material:	**Vapor Implant**
Logged By:	**E. Lervaag**	Top of Casing Elev. (ft):	**--**	Seal Material(s):	**Hydrated Bentonite**
Reviewed By:	**Bob Clark-Riddell**	Location (X,Y):	**--**	Filter Pack:	**#2/12 Sand**



NOTES: HA - Hand Auger
DP - Direct Push
Hand Augered to 5' bgs.

PANGEA	**Client:** City of Livermore **Project:** 2165.003 **Address:** 2205 Railraod Ave, Livermore, CA	**WELL LOG** **Well No.** MW-4 **Page:** 1 of 3

Drilling Start Date:	**7/11/2018**	Boring Depth (ft):	**75**	Well Depth (ft):	**67**
Drilling End Date:	**7/11/2018**	Boring Diameter (in):	**8/2.5**	Well Diameter (in):	**2**
Drilling Company:	**Penecore**	Sampling Method(s):	**Direct Push**	Well Material:	**Sch 40 PVC**
Drilling Method:	**HSA/Direct Push**	DTW During Drilling (ft):	**41.0**	Screen Interval (ft):	**62-67 (0.010" slot)**
Drilling Equipment:	**HSA/Direct Push**	DTW After Drilling (ft):	**35.5**	Seal Interval (ft):	**0.5-61 (Grout/Bentonite)**
Logged By:	**M. Bernard**	Top of Casing Elev. (ft):	**--**	Filter Pack Interval (ft):	**61-67.5 (#3 Sand)**
Reviewed By:	**R. Clark-Riddell, P.E.**	Location (X,Y):	**--**		

DEPTH (ft)	LITHOLOGY	WATER LEVEL	SAMPLE ID	PID (ppm)	WELL COMPLETION	SOIL/ROCK VISUAL DESCRIPTION	DEPTH (ft)
0						(0') SILTY GRAVEL (GM); brown/gray, trace moist, loose, 55% gravel (<2", subangular), 25% silt, 20% sand, high permeability.	0
						(0.5') SANDY SILT (ML); brown, trace moist, soft, 70% silt, 20% sand (well-graded), 10% gravel, high permeability.	
5						(4') SILTY GRAVEL (GM); brown/gray, moist, loose/soft, 50% gravel (<3", subangular), 35% silt, 15% sand, high permeability.	5
10							10
15							15
20						(20') SANDY GRAVEL (GW); brown/gray, moist, loose, 65% gravel (<1.5", subangular), 25% sand (well-graded), 10% silt, high permeability.	20
25							25
30							30

NOTES: Hole pre-cleared to 5' on 7/11/2018 by Penecore using hand auger. Well completed with flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** 2165.003 **Address:** 2205 Railraod Ave, Livermore, CA	**WELL LOG** **Well No.** MW-4 **Page:** 2 of 3

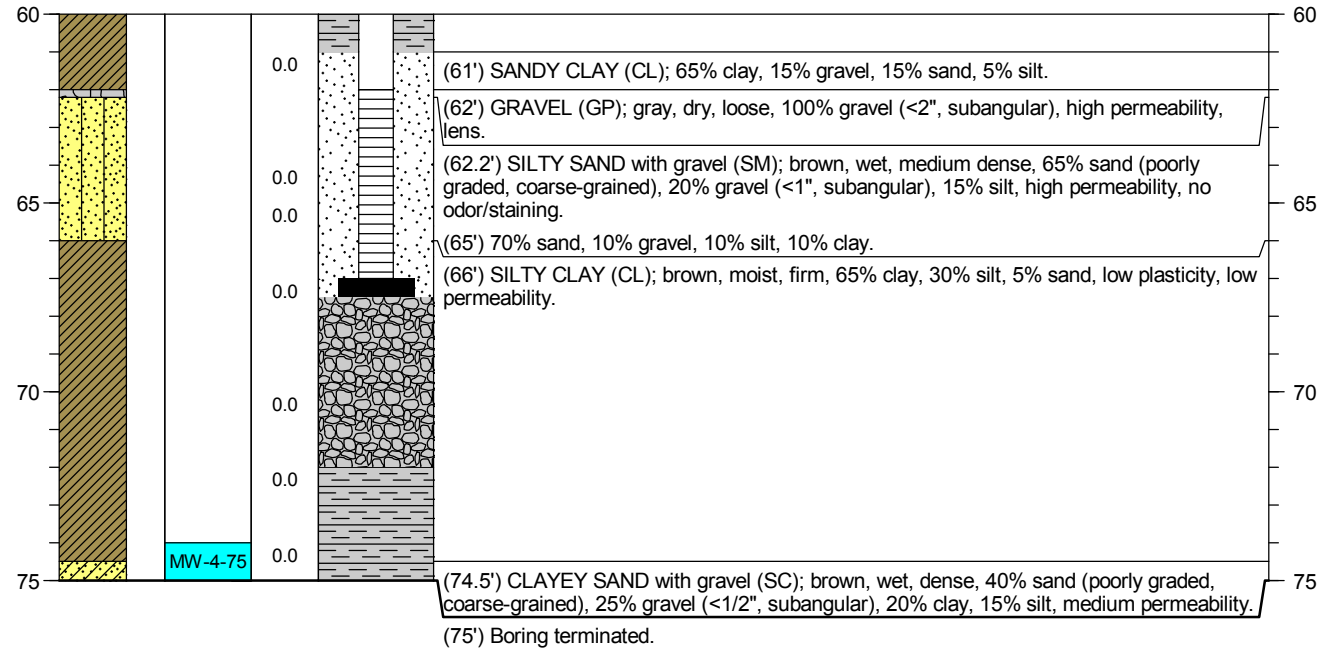
Drilling Start Date:	**7/11/2018**	Boring Depth (ft):	**75**	Well Depth (ft):	**67**
Drilling End Date:	**7/11/2018**	Boring Diameter (in):	**8/2.5**	Well Diameter (in):	**2**
Drilling Company:	**Penecore**	Sampling Method(s):	**Direct Push**	Well Material:	**Sch 40 PVC**
Drilling Method:	**HSA/Direct Push**	DTW During Drilling (ft):	**41.0**	Screen Interval (ft):	**62-67 (0.010" slot)**
Drilling Equipment:	**HSA/Direct Push**	DTW After Drilling (ft):	**35.5**	Seal Interval (ft):	**0.5-61 (Grout/Bentonite)**
Logged By:	**M. Bernard**	Top of Casing Elev. (ft):	**--**	Filter Pack Interval (ft):	**61-67.5 (#3 Sand)**
Reviewed By:	**R. Clark-Riddell, P.E.**	Location (X,Y):	**--**		

DEPTH (ft)	PID (ppm)	SOIL/ROCK VISUAL DESCRIPTION
30		
		(33') CLAYEY SILT (ML); grayish brown, moist, soft, 50% silt, 25% clay, 15% sand, 10% gravel, low-medium permeability.
35		
		(37') SILTY CLAY (CL); grayish brown, moist, soft, 65% clay, 20% silt, 10% sand, 5% gravel, low plasticity, low permeability.
40	0.0	
	0.0	
	0.0	(41') SILTY GRAVEL (GM); gray/brown, wet, loose, 60% gravel, 20% sand, 15% silt, 5% clay, high permeability, no odor/staining.
45	0.0	
	0.0	(46') SANDY CLAY (CL); orangish brown, wet, firm, 45% clay, 25% sand (poorly graded, coarse-grained), 20% gravel (<1/2", subangular), 10% silt, low plasticity, low permeability, no odor/staining.
	0.0	
50	0.0	(49') CLAYEY GRAVEL (GC); gray/brown, moist, medium dense, 50% gravel (<1/2", subangular), 20% clay, 15% sand, 15% silt, medium permeability, no odor/staining.
	0.0	
	0.0	(52') CLAYEY GRAVEL with sand (GC); gray/brown, wet, dense, 45% gravel (<1/2", subangular), 30% sand (poorly graded, coarse-grained), 15% clay, 10% silt, no odor/staining.
55	0.0	(55') 35% gravel, 35% sand, 15% silt, 15% clay.
	0.0	(56.5') CLAY (CL); brown, moist, soft, 80% clay, 10% silt, 5% gravel, 5% sand, low plasticity, low permeability, no odor/staining.
60	0.0	(59') 70% clay, 20% silt, 5% gravel, 5% sand.

NOTES: Hole pre-cleared to 5' on 7/11/2018 by Penecore using hand auger. Well completed with flush-mount well cover set in concrete.

PANGEA	**Client:** City of Livermore **Project:** 2165.003 **Address:** 2205 Railraod Ave, Livermore, CA	**WELL LOG** **Well No.** MW-4 **Page:** 3 of 3

Drilling Start Date:	**7/11/2018**	Boring Depth (ft):	**75**	Well Depth (ft):	**67**
Drilling End Date:	**7/11/2018**	Boring Diameter (in):	**8/2.5**	Well Diameter (in):	**2**
Drilling Company:	**Penecore**	Sampling Method(s):	**Direct Push**	Well Material:	**Sch 40 PVC**
Drilling Method:	**HSA/Direct Push**	DTW During Drilling (ft):	**41.0**	Screen Interval (ft):	**62-67 (0.010" slot)**
Drilling Equipment:	**HSA/Direct Push**	DTW After Drilling (ft):	**35.5**	Seal Interval (ft):	**0.5-61 (Grout/Bentonite)**
Logged By:	**M. Bernard**	Top of Casing Elev. (ft):	**--**	Filter Pack Interval (ft):	**61-67.5 (#3 Sand)**
Reviewed By:	**R. Clark-Riddell, P.E.**	Location (X,Y):	**--**		



NOTES: Hole pre-cleared to 5' on 7/11/2018 by Penecore using hand auger. Well completed with flush-mount well cover set in concrete.

Appendix D

Risk Estimated Using Range of Air Exchange Rates

Appendix D, Table D-1: Risks Estimated Using Range of Air Exchange Rates - Building A (North Building)

ACH[1]	Chemical	Soil Gas Concentration (C_{sg}) (µg/m^3)	Building-weighted Attenuation Factor (AF) (unitless)	Inter-unit Transfer Factor (TF) (unitless)	Indoor Air Concentration (C_{IA}) (µg/m^3)	Residential Indoor Air Environmental Screening Level (ESL) (µg/m^3)		Cancer Risk	Non-cancer Hazard Quotient
						Cancer Endpoint	Non-cancer Endpoint		
0.7	Benzene	58	4.0E-04	0.1	0.002	0.097	3.1	2E-08	0.001
	Tetrachloroethene (PCE)	1,850	2.3E-04	0.1	0.042	0.46	42	9E-08	0.001
	Total =							**1E-07**	**0.002**
1	Benzene	58	2.2E-04	0.1	0.001	0.097	3.1	1E-08	0.000
	Tetrachloroethene (PCE)	1,850	1.3E-04	0.1	0.02	0.46	42	5E-08	0.001
	Total =							**7E-08**	**0.001**
2	Benzene	58	1.1E-04	0.1	0.001	0.097	3.1	7E-09	0.0002
	Tetrachloroethene (PCE)	1,850	6.4E-05	0.1	0.01	0.46	42	3E-08	0.0003
	Total =							**3E-08**	**0.0005**
3	Benzene	58	7.4E-05	0.1	0.0004	0.097	3.1	4E-09	0.0001
	Tetrachloroethene (PCE)	1,850	4.2E-05	0.1	0.008	0.46	42	2E-08	0.0002
	Total =							**2E-08**	**0.0003**

Notes:

[1] The air exchange rates (ACH) range from the Weighted ACH (0.7) corresponding to a ventilation rate of 0.15 cfm/ft^2 and the ACH (3) corresponding to a ventilation rate of 0.75 cfm/ft^2 shown on Table 4.

Appendix D, Table D-2: Risks Estimated Using Range of Air Exchange Rates - Building B (South Building)

ACH[1]	Chemical	Soil Gas Concentration (C_{sg}) (µg/m^3)	Attenuation Factor (AF) (unitless)	Inter-unit Transfer Factor (TF) (unitless)	Indoor Air Concentration (C_{IA}) (µg/m^3)	Residential Indoor Air Environmental Screening Level (ESL) (µg/m^3)		Cancer Risk	Non-cancer Hazard Quotient
						Cancer Endpoint	Non-cancer Endpoint		
0.8	Benzene	2.66	2.1E-04	0.1	0.0001	0.097	3.1	6E-10	0.00002
	Tetrachloroethene (PCE)	4,180	1.2E-04	0.1	0.05	0.46	42	1E-07	0.001
	Total =							**1E-07**	**0.001**
1	Benzene	2.66	1.7E-04	0.1	0.00005	0.097	3.1	5E-10	0.00001
	Tetrachloroethene (PCE)	4,180	9.6E-05	0.1	0.04	0.46	42	9E-08	0.001
	Total =							**9E-08**	**0.001**
2	Benzene	2.66	8.5E-05	0.1	0.00002	0.097	3.1	2E-10	0.00001
	Tetrachloroethene (PCE)	4,180	4.8E-05	0.1	0.02	0.46	42	4E-08	0.0005
	Total =							**4E-08**	**0.0005**
3	Benzene	2.66	5.7E-05	0.1	0.00002	0.097	3.1	2E-10	0.000005
	Tetrachloroethene (PCE)	4,180	3.2E-05	0.1	0.01	0.46	42	3E-08	0.0003
	Total =							**3E-08**	**0.0003**
4	Benzene	2.66	4.3E-05	0.1	0.00001	0.097	3.1	1E-10	0.000004
	Tetrachloroethene (PCE)	4,180	2.4E-05	0.1	0.01	0.46	42	2E-08	0.0002
	Total =							**2E-08**	**0.0002**

Notes:

[1] The air exchange rates (ACH) range from the Weighted ACH (0.8) corresponding to a ventilation rate of 0.15 cfm/ft^2 and the ACH (4) corresponding to a ventilation rate of 0.75 cfm/ft^2 shown on Table 4.

Appendix E

Risk Estimated for Sensitivity Analysis

Appendix E, Table E-1: Cancer Risks and Non-carcinogenic Hazards Estimated using EPA attenuation Factor of 0.003

Building A (North Building)

Chemical	Soil Gas Concentration[1] (C_{sg}) (µg/m^3)	Attenuation Factor (AF) (unitless)	Inter-unit Transfer Factor (TF_{IU}) (unitless)	Indoor Air Concentration (C_{IA}) (µg/m^3)	Residential Indoor Air Environmental Screening Level (ESL) (µg/m^3)		Cancer Risk	Non-cancer Hazard Quotient
					Cancer Endpoint	Non-cancer Endpoint		
Benzene	**5.43**	0.003	0.1	0.002	0.097	3.1	2E-08	0.0005
Tetrachloroethene (PCE)	**606**	0.003	0.1	0.18	0.46	42	4E-07	0.004
						Total =	**4E-07**	**0.005**

Building B (South Building)

Chemical	Soil Gas Concentration[1] (C_{sg}) (µg/m^3)	Attenuation Factor (AF) (unitless)	Inter-unit Transfer Factor (TF_{IU}) (unitless)	Indoor Air Concentration (C_{IA}) (µg/m^3)	Residential Indoor Air Environmental Screening Level (ESL) (µg/m^3)		Cancer Risk	Non-cancer Hazard Quotient
					Cancer Endpoint	Non-cancer Endpoint		
Benzene	**2.66**	0.003	0.1	0.001	0.097	3.1	8E-09	0.0003
Tetrachloroethene (PCE)	**3,300**	0.003	0.1	0.990	0.46	42	2E-06	0.02
						Total =	**2E-06**	**0.02**

Notes:

[1] The maximum concentrations reported in a soil gas sample closest to the garage foundation (15 to 20 feet bgs) were used in this screening level evaluation because the EPA attenuation factor of 0.003 is applicable to sub-slab soil gas. Sub-slab data are not available for the site because the site is currently vacant. Use of the maximum concentration reported in soil gas samples collected from 15 to 20 feet bgs is conservative since the concentrations would likely decrease as the chemicals migrate to sub-slab of the future buildings.

Appendix E, Table E-2: Cancer Risks and Non-carcinogenic Hazards Estimated using DTSC Attenuation Factor of 0.001 for a Future Residential Building

Building A (North Building)

Chemical	Soil Gas Concentration[1] (C_{sg}) ($\mu g/m^3$)	Attenuation Factor (AF) (unitless)	Inter-unit Transfer Factor (TF_{IU}) (unitless)	Indoor Air Concentration (C_{IA}) ($\mu g/m^3$)	Residential Indoor Air Environmental Screening Level (ESL) ($\mu g/m^3$)		Cancer Risk	Non-cancer Hazard Quotient
					Cancer Endpoint	Non-cancer Endpoint		
Benzene	**58**	0.001	0.1	0.006	0.097	3.1	6E-08	0.002
Tetrachloroethene (PCE)	**1850**	0.001	0.1	0.19	0.46	42	4E-07	0.004
						Total =	**5E-07**	**0.006**

Building B (South Building)

Chemical	Soil Gas Concentration[1] (C_{sg}) ($\mu g/m^3$)	Attenuation Factor (AF) (unitless)	Inter-unit Transfer Factor (TF_{IU}) (unitless)	Indoor Air Concentration (C_{IA}) ($\mu g/m^3$)	Residential Indoor Air Environmental Screening Level (ESL) ($\mu g/m^3$)		Cancer Risk	Non-cancer Hazard Quotient
					Cancer Endpoint	Non-cancer Endpoint		
Benzene	**2.66**	0.001	0.1	0.0003	0.097	3.1	3E-09	0.0001
Tetrachloroethene (PCE)	**4,180**	0.001	0.1	0.42	0.46	42	9E-07	0.01
						Total =	**9E-07**	**0.01**

Notes:

[1] The maximum concentration reported in recent soil gas samples collected near the source was used in this screening level evaluation because the DTSC attenuation factors of 0.001 is recommended for evaluation of subsurface soil gas near the contaminant source. Thus, the same concentration terms used in the Site-specific HHRA were used for this evaluation. For PCE, the concentration terms are the maximum concentrations reported at 25 feet bgs in the more recent soil gas samples collected at the Site; these are also the maximum concentration of PCE reported in recent soil gas samples collected beneath the footprints of the buildings. For Building A, the maximum concentration of benzene was also detected at 25 feet bgs; this maximum concentration was used in the site-specific HHRA for Building A. Benzene was not detected in the recent 25 feet bgs soil gas sample collected beneath the planned Building B; thus, to be conservative, the maximum concentration reported in 15 feet bgs soil gas was used to evaluate Building B. The benzene concentration reported in the 15 foot sample is also the maximum concentration detected in recent soil gas samples collected beneath the footprint of the planned building.

Appendix E, Table E-3: Cancer Risks and Non-carcinogenic Hazards Estimated using DTSC Attenuation Factor of 0.0005 for a Future Commercial Building

Building A (North Building)

Chemical	Soil Gas Concentration (C_{sg}) ($\mu g/m^3$)	Attenuation Factor (AF) (unitless)	Inter-unit Transfer Factor (TF_{IU}) (unitless)	Indoor Air Concentration (C_{IA}) ($\mu g/m^3$)	Residential Indoor Air Environmental Screening Level (ESL) ($\mu g/m^3$)		Cancer Risk	Non-cancer Hazard Quotient
					Cancer Endpoint	Non-cancer Endpoint		
Benzene	**58**	0.0005	0.1	0.003	0.097	3.1	3E-08	0.001
Tetrachloroethene (PCE)	**1,850**	0.0005	0.1	0.09	0.46	42	2E-07	0.002
						Total =	**2E-07**	**0.003**

Building B (South Building)

Chemical	Soil Gas Concentration (C_{sg}) ($\mu g/m^3$)	Attenuation Factor (AF) (unitless)	Inter-unit Transfer Factor (TF_{IU}) (unitless)	Indoor Air Concentration (C_{IA}) ($\mu g/m^3$)	Residential Indoor Air Environmental Screening Level (ESL) ($\mu g/m^3$)		Cancer Risk	Non-cancer Hazard Quotient
					Cancer Endpoint	Non-cancer Endpoint		
Benzene	**2.66**	0.0005	0.1	0.0001	0.097	3.1	1E-09	0.00004
Tetrachloroethene (PCE)	**4,180**	0.0005	0.1	0.2	0.46	42	5E-07	0.005
						Total =	**5E-07**	**0.01**

Notes:

[1] The maximum concentration reported in recent soil gas samples collected near the source was used in this screening level evaluation because the DTSC attenuation factors of 0.0005 is recommended for evaluation of subsurface soil gas near the contaminant source. Thus, the same concentration terms used in the Site-specific HHRA were used for this evaluation. For PCE, the concentrations are the maximum concentration reported at 25 feet bgs in the more recent soil gas samples collected at the Site; these concentration are also the maximum concentration of PCE reported in recent soil gas samples collected beneath the footprints of the buildings. For Building A, the maximum concentration of benzene was also detected at 25 feet bgs; this maximum concentration was used in the site-specific HHRA for Building A. Benzene was not detected in the recent 25 feet bgs soil gas sample collected beneath the planned Building B; thus, to be conservative, the maximum concentration reported in 15 feet bgs soil gas was used to evaluate Building B. The benzene concentration reported in the 15 foot sample is also the maximum concentration detected in recent soil gas samples collected beneath the footprint of the planned building.

APPENDIX B

Agency Correspondence

GAVIN NEWSOM
GOVERNOR
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SECRETARY FOR
ENVIRONMENTAL PROTECTION

CALIFORNIA Water Boards

San Francisco Bay Regional Water Quality Control Board

January 31, 2022 (STG)
Cost Recovery ID: 20203842
GeoTracker ID: T10000016758

City of Livermore
Attn: Rick Teczon
1052 South Livermore Avenue
Livermore, CA 94550
rteczon@cityoflivermore.net

Subject: Document Submittal Response and Request Letter for Old Train Depot site – 2009 to 2073 Railroad Ave, Alameda County

Dear Mr. Teczon:

This letter responds to the document submittal as described below and will be maintained in GeoTracker, along with the submitted document, for the regulatory record.

Document Information

- Date and Title: January 13, 2022 – Data Gap Assessment Report and Path to Closure (Report)
- Prepared by: Pangea Environmental Services, Inc.
- Prepared on Behalf of: City of Livermore
- Submitted Pursuant to: June 16, 2021 – Water Board Letter

Water Board Review

- Reviewer/Case Manager: Sherry Gamboa, Water Resource Control Engineer and Ross Steenson, Senior Engineering Geologist
- Result of Review: The Report is approved with the comments below.

Background

Historical uses of the Old Train Depot property (Property) include a railroad depot building, multiple railroad lines, and a former lumber storage yard. Historical uses in the vicinity of the Property include a former dry cleaner operation, auto body operations, and various other commercial and industrial uses. Planned development of the Property consists of two residential buildings, each with multi-level underground parking garages. The development of this project will include soil excavation to a depth of 9 to 20 feet to accommodate the underground parking garage structures.

The February 9, 2021, Water Board Letter requested further investigation of the Property to address data gaps in soil, soil gas, and groundwater. Contaminants of concern based on historical site uses are volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), select metals, pentachlorophenol, creosote, and dioxin. The May 7, 2021, Data Gap Assessment Workplan, submitted by the City of Livermore was approved in the Water Board's June 16, 2021, letter.

Report Summary
The Report presents results of investigation activities conducted in August and September of 2021 in accordance with the Data Gap Assessment Workplan to address data gaps identified by the Regional Water Board in groundwater, soil, and soil vapor.

- Groundwater: Samples were analyzed for VOCs and TPH. Chemicals detected in groundwater include tetrachloroethene (PCE), total petroleum hydrocarbons (TPH) as diesel, and chloroform. Based on historical site use and known use of neighboring properties, the Report concludes these chemicals are a result of releases from upgradient sources and concentrations have been decreasing as a result of reductive dechlorination.

- Soil: Samples were analyzed for VOCs, TPH, CAM 17 metals, pentachlorophenol, creosote, dioxins, and asbestos. VOCs, asbestos, pentachlorophenol, and creosote were not detected in soil samples. Dioxins were not detected greater than Regional Water Board Tier 1 environmental screening levels. The only metals detected at concentrations greater than regional background levels were nickel and arsenic.

- Soil Vapor: Samples were analyzed for VOCs and TPH. PCE and benzene were identified as the primary contaminants of potential concern for evaluation in the human health risk assessment (HHRA).

The Report presents an updated conceptual site model (CSM) based on the additional data collected and concludes, based on multiple lines of evidence, that the upgradient historical Quality Cleaners dry-cleaning operation is the primary source of VOCs detected beneath the Property.

The Report includes an HHRA that evaluates the nature and probability of human health risks associated with potential exposure of future occupants of the planned residential buildings to the chemicals of concern from the contaminated soil gas via inhalation of indoor air. The HHRA estimated future residential unit indoor air concentrations and risks associated with potential residential exposures. The HHRA relied on the Johnson and Ettinger model for the estimation of soil vapor transport into the future building and prediction of maximum indoor air concentrations. The HHRA concluded that 1) the estimated lifetime residential cancer risk is less than one in a million, which is considered to be protective of human health by the California and United States Environmental Protection Agency and 2) no further action is warranted.

The Report recommends the following:

- Preparation of a Remediation Workplan for the Quality Cleaners property, where strong evidence suggests a release occurred.

- Implementation of a site management plan (SMP) before closure of the Old Train Depot Property that includes testing to confirm vapor intrusion does not pose a risk to the occupants of the planned housing project.
- Rescission of the May 17, 2021, Interim Remedial Action Plan because the updated CSM and the HHRA suggest no remediation is necessary for the Property based on the proposed future use.

Comments
The information contained in this Report satisfies the June 16, 2021, Water Board Letter. The HHRA and supporting model have been suitably constructed and documented and provide a reasonable estimation of future risks. In addition, the Report recommends confirmation testing to demonstrate that vapor intrusion does not pose a risk to future occupants. Hence, we concur with the recommendations presented in the Report.

Follow-up Submittal Requests
The City of Livermore is requested to submit a Remediation Workplan for the upgradient Quality Cleaners property and a Site Management Plan for the Old Train Depot Property. The Water Board recommends a meeting(s) with the City of Livermore to discuss the content for these documents, prior to submittal.

No deadline is set for submittal of these documents; however, we request the City of Livermore work with the Water Board case manager to submit the SMP prior to the start of construction.

The City of Livermore is required to submit all documents in electronic format to the State Water Resources Control Board's GeoTracker database, pursuant to the California Code of Regulations (Title 23, Section 3890, et.seq.). See Electronic Submittal of Information for guidance on submitting documents to GeoTracker. Please note that this requirement includes all analytical data, monitoring well information (latitudes, longitudes, elevations, and water depth), site maps, and boring logs.

Basis for Request
The SMP is needed to ensure protection of human health at the property by establishing procedures and protocols to be followed during construction and post-construction. The City of Livermore is named in its capacity as the current landowner.

If you have any questions, please contact Sherry Gamboa at Sherry.Gamboa@waterboards.ca.gov or Ross Steenson at Ross.Steenson@waterboards.ca.gov.

Sincerely,

Sherry Gamboa
Water Resource Control Engineer

Ross Steenson
Senior Engineering Geologist

Copy by email:

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APPENDIX C

Livermore Downtown Core Soil, Groundwater, and Soil Gas Data

C.1 Site Investigations

This background information summarizes prior environmental investigation at the Old Train Depot site. Available soil data is compared to the Tier 1 Environmental Screening Levels established by the San Francisco Regional Water Quality Control Board (SFRWQCB) and updated in January 2019. Soil, groundwater, and soil gas data from these investigations are included in Tables C-1, C-2, and C-3, respectively. Groundwater data from these investigations is included in Appendix C.

2005 Site Assessment by Fugro

Fugro conducted an investigation of soil and groundwater at the Old Train Depot site in 2005. Historical data from the 2005 assessment by Fugro indicated the presence of petroleum hydrocarbons in soil and groundwater, and Volatile Organic Compounds (VOCs) in groundwater at the site. The detected petroleum hydrocarbons at the Old Train Depot site were primarily total petroleum hydrocarbons as gasoline, diesel, and motor (TPHg, TPHd, and TPHmo, respectively). The VOC primarily detected in groundwater beneath the Old Train Depot site was PCE, with a much smaller fraction of breakdown product trichloroethene (TCE). Assessment results from the 2005 investigation are also documented in Fugro's Phase 2 Summary Report, 2009 – 2111 Railroad Avenue, dated May 13, 2005.

Regarding the soil assessment in 2005, a total of 4 soil samples were collected at depths of 0.5 and 3 ft below ground surface (bgs). VOCs, including PCE, and TPHg were not detected above laboratory limits in any of the soil samples collected. TPHd and TPHmo were detected in all analyzed samples at concentrations below their respective Construction Worker Direct Exposure ESLs of 1,100 milligrams per kilogram (mg/kg) and 54,000 mg/kg. All metals detected in soil were below their respective Construction Worker Direct Exposure. Arsenic was not detected above the laboratory reporting limit (1 mg/kg).

For groundwater assessment in 2005, Fugro collected two grab groundwater samples from the shallow perched water-bearing zone. PCE was detected in one of the groundwater samples at a concentration of 21 micrograms per liter (µg/L), above the 2019 Tier 1 ESL of 0.64 µg/L. PCE data from this investigation is shown on Table C-2. No other VOCs were detected in groundwater samples collected during this 2005 investigation. TPHg was also detected in one groundwater sample, at a concentration of 160 µg/L above the 2019 Tier 1 ESL of 100 µg/L. TPHd was detected in groundwater samples from both borings above the 2019 Tier 1 ESL of 100 µg/L.

2018 Site Assessment by BSK Associates

BSK Associates conducted an investigation of petroleum hydrocarbons and metals at the Old Train Depot site soil in 2018. BSK Associates collected twenty-seven (27) soil samples from shallow soil (0-2 ft bgs) at nine soil boring locations at the Old Train Depot Site. Arsenic, lead, and nickel were detected at concentrations above 2019 Construction Worker Direct Exposure ESLs. Most metal concentrations above ESL screening levels are consistent with background soil conditions (Bradford 1996). Arsenic concentrations in five samples were above background conditions (i.e., 11 mg/kg) within the upper 2 ft of soil, possibly associated with the former lumber and/or railroad depot operations. Arsenic was reportedly used historically as a rodenticide in this area. Historical property redevelopment reportedly involved the import of shallow material, an explanation for higher arsenic concentrations detected at 10 to 16 inches bgs

than at 0 to 6 inches bgs. Low levels of TPHd and TPHmo were detected in most samples collected during this investigation, at concentrations below their respective Tier 1 ESLs.

2018 Site Assessment by Pangea

Pangea completed an investigation of soil, groundwater, and soil gas in 2018 to further evaluate site conditions at the Site. This investigation included soil gas sampling from shallow and deep soil gas wells, soil sampling at select soil gas well locations, discrete-depth grab groundwater sampling (as shallow as 41 ft bgs), and installation/sampling of shallow zone groundwater via monitoring well MW-4. PCE was detected in shallow and deep soil gas, and in groundwater at concentrations above 2019 Tier 1 Residential ESLs. Arsenic and nickel were detected in shallow soil at concentrations above 2019 Construction Worker Direct Exposure ESLs. Assessment results from Pangea's investigation are also documented in Pangea's Site Assessment and Summary Report – Old Train Depot, dated April 18, 2020 (Pangea 2020).

For soil assessment, three soil samples collected from boring at SG-4 (3, 6, and 12 ft bgs) were analyzed for TPH and metals. An additional sample collected from SGMF-2 (23 ft bgs) was analyzed for VOCs. TPH and VOCs were not detected above laboratory limits in any of the soil samples analyzed. Arsenic and nickel were detected above their respective 2019 Construction Worker Direct Exposure ESL in each of the samples analyzed for metals. However only one detection of nickel exceeded the background levels established in the Background Concentrations of Trace and Major Elements in California Soils (Bradford 1996). Lead and chromium were also detected in samples analyzed for metals, but below or equal to their respective 2019 Construction Worker Direct Exposure ESLs.

For groundwater assessment in 2018, Pangea collected one perched-zone grab groundwater sample (at 41 ft bgs at well MW-4 location), three grab groundwater samples from shallow zone groundwater, and one shallow zone groundwater monitoring well (MW-4) at the Old Train Depot site. All samples were analyzed for VOCs. PCE was detected in all samples above the 2019 Tier 1 Residential ESL of 0.64 µg/L, with the maximum PCE concentration of 16 µg/L detected at location HP-1-MF. Chloroform was detected in all analyzed samples, with the grab sample concentration of (1.3 µg/L) at 41 to 45 ft bgs exceeding the Tier 1 Residential ESL of 0.81 µg/L. Naphthalene (0.117 µg/L) and TCE (0.138 µg/L) were also detected below their respective Tier 1 Residential ESLs in the sample from shallow zone groundwater monitoring well MW-4.

For soil gas assessment in 2018, Pangea collected samples from shallow (5 ft bgs) and deeper (15 – 25 ft bgs) soil gas. All samples were analyzed for VOCs and low fraction TPH (e.g., TPHg) by EPA Method TO-15 (Carbon Range C6 to C10). PCE was detected above the Tier 1 Residential ESL of 15 microgram per cubic meter (µg/m^3) in all soil gas samples. The maximum PCE concentration detected in shallow (5 ft bgs) soil gas was 387 µg/m^3. The maximum PCE concentration detected in deeper soil gas was 5,340 µg/m^3 at 25 ft bgs. Benzene was also detected in four samples above the 2019 Tier 1 Residential ESL of 3.2 µg/m^3, primarily in deeper soil gas samples located in the central portion of the Site. Ethylbenzene, TPH, TCE, and trans-1,2-Dichlorethlyene (DCE) were also detected in various soil gas samples at the Site, at concentrations below respective 2019 Tier 1 Residential ESLs.

2021 Data Gap Assessment by Pangea

Pangea completed a data gap assessment of soil, groundwater, and soil gas in 2021 to further characterize and delineate subsurface conditions at the Old Train Depot site. The data gap assessment involved: (1) assessing shallow soil near the former lumberyard to evaluate possible impact from compounds (e.g., pentachlorophenol, creosote, and dioxins) not analyzed during prior assessment, (2) assessment of soil to 15 ft depth within the site grading/soil export area for planned Site development, (3) further characterizing the extent of VOCs in soil, groundwater, and soil gas, and (4) providing data to support the HHRA. Results of the investigation are available in the *Data Gap Assessment Report and Path to Closure* (Pangea 2022).

For soil assessment, 14 soil samples were collected and analyzed for VOCs in all samples, and Semi-volatile Organic Compounds (SVOCs), TPH, asbestos, and metals in select samples. No VOCs considered chemicals of potential concern (COPCs) were detected above their respective laboratory limits. All SVOC detections were below their respective 2019 Construction Worker Direct Exposure ESLs. TPH and asbestos were not detected above their respective laboratory limits in any of the soil samples analyzed. Arsenic and nickel were detected above their respective 2019 Con+struction Worker Direct Exposure ESLs in each of the samples analyzed for metals. No detection of arsenic concentrations were above the regional background level published in *Establishing Background Arsenic in Soil of the Urbanized San Francisco Bay Region* (Duverge 2011). One detection of nickel exceeded the background level of 509 mg/kg established in the *Background Concentrations of Trace and Major Elements in California Soils* (Bradford 1996). Lead and chromium were also detected in samples analyzed for metals, but below or equal to their respective 2019 Construction Worker Direct Exposure ESLs.

Fifteen composite samples were also analyzed to assess shallow soil (0 ft to 3 ft below ground surface) near the former lumberyard to evaluate possible impact from compounds not analyzed during prior assessment, and provide preliminary characterization of soil for disposal. All samples were analyzed for TPH and metals. Three of the composite samples were also analyzed for pentachlorophenol, creosote, and dioxins. Pentachlorophenol and creosote were not detected in any composite samples. Dioxin and TPH detections did not exceed their respective 2019 Tier 1 Residential Direct Exposure ESLs. Lead was detected in six samples at concentrations exceeding 50 mg/kg, which is ten times the Soluble Threshold Limit Concentration (STLC) used to classify waste as California hazardous waste. Therefore, future waste profiling of soil would require lead STLC analysis to characterize lead-bearing waste soil as hazardous or non-hazardous for disposal at a proper facility. No other metals detected in composite samples exceeded ten times their respective STLC concentrations.

For groundwater assessment in 2021, Pangea collected eight grab and six groundwater monitoring well samples from shallow zone groundwater at the Site and adjacent properties. All samples were analyzed for VOCs and TPH. PCE was detected in all grab samples and five groundwater monitoring well samples above the 2019 Tier 1 Residential ESL of 0.64 µg/L. TPHd was detected in two grab samples, with both results exceeding the Tier 1 Residential ESL (100 µg/L). Chloroform was detected in two grab samples and one groundwater monitoring well sample above the 2019 Tier 1 Residential ESL of 0.81 µg/L.

For soil gas assessment in 2021, Pangea collected samples from shallow (5 ft bgs) and deeper (15 – 25 ft bgs) soil gas. All samples were analyzed for VOCs and low fraction TPH (e.g., TPHg) by EPA Method TO-15 (Carbon Range C6 to C10). PCE was detected above the Tier 1 Residential ESL of 15 microgram

per cubic meter (µg/m^3) in 17 of 18 soil gas samples. The maximum PCE concentration detected in soil gas was 5,190 µg/m^3 at 5 ft bgs. Benzene was also detected in one sample above the 2019 Tier 1 Residential ESL of 3.2 µg/m^3, in a deeper soil gas sample (15 ft below ground surface). Ethylbenzene, TPH, TCE, and trans-1,2- DCE were also detected in various soil gas samples at the Site, at concentrations below respective 2019 Tier 1 Residential ESLs.

C.2 Adjacent Site Investigations

VOC (and TPH) impact has been identified by City assessment activities at two properties adjacent to the Site: 2048 First Street (former Quality Cleaners) located south of the Site, 2093 Railroad Avenue (former J Cleaners) located east of the Site. These cases are also under oversight by the SFRWQCB.

Former Quality Cleaners (2048 First Street)

The former Quality Cleaners dry-cleaning facility was located on the southern adjacent property to the Old Train Depot site. The former Quality Cleaners operated from approximately late 1940s to 2000, when PCE was the primary chemical commonly used for dry cleaning operations. Past investigations indicate that unauthorized releases of PCE occurred during former operations by Quality Cleaners. The SFRWQCB opened case #01S0828 for regulatory oversight in May 2020.

Concentrations of PCE and its degradation products are highest immediately below and near the former cleaner operations. The highest detected PCE concentrations in soil were found in shallow soil beneath the building floor slab adjacent former floor drain of Quality Cleaners at a concentration of 0.160 mg/kg, above the 2019 Tier 1 Residential ESL of 0.08 mg/kg. PCE has been detected in groundwater beneath the former Quality Cleaners exceeding the 2019 Tier 1 ESL of 0.64 µg/L, with a maximum concentration of 31 µg/L. Vinyl chloride has also been detected in groundwater beneath the former Quality Cleaners at concentrations exceeding the 2019 Tier 1 ESL of 0.0086 µg/L, with the maximum concentration of 7.7 µg/L. Cis-1,2-DCE and trans-1,2-DCE have been detected at maximum concentrations of 19 µg/L and 20 µg/L, respectively, above their respective 2019 Tier 1 ESLs. All soil gas samples collected to date beneath the former Quality Cleaners contained PCE exceeding the 2019 Tier 1 ESL (15 µg/m^3), with a maximum concentration of 6,040 µg/m^3. Benzene was detected in soil gas at Quality Cleaners at a maximum concentration of 117 µg/m^3. Data for soil, groundwater, and soil gas at the former Quality Cleaner site are presented in Tables C-1, C-2, and C-3, respectively.

Former J Cleaners (2093 Railroad Street)

The former J Cleaners dry-cleaning facility was located on the property to the east of the Old Train Depot site and northeast of the former Quality Cleaners site. The drycleaners at 2093 Railroad Street operated from the early 1970's to late 2006 or 2007. Various soil, groundwater and soil gas investigations have identified an apparent PCE release at the former J Cleaners. The SFRWQCB opened case #01S0828 for regulatory oversight on December 31, 2019.

The highest concentrations of PCE have been detected immediately below and near the former cleaner operations. The highest detected PCE concentration in soil beneath the building of former J Cleaners was 13.2 mg/kg, above the 2019 Tier 1 ESL of 0.08 mg/kg. PCE has been detected in perched zone groundwater

beneath the former J Cleaners at a maximum concentration of 34 µg/L, exceeding the 2019 Tier 1 ESL of 0.64 µg/L. PCE has been detected in shallow zone groundwater near (west) of the former J Cleaners at a maximum concentration of 2.7 µg/L, exceeding the 2019 Tier 1 ESL of 0.64 µg/L but below the maximum contaminant level of 5 µg/L. PCE has also been detected in soil gas samples collected beneath the former J Cleaners site exceeding the 2019 Tier 1 ESL (15 µg/m^3) and commercial ESL (67 µg/m^3), at a maximum concentration of 3,460 µg/m^3.

Extensive soil excavation and offsite disposal was performed in December 2019 in conjunction with the grading and construction of Stockmen's Park. A total of 1,795 tons of soil was removed and disposed offsite, providing significant abatement of the historic PCE release at the former J Cleaners. The soil excavation was performed to remove the primary source of PCE to soil vapor by targeting soil impact above 0.1 mg/kg. Excavation was conducted to 15-ft depth near the former J Cleaners dry cleaning equipment and to 4-ft depth near the excavation perimeter. Ongoing soil gas monitoring after the excavation confirms that the 2019 soil removal has significantly improved soil gas conditions, with the recent maximum PCE concentration of 1,670 µg/m^3 (August 2021).

Data for soil, groundwater, and soil gas at the former J Cleaner site are presented in Tables C-1, C-2, and C-3, respectively.

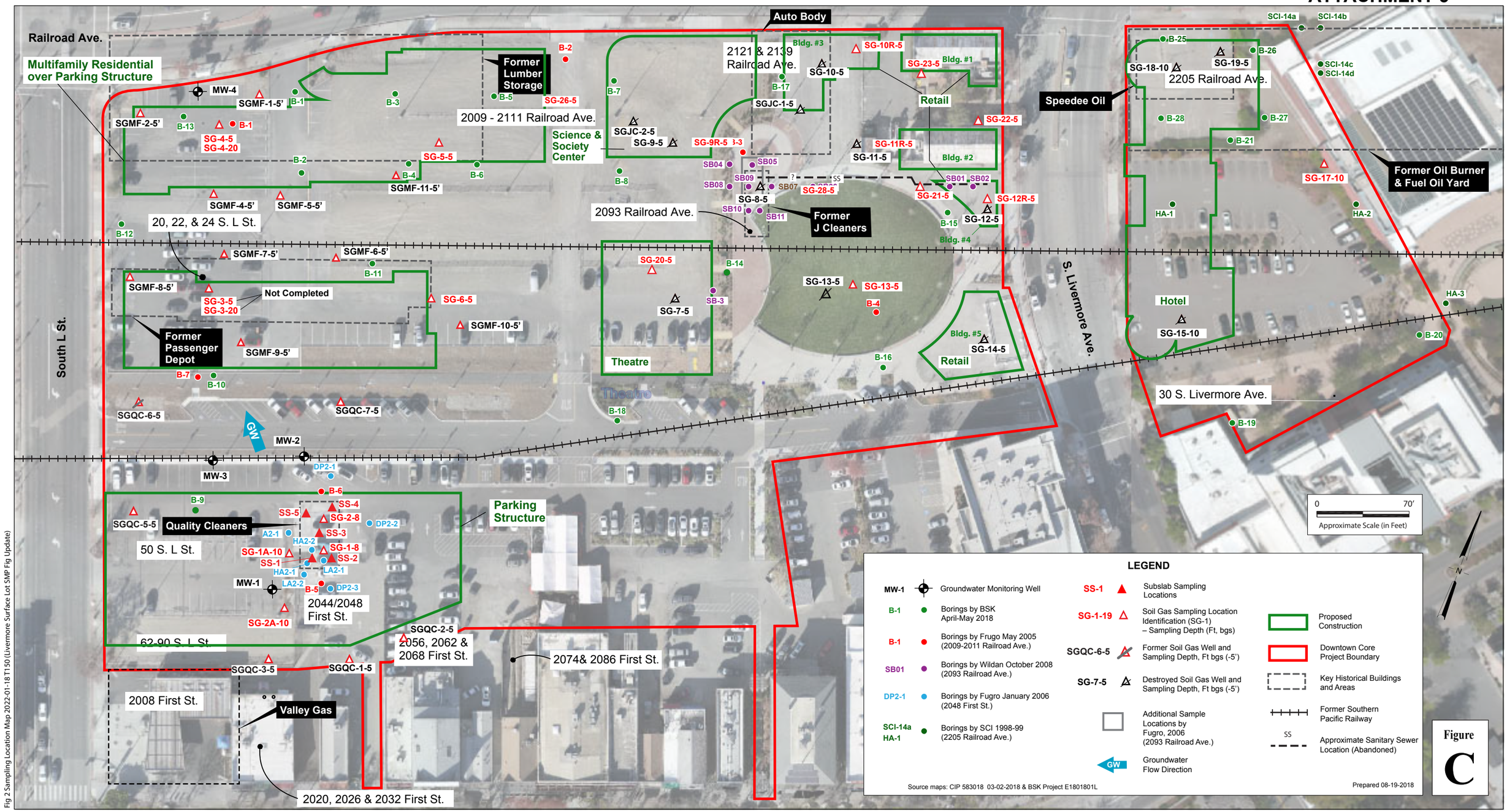

Fig 2 Sampling Location Map 2022-01-18 T150 (Livermore Surface Lot SMP Fig Update)

Figure C

Livermore Downtown Core Project
Livermore, California

PANGEA

Sampling Location Map

Pangea

Table C-1. Soil Analytical Data - Livermore Downtown Core Development, Livermore, California

Boring / Sample ID	Date Sampled	Sample Depth (ft bgs)	TPHg	TPHd	TPHmo	Benzene	Toluene	Ethylbenzene	Total Xylenes	PCE	TCE	Cis-1,2-DCE	Trans-1,2-DCE	Vinyl Chloride	Methylene Chloride	Other VOCs	Arsenic	Total Chromium	Chromium STLC (mg/L)	Lead	Lead STLC (mg/L)	Nickel	Nickel STLC (mg/L)	Other Metals	Chlorinated Herbicides	Asbestos	Organochlorine Pesticides + PCBs	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (g,h,i) perylene	Chrysene	Bis (2-ethylhexyl) Phthalate	Fluoranthene	Phenol	Pyrene	Other SVOCs	p-cresol*	m,p-cresol*	pentachlorophenol	Notes
			mg/kg																							%	mg/kg													
Tier 1 ESL:			**100**	**230**	**5,100**	**0.044**	**2.9**	**1.4**	**2.3**	**0.42**	**0.46**	**0.19**	**0.67**	**0.0082**	**0.1**	**varies**	**0.067**	--	--	**80**	--	**86**	--	varies	varies	--	varies	**0.11**	--	**2.5**	**2.2**	**0.8**	**0.69**	**0.16**	**45**	**varies**	--	--	**0.13**	
Direct Exposure, Construction Worker ESL:			2,800	880	32,000	24	4,100	480	2,400	33	23	82	680	3.4	1.9	varies	0.98	--	--	160	--	86	--	**varies**	**varies**	--	**varies**	11	--	--	9100	950	6700	98000	5000	varies	--	--	1	
Direct Exposure, Residential, Shallow Soil ESL:			740	230	11,000	0.23	970	5.1	560	0.60	1.2	19	160	0.0082	490	varies	0.067	--	--	80	--	820	--	varies	varies	--	varies	0.11	--	--	110	39	2400	23000	1800	varies	--	--	4	
Background Levels[1]:			--	--	--	--	--	--	--	--	--	--	--	--		--	**11**	**1579**	--	**97**	--	**509**	--	**varies**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**1.7**	
2009-2111 Railroad Ave, Fugro, 2005																																							
B-1	5/2/2005	0.5	<1	35	110	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	<5	<1	30	--	12	--	58	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		3.0	<1	11	40	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	<5	<1	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-2	5/2/2005	0.5	<1	17	53	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	<5	<1	32	--	27	--	63	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		3.0	<1	4.2	10	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	<5	<1	--	--	7.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		22.0	--	--	--	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	<5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-3	5/3/2005	0.5	<1	9.0	26	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	<5	<1	25	--	12	--	42	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		3.0	<1	2.5	6.8	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	<5	<1	--	--	7.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-4	5/3/2005	0.5	<1	4.9	59	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	<5	<1	25	--	4.8	--	38	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		3.0	<1	4.9	15	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	<5	<1	--	--	1.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-6	5/3/2005	0.5	<1	18	52	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	<5	<1	40	--	22	--	60	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		3.0	<1	30	70	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	<5	**2.4**	--	--	54	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-7	5/3/2005	0.5	<1	43	99	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	<5	<1	32	--	44	--	60	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		3.0	<1	2.8	6.8	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	<5	<1	--	--	5.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
2044 & 2048 First St, Fugro, 2008																																							
A2-1	12/4/2007	0.0	--	--	--	ND	ND	ND	ND	<0.0049	ND	ND	ND	ND	ND	ND	**3.7**	54	--	**120**	--	**100**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		2.0	--	--	--	ND	ND	ND	ND	<0.0048	ND	ND	ND	ND	ND	ND	**2.9**	--	--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		7.5	--	--	--	ND	ND	ND	ND	<0.0050	ND	ND	ND	ND	ND	ND	**3.2**	--	--	4.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
DP2-1	12/5/2007	0.0	--	--	--	ND	ND	ND	ND	<0.0050	ND	ND	ND	ND	ND	ND	**3.3**	54	--	**360**	--	**110**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		2.0	--	--	--	ND	ND	ND	ND	<0.0050	ND	ND	ND	ND	ND	ND	**5.0**	--	--	7.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		7.5	--	--	--	ND	ND	ND	ND	<0.0050	ND	ND	ND	ND	ND	ND	**3.8**	--	--	3.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
DP2-2	12/5/2007	0.0	--	--	--	ND	ND	ND	ND	<0.0048	ND	ND	ND	ND	ND	ND	**3.3**	--	--	9.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		2.0	--	--	--	ND	ND	ND	ND	<0.0049	ND	ND	ND	ND	ND	ND	**4.5**	--	--	**100**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		7.5	--	--	--	ND	ND	ND	ND	<0.0049	ND	ND	ND	ND	ND	ND	**3.9**	--	--	3.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		15.0	--	--	--	ND	ND	ND	ND	<0.0049	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
DP2-3	12/5/2007	0.0	--	--	--	ND	ND	ND	ND	0.120	ND	ND	ND	ND	ND	ND	**3.4**	--	--	**150**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		2.0	--	--	--	ND	ND	ND	ND	<0.0049	ND	ND	ND	ND	ND	ND	**3.5**	--	--	6.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		7.5	--	--	--	ND	ND	ND	ND	<0.0050	ND	ND	ND	ND	ND	ND	**2.6**	--	--	2.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
LA2-1	12/10/2007	0.0	--	--	--	ND	ND	ND	ND	0.160	ND	ND	ND	ND	ND	ND	**2.4**	--	--	5.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		2.0	--	--	--	ND	ND	ND	ND	<0.0047	ND	ND	ND	ND	ND	ND	**4.1**	--	--	2.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		7.5	--	--	--	ND	ND	ND	ND	0.0052	ND	ND	ND	ND	ND	ND	**2.8**	--	--	3.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
LA2-2	12/10/2007	0.0	--	--	--	ND	ND	ND	ND	0.020	ND	ND	ND	ND	ND	ND	**11**	--	--	**180**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		2.0	--	--	--	ND	ND	ND	ND	<0.0049	ND	ND	ND	ND	ND	ND	**5.0**	--	--	4.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		7.5	--	--	--	ND	ND	ND	ND	<0.0049	ND	ND	ND	ND	ND	ND	**4.3**	--	--	5.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
HA2-1	12/10/2007	1.0	--	--	--	ND	ND	ND	ND	0.110	ND	ND	ND	ND	ND	ND	**2.6**	--	--	73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		2.0	--	--	--	ND	ND	ND	ND	0.035	ND	ND	ND	ND	ND	ND	--	--	--	51	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
HA2-2	12/10/2007	1.0	--	--	--	ND	ND	ND	ND	<0.0047	ND	ND	ND	ND	ND	ND	**2.7**	--	--	6.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
2093 Railroad Ave, Fugro, 2006																																							
B-1	6/17/2006	2.0	--	--	--	--	--	--	--	0.011	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		3.5	--	--	--	--	--	--	--	0.018	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		6.0	--	--	--	--	--	--	--	0.0086	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		8.5	--	--	--	--	--	--	--	<0.0047	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-2	6/17/2006	0.5	--	**33**	**190**	--	--	--	--	0.110	ND	ND	ND	ND	ND	ND	**5.7**	47	--	30	--	**95**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		3.0	--	--	--	--	--	--	--	0.0094	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		6.0	--	--	--	--	--	--	--	0.015	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		8.0	--	--	--	--	--	--	--	<0.0048	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-3	6/17/2006	0.5	--	--	--	--	--	--	--	<0.0048	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A1	7/29/2006	1.0	--	--	--	--	--	--	--	0.015	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		3.0	--	--	--	--	--	--	--	<0.0046	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		8.0	--	--	--	--	--	--	--	<0.0047	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A2	7/29/2006	1.0	--	--	--	--	--	--	--	<0.0046	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		2.0	--	--	--	--	--	--	--	0.080	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10.0	--	--	--	--	--	--	--	0.0051	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A3	7/29/2006	0.5	--	--	--	--	--	--	--	0.044	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		2.0	--	--	--	--	--	--	--	0.031	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		5.0	--	--	--	--	--	--	--	<0.0047	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A4	7/29/2006	0.5	--	--	--	--	--	--	--	<0.0048	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		3.0	--	--	--	--	--	--	--	0.026	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A5	7/29/2006	0.5	--	--	--	--	--	--	--	0.310	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		2.0	--	--	--	--	--	--	--	0.026	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		5.0	--	--	--	--	--	--	--	<0.0050	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A6	7/29/2006	0.5	--	--	--	--	--	--	--	0.016	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		2.0	--	--	--	--	--	--	--	0.039	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		5.0	--	--	--	--	--	--	--	<0.0045	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		8.0	--	--	--	--	--	--	--	<0.0049	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A7	8/3/2006	0.5	--	--	--	--	--	--	--	<0.0049	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		3.0	--	--	--	--	--	--	--	0.026	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		5.0	--	--	--	--	--	--	--	<0.0045	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A10	8/3/2006	0.5	--	--	--	--	--	--	--	<0.0049	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		3.0	--	--	--	--	--	--	--	0.046	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
2093 Railroad Ave, Willdan, 2008																																							
SB-1	9/15/2008	6-8	--	--	--	ND	ND	ND	ND	<0.0047	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		8-12	--	--	--	ND	ND	ND	ND	<0.0045	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		16-20	--	--	--	ND	ND	ND	ND	<0.0043	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SB-2	9/15/2008	4-8	--	--	--	ND	ND	ND	ND	<0.0043	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		12-16	--	--	--	ND	ND	ND	ND	<0.0042	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		16-20	--	--	--	ND	ND	ND	ND	<0.0042	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SB-3	9/15/2008	4-8	--	--	--	ND	ND	ND	ND	<0.0048	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		12-16	--	--	--	ND	ND	ND	ND	<0.0043	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		16-20	--	--	--	ND	ND	ND	ND	<0.0042	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SB-4	9/15/2008	4-8	--	--	--	ND	ND	ND	ND	<0.0050	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

Pangea

Table C-1. Soil Analytical Data - Livermore Downtown Core Development, Livermore, California

Boring / Sample ID	Date Sampled	Sample Depth (ft bgs)	TPHg	TPHd	TPHmo	Benzene	Toluene	Ethylbenzene	Total Xylenes	PCE	TCE	Cis-1,2-DCE	Trans-1,2-DCE	Vinyl Chloride	Methylene Chloride	Other VOCs	Arsenic	Total Chromium	Chromium STLC (mg/L)	Lead	Lead STLC (mg/L)	Nickel	Nickel STLC (mg/L)	Other Metals	Chlorinated Herbicides	Asbestos	Organochlorine Pesticides + PCBs	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (g,h,i) perylene	Chrysene	Bis (2-ethylhexyl Phthalate)	Fluoranthene	Phenol	Pyrene	Other SVOCs	p-cresol*	m,p-cresol*	pentachlorophenol	Notes
			mg/kg																							%	mg/kg													
Tier 1 ESL:			**100**	**230**	**5,100**	**0.044**	**2.9**	**1.4**	**2.3**	**0.42**	**0.46**	**0.19**	**0.67**	**0.0082**	**0.1**	**varies**	**0.067**	--	--	**80**	--	**86**	--	varies	varies	--	varies	**0.11**	--	**2.5**	**2.2**	**0.8**	**0.69**	**0.16**	**45**	**varies**	--	--	**0.13**
Direct Exposure, Construction Worker ESL:			2,800	880	32,000	24	4,100	480	2,400	33	23	82	680	3.4	1.9	varies	0.98	--	--	160	--	86	--	**varies**	**varies**	--	**varies**	11	--	--	9100	950	6700	98000	5000	varies	--	--	1
Direct Exposure, Residential, Shallow Soil ESL:			740	230	11,000	0.23	970	5.1	560	0.60	1.2	19	160	0.0082	490	varies	0.067	--	--	80	--	820	--	varies	varies	--	varies	0.11	--	--	110	39	2400	23000	1800	varies	--	--	4
Background Levels[1]:			--	--	--	--	--	--	--	--	--	--	--	--		--	**11**	**1579**	--	**97**	--	**509**	--	**varies**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**1.7**
		8-12	--	--	--	ND	ND	ND	ND	<0.0043	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		12-16	--	--	--	ND	ND	ND	ND	<0.0045	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-5	9/15/2008	4-8	--	--	--	ND	ND	ND	ND	<0.0044	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		8-12	--	--	--	ND	ND	ND	ND	<0.0043	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		16-20	--	--	--	ND	ND	ND	ND	<0.0048	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-6	9/16/2008	0-4	--	--	--	ND	ND	ND	ND	<0.0048	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4-8	--	--	--	ND	ND	ND	ND	<0.0046	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-7	9/16/2008	0-4	--	--	--	ND	ND	ND	ND	<0.0045	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4-8	--	--	--	ND	ND	ND	ND	<0.0044	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		8-9	--	--	--	ND	ND	ND	ND	<0.0044	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-8	9/16/2008	4-8	--	--	--	ND	ND	ND	ND	0.0050	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		12-16	--	--	--	ND	ND	ND	ND	<0.0048	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		16-20	--	--	--	ND	ND	ND	ND	<0.0047	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-9	9/16/2008	4-8	--	--	--	ND	ND	ND	ND	<0.0042	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		8-12	--	--	--	ND	ND	ND	ND	0.0088	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		16-20	--	--	--	ND	ND	ND	ND	<0.0042	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-10	9/16/2008	0-4	--	--	--	ND	ND	ND	ND	0.011	ND	ND	ND	ND	ND	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		8-12	--	--	--	ND	ND	ND	ND	<0.0042	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		12-16	--	--	--	ND	ND	ND	ND	<0.0048	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-11	9/16/2008	0-4	--	--	--	ND	ND	ND	ND	0.013	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4-8	--	--	--	ND	ND	ND	ND	<0.0042	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		12-16	--	--	--	ND	ND	ND	ND	<0.0049	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2093 Railroad Ave, Willdan, 2009																																							
HA-1	2/12/2009	0.5	--	--	--	<0.0047	<0.0047	<0.0047	<0.0094	0.040	<0.0047	<0.0047	<0.0047	<0.0093	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HA-2	2/12/2009	0.5	--	--	--	<0.0042	<0.0042	<0.0042	<0.0084	<0.0042	<0.0042	<0.0042	<0.0042	<0.0084	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HA-3	2/12/2009	0.5	--	--	--	<0.0042	<0.0042	<0.0042	<0.0084	0.0083	<0.0042	<0.0042	<0.0042	<0.0084	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HA-4	2/12/2009	0.5	--	--	--	<0.0044	<0.0044	<0.0044	<0.0088	<0.0044	<0.0044	<0.0044	<0.0044	<0.0089	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HA-5	2/12/2009	0.5	--	--	--	<0.0045	<0.0045	<0.0045	<0.0090	<0.0045	<0.0045	<0.0045	<0.0045	<0.009	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HA-6	2/12/2009	0.5	--	--	--	<0.0048	<0.0048	<0.0048	<0.0096	<0.0048	<0.0048	<0.0048	<0.0048	<0.0096	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Various Addresses, BSK, April 2018																																							
B-1	4/13/2018	0"-6"	--	5.4	70	--	--	--	--	--	--	--	--	--	--	--	**7.5**	38	--	56	1.8	81	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	4.6	24	--	--	--	--	--	--	--	--	--	--	--	**6.2**	39	--	65	2.7	77	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	13	60	--	--	--	--	--	--	--	--	--	--	--	**8.1**	40	--	**100 a**	3.9	74	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-2	4/13/2018	0"-6"	--	6.2	22	--	--	--	--	--	--	--	--	--	--	--	**2.8**	30	--	19	--	68	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	33	200	--	--	--	--	--	--	--	--	--	--	--	**55**	13	--	**170 a**	9.5	23	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	16	78	--	--	--	--	--	--	--	--	--	--	--	**11**	21	--	**93 a**	2.1	46	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-3	4/13/2018	0"-6"	--	6.4	40	--	--	--	--	--	--	--	--	--	--	--	**20**	41	--	**89 a**	3.0	**96**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	4.7	32	--	--	--	--	--	--	--	--	--	--	--	**5.9**	47	--	**120 a**	1.6	**120**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	8.1	22	--	--	--	--	--	--	--	--	--	--	--	**8.4**	37	--	**140 a**	4.3	**90**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-4	4/13/2018	0"-6"	--	4.6	23	--	--	--	--	--	--	--	--	--	--	--	**5.0**	56	<0.50	58	2.1	**110**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	29	120	--	--	--	--	--	--	--	--	--	--	--	**28**	30	--	**200 a**	7.3	66	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	2.3	<2.0	--	--	--	--	--	--	--	--	--	--	--	**6.4**	36	--	**130 a**	2.8	86	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-5	4/13/2018	0"-6"	--	60	280	--	--	--	--	--	--	--	--	--	--	--	**7.1**	43	--	41	--	**98**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	3.9	24	--	--	--	--	--	--	--	--	--	--	--	**5.0**	52	<0.50	22	--	**130**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	4.6	16	--	--	--	--	--	--	--	--	--	--	--	**7.7**	45	--	27	--	**130**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-6	4/16/2018	0"-6"	--	3.0	18	--	--	--	--	--	--	--	--	--	--	--	**4.6**	62	<0.50	11	--	**140**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	9.0	24	--	--	--	--	--	--	--	--	--	--	--	**8.4**	44	--	43	--	**100**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	11	34	--	--	--	--	--	--	--	--	--	--	--	**7.5**	38	--	41	--	**94**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-7	4/16/2018	0"-6"	--	<1.0	7.5	--	--	--	--	--	--	--	--	--	--	--	**5.0**	37	--	19	--	84	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	13	44	--	--	--	--	--	--	--	--	--	--	--	**4.6**	45	--	**130 a**	14	**110**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	12	39	--	--	--	--	--	--	--	--	--	--	--	**4.0**	44	--	73	4.4	**95**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-8	4/16/2018	0"-6"	--	<1.0	<2.0	--	--	--	--	--	--	--	--	--	--	--	<2.5	18	--	<6.3	--	17	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	11	34	--	--	--	--	--	--	--	--	--	--	--	**8.2**	39	--	44	--	80	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	0.7	18	--	--	--	--	--	--	--	--	--	--	--	**5.4**	34	--	22	--	85	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-9	4/16/2018	0"-6"	--	21	220	--	--	--	--	--	--	--	--	--	--	--	**4.3**	38	--	**120 a**	17	80	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	20	190	--	--	--	--	--	--	--	--	--	--	--	**4.1**	42	--	**110 a**	9.3	83	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	11	95	--	--	--	--	--	--	--	--	--	--	--	**3.0**	40	--	50	1.3	**98**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-10	4/16/2018	0"-6"	--	3.0	19	--	--	--	--	--	--	--	--	--	--	--	**2.6**	32	--	<6.3	--	43	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	<1.0	<2.0	--	--	--	--	--	--	--	--	--	--	--	**3.2**	76	<0.20	8.8	--	**160**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	2.6	6.0	--	--	--	--	--	--	--	--	--	--	--	**3.0**	57	<0.50	9.0	--	**370**	1.9	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-11	4/17/2018	0"-6"	--	17	120	--	--	--	--	--	--	--	--	--	--	--	**7.3**	36	--	63	1.6	74	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	14	72	--	--	--	--	--	--	--	--	--	--	--	**5.1**	30	--	**120 a**	3.8	46	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	5.3	15	--	--	--	--	--	--	--	--	--	--	--	**3.6**	18	--	55	1.4	32	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-12	4/17/2018	0"-6"	--	6.1	53	--	--	--	--	--	--	--	--	--	--	--	**3.2**	25	--	<6.3	--	53	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	37	130	--	--	--	--	--	--	--	--	--	--	--	**48**	67	<0.50	7.3	--	**120**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	37	100	--	--	--	--	--	--	--	--	--	--	--	**18**	52	<0.50	7.0	--	**140**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-13	4/17/2018	0"-6"	--	12	18	--	--	--	--	--	--	--	--	--	--	--	**2.6**	30	--	<6.3	--	55	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	<1.0	<2.0	--	--	--	--	--	--	--	--	--	--	--	**2.9**	55	<0.50	9.0	--	**160**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	3.1	42	--	--	--	--	--	--	--	--	--	--	--	**3.4**	52	<0.50	<6.3	--	**140**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-14	4/17/2018	0"-6"	--	3.8	28	--	--	--	--	--	--	--	--	--	--	--	**4.5**	42	--	38	--	**99**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	<1.0	<2.0	--	--	--	--	--	--	--	--	--	--	--	**4.4**	45	--	18	--	**120**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	<1.0	<2.0	--	--	--	--	--	--	--	--	--	--	--	**2.7**	50	--	<6.3	--	**120**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-15	4/17/2018	0"-6"	--	<1.0	<2.0	--	--	--	--	--	--	--	--	--	--	--	**3.0**	27	--	ND	--	45	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	22	53	--	--	--	--	--	--	--	--	--	--	--	**7.4**	41	--	**220 a**	3.1	**110**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	4.9	6.7	--	--	--	--	--	--	--	--	--	--	--	**4.9**	44	--	19	--	**130**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B-16	4/17/2018	0"-6"	--	31	230	--	--	--	--	--	--	--	--	--	--	--	<2.5	19	--	<6.3	--	36	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10"-16"	--	3.3	7.3	--	--	--	--	--	--	--	--	--	--	--	**3.3**	62	<0.50	<6.3	--	**150**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		18"-24"	--	4.3	28	--	--	--	--	--	--	--	--	--	--	--	**3.1**	47	--	<6.3	--	**150**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Pangea

Table C-1. Soil Analytical Data - Livermore Downtown Core Development, Livermore, California

Boring / Sample ID	Date Sampled	Sample Depth (ft bgs)	TPHg	TPHd	TPHmo	Benzene	Toluene	Ethylbenzene	Total Xylenes	PCE	TCE	Cis-1,2-DCE	Trans-1,2-DCE	Vinyl Chloride	Methylene Chloride	Other VOCs	Arsenic	Total Chromium	Chromium STLC (mg/L)	Lead	Lead STLC (mg/L)	Nickel	Nickel STLC (mg/L)	Other Metals	Chlorinated Herbicides	Asbestos	Organochlorine Pesticides + PCBs	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (g,h,i) perylene	Chrysene	Bis (2-ethylhexyl Phthalate)	Fluoranthene	Phenol	Pyrene	Other SVOCs	p-cresol*	m,p-cresol*	o-nitrochlorobenzol	Notes
			mg/kg																							%	mg/kg													
Tier 1 ESL:			**100**	**230**	**5,100**	**0.044**	**2.9**	**1.4**	**2.3**	**0.42**	**0.46**	**0.19**	**0.67**	**0.0082**	**0.1**	**varies**	**0.067**	--	--	**80**	--	**86**	--	varies	varies	--	varies	**0.11**	--	**2.5**	**2.2**	**0.8**	**0.69**	**0.16**	**45**	**varies**	--	--	**0.13**	
Direct Exposure, Construction Worker ESL:			2,800	880	32,000	24	4,100	480	2,400	33	23	82	680	3.4	1.9	varies	0.98	--	--	160	--	86	--	**varies**	**varies**	--	**varies**	11	--	--	9100	950	6700	98000	5000	varies	--	--	1	
Direct Exposure, Residential, Shallow Soil ESL:			740	230	11,000	0.23	970	5.1	560	0.60	1.2	19	160	0.0082	490	varies	0.067	--	--	80	--	820	--	varies	varies	--	varies	0.11	--	--	110	39	2400	23000	1800	varies	--	--	4	
Background Levels[1]:			--	--	--	--	--	--	--	--	--	--	--	--		--	**11**	**1579**	--	**97**	--	**509**	--	**varies**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**1.7**	
B-17	4/17/2018	0'-6"	--	16	150	--	--	--	--	--	--	--	--	--	--	--	**6.9**	36	--	33	--	**98**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10'-16"	--	<1.0	<2.0	--	--	--	--	--	--	--	--	--	--	--	**3.4**	51	<0.50	7.1	--	**120**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18'-24"	--	<1.0	<2.0	--	--	--	--	--	--	--	--	--	--	--	**3.6**	62	<0.50	6.3	--	**140**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-18	4/23/2018	0'-6"	--	93	280	--	--	--	--	--	--	--	--	--	--	--	**4.2**	40	--	21	--	64	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10'-16"	--	19	22	--	--	--	--	--	--	--	--	--	--	--	**10**	42	--	32	--	**100**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18'-24"	--	28	<2.0	--	--	--	--	--	--	--	--	--	--	--	**9.5**	34	--	16	--	64	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-19	4/26/2018	0'-6"	--	68	480	--	--	--	--	--	--	--	--	--	--	--	7.0	45	--	67	0.77	60	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10'-16"	--	17	150	--	--	--	--	--	--	--	--	--	--	--	3.8	22	--	17	--	**150**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18'-24"	--	13	110	--	--	--	--	--	--	--	--	--	--	--	3.5	32	--	27	--	**110**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-20	4/26/2018	0'-6"	--	26	110	--	--	--	--	--	--	--	--	--	--	--	8.4	47	--	**180 a**	3.3	**110**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10'-16"	--	17	73	--	--	--	--	--	--	--	--	--	--	--	2.6	41	--	63	3.9	73	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18'-24"	--	35	130	--	--	--	--	--	--	--	--	--	--	--	4.2	36	--	**120 a**	4.1	**130**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-21	4/26/2018	0'-6"	--	6.0	20	--	--	--	--	--	--	--	--	--	--	--	3.3	37	--	25	--	20	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10'-16"	--	4.7	22	--	--	--	--	--	--	--	--	--	--	--	5.8	51	<0.50	24	--	22	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18'-24"	--	6.3	29	--	--	--	--	--	--	--	--	--	--	--	5.6	57	<0.50	33	--	29	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-22	4/26/2018	0'-6"	--	4.1	36	--	--	--	--	--	--	--	--	--	--	--	3.0	48	--	48	--	84	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10'-16"	--	4.8	9.2	--	--	--	--	--	--	--	--	--	--	--	5.2	110	<0.50	**470 a**	20	**160**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18'-24"	--	3.3	10	--	--	--	--	--	--	--	--	--	--	--	3.8	61	<0.50	120	5.5	**150**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-23	4/26/2018	0'-6"	--	180	920	--	--	--	--	--	--	--	--	--	--	--	4.5	46	--	22	--	**88**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10'-16"	--	40	370	--	--	--	--	--	--	--	--	--	--	--	4.3	52	<0.50	29	--	**110**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18'-24"	--	17	120	--	--	--	--	--	--	--	--	--	--	--	3.1	50	<0.50	23	--	**110**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-24	4/26/2018	0'-6"	--	8.1	58	--	--	--	--	--	--	--	--	--	--	--	4.6	50	<0.50	22	--	**120**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10'-16"	--	<1.0	48	--	--	--	--	--	--	--	--	--	--	--	4.0	44	--	15	--	**94**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18'-24"	--	<1.0	43	--	--	--	--	--	--	--	--	--	--	--	2.9	36	--	12	--	84	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-25	5/22/2018	0'-6"	--	47	1000	--	--	--	--	--	--	--	--	--	--	--	3.3	21	--	<6.3	--	32	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10'-16"	--	30	580	--	--	--	--	--	--	--	--	--	--	--	2.7	41	--	11	--	**90**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18'-24"	--	<1.0	6.1	--	--	--	--	--	--	--	--	--	--	--	3.7	50	<0.50	10	--	**120**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-26	5/22/2018	0'-6"	--	26	860	--	--	--	--	--	--	--	--	--	--	--	<2.5	15	--	<6.3	--	27	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10'-16"	--	18	540	--	--	--	--	--	--	--	--	--	--	--	<2.5	50	<0.50	<6.3	--	**290**	3.8	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18'-24"	--	4.2	110	--	--	--	--	--	--	--	--	--	--	--	<2.5	58	<0.50	<6.3	--	**330**	3.0	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-27	5/22/2018	0'-6"	--	7.8	120	--	--	--	--	--	--	--	--	--	--	--	<2.5	21	--	<6.3	--	31	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10'-16"	--	4.6	18	--	--	--	--	--	--	--	--	--	--	--	3.2	49	--	8.8	--	**140**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18'-24"	--	8.8	22	--	--	--	--	--	--	--	--	--	--	--	2.8	100	<0.50	9.1	--	**270**	1.2	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
B-28	5/22/2018	0'-6"	--	8.4	260	--	--	--	--	--	--	--	--	--	--	--	3.0	20	--	<6.3	--	25	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		10'-16"	--	6.5	150	--	--	--	--	--	--	--	--	--	--	--	<2.5	28	--	<6.3	--	77	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		18'-24"	--	5.8	150	--	--	--	--	--	--	--	--	--	--	--	<2.5	31	--	<6.3	--	**140**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Various Addresses, Pangea, June 2018																																							
SG-4-3	6/20/2018	3.0	<1.0	<1.0	<5.0	--	--	--	--	--	--	--	--	--	--	--	4.0	54	0.18	7.1	--	**140**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-4-6	6/20/2018	6.0	<1.0	<1.0	<5.0	--	--	--	--	--	--	--	--	--	--	--	3.3	50	<0.10	4.7	--	**110**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-4-12	6/20/2018	12.0	<1.0	<1.0	<5.0	--	--	--	--	--	--	--	--	--	--	--	4.3	48	--	5.3	--	**120**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-15-3	6/20/2018	3.0	<1.0	<1.0	20	--	--	--	--	--	--	--	--	--	--	--	3.2	73	0.47	4.9	--	**350**	**5.3**	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-15-6	6/20/2018	6.0	<1.0	<1.0	<5.0	--	--	--	--	--	--	--	--	--	--	--	3.4	81	0.21	4.0	--	**420**	**2.7**	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-15-10	6/20/2018	10.0	<1.0	<1.0	<5.0	--	--	--	--	--	--	--	--	--	--	--	3.9	47	--	4.7	--	**140**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
						--	--	--	--	--	--	--	--	--	--	--																								
SG-17-3	6/20/2018	3.0	1.8	<1.0	<5.0	--	--	--	--	--	--	--	--	--	--	--	8.5	60	0.12	19	--	**150**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-17-6	6/20/2018	6.0	<1.0	<1.0	<5.0	--	--	--	--	--	--	--	--	--	--	--	3.5	64	0.64	3.8	--	**280**	**2.5**	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-17-10	6/20/2018	10.0	<1.0	<1.0	<5.0	--	--	--	--	--	--	--	--	--	--	--	3.2	34	--	5.4	--	**88**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
2048 First St, Geosphere Consultants, June 2018																																							
L-1	6/18/2018	0.0-2.0	--	14	74	--	--	--	--	--	--	--	--	--	--	--	2.7	36	--	110	1.9	**90**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	
L-2	6/18/2018	2.0-4.0	--	53	27	--	--	--	--	--	--	--	--	--	--	--	3.4	49	--	5.1	--	**100**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	
L-3	6/18/2018	4.0-6.0	--	11	9.8	--	--	--	--	--	--	--	--	--	--	--	3.7	47	--	5.5	--	**110**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	
L-4	6/18/2018	0.0-2.0	--	2.5	11	--	--	--	--	--	--	--	--	--	--	--	3.4	48	--	7.8	--	**110**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	
L-5	6/18/2018	2.0-4.0	--	**400**	140	--	--	--	--	--	--	--	--	--	--	--	3.0	60	--	6.1	--	**190**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	
L-6	6/18/2018	4.0-6.0	--	39	19	--	--	--	--	--	--	--	--	--	--	--	2.8	33	--	3.6	--	**88**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	
L-7	6/18/2018	0.0-2.0	--	5.0	31	--	--	--	--	--	--	--	--	--	--	--	4.0	52	--	32	--	**110**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	
L-8	6/18/2018	2.0-4.0	--	2.6	15	--	--	--	--	--	--	--	--	--	--	--	3.5	48	--	13	--	**130**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	
L-9	6/18/2018	4.0-6.0	--	1.1	5.6	--	--	--	--	--	--	--	--	--	--	--	3.5	45	--	10	--	**120**	--	+	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	
2048 First St, Pangea, August 2018																																							
SG-1A-2	8/2/2018	2.0	--	--	--	<0.0039	<0.0039	<0.0039	<0.0078	<0.0039	<0.0039	<0.0039	<0.0039	<0.0078	ND	ND	3.4	62	0.30	37	--	**140**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-1A-4	8/2/2018	4.0	--	--	--	<0.0039	<0.0039	<0.0039	<0.0078	<0.0039	<0.0039	<0.0039	<0.0039	<0.0078	ND	ND	2.9	71	0.27	9.7	--	**180**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-1A-8	8/2/2018	8.0	--	1.4	<5.1	<0.0043	<0.0043	<0.0043	<0.0086	<0.0043	<0.0043	<0.0043	<0.0043	<0.0085	ND	ND	3.3	110	0.37	4.9	--	**720 b**	3.4	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-1A-10	8/2/2018	10.0	--	--	--	<0.0040	<0.0040	<0.0040	<0.0080	<0.0039	<0.0040	<0.0040	<0.0040	<0.0080	ND	ND	3.8	65	<0.25	6.0	--	**150**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-2A-2	8/2/2018	2.0	--	--	--	<0.0043	<0.0043	<0.0043	<0.0086	<0.0043	<0.0043	<0.0043	<0.0043	<0.0085	ND	+	3.4	49	--	**230**	10	**110**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Acetone detected at 0.019 mg/kg
SG-2A-8	8/2/2018	8.0	--	--	--	<0.0045	<0.0045	<0.0045	<0.0090	<0.0045	<0.0045	<0.0045	<0.0045	<0.0089	ND	+	3.2	69	<0.25	5.2	--	**140**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Acetone detected at 0.022 mg/kg
SG-2A-10	8/2/2018	10.0	--	--	--	<0.0043	<0.0043	<0.0043	<0.0086	<0.0043	<0.0043	<0.0043	<0.0043	<0.0087	ND	ND	4.1	64	0.50	6.0	--	**200**	2.7	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-1-2	8/8/2018	2.0	--	--	--	<0.0036	<0.0036	<0.0036	<0.0072	0.0072	<0.0036	<0.0036	<0.0036	<0.0073	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-1-4	8/8/2018	4.0	--	--	--	<0.0048	<0.0048	<0.0048	<0.0096	<0.0048	<0.0048	<0.0048	<0.0048	<0.0095	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-1-6	8/8/2018	6.0	--	--	--	<0.0053	<0.0053	<0.0053	<0.011	<0.0053	<0.0053	<0.0053	<0.0053	<0.011	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-1-8	8/8/2018	8.0	--	--	--	<0.0046	<0.0046	<0.0046	<0.0092	<0.0046	<0.0046	<0.0046	<0.0046	<0.0092	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-2-2	8/2/2018	2.0	--	--	--	<0.0033	<0.0033	<0.0033	<0.0066	<0.0033	<0.0033	<0.0033	<0.0033	<0.0067	ND	+	3.2	67	<0.25	6.3	--	**140**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Acetone detected at 0.015 mg/kg
SG-2-4	8/2/2018	4.0	--	--	--	<0.0047	<0.0047	<0.0047	<0.0094	<0.0047	<0.0047	<0.0047	<0.0047	<0.0093	ND	ND	3.4	76	<0.25	5.1	--	**160**	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SG-2-8	8/8/2018	8.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not analyzed
2048 First St, Pangea, November 2018																																							

Pangea

Table C-1. Soil Analytical Data - Livermore Downtown Core Development, Livermore, California

Boring / Sample ID	Date Sampled	Sample Depth (ft bgs)	TPHg	TPHd	TPHmo	Benzene	Toluene	Ethylbenzene	Total Xylenes	PCE	TCE	Cis-1,2-DCE	Trans-1,2-DCE	Vinyl Chloride	Methylene Chloride	Other VOCs	Arsenic	Total Chromium	Chromium STLC (mg/L)	Lead	Lead STLC (mg/L)	Nickel	Nickel STLC (mg/L)	Other Metals	Chlorinated Herbicides	Asbestos	Organochlorine Pesticides + PCBs	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (g,h,i) perylene	Chrysene	Bis (2-ethylhexyl) Phthalate(s)	Fluoranthene	Phenol	Pyrene	Other SVOCs	p-cresol*	m,p-cresol*	nitrobenzene/phenol	Notes
			mg/kg																							%	mg/kg													
	Tier 1 ESL:		**100**	**230**	**5,100**	**0.044**	**2.9**	**1.4**	**2.3**	**0.42**	**0.46**	**0.19**	**0.67**	**0.0082**	**0.1**	**varies**	**0.067**	--	--	**80**	--	**86**	--	varies	varies	--	varies	**0.11**	--	**2.5**	**2.2**	**0.8**	**0.69**	**0.16**	**45**	**varies**	--	--	**0.13**	
	Direct Exposure, Construction Worker ESL		2,800	880	32,000	24	4,100	480	2,400	33	23	82	680	3.4	1.9	varies	0.98	--	--	160	--	86	--	**varies**	**varies**	--	**varies**	11	--	--	9100	950	6700	98000	5000	varies	--	--	1	
	Direct Exposure, Residential, Shallow Soil ESL:		740	230	11,000	0.23	970	5.1	560	0.60	1.2	19	160	0.0082	490	varies	0.067	--	--	80	--	820	--	varies	varies	--	varies	0.11	--	--	110	39	2400	23000	1800	varies	--	--	4	
	Background Levels[1]:		--	--	--	--	--	--	--	--	--	--	--	--		--	**11**	**1579**	--	**97**	--	**509**	--	**varies**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**1.7**	
SB-1-0	11/19/2018	0.0	--	--	--	<0.0043	<0.0043	<0.0043	<0.0086	<0.0043	<0.0043	<0.0043	<0.0043	<0.0086	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SB-1-2	11/19/2018	2.0	--	--	--	<0.0041	<0.0041	<0.0041	<0.0082	<0.0041	<0.0041	<0.0041	<0.0041	<0.0082	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SB-1-4	11/19/2018	4.0	--	--	--	<0.0044	<0.0044	<0.0044	<0.0088	<0.0044	<0.0044	<0.0044	<0.0044	<0.0088	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SB-2-0	11/19/2018	0.0	--	--	--	<0.0041	<0.0041	<0.0041	<0.0082	<0.0041	<0.0041	<0.0041	<0.0041	<0.0082	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SB-2-2	11/19/2018	2.0	--	--	--	<0.0044	<0.0044	<0.0044	<0.0087	<0.0044	<0.0044	<0.0044	<0.0044	<0.0087	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SB-2-4	11/19/2018	4.0	--	--	--	<0.0039	<0.0039	<0.0039	<0.0077	<0.0039	<0.0039	<0.0039	<0.0039	<0.0077	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SB-2-7.5	11/19/2018	7.5	--	--	--	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SB-3-0	11/19/2018	0.0	--	--	--	<0.0045	<0.0045	<0.0045	<0.0089	<0.0045	<0.0045	<0.0045	<0.0045	<0.0089	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SB-3-2	11/19/2018	2.0	--	--	--	<0.0044	<0.0044	<0.0044	<0.0089	<0.0044	<0.0044	<0.0044	<0.0044	<0.0089	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SB-3-4	11/19/2018	4.0	--	--	--	<0.0045	<0.0045	<0.0045	<0.0090	<0.0045	<0.0045	<0.0045	<0.0045	<0.0090	ND	See Note	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SB-3-5.5	11/19/2018	5.5	--	--	--	<0.0045	<0.0045	<0.0045	<0.0090	<0.0045	<0.0045	<0.0045	<0.0045	<0.0090	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Acetone detected at 0.025 mg/kg
SGMF-2-23	11/14/2018	23.0	--	--	--	<3.8	<3.8	<3.8	<7.6	<3.8	<3.8	<3.8	<3.8	<3.8	ND	<3.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Data Gap Assessment 2021																																							
SGMF-5-5	8/25/2021	5.0	--	--	--	<0.00079	<0.00079	<0.00079	<0.0031	<0.00079	<0.00079	<0.00079	<0.00079	<0.00039	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-6-5	8/25/2021	5.0	--	--	--	<0.00093	<0.00093	<0.00093	<0.0037	<0.00093	<0.00093	<0.00093	<0.00093	<0.00047	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-7-5	8/25/2021	5.0	--	--	--	<0.00091	<0.00091	<0.00091	<0.0037	<0.00091	<0.00091	<0.00091	<0.00091	<0.00046	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-8-5	8/23/2021	5.0	--	--	--	<0.00082	<0.00082	<0.00082	<0.033	<0.00082	<0.00082	<0.00082	<0.00082	<0.00041	0.0023	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-8-15	8/24/2021	15.0	--	--	--	<0.00089	<0.00089	<0.00089	<0.036	<0.00089	<0.00089	<0.00089	<0.00089	<0.00044	0.0019	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-9-5	8/23/2021	5.0	--	--	--	<0.00091	<0.00091	<0.00091	<0.0037	<0.00091	<0.00091	<0.00091	<0.00091	<0.00046	0.0022	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-10-5	8/24/2021	5.0	--	--	--	<0.00088	<0.00088	<0.00088	<0.035	<0.00088	<0.00088	<0.00088	<0.00088	<0.00044	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-10-15	8/24/2021	15.0	--	--	--	<0.00084	<0.00084	<0.00084	<0.0034	<0.00084	<0.00084	<0.00084	<0.00084	<0.00042	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-11-5	8/26/2021	5.0	--	--	--	<0.00086	<0.00086	<0.00086	<0.0034	<0.00086	<0.00086	<0.00086	<0.00086	<0.00043	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SGMF-12-5	8/26/2021	5.0	--	--	--	<0.00082	<0.00082	<0.00082	<0.0033	<0.00082	<0.00082	<0.00082	<0.00082	<0.00041	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
P1-4	8/26/2021	4.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND		**4.7**	72	--	5.2	--	**140**	--	+	--	ND	ND	<0.0025		<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	ND	<0.25	<0.25	<0.062	
P1-8	8/26/2021	8.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND	ND	**4.5**	77	--	5.0	--	**300**	--	+	--	ND	+	0.0010		<0.0025	0.0021	<0.0025	<0.0025	<0.05	<0.0025	ND	<0.25	<0.25	<0.062	
P1-12	8/26/2021	12.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND	ND	**5.0**	67	--	9.4	--	**220**	--	+	--	ND	ND	<0.0025		<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	ND	<0.25	<0.25	<0.062	
P2-4	8/26/2021	4.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND	ND	**5.1**	77	--	7.2	--	**140**	--	+	--	ND	ND	<0.0025		<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	ND	<0.25	<0.25	<0.062	
P2-8	8/26/2021	8.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND	ND	**4.1**	42	--	3.8	--	**95**	--	+	--	ND	ND	<0.0025		<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	ND	<0.25	<0.25	<0.062	
P2-12	8/26/2021	12.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND	ND	**5.0**	81	--	6.4	--	**180**	--	+	--	ND	ND	<0.0025		<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	ND	<0.25	<0.25	<0.062	
P3-4	8/26/2021	4.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND	ND	**11.0**	70	--	16	--	**150**	--	+	--	ND	ND	<0.0025		<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	ND	<2	<2	<0.5	
P3-8	8/26/2021	8.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND	ND	**3.4**	**160**	--	2.6	--	**670 b**	--	+	--	ND	ND	<0.0025		<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	ND	<0.25	<0.25	<0.062	
P3-12	8/26/2021	12.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND	ND	**4.9**	47	--	5.9	--	**150**	--	+	--	ND	ND	<0.0025		<0.0025	<0.0025	<0.0025	<0.0025	<0.05	<0.0025	ND	<0.25	<0.25	<0.062	
P4-4	8/23/2021	4.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND	ND	**4.1**	69	--	6.3	--	**130**	--	+	--	ND	+	<0.0025		<0.0025	<0.0025	0.0280	0.0017	<0.05	<0.0025	ND	<0.25	<0.25	<0.062	
P4-8	8/24/2021	8.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND	ND	**4.0**	120	--	4.2	--	**340**	--	+	--	ND	+	<0.0025		<0.0025	<0.0025	0.0340	<0.0013	<0.05	<0.0025	ND	<0.25	<0.25	<0.062	
P4-12	8/24/2021	12.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND	ND	**5.8**	72	--	5.2	--	**310**	--	+	--	ND	+	<0.0025		<0.0025	<0.0025	<0.0025	<0.0013	0.054	<0.0025	ND	<0.25	<0.25	<0.062	
P5-4	8/24/2021	4.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND	ND	**3.1**	41	--	6.7	--	**99**	--	+	--	ND	+	<0.0025		<0.0025	<0.0025	<0.0025	0.0390	<0.05	<0.0025	ND	<0.25	<0.25	<0.062	
P5-8	8/24/2021	8.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND	ND	**4.6**	51	--	6.8	--	**490**	--	+	--	ND	+	0.0031		0.0030	0.0028	<0.0025	0.0045	<0.05	0.0028	ND	<0.25	<0.25	<0.062	
P5-12	8/24/2021	12.0	<1.0	<2.0	<10.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00025	ND	ND	**6.0**	80	--	7.0	--	**160**	--	+	--	ND	+	<0.0025		<0.0025	<0.0025	<0.0025	0.0032	<0.05	<0.0025	ND	<0.25	<0.25	<0.062	

Notes and Abbreviations:

TPH = total petroleum hydrocarbons as gasoline (TPHg), diesel (TPHd), and/or motor oil (TPHmo) range

PCE = tetrachloroethene

TCE = trichloroethene

DCE = dichloroethene

Other VOCs = volatile organic compounds not otherwise listed

ft bgs = feet below ground surface

mg/kg = milligrams per kilogram

< n = Chemical not present at a concentration in excess of detection limit shown.

+ = chemicals detected at relatively low concentrations. See laboratory reports for details.

-- = not applicable

ND = Not Detected at levels above laboratory reporting limits. Limits vary by constituent.

ESL = Environmental Screening Levels. Established by the SFBRWQCB, Interim Final - Revised Feb 2016.

1 = background levels (except arsenic) taken from Bradford (1996) "Background Concentrations of Trace and Major Elements in California Soils." Arsenic background taken from "Establishing Background Arsenic in Soil of the Urbanized San Francisco Bay Region," by Dylan Jacques Duverge (December 2011).

BOLD = Analyte detected above Tier 1 ESL, except total lead is bold above the residential human health direct exposure ESL of 80 mg/kg (and STLC > 5 mg/L).

GREY HIGHLIGHT = Analyte concentration exceeds construction worker ESL and background level if applicable (see notes a, b).

RED HIGHLIGHT = Analyte concentration exceeds criteria for waste soil classification as Class I Non-RCRA (California) hazardous waste.

a = 95UCL concentration of lead (75 mg/kg for the April 2018 BSK data set, and 68 mg/kg in Old Train Depot specific soil) is below the residential ESL for soil (80 mg/kg) and construction ESL for soil (160 mg/kg).

b = Only two detected concentrations of nickel in soils exceeds background (509 mg/kg); the 95 UCL concentration of nickel in Old Train Depot site soil is 162 mg/kg.

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Table C-2 - Groundwater Analytical Data - Livermore Downtown Core Development, Livermore, California

Sample / Boring ID	Date Sampled	TOC Elevation (ft amsl)	Sample Depth / Screened Interval (ft bgs)	Depth to Water (feet below TOC)	Groundwater Elevation (feet amsl)	TPHg	TPHd	TPHmo	Benzene	Naphthalene	PCE	TCE	Cis-1,2-DCE	Trans-1,2-DCE	Vinyl Chloride	Chloroform	Other VOCs	Notes
						← µg/L →												
					Tier 1 ESL:	**100**	**100**	**--**	**0.42**	**0.17**	**0.64**	**1.2**	**6.0**	**10**	**0.0086**	**0.81**	**--**	
					MCL:	**--**	**--**	**--**	**5.0**	**17**	**5.0**	**5.0**	**70**	**100**	**2.0**	**--**	**--**	
Monitoring Wells, 2021																		
MW-1	9/22/2021	487.49	55-60	52.00	435.49	<50	**1,600**	1,700	<0.2	<0.3	**3.3**	<0.50	<0.5	<0.5	<0.0050	0.14	--	
MW-2	9/22/2021	486.26	60-72	51.57	434.69	<50	<100	<500	<0.2	<0.3	<0.20	0.98	0.63	0.83	**0.086**	<0.1	+	1,1-DCE detected at 0.047 µg/L
MW-3	9/22/2021	484.50	60-72	50.53	433.97	<50	<100	<500	<0.2	<0.3	**2.3**	<0.5	<0.5	<0.5	**0.65**	<0.1	--	
MW-4	9/22/2021	484.31	62-67	51.29	433.02	<50	<100	<500	<0.2	<0.3	**5.6**	<0.5	<0.5	<0.5	<0.0050	**1.1**	--	
MWMF-5	9/22/2021	481.90	62-72	51.74	430.16	<50	<100	<500	<0.2	<0.3	**7.5**	<0.5	<0.5	<0.5	<0.0050	0.460	--	
MWMF-6	9/22/2021	482.87	62-72	51.11	431.76	<50	<100	<500	<0.2	<0.3	**5.8**	<0.5	<0.5	<0.5	<0.0050	0.850	--	
Dup	9/22/2021	482.87	62-72	51.11	431.76	<50	<100	<500	<0.2	<0.3	**6.1**	<0.5	<0.5	<0.5	<0.0050	0.860	--	
Grab Groundwater Samples, 2021																		
MWMF-6-54	8/5/2021	--	54	--	--	<50	<50	<250	<0.2	<0.3	**8.1**	<0.5	<0.5	<0.5	<.005	**1.0**	--	
HP-5-MF54	9/8/2021	--	54	--	--	--	--	--	<0.2	<0.3	**7.4**	<0.5	<0.5	<0.5	<.005	0.260	--	no TPH information in lab PDF
HP-6-MF56	8/12/2021	--	56	--	--	<50	<50	<250	<0.2	<0.3	**8.9**	<0.5	<0.5	<0.5	<.005	**1.3**	--	
HP-7-MF54	8/5/2021	--	54	--	--	<50	<50	<250	<0.5	<1.8	**9.5**	<0.21	<0.22	<0.24	<0.3	<0.18	--	
HP-7-MF72	8/9/2021	--	72	--	--	<50	<50	<250	<0.2	<0.3	**8.8**	<0.5	<0.5	<0.5	<.005	0.25	--	
HP-8-MF71	8/18/2021	--	71	--	--	<50	**140**	450	<0.2	<0.3	**6.4**	<0.5	<0.5	<0.5	<.005	0.30	--	
HP-11-MF72	8/14/2021	--	72	--	--	<50	64	<250	<0.2	<0.3	**2.3**	<0.5	<0.5	<0.5	<.005	0.29	--	
HP-7-JC	8/18/2021		60-64	--	--	<50	<50	<250	<0.2	<0.3	**1.2**	<0.5	<0.5	<0.5	<0.005	**1.1**	--	
HP-8-JC	8/18/2021		60-64	--	--	<50	**94**	**310**	<0.2	<0.3	**3.0**	<0.5	<0.5	<0.5	<0.005	**1.2**	--	
Monitoring Wells, 2018																		
MW-1	7/26/2018	487.49	55-60	37.03	43269.97	**--**	--	--	0.613	0.146	**3.05**	<0.101	<0.114	<0.104	<0.129		+	
MW-2	7/26/2018	486.26	60-72	36.64	43270.36	**--**	--	--	<0.102	0.126	<0.157	0.920	1.29	1.67	<0.129		+	
MW-3	7/26/2018	484.50	60-72	35.56	43271.44	**--**	--	--	<0.102	**0.202**	0.303	0.391	1.02	2.33	**4.14**		+	
MW-4	7/26/2018	484.31	62-67	36.71	43270.29	**--**	--	--	<0.102	0.117	**10.2**	0.138	<0.114	<0.104	<0.129		+	
Grab Groundwater Samples, 2018																		
B-2 (MW-1)	6/18/2018		55-60	--	--	<50	96	<250	<0.50	<0.50	**11**	<0.50	<0.50	<0.50	<0.50		--	
HP-1-QC	########		62-70	46.90	--	**--**	--	--	<0.5	<2.0	**7.0**	<0.5	<0.5	<0.5	<0.5		+	Up/crossgradient of site
HP-2-QC	11/8/2018		56-68	45.80	--	**--**	--	--	<3.31	**97.3**	<3.72	<3.98	<2.60	<3.96	<2.59		+	Upgradient of site
HP-3-QC	11/8/2018		66-70	49.10	--	**--**	--	--	<0.331	<1.0	**8.43**	<0.398	<0.260	<0.396	<0.259		--	Downgradient of site
HP-4-QC	11/8/2018		66-70	52.00	--	**--**	--	--	<0.331	<1.0	**3.21**	1.20	<0.260	<0.396	<0.259		--	Downgradient of site
HP-5-QC	########		66-70	45.30	--	**--**	--	--	<0.5	<2.0	**7.6**	<0.5	<0.5	<0.5	<0.5		+	Downgradient of site
Multifamily Grab Groundwater Samples, 2018																		
HP-1-MF	########		66-70	50.10	--	**--**	--	--	<0.5	<2.0	**16**	<0.5	<0.5	<0.5	<0.5		+	
HP-2-MF	########		66-70	46.80	--	**--**	--	--	<0.5	<0.5	**4.6**	<0.5	<0.5	<0.5	<0.5		+	
HP-3-MF	########		62-70	52.00	--	**--**	--	--	<0.5	<0.5	**10**	<0.5	<0.5	<0.5	<0.5		+	
J Cleaners Grab Groundwater Samples, 2018																		
HP-1-JC	########		58-64.2	47.20	--	**--**	--	--	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5		+	
HP-2-JC	########		60-64	46.85	--	**--**	--	--	<0.5	<2.0	2.7	<0.5	<0.5	<0.5	<0.5		+	
HP-3-JC	########		60-64	45.10	--	**--**	--	--	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5		+	
HP-4-JC	########		60-64	45.55	--	**--**	--	--	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5		+	
HP-5-JC	########		60-64	45.40	--	**--**	--	--	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5		+	
HP-6-JC	########		60-64	44.90	--	**--**	--	--	<0.5	<2.0	0.7	<0.5	<0.5	<0.5	<0.5		+	

2009-2111 Railroad Ave, Fugro, May 2005														
B-1	5/2/2005	31-35	--	--	**160**	<62	<62	<0.5	**19**	<0.5	<0.5	<0.5	<0.5	ND
	5/2/2005	40-44	--	--	**160**	**330**	480	<0.5	**18**	<0.5	<0.5	<0.5	<0.5	ND
B-2	5/2/2005	31-35	--	--	<50	**230**	72	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	ND
B-3	5/2/2005	31-35	--	--	**160**	<56	<56	<0.5	**6.8**	<0.5	<0.5	<0.5	<0.5	ND
B-4	5/2/2005	31-35	--	--	**170**	<57	<57	<0.5	**34**	1.0	<0.5	<0.5	<0.5	ND
B-6	5/2/2005	31-35	--	--	**170**	<56	<56	<0.5	**31**	0.91	<0.5	<0.5	<0.5	+
B-7	5/2/2005	31-35	--	--	**210**	**220**	130	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	+
2044 & 2048 First St, Fugro, December 2007														
A2-1	12/4/2007	54-56	--	--	--	--	--	--	1.8	2.7	**19**	**20**	**7.7**	--
Quality Control Samples														
Duplicate-1(B-1)	5/2/2005	31-35	--	--	**160**	--	--	<0.5	**21**	<0.5	--	--	--	ND
Duplicate-2(B-3)	5/2/2005	31-35	--	--	**150**	<54	56	<0.5	**4.8**	<0.5	--	--	--	ND
Duplicate-3(B-4)	5/2/2005	31-35	--	--	**160**	<59	<59	<0.5	**32**	0.88	--	--	--	ND

Notes & Abbreviations:

TOC Elevation - Top of casing elevation surveyed by City of Livermore contracted surveyors using NAVD 88 benchmark elevation.
TPH = total petroleum hydrocarbons as gasoline (TPHg), diesel (TPHd), and/or motor oil (TPHmo) range
PCE = tetrachloroethene
TCE = trichloroethene
DCE = dichloroethene
Other VOCs = volatile organic compounds not otherwise listed
ft bgs = feet below ground surface
µg/L = micrograms per Liter
< n = Chemical not present at a concentration in excess of detection limit shown.
-- = not applicable
ND = Not Detected at levels above laboratory reporting limits. Limits vary by constituent.
ESL = Environmental Screening Levels. Established by the SFBRWQCB, Interim Final - Revised 2019.
BOLD = Analyte detected above Tier 1 ESL.

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Table C-3. Soil Gas Analytical Data - Livermore Downtown Core

Boring / Sample ID	Date Sampled	Sample Depth (ft bgs)	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	Benzene	Ethylbenzene	TPH (Low Fraction)	2-Propanol (Leak Check)	Other VOCs	Notes
			µg/m³										
Residential ESL for Vapor Intrusion Human Health Risk:			**240**	240	4,200	42,000	4.7	48	560	--	--	--	
Commercial ESL for Vapor Intrusion Human Health Risk:			**2,100**	3,000	35,000	350,000	160	420	4,900	--	--	--	
Pangea, September 2021													
SG-4-20	9/14/2021	20	**606**	<1.07	<0.793	<0.793	<0.511	<0.639	1.66	<826	6.39	a	
SG-5-5	9/16/2021	5	**49.5**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<826	3.32	a	
SGMF-1-5	9/14/2021	5	**183**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<826	3.17	a	
SGMF-2-15	9/14/2021	15	**451**	1.24	<0.793	<0.793	<0.511	2.18	<0.867	1,060	5.58	a	
SGMF-3-15	9/16/2021	15	**3,300**	1.44	<0.793	<0.793	<0.511	<0.639	<0.867	2,260	14.30	a	
SGMF-3-25	9/16/2021	25	**4,180**	1.97	<0.793	<0.793	<0.511	<0.639	<0.867	3,020	20.00	a	
SGMF-3-25-DUP	9/16/2021	25	**3,350**	2.79	<0.793	<0.793	<0.511	<0.639	<0.867	2,290	36.40	a	
SGMF-4-5	9/14/2021	5	**1,330**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	1,210	3.91	a	
SGMF-4-15	9/14/2021	15	**767**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	1,100	5.68	a	
SGMF-4-15-DUP	9/14/2021	15	**657**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<826	5.28	a	
SGMF-5-5	9/16/2021	5	**1,180**	1.18	<0.793	<0.793	<0.511	<0.639	<0.867	1,320	<3.07	a	
SGMF-6-5	9/16/2021	5	**621**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	946	<3.07	a	
SGMF-7-5	9/14/2021	5	**454**	<1.07	<0.793	<0.793	<0.511	0.850	<0.867	901	6.29	a	
SGMF-8-5	9/16/2021	5	**612**	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<826	23.60	a	
SGMF-8-15	9/16/2021	15	**1,190**	4.20	<0.793	<0.793	<0.511	0.917	<0.867	1,070	15.20	a	
SGMF-9-5	9/16/2021	5	**5,190**	2.65	<0.793	<0.793	<0.511	<0.639	<0.867	2,160	60.00	a	
SGMF-10-5	9/16/2021	5	**754**	1.69	<0.793	<0.793	<0.511	<0.639	<0.867	1,280	25.80	a	
SGMF-10-15	9/16/2021	15	**1,150**	<1.07	<0.793	<0.793	<0.511	2.66	<0.867	1,260	9.29	a	
SGMF-11-5	9/16/2021	5	**273**	<1.07	<0.793	<0.793	<0.511	0.69	1.29	<826	3.44	a	
SGMF-12-15	9/16/2021	15	14.3	<1.07	<0.793	<0.793	<0.511	**5.43**	<0.867	<826	<3.07	a	
SHROUD 1	9/16/2021	--	--	--	--	--	--	--	--	--	59500	--	
SHROUD 2	9/16/2021	--	--	--	--	--	--	--	--	--	102000	--	
J Cleaners, Pangea, November 2018													
SGJC-1-5	11/27/2018	4.5-5.5	122	<1.07	<0.793	<0.793	<0.511	0.845	2.35		4.90	+	
SGJC-2-5	11/27/2018	4.5-5.5	**322**	<1.07	<0.793	<0.793	<0.511	<0.639	1.76		<3.07	+	
MultiFamily, Pangea, November 2018													
SGMF-1-5	11/27/2018	4.5-5.5	56.5	<1.07	<0.908	<0.908	<0.511	<0.639	2.18	<207	7.11	+	
SGMF-2-5	11/27/2018	4.5-5.5	108	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	<207	38.9	+	
SGMF-2-15	11/27/2018	14.5-15.5	809	<1.07	<0.793	<0.793	<0.511	2	<0.867	960	<3.07	+	
SGMF-2-25	11/27/2018	24.5-25.5	**1,850**	3.9	<0.793	<0.793	<0.511	58	1.10	3,870	8.23	+	
SGMF-3-15	11/28/2018	14.5-15.5	**1,860**	1.4	<0.793	<0.793	<0.511	2.1	<0.867	2,130	28.7	+	
SGMF-3-25	11/28/2018	24.5-25.5	**5,340**	7.2	<0.793	<0.793	<0.511	5.0	<0.867	3,680	4.86	+	
SGMF-4-5	11/28/2018	4.5-5.5	**387**	<1.07	<0.793	<0.793	<0.511	0.863	4.19	611	14.5	+	
SGMF-4-55	11/28/2018	14.5-15.5	**1,070**	<1.07	<0.793	<0.793	<0.511	3.55	10.60	1,540	96.1	+	
SGMF-4-25	11/28/2018	24.5-25.5	**3,320**	12.0	<0.793	0.826	<0.511	14.1	22.10	4,080	7.87	+	
2048 First St, Pangea, November 2018													
SGQC-1-5	11/8/2018	4.5-5.5	380	<1.07	<0.793	<0.793	<0.511	14.3	3.19	811	25.9	+	
SGQC-2-5	11/8/2018	4.5-5.5	103	<1.07	<0.793	<0.793	<0.511	17.8	12.7	1,870	<3.30	+	
SGQC-2-15	11/8/2018	14.5-15.5	1,150	1.44	<0.793	<0.793	<0.511	18.2	3.30	2,080	15.4	+	
SGQC-3-5	11/8/2018	4.5-5.5	584	<1.07	<0.793	<0.793	<0.511	14	1.91	2,670	<3.07	+	
SGQC-3-15	11/8/2018	14.5-15.5	346	<1.07	<0.793	<0.793	<0.511	4.37	1.26	1,410	5.79	+	
SGQC-4-15	11/12/2018	14.5-15.5	2,010	<1.07	<0.793	<0.793	<0.511	2.02	<0.867	2,090	4.80	+	
SGQC-4-30	11/12/2018	29.5-30.5	1,270	<1.07	<0.793	<0.793	<0.511	3.25	8.43	3,570	<3.07	+	
SGQC-4-30 (REP)	11/12/2018	29.5-30.5	1,030	<1.07	<0.793	<0.793	<0.511	3.00	5.97	3,310	<3.07	+	
SGQC-5-5	11/9/2018	4.5-5.5	49.9	<1.07	<0.793	<0.793	<0.511	4.99	11.3	845	26.7	+	
SGQC-5-15	11/9/2018	14.5-15.5	313	1.29	<0.793	<0.793	<0.511	13.8	12.0	3,530	4.71	+	
SGQC-5-30	11/9/2018	29.5-30.5	157	1.56	<0.793	<0.793	<0.511	117	69.9	15,000	<3.07	+	
SGQC-6-5	11/9/2018	4.5-5.5	318	<1.07	<0.793	<0.793	<0.511	27.1	43.6	4,060	8.90	+	
SGQC-6-15	11/9/2018	14.5-15.5	111	<1.07	<0.793	<0.793	<0.511	115	115	10,200	160	+	
SGQC-6-30	11/9/2018	29.5-30.5	690	27.8	<0.793	4.39	0.802	86.5	110	8,890	<3.07	+	
SGQC-7-5	11/9/2018	4.5-5.5	100	<1.07	<0.793	<0.793	<0.511	2.65	3.01	360	9.12	+	
SGQC-7-15	11/9/2018	14.5-15.5	1,010	<1.07	<0.793	<0.793	<0.511	11.6	3.11	1,400	59.8	+	
SHROUD	11/12/2018	--	--	--	--	--	--	--	--		########	--	
2048 First St, Pangea, August 2018													
Soil Gas Data													
SG-1-8	8/13/2018	7-8	**5,630**	2.41	<0.793	<0.793	<0.511	<0.639	<0.867	600	5.63	+	
SG-2-8	8/13/2018	7-8	780	<1.07	<0.793	<0.793	<0.511	2.90	2.31	632	<3.07	+	
SG-1A-10	8/13/2018	9-10	**4,560**	1.19	<0.793	<0.793	<0.511	2.03	1.01	678	4.21	+	
SG-2A-10	8/13/2018	9-10	778	<1.07	<0.793	<0.793	<0.511	2.07	<0.867	610	<3.07	+	
Sub-slab Gas Data													
SS-1	8/2/2018	0.5	**5,470**	1.95	<0.793	<0.793	<0.511	<0.639	<0.867	1,040	361	+	
SS-2	8/2/2018	0.5	**6,040**	2.13	<0.793	<0.793	<0.511	<0.639	<0.867	863	1,570	+	1.1% IPA in sample, Naphthalene detected at 6.19 µg/m3
SS-3	8/2/2018	0.5	1,080	1.97	<0.793	<0.793	<0.511	<0.639	<0.867	894	415	+	Naphthalene detected at 3.31 µg/m3
SS-3	8/2/2018	0.5	1,020	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	877	198	+	Duplicate Sample

Pangea

Table C-3. Soil Gas Analytical Data - Livermore Downtown Core

Boring / Sample ID	Date Sampled	Sample Depth (ft bgs)	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	Benzene	Ethylbenzene	TPH (Low Fraction)	2-Propanol (Leak Check)	Other VOCs	Notes
			µg/m³										
Residential ESL for Vapor Intrusion Human Health Risk:			**240**	240	4,200	42,000	4.7	48	560	--	--	--	
Commercial ESL for Vapor Intrusion Human Health Risk:			**2,100**	3,000	35,000	350,000	160	420	4,900	--	--	--	
SS-4	8/2/2018	0.5	859	<1.07	<0.793	<0.793	<0.511	5.37	0.910	1,190	458	+	Naphthalene detected at 4.66 µg/m3
SS-5	8/2/2018	0.5	317	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	729	223	+	
Various Addresses, Pangea, June 2018													
SG-4-5	6/22/2018	5.0	309	<1.07	<0.793	<0.793	<0.511	0.997	2.35	551	5.04	+	
SG-4-20	6/22/2018	20.0	420	<1.07	<0.793	<0.793	<0.511	2.70	0.954	1,900	<3.07	+	
SG-5-5	6/21/2018	5.0	34.6	<1.07	<0.793	<0.793	<0.511	0.676	<0.867	512	4.70	+	
SG-6-5	6/21/2018	5.0	168	<1.07	<0.793	<0.793	<0.511	<0.639	1.27	329	242	+	
SG-7-5	6/21/2018	5.0	73.2	<1.07	<0.793	<0.793	<0.511	2.29	8.53	731	4.16	+	
SG-8-5	6/21/2018	5.0	**3,460**	2.94	<0.793	<0.793	<0.511	2.34	16.6	2,480	16.8	+	
SG-9-5	6/22/2018	5.0	340	<1.07	<0.793	<0.793	<0.511	1.59	3.98		28.9	+	Bromodichloromethane=1.91, Chloroform=3.98
SG-10-5	6/22/2018	5.0	14.4	<1.07	<0.793	<0.793	<0.511	<0.639	<0.867	255	<3.07	+	
SG-11-5	6/22/2018	5.0	1,700	<1.07	<0.793	<0.793	<0.511	1.18	7.10	2,170	54.4	+	Methylene Chloride = 1.85
SG-12-5	6/22/2018	5.0	5.29	<1.07	<0.793	<0.793	<0.511	2.67	3.68	402	<3.07	+	
SG-13-5	6/22/2018	5.0	40.0	<1.07	<0.793	<0.793	<0.511	0.976	7.45	444	21.6	+	
SG-13-5	6/22/2018	5.0	46.2	<2.14	<1.59	<1.59	<1.02	<1.28	4.79	<413	11.1	+	Replicate Sample
SG-14-5	6/22/2018	5.0	10.6	<2.14	<1.59	<1.59	<1.02	<1.28	1.83	<413	117	+	
SG-15-10	6/22/2018	10.0	1.89	<1.07	<0.793	<0.793	<0.511	25.2	8.73	2,060	<3.07	+	
SG-17-10	6/22/2018	10.0	<1.36	<1.07	<0.793	<0.793	<0.511	1.05	<0.867	285	<3.07	+	
Shroud Sample Data													
Shroud	6/22/2018	--	--	--	--	--	--	--	--	--	219,000	--	
	8/2/2018	--	--	--	--	--	--	--	--	--	135,000	--	
	8/13/2018	--	--	--	--	--	--	--	--	--	215,000	--	
	11/28/2018	--	--	--	--	--	--	--	--	--	150,000	--	

Explanation:

PCE = Tetrachloroethene

TCE = Trichloroethene

DCA = Dichloroethane

DCE = Dichloroethene

TCA = Trichloroethane

Other VOCs = Volatile organic compounds by EPA Method TO-15 or EPA Method 8260 (8010 basic target list).

VLP = Various Location Permitted equipment with Bay Area Air Quality Management District

µg/m3 = Micrograms per cubic meter of air results calculated by laboratory from parts per billion results using normal pressure and temperature (NPT).

ft bgs = feet below ground surface.

< n = Chemical not present above laboratory detection limit.

-- = Not analyzed

ESL = Environmental Screening Level, from California Regional Water Quality Control Board - San Francisco Bay Region, *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater,* Interim Revised February 2016 (Revision 3).

Bold = Concentrations above ESLs for Commercial Land Use for shallow soil gas (SG samples).

+ = chemicals detected at relatively low concentrations. See laboratory reports for details.

APPENDIX D

Health and Safety Guidelines Fact Sheet

Community Protection Measures Fact Sheet
Old Train Depot Site
2009 to 2073 Railroad Avenue, Livermore, CA
Spring 2022

On behalf of the City of Livermore, Eden Housing, Inc. and its contractors will be preparing the former Old Train Depot Site, located at 2009-2073 Railroad Avenue, for development as part the larger Livermore Downtown Core development project. Work at the Site includes constructing two buildings with 130 units of affordable housing over underground parking.



Community Protection Measures

The San Francisco Regional Water Quality Control Board (Water Board) recently concurred with the finding that the project, as planned, will be protective of future site users. The Water Board also requested preparation of a Site Management Plan (SMP) to ensure protection of human health at the property by establishing procedures and protocols to be followed during construction and post-construction.

The SMP developed by the City of Livermore helps ensure that chemicals (e.g., petroleum and metals) in soil and groundwater from historical site uses and uses at other nearby sites are safely managed and disposed of should they be encountered during site development. The SMP will also include protocols for confirmation testing to demonstrate that volatile organic compounds in soil gas (air in between soil particles) do not pose a risk to future occupants. While it is unlikely that groundwater will be encountered during construction, this contingency has been addressed, as well.

This plan has been reviewed and approved by the Water Board and includes procedures for the following:

- Safe handling, management and disposal of contaminated soil or groundwater;
- Conducting real-time and perimeter air monitoring during all soil disturbing work;
- Controlling dust and odors by using water, foam, and securely covering soil stockpiles;
- Limiting vehicle speeds to 15 miles per hour on unpaved roads and minimizing idling times;
- Cleaning truck-tires and undercarriages and using rumble strips to prevent track out of soil;
- Controlling storm water runoff using various site controls including straw wattles and frequent inspections;
- Following a City of Livermore approved truck route when removing soil from the Site;
- Using flaggers and traffic signage to safely manage construction-related traffic; and
- Installing fencing and signage with a number to call for more information.

Protecting Future Residents

The Water Board has confirmed that the residential buildings are designed to protect the environmental health of future site residents. This will be confirmed through pre-occupancy testing.

If the tests warrant additional evaluation, after verification contingency measures (such as increasing air flow rates in garage ventilation) may be implemented with oversight from the Water Board to ensure protection of human health. Pre-occupancy testing and development of contingency measures before residents move in is a standard best practice in these situations.

For More Information

For more information, please contact Tracy Craig at (510) 334-4866 (24/7) or tracy@craig-communications.com. Information on the proposed development project at the Site is also available at the City of Livermore website: https://www.cityoflivermore.net/government/community-development/downtown-eden-housing-project.

APPENDIX E

SFRWQCB Draft Import Fill Material Guidance

REGIONAL WATER BOARD FILL MATERIAL DEFINITIONS

Scope of Guidance

The purpose of this document is to provide guidance regarding fill material import for use as fill in upland areas at cleanup sites and closed landfills under regulatory oversight by the Regional Water Board. This guidance does not apply to wetlands, sensitive environments, jurisdictional waters of the State or US, or areas with the potential presence of special status species/habitats without permits or additional considerations—even clean import fill material should not be placed in these types of environments without appropriate permits. For placement of fill material in aquatic environments, Regional Water Board's Watershed Division staff should be consulted during initial planning prior to placement. The criteria for placement in aquatic environments likely will be different from upland placement. Potentially applicable criteria are in *Staff Report – Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines* (Regional Water Board 2000).

Clean Import Soil

Clean import soil consists of natural materials (e.g., topsoil, clay, silt, sand, gravel, rock, or a mixture or combination of such materials) that have concentrations of naturally occurring chemicals (e.g., metals) at or below the native background soil concentrations at the receiving site while concentrations of manmade chemicals are absent (e.g., not detected at reasonable laboratory detection limits). Clean soil is also free of trash, debris, and construction material. Clean import soil does not include coal or other carbonaceous material. Clean import soil is suitable for unrestricted use at cleanup sites and closed landfills considering the scope of this guidance.

Acceptable Import Soil

The Regional Water Board recognizes that, in the Bay Area, it can be challenging to locate sources of import soil that meet the definition of "clean" due to manmade influences (e.g., aerial deposition of incomplete combustion of fuels from automobiles, agricultural pesticide applications). Therefore, the term "acceptable" has been developed to describe soil that has value for use as fill material and is not a waste. The levels of chemicals in acceptable soil affect how and where that soil can be used or placed. Acceptable soil quality spans a range from clean soil and soil with trace levels of chemicals suitable for placement with limited or no restrictions to marginally contaminated soil suitable for specifically defined uses where exposure pathways and

environmental concerns are mitigated by institutional controls (e.g., soil management plan, deed restriction), defined placement (e.g., beneath hardscape buildings, away from buildings), and/or engineering controls (e.g., cover, engineered cap). The general characteristics of acceptable soil are described below along with two categories of acceptable soil.

- General Characteristics – Natural materials (e.g., soil, clay, silt, sand, gravel, rock, or a mixture or combination of such materials) free of contaminants that would classify it as a waste, visible signs of trash, debris, staining, liquids, or construction material.

- Exposure Pathways and Environmental Concerns – An import soil quality evaluation should be conducted that identifies relevant exposure pathways (e.g., human health direct exposure) or concerns (e.g., nuisance) and discusses whether a risk or threat is posed, respectively. Such evaluations typically consist of qualitative discussions, comparison to screening levels, other testing or mitigation measures/controls. The following is a list of potentially relevant exposure pathways and concerns that should be evaluated when developing and import fill plan. The list below additionally indicates whether the Soil Environmental Screening Levels (ESLs; Regional Water Board 2019a, b, c) could be used to evaluate fill import soil:

    - Human health direct exposure (ingestion, inhalation, dermal contact) – Can be evaluated using the Soil Direct Exposure Human Health Risk ESLs

    - Ecological receptor direct exposure (ingestion, inhalation, dermal contact) – Can be evaluated using the Soil Terrestrial Habitat ESLs.

    - Nuisance – Can be evaluated using the Soil Odor Nuisance ESLs

    - Gross Contamination – Can be evaluated using the Soil Gross Contamination ESLs

    - Chemical migration to a receptor or water body with beneficial uses for the following:

        - Leaching/erosion into surface water – Cannot be evaluated using the Soil ESLs. It is commonly addressed by use of best management practices and/or placement beneath cover materials.

        - Leaching/erosion into groundwater – Can be evaluated using the Soil Leaching to Groundwater ESLs for drinking water or non-drinking water exposures (i.e., ecological concerns, groundwater discharge to surface water). In some cases, the target groundwater pathways used in the

calculation of the Leaching to Groundwater ESLs can be modified (e.g., if the soil is to be placed in an area with where there will be no enclosed structures, the values could be manually re-calculated to remove the Groundwater Vapor Intrusion Human Health Risk Levels). For metals for leaching and subsequent drinking water exposure, the USEPA Resident Soil to Groundwater RSLs can be used. An example alternative approach to the use of screening levels is leaching tests (e.g., Waste Extraction Test with deionized water).

- Vapor intrusion into buildings – Cannot be evaluated using the Soil ESLs. It is typically addressed by evaluation of the import source property, review of any available soil gas data for that property, and either lack of detections or detections below the residential soil ESLs. It can also be addressed by in-situ soil gas sampling at the import source property. Soil containing volatile chemicals generally should not be placed beneath or close to buildings.

- Soil Quality and Use Categories – There are two categories of acceptable soil, Category 1 and Category 2.
  - Category 1 (Surface Placement)
    - Average concentrations (e.g., 95% upper confidence limit of the mean or 95UCL) of naturally occurring chemicals (e.g., metals) do not exceed regional background levels. Regional Water Board recommended regional background levels for metals except for arsenic are from Lawrence Berkeley National Laboratory (2002). For arsenic, the recommended regional background level of 11 milligrams per kilogram is from Duverge (2011).
    - Average concentrations of manmade chemicals (except petroleum-motor oil) do not exceed Tier 1 ESLs.
    - Average concentrations of petroleum-motor oil do not exceed 500 mg/kg. The petroleum-motor oil value of 500 mg/kg is used instead of the Tier 1 ESL because: (1) the Tier 1 ESL is based on gross contamination (i.e., significantly contaminated); (2) total petroleum hydrocarbon oil range detections can result from oils picked up during handling or interferences to the analytical method from naturally occurring organic matter; and (3) this value is achievable based on our experience at cleanup sites under our oversight that have imported fill.

- Category 2 (Subsurface Placement) – Category 2 soil is acceptable provided each pathway/concern listed in "Exposure Pathways and Environmental Concerns" is addressed by one of the following:
  - The average concentrations (95UCL) of chemicals present in the soil do not exceed relevant ESLs for the exposure pathway/concern, or
  - The placement location, institutional controls (e.g., deed restriction, management plan), engineering controls and/or other relevant site conditions may mitigate the exposure pathway/concern. For example, rather than the soil leaching to groundwater pathway being addressed by meeting the leaching ESLs, the pathway is addressed because the import soil will be placed beneath a low-permeability cover that will limit infiltration, stormwater controls will limit runoff to surface water, the import soil placement location is documented, and a deed restriction and risk management plan will be in place. For volatile chemicals and the vapor intrusion pathway, placement beneath buildings actually raises rather than mitigates the level of concern. Placement of soil with detections of volatile chemicals is discouraged or, alternatively, warrants a detailed evaluation of risk.

Unacceptable Import Soil

Material with any of the following characteristics will be deemed unacceptable by the Regional Water Board for import:

- Is a waste considering the following:
  - Meets the definition of a hazardous waste (state or federal) – The potential for inadvertent import of hazardous waste can be screened using a value of ten times the soluble limit threshold concentration (STLC) for a given chemical.
  - Meets the definition of "designated" waste under section 13173 of California Code of Regulations Title 27
  - Exceeds the Criteria for Disposal of Contaminated Soils to Unlined Disposal Cells in Waste Discharge Requirements Order No. R2-2020-0023
  - Contains free anthropogenic liquids based on visual inspection
- Includes trash, debris (e.g., lumber, metal), or animal/human waste
- Contains chemicals from human activity at concentrations that present significant threats for relevant ecological and human exposure pathways or concerns.

Other Considerations

The following may be pertinent when selecting values:

- Lack of ESLs for a Chemical – The hierarchy for choosing screening levels based on availability for a given chemical should be (1) ESLs, (2) DTSC Soil SLs (residential or commercial/industrial, as appropriate), then (3) USEPA RSLs (residential or industrial, as appropriate).
- Laboratory Reporting Limits – Method detection limits and laboratory reporting limits for individual chemicals are not directly considered in development of the ESLs. See ESL User's Guide Section 12.6.1 for options when the ESLs are below laboratory reporting limits.

References

Duvergé, D.J., 2011. Establishing Background Arsenic in Soil of the Urbanized San Francisco Bay Region. Master's thesis, San Francisco State University

Lawrence Berkeley National Laboratory. 2002 (Revised April 2009). Analysis of Background Distributions of Metals in the Soil at Lawrence Berkeley National Laboratory. Environmental Restoration Program (Prepared by D. Diamond, D. Baskin, D. Brown, L. Lund, J. Najita and I. Javandel). June.

Regional Water Board. 2000. Draft Staff Report – Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines – For Planning Purposes Only. California Environmental Protection Agency, Regional Water Board. (Prepared by E. Christian and F. Hetzel). May.

Regional Water Board. 2019a. Environmental Screening Levels (ESLs) Workbook, Revision 2. California Environmental Protection Agency, San Francisco Bay Regional Water Quality Control Board. July 25.

Regional Water Board. 2019b. Frequently Asked Questions (FAQs): Environmental Screening Levels (ESLs), 2019 Update (Revision 1). California Environmental Protection Agency, San Francisco Bay Regional Water Quality Control Board. July 25.

Regional Water Board. 2019c. User's Guide. Derivation and Application of Environmental Screening Levels (ESLs), Revision 1. California Environmental Protection Agency, San Francisco Bay Regional Water Quality Control Board. July 25.

Regional Water Board. 2020. Waste Discharge Requirements Order No. R2-2020-0023, Amendments to Waste Discharge Requirements for Disposal and Onsite Use of Non-Designated/Non-Hazardous Contaminated Soils and Related Wastes at Active Municipal Solid Waste Landfills. July 9. (link)

APPENDIX F

SOP – Indoor Air Sampling

SOP - INDOOR AIR SAMPLING

Procedures for collection of indoor air samples shall follow the guidance specified in the Department of Toxic Substances Control's (DTSC) guidance document "Final Guidance for the Evaluation & Mitigation of Subsurface Vapor Intrusion to Indoor Air" (VIG), October 2011.

Refer to the full VIG document for all requirements; however, a summary is provided below:

Indoor air sampling should be conducted under conservative conditions. Ingress and egress activities within the space being sampled should be minimized. Two events should be performed: first with the Heating, ventilation, and air conditioning (HVAC) systems off, and second with the HVAC system operating normally for the season and time of day. During colder months, heating systems should be operating for at least twenty-four hours prior to the scheduled sampling event to maintain normal indoor temperatures above 65°F before and during sampling.

DTSC recommends the following when conducting indoor air sampling:

1) Sampling Duration. For the first sampling event, indoor air samples should be collected over a 24-hour period to ensure diurnal fluctuations in vapor intrusion and indoor air concentrations are included in the sampling period. After vapor intrusion is confirmed, sampling events should be conducted to produce representative concentrations of the monitored compounds over the anticipated daily exposure period for building occupants. Hence, air samples should be collected over a 24-hour period for residential structures, over an 8-hour period for non-residential structures, and over a typical school day for students. When feasible, 24-hour and 8-hour sampling may be conducted during the same sampling event.

2) Number of Sampling Events. One indoor air sampling event is not representative of continuous long-term exposure within a building. Multiple sampling events should be conducted to characterize exposure over the long-term. Numerous sampling events may be required within a building before DTSC would consider "no further action" for the exposure pathway. At a minimum, sampling data should be obtained over two seasons; late summer/early autumn and late winter/early spring. The data evaluation and contingency plan for the site should guide decisions regarding the objective and number of sampling events.

3) Number of Samples and Locations. All floors of a residential structure potentially subject to vapor intrusion should be sampled for indoor air quality. All occupied areas, as well as basements, should be sampled. Sampling devices should be located in the breathing zone, approximately 3 to 5 feet off the ground for adults. Samples should be collected in the center of the room, away from doors. When sampling an office building, the number and locations of samples should be based on site-specific conditions. In office buildings, samples should be collected from primary work areas and near the points of vapor entry (such as sumps, elevator shafts or floor drains) to help define the potential routes of entry.

4) Sampling Equipment. When sampling indoor air with evacuated canisters, extra canisters, pressure gauges, and flow regulators should be taken into the field in case the integrity of some of the canisters is compromised or if some flow regulators and pressure gauges malfunction. Each sampling canister should have a dedicated vacuum gauge. The gauge is needed to verify the canister is properly evacuated prior to initiation of sampling and to demonstrate that the canister is slightly depressurized upon completion of the sampling. Likewise, the gauge will indicate whether the canister's flow regulator is functioning properly during sample collection. Flow regulators should be configured to produce a constant sampling rate. Sampling canisters, along with all flow regulators and pressure gauges, should be certified clean to the laboratory's method reporting limit.

Indoor Air Sample Collection Procedures:

- For the indoor air sample, identify the sampling location(s) on a floor plan that also identifies locations of HVAC equipment, chemical storage areas, garages, doorways, stairways, sumps, drains, utility perforations, north direction, and separate footing sections. For the ambient air sample, select a location upwind of the building or other area that is being evaluated. If possible, select a location upwind or near the HVAC air intake for the building being sampled.

- Use an evacuated Summa® passivated (or equivalent) stainless-steel canister to collect each sample. The canisters will be provided by the laboratory, along with flow controllers equipped with an in-line particulate filter and vacuum gauge. Each flow controller will be pre-calibrated by the laboratory for the desired flow rate or duration of sample collection (in this case, 24 hours). The sampling flow rate should always be less than 0.2 liter per minute (lpm).

- Place the canisters at the sampling locations. Samples should be collected from breathing height (e.g., 3 to 5 feet above ground). Either mount the canister on a stable platform or attach a length of inert tubing to the flow controller inlet and support it such that the sample inlets will be at the proper height. Measures should also be taken to avoid impact by weather events.

- Remove the protective brass plug from each canister. Connect the pre-calibrated flow controller to each canister.

- Record the identification numbers for the canisters and flow controllers. Record the initial canister pressures on the vacuum gauge (check equipment-specific instructions for taking this measurement). Canisters with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.

- Completely open the valve on the vacuum pressure in each canister. Record the time that each valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.

- Photograph each canister and the area surrounding the canisters. Additionally, for the ambient air sample, document on a field form an outdoor plot sketch that indicates the building being sampled, streets, sampling location, location of potential outdoor air sources, north direction and paved areas. Also record pertinent observations, such as, odors, readings from field instrumentation, and significant activities in the vicinity that result in air emissions.

- Stop sample collection after the scheduled duration of sample collection (24 hours), but make sure that the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and should be collected again in a new canister.

- Record the final vacuum pressure and close the canister valves. Record the date and time that sample collection was stopped.

- Remove the flow controller from each canister and replace the protective brass plugs.

- Attach labels/tags (sample name, time/date of sampling, etc.) to the canisters as directed by the laboratory.
- Place the canisters and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for each canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. The field crew should retain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory within one business day of sample collection and via overnight delivery (when shipping). If pressure reading of canister is "zero" when logged in by the laboratory the sample shall not be analyzed and will be recollected

Ambient (Outdoor) Air Sample Collection Procedures:

Site-specific ambient (outdoor) air samples should be collected when indoor air sampling is conducted, with the realization that indoor and outdoor air samples will always have detectable concentrations of common air pollutants. When conducting a vapor intrusion assessment, site-specific ambient air data are used to interpret the measured indoor air concentrations, not to adjust the indoor air concentrations for risk assessment purposes.

Ambient air samples should be collected at locations that are not influenced by subsurface contamination. Therefore, ambient air samplers should be located upwind of subsurface plumes. In addition, information on the types of industry in the neighborhood should be used when selecting ambient sample locations and interpreting the air data. The ambient air data can be used as a qualitative tool to provide information regarding outside influences on indoor air quality.

The following should be considered when collecting ambient air samples:

- Sampling devices should be located approximately six feet off the ground.
- Ambient sampling should be conducted concurrent with the indoor air sampling.
- Ambient samples should be collected in upwind locations.
- Ambient samples should be located away from gasoline stations, automobiles, gasoline powered engines, fuel and oil storage tanks, chemical storage areas, and dry cleaners.
- Sampling devices should be placed at least 10 feet beyond a tree's drip line.
- Ambient air samples should be collected on the upwind side of a building at a distance equal to twice the height of the building, when feasible.
- Three ambient samples, at a minimum, should be collected with each indoor air sampling event.

IN THE CITY COUNCIL OF THE CITY OF LIVERMORE, CALIFORNIA

A RESOLUTION RESCINDING RESOLUTION NO. 2026-125 AND AUTHORIZING A SUPPLEMENTAL APPROPRIATION OF LOW-INCOME HOUSING FUNDS (FUND 200) IN THE AMOUNT OF $75,000; AUTHORIZING A BUDGET REDUCTION OF $75,000 FROM THE HUMAN SERVICES FACILITY FEES FUND (FUND 290); AWARDING A CONTRACT TO BAY CITIES PAVING & GRADING, INC. FOR THE LIVERMORE VILLAGE REMEDIATION PROJECT DR202118, IN THE AMOUNT OF $2,285,985; FINDING THE PROJECT EXEMPT FROM THE CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) PURSUANT TO GOVERNMENT CODE SECTION 65457 AND CEQA GUIDELINES SECTION 15182(c) AND WITHIN THE SCOPE OF THE 2004 SPECIFIC PLAN EIR, THE 2009 SUBSEQUENT EIR AND ADDENDA IN ACCORDANCE WITH PUBLIC RESOURCES CODE SECTION 21166 AND CEQA GUIDELINES SECTION 15162

The City of Livermore advertised and received bid proposals for the construction of the Livermore Village Remediation Project DR202118. Bay Cities Paving & Grading, Inc. (Bay Cities) submitted the lowest responsible and responsive Base Bid Proposal in the amount of $932,235 that is acceptable to the City of Livermore.

A timely bid protest was received from Goodfellow Bros. California, LLC, the second lowest bidder, claiming that the bid proposal from Bay Cities Paving & Grading, Inc. was non-responsive. After detailed review by staff in coordination with the City Attorney's Office, City staff ultimately determined that Bay Cities Paving & Grading, Inc.’s bid proposal is responsive.

Livermore Municipal Code section 2.68.570(C) requires that the award of contracts subject to formal bidding be awarded to the lowest responsive and responsible bidder. The bid submitted by Bay Cities Paving & Grading, Inc., meets this requirement and therefore, at the July 27, 2026, City Council Meeting, City staff recommended the City Council approve the award of a construction contract with Bay Cities Paving & Grading in the amount of $2,285,985 for Project DR202118.

On July 27, 2026, City Council adopted Resolution No. 2026-125 awarding and authorizing the City Manager to execute a construction contract with Bay Cities, the lowest responsible and responsive bidder, in an amount of $2,285,985 and authorizing a supplemental appropriation in the amount of $75,000 from the Low-Income Housing Fund (Fund 200) to replace Human Services Facility Fees (Fund 290).

On August 3, 2026, the City received a Ralph M. Brown Act Demand to Cure and Correct Under Government Code section 54960.1, related to the noticing of the July 27, 2026, Agenda Item No. 6.8, the Livermore Village Remediation Project DR202118. The Demand alleged that the City violated the Brown Act, because the noticing did not identify the City’s proposed pathway for complying with CEQA along with the

substantive actions the City Council was considering. Although the City maintains that the noticing for the agenda item was in substantial compliance with the Brown Act, for the avoidance of doubt and to promote transparency in the public process, staff revised the agenda description and recommend the City Council reconsider the item. To avoid confusion regarding the operative date of the construction contract, staff recommends the City Council rescind Resolution No. 2026-125.

The Base Bid scope of work involves removal of soil to a depth of two (2) feet below ground surface. Bid Alternate 2 includes additional excavation to extend the depth of soil removal by three (3) feet to a total of five (5) feet below ground surface, with associated off haul, backfill, and compaction. Bay Cities submitted a Base Bid amount of $932,235 with the Bid Alternate 2 work totaling $1,353,750. City Staff recommends re-awarding a contract totaling $2,285,985 for the Base Bid and Bid Alternate 2 to Bay Cities Paving & Grading, Inc. for the construction of the Livermore Village Remediation Project DR202118, which is necessary for the implementation of the Downtown Workforce Housing Project, and adding Bid Alternate 2 to the contract.

Given the uncertainty associated with underground conditions concerning this project, and the potential for encountering contaminated materials, a cumulative Change Order authorization of 10% is recommended.

Additionally, City staff recommends the City Council reauthorize a supplemental appropriation in the amount of $75,000 from the Low-Income Housing Fund (Fund 200) to replace Human Services Facility Fees (Fund 290).

NOW THEREFORE BE IT RESOLVED by the City Council of the City of Livermore that, based upon the City Council's own independent review and considerations, the City Council has determined that the proposed construction contract with Bay Cities is statutorily exempt from review under Government Code section 65457 and CEQA Guidelines 15182(c) and none of the events described in CEQA Guidelines section 15162 have occurred.

1. Findings. The Downtown Specific Plan was initially adopted and its EIR was certified in 2004, with a Downtown Specific Plan Amendment adopted and a subsequent EIR certified in 2009. The City adopted three addenda to the subsequent EIR in March 2019, August 25, 2020, and August 27, 2020, respectively (the original EIR, subsequent EIR, and addenda are collectively referred to as the "EIR"). The Downtown Specific Plan designates the project site for the Downtown Workforce Housing Project, which includes 130 multifamily and the 2-acre park known as Veterans Park. The City approved project-specific entitlements for the Downtown Workforce Housing Project on May 25, 2021, finding that the Project was exempt from further CEQA review because it is a residential project consistent with a Specific Plan for which an EIR was certified, and that none of the circumstances requiring further CEQA review had occurred. The current action regarding the soil excavation contract is a subsequent approval necessary to implement the Downtown Workforce Housing Project, and the excavation activities were contemplated in the

certified SEIR and MMRP. The City worked closely with the San Francisco Regional Water Quality Control Board to implement site cleanup consistent with the MMRP, which resulted in a Site Management Plan dated July 1, 2022 ("SMP"). The SMP includes, among other things, the construction of two multi-story, multi-family residential buildings over underground parking structures and offsite soil disposal. The SMP further acknowledges that the work will disturb the upper approximate 20 ft of soil under Building A (North building), the upper 9 ft of soil under Building B (South building) and the upper 2 ft of soil in the remaining project area. These actions implement the SEIR's MMRP and were anticipated in connection with the City's original approval of the Downtown Workforce Housing Project. As explained further below, therefore the approval of the soil excavation contract is not new information, change in circumstances, or a change in the project, and therefore the actions remain exempt from CEQA without the need for subsequent review under Government Code section 65457 and CEQA Guidelines section 15182(c).

2. Findings. No substantial changes are proposed which would require major revisions to the previous EIR, subsequent EIR, or addenda. The proposed work is for the soil excavation previously required under the MMRP adopted with the certified 2009 Subsequent Downtown Specific Plan EIR (SCH: 2008092085) and subsequently described in the SMP approved by the San Francisco Bay Area Regional Water Quality Control Board. Substantial changes in circumstances have not occurred requiring major revisions to the previous EIR, subsequent EIR or addenda as the excavation work is entirely consistent with the SMP. There is no new information of substantial importance that would result in new impacts not previously discussed, result in more severe impacts, or require modifications to the existing mitigation measures. For these reasons, no events described in CEQA section 15162 have occurred and therefore no further environmental review is required.

BE IT FURTHER RESOLVED, that the proposed work is entirely within the scope of the Specific Plan EIR, dated February 9, 2004 (SCH No.: 2003032038), the Specific Plan Subsequent EIR, dated March 30, 2009 (SCH No.: 2008092085), and the Specific Plan Subsequent EIR Addenda adopted by City Council on September 10, 2018, by Resolution 2018-153, May 13, 2019 by Resolution 2019-064, and October 26, 2020 by Resolution 2020-178. The environmental effects of the project were previously evaluated in the certified 2009 Subsequent Downtown Specific Plan EIR (SCH: 2008092085) and addenda in compliance with the adopted Mitigation Monitoring and Reporting Program (MMRP) and as set forth in the SMP approved by the San Francisco Bay Area Regional Water Quality Control Board. Since adoption of the Subsequent EIR and addenda, there have been no substantial changes in the project or in the circumstances under which the project is being undertaken which would require changes in the Subsequent EIR and addenda, nor has any significant new information become available which would require changes in the Subsequent EIR and addenda. Pursuant to Public Resources Code section 21166 and CEQA Guidelines section 15162, no further environmental review is required.

The record of project approval is available to the General Public at: City of Livermore, 1052 South Livermore Avenue, Livermore, CA 94550.

BE IT FURTHER RESOLVED by the City Council of the City of Livermore, that it hereby:

1. Rescinds Resolution No. 2026-125 in its entirety;

2. Authorizes a supplemental appropriation of $75,000 from the Low-Income Housing Fund (Fund 200) to the budget for the Livermore Village Remediation Project DR202118;

3. Authorizes a budget reduction of $75,000 from the Human Services Facility Fees (Fund 290) to the budget for the Livermore Village Remediation Project DR202118;

4. Awards and authorizes the City Manager to execute a construction contract with Bay Cities Paving & Grading, Inc, attached hereto as Exhibit A and incorporated by this reference, in the amount of $2,285,985, for construction of the Livermore Village Remediation Project DR202118, pursuant to Livermore Municipal Code section 2.68.570 (C);

5. Rejects all other bids or proposals;

6. Authorizes the City Manager to approve and execute change orders up to a cumulative amount of ten percent of the construction contract value of $2,285,985; and

7. Authorizes the City Manager to take whatever actions are necessary and appropriate to carry out the purpose and intent of this resolution.

On motion of Council Member _____, seconded by Council Member _____, the foregoing resolution was passed and adopted on August 20, 2026, by the following vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

ATTEST:

_____
Helena Graves
Acting City Clerk

APPROVED AS TO FORM:

/s/ Kimberly D. Cilley
Kimberly D. Cilley
City Attorney

Exhibit A – Bay Cities Paving & Grading, Inc. Contract

CONTRACT

This public works contract ("Contract") is entered into by and between the City of Livermore, a California Municipal Corporation ("City") and Bay Cities Paving & Grading, Inc., a California corporation ("Contractor") for Work on the Livermore Village Remediation, Project No. DR202118 ("Project").

The Parties Agree as Follows:

1. Award of Contract.

In response to the Notice Inviting Bids, Contractor has submitted a Bid Proposal to perform Work on the Project, and on _____, 20___, as part of Resolution No. _____, City authorized award of this Contract to Contractor for the amount of Contractor's bid.

2. Contract Documents.

This Contract consists of all of the written representations and submissions made by Contractor as part of the Bid process and the following numbered and un-numbered component documents, as detailed on the table of contents of this Contract:

a. Bidding requirements (consisting of the Notice Inviting Bids; Instructions to Bidders; Bid Proposal; Bid Schedule, Subcontractor List, Noncollusion Declaration, Bid Bond, Bidder's Questionnaire, Payment Bond, Performance Bond, Warranty Bond);

b. General Conditions;

c. Special Conditions;

d. Division One Technical Specifications;

e. Appendix;

f. Index of Defined Terms;

g. Project Drawings and Specifications;

h. Bid Addenda, if any;

i. Change Orders, if any;

j. ALB Notice;

k. Notice to Proceed;

l. City Standard Specifications and Details;

m. And the following: No other documents.

3. Contractor's Obligations.

Contractor agrees to perform all of the Work required for the Project, as specified in the Contract Documents. Contractor must provide, furnish, and supply all things necessary and incidental for the timely performance and completion of the Work, including all necessary labor, materials, equipment, transportation, and utilities, unless otherwise specified in the Contract Documents. Contractor must use its best efforts to complete the Work in a professional and expeditious manner and to meet or exceed the performance standards required by the Contract Documents.

4. Payment.

As full and complete compensation for Contractor's timely performance and completion of the Work in strict accordance with the terms and conditions of the Contract Documents, City will pay Contractor two million two-hundred and eighty-five thousand nine-hundred and eighty-five Dollars ($2,285,985.00) (the "**Contract Price**"), in accordance with the payment provisions in the General Conditions.

The Contract Price includes the following amounts as itemized in the Contractor's executed Bid Schedule and Bid Proposal:

- Base Bid
- Add Alternate #2: Additional Excavation – Sitewide

5. Time for Completion.

5.1. Substantial Completion.

Contractor must achieve Substantial Completion, as that term is defined in the General Conditions, of the Project Work within eighty (80) Working Days from the commencement date stated in the Notice to Proceed. ("**Substantial Completion Deadline**."). For this project, the Contractor shall also incorporate five (5) inclement Weather Days into their bid estimate. Contractor shall be solely responsible for the extended overhead and profit for these weather days and shall not be compensated by the City in any way, reference Section 10.3 of the General Conditions and Section 013200-4.3 Contract Schedules for additional weather day information.

5.2. Final Completion.

Contractor must achieve Final Completion, as that term is defined in the General Conditions, of the Project Work within twenty (20) Working Days after the date of substantial completion. ("**Final Completion Deadline**.")

5.3. Early Completion.

By signing below, Contractor expressly waives any claim for delayed early completion.

6. Liquidated Damages.

If Contractor fails to meet either the Substantial Completion Deadline or the Final Completion Deadline, City may assess liquidated damages according the provisions in the General Conditions of the Contract Documents in the following amounts for each day of Unexcused Delay, and the Contract Price shall be reduced accordingly.

6.1. Substantial Completion Deadline: one thousand five hundred dollars ($1,500) per day.

6.2. Final Completion Deadline: one thousand one hundred dollars ($1,100) per day.

7. Labor Code Compliance.

This Contract is subject to all applicable requirements of Chapter 1 of Part 7 of Division 2 of the California Labor Code, including requirements pertaining to wages, working hours and workers' compensation insurance.

7.1. Prevailing Wages.

This Project is subject to the prevailing wage requirements applicable to the locality in which the Work is to be performed for each craft, classification or type of worker needed to perform the Work, including employer payments for health and welfare, pension, vacation, apprenticeship and similar purposes. The general prevailing wage rates for each craft, classification or type of covered work are available online at http://www.dir.ca.gov/DLSR.

7.2. DIR Registration.

City will not accept a Bid Proposal from or enter into the Contract with a bidder without proof that the bidder and its Subcontractors are registered with the California Department of Industrial Relations to perform public work under Labor Code, Section 1725.5, subject to limited legal exceptions allowed by the Labor Code.

8. Workers' Compensation Certification.

Under Labor Code, Section 1861, by signing this Contract, Contractor certifies as follows: "I am aware of the provisions of Labor Code, Section 3700 which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the Work on this Contract."

The successful bidder previous to the entering of the contract to do the said work shall take out and maintain in full force and effect worker's compensation insurance with an insurance carrier authorized to transact business in the State of California, covering the bidder's full liability for compensation to any persons employed who may be injured in the

carrying out of said contract or the dependents thereof. Evidence of such worker's compensation insurance shall be furnished to the City of Livermore by certificate and waiver of subrogation in the City's electronic insurance certificate tracking system (PINS) prior to the commencement of the work and said certificate shall contain a provision that the coverage thereunder will not be canceled until at least thirty (30) days prior written notice has been given to the City.

9. Notice.

Any notice, billing, or payment required by the Contract Documents must be made in writing, and sent to the other party by personal delivery, U.S. Mail, a reliable overnight delivery service, facsimile, or by email as a PDF (or comparable) file. Notice is deemed effective upon delivery unless otherwise specified. Notice for each party must be given as follows:

	City	Contractor
Name	City of Livermore Community Development Dept Engineering Division	Bay Cities Paving & Grading, Inc.
Address	1052 South Livermore Avenue	P.O. Box 6227
City/state/zip	Livermore, CA 94550	Concord, CA 94524
Phone	(925) 960-4500	(925) 687-6666
Fax	(925) 960-4505	
Attention	City Engineer	Vice President
Email	jhwaxdeck@livermoreca.gov	
Copy to	Li-Teck Lau llau@livermoreca.gov	

10. General Provisions.

The following items are repeated here as stated as part of Part 2, General Conditions, for emphasis:

10.1. Assignment and Successors.

Contractor may not assign its rights or obligations under this Contract, in part or in whole, without City's written consent. This Contract is binding on Contractor's successors and permitted assigns. A consolidation or merger of Contractor or a change in ownership of twenty-five percent (25%) or more of Contractor's capital stock constitutes an assignment by Contractor requiring the City's written consent.

10.2. Third Party Beneficiaries.

There are no intended third party beneficiaries to this Contract except as expressly provided in the General Conditions or Special Conditions.

10.3. Governing Law and Venue.

This Contract will be governed by California law and venue will be in the Superior Court of the County in which the Project is located, and no other place.

10.4. Amendment.

No amendment or modification of this Contract will be binding unless it is in a writing duly authorized and signed by the parties to this Contract.

10.5. Integration; Severability.

This Contract and the Contract Documents incorporated herein, including authorized amendments or Change Orders thereto, constitute the final, complete, and exclusive terms of the agreement between City and Contractor. If any provision of the Contract Documents, or portion of a provision, is determined to be illegal, invalid, or unenforceable, the remaining provisions of the Contract Documents will remain in full force and effect.

11. Authorization.

Each individual signing below warrants that he or she is authorized to do so by the party that he or she represents, and that this Contract is legally binding on that party. If Contractor is a corporation, signatures from two officers of the corporation are required under California Corporation Code, Section 313.

The parties agree to this Contract as witnessed by the signatures below:

CITY
City of Livermore, a California Municipal Corporation

s/_____

Marianna Burch, City Manager

Date:_____

Approved as to form:

_____
City of Livermore City Attorney

CONTRACTOR

Bay Cities Paving & Grading Inc.

s/_____

Name: Daniel Rodriguez

Title: Vice President

Date: 8/10/2026

s/_____

Name: Ruby Athwal

Title: Secretary / Treas.

Date: 8/10/2026

238650
Contractor's Calif. License Number(s)

Seal:

6/30/2027
Expiration Date(s)

END OF DOCUMENT

- Ju



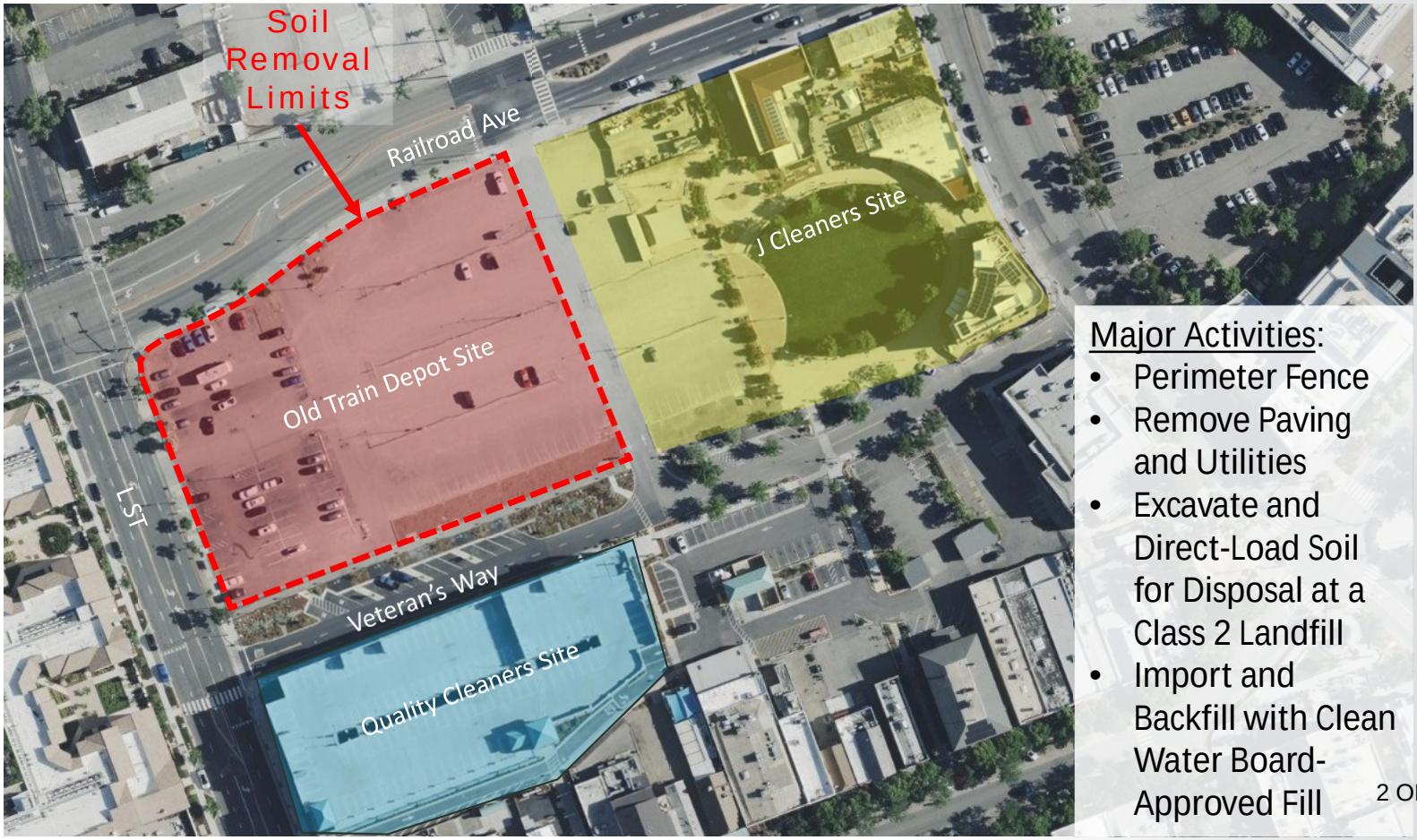
CITY OF LIVERMORE CALIFORNIA

Award Construction Contract to Bay Cities Paving & Grading for City CIP No. DR202118

August 20, 2026

Project Description – CIP DR202118

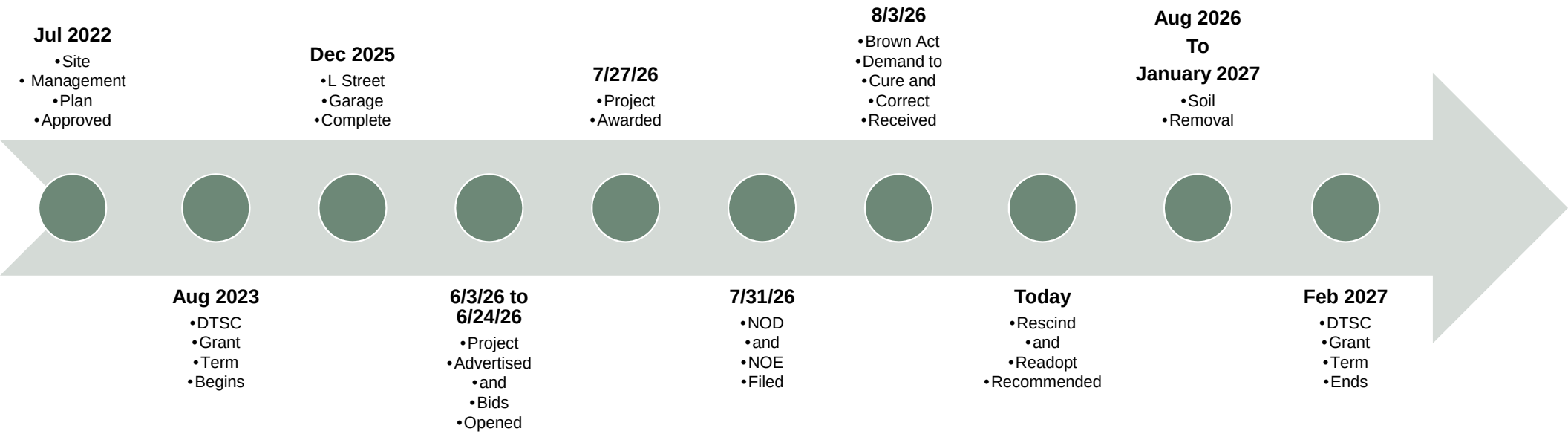
- One of three Water Board Sites Downtown
- Soil Removal to Facilitate Park and Housing Construction
- Work Performed in Compliance with Water Board-Approved Site Management Plan
- Project Funded by Department of Toxic Substances Control Equitable Community Revitalization Grant



Major Activities:

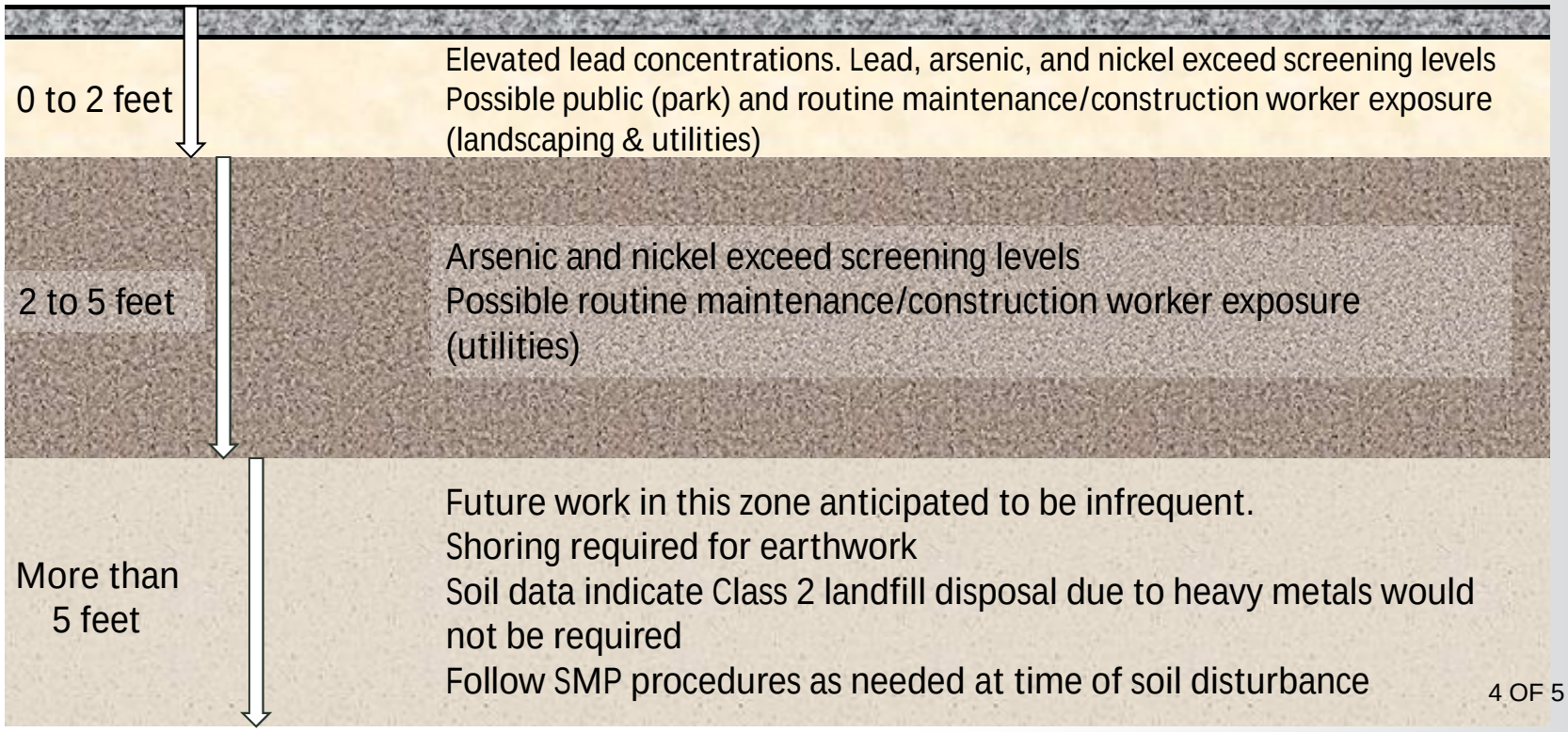
- Perimeter Fence
- Remove Paving and Utilities
- Excavate and Direct-Load Soil for Disposal at a Class 2 Landfill
- Import and Backfill with Clean Water Board-Approved Fill

Project Timeline



Project Benefits

- In general, excavation in the downtown area shows elevated heavy metals in shallow soil.
- Excavation to a depth of two feet has required Class2 landfill disposal.
- Excavation to a depth of five feet will reduce possible exposure.



Recommended Action

- Rescind Resolution No. 2026-125;
- Adopt California Environmental Quality Act (CEQA) findings;
- Authorize supplemental appropriation and budget reduction;
- Award construction contract with Bay Cities Paving & Grading, Inc.;
- Reject all other bids or proposals;
- Authorize ten percent (10%) change order allowance; and
- Authorize the City Manager to take whatever actions are necessary and appropriate to carry out the purpose and intent of this resolution.