Appendix J

Cultural Resources Monitoring Plan for the T-3 at Mandela Station Project

SWCA, October 2025

Cultural Resources Monitoring Plan for the T-3 at Mandela Station Project, Oakland, Alameda County, California

OCTOBER 2025

PREPARED FOR

Lamphier-Gregory

PREPARED BY

SWCA Environmental Consultants

CULTURAL RESOURCES MONITORING PLAN FOR THE T-3 AT MANDELA STATION PROJECT, OAKLAND, ALAMEDA COUNTY, CALIFORNIA

Prepared for

Lamphier-Gregory
4100 Redwood Road, STE 20A - #601
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SWCA Project No. 73884

SWCA Cultural Resources Report No. 22-515

October 2025

Archaeological and other heritage resources can be damaged or destroyed through uncontrolled public disclosure of information regarding their location. This document contains sensitive information regarding the nature and location of archaeological sites which should not be disclosed to the general public or unauthorized persons. This information is exempt from public disclosure pursuant to the Public Records Act (California Code of Regulations Section 15120(d)).

Information regarding the location, character, or ownership of a cultural resource is exempt from the Freedom of Information Act pursuant to 54 USC Section 307103 (National Historic Preservation Act) and 16 USC Section 470(h)(h) (Archaeological Resources Protection Act).

CONTENTS

Introduction **1**
  Project Location 1
  Project Description 1
  Purpose 1
Regulatory Setting **5**
    City of Oakland Standard Conditions of Approval 5
Potential Resource Types **7**
    Potential Prehistoric Archaeological Resources and Tribal Cultural Resources 7
    Potential Historic Archaeological Resources 7
Monitoring and Field Methods **7**
  Monitoring Methods 8
    Monitoring Discoveries and Resource Evaluation 8
    Monitoring Discoveries and Tribal Involvement 8
    Treatment of Significant Resources 9
    Unanticipated Discovery of Human Remains 10
References Cited **11**

Figures

Figure 1. Project Vicinity Map. 2
Figure 2. Project Location Map. 3
Figure 3. Plan View of Project Site 4

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INTRODUCTION

SWCA Environmental Consultants (SWCA) was retained by Lamphier-Gregory to draft an Archaeological Monitoring Plan (AMP) in support of the T-3 at Mandela Station Project (project), located in the city of Oakland, Alameda County, California. This AMP describes the procedural framework used to identify, evaluate, and treat any cultural resources encountered during construction.

Project Location

The project is located in an urban setting within the city of Oakland, Alameda County, California. The project site is located at 1451 7th Street (Assessor's Parcel Number [APN] 4-77-3, Block 494) an approximately 1.23-acre lot south of the West Oakland, Bay Area Rapid Transit (BART) station. The project limits are formed by the West Oakland BART station on the north, the parking lot for that station on the east, 5th Street to the south, and Chester Street to the west (Figures 1 through 3). The project site is located in Township 1 South, Range 4 West, Sections 33 and 34 (Mount Diablo Base and Meridian) and falls within the Oakland West, California U.S. Geological Survey (USGS) 7.5-minute quadrangle (see Figure 1). The Universal Transverse Mercator (UTM) grid coordinates at the approximate center of the project site are: 4184369.96 m North and 562003.84 m East, Zone 10.

Project Description

The T-3 project will convert the current BART parking lot into a seven-story, 253,774 square-foot, mixed-use development that would contain 240 affordable housing units, retail space, lobby and amenity spaces, and a 50-space parking garage. Although the construction schedule is not presently defined, the project will include several construction phases. The first phase will consist of pavement removal, site preparation, minimal grading for the building pad and footings, and utility trenching. The second phase will consist of the building construction, and the final phase will include improvements to landscape and streetscape, as well as paving and architectural coatings. Ground-disturbing activities will include demolition and site clearing, potentially ground improvement measures and/or deep pile installation, mechanical trenching, and mechanical excavation. Depth of ground disturbance is not yet defined.

Purpose

This AMP has been prepared to guide cultural resources monitoring for the T-3 project during construction. The purpose of the AMP is to lay out the methods, and notification procedures for cultural resources monitoring and evaluation activities within the project site. The AMP also provides a plan for avoidance or data recovery in the event that significant cultural resources are identified during monitoring, including a discussion of artifact collection, retention/disposal, and curation requirements.

Cultural resources are defined as anything made or affected by human beings or the remains thereof, as well as human remains. For the purposes of this AMP, the terms "finds," "cultural resource," "cultural material," "discovery," and "cultural resource materials" are used interchangeably. Types of cultural resources will be consistent with California Code of Regulations (CCR) Title 14, Chapter 11.5, Section 4852(a), including archaeological and historical objects, sites and districts, historic buildings and structures, cultural landscapes, and sites and resources of concern to local Native American or other ethnic groups.

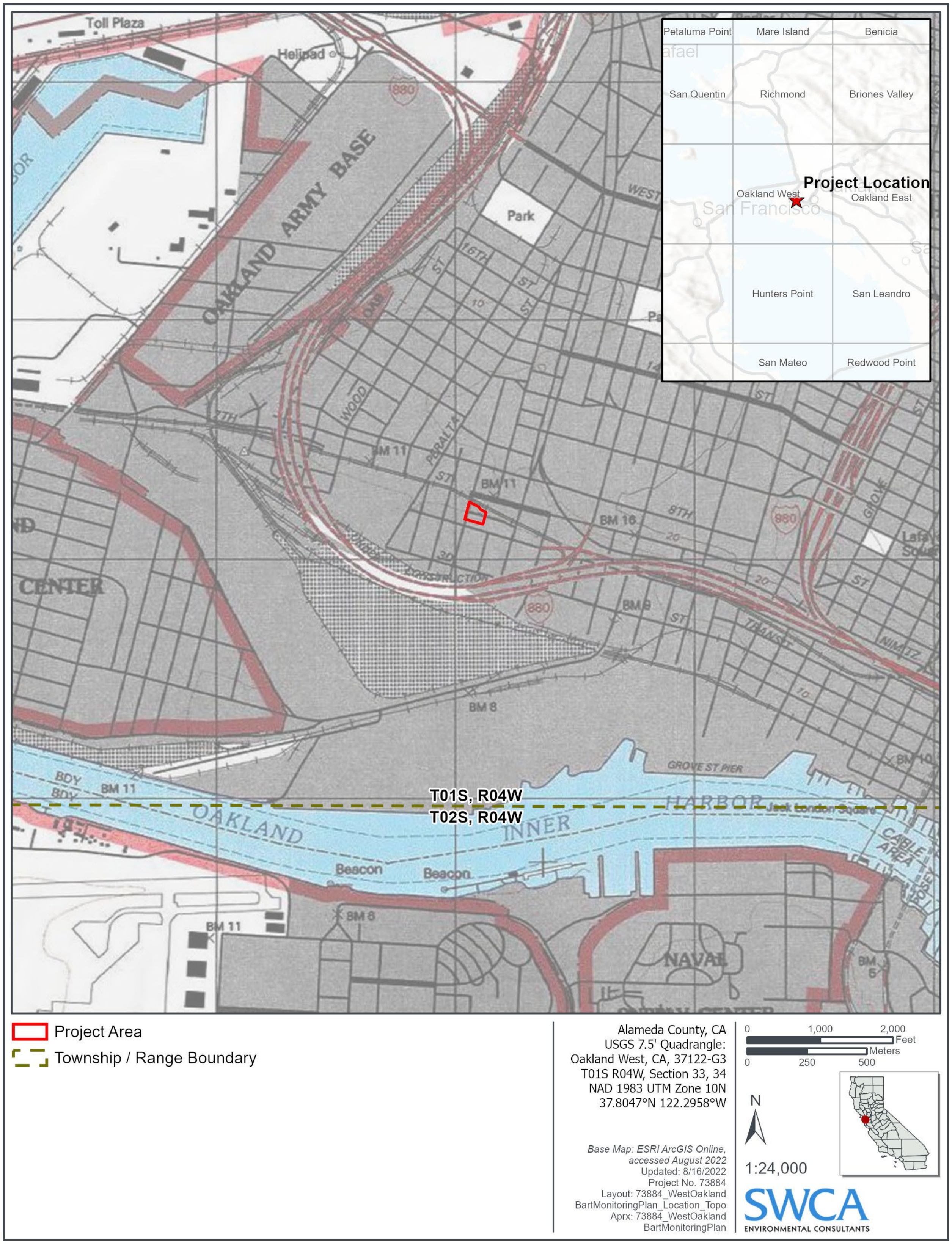

Figure 1. Project Vicinity Map.

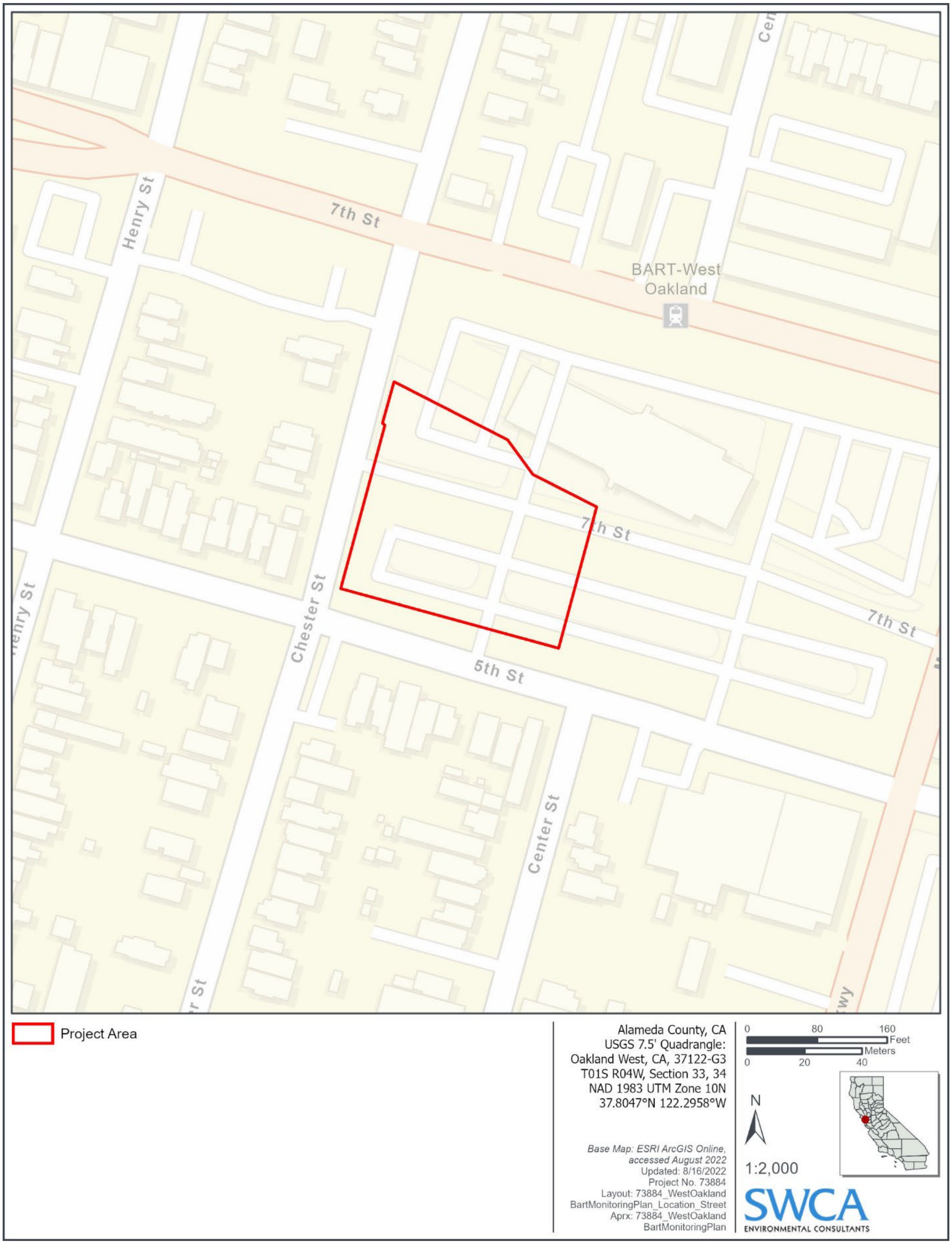

Figure 2. Project Location Map.

Alameda County, CA
USGS 7.5' Quadrangle:
Oakland West, CA, 37122-G3
T01S R04W, Section 33, 34
NAD 1983 UTM Zone 10N
37.8047°N 122.2958°W

*Credits: JRDV Architects Inc.
Base Map: ESRI ArcGIS Online,
accessed August 2022*
Updated: 8/16/2022
Project No. 73884
Layout: 73884_WestOakland
BartMonitoringPlan_Location_aerial
Aprx: 73884_WestOakland
BartMonitoringPlan

Figure 3. Plan View of Project Site.

REGULATORY SETTING

The following requirements apply to the project.

City of Oakland Standard Conditions of Approval

The City created a set of Standard Conditions of Approval (SCA), which are relevant to and mandatory requirements of each project located within the City's planning area. The intent of these conditions is to avoid or reduce the impacts to significant cultural resources. The SCAs are considered part of the development process and do not constitute project-specific mitigation measures. As such, additional mitigation measures particular to a given development or improvement project may be required. The SCAs pertinent to this AMP are (excerpted):

- **SCA 32**: Archaeologically Sensitive Areas – Pre-Construction Measures: The project applicant shall implement either Provision A (Intensive Pre- Construction Study) and/or Provision B (Construction ALERT Sheet) concerning archaeological resources.

  <u>Provision A, Intensive Pre-Construction Study</u>: The project applicant shall retain a qualified archaeologist to conduct a site-specific, intensive archaeological resources study for review and approval by the City prior to soil-disturbing activities occurring on the project site. The purpose of the site-specific, intensive archaeological resources study is to identify early the potential presence of history-period archaeological resources on the project site. At a minimum, the study shall include:

  a. Subsurface presence/absence studies of the project site. Field studies may include, but are not limited to, auguring and other common methods used to identify the presence of archaeological resources.
  b. A report disseminating the results of this research.
  c. Recommendations for any additional measures that could be necessary to mitigate any adverse impacts to recorded and/or inadvertently discovered cultural resources.

  If the results of the study indicate a high potential presence of historic-period archaeological resources on the project site, or a potential resource is discovered, the project applicant shall hire a qualified archaeologist to monitor any ground-disturbing activities on the project site during construction. The project applicant shall also prepare an ALERT sheet pursuant to Provision B below that details what could potentially be found at the project site. Archaeological monitoring would include briefing construction personnel about the type of artifacts that may be present (as referenced in the ALERT sheet, required per Provision B below) and the procedures to follow if any artifacts are encountered. Field recording and sampling shall be conducted in accordance with the Secretary of Interior's Standards and Guidelines for Archaeological Documentation, notifying the appropriate officials if human remains or cultural resources are discovered, and preparing a report to document negative findings after construction is completed if no archaeological resources are discovered during construction.

  Provision B, Construction ALERT Sheet: The project applicant shall prepare a construction "ALERT" sheet developed by a qualified archaeologist for review and approval by the City prior to soil-disturbing activities occurring on the project site. The ALERT sheet shall contain, at a minimum, visuals that depict each type of artifact that could be encountered on the project site. Training by the qualified archaeologist shall be provided to the project's prime contractor, any project subcontractor firms (including demolition, excavation, grading, foundation, and pile driving), and utility firms involved in soil-disturbing activities within the project site. The ALERT sheet shall state, in addition to the basic archaeological resource protection measures contained in other standard conditions of approval, all work must stop and the City's

Environmental Review Officer contacted in the event of discovery of cultural materials. Prior to any soil-disturbing activities, each contractor shall be responsible for ensuring that the ALERT sheet is circulated to all field personnel, including machine operators, field crew, pile drivers, and supervisory personnel. The ALERT sheet shall also be posted in a visible location at the project site.

- **SCA 52**: Archaeological Resources: Ongoing throughout demolition, grading, and/or construction. Pursuant to CEQA Guidelines section 15064.5 (f), "provisions for historical or unique archaeological resources accidentally discovered during construction" should be instituted.
  a. Therefore, in the event that any prehistoric or historic subsurface cultural resources are discovered during ground disturbing activities, all work within 50 feet of the resources shall be halted and the project applicant and/or lead agency shall consult with a qualified archaeologist or paleontologist to assess the significance of the find. If any find is determined to be significant, representatives of the project proponent and/or lead agency and the qualified archaeologist would meet to determine the appropriate avoidance measures or other appropriate measure, with the ultimate determination to be made by the City of Oakland. All significant cultural materials recovered shall be subject to scientific analysis, professional museum curation, and a report prepared by the qualified archaeologist according to current professional standards.
  b. In considering any suggested measure proposed by the consulting archaeologist in order to mitigate impacts to historical resources or unique archaeological resources, the project applicant shall determine whether avoidance is necessary and feasible in light of factors such as the nature of the find, project design, costs, and other considerations. If avoidance is unnecessary or infeasible, other appropriate measures (e.g., data recovery) shall be instituted. Work may proceed on other parts of the project site while measures for historical resources or unique archaeological resources are carried out.
  c. Should an archaeological artifact or feature be discovered on-site during project construction, all activities within a 50-foot radius of the find would be halted until the findings can be fully investigated by a qualified archaeologist to evaluate the find and assess the significance of the find according to the CEQA definition of a historical or unique archaeological resource. If the deposit is determined to be significant, the project applicant and the qualified archaeologist shall meet to determine the appropriate avoidance measures or other appropriate measure, subject to approval by the City of Oakland, which shall assure implementation of appropriate measures recommended by the archaeologist. Should archaeologically significant materials be recovered, the qualified archaeologist shall recommend appropriate analysis and treatment, and shall prepare a report on the findings for submittal to the Northwest Information Center.

Human Remains

Although not anticipated, there remains the potential to encounter previously unknown human remains during ground-disturbing activities. If human remains are encountered during project implementation, the applicable SCA states:

- **SCA 53**: Human Remains. Ongoing throughout demolition, grading, and/or construction. In the event that human skeletal remains are uncovered at the project site during construction or ground breaking activities, all work shall immediately halt and the Alameda County Coroner shall be contacted to evaluate the remains, and following the procedures and protocols pursuant to Section 15064.5 (e)(1) of the CEQA Guidelines. If the County Coroner determines that the remains are Native American, the City shall contact the California Native American Heritage Commission

(NAHC), pursuant to subdivision (c) of Section 7050.5 of the Health and Safety Code, and all excavation and site preparation activities shall cease within a 50-foot radius of the find until appropriate arrangements are made. If the agencies determine that avoidance is not feasible, then an alternative plan shall be prepared with specific steps and timeframe required to resume construction activities. Monitoring, data recovery, determination of significance and avoidance measures (if applicable) shall be completed expeditiously.

POTENTIAL RESOURCE TYPES

Potential Prehistoric Archaeological Resources and Tribal Cultural Resources

The cultural resources assessment conducted pursuant to Section 106 review for the project did not indicate an elevated sensitivity for prehistoric archaeological resources to be present within the APE. However, pursuant to that Section 106 process, the City of Oakland did notify and seek consultation regarding the project with Native American Tribes. Three non-federally recognized Native American Tribes responded to this notification (the North Valley Yokuts Tribe, Indian Canyon Band of Costanoan Ohlone People, and Confederated Villages of Lisjan), all of whom requested that a Tribal monitor be present for on-site construction. Based on this consultation, the City of Oakland (serving as the NEPA Responsible Entity) determined that the project applicant shall retain a Tribal monitor to monitor any ground-disturbing activities on the project site. Occurrences of Native American tribal cultural resources may include, but are not limited to, the following:

- Artifacts (stone tools or debitage from stone tool manufacturing, ceramics, faunal shell, shell beads, ground stone implements, etc.)
- Evidence of habitation (house pit depressions, midden deposits, etc.)
- Features (hearths, stone features, artifact caches, etc.)
- Human remains (burials, cremations, isolated skeletal fragments, cemeteries, etc.)

Potential Historic Archaeological Resources

Historic-period cultural resources are defined as isolated occurrences or clusters of artifacts, features, and structures (or their remains) at least 50 years of age and are evidence of the activities of peoples of all ethnicities of the historic period. Historic-period archaeological materials may include, but are not limited to, the following:

- Buildings and structures, or the remains thereof
- Native American sacred sites or other significant ethnic sites (of any age)
- Trash pits, privies, wells, and associated artifacts, surface dumps, and artifact scatters
- Historic pipes or utilities
- Isolated artifacts or isolated clusters of artifacts (metal cans, glass bottles, ceramic vessels, etc.)

MONITORING AND FIELD METHODS

This section discusses field methods that will be employed during the monitoring effort. A Tribal monitor will monitor all ground-disturbing activities, including, but not limited to, excavation, trenching, boring, and grading, while adhering to defined project safety protocol. This monitoring will consist of directly watching the excavation and earthmoving activities in all areas of the project. Monitoring will continue until construction involving ground disturbance is complete. Based on preliminary observations, the Tribal monitor may decide to reduce monitoring to spot checking based on the extent of previous disturbance observed and the likelihood of encountering intact native sediments.

Monitoring Methods

Prior to ground disturbance, a Tribal monitor shall be retained to monitor ground-disturbing activities within the project site. Monitoring will consist of visual inspection of excavated or graded areas and trench sidewalls. Monitoring will continue until construction involving ground disturbance is complete, or until the Tribal monitor concludes that there is no continuing potential for encountering cultural resources. Specifically, the following steps will be taken by the Tribal monitor in the event of an unanticipated find:

- Work will stop in the immediate vicinity of the find (within 50 feet).
- Workers will not touch, move, or disturb artifacts or features associated or thought to be associated with the discovery.
- Mark the area with flagging to make sure no one else working in the area disturbs the find.
- The Tribal monitor will immediately contact their supervisor and the City regarding next steps.
- Should historic or precontact archaeological materials be encountered by the Tribal monitor, per SCA 52, a qualified archaeologist will then conduct a site visit to evaluate the inadvertent discovery.

Monitoring Discoveries and Resource Evaluation

If archaeological resources are exposed during ground-disturbing activities, **SCA 52a** through **52c** will be implemented. SCA 52 states work in the immediate vicinity of the find (within 50 feet) must stop until a qualified archaeologist evaluates the significance of the find. Ground-disturbing activities may continue in other areas. If the discovery proves significant, the project applicant, Tribal monitor, and qualified archaeologist shall meet to determine the appropriate avoidance or other measures, subject to approval by the City. Should archaeologically significant materials be recovered, the Tribal monitor and qualified archaeologist shall recommend appropriate analysis and treatment, and will prepare a report on the findings for submittal to the CHRIS NWIC.

Monitoring Discoveries and Tribal Involvement

Prior to the start of construction activities, the project applicant will coordinate with the three Tribes that requested monitoring during project-related ground disturbance in order to enter into an agreement for a shared/coordinated monitoring plan or a plan that allows one Tribe to defer monitoring to another. This plan will identify the Tribe(s) and monitor(s) responsible for being on-site during project-related ground disturbance.

Contact information for these individuals can be found below.

Northern Valley Yokuts Tribe
Katherine Perez, Chairperson
(209) 887-3415, canutes@verizon.net

Indian Canyon Band of Costanoan Ohlone People
Ann Marie Sayers, Chairperson
(831) 637-4238, ams@indiancanyon.org

Confederated Villages of Lisjan Tribal Governments
Corrina Gould, Chairperson
(510) 575-8408, cvltribe@gmail.com

Treatment of Significant Resources

Any discovery, whether prehistoric, historic, or multi-component, that is evaluated and determined to be significant should be avoided where possible. Avoidance measures, as determined in consultation with the SHPO and consulting parties, might include using flagging and/or fencing under the guidance of the Tribal monitor and/or qualified archaeological monitors to clearly demarcate resource boundaries and restrict construction equipment access, as well as the implementation of stronger measures, such as relocating project components or capping buried resources with a protective layer of soil.

Significant resources that cannot be avoided by access restriction or project redesign would be subject to treatment to avoid, minimize, or mitigate adverse effects on historic properties. Such treatment (e.g., data recovery) would require the preparation of a research design by the principal investigator based on the findings of the site evaluation. Should it be determined through consultation with the City's Environmental Principal Planner, the project applicant or their designee, and consulting tribal parties that data recovery is the appropriate treatment measure to resolve adverse effects to historic properties, a data recovery plan with a research design will be developed in consultation the SHPO, City, and consulting Native Americans.

Although such a research design must be tailored to the particular resource type that is encountered, a basic data recovery research framework is presented here. The data recovery effort for significant discoveries of any era would be conducted by field technicians under the supervision of the field director.

This effort would, at minimum, include the following components:

1. Defining the horizontal and vertical boundaries of the deposit through intensive surface mapping and, if needed to determine eligibility, subsurface testing.
2. Investigating the content of the deposit, particularly the date range and information potential, including by means of subsurface testing if needed to determine eligibility.
3. Defining the stratigraphic relationships and depth of the deposit through subsurface testing, should the patterning or apparent date range and information potential of surface artifacts and features be insufficient to determine eligibility.
4. Recording resources identified during the test investigation, by exposing them in plan view by hand, photographing, and mapping them in relation to a permanent datum. Excavated soils should be passed through 1/4- or 1/8-inch screen, as appropriate, to extract and document the presence of all classes of artifacts. Column samples may be collected if smaller materials are likely to be present and may contribute to the resolution of research questions. Archaeologists may record and discard all but an appropriate sample of these items according to a record/discard plan contained in the research design.
5. Establishing standards for cleaning, labeling, cataloging, classifying, and dating, and the database to be used, consistent with best practices and other recovery efforts in California.
6. Analysis of recovered artifacts, ecofacts, and other samples by qualified specialists. In the case of prehistoric resources, these analyses may include, but are not limited to, the following studies:

radiocarbon dating, obsidian sourcing, obsidian hydration dating, flaked stone analysis, ground stone analysis, ceramic sourcing studies, faunal analysis, paleobotanical analysis, and pollen analysis.

7. Upon completion of the monitoring effort, a technical report documenting the monitoring program will be prepared. The report will incorporate a discussion of the scope, location, methodology, and results of the monitoring. The technical report should follow contemporary standards as identified in the *Archaeological Resources Management Report* (California Office of Historic Preservation [OHP] 1990). The report and any DPR 523 forms will be provided to the City and NWIC, as required, upon completion.

Unanticipated Discovery of Human Remains

In accordance with HSC Section 7050.5, PRC Section 5097.98, and **SCA 53**, if human remains are encountered during construction, whether or not a Tribal monitor or an archaeological monitor is present, all work shall be halted in the immediate vicinity (within 50 feet) of the find. If the Tribal monitor or qualified archaeologist suspects that a discovery includes human remains:

1. The project applicant would contact the Alameda County Coroner:

   Alameda County Medical Examiner & Coroner
   Phone: (510) 382-3000
   2901 Peralta Oaks Court
   Oakland, California 94605
   https://www.countyoffice.org/alameda-county-medical-examiner-coroner-oakland-ca-b83/

2. The Coroner would have 2 working days to examine the remains after being notified in accordance with HSC 7050.5. If the Coroner determines that the remains are Native American and are not subject to the Coroner's authority, the Coroner has 24 hours to notify the NAHC of the discovery.

   Native American Heritage Commission
   Phone: (916) 653-4082
   1550 Harbor Boulevard, Room 100
   West Sacramento, California 9569
   Email: nahc@nahc.ca.gov

3. The NAHC would immediately designate and notify the Native American MLD, who will have 48 hours after being granted access to the location of the remains to inspect them and make recommendations for their treatment and disposition. Work will be suspended in the area of the find until the landowner, in consultation with the Native American MLD, approves the proposed treatment of the human remains. In addition, the landowner will ensure that the remains are protected from damage or further disturbance of any sort until such decisions can be made.

REFERENCES CITED

Alonso, Christina, Garret Root, and Nathaniel Ramos

2021 *Cultural Resources Assessment in Support of the West Oakland BART Project, Oakland, Alameda County, California*. Prepared by PaleoWest, LLC for Lamphier-Gregory.

California Governor's Office of Planning and Research

2022 *CEQA, California Environmental Quality Act Statute and Guidelines*. Sacramento, California: Governor's Office of Planning and Research. Available at: http://resources.ca.gov. Accessed August 2022.

California Office of Historic Preservation (OHP)

1990 *Archaeological Resources Management Reports (ARMR): Recommended Contents and Formats.* Available at: http://ohp.parks.ca.gov. Accessed August 2022.

City of Oakland

2014 *West Oakland Specific Plan –Draft EIR, Section 4.3: Cultural Resources.* Available at: https://oaklandca.s3.us-west-1.amazonaws.com/oakca1/groups/ceda/documents/report/oak045557.pdf. Accessed August 2022.

National Park Service (NPS)

1983 *Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines*. Washington, D.C.: U.S. Department of the Interior.

Appendix K

Native American Heritage Commission (NAHC), Review of the Sacred Lands File and Correspondence with Native American Tribes

SWCA, November 20, 2020

Sacred Lands File & Native American Contacts List Request

NATIVE AMERICAN HERITAGE COMMISSION
1550 Harbor Blvd, Suite 100
West Sacramento, CA 95501
(916) 373-3710
(916) 373-5471 – Fax
nahc@nahc.ca.gov

Information Below is Required for a Sacred Lands File Search

Project: West Oakland Bart Survey

County: Alamaeda

USGS Quadrangle

Name: West Oakland 7.5' 1:240000

Township: N/A Range: N/A Section(s): N/A

Company/Firm/Agency:
PaleoWest Archaeology

Contact Person: Christina Alonso

Street Address: 1870 Olympic Blvd Ste 100

City: Walnut Creek Zip: 94596

Phone: (925) 253-9070 Extension:

Fax:

Email: calonso@paleowest.com

Project Description:

The Project applicant is proposing the construction of a mixed-use multi-story building on a 1.4 acre plot of land located south of the West Oakland Bart station. PaleoWest has been contracted to conduct a pedestrian survey and compile a Cultural Resources Assessment Report for the project.

☑ Project Location Map is attached

Legend

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, Compiled by the Bureau of Land Management (BLM), National Operations Center (NOC) OC-53, BLM_GeoSpatialGateway@blm.gov

For Official Use Only. Public Disclosure of Archaeological Site Locations is Prohibited (54 USC 307103)

0 0.06
mi
0 0.075
km

1:4,513.99

STATE OF CALIFORNIA **Gavin Newsom, *Governor***

NATIVE AMERICAN HERITAGE COMMISSION

NAHC HEADQUARTERS
1550 Harbor Boulevard
Suite 100
West Sacramento,
California 95691
(916) 373-3710
nahc@nahc.ca.gov
NAHC.ca.gov

December 2, 2020

Christina Alonso
PaleoWest Archaeology

Via Email to: calonso@paleowest.com
Cc to: amahmutsun@gmail.com
canutes@verizon.net
huskanam@gmail.com

Re: West Oakland Bart Survey Project, Alameda County

Dear Ms. Alonso:

A record search of the Native American Heritage Commission (NAHC) Sacred Lands File (SLF) was completed for the information you have submitted for the above referenced project. The results were positive. Please contact all the Amah Mutsun Tribal Band of Mission San Juan Bautista and the North Valley Yokuts Tribe on the attached list for more information. Other sources of cultural resources should also be contacted for information regarding known and recorded sites.

Attached is a list of Native American tribes who may also have knowledge of cultural resources in the project area. This list should provide a starting place in locating areas of potential adverse impact within the proposed project area. I suggest you contact all of those indicated; if they cannot supply information, they might recommend others with specific knowledge. By contacting all those listed, your organization will be better able to respond to claims of failure to consult with the appropriate tribe. If a response has not been received within two weeks of notification, the Commission requests that you follow-up with a telephone call or email to ensure that the project information has been received.

If you receive notification of change of addresses and phone numbers from tribes, please notify me. With your assistance, we can assure that our lists contain current information.

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

Sincerely,

Sarah Fonseca
Cultural Resources Analyst

Attachment

Native American Heritage Commission
Native American Contact List
Alameda County
12/2/2020

Amah MutsunTribal Band of Mission San Juan Bautista
Irenne Zwierlein, Chairperson
789 Canada Road
Woodside, CA, 94062
Phone: (650) 851 - 7489
Fax: (650) 332-1526
amahmutsuntribal@gmail.com
Costanoan

Costanoan Rumsen Carmel Tribe
Tony Cerda, Chairperson
244 E. 1st Street
Pomona, CA, 91766
Phone: (909) 629 - 6081
Fax: (909) 524-8041
rumsen@aol.com
Costanoan

Guidiville Indian Rancheria
Donald Duncan, Chairperson
P.O. Box 339
Talmage, CA, 95481
Phone: (707) 462 - 3682
Fax: (707) 462-9183
admin@guidiville.net
Pomo

Indian Canyon Mutsun Band of Costanoan
Ann Marie Sayers, Chairperson
P.O. Box 28
Hollister, CA, 95024
Phone: (831) 637 - 4238
ams@indiancanyon.org
Costanoan

Indian Canyon Mutsun Band of Costanoan
Kanyon Sayers-Roods, MLD Contact
1615 Pearson Court
San Jose, CA, 95122
Phone: (408) 673 - 0626
kanyon@kanyonkonsulting.com
Costanoan

Muwekma Ohlone Indian Tribe of the SF Bay Area
Monica Arellano,
20885 Redwood Road, Suite 232
Castro Valley, CA, 94546
Phone: (408) 205 - 9714
marellano@muwekma.org
Costanoan

North Valley Yokuts Tribe
Timothy Perez, MLD Contact
P.O. Box 717
Linden, CA, 95236
Phone: (209) 662 - 2788
huskanam@gmail.com
Costanoan
Northern Valley Yokut

North Valley Yokuts Tribe
Katherine Perez, Chairperson
P.O. Box 717
Linden, CA, 95236
Phone: (209) 887 - 3415
canutes@verizon.net
Costanoan
Northern Valley Yokut

The Ohlone Indian Tribe
Andrew Galvan,
P.O. Box 3388
Fremont, CA, 94539
Phone: (510) 882 - 0527
Fax: (510) 687-9393
chochenyo@AOL.com
Bay Miwok
Ohlone
Patwin
Plains Miwok

The Confederated Villages of Lisjan
Corrina Gould, Chairperson
10926 Edes Avenue
Oakland, CA, 94603
Phone: (510) 575 - 8408
cvltribe@gmail.com
Bay Miwok
Ohlone
Delta Yokut

This list is current only as of the date of this document. Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resource Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting local Native Americans with regard to cultural resources assessment for the proposed West Oakland Bart Survey Project, Alameda County.

PALEOWEST
archaeology
925.253.9070 | paleowest.com | 1870 Olympic Boulevard, Suite 100 | Walnut Creek, CA 94596

December 8, 2020

Amah Mutsun Tribal Band of Mission San Juan Bautista
Irenne Zwierlein, Chairperson
789 Canada Road
Woodside, CA 94062

RE: West Oakland BART Survey, Alameda County, California

Dear Irenne Zwierlein,

PaleoWest has been contracted by Lampher-Gregory to prepare a Cultural Resources Technical Report for the West Oakland Bart Survey, located in Oakland, Alameda County. The Project area is shown on the attached map.

PaleoWest has conducted a Records Search with the Northwest Information Center (NWIC) of the ~1.4-acre proposed project area and a 1/2-mile radius to identify known cultural resource sites and previous surveys in or near the project area.

PaleoWest contacted the NAHC on November 20, 2020 with a request that they search their Sacred Lands File for the project vicinity. The December 2, 2020 response from Sara Fonseca of the NAHC states, "A record search of the Native American Heritage Commission (NAHC) Sacred Lands File (SLF) was completed for the information you have submitted for the above referenced project. The results were Positive.".

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Thank you again for your assistance.
Sincerely,

Christina Alonso, MA, RPA
Supervisory Archaeologist/Project Manager

PALEOWEST
archaeology

925.253.9070 | paleowest.com | 1870 Olympic Boulevard, Suite 100 | Walnut Creek, CA 94596

December 8, 2020

Costanoan Rumsen Carmel Tribe
Tony Cerda, Chairperson
244 E. 1st Street
Pomona, Ca 91766

RE: West Oakland BART Survey, Alameda County, California

Dear Tony Cerda,

PaleoWest has been contracted by Lampher-Gregory to prepare a Cultural Resources Technical Report for the West Oakland Bart Survey, located in Oakland, Alameda County. The Project area is shown on the attached map.

PaleoWest has conducted a Records Search with the Northwest Information Center (NWIC) of the ~1.4-acre proposed project area and a 1/2-mile radius to identify known cultural resource sites and previous surveys in or near the project area.

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December 8, 2020

Guidiville Indian Rancheria
Donald Duncan, Chairperson
P.O. Box 339
Talmage, CA 95481

RE: West Oakland BART Survey, Alameda County, California

Dear Donald Duncan,

PaleoWest has been contracted by Lampher-Gregory to prepare a Cultural Resources Technical Report for the West Oakland Bart Survey, located in Oakland, Alameda County. The Project area is shown on the attached map.

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December 8, 2020

Indian Canyon Mutsun Band of Costanoan
Ann Marie Sayers, Chairperson
P.O. Box 28
Hollister, CA 95024

RE: West Oakland BART Survey, Alameda County, California

Dear Ann Marie Sayers,

PaleoWest has been contracted by Lampher-Gregory to prepare a Cultural Resources Technical Report for the West Oakland Bart Survey, located in Oakland, Alameda County. The Project area is shown on the attached map.

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December 8, 2020

Indian Canyon Mutsun Band of Costanoan
Kanyon Sayers-Roods, MLD Contact
1615 Pearson Court
San Jose, CA 95122

RE: West Oakland BART Survey, Alameda County, California

Dear Kanyon Sayers-Roods,

PaleoWest has been contracted by Lampher-Gregory to prepare a Cultural Resources Technical Report for the West Oakland Bart Survey, located in Oakland, Alameda County. The Project area is shown on the attached map.

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December 8, 2020

Muwekma Ohlone Indian Tribe of the SF Bay Area
Monica Arellano, Vice Chairwoman
20885 Redwood Road, Suite 232
Castro Valley, CA 94546

RE: West Oakland BART Survey, Alameda County, California

Dear Monica Arellano,

PaleoWest has been contracted by Lampher-Gregory to prepare a Cultural Resources Technical Report for the West Oakland Bart Survey, located in Oakland, Alameda County. The Project area is shown on the attached map.

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December 8, 2020

North Valley Yokuts Tribe
Timothy Perez, MLD Contact
P.O. Box 717
Linden, CA 95236

RE: West Oakland BART Survey, Alameda County, California

Dear Timothy Perez,

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December 8, 2020

North Valley Yokuts Tribe
Katherine Erolinda Perez, Chairperson
P.O. Box 717
Linden, CA 95236

RE: West Oakland BART Survey, Alameda County, California

Dear Katherine Erolinda Perez,

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Supervisory Archaeologist/Project Manager

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archaeology
925.253.9070 | paleowest.com | 1870 Olympic Boulevard, Suite 100 | Walnut Creek, CA 94596

December 8, 2020

The Ohlone Indian Tribe
Andrew Galvan
P.O. Box 3388
Fremont, CA 94539

RE: West Oakland BART Survey, Alameda County, California

Dear Andrew Galvan,

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Supervisory Archaeologist/Project Manager

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925.253.9070 | paleowest.com | 1870 Olympic Boulevard, Suite 100 | Walnut Creek, CA 94596

December 8, 2020

The Confederated Villages of Lisjan
Corrina Gould, Chairperson
10926 Edes Avenue
Oakland, CA 94603

RE: West Oakland BART Survey, Alameda County, California

Dear Corrina Gould,

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Thank you again for your assistance.
Sincerely,

Christina Alonso, MA, RPA
Supervisory Archaeologist/Project Manager

Native American Correspondence – (20-1089 // West Oakland BART Survey)

Name / Affiliation	Date Email Sent	Comments	Date of Follow Up Phonecall	Comments
Amah Mutsun Tribal Band of Mission San Juan Bautista Irenne Zwierlein, Chairperson 789 Canada Road Woodside, CA 94062	12/8/2020	None	12/15/20 12/30/20	12/15 - No answer. Left message. 12/30 – No answer, left message.
Costanoan Rumsen Carmel Tribe Tony Cerda, Chairperson 244 E. 1st Street Pomona, Ca 91766	12/8/2020	None	12/15/20 12/30/20	12/15 - Attempted call, no answer. 12/30 – Attempted call, no answer, line busy. Called again, no answer.
Guidiville Indian Rancheria Donald Duncan, Chairperson P.O. Box 339 Talmage, CA 95481	12/8/2020	None	12/15/20 12/30/20	12/15 - Attempted call, no answer. 12/30 – No answer, left message.
Indian Canyon Mutsun Band of Costanoan Ann Marie Sayers, Chairperson P.O. Box 28 Hollister, CA 95024	12/8/2020	None	12/15/20 12/30/20	12/15 - Answered, call was terminated on Ann’s end. Tried calling back, no answer. 12/30 – Call was picked up and hung up immediately. Attempted call back, same result.
Indian Canyon Mutsun Band of Costanoan Kanyon Sayers-Roods, MLD 1615 Pearson Court San Jose, CA 95122	12/8/2020	None	12/15/20 12/30/20	12/15 - No answer, left message. 12/30 – No answer, left message.
Muwekma Ohlone Indian Tribe of the SF Bay Area Monica Arellano, Vice Chairwoman 20885 Redwood Road, Suite 232 Castro Valley, CA 94546	12/8/2020	None	12/15/20 12/30/20	12/15 - No answer, mailbox full. 12/30 – No answer, mailbox full.
North Valley Yokuts Tribe Timothy Perez, MLD Contact P.O. Box 717 Linden, CA 95236	12/8/2020	In an email dated 12/11, Timothy stated that their tribe would request that Native American monitoring would be conducted on the project.	12/15/20 12/30/20	12/15 - No answer, left voicemail. 12/30 – After receiving communication via email, no need for further phone contact.
North Valley Yokuts Tribe Katherine Erolinda Perez, Chairperson P.O. Box 717 Linden, CA 95236	12/8/2020	None	12/15/20 12/30/20	12/15 - No answer. 12/30 – No answer.
The Ohlone Indian Tribe Andrew Galvan P.O. Box 3388 Fremont, CA 94539	12/8/2020	None	12/15/20 12/30/20	Prefers email, resent email.
The Confederated Villages of Lisjan Corrina Gould, Chairperson 10926 Edes Avenue Oakland, CA 94603	12/8/2020	None	12/15/20 12/30/20	12/15 - No answer. 12/30 – Answered call, was told she needed to review that information in the email and would call or email with a response sometime around the 4th of January 2021.

Appendix L

L-1: Mandela Station, Parcel T-3 HUD Environmental Noise Analysis

Charles Salter Associates, November 6, 2024

L-2: Mandela Station, Building T-3 Environmental Noise Study

Charles Salter Associates, July 23, 2025

6 November 2024

Gene Broussard
Mandela Station Affordable LP
PO Box 260770
Encino, CA 91426
gbroussard@amgland.com

Subject: **Mandela Station, Parcel T3**
HUD Environmental Noise Analysis
Salter Project 24-0292

Dear Gene:

We have used the Housing and Urban Development (HUD) Environmental Noise Analysis tools[1] to determine if the noise level requirements at the project will be met. This report summarizes our analysis with respect to the HUD requirements.

CRITERIA

HUD defines areas exposed to less than DNL[2] 65 dB as "Acceptable". Areas exposed to noise levels between DNL 65 and 75 dB are defined as "Normally Unacceptable". Areas exposed to DNL greater than 75 dB are considered "Unacceptable".

HUD has a goal stating that indoor noise levels should not exceed DNL 45 dB. This is consistent with the California Building Code (Title 24).

HUD also has a goal for outdoor-use spaces, which states that the DNL should not exceed 65 dB. We have applied this goal to the Level 2 courtyards and Level 4 amenity deck accessible to the residents.

---

[1] https://www.hudexchange.info/programs/environmental-review/noise-abatement-and-control/

[2] Day-Night Average Sound Level (DNL) – A descriptor established by the U.S. Environmental Protection Agency to represent a 24-hour average noise level with a 10 dB penalty applied to noise occurring during the nighttime hours (10 p.m. to 7 a.m.) to account for the increased sensitivity of people during sleeping hours.

NOISE ENVIRONMENT

The project site is bordered by 5th Street to the south, Chester Street to the west, and West Oakland BART station to the north. Mandela Parkway is approximately 450 feet to the east, Interstate 880 (I-880) is approximately 700 feet to the south, and 7th Street is approximately 200 feet to the north. The noise environment is dominated by traffic along these streets, as well as intermittent BART trains. Since the project is located directly next to the BART station, noise levels from the trains are lower than typical, due to slower speeds of approaching and departing trains.

ANALYSIS

We analyzed noise at nine Noise Assessment Locations (NAL) around the building for both indoor and outdoor-use spaces, as shown in **Figure 1**. Our analysis is based on the Substantial Conformance Set for Building T3 dated 21 August 2024. The following describes the NAL locations.

- NAL1: Northeast corner of the building
- NAL2: Southeast corner of the building
- NAL3: Center of south facade facing I-880
- NAL4: Southwest corner of the building
- NAL5: Northwest corner of the building
- NAL6: Center of north facade facing BART
- NAL7: East courtyard
- NAL8: West courtyard
- NAL9: Level 4 amenity deck

The exterior noise levels around the building are calculated to be between DNL 67 to 69 dB, which is considered “Normally Unacceptable” per HUD. Therefore, noise attenuation features must be provided to reduce interior noise levels to the HUD interior goal of DNL 45 dB.

We reviewed the 29 January 2019 West Oakland BART TOD Transportation Assessment by Fehr & Peers[3] to evaluate traffic increases along the roadways. The study includes Existing Peak Hour volumes and Existing Plus Project Peak Hour volumes for Mandela Parkway and 7th Street (though it does not include cumulative vehicle volumes). The traffic study did not include Peralta Street.

Based on this, traffic along Mandela Parkway increases 0% and traffic along 7th Street increases 34%. This results in noise level increases of 0 dB and 1 dB, respectively, over a 10-year period.

---

[3] A new traffic study has not been published since.

For I-880, we used traffic volume data from the Federal Highway Administration (FHWA)[4]. The traffic volume increase along I-880 is based on the California Department of Transportation (DOT), which assumes a traffic volume increase of 3 percent per year, which corresponds to a 1 dB increase in DNL over a ten-year period.

Interior Noise

We used the HUD DNL Calculator and Barrier Performance Module (BPM) to calculate exterior noise levels at the residences. At NAL1 to NAL6, the exterior noise levels at the facade are calculated to DNL 67 to 69 dB, which is considered “Normally Unacceptable”.

See **Appendix A** for the HUD DNL calculations. See **Appendix B** for the BPM calculations. Since the HUD Exchange tools do not allow for a detailed analysis from multiple noise sources (e.g., roadways) with barrier effects, we have included a comprehensive summary table of DNL and BPM calculations at each NAL in **Appendix C**.

Since the noise levels exceed DNL 65 dB, we used the Sound Transmission Classification Assessment Tool (STraCAT) to calculate interior noise levels at each NAL. The exterior wall construction and window sizes are based on the project’s Substantial Conformance Set dated 21 August 2024. We have assumed that the exterior wall assembly achieves STC 45 (e.g., a three-coat stucco system). The elevations also show PTAC (i.e., through-wall) units at residences. We understand that the vents for the PTAC will be closed (i.e., not used for fresh air), and we assume that the PTAC will achieve STC 31.

Using the STraCAT, interior noise levels are calculated to meet DNL 45 dB with the planned exterior wall and window assemblies at each NAL. See **Appendix D** for the STraCAT calculations.

Exterior Noise

We used the HUD DNL Calculator and Barrier Performance Module (BPM) to analyze exterior noise levels at the outdoor-use spaces. At NAL7 to NAL9, the noise levels are calculated to be DNL 65 dB or lower, which is considered “Acceptable” per the HUD guidelines. See **Appendix A to C** for the HUD DNL and BPM calculations.

* * *

---

[4] https://gisdata-caltrans.opendata.arcgis.com/datasets/d8833219913c44358f2a9a71bda57f76_0/explore?location=37.803422%2C-122.295246%2C16.45

This concludes our HUD Environmental Noise Analysis for the project. Please contact us with any questions.

Best,

SALTER

Blake Wells, LEED GA
Senior Associate

Eric Mori, PE
Executive Vice President

cc: Art May
Keystone Development Group, LLC
amay@keystonedg.com

SALTER © 2024
FOR ACOUSTICAL DESIGN INFORMATION ONLY

MANDELA STATION – PARCEL T3
HUD NOISE ASSESSMENT LOCATIONS (NAL)

FIGURE 1

Salter #
24–0292

SMR/EBM
11.06.24

APPENDIX A

HUD DNL CALCULATOR

Site ID	NAL1 (NE Corner)
Record Date	11/05/2024
User's Name	Salter

Road # 1 Name:	**I-880**

Road #1

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☑
Effective Distance	940	940	940
Distance to Stop Sign			
Average Speed	65	65	65
Average Daily Trips (ADT)	114176	6220	7604
Night Fraction of ADT	10	20	20
Road Gradient (%)			0
Vehicle DNL	60	59	66
Calculate Road #1 DNL	67	Reset	

Road # 2 Name:	**7th Street**

Road #2

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐
Effective Distance	255	255	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	10000	200	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	52	45	0
Calculate Road #2 DNL	53	Reset	

Road # 3 Name:	**Mandela Pkwy**

Road #3

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐

Effective Distance	435	435	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	4740	236	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	46	43	0
Calculate Road #3 DNL	47	Reset	

Railroad #1 Track Identifier: **BART**

Rail # 1

Train Type	**Electric** ☑	**Diesel** ☐
Effective Distance	95	
Average Train Speed	20	
Engines per Train	0	
Railway cars per Train	8	
Average Train Operations (ATO)	539	
Night Fraction of ATO	15	
Railway whistles or horns?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Bolted Tracks?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Train DNL	61	0
Calculate Rail #1 DNL	61	Reset

Add Road Source Add Rail Source

Airport Noise Level	
Loud Impulse Sounds?	○**Yes** ●**No**

Combined DNL for all Road and Rail sources	**68**
Combined DNL including Airport	**N/A**
Site DNL with Loud Impulse Sound	

Calculate Reset

Site ID	NAL2 (SE Corner)
Record Date	11/05/2024
User's Name	Salter

Road # 1 Name:	**I-880**

Road #1

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☑
Effective Distance	820	820	820
Distance to Stop Sign			
Average Speed	65	65	65
Average Daily Trips (ADT)	114176	6220	7604
Night Fraction of ADT	10	20	20
Road Gradient (%)			0
Vehicle DNL	61	60	66
Calculate Road #1 DNL	68	Reset	

Road # 2 Name:	**7th Street**

Road #2

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐
Effective Distance	385	385	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	10000	200	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	50	43	0
Calculate Road #2 DNL	50	Reset	

Road # 3 Name:	**Mandela Pkwy**

Road #3

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐

Effective Distance	435	435	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	4740	236	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	46	43	0
Calculate Road #3 DNL	47	Reset	

Railroad #1 Track Identifier: **BART**

Rail # 1

Train Type	**Electric** ☑	**Diesel** ☐
Effective Distance	210	
Average Train Speed	20	
Engines per Train	0	
Railway cars per Train	8	
Average Train Operations (ATO)	539	
Night Fraction of ATO	15	
Railway whistles or horns?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Bolted Tracks?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Train DNL	56	0
Calculate Rail #1 DNL	56	Reset

Add Road Source Add Rail Source

Airport Noise Level	
Loud Impulse Sounds?	○**Yes** ●**No**

Combined DNL for all Road and Rail sources	**68**
Combined DNL including Airport	**N/A**
Site DNL with Loud Impulse Sound	

Calculate Reset

Site ID	NAL3 (South Center)
Record Date	11/05/2024
User's Name	Salter

Road # 1 Name:	**I-880**

Road #1

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☑
Effective Distance	850	850	850
Distance to Stop Sign			
Average Speed	65	65	65
Average Daily Trips (ADT)	114176	6220	7604
Night Fraction of ADT	10	20	20
Road Gradient (%)			0
Vehicle DNL	60	59	66
Calculate Road #1 DNL	68	Reset	

Road # 2 Name:	**7th Street**

Road #2

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐
Effective Distance	420	420	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	10000	200	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	49	42	0
Calculate Road #2 DNL	50	Reset	

Road # 3 Name:	**Mandela Pkwy**

Road #3

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐

Effective Distance	500	500	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	4740	236	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	45	42	0
Calculate Road #3 DNL	46	Reset	

Railroad #1 Track Identifier: **BART**

Rail # 1

Train Type	**Electric** ☑	**Diesel** ☐
Effective Distance	280	
Average Train Speed	20	
Engines per Train	0	
Railway cars per Train	8	
Average Train Operations (ATO)	539	
Night Fraction of ATO	15	
Railway whistles or horns?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Bolted Tracks?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Train DNL	54	0
Calculate Rail #1 DNL	54	Reset

Add Road Source Add Rail Source

Airport Noise Level	
Loud Impulse Sounds?	○**Yes** ●**No**

Combined DNL for all Road and Rail sources	**68**
Combined DNL including Airport	**N/A**
Site DNL with Loud Impulse Sound	

Calculate Reset

Site ID	NAL4 (SW Corner)
Record Date	11/05/2024
User's Name	Salter

Road # 1 Name:	**I-880**

Road #1

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☑
Effective Distance	980	980	980
Distance to Stop Sign			
Average Speed	65	65	65
Average Daily Trips (ADT)	114176	6220	7604
Night Fraction of ADT	10	20	20
Road Gradient (%)			0
Vehicle DNL	59	58	65
Calculate Road #1 DNL	67	Reset	

Road # 2 Name:	**7th Street**

Road #2

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐
Effective Distance	380	380	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	10000	200	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	50	43	0
Calculate Road #2 DNL	50	Reset	

Road # 3 Name:	**Mandela Pkwy**

Road #3

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐

Effective Distance	685	685	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	4740	236	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	43	40	0
Calculate Road #3 DNL	44	Reset	

Railroad #1 Track Identifier: **BART**

Rail # 1

Train Type	**Electric** ☑	**Diesel** ☐
Effective Distance	270	
Average Train Speed	20	
Engines per Train	0	
Railway cars per Train	8	
Average Train Operations (ATO)	539	
Night Fraction of ATO	15	
Railway whistles or horns?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Bolted Tracks?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Train DNL	55	0
Calculate Rail #1 DNL	55	Reset

Add Road Source | Add Rail Source

Airport Noise Level	
Loud Impulse Sounds?	○**Yes** ●**No**

Combined DNL for all Road and Rail sources	**67**
Combined DNL including Airport	**N/A**
Site DNL with Loud Impulse Sound	

Calculate | Reset

Site ID	NAL5 (NW Corner)
Record Date	11/05/2024
User's Name	Salter

Road # 1 Name:	**I-880**

Road #1

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☑
Effective Distance	1160	1160	1160
Distance to Stop Sign			
Average Speed	65	65	65
Average Daily Trips (ADT)	114176	6220	7604
Night Fraction of ADT	10	20	20
Road Gradient (%)			0
Vehicle DNL	58	57	64
Calculate Road #1 DNL	66	Reset	

Road # 2 Name:	**7th Street**

Road #2

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐
Effective Distance	180	180	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	10000	200	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	55	48	0
Calculate Road #2 DNL	55	Reset	

Road # 3 Name:	**Mandela Pkwy**

Road #3

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐

Effective Distance	685	685	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	4740	236	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	43	40	0
Calculate Road #3 DNL	44	Reset	

Railroad #1 Track Identifier: **BART**

Rail # 1

Train Type	**Electric** ☑	**Diesel** ☐
Effective Distance	75	
Average Train Speed	20	
Engines per Train	0	
Railway cars per Train	8	
Average Train Operations (ATO)	539	
Night Fraction of ATO	15	
Railway whistles or horns?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Bolted Tracks?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Train DNL	63	0
Calculate Rail #1 DNL	63	Reset

Add Road Source Add Rail Source

Airport Noise Level	
Loud Impulse Sounds?	○**Yes** ●**No**

Combined DNL for all Road and Rail sources	**68**
Combined DNL including Airport	**N/A**
Site DNL with Loud Impulse Sound	

Calculate Reset

Site ID	NAL6 (North Center)
Record Date	11/05/2024
User's Name	Salter

Road # 1 Name:	**I-880**

Road #1

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☑
Effective Distance	1000	1000	1000
Distance to Stop Sign			
Average Speed	65	65	65
Average Daily Trips (ADT)	114176	6220	7604
Night Fraction of ADT	10	20	20
Road Gradient (%)			0
Vehicle DNL	59	58	65
Calculate Road #1 DNL	67	Reset	

Road # 2 Name:	**7th Street**

Road #2

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐
Effective Distance	230	230	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	10000	200	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	53	46	0
Calculate Road #2 DNL	54	Reset	

Road # 3 Name:	**Mandela Pkwy**

Road #3

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐

Effective Distance	530	530	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	4740	236	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	44	41	0
Calculate Road #3 DNL	46	Reset	

Railroad #1 Track Identifier:	**BART**

Rail # 1

Train Type	**Electric** ☑	**Diesel** ☐
Effective Distance	80	
Average Train Speed	20	
Engines per Train	0	
Railway cars per Train	8	
Average Train Operations (ATO)	539	
Night Fraction of ATO	15	
Railway whistles or horns?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Bolted Tracks?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Train DNL	63	0
Calculate Rail #1 DNL	63	Reset

Add Road Source Add Rail Source

Airport Noise Level	
Loud Impulse Sounds?	○**Yes** ●**No**

Combined DNL for all Road and Rail sources	**68**
Combined DNL including Airport	**N/A**
Site DNL with Loud Impulse Sound	

Calculate Reset

Site ID	NAL7 (East Courtyard)
Record Date	11/05/2024
User's Name	Salter

Road # 1 Name:	**I-880**

Road #1

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☑
Effective Distance	930	930	930
Distance to Stop Sign			
Average Speed	65	65	65
Average Daily Trips (ADT)	114176	6220	7604
Night Fraction of ADT	10	20	20
Road Gradient (%)			0
Vehicle DNL	60	59	66
Calculate Road #1 DNL	67	Reset	

Road # 2 Name:	**7th Street**

Road #2

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐
Effective Distance	310	310	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	10000	200	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	51	44	0
Calculate Road #2 DNL	52	Reset	

Road # 3 Name:	**Mandela Pkwy**

Road #3

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐

Effective Distance	530	530	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	4740	236	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	44	41	0
Calculate Road #3 DNL	46	Reset	

Railroad #1 Track Identifier: **BART**

Rail # 1

Train Type	**Electric** ☑	**Diesel** ☐
Effective Distance	160	
Average Train Speed	20	
Engines per Train	0	
Railway cars per Train	8	
Average Train Operations (ATO)	539	
Night Fraction of ATO	15	
Railway whistles or horns?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Bolted Tracks?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Train DNL	58	0
Calculate Rail #1 DNL	58	Reset

Add Road Source Add Rail Source

Airport Noise Level	
Loud Impulse Sounds?	○**Yes** ●**No**

Combined DNL for all Road and Rail sources	**68**
Combined DNL including Airport	**N/A**
Site DNL with Loud Impulse Sound	

Calculate Reset

Site ID	NAL8 (West Courtyard)
Record Date	11/05/2024
User's Name	Salter

Road # 1 Name:	**I-880**

Road #1

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☑
Effective Distance	970	970	970
Distance to Stop Sign			
Average Speed	65	65	65
Average Daily Trips (ADT)	114176	6220	7604
Night Fraction of ADT	10	20	20
Road Gradient (%)			0
Vehicle DNL	60	59	65
Calculate Road #1 DNL	67	Reset	

Road # 2 Name:	**7th Street**

Road #2

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐
Effective Distance	300	300	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	10000	200	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	51	44	0
Calculate Road #2 DNL	52	Reset	

Road # 3 Name:	**Mandela Pkwy**

Road #3

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐

Effective Distance	600	600	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	4740	236	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	43	40	0
Calculate Road #3 DNL	45	Reset	

Railroad #1 Track Identifier:	**BART**

Rail # 1

Train Type	**Electric** ☑	**Diesel** ☐
Effective Distance	170	
Average Train Speed	20	
Engines per Train	0	
Railway cars per Train	8	
Average Train Operations (ATO)	539	
Night Fraction of ATO	15	
Railway whistles or horns?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Bolted Tracks?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Train DNL	58	0
Calculate Rail #1 DNL	58	Reset

Add Road Source Add Rail Source

Airport Noise Level	
Loud Impulse Sounds?	○**Yes** ●**No**
Combined DNL for all Road and Rail sources	**68**
Combined DNL including Airport	**N/A**
Site DNL with Loud Impulse Sound	

Calculate Reset

Site ID	NAL9 (Level 4 Amenity)
Record Date	11/05/2024
User's Name	Salter

Road # 1 Name:	**I-880**

Road #1

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☑
Effective Distance	1000	1000	1000
Distance to Stop Sign			
Average Speed	65	65	65
Average Daily Trips (ADT)	114176	6220	7604
Night Fraction of ADT	10	20	20
Road Gradient (%)			0
Vehicle DNL	59	58	65
Calculate Road #1 DNL	67	Reset	

Road # 2 Name:	**7th Street**

Road #2

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐
Effective Distance	300	300	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	10000	200	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	51	44	0
Calculate Road #2 DNL	52	Reset	

Road # 3 Name:	**Mandela Pkwy**

Road #3

Vehicle Type	**Cars** ☑	**Medium Trucks** ☑	**Heavy Trucks** ☐

Effective Distance	660	660	
Distance to Stop Sign			
Average Speed	35	35	
Average Daily Trips (ADT)	4740	236	
Night Fraction of ADT	10	10	
Road Gradient (%)			
Vehicle DNL	43	40	0
Calculate Road #3 DNL	45	Reset	

Railroad #1 Track Identifier: **BART**

Rail # 1

Train Type	**Electric** ☑	**Diesel** ☐
Effective Distance	180	
Average Train Speed	20	
Engines per Train	0	
Railway cars per Train	8	
Average Train Operations (ATO)	539	
Night Fraction of ATO	15	
Railway whistles or horns?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Bolted Tracks?	Yes: ☐ No: ☑	Yes: ☐ No: ☐
Train DNL	57	0
Calculate Rail #1 DNL	57	Reset

Add Road Source Add Rail Source

Airport Noise Level	
Loud Impulse Sounds?	○**Yes** ●**No**

Combined DNL for all Road and Rail sources	**67**
Combined DNL including Airport	**N/A**
Site DNL with Loud Impulse Sound	

Calculate Reset

APPENDIX B

HUD BARRIER PERFORMANCE MODULE

Home (/) > Programs (/programs/) > Environmental Review (/programs/environmental-review/) > Barrier Performance Module (BPM) Calculator

Barrier Performance Module (BPM) Calculator

This module provides to the user a measure on the barrier's effectiveness on noise reduction. A list of the input/output variables and their definitions, as well as illustrations of different scenarios are provided.

Calculator

View Day/Night Noise Level Calculator (/programs/environmental-review/dnl-calculator/)

View Descriptions of the Input/Output variables.

Note: Tool tips, containing field specific information, have been added in this tool and may be accessed by hovering over the Input and Output variables with the mouse.

WARNING: If there is direct line-of-sight between the Source and the Observer, the module will report erroneous attenuation. “Direct line-of-sight” means if the 5’ tall Observer can see the noise Source (cars, trucks, trains, etc.) over the Barrier (wall, hill/excavation, building, etc.), the current version of Barrier Performance Module will not accurately calculate the attenuation provided. In this instance, there is unlikely to be any appreciable attenuation.

Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	935
S	32	**D^1**	160
O	85	**α**	70

Calculate Output

Output Data

h	13	**R**	936
D	160	**FS**	2.1624

Reduction From Barrier (dB):

-2.1624

Refresh

Home (/) > **Programs (/programs/)** > **Environmental Review (/programs/environmental-review/)** > Barrier Performance Module (BPM) Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	250
S	10	**D^1**	135
O	85	**α**	90

Calculate Output

Output Data

h	31	**R**	260
D	131	**FS**	2.9821

Reduction From Barrier (dB):

-2.9821

Refresh

Home (/) > Programs (/programs/) > Environmental Review (/programs/environmental-review/) > Barrier Performance Module (BPM) Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	90
S	35	**D^1**	120
O	85	**α**	90

Calculate Output

Output Data

h	33	**R**	100
D	115	**FS**	3.1105

Reduction From Barrier (dB):

-3.1105

Refresh

Home (/) > Programs (/programs/) > Environmental Review (/programs/environmental-review/) > Barrier Performance Module (BPM) Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	220
S	10	**D^1**	200
O	85	**α**	180

Calculate Output

Output Data

h	40	**R**	230
D	195	**FS**	18.5699

Reduction From Barrier (dB):

-18.5699

Refresh

Home (/) > **Programs (/programs/)** > **Environmental Review (/programs/environmental-review/)** > Barrier Performance Module (BPM) Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	430
S	10	**D^1**	190
O	85	**α**	90

Calculate Output

Output Data

h	28	**R**	436
D	188	**FS**	2.9882

Reduction From Barrier (dB):

-2.9882

Refresh

Home (/) > Programs (/programs/) > Environmental Review (/programs/environmental-review/) > Barrier Performance Module (BPM) Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	80
S	35	**D^1**	200
O	85	**α**	180

Calculate Output

Output Data

h	40	**R**	88
D	195	**FS**	18.1566

Reduction From Barrier (dB):

-18.1566

Refresh

Home (/) > Programs (/programs/) > Environmental Review (/programs/environmental-review/) > Barrier Performance Module (BPM) Calculator

Barrier Performance Module (BPM) Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	170
S	10	**D^1**	210
O	85	**α**	90

Calculate Output

Output Data

h	46	**R**	182
D	204	**FS**	3.136

Reduction From Barrier (dB):

-3.136

Refresh

Barrier Performance Module (BPM) Calculator

This module provides to the user a measure on the barrier's effectiveness on noise reduction. A list of the input/output variables and their definitions, as well as illustrations of different scenarios are provided.

Calculator

View Day/Night Noise Level Calculator (/programs/environmental-review/dnl-calculator/)

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	430
S	10	**D^1**	255
O	85	**α**	90

Calculate Output

Output Data

h	33	**R**	436
D	253	**FS**	2.9784

Reduction From Barrier (dB):

-2.9784

Refresh

Home (/) > Programs (/programs/) > Environmental Review (/programs/environmental-review/) > Barrier Performance Module (BPM) Calculator

Barrier Performance Module (BPM) Calculator

This module provides to the user a measure on the barrier's effectiveness on noise reduction. A list of the input/output variables and their definitions, as well as illustrations of different scenarios are provided.

Calculator

View Day/Night Noise Level Calculator (/programs/environmental-review/dnl-calculator/)

View Descriptions of the Input/Output variables.

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	60
S	35	**D^1**	210
O	85	**α**	90

Calculate Output

Output Data

h	43	**R**	69
D	205	**FS**	2.9817

Reduction From Barrier (dB):

-2.9817

Refresh

Home (/) > Programs (/programs/) > Environmental Review (/programs/environmental-review/) > Barrier Performance Module (BPM) Calculator

Barrier Performance Module (BPM) Calculator

This module provides to the user a measure on the barrier's effectiveness on noise reduction. A list of the input/output variables and their definitions, as well as illustrations of different scenarios are provided.

Calculator

View Day/Night Noise Level Calculator (/programs/environmental-review/dnl-calculator/)

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	930
S	32	**D^1**	230
O	85	**α**	90

Calculate Output

Output Data

h	15	**R**	931
D	229	**FS**	3.0471

Reduction From Barrier (dB):

-3.0471

Refresh

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	430
S	10	**D^1**	255
O	85	**α**	90

Calculate Output

Output Data

h	33	**R**	436
D	253	**FS**	2.9784

Reduction From Barrier (dB):

-2.9784

Refresh

Home (/) > Programs (/programs/) > Environmental Review (/programs/environmental-review/) > Barrier Performance Module (BPM) Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	935
S	32	**D^1**	30
O	85	**α**	90

Calculate Output

Output Data

h	7	**R**	936
D	30	**FS**	3.0614

Reduction From Barrier (dB):

-3.0614

Refresh

Home (/) > Programs (/programs/) > Environmental Review (/programs/environmental-review/) > Barrier Performance Module (BPM) Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	410
S	10	**D^1**	120
O	85	**α**	80

Calculate Output

Output Data

h	22	**R**	416
D	118	**FS**	2.507

Reduction From Barrier (dB):

-2.507

Refresh

Barrier Performance Module (BPM) Calculator

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Calculator

View Day/Night Noise Level Calculator (/programs/environmental-review/dnl-calculator/)

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	830
S	32	**D^1**	100
O	25	**α**	180

Calculate Output

Output Data

h	64	**R**	830
D	100	**FS**	19.9791

Reduction From Barrier (dB):

-19.9791

Refresh

Home (/) > **Programs (/programs/)** > **Environmental Review (/programs/environmental-review/)** > Barrier Performance Module (BPM) Calculator

Barrier Performance Module (BPM) Calculator

This module provides to the user a measure on the barrier's effectiveness on noise reduction. A list of the input/output variables and their definitions, as well as illustrations of different scenarios are provided.

Calculator

View Day/Night Noise Level Calculator (/programs/environmental-review/dnl-calculator/)

View Descriptions of the Input/Output variables.

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	230
S	10	**D^1**	80
O	25	**α**	170

Calculate Output

Output Data

h	69	**R**	234
D	77	**FS**	13.8475

Reduction From Barrier (dB):

-13.8475

Refresh

Barrier Performance Module (BPM) Calculator

This module provides to the user a measure on the barrier's effectiveness on noise reduction. A list of the input/output variables and their definitions, as well as illustrations of different scenarios are provided.

Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	430
S	10	**D^1**	100
O	25	**α**	180

Calculate Output

Output Data

h	68	**R**	432
D	98	**FS**	19.9852

Reduction From Barrier (dB):

-19.9852

Refresh

Barrier Performance Module (BPM) Calculator

This module provides to the user a measure on the barrier's effectiveness on noise reduction. A list of the input/output variables and their definitions, as well as illustrations of different scenarios are provided.

Calculator

View Day/Night Noise Level Calculator (/programs/environmental-review/dnl-calculator/)

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	80
S	35	**D^1**	80
O	25	**α**	170

Calculate Output

Output Data

h	60	**R**	76
D	84	**FS**	13.7717

Reduction From Barrier (dB):

-13.7717

Refresh

Home (/) > Programs (/programs/) > Environmental Review (/programs/environmental-review/) > Barrier Performance Module (BPM) Calculator

Barrier Performance Module (BPM) Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	930
S	32	**D^1**	120
O	25	**α**	180

Calculate Output

Output Data

h	64	**R**	930
D	120	**FS**	19.9619

Reduction From Barrier (dB):

-19.9619

Refresh

Home (/) > Programs (/programs/) > Environmental Review (/programs/environmental-review/) > Barrier Performance Module (BPM) Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	230
S	10	**D^1**	110
O	25	**α**	170

Calculate Output

Output Data

h	70	**R**	233
D	107	**FS**	13.8438

Reduction From Barrier (dB):

-13.8438

Refresh

Home (/) > **Programs (/programs/)** > **Environmental Review (/programs/environmental-review/)** > Barrier Performance Module (BPM) Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	430
S	10	**D^1**	190
O	25	**α**	180

Calculate Output

Output Data

h	70	**R**	432
D	188	**FS**	19.9462

Reduction From Barrier (dB):

-19.9462

Refresh

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	80
S	35	**D^1**	80
O	25	**α**	170

Calculate Output

Output Data

h	60	**R**	76
D	84	**FS**	13.7717

Reduction From Barrier (dB):

-13.7717

Refresh

Home (/) > **Programs (/programs/)** > **Environmental Review (/programs/environmental-review/)** > Barrier Performance Module (BPM) Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	935
S	32	**D^1**	115
O	45	**α**	90

Calculate Output

Output Data

h	46	**R**	936
D	114	**FS**	3.1527

Reduction From Barrier (dB):

-3.1527

Refresh

Home (/) > Programs (/programs/) > Environmental Review (/programs/environmental-review/) > Barrier Performance Module (BPM) Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	170
S	10	**D^1**	120
O	45	**α**	90

Calculate Output

Output Data

h	59	**R**	178
D	114	**FS**	3.2359

Reduction From Barrier (dB):

-3.2359

Refresh

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	430
S	10	**D^1**	260
O	45	**α**	180

Calculate Output

Output Data

h	58	**R**	433
D	257	**FS**	19.4852

Reduction From Barrier (dB):

-19.4852

Refresh

Home (/) > **Programs (/programs/)** > **Environmental Review (/programs/environmental-review/)** > Barrier Performance Module (BPM) Calculator

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Note: Barrier height must block the line of sight

Input Data

H	90	**R^1**	170
S	35	**D^1**	120
O	45	**α**	90

Calculate Output

Output Data

h	49	**R**	172
D	118	**FS**	3.2259

Reduction From Barrier (dB):

-3.2259

Refresh

APPENDIX C

SUMMARY TABLE

APPENDIX C: DNL and BPM Calculation Summary

Mandela T3 - HUD Calculations Summary

Assessment using the HUD DNL Calculator Tool

Source	Distance (in ft)	DNL w/o Barrier	Barrier Effect	Calculated DNL	DNL with Future Traffic Increase
NAL1 (NE Corner)					
I-880	940	67	-2	65	66
7th St	255	53	0	53	54
Mandela Pkwy	435	47	0	47	47
BART	95	61	0	61	61
	Combined DNL	**68**		**67**	**67**
NAL2 (SE Corner)					
I-880	820	68	0	68	69
7th St	385	50	-3	47	48
Mandela Pkwy	435	47	0	47	47
BART	210	56	-3	53	53
	Combined DNL	**68**		**68**	**69**
NAL3 (South Center)					
I-880	850	68	0	68	69
7th St	420	50	-19	31	32
Mandela Pkwy	500	46	-3	43	43
BART	280	54	-18	36	36
	Combined DNL	**68**		**68**	**69**
NAL4 (SW Corner)					
I-880	980	67	0	67	68
7th St	380	50	-3	47	48
Mandela Pkwy	685	44	-3	41	41
BART	270	55	-3	52	52
	Combined DNL	**67**		**67**	**68**
NAL5 (NW Corner)					
I-880	1160	66	-3	63	64
7th St	180	55	0	55	56
Mandela Pkwy	685	44	-3	41	41
BART	75	63	0	63	63
	Combined DNL	**68**		**66**	**67**
NAL6 (North Center)					
I-880	1000	67	-3	64	65
7th Street	230	54	0	54	55
Mandela Pkwy	530	46	-4	42	42
BART	80	63	0	63	63
	Combined DNL	**69**		**67**	**67**
NAL7 (East Courtyard)					
I-880	930	67	-20	47	48
7th Street	310	52	-14	38	39
Mandela Pkwy	530	46	-20	26	26
BART	160	58	-14	44	44
	Combined DNL	**68**		**49**	**50**
NAL8 (West Courtyard)					
I-880	970	67	-20	47	48
7th St	300	52	-14	38	39
Mandela Pkwy	600	45	-20	25	25
BART	170	58	-14	44	44
	Combined DNL	**68**		**49**	**50**
NAL9 (Level 4 Amenity)					
I-880	1000	67	-3	64	65
7th Street	300	52	-3	49	50
Mandela Pkwy	660	45	-19	26	26
BART	180	57	-3	54	54
	Combined DNL	**68**		**65**	**65**

APPENDIX D

STraCAT CALCULATIONS

Part I - Description

Project

Mandela Station T3

Sponsor/Developer

Keystone Development

Location

NAL1

Prepared by

Salter

Noise Level

67

Date

11/5/2024

Primary Source(s)

I-880

Part II - Wall Components

Wall Construction Detail	Area	STC
3-coat cement plaster	194	45
Add new wall		
	194 Sq. Feet	**45**

Window Construction Detail	Quantity	Sq Ft/Unit	STC
Window	1	64	28
PTAC	1	5	31
Add new window			

Door Construction Detail	Quantity	Sq Ft/Unit	STC
Add new door			

Part III - Results

Wall Statistics

Stat	Value
Area:	194 ft^2
Wall STC:	45

Aperture Statistics

Aperture	Count	Area	% of wall
Windows:	2	**69 ft^2**	**35.57%**
Doors:	0	**0 ft^2**	**0%**

Evaluation Criteria

Criteria	Value
Noise source sound level (dB):	**67**
Combined STC for wall assembly:	**32.49**
Required STC rating:	**25**
Does wall assembly meet requirements?	**Yes**

Print

Part 4 - Tips

What do you do if the preferred wall design is not sufficient to achieve the required attenuation? Another wall design with more substantial materials will work, but may not be the most cost-effective solution. Try adding some other elements for just a little more attenuation.

For example:

- Staggering the studs in a wall offers approximately 4dB of additional protection.
- Increasing the stud spacing from 16” on center to 24” can increase the STC from 2-5dB.
- Adding a 2” air space can provide 3dB more attenuation.
- Increasing a wall’s air space from 3” to 6”can reduce noise levels by an additional 5dB.
- Adding a layer of ½” gypsum board on “Z” furring channels adds 2dB of attenuation.
- Using resilient channels and clips between wall panels and studs can improve the STC from 2-5dB.
- Adding a layer of ½” gypsum board on resilient channels adds 5dB of attenuation.
- Adding acoustical or isolation blankets to a wall’s airspace can add 4-10dB of attenuation.
- A 1” rockwool acoustical blanket adds 3dB to the wall’s STC.
- Filling the cells of lightweight concrete masonry units with expanded mineral loose-fill insulation adds 2dB to the STC.

Part I - Description

Project

Mandela Station T3

Sponsor/Developer

Keystone Development

Location

NAL2

Prepared by

Salter

Noise Level

69

Date

11/5/2024

Primary Source(s)

I-880

Part II - Wall Components

Wall Construction Detail	Area	STC
3-coat cement plaster	194	45
Add new wall		
	194 Sq. Feet	45

Window Construction Detail	Quantity	Sq Ft/Unit	STC
Window	1	64	28
PTAC	1	5	31
Add new window			

Door Construction Detail	Quantity	Sq Ft/Unit	STC
Add new door			

Part III - Results

Part III - Results

Wall Statistics

Stat	Value
Area:	194 ft^2
Wall STC:	45

Aperture Statistics

Aperture	Count	Area	% of wall
Windows:	2	**69 ft^2**	**35.57%**
Doors:	0	**0 ft^2**	**0%**

Evaluation Criteria

Criteria	Value
Noise source sound level (dB):	**69**
Combined STC for wall assembly:	**32.49**
Required STC rating:	**27**
Does wall assembly meet requirements?	**Yes**

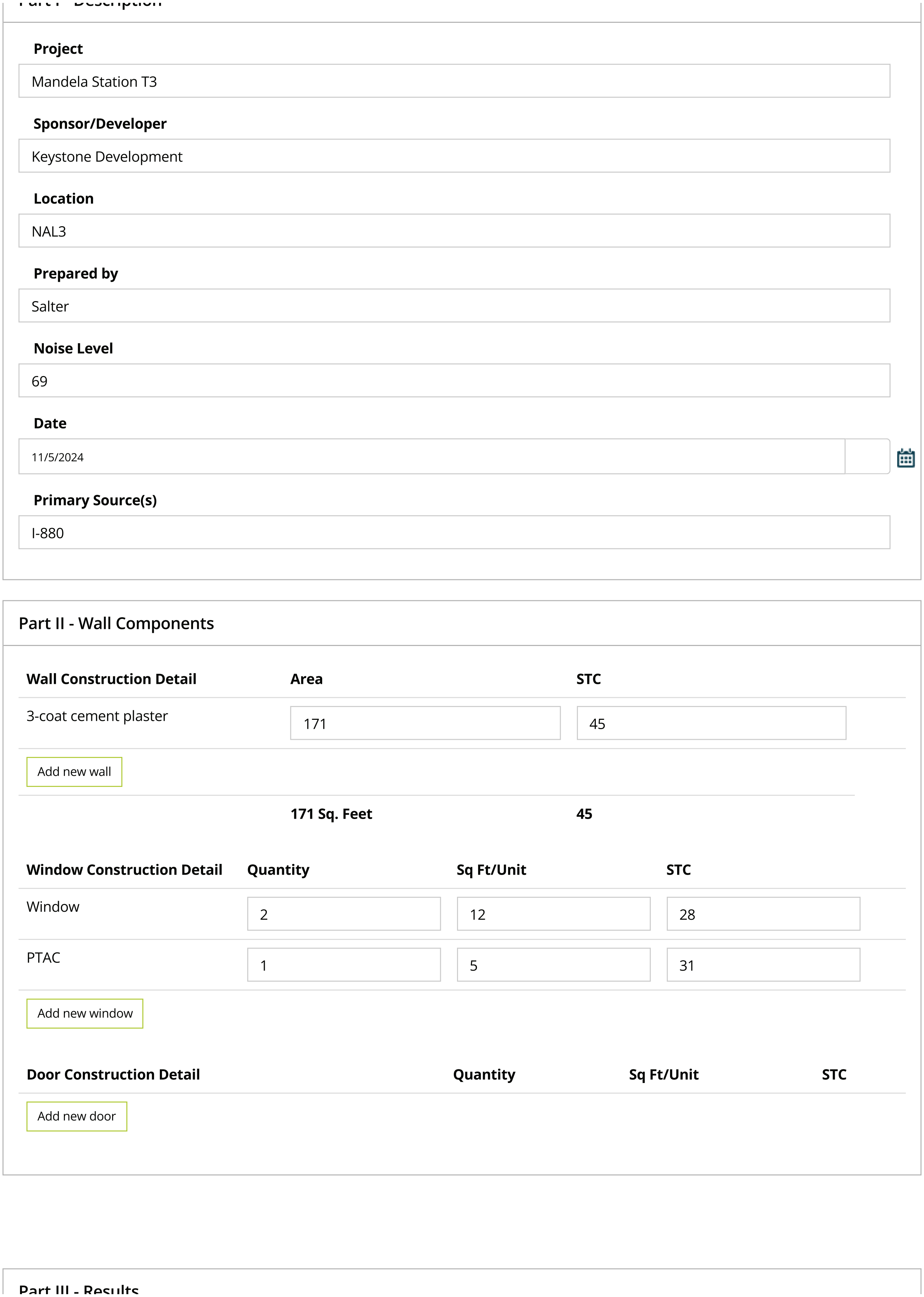
Print

Part 4 - Tips

What do you do if the preferred wall design is not sufficient to achieve the required attenuation? Another wall design with more substantial materials will work, but may not be the most cost-effective solution. Try adding some other elements for just a little more attenuation.

For example:

- Staggering the studs in a wall offers approximately 4dB of additional protection.
- Increasing the stud spacing from 16” on center to 24” can increase the STC from 2-5dB.
- Adding a 2” air space can provide 3dB more attenuation.
- Increasing a wall’s air space from 3” to 6”can reduce noise levels by an additional 5dB.
- Adding a layer of ½” gypsum board on “Z” furring channels adds 2dB of attenuation.
- Using resilient channels and clips between wall panels and studs can improve the STC from 2-5dB.
- Adding a layer of ½” gypsum board on resilient channels adds 5dB of attenuation.
- Adding acoustical or isolation blankets to a wall’s airspace can add 4-10dB of attenuation.
- A 1” rockwool acoustical blanket adds 3dB to the wall’s STC.
- Filling the cells of lightweight concrete masonry units with expanded mineral loose-fill insulation adds 2dB to the STC.



Part I - Description

Project
Mandela Station T3

Sponsor/Developer
Keystone Development

Location
NAL3

Prepared by
Salter

Noise Level
69

Date
11/5/2024

Primary Source(s)
I-880

Part II - Wall Components

Wall Construction Detail	Area	STC
3-coat cement plaster	171	45
	171 Sq. Feet	**45**

Window Construction Detail	Quantity	Sq Ft/Unit	STC
Window	2	12	28
PTAC	1	5	31

Door Construction Detail	Quantity	Sq Ft/Unit	STC

Part III - Results

Part III - Results

Wall Statistics

Stat	Value
Area:	171 ft^2
Wall STC:	45

Aperture Statistics

Aperture	Count	Area	% of wall
Windows:	3	**29 ft^2**	**16.96%**
Doors:	0	**0 ft^2**	**0%**

Evaluation Criteria

Criteria	Value
Noise source sound level (dB):	**69**
Combined STC for wall assembly:	**35.66**
Required STC rating:	**27**
Does wall assembly meet requirements?	**Yes**

Print

Part 4 - Tips

What do you do if the preferred wall design is not sufficient to achieve the required attenuation? Another wall design with more substantial materials will work, but may not be the most cost-effective solution. Try adding some other elements for just a little more attenuation.

For example:

- Staggering the studs in a wall offers approximately 4dB of additional protection.
- Increasing the stud spacing from 16” on center to 24” can increase the STC from 2-5dB.
- Adding a 2” air space can provide 3dB more attenuation.
- Increasing a wall’s air space from 3” to 6”can reduce noise levels by an additional 5dB.
- Adding a layer of ½” gypsum board on “Z” furring channels adds 2dB of attenuation.
- Using resilient channels and clips between wall panels and studs can improve the STC from 2-5dB.
- Adding a layer of ½” gypsum board on resilient channels adds 5dB of attenuation.
- Adding acoustical or isolation blankets to a wall’s airspace can add 4-10dB of attenuation.
- A 1” rockwool acoustical blanket adds 3dB to the wall’s STC.
- Filling the cells of lightweight concrete masonry units with expanded mineral loose-fill insulation adds 2dB to the STC.

Part I - Description

Project

Mandela Station T3

Sponsor/Developer

Keystone Development

Location

NAL4

Prepared by

Salter

Noise Level

68

Date

11/5/2024

Primary Source(s)

I-880

Part II - Wall Components

Wall Construction Detail	Area	STC
3-coat cement plaster	194	45

Add new wall

	194 Sq. Feet	**45**

Window Construction Detail	Quantity	Sq Ft/Unit	STC
Window	1	64	28
PTAC	1	5	31

Add new window

Door Construction Detail	Quantity	Sq Ft/Unit	STC

Add new door

Part III - Results

Wall Statistics

Stat	Value
Area:	194 ft^2
Wall STC:	45

Aperture Statistics

Aperture	Count	Area	% of wall
Windows:	2	**69 ft^2**	**35.57%**
Doors:	0	**0 ft^2**	**0%**

Evaluation Criteria

Criteria	Value
Noise source sound level (dB):	**68**
Combined STC for wall assembly:	**32.49**
Required STC rating:	**26**
Does wall assembly meet requirements?	**Yes**

Print

Part 4 - Tips

What do you do if the preferred wall design is not sufficient to achieve the required attenuation? Another wall design with more substantial materials will work, but may not be the most cost-effective solution. Try adding some other elements for just a little more attenuation.

For example:

- Staggering the studs in a wall offers approximately 4dB of additional protection.
- Increasing the stud spacing from 16” on center to 24” can increase the STC from 2-5dB.
- Adding a 2” air space can provide 3dB more attenuation.
- Increasing a wall’s air space from 3” to 6”can reduce noise levels by an additional 5dB.
- Adding a layer of ½” gypsum board on “Z” furring channels adds 2dB of attenuation.
- Using resilient channels and clips between wall panels and studs can improve the STC from 2-5dB.
- Adding a layer of ½” gypsum board on resilient channels adds 5dB of attenuation.
- Adding acoustical or isolation blankets to a wall’s airspace can add 4-10dB of attenuation.
- A 1” rockwool acoustical blanket adds 3dB to the wall’s STC.
- Filling the cells of lightweight concrete masonry units with expanded mineral loose-fill insulation adds 2dB to the STC.

Part I - Description

Project

Mandela Station T3

Sponsor/Developer

Keystone Development

Location

NAL5

Prepared by

Salter

Noise Level

67

Date

11/5/2024

Primary Source(s)

I-880

Part II - Wall Components

Wall Construction Detail	Area	STC
3-coat cement plaster	216	45

Add new wall

	216 Sq. Feet	**45**

Window Construction Detail	Quantity	Sq Ft/Unit	STC
Window	1	64	28
PTAC	1	5	31

Add new window

Door Construction Detail	Quantity	Sq Ft/Unit	STC

Add new door

Part III - Results

Wall Statistics

Stat	**Value**
Area:	216 ft^2
Wall STC:	45

Aperture Statistics

Aperture	**Count**	**Area**	**% of wall**
Windows:	2	**69 ft^2**	**31.94%**
Doors:	0	**0 ft^2**	**0%**

Evaluation Criteria

Criteria	**Value**
Noise source sound level (dB):	**67**
Combined STC for wall assembly:	**32.93**
Required STC rating:	**25**
Does wall assembly meet requirements?	**Yes**

Print

Part 4 - Tips

What do you do if the preferred wall design is not sufficient to achieve the required attenuation? Another wall design with more substantial materials will work, but may not be the most cost-effective solution. Try adding some other elements for just a little more attenuation.

For example:

- Staggering the studs in a wall offers approximately 4dB of additional protection.
- Increasing the stud spacing from 16” on center to 24” can increase the STC from 2-5dB.
- Adding a 2” air space can provide 3dB more attenuation.
- Increasing a wall’s air space from 3” to 6”can reduce noise levels by an additional 5dB.
- Adding a layer of ½” gypsum board on “Z” furring channels adds 2dB of attenuation.
- Using resilient channels and clips between wall panels and studs can improve the STC from 2-5dB.
- Adding a layer of ½” gypsum board on resilient channels adds 5dB of attenuation.
- Adding acoustical or isolation blankets to a wall’s airspace can add 4-10dB of attenuation.
- A 1” rockwool acoustical blanket adds 3dB to the wall’s STC.
- Filling the cells of lightweight concrete masonry units with expanded mineral loose-fill insulation adds 2dB to the STC.

Part I - Description

Project

Mandela Station T3

Sponsor/Developer

Keystone Development

Location

NAL6

Prepared by

Salter

Noise Level

67

Date

11/5/2024

Primary Source(s)

I-880

Part II - Wall Components

Wall Construction Detail	Area	STC
3-coat cement plaster	194	45
Add new wall		
	194 Sq. Feet	**45**

Window Construction Detail	Quantity	Sq Ft/Unit	STC
Window	1	64	28
PTAC	1	5	31
Add new window			

Door Construction Detail	Quantity	Sq Ft/Unit	STC
Add new door			

Part III - Results

Wall Statistics

Stat	Value
Area:	194 ft²
Wall STC:	45

Aperture Statistics

Aperture	Count	Area	% of wall
Windows:	2	**69 ft²**	**35.57%**
Doors:	0	**0 ft²**	**0%**

Evaluation Criteria

Criteria	Value
Noise source sound level (dB):	**67**
Combined STC for wall assembly:	**32.49**
Required STC rating:	**25**
Does wall assembly meet requirements?	**Yes**

Print

Part 4 - Tips

What do you do if the preferred wall design is not sufficient to achieve the required attenuation? Another wall design with more substantial materials will work, but may not be the most cost-effective solution. Try adding some other elements for just a little more attenuation.

For example:

- Staggering the studs in a wall offers approximately 4dB of additional protection.
- Increasing the stud spacing from 16” on center to 24” can increase the STC from 2-5dB.
- Adding a 2” air space can provide 3dB more attenuation.
- Increasing a wall’s air space from 3” to 6”can reduce noise levels by an additional 5dB.
- Adding a layer of ½” gypsum board on “Z” furring channels adds 2dB of attenuation.
- Using resilient channels and clips between wall panels and studs can improve the STC from 2-5dB.
- Adding a layer of ½” gypsum board on resilient channels adds 5dB of attenuation.
- Adding acoustical or isolation blankets to a wall’s airspace can add 4-10dB of attenuation.
- A 1” rockwool acoustical blanket adds 3dB to the wall’s STC.
- Filling the cells of lightweight concrete masonry units with expanded mineral loose-fill insulation adds 2dB to the STC.

23 July 2025

Gene Broussard
Mandela Station Affordable LP
P.O. Box 260770
Encino, CA 91426
gbroussard@amgland.com

Subject: **Mandela Station, Building T3**
Environmental Noise Study
Salter Project 24-0292

Dear Gene:

As requested, we have conducted an environmental noise study for the project, based on new layouts for this building. The purpose of our study is to determine the noise environment at the proposed site, to compare the measured data with applicable standards, and to recommend mitigation measures as necessary. This report summarizes the results.

PROJECT CRITERIA

Interior Noise

California Building Code (Title 24)

Section 1206 of the 2022 California Building Code requires that the indoor noise level not exceed DNL 45 dB in multi-family residential units, where the exterior noise level is greater than DNL[1] 60 dB.

---

[1] DNL (Day-Night Average Sound Level) – A descriptor for a 24-hour A-weighted average noise level. DNL accounts for the increased acoustical sensitivity of people to noise during the nighttime hours. DNL penalizes sound levels by 10 dB during the hours from 10 PM to 7 AM. For practical purposes, the DNL and CNEL are usually interchangeable. DNL is sometimes written as L_{dn}.

CALGreen

Section 5.507.4 of the CALGreen code addresses acoustics for non-residential buildings, which includes commercial and amenity spaces within the building. If a building is exposed to an exterior $L_{eq}(h)$[2] of 65 dB during any hour of operation, the building envelope must reduce the interior noise environment to $L_{eq}(h)$ 50 dB in occupied areas.

We assumed that the hours of operation for the commercial spaces would be from 7 am to 10 pm and used the loudest $L_{eq}(h)$ during that period as the basis of design.

Outdoor Noise

City Noise Element

The Noise Land-Use Compatibility of the Oakland General Plan Noise Element has a goal of DNL 60 dB for residential outdoor-use spaces, such as the common courtyards.

NOISE ENVIRONMENT

The building is bounded by 5th Street, the West Oakland BART station, Chester Street, and Mandela Parkway. Interstate 880 (I-880) is approximately 700 feet to the south. The noise environment is dominated by traffic along these streets, and BART.

A traffic volume study has not been provided for the roadways, so we have added 1 dB to the measured noise level to account for future traffic increases.[3]

To quantify the existing noise environment, we conducted five long-term noise measurements between 10 January and 14 January 2020 (LT-1 through LT-5) and two short-term noise measurements (ST-1 and ST-2). The long-term monitors were located approximately 12-feet above grade and the short-term were located approximately 35-feet above grade. Please refer to **Figure 1** for a summary of noise levels and measurement locations.

RECOMMENDATIONS

Our analysis is based on the floor plans of the Submittal Set received 30 September 2024.

---

[2] L_{eq} – The equivalent steady-state A-weighted sound level that, in a stated period of time, would contain the same acoustic energy as the time-varying sound level during the same period.

[3] The California Department of Transportation (DOT assumes a traffic volume increase of three-percent per year, which corresponds to a 1 dB increase in DNL over a ten year period.

Interior Noise

The elevations show PTAC (through-wall) AC units at residences. We understand that the vents for the PTAC will be closed (i.e., not used for fresh air). The exact product is not yet known.

To meet the interior noise criteria, the window system STC ratings would need to be as shown on **Figures 2 to 4**. These calculations assume the following:

- All spaces have hard-surfaced flooring
- Residential PTAC units achieve STC 31 (when closed)
- Level 1 spaces have approximately 15-foot tall ceilings
- Levels 2 to 6 have approximately 9-foot tall ceilings
- The typical exterior wall assembly achieves STC 45 (e.g., a three-coat stucco system)

At various residential locations along the northern facades, an upgraded exterior wall (achieving STC 50) will be necessary to meet Code. These walls should consist of a staggered-stud assembly as shown on **Figure 5**. These locations are indicated on **Figures 3 and 4**.

The recommended STC ratings are for full window and door assemblies (glass and frame) rather than just the glass itself. Tested sound-rated assemblies should be used. For reference, typical one-inch glazing assemblies (two 1/4-inch thick panes with a 1/2-inch airspace) achieve approximately STC 32 (depending on the window type and manufacturer). Where STC ratings above 32 are required, at least one pane will need to be laminated. STC ratings above 38 typically require IGU thicker than one-inch thick. This will vary depending on the manufacturer.

Since the windows need to be closed to achieve an indoor DNL of 45 dB, an alternative method of supplying fresh air (e.g., mechanical ventilation) should be provided. This applies to all locations where an STC rating is shown. The mitigation measures in **Tables 1 and 2** are necessary for all air vents into residences. The mitigation measure will vary depending on the types of vents. (e.g., kitchen and make-up air) and the window STC rating needed at each room. This issue should be discussed with the project mechanical engineer.

Table 1: Kitchen Exhaust Vents Mitigation

Window STC Rating	Recommended Mitigation
STC 31 or less	Provide two 90-degree turns between exhaust duct and exterior
STC 34 to 39	Provide two 90-degree turns and exterior flapper between exhaust duct and exterior

Table 2: Make-up Air Mitigation

Window STC Rating	Recommended Mitigation
STC 31 to 37	Z-duct with minimum 6-feet between interior and exterior vents
Greater than STC 37	Duct directly to the fan-coil unit

Outdoor Noise

Courtyards

The building includes two courtyards on Level 2, about 20 feet above grade. The BART tracks are located at about 30 feet above grade. There are 25-foot tall sound-rated art walls at the north courtyard openings, as measured from the courtyard elevation. This design meets the DNL 60 dB goal.

Level 4 Amenity Deck

The building also has a residential amenity deck on Level 4 along the west facade. Based on our measured sound data and calculations, the noise level in the courtyards will be up to about DNL 70 dB. Therefore, at least 10 dB of noise reduction is needed.

To meet the DNL 60 dB goal, a sound-rated barrier will be needed at around the amenity deck roof perimeter. The wall will need to be at least 7 feet tall, as measured from the Level 4 deck elevation. The wall needs to have a surface density of at least 3 psf, be solid from top-to-bottom, and have no cracks or gaps in its face.

* * *

This concludes our environmental noise study for the project. Please reach out with any questions.

Sincerely,

SALTER

Zamar Bravo Tapia
Consultant

Eric Mori, PE
Executive Vice President

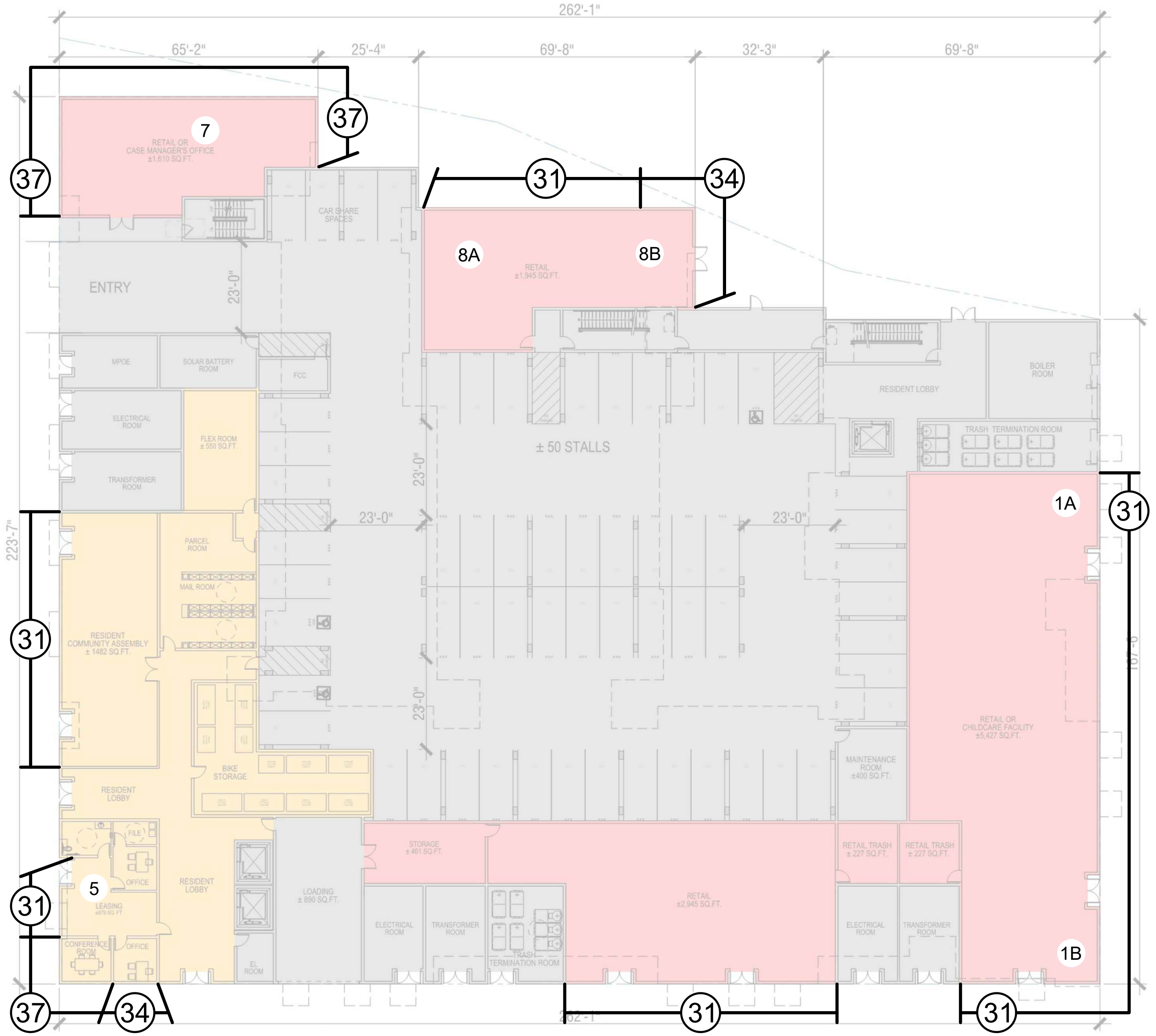
Enclosures as noted

MANDELA STATION – PARCEL T3 MEASUREMENT LOCATIONS AND MEASURED NOISE LEVELS

FIGURE 1

Salter #
24-0292

SMR/EBM
07.23.25



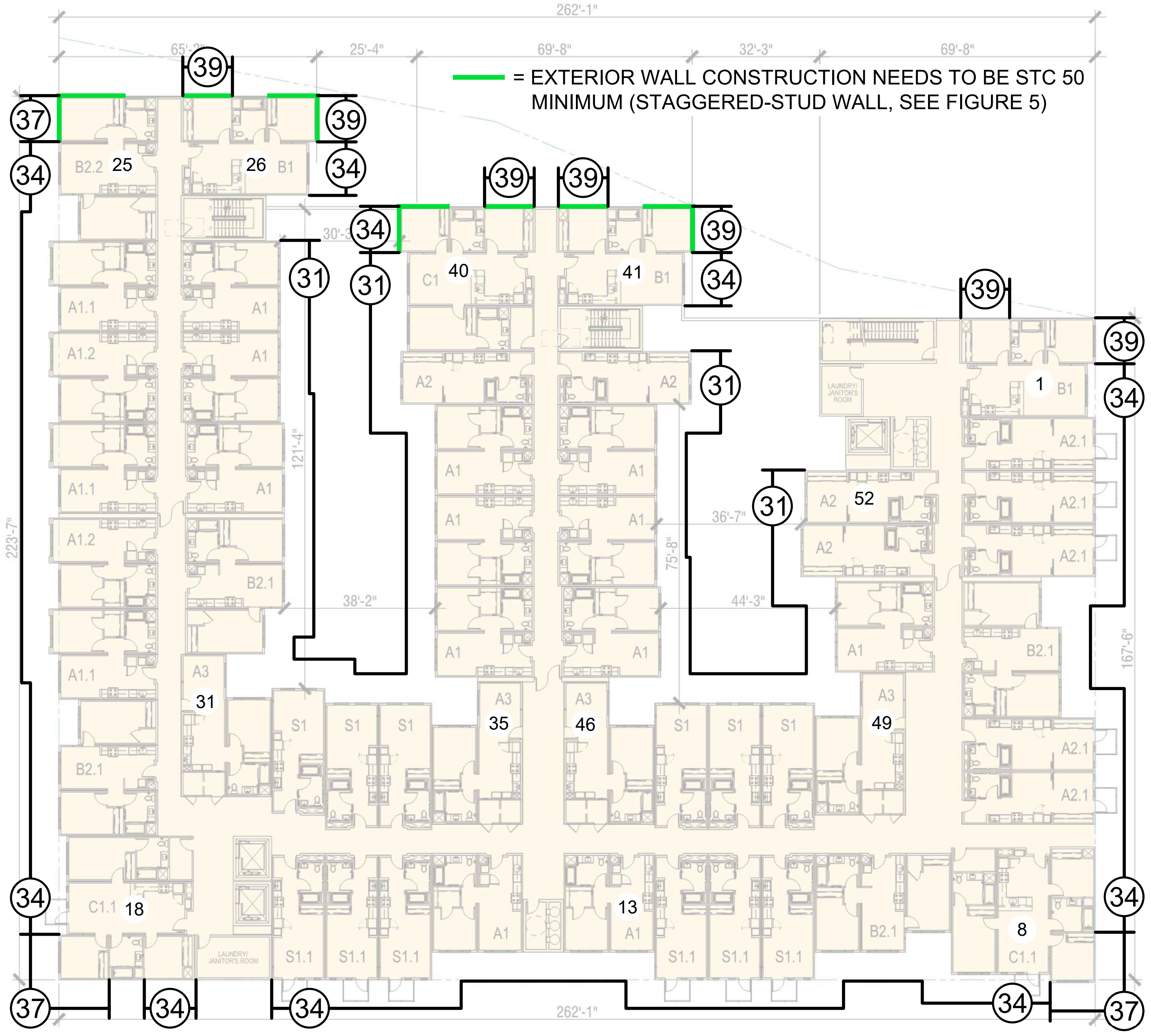
NOTE: STC RATINGS ARE FOR THE COMPLETE ASSEMBLY (E.G., GLASS, FRAME, AND OPERABLE SECTIONS) BASED ON TEST REPORTS FROM AN NVLAP-ACCREDITED LAB

MANDELA STATION – PARCEL T3
MINIMUM CODE–REQUIRED STC RATINGS FOR WINDOWS AND EXTERIOR DOORS (FLOOR 1)

FIGURE 2

Salter #
24–0292

SMR/EBM
07.23.25

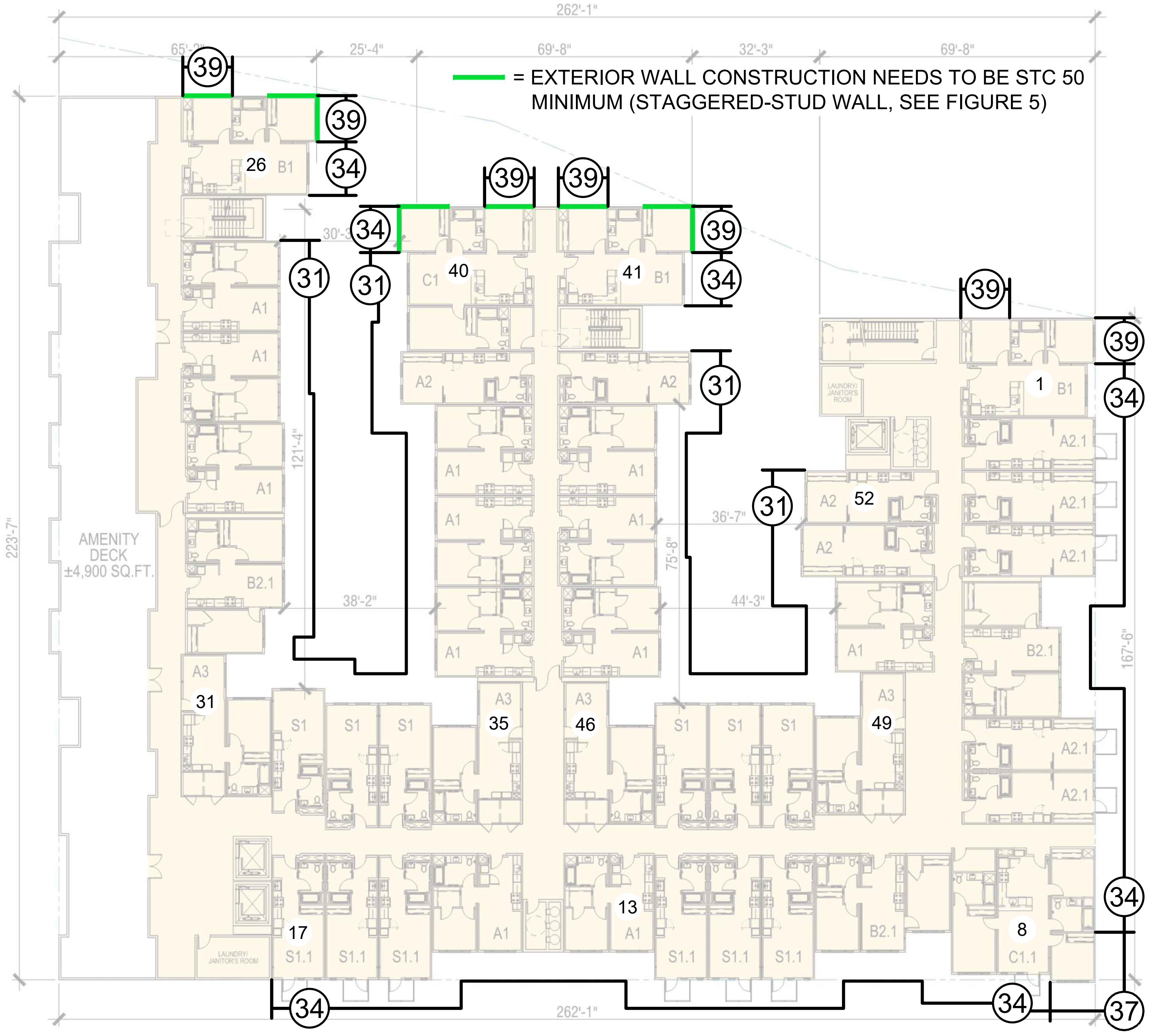

🟩 = EXTERIOR WALL CONSTRUCTION NEEDS TO BE STC 50 MINIMUM (STAGGERED-STUD WALL, SEE FIGURE 5)

NOTE: STC RATINGS ARE FOR THE COMPLETE ASSEMBLY (E.G., GLASS, FRAME, AND OPERABLE SECTIONS) BASED ON TEST REPORTS FROM AN NVLAP-ACCREDITED LAB

MANDELA STATION – PARCEL T3
MINIMUM CODE–REQUIRED STC RATINGS FOR WINDOWS AND EXTERIOR DOORS (FLOORS 2 AND 3)

FIGURE 3

Salter # 24–0292
SMR/EBM
07.23.25



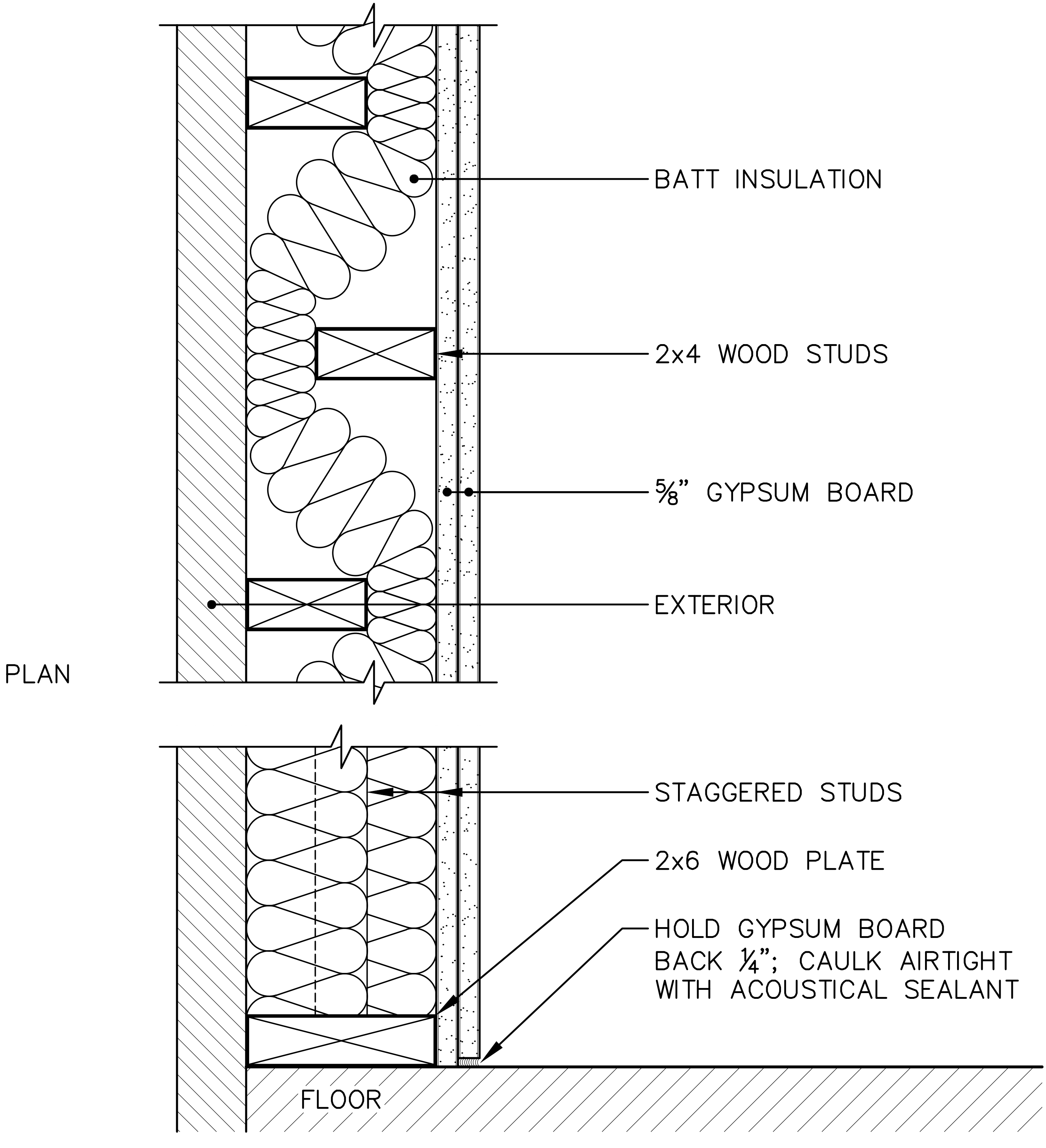
🟩 = EXTERIOR WALL CONSTRUCTION NEEDS TO BE STC 50 MINIMUM (STAGGERED-STUD WALL, SEE FIGURE 5)

NOTE: STC RATINGS ARE FOR THE COMPLETE ASSEMBLY (E.G., GLASS, FRAME, AND OPERABLE SECTIONS) BASED ON TEST REPORTS FROM AN NVLAP-ACCREDITED LAB

MANDELA STATION – PARCEL T3
MINIMUM CODE–REQUIRED STC RATINGS FOR WINDOWS AND EXTERIOR DOORS (FLOORS 4 TO 6)

FIGURE 4

Salter # 24–0292
SMR/EBM 07.23.25



STAGGERED—STUD EXTERIOR WALL

FIGURE 5

3012X
1.1.1.3

MFH
06.06.24

Appendix M

M-1: Preliminary Geotechnical Report for the West Oakland BART Station Transit-Oriented Design Project

Parikh Consultants, Inc., December 2019

M-2: Final Geotechnical Investigation, Proposed Affordable Housing, West Oakland Transit Village – Parcel T3

Rockridge Geotechnical, October 21, 2024

PRELIMINARY GEOTECHNICAL REPORT
WEST OAKLAND BART STATION
TRANSIT-ORIENTED DESIGN PROJECT
1451 7TH STREET, OAKLAND, CALIFORNIA

For

STRATEGIC URBAN DEVELOPMENT ALLIANCE (SUDA) LLC
1210 Excelsior Avenue
Oakland, CA 94610

PARIKH CONSULTANTS, INC.
2360 Qume Drive, Suite A
San Jose, CA 95131

December 15, 2019

Job No. 2019-127-GEO

TABLE OF CONTENTS PAGE

1.0 INTRODUCTION 1
2.0 PROJECT DESCRIPTION 2
3.0 AS-BUILT GEOTECHNICAL DATA 3
4.0 FIELD INVESTIGATION AND TESTING PROGRAM 3
5.0 LABORATORY TESTING PROGRAM 5
6.0 GEOLOGY, SEISMICITY AND SUBSURFACE CONDITIONS 5
  6.1 Regional Geology 5
  6.2 Seismicity 6
  6.3 Site Geology 6
  6.4 Subsurface Conditions 7
7.0 GROUNDWATER 10
8.0 CORROSION EVALUATION 11
9.0 SEISMIC DESIGN INFORMATION AND RECOMMENDATIONS 11
  9.1 Seismic Sources 11
  9.2 Seismic Design Criteria 12
  9.3 Seismic Hazards 13
10.0 GEOTECHNICAL DESIGN CONSIDERATIONS 14
11.0 GEOTECHNICAL RECOMMENDATIONS 16
  11.1 General 16
  11.2 Design Groundwater Level 17
  11.3 ACP Pile Foundation Design (Building T-1 and Option A for T-3 & T-4) 17
  11.4 Testing Plan for Auger Cast Piles (Building T-1 and Option A for T-3 & T-4) 18
  11.5 Mat Foundations (Option B for T-3 & T-4) 19
  11.6 Basement Walls and Lateral Earth Pressures (Option B for T-3 & T-4) 19
  11.7 Temporary Excavation and Shoring (Option B for T-3 & T-4) 20
  11.8 Construction Dewatering 21
  11.9 Working Platform 22
  11.10 Baseline Distress Surveys and Monitoring 22
  11.11 Drainage 23
12.0 GRADING 23
13.0 CONSTRUCTION OBSERVATION 24
14.0 INVESTIGATION LIMITATIONS 25

LIST OF FIGURES

Figure 1: Project Location Map
Figure 2: Site Plan
Figure 3: Subsurface Profiles A-A’ and B-B’
Figure 4: Quaternary Geology & Liquefaction Susceptibility Map
Figure 4A: Seismic Hazards Map Showing Historic Ground Failures and Groundwater Levels
Figure 4B: Oakland Historic Shorelines
Figure 5: Fault Map
Figure 6: SEAOC/OSHPD Design Maps Summary Report
Figure 7: Liquefaction Hazard Map
Figure 8: Lateral Earth Pressure Diagram for Shoring
Figure 9: Typical Pictures of Multi-Shaft Auger and Soil Cutter Mix Systems

APPENDICES

APPENDIX A: Boring Logs and As-Built Logs of Test Borings
APPENDIX B: Laboratory Test Results
APPENDIX C: Cone Penetration Test Report (Gregg Drilling)
APPENDIX D: Geophysical Logging Survey Report (Norcal Geophysical)
APPENDIX E: Analyses and Calculations

PRELIMINARY GEOTECHNICAL REPORT
WEST OAKLAND BART STATION
TRANSIT-ORIENTED DESIGN PROJECT
1451 7TH STREET, OAKLAND, CALIFORNIA

1.0 INTRODUCTION

This report presents the results of our geotechnical investigation, preliminary geotechnical information and recommendations for the West Oakland BART Station Transit-Oriented Design (TOD) project to be constructed at 1451 7th Street in Oakland, California. The project site is situated between 5th Street and 7th Street, and between Chester Street and Mandela Parkway as shown on the Project Location Map, Figure 1. Our work was performed for in general accordance with the proposed scope of work presented in our Revised Scope of Work and Cost Estimate dated May 13, 2019.

The purpose of this investigation was to evaluate the general soil and groundwater conditions at the project site, to evaluate their engineering properties, and to provide preliminary geotechnical design criteria and construction recommendations for the proposed project. The scope of work performed for this investigation included a review of the readily available geologic and geotechnical literature pertaining to the site including as-built soil data in the vicinity of the subject site, drilling of four exploratory soil borings, obtaining representative soil samples and logging subsurface materials encountered in the borings, laboratory testing of the representative soil samples, performing preliminary engineering analyses, and preparation of this report.

The intent is to provide the preliminary and geotechnical design considerations for the designer and developer for discussion and interaction on the proposed concept. Design details are not available at this time. Further collaboration with the design team is required for final design, and the preliminary recommendations presented herein may be refined/updated.

The geotechnical information, design criteria and preliminary foundation recommendations presented in this report are intended to characterize the subsurface conditions at the site and to assess potential geotechnical and geologic impacts on the project. The report includes the results of our review of readily available geotechnical and geologic data for the site, logs of the materials encountered in our borings, and results of laboratory testing performed on soil samples recovered from the borings.

Preliminary engineering analyses included seismic design criteria for the site, assessment of liquefaction potential, identifying soil strength parameters for the soil profile at the site, recommendations for foundation types for the buildings, evaluations of bearing and pile capacity. Discussion for a possible design option including basement walls, construction considerations for temporary excavation and shoring, and construction dewatering are also addressed.

The information contained in this report has been prepared for SUDA LLC and their architect and engineers during the entitlement phase, and preliminary foundation design.

2.0 PROJECT DESCRIPTION

According to a Preliminary Development Plan, by SUDA LLC, dated January 28, 2019, the proposed development at the West Oakland BART station is divided into four Building plans, T-1 through T-4 which would be constructed in areas currently in use for BART station parking.

The existing BART tracks run approximately east west on a viaduct structure through the site, and the BART West Oakland station is located central portion of the site. It is our understanding that the existing station structure and the east and west approach track structures are supported on shallow spread footing foundations bearing in the Merritt Sand. It is recommended that the designer communicate with BART and review the as-built drawings to confirm the as-built foundations (footing size, elevation, and as-built design information) of the viaduct and station structures.

Building T-1 will consist of a 320-foot (30-story) residential tower at the northeast corner of the property. The proposed building would consist of at-grade retail and parking, three levels of office spaces and 26 levels of residential apartments. Building T-1 does not include below grade floor (basement).

Building T-2 will consist of commercial infill beneath the existing BART station aerial viaduct, and development of an at-grade courtyard northwest of the station.

Building T-3 at the southwest portion of the property will consist of an 8-story residential apartment building with 6 levels of residential units over 3 levels of parking, and at-grade retail space.

Building T-4 at the southeast portion of the property will consist of a 7- story office building with 6 levels of office space over an at-grade office lobby, retail and lab space. Per information provided, Building T-4 may also be a 15-story office tower.

It is our understanding that during the development process, one option was to have a continuous basement parking level connecting Buildings T-3 and T-4. The recent information indicates that the basement garage concept is eliminated, and all parking will be on or above grade within each parcel.

3.0 AS-BUILT GEOTECHNICAL DATA

A "Soil Investigation, Segment B-004, Oakland, California, San Francisco Bay Area Rapid Transit System" report, dated June 16, 1965 was prepared by Dames & Moore for a portion of the Trans-Bay Line – Oakland Approach between the portal structure just east of Maritime Street overpass and the West Oakland Station.

A Soil Investigation Report (K702) for BART West Oakland Line, Segment K-002", dated March 1966 was prepared by Bechtel Corporation. This investigation included several borings performed in the immediate area of the project site.

PARIKH previously prepared a Geotechnical Engineering Report for the BART Aerial Structures for West Oakland as part of BART's Earthquake Safety Program. The results were presented in a "Geotechnical Engineering Report, Aerial Structures – West Oakland, Oakland, California" dated November 2007. This report includes borehole data from both the Dames & Moore and Bechtel Corporation reports noted above, and boring (B8) a relevant supplemental boring logged by PARIKH in 2001.

The as-built geotechnical boring logs and logs of test boring data from these studies are considered relevant to the proposed T-1 through T-4 development areas shown on the Site Plan, Figure No. 2, and are appended to the report.

4.0 FIELD INVESTIGATION AND TESTING PROGRAM

Subsurface investigation of the site included the drilling of four mud-rotary borings (three to depths of about 100 feet, and one to 150 feet), and five cone penetration tests (CPTs) advanced to depths of between 47 and 131 feet. Downhole geophysics consisting of P- & S-wave seismic velocity testing was performed in the deeper (150-foot) boring. The approximate locations of the borings and CPTs are presented on the Site Plan, Figure 2.

The drilling was performed by Pitcher Drilling Company from East Palo Alto, California using a truck-mounted Failing 1500 rig. The drilling at each hole began with hand-auger to a depth of 5 feet to clear the boring location of utilities, and a solid stem auger to determine groundwater level before switching to mud rotary drilling. During this initial auguring process, bulk samples of the soil cuttings were collected at each boring for laboratory R-value testing.

Drive samples of soil encountered in the borings were obtained at selected depths using either a 3.0-inch O.D. (2.5-inch I.D.) Modified California (MC) sampler lined with 1-inch brass rings, or 1.5-inch I.D. (shoe diameter 1-3/8-inch) Standard Penetration Test (SPT) sampler at various depths. Sampling was also performed using a Pitcher Barrel sampler, the Dames & Moore

Piston sampler, and direct push Shelby tubes in softer clayey materials; sampling resistance pressures for these samplers was recorded in the field and are included on the boring logs for the current study.

Drive samplers were driven into subsurface soils under the impact of a 140-pound automatic hammer having a free fall of 30 inches. The blow counts required to drive the sampler for the last 12 inches are presented on the boring logs. The logs of test borings and details regarding the samplers and other symbols used on the logs are included in Appendix A.

Hammer energy calibration information provided by Pitcher Services for the Failing 1500 rig's automatic hammer shows the hammer to have an efficiency of approximately 75%. Blow counts for the MC sampler were correlated to equivalent SPT blow counts using a method suggested by Daniel, Howie, and Sy (2003), by multiplying MC blow counts by a conversion factor of 0.65.

The drilling operation was conducted by our Field Geologist who maintained logs of the materials encountered in the borings, recovered and prepared the soil samples for transport. Samples recovered from the borings were transported to our laboratory for further evaluation and testing.

The in-situ field testing consisted of Cone Penetration Testing (CPT) by Gregg Drilling, LLC of Martinez, California, and a down-hole P- & S-wave geophysical survey conducted by Norcal Geophysical (a Terracon Company) of Cotati, California. The CPT testing was conducted concurrently with the drilling under the observation of our Senior Project Engineer.

The CPTs were performed using a 20-ton CPT rig to vertically advance an instrumented 60-degree 15cm^2 cone attached to 1.7-inch diameter rods into the ground using hydraulic rams acting against the weight of the rig. The CPTs generally met refusal in dense sands at depths of between 47 and 57 feet, but CPT-2 was successfully advanced to a depth of 131 feet. The advance of CPT Nos. 1, 3 and 4 was halted briefly in to conduct dissipation testing for estimating groundwater depths; results of the dissipation testing are included in Gregg Drilling's report in Appendix C.

Following the drilling, the boreholes and CPT holes were backfilled with cement grout using tremie method. Boreholes were backfilled under the observation of Alameda County Public Works Agency personnel, per ACPWA Permit W2019-0536 requirements.

In accordance with the requirements of BART Permit to Enter (Work) No. M-01.5-014-OK, all vehicles, drilling equipment, and drummed drill spoils generated during the drilling were removed from the site daily. Drill spoils were picked-up by Pitcher Services' subcontractor, Integrated Waste Management (IWM) and transported to their licensed waste facility for holding pending the results of analytical testing on the soil cuttings and were subsequently disposed by IWM.

The approximate locations of the borings and CPTs for the current study, and as-built borings are shown on the Site Plan, Figure No. 2. The logs of the test borings and as-built geotechnical borings from the above referenced studies are included in Appendix A. The report for the Cone Penetration Testing prepared by Gregg Drilling is included in Appendix C. The report for the downhole P- & S-wave geophysical survey by Norcal Geophysical is presented in Appendix D.

5.0 LABORATORY TESTING PROGRAM

Laboratory tests were performed on selected soil samples to evaluate the physical and engineering properties of soils. The test types performed for this study included:

- Moisture Content (ASTM D 2216)
- Atterberg Limits (ASTM D 4318)
- Particle Size Analysis (PA) (ASTM D 422)
- Triaxial Unconsolidated Undrained (UU) Test (ASTM D 2850)
- Consolidation (ASTM D 2435)
- Corrosion (California Test Methods 643/417/422)

The consolidation and triaxial UU tests were performed by Cooper Testing Laboratory in Palo Alto, California. The corrosion tests were performed by Sunland Analytical in Rancho Cordova, California. The laboratory test results are presented in Appendix B.

6.0 GEOLOGY, SEISMICITY AND SUBSURFACE CONDITIONS

6.1 Regional Geology

The Bay Area is identified as a structural depression within the geologically complex and seismically active California Coast Ranges Geomorphic Province. The Coast Ranges have been divided into the northwest-trending Coastal, Central, and Eastern tectonic belts, and include several sub-parallel northwest-trending faults, mountain ranges, and valleys characterize the Coast Ranges topography. The Bay is bordered by nearly parallel northwest-southeast trending mountain ranges; the Santa Cruz Mountains to the west and the Diablo Range to the east. Extensive late Cretaceous through early Tertiary folding and thrust faulting created complex geologic structural conditions that underlie the highly varied topography of today.

West Oakland is situated on the East Bay plains, a broad alluvial pediment consisting of a thick sequence of Pleistocene age alluvial and marine sediments. The basal Pleistocene sediments are overlain by Holocene age Bay Mud, and alluvial and fluvial deposits derived from the erosion of Diablo Range.

The East Bay plains are bounded to the west by the San Francisco Bay, and to the east by the Hayward fault which forms a steep structural boundary between the thick alluvial deposits comprising the East Bay plain and mountains of the Diablo Range. The East Bay plains sediments mantle the Franciscan Assemblage Complex; Jurassic-Cretaceous age bedrock comprised mostly of detrital sedimentary rocks (sandstone, siltstone) with subordinate basaltic volcanic rock, chert and greenstone, with minor limestone. Based on the “Engineering Geologic Site Characterization of the Greater Oakland-Alameda Area, Alameda and San Francisco Counties, California” by Rogers J.D. and Figuers, S.H., 1991, bedrock at the subject site is on the order of 500 to 550 feet deep.

6.2 Seismicity

The San Francisco Bay Area lays within one of the most seismically active areas of the North America and is influenced mostly by the San Andreas fault system which spans the Coast Ranges from the Pacific Ocean to the San Joaquin Valley. Regional faults within about 30 miles of the project site are shown on Figure 5.

Movement of these active faults can generate strong ground shaking at the project site. Historic major regional earthquakes include Hayward (1868; Mw=6.7), San Francisco (1906; Mw 7.9), Loma Prieta (1989; Mw 6.9), and South Napa (2014; Mw 6.0). During the October 17, 1989 Loma Prieta earthquake strong motion records recovered from five structures in the Oakland-Alameda area showed peak horizontal ground acceleration values varied between 0.26g and 0.29g in the vicinity of the project site (Rogers, J.D. and Figuers, S.H., 1991).

According to the California Geological Survey map “Earthquake Zones of Required Investigation Oakland West Quadrangle”, 1982, Revised 2003, the project site is not located within a mapped Earthquake Fault Zone.

6.3 Site Geology

Based on the above-noted report by Rogers & Figuers, 1991, soil profile of their study area (including West Oakland) can be subdivided as follows, in order of increasing age and depth.

- Artificial Fill

- Temescal Formation (olive gray and yellowish mottled silts and clays (Radbruch, 1969)
- Young Bay Mud
- Merritt Sand (eolian fine to medium grained sand and silt w/ lenses of sandy clay & clay)
- Posey Formation (non-marine sands identified by others)
- San Antonio Formation (non-marine estuary and alluvial sediments)
- Yerba Buena Mud (aka “Old Bay Mud”)
- Alameda Formation - upper unit (alluvium interlayered with marine mud; 200 to 400 feet thick); lower unit (alluvium; 300 to 600 feet thick)

Rogers and Figuers discuss deposition of the Merritt Sand and Posey Sand separately but explain that their use of “San Antonio Formation” in their report refers collectively to non-marine sands deposited on top of the Yerba Buena Mud. They also point out that, as such, the San Antonio Formation would include the traditional San Antonio Formation of Trask and Rolston (1951) as well as the Merritt Sands and Posey Formation, terms originally coined by Lee and Derleth and others, Whitworth (1932), Lee (1935) and continued by Radbruch (1957, 1969) and Lee and Prazker (1969).

According to the “Map showing Quaternary Geology and Liquefaction Susceptibility, San Francisco, California” by Knudsen et al. 1997, the site is underlain by Merritt Sand consisting of fine-grained, well sorted, well drained eolian (wind born) deposits with moderate susceptibility to liquefaction, see Figure 4.

Based on a historical map of the bay shoreline (Bache, 1856) the site is located about 2800 feet east of the historic shoreline, and 600 feet north of a historic estuarine marsh. A map of the historic shorelines along the Oakland waterfront since 1860 is included in the Rogers and Figuers 1991 report and is presented on Figure 4B.

6.4 Subsurface Conditions

Overall Summary

The subsurface profile consists of up to 5 feet of **surficial granular Fill** over about 50 to 55 feet of medium dense to very dense silty sands. These sands are interpreted as the **Merritt Sand**, consistent with the Quaternary geologic map for the area. Below the dense sands, alternating layers of stiff to very stiff clay and dense to very dense sands interpreted to comprise the **San Antonio Formation** were encountered to depths on the order of 100 feet. The deposits are said to have been deposited over the Yerba Buena Mud in complex and ever-changing depositional environments from alluvial fans, to flood plains, to lakes, swamps and beaches; the individual units are discontinuous and difficult to correlate over distance (Rogers & Figuers, 1991).

Boring B1 and CPT-2 were advanced below 100 feet revealing several layers of marine deposits predominantly consisting of stiff to very stiff lean to fat clay, and fat clay with little or no sand. These layers are interpreted to comprise the **Yerba Buena Mud** (or Old Bay Clay).

Subsurface Profiles A-A' and B-B' (Figures 3A and 3B) were developed based on the exploration and as-built data and depict the subsurface profiles at the site.

Detailed Stratigraphy

Pavement Section. Based on the borings for the current investigation, the existing pavement section for the BART parking lot consists of 3 to 5 inches of asphaltic concrete over between 1 and 18 inches of granular base course materials.

On-Site Fill. The pavement section overlies about 1 to 5 feet of fill consisting of poorly graded sand with clay, clayey gravel with sand, and silty sand. Bulk samples of the materials encountered in the upper 5 feet of the borings were predominantly granular.

Merritt Sand. Below the fill, about 50 to 55 feet of medium dense to very dense sands were encountered. The upper 20 to 25 feet of this layer consists of medium dense to dense silty sand, and the lower 20 to 30 feet consists of dense to very dense poorly graded sand with silt. These sands are interpreted as Merritt Sand.

San Antonio Formation. Below the very dense sands, a layer of brown to olive-brown hard sandy silt and bluish-gray very stiff sandy lean clay about 2 to 6 feet thick was encountered between depths of about 58 to 64 feet. Materials encountered below a depth of about 60 feet consist of alternating layers of sand (dense to very dense silty and clayey sands, and poorly graded sand), and clay (dark greenish-gray, stiff to very stiff) to depths of between about 95 to 106 feet. These layers appear to be interfingered and somewhat discontinuous and are interpreted as the San Antonio Formation.

Yerba Buena Clay. Boring B-1 at the northeast portion of the property was drilled to a depth of 150 feet and revealed predominantly stiff to very stiff fat clay with little or no sand between depths of about 100 and 150 feet. These materials are interpreted at Yerba Buena Mud (or Old Bay Clay).

CPT Nos. 1 through 5 advanced for the current study reveal similar resistance profiles suggesting the presence of dense sand beginning at depths of 10 to 12 feet, uniformly lower tip and friction resistance between depths of about 17 and 21 feet suggesting weaker materials silty sand, sandy silt or silty clay. Cone tip pressures uniformly increase between depths of about 25 and 50 feet from 200 tsf to 700 tsf or more. All CPTs except CPT-2 met early refusal in the dense sands at depths between depths of 47 and 57 feet.

CPT-2 was performed at the west side of the property and was advanced to a depth of 131 feet. Very stiff/dense materials were encountered in CPT-2 between depths of 60 and 80 feet and below 125 feet. Materials of low tip and frictional resistance were encountered between depths of 55 and 60 feet and between about 80 and 125 feet. The plot for CPT-2 suggests the presence of predominantly very stiff fine-grained soils in these weaker intervals, likely Yerba Buena Mud.

Contour and Isopach maps included in the Rogers and Figuers, 1991 report indicate that the top of the Alameda Formation at the site is at a depth of about 125 feet in the vicinity of the site, and that the top of the Yerba Buena Mud (Old Bay Clay) is on the order of 75 to 80 feet at the site and on the order of 50 feet thick. These depths appear to agree with the results obtained between about 80 and 125 feet in CPT-2. Based on the materials encountered in Boring B1, it’s possible the top of the Yerba Buena Mud (or Old Bay Clay) begins at a depth of about 80 feet, but a comparison of subsurface profiles developed from the available site data suggests it begins about 15 feet deeper at this site than noted by Rogers & Figuers 1991 report.

As-Built Soil Boring Data

Previously a geotechnical investigation was performed by Dames and Moore in 1965 for the construction of BART Segment B-004 along 7th Street. This investigation included Boring B-004-37 drilled on Chester Street west of the station. This boring encountered medium dense silty and clayey sands in the upper 8 feet, over dense to very dense poorly graded sand and poorly graded sand with silt or clay a depth of about 57 feet. Below the sand, layers of clayey sand with silty clay and dense sand were encountered to the explored depth of 70 feet.

A Soil Investigation Report (K702) for BART West Oakland Line, Segment K-002”, dated March 1966 was prepared by Bechtel Corporation. Logs of several borings drilled for their investigation are included in a Geotechnical Engineering Report, Aerial Structures – West Oakland, Oakland, California prepared by PARIKH in 2007. Borings K-702-2 (71’), K-702-4 (72’), K-702-27 (30’), K-702-28 (71’), K-702-30 (31’), K-702-31 (31’), and 01-B-8 (80’) are relevant to the project site. Logs for these borings generally reflect similar subsurface profiles with medium dense clayey and silty sands in the upper 10 to 15 feet over dense to very dense, poorly graded sand with silt to depths of 30 (for the shorter borings) and to depths of 53 feet (for the deeper borings). Below the very dense sand the deeper borings encountered 5- to 8-foot layer of very stiff lean or fat clay. Below the clay layer, very dense silty sands were encountered to the maximum explored depth of 71 feet.

The as-built borehole data appears to be consistent with the profile developed for the current study revealing predominantly dense to very dense Merritt Sand over San Antonio Formation consisting of very stiff clay, dense clayey sand and silty sand.

Boring Logs and CPT profiles for the current investigation, and as-built Logs of Test borings are presented in Appendix A. The PARIKH boring logs in Appendix A were prepared from the field logs which were edited after visual re-examination of the soil samples and the results laboratory tests on selected soil samples as indicated on the logs. Abrupt stratum changes shown on these logs may be gradual and relatively minor changes in soil types within a stratum may not be noted on the logs due to field limitations.

Due to limitations inherent in geotechnical investigations, it is neither uncommon to encounter unforeseen variations in the soil conditions during construction nor is it practical to determine all such variations during an acceptable program of drilling and sampling for a project of this scope. Such variations, when encountered, generally require additional engineering services to attain a properly constructed project. We, therefore, recommend that a contingency fund be provided to accommodate any additional charges resulting from technical services that may be required during construction.

7.0 GROUNDWATER

Groundwater was encountered in the current borings at depths of between 6.5 and 11 feet below the ground surface (Elev. +3.0 to +5.5 feet). Results of dissipation tests performed in CPT Nos. 1, 3 and 4 indicate groundwater depths of 8.9 feet, 2.4 feet and 11.9 feet, respectively (about Elev. +0.3 feet to +10.6 feet).

The log for Boring B-004-37 at Chester Street (Dames & Moore, 1965) did not provide a groundwater level; however, B-004-36 one block west encountered groundwater at about 6.5 feet below the ground surface (Elev. +5.5 feet).

Borehole data from the Bechtel investigation (1965) indicates groundwater was encountered at depths of between about 4.6 and 8.3 feet below the ground surface (Elev. +2.7 feet to +6.5 feet).

The Seismic Hazard Zone Report 081 for the Oakland West 7.5-Minute Quadrangle, Alameda County, California (California Geologic Survey, 2003), indicates that the depth to historically high groundwater in the vicinity of the Project site is about 5 feet (see Figure 4A). For the proposed development, we recommend that the groundwater be assumed at 5 feet depth below the existing street level for design.

Groundwater elevation could significantly vary in the event of a 'normal' rainfall period or following an El Nino event. Also, groundwater may take time to recharge or react to such changes as seasonal fluctuations, or the extreme conditions as noted above, and such changes may or may not affect the groundwater immediately following such event. Therefore, it is all-the-more important to not rely on such transient measurements of groundwater for the design and construction of any underground improvements. It may be prudent to make conservative assumptions in the design and construction program.

8.0 CORROSION EVALUATION

Based on the 2018 Caltrans Corrosion Guidelines, soil or water are considered corrosive when one or more of the following conditions exist:

- The pH is 5.5 or less.
- The soil contains a chloride concentration of 500 ppm or greater.
- The soil contains a sulfate concentration of 1,500 ppm or greater.

TABLE 8.1 – CORROSION TEST RESULTS

Boring No.	Depth (ft)	pH	Minimum Resistivity (ohms-cm)	Chloride Content (ppm)	Sulfate Content (ppm)
B-2	57.5	7.44	860	6.7	40.7
B-4	10.5	6.81	4020	7.9	22.2

Based on the corrosion test results, the on-site subsurface soils are considered non-corrosive to concrete substructures. The guidelines presented in the California Amendments to the AASHTO LRFD Bridge Design Specifications (BDS, 2012), Article 5.12.3, references minimum cement factor and cover thickness for concrete substructures.

9.0 SEISMIC DESIGN INFORMATION AND RECOMMENDATIONS

9.1 Seismic Sources

The project site is in a seismically active part of northern California. Many faults in the region can produce earthquakes, which may cause strong or very strong ground shaking at the site. Major active faults in the Bay Area capable of producing strong ground shaking at the project site are listing in Table 8.1 along with the bearings and distances to the faults and mean 30-year percent participation probabilities for various moment magnitudes.

TABLE 9.1 –FAULT RUPTURE PROBABILITY SUMMARY

Fault name	Distance to Fault (miles)/ Azimuth (deg) to Fault from Project Site	30yr Participation Probability (%)			
		M ≥ 6.7	M ≥ 7.0	M ≥ 7.5	M ≥ 8.0
Hayward	(4.3) / 55	14.11	10.10	3.60	0.04
Northern Calaveras	(14.0) / 78	6.98	4.97	2.39	0.04
San Andreas	(14.1) / 234	6.19	6.15	5.65	1.96
San Gregorio	(17.6) / 254	2.68	2.34	1.92	0.08
Rodgers Creek	(25.0) / 344	13.36	11.21	3.53	N/A

Probability of fault rupture for a given magnitude for the closest faults to the project area (distance to project is the closest fault intercept; M=magnitude; data derived from Field et al. 2013).

The latitude and longitude coordinates for the site are Lat: 37.804801 degrees north and -Long: 122.295104 degrees west (at the center of the property; Google Earth, 2019). Based on the Caltrans Fault Database (V2b, 2012) of known active faults, and Caltrans Acceleration Response Spectrum (ARS) Online tool (V2, 2012) movement on the Hayward North Fault (Fault ID: 123) with a maximum magnitude (M_{max} = 7.3) would produce the largest deterministic seismic response at this site.

9.2 Seismic Design Criteria

The subsurface profile contains loose to very dense sands and stiff to very stiff clays. The seismic velocity of the site profile in the upper 100 feet was determined using a Caltrans correlation with SPT blow counts from Boring B1 through B-4, and the results of the downhole Geophysical P- & S-wave testing performed in Boring B-1 by Norcal Geophysical for the current study. The Vs_{30} value using Caltrans Correlation varied between 232m/s and 258m/s (761 to 846ft/s), and 1090 ft/s using the Norcal P- & S-wave survey data, respectively.

Since the proposed building tower is up to 320 feet above grade, we anticipate that the design codes may require site-specific seismic design that may involve time histories and site-specific response spectrum for structural analysis. That scope for site-specific seismic analysis involving response spectrum and time histories is not included in Parikh’s scope. The above information of measured shear wave velocity (Vs_{30}) is provided for the designer to use for site-specific seismic design.

For regular structural design, the common practice is to follow California Building Code. Based on the CBC (2016), the subsurface profile of the site was determined to be Site

Class “D”. The U.S. Seismic Design Map Web Services SEAOC/OSHPD Seismic Design Maps Tool by the United States Geologic Survey (USGS) was used to generate the seismic design parameters presented in Table 8.2 are generated and may be used for preliminary seismic design of the proposed structures. The SEAOC/OSHPD Design Maps Summary Report is presented on Figure 6.

TABLE 9.2 – USGS SEISMIC DESIGN PARAMETERS

Approximate Location	N 37.3354° & W 121.8907°
Site Class	D
Mapped Spectral Acceleration for Short Period, S_s (Site Class B with 5% damping)	1.522 g
Mapped Spectral Acceleration for 1-second Period, S_1 (Site Class B with 5% damping)	0.604 g
Fa	1.0
Fv	1.5
S_{MS} (Site Class D)	1.522 g
S_{M1} (Site Class D)	0.906 g
S_{DS} (Site Class D)	1.014 g
S_{D1} (Site Class D)	0.604 g
Seismic Design Risk Categeory	D
Peak Ground Acceleration (PGA)	0.584 g
Site Amplification Factor at PGA (F_{PGA})	1.0
Site Modified Peak Ground Acceleration (PGA_M)	0.584 g
Long Period Transition Period (T_L) in Seconds	8

Reference: https://earthquake.usgs.gov/hazards/designmaps

Note: Due to insufficient resources, and the recent development of similar web tools by third parties, the USGS has replaced its former U.S. Seismic Design Maps web applications with web services that can be used through third-party tools. The results above were determined using the “SEAOC/OSHPD Seismic Design Maps Tool” and listed at the reference website as one of the third-party tool options.

9.3 Seismic Hazards

Surface Fault Rupture. The site is not located within an area mapped State of California Alquist-Priolo Earthquake Fault Zone for active faults, and no mapped evidence of active or potentially active faulting was found for the site. The potential for surface fault rupture at the site is low.

Liquefaction. Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary but essentially total loss of shear strength under the reversing, cyclic shear stresses associated with earthquake shaking. Submerged cohesionless sands and low-plastic silts of low relative density are the type of soils that usually are susceptible to liquefaction. Clay is generally not susceptible to liquefaction. According to the AASHTO

BDS guidelines (2012), sand and non-plastic silt with corrected SPT blow count $(N_1)_{60}$ less than or equal to 25 are susceptible to liquefaction.

The USGS Liquefaction Hazard Map for the Oakland West 7.5-Minute Quadrangle (Figure 7) shows that the site is located within an area of mapped historical occurrence of liquefaction. An update of this map, "Maps of Quaternary Deposits and Liquefaction Susceptibility in the Central San Francisco Bay Region, California (Witter et al., 2006, Open File Report 06-1037)" shows the site in an area mapped to be underlain by Merritt Sand and designated as having moderate liquefaction susceptibility. A portion of the updated Liquefaction Susceptibility Map publication pertinent to the project site is presented on Figure 4.

An updated map compilation of data for historic liquefaction sites (Knudsen and Others, 2000) is included in the Seismic Hazard Zone Report for the Oakland West 7.5-Minute Quadrangle, Alameda County California, 2003. Based on the updated map, no historic evidence of liquefaction or other ground failures have been mapped at the project site (see Figure 4A).

Assessment of the liquefaction potential at the site was performed by using computer software Cliq (by Geologismiki) to process the CPT data from the current investigation (CPT-1 through CPT-5). Cliq results are produced using the NCEER method (Youd et al., 2001), and the latest assessment procedure developed by Robertson (2009). The liquefaction potential of fine-grained materials in the soil profile was evaluated per criteria developed by Bray and Sancio (2006).

Based on our CLiq liquefaction assessment under the design earthquake loading (Mw-7.3, and a PGA_M value of 0.584 g) post-liquefaction settlement at the site would be on the order of 0.5 to 0.8 inches. Hence, the liquefaction potential does not appear to be a major design issue for the proposed development as the liquefiable soils appear to be relatively thin and may not be continuous. The primary engineering consequence would be some post-liquefaction settlement on the order of one inch .

10.0 GEOTECHNICAL DESIGN CONSIDERATIONS

From geotechnical standpoint, the primary design concern is not to impact the existing BART Station and approach aerial structures during construction of the project. The existing BART structures are supported mainly on shallow spread footings near the proposed buildings. New foundation installation and construction activities including excavation, shoring and/or dewatering should not pose adverse impact on existing BART structures.

Building T-1. For the proposed 320-foot high tower with no basement construction (Building T-1), we recommend deep pile foundations be used for support. Driven displacement piles would likely encounter driving refusal in the Merritt Sand. Concerns of noise and vibration also render the driven foundation system not feasible. Cast-in-Drilled-Hole (CIDH) piles or drilled piers could be used; however, due to high groundwater level and sandy soil conditions, the potential for caving may make the foundation construction difficult. Alternatively, in our opinion, the building may be supported on Auger-Cast piles.

Building T-2. The proposed commercial infill structures (Building T-2) beneath the existing BART viaduct structure are anticipated to consist primarily perimeter and partition bearing walls for commercial units. We expect that these structures will be lightly loaded, and that spread footings bearing on the native sand with footing bottom preparation may be used.

Buildings T-3 & T-4. Buildings T-3 and T-4 are 7- and 8-story buildings south of the station; Building T-4 may also be a 15-story office tower. It is our understanding that during the development process, one option was to have a continuous basement parking level connecting Buildings T-3 and T-4. The recent information indicates that the basement garage concept is eliminated, and all parking will be on or above grade within each parcel. For the preliminary report, we have provided discussion for both options, i.e., the option with no basement (all structures on or above grade), and the option with one level basement garage.

Option A for T-3 & T-4. This option represents the current design plan of having Buildings T-3 and T-4 with all parking garage on or above grade with each parcel. The buildings could be 7- to 8- story structure, or 15-story office tower for T-4. For this case, the foundation design consideration for Buildings T-3 and T-4 is similar to that of Building T-1. Pile foundations are recommended. Drilled piles are feasible, and Auger-Cast pile may be used, in consideration of the benefit of low noise and vibration and presence of high groundwater. For Option A, the deep soil-cement mixing discussed in Option B for excavation/shoring and water cut off is not required.

Option B for T-3 & T-4. This option represents a previous concept for development of Buildings T-3 and T-4, in which a single level below-grade parking (basement) is shared and connects the two buildings. The preliminary architectural plans indicated that the basement floor is about 10 feet below street grade. For this option, a mat foundation appears feasible for support. With anticipated floor slab, mat foundation, and typically 1.5 to 2 feet of gravel/drain rock below the mat, the anticipated maximum construction excavation could be on the order of 15 to 16 feet bgs. The natural groundwater may be at 5 to 6 feet bgs, so temporary excavation, shoring and dewatering are required for construction for this option.

Due to the presence of dense sands within the depth of cut and one level of basement excavation, mat foundation is considered suitable for foundation support for these buildings as a major portion of the new building loads will be compensated by the excavated soil weight.

With the anticipated cut and groundwater, the shoring system needs to provide both excavation support and lateral water control/cutoff during construction. This is a critical construction aspect of the project because the existing BART aerial structures are supported on shallow spread footings below water table bearing in Merritt Sand (BART foundations at ~18 feet embedment below grade). The excavation, shoring and dewatering operation should not impact the existing BART structures. The designer should communicate with BART and obtain the as-built plans of the BART West Oakland station and aerial structures.

Therefore, a shoring system consisting of a deep soil-cement mixing system is recommended at the perimeter of the excavation to provide continuity and uniformity of the shoring. Two typical systems commonly used in the Bay Area include (1) Multi-Shaft Auger mix system, and (2) Soil Cutter mix system. Both systems incorporate placement of either wide flange structural members or steel H piles while mixing soil & cement grout in-place to form a “soil-cement mix wall.” The deep soil cement mixing system is always used in conjunction with tiebacks or struts to meet structural demands. The soil-cement mix wall should penetrate deep enough to provide water control and cutoff purpose for dewatering. Further discussions are provided in Section 11.8 of the report.

If Option B for T-3 & T-4 is adopted, we do not recommend single auger mix equipment as the verticality of the mixing can deviate with depth, and the control is generally poor. When soil-cement columns deviate from vertical position, gaps can occur between the columns allowing water to seep through, introducing construction difficulties, losing material, and potential damage to adjacent structures or developments. This may also be of concern where BART station and aerial structure supports are supported on spread footings.

11.0 GEOTECHNICAL RECOMMENDATIONS

11.1 General

This report was prepared specifically for the proposed Project as described earlier. Normal procedures were assumed for construction throughout our analysis and represent one of the bases of recommendations presented herein. The design criteria have been based upon the materials encountered at the site. Therefore, this office should be notified if these conditions change, so that our recommendations can be modified or amended.

11.2 Design Groundwater Level

Groundwater level was encountered in borings at ~6 to 8 feet depth below existing street level in September 2019. The groundwater is expected to vary and fluctuate with time. Regionally, the groundwater and ocean levels are on a rising trend. The USGS Seismic Hazard Zone Report for the Oakland West Quadrangle (#081 shows the historically high groundwater level at the site is about 5 feet (see Figure 4A). For project design, the recommended groundwater level is 5 feet bgs to account for variation and fluctuation. Assuming the existing street grade is at Elevation ~14 feet, the recommended design groundwater level is Elevation ~+9 feet.

11.3 ACP Pile Foundation Design (Building T-1 and Option A for T-3 & T-4)

For foundation support of the proposed 320-foot high tower (T-1) and up to 7- to 15-story towers (T-3 & T-4), drilled piles are recommended as driven pile system is not feasible due to dense sands, the proximity of existing BART structures, and concerns of noise and vibration in urban area. Based on the subsurface conditions, it is our opinion that Auger Cast Piles may be used for foundation support. An ACP pile is installed by rotating a continuous flight hollow-stem auger into the ground to the design depth. While the auger is drilled into the ground, the flights of the auger are filled with soil, providing lateral support and maintaining the stability of the hole. At the same time the auger is withdrawn from the hole, sand/cement grout is pumped into the hole under pressure through the hollow shaft. Simultaneous pumping of the grout and withdrawing of the auger provides continuous support of the hole. Reinforcement is placed into the hole filled with fluid grout immediately after withdrawal of the auger. ACP piles are like cast-in-drilled-hole (CIDH) concrete piles, but the use of temporary casing and slurry displacement to control cave-in condition is substituted with continuous flight auger.

For preliminary design, 30-inch diameter ACP piles with a service capacity of 150 to 175 Tons per pile may be assumed in our experience. The design of ACP piles should be based on working stress design (WSD) approach, in which a factor of safety of 2 to 2.5 is typically adopted to obtain the allowable/service capacity. For information, a preliminary pile capacity chart is provided in Appendix E to show the capacity vs. depth curves for 24-inch, 30-inch and 36-inch diameter Auger Cast Piles. We assumed that the pile cap bottom is located at about 7 feet below grade. A pile spacing of 3D is recommended. For final design, we will further fine-tune the pile analysis, interact and collaborate with the designer to determine the pile length, stiffness and lateral design.

We anticipate that the bottom of the footing/pile cap for the tower may be on the order of 5 to 8 feet below grade. A minimum pile spacing of 3 times the pile diameter, center to center, is recommended. For 30-inch diameter piles, the recommended pile spacing is 7.5 feet.

11.4 Testing Plan for Auger Cast Piles (Building T-1 and Option A for T-3 & T-4)

The quality of auger cast piles is highly dependent upon the skill of the contractor and the specific crew assigned to the project. Only experienced contractors should be allowed to perform the work, and the contractor is required to construct a test pile. It is recommended to pre-qualify the specialty auger case pile contractor. The contractor should have completed a minimum of three projects in the last five years in which auger cast piles were installed successfully under similar subsurface and project conditions as the current project. In addition, the designated project manager, job site supervisor/foreman and drill rig operators should have a minimum of three years of experience installing auger cast piles. The specialty contractor should submit a Pile Installation Plan, working drawings and calculation for review.

For construction quality control, the Pile Testing Plan discussed herein should be included as the contract requirements. The specialty contractor's Pile Installation Plan should address these items.

Pre-Production Testing. The pre-production load test program should consist of a minimum of one static load test in accordance with ASTM D1143. The test pile location should be selected which is representative of the dominant site condition. The pile installed for pre-production testing should include all construction, monitoring, testing and inspection requirements of production piles. The results of the installation and testing will be used to:

- Establish target drilling penetration rates for the various subsurface conditions;
- Establish pressure/volume relations for placement of the grout;
- Establish target values for torque and downward thrust/crowd for displacement piles;
- Establish mix design parameters such as grout flow, admixtures, etc.; and
- Evaluate design correlations with the site-specific soil parameters.

Automated Installation Monitoring. Automated monitoring provides "real time" evaluation of each pile and is recommended for the project. The special contractor's installation plan should include type of monitoring equipment, data to be collected, current calibration records, and sample data records. As a minimum, the monitoring equipment should have the capability to record the following: auger rotation, depth of auger injection point, torque, and crowd force. During grouting, the following automatic measurements should be recorded: volume of grout, maximum and minimum grout pressure, auger rotation, and depth of injection point.

Integrity Testing. Post-installation integrity tests are recommended for construction. Sonic echo tests performed from the pile top is a practical way for routine use to verify the overall integrity of the piles in the upper 10 to 20 diameters, which is acceptable for the intended design. Due to the nature of the design of auger cast piles, the integrity of the upper 20 feet is typically the most critical for structural capacity, particularly for shear and bending moment. A frequency of 10% to 20% of production piles should be subjected to integrity testing. The pre-production pile and verification test piles should be included in the integrity testing program.

Verification Testing. Verification tests should be performed on a minimum of two percent (2%) of production piles. Verification tests can be performed using static load tests, or dynamic load tests (DLT, using drop hammer). The verification testing should be performed periodically throughout production pile installation.

11.5 Mat Foundations (Option B for T-3 & T-4)

This option represents buildings of 7- to 8-story and up to 15-sotry structures with a shared one level below grade basement/parking. Due to the presence of dense sands within the depth of cut and one level of basement excavation, mat foundation is considered suitable for foundation support for these buildings as a major portion of the new building loads will be compensated by the excavated soil weight (basement floor is anticipated to be on the order of 10 feet below grade).

We will interact with the designer to provide further information on bearing capacity and mat settlement. Typically, a drain rock or gravel layer of 18 inches to 24 inches is placed below the mat bottom to facilitate construction. For design of the mat in Merritt Sand, the recommended modulus of subgrade reaction is 250 kcf. In our opinion, bearing is not a design concern as majority of the new building load is compensated by the excavation.

11.6 Basement Walls and Lateral Earth Pressures (Option B for T-3 & T-4)

Basement walls are below-grade retaining walls and are restrained. The boring data indicate that the soils within the anticipated excavation depth consist primarily of sandy backfill material. The new basement walls should be water-proofed and be designed to resist the following (Table 10.1) lateral pressures. The water proofing should be designed by others.

TABLE 10.1 – SOIL DATA FOR BASEMENT WALLS

At-Rest Equivalent Fluid Pressure	65 pcf (above Design Groundwater Level) 95 pcf (below Design Groundwater Level)*
Traffic Surcharge Load (where applicable near street side)	125 psf (rectangular uniform distribution)
Total Seismic Lateral Earth Pressure	78 pcf (triangular distribution) above Design Groundwater Level 100 pcf (triangular distribution) below Design Groundwater Level*

* Pressures below Design Groundwater include lateral earth and static water pressure.

The designer should include other appropriate surcharge loads to the retaining wall design. Heavy compaction equipment should not be used within 24 inches of the back of any wall and where used, it should be used in such a manner as to avoid overstressing or deflecting the wall. The wall should be properly braced during backfilling if heavy compaction equipment will be used directly behind the wall, excessive lateral surcharge pressures due to compaction is anticipated.

The basement walls should be designed for hydrostatic pressure with a groundwater table at about 5 feet below the existing street grade. Accordingly, the basement retaining walls should be waterproofed.

11.7 Temporary Excavation and Shoring (Option B for T-3 & T-4)

The planned excavation site for future Buildings T-3 and T-4 is immediately bounded by Chester Street, 5th Street and Mandela Street on the west, south and east, respectively. On the north, the planned excavation will be near the existing BART West Oakland Station and aerial structures which are supported on shallow spreading footings. We expect that there are existing utility lines surrounding the site.

It is the contractor's responsibility to verify the type and location of the existing utility lines in the project vicinity and protect them from being damaged due to construction and excavation. Where the shoring will be in close proximity to the existing BART foundations, the shoring may have design additional surcharge due to the existing foundation loads. Conventional earthwork equipment is feasible for excavating the on-site alluvial soils. It is also possible that unknown old buried utilities or abandoned structures, concrete rubble, etc. may be encountered. It might require special equipment and additional efforts to remove these buried objects.

In our opinion, both the use of internal bracing system and the use of tiebacks may have to be considered. The shoring program should include an adequate monitoring procedure to ensure that the shoring is performing satisfactorily and include provisions for corrective measures with respect to lateral movement. The shoring system should be designed to be relatively rigid and with as many supports or struts as necessary to prevent excessive straining and deformation of the supported soils. This is important for protection of the existing BART West Oakland station, aerial structures, and utilities.

An apparent lateral earth pressure for shoring design is presented on Plate 8. Relevant surcharge loads due to soil/material stockpile, traffic, existing BART foundation loads and construction equipment should also be considered in shoring design. The shoring system should be designed and signed by a California Registered Engineer.

We anticipate that steel sheet piles may have drivability issue in the dense sand. Therefore, drilled system such as deep soil-cement mixing walls are feasible. Additional evaluation is required once further design progress is formulated. If Option B for T-3 & T-4 (basement option) is adopted for final project development, we will re-visit and collaborate with the structural engineer for design of the Deep Soil-Cement Mixing/cutoff system.

11.8 Construction Dewatering

Groundwater level was encountered in the exploration borings at ~6 to 8 feet below existing street in September 2019. Regionally, the groundwater and the sea level are in the rising trend.

It is anticipated that either the pile cap excavation or basement excavation will be below groundwater, so construction dewatering (inside the cut-off shoring wall for basement construction) will be required. Uncontrolled groundwater inflow will cause instability of basement walls (piping, erosion, etc.), instability of the excavation bottom (blow-outs, piping, etc.), and will also result in difficult working conditions at the bottom of the excavation. Instability of the basement walls and excavation subgrade may cause damage of the shoring system, excessive settlements of surrounding ground, damage to adjacent underground utilities and excessive long-term differential settlement of the adjacent buildings. Excessive water in the excavation will also result in difficult working conditions causing subsequent delays in work and/or additional efforts during construction.

The contractor should implement a dewatering system to mitigate the groundwater conditions encountered in the excavations. All dewatering schemes proposed by the contractor should be submitted to the Engineer for information prior to implementation. However, developing and implementing an effective dewatering program should be the contractor’s responsibility. The contractor should install a dewatering system that will lower the groundwater level at least 2 feet below the bottom of excavation. In some areas, it may be necessary to maintain the groundwater at a deeper depth to minimize wet and spongy subgrade conditions.

The dewatering systems should be properly designed to prevent pumping soil fines with the discharge water. The contractor should sample and test the groundwater for soil fines content from the wells, as needed. If soil fines are being pumped, the contractor should revise his dewatering operations; otherwise, failure of shoring, partial instability of excavation resulting in intolerable ground settlement/movement of existing utilities and buildings and unsafe working conditions might occur. The contractor should provide discharge sampling locations for each pump.

The contractor is encouraged to perform his own investigation, test program, etc. prior to construction in order to satisfy their design requirements for an effective dewatering program. An investigation for subsurface environmental contamination was beyond the scope of our services. We are not aware of potential hazardous materials that may be present in the area.

11.9 Working Platform

Soft and loose, saturated native soil deposits may be encountered at the bottom of excavation when preparing the mat foundation subgrade. In such case, working conditions at the bottom of excavation may become difficult; equipment used at the bottom of the excavation may lose mobility, etc. The contractor should take adequate measures to minimize the disturbance of the sensitive deposits at the excavation subgrade. The contractor may minimize the disturbance of sensitive deposits or mitigate existing soft ground conditions by constructing a working platform at the mat subgrade. The working platform may be installed by 1) over excavating about 18 inches below the planned subgrade; 2) placing a stabilizing subgrade enhancement geotextile at the bottom of the resulting excavation; 3) backfilling with 2-inch crushed rock, compacted AB, lean concrete or other such approved bridging material. The contractor may use other methods of subgrade stabilization. The contractor’s proposed method should be reviewed by the Geotechnical Engineer.

11.10 Baseline Distress Surveys and Monitoring

A baseline distress survey and monitoring program should be considered for the existing structures and roadway pavements adjacent to the proposed construction. The survey should document existing structural distress (cracking) in existing buildings and pavement and hardscape displacements to provide a baseline of conditions prior to construction.

For the existing BART aerial structures and station, a daily monitoring program should be implemented during excavation, dewatering, pile installation, and building construction. The intent is to provide contractors "quantitative" measurements of how the construction activity is affecting the adjacent developments so that they may be "proactive" and adjust their work activities, if needed. The baseline distress survey and results of the monitoring program during construction provides a basis for settling any claims from neighboring properties that may or may not be affected by the construction at this site. The program can also assist the contractor in assessing the performance of the existing buildings, shoring or excavation during various construction activities.

11.11 Drainage

Since soils generally tend to lose strength when they become wet, it is essential that drainage be properly controlled. The site should be graded to provide positive drainage away from all structures/pavement sections so that water does not collect or discharge near the foundation lines or pavement edges. Landscaping within 5 feet of the perimeter of the foundations should be avoided to reduce the potential for ponding and saturation along the foundations.

Runoff from roof and paved areas should be collected and drained to suitable discharge points. Usually this drainage is connected to the storm drainage system. The site grading should not be altered or ditched, and drains should not be blocked as a result of future landscaping or any other future construction activities.

12.0 GRADING

Grading of the project primarily consists of excavation for the proposed basement levels (Option B for T-3 & T-4), and subgrade preparation for the proposed courtyard areas between the proposed buildings and the existing BART station. All grading operations should be performed in accordance with the California Building Code. A representative from our office or the regulatory agency should observe the grading operation and perform moisture and density tests on prepared subgrade and compacted fill material. Any fill material imported to the site should be non-expansive, relatively granular material and should be reviewed by the Geotechnical Engineer.

Should there be any alterations of the proposed construction that will affect the stated bases of our recommendations, we should be informed so that we can review such changes and amend or submit additional recommendations.

Site Preparation

The existing parking lots and other flatwork will be demolished. The subgrade materials beneath existing pavement and flatwork may be used as engineered backfill provided they meet the specifications discussed below. The subgrade of the planned excavation is anticipated to be below the groundwater level and may be wet and soft (Option B for T-3 & T-4). If subgrade instability is an issue such that soft, wet and pumping conditions cause equipment mobility difficulty, the subgrade may be improved as discussed in the "Work Platform," Section 11.10 of the report.

Engineered Fill

Engineered fill should be non-expansive and consist of relatively granular material having a P.I. of less than 15 and Sand Equivalent greater than 10. It should be free of vegetation or other deleterious material. Backfill should consist of Structure Backfill in accordance with Caltrans Standard Specifications (Section 19-3.06).

If Option B for T-3 & T-4 is adopted, the material to be excavated is anticipated to consist predominantly of sand. The moisture content of materials excavated for the basement is expected to be wet. Re-use of the material will require re-working and aeration. Majority of the on-site material are anticipated meet the requirements for engineered fill.

Compaction Requirements

The project specific recommendations for required compaction as per the building code as follows:

- 90% for backfilling after removing buried utilities and depressions caused due to construction activities, etc.; and, backfilling behind walls.
- 95% for Aggregate Base rock under basement floor slab and wall footings.
- 95% for upper 6 inches of pavement and slab subgrade

13.0 CONSTRUCTION OBSERVATION

The performance of any structure is dependent upon construction procedures and quality. Hence, observation of shoring construction and grading operations should be carried out by the Geotechnical Engineer. If the encountered subsurface conditions differ from those forming the basis of our recommendations, this office should be informed in order to assess the need for design changes. Therefore, the recommendations presented in this report are contingent upon good quality control and these geotechnical observations during construction.

Prospective contractors for the Project must evaluate construction-related issues on the basis of their own knowledge and experience in the local area, on the basis of similar projects in other localities, or on the basis of field investigation on the site performed by them, taking into account their proposed construction methods and procedures. In addition, construction activities related to excavation and lateral earth support must conform to safety requirements of OSHA and other applicable municipal and State regulatory agencies.

14.0 INVESTIGATION LIMITATIONS

Our services consist of professional opinions and recommendations made in accordance with generally accepted geotechnical engineering principles and practices and are based on our site reconnaissance and the assumption that the subsurface conditions do not deviate from observed conditions. No warranty, either expressed or implied, of merchantability or fitness, is made or intended in connection with our work or by the furnishing of oral or written reports or findings.

The scope of our services did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in structures, soil, surface water, groundwater or air, below or around this site.

Unanticipated soil conditions are commonly encountered and cannot be fully determined by taking soil samples and excavating test borings; different soil conditions may require that additional expenditures be made during construction to attain a properly constructed project. Some contingency fund is thus recommended to accommodate these possible extra costs.

This report has been prepared for the proposed Project as described earlier, to assist the engineer in the design of this Project. In the event any changes in the design or location of the facilities are planned, or if any variations or undesirable conditions are encountered during construction, our conclusions and recommendations shall not be considered valid unless the changes or variations are reviewed and our recommendations modified or approved by us in writing.

This report is issued with the understanding that it is the Designer's responsibility to ensure that the information and recommendations contained herein are incorporated into the project and that necessary steps are also taken to see that the recommendations are carried out in the field.

The findings in this report are valid as of the present date. However, changes in the subsurface conditions can occur with the passage of time, whether they are due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control.

Respectfully submitted,
PARIKH CONSULTANTS, INC.

Mark McKee, G.E. 2897
Senior Engineer

Y. David Wang, Ph.D., P.E. 52911
Project Manager

PROJECT LOCATION MAP

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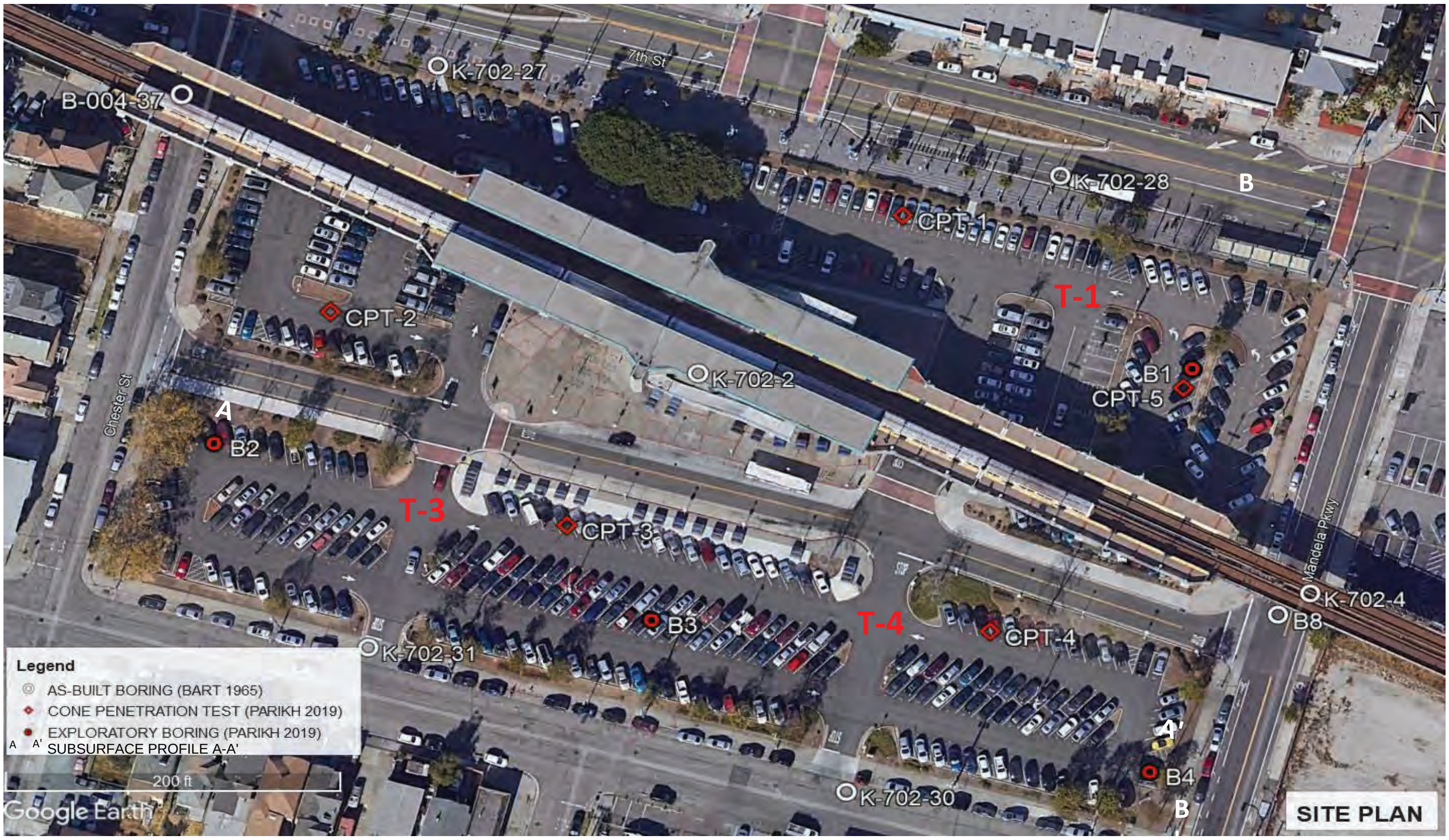
West Oakland BART Station TOD
1451 7th Street, Oakland, California

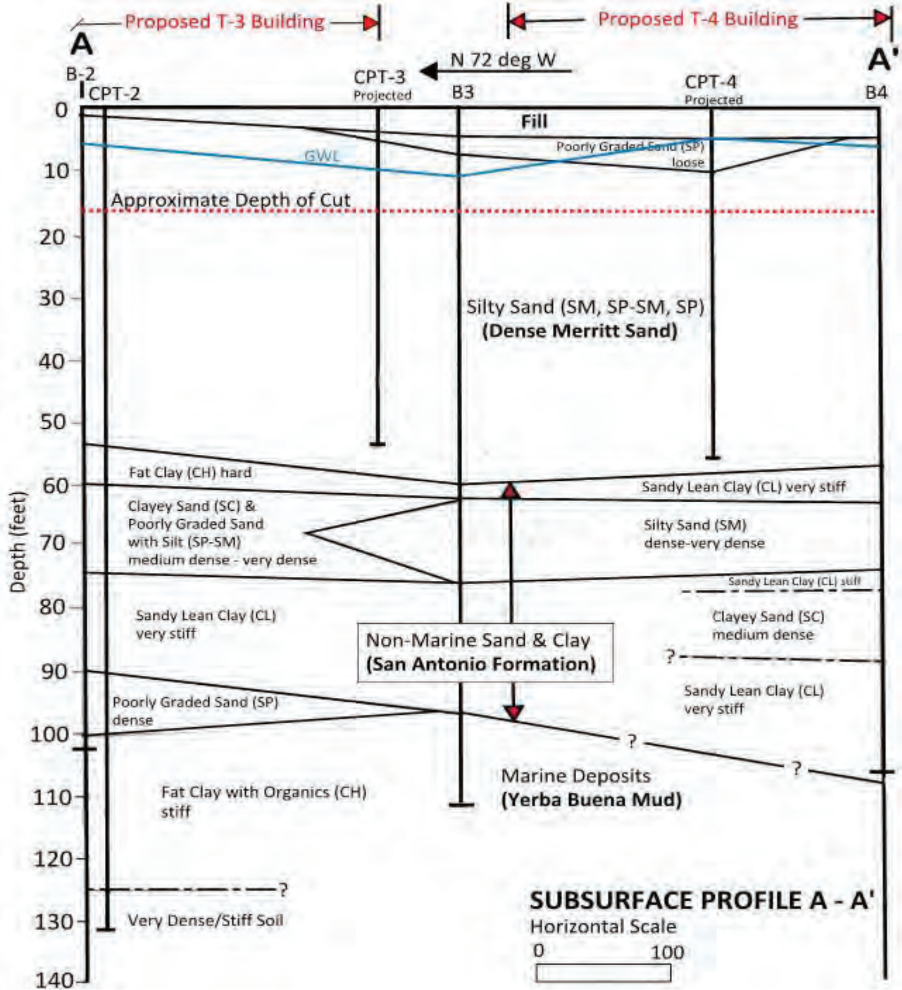
Project No. 2019-127-GEO	Figure No. 1



PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

West Oakland BART Station - Transit-Oriented Design Project
1451 7th Street Oakland, Alameda County, California

Project No. 2019-127-GEO	Figure No. 2



SUBSURFACE PROFILE A - A'

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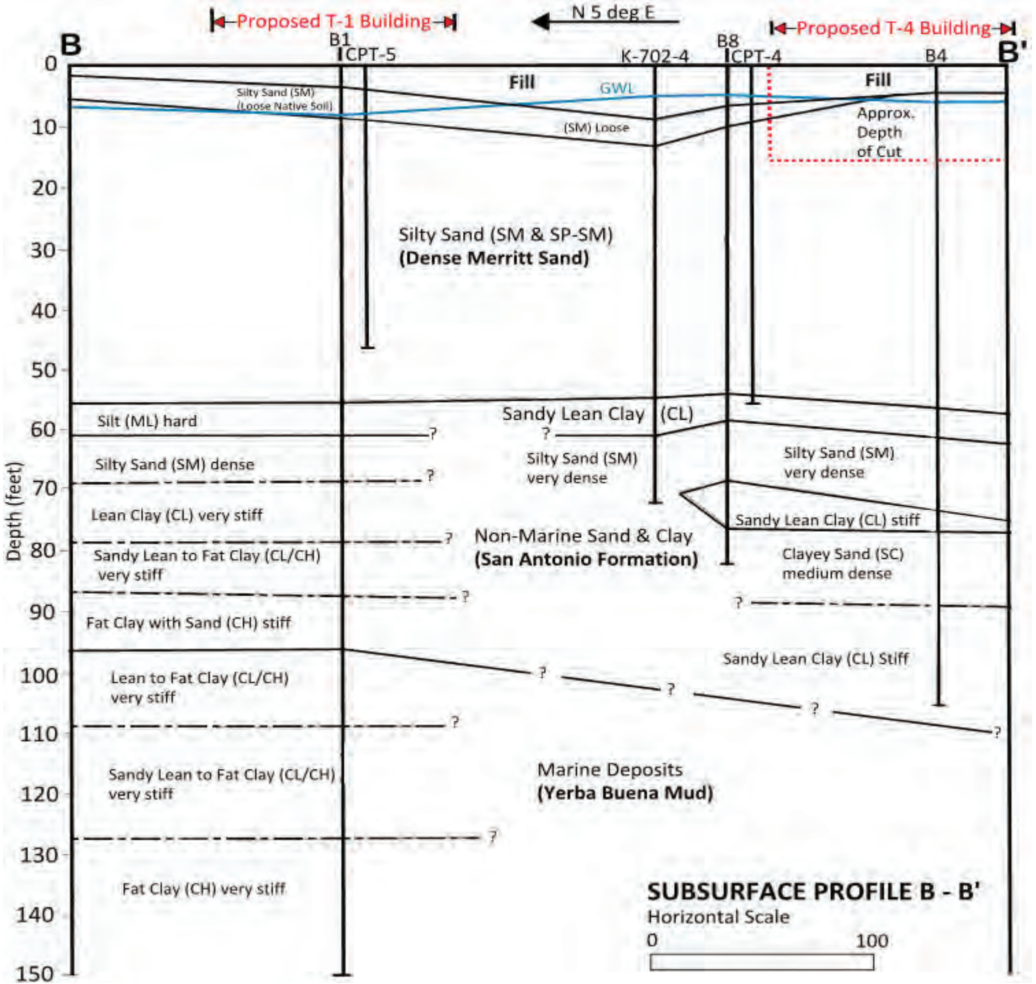
WEST OAKLAND BART STATION TOD PROJECT
1451 7TH Street, Oakland California

JOB NO.: 2017-144-T01	**FIGURE 3A**



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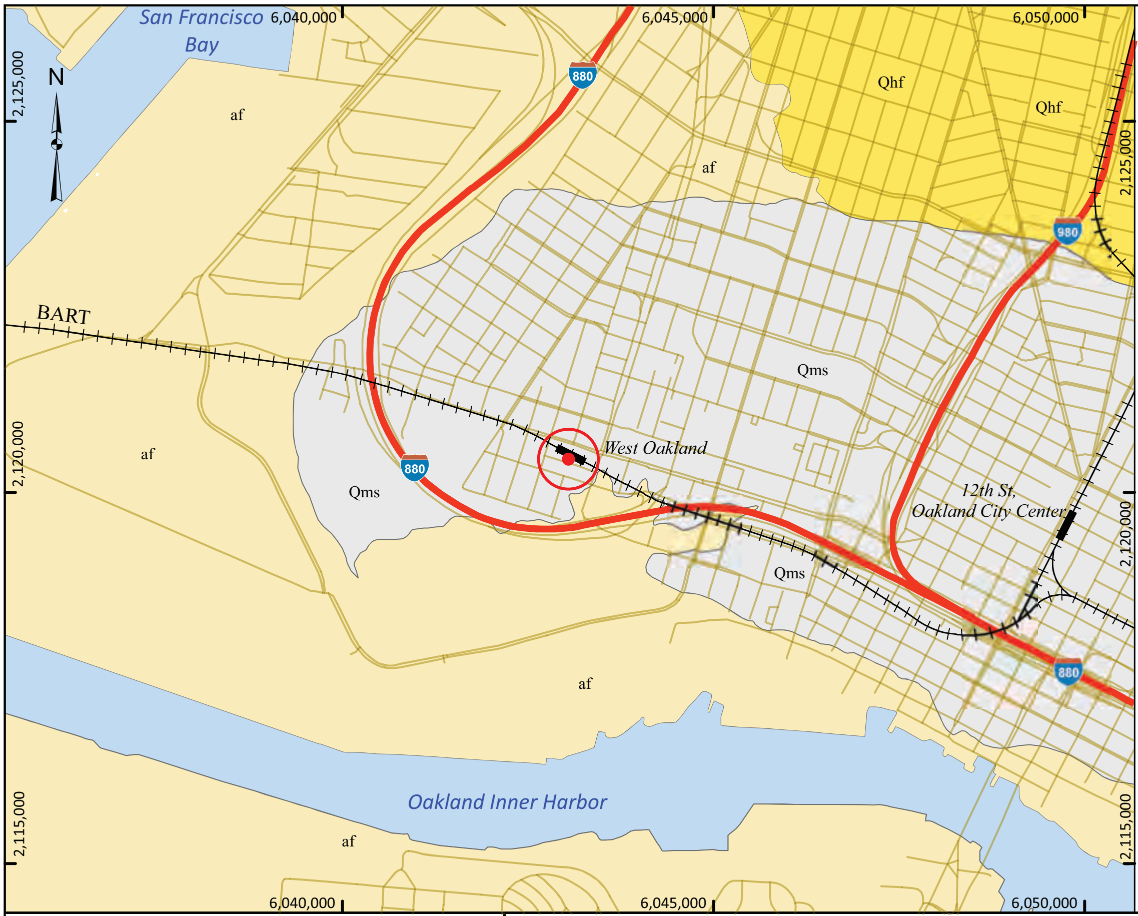
WEST OAKLAND BART STATION TOD PROJECT
1451 7TH Street, Oakland California

JOB NO.: 2017-127-GEO	**FIGURE 3B**



Legend

af	Artificial fill

Man-made deposit of various materials and ages; Very High liquefaction susceptibility.

Qms	Merritt Sand

Fine-grained, very well sorted, well-drained, eolian deposits; Moderate liquefaction susceptibility.

Qhf	Alluvial fan and fluvial deposits

Medium dense to dense, gravelly sand or sandy gravel grading upward to sandy or silty clay; Moderate liquefaction susceptibility.

● Project site

Data derived from:
Knudsen et.al., 1997. Map showing Quaternary Geology and Liquefaction Susceptibility, San Francisco, CA, 1:100k Quad; *and*

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

0 4,000

Scale 1:24k (feet)

Coordinate System:
NAD 1983 State Plane California III FIPS 0403 Feet

QUATERNARY GEOLOGY

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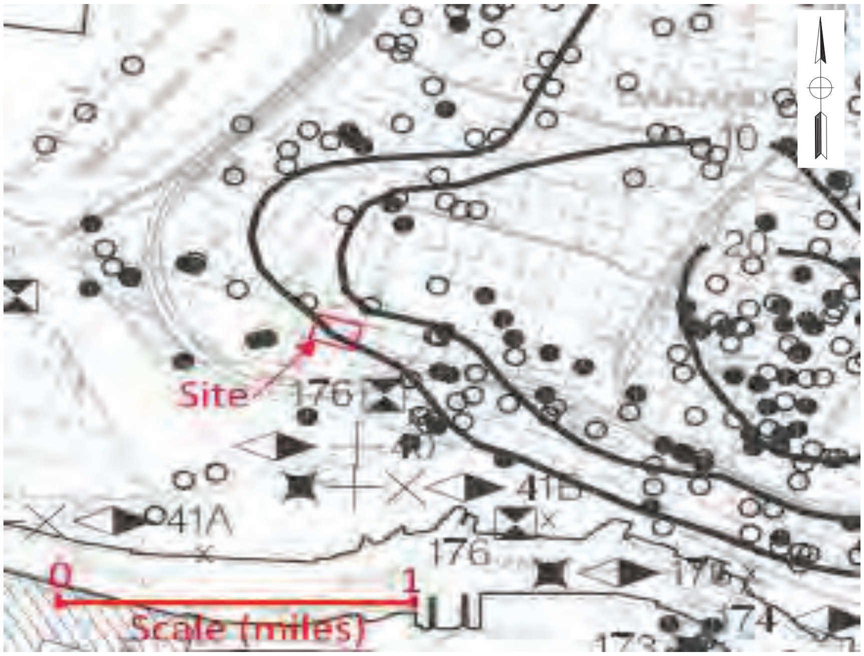
West Oakland BART Station TOD
1451 7th Street, Oakland, California

Project No. 2019-127-GEO

Figure No. 4



☒ Miscellaneous effects

⧗ Ground settlement

◁▶ Lateral spread

○ Sand boil

\+ Pipeline break

× Cracks in streets or ground

☐ Absence of ground failure noted

x Location of multiple ground effects. (See corresponding symbols)

▨ Areas within which multiple failures were recorded. Symbols show failure types.

Stretch of highway along which multiple failures were recorded. Symbols show failure types.

174 Number assigned to ground failure site (adapted from Youd and Hoose (1978) and Tinsley and others (1998) by Knudsen and others (2000))

— 20 — Depth to Groundwater (feet)

● Geotechnical Borings Used (by others) for Liquefaction Assessment

○ Groundwater Investigations by the California State Water Control Board

B Bedrock

Reference Map: Seismic Hazard Map of the Oakland West Quadrangle, California, 2003

SEISMIC HAZARD MAP SHOWING HISTORIC GROUND FAILURES AND GROUNDWATER LEVELS

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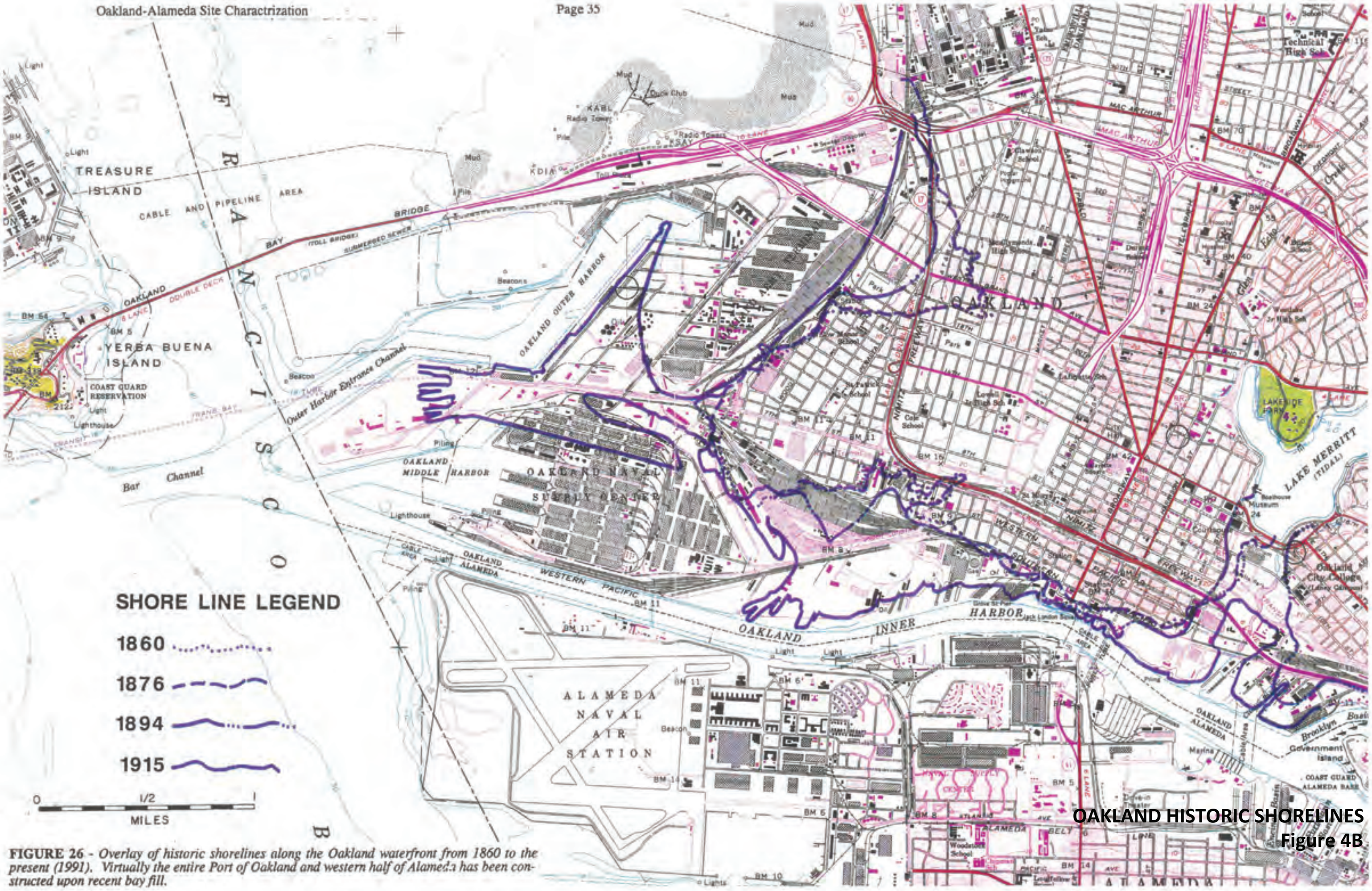
WEST OAKLAND BART STATION TOD PROJECT
1451 7TH Street, Oakland California

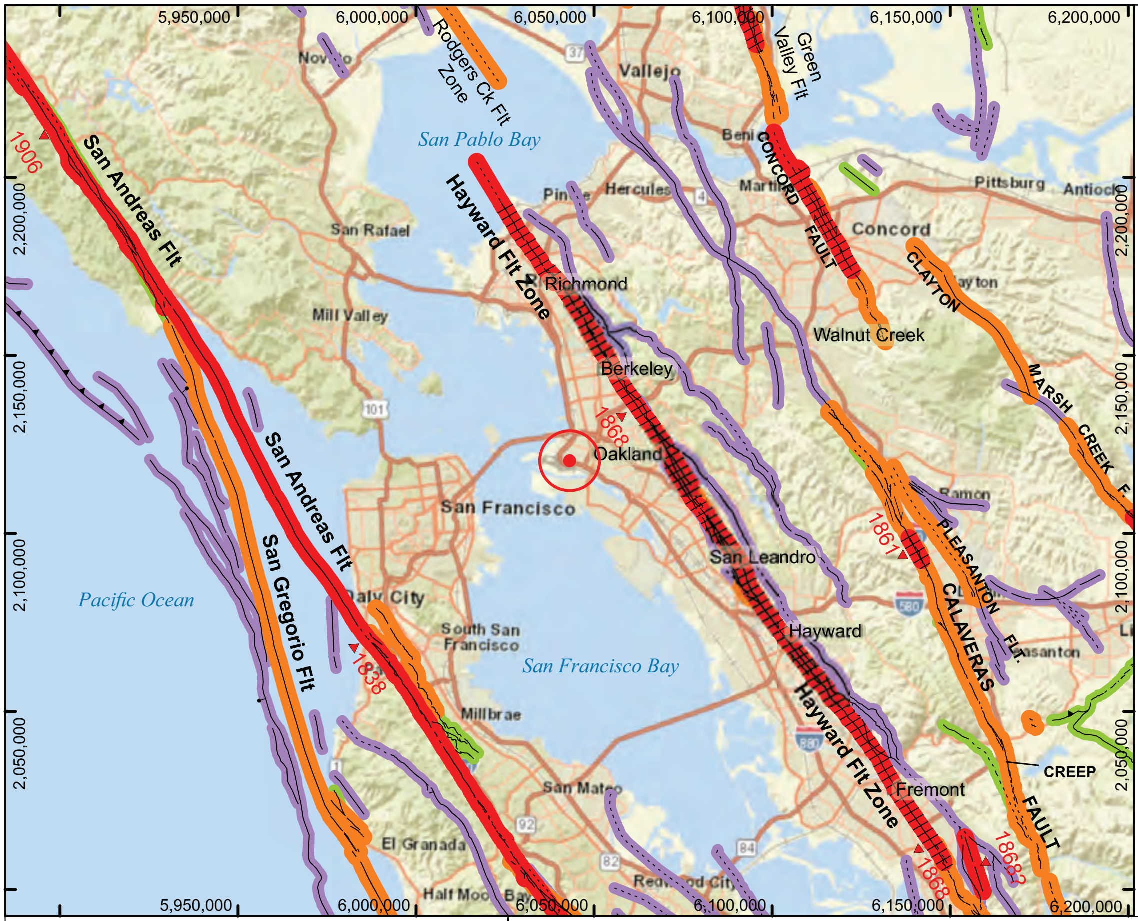
JOB NO.: 2017-127-GEO

FIGURE 4A



OAKLAND HISTORIC SHORELINES
Figure 4B

FIGURE 26 - *Overlay of historic shorelines along the Oakland waterfront from 1860 to the present (1991). Virtually the entire Port of Oakland and western half of Alameda has been constructed upon recent bay fill.*



Legend

🟥 Hayward — Historic (<200 yrs); name; creeping section.

🟧 Holocene (11,700 yrs)

🟩 Late Quaternary (<700,000 yrs)

🟪 Quaternary (<1.6 Million yrs)

— Fault location certain

– – – Fault location approximate

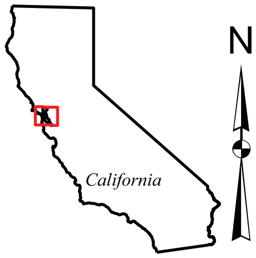
- - - - Fault concealed

▲ 1980 Surface rupture point and year

◉ Project Location

— Major roads

Map Location



Coordinate System:
NAD 1983 State Plane California III FIPS 0403 Feet

Fault data derived from:
Jennings and Bryant, 2010,
Fault activity map of California.

FAULT MAP

0 Miles 15

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West Oakland BART Station TOD
1451 7th Street, Oakland, California

Project No. 2019-127-GEO

Figure No. 45

Prepared for **Mandela Station Affordable LP**

FINAL GEOTECHNICAL INVESTIGATION
PROPOSED AFFORDABLE HOUSING
WEST OAKLAND TRANSIT VILLAGE – PARCEL T3
OAKLAND, CALIFORNIA

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October 21, 2024
Project No. 24-2662

1350 Ocean Avenue • Emeryville, CA 94608 • (510) 420-5738
www.rockridgegeo.com

ROCKRIDGE
GEOTECHNICAL

October 21, 2024
Project No. 24-2662

Gene Broussard
Mandela Station Affordable LP
PO Box 260770
Encino, California 91426

Subject: Final Geotechnical Investigation
Proposed Affordable Housing
West Oakland Transit Village – Parcel T3
Oakland, California

Dear Mr. Broussard,

We are pleased to present our geotechnical investigation report for the proposed affordable housing to be constructed on Parcel T3 of the West Oakland Transit Village development in Oakland, California. Our geotechnical investigation was performed in accordance with our proposal dated June 3, 2024.

The subject property, Parcel T3, is located to the southwest of the West Oakland BART Station and is bordered by Chester Street to the west, 5th Street to the south, and surface parking lots to the north and east. Currently, Parcel T3 is occupied by a surface parking lot and drive aisles for BART patrons.

We understand plans are to construct a six-story affordable housing building on Parcel T3. The proposed building will be constructed at-grade and will likely consist of five levels of residential units over a one-level concrete podium with parking and retail space: except at the western portion (along Chester Street) there will be two levels of residential units above the podium. Other proposed improvements include communal courtyards on the podium level.

From a geotechnical standpoint, we conclude the site can be developed as planned, provided the recommendations presented in this report are incorporated into the project plans and specifications and implemented during construction. The primary geotechnical concerns at the site are: 1) relatively shallow groundwater, 2) the presence of soil susceptible to liquefaction, and 3) providing adequate foundation support. We conclude the proposed building may be supported on a mat foundation bearing on ground improved with compacted aggregate columns.

The recommendations contained in our report are based on limited subsurface exploration. Consequently, variations between expected and actual subsurface conditions may be encountered during construction. Therefore, we should be engaged to observe site preparation and foundation installation, during which time we may make changes to our recommendations if deemed necessary.

We appreciate the opportunity to provide our services to you on this project. Should you have any questions, please call.

Sincerely yours,
ROCKRIDGE GEOTECHNICAL, INC.

REGISTERED PROFESSIONAL ENGINEER
HUI JUN LIANG
GE 2663
GEOTECHNICAL
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
KRYSTIAN P. SAMLIK
GE 3193
GEOTECHNICAL
STATE OF CALIFORNIA

Date: 10/21/2024

Date: 10/21/2024

Linda H.J. Liang, P.E., G.E.
Principal Engineer

Krystian P. Samlik, P.E., G.E.
Senior Project Engineer

Enclosure

QUALITY CONTROL REVIEWER:

Craig S. Shields, P.E., G.E.
Principal Engineer

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SCOPE OF SERVICES 1

3.0 FIELD INVESTIGATION AND LABORATORY TESTING 2
    3.1 Cone Penetration Tests 2
    3.2 Hand-Auger Borings 3
    3.3 Laboratory Testing 3
    3.4 Data Review 4

4.0 SUBSURFACE CONDITIONS 4
    4.1 Groundwater 5

5.0 SEISMIC CONSIDERATIONS 5
    5.1 Regional Seismicity 5
    5.2 Geologic Hazards 7
        5.2.1 Ground Shaking 7
        5.2.2 Ground Surface Rupture 8
        5.2.3 Liquefaction and Associated Hazards 8
        5.2.4 Cyclic Densification 10
        5.2.5 Earthquake-Induced Landslide 10

6.0 DISCUSSIONS AND CONCLUSIONS 11
    6.1 Design Groundwater Table 11
    6.2 Foundation and Settlement 11
    6.3 Ground Improvement 12
    6.4 Soil Corrosivity 12
    6.5 Excavation and Construction Considerations 13

7.0 RECOMMENDATIONS 14
    7.1 Site Preparation and Grading 14
        7.1.1 Subgrade Preparation 15
        7.1.2 Fill Quality and Compaction 15
        7.1.3 Utility Trenches 16
        7.1.4 Exterior Concrete Flatwork 16
    7.2 Mat Foundation 17
    7.3 Compacted Aggregate Columns 18
    7.4 Permanent Below-Grade Walls 19
    7.5 Seismic Design 20

8.0 ADDITIONAL GEOTECHNICAL SERVICES 21

9.0 LIMITATIONS 21

REFERENCES

FIGURES

APPENDIX A – Logs of Borings and Cone Penetration Test Results

APPENDIX B – Laboratory Test Results

APPENDIX C – Boring Logs, Cone Penetration Test Results, and Laboratory Test Results By Others

LIST OF FIGURES

Figure 1 Site Location Map

Figure 2 Site Plan

Figure 3 Regional Geologic Map

Figure 4 Regional Fault and Historic Seismicity Map

Figure 5 Earthquake Zones of Required Investigation Map

APPENDIX A

Figures A-1 through A-4 Cone Penetration Test Results, RG-CPT-1 through RG-CPT-4

Figures A-5 through A-6 Logs of Borings, HA-1 and HA-2

Figure A-7 Classification Chart

APPENDIX B

Figure B-1 Soil Corrosivity

FINAL GEOTECHNICAL INVESTIGATION
PROPOSED AFFORDABLE HOUSING
WEST OAKLAND TRANSIT VILLAGE – PARCEL T3
Oakland, California

1.0 INTRODUCTION

This report presents the results of the final geotechnical investigation performed by Rockridge Geotechnical, Inc. for the proposed affordable housing to be constructed on Parcel T3 of the West Oakland Transit Village development in Oakland, California. The site is located to the southwest of the West Oakland BART Station and is bordered by Chester Street to the west, 5th Street to the south, and surface parking lots to the north and east, as shown in the Site Location Map (Figure 1).

The site consists of a relatively flat, trapezoidal-shaped lot with plan dimensions of about 265 feet by 166 to 236 feet, as shown in the Site Plan (Figure 2). Currently, Parcel T3 is occupied by a surface parking lot and drive aisles for BART patrons.

We understand plans are to construct a six-story affordable housing building on Parcel T3. The proposed building will be constructed at-grade and will likely consist of five levels of residential units over a one-level concrete podium with parking and retail space: except at the western portion (along Chester Street) there will be two levels of residential units above the podium. Other proposed improvements include communal courtyards on the podium level.

2.0 SCOPE OF SERVICES

Our final geotechnical investigation was performed in accordance with our proposal dated June 3, 2024. Our scope of services consisted of reviewing available subsurface information for the site and vicinity, performing four cone penetration tests (CPTs), advancing two hand-auger borings, performing laboratory testing on selected soil samples, and performing engineering analyses to develop conclusions and recommendations regarding:

- subsurface soil and groundwater conditions
- site seismicity and seismic hazards, including the potential for liquefaction and earthquake-induced landslides

- ground improvement to mitigate the effects of liquefaction, as appropriate
- the most appropriate foundation type(s) for the proposed building
- design criteria for the recommended foundation type(s), including vertical and lateral capacities for each of the foundation type(s)
- estimates of static and seismically induced foundation settlements
- lateral earth pressures for design of the below-grade walls (i.e., elevator pit walls)
- site grading and excavation, including criteria for fill quality and compaction
- subgrade preparation for floor slabs, pavements, and exterior concrete flatwork
- 2022 California Building Code (CBC) site class and design spectral response acceleration parameters
- corrosivity of the near-surface soil and the potential effects on buried concrete and metal structures and foundations
- construction considerations.

3.0 FIELD INVESTIGATION AND LABORATORY TESTING

We reviewed available subsurface information for the site and vicinity and explored subsurface conditions at the site by performing four CPTs, advancing two hand-auger borings, and performing laboratory testing on selected soil samples from the hand-auger borings. Prior to performing our CPTs, we contacted Underground Service Alert (USA) to notify them of our work, as required by law, and retained C. Cruz Sub-Surface Locators, Inc., a private utility locator, to check CPT locations were clear of existing utilities. We also obtained a Permit to Enter from the San Francisco Bay Area Rapid Transit District (BART) and a drilling permit from Alameda County Public Works Agency (ACPWA) for the CPTs. Details of our field investigations, laboratory testing, and data review are presented in this section.

3.1 Cone Penetration Tests

We performed four CPTs, designated as RG-CPT-1 through RG-CPT-4, at the approximate locations shown in Figure 2. RG-CPT-1, RG-CPT-2, and RG-CPT-3 were advanced to target depths of 100, 70, and 70 feet below the ground surface (bgs), respectively. RG-CPT-4 encountered early refusal in very dense soil at a depth of about 50 feet bgs.

The CPTs were performed on September 10, 2024, by Gregg Drilling, LLC (Gregg Drilling) of Benicia, California. Gregg Drilling performed the CPTs by hydraulically pushing a 1.7-inch-diameter cone-tipped probe with a projected area of 15 square centimeters into the ground with a 30-ton capacity truck rig. The cone-tipped probe measured tip resistance, and the friction sleeve behind the cone tip measured frictional resistance. Electrical strain gauges within the cone measured soil parameters at a recording interval of approximately 1 inch for the entire depth advanced. A special cone was also used to measure the in-situ soil shear wave velocity in approximately 5-foot intervals in RG-CPT-1. Soil data, including tip resistance, frictional resistance, and shear wave velocity (for RG-CPT-1), were recorded by a computer while the test was conducted. Accumulated data were processed by computer to provide engineering information, such as the soil behavior type and approximate strength characteristics of the soil encountered. The CPT logs showing tip resistance and friction ratio, as well as interpreted soil behavior type and shear wave velocity profiles, are presented in Figures A-1 through A-4 in Appendix A.

Upon completion, the CPT holes were backfilled with cement grout in accordance with ACPWA guidelines and patched with asphalt.

3.2 Hand-Auger Borings

To supplement the CPT data and obtain near-surface soil samples for visual classification and laboratory testing, we advanced two hand-auger borings, designated as HA-1 and HA-2, at the approximate locations shown in Figure 2. Borings HA-1 and HA-2 were advanced to depths of 4 and 4.5 feet bgs, respectively, using a 3-inch-diameter hand auger. Samples were collected and brought back to the office for visual classification. The borings were backfilled with soil cuttings. The logs of the hand-auger borings are presented in Figures A-5 and A-6 in Appendix A. The soil encountered in the borings was classified in accordance with the classification chart shown in Figure A-7.

3.3 Laboratory Testing

We re-examined the soil samples obtained from our borings to confirm the field classifications and selected representative samples for laboratory testing. Laboratory tests were performed by

Project X Corrosion Engineering of Murrieta, California on two near-surface soil samples to provide data for evaluating the soil corrosivity. The results of the laboratory tests are presented in Appendix B.

3.4 Data Review

Our study included reviewing subsurface data from the geotechnical report titled *Preliminary Geotechnical Report, West Oakland BART Station, Transit-Oriented Design Project*, dated December 15, 2019, prepared by Parikh Consultants, Inc. (Parikh). Parikh's investigation spanned Parcels T1, T2, and T3 of the proposed transit village development and included performing five CPTs and drilling four borings. Of that investigation, two CPTs and one boring were performed within/adjacent to Parcel T3, as shown in Figure 2. The Parikh report also included logs of two borings drilled near the site by Bechtel Corporation (see Figure 2). Selected logs of borings, CPT results, and laboratory test results presented in the Parikh report are attached in Appendix C.

4.0 SUBSURFACE CONDITIONS

A regional geologic map prepared by Graymer (2000), a portion of which is presented in Figure 3, indicates the site is underlain by Holocene- and Pleistocene-age Merritt sand (Qms). Where explored, the site is underlain by about 1 to 5 feet of fill consisting of loose to medium dense sand with variable amounts of silt, clay, and gravel.

The fill is underlain by Merritt sand that extends to depths of about 55 feet bgs. The Merritt sand generally consists of sand with variable amounts of silt and clay. Where explored, the Merritt sand is loose to medium dense to a depth of about 10 feet bgs and is dense between depths of about 10 and 17 to 21 feet bgs. There is a 2- to 6-foot-thick layer of medium dense silty sand/stiff sandy silt between depths of 17 and 25 feet bgs. Between depths of 25 and 55 feet bgs, the Merritt sand is very dense.

The Merritt sand is underlain by interbedded layers of hard clay and very dense sand that extend to about 80 feet bgs. Below a depth of 80 feet bgs, we encountered very stiff clay that extend to the maximum depth explored of 100 feet bgs (RG-CPT-1).

4.1 Groundwater

Groundwater was not encountered in our hand-auger borings advanced to depths of 4 and 4.5 feet bgs. The depth to groundwater was estimated to about 3.5 feet bgs based on a pore pressure dissipation test performed in RG-CPT-3. Groundwater was encountered at depths of 6.5 and 11 feet bgs in Borings B-2 and B-3 by Parikh (2019) during drilling. The depth to groundwater was estimated to be about 2.4 feet bgs in CPT-3 (Parikh, 2019) based on pore pressure dissipation test. Additionally, groundwater was encountered Bechtel Borings K-702-2 and K-702-31 at depths of 6.1 and 5.5 feet bgs, respectively, during drilling.

The California Geological Survey (CGS) Seismic Hazard Zone Reports for the Oakland West 7.5-Minute Quadrangle present a historic high groundwater level on the order of about 5 feet bgs at the site vicinity. The groundwater level at the site is expected to fluctuate several feet seasonally with potentially larger fluctuations annually, depending on the amount of rainfall. Based on the available groundwater data, we conclude a design groundwater table at 3 feet below existing grade should be used for this project.

5.0 SEISMIC CONSIDERATIONS

5.1 Regional Seismicity

The site is located within the Coast Ranges Geomorphic Province of California, which is characterized by northwest-trending valleys and ridges. These topographic features are controlled by folds and faults that resulted from the collision of the Farallon and North American plates and subsequent strike-slip faulting along the San Andreas Fault system. The San Andreas Fault is more than 600 miles long and extends from Point Arena in the north to the Gulf of California in the south. The Coast Ranges Geomorphic Province is bounded on the east by the Great Valley and on the west by the Pacific Ocean.

The major active faults in the area are the Hayward, San Andreas, and Calaveras faults. These and other faults in the region are shown in Figure 4. For these and other active faults within a 50-kilometer radius of the site, the distance from the site and estimated characteristic moment magnitude[1] [Petersen et al. (2014) & Thompson et al. (2016)] are summarized in Table 1. These references are based on the Third Uniform California Earthquake Rupture Forecast (UCERF3), prepared by Field et al. (2013).

TABLE 1
Regional Faults and Seismicity

Fault Segment	Approximate Distance from Site (km)	Direction from Site	Characteristic Moment Magnitude
Total Hayward + Rodgers Creek (RC+HN+HS+HE)	7.5	East	7.58
Hayward (North, HN)	7.5	East	6.90
Hayward (South, HS)	11	East	7.00
Total Calaveras (CN+CC+CS+CE)	23	East	7.43
Calaveras (North, CN)	23	East	6.86
Total North San Andreas (SAO+SAN+SAP+SAS)	23	Southwest	8.04
North San Andreas (Peninsula, SAP)	23	Southwest	7.38
Mount Diablo Thrust North CFM	24	East	6.72
Mount Diablo Thrust	24	East	6.67
San Gregorio (North)	28	West	7.44
Concord	29	East	6.45
Green Valley	32	Northeast	6.30
North San Andreas (North Coast, SAN)	34	West	7.52
Mount Diablo Thrust South	35	East	6.50
Clayton	35	East	6.57
Monte Vista - Shannon	37	South	7.14
Greenville (North)	38	East	6.86
West Napa	40	North	6.97
Rodgers Creek - Healdsburg	42	North	7.19
Great Valley 05 (Pittsburg - Kirby Hills alt1)	43	Northeast	6.60
Great Valley 05 (Pittsburg - Kirby Hills alt2)	46	East	6.66
Las Positas	48	East	6.50

Damaging earthquakes have occurred along many of these faults in recorded history, as depicted in Figure 4 (USGS, 2021). Notable historic earthquakes which have impacted the Bay Area in recorded history include:

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[1] Moment magnitude (M_w) is an energy-based scale and provides a physically meaningful measure of the size of a faulting event. Moment magnitude is directly related to average slip and fault rupture area.

- 1838 San Andreas Earthquake, M_w = 7.4 (estimated)
- 1865 San Andreas Earthquake, M_w = 6.5 (estimated)
- 1868 Hayward Earthquake, M_w = 7.0 (estimated)
- 1906 Great San Francisco Earthquake (San Andreas Fault), M_w = 7.9 (estimated)
- 1989 Loma Prieta Earthquake (San Andreas Fault), M_w = 6.9
- 2014 West Napa Earthquake, M_w = 6.0

As a part of the UCERF3 project, researchers estimated that the probability of at least one $M_w \geq 6.7$ earthquake occurring in the greater San Francisco Bay Area during a 30-year period (starting in 2014) is 72 percent. The highest probabilities are assigned to sections of the Hayward (South), Calaveras (Central), and San Andreas (Santa Cruz Mountains) faults. The respective probabilities are approximately 25, 21, and 17 percent.

5.2 Geologic Hazards

Because the site is in a seismically active region, we evaluated the potential for earthquake-induced geologic hazards including ground shaking, ground surface rupture, liquefaction,[2] lateral spreading,[3] and cyclic densification,[4] and earthquake-induced landslides. We used the results of our geotechnical investigation to evaluate the potential of these phenomena occurring at the site.

5.2.1 Ground Shaking

The seismicity of the site is governed by the activity of the Hayward Fault, although ground shaking from future earthquakes on other faults, including the San Andreas and Calaveras faults, will also be felt at the site. The intensity of earthquake ground motion at the site will depend upon the characteristics of the generating fault, distance to the earthquake epicenter, and

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[2] Liquefaction is a phenomenon where loose, saturated, cohesionless soil experiences temporary reduction in strength during cyclic loading such as that produced by earthquakes.

[3] Lateral spreading is a phenomenon in which surficial soil displaces along a shear zone that has formed within an underlying liquefied layer. Upon reaching mobilization, the surficial blocks are transported downslope or in the direction of a free face by earthquake and gravitational forces.

[4] Cyclic densification is a phenomenon in which non-saturated, cohesionless soil is compacted by earthquake vibrations, causing ground-surface settlement.

magnitude and duration of the earthquake. We judge strong to very strong ground shaking could occur at the site during a large earthquake on one of the nearby faults.

5.2.2 Ground Surface Rupture

Historically, ground surface displacements closely follow the trace of geologically young faults. The site is not within an Earthquake Fault Zone, as defined by the Alquist-Priolo Earthquake Fault Zoning Act, and no known active or potentially active faults exist on the site. Therefore, we conclude the probability of fault offset at the site from a known active fault to be very low. In a seismically active area, the remote possibility exists for future faulting in areas where no faults previously existed; however, we conclude the probability of surface faulting, and consequently secondary ground failure from previously unknown faults, is very low.

5.2.3 Liquefaction and Associated Hazards

When saturated, cohesionless soil liquefies, it experiences a temporary loss of shear strength created by a transient rise in excess pore pressure generated by strong ground motion. Soil susceptible to liquefaction includes loose to medium dense sand and gravel, low-plasticity silt, and some low-plasticity clay deposits. Flow failure, lateral spreading, differential settlement, loss of bearing strength, ground fissures and sand boils are evidence of excess pore pressure generation and liquefaction.

The site is located within a mapped zone of liquefaction potential as shown on the map titled *Earthquake Zones of Required Investigation Map, Oakland West Quadrangle, Official Map*, prepared by the California Geological Survey (CGS), dated February 14, 2003 (Figure 5). CGS has provided recommendations for procedures and report content for site investigations performed within seismic hazard zones in Special Publication 117 (SP-117), titled *Guidelines for Evaluating and Mitigating Seismic Hazard Zones in California*, dated September 11, 2008. SP-117 recommends subsurface investigations in mapped liquefaction hazard zones be performed using rotary-wash borings and/or CPTs to a depth of at least 50 feet bgs.

We evaluated liquefaction potential using data collected from the CPTs and the computer program, CLiq v3.5 (GeoLogismiki, 2024). CLiq uses measured CPT data and assesses liquefaction susceptibility and post-earthquake vertical settlement given a user-defined earthquake magnitude and peak ground acceleration (PGA). We performed the liquefaction-triggering analysis using the general methodology proposed by Boulanger and Idriss (2014) while considering an I_B (Robertson, 2016) cutoff value of 28. This cutoff is similar to an I_c of 2.65 for “young” and “normally consolidated” soils (i.e., those most susceptible to liquefaction) and consistent with local experience (Proto, 2024). We also used the relationship proposed by Zhang, Robertson, and Brachman (2002) to estimate post-liquefaction volumetric strains and corresponding ground surface settlement. Volumetric strains were modified using the methodology proposed by Çetin et al. (2009) to account for the depth of the liquefiable layers.

Our analyses were performed using a “during earthquake” groundwater level of 3 feet bgs. In accordance with the 2022 CBC, we used a peak ground acceleration of 0.71 times gravity (g) in our liquefaction evaluation; this peak ground acceleration is consistent with the Maximum Considered Earthquake Geometric Mean (MCE_G) peak ground acceleration adjusted for site effects (PGA_M). We also used a moment magnitude 7.58 earthquake, which is consistent with the characteristic moment magnitude for the Hayward Fault, as presented in Table 1.

Our liquefaction analyses indicate there are layers of potentially liquefiable soil between depths of 4 and 9 feet bgs and between depths of 17 and 23 feet bgs. The potentially liquefiable soils have interpreted soil behavior types “sandy silt”, “silty sand”, and “sand”. We estimate total and differential settlements resulting from post-earthquake reconsolidation following an MCE event with PGA_M of 0.71g will up to 1-1/2 inches and 3/4 inch across a horizontal distance of 30 feet, respectively. If the proposed building will be supported on a mat bearing on improved ground (see Sections 6.3 and 7.3), we estimate total and differential liquefaction-induced settlements of the mat will be less than 3/4 inch and less than 1/2 inch across a horizontal distance of 30 feet, respectively.

Considering the potentially liquefiable soil is relatively shallow, the potential for surface manifestations from liquefaction, such as sand boils and loss of bearing capacity for shallow foundations, is high at the site.

Lateral spreading is a phenomenon in which a surficial soil displaces along a shear zone that has formed within an underlying liquefied layer. The surficial blocks are transported downslope or in the direction of a free face, such as a channel, by earthquake and gravitational forces. Lateral spreading is generally the most pervasive and damaging type of liquefaction-induced ground failure generated by earthquakes. Case history data suggest that granular soil with the clean sand equivalent normalized cone parameter, $Q_{tn,cs}$, values greater than 70 are not susceptible to lateral spreading (Robertson, 2010). Considering the site is relatively level and the Qtn,cs values of the potentially liquefiable soil are greater than 70, we conclude that the potential for lateral spread is very low.

5.2.4 Cyclic Densification

Cyclic densification (also referred to as differential compaction) of non-saturated sand (sand above groundwater table) can occur during an earthquake, resulting in settlement of the ground surface and overlying improvements. Where explored, the loose to medium dense fill and sand above the groundwater is susceptible to cyclic densification. We estimate cyclic densification induced settlement will be up to about 1/4 inch during an MCE event with PGA_M of 0.71g. Considering the upper 3 feet of soil will be removed or recompacted during construction of the proposed building, we conclude cyclic densification induced settlement will be negligible beneath the building footprint.

5.2.5 Earthquake-Induced Landslide

The site is **not** located within a mapped zone of earthquake-induced landslide potential as shown on the map titled *Earthquake Zones of Required Investigation Map, Oakland West Quadrangle, Official Map*, prepared by the California Geological Survey (CGS), dated February 14, 2003 (Figure 5). Considering the gradient of the site and vicinity are relatively flat, we conclude the probability for a landslide or an earthquake-induced landslide to occur at the site is nil.

6.0 DISCUSSIONS AND CONCLUSIONS

From a geotechnical standpoint, we conclude the site can be developed as planned, provided the recommendations presented in this report are incorporated into the project plans and specifications and implemented during construction. The primary geotechnical concerns at the site are: 1) relatively shallow groundwater, 2) the presence of soil susceptible to liquefaction, and 3) providing adequate foundation support. These and other geotechnical issues as they pertain to the project are presented in this section.

6.1 Design Groundwater Table

Based on available groundwater table information presented in Section 4.1, we conclude a design groundwater table at 3 feet below existing grade should be used for this project. Where proposed improvements, such as floor slab or below-grade walls, will extend below the design groundwater table, the floor slab and below-grade walls should be waterproofed and designed to resist hydrostatic pressures. The mat for the proposed building will bottom close to or below the design groundwater table and should be waterproofed.

6.2 Foundation and Settlement

The site is underlain by loose to medium dense sandy soil to a depth of about 10 feet bgs that is susceptible to liquefaction. Shallow foundations, such as spread footings or a mat, supported on the near-surface sand may experience bearing failure due to reduced strength in the potentially liquefiable soils during an earthquake. Therefore, we conclude the proposed building should not be supported on shallow foundations bearing on existing (unimproved) ground.

We conclude a mat foundation bearing on improved soil would be an appropriate foundation system for the proposed building, provided the ground improvement is capable of transferring building loads to the dense Merritt sand below a depth of about 10 feet bgs. We judge compacted aggregate columns (CACs), as discussed in Section 6.3, to be the most appropriate and economical ground improvement system for this project. The CACs should bottom at least 12 feet below existing grade in dense sand.

We estimate total and differential settlement of a mat supported on ground improved with CACs will be less than 3/4 inch and less than 1/2 inch across a horizontal distance of 30 feet, respectively. As presented in Section 5.2.3, we estimate additional total and differential liquefaction-induced settlement of the mat supported on ground improved with CACs will be less than 3/4 inch and less than 1/2 inch across a horizontal distance of 30 feet, respectively.

6.3 Ground Improvement

Ground improvement serves to stiffen the overall soil matrix by densifying and/or reinforcing weaker or potentially liquefiable soil layers. As a result, foundation loads are transferred to more competent materials below the liquefiable layers, or liquefaction potential is mitigated, thus reducing settlements and providing increased bearing capacity below the mat foundation.

There are several types of ground improvement that may be utilized to mitigate the effects of liquefaction and densify the loose to medium dense sand beneath the proposed building footprint. Although we believe ground improvement consisting of dynamic compaction using rapid impact compaction (RIC) would be the most economical ground improvement method, we conclude the large vibrations may not be acceptable due to the proximity of the BART structures. Consequently, we recommend the ground improvement consists of compacted aggregate columns (CACs). Aggregate columns can be installed by a variety of techniques, such as open-drilled holes backfilled in lifts (compacted aggregate piers) or full-displacement bottom-feed mandrels, some of which are proprietary techniques. Regardless of the technique used, the resulting aggregate column is typically 24 to 36 inches in diameter. The aggregate column serves to transfer building loads to deeper strata and, to a varying extent, densify the surrounding soil.

6.4 Soil Corrosivity

Corrosivity tests were performed by Project X Corrosion Engineering of Murrieta, California on two soil samples obtained from Borings HA-1, and HA-2 at depths of 3 and 3.5 feet bgs, respectively. The corrosivity test results are presented in Appendix B.

Many factors can affect the corrosion potential of soil including, but not limited to, resistivity, pH, and chloride and sulfate concentrations. Based on the minimum soil resistivity measurements ranging from 5,829 to 8,040 ohm-cm, we conclude the soil is “moderately corrosive” to buried metal (Roberge, 2018). Accordingly, all buried iron, steel, cast iron, galvanized steel, and dielectric-coated steel or iron should be protected against corrosion depending upon the critical nature of the structure. If it is necessary to have metal in contact with soil, a corrosion engineer should be consulted to provide recommendations for corrosion protection.

The results of the pH tests (7.0 to 7.4) indicate the near-surface soil is “mildly to negligibly corrosive” to buried metallic and concrete structures. The chloride ion concentrations (10.5 to 41.0 mg/kg) indicate the chlorides in the near-surface soil are “negligibly corrosive” to buried metallic structures and reinforcing steel in concrete structures below ground. The results also indicate the sulfate ion concentrations (58.6 to 93.0 mg/kg) are sufficiently low such that sulfates do not pose a threat to buried concrete and mortars.

6.5 Excavation and Construction Considerations

We anticipate excavation at the site will generally be limited to foundations, elevator pits, and new underground utilities. Excavation at the site can be performed with typical earth-moving equipment. If groundwater is encountered during excavation, dewatering measures, such as placing sumps in the bottom of trenches or excavations should be used.

Excavations that will be entered by workers should be sloped or shored in accordance with CAL-OSHA standards (29 CFR Part 1926). Where there is sufficient clearance from the property line, the excavation sides above groundwater may be slope cut at a maximum inclination of 1.5:1 (horizontal to vertical), which is consistent with OSHA Type C soil. The contractor should be responsible for the construction and safety of temporary slopes. Where there is insufficient space to slope-cut the excavations, shoring may be required. The selection, design, construction, and performance of the shoring system (if needed) should be the responsibility of the contractor.

If site grading is performed during the rainy season, repeated loads by heavy equipment will reduce the strength of the surficial soil and decrease its ability to resist deformation; this phenomenon could result in severe rutting of the exposed subgrade. To reduce the potential for this behavior, heavy rubber-tired equipment as well as vibratory rollers, should be avoided near the groundwater table.

Where there are existing structures nearby, heavy equipment should not be used within 10 horizontal feet from existing structures. Jumping jack or hand-operated vibratory plate compactors should be used for compacting fill within this zone.

7.0 RECOMMENDATIONS

Our recommendations for site preparation and grading, foundation design, ground improvement, seismic design, and other geotechnical aspects of the project are presented in this section.

7.1 Site Preparation and Grading

Any vegetation and organic topsoil should be stripped and disposed of off-site. Site demolition should include removal of all existing pavements, former foundation elements (if any), and underground utilities. We recommend demolished asphalt concrete be taken to an asphalt recycling facility. Aggregate base beneath existing pavements may be re-used as general site fill or select fill (see Section 7.1.2) if carefully segregated. In general, abandoned underground utilities should be removed to the property line or service connections and properly capped or plugged with concrete. Where existing utility lines are outside of the footprint of the proposed improvements and will not interfere with the proposed construction, they may be abandoned in-place provided the lines are filled with lean concrete or cement grout to the property line. Voids resulting from demolition activities should be properly backfilled with compacted fill under the observation of our field engineer and following the recommendations provided later in this section.

If grading is performed during the rainy season, the contractor may find the subgrade material too wet to compact to the recommended relative compaction and will have to be scarified and aerated to lower its moisture content so the recommended compaction can be achieved. Material to be dried by aeration should be scarified to a depth of at least 8 inches; the scarified soil should be turned at least twice a day to promote uniform drying. Once the moisture content of the aerated soil has been reduced to acceptable levels, the soil should be compacted in accordance with our recommendations. Aeration is typically the least costly method used to stabilize the subgrade soil; however, it generally takes the most time and favorable weather conditions to complete. Other soil stabilization alternatives include over-excavating the wet soil and replacing or mixing it with drier soil, and chemical treatment.

7.1.1 Subgrade Preparation

In areas that will receive fill or improvements (i.e., pavements, paver, and flatwork), the soil subgrade exposed should be scarified to a depth of at least 8 inches, moisture-conditioned to near optimum moisture content, and compacted to at least 90 percent relative compaction.[5] If the subgrade is within 8 inches of finished subgrade in areas to receive vehicular traffic, it should be moisture-conditioned to near optimum moisture content, and compacted to at least 95 percent relative compaction and be non-yielding. We anticipate the building pad/mat subgrade will be near the design groundwater level. Therefore, scarification and recompaction will not be required; instead, the building pad/mat subgrade should be static rolled with a smooth-drum roller and then proof-rolled with a fully loaded water truck or equivalent. The soil subgrade should be kept moist until it is covered by fill or improvements.

7.1.2 Fill Quality and Compaction

Fill should consist of on-site soil or imported soil (select fill) that is free of organic matter and contains no rocks or lumps larger than 3 inches in greatest dimension. Imported select fill should also have a liquid limit of less than 40 and a plasticity index lower than 12, and is approved by the Geotechnical Engineer. Samples of proposed imported fill should be submitted to the Geotechnical Engineer at least three business days prior to use at the site. The grading contractor should also provide analytical test results or other suitable environmental documentation indicating the proposed imported fill is free of hazardous materials at least three days before use at the site.

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[5] Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same material, as determined by the ASTM D1557 laboratory compaction procedure.

Fill should be placed in horizontal lifts not exceeding 8 inches in uncompacted thickness, moisture-conditioned to near optimum moisture content, and compacted to at least 90 percent relative compaction. Note that "moisture-conditioning" may require wetting or drying of the soil, depending on the conditions encountered. Fill consisting of clean sand or gravel (defined as poorly graded soil with less than 5 percent fines by weight) or greater than 5 feet in thickness should be compacted to at least 95 percent relative compaction. Fill placed within the upper 12 inches of vehicular pavement soil subgrade should also be compacted to at least 95 percent relative compaction and be non-yielding.

7.1.3 Utility Trenches

Excavations for utility trenches should conform to the current CAL-OSHA requirements. To provide uniform support, pipes or conduits should be bedded on a minimum of 4 inches of sand or fine gravel. After the pipes and conduits are tested, inspected (if required), and approved, they should be covered to a depth of 6 inches with sand or fine gravel, which should be mechanically tamped. Backfill for utility trenches and other excavations is also considered fill and should be placed and compacted according to the recommendations previously presented. Jetting of trench backfill should not be permitted. Special care should be taken when backfilling utility trenches in pavement areas. Poor compaction may cause excessive settlements, resulting in damage to the pavement section.

Foundations for the proposed building should be bottomed below an imaginary line extending up at a 1.5:1 (horizontal to vertical) inclination from the base of utility trenches running parallel to the foundation. Alternatively, the portion of the utility trench (excluding bedding) that is below the 1.5:1 line can be backfilled with controlled low strength material (CLSM) with a 28-day unconfined compressive strength of at least 100 pounds per square inch (psi).

7.1.4 Exterior Concrete Flatwork

We recommend exterior concrete flatwork, including patio slabs and sidewalks, be underlain by at least 4 inches of Class 2 aggregate base. The Class 2 aggregate base should extend at least 6 inches beyond the slab edges where the flatwork is adjacent to landscaping. Class 2 aggregate base and the soil subgrade should be moisture-conditioned and compacted to at least 90 percent relative compaction.

7.2 Mat Foundation

As discussed in Section 6.2, we conclude the proposed building may be supported on a mat bearing on ground improved with CACs. We estimate the CAC ground improvement system described in Section 7.3 if properly designed and installed, should be capable of increasing the allowable bearing pressure to 4,000 to 6,000 pounds per square foot (psf) for dead-plus-live loads and 5,300 psf to 8,000 psf for total loads—the actual allowable pressures may be higher or lower, depending on the size, spacing, depth, strength, and construction methods of the ground improvement elements selected by the design-build contractor.

For preliminary structural design of the mat foundation, we recommend using a coefficient of vertical subgrade reaction of 50 pounds per cubic inch (pci) for dead-plus-live loads; this value has already been scaled to take into account the plan dimensions of the mat foundation (therefore, this is not k_{v1} for 1-foot-square plate) and may be increased by one-third for total load conditions. Once the Structural Engineer estimates the distribution of bearing stress on the bottom of the mat, we should review the distribution and revise the modulus of subgrade reaction, if appropriate.

Lateral forces can be resisted by friction along the base of the mat and by passive pressure against the sides of the mat foundation. To compute passive resistance, we recommend using allowable equivalent fluid weights of 260 and 125 pounds per cubic foot (pcf) above and below the design groundwater table, respectively. The upper foot of soil should be ignored unless confined by a slab or pavement. The allowable friction factor will depend on the type of material at the base of the footing/mat. If the mat is underlain by bentonite-based waterproofing membranes, such as Paraseal or Voltex, a friction factor of 0.12 should be used (assumes a bentonite friction angle of 10 degrees). If the mat is underlain by Preprufe waterproofing membrane, a base friction factor of 0.20 should be used. Friction factors for other types of waterproofing membranes can be provided upon request. The passive pressure and frictional resistance values include a factor of safety of at least 1.5 and may be used in combination without further reduction.

The mat should be waterproofed. A rat slab consisting of at least 3 inches of structural concrete may be placed to protect the mat subgrade from softening from ponding water and/or disturbance from foot traffic during construction, and to provide a working surface on which to install the waterproofing system. We should check the mat subgrade prior to placing the rat slab or waterproofing membrane to confirm it is free of standing water, debris, and disturbed materials.

7.3 Compacted Aggregate Columns

As discussed in Section 6.3, we conclude CACs to be the most appropriate and economical ground improvement system for this project. Aggregate columns can be installed by a variety of techniques, such as open-drilled holes backfilled in lifts (compacted aggregate piers) or full-displacement bottom-feed mandrels, some of which are proprietary techniques. Regardless of the technique used, the resulting aggregate column is typically 24 to 36 inches in diameter. The CACs should extend at least 5 feet outside the building footprint. The aggregate column serves to transfer building loads to deeper strata and to densify the surrounding soil. We recommend the columns be installed to a minimum depth of 12 feet below the existing ground surface.

The soil to be improved consists of fine- to medium-grained sand with varying fines content. To minimize the potential for long-term migration of fines into void spaces in the CACs, the aggregate columns should be constructed out of a well-graded aggregate, such as Class 2 aggregate base. The required size, spacing, length, and strength of aggregate should be determined by the design-build contractor, to achieve specified level of improvement.

The intent of the ground improvement is to: 1) reduce seismically induced settlement beneath the entire building footprint to less than 3/4 inch under a magnitude 7.58 earthquake and a PGA_M of 0.71g, 2) limit total settlement of mat under static loading to 3/4 inch, and 3) provide an allowable bearing pressure of at least 4,000 psf for the mat foundation under dead-plus-live loads and 5,300 psf for total loads. The design of the ground improvement system should be performed by a Specialty GeoContractor. Prior to construction, the Specialty GeoContractor should submit a ground improvement design-build package for review by the project team. The design-build package should include settlement and bearing capacity calculations for both static and seismic conditions, demonstrating the proposed design will meet the performance criteria. The bid should provide a unit price (on a square-foot basis) to install additional columns; however, the base bid should assume no additional columns are needed.

To confirm the ground improvement meets the above performance criteria, a pre-production test section consisting of a minimum of nine CACs (three rows of three CACs) should be prepared in the building footprint near one of the CPT performed for this geotechnical investigation. A static load test should be performed on one CAC with the maximum load corresponding to 150 percent of the design maximum bearing stress on the CAC. In addition, at least two CPTs should be performed to a minimum depth of 30 feet at the center point between CACs in the test section to check the specified improvement has been achieved.

7.4 Permanent Below-Grade Walls

Below-grade walls (i.e., elevator pit walls) should be designed to resist lateral earth pressure imposed by the retained soil, as well as a surcharge pressure from nearby vehicles and foundations, where appropriate. In addition, because the site is in a seismically active area, below-grade walls that retain more than 6 feet of soil should be designed to resist pressures associated with seismic forces.

For static conditions, we recommend restrained and unrestrained walls be designed for the following lateral earth pressures:

- Restrained Wall - At-rest earth pressure using an equivalent fluid weight of 56 pcf for drained conditions and 89 pcf for undrained conditions
- Unrestrained Wall - Active earth pressure using an equivalent fluid weight of 37 pcf for drained conditions and 80 pcf for undrained conditions

Walls that will retain more than 6 feet of soil will need to be designed for the more critical of static (presented above) or the following seismic conditions.

- Restrained Wall - Active earth pressure using an equivalent fluid weight of 37 pcf plus a seismic increment of 32 pcf for drained conditions; and 80 pcf plus a seismic increment of 15 pcf for undrained conditions

- Unrestrained Wall - Active earth pressure using an equivalent fluid weight of 37 pcf plus a seismic increment of 14 pcf for drained conditions; and 80 pcf plus a seismic increment of 7 pcf for undrained conditions

Where the wall extends below the design groundwater table (3 feet below existing grade), the wall should be designed for undrained conditions. Where there will be traffic loading within 10 feet behind the wall, the wall should be designed for vehicular surcharge of 100 psf over the upper 10 feet of the wall. If the traffic loading is limited to passenger vehicles only (e.g., a garage ramp or elevator pit walls inside a garage), the vehicular surcharge may be reduced to 50 psf. Where foundations will be supported above a “zone-of-influence” line extending up from a permanent wall at an inclination of 1.5:1 (horizontal to vertical), the wall should be designed for a surcharge pressure. The magnitude of the surcharge pressure will need to be evaluated on a case-by-case basis.

To protect against moisture migration, below-grade walls should be waterproofed and water stops should be placed at all construction joints. If backfill is required behind below-grade walls, the walls should be braced, or hand compaction equipment used, to prevent unacceptable surcharges on walls (as determined by the Structural Engineer).

7.5 Seismic Design

The results of the seismic CPT indicate that the site has an estimated shear wave velocity in the upper 100 feet (30 meters, V_{s30}) of 1,090 feet/second for RG-CPT-1. The site is underlain by potentially liquefiable soil. The 2022 CBC calls for a Site Class F designation for sites underlain by potentially liquefiable soil. Much of the potentially liquefiable soil will be improved during ground improvement below the proposed building. Considering the site will not incur significant nonlinear behavior during strong ground shaking, we conclude the Site Class D designation, in accordance with the 2019 CBC, may be used for building design.

The latitude and longitude of the site are 37.8046° and -122.2958°, respectively. For design in accordance with the 2022 CBC, we recommend the following:

- Site Class D (stiff soil, non-default)
- S_S = 1.527g, S_1 = 0.6g

The 2022 CBC is based on the guidelines contained within ASCE 7-16 (Supplement 3 revision), which stipulate that if S_1 is greater than 0.2 times gravity (g) for Site Class D, a ground motion hazard analysis is required unless the long-period spectral design parameters (S_{M1}, S_{D1}) are increased by 50%. Therefore, we recommend the following seismic design parameters, which include the 50% increase as indicated by an asterisk:

- $F_a = 1.0$, $F_v = 1.7$
- $S_{MS} = 1.527g$, $S_{M1}^* = 1.530g$
- $S_{DS} = 1.018g$, $S_{D1}^* = 1.020g$
- Seismic Design Category D for Risk Categories I, II, and III

8.0 ADDITIONAL GEOTECHNICAL SERVICES

Prior to construction, we should review the project plans and specifications to check that they conform to the intent of our recommendations. During construction, our field engineer should observe ground improvement installation, check foundation subgrade preparation, and check fill placement and compaction. These observations will allow us to compare actual with anticipated soil conditions and to check the contractor's work conforms to the geotechnical aspects of the plans and specifications.

9.0 LIMITATIONS

This geotechnical investigation has been conducted in accordance with the standard of care commonly used as state-of-practice in the profession. No other warranties are either expressed or implied. The recommendations made in this report are based on the assumption that the subsurface conditions do not deviate appreciably from those disclosed in our field investigation. If any variations or undesirable conditions are encountered during construction, we should be notified so additional recommendations can be made. The foundation recommendations presented in this report are developed exclusively for the proposed development described in this report and are not valid for other locations and construction in the site vicinity.

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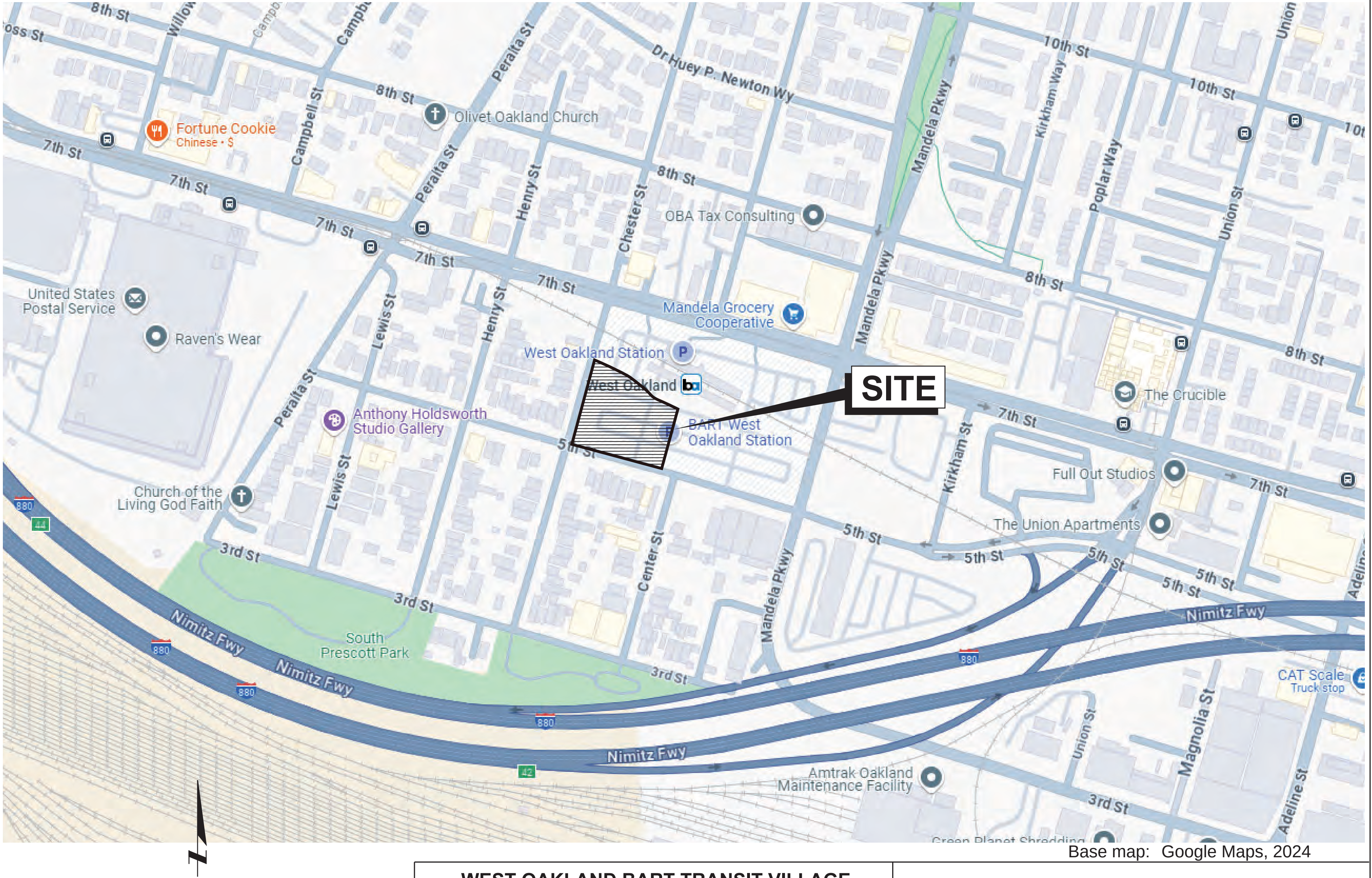

Base map: Google Maps, 2024

WEST OAKLAND BART TRANSIT VILLAGE
PARCEL T3
Oakland, California

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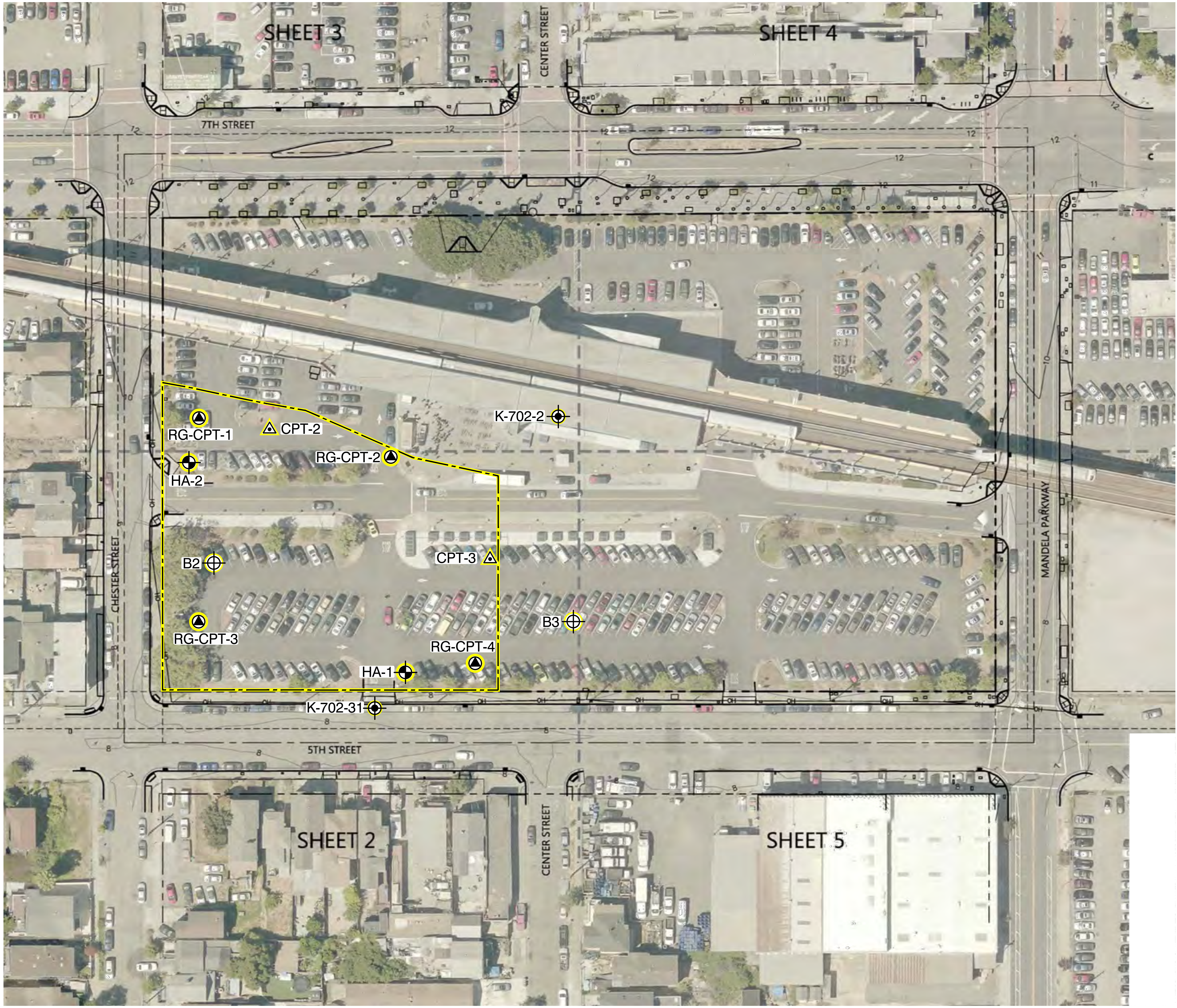
SITE LOCATION MAP

Date 09/24/24	Project No. 24-2662	Figure 1



Reference: Base map from a drawing titled "Topographic & Boundary Survey, West Oakland Bart", by Bkf Surveyors, dated December 6, 2018.

EXPLANATION

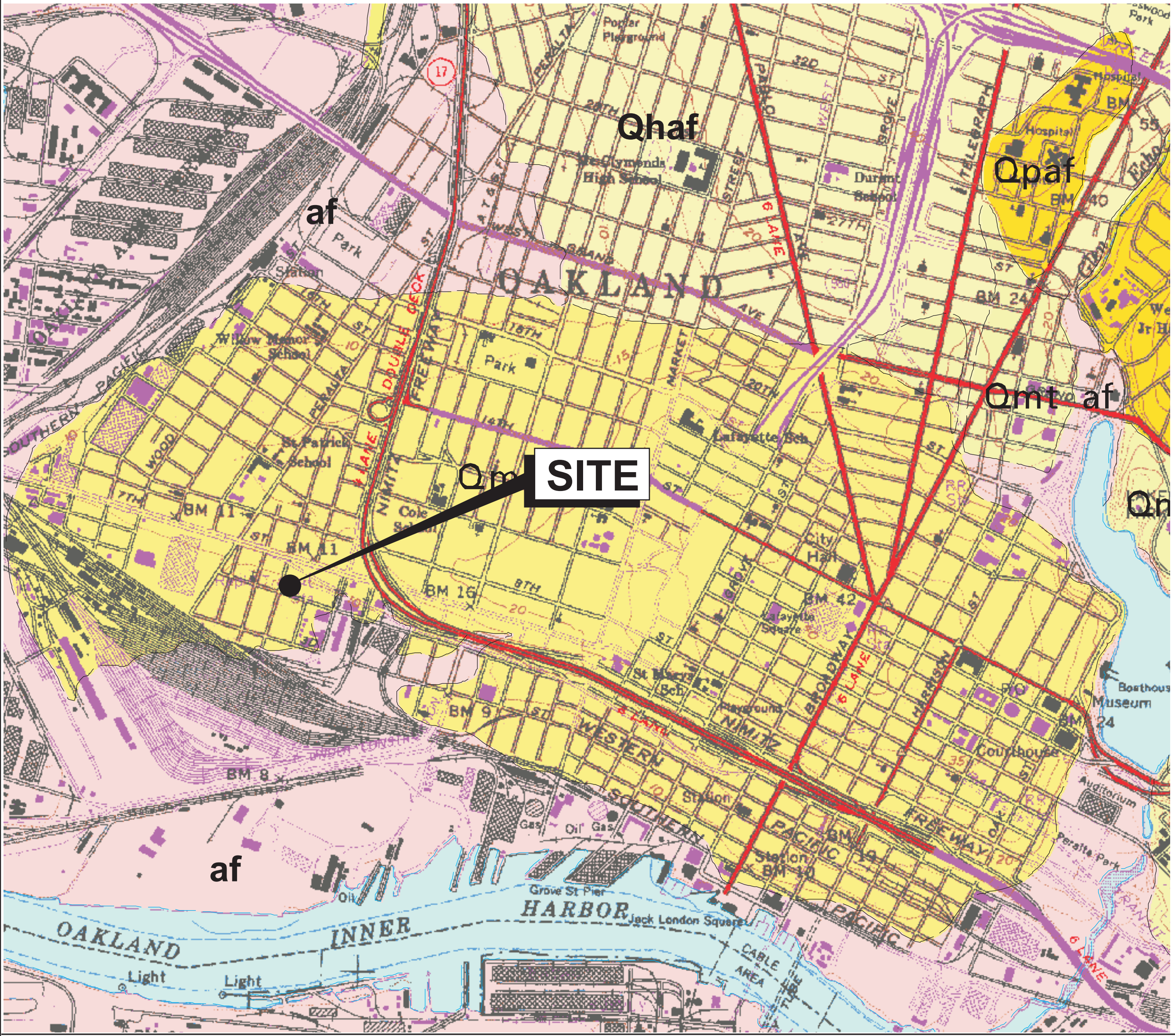
RG-CPT-1	Approximate location of cone penetration test by Rockridge Geotechnical, Inc., September 10, 2024
HA-1	Approximate location of hand-auger boring by Rockridge Geotechnical, Inc., September 23, 2024
CPT-3	Approximate location of cone penetration test by Parikh Consultants, Inc., September 13, 2019
B3	Approximate location of boring by Parikh Consultants, Inc., September 9-13, 2019
K-702-2	Approximate location of boring by Bechtel Corporation, September 8-28, 1965
— · —	Approximate Parcel T3 Boundary

WEST OAKLAND BART TRANSIT VILLAGE
PARCEL T3
Oakland, California

SITE PLAN

Date 10/07/24	Project No. 24-2665	Figure 2

ROCKRIDGE GEOTECHNICAL

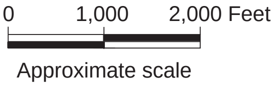


Base map: USGS MF 2342, Geologic Map and Map Database of the Oakland Metropolitan Area, Alameda, Contra Costa, and San Francisco Counties, California (Graymer, 2000).

EXPLANATION

- Contact - Depositional or intrusive contact, dashed where approximately located, dotted where concealed
- Fault - Dashed where approximately located, small dashed where inferred, dotted where concealed, queried where locations is uncertain
- Reverse or thrust fault - Dotted where concealed
- Anticline -Shows fold axis, dotted where concealed
- Syncline
- 35 Strike and dip of bedding
- Overturned bedding
- Flat bedding
- Vertical bedding
- 35 Strike and dip of foliation
- Vertical foliation
- 35 Strike and dip of joints in plutonic rocks
- Vertical joint

af	**Artificial fill (Historic)**
Qhaf	**Alluvial fan and fluvial deposits (Holocene)**
Qms	**Merrit sand (Holocene and Pleistocene)**
Qpaf	**Alluvial fan and fluvial deposits (Pleistocene)**
Qmt	**Marine terrace deposits (Pleistocene)**



WEST OAKLAND BART TRANSIT VILLAGE
PARCEL T3
Oakland, California

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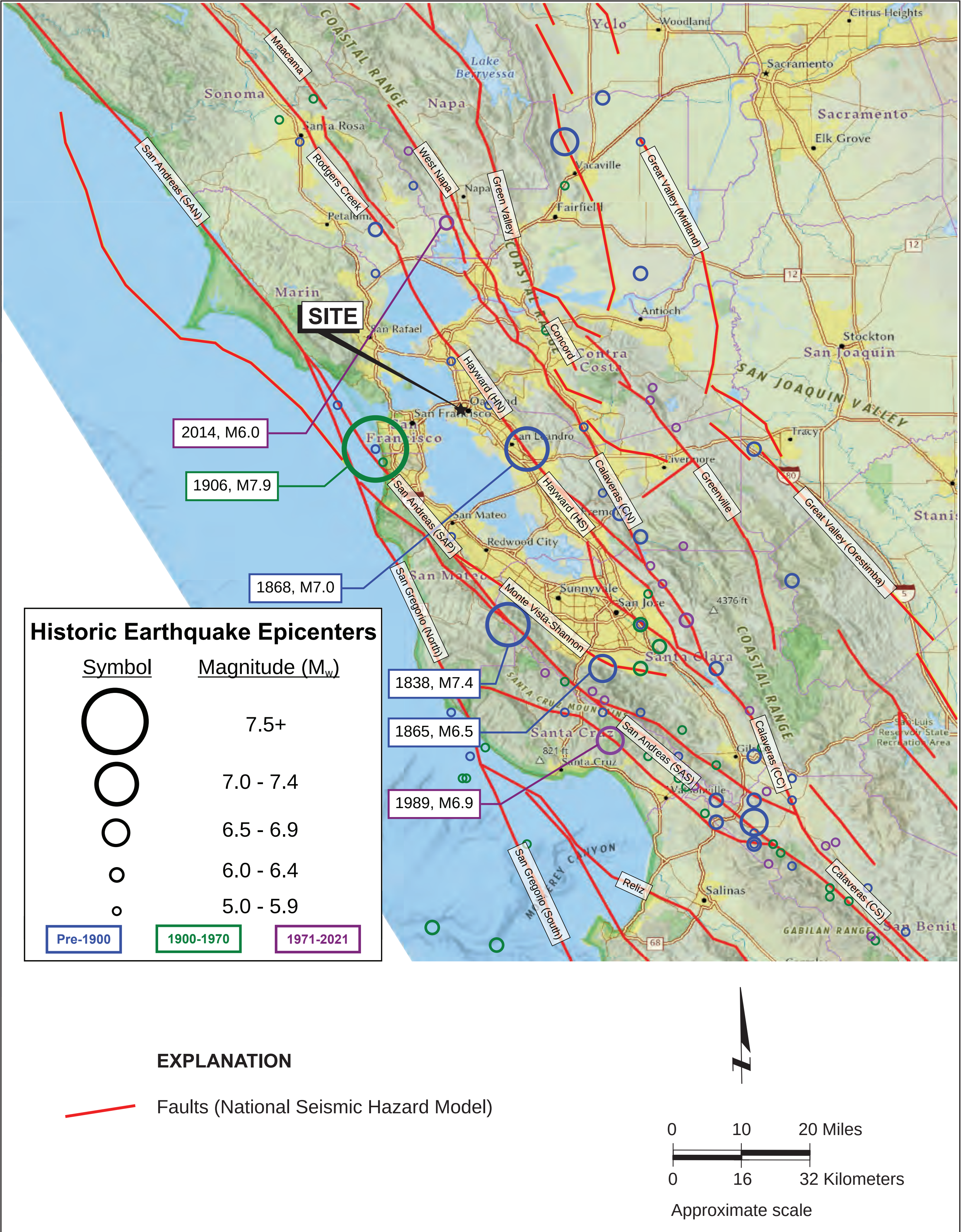
REGIONAL GEOLOGIC MAP

Date 09/24/24 | Project No. 24-2662 | Figure 3



WEST OAKLAND BART TRANSIT VILLAGE
PARCEL T3
Oakland, California

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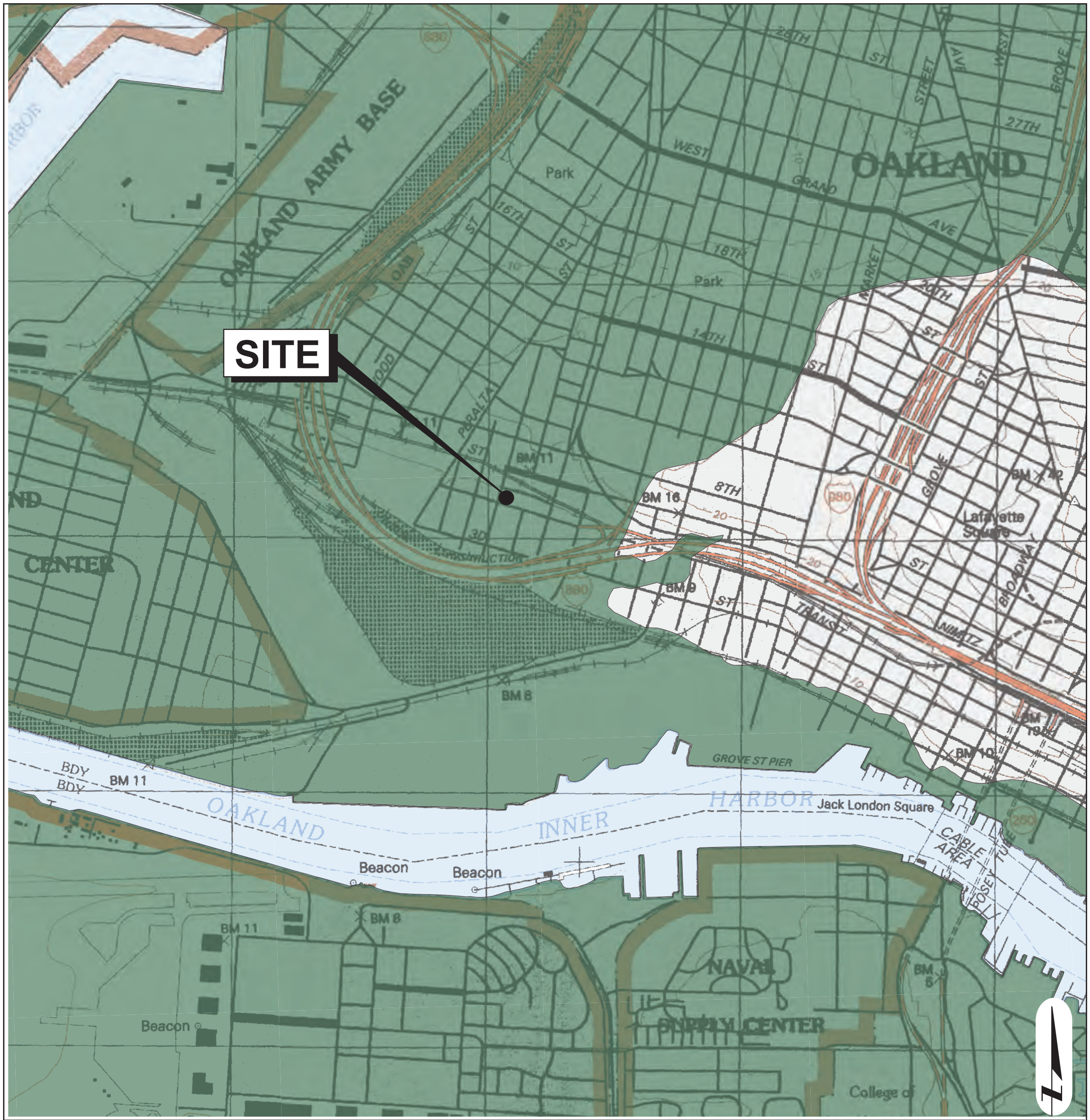
REGIONAL FAULT AND HISTORIC SEISMICITY MAP

Date 09/24/24 | Project No. 24-2662 | Figure 4



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

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

Reference:
Earthquake Zones of Required Investigation
Oakland West Quadrangle
California Geological Survey
Released February 14, 2003

0 2,000 4,000 Feet
Approximate scale

WEST OAKLAND BART TRANSIT VILLAGE
PARCEL T3
Oakland, California

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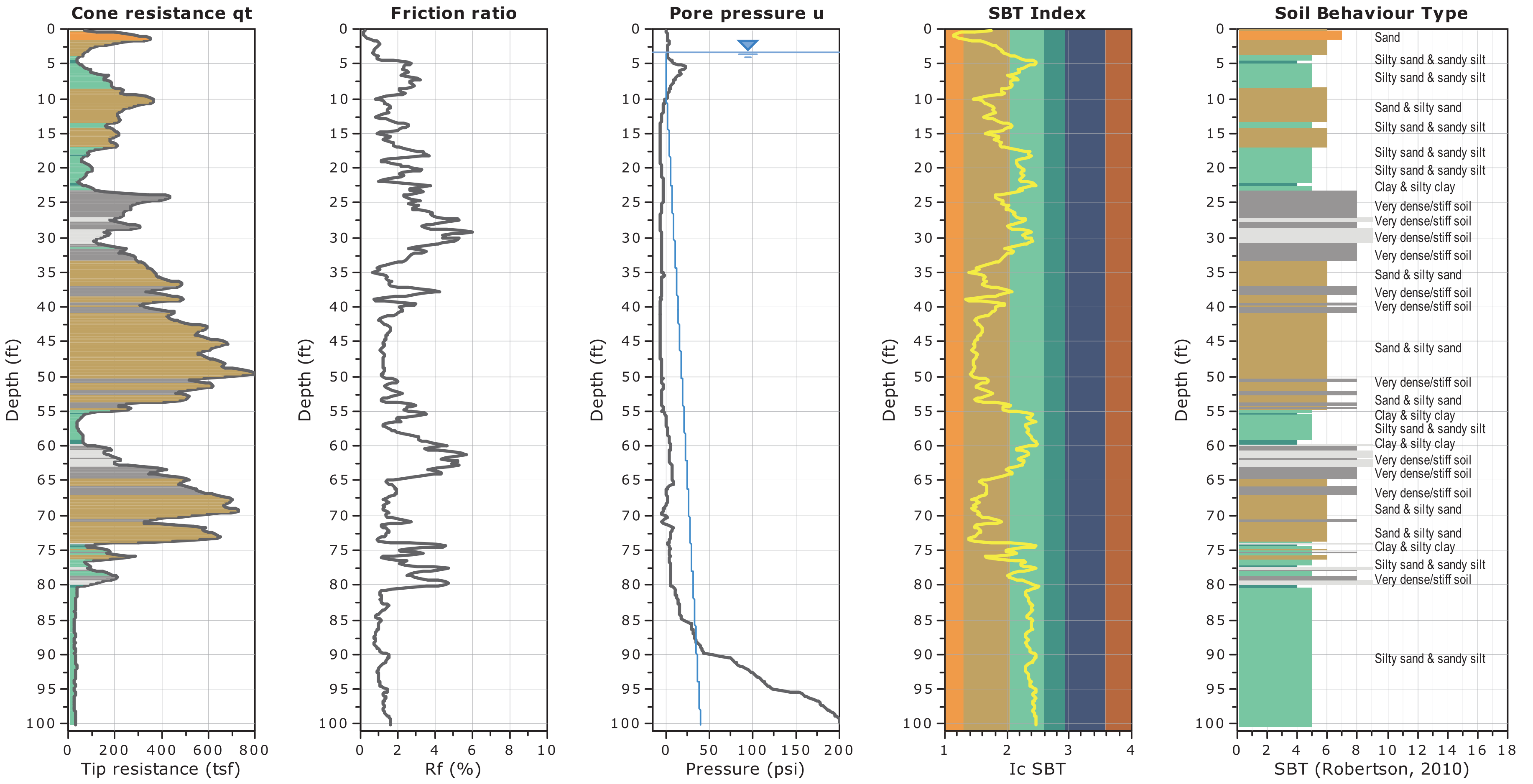
EARTHQUAKE ZONES OF REQUIRED INVESTIGATION MAP

Date 09/24/24 | Project No. 24-2662 | Figure 5



Total Depth: 100.2 ft, Date: September 23, 2024

Depth to Groundwater: 3.5 feet (estimated from CPT-3 pore pressure dissipation test)

Cone Operator: Gregg Drilling, LLC

SBT legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

WEST OAKLAND BART TRANSIT VILLAGE
PARCEL T3
Oakland, California

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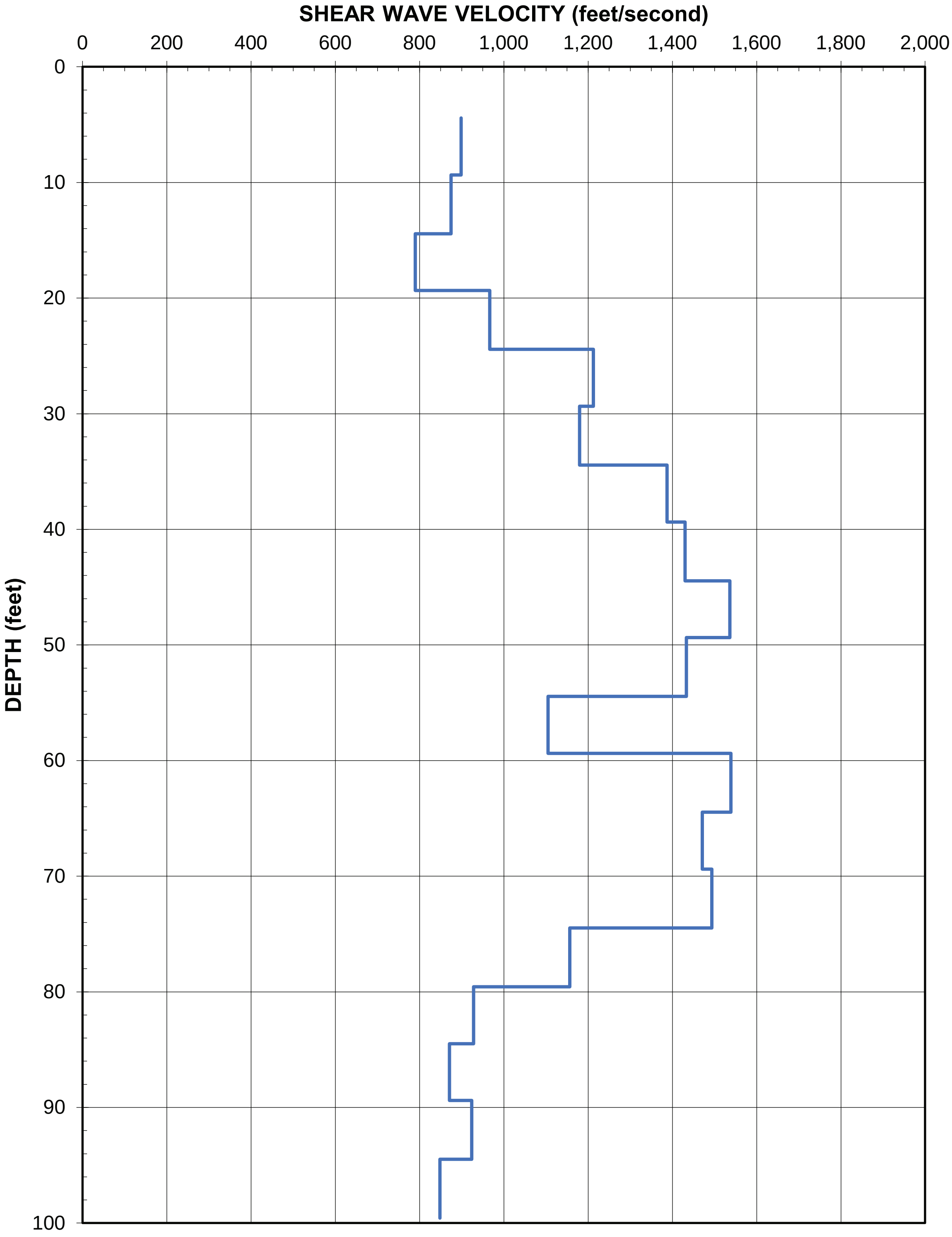
CONE PENETRATION TEST RESULTS
RG-CPT-1

Date 10/07/24 | Project No. 24-2662 | Figure A-1a



WEST OAKLAND BART TRANSIT VILLAGE
PARCEL T3
Oakland, California

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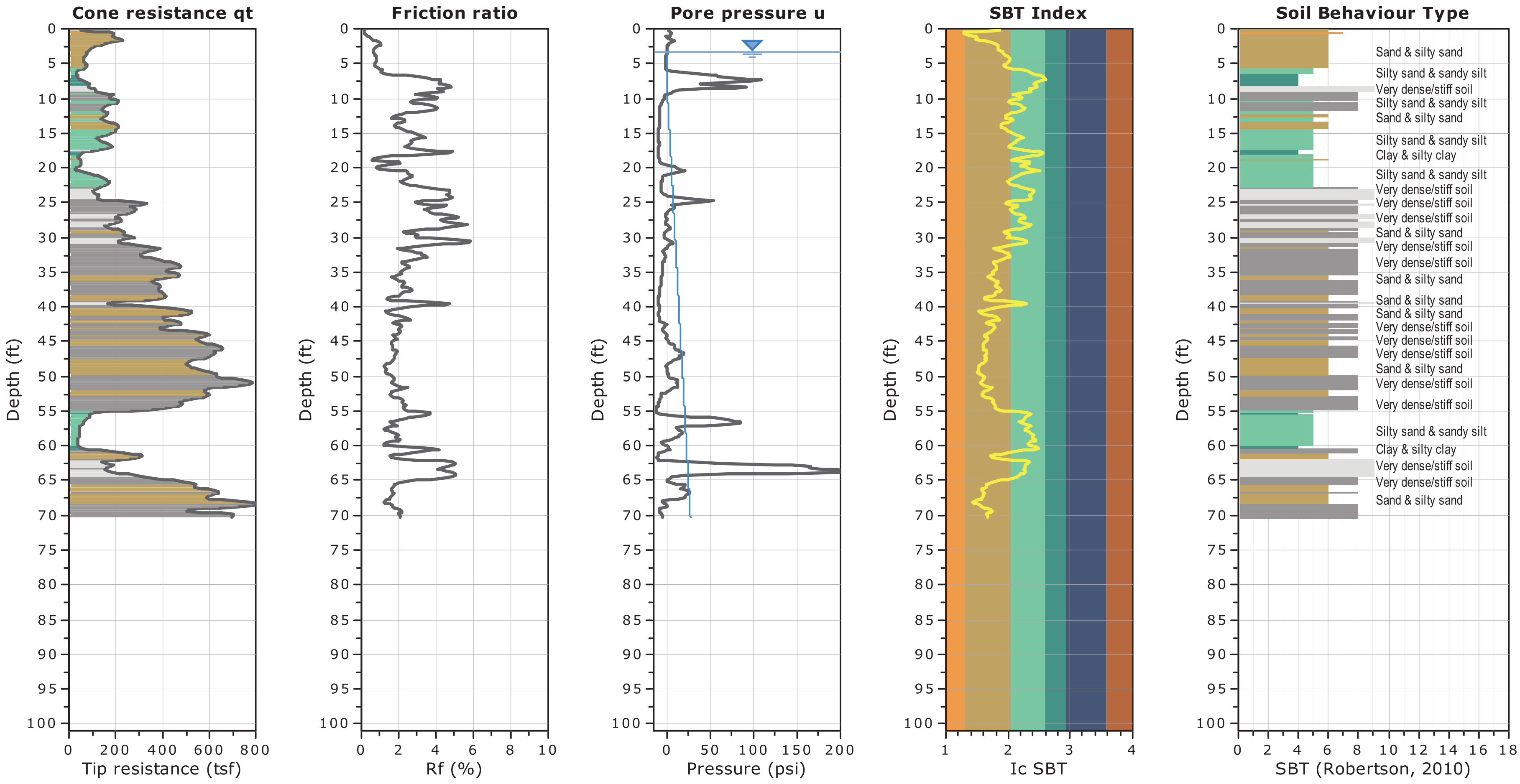
SHEAR WAVE VELOCITY PROFILE
RG-CPT-1

Date 10/07/24 | Project No. 24-2662 | Figure A-1b



Total Depth: 70.2 ft, Date: September 23, 2024
Depth to Groundwater: 3.5 feet (estimated from CPT-3 pore pressure dissipation test)
Cone Operator: Gregg Drilling, LLC

SBT legend

🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟫 6. Clean sand to silty sand
🟧 7. Gravelly sand to sand
⬜ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

WEST OAKLAND BART TRANSIT VILLAGE
PARCEL T3
Oakland, California

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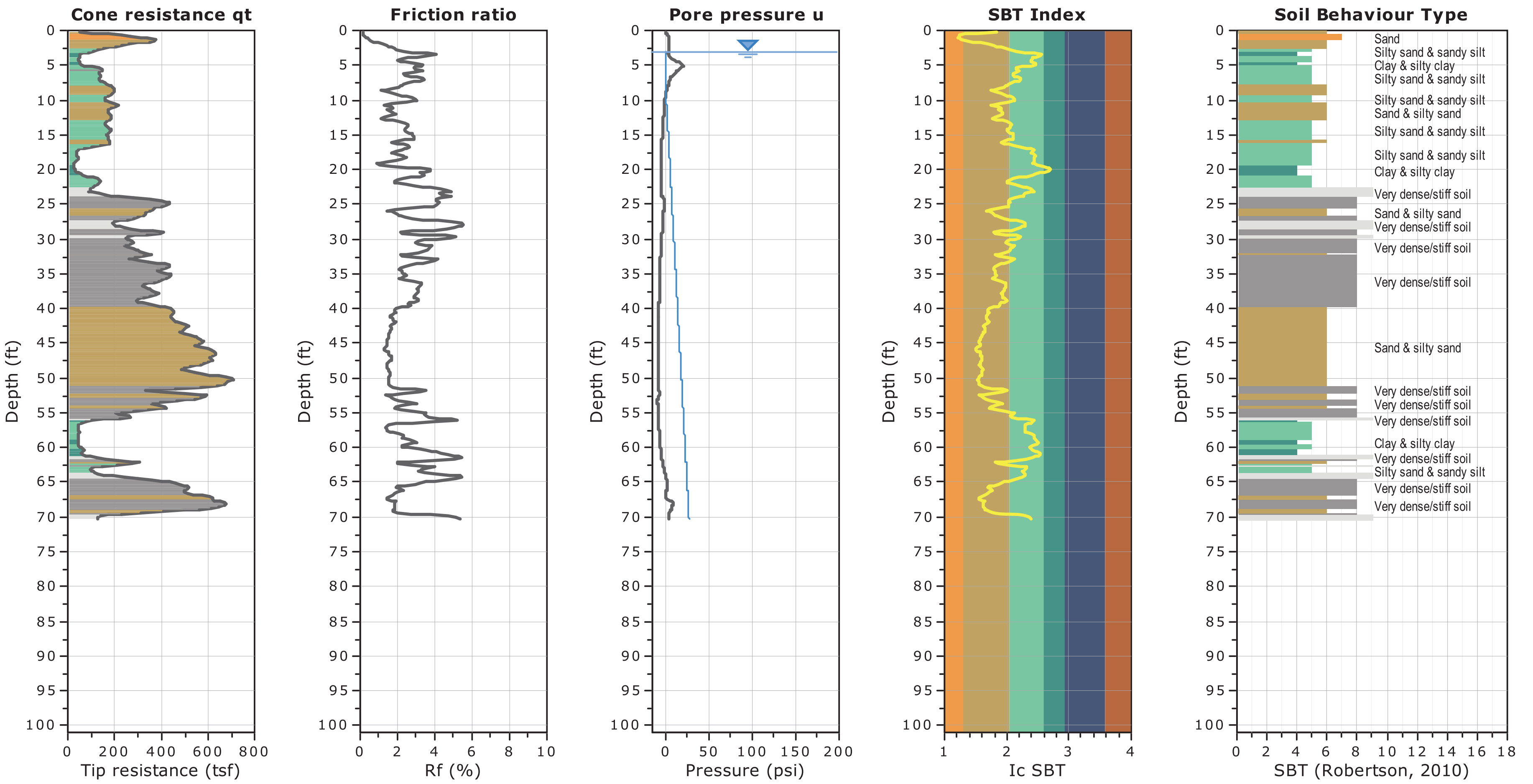
CONE PENETRATION TEST RESULTS
RG-CPT-2

Date 10/01/24 | Project No. 24-2662 | Figure A-2



Total Depth: 70.2 ft, Date: September 23, 2024
Depth to Groundwater: 3.5 feet (based on pore pressure dissipation test at depth of 10.8 feet)
Cone Operator: Gregg Drilling, LLC

SBT legend

🟥 1. Sensitive fine grained	🟩 4. Clayey silt to silty clay	🟧 7. Gravelly sand to sand
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	⬛ 8. Very stiff sand to clayey sand
🟦 3. Clay to silty clay	🟨 6. Clean sand to silty sand	⬜ 9. Very stiff fine grained

WEST OAKLAND BART TRANSIT VILLAGE
PARCEL T3
Oakland, California

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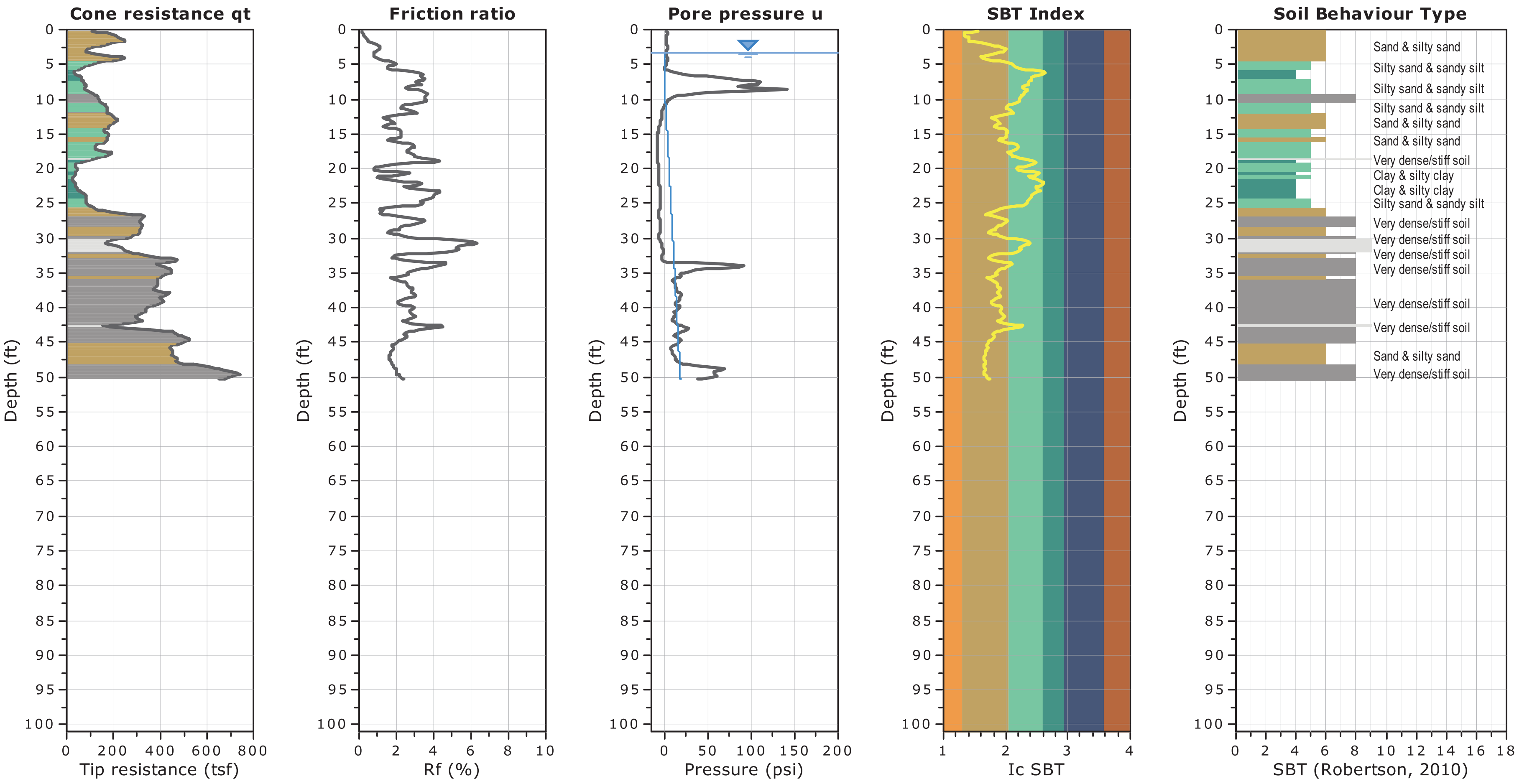
CONE PENETRATION TEST RESULTS
RG-CPT-3

Date 10/07/24	Project No. 24-2662	Figure A-3



Total Depth: 50.4 ft, Date: September 23, 2024
Depth to Groundwater: 3.5 feet (estimated from CPT-3 pore pressure dissipation test)
Cone Operator: Gregg Drilling, LLC

SBT legend

🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟨 6. Clean sand to silty sand
🟧 7. Gravelly sand to sand
⬛ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

WEST OAKLAND BART TRANSIT VILLAGE
PARCEL T3
Oakland, California

ROCKRIDGE
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CONE PENETRATION TEST RESULTS
RG-CPT-4

Date 10/01/24 | Project No. 24-2662 | Figure A-4

PROJECT: **WEST OAKLAND BART TRANSIT VILLAGE PARCEL T3**
Oakland, California

Log of Boring HA-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 09/23/2024
Date finished: 09/23/2024
Drilling method:
Hammer weight/drop: N/A
Hammer type: N/A
Sampler: Grab
Logged by: J. Graham

LABORATORY TEST DATA

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						CLAYEY SAND with GRAVEL (SC) dark brown, moist, fine to coarse sand, fine to coarse subangular to subrounded gravel, roots and rootlets						
1	GRAB	☒			SC							
2	GRAB	☒										
3	GRAB	☒				SAND with CLAY (SP-SC) yellow-brown, moist, fine sand, trace fine subrounded gravel Soil Corrosivity Test; see Appendix B						
4	GRAB	☒			SP-SC							
5												
6												
7												
8												
9												
10												

Boring terminated at a depth of 4.5 feet below ground surface.
Boring backfilled with soil cuttings.
Groundwater not encountered during hand-augering.

ROCKRIDGE GEOTECHNICAL

Project No.: 24-2662
Figure: A-5

PROJECT: **WEST OAKLAND BART TRANSIT VILLAGE PARCEL T3**
Oakland, California

Log of Boring HA-2

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 09/23/2024
Date finished: 09/23/2024
Drilling method:
Hammer weight/drop: N/A
Hammer type: N/A
Sampler: Grab
Logged by: J. Graham

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						SAND with CLAY (SP-SC) yellow-brown, moist, fine sand, trace fine to coarse subrounded gravel, roots and rootlets						
1												
	GRAB	☒			SP-SC							
2												
	GRAB	☒										
3												
	GRAB	☒			SC	CLAYEY SAND (SC) red-yellow with red, moist, fine sand Soil Corrosivity Test; see Appendix B						
4												
5												
6												
7												
8												
9												
10												

Boring terminated at a depth of 4 feet below ground surface.
Boring backfilled with soil cuttings.
Groundwater not encountered during hand-augering.

ROCKRIDGE GEOTECHNICAL

Project No.: 24-2662
Figure: A-6

UNIFIED SOIL CLASSIFICATION SYSTEM

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

GRAIN SIZE CHART

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

▽ Unstabilized groundwater level

▼ Stabilized groundwater level

SAMPLE DESIGNATIONS/SYMBOLS

⬒	Sample taken with California or Modified California split-barrel sampler. Darkened area indicates soil recovered
◪	Classification sample taken with Standard Penetration Test sampler
◨	Undisturbed sample taken with thin-walled tube
☒	Disturbed sample
⊡	Sampling attempted with no recovery
◫	Core sample
▣	Analytical laboratory sample
▥	Sample taken with Direct Push sampler
▥	Sonic

SAMPLER TYPE

C	Core barrel
CA	California split-barrel sampler with 2.5-inch outside diameter and a 1.93-inch inside diameter
D&M	Dames & Moore piston sampler using 2.5-inch outside diameter, thin-walled tube
O	Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube
PT	Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube
MC	Modified California sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter
SPT	Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.38- or 1.5-inch inside diameter (refer to text)
ST	Shelby Tube (3.0-inch outside diameter, thin-walled tube) advanced with hydraulic pressure

WEST OAKLAND BART TRANSIT VILLAGE
PARCEL T3
Oakland, California

ROCKRIDGE
GEOTECHNICAL

CLASSIFICATION CHART

Date 09/24/24 | Project No. 24-2662 | Figure A-7

Project X
Corrosion Engineering
Corrosion Control – Soil, Water, Metallurgy Testing Lab

REPORT S240926B

	Method	ASTM D4327		ASTM D4327		ASTM G187		ASTM G51	ASTM G200	SM 4500-D	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D4327	ASTM D4327
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-		**Resistivity** As Rec'd	Minimum	**pH**	**Redox**	**Sulfide** S^{2-}	**Nitrate** NO_3^-	**Ammonium** NH_4^+	**Lithium** Li^+	**Sodium** Na^+	**Potassium** K^+	**Magnesium** Mg^{2+}	**Calcium** Ca^{2+}	**Fluoride** F_2^{2-}	**Phosphate** PO_4^{3-}
	(ft)	(mg/kg)	(wt%)	(mg/kg)	(wt%)	(Ω-cm)	(Ω-cm)		(mV)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
HA-1: SAND with CLAY (SP-SC), yellow-brown	3.0	58.6	0.0059	10.5	0.0010	22,110	8,040	7.0	121	0.6	4.6	3.0	ND	12.0	7.3	11.9	79.6	2.0	1.7
HA-2: CLAYEY SAND (SC), red-yellow with red	3.5	93.0	0.0093	41.0	0.0041	6,164	5,829	7.4	109	2.2	5.0	0.2	ND	40.3	5.2	25.2	101.2	6.9	4.5

Cations and Anions, except Sulfide and Bicarbonate, tested with Ion Chromatography
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
ND = 0 = Not Detected | NT = Not Tested | Unk = Unknown
Chemical Analysis performed on 1:3 Soil-To-Water extract
PPM = mg/kg (soil) = mg/L (Liquid)

Note: Sometimes a bad sulfate hit is a contaminated spot. Typical fertilizers are Potassium chloride, ammonium sulfate or ammonium sulfate nitrate (ASN). So this is another reason why testing full corrosion series is good because we then have the data to see if those other ingredients are present meaning the soil sample is just fertilizer-contaminated soil. This can happen often when the soil samples collected are simply surface scoops. This is why it's best to dig in a foot, throw away the top and test the deeper stuff. Dairy farms are also notorious for these items.

If one sample pops up much more corrosive than all others, we would recommend collecting more samples surrounding the problem sample location to determine if the peak is isolated to it. This allows us to conclude it was a contaminated sample and able to declare it an outlier.

WEST OAKLAND BART TRANSIT VILLAGE
PARCEL T3
Oakland, California

ROCKRIDGE
GEOTECHNICAL

SOIL CORROSIVITY
TEST RESULTS

Date 10/07/24 | Project No. 24-2662 | Figure B-1

Appendix N

West Oakland BART TOD Transportation Assessment

Fehr & Peers, January 29, 2019

FEHR & PEERS

MEMORANDUM

Date: January 29, 2019

To: Rebecca Auld, Lamphier-Gregory

From: Sam Tabibnia and Jordan Brooks, Fehr & Peers

Subject: West Oakland BART TOD – Transportation Assessment (non-CEQA)

OK18-0294

This memorandum summarizes the non-CEQA transportation assessment that Fehr & Peers completed for the proposed West Oakland BART TOD project in Oakland. This document provides a brief description of the project, an estimate of project trip generation, a review of the project site plan and surrounding areas for access and circulation for various modes, an intersection operations analysis, and a collision analysis. This memorandum also includes recommendations that improve multi-modal access, circulation, and safety.

PROJECT DESCRIPTION

The proposed project would be located adjacent to the West Oakland BART station, bounded by 7th Street to the north, Mandela Parkway to the east, 5th Street to the south, and Chester Street to the west. Based on the project site plan dated January 11, 2019, the project would consist of the following:

- 762 multi-family dwelling units
- approximately 382,000 square feet of office space
- approximately 75,000 square feet of ground-level commercial space

The project would also include 400 automobile parking spaces, with six dedicated carshare spaces, in a garage accessible via a driveway on Chester Street.

The project site is currently occupied by surface parking lots that provide 413 automobile parking spaces for the West Oakland BART station. These spaces for BART riders would be eliminated by the project and would not be replaced.

TRIP GENERATION AND INTERSECTION COUNTS

Automobile Trip Generation

Trip generation is the process of estimating the number of vehicles that would likely access the project on any given day. **Table 1** summarizes the trip generation for the proposed project. Trip generation data published by the Institute of Transportation Engineers (ITE) in the *Trip Generation Manual (10th Edition)* was used as a starting point to estimate the vehicle trip generation.

ITE's *Trip Generation Manual (10th Edition)* is primarily based on data collected at single-use suburban sites where the automobile is often the only travel mode. However, the project site is located in a moderately dense area with streets generally laid out in a grid and sidewalks on most streets. It is located near some existing neighborhood-serving retail and industrial uses, and several projects are proposed in the area that would increase residential and employment densities and provide neighborhood-serving retail uses. Additionally, the project is located within two miles of Downtown Oakland, a dense employment center. Thus, many trips generated by the project may be walking, bicycling, or transit trips.

Since the project borders the West Oakland BART station, this analysis reduces the ITE-based trip generation by about 47 percent to account for non-automobile trips. This reduction is consistent with the City of Oakland's TIRG and is based on US Census commute data for Alameda County from the 2014 5-Year Estimates of the American Community Survey (ACS), which shows that the non-automobile mode share for areas less than 0.5 miles from a BART Station is about 47 percent.

In addition, pass-by adjustments were applied for the retail use. Pass-by trips are trips attracted to the site from adjacent roadways as an interim stop on the way to their ultimate destination. These vehicles would be on the roadway network regardless of the project, so pass-by trips result in changed travel patterns but do not add new vehicle trips to the roadway network. According to the ITE *Trip Generation Handbook (2nd Edition)*, the average weekday PM peak hour pass-by reduction is 34 percent for retail uses (ITE land use category 820). Since AM peak hour and daily pass-by reductions are not available, a pass-by reduction was not applied for the AM peak hour, and a 17-percent reduction (half the PM peak hour pass-by reduction) was applied to daily trips.

The estimated trip generation presented in Table 1 is conservative and likely overestimates the actual trip generation of the project in that it does not account for the following:

- The proposed project would eliminate about 413 surface parking spaces currently used for BART parking. Considering that many streets near the BART station have restricted parking, such as residential parking permit (RPP) which limits on-street parking to two-hours by non-local residents and that many streets and other off-street public parking facilities in the vicinity operate at or near capacity during most weekdays, it is likely that many of the current BART riders that park at the West Oakland BART Station surface parking lot would either shift to other modes, drive to other stations, or not use BART. Thus, it is likely that the elimination of the existing surface lot would reduce the number of BART riders who currently drive to and from the West Oakland BART Station. However, in order to present a conservative analysis, this analysis does not eliminate any trips associated with these existing BART parking spaces, and assumes that all of the BART riders who currently drive to the station would continue to drive and park in nearby surface lots or on-street.
- At least 20 percent of the residential units in the proposed project would be affordable. Although research on the transportation impacts of affordable housing in California shows that for any given location and housing type, lower income residents generate fewer automobile trips than residents of a typical multifamily development, this analysis does not reduce the trip generation for these units.[1]

As summarized in Table 1, the net new automobile trip generation for the proposed development is approximately 6,300 daily, 472 AM peak hour, and 548 PM peak hour automobile trips.

---

[1] Howell, A., Currans, K., Norton, G., & Clifton, K. (2018). Transportation impacts of affordable housing: Informing development review with travel behavior analysis. *Journal of Transport and Land Use, 11*(1). doi:10.5198/jtlu.2018.1129, https://www.jtlu.org/index.php/jtlu/article/download/1129/986

TABLE 1
WEST OAKLAND BART TOD PROJECT AUTOMOBILE TRIP GENERATION

Land Use	ITE Code	Size[1]	Daily Trips	Weekday AM Peak Hour			Weekday PM Peak Hour		
				In	Out	Total	In	Out	Total
High-Rise Apartment	222[2]	500 DU	2,230	37	118	155	110	70	180
Mid-Rise Apartment	221[3]	240 DU	1,310	23	64	87	65	41	106
Duplex	220[4]	22 DU	130	3	9	12	10	6	16
Office	710[5]	382.5 KSF	3,900	382	62	444	70	370	440
Retail	820[6]	75.0 KSF	4,950	118	72	190	211	229	440
ITE Trip Generation Subtotal			12,520	563	325	888	466	716	1,182
Non-Auto Mode Reduction[7]			-5,870	-264	-152	-416	-219	-336	-554
Retail Pass-By Reduction[8]			-350	0	0	0	-38	-41	-80
Existing Land Use Reduction[9]			-0	-0	-0	-0	-0	-0	-0
Net New Project Trips			**6,300**	**299**	**173**	**472**	**209**	**339**	**548**

Notes:

1. DU = Dwelling Units; KSF = 1,000 square feet.
2. ITE *Trip Generation (10th Edition)* land use category 222 (High-Rise Apartment, General Urban/Suburban):
   Daily: $T = 4.45 * X$
   AM Peak Hour: $T = 0.31 * X$ (24% in, 76% out)
   PM Peak Hour: $T = 0.36 * X$ (61% in, 39% out)
3. ITE *Trip Generation (10th Edition)* land use category 221 (Mid-Rise Apartment, General Urban/Suburban):
   Daily: $T = 5.44 * X$
   AM Peak Hour: $T = 0.36 * X$ (26% in, 74% out)
   PM Peak Hour: $T = 0.44 * X$ (61% in, 39% out)
4. ITE *Trip Generation (10th Edition)* land use category 220 (Low-Rise Apartment, General Urban/Suburban):
   Daily: $T= 7.56 * X – 40.86$
   AM Peak Hour: $Ln(T) = 0.95 * ln(X) – 0.51$ (23% in, 77% out)
   PM Peak Hour: $Ln(T) = 0.89 * ln(X) – 0.02$ (63% in, 37% out)
5. ITE *Trip Generation (10th Edition)* land use category 710 (General Office Building, General Urban/Suburban):
   Daily: $Ln(T) = 0.97 * ln(X) + 2.5$
   AM Peak Hour: $T = 1.16 * X$ (86% in, 14% out)
   PM Peak Hour: $T = 1.15 * X$ (16% in, 84% out)
6. ITE *Trip Generation (10th Edition)* land use category 820 (Shopping Center, General Urban/Suburban):
   Daily: $Ln(T) = 0.68 * ln(X) + 5.57$
   AM Peak Hour: $T = 0.5 * X + 151.78$ (62% in, 38% out)
   PM Peak Hour: $Ln(T) = 0.74 * ln(X) + 2.89$ (48% in, 52% out)
7. Reduction of 47% assumed, based on City of Oakland *Transportation Impact Review Guidelines*, using Census data for urban environments less than 0.5 miles from a BART station.

8. Based on *ITE Trip Generation Handbook (2nd Edition)*, the average PM peak hour pass-by rate for land use category 820 is 34%. A reduction was not applied to the AM peak hour, and a 17% reduction was applied for daily trips.
9. The West Oakland BART TOD project would eliminate 413 surface parking spaces currently used for BART parking. To present a conservative analysis, the project was assumed to not eliminate any trips associated with those parking spaces, because some or all of the BART riders who currently drive to the station would continue to drive and park in nearby surface lots or on-street.

Source: Fehr & Peers, 2019.

Non-Vehicular Trip Generation

Consistent with the City of Oakland TIRG, **Table 2** presents the estimates of project trip generation for all travel modes for the project site. The automobile trip generation shown in Table 2 does not account for pass-by reductions.

TABLE 2
WEST OAKLAND BART TOD PROJECT TRIP GENERATION BY TRAVEL MODE

Mode	Mode Share Adjustment Factors[1]	Daily	AM Peak Hour	PM Peak Hour
Automobile	53.1%	6,650	472	628
Transit	29.7%	3,720	264	351
Bike	5.1%	640	45	60
Walk	10.5%	1,310	93	124
	Total Trips	**12,320**	**874**	**1,163**

Notes:

1. Based on *City of Oakland Transportation Impact Study Guidelines* assuming project site is in an urban environment less than 0.5 miles from a BART station.

Source: Fehr & Peers, 2019.

Trip Distribution and Study Intersection Selection

The trip distribution and assignment process is used to estimate how the trips generated by the project would be distributed across the roadway network. Trip distribution and assignment for the project were developed based on the locations of complementary land uses, existing travel patterns, the street network in the area, and the results of the Alameda County Transportation Commission (CTC) travel demand model. **Table 3** shows the resulting trip distribution.

TABLE 3
WEST OAKLAND BART TOD PROJECT
VEHICLE DISTRIBUTION

Zone	Distribution
To/From West	21%
To/From East	24%
To/From North	17%
To/From South	6%
To/From I-880 South	20%
To/From I-880 North	12%
Total	**100%**

Sources: Fehr & Peers, 2019.

Trips generated by the proposed project, as shown in Table 1, were assigned to the roadway network according to the trip distribution shown on Table 3.

According to the City of Oakland's TIRG, the criteria for selecting study intersections include:

- All intersection(s) of streets adjacent to project site;
- All signalized intersection(s), all-way stop-controlled intersection(s) or roundabouts where 100 or more peak hour trips are added by the project;
- All signalized intersection(s) with 50 or more project-related peak hour trips and existing LOS D-E-F; and
- Side-street stop-controlled intersection(s) where 50 or more peak hour trips are added by the project to any individual movement other than the major-street through movement.

This analysis evaluates the following intersections due to being adjacent to the project site:

1. 7th Street/Chester Street
2. 7th Street/Center Street
3. 7th Street/Mandela Parkway
4. 5th Street/Chester Street
5. 5th Street/Center Street
6. 5th Street/Mandela Parkway

Automobile turning movements, pedestrian counts, and bicycle counts were collected at these intersections during the AM and PM peak commuting hours (7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM) on December 12, 2018, a typical weekday with local schools in normal session, moderate weather, and no observed traffic incidents. **Figure 1** shows the peak hour intersection volumes, and **Appendix A** provides the raw traffic counts.

SITE ACCESS AND CIRCULATION ANALYSIS

Fehr & Peers reviewed the project site plan dated January 11, 2019 and the existing street network adjacent to the project site to evaluate safety, access, and circulation for all travel modes.

Automobile Access and Circulation

Currently, the project site is occupied by parking facilities for the West Oakland BART Station, which would be demolished by the project. Access to the existing site is provided by driveways on Mandela Parkway, Chester Street, and 5th Street. These driveways would be eliminated by the project. The proposed project would include a 400-space parking garage which would be accessed through a driveway on Chester Street. Each project building would also provide a loading dock for two trucks. The loading dock for Buildings T1 and T4 would be on Mandela Parkway and the loading dock for Building T3 would be on 5th Street. Based on the project site plan, the garage driveway and/or the loading docks may not provide adequate sight distance between exiting vehicles and pedestrians on the adjacent sidewalk.

> **Recommendation 1:** While not required to address a CEQA impact, the following should be considered as part of the final design for the project:
>
> - Review the final site plans for the project to ensure that the garage driveway on Chester Street and the loading docks for each project building would provide adequate sight distance between vehicles exiting the garage and pedestrians on the adjacent sidewalk.

The project would eliminate the existing merge on westbound 7th Street just west of Mandela Parkway in order to accommodate a Class 4 cycletrack along this segment of 7th Street. Thus the existing shared right/through lane on westbound 7th Street at Mandela Parkway would need to be converted to a right-turn lane.

With the addition of the traffic generated by the proposed project, it is expected that the 7th Street/ Chester Street intersection would meet the Manual on Uniform Traffic Control Devices (MUTCD) Peak Hour Signal Warrant, and the intersection may need to be signalized. Signal warrant analysis is used to determine whether conditions warrant the installation of a new traffic signal. However, meeting one or more signal warrants does not mean that the intersection must be signalized.

> **Recommendation 2:** While not required to address a CEQA impact, the following should be considered as part of the final design for the project:
>
> - Implement the following at the 7th Street/Mandela Parkway intersection:
>   - Convert the existing through/right-turn lane on the westbound 7th Street approach to a right-turn/bus only lane, and remove the merge lane on westbound 7th Street west of the intersection
>   - Modify the signal timings at the intersection to provide a bus only phase for the westbound approach, and reduce the signal cycle length to 90 seconds
> - After the completion of the first phase of the project, conduct a signal warrant analysis at the 7th Street/Chester Street intersection to determine if and when the intersection should be signalized. If signalization is warranted, the project shall signalize the intersection with protected left-turn phasing for the east/west 7th Street approaches. In addition and as determined by the City of Oakland staff, the signal may be interconnected with existing adjacent signals along 7th Street. If signalization is not warranted, the project shall conduct an analysis to determine if other control devices, such as all-way stop controls, or rectangular rapid flash beacon (RRFB) should be installed at the intersection. The project shall implement the recommended improvement at the intersection as approved by the City of Oakland.

Bicycle Access and Bicycle Parking

Currently, Class 2 bicycle lanes are provided along the project frontage on 7th Street and on Mandela Parkway. The 7th Street bicycle lanes connect Peralta Street to the west and about 140 feet west of Mandela Parkway to the east, where they convert to Class 3 bicycle routes with shared-lane markings and continue to Union Street. The bicycle lanes on Mandela Parkway connect 3rd Street in the south and Horton Street in the north. The City's 2007 Bicycle Master Plan proposes Class 2 bicycle lanes on 7th Street between Wood and Union Streets.

The project would include the following modifications that would benefit bicyclists in the project vicinity:

- Raised one-way Class 4 separated bikeways on both sides of 7th Street between Chester Street and Mandela Parkway.
- One-way Class 4 separated bikeways on both sides of Mandela Parkway between 7th and 5th Streets.
- A bike station on the east side of the existing BART station under the BART tracks and adjacent to a mid-block crossing on Mandela Parkway. The bike station is estimated to accommodate at least 500 bicycles, and would provide a repair station.

The nearest Ford GoBike bikeshare station is located adjacent to the site on 7th Street just east of Center Street within the street right-of-way. The project would remove this station to accommodate a bus stop on eastbound 7th Street east of Center Street, but the site plan does not indicate where the bikeshare station would be relocated.

> **Recommendation 3:** While not required to address a CEQA impact, the following should be considered as part of the final design for the project:
>
> - Ensure that the Ford GoBike station currently located in-street on 7th Street just east of Center Street is relocated on the BART Station Plaza to provide close and convenient access to the West Oakland BART station and the bicycle facilities adjacent to the project site.

Chapter 17.117 of the Oakland Municipal Code requires long-term and short-term bicycle parking for new buildings. Long-term bicycle parking includes lockers or locked enclosures, and short-term bicycle parking includes bicycle racks. The Code requires one long-term space for every four multi-family dwelling units and one short-term space for every 20 multi-family dwelling units. The Code does not require any bicycle parking for duplexes. For office uses, the Code requires one long-term space for every 10,000 square feet of floor area and one short-term space for every 20,000 square feet of floor area. For retail uses, the Code requires one long-term space for every 12,000 square feet of floor area and one short-term space for every 5,000 square feet of floor area.

Table 4 presents the bicycle parking requirements for the proposed project. The project would be required to provide at least 229 long-term bicycle parking spaces and 71 short-term spaces.

TABLE 4
BICYCLE PARKING REQUIREMENTS

		Long-Term		Short-Term	
Land Use	**Size**[1]	**Spaces per Unit**[2]	**Spaces**	**Spaces per Unit**[2]	**Spaces**
Multi-family Residential	740 DU	1:4 DU	185	1:20 DU	37
Duplex	22 DU	None Required	0	None Required	0
Office	382.5 KSF	1:10 KSF	38	1:20 KSF	19
Retail	75.0 KSF	1:12 KSF	6	1:5 KSF	15
Total Required Bicycle Spaces			229		71
Total Bicycle Parking Provided			252		94
Bicycle Parking Met?			**Yes**		**Yes**

Notes:
1. DU = dwelling unit, KSF = 1,000 square feet
2. Based on Oakland Municipal Code Sections 17.117.090 and 17.117.110

Source: Fehr & Peers, 2019.

The project would provide 252 long-term bicycle parking spaces, which would consist of bike rooms for 150 bicycles in the T1 building (northeast corner of the site), 70 bicycles in the T3 building (southwest corner of the site), and 32 bicycles in the T4 building (southeast corner of the site). Thus, the project would exceed the minimum requirements for long-term bicycle parking.

The project would provide 94 short-term bicycle parking spaces. The short-term spaces would consist of bicycle racks for 34 bicycles along the 5th Street frontage, 40 bicycles along the 7th Street frontage, and 20 bicycles on the pedestrian plaza between 5th Street and the BART station. Thus, the project would exceed the minimum requirements for short-term bicycle parking.

In addition, the bike station at the BART Station would also be available to project residents, workers, and visitors.

Pedestrian Access and Circulation

Most streets in the vicinity of the project site provide sidewalks on both sides of the street, except for the south side of 5th Street between Center Street and Mandela Parkway. The project site currently provides 10-foot sidewalks along the project frontage on Mandela Parkway, 5th Street, and Chester Street. Along the project site's 7th Street frontage, a 30-foot sidewalk is provided between Chester and Center Streets, and a 20-foot sidewalk is provided between Center Street and Mandela Parkway. The City of Oakland's 2017 Pedestrian Master Plan does not list any planned improvements along the project frontages.

Pedestrian facilities at the intersections adjacent to the site include:

- The 7th Street/Chester Street intersection is stop-controlled on both the northbound and southbound Chester Street approaches and provides directional curb ramps with truncated domes on all four corners. The intersection provides curb extensions at the northwest and northeast corners and provides colored crosswalks for all four approaches.
- The 7th Street/Center Street intersection is a signalized T-intersection that provides directional curb ramps with truncated domes on all corners and approaches. The intersection provides curb extensions at the northwest and northeast corners and provides colored crosswalks, and pedestrian countdown signal heads and push buttons for all three approaches. The signal currently provides continuous green phase for the east/west 7th Street approaches, unless vehicles are detected on the southbound Center Street approach or pedestrians activate the push buttons to cross 7th Street.
- The 7th Street/Mandela Parkway intersection is a signalized intersection that provides directional curb ramps with truncated domes on all four corners. The intersection provides curb extensions at the northwest and northeast corners and provides colored crosswalks, and pedestrian countdown signal heads and push buttons for all four approaches.
- The 5th Street/Chester Street intersection is stop-controlled on both the northbound and southbound Chester Street approaches and provides diagonal curb ramps on the northeast, southeast and southwest corners and a directional curb ramp leading across 5th Street on the northwest corner. None of the curb ramps provide truncated domes, and no marked crosswalks are provided on any approach.
- The 5th Street/Center Street intersection is a T-intersection and stop-controlled on the northbound Center Street approach. The intersection provides diagonal curb ramps at both corners. Neither of the curb ramps provide truncated domes, and no marked crosswalks are provided on any approach. Currently, on-street parking is allowed along the north side of the intersection, blocking pedestrian crossings of 5th Street.
- The 5th Street/Mandela Parkway intersection is a signalized intersection that provides diagonal curb ramps with substandard truncated domes on all four corners. The intersection provides a curb extension across the 5th Street approach at the southeast corner and provides marked crosswalks, and pedestrian countdown signal heads and push buttons for all four approaches.

The project would provide pedestrian access to the BART Station from all the four streets bordering the project site, including a north-south pedestrian plaza aligned with Center Street that would provide direct access to the BART station entrance. The site would also provide internal walkways along the south side of the elevated BART tracks that would connect to Chester Street and Mandela Parkway. Each project building would have a lobby that would be accessed from the adjacent street and/or the internal site plazas. The project would include the following modifications that would benefit pedestrian access and circulation in the areas surrounding the project site:

- The project proposes a 19-foot sidewalk along the project frontage on 5th Street, between Chester Street and Mandela Parkway. The sidewalk would have a minimum eight-foot pedestrian through zone, and the sidewalk width would accommodate the needs of pedestrians, bus passengers, and curbside passenger loading.
- The project proposes a sidewalk along the project frontage on 7th Street with a minimum eight-foot pedestrian through zone between Chester Street and Mandela Parkway. The sidewalk would provide adequate width to accommodate the high level of pedestrians with pedestrian amenities such as seating, real-time bus arrival information, trash receptacles, and pedestrian-lighting.
- The project proposes an 11 to 15-foot sidewalk along the project frontage on Chester Street and a 15-foot sidewalk along Mandela Parkway between 5th and 7th Street. All sidewalks would have a minimum eight-foot pedestrian through zone.
- As part of implementing a Class 4 cycletrack along westbound 7th Street, the project would eliminate the second receiving lane west of Mandela Parkway and shorten the pedestrian crossing distance for the west crosswalk at the 7th Street/Mandela Parkway intersection.
- The sidewalks along the project frontage and the internal pedestrian plazas would provide pedestrian-scale lighting and street trees/plantings.
- At the intersections of 5th Street with Chester Street, Center Street and Mandela Parkway, the project would provide high-visibility crosswalks and directional ramps along all approaches.
- At the 5th Street/Center Street intersection, project would provide curb extensions (bulb-outs) at all four intersection corners.
- High-visibility, mid-block pedestrian crossing would be provided on Mandela Parkway between 5th and 7th Streets to align with the east-west pedestrian path within the project site. The mid-block crossing would also allow access between the bike station and the northbound Class 4 cycletrack on Mandela Parkway.

In addition, Recommendation 2 would either signalize or implement other modifications at the 7th Street/Chester Street intersection which would improve pedestrian crossings across 7th Street. The following recommendations are provided to further enhance pedestrian access for the project site:

> **Recommendation 4:** While not required to address a CEQA impact, the following should be considered as part of the final design for the project:
>
> - Explore the feasibility of (and implement, if feasible) installing curb extensions (bulb-outs) and directional curb ramps with truncated domes at the following locations:
>   - Southwest corner of the 7th Street/Chester Street intersection.
>   - All four corners of the 5th Street/Mandela Parkway intersection and curb extensions (bulb-outs) across the 5th Street approaches of the southwest and northeast corners.
> - Provide all-way stop control at the 5th Street/Center Street and 5th Street/Chester Street intersection.
> - If reviewed and approved by BART and Oakland Fire Department, provide rolled curb instead of curb cuts for emergency vehicle access points on Chester Street and Mandela Parkway.
> - Install a pedestrian scramble at the 7th Street/Center Street intersection.
> - Install improvement measures at the proposed mid-block crossing on Mandela Parkway, such as raised crosswalk, RRFB, or other measures as approved by the City of Oakland.
>
> **Recommendation 5:** While not required to address a CEQA impact, the following should be considered as part of the final design for the project:
>
> - Coordinate with the City of Oakland and the appropriate property owners to determine the feasibility of and if deemed feasible, complete the sidewalk gap on the south side of 5th Street just east of Center Street.

Transit Access

Transit service providers in the vicinity of the proposed project include BART and AC Transit.

BART provides regional rail service throughout the East Bay and across the San Francisco Bay. The proposed project is located adjacent to the West Oakland BART station. The project would eliminate the majority of the existing parking spaces used by BART rider. The project would continue to provide and enhance pedestrian and bicycle access for the BART station as described above.

Currently, the BART station is served by Lines 14, 29, 36, and 62. All bus routes are currently accommodated within the BART station and described in **Table 5**. In addition, 7th Street also accommodates bus stops for Lines 29 and 62, as well as intercity buses (Mega Bus and Bolt), and other shuttle services.

TABLE 5
AC TRANSIT ROUTES AND HEADWAYS

Line	Description	Layover at West Oakland BART	Weekday Hours of Operation	Weekday Headways[1]	Weekend Hours of Operation	Weekend Headways[1]
14	Fruitvale BART to West Oakland BART via 14th Street	10-20 min	5:00 AM – 11:00 PM	15 min	6:30 AM – 11:15 PM	30 min
29	Emeryville Public Market to Lakeshore via Peralta Street and 10th Street	n/a	6:00 AM – 10:45 PM	20 (30) min	6:00 AM – 10:45 PM	30 min
36	UC Berkeley to West Oakland BART via Adeline Street	10-20 min	6:00 AM – 12:45 AM	30 min	6:00 AM – 12:45 AM	30 min
62	Fruitvale BART to West Oakland BART via 7th Street	10-20 min	5:45 AM – 12:45 AM	15 (20) min	6:15 AM – 12:45 AM	20 (30) min

Notes:

1. Headways in parentheses show off-peak headways if different from peak headways.

Source: AC Transit and Fehr & Peers, 2019.

The proposed project would not be able to accommodate the bus stops within the project site and proposes the following modifications:

- The project would provide a bus stop/layover zone along the project frontage on 5th Street just west of Mandela Parkway. The bus zone would be at least 170 feet long and a concrete bus pad would also be installed in the roadway. The bus stop and layover for AC Transit Lines 36 and 62 could be relocated to this location.

- The existing bus stop on eastbound 7th Street west of Mandel Parkway would be retained and extended for an approximate length of 270 feet. This stop could serve AC Transit Lines 29, 36, and 62 and could serve as both a stop and layover space for AC Transit Line 14. The bus stop would be located on a 10-foot bus island that separates the Class 4 cycletrack along this segment of 7th Street. A new bus stop would be installed on westbound 7th Street just west of Center Street that could serve AC Transit Line 29. The bus stop would be about 130 feet long. The bus stop would be located on a 10-foot bus island that separates the Class 4 cycletrack along this segment of 7th Street.
- The sidewalks along project frontage on 5th and 7th Street would have adequate width and would accommodate a high level of passenger amenities, including shelters with seating, maps and other information, and real-time bus arrival information; trash receptacles; and lighting. In addition, the roadway pavement would be upgraded to provide concrete pads for the bus stops.
- To facilitate buses turning from northbound Chester Street to eastbound 7th Street, Chester Street is redesigned so that buses are positioned closer to the center line of Chester Street, which would improve current conditions for buses. Due to the tight turning radius of the corner, buses cannot make the turn from Chester Street to 7th Street when positioned close to the curb on northbound Chester Street.

  Recommendation 6: While not required to address a CEQA impact, the following should be considered as part of the final design for the project:

  - Consider designating a bus stop for intercity coaches (e.g., Megabus and Bolt) and other shuttles on 7th Street between Henry and Chester Streets.

Off-street Automobile Parking Requirements

The *City of Oakland Municipal Code* sets minimum and maximum parking requirements. According to Section 17.116.060, the residential component of the project has minimum required parking of 0.5 spaces per unit and maximum allowable parking of 1.25 spaces per unit. According to Section 17.116.110, this parking requirement can be reduced by 30 percent for projects within a Transit Accessible Area[2] and by 20 percent for projects that provide on-site carshare spaces at the level

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[2] "Transit Accessible Area" means the area within one-half mile of a: (1) BART Station; (2) BRT Station; (3) designated rapid bus line; or (4) transit stop served by a frequency of service interval of fifteen (15) minutes or less during the morning and afternoon peak commute periods. (Section 17.09.040)

described in Section 17.116.105. For projects with 600 to 800 residential units, Section 17.116.105 requires four carshare spaces.

For the retail and office components of the project, Section 17.116.090 does not require any parking to be provided, maximum allowable parking of 1.0 spaces for each 300 square feet of ground floor area and 1.0 spaces per 500 square feet of above ground floor area.

Table 6 presents the off-street automobile parking requirements for the proposed project, per City of Oakland Municipal Code. Because the project is located within one-half mile of a BART station and provides six on-site carshare spaces, residential parking requirements are reduced by a total of 50 percent. Overall, the project is required to provide a minimum of 191 spaces, with a maximum of 1,968 spaces allowed. The proposed project would include 400 off-street parking spaces, more than the minimum requirement and less than the maximum allowed by City Code. Consistent with Code Section 17.116.310, all parking spaces would be leased separately from the rent of the dwelling units.

TABLE 6
AUTOMOBILE PARKING CODE REQUIREMENTS

Land Use	Size[1]	Required Off-Street Parking Supply		Provided Off-Street Parking Supply	Within Range?
		Minimum	Maximum		
Residential[2]	762 DU	191	953		
Office[3]	382.5 DU	0	765		
Retail[3]	75.0 KSF	0	250		
Total		**191**	**1,968**	**400**	**Yes**

Notes:

1. DU = Dwelling Unit, KSF = 1,000 square feet
2. The City of Oakland off-street parking requirement for two-family and multi-family residential in the S-15W zone is a minimum of 0.5 spaces per unit, with a maximum of 1.25 spaces per unit (Section 17.116.060). The minimum is reduced to 0.25 spaces per unit for this project due to its location in a Transit Accessible Area and because it provides at least four carshare space for a project between 600 and 800 multifamily units (Section 17.116.110).
3. The City of Oakland does not have a minimum off-street parking requirement for Commercial Activities in the S-15W zone and allows a maximum of 1.0 spaces per 300 square feet of ground floor area and 1.0 spaces per 500 feet of above ground floor area.

Source: Fehr & Peers, 2019.

On-Street Parking and Curb Use

Most streets currently provide unrestricted parking along both sides of the street in the vicinity of the project side except the following:

- On-street parking is currently prohibited along the project frontage on 7th Street and the east side of Mandela Parkway between 5th and 7th Streets.
- On-street parking along the north side of 7th Street between Mandela Parkway and Center Street is limited to two-hours from 8:00 AM to 6:00 PM Monday through Saturday
- On-Street parking on south side of 5th Street between Chester and Center Street, on the west side Chester Street between 5th and 7th Street and many of the residential streets to the south, west, and north of the site is controlled by residential parking permit (RPP), where vehicles without RPP are restricted to a two-hour time limit between 8:00 AM and 6:00 PM Monday through Saturday except for those with a residential parking permit.

The project site currently contains surface parking lots providing 413 parking spaces for BART riders. About 80 feet of white curb for passenger loading/unloading and about 20 feet of blue curb for accessible loading/unloading is provided on an internal drive aisle adjacent to the BART station entrance. The project would eliminate the internal loading zones and surface parking lots. The project would relocate the passenger loading zones to the streets along the project frontage, which can be used for both BART riders and project residents, workers, and visitors. The project proposes the following uses for the curbs in the project vicinity:

- The following would be designated for passenger loading and unloading:
    - Approximately 100 feet of linear curb along the north side of 5th street east of Center Street and about 200 feet west of Center Street
    - Approximately 250 feet of linear curb along eastbound 7th Street between Chester and Center Streets, with about 50 feet of curb on eastbound 7th Street just west of Center Street designated as a blue accessible loading zone
- Parking would be prohibited at the following locations:
    - On both sides of Mandela Parkway between 5th and 7th Street
    - On the east side of Chester Street between 5th and 7th Streets and on the west side of Chester Street for about 100 feet south of 7th Street.

The proposed space for passenger loading is much greater than the approximately 100 feet of linear white curb currently available at the station. The West Oakland station has one of the highest shares of pick-up/drop-off access modes, and that condition is likely to continue in the future considering the removal of parking and the station's location within the BART system and its proximity to I-880.

INTERSECTION OPERATIONS

Intersection operations under Existing Conditions and Existing Plus Project conditions were analyzed for the six study intersections. The traffic volumes, intersection lane configurations, and traffic controls presented on **Figure 1** form the basis for the intersection level of service (LOS) analysis under Existing Conditions.[3] The project trip assignment was added to the Existing Conditions peak hour traffic volumes to estimate the Existing plus Project peak hour traffic volumes, as shown on **Figure 2**.

The Existing Plus Project analysis also accounts for the modifications to the streets as proposed by the project or as recommended in this memorandum. The main modifications that would affect intersection operations include:

- 7th Street/Mandela Parkway intersection:
    - Convert the existing through/right-turn lane on the westbound 7th Street approach to a right-turn/bus only lane, and remove the merge lane on westbound 7th Street west of the intersection
    - Modify the signal timings at the intersection to provide a bus only phase for the westbound approach, and reduce the signal cycle length to 90 seconds
- 7th Street/Center Street intersection:
    - Modify signal timings at the intersection to provide a pedestrian scramble phase.
- 7th Street/Chester Street intersection:
    - Convert intersection from side-street stop-controlled to signalized operations with protected left-turn phasing for the east/west 7th Street approaches.

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[3] The operations of roadway facilities are typically described with the term level of service (LOS), a qualitative description of traffic flow based on factors such as speed, travel time, delay, and freedom to maneuver. Six levels are defined from LOS A, which reflects free-flow conditions where there is very little interaction between vehicles, to LOS F, where the vehicle demand exceeds the capacity and high levels of vehicle delay result. LOS E represents "at-capacity" operations. When traffic volumes exceed the intersection capacity, stop-and-go conditions result and a vehicle may wait through multiple signal cycles before passing through the intersection; these operations are designated as LOS F.

- 5th Street/Chester Street and 5th Street/Center Street:
    - Convert intersections from side-street stop-controlled to all-way stop-controlled.

Table 7 summarizes the results of the intersection operations analysis under Existing Conditions and Existing Plus Project conditions. **Appendix B** provides the detailed intersection LOS calculation worksheets.

TABLE 7
EXISTING AND EXISTING PLUS PROJECT CONDITIONS STUDY INTERSECTION LOS SUMMARY

Intersection	Traffic Control[1]	Peak Hour	Existing		Exiting Plus Project	
			Delay[2] (seconds)	LOS[2]	Delay[2] (seconds)	LOS[2]
1. 7th Street/Chester Street	SSSC/ Signalized[4]	AM PM	10 (23) 8 (29)	A (C) A (D)	26 27	C C
2. 7th Street/Center Street[3]	Signalized	AM PM	3 4	A A	3 3	A A
3. 7th Street/Mandela Parkway	Signalized	AM PM	33 34	C C	29 28	C C
4. 5th Street/Chester Street	SSSC/ AWSC[5]	AM PM	4 (10) 4 (11)	A (A) A (B)	8 5	A A
5. 5th Street/Center Street	SSSC/ AWSC[5]	AM PM	1 (9) 1 (10)	A (A) A (A)	9 9	A A
6. 5th Street/Mandela Parkway	Signalized	AM PM	8 9	A A	9 9	A A

1. SSSC = Side-Street Stop-Controlled; AWSC = All-Way Stop-Controlled
2. Average intersection delay and LOS based on the 2010 HCM method except where noted. Average delay is reported for signalized intersections. Average and worst-approach delays, respectively, are reported for side-street stop controlled intersections.
3. Average intersection delay and LOS based on HCM 2000 because the intersection cannot be accurately evaluated in the 2010 HCM.
4. Side-street stop-controlled under Existing conditions; signalized under Existing Plus Project conditions.
5. Side-street stop-controlled under Existing conditions; all-way stop-controlled under Existing Plus Project conditions.

Source: Fehr & Peers, 2019.

All study intersections operate at LOS D or better under both Existing Conditions and Existing Plus Project conditions. Note that the northbound approach at the 7th Street/Chester Street intersection would operate at LOS F during both the AM and PM peak hours under Existing Plus Project conditions if the intersection remains side-street stop-controlled. The 7th Street/Chester Street intersection would meet the MUTCD Peak Hour Signal Warrant under Existing Plus Project conditions. The intersection would operate at LOS C during both AM and PM peak hours with a signalized intersection.

COLLISION ANALYSIS

A five-year history (January 1, 2013 to December 31, 2017) of collision data in the study area was obtained from the Statewide Integrated Traffic Records System (SWITRS) and evaluated for this collision analysis. **Table 8** summarizes the collision data by type and location, and **Table 9** summarizes the collision data by severity and location.

As shown in Table 8, 24 collisions were reported adjacent to the project site during this five-year period. The most common collision type was broadside (25 percent), and the most frequent primary collision factor violation category was vehicles making an improper turn (33 percent). Pedestrians were involved in three (13 percent) and bicyclists were also involved in three (13 percent) of the reported collisions. Of the 24 reported collisions, 12 (50 percent) resulted in injuries, and none resulted in fatalities, as shown in Table 9.

The Highway Safety Manual (HSM, Predictive Method - Volume 2, Part C) provides a methodology to predict the number of collisions for intersections and street segments based on roadway and intersection characteristics like vehicle and pedestrian volumes, number of lanes, signal phasing, on-street parking, and number of driveways. **Table 10** presents the predicted collision frequencies for the six study intersections and six study segments using the HSM Predictive Method for Urban and Suburban Arterials and compares predicted collision frequencies to reported collision frequencies. **Appendix C** provides detailed predicted collision frequency calculation sheets based on the HSM methodology. Intersections or roadway segments with collision frequency greater than the predicted frequency should have their collision trends and potential roadway or intersection modifications evaluated in greater detail.

TABLE 8
SUMMARY OF COLLISIONS BY TYPE

Location	Head-on	Sideswipe	Rear-End	Broadside	Hit Object	Pedestrian-Involved	Bicycle-Involved	Total
Intersection								
7th Street/Chester Street	0	1	1	1	0	0	0	3
7th Street/Center Street	0	0	1	0	0	0	0	1
7th Street/Mandela Parkway	0	3	1	0	0	2	2	8
5th Street/Chester Street	0	0	0	0	0	0	0	0
5th Street/Center Street	0	0	0	0	0	0	0	0
5th Street/Mandela Parkway	0	0	0	1	1	1	0	3
Roadway Segment								
7th Street between Chester Street and Center Street	0	0	0	1	0	0	0	1
7th Street between Center Street and Mandela Parkway	0	0	0	0	0	0	0	0
5th Street between Chester Street and Center Street	0	0	0	0	0	0	0	0
5th Street between Center Street and Mandela Parkway	0	0	0	0	1	0	0	1
Chester Street between 7th Street and 5th Street	0	0	0	0	0	0	1	1
Mandela Parkway between 7th Street and 5th Street	1	1	1	3	0	0	0	6
Total	**1**	**5**	**4**	**6**	**2**	**3**	**3**	**24**

Notes:
1. Based on SWITRS five-year collision data reported from January 1, 2013 to December 31, 2017.

Source: SWITRS, Fehr & Peers, 2019.

TABLE 9
SUMMARY OF COLLISION SEVERITY

Location	Property Damage Only	Injury Collisions	Fatality Collisions	Total	Person-Injuries			
					Bike	Ped	Driver/ Passenger	Total
Intersection								
7th Street/Chester Street	2	1	0	3	0	0	1	1
7th Street/Center Street	1	0	0	1	0	0	0	0
7th Street/Mandela Parkway	2	6	0	8	2	2	3	7
5th Street/Chester Street	0	0	0	0	0	0	0	0
5th Street/Center Street	0	0	0	0	0	0	0	0
5th Street/Mandela Parkway	2	1	0	3	0	1	0	1
Roadway Segment								
7th Street between Chester Street and Center Street	0	1	0	1	0	0	3	3
7th Street between Center Street and Mandela Parkway	0	0	0	0	0	0	0	0
5th Street between Chester Street and Center Street	0	0	0	0	0	0	0	0
5th Street between Center Street and Mandela Parkway	1	0	0	1	0	0	0	0
Chester Street between 7th Street and 5th Street	0	1	0	1	1	0	0	1
Mandela Parkway between 7th Street and 5th Street	4	2	0	6	0	0	2	2
Total	**12**	**12**	**0**	**24**	**3**	**3**	**9**	**15**

Notes:

1. Based on SWITRS five-year collision data reported from January 1, 2013 to December 31, 2017.

Source: SWITRS, Fehr & Peers, 2019.

TABLE 10
PREDICTED AND ACTUAL COLLISION FREQUENCIES

Location	Predicted Collision Frequency[1] (per year)	Actual Collision Frequency[2] (per year)	Difference	Higher Than Predicted?
Intersection				
7th Street/Chester Street	0.8	0.6	-0.2	No
7th Street/Center Street	0.6	0.2	-0.4	No
7th Street/Mandela Parkway	2.0	1.6	-0.4	No
5th Street/Chester Street	0.4	0.0	-0.4	No
5th Street/Center Street	0.2	0.0	-0.2	No
5th Street/Mandela Parkway	1.3	0.6	-0.7	No
Roadway Segment				
7th Street between Chester Street and Center Street	0.3	0.2	-0.1	No
7th Street between Center Street and Mandela Parkway	0.2	0.0	-0.2	No
5th Street between Chester Street and Center Street	0.1	0.0	-0.1	No
5th Street between Center Street and Mandela Parkway	0.6	0.2	-0.4	No
Chester Street between 7th Street and 5th Street	0.1	0.0	-0.1	No
Mandela Parkway between 7th Street and 5th Street	0.4	1.2	0.8	**Yes**

Notes:

1. Based on the Highway Safety Manual Predictive Method (Volume 2, Part C)
2. Based on five-year collision data reported from January 1, 2013 to December 31, 2017.

Source: Fehr & Peers, 2019

As shown in Table 10, all study locations had a lower reported collision frequency than predicted by the HSM, except for Mandela Parkway between 7th Street and 5th Street. The collisions along this segment mostly occurred near the BART station driveway on the west side of the street. Sight distance between the vehicles exiting the BART driveway and vehicles traveling northbound on Mandela Parkway is limited due to on-street parking on the west side street. Half of the collisions along this street segment were broadside collisions, which is consistent with the limited sight distance at the BART driveway. The project would eliminate the BART station driveway, and on-street parking, which would improve safety along this segment of Mandela Parkway. Thus, no additional modifications related to roadway safety beyond the ones provided in this memorandum are recommended.

CONCLUSION

Per the site plan review, the project would have adequate automobile, bicycle, pedestrian, and transit access and circulation with the inclusion of **Recommendations 1** through **6**.

Please contact Sam Tabibnia (s.tabibnia@fehrandpeers.com or 510-835-1943) with questions or comments.

ATTACHMENTS

Figure 1 - Existing Conditions Peak Hour Intersection Traffic Volumes, Lane Configurations and Traffic Controls

Figure 2 - Existing Plus Project Peak Hour Intersection Traffic Volumes, Lane Configurations and Traffic Controls

Appendix A – Traffic Counts

Appendix B – Intersection Analysis Worksheets

Appendix C – Predicted Crash Frequency Calculation Sheets

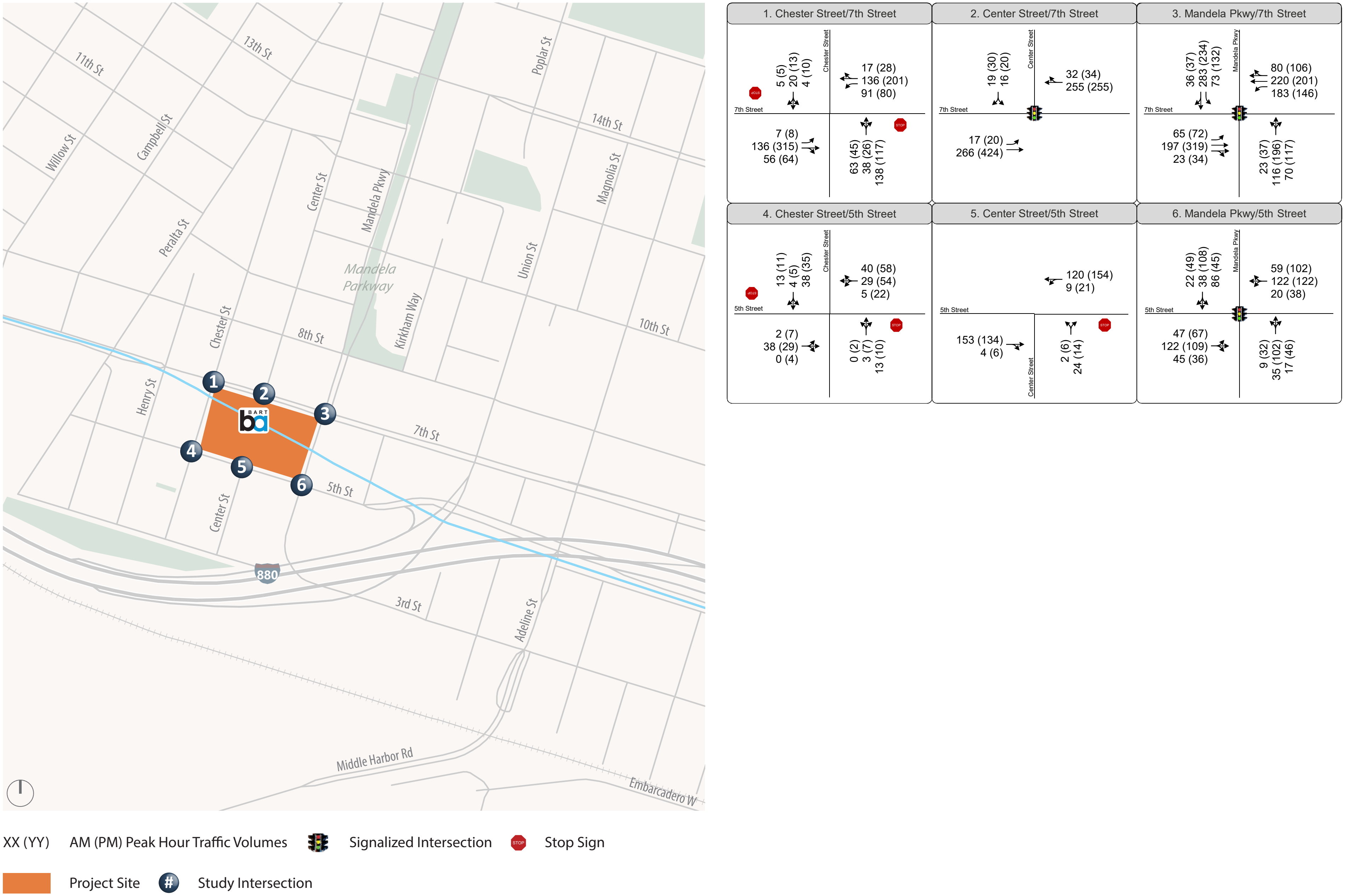

Figure 1

Existing Peak Hour
Intersection Traffic Volumes, Lane Configurations and Traffic Controls

OK18-0294_X_Volumes

XX (YY) AM (PM) Peak Hour Traffic Volumes 🚦 Signalized Intersection STOP Stop Sign

🟧 Project Site # Study Intersection

Figure 2

Existing with Project Peak Hour Intersection Traffic Volumes, Lane Configurations and Traffic Controls

OK18-0294_X_Volumes

National Data & Surveying Services

Intersection Turning Movement Count

Location: Chester St & 7th St
City: Oakland
Control: 2-Way Stop(NB/SB)

Project ID: 18-08661-001
Date: 12/12/2018

Total

NS/EW Streets:	Chester St				Chester St				7th St				7th St				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	1	0	0	1	1	0	0	1	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
7:00 AM	11	6	16	0	2	4	0	0	0	29	12	0	13	41	4	0	138
7:15 AM	19	4	26	0	2	4	3	0	0	30	13	0	16	24	0	0	141
7:30 AM	9	13	31	2	2	7	1	0	0	35	11	0	20	30	5	1	167
7:45 AM	17	7	41	0	2	2	0	0	0	28	10	0	19	29	6	0	161
8:00 AM	17	6	27	0	0	4	0	0	2	36	13	2	24	33	5	0	169
8:15 AM	18	18	32	0	0	8	2	0	1	33	19	0	20	37	2	1	191
8:30 AM	11	7	38	0	2	6	3	0	2	39	14	0	27	37	4	0	190
8:45 AM	12	12	33	1	1	8	1	0	0	28	4	0	12	29	3	0	144
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	114	73	244	3	11	43	10	0	5	258	96	2	151	260	29	2	1301
APPROACH %'s :	26.27%	16.82%	56.22%	0.69%	17.19%	67.19%	15.63%	0.00%	1.39%	71.47%	26.59%	0.55%	34.16%	58.82%	6.56%	0.45%	
PEAK HR :	07:45 AM - 08:45 AM																TOTAL
PEAK HR VOL :	63	38	138	0	4	20	5	0	5	136	56	2	90	136	17	1	711
PEAK HR FACTOR :	0.875	0.528	0.841	0.000	0.500	0.625	0.417	0.000	0.625	0.872	0.737	0.250	0.833	0.919	0.708	0.250	0.931
	0.879				0.659				0.905				0.897				

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	1	0	0	1	1	0	0	1	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
4:00 PM	9	3	14	0	1	4	2	0	0	54	6	0	8	37	6	1	145
4:15 PM	8	4	27	0	2	6	1	0	4	64	10	0	10	29	3	0	168
4:30 PM	8	7	21	0	2	1	1	0	4	75	18	0	8	45	5	1	196
4:45 PM	10	10	24	0	2	3	3	0	4	87	12	0	10	43	3	0	211
5:00 PM	6	7	25	0	1	1	2	0	2	86	16	0	21	46	6	0	219
5:15 PM	16	8	34	0	2	3	1	0	2	73	17	0	20	58	3	1	238
5:30 PM	9	8	30	0	4	4	1	0	2	77	16	0	19	49	7	0	226
5:45 PM	14	3	28	0	3	5	1	0	2	79	15	0	18	48	12	1	229
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	80	50	203	0	17	27	12	0	20	595	110	0	114	355	45	4	1632
APPROACH %'s :	24.02%	15.02%	60.96%	0.00%	30.36%	48.21%	21.43%	0.00%	2.76%	82.07%	15.17%	0.00%	22.01%	68.53%	8.69%	0.77%	
PEAK HR :	05:00 PM - 06:00 PM																TOTAL
PEAK HR VOL :	45	26	117	0	10	13	5	0	8	315	64	0	78	201	28	2	912
PEAK HR FACTOR :	0.703	0.813	0.860	0.000	0.625	0.650	0.625	0.000	1.000	0.916	0.941	0.000	0.929	0.866	0.583	0.500	0.958
	0.810				0.778				0.930				0.942				

National Data & Surveying Services

Intersection Turning Movement Count

Location: Chester St & 7th St
City: Oakland
Control: 2-Way Stop(NB/SB)

Project ID: 18-08661-001
Date: 12/12/2018

Bikes

NS/EW Streets:	Chester St				Chester St				7th St				7th St				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	1	0	0	1	1	0	0	1	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
7:00 AM	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2
7:15 AM	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	3
7:30 AM	0	0	0	0	1	1	0	0	0	2	0	0	0	1	1	0	6
7:45 AM	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	3
8:00 AM	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	3
8:15 AM	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0	4
8:30 AM	1	0	0	0	1	1	0	0	0	2	1	0	0	0	0	0	6
8:45 AM	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	4
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	1	0	0	0	2	5	0	0	0	12	6	0	0	4	1	0	31
APPROACH %'s :	100.00%	0.00%	0.00%	0.00%	28.57%	71.43%	0.00%	0.00%	0.00%	66.67%	33.33%	0.00%	0.00%	80.00%	20.00%	0.00%	
PEAK HR :	07:45 AM - 08:45 AM																TOTAL
PEAK HR VOL :	1	0	0	0	1	4	0	0	0	5	4	0	0	1	0	0	16
PEAK HR FACTOR :	0.250	0.000	0.000	0.000	0.250	1.000	0.000	0.000	0.000	0.625	1.000	0.000	0.000	0.250	0.000	0.000	0.667
	0.250				0.625				0.750				0.250				

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	1	0	0	1	1	0	0	1	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
4:00 PM	0	0	0	0	0	0	0	0	0	2	0	0	0	3	2	0	7
4:15 PM	1	1	2	0	0	0	0	0	0	0	1	0	0	1	0	0	6
4:30 PM	1	0	0	0	0	0	1	0	0	1	0	0	1	2	0	0	6
4:45 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	3	1	0	5
5:00 PM	0	0	0	0	0	0	1	0	1	0	0	0	1	2	2	0	7
5:15 PM	3	0	4	0	0	0	0	0	0	1	1	0	0	3	0	0	12
5:30 PM	2	0	1	0	1	0	0	0	0	1	2	0	1	4	0	0	12
5:45 PM	0	0	2	0	0	0	0	0	0	2	1	0	0	3	0	0	8
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	7	2	9	0	1	0	2	0	1	7	5	0	3	21	5	0	63
APPROACH %'s :	38.89%	11.11%	50.00%	0.00%	33.33%	0.00%	66.67%	0.00%	7.69%	53.85%	38.46%	0.00%	10.34%	72.41%	17.24%	0.00%	
PEAK HR :	05:00 PM - 06:00 PM																TOTAL
PEAK HR VOL :	5	0	7	0	1	0	1	0	1	4	4	0	2	12	2	0	39
PEAK HR FACTOR :	0.42	0.000	0.438	0.000	0.250	0.000	0.250	0.000	0.250	0.500	0.500	0.000	0.500	0.750	0.250	0.000	0.813
	0.429				0.500				0.750				0.800				

National Data & Surveying Services

Intersection Turning Movement Count

Location: Chester St & 7th St
City: Oakland
Project ID: 18-08661-001
Date: 12/12/2018

Pedestrians (Crosswalks)

NS/EW Streets:	Chester St		Chester St		7th St		7th St		
AM	NORTH LEG		SOUTH LEG		EAST LEG		WEST LEG		
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
7:00 AM	5	1	19	3	2	9	0	3	42
7:15 AM	6	2	21	3	1	19	0	0	52
7:30 AM	3	2	24	3	2	19	0	3	56
7:45 AM	5	3	18	1	2	18	1	3	51
8:00 AM	6	3	22	3	1	31	1	4	71
8:15 AM	3	2	22	1	1	17	0	2	48
8:30 AM	3	0	21	0	3	22	1	5	55
8:45 AM	4	2	26	5	2	13	1	4	57
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
TOTAL VOLUMES :	35	15	173	19	14	148	4	24	432
APPROACH %'s :	70.00%	30.00%	90.10%	9.90%	8.64%	91.36%	14.29%	85.71%	
PEAK HR :	07:45 AM - 08:45 AM								TOTAL
PEAK HR VOL :	17	8	83	5	7	88	3	14	225
PEAK HR FACTOR :	0.708	0.667	0.943	0.417	0.583	0.710	0.750	0.700	0.792
	0.694		0.880		0.742		0.708		

PM	NORTH LEG		SOUTH LEG		EAST LEG		WEST LEG		
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
4:00 PM	2	9	4	6	8	2	4	0	35
4:15 PM	5	8	7	9	10	4	0	0	43
4:30 PM	0	10	7	18	14	0	3	0	52
4:45 PM	5	8	9	16	7	3	4	3	55
5:00 PM	4	10	2	14	19	3	3	0	55
5:15 PM	5	12	6	21	22	2	2	2	72
5:30 PM	2	11	13	20	14	9	2	0	71
5:45 PM	8	15	4	13	14	5	1	0	60
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
TOTAL VOLUMES :	31	83	52	117	108	28	19	5	443
APPROACH %'s :	27.19%	72.81%	30.77%	69.23%	79.41%	20.59%	79.17%	20.83%	
PEAK HR :	05:00 PM - 06:00 PM								TOTAL
PEAK HR VOL :	19	48	25	68	69	19	8	2	258
PEAK HR FACTOR :	0.594	0.800	0.481	0.810	0.784	0.528	0.667	0.250	0.896
	0.728		0.705		0.917		0.625		

National Data & Surveying Services

Intersection Turning Movement Count

Location: Center St & 7th St
City: Oakland
Control: Signalized

Project ID: 18-08661-002
Date: 12/12/2018

Total

NS/EW Streets:	Center St				Center St				7th St				7th St				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
7:00 AM	0	0	0	0	0	0	3	0	2	42	0	0	0	46	3	0	96
7:15 AM	0	0	0	0	6	0	4	0	2	58	0	0	0	41	7	0	118
7:30 AM	0	0	0	0	7	0	5	0	6	58	0	0	0	59	9	0	144
7:45 AM	0	0	0	0	2	0	3	0	3	73	0	0	0	58	3	0	142
8:00 AM	0	0	0	0	5	0	6	0	3	61	0	1	0	64	15	0	155
8:15 AM	0	0	0	0	4	0	7	0	5	59	0	0	0	59	10	0	144
8:30 AM	0	0	0	0	5	0	3	0	5	73	0	0	0	74	4	0	164
8:45 AM	0	0	0	0	5	0	4	0	1	62	0	0	0	50	10	0	132
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	0	0	0	0	34	0	35	0	27	486	0	1	0	451	61	0	1095
APPROACH %'s :					49.28%	0.00%	50.72%	0.00%	5.25%	94.55%	0.00%	0.19%	0.00%	88.09%	11.91%	0.00%	
PEAK HR :	07:45 AM - 08:45 AM																TOTAL
PEAK HR VOL :	0	0	0	0	16	0	19	0	16	266	0	1	0	255	32	0	605
PEAK HR FACTOR :	0.000	0.000	0.000	0.000	0.800	0.000	0.679	0.000	0.800	0.911	0.000	0.250	0.000	0.861	0.533	0.000	0.922
					0.795				0.907				0.908				

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
4:00 PM	0	0	0	0	7	0	6	0	3	67	0	0	0	40	13	0	136
4:15 PM	0	0	0	0	6	0	5	0	2	101	0	0	0	36	11	1	162
4:30 PM	0	0	0	0	6	0	3	0	1	99	0	0	0	49	12	0	170
4:45 PM	0	0	0	0	5	0	4	0	6	101	0	1	0	48	10	0	175
5:00 PM	0	0	0	0	7	0	8	0	6	114	0	0	0	61	7	1	204
5:15 PM	0	0	0	0	6	0	10	0	3	102	0	0	0	68	11	0	200
5:30 PM	0	0	0	0	3	0	8	0	6	101	0	0	0	64	8	0	190
5:45 PM	0	0	0	0	4	0	4	0	3	107	0	2	0	61	8	0	189
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	0	0	0	0	44	0	48	0	30	792	0	3	0	427	80	2	1426
APPROACH %'s :					47.83%	0.00%	52.17%	0.00%	3.64%	96.00%	0.00%	0.36%	0.00%	83.89%	15.72%	0.39%	
PEAK HR :	05:00 PM - 06:00 PM																TOTAL
PEAK HR VOL :	0	0	0	0	20	0	30	0	18	424	0	2	0	254	34	1	783
PEAK HR FACTOR :	0.000	0.000	0.000	0.000	0.714	0.000	0.750	0.000	0.750	0.930	0.000	0.250	0.000	0.934	0.773	0.250	0.960
					0.781				0.925				0.915				

National Data & Surveying Services

Intersection Turning Movement Count

Location: Center St & 7th St
City: Oakland
Control: Signalized

Project ID: 18-08661-002
Date: 12/12/2018

Bikes

NS/EW Streets:	Center St				Center St				7th St				7th St				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
7:00 AM	0	0	0	0	0	4	0	0	0	0	1	0	3	2	0	0	10
7:15 AM	0	6	0	0	0	2	0	0	0	0	0	0	2	2	0	0	12
7:30 AM	0	1	4	0	0	0	0	0	0	2	0	0	8	0	0	0	15
7:45 AM	0	0	1	0	0	7	0	0	0	1	0	0	0	1	0	0	10
8:00 AM	0	10	2	0	0	5	0	0	0	0	0	0	11	1	0	0	29
8:15 AM	0	2	1	0	0	3	0	0	0	0	0	0	8	0	0	0	14
8:30 AM	0	5	6	0	0	6	0	0	0	1	0	0	7	0	0	0	25
8:45 AM	0	1	1	0	0	4	0	0	0	1	0	0	10	0	0	0	17
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	0	25	15	0	0	31	0	0	0	5	1	0	49	6	0	0	132
APPROACH %'s :	0.00%	62.50%	37.50%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	83.33%	16.67%	0.00%	89.09%	10.91%	0.00%	0.00%	
PEAK HR :	07:45 AM - 08:45 AM																TOTAL
PEAK HR VOL :	0	17	10	0	0	21	0	0	0	2	0	0	26	2	0	0	78
PEAK HR FACTOR :	0.000	0.425	0.417	0.000	0.000	0.750	0.000	0.000	0.000	0.500	0.000	0.000	0.591	0.500	0.000	0.000	0.672
	0.563				0.750				0.500				0.583				

	Center St				Center St				7th St				7th St				
PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
4:00 PM	2	1	2	0	0	1	0	0	1	1	0	0	0	0	0	0	8
4:15 PM	0	1	4	0	0	1	0	0	0	2	0	0	2	1	0	0	11
4:30 PM	2	1	5	0	0	4	1	0	0	1	0	0	2	0	0	0	16
4:45 PM	1	3	8	0	0	4	1	0	0	0	0	0	3	1	0	0	21
5:00 PM	1	1	8	0	1	2	0	0	0	1	0	0	6	1	0	1	22
5:15 PM	1	2	9	0	0	1	0	0	0	1	0	0	5	4	0	0	23
5:30 PM	0	4	3	0	0	1	0	0	0	2	0	0	7	2	1	0	20
5:45 PM	0	6	6	0	0	3	0	0	0	0	0	0	3	3	0	0	21
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	7	19	45	0	1	17	2	0	1	8	0	0	28	12	1	1	142
APPROACH %'s :	9.86%	26.76%	63.38%	0.00%	5.00%	85.00%	10.00%	0.00%	11.11%	88.89%	0.00%	0.00%	66.67%	28.57%	2.38%	2.38%	
PEAK HR :	05:00 PM - 06:00 PM																TOTAL
PEAK HR VOL :	2	13	26	0	1	7	0	0	0	4	0	0	21	10	1	1	86
PEAK HR FACTOR :	0.50	0.542	0.722	0.000	0.250	0.583	0.000	0.000	0.000	0.500	0.000	0.000	0.750	0.625	0.250	0.250	0.935
	0.854				0.667				0.500				0.825				

National Data & Surveying Services

Intersection Turning Movement Count

Location: Center St & 7th St
City: Oakland

Project ID: 18-08661-002
Date: 12/12/2018

Pedestrians (Crosswalks)

NS/EW Streets:	Center St		Center St		7th St		7th St		
AM	NORTH LEG		SOUTH LEG		EAST LEG		WEST LEG		
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
7:00 AM	4	1	0	0	1	7	7	14	34
7:15 AM	5	5	0	0	5	10	19	32	76
7:30 AM	3	1	0	0	3	17	15	26	65
7:45 AM	2	3	0	0	4	12	8	22	51
8:00 AM	1	1	0	0	6	17	5	29	59
8:15 AM	2	2	0	0	4	17	11	33	69
8:30 AM	2	2	0	0	5	17	1	25	52
8:45 AM	3	3	0	0	2	16	5	19	48
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
TOTAL VOLUMES :	22	18	0	0	30	113	71	200	454
APPROACH %'s :	55.00%	45.00%			20.98%	79.02%	26.20%	73.80%	
PEAK HR :	07:45 AM - 08:45 AM								TOTAL
PEAK HR VOL :	7	8	0	0	19	63	25	109	231
PEAK HR FACTOR :	0.875	0.667			0.792	0.926	0.568	0.826	0.837
	0.750				0.891		0.761		

PM	NORTH LEG		SOUTH LEG		EAST LEG		WEST LEG		
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
4:00 PM	7	3	0	0	7	4	17	7	45
4:15 PM	4	10	0	0	11	0	26	4	55
4:30 PM	9	5	0	0	8	4	32	11	69
4:45 PM	8	2	0	0	8	8	32	10	68
5:00 PM	9	5	0	0	8	4	32	18	76
5:15 PM	10	4	0	0	16	5	29	9	73
5:30 PM	6	7	0	0	15	6	15	9	58
5:45 PM	9	5	0	0	26	2	42	10	94
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
TOTAL VOLUMES :	62	41	0	0	99	33	225	78	538
APPROACH %'s :	60.19%	39.81%			75.00%	25.00%	74.26%	25.74%	
PEAK HR :	05:00 PM - 06:00 PM								TOTAL
PEAK HR VOL :	34	21	0	0	65	17	118	46	301
PEAK HR FACTOR :	0.850	0.750			0.625	0.708	0.702	0.639	0.801
	0.982				0.732		0.788		

National Data & Surveying Services

Intersection Turning Movement Count

Location: Mandela Pkwy & 7th St
City: Oakland
Control: Signalized

Project ID: 18-08661-003
Date: 12/12/2018

Total

NS/EW Streets:	Mandela Pkwy					Mandela Pkwy					7th St					7th St											
AM	NORTHBOUND					SOUTHBOUND					EASTBOUND					WESTBOUND					NORTHBOUND2						
	0	1	0	0	0	1	1	0	0	0	1	2	0	0	0	1	2	0	0	0	0	0	0	0	0	0	
	NL	NT	NR	NU	NU2	SL	ST	SR	SU	ST2	EL	ET	ER	EU	ER2	WL	WT	WR	WU	WL2	N2L	N2U	N2L2	N2T2	N2R2	N2U2	TOTAL
7:00 AM	5	17	14	0	0	10	44	4	2	3	10	30	6	0	2	30	42	8	0	5		0	0	0	1	0	233
7:15 AM	3	11	18	0	0	7	53	1	1	0	13	40	5	0	1	35	45	14	0	1		0	0	0	2	0	250
7:30 AM	2	23	15	0	0	13	55	9	0	2	11	51	7	0	0	40	57	9	1	4		0	0	0	0	0	299
7:45 AM	3	19	16	0	0	11	60	6	1	3	14	56	7	0	1	39	52	22	0	7		0	0	0	1	0	318
8:00 AM	8	29	18	0	0	13	79	5	2	4	21	40	3	0	0	44	58	20	0	9		0	0	0	0	0	353
8:15 AM	7	23	20	0	0	19	69	10	4	1	13	44	7	0	0	49	49	22	0	6		0	0	1	0	0	344
8:30 AM	5	45	16	0	0	22	75	15	1	5	17	57	6	0	0	51	61	16	0	10		0	0	0	0	0	402
8:45 AM	7	31	13	0	0	20	55	7	1	2	13	41	7	0	2	34	44	15	0	4		0	0	0	0	0	296
	NL	NT	NR	NU	NU2	SL	ST	SR	SU	ST2	EL	ET	ER	EU	ER2	WL	WT	WR	WU	WL2	N2L	N2U	N2L2	N2T2	N2R2	N2U2	TOTAL
TOTAL VOLUMES :	40	198	130	0	0	115	490	57	12	20	112	359	48	0	6	322	408	126	1	46	0	0	0	1	4	0	2495
APPROACH %'s :	10.87%	53.80%	35.33%	0.00%	0.00%	16.57%	70.61%	8.21%	1.73%	2.88%	21.33%	68.38%	9.14%	0.00%	1.14%	35.66%	45.18%	13.95%	0.11%	5.09%	0.00%	0.00%	0.00%	20.00%	80.00%	0.00%	
PEAK HR :	07:45 AM - 08:45 AM																										TOTAL
PEAK HR VOL :	23	116	70	0	0	65	283	36	8	13	65	197	23	0	1	183	220	80	0	32	0	0	0	1	1	0	1417
PEAK HR FACTOR :	0.719	0.644	0.875	0.000	0.000	0.739	0.896	0.600	0.500	0.650	0.774	0.864	0.821	0.000	0.250	0.897	0.902	0.909	0.000	0.800	0.000	0.000	0.000	0.250	0.250	0.000	0.881
			0.792					0.858					0.894					0.933					0.500				

PM	NORTHBOUND					SOUTHBOUND					EASTBOUND					WESTBOUND					NORTHBOUND2						
	0	1	0	0	0	1	1	0	0	0	1	2	0	0	0	1	2	0	0	0	0	0	0	0	0	0	
	NL	NT	NR	NU	NU2	SL	ST	SR	SU	ST2	EL	ET	ER	EU	ER2	WL	WT	WR	WU	WL2	N2L	N2U	N2L2	N2T2	N2R2	N2U2	TOTAL
4:00 PM	7	40	20	0	0	25	38	8	1	4	19	56	4	0	2	23	39	20	0	1		0	0	0	0	0	307
4:15 PM	6	42	26	0	0	26	28	8	0	3	24	68	8	0	0	26	32	11	0	2		0	0	0	0	0	310
4:30 PM	6	42	34	0	0	31	50	10	0	5	11	93	3	0	3	34	43	23	1	0		0	0	1	0	0	390
4:45 PM	7	47	26	0	0	32	51	10	3	4	17	82	6	0	1	33	46	35	0	4		0	0	0	0	0	404
5:00 PM	8	50	36	0	0	34	51	10	1	1	21	81	6	0	3	25	41	25	1	7		0	0	1	1	0	403
5:15 PM	13	53	23	0	0	25	59	7	5	2	20	84	9	0	3	43	61	21	0	3		0	0	0	8	0	439
5:30 PM	9	46	32	0	0	31	73	10	1	4	14	72	13	0	2	43	53	25	1	3		0	0	0	2	0	434
5:45 PM	9	56	30	0	0	25	52	10	0	2	20	75	14	0	0	26	43	15	2	5		0	1	0	1	0	386
	NL	NT	NR	NU	NU2	SL	ST	SR	SU	ST2	EL	ET	ER	EU	ER2	WL	WT	WR	WU	WL2	N2L	N2U	N2L2	N2T2	N2R2	N2U2	TOTAL
TOTAL VOLUMES :	65	376	227	0	0	229	402	73	11	25	146	611	63	0	14	253	358	175	5	25	0	0	1	2	12	0	3073
APPROACH %'s :	9.73%	56.29%	33.98%	0.00%	0.00%	30.95%	54.32%	9.86%	1.49%	3.38%	17.51%	73.26%	7.55%	0.00%	1.68%	31.00%	43.87%	21.45%	0.61%	3.06%	0.00%	0.00%	6.67%	13.33%	80.00%	0.00%	
PEAK HR :	04:45 PM - 05:45 PM																										TOTAL
PEAK HR VOL :	37	196	117	0	0	122	234	37	10	11	72	319	34	0	9	144	201	106	2	17	0	0	0	1	11	0	1680
PEAK HR FACTOR :	0.712	0.925	0.813	0.000	0.000	0.897	0.801	0.925	0.500	0.688	0.857	0.949	0.654	0.000	0.750	0.837	0.824	0.757	0.500	0.607	0.000	0.000	0.000	0.250	0.344	0.000	0.957
			0.931					0.870					0.935					0.918					0.375				

National Data & Surveying Services

Intersection Turning Movement Count

Location: Mandela Pkwy & 7th St
City: Oakland
Control: Signalized

Project ID: 18-08661-003
Date: 12/12/2018

Bikes

NS/EW Streets:	Mandela Pkwy					Mandela Pkwy					7th St					7th St											
AM	NORTHBOUND					SOUTHBOUND					EASTBOUND					WESTBOUND					NORTHBOUND2						
	0	1	0	0	0	1	1	0	0	0	1	2	0	0	0	1	2	0	0	0	0	0	0	0	0	0	
	NL	NT	NR	NU	NU2	SL	ST	SR	SU	ST2	EL	ET	ER	EU	ER2	WL	WT	WR	WU	WL2	N2L	N2U	N2L2	N2T2	N2R2	N2U2	TOTAL
7:00 AM	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	1	0	0	0	0		0	0	0	0	0	9
7:15 AM	0	1	0	0	0	0	1	2	0	0	0	1	2	0	0	0	1	0	0	0		0	0	0	0	0	8
7:30 AM	1	0	0	0	0	0	5	8	0	0	5	1	1	0	0	0	1	0	0	0		0	0	0	0	0	22
7:45 AM	0	1	0	0	0	0	3	4	0	0	3	2	0	0	0	0	0	0	0	0		0	0	0	0	0	13
8:00 AM	0	0	0	0	0	0	9	12	0	0	1	0	0	0	0	0	3	2	0	0		0	0	0	0	0	27
8:15 AM	0	1	0	0	0	0	10	6	0	0	2	0	0	0	0	0	2	0	0	0		0	0	0	0	0	21
8:30 AM	0	0	0	0	0	0	9	8	0	0	4	1	0	0	0	0	0	0	0	0		0	0	0	0	0	22
8:45 AM	0	0	0	0	0	0	8	8	0	0	5	0	0	0	0	0	0	0	0	0		0	0	0	0	0	21
	NL	NT	NR	NU	NU2	SL	ST	SR	SU	ST2	EL	ET	ER	EU	ER2	WL	WT	WR	WU	WL2	N2L	N2U	N2L2	N2T2	N2R2	N2U2	TOTAL
TOTAL VOLUMES :	1	3	0	0	0	0	49	52	0	0	20	5	3	0	0	1	7	2	0	0	0	0	0	0	0	0	143
APPROACH %'s :	25.00%	75.00%	0.00%	0.00%	0.00%	0.00%	48.51%	51.49%	0.00%	0.00%	71.43%	17.86%	10.71%	0.00%	0.00%	10.00%	70.00%	20.00%	0.00%	0.00%							
PEAK HR :	07:45 AM - 08:45 AM																										TOTAL
PEAK HR VOL :	0	2	0	0	0	0	31	30	0	0	10	3	0	0	0	0	5	2	0	0	0	0	0	0	0	0	83
PEAK HR FACTOR :	0.000	0.500	0.000	0.000	0.000	0.000	0.775	0.625	0.000	0.000	0.625	0.375	0.000	0.000	0.000	0.000	0.417	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.769
			0.500					0.726					0.650					0.350									

PM	NORTHBOUND					SOUTHBOUND					EASTBOUND					WESTBOUND					NORTHBOUND2						
	0	1	0	0	0	1	1	0	0	0	1	2	0	0	0	1	2	0	0	0	0	0	0	0	0	0	
	NL	NT	NR	NU	NU2	SL	ST	SR	SU	ST2	EL	ET	ER	EU	ER2	WL	WT	WR	WU	WL2	N2L	N2U	N2L2	N2T2	N2R2	N2U2	TOTAL
4:00 PM	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0		0	0	0	0	0	3
4:15 PM	0	4	0	0	0	0	0	0	0	0	5	3	0	0	0	0	1	0	0	0		0	0	0	0	0	13
4:30 PM	0	6	0	0	0	0	0	3	0	0	6	1	0	0	0	0	1	0	0	0		0	0	0	0	0	17
4:45 PM	0	2	0	0	0	0	2	4	0	0	6	0	0	0	0	0	1	0	0	0		0	0	0	1	0	16
5:00 PM	0	3	0	0	0	0	0	3	0	0	10	1	0	0	0	0	5	2	0	0		0	0	0	0	0	24
5:15 PM	1	8	1	0	0	0	1	5	0	0	7	1	0	0	0	0	3	0	0	0		0	0	0	0	0	27
5:30 PM	1	7	0	0	0	0	3	6	0	0	5	2	0	0	0	1	2	0	0	0		0	0	0	0	0	27
5:45 PM	0	10	1	0	0	0	1	4	0	0	5	1	0	0	0	0	0	0	0	0		0	0	0	0	0	22
	NL	NT	NR	NU	NU2	SL	ST	SR	SU	ST2	EL	ET	ER	EU	ER2	WL	WT	WR	WU	WL2	N2L	N2U	N2L2	N2T2	N2R2	N2U2	TOTAL
TOTAL VOLUMES :	2	41	2	0	0	0	8	25	0	0	45	9	0	0	0	1	13	2	0	0	0	0	0	0	1	0	149
APPROACH %'s :	4.44%	91.11%	4.44%	0.00%	0.00%	0.00%	24.24%	75.76%	0.00%	0.00%	83.33%	16.67%	0.00%	0.00%	0.00%	6.25%	81.25%	12.50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	
PEAK HR :	04:45 PM - 05:45 PM																										TOTAL
PEAK HR VOL :	2	20	1	0	0	0	6	18	0	0	28	4	0	0	0	1	11	2	0	0	0	0	0	0	1	0	94
PEAK HR FACTOR :	0.50	0.625	0.250	0.000	0.000	0.000	0.500	0.750	0.000	0.000	0.700	0.500	0.000	0.000	0.000	0.250	0.550	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.870
			0.575					0.667					0.727					0.500						0.250			

National Data & Surveying Services

Intersection Turning Movement Count

Location: Mandela Pkwy & 7th St
City: Oakland

Project ID: 18-08661-003
Date: 12/12/2018

Pedestrians (Crosswalks)

NS/EW Streets:	Mandela Pkwy		Mandela Pkwy		7th St		7th St				
AM	NORTH LEG		SOUTH LEG		EAST LEG		WEST LEG		SOUTH LEG 2		
	EB	WB	EB	WB	NB	SB	NB	SB	EB	WB	TOTAL
7:00 AM	0	0	2	5	0	0	0	0	2	5	14
7:15 AM	0	0	4	17	0	0	0	0	4	17	42
7:30 AM	0	0	5	15	0	0	0	0	5	15	40
7:45 AM	0	0	6	23	0	0	0	0	6	23	58
8:00 AM	0	0	3	7	0	0	0	0	3	7	20
8:15 AM	0	0	3	24	0	0	0	0	3	24	54
8:30 AM	0	0	1	12	0	0	0	0	1	12	26
8:45 AM	0	0	3	17	0	0	0	0	3	17	40
	EB	WB	EB	WB	NB	SB	NB	SB	EB	WB	TOTAL
TOTAL VOLUMES :	0	0	27	120	0	0	0	0	27	120	294
APPROACH %'s :			18.37%	81.63%					18.37%	81.63%	
PEAK HR :	07:45 AM - 08:45 AM										TOTAL
PEAK HR VOL :	0	0	13	66	0	0	0	0	13	66	158
PEAK HR FACTOR :			0.542	0.688					0.542	0.688	0.681
			0.681						0.681		

PM	NORTH LEG		SOUTH LEG		EAST LEG		WEST LEG		SOUTH LEG 2		
	EB	WB	EB	WB	NB	SB	NB	SB	EB	WB	TOTAL
4:00 PM	0	0	7	1	0	0	0	0	7	1	16
4:15 PM	0	0	10	1	0	0	0	0	10	1	22
4:30 PM	0	0	13	5	0	0	0	0	13	5	36
4:45 PM	0	0	10	5	0	0	0	0	10	5	30
5:00 PM	0	0	14	1	0	0	0	0	14	1	30
5:15 PM	0	0	18	5	0	0	0	0	18	5	46
5:30 PM	0	0	29	1	0	0	0	0	29	1	60
5:45 PM	0	0	14	2	0	0	0	0	14	2	32
	EB	WB	EB	WB	NB	SB	NB	SB	EB	WB	TOTAL
TOTAL VOLUMES :	0	0	115	21	0	0	0	0	115	21	272
APPROACH %'s :			84.56%	15.44%					84.56%	15.44%	
PEAK HR :	04:45 PM - 05:45 PM										TOTAL
PEAK HR VOL :	0	0	71	12	0	0	0	0	71	12	166
PEAK HR FACTOR :			0.612	0.600					0.612	0.600	0.692
			0.692						0.692		

National Data & Surveying Services

Intersection Turning Movement Count

Location: Chester St & 5th St
City: Oakland
Control: 2-Way Stop(NB/SB)

Project ID: 18-08661-004
Date: 12/12/2018

Total

NS/EW Streets:	Chester St				Chester St				5th St				5th St				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
7:00 AM	0	1	0	0	10	3	0	0	1	5	1	0	1	2	5	0	29
7:15 AM	0	1	2	0	8	1	2	0	1	14	0	0	1	7	6	0	43
7:30 AM	0	1	2	0	9	3	1	0	0	10	0	0	4	4	10	0	44
7:45 AM	1	0	2	0	5	2	0	0	1	10	0	0	2	6	6	0	35
8:00 AM	0	1	3	0	7	1	0	0	0	11	0	0	0	5	8	0	36
8:15 AM	0	0	4	0	9	0	4	0	2	9	0	0	4	5	12	0	49
8:30 AM	0	2	1	0	10	3	6	0	0	11	0	0	0	12	7	0	52
8:45 AM	0	0	5	0	12	0	3	0	0	7	0	0	1	7	13	0	48
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	1	6	19	0	70	13	16	0	5	77	1	0	13	48	67	0	336
APPROACH %'s :	3.85%	23.08%	73.08%	0.00%	70.71%	13.13%	16.16%	0.00%	6.02%	92.77%	1.20%	0.00%	10.16%	37.50%	52.34%	0.00%	
PEAK HR :	08:00 AM - 09:00 AM																TOTAL
PEAK HR VOL :	0	3	13	0	38	4	13	0	2	38	0	0	5	29	40	0	185
PEAK HR FACTOR :	0.000	0.375	0.650	0.000	0.792	0.333	0.542	0.000	0.250	0.864	0.000	0.000	0.313	0.604	0.769	0.000	0.889
	0.800				0.724				0.909				0.881				

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
4:00 PM	0	3	1	0	1	0	2	0	2	8	2	0	3	8	7	0	37
4:15 PM	2	3	1	0	7	1	0	0	1	8	0	0	1	4	5	0	33
4:30 PM	0	3	3	0	6	2	1	0	3	13	0	0	1	7	9	0	48
4:45 PM	0	2	2	0	7	2	2	0	1	7	0	0	3	8	7	0	41
5:00 PM	1	0	1	0	9	0	0	0	1	5	2	0	4	14	17	1	55
5:15 PM	0	3	3	0	9	1	5	0	3	6	1	0	2	12	9	1	55
5:30 PM	0	1	3	0	10	1	4	0	1	10	1	0	7	10	18	2	68
5:45 PM	1	3	3	0	7	3	2	0	1	8	0	1	4	18	14	1	66
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	4	18	17	0	56	10	16	0	13	65	6	1	25	81	86	5	403
APPROACH %'s :	10.26%	46.15%	43.59%	0.00%	68.29%	12.20%	19.51%	0.00%	15.29%	76.47%	7.06%	1.18%	12.69%	41.12%	43.65%	2.54%	
PEAK HR :	05:00 PM - 06:00 PM																TOTAL
PEAK HR VOL :	2	7	10	0	35	5	11	0	6	29	4	1	17	54	58	5	244
PEAK HR FACTOR :	0.500	0.583	0.833	0.000	0.875	0.417	0.550	0.000	0.500	0.725	0.500	0.250	0.607	0.750	0.806	0.625	0.897
	0.679				0.850				0.833				0.905				

National Data & Surveying Services

Intersection Turning Movement Count

Location: Chester St & 5th St
City: Oakland
Control: 2-Way Stop(NB/SB)

Project ID: 18-08661-004
Date: 12/12/2018

Bikes

NS/EW Streets:	Chester St				Chester St				5th St				5th St				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
7:30 AM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
7:45 AM	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 AM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	1	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	5
APPROACH %'s :	50.00%	50.00%	0.00%	0.00%					66.67%	33.33%	0.00%	0.00%					
PEAK HR :	08:00 AM - 09:00 AM																TOTAL
PEAK HR VOL :	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
PEAK HR FACTOR :	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.500
		0.250								0.250							

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
4:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:30 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
4:45 PM	0	0	0	0	0	0	0	0	2	1	0	0	0	1	0	0	4
5:00 PM	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	2
5:15 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
5:30 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2
5:45 PM	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	0	0	0	0	2	0	1	0	2	4	1	0	0	2	0	0	12
APPROACH %'s :					66.67%	0.00%	33.33%	0.00%	28.57%	57.14%	14.29%	0.00%	0.00%	100.00%	0.00%	0.00%	
PEAK HR :	05:00 PM - 06:00 PM																TOTAL
PEAK HR VOL :	0	0	0	0	2	0	0	0	0	2	1	0	0	1	0	0	6
PEAK HR FACTOR :	0.00	0.000	0.000	0.000	0.500	0.000	0.000	0.000	0.000	0.500	0.250	0.000	0.000	0.250	0.000	0.000	0.750
						0.500				0.750				0.250			

National Data & Surveying Services

Intersection Turning Movement Count

Location: Chester St & 5th St
City: Oakland

Project ID: 18-08661-004
Date: 12/12/2018

Pedestrians (Crosswalks)

NS/EW Streets:	Chester St		Chester St		5th St		5th St		
AM	NORTH LEG		SOUTH LEG		EAST LEG		WEST LEG		
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
7:00 AM	1	0	0	0	0	0	0	0	1
7:15 AM	3	0	0	0	0	0	0	0	3
7:30 AM	3	1	0	0	0	0	0	0	4
7:45 AM	4	0	0	0	0	0	0	0	4
8:00 AM	9	0	0	0	0	0	0	0	9
8:15 AM	3	0	0	0	0	0	0	0	3
8:30 AM	11	0	0	0	0	0	0	0	11
8:45 AM	8	0	0	0	0	0	0	0	8
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
TOTAL VOLUMES :	42	1	0	0	0	0	0	0	43
APPROACH %'s :	97.67%	2.33%							
PEAK HR :	08:00 AM - 09:00 AM								TOTAL
PEAK HR VOL :	31	0	0	0	0	0	0	0	31
PEAK HR FACTOR :	0.705								0.705
	0.705								

PM	NORTH LEG		SOUTH LEG		EAST LEG		WEST LEG		
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
4:00 PM	0	6	0	0	2	1	0	5	14
4:15 PM	0	3	1	1	1	1	0	1	8
4:30 PM	1	4	0	0	0	0	0	0	5
4:45 PM	1	1	0	1	0	2	0	0	5
5:00 PM	2	5	0	1	0	0	1	3	12
5:15 PM	2	4	0	4	0	4	2	1	17
5:30 PM	4	4	0	0	2	2	2	3	17
5:45 PM	3	7	0	6	2	5	3	4	30
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
TOTAL VOLUMES :	13	34	1	13	7	15	8	17	108
APPROACH %'s :	27.66%	72.34%	7.14%	92.86%	31.82%	68.18%	32.00%	68.00%	
PEAK HR :	05:00 PM - 06:00 PM								TOTAL
PEAK HR VOL :	11	20	0	11	4	11	8	11	76
PEAK HR FACTOR :	0.688	0.714		0.458	0.500	0.550	0.667	0.688	0.633
	0.775		0.458		0.536		0.679		

National Data & Surveying Services

Intersection Turning Movement Count

Location: Center St & 5th St
City: Oakland
Control: 1-Way Stop(NB)

Project ID: 18-08661-005
Date: 12/12/2018

Total

NS/EW Streets:	Center St				Center St				5th St				5th St				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
7:00 AM	1	0	1	0	0	0	0	0	0	23	1	0	3	18	0	2	49
7:15 AM	0	0	4	0	0	0	0	0	0	30	3	0	2	22	0	2	63
7:30 AM	1	0	3	0	0	0	0	0	0	25	4	0	2	29	0	0	64
7:45 AM	0	0	7	0	0	0	0	0	0	30	1	0	4	28	0	0	70
8:00 AM	0	0	5	0	0	0	0	0	0	29	0	0	2	17	0	0	53
8:15 AM	1	0	5	0	0	0	0	0	0	47	1	0	2	34	0	2	92
8:30 AM	1	0	5	0	0	0	0	0	0	37	2	0	2	34	0	0	81
8:45 AM	0	0	9	0	0	0	0	0	0	39	1	1	1	35	0	0	86
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	4	0	39	0	0	0	0	0	0	260	13	1	18	217	0	6	558
APPROACH %'s :	9.30%	0.00%	90.70%	0.00%					0.00%	94.89%	4.74%	0.36%	7.47%	90.04%	0.00%	2.49%	
PEAK HR :	08:00 AM - 09:00 AM																TOTAL
PEAK HR VOL :	2	0	24	0	0	0	0	0	0	152	4	1	7	120	0	2	312
PEAK HR FACTOR :	0.500	0.000	0.667	0.000	0.000	0.000	0.000	0.000	0.000	0.809	0.500	0.250	0.875	0.857	0.000	0.250	0.848
	0.722								0.818				0.849				

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
4:00 PM	2	0	7	0	0	0	0	0	0	18	0	0	5	18	0	0	50
4:15 PM	0	0	7	0	0	0	0	0	0	21	0	0	3	13	0	0	44
4:30 PM	1	0	6	0	0	0	0	0	0	33	1	0	5	23	0	1	70
4:45 PM	0	0	4	0	0	0	0	0	0	24	0	0	6	28	0	0	62
5:00 PM	2	0	0	0	0	0	0	0	0	29	1	0	1	40	0	0	73
5:15 PM	2	0	6	0	0	0	0	0	0	27	1	0	6	34	0	2	78
5:30 PM	2	0	6	0	0	0	0	0	0	43	1	0	3	36	0	3	94
5:45 PM	0	0	2	0	0	0	0	0	0	35	3	0	6	44	0	0	90
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	9	0	38	0	0	0	0	0	0	230	7	0	35	236	0	6	561
APPROACH %'s :	19.15%	0.00%	80.85%	0.00%					0.00%	97.05%	2.95%	0.00%	12.64%	85.20%	0.00%	2.17%	
PEAK HR :	05:00 PM - 06:00 PM																TOTAL
PEAK HR VOL :	6	0	14	0	0	0	0	0	0	134	6	0	16	154	0	5	335
PEAK HR FACTOR :	0.750	0.000	0.583	0.000	0.000	0.000	0.000	0.000	0.000	0.779	0.500	0.000	0.667	0.875	0.000	0.417	0.891
	0.625								0.795				0.875				

National Data & Surveying Services

Intersection Turning Movement Count

Location: Center St & 5th St
City: Oakland
Control: 1-Way Stop(NB)

Project ID: 18-08661-005
Date: 12/12/2018

Bikes

NS/EW Streets:	Center St				Center St				5th St				5th St				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
7:30 AM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
7:45 AM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
8:45 AM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	0	0	1	0	0	0	0	0	0	3	0	0	1	2	0	0	7
APPROACH %'s :	0.00%	0.00%	100.00%	0.00%					0.00%	100.00%	0.00%	0.00%	33.33%	66.67%	0.00%	0.00%	
PEAK HR :	08:00 AM - 09:00 AM																TOTAL
PEAK HR VOL :	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	4
PEAK HR FACTOR :	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.000	0.000	0.000	0.250	0.000	0.000	0.500
										0.500				0.250			

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
4:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
4:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
4:45 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
5:15 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
5:30 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2
5:45 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	0	0	0	0	0	0	0	0	0	5	1	0	0	3	0	0	9
APPROACH %'s :									0.00%	83.33%	16.67%	0.00%	0.00%	100.00%	0.00%	0.00%	
PEAK HR :	05:00 PM - 06:00 PM																TOTAL
PEAK HR VOL :	0	0	0	0	0	0	0	0	0	3	0	0	0	2	0	0	5
PEAK HR FACTOR :	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.750	0.000	0.000	0.000	0.500	0.000	0.000	0.625
										0.750				0.500			

National Data & Surveying Services

Intersection Turning Movement Count

Location: Center St & 5th St
City: Oakland

Project ID: 18-08661-005
Date: 12/12/2018

Pedestrians (Crosswalks)

NS/EW Streets:	Center St		Center St		5th St		5th St		
AM	NORTH LEG		SOUTH LEG		EAST LEG		WEST LEG		
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
7:00 AM	0	0	1	0	0	1	0	1	3
7:15 AM	0	0	2	0	3	0	0	0	5
7:30 AM	0	0	0	0	1	0	3	0	4
7:45 AM	0	0	0	0	1	0	3	0	4
8:00 AM	0	0	0	0	1	0	1	0	2
8:15 AM	0	0	0	0	0	0	3	0	3
8:30 AM	0	0	0	0	0	0	0	1	1
8:45 AM	0	0	0	0	0	0	2	2	4
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
TOTAL VOLUMES :	0	0	3	0	6	1	12	4	26
APPROACH %'s :			100.00%	0.00%	85.71%	14.29%	75.00%	25.00%	
PEAK HR :	08:00 AM - 09:00 AM								TOTAL
PEAK HR VOL :	0	0	0	0	1	0	6	3	10
PEAK HR FACTOR :					0.250		0.500	0.375	
					0.250		0.563		0.625

PM	NORTH LEG		SOUTH LEG		EAST LEG		WEST LEG		
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
4:00 PM	0	0	0	1	0	0	0	1	2
4:15 PM	0	0	0	0	0	1	0	1	2
4:30 PM	0	0	0	0	0	0	0	0	0
4:45 PM	0	0	1	0	0	0	4	2	7
5:00 PM	0	0	0	0	1	1	0	1	3
5:15 PM	0	0	2	0	0	0	0	3	5
5:30 PM	0	0	0	1	0	0	2	1	4
5:45 PM	0	0	0	0	1	0	2	0	3
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
TOTAL VOLUMES :	0	0	3	2	2	2	8	9	26
APPROACH %'s :			60.00%	40.00%	50.00%	50.00%	47.06%	52.94%	
PEAK HR :	05:00 PM - 06:00 PM								TOTAL
PEAK HR VOL :	0	0	2	1	2	1	4	5	15
PEAK HR FACTOR :			0.250	0.250	0.500	0.250	0.500	0.417	
			0.375		0.375		0.750		0.750

National Data & Surveying Services

Intersection Turning Movement Count

Location: Mandela Pkwy & 5th St
City: Oakland
Control: Signalized

Project ID: 18-08661-006
Date: 12/12/2018

Total

NS/EW Streets:	Mandela Pkwy				Mandela Pkwy				5th St				5th St				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
7:00 AM	3	6	6	0	22	8	5	0	6	23	3	0	3	23	10	0	118
7:15 AM	0	9	3	0	23	4	6	0	7	31	5	0	10	22	21	0	141
7:30 AM	2	6	2	0	20	11	10	0	3	28	3	0	10	29	19	0	143
7:45 AM	3	4	8	0	17	12	8	0	6	31	7	0	1	23	19	0	139
8:00 AM	1	7	3	0	23	7	4	0	8	26	9	0	3	19	13	0	123
8:15 AM	4	10	4	0	17	11	9	0	11	41	10	0	8	35	13	1	174
8:30 AM	3	12	7	0	30	10	7	0	13	31	8	0	5	36	17	0	179
8:45 AM	1	6	3	0	16	10	2	0	15	24	18	0	3	32	16	0	146
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	17	60	36	0	168	73	51	0	69	235	63	0	43	219	128	1	1163
APPROACH %'s :	15.04%	53.10%	31.86%	0.00%	57.53%	25.00%	17.47%	0.00%	18.80%	64.03%	17.17%	0.00%	11.00%	56.01%	32.74%	0.26%	
PEAK HR :	**08:00 AM - 09:00 AM**																TOTAL
PEAK HR VOL :	9	35	17	0	86	38	22	0	47	122	45	0	19	122	59	1	622
PEAK HR FACTOR :	0.563	0.729	0.607	0.000	0.717	0.864	0.611	0.000	0.783	0.744	0.625	0.000	0.594	0.847	0.868	0.250	0.869
	0.693				0.777				0.863				0.866				

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
4:00 PM	2	12	4	0	11	12	9	1	13	14	7	0	1	17	9	0	112
4:15 PM	0	19	4	0	9	15	4	0	10	29	7	0	6	19	18	0	140
4:30 PM	8	17	10	0	16	19	10	0	15	24	7	0	9	22	28	0	185
4:45 PM	6	16	16	0	11	18	6	0	9	20	3	0	4	26	27	0	162
5:00 PM	13	31	20	0	11	15	12	0	8	25	11	0	9	31	31	0	217
5:15 PM	3	28	16	0	13	25	13	0	21	24	9	0	4	37	26	0	219
5:30 PM	7	18	6	0	10	35	12	0	19	37	13	0	13	23	23	0	216
5:45 PM	9	25	4	0	11	33	12	0	19	23	3	0	12	31	22	0	204
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	48	166	80	0	92	172	78	1	114	196	60	0	58	206	184	0	1455
APPROACH %'s :	16.33%	56.46%	27.21%	0.00%	26.82%	50.15%	22.74%	0.29%	30.81%	52.97%	16.22%	0.00%	12.95%	45.98%	41.07%	0.00%	
PEAK HR :	**05:00 PM - 06:00 PM**																TOTAL
PEAK HR VOL :	32	102	46	0	45	108	49	0	67	109	36	0	38	122	102	0	856
PEAK HR FACTOR :	0.615	0.823	0.575	0.000	0.865	0.771	0.942	0.000	0.798	0.736	0.692	0.000	0.731	0.824	0.823	0.000	0.977
	0.703				0.886				0.768				0.923				

National Data & Surveying Services

Intersection Turning Movement Count

Location: Mandela Pkwy & 5th St
City: Oakland
Control: Signalized

Project ID: 18-08661-006
Date: 12/12/2018

Bikes

NS/EW Streets:	Mandela Pkwy				Mandela Pkwy				5th St				5th St				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
7:00 AM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
7:15 AM	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	3
7:30 AM	0	1	0	0	0	2	0	0	0	1	0	0	0	0	0	0	4
7:45 AM	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	3
8:00 AM	0	0	0	0	0	5	0	0	0	0	0	0	0	0	1	0	6
8:15 AM	0	2	0	0	0	4	0	0	0	0	2	0	0	0	0	0	8
8:30 AM	2	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	5
8:45 AM	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	4
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	2	5	0	0	0	17	1	0	0	3	2	0	0	1	3	0	34
APPROACH %'s :	28.57%	71.43%	0.00%	0.00%	0.00%	94.44%	5.56%	0.00%	0.00%	60.00%	40.00%	0.00%	0.00%	25.00%	75.00%	0.00%	
PEAK HR :	08:00 AM - 09:00 AM																TOTAL
PEAK HR VOL :	2	3	0	0	0	11	1	0	0	1	2	0	0	0	3	0	23
PEAK HR FACTOR :	0.250	0.375	0.000	0.000	0.000	0.550	0.250	0.000	0.000	0.250	0.250	0.000	0.000	0.000	0.375	0.000	0.719
		0.625				0.600				0.375				0.375			

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
4:00 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
4:15 PM	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
4:30 PM	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4
4:45 PM	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	3
5:00 PM	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4
5:15 PM	2	4	0	0	0	0	0	0	0	0	2	0	0	0	1	0	9
5:30 PM	1	3	0	0	2	4	0	0	0	1	0	0	0	0	0	0	11
5:45 PM	0	2	0	0	0	3	0	0	0	0	1	0	0	0	0	0	6
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	6	13	0	0	3	11	0	0	2	1	3	0	0	0	1	0	40
APPROACH %'s :	31.58%	68.42%	0.00%	0.00%	21.43%	78.57%	0.00%	0.00%	33.33%	16.67%	50.00%	0.00%	0.00%	0.00%	100.00%	0.00%	
PEAK HR :	05:00 PM - 06:00 PM																TOTAL
PEAK HR VOL :	4	11	0	0	3	7	0	0	0	1	3	0	0	0	1	0	30
PEAK HR FACTOR :	0.50	0.688	0.000	0.000	0.375	0.438	0.000	0.000	0.000	0.250	0.375	0.000	0.000	0.000	0.250	0.000	0.682
		0.625				0.417				0.500				0.250			

National Data & Surveying Services

Intersection Turning Movement Count

Location: Mandela Pkwy & 5th St
City: Oakland

Project ID: 18-08661-006
Date: 12/12/2018

Pedestrians (Crosswalks)

NS/EW Streets:	Mandela Pkwy		Mandela Pkwy		5th St		5th St		
AM	NORTH LEG		SOUTH LEG		EAST LEG		WEST LEG		
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
7:00 AM	2	9	0	5	7	2	6	2	33
7:15 AM	0	7	0	14	8	2	13	2	46
7:30 AM	1	7	0	18	7	0	20	1	54
7:45 AM	2	19	1	22	16	2	20	8	90
8:00 AM	0	23	1	25	18	0	24	5	96
8:15 AM	3	28	0	24	24	3	24	0	106
8:30 AM	0	28	0	19	28	0	19	1	95
8:45 AM	0	29	1	21	28	0	20	5	104
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
TOTAL VOLUMES :	8	150	3	148	136	9	146	24	624
APPROACH %'s :	5.06%	94.94%	1.99%	98.01%	93.79%	6.21%	85.88%	14.12%	
PEAK HR :	08:00 AM - 09:00 AM								TOTAL
PEAK HR VOL :	3	108	2	89	98	3	87	11	401
PEAK HR FACTOR :	0.250	0.931	0.500	0.890	0.875	0.250	0.906	0.550	0.946
	0.895		0.875		0.902		0.845		

PM	NORTH LEG		SOUTH LEG		EAST LEG		WEST LEG		
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
4:00 PM	6	0	7	0	0	8	1	4	26
4:15 PM	15	3	8	1	1	12	6	8	54
4:30 PM	21	1	18	0	2	20	3	15	80
4:45 PM	15	1	12	1	0	13	3	13	58
5:00 PM	26	1	4	2	1	21	5	5	65
5:15 PM	14	2	8	1	2	18	6	9	60
5:30 PM	25	5	17	4	1	18	2	20	92
5:45 PM	17	6	10	0	3	20	1	11	68
	EB	WB	EB	WB	NB	SB	NB	SB	TOTAL
TOTAL VOLUMES :	139	19	84	9	10	130	27	85	503
APPROACH %'s :	87.97%	12.03%	90.32%	9.68%	7.14%	92.86%	24.11%	75.89%	
PEAK HR :	05:00 PM - 06:00 PM								TOTAL
PEAK HR VOL :	82	14	39	7	7	77	14	45	285
PEAK HR FACTOR :	0.788	0.583	0.574	0.438	0.583	0.917	0.583	0.563	0.774
	0.800		0.548		0.913		0.670		

HCM 2010 TWSC
1: Chester Street & 7th Street

01/11/2019

Intersection	
Int Delay, s/veh	9.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			✣			✣	
Traffic Vol, veh/h	7	136	56	91	136	17	63	38	138	4	20	5
Future Vol, veh/h	7	136	56	91	136	17	63	38	138	4	20	5
Conflicting Peds, #/hr	67	0	93	93	0	67	10	0	88	88	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	60	-	-	55	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	3	3	3	3	3	3	3	3	3	3	3	3
Mvmt Flow	7	136	56	91	136	17	63	38	138	4	20	5

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	220	0	0	285	0	0	620	673	345	748	693	222
Stage 1	-	-	-	-	-	-	271	271	-	394	394	-
Stage 2	-	-	-	-	-	-	349	402	-	354	299	-
Critical Hdwy	4.13	-	-	4.13	-	-	7.13	6.53	6.23	7.13	6.53	6.23
Critical Hdwy Stg 1	-	-	-	-	-	-	6.13	5.53	-	6.13	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.13	5.53	-	6.13	5.53	-
Follow-up Hdwy	2.227	-	-	2.227	-	-	3.527	4.027	3.327	3.527	4.027	3.327
Pot Cap-1 Maneuver	1343	-	-	1271	-	-	399	375	696	327	366	815
Stage 1	-	-	-	-	-	-	733	683	-	629	603	-
Stage 2	-	-	-	-	-	-	665	599	-	661	664	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1332	-	-	1178	-	-	322	300	595	186	293	763
Mov Cap-2 Maneuver	-	-	-	-	-	-	322	300	-	186	293	-
Stage 1	-	-	-	-	-	-	673	627	-	591	525	-
Stage 2	-	-	-	-	-	-	581	522	-	440	609	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	3.1	23.3	18.2
HCM LOS			C	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	431	1332	-	-	1178	-	-	301
HCM Lane V/C Ratio	0.555	0.005	-	-	0.077	-	-	0.096
HCM Control Delay (s)	23.3	7.7	-	-	8.3	-	-	18.2
HCM Lane LOS	C	A	-	-	A	-	-	C
HCM 95th %tile Q(veh)	3.3	0	-	-	0.3	-	-	0.3

HCM Signalized Intersection Capacity Analysis
2: 7th Street & Center Street

01/11/2019

	↗	→	←	↖	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		Y	
Traffic Volume (vph)	17	266	255	32	16	19
Future Volume (vph)	17	266	255	32	16	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		3.0	
Lane Util. Factor	1.00	1.00	1.00		1.00	
Frpb, ped/bikes	1.00	1.00	0.99		0.90	
Flpb, ped/bikes	0.94	1.00	1.00		1.00	
Frt	1.00	1.00	0.98		0.93	
Flt Protected	0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1656	1845	1796		1501	
Flt Permitted	0.58	1.00	1.00		0.98	
Satd. Flow (perm)	1018	1845	1796		1501	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	17	266	255	32	16	19
RTOR Reduction (vph)	0	0	5	0	17	0
Lane Group Flow (vph)	17	266	282	0	18	0
Confl. Peds. (#/hr)	55			55	82	164
Confl. Bikes (#/hr)				10		7
Turn Type	Perm	NA	NA		Prot	
Protected Phases		6	2		4	
Permitted Phases	6					
Actuated Green, G (s)	24.4	24.4	24.4		3.4	
Effective Green, g (s)	24.4	24.4	24.4		3.4	
Actuated g/C Ratio	0.68	0.68	0.68		0.09	
Clearance Time (s)	5.0	5.0	5.0		3.0	
Vehicle Extension (s)	2.0	2.0	2.0		2.0	
Lane Grp Cap (vph)	693	1257	1224		142	
v/s Ratio Prot		0.14	c0.16		c0.01	
v/s Ratio Perm	0.02					
v/c Ratio	0.02	0.21	0.23		0.13	
Uniform Delay, d1	1.8	2.1	2.2		14.8	
Progression Factor	1.00	1.00	1.00		1.00	
Incremental Delay, d2	0.0	0.0	0.0		0.1	
Delay (s)	1.9	2.2	2.2		15.0	
Level of Service	A	A	A		B	
Approach Delay (s)		2.1	2.2		15.0	
Approach LOS		A	A		B	

Intersection Summary			
HCM 2000 Control Delay	2.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.22		
Actuated Cycle Length (s)	35.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	40.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM 2010 Signalized Intersection Summary
3: Mandela Pkwy & 7th Street

01/11/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱			✥		↰	↱	
Traffic Volume (veh/h)	65	197	23	183	220	80	23	116	70	73	283	36
Future Volume (veh/h)	65	197	23	183	220	80	23	116	70	73	283	36
Number	1	6	16	5	2	12	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.94	1.00		0.90	1.00		0.97	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1845	1845	1900	1845	1845	1900	1900	1845	1900	1845	1845	1900
Adj Flow Rate, veh/h	65	197	23	183	220	80	23	116	70	73	283	36
Adj No. of Lanes	1	2	0	1	2	0	0	1	0	1	1	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	139	1721	198	214	1438	498	49	156	83	190	353	45
Arrive On Green	0.08	0.55	0.55	0.12	0.58	0.58	0.22	0.22	0.22	0.22	0.22	0.22
Sat Flow, veh/h	1757	3146	361	1757	2479	859	42	709	378	1181	1601	204
Grp Volume(v), veh/h	65	108	112	183	152	148	209	0	0	73	0	319
Grp Sat Flow(s),veh/h/ln	1757	1752	1755	1757	1752	1585	1129	0	0	1181	0	1804
Q Serve(g_s), s	3.5	3.0	3.1	10.2	4.0	4.3	2.4	0.0	0.0	0.0	0.0	16.7
Cycle Q Clear(g_c), s	3.5	3.0	3.1	10.2	4.0	4.3	19.2	0.0	0.0	15.5	0.0	16.7
Prop In Lane	1.00		0.21	1.00		0.54	0.11		0.33	1.00		0.11
Lane Grp Cap(c), veh/h	139	959	960	214	1016	919	289	0	0	190	0	398
V/C Ratio(X)	0.47	0.11	0.12	0.85	0.15	0.16	0.72	0.00	0.00	0.38	0.00	0.80
Avail Cap(c_a), veh/h	139	959	960	264	1016	919	336	0	0	225	0	451
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	44.0	10.9	10.9	43.0	9.7	9.7	35.6	0.0	0.0	36.4	0.0	36.9
Incr Delay (d2), s/veh	0.9	0.2	0.2	17.0	0.3	0.4	4.8	0.0	0.0	0.5	0.0	7.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.8	1.5	1.6	5.9	2.0	2.0	6.0	0.0	0.0	1.9	0.0	9.2
LnGrp Delay(d),s/veh	44.9	11.2	11.2	60.1	10.0	10.1	40.4	0.0	0.0	36.9	0.0	44.6
LnGrp LOS	D	B	B	E	A	B	D			D		D
Approach Vol, veh/h		285			483			209			392	
Approach Delay, s/veh		18.9			29.0			40.4			43.2	
Approach LOS		B			C			D			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	11.9	62.0		26.1	15.2	58.7		26.1
Change Period (Y+Rc), s	4.0	* 4		4.0	3.0	4.0		4.0
Max Green Setting (Gmax), s	6.0	* 58		25.0	15.0	49.0		25.0
Max Q Clear Time (g_c+I1), s	5.5	6.3		18.7	12.2	5.1		21.2
Green Ext Time (p_c), s	0.0	1.3		1.3	0.1	0.9		0.9

Intersection Summary	
HCM 2010 Ctrl Delay	32.7
HCM 2010 LOS	C

Notes

Intersection	
Int Delay, s/veh	4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	2	38	0	5	29	40	0	3	13	38	4	13
Future Vol, veh/h	2	38	0	5	29	40	0	3	13	38	4	13
Conflicting Peds, #/hr	31	0	11	11	0	31	19	0	15	15	0	19
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	3	3	3	3	3	3	3	3	3	3	3	3
Mvmt Flow	2	38	0	5	29	40	0	3	13	38	4	13

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	100	0	0	49	0	0	140	163	64	155	143	99
Stage 1	-	-	-	-	-	-	53	53	-	90	90	-
Stage 2	-	-	-	-	-	-	87	110	-	65	53	-
Critical Hdwy	4.13	-	-	4.13	-	-	7.13	6.53	6.23	7.13	6.53	6.23
Critical Hdwy Stg 1	-	-	-	-	-	-	6.13	5.53	-	6.13	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.13	5.53	-	6.13	5.53	-
Follow-up Hdwy	2.227	-	-	2.227	-	-	3.527	4.027	3.327	3.527	4.027	3.327
Pot Cap-1 Maneuver	1486	-	-	1551	-	-	828	728	998	809	746	954
Stage 1	-	-	-	-	-	-	957	849	-	915	818	-
Stage 2	-	-	-	-	-	-	918	802	-	943	849	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1462	-	-	1532	-	-	790	700	976	763	717	915
Mov Cap-2 Maneuver	-	-	-	-	-	-	790	700	-	763	717	-
Stage 1	-	-	-	-	-	-	947	840	-	890	794	-
Stage 2	-	-	-	-	-	-	883	779	-	915	840	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.4	0.5	9	9.9
HCM LOS			A	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	909	1462	-	-	1532	-	-	790
HCM Lane V/C Ratio	0.018	0.001	-	-	0.003	-	-	0.07
HCM Control Delay (s)	9	7.5	0	-	7.4	0	-	9.9
HCM Lane LOS	A	A	A	-	A	A	-	A
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0.2

Intersection	
Int Delay, s/veh	1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱			↰	Y	
Traffic Vol, veh/h	153	4	9	120	2	24
Future Vol, veh/h	153	4	9	120	2	24
Conflicting Peds, #/hr	0	3	3	0	9	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	153	4	9	120	2	24

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	160	0	305	161
Stage 1	-	-	-	-	158	-
Stage 2	-	-	-	-	147	-
Critical Hdwy	-	-	4.13	-	6.43	6.23
Critical Hdwy Stg 1	-	-	-	-	5.43	-
Critical Hdwy Stg 2	-	-	-	-	5.43	-
Follow-up Hdwy	-	-	2.227	-	3.527	3.327
Pot Cap-1 Maneuver	-	-	1413	-	685	881
Stage 1	-	-	-	-	868	-
Stage 2	-	-	-	-	878	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1409	-	673	877
Mov Cap-2 Maneuver	-	-	-	-	673	-
Stage 1	-	-	-	-	866	-
Stage 2	-	-	-	-	865	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	9.3
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	857	-	-	1409	-
HCM Lane V/C Ratio	0.03	-	-	0.006	-
HCM Control Delay (s)	9.3	-	-	7.6	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0	-

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (veh/h)	47	122	45	20	122	59	9	35	17	86	38	22
Future Volume (veh/h)	47	122	45	20	122	59	9	35	17	86	38	22
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	0.92		0.87	0.92		0.88	0.91		0.87	0.90		0.87
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1845	1900	1900	1845	1900	1900	1845	1900	1900	1845	1900
Adj Flow Rate, veh/h	47	122	45	20	122	59	9	35	17	86	38	22
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	193	432	138	122	456	201	143	414	177	422	176	81
Arrive On Green	0.42	0.42	0.42	0.42	0.42	0.42	0.39	0.39	0.39	0.39	0.39	0.39
Sat Flow, veh/h	210	1038	332	64	1097	482	111	1059	452	726	449	209
Grp Volume(v), veh/h	214	0	0	201	0	0	61	0	0	146	0	0
Grp Sat Flow(s),veh/h/ln	1580	0	0	1643	0	0	1623	0	0	1385	0	0
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0
Cycle Q Clear(g_c), s	3.4	0.0	0.0	3.3	0.0	0.0	1.0	0.0	0.0	2.6	0.0	0.0
Prop In Lane	0.22		0.21	0.10		0.29	0.15		0.28	0.59		0.15
Lane Grp Cap(c), veh/h	763	0	0	779	0	0	734	0	0	679	0	0
V/C Ratio(X)	0.28	0.00	0.00	0.26	0.00	0.00	0.08	0.00	0.00	0.21	0.00	0.00
Avail Cap(c_a), veh/h	1047	0	0	1078	0	0	1258	0	0	1131	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	8.1	0.0	0.0	8.0	0.0	0.0	8.0	0.0	0.0	8.4	0.0	0.0
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	0.0	0.0	1.5	0.0	0.0	0.4	0.0	0.0	1.1	0.0	0.0
LnGrp Delay(d),s/veh	8.1	0.0	0.0	8.1	0.0	0.0	8.0	0.0	0.0	8.5	0.0	0.0
LnGrp LOS	A			A			A			A		
Approach Vol, veh/h		214			201			61			146	
Approach Delay, s/veh		8.1			8.1			8.0			8.5	
Approach LOS		A			A			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		20.1		21.2		20.1		21.2
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		30.0		25.0		30.0		25.0
Max Q Clear Time (g_c+I1), s		3.0		5.4		4.6		5.3
Green Ext Time (p_c), s		0.8		1.8		0.8		1.8

Intersection Summary			
HCM 2010 Ctrl Delay			8.2
HCM 2010 LOS			A

Intersection	
Int Delay, s/veh	7.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			✥			✥	
Traffic Vol, veh/h	8	315	64	80	201	28	45	26	117	10	13	5
Future Vol, veh/h	8	315	64	80	201	28	45	26	117	10	13	5
Conflicting Peds, #/hr	67	0	93	93	0	67	10	0	88	88	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	60	-	-	55	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	3	3	3	3	3	3	3	3	3	3	3	3
Mvmt Flow	8	315	64	80	201	28	45	26	117	10	13	5

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	296	0	0	472	0	0	850	912	528	965	930	292
Stage 1	-	-	-	-	-	-	456	456	-	442	442	-
Stage 2	-	-	-	-	-	-	394	456	-	523	488	-
Critical Hdwy	4.13	-	-	4.13	-	-	7.13	6.53	6.23	7.13	6.53	6.23
Critical Hdwy Stg 1	-	-	-	-	-	-	6.13	5.53	-	6.13	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.13	5.53	-	6.13	5.53	-
Follow-up Hdwy	2.227	-	-	2.227	-	-	3.527	4.027	3.327	3.527	4.027	3.327
Pot Cap-1 Maneuver	1260	-	-	1085	-	-	279	273	548	233	266	745
Stage 1	-	-	-	-	-	-	582	566	-	592	575	-
Stage 2	-	-	-	-	-	-	629	566	-	535	548	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1250	-	-	1005	-	-	226	217	468	130	212	698
Mov Cap-2 Maneuver	-	-	-	-	-	-	226	217	-	130	212	-
Stage 1	-	-	-	-	-	-	533	519	-	555	500	-
Stage 2	-	-	-	-	-	-	555	492	-	351	502	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.2	2.3	29.4	26.8
HCM LOS			D	D

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	330	1250	-	-	1005	-	-	193
HCM Lane V/C Ratio	0.57	0.006	-	-	0.08	-	-	0.145
HCM Control Delay (s)	29.4	7.9	-	-	8.9	-	-	26.8
HCM Lane LOS	D	A	-	-	A	-	-	D
HCM 95th %tile Q(veh)	3.3	0	-	-	0.3	-	-	0.5

	↱	→	←	↖	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		↰↱	
Traffic Volume (vph)	20	424	255	34	20	30
Future Volume (vph)	20	424	255	34	20	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		3.0	
Lane Util. Factor	1.00	1.00	1.00		1.00	
Frpb, ped/bikes	1.00	1.00	0.99		0.88	
Flpb, ped/bikes	0.94	1.00	1.00		1.00	
Frt	1.00	1.00	0.98		0.92	
Flt Protected	0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1648	1845	1791		1468	
Flt Permitted	0.58	1.00	1.00		0.98	
Satd. Flow (perm)	1011	1845	1791		1468	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	20	424	255	34	20	30
RTOR Reduction (vph)	0	0	6	0	26	0
Lane Group Flow (vph)	20	424	283	0	24	0
Confl. Peds. (#/hr)	55			55	82	164
Confl. Bikes (#/hr)				10		7
Turn Type	Perm	NA	NA		Prot	
Protected Phases		6	2		4	
Permitted Phases	6					
Actuated Green, G (s)	26.2	26.2	26.2		4.7	
Effective Green, g (s)	26.2	26.2	26.2		4.7	
Actuated g/C Ratio	0.67	0.67	0.67		0.12	
Clearance Time (s)	5.0	5.0	5.0		3.0	
Vehicle Extension (s)	2.0	2.0	2.0		2.0	
Lane Grp Cap (vph)	680	1242	1206		177	
v/s Ratio Prot		c0.23	0.16		c0.02	
v/s Ratio Perm	0.02					
v/c Ratio	0.03	0.34	0.24		0.13	
Uniform Delay, d1	2.1	2.7	2.5		15.3	
Progression Factor	1.00	1.00	1.00		1.00	
Incremental Delay, d2	0.0	0.1	0.0		0.1	
Delay (s)	2.1	2.8	2.5		15.4	
Level of Service	A	A	A		B	
Approach Delay (s)		2.7	2.5		15.4	
Approach LOS		A	A		B	

Intersection Summary			
HCM 2000 Control Delay	3.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.31		
Actuated Cycle Length (s)	38.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	46.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM 2010 Signalized Intersection Summary
3: Mandela Pkwy & 7th Street

01/11/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱			✣		↰	↱	
Traffic Volume (veh/h)	72	319	34	146	201	106	37	196	117	132	234	37
Future Volume (veh/h)	72	319	34	146	201	106	37	196	117	132	234	37
Number	1	6	16	5	2	12	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.94	1.00		0.88	1.00		0.97	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1845	1845	1900	1845	1845	1900	1900	1845	1900	1845	1845	1900
Adj Flow Rate, veh/h	72	319	34	146	201	106	37	196	117	132	234	37
Adj No. of Lanes	1	2	0	1	2	0	0	1	0	1	1	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	196	1626	172	137	1017	498	72	267	148	251	447	71
Arrive On Green	0.11	0.51	0.51	0.08	0.47	0.47	0.29	0.29	0.29	0.29	0.29	0.29
Sat Flow, veh/h	1757	3177	335	1757	2179	1067	96	926	513	1052	1551	245
Grp Volume(v), veh/h	72	174	179	146	159	148	350	0	0	132	0	271
Grp Sat Flow(s),veh/h/ln	1757	1752	1760	1757	1752	1493	1536	0	0	1052	0	1796
Q Serve(g_s), s	3.4	4.9	5.0	7.0	4.8	5.3	8.0	0.0	0.0	2.9	0.0	11.4
Cycle Q Clear(g_c), s	3.4	4.9	5.0	7.0	4.8	5.3	19.3	0.0	0.0	22.2	0.0	11.4
Prop In Lane	1.00		0.19	1.00		0.71	0.11		0.33	1.00		0.14
Lane Grp Cap(c), veh/h	196	897	901	137	818	697	487	0	0	251	0	518
V/C Ratio(X)	0.37	0.19	0.20	1.07	0.19	0.21	0.72	0.00	0.00	0.53	0.00	0.52
Avail Cap(c_a), veh/h	196	897	901	137	818	697	578	0	0	310	0	619
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	37.0	11.9	11.9	41.5	14.1	14.2	29.5	0.0	0.0	32.1	0.0	26.9
Incr Delay (d2), s/veh	0.4	0.5	0.5	96.5	0.5	0.7	2.5	0.0	0.0	0.6	0.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.7	2.4	2.5	7.0	2.4	2.3	8.4	0.0	0.0	3.2	0.0	5.7
LnGrp Delay(d),s/veh	37.4	12.4	12.4	138.0	14.6	14.9	31.9	0.0	0.0	32.8	0.0	27.2
LnGrp LOS	D	B	B	F	B	B	C			C		C
Approach Vol, veh/h		425			453			350			403	
Approach Delay, s/veh		16.7			54.5			31.9			29.0	
Approach LOS		B			D			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	14.1	46.0		29.9	10.0	50.1		29.9
Change Period (Y+Rc), s	4.0	* 4		4.0	3.0	4.0		4.0
Max Green Setting (Gmax), s	6.0	* 42		31.0	7.0	41.0		31.0
Max Q Clear Time (g_c+I1), s	5.4	7.3		24.2	9.0	7.0		21.3
Green Ext Time (p_c), s	0.1	1.3		1.8	0.0	1.5		2.1

Intersection Summary	
HCM 2010 Ctrl Delay	33.5
HCM 2010 LOS	C

Notes

Intersection	
Int Delay, s/veh	3.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	7	29	4	22	54	58	2	7	10	35	5	11
Future Vol, veh/h	7	29	4	22	54	58	2	7	10	35	5	11
Conflicting Peds, #/hr	31	0	11	11	0	31	19	0	15	15	0	19
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	3	3	3	3	3	3	3	3	3	3	3	3
Mvmt Flow	7	29	4	22	54	58	2	7	10	35	5	11

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	143	0	0	44	0	0	210	243	57	227	216	133
Stage 1	-	-	-	-	-	-	56	56	-	158	158	-
Stage 2	-	-	-	-	-	-	154	187	-	69	58	-
Critical Hdwy	4.13	-	-	4.13	-	-	7.13	6.53	6.23	7.13	6.53	6.23
Critical Hdwy Stg 1	-	-	-	-	-	-	6.13	5.53	-	6.13	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.13	5.53	-	6.13	5.53	-
Follow-up Hdwy	2.227	-	-	2.227	-	-	3.527	4.027	3.327	3.527	4.027	3.327
Pot Cap-1 Maneuver	1434	-	-	1558	-	-	745	657	1006	726	680	913
Stage 1	-	-	-	-	-	-	954	846	-	842	765	-
Stage 2	-	-	-	-	-	-	846	743	-	939	845	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1411	-	-	1539	-	-	702	622	984	675	643	875
Mov Cap-2 Maneuver	-	-	-	-	-	-	702	622	-	675	643	-
Stage 1	-	-	-	-	-	-	941	834	-	816	734	-
Stage 2	-	-	-	-	-	-	804	713	-	906	833	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.3	1.2	9.7	10.5
HCM LOS			A	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	783	1411	-	-	1539	-	-	706
HCM Lane V/C Ratio	0.024	0.005	-	-	0.014	-	-	0.072
HCM Control Delay (s)	9.7	7.6	0	-	7.4	0	-	10.5
HCM Lane LOS	A	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0.2

Intersection	
Int Delay, s/veh	1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱			↰	Y	
Traffic Vol, veh/h	134	6	21	154	6	14
Future Vol, veh/h	134	6	21	154	6	14
Conflicting Peds, #/hr	0	3	3	0	9	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	134	6	21	154	6	14

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	143	0	345	143
Stage 1	-	-	-	-	140	-
Stage 2	-	-	-	-	205	-
Critical Hdwy	-	-	4.13	-	6.43	6.23
Critical Hdwy Stg 1	-	-	-	-	5.43	-
Critical Hdwy Stg 2	-	-	-	-	5.43	-
Follow-up Hdwy	-	-	2.227	-	3.527	3.327
Pot Cap-1 Maneuver	-	-	1434	-	650	902
Stage 1	-	-	-	-	884	-
Stage 2	-	-	-	-	827	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1430	-	633	897
Mov Cap-2 Maneuver	-	-	-	-	633	-
Stage 1	-	-	-	-	882	-
Stage 2	-	-	-	-	808	-

Approach	EB		WB		NB	
HCM Control Delay, s	0		0.9		9.6	
HCM LOS					A	

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	797	-	-	1430	-
HCM Lane V/C Ratio	0.025	-	-	0.015	-
HCM Control Delay (s)	9.6	-	-	7.6	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0	-

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	67	109	36	38	122	102	32	102	46	45	108	49
Future Volume (veh/h)	67	109	36	38	122	102	32	102	46	45	108	49
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	0.93		0.87	0.92		0.89	0.92		0.87	0.92		0.87
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1845	1900	1900	1845	1900	1900	1845	1900	1900	1845	1900
Adj Flow Rate, veh/h	67	109	36	38	122	102	32	102	46	45	108	49
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	258	381	108	145	356	258	159	406	159	186	383	149
Arrive On Green	0.42	0.42	0.42	0.42	0.42	0.42	0.39	0.39	0.39	0.39	0.39	0.39
Sat Flow, veh/h	347	904	256	113	846	612	150	1042	409	211	982	382
Grp Volume(v), veh/h	212	0	0	262	0	0	180	0	0	202	0	0
Grp Sat Flow(s),veh/h/ln	1508	0	0	1571	0	0	1600	0	0	1575	0	0
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	3.4	0.0	0.0	4.7	0.0	0.0	3.1	0.0	0.0	3.5	0.0	0.0
Prop In Lane	0.32		0.17	0.15		0.39	0.18		0.26	0.22		0.24
Lane Grp Cap(c), veh/h	747	0	0	759	0	0	724	0	0	718	0	0
V/C Ratio(X)	0.28	0.00	0.00	0.35	0.00	0.00	0.25	0.00	0.00	0.28	0.00	0.00
Avail Cap(c_a), veh/h	988	0	0	1015	0	0	1211	0	0	1197	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	8.1	0.0	0.0	8.4	0.0	0.0	8.8	0.0	0.0	8.9	0.0	0.0
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	0.0	0.0	2.1	0.0	0.0	1.4	0.0	0.0	1.6	0.0	0.0
LnGrp Delay(d),s/veh	8.2	0.0	0.0	8.5	0.0	0.0	8.9	0.0	0.0	9.0	0.0	0.0
LnGrp LOS	A			A			A			A		
Approach Vol, veh/h		212			262			180			202	
Approach Delay, s/veh		8.2			8.5			8.9			9.0	
Approach LOS		A			A			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		20.5		21.8		20.5		21.8
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		30.0		25.0		30.0		25.0
Max Q Clear Time (g_c+I1), s		5.1		5.4		5.5		6.7
Green Ext Time (p_c), s		1.6		2.2		1.6		2.2

Intersection Summary			
HCM 2010 Ctrl Delay			8.6
HCM 2010 LOS			A

HCM 2010 Signalized Intersection Summary
1: Chester Street & 7th Street

01/11/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			✥			✥	
Traffic Volume (veh/h)	7	136	118	209	136	17	97	41	217	4	24	5
Future Volume (veh/h)	7	136	118	209	136	17	97	41	217	4	24	5
Number	1	6	16	5	2	12	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.80	1.00		0.88	0.87		0.86	0.98		0.86
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1845	1845	1900	1845	1845	1900	1900	1845	1900	1900	1845	1900
Adj Flow Rate, veh/h	7	136	118	209	136	17	97	41	217	4	24	5
Adj No. of Lanes	1	1	0	1	1	0	0	1	0	0	1	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	13	208	181	452	802	100	159	74	263	90	425	82
Arrive On Green	0.01	0.26	0.26	0.26	0.51	0.51	0.31	0.31	0.31	0.31	0.31	0.31
Sat Flow, veh/h	1757	809	702	1757	1581	198	298	235	837	102	1354	260
Grp Volume(v), veh/h	7	0	254	209	0	153	355	0	0	33	0	0
Grp Sat Flow(s),veh/h/ln	1757	0	1512	1757	0	1779	1370	0	0	1716	0	0
Q Serve(g_s), s	0.3	0.0	10.5	7.0	0.0	3.2	12.5	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	0.3	0.0	10.5	7.0	0.0	3.2	16.6	0.0	0.0	0.9	0.0	0.0
Prop In Lane	1.00		0.46	1.00		0.11	0.27		0.61	0.12		0.15
Lane Grp Cap(c), veh/h	13	0	389	452	0	902	496	0	0	597	0	0
V/C Ratio(X)	0.55	0.00	0.65	0.46	0.00	0.17	0.72	0.00	0.00	0.06	0.00	0.00
Avail Cap(c_a), veh/h	100	0	389	452	0	902	496	0	0	597	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.97	0.00	0.97	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	34.6	0.0	23.2	21.9	0.0	9.3	22.0	0.0	0.0	16.8	0.0	0.0
Incr Delay (d2), s/veh	12.9	0.0	8.3	0.3	0.0	0.4	8.6	0.0	0.0	0.2	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	5.3	3.4	0.0	1.7	7.5	0.0	0.0	0.5	0.0	0.0
LnGrp Delay(d),s/veh	47.5	0.0	31.5	22.2	0.0	9.7	30.5	0.0	0.0	17.0	0.0	0.0
LnGrp LOS	D		C	C		A	C			B		
Approach Vol, veh/h		261			362			355			33	
Approach Delay, s/veh		31.9			16.9			30.5			17.0	
Approach LOS		C			B			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	4.5	39.5		26.0	22.0	22.0		26.0
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	4.0	32.0		22.0	18.0	18.0		22.0
Max Q Clear Time (g_c+I1), s	2.3	5.2		2.9	9.0	12.5		18.6
Green Ext Time (p_c), s	0.0	0.8		1.9	0.6	0.5		0.7

Intersection Summary	
HCM 2010 Ctrl Delay	25.6
HCM 2010 LOS	C

HCM Signalized Intersection Capacity Analysis
2: 7th Street & Center Street

01/11/2019

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		↰↱	
Traffic Volume (vph)	20	342	369	32	16	23
Future Volume (vph)	20	342	369	32	16	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		3.0	
Lane Util. Factor	1.00	1.00	1.00		1.00	
Frpb, ped/bikes	1.00	1.00	0.99		0.88	
Flpb, ped/bikes	0.95	1.00	1.00		1.00	
Frt	1.00	1.00	0.99		0.92	
Flt Protected	0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1659	1845	1808		1465	
Flt Permitted	0.53	1.00	1.00		0.98	
Satd. Flow (perm)	918	1845	1808		1465	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	20	342	369	32	16	23
RTOR Reduction (vph)	0	0	2	0	20	0
Lane Group Flow (vph)	20	342	399	0	19	0
Confl. Peds. (#/hr)	55			55	82	164
Confl. Bikes (#/hr)				10		7
Turn Type	Perm	NA	NA		Prot	
Protected Phases		6	2		4	
Permitted Phases	6					
Actuated Green, G (s)	28.1	28.1	28.1		4.7	
Effective Green, g (s)	28.1	28.1	28.1		4.7	
Actuated g/C Ratio	0.69	0.69	0.69		0.12	
Clearance Time (s)	5.0	5.0	5.0		3.0	
Vehicle Extension (s)	2.0	2.0	2.0		2.0	
Lane Grp Cap (vph)	632	1270	1245		168	
v/s Ratio Prot		0.19	c0.22		c0.01	
v/s Ratio Perm	0.02					
v/c Ratio	0.03	0.27	0.32		0.11	
Uniform Delay, d1	2.0	2.4	2.5		16.2	
Progression Factor	1.00	1.00	1.00		1.00	
Incremental Delay, d2	0.0	0.0	0.1		0.1	
Delay (s)	2.0	2.5	2.6		16.3	
Level of Service	A	A	A		B	
Approach Delay (s)		2.4	2.6		16.3	
Approach LOS		A	A		B	

Intersection Summary			
HCM 2000 Control Delay	3.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.31		
Actuated Cycle Length (s)	40.8	Sum of lost time (s)	10.0
Intersection Capacity Utilization	45.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM 2010 Signalized Intersection Summary
3: Mandela Pkwy & 7th Street

01/11/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑	↱		✥		↰	↱	
Traffic Volume (veh/h)	78	260	23	183	313	80	23	116	70	73	283	58
Future Volume (veh/h)	78	260	23	183	313	80	23	116	70	73	283	58
Number	1	6	16	5	2	12	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.93	1.00		0.87	1.00		0.95	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1845	1845	1900	1845	1845	1845	1900	1845	1900	1845	1845	1900
Adj Flow Rate, veh/h	78	260	23	183	313	80	23	116	70	73	283	58
Adj No. of Lanes	1	1	0	1	1	1	0	1	0	1	1	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	310	769	68	218	738	545	54	167	89	220	348	71
Arrive On Green	0.18	0.46	0.46	0.12	0.40	0.40	0.23	0.23	0.23	0.23	0.23	0.23
Sat Flow, veh/h	1757	1660	147	1757	1845	1363	40	713	379	1181	1481	304
Grp Volume(v), veh/h	78	0	283	183	313	80	209	0	0	73	0	341
Grp Sat Flow(s),veh/h/ln	1757	0	1806	1757	1845	1363	1132	0	0	1181	0	1785
Q Serve(g_s), s	3.4	0.0	9.0	9.2	11.0	3.4	1.1	0.0	0.0	0.0	0.0	16.3
Cycle Q Clear(g_c), s	3.4	0.0	9.0	9.2	11.0	3.4	17.4	0.0	0.0	12.6	0.0	16.3
Prop In Lane	1.00		0.08	1.00		1.00	0.11		0.33	1.00		0.17
Lane Grp Cap(c), veh/h	310	0	837	218	738	545	310	0	0	220	0	419
V/C Ratio(X)	0.25	0.00	0.34	0.84	0.42	0.15	0.67	0.00	0.00	0.33	0.00	0.81
Avail Cap(c_a), veh/h	310	0	837	332	738	545	448	0	0	323	0	575
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	31.9	0.0	15.4	38.5	19.5	17.2	30.4	0.0	0.0	31.2	0.0	32.6
Incr Delay (d2), s/veh	0.2	0.0	1.1	6.9	1.8	0.6	1.0	0.0	0.0	0.3	0.0	4.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.7	0.0	4.7	4.8	5.9	1.4	5.1	0.0	0.0	1.7	0.0	8.5
LnGrp Delay(d),s/veh	32.1	0.0	16.5	45.4	21.3	17.8	31.3	0.0	0.0	31.5	0.0	37.1
LnGrp LOS	C		B	D	C	B	C			C		D
Approach Vol, veh/h		361			576			209			414	
Approach Delay, s/veh		19.8			28.5			31.3			36.1	
Approach LOS		B			C			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	19.9	40.0		30.1	14.2	45.7		30.1
Change Period (Y+Rc), s	4.0	* 4		9.0	3.0	4.0		9.0
Max Green Setting (Gmax), s	9.0	* 36		29.0	17.0	28.0		29.0
Max Q Clear Time (g_c+I1), s	5.4	13.0		18.3	11.2	11.0		19.4
Green Ext Time (p_c), s	0.1	1.4		1.8	0.1	1.1		1.7

Intersection Summary	
HCM 2010 Ctrl Delay	28.9
HCM 2010 LOS	C

Notes

Intersection	
Intersection Delay, s/veh	7.8
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	2	38	0	5	29	152	0	3	13	92	4	13
Future Vol, veh/h	2	38	0	5	29	152	0	3	13	92	4	13
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	3	3	3	3	3	3	3	3	3	3	3	3
Mvmt Flow	2	38	0	5	29	152	0	3	13	92	4	13
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	7.7	7.7	7.1	8.2
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	5%	3%	84%
Vol Thru, %	19%	95%	16%	4%
Vol Right, %	81%	0%	82%	12%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	16	40	186	109
LT Vol	0	2	5	92
Through Vol	3	38	29	4
RT Vol	13	0	152	13
Lane Flow Rate	16	40	186	109
Geometry Grp	1	1	1	1
Degree of Util (X)	0.018	0.049	0.192	0.135
Departure Headway (Hd)	4.053	4.433	3.713	4.452
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	888	813	949	796
Service Time	2.055	2.433	1.807	2.532
HCM Lane V/C Ratio	0.018	0.049	0.196	0.137
HCM Control Delay	7.1	7.7	7.7	8.2
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.1	0.2	0.7	0.5

Intersection	
Intersection Delay, s/veh	8.7
Intersection LOS	A

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱			↰	Y	
Traffic Vol, veh/h	207	4	9	232	2	24
Future Vol, veh/h	207	4	9	232	2	24
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	207	4	9	232	2	24
Number of Lanes	1	0	0	1	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	
Opposing Lanes	1	1	0
Conflicting Approach Left		NB	EB
Conflicting Lanes Left	0	1	1
Conflicting Approach Right	NB		WB
Conflicting Lanes Right	1	0	1
HCM Control Delay	8.6	8.9	7.5
HCM LOS	A	A	A

Lane	NBLn1	EBLn1	WBLn1
Vol Left, %	8%	0%	4%
Vol Thru, %	0%	98%	96%
Vol Right, %	92%	2%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	26	211	241
LT Vol	2	0	9
Through Vol	0	207	232
RT Vol	24	4	0
Lane Flow Rate	26	211	241
Geometry Grp	1	1	1
Degree of Util (X)	0.032	0.244	0.279
Departure Headway (Hd)	4.383	4.165	4.162
Convergence, Y/N	Yes	Yes	Yes
Cap	822	852	856
Service Time	2.383	2.239	2.228
HCM Lane V/C Ratio	0.032	0.248	0.282
HCM Control Delay	7.5	8.6	8.9
HCM Lane LOS	A	A	A
HCM 95th-tile Q	0.1	1	1.1

HCM 2010 Signalized Intersection Summary
6: Mandela Pkwy & 5th Street

01/11/2019

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	47	173	47	20	231	59	12	35	17	86	38	22
Future Volume (veh/h)	47	173	47	20	231	59	12	35	17	86	38	22
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	0.94		0.87	0.93		0.89	0.91		0.86	0.90		0.87
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1845	1900	1900	1845	1900	1900	1845	1900	1900	1845	1900
Adj Flow Rate, veh/h	47	173	47	20	231	59	12	35	17	86	38	22
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	165	503	122	109	572	139	164	389	164	414	172	80
Arrive On Green	0.43	0.43	0.43	0.43	0.43	0.43	0.38	0.38	0.38	0.38	0.38	0.38
Sat Flow, veh/h	154	1177	284	43	1339	325	164	1013	426	726	448	208
Grp Volume(v), veh/h	267	0	0	310	0	0	64	0	0	146	0	0
Grp Sat Flow(s),veh/h/ln	1616	0	0	1707	0	0	1603	0	0	1382	0	0
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0
Cycle Q Clear(g_c), s	4.4	0.0	0.0	5.3	0.0	0.0	1.0	0.0	0.0	2.7	0.0	0.0
Prop In Lane	0.18		0.18	0.06		0.19	0.19		0.27	0.59		0.15
Lane Grp Cap(c), veh/h	790	0	0	820	0	0	717	0	0	666	0	0
V/C Ratio(X)	0.34	0.00	0.00	0.38	0.00	0.00	0.09	0.00	0.00	0.22	0.00	0.00
Avail Cap(c_a), veh/h	1036	0	0	1087	0	0	1212	0	0	1100	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	8.2	0.0	0.0	8.5	0.0	0.0	8.4	0.0	0.0	8.8	0.0	0.0
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.1	0.0	0.0	2.5	0.0	0.0	0.5	0.0	0.0	1.1	0.0	0.0
LnGrp Delay(d),s/veh	8.3	0.0	0.0	8.6	0.0	0.0	8.4	0.0	0.0	8.9	0.0	0.0
LnGrp LOS	A			A			A			A		
Approach Vol, veh/h		267			310			64			146	
Approach Delay, s/veh		8.3			8.6			8.4			8.9	
Approach LOS		A			A			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		20.3		22.2		20.3		22.2
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		30.0		25.0		30.0		25.0
Max Q Clear Time (g_c+I1), s		3.0		6.4		4.7		7.3
Green Ext Time (p_c), s		0.8		2.6		0.8		2.5

Intersection Summary	
HCM 2010 Ctrl Delay	8.5
HCM 2010 LOS	A

1: Chester Street & 7th Street

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱			✥			✥	
Traffic Volume (veh/h)	8	315	106	160	201	28	108	30	271	10	16	5
Future Volume (veh/h)	8	315	106	160	201	28	108	30	271	10	16	5
Number	1	6	16	5	2	12	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.84	1.00		0.88	0.87		0.87	1.00		0.87
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1845	1845	1900	1845	1845	1900	1900	1845	1900	1900	1845	1900
Adj Flow Rate, veh/h	8	315	106	160	201	28	108	30	271	10	16	5
Adj No. of Lanes	1	1	0	1	1	0	0	1	0	0	1	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	14	430	145	276	765	107	162	54	297	173	254	69
Arrive On Green	0.01	0.34	0.34	0.16	0.49	0.49	0.33	0.33	0.33	0.33	0.33	0.33
Sat Flow, veh/h	1757	1255	422	1757	1555	217	294	166	903	318	773	210
Grp Volume(v), veh/h	8	0	421	160	0	229	409	0	0	31	0	0
Grp Sat Flow(s),veh/h/ln	1757	0	1678	1757	0	1771	1362	0	0	1302	0	0
Q Serve(g_s), s	0.3	0.0	15.4	5.9	0.0	5.3	16.3	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	0.3	0.0	15.4	5.9	0.0	5.3	20.1	0.0	0.0	0.9	0.0	0.0
Prop In Lane	1.00		0.25	1.00		0.12	0.26		0.66	0.32		0.16
Lane Grp Cap(c), veh/h	14	0	575	276	0	871	513	0	0	496	0	0
V/C Ratio(X)	0.55	0.00	0.73	0.58	0.00	0.26	0.80	0.00	0.00	0.06	0.00	0.00
Avail Cap(c_a), veh/h	100	0	575	276	0	871	513	0	0	496	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.98	0.00	0.98	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	34.6	0.0	20.2	27.4	0.0	10.4	22.4	0.0	0.0	16.1	0.0	0.0
Incr Delay (d2), s/veh	11.7	0.0	8.0	2.0	0.0	0.7	12.2	0.0	0.0	0.2	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	8.4	3.0	0.0	2.7	9.2	0.0	0.0	0.4	0.0	0.0
LnGrp Delay(d),s/veh	46.3	0.0	28.2	29.3	0.0	11.1	34.6	0.0	0.0	16.3	0.0	0.0
LnGrp LOS	D		C	C		B	C			B		
Approach Vol, veh/h		429			389			409			31	
Approach Delay, s/veh		28.5			18.6			34.6			16.3	
Approach LOS		C			B			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	4.6	38.4		27.0	15.0	28.0		27.0
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	4.0	31.0		23.0	11.0	24.0		23.0
Max Q Clear Time (g_c+I1), s	2.3	7.3		2.9	7.9	17.4		22.1
Green Ext Time (p_c), s	0.0	1.1		2.3	0.2	1.1		0.2

Intersection Summary	
HCM 2010 Ctrl Delay	27.1
HCM 2010 LOS	C

2: 7th Street & Center Street

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		↰↱	
Traffic Volume (vph)	24	574	337	34	20	33
Future Volume (vph)	24	574	337	34	20	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		3.0	
Lane Util. Factor	1.00	1.00	1.00		1.00	
Frpb, ped/bikes	1.00	1.00	0.99		0.85	
Flpb, ped/bikes	0.93	1.00	1.00		1.00	
Frt	1.00	1.00	0.99		0.92	
Flt Protected	0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1631	1845	1799		1407	
Flt Permitted	0.54	1.00	1.00		0.98	
Satd. Flow (perm)	928	1845	1799		1407	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	24	574	337	34	20	33
RTOR Reduction (vph)	0	0	2	0	29	0
Lane Group Flow (vph)	24	574	369	0	24	0
Confl. Peds. (#/hr)	55			55	82	164
Confl. Bikes (#/hr)				10		7
Turn Type	Perm	NA	NA		Prot	
Protected Phases		6	2		4	
Permitted Phases	6					
Actuated Green, G (s)	37.4	37.4	37.4		5.4	
Effective Green, g (s)	37.4	37.4	37.4		5.4	
Actuated g/C Ratio	0.74	0.74	0.74		0.11	
Clearance Time (s)	5.0	5.0	5.0		3.0	
Vehicle Extension (s)	2.0	2.0	2.0		2.0	
Lane Grp Cap (vph)	683	1358	1324		149	
v/s Ratio Prot		c0.31	0.21		c0.02	
v/s Ratio Perm	0.03					
v/c Ratio	0.04	0.42	0.28		0.16	
Uniform Delay, d1	1.8	2.6	2.2		20.6	
Progression Factor	1.00	1.00	1.00		1.00	
Incremental Delay, d2	0.0	0.1	0.0		0.2	
Delay (s)	1.8	2.6	2.3		20.8	
Level of Service	A	A	A		C	
Approach Delay (s)		2.6	2.3		20.8	
Approach LOS		A	A		C	

Intersection Summary			
HCM 2000 Control Delay	3.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	50.8	Sum of lost time (s)	10.0
Intersection Capacity Utilization	54.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM 2010 Signalized Intersection Summary
3: Mandela Pkwy & 7th Street

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑	↱		✥		↰	↱	
Traffic Volume (veh/h)	95	445	34	146	263	106	37	196	117	132	234	51
Future Volume (veh/h)	95	445	34	146	263	106	37	196	117	132	234	51
Number	1	6	16	5	2	12	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.93	1.00		0.87	1.00		0.95	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1845	1845	1900	1845	1845	1845	1900	1845	1900	1845	1845	1900
Adj Flow Rate, veh/h	95	445	34	146	263	106	37	196	117	132	234	51
Adj No. of Lanes	1	1	0	1	1	1	0	1	0	1	1	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	209	720	55	179	738	545	71	262	145	245	427	93
Arrive On Green	0.12	0.43	0.43	0.10	0.40	0.40	0.29	0.29	0.29	0.29	0.29	0.29
Sat Flow, veh/h	1757	1682	129	1757	1845	1363	91	899	497	1052	1463	319
Grp Volume(v), veh/h	95	0	479	146	263	106	350	0	0	132	0	285
Grp Sat Flow(s),veh/h/ln	1757	0	1810	1757	1845	1363	1487	0	0	1052	0	1782
Q Serve(g_s), s	4.5	0.0	18.5	7.3	9.0	4.6	8.1	0.0	0.0	2.8	0.0	12.1
Cycle Q Clear(g_c), s	4.5	0.0	18.5	7.3	9.0	4.6	20.2	0.0	0.0	23.0	0.0	12.1
Prop In Lane	1.00		0.07	1.00		1.00	0.11		0.33	1.00		0.18
Lane Grp Cap(c), veh/h	209	0	775	179	738	545	478	0	0	245	0	520
V/C Ratio(X)	0.45	0.00	0.62	0.81	0.36	0.19	0.73	0.00	0.00	0.54	0.00	0.55
Avail Cap(c_a), veh/h	209	0	775	332	738	545	527	0	0	277	0	574
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	0.97	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	36.9	0.0	20.0	39.6	18.9	17.6	29.4	0.0	0.0	32.2	0.0	26.9
Incr Delay (d2), s/veh	0.6	0.0	3.7	3.4	1.3	0.8	3.7	0.0	0.0	0.7	0.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.2	0.0	10.0	3.7	4.8	1.8	8.6	0.0	0.0	3.2	0.0	6.0
LnGrp Delay(d),s/veh	37.5	0.0	23.7	43.0	20.2	18.4	33.1	0.0	0.0	32.9	0.0	27.2
LnGrp LOS	D		C	D	C	B	C			C		C
Approach Vol, veh/h		574			515			350			417	
Approach Delay, s/veh		26.0			26.3			33.1			29.0	
Approach LOS		C			C			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	14.7	40.0		35.3	12.2	42.5		35.3
Change Period (Y+Rc), s	4.0	* 4		9.0	3.0	4.0		9.0
Max Green Setting (Gmax), s	9.0	* 36		29.0	17.0	28.0		29.0
Max Q Clear Time (g_c+I1), s	16.5	11.0		25.0	9.3	20.5		22.2
Green Ext Time (p_c), s	0.1	1.2		1.2	0.1	1.4		1.8

Intersection Summary	
HCM 2010 Ctrl Delay	28.1
HCM 2010 LOS	C

Notes

HCM 2010 TWSC
4: Chester Street & 5th Street

Intersection	
Int Delay, s/veh	5.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	7	29	4	22	54	134	2	7	10	135	5	11
Future Vol, veh/h	7	29	4	22	54	134	2	7	10	135	5	11
Conflicting Peds, #/hr	31	0	11	11	0	31	19	0	15	15	0	19
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	3	3	3	3	3	3	3	3	3	3	3	3
Mvmt Flow	7	29	4	22	54	134	2	7	10	135	5	11

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	219	0	0	44	0	0	248	319	57	265	254	171
Stage 1	-	-	-	-	-	-	56	56	-	196	196	-
Stage 2	-	-	-	-	-	-	192	263	-	69	58	-
Critical Hdwy	4.13	-	-	4.13	-	-	7.13	6.53	6.23	7.13	6.53	6.23
Critical Hdwy Stg 1	-	-	-	-	-	-	6.13	5.53	-	6.13	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.13	5.53	-	6.13	5.53	-
Follow-up Hdwy	2.227	-	-	2.227	-	-	3.527	4.027	3.327	3.527	4.027	3.327
Pot Cap-1 Maneuver	1344	-	-	1558	-	-	704	596	1006	686	648	870
Stage 1	-	-	-	-	-	-	954	846	-	803	737	-
Stage 2	-	-	-	-	-	-	807	689	-	939	845	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1323	-	-	1539	-	-	662	563	984	637	612	834
Mov Cap-2 Maneuver	-	-	-	-	-	-	662	563	-	637	612	-
Stage 1	-	-	-	-	-	-	941	834	-	778	706	-
Stage 2	-	-	-	-	-	-	766	660	-	906	833	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.4	0.8	10	12.3
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	742	1323	-	-	1539	-	-	647
HCM Lane V/C Ratio	0.026	0.005	-	-	0.014	-	-	0.233
HCM Control Delay (s)	10	7.7	0	-	7.4	0	-	12.3
HCM Lane LOS	B	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0.9

Intersection	
Intersection Delay, s/veh	8.9
Intersection LOS	A

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱			↰	↰↱	
Traffic Vol, veh/h	234	6	21	230	6	14
Future Vol, veh/h	234	6	21	230	6	14
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	234	6	21	230	6	14
Number of Lanes	1	0	0	1	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	
Opposing Lanes	1	1	0
Conflicting Approach Left		NB	EB
Conflicting Lanes Left	0	1	1
Conflicting Approach Right	NB		WB
Conflicting Lanes Right	1	0	1
HCM Control Delay	8.8	9	7.8
HCM LOS	A	A	A

Lane	NBLn1	EBLn1	WBLn1
Vol Left, %	30%	0%	8%
Vol Thru, %	0%	97%	92%
Vol Right, %	70%	3%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	20	240	251
LT Vol	6	0	21
Through Vol	0	234	230
RT Vol	14	6	0
Lane Flow Rate	20	240	251
Geometry Grp	1	1	1
Degree of Util (X)	0.026	0.277	0.292
Departure Headway (Hd)	4.644	4.159	4.182
Convergence, Y/N	Yes	Yes	Yes
Cap	775	854	851
Service Time	2.644	2.234	2.253
HCM Lane V/C Ratio	0.026	0.281	0.295
HCM Control Delay	7.8	8.8	9
HCM Lane LOS	A	A	A
HCM 95th-tile Q	0.1	1.1	1.2

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	67	206	39	38	196	102	34	102	46	45	108	49
Future Volume (veh/h)	67	206	39	38	196	102	34	102	46	45	108	49
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	0.94		0.87	0.93		0.89	0.92		0.86	0.92		0.87
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1845	1900	1900	1845	1900	1900	1845	1900	1900	1845	1900
Adj Flow Rate, veh/h	67	206	39	38	196	102	34	102	46	45	108	49
Adj No. of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	191	511	86	132	445	211	161	396	155	183	377	147
Arrive On Green	0.43	0.43	0.43	0.43	0.43	0.43	0.39	0.39	0.39	0.39	0.39	0.39
Sat Flow, veh/h	210	1188	200	91	1034	491	162	1028	403	212	980	382
Grp Volume(v), veh/h	312	0	0	336	0	0	182	0	0	202	0	0
Grp Sat Flow(s),veh/h/ln	1597	0	0	1616	0	0	1593	0	0	1573	0	0
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	5.3	0.0	0.0	6.2	0.0	0.0	3.2	0.0	0.0	3.6	0.0	0.0
Prop In Lane	0.21		0.12	0.11		0.30	0.19		0.25	0.22		0.24
Lane Grp Cap(c), veh/h	788	0	0	788	0	0	712	0	0	707	0	0
V/C Ratio(X)	0.40	0.00	0.00	0.43	0.00	0.00	0.26	0.00	0.00	0.29	0.00	0.00
Avail Cap(c_a), veh/h	1009	0	0	1016	0	0	1179	0	0	1168	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	8.5	0.0	0.0	8.8	0.0	0.0	9.2	0.0	0.0	9.3	0.0	0.0
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	0.0	0.0	2.8	0.0	0.0	1.5	0.0	0.0	1.7	0.0	0.0
LnGrp Delay(d),s/veh	8.7	0.0	0.0	8.9	0.0	0.0	9.3	0.0	0.0	9.4	0.0	0.0
LnGrp LOS	A			A			A			A		
Approach Vol, veh/h		312			336			182			202	
Approach Delay, s/veh		8.7			8.9			9.3			9.4	
Approach LOS		A			A			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		20.7		22.6		20.7		22.6
Change Period (Y+Rc), s		4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s		30.0		25.0		30.0		25.0
Max Q Clear Time (g_c+I1), s		5.2		7.3		5.6		8.2
Green Ext Time (p_c), s		1.6		3.0		1.6		2.9

Intersection Summary	
HCM 2010 Ctrl Delay	9.0
HCM 2010 LOS	A

Worksheet 1A -- General Information and Input Data for Urban and Suburban Roadway Segments

General Information		Location Information	
Analyst	Jordan Brooks	Roadway	7th Street
Agency or Company	Fehr & Peers	Roadway Section	Between Chester Street and Center Street
Date Performed	01/02/19	Jurisdiction	Oakland, CA
		Analysis Year	2019

Input Data		Base Conditions	Site Conditions
Roadway type (2U, 3T, 4U, 4D, ST)		--	3T
Length of segment, L (mi)		--	0.06
AADT (veh/day)	$AADT_{MAX}$ = 32,900 (veh/day)	--	7,415
Type of on-street parking (none/parallel/angle)		None	Parallel (Comm/Ind)
Proportion of curb length with on-street parking		--	0.34
Median width (ft) - for divided only		15	Not Present
Lighting (present / not present)		Not Present	Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)		--	0
Minor commercial driveways (number)		--	3
Major industrial / institutional driveways (number)		--	0
Minor industrial / institutional driveways (number)		--	0
Major residential driveways (number)		--	0
Minor residential driveways (number)		--	0
Other driveways (number)		--	0
Speed Category		--	Posted Speed 30 mph or Lower
Roadside fixed object density (fixed objects / mi)		0	132
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		30	14
Calibration Factor, Cr		1.00	1.00

Worksheet 1B -- Crash Modification Factors for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMF 5r*	*CMF comb*
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.36	1.28	1.00	0.93	1.00	1.63

Worksheet 1C -- Multiple-Vehicle Nondriveway Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brmv}**	**Proportion of Total Crashes**	**Adjusted N_{brmv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brmv}**
	from Table 12-3		from Table 12-3	from Equation 12-10		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-12.40	1.41	0.66	0.073	1.000	0.073	1.63	1.00	0.119
Fatal and Injury (FI)	-16.45	1.69	0.59	0.015	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.216	0.016	1.63	1.00	0.026
Property Damage Only (PDO)	-11.95	1.33	0.59	0.056	$(5)_{TOTAL}-(5)_{FI}$ 0.784	0.057	1.63	1.00	0.093

Worksheet 1D -- Multiple-Vehicle Nondriveway Collisions by Collision Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{brmv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{brmv\ (PDO)}$ (crashes/year)**	**Predicted $N_{brmv\ (TOTAL)}$ (crashes/year)**
	from Table 12-4	$(9)_{FI}$ from Worksheet 1C	from Table 12-4	$(9)_{PDO}$ from Worksheet 1C	$(9)_{TOTAL}$ from Worksheet 1C
Total	1.000	0.026	1.000	0.093	0.119
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.845	0.022	0.842	0.078	0.100
Head-on collision	0.034	0.001	0.020	0.002	0.003
Angle collision	0.069	0.002	0.020	0.002	0.004
Sideswipe, same direction	0.001	0.000	0.078	0.007	0.007
Sideswipe, opposite direction	0.017	0.000	0.020	0.002	0.002
Other multiple-vehicle collision	0.034	0.001	0.020	0.002	0.003

Worksheet 1E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brsv}**	**Proportion of Total Crashes**	**Adjusted N_{brsv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brsv}**
	from Table 12-5		from Table 12-5	from Equation 12-13		$(4)_{TOTAL}*(5)$	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-5.74	0.54	1.37	0.024	1.000	0.024	1.63	1.00	0.040
Fatal and Injury (FI)	-6.37	0.47	1.06	0.007	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.293	0.007	1.63	1.00	0.012
Property Damage Only (PDO)	-6.29	0.56	1.93	0.017	$(5)_{TOTAL}-(5)_{FI}$ 0.707	0.017	1.63	1.00	0.028

Worksheet 1F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{brsv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{brsv\ (PDO)}$ (crashes/year)**	**Predicted $N_{brsv\ (TOTAL)}$ (crashes/year)**
	from Table 12-6	$(9)_{FI}$ from Worksheet 1E	from Table 12-6	$(9)_{PDO}$ from Worksheet 1E	$(9)_{TOTAL}$ from Worksheet 1E
Total	1.000	0.012	1.000	0.028	0.040
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Collision with animal	0.001	0.000	0.001	0.000	0.000
Collision with fixed object	0.688	0.008	0.963	0.027	0.035
Collision with other object	0.001	0.000	0.001	0.000	0.000
Other single-vehicle collision	0.310	0.004	0.035	0.001	0.005

Worksheet 1G -- Multiple-Vehicle Driveway-Related Collisions by Driveway Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	**Number of driveways, n_j**	**Crashes per driveway per year, N_j**	**Coefficient for traffic adjustment, t**	**Initial N_{brdwy}**	**Overdispersion parameter, k**
		from Table 12-7	from Table 12-7	Equation 12-16	from Table 12-7
				$n_j * N_j * (AADT/15,000)^t$	
Major commercial	0	0.102	1.000	0.000	--
Minor commercial	3	0.032	1.000	0.047	
Major industrial/institutional	0	0.110	1.000	0.000	
Minor industrial/institutional	0	0.015	1.000	0.000	
Major residential	0	0.053	1.000	0.000	
Minor residential	0	0.010	1.000	0.000	
Other	0	0.016	1.000	0.000	
Total	--	--	--	0.047	1.10

Worksheet 1H -- Multiple-Vehicle Driveway-Related Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Initial N_{brdwy}**	**Proportion of total crashes (f_{dwy})**	**Adjusted N_{brdwy}**	**Combined CMFs**	**Calibration factor, C_r**	**Predicted N_{brdwy}**
	$(5)_{TOTAL}$ from Worksheet 1G	from Table 12-7	$(2)_{TOTAL}$ * (3)	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.047	1.000	0.047	1.63	1.00	0.078
Fatal and injury (FI)	--	0.243	0.012	1.63	1.00	0.019
Property damage only (PDO)	--	0.757	0.036	1.63	1.00	0.059

Worksheet 1I -- Vehicle-Pedestrian Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{pedr}**	**Calibration factor, C_r**	**Predicted N_{pedr}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8		(5)*(6)*(7)
Total	0.119	0.040	0.078	0.236	0.041	1.00	0.010
Fatal and injury (FI)	--	--	--	--	--	1.00	0.010

Worksheet 1J -- Vehicle-Bicycle Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{biker}**	**Calibration factor, C_r**	**Predicted N_{biker}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9		(5)*(6)*(7)
Total	0.119	0.040	0.078	0.236	0.027	1.00	0.006
Fatal and injury (FI)	--	--	--	--	--	1.00	0.006

Worksheet 1K -- Crash Severity Distribution for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
	MULTIPLE-VEHICLE		
Rear-end collisions (from Worksheet 1D)	0.022	0.078	0.100
Head-on collisions (from Worksheet 1D)	0.001	0.002	0.003
Angle collisions (from Worksheet 1D)	0.002	0.002	0.004
Sideswipe, same direction (from Worksheet 1D)	0.000	0.007	0.007
Sideswipe, opposite direction (from Worksheet 1D)	0.000	0.002	0.002
Driveway-related collisions (from Worksheet 1H)	0.019	0.059	0.078
Other multiple-vehicle collision (from Worksheet 1D)	0.001	0.002	0.003
Subtotal	0.044	0.152	0.196
	SINGLE-VEHICLE		
Collision with animal (from Worksheet 1F)	0.000	0.000	0.000
Collision with fixed object (from Worksheet 1F)	0.008	0.027	0.035
Collision with other object (from Worksheet 1F)	0.000	0.000	0.000
Other single-vehicle collision (from Worksheet 1F)	0.004	0.001	0.005
Collision with pedestrian (from Worksheet 1I)	0.010	0.000	0.010
Collision with bicycle (from Worksheet 1J)	0.006	0.000	0.006
Subtotal	0.028	0.028	0.056
Total	0.072	0.180	0.252

Worksheet 1L -- Summary Results for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)
Crash Severity Level	**Predicted average crash frequency, $N_{predicted\ rs}$ (crashes/year)**	**Roadway segment length, L (mi)**	**Crash rate (crashes/mi/year)**
	(Total) from Worksheet 1K		(2) / (3)
Total	0.252	0.06	4.1
Fatal and injury (FI)	0.1	0.06	1.2
Property damage only (PDO)	0.2	0.06	2.9

Worksheet 1A -- General Information and Input Data for Urban and Suburban Roadway Segments

General Information		Location Information	
Analyst	Jordan Brooks	Roadway	7th Street
Agency or Company	Fehr & Peers	Roadway Section	Between Center Street and Mandela Parkway
Date Performed	01/02/19	Jurisdiction	Oakland, CA
		Analysis Year	2019

Input Data		Base Conditions	Site Conditions
Roadway type (2U, 3T, 4U, 4D, ST)		--	3T
Length of segment, L (mi)		--	0.08
AADT (veh/day)	$AADT_{MAX}$ = 32,900 (veh/day)	--	7,170
Type of on-street parking (none/parallel/angle)		None	Parallel (Comm/Ind)
Proportion of curb length with on-street parking		--	0.35
Median width (ft) - for divided only		15	Not Present
Lighting (present / not present)		Not Present	Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)		--	0
Minor commercial driveways (number)		--	0
Major industrial / institutional driveways (number)		--	0
Minor industrial / institutional driveways (number)		--	0
Major residential driveways (number)		--	0
Minor residential driveways (number)		--	0
Other driveways (number)		--	0
Speed Category		--	Posted Speed 30 mph or Lower
Roadside fixed object density (fixed objects / mi)		0	151
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		30	19
Calibration Factor, Cr		1.00	1.00

Worksheet 1B -- Crash Modification Factors for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMF 5r*	*CMF comb*
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.37	1.27	1.00	0.93	1.00	1.62

Worksheet 1C -- Multiple-Vehicle Nondriveway Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brmv}**	**Proportion of Total Crashes**	**Adjusted N_{brmv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brmv}**
	from Table 12-3		from Table 12-3	from Equation 12-10		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-12.40	1.41	0.66	0.085	1.000	0.085	1.62	1.00	0.138
Fatal and Injury (FI)	-16.45	1.69	0.59	0.018	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.213	0.018	1.62	1.00	0.030
Property Damage Only (PDO)	-11.95	1.33	0.59	0.066	$(5)_{TOTAL}-(5)_{FI}$ 0.787	0.067	1.62	1.00	0.109

Worksheet 1D -- Multiple-Vehicle Nondriveway Collisions by Collision Type for Urban and Suburban Roadway Segments					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{brmv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{brmv\ (PDO)}$ (crashes/year)**	**Predicted $N_{brmv\ (TOTAL)}$ (crashes/year)**
	from Table 12-4	$(9)_{FI}$ from Worksheet 1C	from Table 12-4	$(9)_{PDO}$ from Worksheet 1C	$(9)_{TOTAL}$ from Worksheet 1C
Total	1.000	0.030	1.000	0.109	0.138
		$(2)^*(3)_{FI}$		$(4)^*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.845	0.025	0.842	0.092	0.117
Head-on collision	0.034	0.001	0.020	0.002	0.003
Angle collision	0.069	0.002	0.020	0.002	0.004
Sideswipe, same direction	0.001	0.000	0.078	0.008	0.009
Sideswipe, opposite direction	0.017	0.001	0.020	0.002	0.003
Other multiple-vehicle collision	0.034	0.001	0.020	0.002	0.003

Worksheet 1E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Roadway Segments									
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brsv}**	**Proportion of Total Crashes**	**Adjusted N_{brsv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brsv}**
	from Table 12-5		from Table 12-5	from Equation 12-13		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-5.74	0.54	1.37	0.029	1.000	0.029	1.62	1.00	0.048
Fatal and Injury (FI)	-6.37	0.47	1.06	0.008	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.293	0.009	1.62	1.00	0.014
Property Damage Only (PDO)	-6.29	0.56	1.93	0.020	$(5)_{TOTAL}-(5)_{FI}$ 0.707	0.021	1.62	1.00	0.034

Worksheet 1F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Roadway Segments					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{brsv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{brsv\ (PDO)}$ (crashes/year)**	**Predicted $N_{brsv\ (TOTAL)}$ (crashes/year)**
	from Table 12-6	$(9)_{FI}$ from Worksheet 1E	from Table 12-6	$(9)_{PDO}$ from Worksheet 1E	$(9)_{TOTAL}$ from Worksheet 1E
Total	1.000	0.014	1.000	0.034	0.048
		$(2)^*(3)_{FI}$		$(4)^*(5)_{PDO}$	(3)+(5)
Collision with animal	0.001	0.000	0.001	0.000	0.000
Collision with fixed object	0.688	0.010	0.963	0.033	0.042
Collision with other object	0.001	0.000	0.001	0.000	0.000
Other single-vehicle collision	0.310	0.004	0.035	0.001	0.006

Worksheet 1G -- Multiple-Vehicle Driveway-Related Collisions by Driveway Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	**Number of driveways, n_j**	**Crashes per driveway per year, N_j**	**Coefficient for traffic adjustment, t**	**Initial N_{brdwy}**	**Overdispersion parameter, k**
		from Table 12-7	from Table 12-7	Equation 12-16	from Table 12-7
				$n_j * N_j * (AADT/15,000)^t$	
Major commercial	0	0.102	1.000	0.000	--
Minor commercial	0	0.032	1.000	0.000	
Major industrial/institutional	0	0.110	1.000	0.000	
Minor industrial/institutional	0	0.015	1.000	0.000	
Major residential	0	0.053	1.000	0.000	
Minor residential	0	0.010	1.000	0.000	
Other	0	0.016	1.000	0.000	
Total	--	--	--	0.000	1.10

Worksheet 1H -- Multiple-Vehicle Driveway-Related Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Initial N_{brdwy}**	**Proportion of total crashes (f_{dwy})**	**Adjusted N_{brdwy}**	**Combined CMFs**	**Calibration factor, C_r**	**Predicted N_{brdwy}**
	$(5)_{TOTAL}$ from Worksheet 1G	from Table 12-7	$(2)_{TOTAL}$ * (3)	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.000	1.000	0.000	1.62	1.00	0.000
Fatal and injury (FI)	--	0.243	0.000	1.62	1.00	0.000
Property damage only (PDO)	--	0.757	0.000	1.62	1.00	0.000

Worksheet 1I -- Vehicle-Pedestrian Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{pedr}**	**Calibration factor, C_r**	**Predicted N_{pedr}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8		(5)*(6)*(7)
Total	0.138	0.048	0.000	0.186	0.041	1.00	0.008
Fatal and injury (FI)	--	--	--	--	--	1.00	0.008

Worksheet 1J -- Vehicle-Bicycle Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{biker}**	**Calibration factor, C_r**	**Predicted N_{biker}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9		(5)*(6)*(7)
Total	0.138	0.048	0.000	0.186	0.027	1.00	0.005
Fatal and injury (FI)	--	--	--	--	--	1.00	0.005

Worksheet 1K -- Crash Severity Distribution for Urban and Suburban Roadway Segments			
(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)** (3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	**Property damage only (PDO)** (5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	**Total** (6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	0.025	0.092	0.117
Head-on collisions (from Worksheet 1D)	0.001	0.002	0.003
Angle collisions (from Worksheet 1D)	0.002	0.002	0.004
Sideswipe, same direction (from Worksheet 1D)	0.000	0.008	0.009
Sideswipe, opposite direction (from Worksheet 1D)	0.001	0.002	0.003
Driveway-related collisions (from Worksheet 1H)	0.000	0.000	0.000
Other multiple-vehicle collision (from Worksheet 1D)	0.001	0.002	0.003
Subtotal	0.030	0.109	0.138
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.000	0.000	0.000
Collision with fixed object (from Worksheet 1F)	0.010	0.033	0.042
Collision with other object (from Worksheet 1F)	0.000	0.000	0.000
Other single-vehicle collision (from Worksheet 1F)	0.004	0.001	0.006
Collision with pedestrian (from Worksheet 1I)	0.008	0.000	0.008
Collision with bicycle (from Worksheet 1J)	0.005	0.000	0.005
Subtotal	0.027	0.034	0.060
Total	0.056	0.143	0.199

Worksheet 1L -- Summary Results for Urban and Suburban Roadway Segments			
(1)	(2)	(3)	(4)
Crash Severity Level	**Predicted average crash frequency, N $_{predicted\ rs}$ (crashes/year)** (Total) from Worksheet 1K	**Roadway segment length, L (mi)**	**Crash rate (crashes/mi/year)** (2) / (3)
Total	0.199	0.08	2.6
Fatal and injury (FI)	0.1	0.08	0.7
Property damage only (PDO)	0.1	0.08	1.9

Worksheet 1A -- General Information and Input Data for Urban and Suburban Roadway Segments

General Information		Location Information	
Analyst	Jordan Brooks	Roadway	5th Street
Agency or Company	Fehr & Peers	Roadway Section	Between Chester Street and Center Street
Date Performed	01/02/19	Jurisdiction	Oakland, CA
		Analysis Year	2019

Input Data	Base Conditions	Site Conditions
Roadway type (2U, 3T, 4U, 4D, ST)	--	2U
Length of segment, L (mi)	--	0.06
AADT (veh/day) $AADT_{MAX}$ = 32,600 (veh/day)	--	2,565
Type of on-street parking (none/parallel/angle)	None	Parallel (Residential)
Proportion of curb length with on-street parking	--	0.95
Median width (ft) - for divided only	15	Not Present
Lighting (present / not present)	Not Present	Present
Auto speed enforcement (present / not present)	Not Present	Not Present
Major commercial driveways (number)	--	0
Minor commercial driveways (number)	--	0
Major industrial / institutional driveways (number)	--	1
Minor industrial / institutional driveways (number)	--	0
Major residential driveways (number)	--	0
Minor residential driveways (number)	--	4
Other driveways (number)	--	0
Speed Category	--	Posted Speed 30 mph or Lower
Roadside fixed object density (fixed objects / mi)	0	27
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]	30	15
Calibration Factor, Cr	1.00	1.00

Worksheet 1B -- Crash Modification Factors for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMF 5r*	*CMF comb*
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.44	1.05	1.00	0.93	1.00	1.41

Worksheet 1C -- Multiple-Vehicle Nondriveway Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brmv}**	**Proportion of Total Crashes**	**Adjusted N_{brmv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brmv}**
	from Table 12-3		from Table 12-3	from Equation 12-10		$(4)_{TOTAL}*(5)$	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-15.22	1.68	0.84	0.008	1.000	0.008	1.41	1.00	0.012
Fatal and Injury (FI)	-16.22	1.66	0.65	0.003	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.302	0.002	1.41	1.00	0.003
Property Damage Only (PDO)	-15.62	1.69	0.87	0.006	$(5)_{TOTAL}-(5)_{FI}$ 0.698	0.006	1.41	1.00	0.008

Worksheet 1D -- Multiple-Vehicle Nondriveway Collisions by Collision Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{brmv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{brmv\ (PDO)}$ (crashes/year)**	**Predicted N $_{brmv\ (TOTAL)}$ (crashes/year)**
	from Table 12-4	$(9)_{FI}$ from Worksheet 1C	from Table 12-4	$(9)_{PDO}$ from Worksheet 1C	$(9)_{TOTAL}$ from Worksheet 1C
Total	1.000	0.003	1.000	0.008	0.012
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.730	0.003	0.778	0.006	0.009
Head-on collision	0.068	0.000	0.004	0.000	0.000
Angle collision	0.085	0.000	0.079	0.001	0.001
Sideswipe, same direction	0.015	0.000	0.031	0.000	0.000
Sideswipe, opposite direction	0.073	0.000	0.055	0.000	0.001
Other multiple-vehicle collision	0.029	0.000	0.053	0.000	0.001

Worksheet 1E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brsv}**	**Proportion of Total Crashes**	**Adjusted N_{brsv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brsv}**
	from Table 12-5		from Table 12-5	from Equation 12-13		$(4)_{TOTAL}*(5)$	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-5.47	0.56	0.81	0.021	1.000	0.021	1.41	1.00	0.030
Fatal and Injury (FI)	-3.96	0.23	0.50	0.007	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.339	0.007	1.41	1.00	0.010
Property Damage Only (PDO)	-6.51	0.64	0.87	0.014	$(5)_{TOTAL}-(5)_{FI}$ 0.661	0.014	1.41	1.00	0.020

Worksheet 1F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{brsv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{brsv\ (PDO)}$ (crashes/year)**	**Predicted N $_{brsv\ (TOTAL)}$ (crashes/year)**
	from Table 12-6	$(9)_{FI}$ from Worksheet 1E	from Table 12-6	$(9)_{PDO}$ from Worksheet 1E	$(9)_{TOTAL}$ from Worksheet 1E
Total	1.000	0.010	1.000	0.020	0.030
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Collision with animal	0.026	0.000	0.066	0.001	0.002
Collision with fixed object	0.723	0.007	0.759	0.015	0.022
Collision with other object	0.010	0.000	0.013	0.000	0.000
Other single-vehicle collision	0.241	0.002	0.162	0.003	0.006

Worksheet 1G -- Multiple-Vehicle Driveway-Related Collisions by Driveway Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	**Number of driveways, n_j**	**Crashes per driveway per year, N_j**	**Coefficient for traffic adjustment, t**	**Initial N_{brdwy}**	**Overdispersion parameter, k**
		from Table 12-7	from Table 12-7	Equation 12-16 n_j * N_j * $(AADT/15,000)^t$	from Table 12-7
Major commercial	0	0.158	1.000	0.000	--
Minor commercial	0	0.050	1.000	0.000	
Major industrial/institutional	1	0.172	1.000	0.029	
Minor industrial/institutional	0	0.023	1.000	0.000	
Major residential	0	0.083	1.000	0.000	
Minor residential	4	0.016	1.000	0.011	
Other	0	0.025	1.000	0.000	
Total	--	--	--	0.040	0.81

Worksheet 1H -- Multiple-Vehicle Driveway-Related Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Initial N_{brdwy}**	**Proportion of total crashes (f_{dwy})**	**Adjusted N_{brdwy}**	**Combined CMFs**	**Calibration factor, C_r**	**Predicted N_{brdwy}**
	$(5)_{TOTAL}$ from Worksheet 1G	from Table 12-7	$(2)_{TOTAL}$ * (3)	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.040	1.000	0.040	1.41	1.00	0.057
Fatal and injury (FI)	--	0.323	0.013	1.41	1.00	0.018
Property damage only (PDO)	--	0.677	0.027	1.41	1.00	0.039

Worksheet 1I -- Vehicle-Pedestrian Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{pedr}**	**Calibration factor, C_r**	**Predicted N_{pedr}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8		(5)*(6)*(7)
Total	0.012	0.030	0.057	0.099	0.036	1.00	0.004
Fatal and injury (FI)	--	--	--	--	--	1.00	0.004

Worksheet 1J -- Vehicle-Bicycle Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{biker}**	**Calibration factor, C_r**	**Predicted N_{biker}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9		(5)*(6)*(7)
Total	0.012	0.030	0.057	0.099	0.018	1.00	0.002
Fatal and injury (FI)	--	--	--	--	--	1.00	0.002

Worksheet 1K -- Crash Severity Distribution for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	0.003	0.006	0.009
Head-on collisions (from Worksheet 1D)	0.000	0.000	0.000
Angle collisions (from Worksheet 1D)	0.000	0.001	0.001
Sideswipe, same direction (from Worksheet 1D)	0.000	0.000	0.000
Sideswipe, opposite direction (from Worksheet 1D)	0.000	0.000	0.001
Driveway-related collisions (from Worksheet 1H)	0.018	0.039	0.057
Other multiple-vehicle collision (from Worksheet 1D)	0.000	0.000	0.001
Subtotal	0.022	0.047	0.068
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.000	0.001	0.002
Collision with fixed object (from Worksheet 1F)	0.007	0.015	0.022
Collision with other object (from Worksheet 1F)	0.000	0.000	0.000
Other single-vehicle collision (from Worksheet 1F)	0.002	0.003	0.006
Collision with pedestrian (from Worksheet 1I)	0.004	0.000	0.004
Collision with bicycle (from Worksheet 1J)	0.002	0.000	0.002
Subtotal	0.016	0.020	0.035
Total	0.037	0.066	0.104

Worksheet 1L -- Summary Results for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)
Crash Severity Level	**Predicted average crash frequency, $N_{predicted\ rs}$ (crashes/year)**	**Roadway segment length, L (mi)**	**Crash rate (crashes/mi/year)**
	(Total) from Worksheet 1K		(2) / (3)
Total	0.104	0.06	1.7
Fatal and injury (FI)	0.0	0.06	0.6
Property damage only (PDO)	0.1	0.06	1.1

Worksheet 1A -- General Information and Input Data for Urban and Suburban Roadway Segments

General Information		**Location Information**	
Analyst	Jordan Brooks	Roadway	5th Street
Agency or Company	Fehr & Peers	Roadway Section	Between Center Street and Mandela Parkway
Date Performed	01/02/19	Jurisdiction	Oakland, CA
		Analysis Year	2019

Input Data		**Base Conditions**	**Site Conditions**
Roadway type (2U, 3T, 4U, 4D, ST)		--	2U
Length of segment, L (mi)		--	0.07
AADT (veh/day)	$AADT_{MAX}$ = 32,600 (veh/day)	--	3,715
Type of on-street parking (none/parallel/angle)		None	Angle (Comm/Ind)
Proportion of curb length with on-street parking		--	0.84
Median width (ft) - for divided only		15	Not Present
Lighting (present / not present)		Not Present	Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)		--	0
Minor commercial driveways (number)		--	0
Major industrial / institutional driveways (number)		--	1
Minor industrial / institutional driveways (number)		--	4
Major residential driveways (number)		--	0
Minor residential driveways (number)		--	0
Other driveways (number)		--	0
Speed Category		--	Posted Speed 30 mph or Lower
Roadside fixed object density (fixed objects / mi)		0	75
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		30	20
Calibration Factor, Cr		1.00	1.00

Worksheet 1B -- Crash Modification Factors for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMF 5r*	*CMF comb*
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
4.23	1.19	1.00	0.93	1.00	4.70

Worksheet 1C -- Multiple-Vehicle Nondriveway Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brmv}**	**Proportion of Total Crashes**	**Adjusted N_{brmv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brmv}**
	from Table 12-3		from Table 12-3	from Equation 12-10		$(4)_{TOTAL}*(5)$	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-15.22	1.68	0.84	0.017	1.000	0.017	4.70	1.00	0.082
Fatal and Injury (FI)	-16.22	1.66	0.65	0.005	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.300	0.005	4.70	1.00	0.024
Property Damage Only (PDO)	-15.62	1.69	0.87	0.013	$(5)_{TOTAL}-(5)_{FI}$ 0.700	0.012	4.70	1.00	0.057

Worksheet 1D -- Multiple-Vehicle Nondriveway Collisions by Collision Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{brmv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{brmv\ (PDO)}$ (crashes/year)**	**Predicted $N_{brmv\ (TOTAL)}$ (crashes/year)**
	from Table 12-4	$(9)_{FI}$ from Worksheet 1C	from Table 12-4	$(9)_{PDO}$ from Worksheet 1C	$(9)_{TOTAL}$ from Worksheet 1C
Total	1.000	0.024	1.000	0.057	0.082
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.730	0.018	0.778	0.044	0.062
Head-on collision	0.068	0.002	0.004	0.000	0.002
Angle collision	0.085	0.002	0.079	0.005	0.007
Sideswipe, same direction	0.015	0.000	0.031	0.002	0.002
Sideswipe, opposite direction	0.073	0.002	0.055	0.003	0.005
Other multiple-vehicle collision	0.029	0.001	0.053	0.003	0.004

Worksheet 1E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brsv}**	**Proportion of Total Crashes**	**Adjusted N_{brsv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brsv}**
	from Table 12-5		from Table 12-5	from Equation 12-13		$(4)_{TOTAL}*(5)$	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-5.47	0.56	0.81	0.030	1.000	0.030	4.70	1.00	0.140
Fatal and Injury (FI)	-3.96	0.23	0.50	0.009	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.306	0.009	4.70	1.00	0.043
Property Damage Only (PDO)	-6.51	0.64	0.87	0.020	$(5)_{TOTAL}-(5)_{FI}$ 0.694	0.021	4.70	1.00	0.097

Worksheet 1F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{brsv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{brsv\ (PDO)}$ (crashes/year)**	**Predicted $N_{brsv\ (TOTAL)}$ (crashes/year)**
	from Table 12-6	$(9)_{FI}$ from Worksheet 1E	from Table 12-6	$(9)_{PDO}$ from Worksheet 1E	$(9)_{TOTAL}$ from Worksheet 1E
Total	1.000	0.043	1.000	0.097	0.140
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Collision with animal	0.026	0.001	0.066	0.006	0.008
Collision with fixed object	0.723	0.031	0.759	0.074	0.105
Collision with other object	0.010	0.000	0.013	0.001	0.002
Other single-vehicle collision	0.241	0.010	0.162	0.016	0.026

Worksheet 1G -- Multiple-Vehicle Driveway-Related Collisions by Driveway Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	**Number of driveways, n_j**	**Crashes per driveway per year, N_j**	**Coefficient for traffic adjustment, t**	**Initial N_{brdwy}**	**Overdispersion parameter, k**
		from Table 12-7	from Table 12-7	Equation 12-16 $n_j * N_j * (AADT/15,000)^t$	from Table 12-7
Major commercial	0	0.158	1.000	0.000	--
Minor commercial	0	0.050	1.000	0.000	
Major industrial/institutional	1	0.172	1.000	0.043	
Minor industrial/institutional	4	0.023	1.000	0.023	
Major residential	0	0.083	1.000	0.000	
Minor residential	0	0.016	1.000	0.000	
Other	0	0.025	1.000	0.000	
Total	--	--	--	0.065	0.81

Worksheet 1H -- Multiple-Vehicle Driveway-Related Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Initial N_{brdwy}**	**Proportion of total crashes (f_{dwy})**	**Adjusted N_{brdwy}**	**Combined CMFs**	**Calibration factor, C_r**	**Predicted N_{brdwy}**
	$(5)_{TOTAL}$ from Worksheet 1G	from Table 12-7	$(2)_{TOTAL}$ * (3)	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.065	1.000	0.065	4.70	1.00	0.307
Fatal and injury (FI)	--	0.323	0.021	4.70	1.00	0.099
Property damage only (PDO)	--	0.677	0.044	4.70	1.00	0.208

Worksheet 1I -- Vehicle-Pedestrian Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{pedr}**	**Calibration factor, C_r**	**Predicted N_{pedr}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8		(5)*(6)*(7)
Total	0.082	0.140	0.307	0.529	0.036	1.00	0.019
Fatal and injury (FI)	--	--	--	--	--	1.00	0.019

Worksheet 1J -- Vehicle-Bicycle Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{biker}**	**Calibration factor, C_r**	**Predicted N_{biker}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9		(5)*(6)*(7)
Total	0.082	0.140	0.307	0.529	0.018	1.00	0.010
Fatal and injury (FI)	--	--	--	--	--	1.00	0.010

Worksheet 1K -- Crash Severity Distribution for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)** (3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	**Property damage only (PDO)** (5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	**Total** (6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
	MULTIPLE-VEHICLE		
Rear-end collisions (from Worksheet 1D)	0.018	0.044	0.062
Head-on collisions (from Worksheet 1D)	0.002	0.000	0.002
Angle collisions (from Worksheet 1D)	0.002	0.005	0.007
Sideswipe, same direction (from Worksheet 1D)	0.000	0.002	0.002
Sideswipe, opposite direction (from Worksheet 1D)	0.002	0.003	0.005
Driveway-related collisions (from Worksheet 1H)	0.099	0.208	0.307
Other multiple-vehicle collision (from Worksheet 1D)	0.001	0.003	0.004
Subtotal	0.124	0.265	0.389
	SINGLE-VEHICLE		
Collision with animal (from Worksheet 1F)	0.001	0.006	0.008
Collision with fixed object (from Worksheet 1F)	0.031	0.074	0.105
Collision with other object (from Worksheet 1F)	0.000	0.001	0.002
Other single-vehicle collision (from Worksheet 1F)	0.010	0.016	0.026
Collision with pedestrian (from Worksheet 1I)	0.019	0.000	0.019
Collision with bicycle (from Worksheet 1J)	0.010	0.000	0.010
Subtotal	0.071	0.097	0.169
Total	0.195	0.363	0.558

Worksheet 1L -- Summary Results for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)
Crash Severity Level	**Predicted average crash frequency, $N_{predicted\ rs}$ (crashes/year)**	**Roadway segment length, L (mi)**	**Crash rate (crashes/mi/year)**
	(Total) from Worksheet 1K		(2) / (3)
Total	0.558	0.07	7.9
Fatal and injury (FI)	0.2	0.07	2.7
Property damage only (PDO)	0.4	0.07	5.1

Worksheet 1A -- General Information and Input Data for Urban and Suburban Roadway Segments

General Information		Location Information	
Analyst	Jordan Brooks	Roadway	Chester Street
Agency or Company	Fehr & Peers	Roadway Section	Between 7th Street and 5th Street
Date Performed	01/02/19	Jurisdiction	Oakland, CA
		Analysis Year	2019

Input Data		Base Conditions	Site Conditions
Roadway type (2U, 3T, 4U, 4D, ST)		--	2U
Length of segment, L (mi)		--	0.09
AADT (veh/day)	AADT$_{MAX}$ = 32,600 (veh/day)	--	2,325
Type of on-street parking (none/parallel/angle)		None	Parallel (Residential)
Proportion of curb length with on-street parking		--	0.76
Median width (ft) - for divided only		15	Not Present
Lighting (present / not present)		Not Present	Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)		--	0
Minor commercial driveways (number)		--	0
Major industrial / institutional driveways (number)		--	1
Minor industrial / institutional driveways (number)		--	1
Major residential driveways (number)		--	0
Minor residential driveways (number)		--	4
Other driveways (number)		--	0
Speed Category		--	Posted Speed 30 mph or Lower
Roadside fixed object density (fixed objects / mi)		0	39
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		30	15
Calibration Factor, Cr		1.00	1.00

Worksheet 1B -- Crash Modification Factors for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMF 5r*	*CMF comb*
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.35	1.10	1.00	0.93	1.00	1.38

Worksheet 1C -- Multiple-Vehicle Nondriveway Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brmv}**	**Proportion of Total Crashes**	**Adjusted N_{brmv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brmv}**
	from Table 12-3		from Table 12-3	from Equation 12-10		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-15.22	1.68	0.84	0.010	1.000	0.010	1.38	1.00	0.013
Fatal and Injury (FI)	-16.22	1.66	0.65	0.003	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.303	0.003	1.38	1.00	0.004
Property Damage Only (PDO)	-15.62	1.69	0.87	0.007	$(5)_{TOTAL}-(5)_{FI}$ 0.697	0.007	1.38	1.00	0.009

Worksheet 1D -- Multiple-Vehicle Nondriveway Collisions by Collision Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{brmv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{brmv\ (PDO)}$ (crashes/year)**	**Predicted $N_{brmv\ (TOTAL)}$ (crashes/year)**
	from Table 12-4	$(9)_{FI}$ from Worksheet 1C	from Table 12-4	$(9)_{PDO}$ from Worksheet 1C	$(9)_{TOTAL}$ from Worksheet 1C
Total	1.000	0.004	1.000	0.009	0.013
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.730	0.003	0.778	0.007	0.010
Head-on collision	0.068	0.000	0.004	0.000	0.000
Angle collision	0.085	0.000	0.079	0.001	0.001
Sideswipe, same direction	0.015	0.000	0.031	0.000	0.000
Sideswipe, opposite direction	0.073	0.000	0.055	0.001	0.001
Other multiple-vehicle collision	0.029	0.000	0.053	0.000	0.001

Worksheet 1E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brsv}**	**Proportion of Total Crashes**	**Adjusted N_{brsv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brsv}**
	from Table 12-5		from Table 12-5	from Equation 12-13		$(4)_{TOTAL}*(5)$	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-5.47	0.56	0.81	0.028	1.000	0.028	1.38	1.00	0.039
Fatal and Injury (FI)	-3.96	0.23	0.50	0.010	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.348	0.010	1.38	1.00	0.014
Property Damage Only (PDO)	-6.51	0.64	0.87	0.019	$(5)_{TOTAL}-(5)_{FI}$ 0.652	0.018	1.38	1.00	0.025

Worksheet 1F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{brsv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{brsv\ (PDO)}$ (crashes/year)**	**Predicted $N_{brsv\ (TOTAL)}$ (crashes/year)**
	from Table 12-6	$(9)_{FI}$ from Worksheet 1E	from Table 12-6	$(9)_{PDO}$ from Worksheet 1E	$(9)_{TOTAL}$ from Worksheet 1E
Total	1.000	0.014	1.000	0.025	0.039
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Collision with animal	0.026	0.000	0.066	0.002	0.002
Collision with fixed object	0.723	0.010	0.759	0.019	0.029
Collision with other object	0.010	0.000	0.013	0.000	0.000
Other single-vehicle collision	0.241	0.003	0.162	0.004	0.007

Worksheet 1G -- Multiple-Vehicle Driveway-Related Collisions by Driveway Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	**Number of driveways, n_j**	**Crashes per driveway per year, N_j**	**Coefficient for traffic adjustment, t**	**Initial N_{brdwy}**	**Overdispersion parameter, k**
		from Table 12-7	from Table 12-7	Equation 12-16	from Table 12-7
				$n_j * N_j * (AADT/15,000)^t$	
Major commercial	0	0.158	1.000	0.000	--
Minor commercial	0	0.050	1.000	0.000	
Major industrial/institutional	1	0.172	1.000	0.027	
Minor industrial/institutional	1	0.023	1.000	0.004	
Major residential	0	0.083	1.000	0.000	
Minor residential	4	0.016	1.000	0.010	
Other	0	0.025	1.000	0.000	
Total	--	--	--	0.040	0.81

Worksheet 1H -- Multiple-Vehicle Driveway-Related Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Initial N_{brdwy}**	**Proportion of total crashes (f_{dwy})**	**Adjusted N_{brdwy}**	**Combined CMFs**	**Calibration factor, C_r**	**Predicted N_{brdwy}**
	$(5)_{TOTAL}$ from Worksheet 1G	from Table 12-7	$(2)_{TOTAL}$ * (3)	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.040	1.000	0.040	1.38	1.00	0.055
Fatal and injury (FI)	--	0.323	0.013	1.38	1.00	0.018
Property damage only (PDO)	--	0.677	0.027	1.38	1.00	0.037

Worksheet 1I -- Vehicle-Pedestrian Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{pedr}**	**Calibration factor, C_r**	**Predicted N_{pedr}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8		(5)*(6)*(7)
Total	0.013	0.039	0.055	0.108	0.036	1.00	0.004
Fatal and injury (FI)	--	--	--	--	--	1.00	0.004

Worksheet 1J -- Vehicle-Bicycle Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{biker}**	**Calibration factor, C_r**	**Predicted N_{biker}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9		(5)*(6)*(7)
Total	0.013	0.039	0.055	0.108	0.018	1.00	0.002
Fatal and injury (FI)	--	--	--	--	--	1.00	0.002

Worksheet 1K -- Crash Severity Distribution for Urban and Suburban Roadway Segments			
(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	0.003	0.007	0.010
Head-on collisions (from Worksheet 1D)	0.000	0.000	0.000
Angle collisions (from Worksheet 1D)	0.000	0.001	0.001
Sideswipe, same direction (from Worksheet 1D)	0.000	0.000	0.000
Sideswipe, opposite direction (from Worksheet 1D)	0.000	0.001	0.001
Driveway-related collisions (from Worksheet 1H)	0.018	0.037	0.055
Other multiple-vehicle collision (from Worksheet 1D)	0.000	0.000	0.001
Subtotal	0.022	0.047	0.069
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.000	0.002	0.002
Collision with fixed object (from Worksheet 1F)	0.010	0.019	0.029
Collision with other object (from Worksheet 1F)	0.000	0.000	0.000
Other single-vehicle collision (from Worksheet 1F)	0.003	0.004	0.007
Collision with pedestrian (from Worksheet 1I)	0.004	0.000	0.004
Collision with bicycle (from Worksheet 1J)	0.002	0.000	0.002
Subtotal	0.019	0.025	0.045
Total	0.041	0.072	0.113

Worksheet 1L -- Summary Results for Urban and Suburban Roadway Segments			
(1)	(2)	(3)	(4)
Crash Severity Level	**Predicted average crash frequency, $N_{predicted\ rs}$ (crashes/year)**	**Roadway segment length, L (mi)**	**Crash rate (crashes/mi/year)**
	(Total) from Worksheet 1K		(2) / (3)
Total	0.113	0.09	1.3
Fatal and injury (FI)	0.0	0.09	0.5
Property damage only (PDO)	0.1	0.09	0.8

Worksheet 1A -- General Information and Input Data for Urban and Suburban Roadway Segments

General Information		Location Information	
Analyst	Jordan Brooks	Roadway	Mandela Parkway
Agency or Company	Fehr & Peers	Roadway Section	Between 7th Street and 5th Street
Date Performed	01/02/19	Jurisdiction	Oakland, CA
		Analysis Year	2019

Input Data		Base Conditions	Site Conditions
Roadway type (2U, 3T, 4U, 4D, ST)		--	2U
Length of segment, L (mi)		--	0.09
AADT (veh/day)	$AADT_{MAX}$ = 32,600 (veh/day)	--	6,175
Type of on-street parking (none/parallel/angle)		None	Parallel (Comm/Ind)
Proportion of curb length with on-street parking		--	0.36
Median width (ft) - for divided only		15	Not Present
Lighting (present / not present)		Not Present	Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)		--	1
Minor commercial driveways (number)		--	2
Major industrial / institutional driveways (number)		--	1
Minor industrial / institutional driveways (number)		--	0
Major residential driveways (number)		--	0
Minor residential driveways (number)		--	0
Other driveways (number)		--	0
Speed Category		--	Posted Speed 30 mph or Lower
Roadside fixed object density (fixed objects / mi)		0	79
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		30	25
Calibration Factor, Cr		1.00	1.00

Worksheet 1B -- Crash Modification Factors for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMF 5r*	*CMF comb*
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.39	1.17	1.00	0.93	1.00	1.52

Worksheet 1C -- Multiple-Vehicle Nondriveway Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brmv}**	**Proportion of Total Crashes**	**Adjusted N_{brmv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brmv}**
	from Table 12-3		from Table 12-3	from Equation 12-10		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-15.22	1.68	0.84	0.050	1.000	0.050	1.52	1.00	0.076
Fatal and Injury (FI)	-16.22	1.66	0.65	0.015	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.297	0.015	1.52	1.00	0.022
Property Damage Only (PDO)	-15.62	1.69	0.87	0.037	$(5)_{TOTAL}-(5)_{FI}$ 0.703	0.035	1.52	1.00	0.053

Worksheet 1D -- Multiple-Vehicle Nondriveway Collisions by Collision Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{brmv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{brmv\ (PDO)}$ (crashes/year)**	**Predicted $N_{brmv\ (TOTAL)}$ (crashes/year)**
	from Table 12-4	$(9)_{FI}$ from Worksheet 1C	from Table 12-4	$(9)_{PDO}$ from Worksheet 1C	$(9)_{TOTAL}$ from Worksheet 1C
Total	1.000	0.022	1.000	0.053	0.076
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.730	0.016	0.778	0.041	0.058
Head-on collision	0.068	0.002	0.004	0.000	0.002
Angle collision	0.085	0.002	0.079	0.004	0.006
Sideswipe, same direction	0.015	0.000	0.031	0.002	0.002
Sideswipe, opposite direction	0.073	0.002	0.055	0.003	0.005
Other multiple-vehicle collision	0.029	0.001	0.053	0.003	0.003

Worksheet 1E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brsv}**	**Proportion of Total Crashes**	**Adjusted N_{brsv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brsv}**
	from Table 12-5		from Table 12-5	from Equation 12-13		$(4)_{TOTAL}*(5)$	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-5.47	0.56	0.81	0.049	1.000	0.049	1.52	1.00	0.074
Fatal and Injury (FI)	-3.96	0.23	0.50	0.012	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.263	0.013	1.52	1.00	0.019
Property Damage Only (PDO)	-6.51	0.64	0.87	0.035	$(5)_{TOTAL}-(5)_{FI}$ 0.737	0.036	1.52	1.00	0.054

Worksheet 1F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{brsv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{brsv\ (PDO)}$ (crashes/year)**	**Predicted $N_{brsv\ (TOTAL)}$ (crashes/year)**
	from Table 12-6	$(9)_{FI}$ from Worksheet 1E	from Table 12-6	$(9)_{PDO}$ from Worksheet 1E	$(9)_{TOTAL}$ from Worksheet 1E
Total	1.000	0.019	1.000	0.054	0.074
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Collision with animal	0.026	0.001	0.066	0.004	0.004
Collision with fixed object	0.723	0.014	0.759	0.041	0.055
Collision with other object	0.010	0.000	0.013	0.001	0.001
Other single-vehicle collision	0.241	0.005	0.162	0.009	0.013

Worksheet 1G -- Multiple-Vehicle Driveway-Related Collisions by Driveway Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	**Number of driveways, n_j**	**Crashes per driveway per year, N_j**	**Coefficient for traffic adjustment, t**	**Initial N_{brdwy}**	**Overdispersion parameter, k**
		from Table 12-7	from Table 12-7	Equation 12-16 $n_j * N_j * (AADT/15{,}000)^t$	from Table 12-7
Major commercial	1	0.158	1.000	0.065	--
Minor commercial	2	0.050	1.000	0.041	
Major industrial/institutional	1	0.172	1.000	0.071	
Minor industrial/institutional	0	0.023	1.000	0.000	
Major residential	0	0.083	1.000	0.000	
Minor residential	0	0.016	1.000	0.000	
Other	0	0.025	1.000	0.000	
Total	--	--	--	0.177	0.81

Worksheet 1H -- Multiple-Vehicle Driveway-Related Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Initial N_{brdwy}**	**Proportion of total crashes (f_{dwy})**	**Adjusted N_{brdwy}**	**Combined CMFs**	**Calibration factor, C_r**	**Predicted N_{brdwy}**
	$(5)_{TOTAL}$ from Worksheet 1G	from Table 12-7	$(2)_{TOTAL}$ * (3)	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.177	1.000	0.177	1.52	1.00	0.268
Fatal and injury (FI)	--	0.323	0.057	1.52	1.00	0.087
Property damage only (PDO)	--	0.677	0.120	1.52	1.00	0.182

Worksheet 1I -- Vehicle-Pedestrian Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{pedr}**	**Calibration factor, C_r**	**Predicted N_{pedr}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8		(5)*(6)*(7)
Total	0.076	0.074	0.268	0.418	0.036	1.00	0.015
Fatal and injury (FI)	--	--	--	--	--	1.00	0.015

Worksheet 1J -- Vehicle-Bicycle Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{biker}**	**Calibration factor, C_r**	**Predicted N_{biker}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9		(5)*(6)*(7)
Total	0.076	0.074	0.268	0.418	0.018	1.00	0.008
Fatal and injury (FI)	--	--	--	--	--	1.00	0.008

Worksheet 1K -- Crash Severity Distribution for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)** (3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	**Property damage only (PDO)** (5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	**Total** (6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
	MULTIPLE-VEHICLE		
Rear-end collisions (from Worksheet 1D)	0.016	0.041	0.058
Head-on collisions (from Worksheet 1D)	0.002	0.000	0.002
Angle collisions (from Worksheet 1D)	0.002	0.004	0.006
Sideswipe, same direction (from Worksheet 1D)	0.000	0.002	0.002
Sideswipe, opposite direction (from Worksheet 1D)	0.002	0.003	0.005
Driveway-related collisions (from Worksheet 1H)	0.087	0.182	0.268
Other multiple-vehicle collision (from Worksheet 1D)	0.001	0.003	0.003
Subtotal	0.109	0.235	0.344
	SINGLE-VEHICLE		
Collision with animal (from Worksheet 1F)	0.001	0.004	0.004
Collision with fixed object (from Worksheet 1F)	0.014	0.041	0.055
Collision with other object (from Worksheet 1F)	0.000	0.001	0.001
Other single-vehicle collision (from Worksheet 1F)	0.005	0.009	0.013
Collision with pedestrian (from Worksheet 1I)	0.015	0.000	0.015
Collision with bicycle (from Worksheet 1J)	0.008	0.000	0.008
Subtotal	0.042	0.054	0.096
Total	0.151	0.289	0.441

Worksheet 1L -- Summary Results for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)
Crash Severity Level	**Predicted average crash frequency, $N_{predicted\ rs}$ (crashes/year)**	**Roadway segment length, L (mi)**	**Crash rate (crashes/mi/year)**
	(Total) from Worksheet 1K		(2) / (3)
Total	0.441	0.09	5.1
Fatal and injury (FI)	0.2	0.09	1.7
Property damage only (PDO)	0.3	0.09	3.3

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections

General Information		**Location Information**	
Analyst	Jordan Brooks	Roadway	
Agency or Company	Fehr & Peers	Intersection	7th Street and Chester Street
Date Performed	01/02/19	Jurisdiction	Oakland, CA
		Analysis Year	2019
Input Data		**Base Conditions**	**Site Conditions**
Intersection type (3ST, 3SG, 4ST, 4SG)		--	4ST
AADT $_{major}$ (veh/day)	AADT$_{MAX}$ = 46,800 (veh/day)	--	6,960
AADT $_{minor}$ (veh/day)	AADT$_{MAX}$ = 5,900 (veh/day)	--	2,160
Intersection lighting (present/not present)		Not Present	Present
Calibration factor, C_i		1.00	1.00
Data for unsignalized intersections only:		--	--
Number of major-road approaches with left-turn lanes (0,1,2)		0	2
Number of major-road approaches with right-turn lanes (0,1,2)		0	0
Data for signalized intersections only:		--	--
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]		--	
Type of left-turn signal phasing for Leg #1		Permissive	
Type of left-turn signal phasing for Leg #2		--	
Type of left-turn signal phasing for Leg #3		--	
Type of left-turn signal phasing for Leg #4 (if applicable)		--	
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]		0	
Intersection red light cameras (present/not present)		Not Present	
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only			
Maximum number of lanes crossed by a pedestrian (n_{lanesx})		--	
Number of bus stops within 300 m (1,000 ft) of the intersection		0	
Schools within 300 m (1,000 ft) of the intersection (present/not present)		Not Present	
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection		0	

Worksheet 2B -- Crash Modification Factors for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	*CMF* $_{COMB}$
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
0.53	1.00	1.00	1.00	0.91	0.97	0.47

Worksheet 2C -- Multiple-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-8.90	0.82	0.25	0.40	1.316	1.000	1.316	0.47	1.00	0.620
Fatal and Injury (FI)	-11.13	0.93	0.28	0.48	0.472	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.357	0.469	0.47	1.00	0.221
Property Damage Only (PDO)	-8.74	0.77	0.23	0.40	0.851	$(5)_{TOTAL}-(5)_{FI}$ 0.643	0.847	0.47	1.00	0.399

Worksheet 2D -- Multiple-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.221	1.000	0.399	0.620
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.338	0.075	0.374	0.149	0.224
Head-on collision	0.041	0.009	0.030	0.012	0.021
Angle collision	0.440	0.097	0.335	0.134	0.231
Sideswipe	0.121	0.027	0.044	0.018	0.044
Other multiple-vehicle collision	0.060	0.013	0.217	0.087	0.100

Worksheet 2E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-5.33	0.33	0.12	0.65	0.226	1.000	0.226	0.47	1.00	0.106
Fatal and Injury (FI)	--	--	--	--	0.063	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.304	0.069	0.47	1.00	0.032
Property Damage Only (PDO)	-7.04	0.36	0.25	0.54	0.144	$(5)_{TOTAL}-(5)_{FI}$ 0.696	0.157	0.47	1.00	0.074

Worksheet 2F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{bisv\ (PDO)}$ (crashes/year)**	**Predicted $N_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	$(9)_{FI}$ from Worksheet 2E	from Table 12-13	$(9)_{PDO}$ from Worksheet 2E	$(9)_{PDO}$ from Worksheet 2E
Total	1.000	0.032	1.000	0.074	0.106
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.000	0.000
Collision with animal	0.001	0.000	0.026	0.002	0.002
Collision with fixed object	0.679	0.022	0.847	0.063	0.085
Collision with other object	0.089	0.003	0.070	0.005	0.008
Other single-vehicle collision	0.051	0.002	0.007	0.001	0.002
Single-vehicle noncollision	0.179	0.006	0.049	0.004	0.009

Worksheet 2G -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Stop-Controlled Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	0.620	0.106	0.726	0.022	1.00	0.016
Fatal and injury (FI)	--	--	--	--	1.00	0.016

Worksheet 2H -- Crash Modification Factors for Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
--	--	--	--

Worksheet 2I -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	--	--	--	--	--	--	--	--	1.00	--
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	1.00	--

Worksheet 2J -- Vehicle-Bicycle Collisions for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	0.620	0.106	0.726	0.018	1.00	0.013
Fatal and injury (FI)	--	--	--	--	1.00	0.013

Worksheet 2K -- Crash Severity Distribution for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)** (3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	**Property damage only (PDO)** (5) from Worksheet 2D and 2F	**Total** (6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	0.075	0.149	0.224
Head-on collisions (from Worksheet 2D)	0.009	0.012	0.021
Angle collisions (from Worksheet 2D)	0.097	0.134	0.231
Sideswipe (from Worksheet 2D)	0.027	0.018	0.044
Other multiple-vehicle collision (from Worksheet 2D)	0.013	0.087	0.100
Subtotal	0.221	0.399	0.620
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.000
Collision with animal (from Worksheet 2F)	0.000	0.002	0.002
Collision with fixed object (from Worksheet 2F)	0.022	0.063	0.085
Collision with other object (from Worksheet 2F)	0.003	0.005	0.008
Other single-vehicle collision (from Worksheet 2F)	0.002	0.001	0.002
Single-vehicle noncollision (from Worksheet 2F)	0.006	0.004	0.009
Collision with pedestrian (from Worksheet 2G or 2I)	0.016	0.000	0.016
Collision with bicycle (from Worksheet 2J)	0.013	0.000	0.013
Subtotal	0.061	0.074	0.135
Total	0.282	0.473	0.755

Worksheet 2L -- Summary Results for Urban and Suburban Arterial Intersections

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	0.8
Fatal and injury (FI)	0.3
Property damage only (PDO)	0.5

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections

General Information		Location Information	
Analyst	Jordan Brooks	Roadway	
Agency or Company	Fehr & Peers	Intersection	7th Street and Center Street
Date Performed	01/02/19	Jurisdiction	Oakland, CA
		Analysis Year	2019

Input Data		Base Conditions	Site Conditions
Intersection type (3ST, 3SG, 4ST, 4SG)		--	3SG
AADT $_{major}$ (veh/day)	$AADT_{MAX}$ = 58,100 (veh/day)	--	7,330
AADT $_{minor}$ (veh/day)	$AADT_{MAX}$ = 16,400 (veh/day)	--	500
Intersection lighting (present/not present)		Not Present	Present
Calibration factor, C_i		1.00	1.00
Data for unsignalized intersections only:		--	--
Number of major-road approaches with left-turn lanes (0,1,2)		0	
Number of major-road approaches with right-turn lanes (0,1,2)		0	
Data for signalized intersections only:		--	--
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	1
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	0
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]		--	0
Type of left-turn signal phasing for Leg #1		Permissive	Permissive
Type of left-turn signal phasing for Leg #2		--	Permissive
Type of left-turn signal phasing for Leg #3		--	Not Applicable
Type of left-turn signal phasing for Leg #4 (if applicable)		--	
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]		0	0
Intersection red light cameras (present/not present)		Not Present	Not Present
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only			3,010
Maximum number of lanes crossed by a pedestrian (n_{lanesx})		--	3
Number of bus stops within 300 m (1,000 ft) of the intersection		0	2
Schools within 300 m (1,000 ft) of the intersection (present/not present)		Not Present	Not Present
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection		0	2

Worksheet 2B -- Crash Modification Factors for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	*CMF* $_{COMB}$
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
0.93	1.00	1.00	1.00	0.91	1.00	0.85

Worksheet 2C -- Multiple-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-12.13	1.11	0.26	0.33	0.530	1.000	0.530	0.85	1.00	0.449
Fatal and Injury (FI)	-11.58	1.02	0.17	0.30	0.236	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.446	0.236	0.85	1.00	0.200
Property Damage Only (PDO)	-13.24	1.14	0.30	0.36	0.292	$(5)_{TOTAL}-(5)_{FI}$ 0.554	0.293	0.85	1.00	0.248

Worksheet 2D -- Multiple-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.200	1.000	0.248	0.449
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.549	0.110	0.546	0.136	0.246
Head-on collision	0.038	0.008	0.020	0.005	0.013
Angle collision	0.280	0.056	0.204	0.051	0.107
Sideswipe	0.076	0.015	0.032	0.008	0.023
Other multiple-vehicle collision	0.057	0.011	0.198	0.049	0.061

Worksheet 2E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-9.02	0.42	0.40	0.36	0.061	1.000	0.061	0.85	1.00	0.052
Fatal and Injury (FI)	-9.75	0.27	0.51	0.24	0.015	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.240	0.015	0.85	1.00	0.012
Property Damage Only (PDO)	-9.08	0.45	0.33	0.53	0.049	$(5)_{TOTAL}-(5)_{FI}$ 0.760	0.046	0.85	1.00	0.039

Worksheet 2F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{bisv\ (PDO)}$ (crashes/year)**	**Predicted $N_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	$(9)_{FI}$ from Worksheet 2E	from Table 12-13	$(9)_{PDO}$ from Worksheet 2E	$(9)_{PDO}$ from Worksheet 2E
Total	1.000	0.012	1.000	0.039	0.052
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.000	0.000
Collision with animal	0.001	0.000	0.003	0.000	0.000
Collision with fixed object	0.653	0.008	0.895	0.035	0.043
Collision with other object	0.091	0.001	0.069	0.003	0.004
Other single-vehicle collision	0.045	0.001	0.018	0.001	0.001
Single-vehicle noncollision	0.209	0.003	0.014	0.001	0.003

Worksheet 2G -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Stop-Controlled Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	f_{pedi}	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	--	--	--	--	1.00	--
Fatal and injury (FI)	--	--	--	--	1.00	--

Worksheet 2H -- Crash Modification Factors for Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
2.78	1.00	1.12	3.11

Worksheet 2I -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	$N_{pedbase}$	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	-6.60	0.05	0.24	0.41	0.09	0.52	0.039	3.11	1.00	0.122
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	1.00	0.122

Worksheet 2J -- Vehicle-Bicycle Collisions for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	0.449	0.052	0.500	0.011	1.00	0.006
Fatal and injury (FI)	--	--	--	--	1.00	0.006

Worksheet 2K -- Crash Severity Distribution for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
	MULTIPLE-VEHICLE		
Rear-end collisions (from Worksheet 2D)	0.110	0.136	0.246
Head-on collisions (from Worksheet 2D)	0.008	0.005	0.013
Angle collisions (from Worksheet 2D)	0.056	0.051	0.107
Sideswipe (from Worksheet 2D)	0.015	0.008	0.023
Other multiple-vehicle collision (from Worksheet 2D)	0.011	0.049	0.061
Subtotal	0.200	0.248	0.449
	SINGLE-VEHICLE		
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.000
Collision with animal (from Worksheet 2F)	0.000	0.000	0.000
Collision with fixed object (from Worksheet 2F)	0.008	0.035	0.043
Collision with other object (from Worksheet 2F)	0.001	0.003	0.004
Other single-vehicle collision (from Worksheet 2F)	0.001	0.001	0.001
Single-vehicle noncollision (from Worksheet 2F)	0.003	0.001	0.003
Collision with pedestrian (from Worksheet 2G or 2I)	0.122	0.000	0.122
Collision with bicycle (from Worksheet 2J)	0.006	0.000	0.006
Subtotal	0.140	0.039	0.179
Total	0.340	0.288	0.627

Worksheet 2L -- Summary Results for Urban and Suburban Arterial Intersections

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	0.6
Fatal and injury (FI)	0.3
Property damage only (PDO)	0.3

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections

General Information		Location Information	
Analyst	Jordan Brooks	Roadway	
Agency or Company	Fehr & Peers	Intersection	7th Street and Mandela Parkway
Date Performed	01/02/19	Jurisdiction	Oakland, CA
		Analysis Year	2019

Input Data		Base Conditions	Site Conditions
Intersection type (3ST, 3SG, 4ST, 4SG)		--	4SG
AADT $_{major}$ (veh/day)	$AADT_{MAX}$ = 67,700 (veh/day)	--	8,780
AADT $_{minor}$ (veh/day)	$AADT_{MAX}$ = 33,400 (veh/day)	--	7,530
Intersection lighting (present/not present)		Not Present	Present
Calibration factor, C_i		1.00	1.00
Data for unsignalized intersections only:		--	--
Number of major-road approaches with left-turn lanes (0,1,2)		0	
Number of major-road approaches with right-turn lanes (0,1,2)		0	
Data for signalized intersections only:		--	--
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	3
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	0
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]		--	2
Type of left-turn signal phasing for Leg #1		Permissive	Protected
Type of left-turn signal phasing for Leg #2		--	Protected
Type of left-turn signal phasing for Leg #3		--	Permissive
Type of left-turn signal phasing for Leg #4 (if applicable)		--	Permissive
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]		0	0
Intersection red light cameras (present/not present)		Not Present	Not Present
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only			1,660
Maximum number of lanes crossed by a pedestrian (n_{lanesx})		--	5
Number of bus stops within 300 m (1,000 ft) of the intersection		0	3
Schools within 300 m (1,000 ft) of the intersection (present/not present)		Not Present	Not Present
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection		0	2

Worksheet 2B -- Crash Modification Factors for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	*CMF* $_{COMB}$
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
0.73	0.88	1.00	1.00	0.91	1.00	0.59

Worksheet 2C -- Multiple-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-10.99	1.07	0.23	0.39	2.179	1.000	2.179	0.59	1.00	1.280
Fatal and Injury (FI)	-13.14	1.18	0.22	0.33	0.630	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.300	0.655	0.59	1.00	0.384
Property Damage Only (PDO)	-11.02	1.02	0.24	0.44	1.468	$(5)_{TOTAL}-(5)_{FI}$ 0.700	1.525	0.59	1.00	0.896

Worksheet 2D -- Multiple-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.384	1.000	0.896	1.280
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.450	0.173	0.483	0.433	0.606
Head-on collision	0.049	0.019	0.030	0.027	0.046
Angle collision	0.347	0.133	0.244	0.219	0.352
Sideswipe	0.099	0.038	0.032	0.029	0.067
Other multiple-vehicle collision	0.055	0.021	0.211	0.189	0.210

Worksheet 2E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-10.21	0.68	0.27	0.36	0.197	1.000	0.197	0.59	1.00	0.116
Fatal and Injury (FI)	-9.25	0.43	0.29	0.09	0.063	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.325	0.064	0.59	1.00	0.038
Property Damage Only (PDO)	-11.34	0.78	0.25	0.44	0.132	$(5)_{TOTAL}-(5)_{FI}$ 0.675	0.133	0.59	1.00	0.078

Worksheet 2F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{bisv\ (PDO)}$ (crashes/year)**	**Predicted $N_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	$(9)_{FI}$ from Worksheet 2E	from Table 12-13	$(9)_{PDO}$ from Worksheet 2E	$(9)_{PDO}$ from Worksheet 2E
Total	1.000	0.038	1.000	0.078	0.116
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.000	0.000
Collision with animal	0.002	0.000	0.002	0.000	0.000
Collision with fixed object	0.744	0.028	0.870	0.068	0.096
Collision with other object	0.072	0.003	0.070	0.005	0.008
Other single-vehicle collision	0.040	0.002	0.023	0.002	0.003
Single-vehicle noncollision	0.141	0.005	0.034	0.003	0.008

Worksheet 2G -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Stop-Controlled Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	--	--	--	--	1.00	--
Fatal and injury (FI)	--	--	--	--	1.00	--

Worksheet 2H -- Crash Modification Factors for Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
4.15	1.00	1.12	4.65

Worksheet 2I -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	-9.53	0.40	0.26	0.45	0.04	0.24	0.116	4.65	1.00	0.539
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	1.00	0.539

Worksheet 2J -- Vehicle-Bicycle Collisions for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	1.280	0.116	1.396	0.015	1.00	0.021
Fatal and injury (FI)	--	--	--	--	1.00	0.021

Worksheet 2K -- Crash Severity Distribution for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	0.173	0.433	0.606
Head-on collisions (from Worksheet 2D)	0.019	0.027	0.046
Angle collisions (from Worksheet 2D)	0.133	0.219	0.352
Sideswipe (from Worksheet 2D)	0.038	0.029	0.067
Other multiple-vehicle collision (from Worksheet 2D)	0.021	0.189	0.210
Subtotal	0.384	0.896	1.280
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.000
Collision with animal (from Worksheet 2F)	0.000	0.000	0.000
Collision with fixed object (from Worksheet 2F)	0.028	0.068	0.096
Collision with other object (from Worksheet 2F)	0.003	0.005	0.008
Other single-vehicle collision (from Worksheet 2F)	0.002	0.002	0.003
Single-vehicle noncollision (from Worksheet 2F)	0.005	0.003	0.008
Collision with pedestrian (from Worksheet 2G or 2I)	0.539	0.000	0.539
Collision with bicycle (from Worksheet 2J)	0.021	0.000	0.021
Subtotal	0.598	0.078	0.676
Total	0.982	0.974	1.956

Worksheet 2L -- Summary Results for Urban and Suburban Arterial Intersections

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	2.0
Fatal and injury (FI)	1.0
Property damage only (PDO)	1.0

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections

General Information		Location Information	
Analyst	Jordan Brooks	Roadway	
Agency or Company	Fehr & Peers	Intersection	5th Street and Chester Street
Date Performed	01/02/19	Jurisdiction	Oakland, CA
		Analysis Year	2019

Input Data		Base Conditions	Site Conditions
Intersection type (3ST, 3SG, 4ST, 4SG)		--	4ST
AADT $_{major}$ (veh/day)	$AADT_{MAX}$ = 46,800 (veh/day)	--	1,740
AADT $_{minor}$ (veh/day)	$AADT_{MAX}$ = 5,900 (veh/day)	--	700
Intersection lighting (present/not present)		Not Present	Present
Calibration factor, C_i		1.00	1.00
Data for unsignalized intersections only:		--	--
Number of major-road approaches with left-turn lanes (0,1,2)		0	0
Number of major-road approaches with right-turn lanes (0,1,2)		0	0
Data for signalized intersections only:		--	--
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]		--	
Type of left-turn signal phasing for Leg #1		Permissive	
Type of left-turn signal phasing for Leg #2		--	
Type of left-turn signal phasing for Leg #3		--	
Type of left-turn signal phasing for Leg #4 (if applicable)		--	
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]		0	
Intersection red light cameras (present/not present)		Not Present	
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only			
Maximum number of lanes crossed by a pedestrian (n_{lanesx})		--	
Number of bus stops within 300 m (1,000 ft) of the intersection		0	
Schools within 300 m (1,000 ft) of the intersection (present/not present)		Not Present	
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection		0	

Worksheet 2B -- Crash Modification Factors for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	*CMF* $_{COMB}$
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
1.00	1.00	1.00	1.00	0.91	0.98	0.89

Worksheet 2C -- Multiple-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-8.90	0.82	0.25	0.40	0.319	1.000	0.319	0.89	1.00	0.285
Fatal and Injury (FI)	-11.13	0.93	0.28	0.48	0.095	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.296	0.094	0.89	1.00	0.084
Property Damage Only (PDO)	-8.74	0.77	0.23	0.40	0.226	$(5)_{TOTAL}-(5)_{FI}$ 0.704	0.224	0.89	1.00	0.201

Worksheet 2D -- Multiple-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.084	1.000	0.201	0.285
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Rear-end collision	0.338	0.028	0.374	0.075	0.103
Head-on collision	0.041	0.003	0.030	0.006	0.009
Angle collision	0.440	0.037	0.335	0.067	0.104
Sideswipe	0.121	0.010	0.044	0.009	0.019
Other multiple-vehicle collision	0.060	0.005	0.217	0.044	0.049

Worksheet 2E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-5.33	0.33	0.12	0.65	0.125	1.000	0.125	0.89	1.00	0.111
Fatal and Injury (FI)	--	--	--	--	0.035	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.346	0.043	0.89	1.00	0.039
Property Damage Only (PDO)	-7.04	0.36	0.25	0.54	0.066	$(5)_{TOTAL}-(5)_{FI}$ 0.654	0.082	0.89	1.00	0.073

Worksheet 2F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{bisv\ (PDO)}$ (crashes/year)**	**Predicted $N_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	$(9)_{FI}$ from Worksheet 2E	from Table 12-13	$(9)_{PDO}$ from Worksheet 2E	$(9)_{PDO}$ from Worksheet 2E
Total	1.000	0.039	1.000	0.073	0.111
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.000	0.000
Collision with animal	0.001	0.000	0.026	0.002	0.002
Collision with fixed object	0.679	0.026	0.847	0.062	0.088
Collision with other object	0.089	0.003	0.070	0.005	0.009
Other single-vehicle collision	0.051	0.002	0.007	0.001	0.002
Single-vehicle noncollision	0.179	0.007	0.049	0.004	0.010

Worksheet 2G -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Stop-Controlled Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	0.285	0.111	0.396	0.022	1.00	0.009
Fatal and injury (FI)	--	--	--	--	1.00	0.009

Worksheet 2H -- Crash Modification Factors for Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
--	--	--	--

Worksheet 2I -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	--	--	--	--	--	--	--	--	1.00	--
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	1.00	--

Worksheet 2J -- Vehicle-Bicycle Collisions for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	0.285	0.111	0.396	0.018	1.00	0.007
Fatal and injury (FI)	--	--	--	--	1.00	0.007

Worksheet 2K -- Crash Severity Distribution for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
	MULTIPLE-VEHICLE		
Rear-end collisions (from Worksheet 2D)	0.028	0.075	0.103
Head-on collisions (from Worksheet 2D)	0.003	0.006	0.009
Angle collisions (from Worksheet 2D)	0.037	0.067	0.104
Sideswipe (from Worksheet 2D)	0.010	0.009	0.019
Other multiple-vehicle collision (from Worksheet 2D)	0.005	0.044	0.049
Subtotal	0.084	0.201	0.285
	SINGLE-VEHICLE		
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.000
Collision with animal (from Worksheet 2F)	0.000	0.002	0.002
Collision with fixed object (from Worksheet 2F)	0.026	0.062	0.088
Collision with other object (from Worksheet 2F)	0.003	0.005	0.009
Other single-vehicle collision (from Worksheet 2F)	0.002	0.001	0.002
Single-vehicle noncollision (from Worksheet 2F)	0.007	0.004	0.010
Collision with pedestrian (from Worksheet 2G or 2I)	0.009	0.000	0.009
Collision with bicycle (from Worksheet 2J)	0.007	0.000	0.007
Subtotal	0.054	0.073	0.127
Total	0.139	0.273	0.412

Worksheet 2L -- Summary Results for Urban and Suburban Arterial Intersections

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	0.4
Fatal and injury (FI)	0.1
Property damage only (PDO)	0.3

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections

General Information		**Location Information**	
Analyst	Jordan Brooks	Roadway	
Agency or Company	Fehr & Peers	Intersection	5th Street and Center Street
Date Performed	01/02/19	Jurisdiction	Oakland, CA
		Analysis Year	2019

Input Data		**Base Conditions**	**Site Conditions**
Intersection type (3ST, 3SG, 4ST, 4SG)		--	3ST
AADT $_{major}$ (veh/day)	AADT$_{MAX}$ = 45,700 (veh/day)	--	3,150
AADT $_{minor}$ (veh/day)	AADT$_{MAX}$ = 9,300 (veh/day)	--	200
Intersection lighting (present/not present)		Not Present	Present
Calibration factor, C_i		1.00	1.00
Data for unsignalized intersections only:		--	--
Number of major-road approaches with left-turn lanes (0,1,2)		0	0
Number of major-road approaches with right-turn lanes (0,1,2)		0	0
Data for signalized intersections only:		--	--
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]		--	
Type of left-turn signal phasing for Leg #1		Permissive	
Type of left-turn signal phasing for Leg #2		--	
Type of left-turn signal phasing for Leg #3		--	
Type of left-turn signal phasing for Leg #4 (if applicable)		--	
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]		0	
Intersection red light cameras (present/not present)		Not Present	
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only			
Maximum number of lanes crossed by a pedestrian (n_{lanesx})		--	
Number of bus stops within 300 m (1,000 ft) of the intersection		0	
Schools within 300 m (1,000 ft) of the intersection (present/not present)		Not Present	
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection		0	

Worksheet 2B -- Crash Modification Factors for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	*CMF* $_{COMB}$
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
1.00	1.00	1.00	1.00	0.91	1.00	0.91

Worksheet 2C -- Multiple-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-13.36	1.11	0.41	0.80	0.106	1.000	0.106	0.91	1.00	0.096
Fatal and Injury (FI)	-14.01	1.16	0.30	0.69	0.046	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.484	0.051	0.91	1.00	0.047
Property Damage Only (PDO)	-15.38	1.20	0.51	0.77	0.049	$(5)_{TOTAL}-(5)_{FI}$ 0.516	0.055	0.91	1.00	0.050

Worksheet 2D -- Multiple-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.047	1.000	0.050	0.096
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.421	0.020	0.440	0.022	0.041
Head-on collision	0.045	0.002	0.023	0.001	0.003
Angle collision	0.343	0.016	0.262	0.013	0.029
Sideswipe	0.126	0.006	0.040	0.002	0.008
Other multiple-vehicle collision	0.065	0.003	0.235	0.012	0.015

Worksheet 2E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-6.81	0.16	0.51	1.14	0.060	1.000	0.060	0.91	1.00	0.054
Fatal and Injury (FI)	--	--	--	--	0.018	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.364	0.022	0.91	1.00	0.020
Property Damage Only (PDO)	-8.36	0.25	0.55	1.29	0.032	$(5)_{TOTAL}-(5)_{FI}$ 0.636	0.038	0.91	1.00	0.034

Worksheet 2F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{bisv\ (PDO)}$ (crashes/year)**	**Predicted $N_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	(9)$_{FI}$ from Worksheet 2E	from Table 12-13	(9)$_{PDO}$ from Worksheet 2E	(9)$_{PDO}$ from Worksheet 2E
Total	1.000	0.020	1.000	0.034	0.054
		(2)*(3)$_{FI}$		(4)*(5)$_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.003	0.000	0.000
Collision with animal	0.003	0.000	0.018	0.001	0.001
Collision with fixed object	0.762	0.015	0.834	0.029	0.044
Collision with other object	0.090	0.002	0.092	0.003	0.005
Other single-vehicle collision	0.039	0.001	0.023	0.001	0.002
Single-vehicle noncollision	0.105	0.002	0.030	0.001	0.003

Worksheet 2G -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Stop-Controlled Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	0.096	0.054	0.150	0.021	1.00	0.003
Fatal and injury (FI)	--	--	--	--	1.00	0.003

Worksheet 2H -- Crash Modification Factors for Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
--	--	--	--

Worksheet 2I -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	--	--	--	--	--	--	--	--	1.00	--
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	1.00	--

Worksheet 2J -- Vehicle-Bicycle Collisions for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	0.096	0.054	0.150	0.016	1.00	0.002
Fatal and injury (FI)	--	--	--	--	1.00	0.002

Worksheet 2K -- Crash Severity Distribution for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
	MULTIPLE-VEHICLE		
Rear-end collisions (from Worksheet 2D)	0.020	0.022	0.041
Head-on collisions (from Worksheet 2D)	0.002	0.001	0.003
Angle collisions (from Worksheet 2D)	0.016	0.013	0.029
Sideswipe (from Worksheet 2D)	0.006	0.002	0.008
Other multiple-vehicle collision (from Worksheet 2D)	0.003	0.012	0.015
Subtotal	0.047	0.050	0.096
	SINGLE-VEHICLE		
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.000
Collision with animal (from Worksheet 2F)	0.000	0.001	0.001
Collision with fixed object (from Worksheet 2F)	0.015	0.029	0.044
Collision with other object (from Worksheet 2F)	0.002	0.003	0.005
Other single-vehicle collision (from Worksheet 2F)	0.001	0.001	0.002
Single-vehicle noncollision (from Worksheet 2F)	0.002	0.001	0.003
Collision with pedestrian (from Worksheet 2G or 2I)	0.003	0.000	0.003
Collision with bicycle (from Worksheet 2J)	0.002	0.000	0.002
Subtotal	0.025	0.035	0.060
Total	0.072	0.084	0.156

Worksheet 2L -- Summary Results for Urban and Suburban Arterial Intersections

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	0.2
Fatal and injury (FI)	0.1
Property damage only (PDO)	0.1

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections

General Information		**Location Information**	
Analyst	Jordan Brooks	Roadway	
Agency or Company	Fehr & Peers	Intersection	5th Street and Mandela Parkway
Date Performed	01/02/19	Jurisdiction	Oakland, CA
		Analysis Year	2019

Input Data		**Base Conditions**	**Site Conditions**
Intersection type (3ST, 3SG, 4ST, 4SG)		--	4SG
AADT $_{major}$ (veh/day)	AADT$_{MAX}$ = 67,700 (veh/day)	--	4,740
AADT $_{minor}$ (veh/day)	AADT$_{MAX}$ = 33,400 (veh/day)	--	3,820
Intersection lighting (present/not present)		Not Present	Present
Calibration factor, C_i		1.00	1.00
Data for unsignalized intersections only:		--	--
Number of major-road approaches with left-turn lanes (0,1,2)		0	
Number of major-road approaches with right-turn lanes (0,1,2)		0	
Data for signalized intersections only:		--	--
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	0
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	0
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]		--	0
Type of left-turn signal phasing for Leg #1		Permissive	Permissive
Type of left-turn signal phasing for Leg #2		--	Permissive
Type of left-turn signal phasing for Leg #3		--	Permissive
Type of left-turn signal phasing for Leg #4 (if applicable)		--	Permissive
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]		0	0
Intersection red light cameras (present/not present)		Not Present	Not Present
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only			2,850
Maximum number of lanes crossed by a pedestrian (n_{lanesx})		--	2
Number of bus stops within 300 m (1,000 ft) of the intersection		0	2
Schools within 300 m (1,000 ft) of the intersection (present/not present)		Not Present	Not Present
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection		0	2

Worksheet 2B -- Crash Modification Factors for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	*CMF* $_{COMB}$
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
1.00	1.00	1.00	1.00	0.91	1.00	0.91

Worksheet 2C -- Multiple-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-10.99	1.07	0.23	0.39	0.964	1.000	0.964	0.91	1.00	0.878
Fatal and Injury (FI)	-13.14	1.18	0.22	0.33	0.262	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.283	0.273	0.91	1.00	0.248
Property Damage Only (PDO)	-11.02	1.02	0.24	0.44	0.665	$(5)_{TOTAL}-(5)_{FI}$ 0.717	0.691	0.91	1.00	0.630

Worksheet 2D -- Multiple-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted $N_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted $N_{bimv\ (PDO)}$ (crashes/year)**	**Predicted $N_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.248	1.000	0.630	0.878
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.450	0.112	0.483	0.304	0.416
Head-on collision	0.049	0.012	0.030	0.019	0.031
Angle collision	0.347	0.086	0.244	0.154	0.240
Sideswipe	0.099	0.025	0.032	0.020	0.045
Other multiple-vehicle collision	0.055	0.014	0.211	0.133	0.147

Worksheet 2E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-10.21	0.68	0.27	0.36	0.108	1.000	0.108	0.91	1.00	0.098
Fatal and Injury (FI)	-9.25	0.43	0.29	0.09	0.040	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ 0.368	0.040	0.91	1.00	0.036
Property Damage Only (PDO)	-11.34	0.78	0.25	0.44	0.069	$(5)_{TOTAL}-(5)_{FI}$ 0.632	0.068	0.91	1.00	0.062

Worksheet 2F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bisv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	(9)$_{FI}$ from Worksheet 2E	from Table 12-13	(9)$_{PDO}$ from Worksheet 2E	(9)$_{PDO}$ from Worksheet 2E
Total	1.000	0.036	1.000	0.062	0.098
		(2)*(3)$_{FI}$		(4)*(5)$_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.000	0.000
Collision with animal	0.002	0.000	0.002	0.000	0.000
Collision with fixed object	0.744	0.027	0.870	0.054	0.081
Collision with other object	0.072	0.003	0.070	0.004	0.007
Other single-vehicle collision	0.040	0.001	0.023	0.001	0.003
Single-vehicle noncollision	0.141	0.005	0.034	0.002	0.007

Worksheet 2G -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Stop-Controlled Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N$_{bimv}$**	**Predicted N$_{bisv}$**	**Predicted N$_{bi}$**	**f_{pedi}**	**Calibration factor, C$_i$**	**Predicted N$_{pedi}$**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	--	--	--	--	1.00	--
Fatal and injury (FI)	--	--	--	--	1.00	--

Worksheet 2H -- Crash Modification Factors for Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF$_{1p}$	CMF$_{2p}$	CMF$_{3p}$	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
2.78	1.00	1.12	3.11

Worksheet 2I -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**N$_{pedbase}$**	**Combined CMF**	**Calibration factor, C$_i$**	**Predicted N$_{pedi}$**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	-9.53	0.40	0.26	0.45	0.04	0.24	0.100	3.11	1.00	0.311
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	1.00	0.311

Worksheet 2J -- Vehicle-Bicycle Collisions for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	0.878	0.098	0.976	0.015	1.00	0.015
Fatal and injury (FI)	--	--	--	--	1.00	0.015

Worksheet 2K -- Crash Severity Distribution for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
	MULTIPLE-VEHICLE		
Rear-end collisions (from Worksheet 2D)	0.112	0.304	0.416
Head-on collisions (from Worksheet 2D)	0.012	0.019	0.031
Angle collisions (from Worksheet 2D)	0.086	0.154	0.240
Sideswipe (from Worksheet 2D)	0.025	0.020	0.045
Other multiple-vehicle collision (from Worksheet 2D)	0.014	0.133	0.147
Subtotal	0.248	0.630	0.878
	SINGLE-VEHICLE		
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.000
Collision with animal (from Worksheet 2F)	0.000	0.000	0.000
Collision with fixed object (from Worksheet 2F)	0.027	0.054	0.081
Collision with other object (from Worksheet 2F)	0.003	0.004	0.007
Other single-vehicle collision (from Worksheet 2F)	0.001	0.001	0.003
Single-vehicle noncollision (from Worksheet 2F)	0.005	0.002	0.007
Collision with pedestrian (from Worksheet 2G or 2I)	0.311	0.000	0.311
Collision with bicycle (from Worksheet 2J)	0.015	0.000	0.015
Subtotal	0.362	0.062	0.424
Total	0.610	0.692	1.301

Worksheet 2L -- Summary Results for Urban and Suburban Arterial Intersections

(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	1.3
Fatal and injury (FI)	0.6
Property damage only (PDO)	0.7

FEHR & PEERS

MEMORANDUM

Date: January 29, 2019

To: Rebecca Auld, Lamphier-Gregory

From: Sam Tabibnia and Jordan Brooks, Fehr & Peers

Subject: **West Oakland BART TOD – Transportation and Parking Demand Management Plan**

OK18-0294

The proposed West Oakland BART TOD project is required to prepare a Transportation and Parking Demand Management (TDM) Plan per the *City of Oakland's Transportation Impact Review Guidelines* and the City's Standard Conditions of Approval because the project would generate more than 50 net new peak hour trips. Since the project would generate more than 100 net new peak hour trips, the goal of the TDM Plan is to achieve a 20 percent vehicle trip reduction (VTR). This memorandum describes the project and its setting, lists the mandatory TDM strategies that the project shall implement to achieve the 20 percent VTR, provides the additional strategies that should be considered if the 20 percent VTR is not achieved, and describes the monitoring, evaluation, and enforcement of the TDM Plan.

PROJECT DESCRIPTION

The proposed project would be located adjacent to the West Oakland BART station, bounded by 7th Street to the north, Mandela Parkway to the east, 5th Street to the south, and Chester Street to the west. The project would consist of four buildings that would include:

- 762 multi-family dwelling units
- approximately 382,000 square feet of office space
- approximately 75,000 square feet of ground-level commercial space

The project would also include 400 automobile parking spaces in a garage accessible via a driveway on Chester Street.

The project site is currently occupied by surface parking lots that provide 413 parking spaces for the West Oakland BART station, which the project would eliminate.

The following infrastructure improvements in the project vicinity are assumed to be part of the project because they are shown on the project site plan:

- Raised one-way Class 4 separated bikeways on both sides of 7th Street between Chester Street and Mandela Parkway.
- One-way Class 4 separated bikeways on both sides of Mandela Parkway between 7th and 5th Streets.
- A bike station on the east side of the existing BART station under the BART tracks and adjacent to a mid-block crossing on Mandela Parkway. The bike station is estimated to accommodate at least 500 bicycles, and would provide a repair station.
- The project proposes a 19-foot sidewalk along the project frontage on 5th Street, between Chester Street and Mandela Parkway. The sidewalk would have a minimum eight-foot pedestrian through zone, and the sidewalk width would accommodate the needs of pedestrians, bus passengers, and curbside passenger loading.
- The project proposes a sidewalk along the project frontage on 7th Street with a minimum eight-foot pedestrian through zone between Chester Street and Mandela Parkway. The sidewalk would provide adequate width to accommodate the high level of pedestrians with pedestrian amenities such as seating, real-time bus arrival information, trash receptacles, and pedestrian-lighting.
- The project proposes an 11 to 15-foot sidewalk along the project frontage on Chester Street and a 15-foot sidewalk along Mandela Parkway between 5th and 7th Street. All sidewalks would have a minimum eight-foot pedestrian through zone.
- As part of implementing a Class 4 cycletrack along westbound 7th Street, the project would eliminate the second receiving lane west of Mandela Parkway and shorten the pedestrian crossing distance for the west crosswalk at the 7th Street/Mandela Parkway intersection.
- The sidewalks along the project frontage and the internal pedestrian plazas would provide pedestrian-scale lighting and street trees/plantings.
- At the intersections of 5th Street with Chester Street, Center Street and Mandela Parkway, the project would provide high-visibility crosswalks, and directional ramps along all approaches.
- At the 5th Street/Center Street intersection, project would provide curb extensions (bulb-outs) at all four intersection corners.

- High-visibility, mid-block pedestrian crossing would be provided on Mandela Parkway between 5th and 7th Streets to align with the east-west pedestrian path within the project site. The midblock crossing would also allow access between the bike station and the northbound Class 4 cycletrack on Mandela Parkway.

- The project would provide a bus stop/layover zone along the project frontage on 5th Street just west of Mandela Parkway. The bus zone would be at least 170 feet long and a concrete bus pad would also be installed in the roadway. The bus stop and layover for AC Transit Lines 36 and 62 could be relocated to this location.

- The existing bus stop on eastbound 7th Street west of Mandel Parkway would be retained and extended for an approximate length of 270 feet. This stop could serve AC Transit Lines 29, 36, and 62 and could serve as both a stop and layover space for AC Transit Line 14. The bus stop would be located on a 10-foot bus island that separates the Class 4 cycletrack along this segment of 7th Street.

- A new bus stop would be installed on westbound 7th Street just west of Center Street that could serve AC Transit Line 29. The bus stop would be about 130 feet long. The bus stop would be located on a 10-foot bus island that separates the Class 4 cycletrack along this segment of 7th Street.

- The sidewalks along project frontage on 5th and 7th Street would have adequate width and would accommodate a high level of passenger amenities, including shelters with seating, maps and other information, and real-time bus arrival information; trash receptacles; and lighting. In addition, the roadway pavement would be upgraded to provide concrete pads for the bus stops.

- To facilitate buses turning from northbound Chester Street to eastbound 7th Street, Chester Street is redesigned so that buses are positioned closer to the center line of Chester Street, which would improve current conditions for buses. Due to the tight turning radius of the corner, buses cannot make the turn from Chester Street to 7th Street when positioned close to the curb on northbound Chester Street.

- The following would be designated for passenger loading and unloading:
  - Approximately 100 feet of linear curb along the north side of 5th street east of Center Street and about 200 feet west of Center Street
  - Approximately 250 feet of linear curb along the south side of 7th Street between Chester and Center Streets, with about 50 feet of curb on eastbound 7th Street just west of Center Street designated as a blue accessible loading zone.
- Parking would be prohibited at the following locations:
  - On the west side of Mandela Parkway between 5th and 7th Street

- On the east side of Chester Street between 5th and 7th Streets and on the west side of Chester Street between the mid-block crossing and 7th Street.

PROJECT LOCATION

The project is located in a moderately dense area with streets generally laid out in a grid and sidewalks on most streets. It is located near some existing neighborhood-serving retail and industrial uses, and there are several proposed projects in the area that would increase residential density and provide neighborhood-serving retail uses. Additionally, the project is located within two miles of Downtown Oakland, a dense employment center.

The project is adjacent to the West Oakland BART Station, which is served by four BART lines and four AC Transit local bus lines. AC Transit Lines 14 and 62 have 15-minute peak headways, while Line 29 has 20-minute peak headways, and Line 36 has 30-minute peak headways. The Line 800 overnight bus also operates adjacent to the project site. No major changes to the bus routes operating near the project site are planned, though the project would involve relocating the bus stops within the site to the adjacent streets.

The project's proximity to regional transit and dense employment centers is likely to result in relatively high rates of walking, bicycling and transit use by residents and visitors. This is evidenced in part by the travel patterns of the area's existing residents. Based on US Census data, **Table 1** summarizes the transportation mode split for employed residents' journey to work for the census tracts in the project vicinity. About 46 percent of employed residents report driving alone to work. A high proportion of residents, approximately 29 percent, used public transportation to travel to work. The proportion of residents who walk or bike to work was also relatively high, with 12 percent reporting walking or biking to work. **Table 2** summarizes vehicle ownership for renter households for the census tracts in the project vicinity. About 38 percent of renter households near the project do not own vehicles, and the average automobile ownership is about 0.8 vehicles per renter household.

The number of automobile trips generated by the project is estimated to be slightly more than half the trips generated by a typical suburban residential development, as shown in **Table 3**. The project would also be expected to generate a vehicle-miles traveled (VMT) per resident that is about 83 percent of the regional VMT per worker, as the residential VMT per capita in the project TAZ is 12.5, comparted to the regional average of 15.0, as documented in the Project CEQA Analysis document.

TABLE 1
JOURNEY TO WORK FOR EMPLOYED RESIDENTS

Transportation Mode	Percent of Households with Employed Residents
Drove Alone	46%
Carpooled	5%
Public transportation	29%
Motorcycle	2%
Bicycle	7%
Walked	5%
Other	6%
Total	**100%**

Source: U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates, Census Tracts 4018, 4022, 4024, 4025, and 4105, Table B08006.

TABLE 2
VEHICLE OWNERSHIP FOR EMPLOYED RESIDENTS

Vehicles Available	Percent of Renter Households with Employed Residents
No vehicle available	38%
1 vehicle available	46%
2 vehicles available	14%
3+ vehicles available	2%
Total	**100%**

Source: U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates, Census Tracts 4018, 4022, 4024, 4025, and 4105, Table B08203.

TABLE 3
WEST OAKLAND BART TOD PROJECT TRIP GENERATION BY TRAVEL MODE[1]

Mode	Mode Share Adjustment Factors[2]	Daily	AM Peak Hour	PM Peak Hour
Automobile	53.1%	6,650	472	628
Transit	29.7%	3,720	264	351
Bike	5.1%	640	45	60
Walk	10.5%	1,310	93	124
	Total Trips	**12,320**	**874**	**1,163**

Notes:

1. See West Oakland BART TOD – Transportation Assessment (non-CEQA) Memorandum for detailed assumptions and calculations.
2. Based on *City of Oakland Transportation Impact Study Guidelines* assuming project site is in an urban environment less than 0.5 miles from a BART station.

Source: Fehr & Peers, 2019.

MANDATORY TDM STRATEGIES

This section describes the mandatory strategies that shall be implemented as part of the project. These strategies shall be directly implemented by the project applicant and building management. **Table 4** describes all mandatory TDM strategies that apply to the project, as well as the effectiveness of each strategy based on research compiled in Quantifying Greenhouse Gas Mitigation Measures (California Air Pollution Control Officers Association (CAPCOA), August 2010). The CAPCOA report is a resource for local agencies to quantify the benefit, in terms of reduced travel demand, of implementing various TDM strategies.

The City of Oakland Standard Conditions of Approval lists infrastructure and operational strategies that must be incorporated into a TDM plan based on project location and other characteristics. **Appendix A** presents these strategies and indicates if and how they apply to the proposed project.

TABLE 4
MANDATORY TDM PROGRAM COMPONENTS

TDM Strategy	**Description**	**Estimated Vehicle Trip Reduction[1]**	
		Residents	**Workers**
Infrastructure Improvements	Various improvements	--[3]	--[3]
Limited Residential Parking Supply	Project would provide a maximum of 0.5 parking spaces per unit, compared to average vehicle ownership of 0.8 in the surrounding neighborhood	8 – 15%[2]	N/A
Unbundled Parking	Parking spaces leased separately from unit rent		
No or Minimal Parking for Office/Commercial Uses	No or minimal parking is provided for the office or commercial uses	N/A	10 – 15%
Commercial Parking Management	No monthly permits and market-rate parking rates		
Carshare Parking Spaces	Dedicated on-site carshare parking spaces	<1%	<1%
Guaranteed Ride Home	Promotion of and enrollment of employees in Alameda County's Guaranteed Ride Home program	N/A	--[3]
Bicycle Parking Supply and Monitoring	Provide bicycle parking above the minimum requirement and monitor usage of the bicycle parking facilities	<1%	<1%
Transit Operations	Contribute to AC Transit service enhancement	N/A	N/A
Transit Fare Subsidy	Provide transit subsidy to residents and employees[4]	5 – 10%	10 – 15%
Pre-Tax Commuter Benefit	Enroll in a service to assist with employees deducting transit passes using pre-tax income	N/A	--[3]
TDM Marketing and Education	Active marketing of carpooling, BART, AC Transit, bikesharing, and other non-auto modes	--[3]	1%
On-Site TDM Coordinator	Coordinator responsible for implementing and managing the TDM Plan		
	Component Estimated Vehicle Trip Reduction	13 – 25%	21 – 31%
	Percent of Total Trip Generation	44%	56%

Total Estimated Vehicle Trip Generation	**17 – 28%**

Notes:

1. The focus of the CAPCOA document is reductions to VMT but the research used to generate the reductions also indicates vehicle trip reductions are applicable as well. For the purposes of this analysis the VTR is assumed to equal the VMT reduction. See the cited CAPCOA research for more information and related information on page 8 of the BAAQMD *Transportation Demand Management Tool User's Guide* (June 2012).
2. CAPCOA document suggest that limited parking supply combined with unbundled parking can result in up to 20% VTR. However, the CAPCOA results assume minimal other parking facilities in the area. Thus, the CAPCOA-based results are adjusted because some free unrestricted on-street parking is available in the project area.
3. The effectiveness of this strategy cannot be quantified at this time. This does not necessarily imply that the strategy is ineffective. It only demonstrates that at the time of the CAPCOA report development, existing literature did not provide a robust methodology for calculating its effectiveness. In addition, many strategies are complementary to each other and isolating their specific effectiveness may not be feasible.
4. Assuming a subsidy of about $1.50 per unit and per employee per day available to all residents and employees.

Source: Fehr & Peers, 2019.

The mandatory operational strategies in Table 4 are generally targeted at project residents and employees. While some of the mandatory operational strategies would also affect the travel behavior of retail customers and residential and office visitors, these groups are not directly targeted with TDM programs. The majority of the retail customers would likely be local residents and workers who would walk or bike to the site, and most residential and office visitors would visit the project too infrequently to be aware of the TDM benefits or to make them cost effective. The TDM program also includes infrastructure improvements that would benefit all site residents, employees, and visitors, as well residents, employees, and visitors in the surrounding areas, and BART riders at the West Oakland BART Station.

The VTR estimates in Table 4 represent conservative assumptions about potential trip reduction at the low end of the range. Due to the project’s location in an area with very good transit, bicycle, and pedestrian access, it is expected that the high end of the VTR range would be achieved with this TDM program.

The TDM strategies include both one-time physical improvements and on-going operational strategies. Physical improvements will be constructed as part of the project and are therefore anticipated to have a one-time capital cost. Some level of ongoing maintenance cost may also be required for certain improvements. Operational strategies provide on-going incentives and support for the use of non-auto transportation modes. These TDM measures have monthly or annual costs and will require on-going management. A more detailed description of the TDM measures that comprise the mandatory TDM program is provided below:

- *Infrastructure Improvements* – the following infrastructure improvements in the project vicinity were identified as part of the Site Plan Review for the project, and improve the bicycling, walking, and transit systems in the area and further encourage the use of these mode:
    - Review the final site plans for the project to ensure that the garage driveway on Chester Street and the loading docks for each project building would provide adequate sight distance between vehicles exiting the garage and pedestrians on the adjacent sidewalk.
    - Implement the following at the 7th Street/Mandela Parkway intersection:
        - Convert the existing through/right-turn lane on the westbound 7th Street approach to a right-turn/bus only lane, and remove the merge lane on westbound 7th Street west of the intersection
        - Modify the signal timings at the intersection to provide a bus only phase for the westbound approach, and reduce the signal cycle length to 90 seconds
    - After the completion of the first phase of the project, conduct a signal warrant analysis at the 7th Street/Chester Street intersection to determine if and when the intersection should be signalized. If signalization is warranted, the project shall signalize the intersection with protected left-turn phasing for the east/west 7th Street approaches. In addition and as determined by the City of Oakland staff, the signal may be interconnected with existing adjacent signals along 7th Street. If signalization is not warranted, the project shall conduct an analysis to determine if other control devices, such as all-way stop controls, or rectangular rapid flash beacon (RRFB) should be installed at the intersection. The project shall implement the recommended improvement at the intersection as approved by the City of Oakland.
    - Ensure that the Ford GoBike station currently located in-street on 7th Street just east of Center Street is relocated on the BART Station Plaza to provide close and convenient access to the West Oakland BART station and the bicycle facilities adjacent to the project site.
    - Explore the feasibility of (and implement, if feasible) installing curb extensions (bulb-outs) and directional curb ramps with truncated domes at the following locations:
        - Southwest corner of the 7th Street/Chester Street intersection.
        - All four corners of the 5th Street/Mandela Parkway intersection and curb extensions (bulb-outs) across the 5th Street approaches of the southwest and northeast corners.
    - Provide all-way stop control at the 5th Street/Center Street and 5th Street/Chester Street intersection.

  - If reviewed and approved by BART and Oakland Fire Department, provide rolled curb instead of curb cuts for emergency vehicle access points on Chester Street and Mandela Parkway.
  - Install a pedestrian scramble at the 7th Street/Center Street intersection.
  - Install improvement measures at the proposed mid-block crossing on Mandela Parkway, such as raised crosswalk, RRFB, or other measures as approved by the City of Oakland.
  - Coordinate with the City of Oakland and the appropriate property owners to determine the feasibility of and if deemed feasible, complete the sidewalk gap on the south side of 5th Street just east of Center Street.
  - Consider designating a bus stop for intercity coaches (e.g., Megabus and Bolt) and other shuttles on 7th Street between Henry and Chester Streets.
- *Limited Residetial Parking Supply* – The project would provide up to 400 off-street automobile parking spaces for the residential component of the project, which corresponds to a maximum of 0.5 spaces per unit. This is less than the current average auto ownership of 0.8 vehicles per household in the project area, as shown in Table 1, and would attract households with no vehicles.
- *Unbundled Parking* – Unbundle parking costs from housing costs (as required by Oakland Municipal Code, Section 17.116.310). This would result in residents paying one price for the residential unit and a separate price for parking, should they opt for a space. The price of a parking space can be adjusted so that resident parking demand matches the building's parking supply.
- *No or Minimal Parking for Office/Commercial Uses* – The project would provide none or minimal automobile parking for the office/commercial component.
- *Commercial Parking* Management – If the project provides parking for the commercial and retail components of the project, or parking for the general public, the following shall also be implemented:
  - *No monthly permits and establish minimum price floor for any public parking* — required by the City of Oakland if proposed parking ratio exceeds 1:1,000 square feet (commercial) but should be implemented regardless.
  - *Price parking to achieve desired usage goals* - parking should be priced at the market rate at a minimum and ideally set at a level that makes driving more expensive than non-automobile modes of transportation

- *Carshare Parking Spaces* – Offer to dedicate for free at least six on-site parking spaces available for carsharing. Monitor the usage of the carsharing spaces and adjust if necessary.
- *Guaranteed Ride Home* – Encourage project commercial tenants to register their employees and promote the Alameda County Transportation Commission Guaranteed Ride Home (GRH) program. GRH programs encourage the use of alternative modes of transportation by offering free rides home if an illness or crisis occurs, if the employee is required to work unscheduled overtime, if a carpool or vanpool is unexpectedly unavailable, or if a bicycle problem arises. The Alameda County Transportation Commission offers their GRH service for all registered permanent employees who are employed within Alameda County, live within 100 miles of their worksite, and do not drive alone to work. The GRH program is offered at no cost to the employer, and employers are not required to register in order for their employees to enroll and use the program.
- *Bicycle Parking Supply and Monitoring* – The project would include long-term on-site parking for project residents and employees, a bike station at the BART station, and short-term parking in the form of bike racks along the project frontages, exceeding the City's minimum requirements for bicycle parking. Building management shall monitor the usage of these facilities and provide additional bicycle parking, if necessary.
- *Transit Operations* – The project applicant shall, if feasible, contribute its fair share to AC Transit service enhancements to meet access goals outlined in the City of Oakland West Oakland Specific Plan and AC Transit's ACgo expanded service plan and improve connections to local goods and services. Alternatively, the project applicant may explore and propose other TDM measure(s), including those already set forth in the TDM plan, in lieu of this fair share contribution. The City may approve the substitute TDM measure(s) if the City, in its discretion, deems the measure(s) more feasible, reasonably related and roughly proportional to the transportation impacts of the development.
- *Transit Fare Subsidy (Residents)* – Provide a monthly transit benefit to each dwelling unit. Options include providing discounted Adult 31-Day AC Transit Pass (valued at $84.60 as of January 2019), AC Transit EasyPass, or monthly Clipper Card contributions.
- *Transit Fare Subsidy (Workers)* – Building management shall either offer to provide or require project tenants to provide free or reduced cost transit in order to increase transit mode share. This analysis assumes that a subsidy of $1.50 per weekday per worker (value to worker) would be available to all site workers. Options include:
    - Building management or employers can offer a monthly commuter check (or alternatively Clipper Card, which is accepted by BART, AC Transit, and other major transit providers in the Bay Area) to employees to use public transit. Note that as of 2018, IRS allows up to $260 per employee per month.

  - Building management or employers can participate in AC Transit's EasyPass program, which enables employers to purchase annual bus passes for their employees in bulk at a deep discount. The passes allow unlimited rides on all AC Transit buses for all employees. For more information, see www.actransit.org/rider-info/easypass.

- *Pre-tax Commuter Benefits* – Building management shall encourage project tenants to enroll in a service (such as WageWorks) to help with pre-tax commuter savings. This strategy allows employees to deduct monthly transit passes or other amount using pre-tax dollars. This can help to lower payroll taxes and allows employees to save on transit.

- *TDM Marketing and Resident Education* – Site management shall provide residents and employees information about transportation options. This information would also be posted at central location(s) and be updated as necessary. This information shall include:

  - *Transit Routes* – Promote the use of transit by providing user-focused maps. These maps provide residents with wayfinding to nearby transit stops and transit-accessible destinations and are particularly useful for those without access to portable mapping applications. The project should consider installing real-time transit information, such as TransitScreen, in a visible location to provide residents with up-to-date transit arrival and departure times.

  - *Transit Fare Discounts* – Provide information about local discounted fare options offered by BART and AC Transit, including discounts for youth, elderly, persons with disabilities, and Medicare cardholders.

  - *Car Sharing* – Promote accessible car sharing programs, such as Zipcar, and Getaround by informing residents and employees of on-site and nearby car sharing locations and applicable membership information.

  - *Ridesharing* – Provide residents and employees with phone numbers and contact information for ride sharing options including Uber, Lyft, and Oakland taxi cab services.

  - *Carpooling* – Provide residents and employees with phone numbers and contact information for carpool matching services such as the Metropolitan Transportation Commission's 511 RideMatching.

  - *Walking and Biking Events* – Provide information about local biking and walking events, such as Oaklavia, as events are planned.

  - *Bikeshare* – Educate residents and employees about nearby bike sharing station locations and membership information.

- *On-Site TDM Coordinator* – The project shall provide an on-site TDM coordinator responsible for implementing and managing the TDM Plan. The TDM coordinator would also be responsible for ensuring that all residents, employees, and visitors are aware of their transportation options and would serve as a point of contact for hotel guests and employees regarding TDM programs.

ADDITIONAL OPERATIONAL STRATEGIES

If the mandatory measures do not meet the required goal of 20 percent VTR, and additional vehicle trip reduction is needed, the project shall consider the implementation of some or all of the following additional strategies to limit automobile use and encourage non-automotive travel.

- *Residential Parking Management* – Restrict parking to one parking space per unit or less, thereby discouraging multiple car ownership and/or use. Exceptions will only be made for residents with management approved Reasonable Accommodation Requests. A Reasonable Accommodation Request shall need to demonstrate a hardship wherein a household requires more than one vehicle per unit. Examples could include households with multiple disabled residents requiring vehicles or households with multiple residents with places of work inaccessible via transit. Additionally, if a residential parking permit (RPP) program is implemented in the project vicinity, project residents shall not be eligible for parking permits.
- *Bikeshare/Scooter Membership* – Provide tenants and residents a subsidy to offset the cost of bikeshare and/or scooter membership and encourage the use of non-automobile modes.
- *Carshare Memberships* – Provide residents with free or discounted carshare membership to offset the cost of car sharing programs and reduce the demand for private vehicle ownership.
- *Increased Transit Fare Subsidy* – Increase the transit fare subsidy for project residents and employes.
- *Personalized Trip Planning* – In the form of in-person assistance or as a web tool, provides residents and employees with a customized menu of options for commuting. Trip planning reduces the barriers the residents and employees see to making a walk, bike, or transit trip to the site. Transit trip making tools, such as those available from Google or 511.org, could be promoted to inform residents and employees of transit options to/from work. Providing a preferred walking map routes to residents and employees living within one mile of the site and a bicycling route map to all residents and employees living within five miles of the site would be a proactive strategy to encourage those employees to use alternatives to driving.

TDM MONITORING, EVALUATION AND ENFORCEMENT

Consistent with the requirements of the City's Standard Conditions of Approval, this TDM program requires regular periodic evaluation to determine if the program goal of reducing automobile trips has been satisfied and to assess the effectiveness of the implemented strategies. Beginning the first year after the development and occupancy of the project, building management must prepare an annual TDM monitoring report consisting of the following:

- Summary of implemented TDM measures and their effectiveness (e.g. bicycle parking occupancy, number of transit passes issued, etc.)
- Results of project resident and employee transportation surveys to monitor the vehicle trip generation and mode share for project residents and employees
- Weekday AM and PM peak period and daily traffic volume counts at the garage driveway on Chester Street

As previously discussed, the goal of the TDM program is to reduce the number of vehicle trips generated by the project by 20 percent. This level would correspond to a total project vehicle trip generation of no more than 378 trips during the AM peak hour and 467 in the PM peak hour.

Based on the results of the surveys, TDM programs shall be increased if these goals are not met. This program ensures the implementation of the mandatory TDM measures and related requirements through compliance with the Mitigation Monitoring and Reporting Program, as implemented through the Conditions of Approval adopted for the project.

The first monitoring report must be prepared one year after full occupancy of the first phase of the project, and subsequent monitoring reports must be prepared annually. If following the annual monitoring the TDM goals are not satisfied, additional measures shall be implemented, with consultation with City staff, until the goal is met.

If in two successive years the project’s TDM goals are not satisfied, site management shall prepare and submit for City approval a Corrective Action Plan. The Corrective Action Plan shall detail the additional TDM measures to be implemented on site and their expected modal split reduction.

If, one year after the Corrective Action Plan is implemented, the required automobile mode share reduction target is still not being achieved, or if site management fails to submit a report as described above, or if the reports do not meet City requirements outlined above, the City may, in addition to its other remedies, (a) assess the project a financial penalty based on the observed reduction in the automobile mode share compared to the target; or (b) refer the matter to the City Planning Commission for scheduling of a compliance hearing to determine whether the project’s approvals should be revoked, altered or additional conditions of approval imposed.

The penalty as described in (a) above shall be determined by assigning a cost to the number of additional automobile trips to be reduced in order to meet the required goal. Assuming the cost per new alternative commuter is $26/day and that there are 261 workdays per year, the annual cost per new alternative commuter is $6,790. The project shall therefore pay a penalty of $6,790 per year for each trip that should have been using an alternative mode if the 20 percent reduction after completion of the Project had been achieved.

In determining if a financial penalty or other remedy is appropriate, the City shall not impose a penalty if the project has made a good faith effort to comply with the TDM program. The City would only have the ability to impose a monetary penalty after a reasonable cure period and in accordance with the enforcement process outlined in the City's Planning Code Chapter 17.152. If a financial penalty is imposed, such penalty sums shall be used by the City solely toward the implementation of the TDM plan.

If in five successive years the project is found to meet the stated TDM goal, additional surveys and monitoring shall be suspended until such a time as the City deems they are needed.

Please contact Sam Tabibnia (s.tabibnia@fehrandpeers.com or 510-835-1943) with questions or comments.

APPENDIX A
TDM PROGRAM CONSISTENCY WITH CITY REQUIREMENTS

TDM Strategy	Required When	Required for Proposed Project?
Bus boarding bulbs or islands	• A bus boarding bulb or island does not already exist, and a bus stop is located along the project frontage; and/or • A bus stop along the project frontage serves a route with 15 minutes or better peak hour service and has a shared bus-bike lane curb	**Yes**, the project would relocate several bus stops from within the BART station to adjacent streets, including bus boarding islands on both directions of 7th Street.
Bus shelter	• A stop with no shelter is located within the project frontage, or • The project is located within 0.10 miles of a flag stop with 25 or more boardings per day	**Yes**, bus shelters would be provided at all bus stops along the project frontage.
Concrete bus pad	• A bus stop is located along the project frontage and a concrete bus pad does not already exist	**Yes**, concrete bus pads would be provided at all the bus stops relocated to the project frontage.
Curb extensions or bulb-outs	• Identified as an improvement within site analysis	**Yes**, the project would provide curb extensions at intersections along the project frontage
Implementation of a corridor-level bikeway improvement	• A buffered Class 2 or Class 4 bikeway facility is in a local or county adopted plan within 0.10 miles of the project location; and • The project would generate 500 or more daily bicycle trips	**Yes**, the project would provide Class 4 bikeways on both directions of 7th Street and Mandela Parkway along the project frontage.
Implementation of a corridor-level transit capital improvement	• A high-quality transit facility is in a local or county adopted plan within 0.25 miles of the project location; and • The project would generate 400 or more peak period transit trips	**Yes**, while the project is estimated to generate fewer than 400 peak hour transit trips, the project would implement a bus queue jump Lane on westbound 7th Street at Mandela Parkway.
Installation of amenities such as lighting; pedestrian-oriented green infrastructure, trees, or other greening landscape; and trash receptacles per the Pedestrian Master Plan and any applicable streetscape plan	• Always required	**Yes**, the project would upgrade the pedestrian amenities within the site and on the adjacent sidewalks.

APPENDIX A
TDM PROGRAM CONSISTENCY WITH CITY REQUIREMENTS

TDM Strategy	Required When	Required for Proposed Project?
Installation of safety improvements identified in the Pedestrian Master Plan (such as crosswalk striping, curb ramps, count down signals, bulb outs, etc.)	• When improvements are identified in the Pedestrian Master Plan (PMP) along project frontage or at an adjacent intersection	**Yes**, although the PMP does not identify any specific improvements near the project, the project would provide high-visibility crosswalk striping and directional curb ramps at intersection adjacent to the project.
In-street bicycle corral	• A project includes more than 10,000 square feet of ground floor retail, is located along a Tier 1 bikeway, and on-street vehicle parking is provided along the project frontages.	No, the project would not provide on-street vehicle parking along the project frontage. Short-term bicycle parking will be accommodated within the project site.
Intersection improvements, including but not limited to visibility improvements, shortening corner radii, pedestrian safety islands, accounting for pedestrian desire lines.	• Identified as an improvement within site analysis	**Yes**, the project would provide curb extensions at intersections along the project frontage.
New sidewalk, curb ramps, curb and gutter meeting current City and ADA standards	• Always required	**Yes**, the project would upgrade the sidewalks along the project frontage.
No monthly permits and establish minimum price floor for public parking	• If proposed parking ratio exceeds 1:1,000 sf (commercial)	**Yes**, if commercial parking is provided, no monthly permit would be provided and a minimum price floor for public parking would be established. Although, off-street commercial parking would be at less than 1:1,000 sf, if provided.
Parking garage is designed with retrofit capability	• Optional if proposed parking ratio exceeds 1:1.25 (residential) or 1:1,000 sf (commercial)	Not applicable, the residential parking ratio would be less than 1.25; if off-street commercial parking is provided, it would be at less than 1:1,000 sf.

APPENDIX A
TDM PROGRAM CONSISTENCY WITH CITY REQUIREMENTS

TDM Strategy	Required When	Required for Proposed Project?
Parking space reserved for car share	• A project is located within downtown (CBD and D-LM zones). One car share space preserved for buildings between 50 – 200 units, then one car share space per 200 units.	**Yes**, although the project is not located in a downtown zone, the project would offer to dedicate up to six spaces in the garage for car share.
Paving, lane striping or restriping (vehicle and bicycle), and signs to midpoint of street section	• Typically required	**Yes**, provided.
Pedestrian crossing improvements, pedestrian-supportive signal changes, including but not limited to reducing signal cycle lengths to less than 90 seconds to avoid pedestrian crossings against the signal, providing a leading pedestrian interval, provide a "scramble" signal phase where appropriate.	• Identified as an improvement within site analysis • Identified as an improvement within operations analysis	**Yes**, cycle lengths adjacent to the project would be reduced to 90 seconds and a pedestrian scramble would be provided at the 7th Street/ Center Street intersection.
Real-time transit information system	• A project frontage block includes a bus stop or BART station and is along a Tier 1 transit route with 2 or more routes or peak period frequency of 15 minutes or better	**Yes**, project would provide real-time transit information.
Relocating bus stops to far side	• A project is located within 0.10 mile of any active bus stop that is currently near-side	**Yes**, project would relocate bus stops from within the BART Station to adjacent streets, including the far sides of westbound 7th Street at Center Street and eastbound 5th Street at Mandela Parkway.
Signal upgrades, including typical traffic lights, pedestrian signals, bike actuated signals, transit only signals	• Project size exceeds 100 residential units, 80,000 sf of retail, or 100,000 sf of commercial; and • Project frontage abuts an intersection with signal infrastructure older than 15 years	**Yes**, a new traffic signal may be installed at the 7th Street/ Chester Street intersection.
Transit queue jumps	• Identified as a needed improvement within operations analysis of a project with frontage along a Tier 1 transit route with 2 or more routes or peak period frequency of 15 minutes or better	**Yes**, the project would provide a bus queue jump Lane on westbound 7th Street at Mandela Parkway.

APPENDIX A
TDM PROGRAM CONSISTENCY WITH CITY REQUIREMENTS

TDM Strategy	Required When	Required for Proposed Project?
Trenching and placement of conduit for providing traffic signal interconnect	• Project size exceeds 100 units, 80,000 sf of retail, or 100,000 sf of commercial; and • Project frontage block is identified for signal interconnect improvements as part of a planned ITS improvement; and • A major transit improvement is identified within operations analysis requiring traffic signal interconnect	**Yes**, a new traffic signal may be installed at the 7th Street/ Chester Street intersection and be interconnected with existing signals along 7th Street.
Unbundled parking	• New multifamily dwelling residential facilities of ten (10) or more units, with the exception of affordable housing	**Yes**, the residential component of the project would provide unbundled parking.

Sources: City of Oakland Transportation Impact Review Guidelines, 2017 and City of Oakland Municipal Code, 2018

Appendix O

West Oakland BART TOD Transportation and Parking Demand Management Plan

Fehr & Peers, January 28, 2019

DRAFT MEMORANDUM

Date:	January 18, 2019
To:	Rebecca Auld, Lamphier-Gregory
From:	Sam Tabibnia and Jordan Brooks, Fehr & Peers
Subject:	**West Oakland BART TOD – Transportation and Parking Demand Management Plan**

OK18-0294

The proposed West Oakland BART TOD project is required to prepare a Transportation and Parking Demand Management (TDM) Plan per the *City of Oakland's Transportation Impact Review Guidelines* and the City's Standard Conditions of Approval because the project would generate more than 50 net new peak hour trips. Since the project would generate more than 100 net new peak hour trips, the goal of the TDM Plan is to achieve a 20 percent vehicle trip reduction (VTR). This memorandum describes the project and its setting, lists the mandatory TDM strategies that the project shall implement to achieve the 20 percent VTR, provides the additional strategies that should be considered if the 20 percent VTR is not achieved, and describes the monitoring, evaluation, and enforcement of the TDM Plan.

PROJECT DESCRIPTION

The proposed project would be located adjacent to the West Oakland BART station, bounded by 7th Street to the north, Mandela Parkway to the east, 5th Street to the south, and Chester Street to the west. The project would consist of four buildings that would include:

- 762 multi-family dwelling units
- approximately 382,000 square feet of office space
- approximately 75,000 square feet of ground-level commercial space

The project would also include 400 automobile parking spaces in a garage accessible via a driveway on Chester Street.

The project site is currently occupied by surface parking lots that provide 337 parking spaces for the West Oakland BART station, which the project would eliminate.

PROJECT LOCATION

The project is located in a moderately dense area with streets generally laid out in a grid and sidewalks on most streets. It is located near some existing neighborhood-serving retail and industrial uses, and there are several proposed projects in the area that would increase residential density and provide neighborhood-serving retail uses. Additionally, the project is located within two miles of Downtown Oakland, a dense employment center.

The project is adjacent to the West Oakland BART Station, which is served by four BART lines and four AC Transit local bus lines. AC Transit Lines 14 and 62 have 15-minute peak headways, while Line 29 has 20-minute peak headways, and Line 36 has 30-minute peak headways. The Line 800 overnight bus also operates adjacent to the project site. No major changes to the bus routes operating near the project site are planned, though the project would involve relocating the bus stops within the site to the adjacent streets.

The project's proximity to regional transit and dense employment centers is likely to result in relatively high rates of walking, bicycling and transit use by residents and visitors. This is evidenced in part by the travel patterns of the area's existing residents. Based on US Census data, **Table 1** summarizes the transportation mode split for employed residents' journey to work for the census tracts in the project vicinity. About 46 percent of employed residents report driving alone to work. A high proportion of residents, approximately 29 percent, used public transportation to travel to work. The proportion of residents who walk or bike to work was also relatively high, with 12 percent reporting walking or biking to work. **Table 2** summarizes vehicle ownership for renter households for the census tracts in the project vicinity. About 38 percent of renter households near the project do not own vehicles, and the average automobile ownership is about 0.8 vehicles per renter household.

The number of automobile trips generated by the project is estimated to be slightly more than half the trips generated by a typical suburban residential development, as shown in **Table 3**. The project would also be expected to generate a vehicle-miles traveled (VMT) per resident that is about 83 percent of the regional VMT per worker, as the residential VMT per capita in the project TAZ is 12.5, comparted to the regional average of 15.0, as documented in the Project CEQA Analysis document.

TABLE 1
JOURNEY TO WORK FOR EMPLOYED RESIDENTS

Transportation Mode	Percent of Households with Employed Residents
Drove Alone	46%
Carpooled	5%
Public transportation	29%
Motorcycle	2%
Bicycle	7%
Walked	5%
Other	6%
Total	**100%**

Source: U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates, Census Tracts 4018, 4022, 4024, 4025, and 4105, Table B08006.

TABLE 2
VEHICLE OWNERSHIP FOR EMPLOYED RESIDENTS

Vehicles Available	Percent of Renter Households with Employed Residents
No vehicle available	38%
1 vehicle available	46%
2 vehicles available	14%
3+ vehicles available	2%
Total	**100%**

Source: U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates, Census Tracts 4018, 4022, 4024, 4025, and 4105, Table B08203.

TABLE 3
WEST OAKLAND BART TOD PROJECT TRIP GENERATION BY TRAVEL MODE[1]

Mode	Mode Share Adjustment Factors[2]	Daily	AM Peak Hour	PM Peak Hour
Automobile	53.1%	6,650	472	628
Transit	29.7%	3,720	264	351
Bike	5.1%	640	45	60
Walk	10.5%	1,310	93	124
	Total Trips	**12,320**	**874**	**1,163**

Notes:

1. See West Oakland BART TOD – Transportation Assessment (non-CEQA) Memorandum for detailed assumptions and calculations.
2. Based on *City of Oakland Transportation Impact Study Guidelines* assuming project site is in an urban environment less than 0.5 miles from a BART station.

Source: Fehr & Peers, 2019.

MANDATORY TDM STRATEGIES

This section describes the mandatory strategies that shall be implemented as part of the project. These strategies shall be directly implemented by the project applicant and building management. **Table 4** describes all mandatory TDM strategies that apply to the project, as well as the effectiveness of each strategy based on research compiled in Quantifying Greenhouse Gas Mitigation Measures (California Air Pollution Control Officers Association (CAPCOA), August 2010). The CAPCOA report is a resource for local agencies to quantify the benefit, in terms of reduced travel demand, of implementing various TDM strategies.

The City of Oakland Standard Conditions of Approval lists infrastructure and operational strategies that must be incorporated into a TDM plan based on project location and other characteristics. **Appendix A** presents these strategies and indicates if and how they apply to the proposed project.

TABLE 4
MANDATORY TDM PROGRAM COMPONENTS

TDM Strategy	Description	Estimated Vehicle Trip Reduction[1]	
		Residents	Workers
Infrastructure Improvements	Various improvements	--[3]	--[3]
Limited Residential Parking Supply	Project would provide a maximum of 0.5 parking spaces per unit, compared to average vehicle ownership of 0.8 in the surrounding neighborhood	8 – 15%[2]	N/A
Unbundled Parking	Parking spaces leased separately from unit rent		
No or Minimal Parking for Office/Commercial Uses	No or minimal parking is provided for the office or commercial uses	N/A	10 – 15%
Commercial Parking Management	No monthly permits and market-rate parking rates		
Carshare Parking Spaces	Dedicated on-site carshare parking spaces	<1%	<1%
Guaranteed Ride Home	Promotion of and enrollment of employees in Alameda County's Guaranteed Ride Home program	N/A	--[3]
Bicycle Parking Supply and Monitoring	Provide bicycle parking above the minimum requirement and monitor usage of the bicycle parking facilities	<1%	<1%
Transit Fare Subsidy	Provide transit subsidy to residents and employees[4]	5 – 10%	10 – 15%
Pre-Tax Commuter Benefit	Enroll in a service to assist with employees deducting transit passes using pre-tax income	N/A	--[3]
TDM Marketing and Education	Active marketing of carpooling, BART, AC Transit, bikesharing, and other non-auto modes	--[3]	1%
On-Site TDM Coordinator	Coordinator responsible for implementing and managing the TDM Plan		
	Component Estimated Vehicle Trip Reduction	13 – 25%	21 – 31%
	Percent of Total Trip Generation	44%	56%

Total Estimated Vehicle Trip Generation	**17 – 28%**

Notes:

1. The focus of the CAPCOA document is reductions to VMT but the research used to generate the reductions also indicates vehicle trip reductions are applicable as well. For the purposes of this analysis the VTR is assumed to equal the VMT reduction. See the cited CAPCOA research for more information and related information on page 8 of the BAAQMD *Transportation Demand Management Tool User's Guide* (June 2012).
2. CAPCOA document suggest that limited parking supply combined with unbundled parking can result in up to 20% VTR. However, the CAPCOA results assume minimal other parking facilities in the area. Thus, the CAPCOA-based results are adjusted because some free unrestricted on-street parking is available in the project area.
3. The effectiveness of this strategy cannot be quantified at this time. This does not necessarily imply that the strategy is ineffective. It only demonstrates that at the time of the CAPCOA report development, existing literature did not provide a robust methodology for calculating its effectiveness. In addition, many strategies are complementary to each other and isolating their specific effectiveness may not be feasible.
4. Assuming a subsidy of about $1.50 per unit and per employee per day available to all residents and employees.

Source: Fehr & Peers, 2019.

The mandatory operational strategies in Table 4 are generally targeted at project residents and employees. While some of the mandatory operational strategies would also affect the travel behavior of retail customers and residential and office visitors, these groups are not directly targeted with TDM programs. The majority of the retail customers would likely be local residents and workers who would walk or bike to the site, and most residential and office visitors would visit the project too infrequently to be aware of the TDM benefits or to make them cost effective. The TDM program also includes infrastructure improvements that would benefit all site residents, employees, and visitors, as well residents, employees, and visitors in the surrounding areas, and BART riders at the West Oakland BART Station.

The VTR estimates in Table 4 represent conservative assumptions about potential trip reduction at the low end of the range. Due to the project’s location in an area with very good transit, bicycle, and pedestrian access, it is expected that the high end of the VTR range would be achieved with this TDM program.

The TDM strategies include both one-time physical improvements and on-going operational strategies. Physical improvements will be constructed as part of the project and are therefore anticipated to have a one-time capital cost. Some level of ongoing maintenance cost may also be required for certain improvements. Operational strategies provide on-going incentives and support for the use of non-auto transportation modes. These TDM measures have monthly or annual costs and will require on-going management. A more detailed description of the TDM measures that comprise the mandatory TDM program is provided below:

- *Infrastructure Improvements* – the following infrastructure improvements in the project vicinity, which were either included as part of the project or identified as part of the Site Plan Review for the project, would improve the bicycling, walking, and transit systems in the area and further encourage the use of these modes. These improvements include the following features shown on the project site plan and assumed to be included in the project:
    - One-way Class 4 separated bikeways on both sides of 7th Street between Chester Street and Mandela Parkway.
    - One-way Class 4 separated bikeways on both sides of Mandela Parkway between 7th and 5th Streets.
    - A bike station on the east side of the existing BART station under the BART tracks and adjacent to a mid-block crossing on Mandela Parkway. The bike station is estimated to accommodate up to 600 bicycles, and would provide a repair station.
    - The project proposes a 19-foot sidewalk along the project frontage on 5th Street, between Chester Street and Mandela Parkway. The sidewalk width would accommodate the needs of pedestrians, bus passengers, and curbside passenger loading.
    - The project proposes an 11 to 15-foot sidewalk along the project frontage on Chester Street and a 15-foot sidewalk along Mandela Parkway between 5th and 7th Street.
    - The sidewalks along the project frontage and the internal pedestrian plazas would provide pedestrian-scale lighting and street trees/plantings.
    - At the intersections of 5th Street with Chester Street, Center Street and Mandela Parkway, the project would provide high-visibility crosswalks, and directional ramps along all approaches.
    - At the 5th Street/Center Street intersection, project would provide curb extensions (bulb-outs) at all four intersection corners.
    - High-visibility, mid-block pedestrian crossing would be provided on Mandela Parkway and Chester Street between 5th and 7th Streets to align with the east-west pedestrian path within the project site. The midblock crossing would also allow access between the bike station and the northbound Class 4 cycletrack on Mandela Parkway.
    - The project would provide a bus stop/layover zone along the project frontage on 5th Street just west of Mandela Parkway. The bus zone would be at least 170 feet long and a concrete bus pad would also be installed in the roadway. The bus stop and layover for AC Transit Lines 36 and 62 could be relocated to this location.

- The existing bus stop on eastbound 7th Street west of Mandel Parkway would be retained and extended for an approximate length of 270 feet. This stop could serve AC Transit Lines 29, 36, and 62 and could serve as both a stop and layover space for AC Transit Line 14. The bus stop would be located on a 10-foot bus island that separates the Class 4 cycletrack along this segment of 7th Street.

- A new bus stop would be installed on westbound 7th Street just west of Center Street that could serve AC Transit Line 29. The bus stop would be about 130 feet long. The bus stop would be located on a 10-foot bus island that separates the Class 4 cycletrack along this segment of 7th Street.

- The sidewalks along project frontage on 5th and 7th Street would have adequate width and would accommodate a high level of passenger amenities, including shelters with seating, maps and other information, and real-time bus arrival information; trash receptacles; and lighting. In addition, the roadway pavement would be upgraded to provide concrete pads for the bus stops.

- To facilitate buses turning from northbound Chester Street to eastbound 7th Street, Chester Street is redesigned so that buses are positioned closer to the center line of Chester Street, which would improve current conditions for buses. Due to the tight turning radius of the corner, buses cannot make the turn from Chester Street to 7th Street when positioned close to the curb on northbound Chester Street.

- The following would be designated for passenger loading and unloading:
    - Approximately 100 feet of linear curb along the north side of 5th street east of Center Street and about 200 feet west of Center Street
    - Approximately 250 feet of linear curb along the south side of 7th Street between Chester and Center Streets, with about 50 feet of curb on eastbound 7th Street just west of Center Street designated as a blue accessible loading zone.

- Parking would be prohibited at the following locations:
    - On the west side of Mandela Parkway between 5th and 7th Street
    - On the east side of Chester Street between 5th and 7th Streets and on the west side of Chester Street between the mid-block crossing and 7th Street.

The infrastructure improvements also include the following identified as part of the Site Plan Review:

- Review the final site plans for the project to ensure that the garage driveway on Chester Street and the loading docks for each project building would provide adequate sight distance between vehicles exiting the garage and pedestrians on the adjacent sidewalk.

  - Implement the following at the 7th Street/Mandela Parkway intersection:
    - Convert the existing through/right-turn lane on the westbound 7th Street approach to a right-turn/bus only lane, and remove the merge lane on westbound 7th Street west of the intersection
    - Modify the signal timings at the intersection to provide a bus only phase for the westbound approach, and reduce the signal cycle length to 90 seconds
  - After the completion of the first phase of the project, conduct a signal warrant analysis at the 7th Street/Chester Street intersection to determine if and when the intersection should be signalized. If signalization is warranted, the project shall signalize the intersection with protected left-turn phasing for the east/west 7th Street approaches.
  - Ensure that the Ford GoBike station currently located in-street on 7th Street just east of Center Street is relocated on the BART Station Plaza to provide close and convenient access to the West Oakland BART station and the bicycle facilities adjacent to the project site.
  - Explore the feasibility of (and implement, if feasible) installing curb extensions (bulb-outs) and directional curb ramps with truncated domes at the following locations:
    - Southwest corner of the 7th Street/Chester Street intersection.
    - All four corners of the 5th Street/Mandela Parkway intersection and curb extensions (bulb-outs) across the 5th Street approaches of the southwest and northeast corners.
  - Provide all-way stop control at the 5th Street/Center Street and 5th Street/Chester Street intersection.
  - Provide rolled curb instead of curb cuts for emergency vehicle access points on Chester Street and Mandela Parkway.
  - Install a pedestrian scramble at the 7th Street/Center Street intersection.
  - Coordinate with the City of Oakland and the appropriate property owners to complete the sidewalk gap on the south side of 5th Street just east of Center Street.
  - Consider designating a bus stop for intercity coaches (e.g., Megabus and Bolt) and other shuttles on 7th Street between Henry and Chester Streets.
  - Consider installing parking meters with two-hour limits along segments of 7th Street with commercial frontage.

- *Limited Residetial Parking Supply* – The project would provide up to 400 off-street automobile parking spaces for the residential component of the project, which corresponds to a maximum of 0.5 spaces per unit. This is less than the current average auto ownership of 0.8 vehicles per household in the project area, as shown in Table 1, and would attract households with no vehicles.

- *Unbundled Parking* – Unbundle parking costs from housing costs (as required by Oakland Municipal Code, Section 17.116.310). This would result in residents paying one price for the residential unit and a separate price for parking, should they opt for a space. The price of a parking space can be adjusted so that resident parking demand matches the building's parking supply.

- *No or Minimal Parking for Office/Commercial Uses* – The project would provide none or minimal any automobile parking for the office/commercial component.

- *Commercial Parking* Management – If the project provides parking for the commercial and reail components of the project, or parking for the general public, the following shall also be implemented:

    - *No monthly permits and establish minimum price floor for any public parking* — required by the City of Oakland if proposed parking ratio exceeds 1:1,000 square feet (commercial) but should be implemented regardless.

    - *Price parking to achieve desired usage goals* - parking should be priced at the market rate at a minimum and ideally set at a level that makes driving more expensive than non-automobile modes of transportation

- *Carshare Parking Spaces* – Offer to dedicate for free at least six on-site parking spaces available for carsharing. Monitor the usage of the carsharing spaces and adjust if necessary.

- *Guaranteed Ride Home* – Encourage project commercial tenants to register their employees and promote the Alameda County Transportation Commission Guaranteed Ride Home (GRH) program. GRH programs encourage the use of alternative modes of transportation by offering free rides home if an illness or crisis occurs, if the employee is required to work unscheduled overtime, if a carpool or vanpool is unexpectedly unavailable, or if a bicycle problem arises. The Alameda County Transportation Commission offers their GRH service for all registered permanent employees who are employed within Alameda County, live within 100 miles of their worksite, and do not drive alone to work. The GRH program is offered at no cost to the employer, and employers are not required to register in order for their employees to enroll and use the program.

- *Bicycle Parking Supply and Monitoring* – The project would include long-term on-site parking for project residents and employees, a bike station at the BART station, and short-term parking in the form of bike racks along the project frontages, exceeding the City's minimum requirements for bicycle parking. Building management shall monitor the usage of these facilities and provide additional bicycle parking, if necessary.

- *Transit Fare Subsidy (Residents)* – Provide a monthly transit benefit to each dwelling unit. Options include providing discounted Adult 31-Day AC Transit Pass (valued at $84.60 as of January 2019), AC Transit EasyPass, or monthly Clipper Card contributions. This analysis assumes that a subsidy of $1.50 per weekday per residential unit (value to residents) would be available to all site residents.
- *Transit Fare Subsidy (Workers)* – Building management shall either offer to provide or require project tenants to provide free or reduced cost transit in order to increase transit mode share. This analysis assumes that a subsidy of $1.50 per weekday per worker (value to worker) would be available to all site workers. Options include:
  - Building management or employers can offer a monthly commuter check (or alternatively Clipper Card, which is accepted by BART, AC Transit, and other major transit providers in the Bay Area) to employees to use public transit. Note that as of 2018, IRS allows up to $260 per employee per month.
  - Building management or employers can participate in AC Transit’s EasyPass program, which enables employers to purchase annual bus passes for their employees in bulk at a deep discount. The passes allow unlimited rides on all AC Transit buses for all employees. For more information, see www.actransit.org/rider-info/easypass.
- *Pre-tax Commuter Benefits* – Building management shall encourage project tenants to enroll in a service (such as WageWorks) to help with pre-tax commuter savings. This strategy allows employees to deduct monthly transit passes or other amount using pre-tax dollars. This can help to lower payroll taxes and allows employees to save on transit.
- *TDM Marketing and Resident Education* – Site management shall provide residents and employees information about transportation options. This information would also be posted at central location(s) and be updated as necessary. This information shall include:
  - *Transit Routes* – Promote the use of transit by providing user-focused maps. These maps provide residents with wayfinding to nearby transit stops and transit-accessible destinations and are particularly useful for those without access to portable mapping applications. The project should consider installing real-time transit information, such as TransitScreen, in a visible location to provide residents with up-to-date transit arrival and departure times.
  - *Transit Fare Discounts* – Provide information about local discounted fare options offered by BART and AC Transit, including discounts for youth, elderly, persons with disabilities, and Medicare cardholders.

  - *Car Sharing* – Promote accessible car sharing programs, such as Zipcar, and Getaround by informing residents and employees of on-site and nearby car sharing locations and applicable membership information.
  - *Ridesharing* – Provide residents and employees with phone numbers and contact information for ride sharing options including Uber, Lyft, and Oakland taxi cab services.
  - *Carpooling* – Provide residents and employees with phone numbers and contact information for carpool matching services such as the Metropolitan Transportation Commission's 511 RideMatching.
  - *Walking and Biking Events* – Provide information about local biking and walking events, such as Oaklavia, as events are planned.
  - *Bikeshare* – Educate residents and employees about nearby bike sharing station locations and membership information.
- *On-Site TDM Coordinator* – The project shall provide an on-site TDM coordinator responsible for implementing and managing the TDM Plan. The TDM coordinator would also be responsible for ensuring that all residents, employees, and visitors are aware of their transportation options and would serve as a point of contact for hotel guests and employees regarding TDM programs.

ADDITIONAL OPERATIONAL STRATEGIES

If the mandatory measures do not meet the required goal of 20 percent VTR, and additional vehicle trip reduction is needed, the project shall consider the implementation of some or all of the following additional strategies to limit automobile use and encourage non-automotive travel.

- *Residential Parking Management* – Restrict parking to one parking space per unit or less, thereby discouraging multiple car ownership and/or use. Exceptions will only be made for residents with management approved Reasonable Accommodation Requests. A Reasonable Accommodation Request shall need to demonstrate a hardship wherein a household requires more than one vehicle per unit. Examples could include households with multiple disabled residents requiring vehicles or households with multiple residents with places of work inaccessible via transit. Additionally, if a residential parking permit (RPP) program is implemented in the project vicinity, project residents shall not be eligible for parking permits.
- *Bikeshare/Scooter Membership* – Provide tenants and residents a subsidy to offset the cost of bikeshare and/or scooter membership and encourage the use of non-automobile modes.
- *Carshare Memberships* – Provide residents with free or discounted carshare membership to offset the cost of car sharing programs and reduce the demand for private vehicle ownership.

- *Increased Transit Fare Subsidy* – Increase the transit fare subsidy for project residents and employes.
- *Personalized Trip Planning* – In the form of in-person assistance or as a web tool, provides residents and employees with a customized menu of options for commuting. Trip planning reduces the barriers the residents and employees see to making a walk, bike, or transit trip to the site. Transit trip making tools, such as those available from Google or 511.org, could be promoted to inform residents and employees of transit options to/from work. Providing a preferred walking map routes to residents and employees living within one mile of the site and a bicycling route map to all residents and employees living within five miles of the site would be a proactive strategy to encourage those employees to use alternatives to driving.

TDM MONITORING, EVALUATION AND ENFORCEMENT

Consistent with the requirements of the City's Standard Conditions of Approval, this TDM program requires regular periodic evaluation to determine if the program goal of reducing automobile trips has been satisfied and to assess the effectiveness of the implemented strategies. Beginning the first year after the development and occupancy of the project, building management must prepare an annual TDM monitoring report consisting of the following:

- Summary of implemented TDM measures and their effectiveness (e.g. bicycle parking occupancy, number of transit passes issued, etc.)
- Results of project resident and employee transportation surveys to monitor the vehicle trip generation and mode share for project residents and employees
- Weekday AM and PM peak period and daily traffic volume counts at the garage driveway on Chester Street

As previously discussed, the goal of the TDM program is to reduce the number of vehicle trips generated by the project by 20 percent. This level would correspond to a total project vehicle trip generation of no more than 378 trips during the AM peak hour and 467 in the PM peak hour.

Based on the results of the surveys, TDM programs shall be increased if these goals are not met. This program ensures the implementation of the mandatory TDM measures and related requirements through compliance with the Mitigation Monitoring and Reporting Program, as implemented through the Conditions of Approval adopted for the project.

The first monitoring report must be prepared one year after full occupancy of the first phase of the project, and subsequent monitoring reports must be prepared annually. If following the annual monitoring the TDM goals are not satisfied, additional measures shall be implemented until the goal is met.

If in two successive years the project's TDM goals are not satisfied, site management shall prepare and submit for City approval a Corrective Action Plan. The Corrective Action Plan shall detail the additional TDM measures to be implemented on site and their expected modal split reduction.

If, one year after the Corrective Action Plan is implemented, the required automobile mode share reduction target is still not being achieved, or if site management fails to submit a report as described above, or if the reports do not meet City requirements outlined above, the City may, in addition to its other remedies, (a) assess the project a financial penalty based on the observed reduction in the automobile mode share compared to the target; or (b) refer the matter to the City Planning Commission for scheduling of a compliance hearing to determine whether the project's approvals should be revoked, altered or additional conditions of approval imposed.

The penalty as described in (a) above shall be determined by assigning a cost to the number of additional automobile trips to be reduced in order to meet the required goal. Assuming the cost per new alternative commuter is $26/day and that there are 261 workdays per year, the annual cost per new alternative commuter is $6,790. The project shall therefore pay a penalty of $6,790 per year for each trip that should have been using an alternative mode if the 20 percent reduction after completion of the Project had been achieved.

In determining if a financial penalty or other remedy is appropriate, the City shall not impose a penalty if the project has made a good faith effort to comply with the TDM program. The City would only have the ability to impose a monetary penalty after a reasonable cure period and in accordance with the enforcement process outlined in Planning Code Chapter 17.152. If a financial penalty is imposed, such penalty sums shall be used by the City solely toward the implementation of the TDM plan.

If in five successive years the project is found to meet the stated TDM goal, additional surveys and monitoring shall be suspended until such a time as the City deems they are needed.

Please contact Sam Tabibnia (s.tabibnia@fehrandpeers.com or 510-835-1943) with questions or comments.

APPENDIX A
TDM PROGRAM CONSISTENCY WITH CITY REQUIREMENTS

TDM Strategy	Required When	Required for Proposed Project?
Bus boarding bulbs or islands	• A bus boarding bulb or island does not already exist, and a bus stop is located along the project frontage; and/or • A bus stop along the project frontage serves a route with 15 minutes or better peak hour service and has a shared bus-bike lane curb	**Yes**, the project would relocate several bus stops from within the BART station to adjacent streets, including bus boarding islands on both directions of 7th Street.
Bus shelter	• A stop with no shelter is located within the project frontage, or • The project is located within 0.10 miles of a flag stop with 25 or more boardings per day	**Yes**, bus shelters would be provided at all bus stops along the project frontage.
Concrete bus pad	• A bus stop is located along the project frontage and a concrete bus pad does not already exist	**Yes**, concrete bus pads would be provided at all the bus stops relocated to the project frontage.
Curb extensions or bulb-outs	• Identified as an improvement within site analysis	**Yes**, the project would provide curb extensions at intersections along the project frontage
Implementation of a corridor-level bikeway improvement	• A buffered Class 2 or Class 4 bikeway facility is in a local or county adopted plan within 0.10 miles of the project location; and • The project would generate 500 or more daily bicycle trips	**Yes**, the project would provide Class 4 bikeways on both directions of 7th Street and Mandela Parkway along the project frontage.
Implementation of a corridor-level transit capital improvement	• A high-quality transit facility is in a local or county adopted plan within 0.25 miles of the project location; and • The project would generate 400 or more peak period transit trips	**Yes**, while the project is estimated to generate fewer than 400 peak hour transit trips, the project would implement a bus queue jump Lane on westbound 7th Street at Mandela Parkway.
Installation of amenities such as lighting; pedestrian-oriented green infrastructure, trees, or other greening landscape; and trash receptacles per the Pedestrian Master Plan and any applicable streetscape plan	• Always required	**Yes**, the project would upgrade the pedestrian amenities within the site and on the adjacent sidewalks.

APPENDIX A
TDM PROGRAM CONSISTENCY WITH CITY REQUIREMENTS

TDM Strategy	Required When	Required for Proposed Project?
Installation of safety improvements identified in the Pedestrian Master Plan (such as crosswalk striping, curb ramps, count down signals, bulb outs, etc.)	• When improvements are identified in the Pedestrian Master Plan (PMP) along project frontage or at an adjacent intersection	**Yes**, although the PMP does not identify any specific improvements near the project, the project would provide high-visibility crosswalk striping and directional curb ramps at intersection adjacent to the project.
In-street bicycle corral	• A project includes more than 10,000 square feet of ground floor retail, is located along a Tier 1 bikeway, and on-street vehicle parking is provided along the project frontages.	No, the project would not provide on-street vehicle parking along the project frontage. Short-term bicycle parking will be accommodated within the project site.
Intersection improvements, including but not limited to visibility improvements, shortening corner radii, pedestrian safety islands, accounting for pedestrian desire lines.	• Identified as an improvement within site analysis	**Yes**, the project would provide curb extensions at intersections along the project frontage.
New sidewalk, curb ramps, curb and gutter meeting current City and ADA standards	• Always required	**Yes**, the project would upgrade the sidewalks along the project frontage.
No monthly permits and establish minimum price floor for public parking	• If proposed parking ratio exceeds 1:1,000 sf (commercial)	**Yes**, if commercial parking is provided, no monthly permit would be provided and a minimum price floor for public parking would be established. Although, off-street commercial parking would be at less than 1:1,000 sf, if provided.
Parking garage is designed with retrofit capability	• Optional if proposed parking ratio exceeds 1:1.25 (residential) or 1:1,000 sf (commercial)	Not applicable, the residential parking ratio would be less than 1.25; if off-street commercial parking is provided, it would be at less than 1:1,000 sf.

APPENDIX A
TDM PROGRAM CONSISTENCY WITH CITY REQUIREMENTS

TDM Strategy	Required When	Required for Proposed Project?
Parking space reserved for car share	• A project is located within downtown (CBD and D-LM zones). One car share space preserved for buildings between 50 – 200 units, then one car share space per 200 units.	**Yes**, although the project is not located in a downtown zone, the project would offer to dedicate up to six spaces in the garage for car share.
Paving, lane striping or restriping (vehicle and bicycle), and signs to midpoint of street section	• Typically required	**Yes**, provided.
Pedestrian crossing improvements, pedestrian-supportive signal changes, including but not limited to reducing signal cycle lengths to less than 90 seconds to avoid pedestrian crossings against the signal, providing a leading pedestrian interval, provide a “scramble” signal phase where appropriate.	• Identified as an improvement within site analysis • Identified as an improvement within operations analysis	**Yes**, cycle lengths adjacent to the project would be reduced to 90 seconds and a pedestrian scramble would be provided at the 7th Street/ Center Street intersection.
Real-time transit information system	• A project frontage block includes a bus stop or BART station and is along a Tier 1 transit route with 2 or more routes or peak period frequency of 15 minutes or better	**Yes**, project would provide real-time transit information.
Relocating bus stops to far side	• A project is located within 0.10 mile of any active bus stop that is currently near-side	**Yes**, project would relocate bus stops from within the BART Station to adjacent streets, including the far sides of westbound 7th Street at Center Street and eastbound 5th Street at Mandela Parkway.
Signal upgrades, including typical traffic lights, pedestrian signals, bike actuated signals, transit only signals	• Project size exceeds 100 residential units, 80,000 sf of retail, or 100,000 sf of commercial; and • Project frontage abuts an intersection with signal infrastructure older than 15 years	**Yes**, a new traffic signal may be installed at the 7th Street/ Chester Street intersection.
Transit queue jumps	• Identified as a needed improvement within operations analysis of a project with frontage along a Tier 1 transit route with 2 or more routes or peak period frequency of 15 minutes or better	**Yes**, the project would provide a bus queue jump Lane on westbound 7th Street at Mandela Parkway.

APPENDIX A
TDM PROGRAM CONSISTENCY WITH CITY REQUIREMENTS

TDM Strategy	Required When	Required for Proposed Project?
Trenching and placement of conduit for providing traffic signal interconnect	• Project size exceeds 100 units, 80,000 sf of retail, or 100,000 sf of commercial; and • Project frontage block is identified for signal interconnect improvements as part of a planned ITS improvement; and • A major transit improvement is identified within operations analysis requiring traffic signal interconnect	No, a major transit improvement requiring traffic signal interconnect was not identified as a need improvement.
Unbundled parking	• New multifamily dwelling residential facilities of ten (10) or more units, with the exception of affordable housing	**Yes**, the residential component of the project would provide unbundled parking.

Sources: City of Oakland Transportation Impact Review Guidelines, 2017 and City of Oakland Municipal Code, 2018